XDH/XLH/XG2 series PLC

User manual [Motion control]

Wuxi Xinje Electric Co., Ltd.

Data No. PD11 20231127EN 1.3.1

Basic notes

- Thank you for purchasing Xinje XDH and XLH and XG2 series PLC.
- This manual mainly introduces the motion control function of XDH and XLH and XG2 series PLC.
- Before using the product, please read this manual carefully and operate on the premise of fully understanding the contents of the manual.
- For the introduction of software and programming, please refer to the relevant manuals.
- Please deliver this manual to the end user.

User instructions

- Only operators with certain electrical knowledge can carry out wiring and other operations on the product. If there are any unknown cases, please consult our technicians.
- The examples listed in the manual and other technical materials are only for users' understanding and reference, and do not guarantee certain actions.
- When using this product in combination with other products, please confirm whether it complies with relevant specifications and principles.
- When using this product, please confirm whether it meets the requirements and is safe.
- Please set up backup and safety functions by yourself to avoid possible machine failure or loss caused by the failure of this product.

Statement of responsibility

- Although the contents of the manual have been carefully checked, errors are inevitable, and we can't guarantee complete consistency.
- We will often check the contents of the manual and correct them in subsequent versions. We welcome your valuable comments.
- Please understand that the contents described in the manual are subject to change without notice.

Contact method

If you have any questions about the use of this product, please contact the agent and office who purchased the product, or directly contact Xinje company.

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Preface

This manual is XDH / XLH / XG2 series PLC [motion control], which mainly introduces the upgraded motion control function, which is applicable to XDH and XLH and XG2 series PLC.

Note: please confirm that the value of SFD811 is 1 before using the relevant instructions in this manual (SFD811 parameter setting please refer to chapter 5-1-3).

1. EtherCAT technical overview

1-1. EtherCAT overview

EtherCAT, fully known as Ethernet for control automation technology, developed by Beckhoff automation GmbH, is a real-time Ethernet used for open network communication between master station and slave station. As a mature industrial Ethernet technology, EtherCAT has the characteristics of high performance, low cost and easy use.

XDH, XLH, XG2 series controller (master station) and DS5C servo driver (slave station) comply with the standard EtherCAT protocol, support the maximum 32-axis slave stations, 32-axis synchronization cycle of 1ms, 2-channel touch probe function, position, speed, torque and other control modes, and are widely applicable to various industrial applications.

1-2. System composition (master and slave station)

The connection form of EtherCAT is the network system of linear connection master station (FA controller) and multiple slave stations.

The number of nodes that can be connected by the slave station depends on the processing or communication period of the master station, the number of bytes transmitted, etc.

1-3. Communication specification

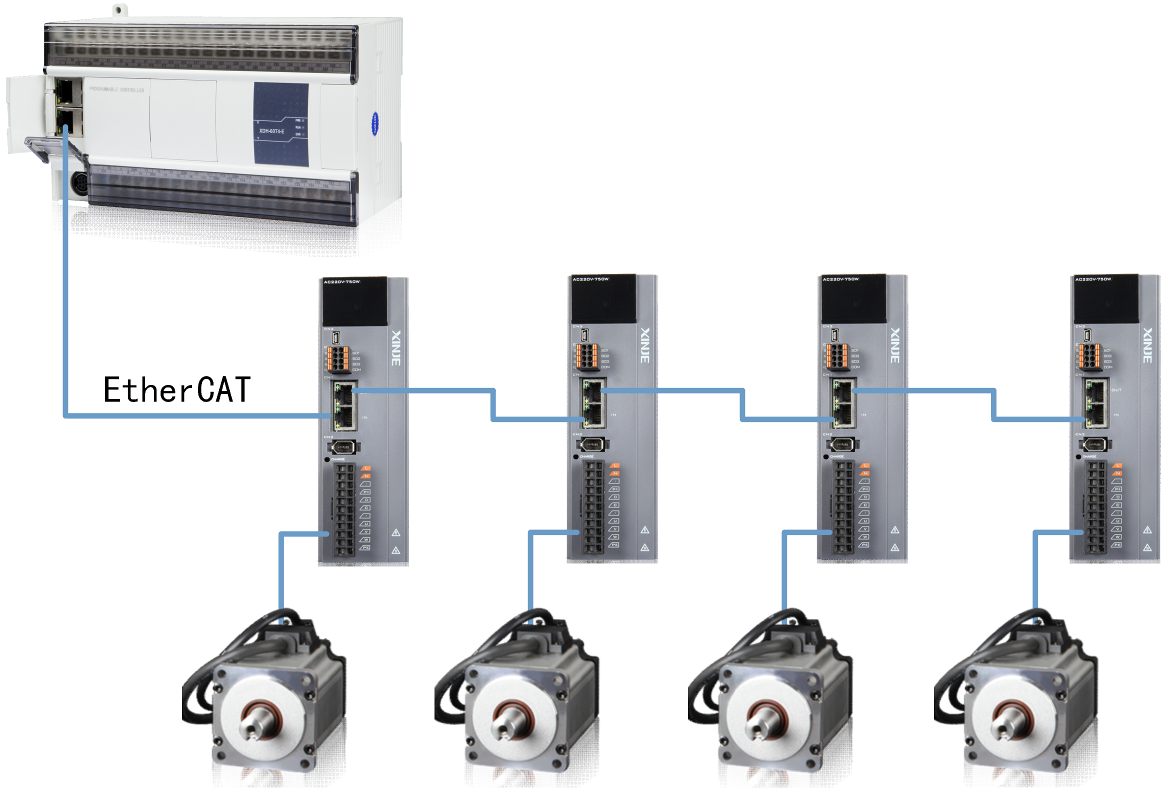
<table>
<tr><th>Item</th><th>Specification</th></tr>
<tr><td>Physical layer</td><td>100BASE-TX (IEEE802.3)</td></tr>
<tr><td>Baud rate</td><td>100[Mbps] (full duplex)</td></tr>
<tr><td>Topology</td><td>Line</td></tr>
<tr><td>Connection cable</td><td>JC-CA twisted pair (shielded twisted pair)</td></tr>
<tr><td>Cable length</td><td>Maximum 50m between nodes</td></tr>
<tr><td>Com port</td><td>2 Port (RJ45)</td></tr>
<tr><td>EtherCAT Indicators (LED)</td><td>[Run] RUN Indicator
[L/A IN] Port0 Link/Activity Indicator (Green)
[L/A OUT] Port1 Link/Activity Indicator (Green)</td></tr>
<tr><td>Station Alias (ID)</td><td>Setting range: 0~65535
Setting address: 2700h</td></tr>
<tr><td>Explicit Device ID</td><td>Not support</td></tr>
<tr><td>Mailbox protocol</td><td>COE (CANopen Over EtherCAT)</td></tr>
<tr><td>SyncManager</td><td>4</td></tr>
<tr><td>FMMU</td><td>3</td></tr>
<tr><td>Modes of operation</td><td>
<table>
<tr><th></th><th colspan="2">Modes of operation</th></tr>
<tr><td rowspan="3">position</td><td>csp</td><td>Cyclic synchronous position mode</td></tr>
<tr><td>PP</td><td>Profile position mode</td></tr>
<tr><td>hm</td><td>Homing mode</td></tr>
<tr><td rowspan="2">Speed</td><td>csv</td><td>Cyclic synchronous velocity mode</td></tr>
<tr><td>pv</td><td>Profile velocity mode</td></tr>
<tr><td rowspan="2">Torque</td><td>cst</td><td>Cyclic synchronous torque mode</td></tr>
<tr><td>tq</td><td>Torque profile mode</td></tr>
</table>
</td></tr>
<tr><td>Touch Probe</td><td>6 channels</td></tr>
<tr><td>Synchronization mode</td><td>DC (SYNCO event synchronization mode)
SM (SM Event synchronization)</td></tr>
<tr><td>Cyclic time (DC</td><td>500,1000,2000,4000[μs]</td></tr>
</table>

communication period)	
Communication object	SDO[Service data object], PDO[Process data object]
Maximum PDO allocation per station	TxPDO: 4 [piece] RxPDO: 4 [piece]
Single station PDO Max bytes	TxPDO: 32[byte] RxPDO: 32[byte]
Mailbox communication interval in PreOP mode	1ms
Mailbox	SDO requests and SDO information

Note:
(1) See [state machine] for the meanings of SDO and PDO.
(2) The node length is recommended to be 50m, and CAT5e network cable shall be used above 50m.
(3) The maximum number of bytes for a single station PDO is not limited by the upper computer. The Xinje servo 3791 and above versions support 32 bytes, while versions below 3791 support 24 bytes. The number of bytes supported by other brands of slave stations is determined by the slave station.

1-4. EtherCAT communication connection

The wiring of EtherCAT motion control system is very simple. Thanks to EtherCAT, the star topology of Ethernet can be replaced by a simple linear structure. Taking Xinje DS5C series servo as an example, because EtherCAT does not need hub and switch, XDH, XLH, XG2 series PLC body and DS5C series servo are equipped with EtherCAT communication network port, so the consumption of cable and bridge is greatly reduced, the workload of connection design and joint calibration is also greatly reduced, which is convenient for saving installation cost.
Linear type connection is recommended for EtherCAT bus connection. The wiring mode is as follows:

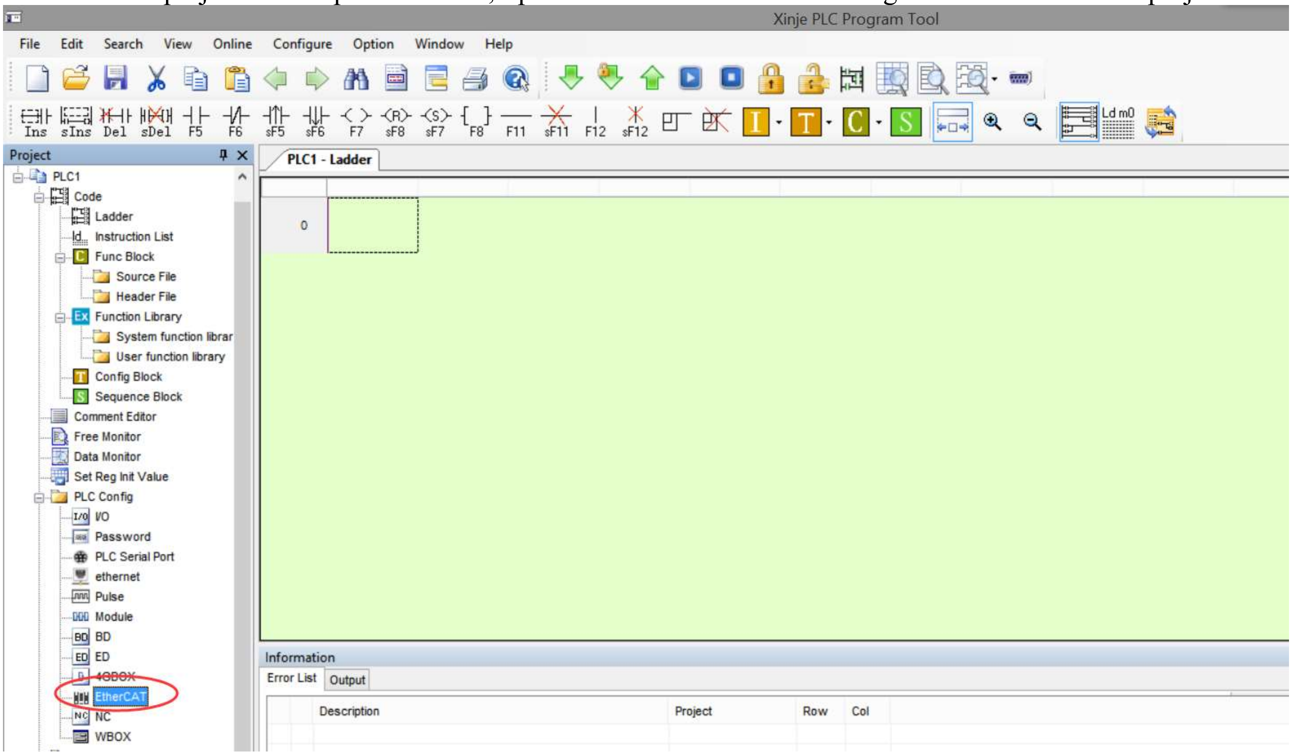


Note: Only LIN2 port in XDH and XLH and XG2 series PLC supports EtherCAT communication. The two communication network ports of the servo driver follow the principle of "down in and up out", that is, the Link2 ports of XDH and XLH and XG2 must be connected with the network port below the LIN1 port of the first servo, and then the network port above the first servo is connected with the network port below the second servo, and so on.
In the process of communication transmission, it will inevitably be affected by the surrounding electromagnetic environment. It is recommended that the user use the industrial CAT5e network cable, which can also be purchased in our company.

2. EtherCAT parameter configuration

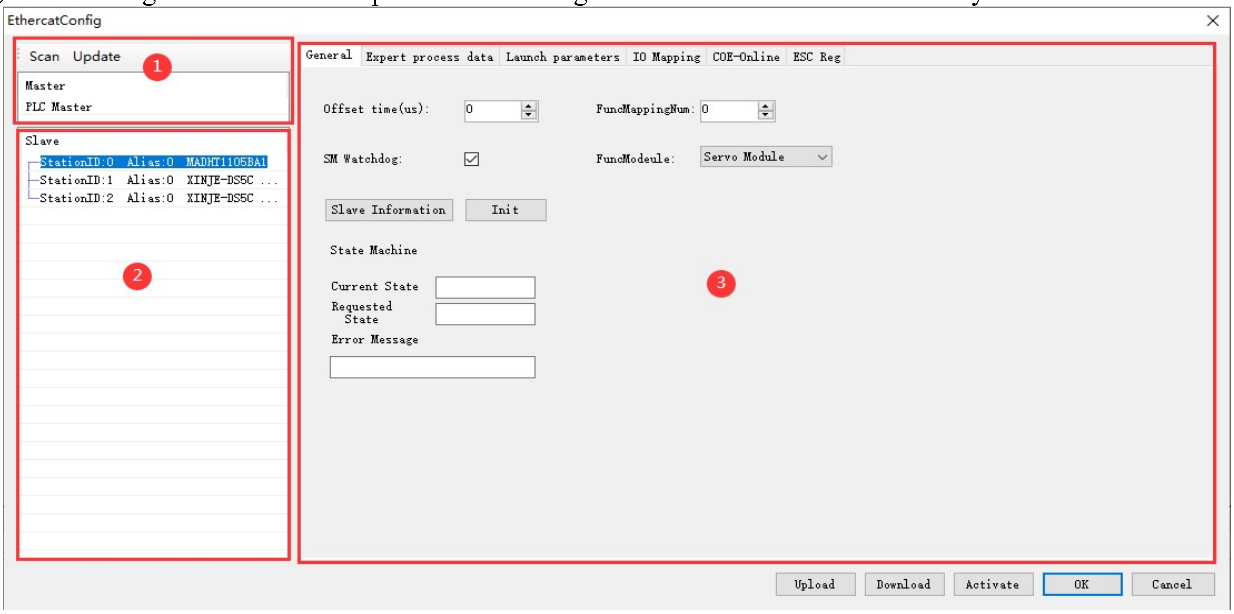
2-1. EtherCAT configuration interface

Create a new project. In the picture below, open EtherCAT in the PLC configuration branch of the project area.

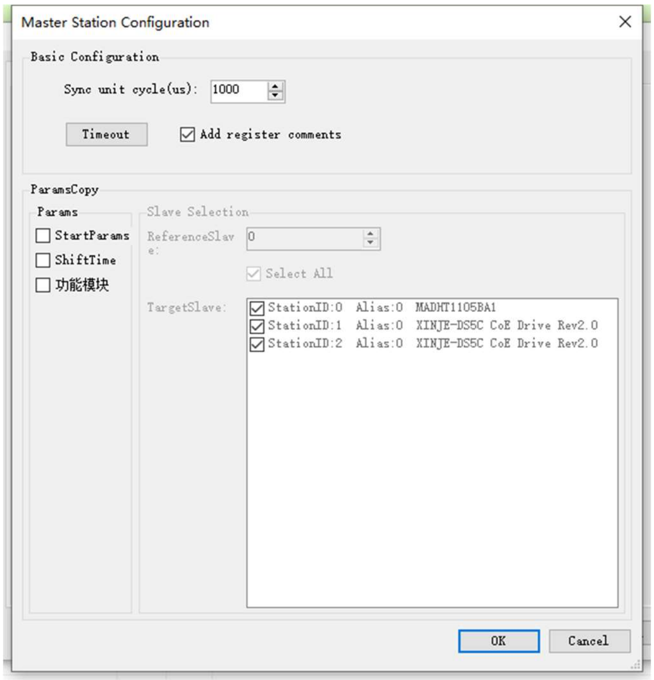


The EtherCAT parameter configuration interface is divided into master station configuration area, slave station display area and slave station configuration area.

① Configuration area of master station: set EtherCAT periodic synchronous communication interval, upper computer timeout, ESM state switching of all slaves. (ESM: Ethernet state machine, refer to [state machine])
② Display area of slave station: scan or manually add the slave station, and the corresponding configuration information of the slave station selected by the cursor will show on the right side.
③ Slave configuration area: corresponds to the configuration information of the currently selected slave station.

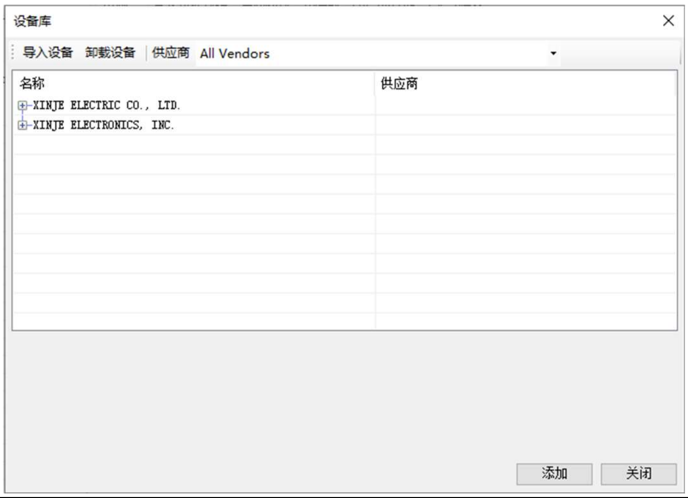


2-2. Master station configuration



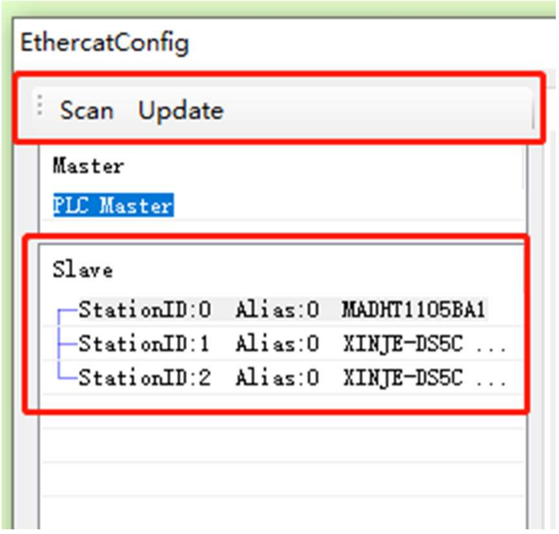
Parameter	Explanation
Synchronization unit cycle	The communication cycle between master station and slave station is 500~10000 (unit: μs) (that is, the sending data time interval between master station and slave station) and SFD2990 is set to the same value. Note: if 16 or less axis slave station is connected, it can be set to 500; if 32 or less axis slave station is connected, it can be set to 1000.
Timeout	Communication timeout setting of upper computer and related functions of EtherCAT.
Parameter copy	Tick the parameters to be copied (the contents include startup parameters and offset time, see 2-5 and 2-7 for the meaning), and copy them to the target slave station based on the parameters of [reference slave station] (the number here refers to station ID). The target slave station can be selected in full or selected in part.

Right click on PLC Master and select Add Device:



Parameter	Explanation
Import device	Add a slave XML file (which needs to have a corresponding XML file stored in the ethercat/folder of the installation directory of the Xinjie PLC programming tool software), and the default configuration of the slave is related to XML.
Uninstalling devices	Select a device and click uninstall to uninstall the XML files in the software.

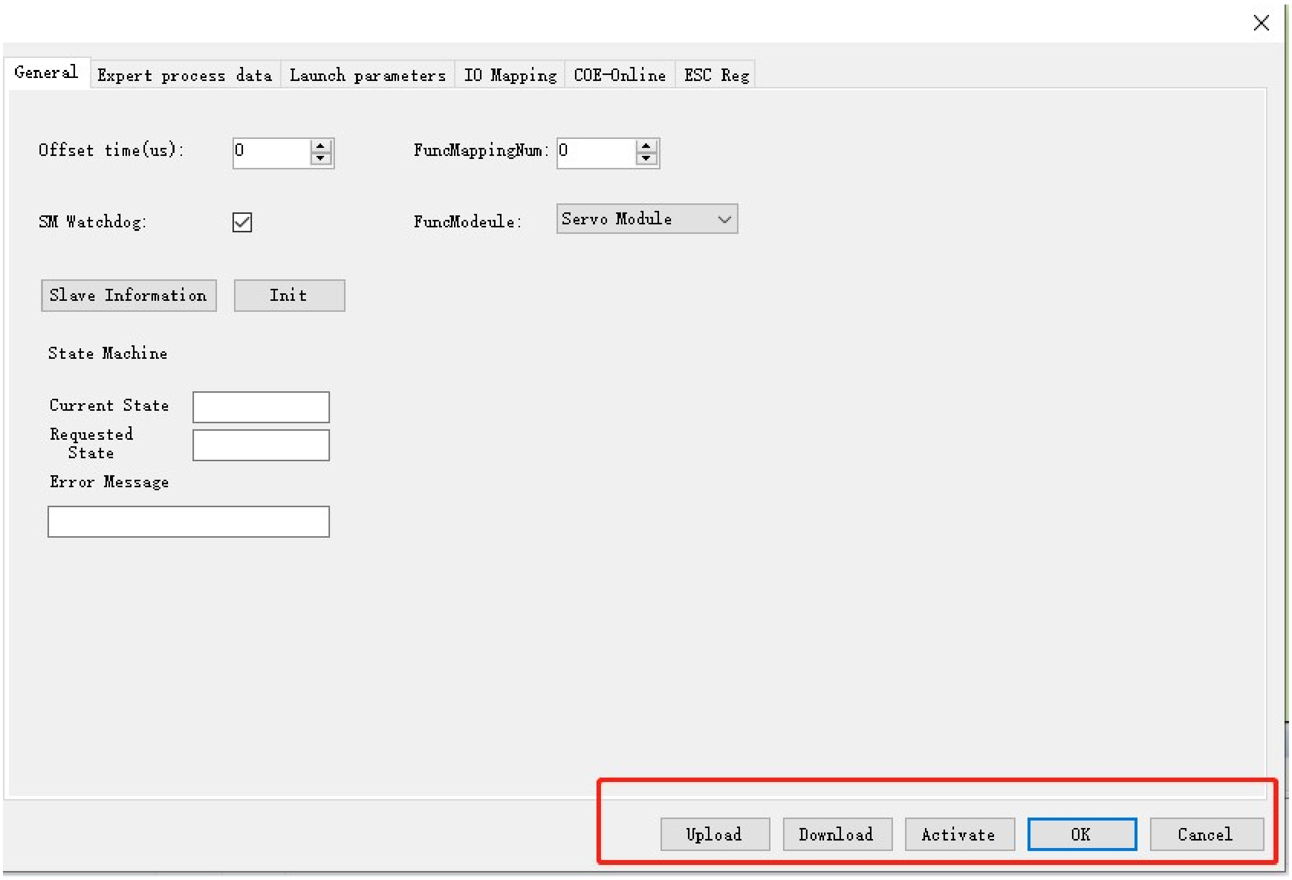
2-3. Slave station list



Parameter	Explanation
Scan	Scan to obtain the topology of the current slave, and find out whether there is a matching slave XML file locally. If not, try to read the EEPROM and object dictionary of the slave to generate temporary XML. There is no need to stop the PLC. Note: the scanned slave station distinguishes the first station by station ID, station ID: 0 represents the first station, and so on.

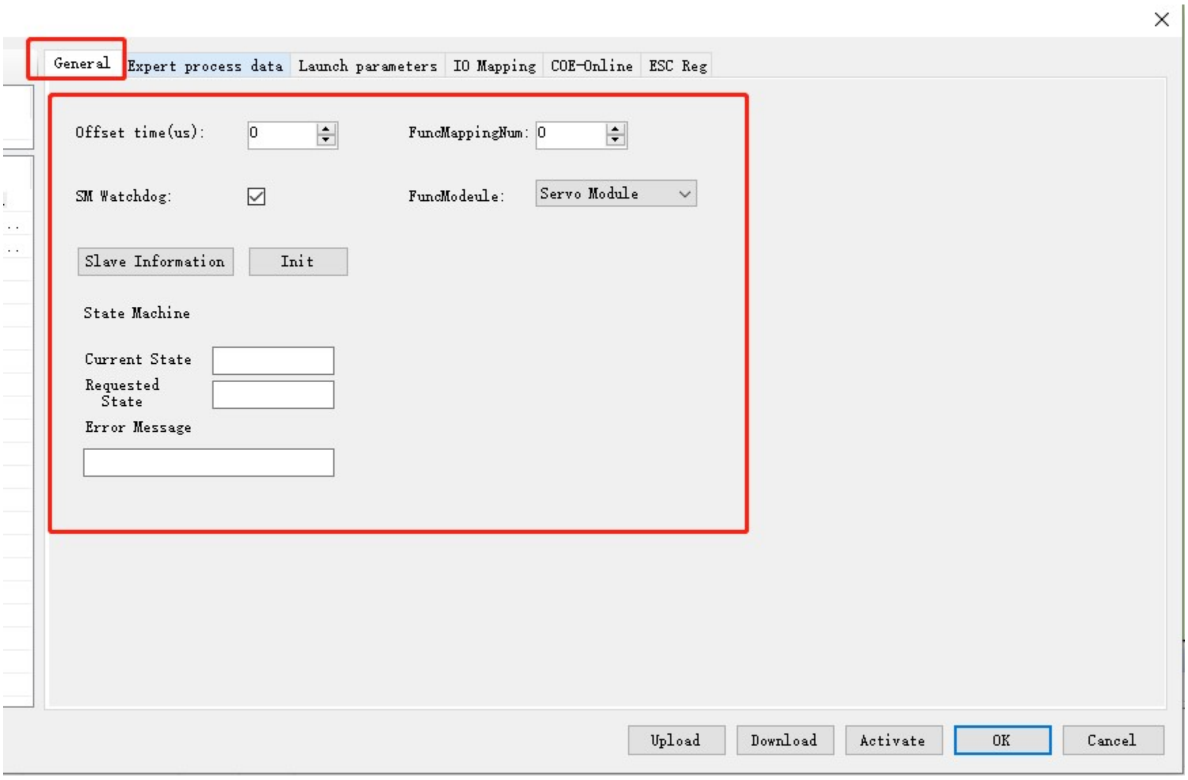
Note: The order in the list of subordinate stations must match the actual order of connections. If it does not match, after clicking on [Activate] (meaning 2-4 of [Activate]), the upper machine will report an error and fail to activate successfully.

2-4. Slave station configuration



Parameter	Explanation
Download	Download the configuration parameters to the flash of PLC without stopping PLC. Note: (1) The downloaded configuration is stored in the flash of PLC. Click activate to take effect. (2) The download here is only for PLC debugging (also can be saved in case of power failure). Please tick the EtherCAT parameter option when downloading the PLC project, otherwise there is no Etherecat configuration data when uploading the PLC project.
Upload	The configuration information in PLC is uploaded to the upper computer without stopping PLC.
Activate	The configuration data in the current PLC will take effect immediately. It will switch from any state of the slave station to Init, and then to OP state (Init → PreOP → Safeop → OP). The effect is equivalent to stopping the PLC and then running the PLC. It is not necessary to stop PLC (for the meaning of slave station state, see the state machine in the general interface).
Ok	Exit the interface and save the currently modified data. Note: only the data will be saved, and the activation parameters will not take effect without downloading.
Cancel	Exit the interface without saving, which is equivalent to pressing the X button in the upper right corner.

2-5. General

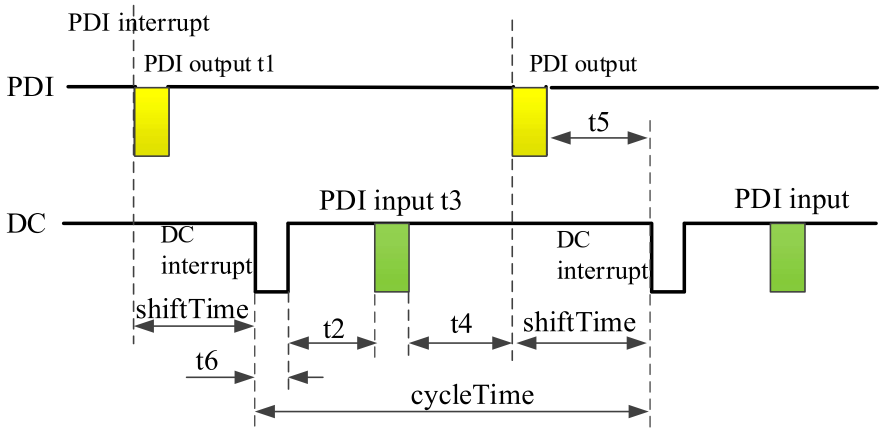


Parameter	Explanation
Offset time	Its specific meaning is shown in the communication sequence diagram. The shift time in the diagram represents the experienced offset time.
SM watchdog	If the watchdog is selected, it will force set 0x420 (watchdog timing time) of ESC register to 1000. Note: the function of the watchdog is to reset the system when the program dead or crashes.
Initialzation	Restore all the configuration of the selected slave station to the default configuration, which needs to be downloaded again to take effect.
Slave information	It is used to download EEPROM during servo production and updating, and its download function is not open to users by default.
PreOP, OP, Init, SafeOP	Switch the slave station to specified state.
Current state	The current status of the slave. The current slave status can be monitored through SD [8021 + 20 * I]. * 1
Requested state	Status of the slave request. Mode switching control requirements can be monitored through SD [8029 + 20 * I] . *1
Error message	Error is reported when slave station state switching error. You can confirm the status switching error message through SD [8028 + 20 * I] . *1
Function module	It is used to map the EtherCAT slave station to the specified function module. For example, if the slave station 0 is the servo, the module selection is set as the servo module. At this time, the predefined functions of the motion control module will be associated with some necessary PDO objects. If you want to customize the operation, you can select user define. At this time, PDO data can be modified arbitrarily by the value of IO mapping. (note that IO module is not open temporarily, and its effect is equivalent to user define)
Function mapping number	Used to bind the EtherCAT slave to the specified module function. For example, there are two slave stations, namely, station 0 and station 1. You can set the [function mapping number] of station 0 to 1, and station 1 to 0. At this time, the slave station 1 is controlled by station 0 in the motion control module, while the slave station 0 is controlled by station 1 in the motion control module.

*1: refer to EtherCAT motion control manual appendix 1 for details.

Slave station status	Actions in various states	Communication action		
		SDO (mail) receive and send	PDO send	PDO receive
Init	Communication initialization, SDO, PDO unable to receive and send messages	-	-	-
Pre-Operational (PreOP)	the status of only SDO sends and receives message	Yes	-	-
Safe-Operational (SafeOP)	the status of only SDO sends and receives, PDO sends message	Yes	Yes	-
Operational (OP)	all feasible status of SDO receiving and sending, PDO receiving and sending	Yes	Yes	Yes

Note: the access from the master station to the ESC register is independent of the above table and is available at any time.
PDO (process data object) is used to transfer periodic communication data.
SDO (service data object) is used to transmit non periodic communication data.
Command or interface operation during ESM state switching may cause abnormal communication error.

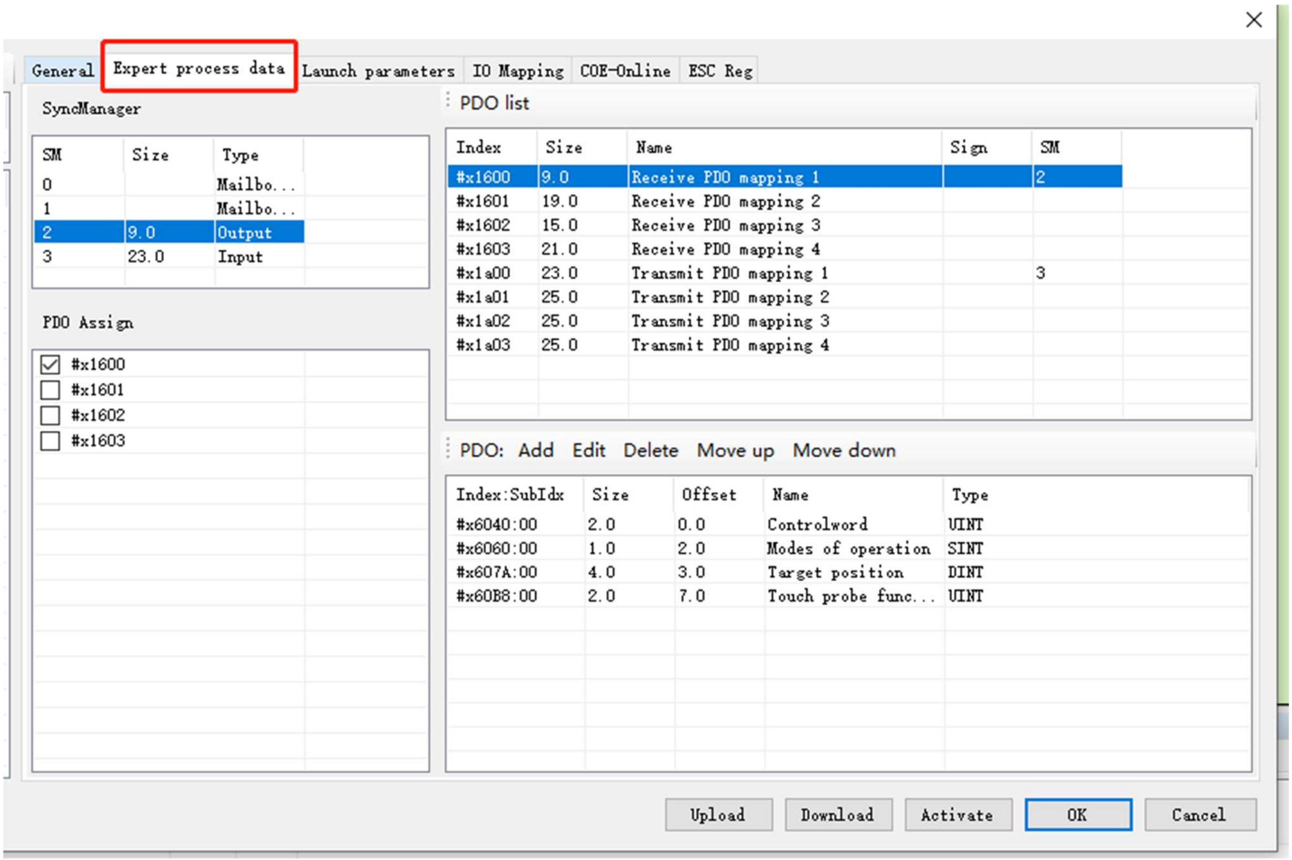


Communication sequence diagram

Related concepts and key time points are as follows:

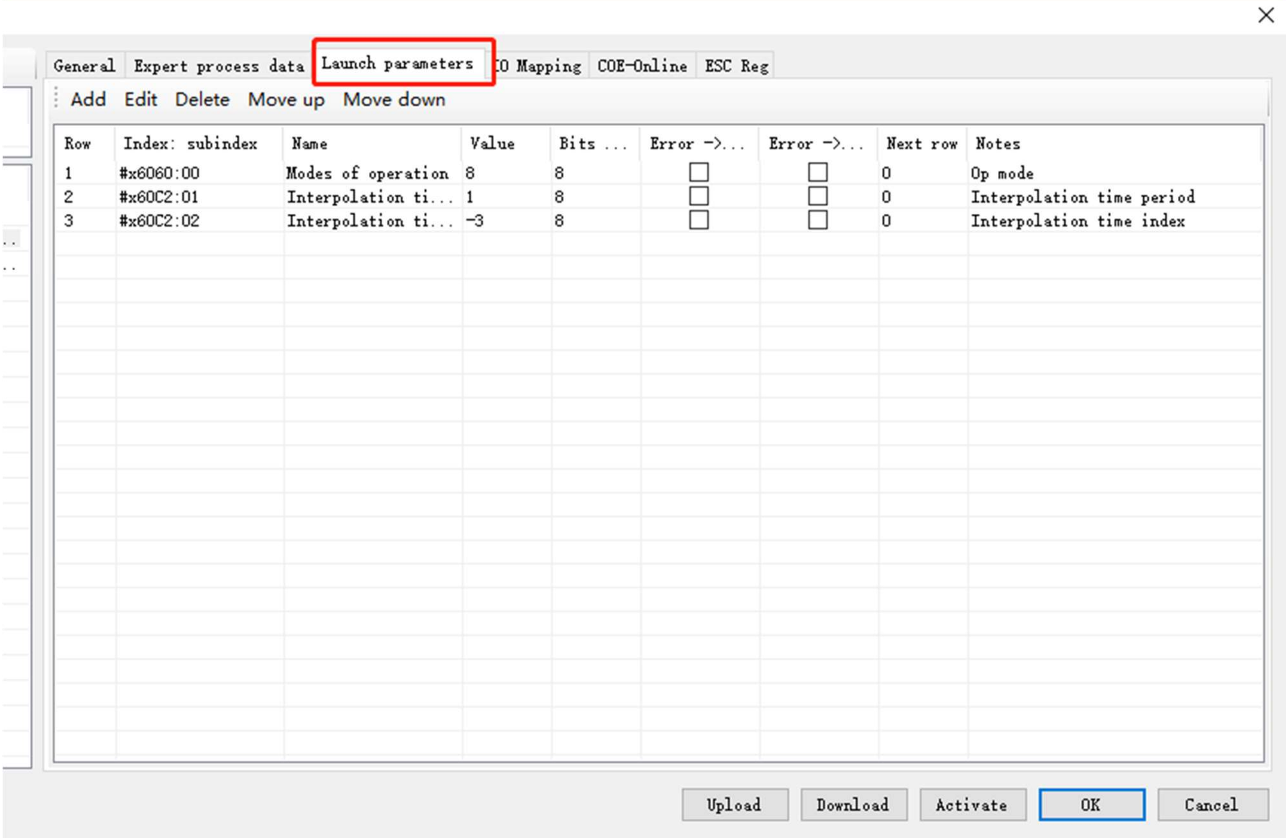
PDI	Process data interface
DC	Distributed clock
ESC	EtherCAT slave station controller
MCU	Microprocessor
PDI interruption	This interrupt is triggered when the master sends data to the slave
PDI falling edge	EOF is the completion of acquiring data frame from the slave station ESC
PDI rising edge	The slave MCU has obtained the current PDO data from ESC
PDI output	Copy PDO data from ESC to MCU and wait for MCU to process, which takes time t1
DC interrupt	Timing interrupt with reference clock as time reference, whose cycle is cycleTime (i.e. synchronization unit cycle), is responsible for triggering data processing of slave station (the same as Xnet data processing)
DC rising edge	Trigger data processing of each slave station
PDI input	Copy PDO data from MCU to ESC and wait for master station to read next cycle, which takes time t3

2-6. Expert process data



Parameter	Explanation
Synchronization manager	SM0, 1: for the interaction of mailbox data (SDO); SM2, 3 for the interaction of PDO data (its type input and output are relative to the master station). Note: (1) PDO (process data object) is used to transfer periodic communication data. (2) SDO (service data object) is used to transmit non periodic communication data.
PDO distribution	Specifies the PDO of the corresponding SM, up to 4 can be selected, and the size does not exceed 24 bytes. (the larger the PDO data is, the longer the transmission time is, and it may not be completed in the synchronization unit cycle. Therefore, it is impossible to guarantee the stability of data transmission when there are many slave stations and each slave station has a large PDO data.)
PDO list	Some PDO maps predefined in the servo XML, RxPDO represents PDO transmitted from the master station to the slave station, 1600h ~ 1603h can be used, TxPDO represents PDO transmitted from the slave station to the master station, and 1A00h ~ 1A03h can be used.
PDO content	The PDO objects to be mapped are specified from the object dictionary, and the objects are periodically exchanged through PDO. (RxPDO must have 6040h, 6060h, 607Ah, TxPDO must have 6041h, 6061h, 6064h, 606Ch)

2-7. Launch parameter



There are three default configurations in the startup parameters, of which 6060h is the operation mode of the slave station, with the default value of 8 (CSP mode); 60C2-1 and 60C2-2 are the synchronization unit cycle, 60C2-1 is the value of the synchronization unit cycle, and 60C2-2 is the unit of the synchronization unit cycle, for example, the default synchronization unit cycle is 100×10^{-5}s, that is, 1000us. (this parameter will change automatically with the synchronization period configured by the master station, and does not need to be modified manually.).

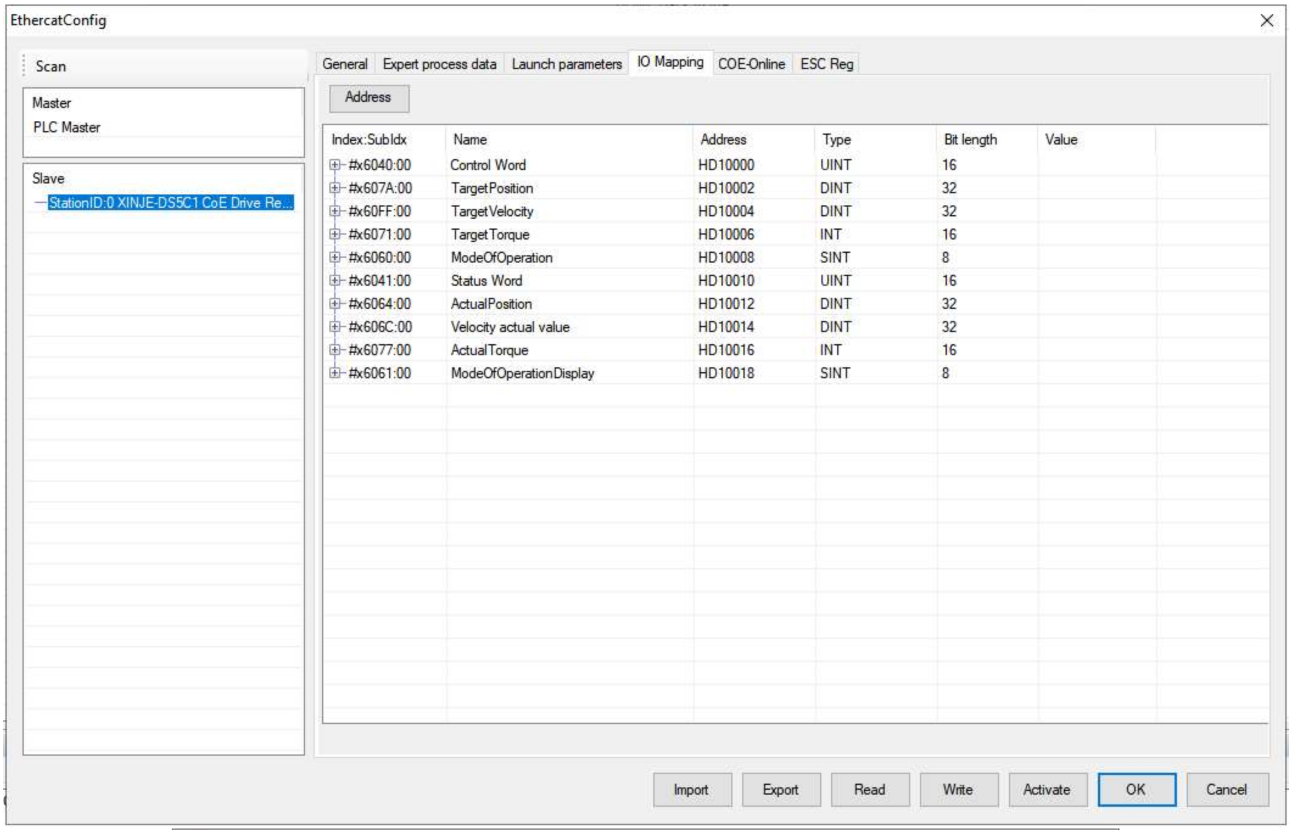
You can configure startup parameters and their execution order through [add], [edit], [delete], [move up] and [move down].

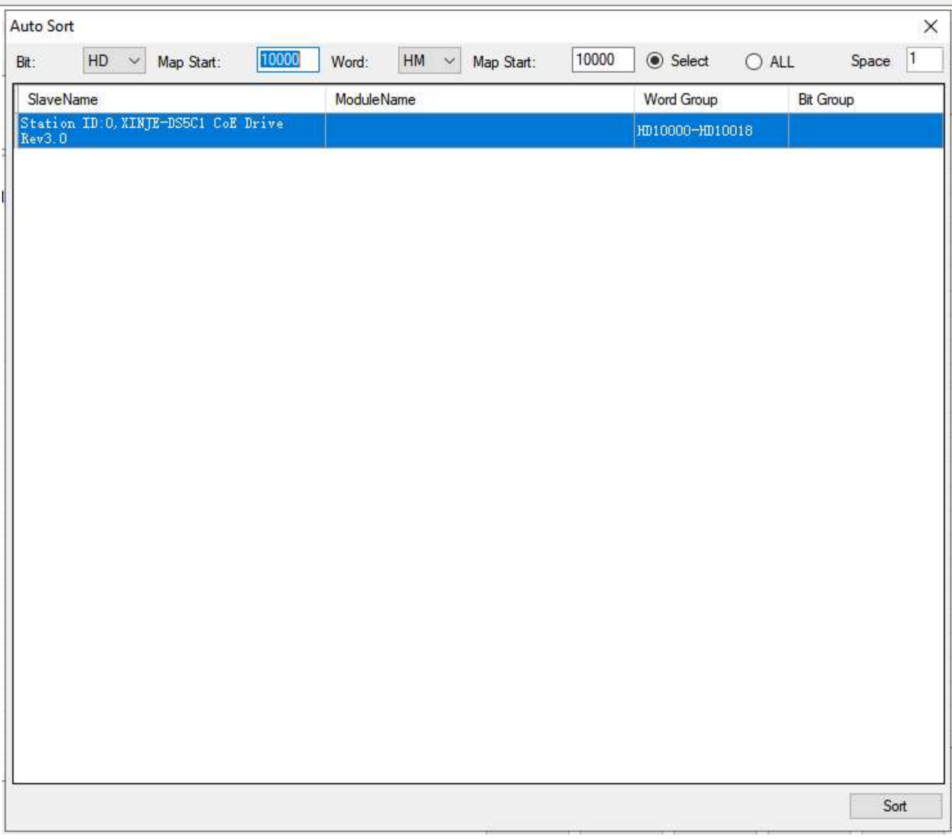
Note: the execution order is from top to bottom. You can write different values to the same parameter, indicating that the parameters are set in the order from top to bottom.

[Error -> Exit]: indicates that if there is an error in configuring this parameter, all the following configurations will be skipped.

[Click error -> jump] and [next line] to specify to jump to the specified line to continue configuration when an error occurs.

2-8. IO mapping

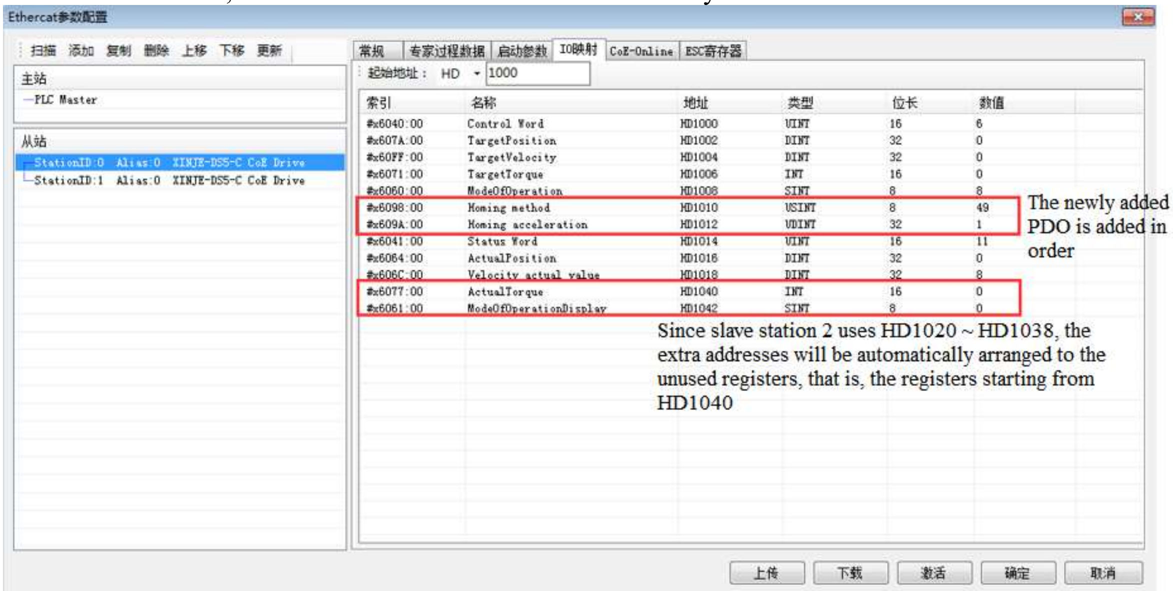




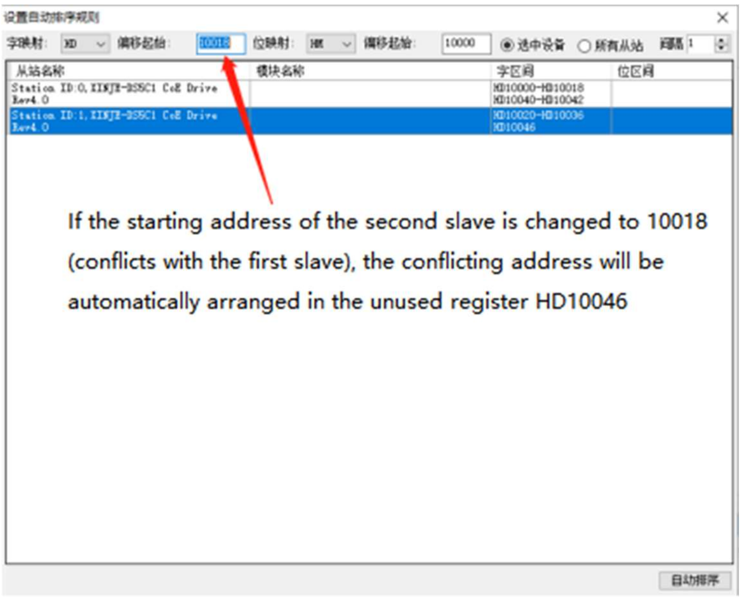
The allocated RxPDO and TxPDO will be mapped to the register starting from the [start address], and the register types can be HD and D. Modifying the [start address] will automatically arrange the addresses according to the parameter order. If there is a duplicate address with other stations, an error will be reported and the address will be automatically arranged to a non duplicate address.

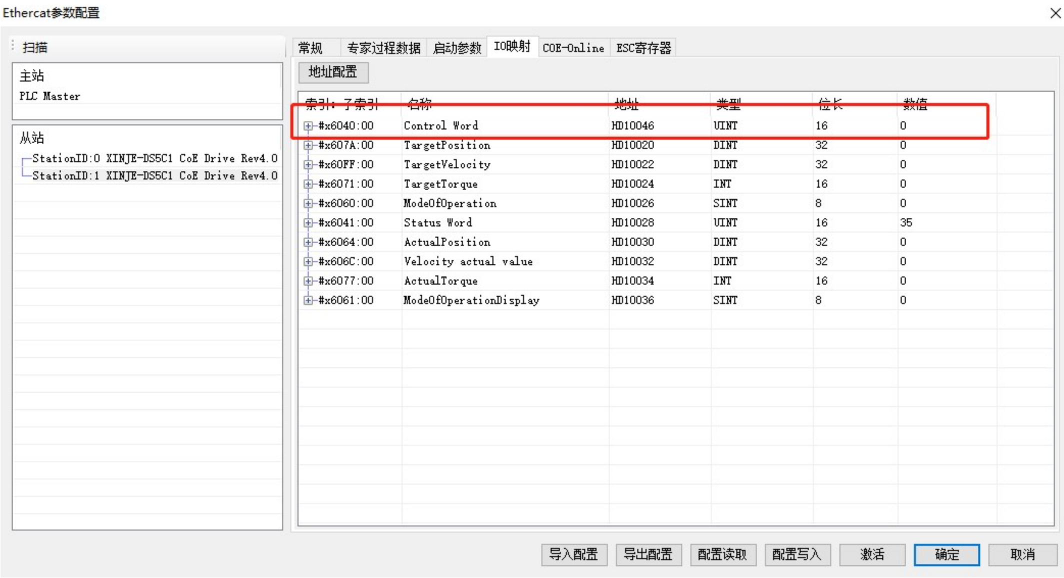
Parameter types in IO mapping can be divided into read-only (RO) and read-write (RW). Parameter types can be seen in CoE-Online. In particular, 6040h (RW) is only writable in homing mode (6060h is 6), and 607A (RW) is

not writable in any mode.
If a new PDO is added to the IO mapping, it will be automatically sorted in the order of RxPDO first and TxPDO later. The corresponding register addresses will also be allocated in order. If the allocated address conflicts with other set slave addresses, the unused addresses will be automatically selected.

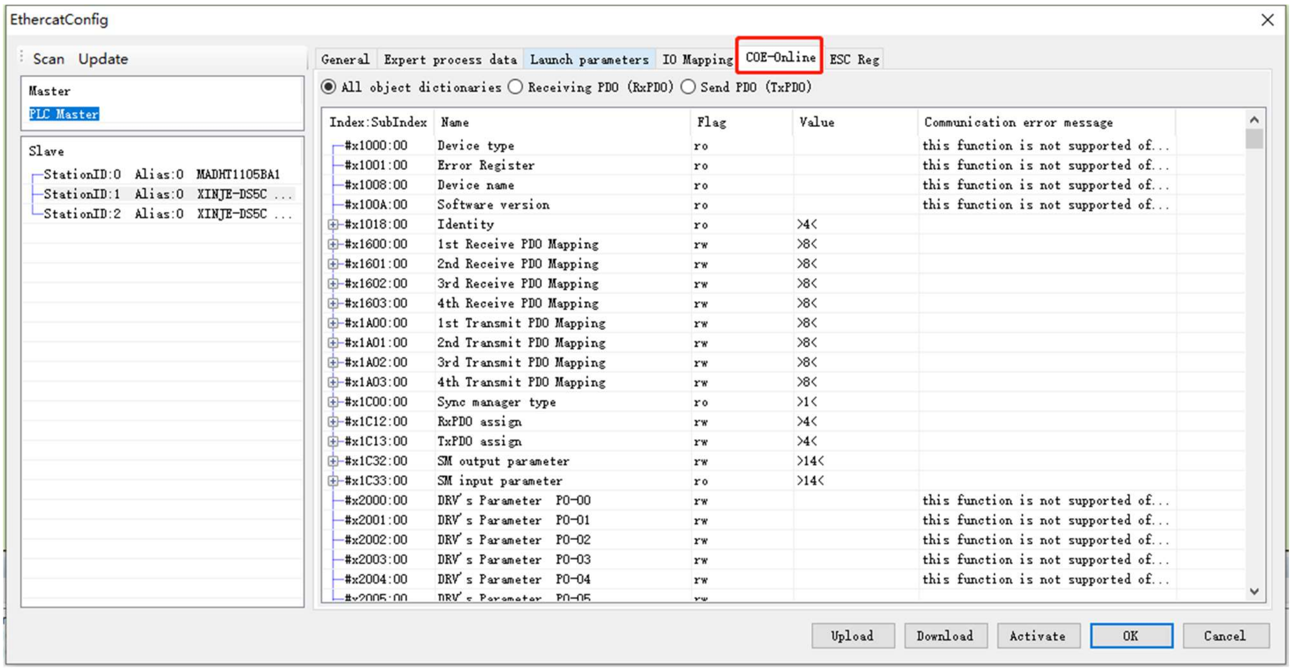


Note: The addresses automatically allocated due to address conflicts will also be automatically arranged in unused registers, as shown in the following figure:





2-9. COE-Online interface



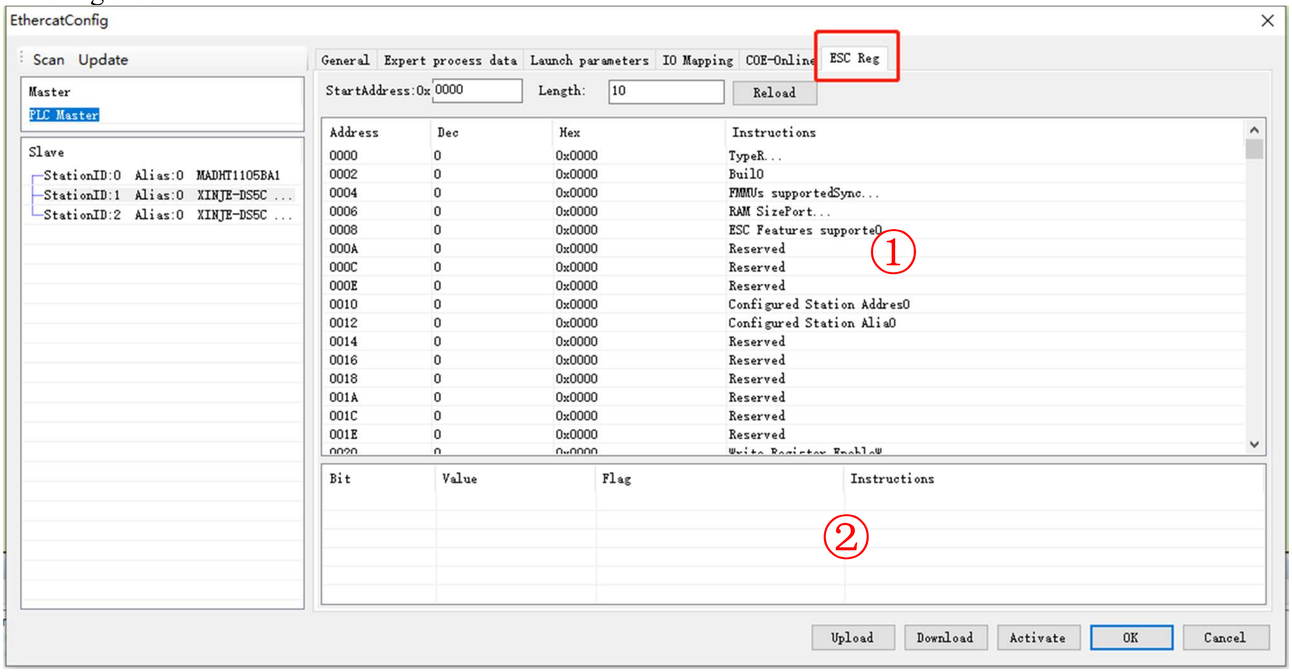
COE-Online has the function of reading and writing all object Dictionaries Online. When the interface is opened, the data will be updated all the time. Select the slave of COE online from the list of slave stations on the left. Double click the RW type object dictionary to make online modification.

COE-Online contains object types:

Object type	Explanation
0x1000	Device type
0x1001	Servo driver alarm type (status)
0x1008	Manufacturer equipment name
0x1009	Manufacturer hardware version
0x100A	Manufacturer software version
0x1018	Device information
0x1C00	Synchronous management communication type (SyncManager)
0x1C12, 0x1C13	Process data object (PD0) mapping
1600h~1603h, 1A00h~1A03h	PDO mapping object
0x1C32, 0x1C33	Synchronous management SM2/3
0x6000-0x6fff	Cia402 Profile COE object
0x2000-0x5fff	Xinje customized object

2-10. ESC register

ESC refers to EtherCAT slave controller, and ESC register interface is the interface for monitoring and modifying slave registers.



Parameter	Explanation
Start address	Set the starting value (hexadecimal) of the register to be monitored.
Length	Number of registers to be monitored, decimal.
Reload	Click to display the value. The current value is displayed only once.
Interface 1	Only the value of each register is displayed and cannot be modified.
Interface 2	The meaning of each bit of the register determines the read/write permission according to the flag. R-readable, w-writable, w (CLR) - write as clear as 0.

Note: the value modification of some registers will disconnect the communication. If there is no special case, it is not necessary to modify.

3. Object dictionary (CoE-Online)

3-1. Object dictionary area assignment

All objects are configured in the object dictionary of each group through the 16-bit index configuration address represented by 4-bit hex.

The object dictionary of CoE (CANopen over EtherCAT) specified by CiA402 and the object dictionary of DS5C series are as follows:

Object dictionary according to CiA402		Object dictionary of DS5C series	
Index	Content	Index	Content
0000h~0FFFh	data type area	0000h~0FFFh	data type area
1000h~1FFFh	COE communication area	1000h~1FFFh	COE communication area
2000h~5FFFh	User-defined area	2000h~2FFFh	servo parameter area
		3000h~3FFFh	Reserved
		4000h~4FFFh	Reserved
		5000h~5FFFh	Reserved
6000h~9FFFh	Profile area	6000h~6FFFh	Driver Profile area
		7000h~9FFFh	Reserved
A000h~FFFFh	Reserved	A000h~FFFFh	Reserved

3-2. COE communication area (0x1000-0x1FFF)

3-2-1. Object list

(1) Device information object

Index	Sub-Index	Name
1000h	00h	Device type
1001h	00h	Error register
1008h	00h	Manufacturer device name
1009h	00h	Manufacturer hardware version
100Ah	00h	Manufacturer software version
1018h	-	Diagnosis history
	00h	Number of entries
	01h	Vendor ID
	02h	Product code
	03h	Revision number
	04h	Serial number

(2) RxPDO object mapping

Index	Sub-Index	Name
1600h	-	Receive PDO mapping 1
	00h	Number of entries
	01h	1st receive PDO mapped
	02h	2nd receive PDO mapped
	03h	3rd receive PDO mapped
	04h	4th receive PDO mapped
	05h	5th receive PDO mapped
	…	…
	18h	24th receive PDO mapped
1601h	-	Receive PDO mapping 2
	00h	Number of entries
	01h	1st receive PDO mapped
	02h	2nd receive PDO mapped
	03h	3rd receive PDO mapped
	04h	4th receive PDO mapped
	05h	5th receive PDO mapped
	…	…
	18h	24th receive PDO mapped
1602h	-	Receive PDO mapping 3
	00h	Number of entries
	01h	1st receive PDO mapped
	02h	2nd receive PDO mapped
	03h	3rd receive PDO mapped
	04h	4th receive PDO mapped
	05h	5th receive PDO mapped
	…	…
	18h	24th receive PDO mapped
1603h	-	Receive PDO mapping 4
	00h	Number of entries
	01h	1st receive PDO mapped
	02h	2nd receive PDO mapped
	03h	3rd receive PDO mapped
	04h	4th receive PDO mapped
	05h	5th receive PDO mapped
	…	…
	18h	24th receive PDO mapped

(3) TxPDO object mapping

Index	Sub-Index	Name
1A00h	-	Transmit PDO mapping 1
	00h	Number of entries
	01h	1st transmit PDO mapped
	02h	2nd transmit PDO mapped
	03h	3rd transmit PDO mapped
	04h	4th transmit PDO mapped
	05h	5th transmit PDO mapped
	…	…
	18h	24th transmit PDO mapped
1A01h	-	Transmit PDO mapping 2
	00h	Number of entries
	01h	1st transmit PDO mapped
	02h	2nd transmit PDO mapped
	03h	3rd transmit PDO mapped
	04h	4th transmit PDO mapped
	05h	5th transmit PDO mapped
	…	…
	18h	24th transmit PDO mapped
1A02h	-	Transmit PDO mapping 3
	00h	Number of entries
	01h	1st transmit PDO mapped
	02h	2nd transmit PDO mapped
	03h	3rd transmit PDO mapped
	04h	4th transmit PDO mapped
	05h	5th transmit PDO mapped
	…	…
	18h	24th transmit PDO mapped
1A03h	-	Transmit PDO mapping 4
	00h	Number of entries
	01h	1st transmit PDO mapped
	02h	2nd transmit PDO mapped
	03h	3rd transmit PDO mapped
	04h	4th transmit PDO mapped
	05h	5th transmit PDO mapped
	…	…
	18h	24th transmit PDO mapped

(4) PDO object distribution

Index	Sub-Indx	Name
1C12h	-	Sync manager channel 2
	00h	Number of assigned PDOs
	01h	Assigned RxPDO 1
	02h	Assigned RxPDO 2
	03h	Assigned RxPDO 3
	04h	Assigned RxPDO 4
1C13h	-	Sync manager channel 3
	00h	Number of assigned PDOs
	01h	Assigned TxPDO 1
	02h	Assigned TxPDO 2
	03h	Assigned TxPDO 3
	04h	Assigned TxPDO 4

(5) PDO synchronous management channel

Index	Sub-Indx	Name
1C32h	-	Sync manager 2 synchronization
	00h	Number of sub-objects

Index	Sub-Indx	Name
	01h	Sync mode
	02h	Cycle time
	03h	Shift time
	04h	Sync modes supported
	05h	Minimum cycle time
	06h	Calc and copy time
	08h	Command
	09h	Delay time
	0Ah	Sync0 cycle time
	0Bh	Cycle time too small
	0Ch	SM-event missed
	0Dh	Shift time too short
	0Eh	RxPDO toggle failed
	20h	Sync error
1C32h	-	Sync manager 2 synchronization
	00h	Number of sub-objects
	01h	Sync mode
	02h	Cycle time
	03h	Shift time
	04h	Sync modes supported
	05h	Minimum cycle time
	06h	Calc and copy time
	08h	Command
	09h	Delay time
	0Ah	Sync0 cycle time
	0Bh	Cycle time too small
	0Ch	SM-event missed
	0Dh	Shift time too short
	0Eh	RxPDO toggle failed
	20h	Sync error

3-2-2. Device information

This section describes the equipment information.

<table>
<tr><th>Index</th><th>Sub-Index</th><th>Name/Description</th><th>Range</th><th>Date Type</th><th>Access</th><th>PDO</th><th>Op-mode</th></tr>
<tr><td rowspan="2">1000h</td><td>00h</td><td>Divece type</td><td>0~4294967295</td><td>U32</td><td>ro</td><td>NO</td><td>All</td></tr>
<tr><td></td><td colspan="6">Indicates the device type. In case of servo driver, the value is fixed to 04020192h.</td></tr>
<tr><td rowspan="2">1001h</td><td rowspan="2">00h</td><td>Error register</td><td>0~65535</td><td>U16</td><td>ro</td><td>TxPDO</td><td>All</td></tr>
<tr><td colspan="6">Displays the type of alarm (status) that is occurring to the servo driver.
When the alarm does not occur, it will display 0000H.
Do not display warnings.
<table>
<tr><th>Bit</th><th>Content</th></tr>
<tr><td>0</td><td rowspan="4">Not support</td></tr>
<tr><td>1</td></tr>
<tr><td>2</td></tr>
<tr><td>3</td></tr>
<tr><td>4</td><td>Alarm occurrence defined by AL status code *1</td></tr>
<tr><td>5</td><td>Not support</td></tr>
<tr><td>6</td><td>Reserved</td></tr>
<tr><td>7</td><td>Alarm occurrence undefined by AL status code *2</td></tr>
</table>
*1) The "alarm defined by AL status code" refers to the EtherCAT Communication Association Error E-800~7, E-810~7, E-850~7.
*2) The "AL status code undefined alarm" refers to the EtherCAT Communication Association Error E-880~7 and the error except EtherCAT Communication Association.</td></tr>
</table>

1008h	00h	Manufacturer device name	-	-	ro	TxPDO	All
		Device name.					
1009h	00h	Manufacturer hardware version	-	-	ro	TxPDO	All
		Hardware version.					

Index	Sub-Index	Name/Description	Range	DateType	Access	PDO	Op-mode
1018h	00h	Number of entries	0~255	U8	ro	TxPDO	All
		Sub-index number for this object. The value is fixed to 04H.					
	01h	Vendor ID	0~4294967295	U32	ro	TxPDO	All
		Manufacturer ID of EtherCAT. The value is fixed to 00000 556h.					
	02h	Product code	0~4294967295	U32	ro	TxPDO	All
		Product code. The value is 10305070h.					
	03h	Revision umber	0~4294967295	U32	ro	TxPDO	All
		Product version number. The value is 02040608h.					
	04h	Divece type	0~4294967295	U32	ro	TxPDO	All
		Product serial number. The value is 00000000h.					

3-2-3. Sync manager communication type (1C00h)

The action mode assigned to each syncmanager is set by 1C00h object.
The value is fixed for the servo driver.

Index	Sub-Index	Name/Description	Range	DateType	Access	PDO	Op-mode
1C00h	00h	Number of used sync manager channels	0~255	U8	ro	TxPDO	All
		The number of child indexes for this object. The value is fixed to 04H.					
	01h	Communication type sync manager 0	0~4	U8	ro	TxPDO	All
		Set the purpose of sync Manager 0. 0: unused. 1: Mailbox receive (master station→slave station) 2: Mailbox send (slave station→master station) 3: RxPDO (master station→slave station) 4: TxPDO (slave station→master station) Because sync manager0 uses mailbox to receive messages, the value is fixed to 1.					
	02h	Communication type sync manager 1	0~4	U8	ro	TxPDO	All
		Set the purpose of sync Manager 1. 0: unused. 1: Mailbox receive (master station→slave station) 2: Mailbox send (slave station→master station) 3: RxPDO (master station→slave station) 4: TxPDO (slave station→master station) Because sync manager1 uses mailbox to send messages, the value is fixed to 2.					
	03h	Communication type sync manager 2	0~4	U8	ro	TxPDO	All
		Set the purpose of sync Manager 2. 0: unused. 1: Mailbox receive (master station→slave station) 2: Mailbox send (slave station→master station) 3: RxPDO (master station→slave station) 4: TxPDO (slave station→master station) Because sync manager2 uses process data output (RxPDO), the value is fixed to 3.					
	04h	Communication type sync manager 3	0~4	U8	ro	TxPDO	All
		Set the purpose of sync Manager 3. 0: unused. 1: Mailbox receive (master station→slave station) 2: Mailbox send (slave station→master station) 3: RxPDO (master station→slave station)					

		4: TxPDO (slave station→master station) Because sync manager3 uses process data output (RxPDO), the value is fixed to 4.

3-2-4. PDO mapping

1. PDO distribution object (1C12h~1C13h)

The type of PDO mapping table allocated by syncmanager is set by 1C12h to 1C13h objects.

Index	Sub-Index	Name/Description	Range	Date Type	Access	PDO	Op-mode
1C12h	00h	Number of assigned PDOs	0~4	U8	rw	NO	All
		The number of subindexes for this object.					
	01h	Assigned RxPDO 1	1600h~1603h	U16	rw	NO	All
		Specify the RxPDO mapping object.					
	02h	Assigned RxPDO 2	1600h~1603h	U16	rw	NO	All
		Specify the RxPDO mapping object.					
	03h	Assigned RxPDO 3	1600h~1603h	U16	rw	NO	All
		Specify the RxPDO mapping object.					
	04h	Assigned RxPDO 4	1600~1603	U16	rw	NO	All
		Specify the RxPDO mapping object.					
1C13h	00h	Number of assigned PDOs	0~4	U8	rw	NO	All
		The number of subindexes for this object. The value is fixed to 04h.					
	01h	Assigned TxPDO 1	1A00h~1A03h	U16	rw	NO	All
		Specify the TxPDO mapping object.					
	02h	Assigned TxPDO 2	1A00h~1A03h	U16	rw	NO	All
		Specify the TxPDO mapping object.					
	03h	Assigned TxPDO 3	1A00h~1A03h	U16	rw	NO	All
		Specify the TxPDO mapping object.					
	04h	Assigned TxPDO 4	1A00h~1A03h	U16	rw	NO	All
		Specify the TxPDO mapping object.					

Subindex01h-04h of 1C12h and 1C13h can only be changed when the ESM state is PreOP and subindex00h = 0. In addition, the status is the return port code (06010003h).
After the setting is changed, set the subindex number of subindex00h, and reflect PDO distribution object setting by converting ESM state to SafeOP.

2. PDO mapping object (1600h~1603h, 1A00h~1A03h)

As a table for PDO mapping objects, objects of 1600h~1603h for RxPDO and 1A00h~1A03h for TxPDO can be used. After subindex 01h, it represents the information of the mapped application layer object.

Index	Sub-Index	Name/Description	Range	DateType	Access	PDO	Op-mode
1600h	00h	Number of entries	0~4294967295	U8	rw	NO	All
		Subindex number of the object.					
	01h	1st receive PDO mapped	0~4294967295	U32	rw	NO	All
		Set the first mapping object. <table><tr><td>bit</td><td>31 …16</td><td>15 ….8</td><td>7 ….0</td></tr><tr><td></td><td>Index number</td><td>Sub-index number</td><td>Bit length</td></tr></table>					
	02h	2nd receive PDO mapped	0~4294967295	U32	rw	NO	All
		Setting method is same to Subindex01h.					
	03h	3rd receive PDO mapped	0~4294967295	U32	rw	NO	All
		Setting method is same to Subindex01h.					
	04h	4th receive PDO mapped	0~4294967295	U32	rw	NO	All
		Setting method is same to Subindex01h.					
	05h	5th receive PDO mapped	0~4294967295	U32	rw	NO	All
		Setting method is same to Subindex01h.					
	06h	6th receive PDO mapped	0~4294967295	U32	rw	NO	All

		Setting method is same to Subindex01h.					
	…	…					
	18h	24th receive PDO mapped	0~4294967295	U32	rw	NO	All
		Setting method is same to Subindex01h.					
1601h	-	Receive PDO mapping 2, the Subindex specification is same to 1600h.					
1602h	-	Receive PDO mapping 3, the Subindex specification is same to 1600h.					
1603h	-	Receive PDO mapping 4, the Subindex specification is same to 1600h.					

Do not map duplicate objects. The change of the repeated setting is unknown.

Subindex01h-18h of 1600h-1603h can only be changed when the ESM state is PreOP and subindex00h = 0. In addition, the status returns abort code (06010003h).

After the setting is changed, set the subindex number of subindex0h, and reflect PDO distribution object setting by converting ESM state to SafeOP.

Index	Sub-Index	Name/Description	Range	DateType	Access	PDO	Op-mode
1A00h	00h	Number of entries	0~4294967295	U8	rw	NO	All
		Subindex number of the object.					
	01h	1st transmit PDO mapped	0~4294967295	U32	rw	NO	All
		Set the first mapping object. bit: 31 …16 = Index number; 15 ….8 = Sub-index number; 7 … 0 = Bit length					
	02h	2nd transmit PDO mapped	0~4294967295	U32	rw	NO	All
		Setting method is same to Subindex01h.					
	03h	3rd transmit PDO mapped	0~4294967295	U32	rw	NO	All
		Setting method is same to Subindex01h.					
	04h	4th transmit PDO mapped	0~4294967295	U32	rw	NO	All
		Setting method is same to Subindex01h.					
	05h	5th transmit PDO mapped	0~4294967295	U32	rw	NO	All
		Setting method is same to Subindex01h.					
	06h	6th transmit PDO mapped	0~4294967295	U32	rw	NO	All
		Setting method is same to Subindex01h.					
	…	…					
	18h	24th transmit PDO mapped	0~4294967295	U32	rw	NO	All
		Setting method is same to Subindex01h.					
1A01h	-	Transmit PDO mapping 2, the Subindex specification is same to 1600h.					
1A02h	-	Transmit PDO mapping 3, the Subindex specification is same to 1600h.					
1A03h	-	Transmit PDO mapping 4, the Subindex specification is same to 1600h.					

Do not map duplicate objects. The change of the repeated setting is unknown.

Subindex01h-18h of 1A00h-1A03h can only be changed when the ESM state is PreOP and subindex00h = 0. In addition, the status returns abort code (06010003h).

After the setting is changed, set the subindex number of subindex0h, and reflect PDO distribution object setting by converting ESM state to SafeOP.

3-2-5. Sync manager 2/3 synchronization (1C32h, 1C33h)

The setting of Sync manager2 is executed as 1C32h (Sync maneger 2 synchronization).
The setting of Sync manager3 is executed as 1C33h (Sync maneger 3 synchronization).

Sync manager 2 synchronization (1C32h)

Index	Sub-Index	Name/Description	Range	Date Type	Access	PDO	Op-mode
1C32	00h	Number of entries	0~20h	U8	ro	NO	All
		Subindex number of the object. The value is fixed to 20h.					
	01h	Sync mode	0-65535	U16	rw	NO	All
		Set the synchronization mode of Sync Manager 2. 00h: FreeRun (not synchronized) 01h: SM2 (synchronized with SM 2 Event) 02h: DC SYNC0 (synchronized with Sync0 Event)					
	02h	Cycle time	0~4294967295	U32	rw	NO	All
		Set the cycle of Sync Manager. Please set it among 500000 (500μs), 1000000 (1ms), 2000000(2ms), 4000000(4ms). If a value other than the above is set, E-810 (abnormal protection of synchronization cycle setting) will occur.					
	03h	Shift time	0~4294967295	U32	rw	NO	All
		Offset time.					
	04h	Sync modes supported	0~65535	U16	ro	NO	All
		Set the supported synchronization type. BIT0: FreeRun mode supported 0: not support; 1: FreeRun mode supported This servo driver is set to 1. BIT1: SM synchronization mode supported 0: not support; 1: SM2 event synchronization supported This servo driver is set to 1. BIT4-2: DC synchronization mode supported 000b: not support 001b: DC sync0 event supported This servo driver is set to 001b. BIT6-5: output offset supported 00b: not support 01b: offset of local clock supported This servo driver is set to 00b. BIT15-7: Reserved					
1C32	05h	Minimum cycle time	0~4294967295	U32	ro	NO	All
		The minimum value of the communication cycle that can be set.					
	06h	Calc and copy time	0~4294967295	U32	ro	NO	All
		The time from SM2 event, sync0 event to ESC read completion. This time can also be extended when there is a deviation in the signal.					
	08h	Command	0~65535	U16	ro	NO	All
		Not support					
	09h	Delay time	0~4294967295	U32	ro	NO	All
		Not support					
	0Ah	Sync0 cycle time	0~4294967295	U16	ro	NO	All
		When DC SYNC0 (1C32h-01h=02h), the value of ESC register 09A0h is set. Except DC SYNC0, the setting is 0.					
	0Bh	Cycle time too small	0~65535	U16	ro	NO	All
		Not support					
	0Ch	SM-event missed	0~65535	U16	ro	NO	All
		Not support					
	0Dh	Shift time too short	0~65535	U16	ro	NO	All
		Not support					
	0Eh	RxPDO toggle failed	0~65535	U16	rw	NO	All
		Not support					

	20h	Sync error	0~1	BOOL	ro	NO	All
		Sync error					

This setting value is a reference value, not a guaranteed value.

Sync manager 3 synchronization (1C33h)

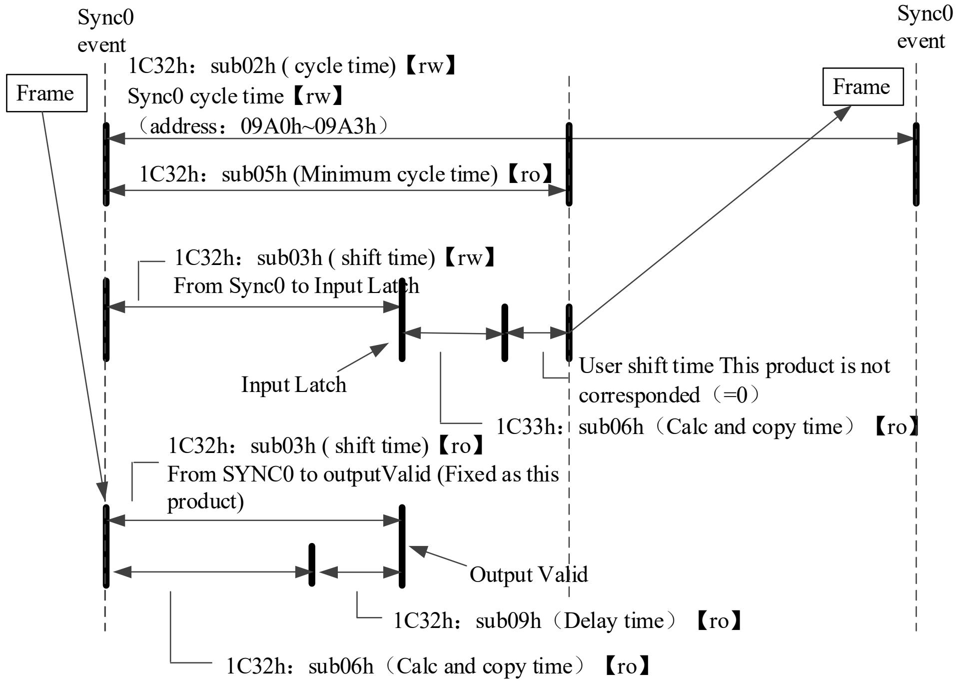
Index	Sub-Index	Name/Description	Range	DateType	Access	PDO	Op-mode
1C33h	00h	Number of entries	0~20h	U8	ro	NO	All
		The Subindex number of this object. The value is fixed to 20h.					
	01h	Sync mode	0~65535	U16	rw	NO	All
		Set the synchronization mode of Sync Manager 2. 00h: FreeRun (not synchronized) 01h: SM2 (synchronized with SM 2 Event) 02h: DC SYNC0 (synchronized with Sync0 Event)					
	02h	Cycle time	0~4294967295	U32	rw	NO	All
		Set the cycle of Sync Manager. Please set it among 500000 (500μs), 1000000 (1ms), 2000000(2ms), 4000000(4ms). If a value other than the above is set, E-810 (abnormal protection of synchronization cycle setting) will occur.					
	03h	Shift time	0~4294967295	U32	rw	NO	All
		Offset time.					
	04h	Sync modes supported	0~65535	U16	ro	NO	All
		Set the supported synchronization type. BIT0: FreeRun mode supported 0: not support; 1: FreeRun mode supported This servo driver is set to 1. BIT1: SM synchronization mode supported 0: not support; 1: SM2 event synchronization supported This servo driver is set to 1. BIT4-2: DC synchronization mode supported 000b: not support 001b: DC sync0 event supported This servo driver is set to 001b. BIT6-5: output offset supported 00b: not support 01b: offset of local clock supported This servo driver is set to 00b. BIT15-7: Reserved					
1C33h	05h	Minimum cycle time	0~4294967295	U32	ro	NO	All
		The minimum value of the communication cycle that can be set.					
	06h	Calc and copy time	0~4294967295	U32	ro	NO	All
		The time from SM2 event, sync0 event to ESC read completion. This time can also be extended when there is a deviation in the signal.					
	08h	Command	0~65535	U16	ro	NO	All
		Not support					
	09h	Delay time	0~4294967295	U32	ro	NO	All
		Not support					
	0Ah	Sync0 cycle time	0~4294967295	U16	ro	NO	All
		The same value with 1C32h-0Ah					
	0Bh	Cycle time too small	0~65535	U16	ro	NO	All
		Not support					
	0Ch	SM-event missed	0~65535	U16	ro	NO	All
		Not support					
	0Dh	Shift time too short	0~65535	U16	ro	NO	All
		Not support					
	0Eh	RxPDO toggle failed	0~65535	U16	rw	NO	All
		Not support					
	20h	Sync error	0~1	BOOL	ro	NO	All
		Sync error					

This setting value is a reference value, not a guaranteed value.

1. DC (SYNC0 event synchronization)

synchronization method	Features
Synchronize the time information of other slave stations based on the time of the first axis	High precision, need to compensate at the main station side

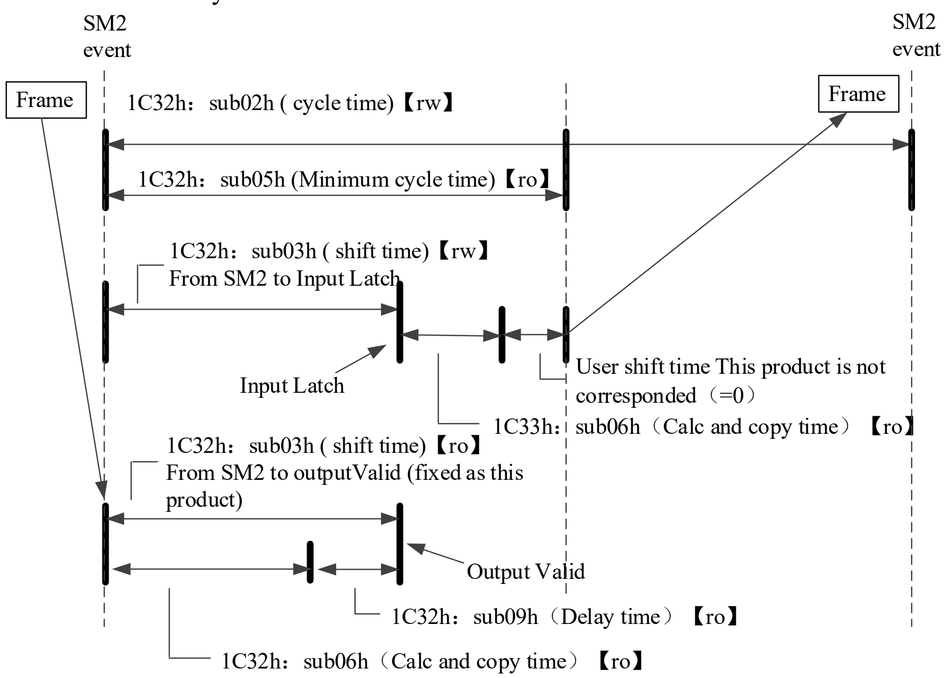
The specification of DC synchronous mode in this servo driver is as follows:



2. SM2 (SM2 event synchronization)

synchronization method	Features
Synchronize with RxPDO receiving time	No transmission delay compensation accuracy difference The transmission time must be ensured on the upper side (special hardware, etc.)

The specifications of SM2 synchronous mode in this servo driver are as follows:



3-3. Driver Profile area (0x6000~0x6FFF)

3-3-1. Object list

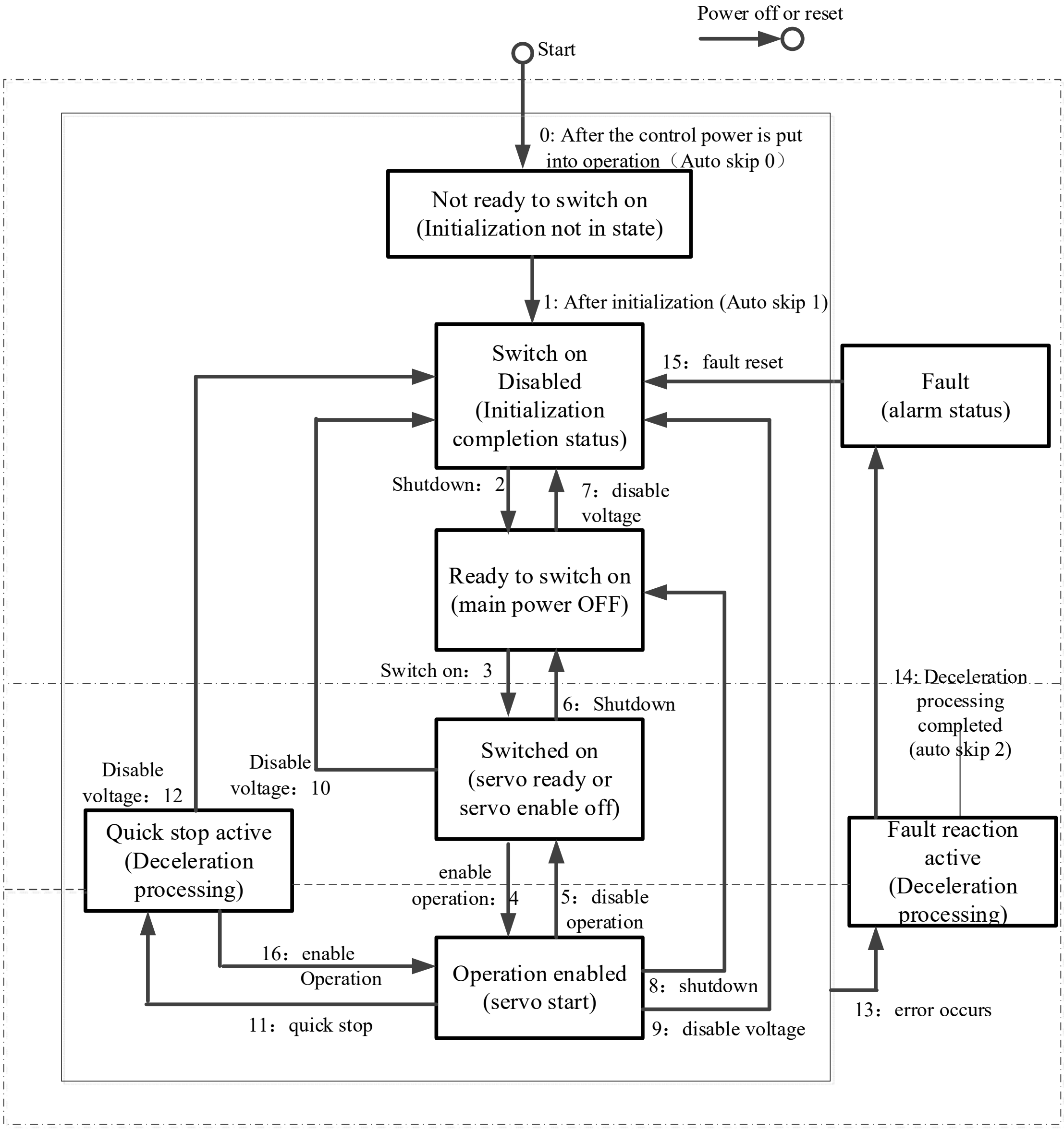
Index	Sub-Index	Name
603Fh	00h	Abort connection option code
6040h	00h	Controlword
6041h	00h	Statusword
605Ah	00h	Quick stop option code
605Bh	00h	Shutdown option code
605Bh	00h	Disable operation option code
605Bh	00h	Halt option code
605Eh	00h	Fault reaction option code
6060h	00h	Modes of operation
6061h	00h	Modes of operation display
6062h	00h	Position demand value
6063h	00h	Position actual internal value
6064h	00h	Position actual value
6065h	00h	Following error window
6066h	00h	Following error time out
6067h	00h	Position window
6068h	00h	Position window time
6069h	00h	Velocity sensor actual value
606Bh	00h	Velocity demand value
606Ch	00h	Velocity actual value
606Dh	00h	Velocity window
606Eh	00h	Velocity window time
606Fh	00h	Velocity threshold
6070h	00h	Velocity threshold time
6071h	00h	Target torque
6072h	00h	Max torque
6073h	00h	Max current
6074h	00h	Torque demand
6075h	00h	Motor rated current
6076h	00h	Motor rated torque
6077h	00h	Torque actual value
6078h	00h	Current actual value
6079h	00h	DC link circuit voltage
607Ah	00h	Target position
607Bh	-	Position range limit
	00h	Highest sub-index supported
	01h	Min position range limit
607Bh	02h	Max position range limit
607Ch	00h	Home offset
607Dh	-	Software position limit
	00h	Number of entries
	01h	Min position limit
	02h	Max position limit
606Eh	00h	Polarity
607Fh	00h	Max profile velocity
6080h	00h	Max motor speed
6081h	00h	Profile velocity
6082h	00h	End velocity
6083h	00h	Profile acceleration
6084h	00h	Profile deceleration
6085h	00h	Quick stop deceleration

Index	Sub-Index	Name
6086h	00h	Motion profile type
6087h	00h	Torque slope
6088h	00h	Torque profile type
608Fh	-	Position encoder resolution
	00h	Highest sub-index supported
	01h	Encoder increments
	02h	Motor revolutions
6091h	-	Gear ratio
	00h	Number of entries
	01h	Motor revolutions
	02h	Shaft revolutions
6092h	-	Feed constant
	00h	Highest sub-index supported
	01h	Feed
	02h	Shaft revolutions
6098h	00h	Homing method
6099h	-	Homing speeds
	00h	Number of entries
	01h	Speed during search for switch
	02h	Speed during search for zero
609Ah	00h	Homing acceleration
60A3h	00h	Profile jerk use
60A4h	-	Profile jerk
	00h	Highest sub-index supported
	01h	Profile jerk1
	02h	Profile jerk2
60B0h	00h	Position offset
60B1h	00h	Velocity offset
60B2h	00h	Torque offset
60B8h	00h	Touch probe function
60B9h	00h	Touch probe status
60BAh	00h	Touch probe pos1 pos value
60BBh	00h	Touch probe pos1 neg value
60BCh	00h	Touch probe pos2 pos value
60BDh	00h	Touch probe pos2 neg value
60C2h	-	Interpolation time period
	00h	Highest sub-index supported
	01h	Interpolation time period value
	02h	Interpolation time index
60C5h	00h	Max acceleration
60C6h	00h	Max deceleration
60E3h	-	Supported homing method
	00h	Number of entries
	01h	1st supported homing method
	..	..
	20h	32nd supported homing method
60F2h	00h	Positioning option code
60F4h	00h	Following error actual value
60FAh	00h	Control effort
60FCh	00h	Position demand internal value
60FDh	00h	Digital inputs
60FEh	-	Digital outputs
	00h	Number of entries
	01h	Physical outputs
	02	Bit mask
60FEh	00h	Target velocity

Index	Sub-Index	Name
6502h	00h	Supported drive modes

3-3-2. PDS (Power Drive Systems) specification

According to the user command or abnormal detection, the state transition of the PDS associated with the power control of the servo driver is defined as follows.



After migrating to operation enabled (servo is enabled), please increase the time to more than 100ms and input the action command.
The following table shows the PDS state migration events (migration conditions) and actions during migration.
For the migration of PDS, the status migration is performed at the same time as the handshake is obtained (through 6041h: Statusword confirm the status has been converted and then send the next migration instruction).

PDS conversion		Event	Action
0	Auto skip 0	After the power supply is put into operation, or after the application layer is reset, it will automatically migrate.	After the power supply is put into operation, or after the application layer is reset, it will automatically migrate.
1	Auto skip 1	Automatic conversion after initialization.	Communications are established.
2	Shut down	The condition of receiving the shutdown instruction.	Nothing special.
3	Switch on	When the power supply is on, the condition of receiving the switch on command.	Nothing special.

4	Enable operation	The condition of receiving the enable operation instruction.	The drive function is effective. In addition, all previous set point data are cleared.
5	Disable operation	The situation of receiving the disable operation instruction.	Invalid driver function.
6	Shutdown	When the power supply is ON, the condition of receiving Shutdown instruction. Check out the condition that the power supply is OFF.	Nothing special.
7	Disable voltage	The condition of receiving Disable voltage instruction. The condition of receiving Quick stop instruction. When the ESM status is PreOP, SafeOP or OP, the condition of migrating to init.	Nothing special.
8	Shutdown	When the power supply is ON, the condition of receiving Shutdown instruction.	Driver function is invalid.
9	Disable voltage	the condition of receiving Disable voltage instruction.	Driver function is invalid.
10	Disable voltage	the condition of receiving Disable voltage instruction. the condition of receiving Quick stop instruction. When the ESM status is PreOP, SafeOP or OP, the condition of migrating to init.	Nothing special.
11	Quick stop	the condition of receiving Quick stop instruction.	Execute Quick stop function.
12	Disable voltage	When the quick stop selection code is the set value of 1, 2 and 3, and the quick stop action is completed. When the quick stop selection code is the set value of 5, 6 and 7, and the quick stop action is completed, the condition of receiving disable voltage instruction. Check the condition that the power supply is off.	Driver function is invalid.
13	Error occurs	Abnormal detection.	Execute Fault reaction function.
14	Auto skip 2	After the abnormal detection and deceleration processing is completed, it will be migrated automatically.	Driver function is invalid.
15	Fault reset	The situation of receiving the fault result instruction after the fault is removed.	If the fault factor does not exist, reset the fault status.
16	Enable operation	When the quick stop selection code is the set value of 5, 6 and 7, the condition of receiving Enable operation instruction.	Driver function is valid.

3-3-3. Controlword (6040h)

PDS status migration, etc. The command to control the slave station (servo driver) is set through 6040h (control word).

Index	Sub-Index	Name/Description	Range	DateType	Access	PDO	Op-mode
6040h	00h	Controlword	0~65535	U16	rw	RxPDO	All

Set the control command to the servo driver such as PDS state conversion.

Bit information

15	14	13	12	11	10	9	8
R						oms	h
7	6	5	4	3	2	1	0
fr	R			eo	qs	ev	so

r = reserved (not corresponding) fr = fault reset
oms = operation mode specific eo = enable operation
(control mode based on bit) qs = quick stop
h = halt ev = enable voltage
so = switch on

Command	bits of the controlword					PDS conversion
	bit7	bit3	bit2	bit1	bit0	
	fault reset	Enable operation	quick stop	Enable voltage	Switch on	
Shutdown	0	-	1	1	0	2, 6, 8
Switch on	0	0	1	1	1	3
Switch on + Enable operation	0	1	1	1	1	3+4
Enable operation	0	1	1	1	1	4, 16
Disable voltage	0	-	-	0	-	7, 9, 10, 12
Quick stop	0	-	0	1	-	7, 10, 11
Disable operation	0	0	1	1	1	5
Fault reset	0->1	-	-	-	-	13

The bit logic of the quick stop instruction is valid at 0.
Please execute other bit logic and the opposite actions.
Bit8 (HALT): 1, the motor deceleration pause is executed by 605Dh (halt selection code).
After the pause, the enable must be turned off to restart the action.

bit9, 6-4(operation mode specific):
The following shows the inherent change of OMS bit in the control mode (OP mode). (for details, please refer to the chapter of related objects of each control mode.)

Op-mode	Bit9	Bit6	Bit5	Bit4
pp	change on set-point	absolute /elative	change set immediately	new set-point
pv	-	-	-	-
tq	-	-	-	-
hm	-	-	-	start homing
csp	-	-	-	-
csv	-	-	-	-
cst	-	-	-	-

3-3-4. Statusword (6041h)

PDS status migration, etc. the command to control the slave station (servo driver) is set through 6040h (control word).

Index	Sub-Index	Name/Description	Range	DateType	Access	PDO	Op-mode
6041h	00h	Statusword	0~65535	U16	ro	TxPDO	All
		Indicates the status of the servo driver. Bit information					

15	14	13	12	11	10	9	8
r		oms		ila	oms	rm	r
7	6	5	4	3	2	1	0
w	sod	qs	ve	f	oe	so	rsto

r = reserved (not corresponding) w = warning
sod = switch on disabled
oms = operation mode specific qs = quick stop
(control mode based on bit) ve = voltage enabled
ila = internal limit active f = fault
oe = operation enabled
rm = remote so = switched on
rtso = ready to switch on

Bit6,5,3-0 (switch on disabled/quick stop/fault/operation enabled/switched on/ready to switch on): confirm PDS status according to this bit. The following shows the status and related bit.

StatusWord	PDS State	
xxxx xxxx x0xx 0000 b	Not ready to switch on	Initialization incomplete state
xxxx xxxx x1xx 0000 b	Switch on disabled	Initialization completion status
xxxx xxxx x01x 0001 b	Ready to switch on	Initialization completion status
xxxx xxxx x01x 0011 b	Switched on	Servo enable off/ servo ready

xxxx xxxx x01x 0111 b	Operation enabled	Servo enable on
xxxx xxxx x00x 0111 b	Quick stop active	Stop immediately
xxxx xxxx x0xx 1111 b	Fault reaction active	Error (alarm) judge
xxxx xxxx x0xx 1000 b	Fault	Error (alarm) status

bit4 (voltage enabled): In case of 1, it means that the power supply voltage is applied to PDS.

bit5 (quick stop): In the case of 0, PDS receives the quick stop request. The bit logic of quick stop is valid at 0. Please excute other bit logic and the opposite actions.
bit7 (warning): In the case of 1, a warning is occurring. When warning, PDS status will not change and motor will continue to operate.
bit9 (remote): In the case of 0(local), indicates the status that 6040 (controlword) cannot process. In the case of 1 (remote), indicates 6040 (Controlword) is in a manageable state. The ESM state changes to 1 when the transition is above PreOP.
bit13,12,10 (operation mode specific): the following means inherent change of OMS bit in control mode. (For details, please refer to the chapter of related objects of each control mode)

Op-mode	bit13	bit12	Bit10
pp	following error	set-point acknowledge	target reached
pv	-	speed	target reached
tq	-	-	target reached
hm	homing error	homing attained	target reached
csp	following error	drive follows command value	-
csv	-	drive follows command value	-
cst	-	drive follows command value	-

bit11 (internal limit active): The main reason for the internal limit is that the bit11 (internal limit active) of 6041h (status word) changes to 1.
bit15,14 (reserved): this bit is not used (fixed 0).

3-3-5. Control mode setting

1. Supported drive modes (6502h)

This servo driver can confirm the supported modes of operation according to 6502h (supported drive modes).

Index	Sub-Index	Name/Description	Range	DateType	Access	PDO	Op-mode
6502h	00h	Supported drive modes	0~4294967295	U32	ro	TxPDO	All

Supported Mode of operation.
A value of 1 indicates the mode supported in this mode.
Bit information

31…16			15…10			9	8
r			r			cst	csv
0			0			1	1
7	6	5	4	3	2	1	0
csp	r	hm	r	tq	pv	r	pp
1	0	1	0	1	1	0	1

bit	Mode of operation	Abbr	corresponding
0	Profile position mode	pp	YES
2	Profile velocity mode	pv	YES
3	Torque profile mode	tq	YES
5	Homing mode	hm	YES
7	Cyclic synchronous position mode	csp	YES
8	Cyclic synchronous velocity mode	csv	YES
9	Cyclic synchronous torque mode	cst	YES

2. Modes of operation (6060h)

The control mode is set through 6060h (modes of operation).

Index	Sub-Index	Name/Description	Range	DateType	Access	PDO	Op-mode

6060h	00h	Mode of operation	-128~127	I8	rw	RxPDO	All
		Set the control mode of servo driver Non corresponding control mode setting inhibit.					

bit	Mode of operation	Abbr	Corresponding
-128~ -1	Reserved	-	-
0	No mode changed/No mode assigned	-	-
1	Profile position mode	pp	YES
3	Profile velocity mode	pv	YES
4	Torque profile mode	tq	YES
6	Homing mode	hm	YES
8	Cyclic synchronous position mode	csp	YES
9	Cyclic synchronous velocity mode	csv	YES
10	Cyclic synchronous torque mode	cst	YES
11~127	Reserved	-	-

Because 6060h (modes of operation) is default = (no mode change / no mode assigned), please set the control mode value to be used after the power is put into operation. When the set value of 6060h is 0 and the set value of 6061h is 0, if the PDS state is migrated to operation enabled, E-881 (control mode setting abnormal protection) occurs.

After the initial state of 6060h = 0 (no mode assigned) is transferred to the supported control mode (PP, PV, TQ, HM, CSP, CSV, CST), set 6060h = 0 again is seemed as "no mode changed", and the control mode can not be switched. (keep the previous control mode).

3. Modes of operation display (6061h)

The confirmation of the control mode inside the servo driver is performed according to 6061h (modes of operation display). After 6060h (modes of operation) is set, please confirm whether it is feasible to set this object action through detection.

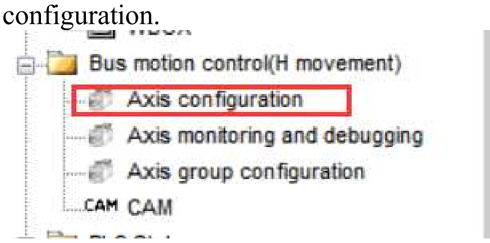
Index	Sub-Index	Name/Description	Range	DateType	Access	PDO	Op-mode
6061h	00h	Mode of operation display	-128~127	I8	ro	TxPDO	All
		Current control mode.					

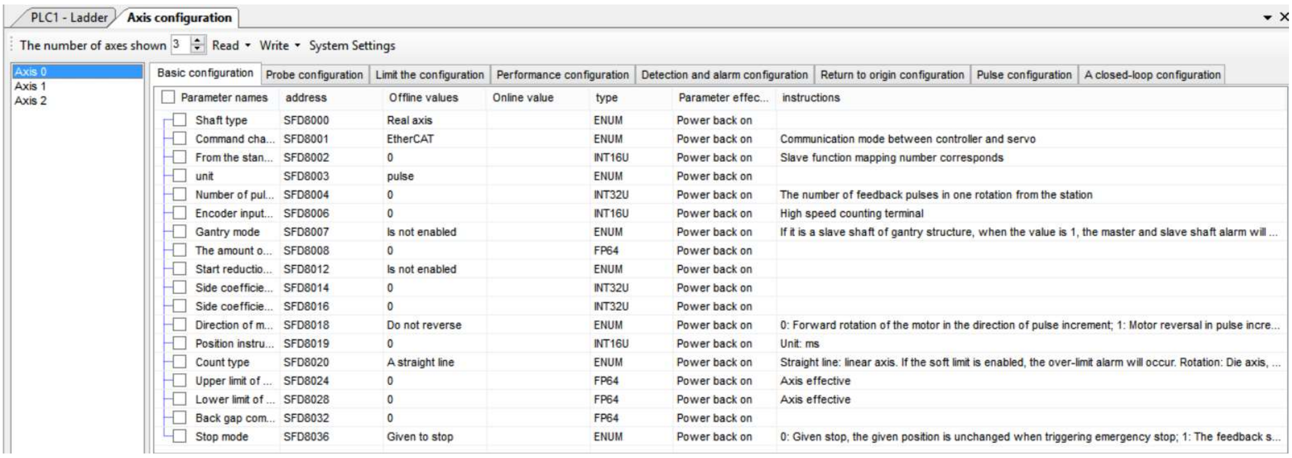
bit	Mode of operation	Abbr	Corresponding
-128~ -1	Reserved	-	-
0	No mode changed/No mode assigned	-	-
1	Profile position mode	pp	YES
3	Profile velocity mode	pv	YES
4	Torque profile mode	tq	YES
6	Homing mode	hm	YES
8	Cyclic synchronous position mode	csp	YES
9	Cyclic synchronous velocity mode	csv	YES
10	Cyclic synchronous torque mode	cst	YES
11~127	Reserved	-	-

4. Motion control configuration interface

4-1. Axis configuration

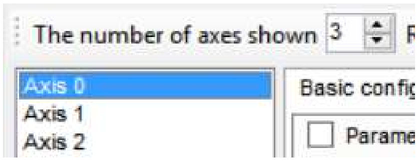
Enable the H motion to use the axis configuration.





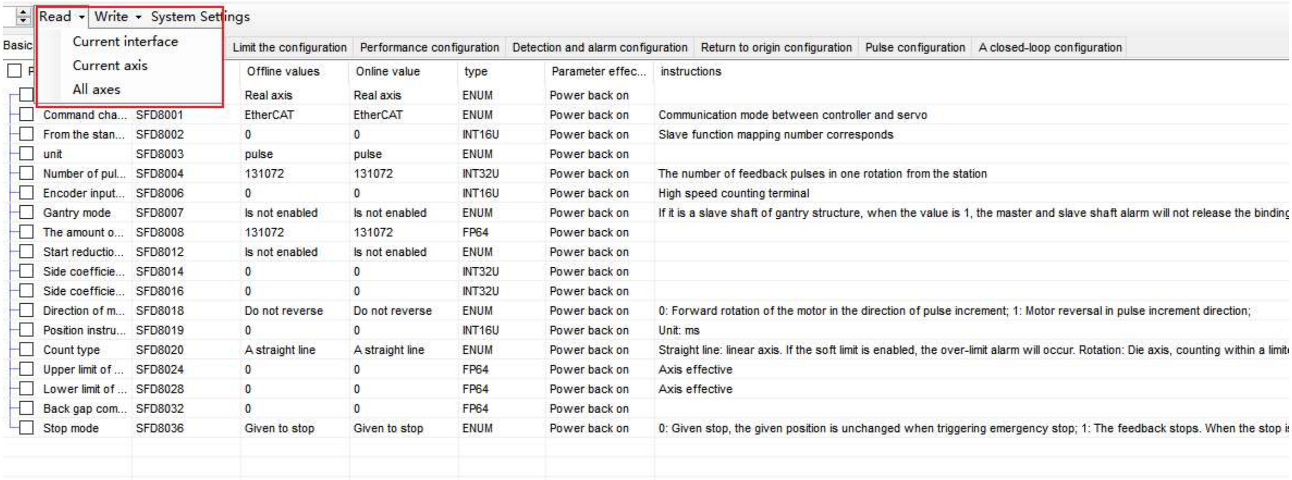
The main interface:

4-1-1.The number of axes shown



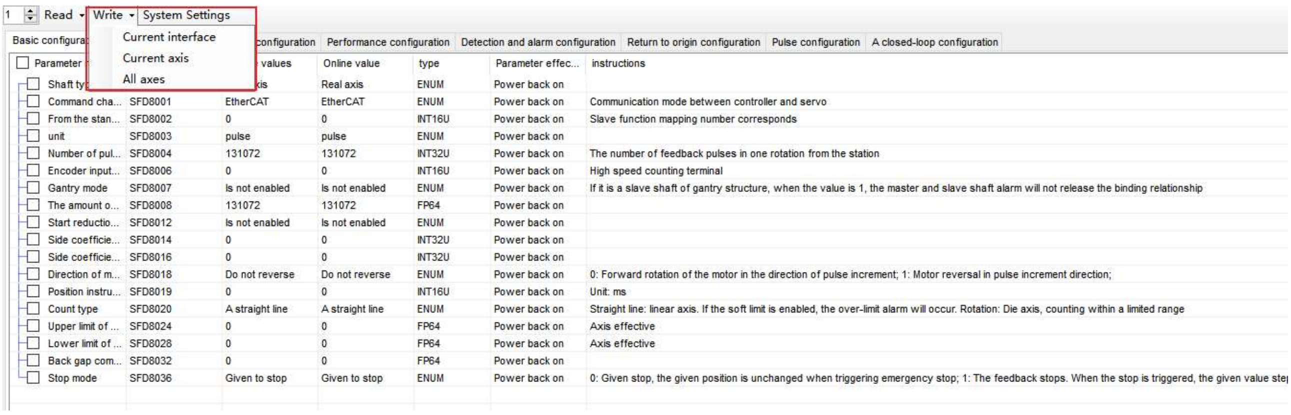
The setting of [the number of axes shown] determines the number of axes in the configuration bar. It has nothing to do with the actual number of connected axes and is only for display. Select the corresponding axis number to configure the axis related parameters.

4-1-2. Read



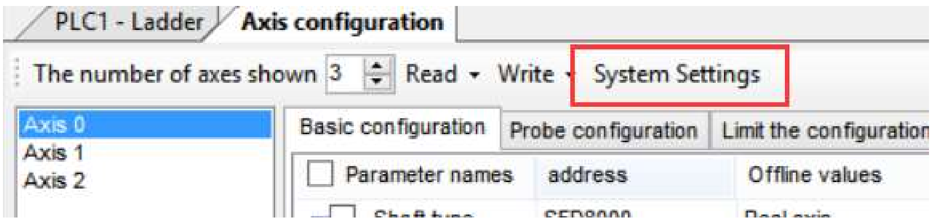
Click [Read] to read all parameters of all axes.

4-1-3. Write

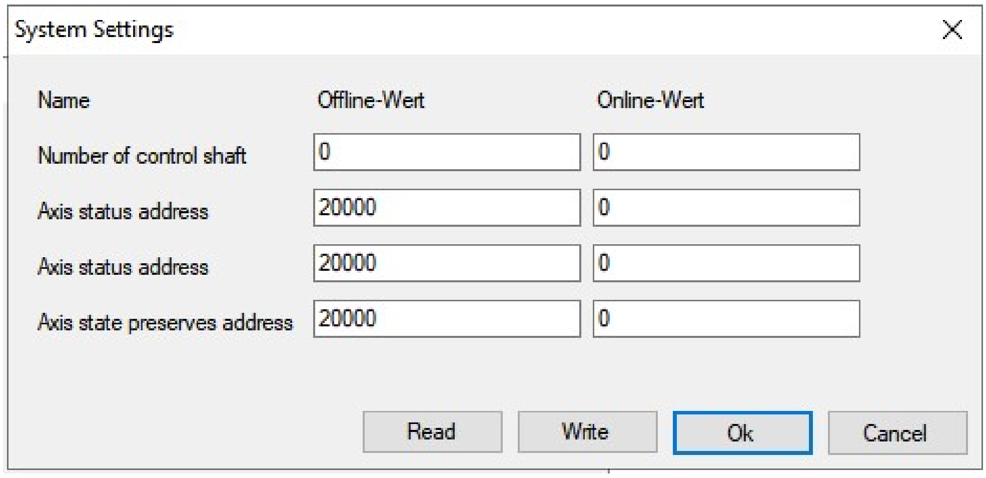


Click [Write] to write all parameters of all axes.

4-1-4. System settings

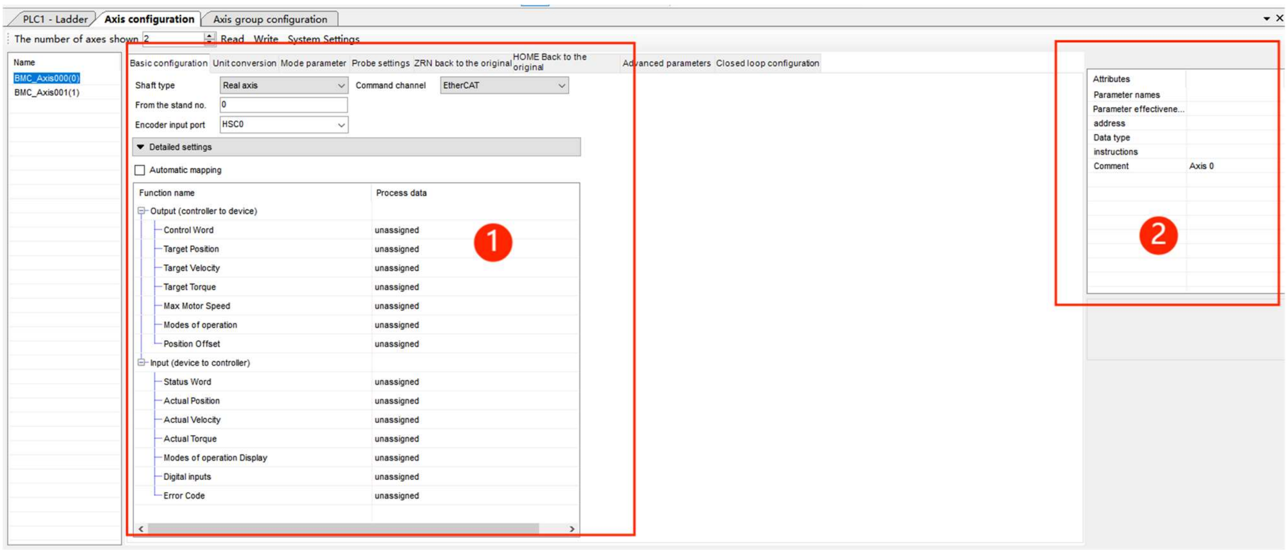


Click the [system settings] to show below interface:



[number of control shaft]: it is SFD810, refer to chapter 5-1-3 (the offline value is the setting value in [the number of axes shown], the online value is the actual value in current register).
[axis bit status start address]: it is SFD814, refer to chapter 5-1-3 (offline default value is 0, the online value is the actual value in current register).
[axis word status start address]: it is SFD816, refer to chapter 5-1-3 (offline default value is 0, the online value is the actual value in current register).
[axis word status preserves address]: not support at the moment.

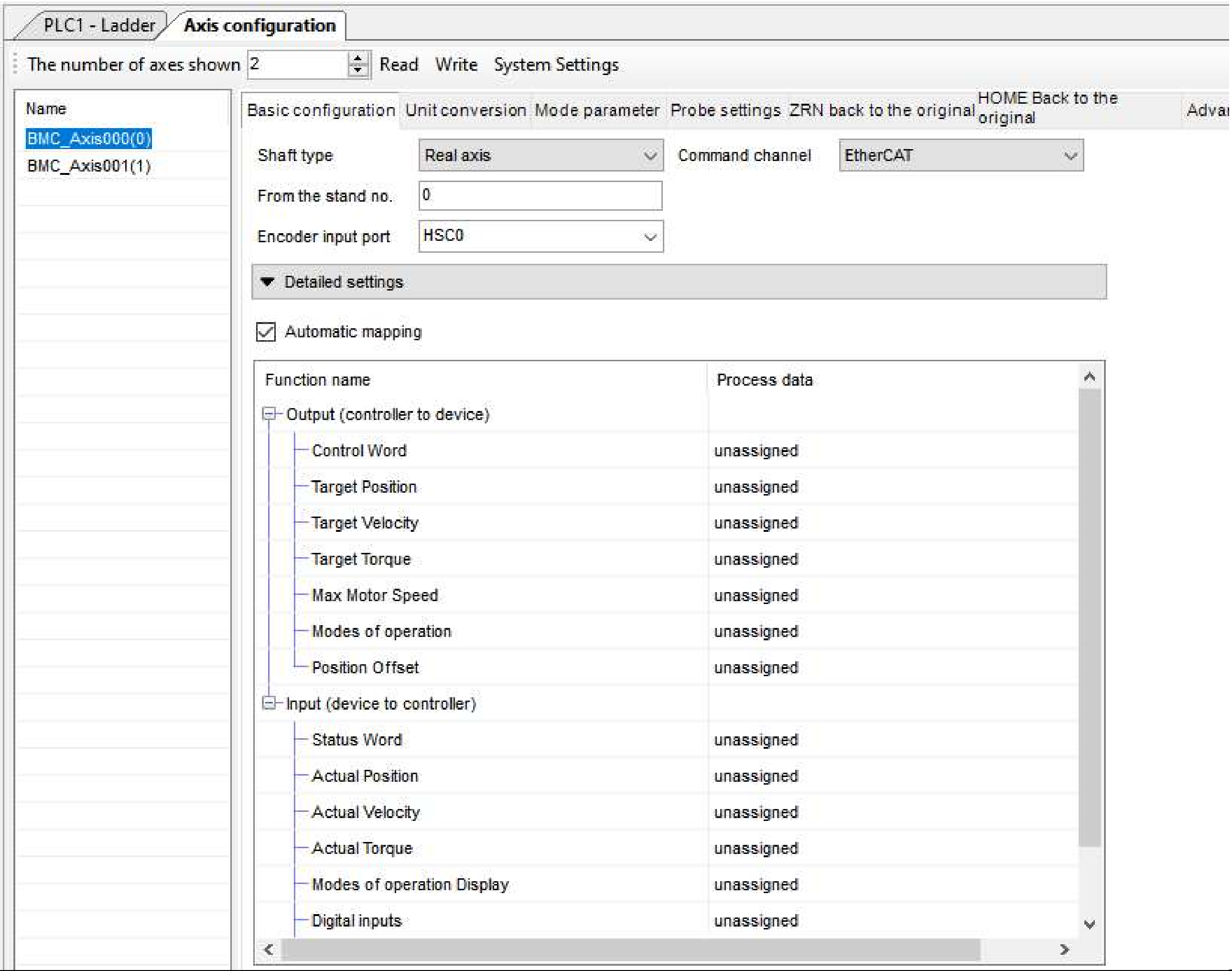
4-1-5. Parameter main interface



Zone 1 is the parameter configuration area (including PDO parameter display), and Zone 2 is the selected parameter attributes, including parameter name, effective time, address, data type, description, comments, etc. For specific parameter types and descriptions, please refer to sections 5-1-3.

- Basic configuration

[Detailed Settings] Mapping Address for Ethercat Interface PDO:

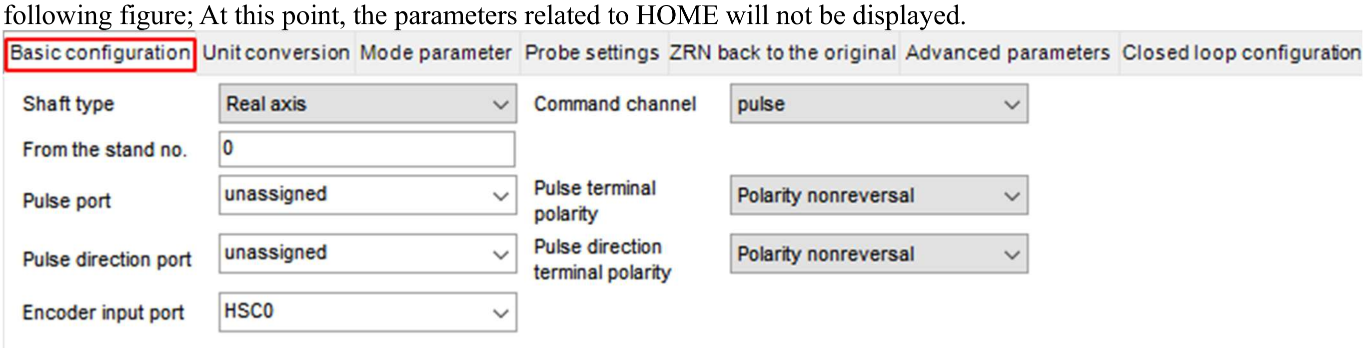


Definition	Address
Axis Type	SFD8000+300*N
Command channel	SFD8001+300*N
Slave station number	SFD8002+300*N
Encoder input port	SFD8006+300*N

[Axis Type]: When the axis type is set to 2 (encoder axis), the encoder input port also needs to be set, and these two parameters need to be used in combination; At the same time, the encoder shaft can only serve as the spindle in the binding command or cam command, and the high-speed counting value will directly affect the position of the encoder shaft, thereby driving the movement of the slave shaft.

[Slave Station Number]: The slave station number and the function mapping number in the EtherCAT configuration interface correspond to the axis number in the instruction, so modifying the slave station number can be done in the axis configuration interface or in the EtherCAT configuration interface.

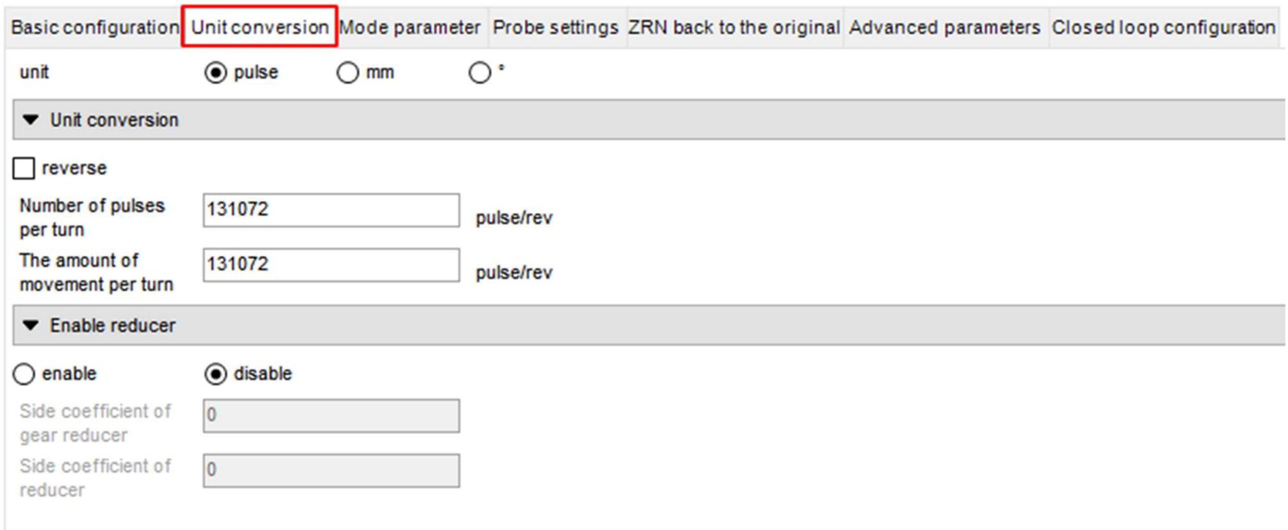
[Instruction Channel]: When selecting the instruction channel as pulse, the configuration is shown in the following figure; At this point, the parameters related to HOME will not be displayed.



Definition	Address
Pulse port	SFD8200+300*N
Pulse direction port	SFD8201+300*N

Pulse port polarity	SFD8202+300*N
Pulse direction port polarity	SFD8203+300*N

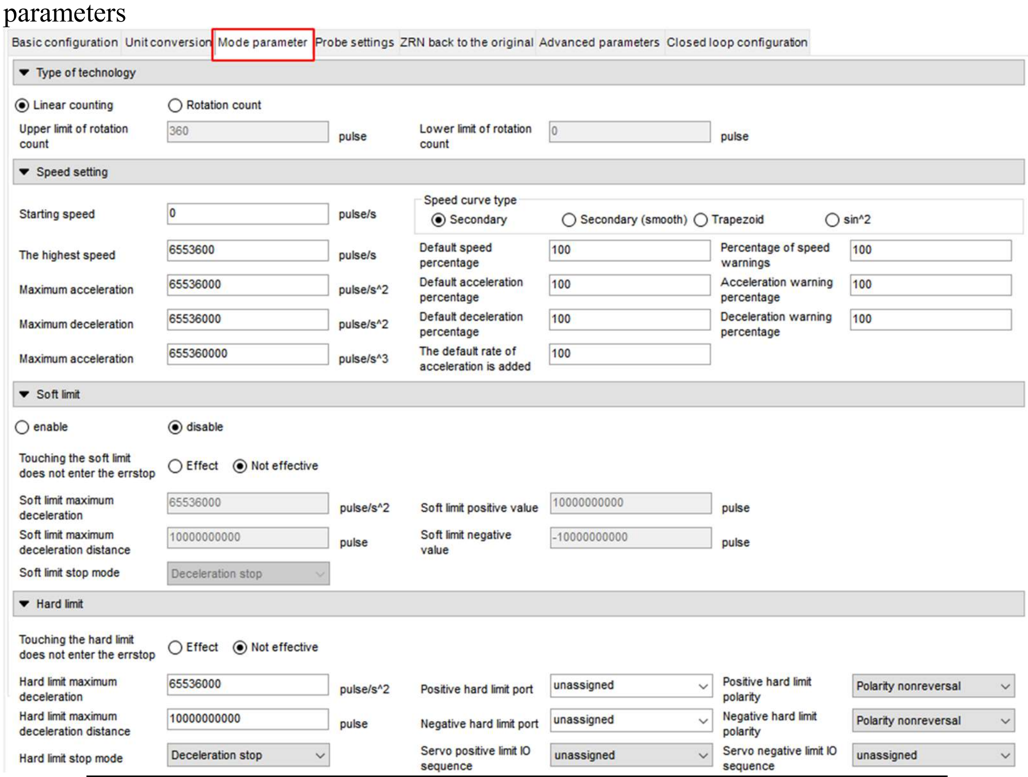
■ Units conversion



[Reducer]: Workpiece side coefficient: Motor side coefficient=Set speed: Actual speed.
For example, if the ratio of the workpiece side coefficient to the motor side coefficient is 10:1, then when the set speed is 10r/min, the actual motor speed is 1r/min.

Definition	Address
Unit	SFD8003+300*N
Direction of Movement	SFD8018+300*N
Pulse count per cycle	SFD8004+300*N
Movement per lap	SFD8008+300*N
Is the gearbox enabled	SFD8012+300*N
Side coefficient of reducer workpiece	SFD8014+300*N
Side coefficient of reducer motor	SFD8016+300*N

■ Mode parameters



Definition	Address
Count Type	

Count Type	SFD8020+300*N
Upper limit of rotation count	SFD8024+300*N
Lower limit of rotation count	SFD8028+300*N
Speed settings	
Starting speed	SFD8108+300*N
Maximum speed	SFD8080+300*N
Maximum acceleration	SFD8084+300*N
Maximum deceleration	SFD8088+300*N
Maximum acceleration speed	SFD8092+300*N
Speed curve type	SFD8038+300*N
Default speed percentage	SFD8096+300*N
Default acceleration percentage	SFD8097+300*N
Default deceleration percentage	SFD8098+300*N
Default acceleration percentage	SFD8099+300*N
Speed warning percentage	SFD8137+300*N
Acceleration warning percentage	SFD8138+300*N
Deceleration warning percentage	SFD8139+300*N
Software limitation	
Is the soft limit enabled	SFD8060+300*N
Soft limit maximum deceleration	SFD8072+300*N
Maximum deceleration distance of soft limit	SFD8076+300*N
Soft limit stop method	SFD8061+300*N
Soft limit positive value	SFD8064+300*N
Negative value of soft limit	SFD8068+300*N
Hard limit stop deceleration	SFD8048+300*N
Hard limit stop maximum deceleration distance	SFD8052+300*N
Hard limit stop method	SFD8040+300*N
Forward hard limit port	SFD8041+300*N
Positive hard limit polarity	SFD8042+300*N
Negative hard limit port	SFD8043+300*N
Negative hard limit polarity	SFD8044+300*N
Servo positive limit IO sequence	SFD8045+300*N
Servo negative limit IO sequence	SFD8046+300*N

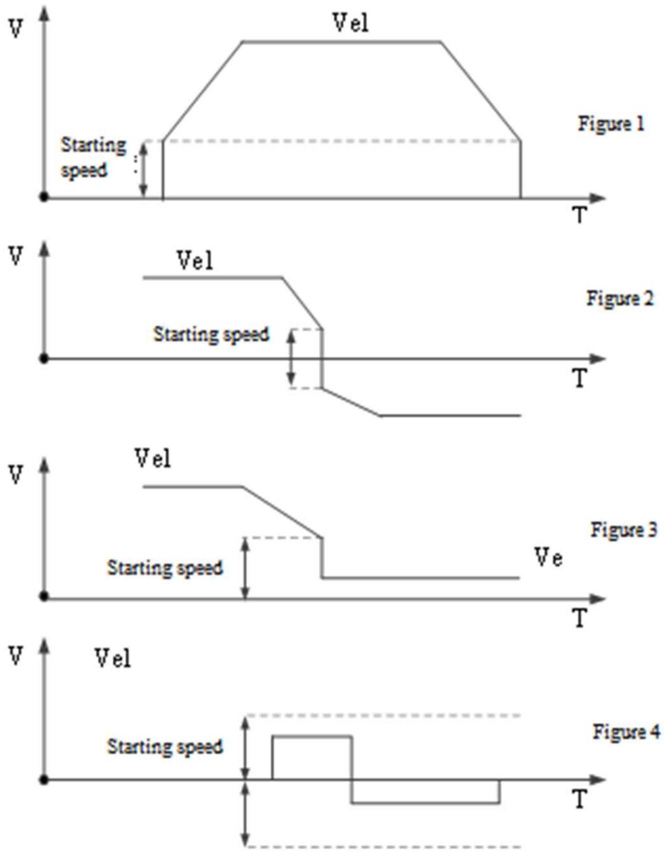
[Starting speed]: Within the range of positive and negative starting speed values, a "step" (speed step, position step does not occur) approach is used to plan for quick response.

As shown in Figure 1: If the target speed is greater than the starting speed, the speed will directly step up to the starting speed during startup, and then proceed with planning.

As shown in Figure 2: When the speed passes through the starting speed range (【 0, starting speed 】 or 【 -starting speed, 0 】), it directly steps within the starting speed range.

As shown in Figure 3: When stopping, if the target speed is within the starting speed (【 0, starting speed 】 or 【 - starting speed, 0 】), step directly to the target speed when reaching the starting speed.

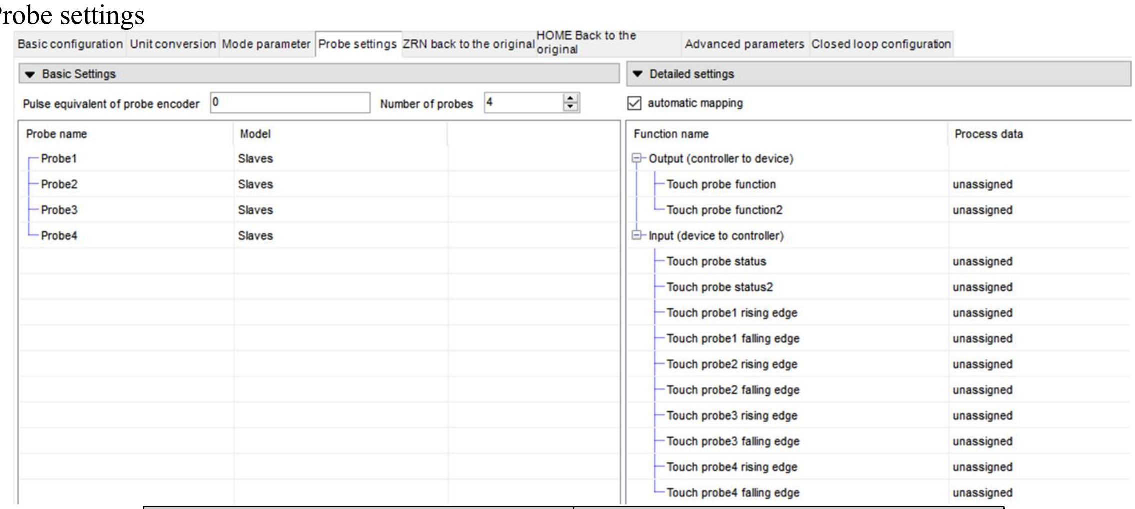
As shown in Figure 4: If the target speed is within the starting speed at the beginning (【 0, starting speed 】 or 【 - starting speed, 0 】), step directly to the target speed for operation.



[Speed curve type]: Supports quadratic, quadratic smoothing, trapezoidal, sin ²。

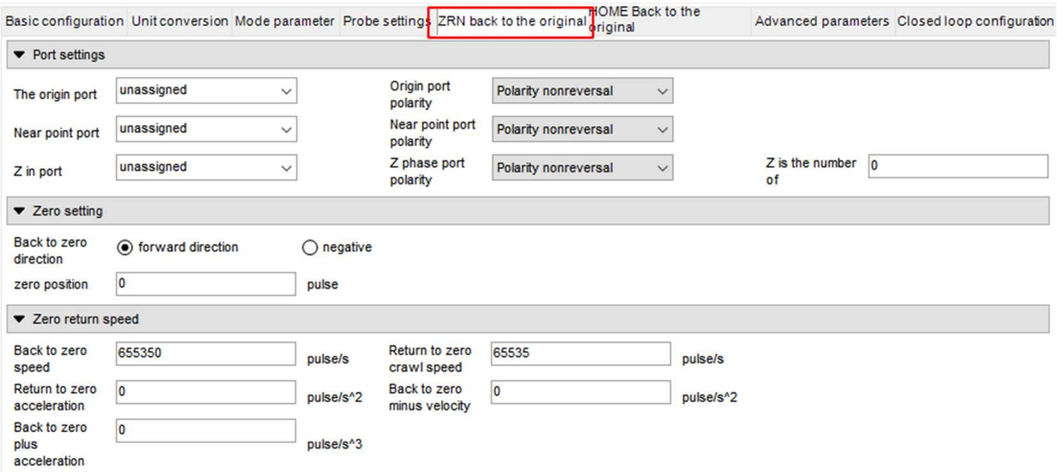
Note: Only single axis partial motion commands support curve selection, axis groups are not supported.

■ Probe settings



Definition	Address
Probe encoder pulse equivalent	SFD8194+300*N
Number of probes	-

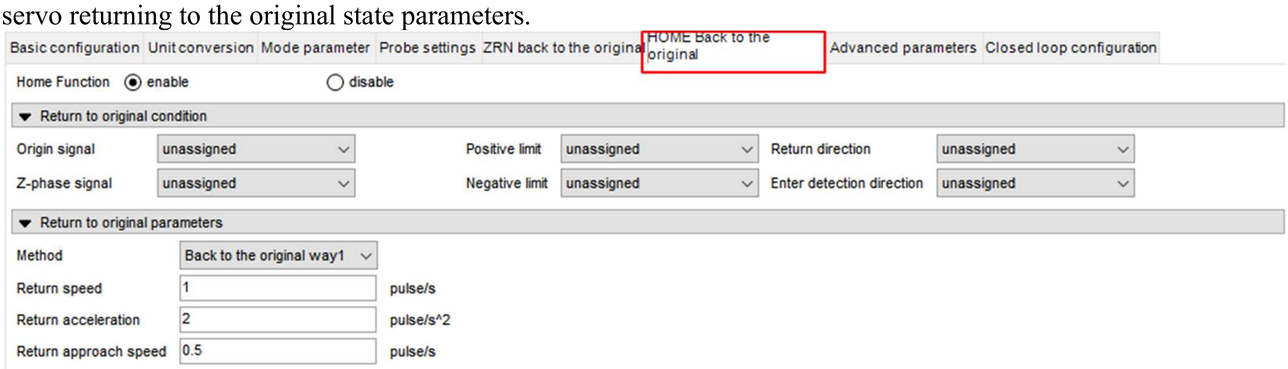
■ ZRN return to its original state



Definition	Address
Port settings	
Origin port	SFD8160+300*N
Origin port polarity	SFD8161+300*N
Near Point Port	SFD8162+300*N
Proximal port polarity	SFD8163+300*N
Z-phase port	SFD8164+300*N
Z-phase port polarity	SFD8165+300*N
Number of Z phases	SFD8166+300*N
Zero return setting	
Zero return direction	SFD8192+300*N
Zero position	SFD8188+300*N
Zero return speed	
Zero return high-speed	SFD8168+300*N
Return to zero crawling speed	SFD8172+300*N
Zero return acceleration	SFD8176+300*N
Zero return deceleration	SFD8180+300*N
Zero return acceleration	SFD8184+300*N

■ HOME rollback (supported in V3.7.3 and above versions)

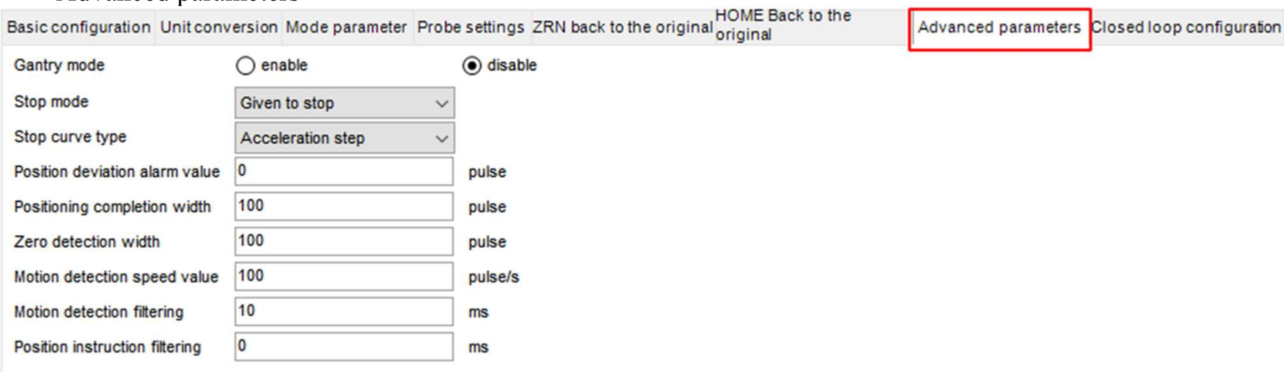
After enabling, filter the conditions that meet the conditions for returning to the original state, set the parameters for returning to the original state, and write them in. After powering off the PLC, write the configuration into the servo returning to the original state parameters.



Definition	Address
Home Return Function Enable	-
Return to original condition (filter servo return to original method)	
Origin signal	-
Z-phase signal	-
Positive limit position	-
Negative limit	-
Origin return direction	-
Origin input detection direction	-
Return to original parameters	

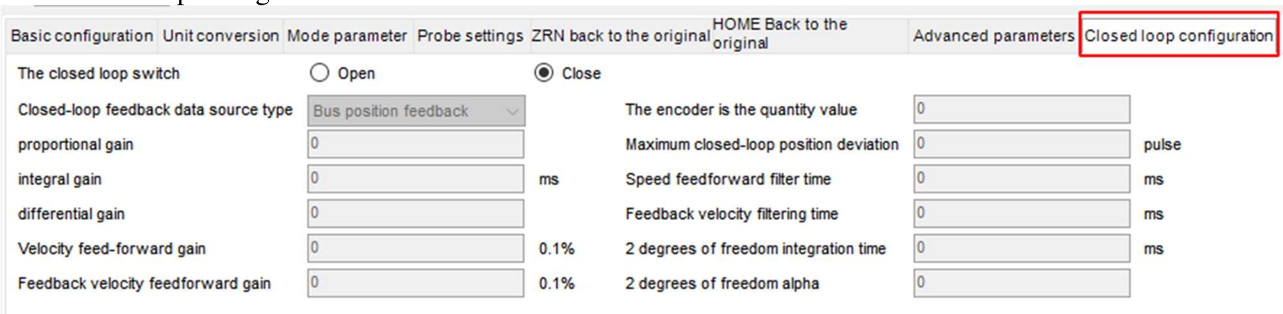
Returning to the original method	-
Origin return speed	-
Origin return acceleration	-
Origin return approach speed	-

■ Advanced parameters



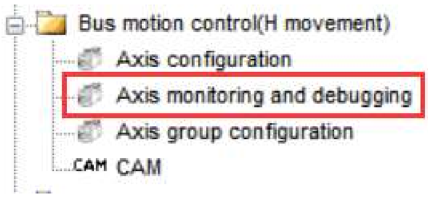
Definition	Address
Dragon Gate Mode	SFD8007+300*N
Emergency stop mode	SFD8036+300*N
Stop curve type	SFD8037+300*N
Position deviation alarm value	SFD8120+300*N
Positioning completion width	SFD8124+300*N
Zero detection width	SFD8128+300*N
Motion detection speed value	SFD8132+300*N
Motion detection filtering	SFD8136+300*N
Position instruction filtering	SFD8019+300*N

■ Closed loop configuration

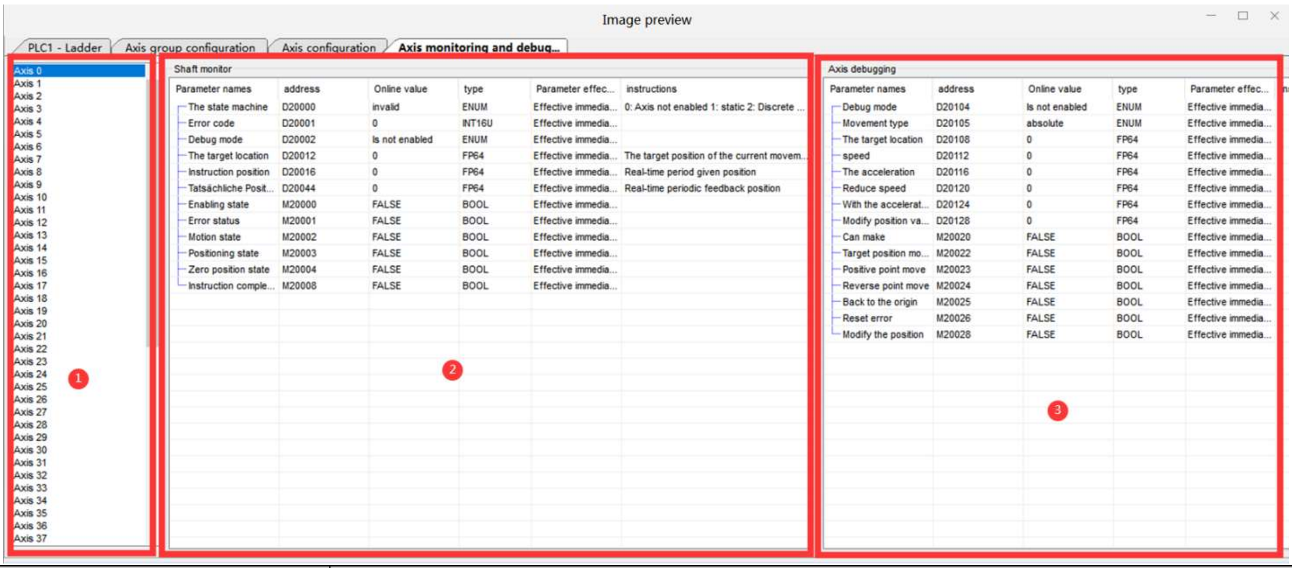


Definition	Address
Closed loop switch	SFD8204+300*N
Closed loop feedback data source type	SFD8205+300*N
Encoder equivalent value	SFD8206+300*N
Proportional gain	SFD8210+300*N
Integral gain	SFD8214+300*N
Differential gain	SFD8218+300*N
Speed feedforward gain	SFD8222+300*N
Feedback speed feedforward gain	SFD8226+300*N
Maximum closed-loop position gain	SFD8230+300*N
Speed feedforward filtering time	SFD8234+300*N
Feedback speed filtering time	SFD8235+300*N
2 degrees of freedom alpha	SFD8236+300*N
2 degrees of freedom integration time	SFD8240+300*N

4-2. Axis monitor and debug



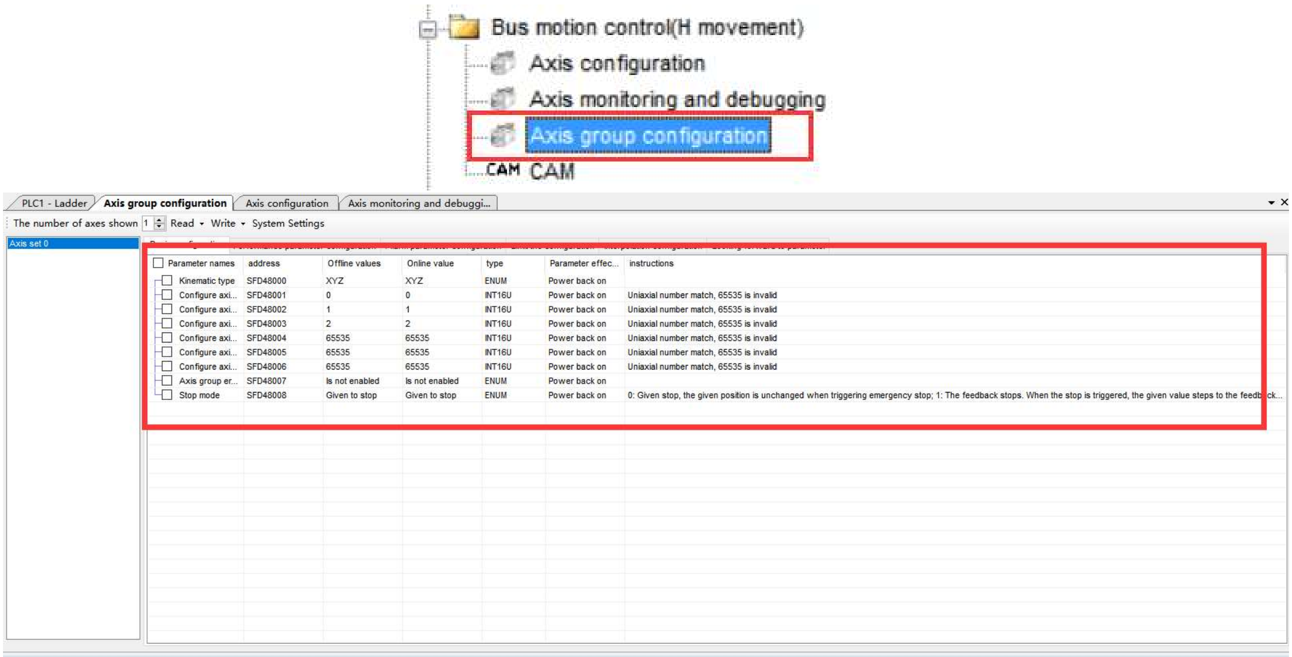
The interface is shown as below:



Designation	Description
Axis selection interface	Click the axis number to monitor / debug the axis
Parameter monitoring interface	Monitor the current axis's given position, feedback position, given speed, feedback speed, given acceleration, feedback acceleration, given torque, and feedback torque.
Status monitoring interface	Monitor the status of the current axis, including motion status, positive and negative hard limit status, positive and negative soft limit status, origin switch status, state machine, error code, positioning status, and command completion status.
Axis debugging interface	Debugging the current axis is valid only when the debugging mode is enabled (directly enable on the interface or modify the corresponding register D20104 + 200*N). After the debugging mode is enabled, you can do the operation of enable, move to the target position, return to the origin and other actions through the registers and coils on the interface. (the homing is the same as the A_HOME command, and the Ethernet parameters 6098h, 6099h and 609Ah need to be set. See section 5-1-2-12 for details)

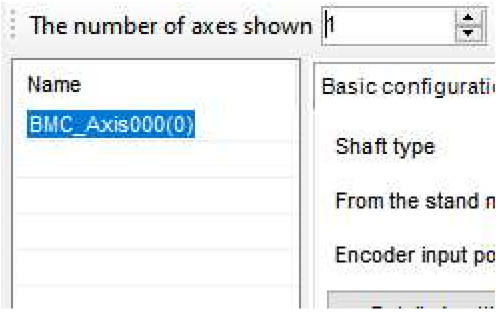
The differences of D20040, D20016, D20044:
D20040: encoder feedback value
D20016: The position that the axis should reach in each scan cycle after the command is executed.
D20044: The position feedback is obtained by conversion according to the set electronic gear ratio, movement per cycle, number of pulses per cycle and other parameters.

4-3. Axis group configuration



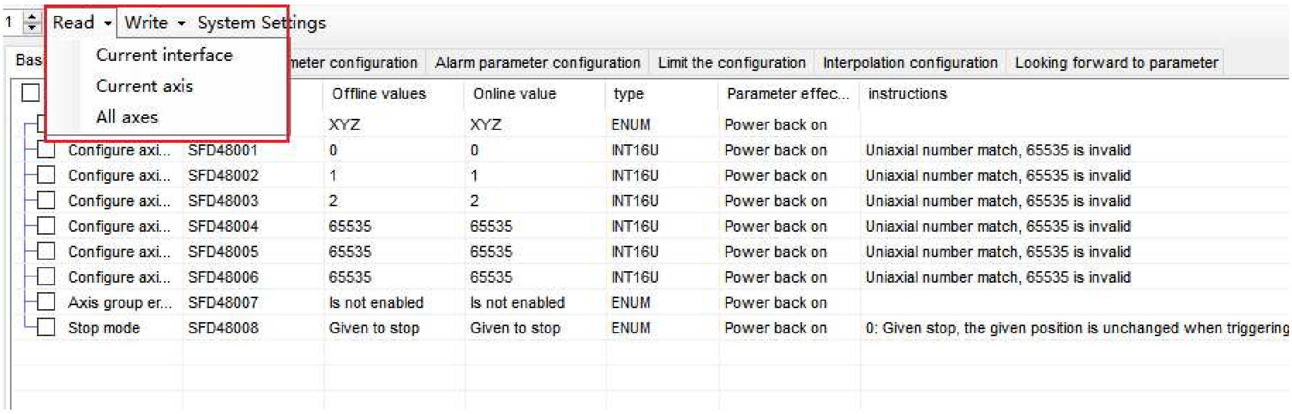
The main interface includes: displaying the number of axes, reading, writing, system settings, and parameter main interface.

4-3-1. The number of axes shown



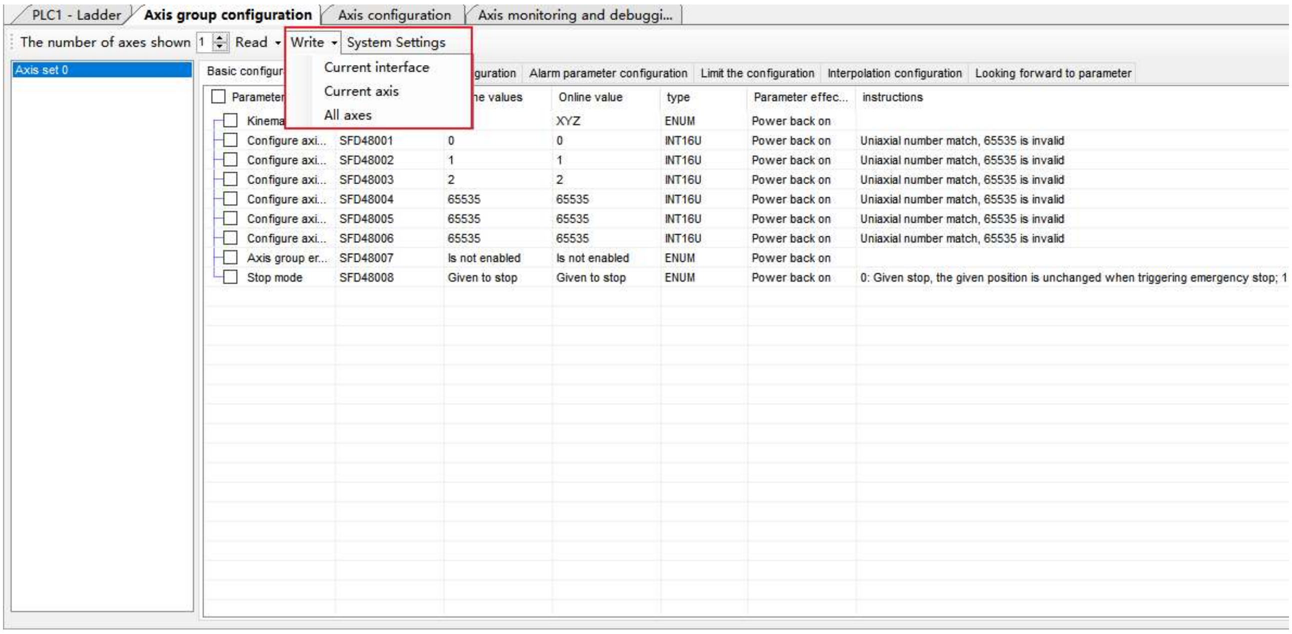
The setting of the number of displayed axes determines the number of axis groups in the configuration bar. It has nothing to do with the number of actually configured axis groups. It is only for display. The number of actually configured axis groups is modified by SFD820. Select the corresponding axis group number to configure the relevant parameters of the axis group.

4-3-2. Read



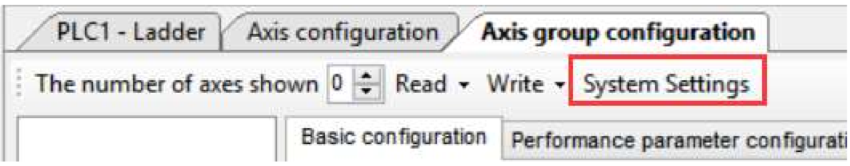
Click [Read] to read all parameters of all axis groups.

4-3-3. Write

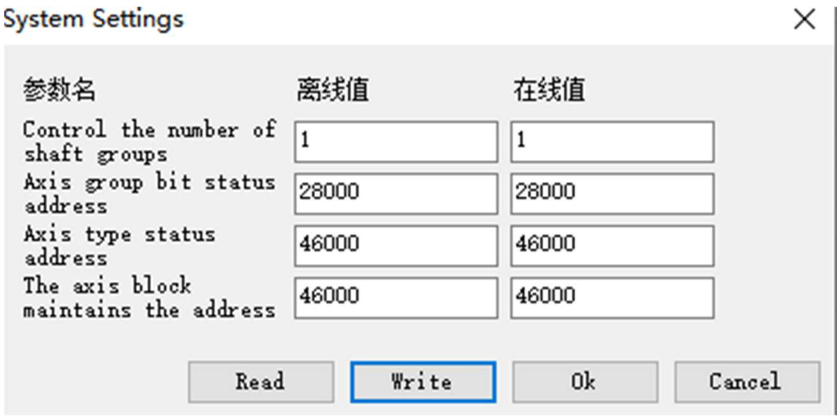


Click [Write] to write all parameters of all axis groups.

4-3-4. System settings

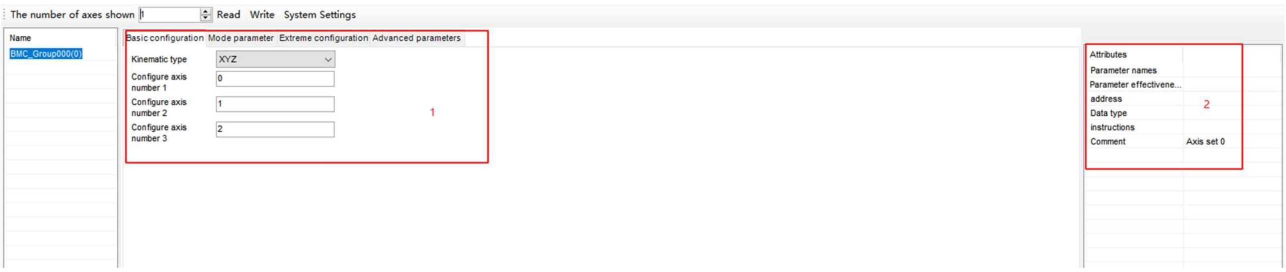


Click [system settings] to show below interface:



[Control the number of shaft groups]: it is SFD820, refer to chapter 5-2-3 (offline value is the set value in [the number of axes shown], the online value is the actual value of the current register).
[Axis group bit status address]: it is SFD824, refer to chapter 5-2-3 (the default offline value is 28000, the online value is the actual value of the current register).
[Axis type status address]: it is SFD826, refer to chapter 5-2-3 (the default offline value is 46000, the online value is the actual value of the current register).
[The axis block maintains the address]: not support at the moment.

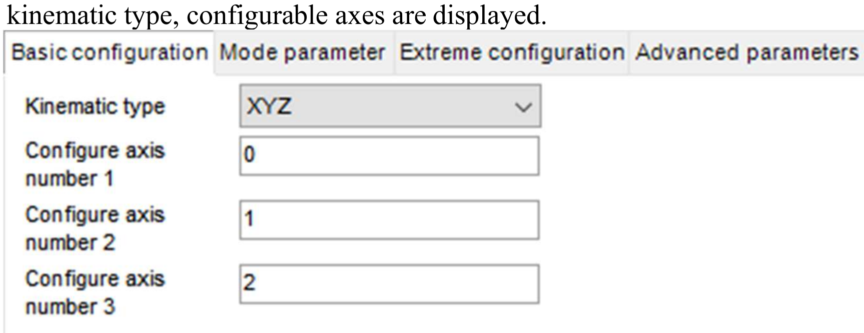
4-3-5. Parameters interface



Zone 1 is the parameter configuration area, and Zone 2 is the selected parameter attributes, including parameter name, effective time, address, data type, description, comments, etc. For specific parameter types and descriptions, please refer to sections 5-2-3.

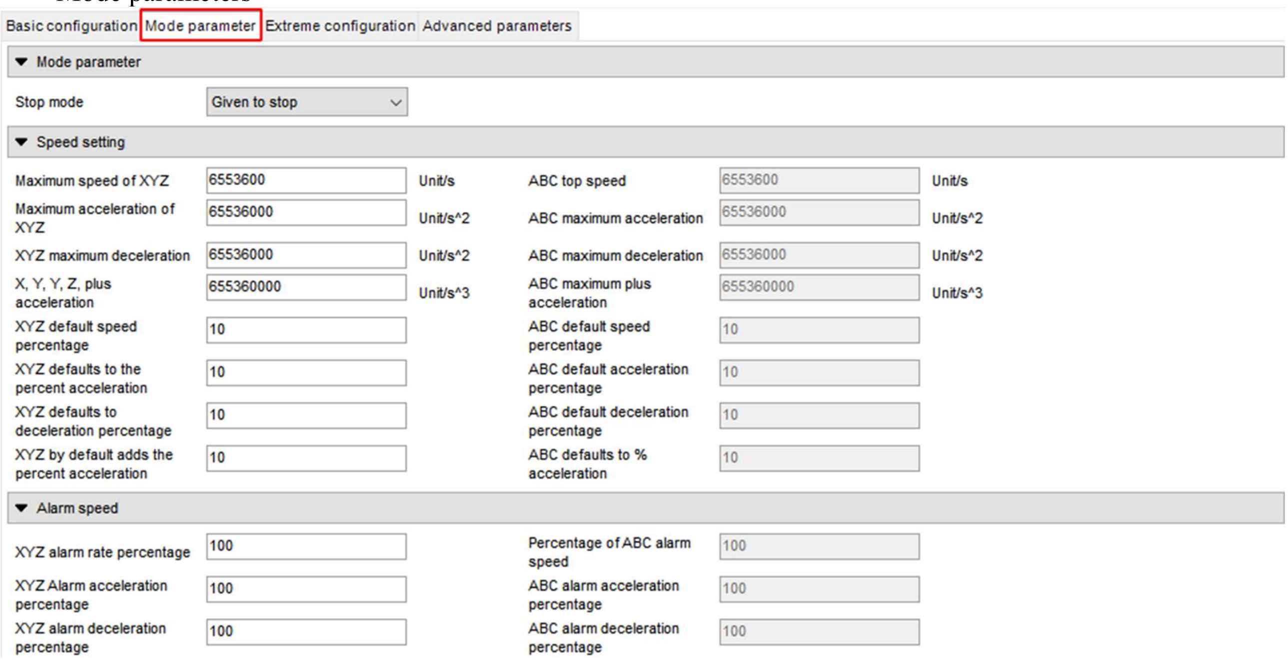
■ Basic configuration

After selecting the kinematic type, configurable axes are displayed.



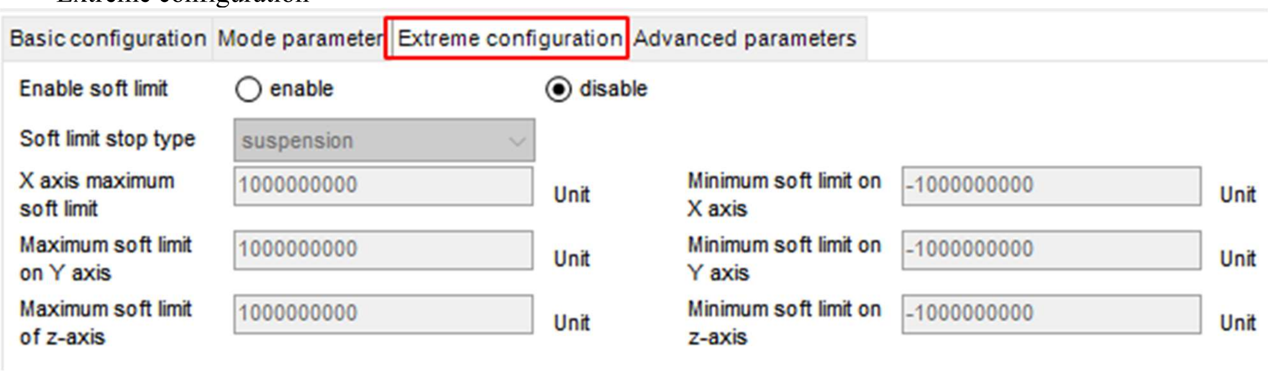
Definition	Address
Kinematic types	SFD48000+300*N
Configure axis number 1	SFD48001+300*N
Configure axis number 2	SFD48002+300*N
Configure axis number 3	SFD48003+300*N
Configure axis number 4	SFD48004+300*N
Configure axis number 5	SFD48005+300*N
Configure axis number 6	SFD48006+300*N

■ Mode parameters



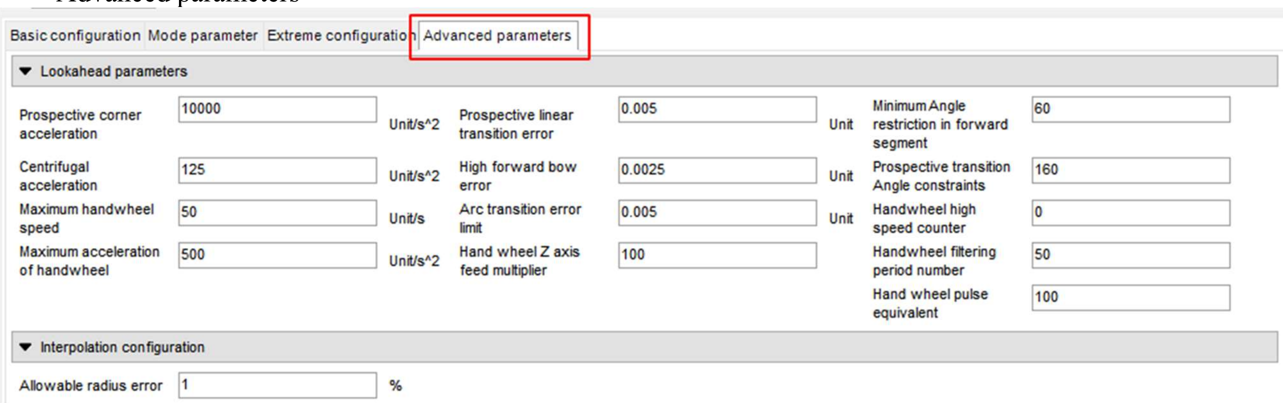
Definition	Address
Mode parameters	
Emergency stop mode	SFD48008+300*N
Speed settings	
XYZ maximum speed	SFD48020+300*N
XYZ maximum acceleration	SFD48024+300*N
XYZ maximum deceleration	SFD48028+300*N
XYZ maximum acceleration speed	SFD48032+300*N
ABC maximum speed	SFD48036+300*N
ABC maximum acceleration	SFD48040+300*N
ABC maximum deceleration	SFD48044+300*N
ABC maximum acceleration speed	SFD48048+300*N
XYZ default speed percentage	SFD48052+300*N
XYZ default acceleration percentage	SFD48053+300*N
XYZ default deceleration percentage	SFD48054+300*N
XYZ default acceleration percentage	SFD48055+300*N
ABC default speed percentage	SFD48056+300*N
ABC default acceleration percentage	SFD48057+300*N
ABC default deceleration percentage	SFD48058+300*N
ABC default acceleration percentage	SFD48059+300*N
Alarm speed	
XYZ alarm speed percentage	SFD48100+300*N
XYZ alarm acceleration percentage	SFD48101+300*N
XYZ alarm deceleration percentage	SFD48102+300*N
ABC alarm speed percentage	SFD48103+300*N
ABC alarm acceleration percentage	SFD48104+300*N
ABC alarm deceleration percentage	SFD48105+300*N

■ Extreme configuration



Definition	Address
Is the soft limit enabled	SFD48144+300*N
Soft limit stop type	SFD48145+300*N
X-axis maximum soft limit	SFD48120+300*N
X-axis minimum soft limit	SFD48132+300*N
Y-axis maximum soft limit	SFD48124+300*N
Y-axis minimum soft limit	SFD48136+300*N
Z-axis maximum soft limit	SFD48128+300*N
Z-axis minimum soft limit	SFD48140+300*N

■ Advanced parameters

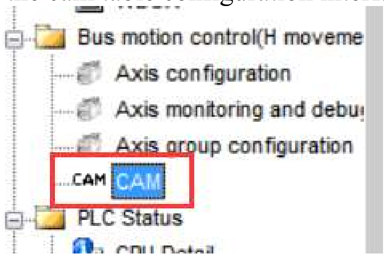


Definition	Address
Prospective parameters	
Forward looking corner acceleration	SFD48240+300*N
Centrifugal acceleration	SFD48244+300*N
Maximum speed of handwheel	SFD48248+300*N
Maximum acceleration of handwheel	SFD48252+300*N
Forward straight line transition error	SFD48256+300*N
Forward looking bow height error	SFD48260+300*N
Arc transition error limit	SFD48264+300*N
Hand wheel Z-axis feed rate	SFD48273+300*N
Minimum angle limit for the prospective segment	SFD48274+300*N
Forward transition angle limitation	SFD48275+300*N
Hand wheel high-speed counting port	SFD48276+300*N
Number of handwheel filtering cycles	SFD48277+300*N
Handwheel pulse equivalent	SFD48280+300*N
Interpolation configuration	
Allowable radius error	SFD48146+300*N

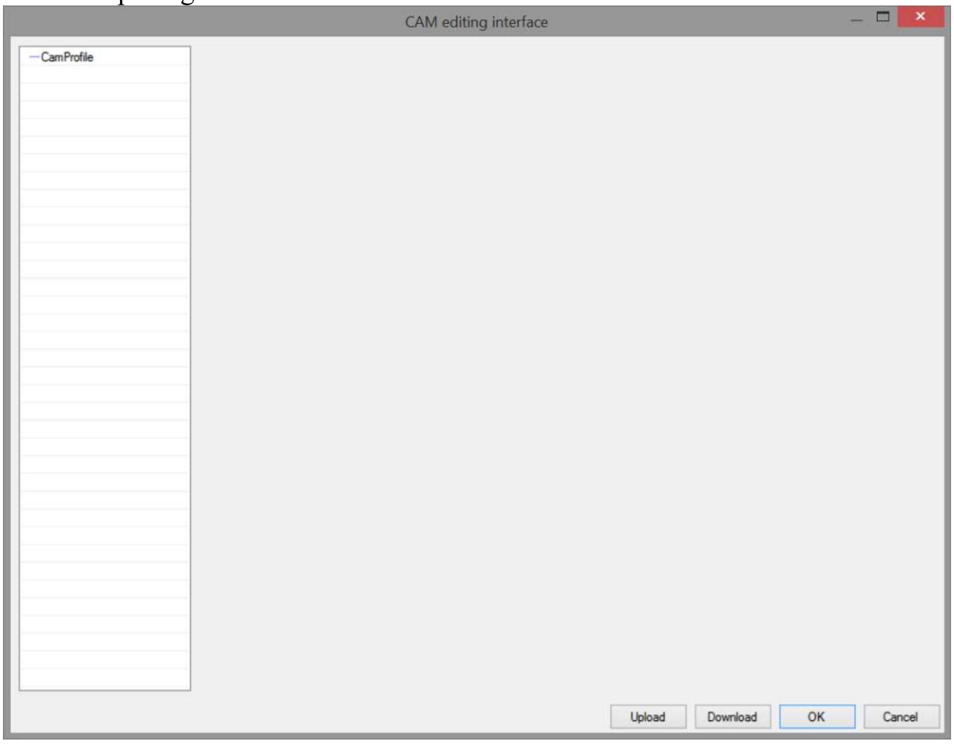
4-4 CAM configuration interface

4-4-1. Open the cam table configuration

Click the CAM in the project bar to open the cam table configuration interface:

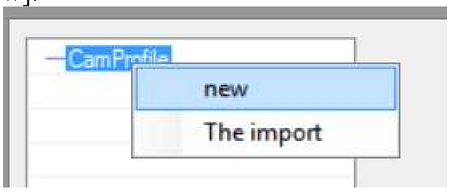


The interface after opening is as follows:

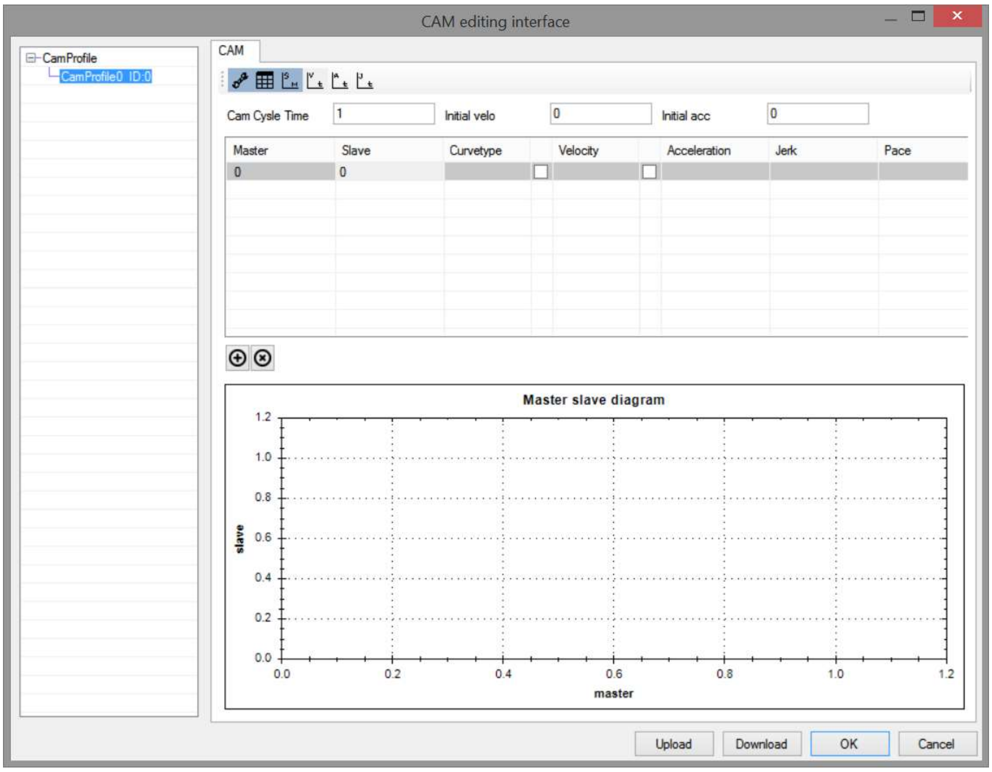


4-4-2. Create a new CAM table

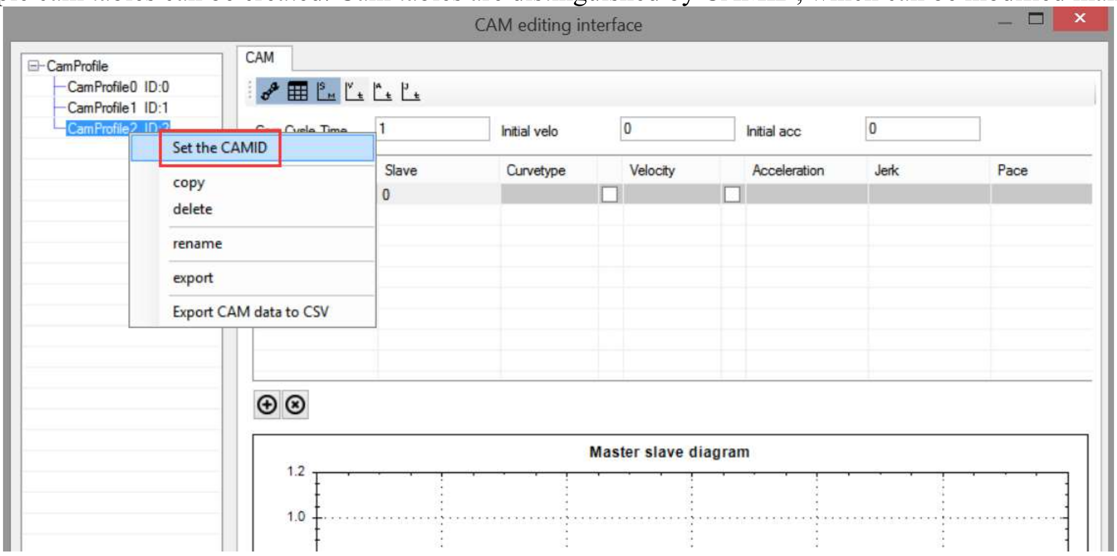
Right click [CamProfile], choose [New]:



The interface after creating:

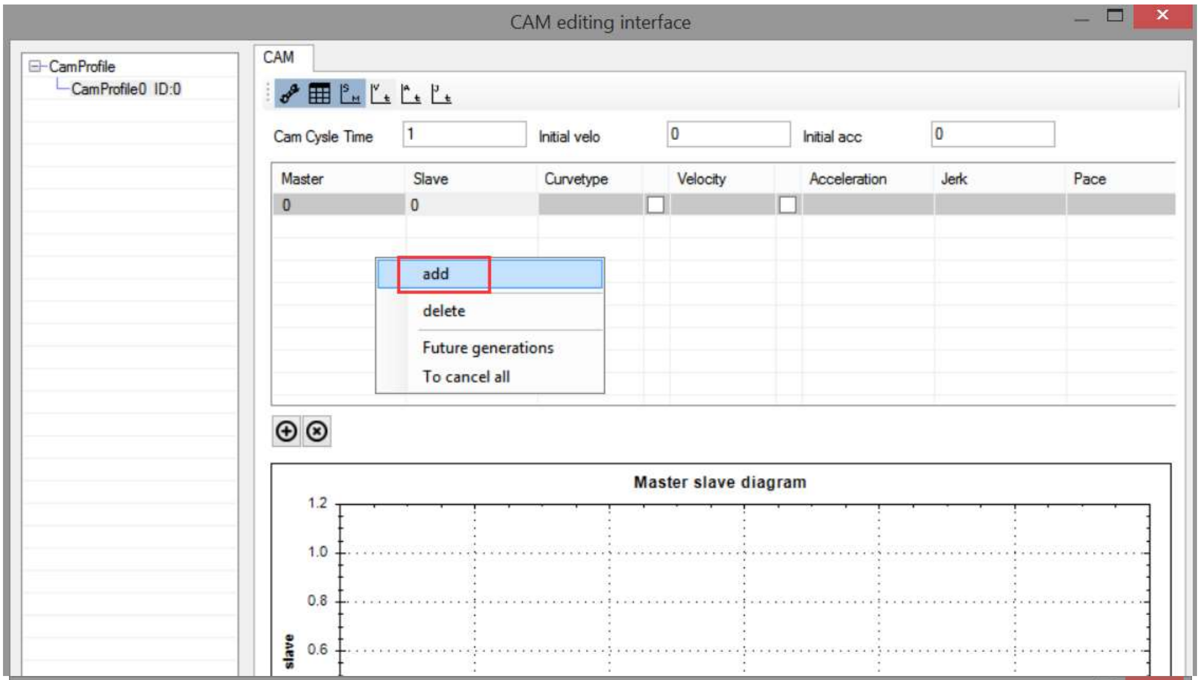


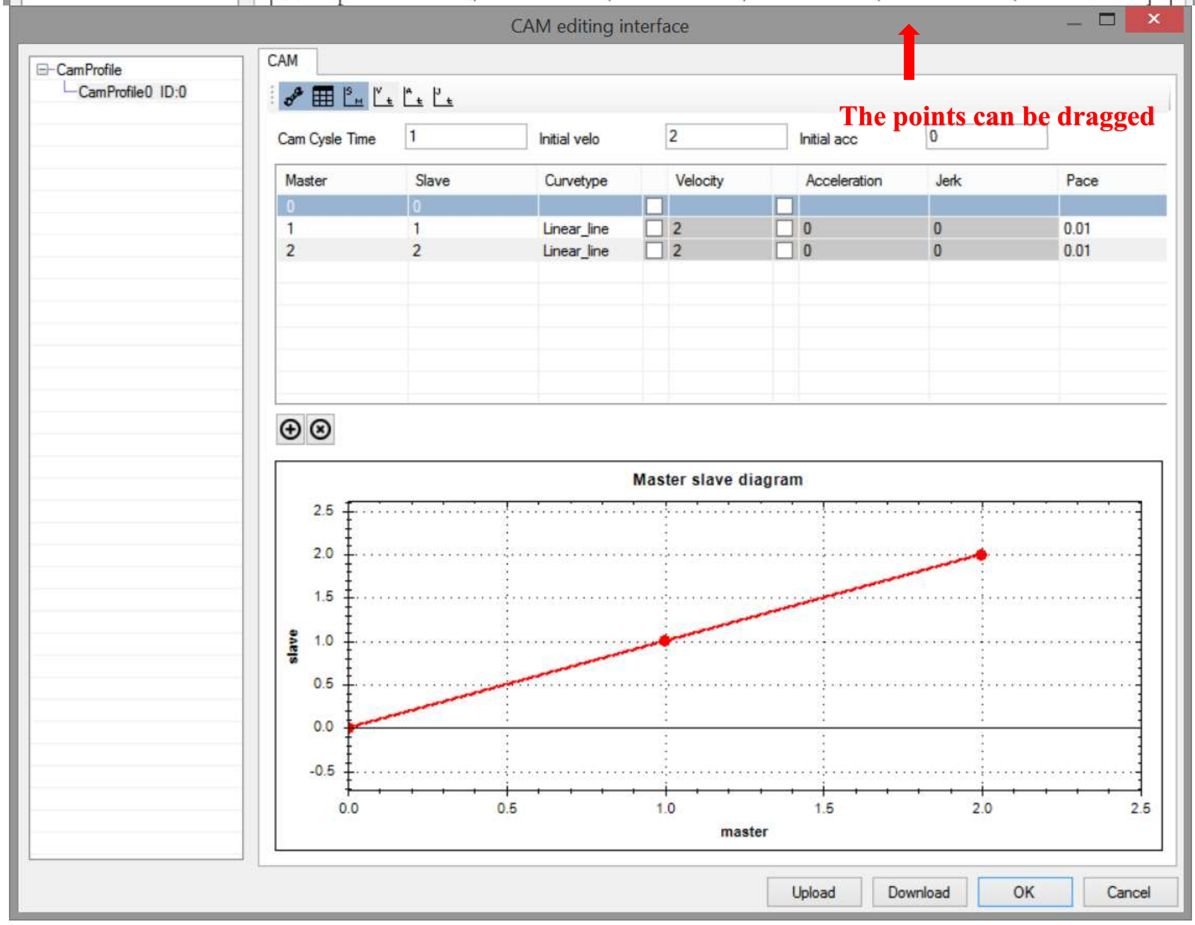
Multiple cam tables can be created. Cam tables are distinguished by CAMID, which can be modified manually:



4-4-3. Add the cam table point

After the cam table is created, right-click in the cam table editing interface and click [add] to add the key points of the cam table (up to 1000 points in a single cam table, and the total key points in all tables do not exceed 65535). The added points can be changed by dragging in the master-slave relationship diagram, or double clicking on the master and slave axes in the cam table editing interface:





[master axis]: The point position of the master axis can be changed manually by double clicking. The subsequent point position must be greater than the previous point position. The number of master axis points cannot exceed 65535. The number of master axis points = (master axis final point position – master axis starting point position) / pace

[slave axis]: The point position of the slave axis can be changed manually by double clicking.

[Cam curve]: The type of curve connection between points. Currently supported curve types: 1-cubic curve; 2-Quintic curve; 3- Parabola; 4-Straight line; 5-Simple harmonic; 6-Cycloid; 7-deformation sine; 8-deformation trapezoid; 9- Always on; 10- Constant deformation speed; 11- Double harmonic; 12- inverse double harmonic; 14- Adaptive smoothing curve 0; 15- Adaptive smoothing curve 1; 50- Easy to use T-shaped; 51- Eccentric wheel rear synchronization curve; 52- Eccentric wheel front synchronization curve; 53- Anti reversal curve; 100- Custom curve;

Note:

① Curve type 100 requires support from V3.7.2 and above versions.
② Curve types 14, 15, 50, 51, 52, and 53 require V3.7.3 and above support.
③ Curve types 1-15 are general curves, and 50-53 are special curves.

- Adaptive smoothing curve 0 (hereinafter referred to as curve 0) is a cubic polynomial curve that can automatically confirm the speed of the connection point, and adaptive smoothing curve 1 (hereinafter referred to as curve 1) is a fifth degree polynomial curve that can automatically confirm the speed of the connection point.

1) Key point speed

When the key point curve type is curve 0 or curve 1, assuming adjacent key points are P1 (M1, S1) and P2 (M2, S2) respectively, then the key point velocity V=(S2-S1)/(M2-M1) * (length of camshaft spindle/cam cycle); The default value for the cam cycle is 1.

Key point serial number ID	Spindle position	From axis position	Curve type	Key point speed
0	0	0		0
1	1000	200	Adaptive curve	3000
2	2000	800	Adaptive curve	333.33
3	5000	1000	Adaptive curve	0

Example of speed calculation:
In the table above, the speed v of key point 1 is (800-200)/(2000-1000) * 5000=3000;
Key point 2: Speed v=(1000-800)/(5000-2000) * 5000=333.33.
Note: When the last point is an adaptive curve, the velocity of the last point v=the initial velocity of the cam table

2) Curve connection

(1) When the adaptive curve is followed by other curve types, the speed planning is as follows::

Curve type	Speed
Constant, cycloid, deformed T-shaped, deformed sine, deformed constant velocity, parabolic, inverse double harmonic, double harmonic, simple harmonic	0
Straight line, eccentric wheel curve	Comes with initial speed (eccentric wheel curve only connects with fifth degree curve without affecting)
Easy to use trapezoid, cubic curve, quintic curve, user-defined curve	User can set initial speed

Note:

① Adaptive smoothing curves connect cubic, quintic, or user-defined curves, as users can only set the final velocity of points without changing the initial velocity of points.

② The point velocity is still calculated using the formula * * v=(s2-s1)/(m2-m1) * (length of camshaft spindle/cam cycle) * *, which is independent of the user set end velocity of the point.

(2) When connecting other curve types before the adaptive curve, the speed planning is as follows:

Curve type	Speed
Constant, cycloid, deformed T-shaped, deformed sine, deformed constant velocity, parabolic, inverse double harmonic, double harmonic, simple harmonic	0
Straight line, eccentric wheel curve	Comes with initial speed (eccentric wheel curve only connects with fifth degree curve without affecting)
Easy to use trapezoid, cubic curve, quintic curve, user-defined curve	User can set

Note:

① The effect of connecting other curves before the adaptive curve is consistent with that of the cubic and fifth curves, ensuring continuous speed. The final speed of the previous curve is used as the initial speed for planning.

② The acceleration at the connection point of curve 0 is 0, and continuous acceleration is not guaranteed. Curve 1 has its own starting and ending accelerationst.

(3) Special situation: If the speed is set alternately in the positive and negative directions, the speed at the curve connection will remain at 0.

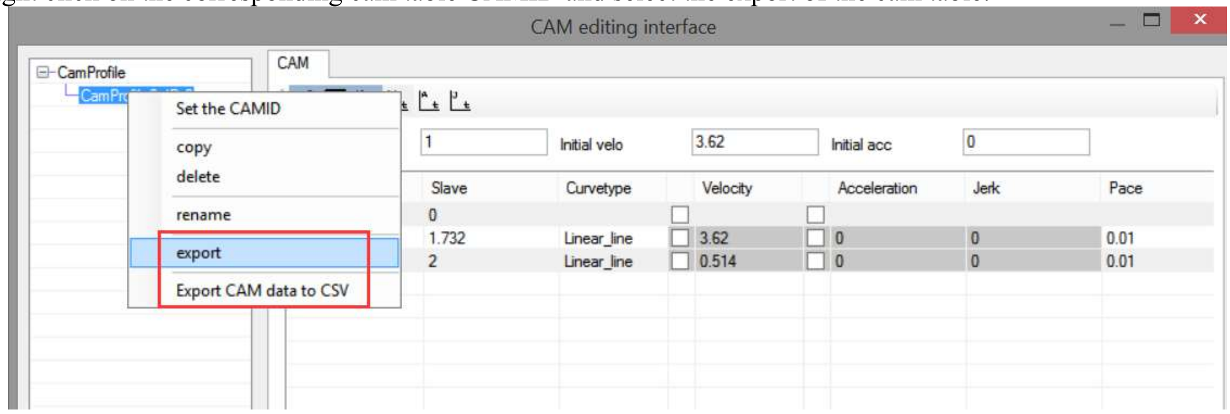
- Easy to use T-shaped curves refer to Chapter 5-3-2-23.

- The use of the front and rear synchronization curves of the eccentric wheel can be found in Chapters 5-3-2-26.
- The use of anti reversal curves can be found in Chapters 5-3-2-29.

[Speed]: Automatically calculated, only when the [Curve Type] is a cubic or quintic curve, the speed value can be manually modified by checking the box. (Inappropriate speed values may lead to step changes at points)
[Acceleration]: Automatically calculated, only when the [Curve Type] is a fifth degree curve, the acceleration value can be manually modified by checking the box. (Inappropriate acceleration values may cause step changes at points)
[Jump]: Automatically calculated. Cannot be modified.
[Phase pitch]: The interval between data points. The smaller the phase pitch, the higher the accuracy of the curve. The number of spindle points=(final spindle position - starting spindle position)/phase pitch.
[Configuration Reading]: The downloaded cam gauge can be uploaded to the programming software through the upload button.
[Configuration Writing]: The configured cam table needs to be downloaded to take effect (note: V3.7.2 and above versions support downloading cam tables using the Modbus TCP protocol, and software version requirements are 3.7.14d and above).
[OK]: Save the editing of the cam table.
[Cancel]: Cancel the editing of the cam table, with the same effect as the one in the upper right corner of the point × Same.

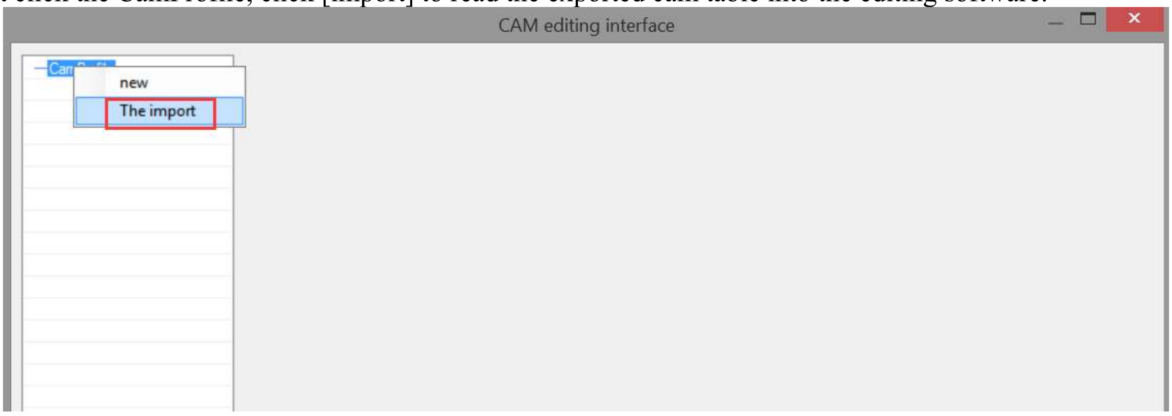
4-4-4. Export the cam table

Right click on the corresponding cam table CAMID and select the export of the cam table:



[export]: The cam table is exported. The generated file can be imported again in the cam table editing interface. The generated file is only a description file and does not contain the points in the cam table.
[export CAM data to CSV]: Export the points in cam table to generate excel table, including each point (key point and intermediate point) of master-slave relationship, and the interval of intermediate points is pace.

Right click the CamProfile, click [import] to read the exported cam table into the editing software.

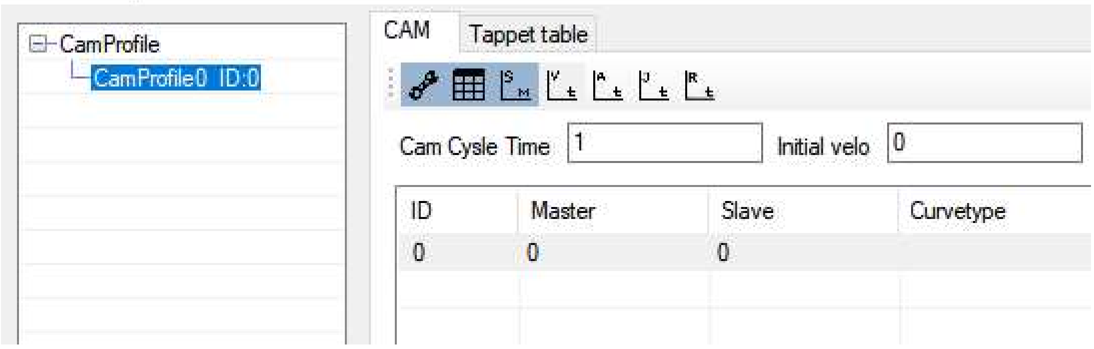


4-4-5. Use of Tappet Gauge

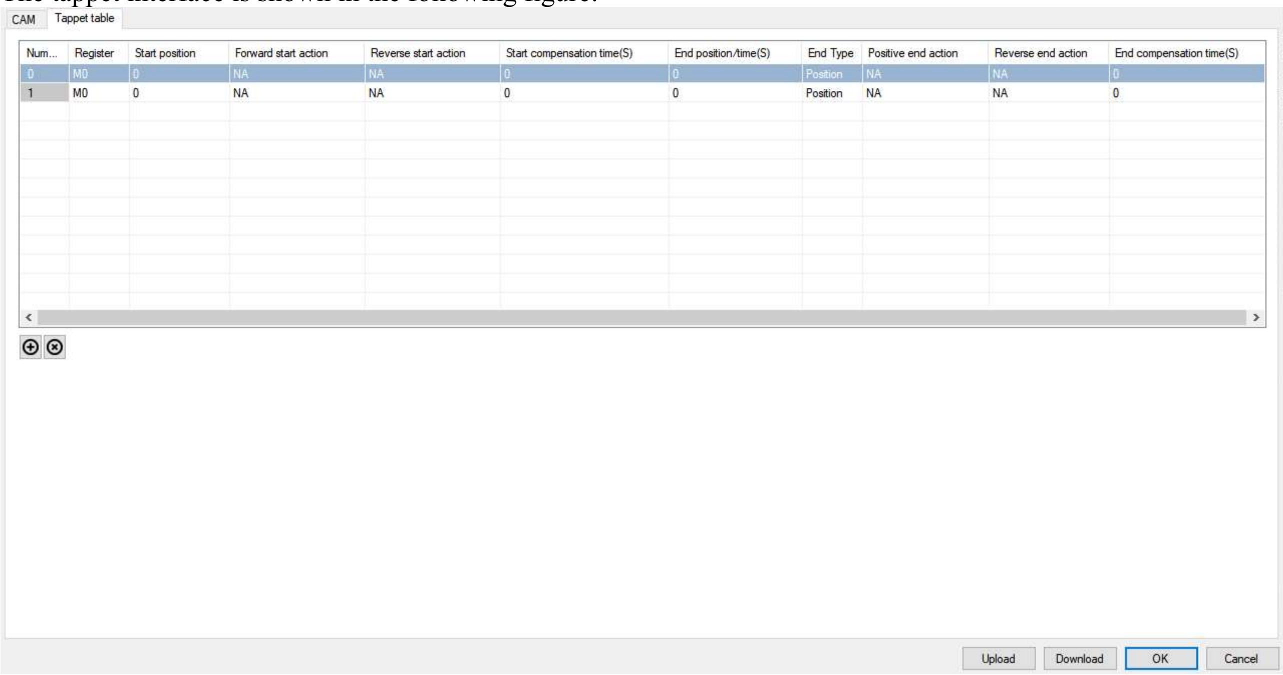
1) Establishment of the Tappet Table

Select the tappet in the upper left corner of the cam table:

CAM editing interface



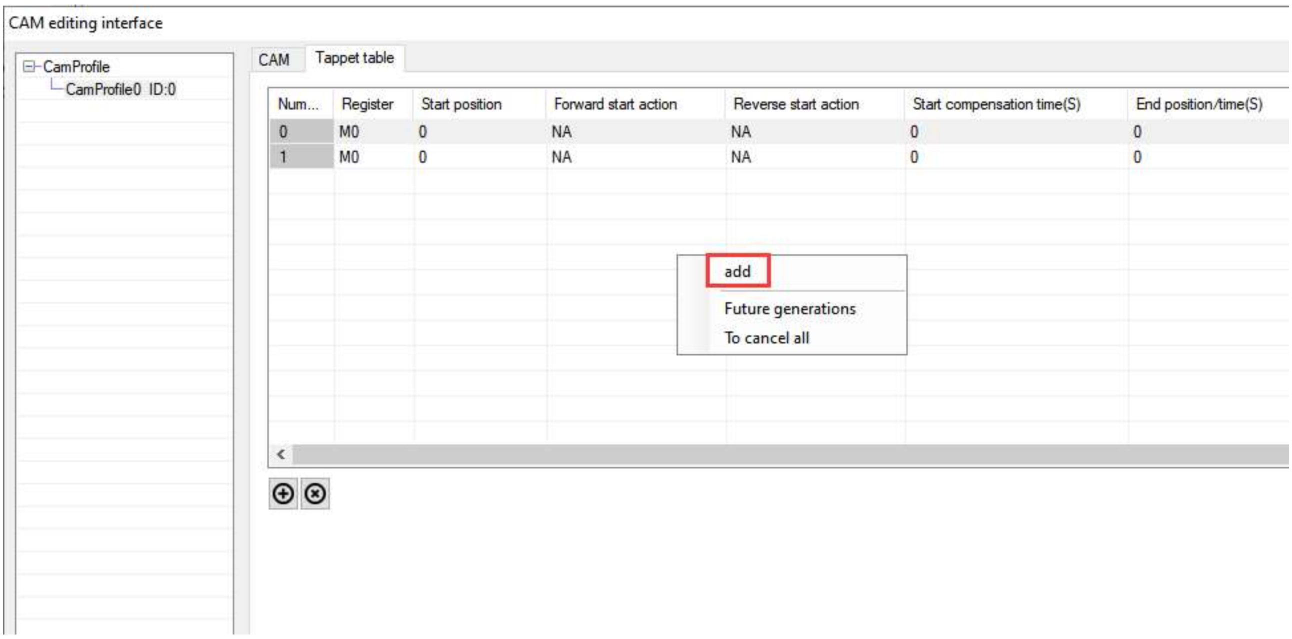
The tappet interface is shown in the following figure:



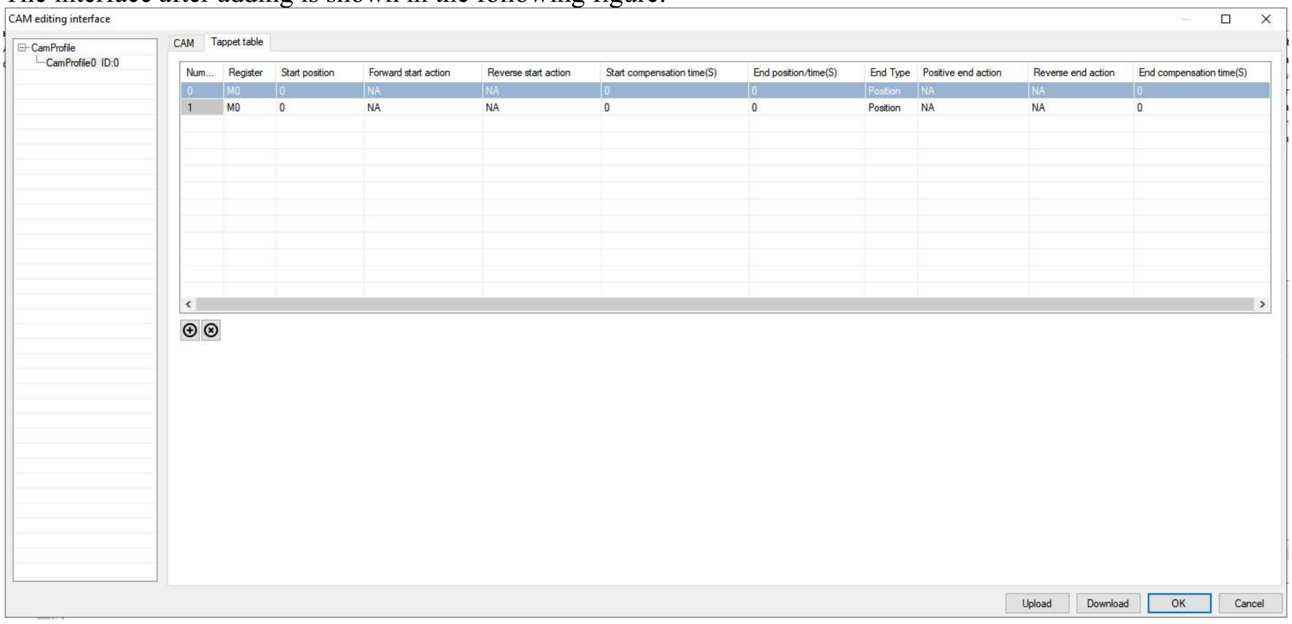
Note: A CAM table corresponds to a unique tappet table.

2) Adding Tappet Points

After creating the tappet table, right-click on the tappet interface and select [Add] to add the tappet points.



The interface after adding is shown in the following figure:

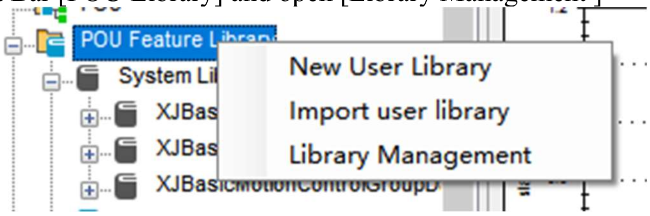


[Register]: The type of register for the output signal, M register or Y register.
[Start position]: The position where the register starts outputting signals.
[Positive start action]: ON: set to 1, OFF: set to 0, LDI: reverse operation, NA: no action.
[Reverse start action]: ON: set to 1, OFF: set to 0, LDI: reverse operation, NA: no action.
[Start compensation time (s)]: Compensates for the position of the output signal, with the actual output signal position=start position+main axis speed * compensation time.
[End position/time (s)]: The position or time at which the action ends.
[End Type]: Position: The spindle position in the corresponding table of the cam table. Time: The time elapsed from the start action to the end action.
[Positive end action]: ON: set to 1, OFF: set to 0, LDI: reverse operation, NA: no action.
[Reverse end action]: ON: set to 1, OFF: set to 0, LDI: reverse operation, NA: no action.
[End Compensation Time (s)]: Compensates for the output position of the end action, with the actual output signal position=End Position+Main Axis Speed * Compensation Time.

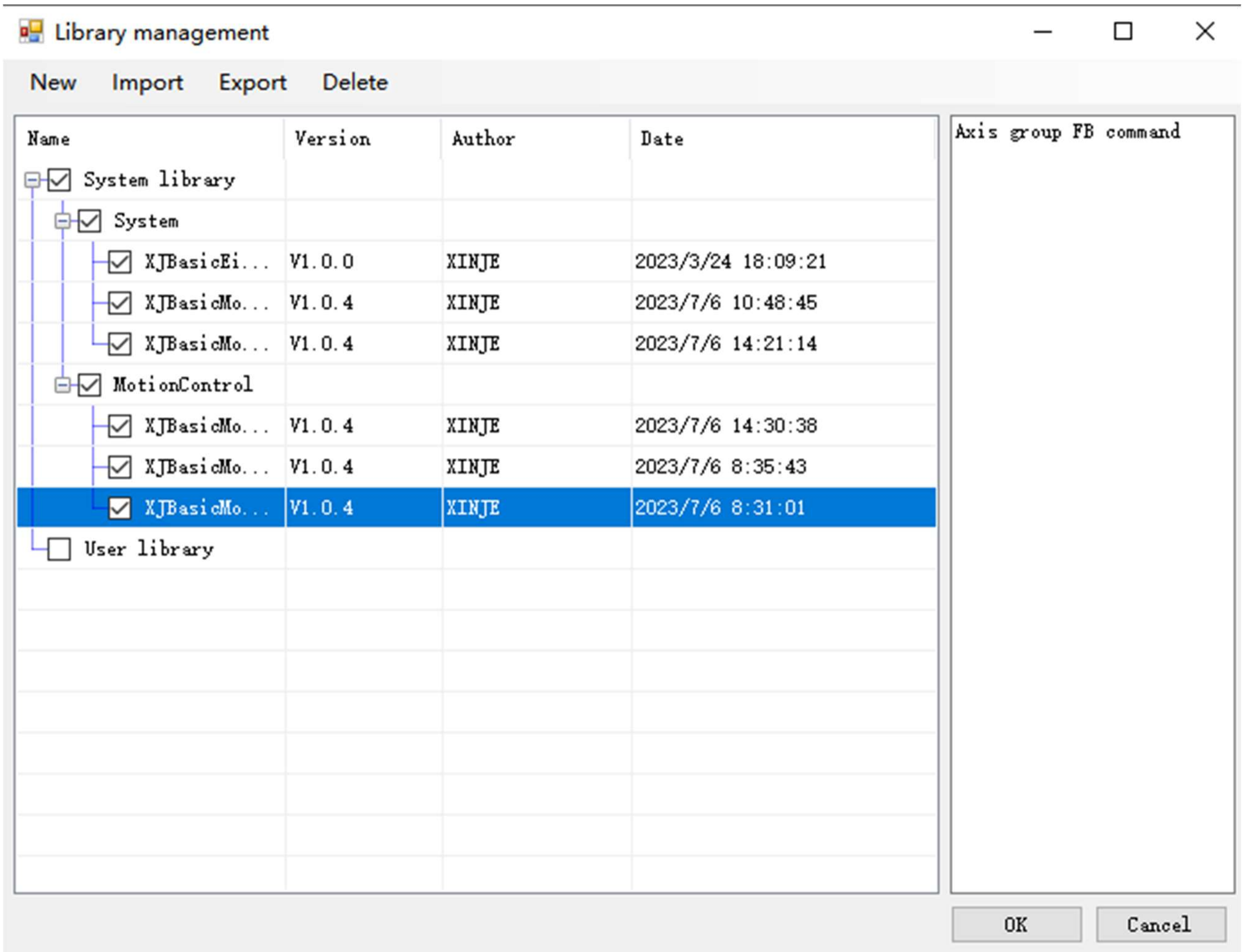
4-5 Introduction to POU applications

4-5-1. Add operation and control POU function library

1. Right click on the Project Bar [POU Library] and open [Library Management]

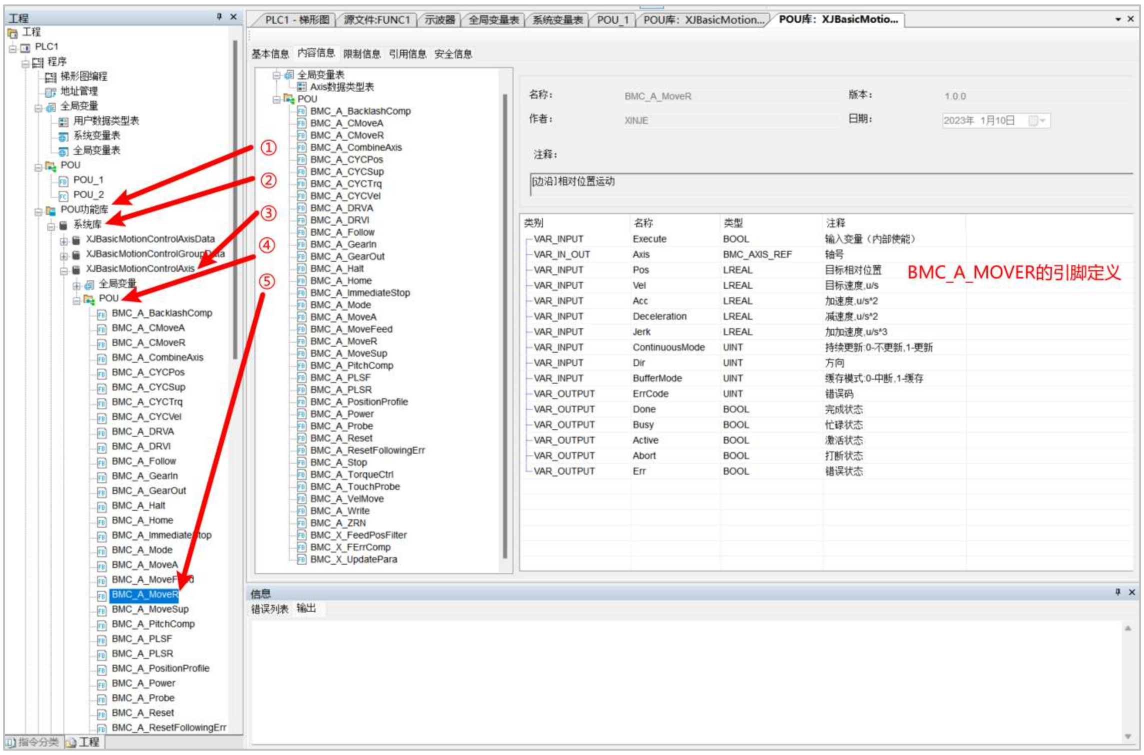


2. Check the single axis POU (XJBasicMotionControlAxis), electronic cam POU (XJBasicMotionControlCAM), and shaft group POU (XJBasicMotionControlGroup) in the MotionControl function library, and then click OK.



4-5-2. View POU pin definitions

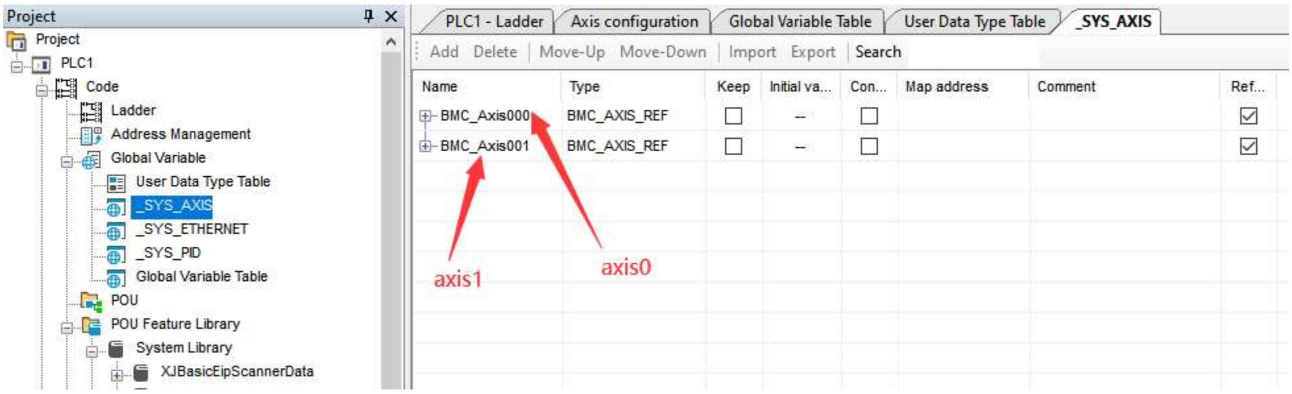
Step	Illustrate
①	Expand [System Library]
②	Expand [XJBasicMotionControlAxis] (single axis operation control POU)
③	Expand [POU] in [XJBasicMotionControlAxis]
④	Double click to select the target POU instruction to view the POU pin definition
⑤	To view the axis group POU, expand [XJBasicMotionControlGroup] in step ③, and to view the electronic cam POU, expand [XJBasicMotionControlCAM] in step ③



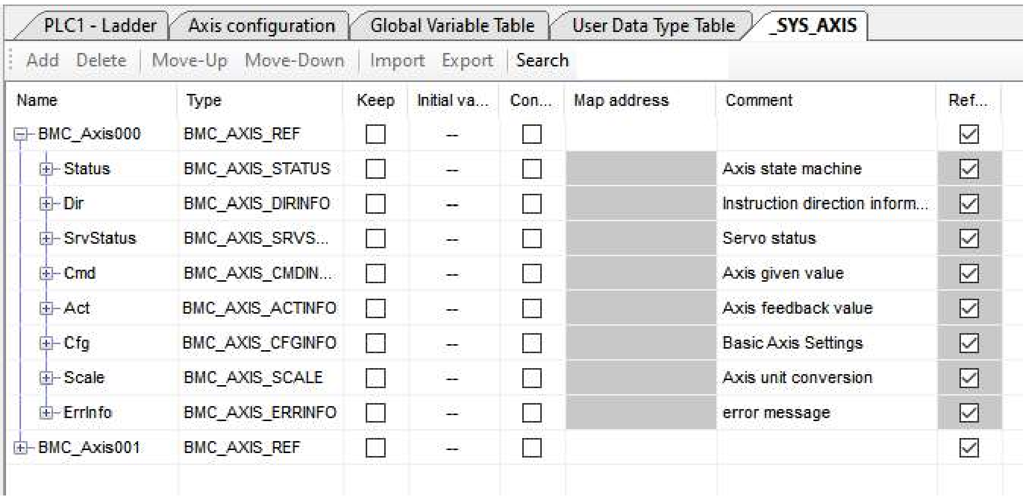
4-5-3. System Variable Table

Before calling the operation control POU command, it is necessary to configure the EtherCAT parameters related to the axis and add the motion axis (refer to 2 in this manual) EtherCAT parameter configuration, 4-1 axis configuration interface).

1. After adding a motion axis to the axis configuration interface, the corresponding axis structure variable will be automatically generated in the system variable table. The axis input pins of subsequent POU commands need to be associated with the axis structure variable.



2. To use axis structure variables, check the "Reference" option in the system variable table. If "Reference" is not checked, this variable will not take effect.

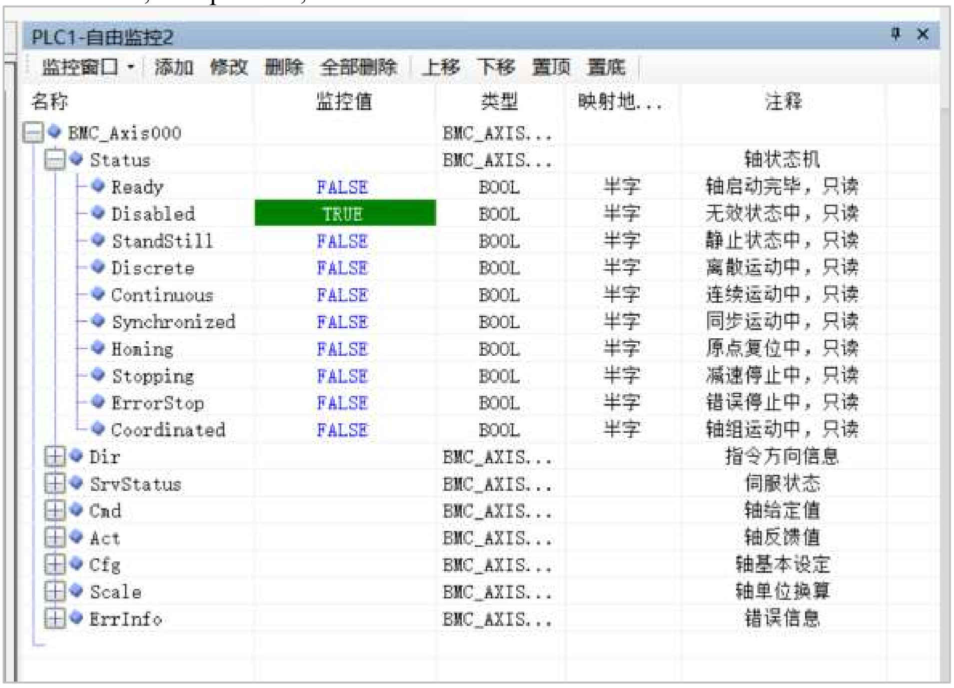


PLC1 - Ladder | Axis configuration | Global Variable Table | User Data Type Table | _SYS_AXIS

Add Delete Move-Up Move-Down Import Export Search

Name	Type	Keep	Initial va...	Con...	Map address	Comment	Ref...
BMC_Axis000	BMC_AXIS_REF	☐	--	☐			☑
Status	BMC_AXIS_STATUS	☐	--	☐		Axis state machine	☑
Dir	BMC_AXIS_DIRINFO	☐	--	☐		Instruction direction inform...	☑
SrvStatus	BMC_AXIS_SRVS...	☐	--	☐		Servo status	☑
Cmd	BMC_AXIS_CMDIN...	☐	--	☐		Axis given value	☑
Act	BMC_AXIS_ACTINFO	☐	--	☐		Axis feedback value	☑
Cfg	BMC_AXIS_CFGINFO	☐	--	☐		Basic Axis Settings	☑
Scale	BMC_AXIS_SCALE	☐	--	☐		Axis unit conversion	☑
ErrInfo	BMC_AXIS_ERRINFO	☐	--	☐		error message	☑
BMC_Axis001	BMC_AXIS_REF	☐	--	☐			☑

3. Adding axis structure variables to the free monitoring interface can monitor state parameters such as axis state, motion direction, axis position, and axis feedback.



PLC1-自由监控2

监控窗口 添加 修改 删除 全部删除 上移 下移 置顶 置底

名称	监控值	类型	映射地...	注释
BMC_Axis000		BMC_AXIS...		
Status		BMC_AXIS...		轴状态机
Ready	FALSE	BOOL	半字	轴启动完毕，只读
Disabled	TRUE	BOOL	半字	无效状态中，只读
StandStill	FALSE	BOOL	半字	静止状态中，只读
Discrete	FALSE	BOOL	半字	离散运动中，只读
Continuous	FALSE	BOOL	半字	连续运动中，只读
Synchronized	FALSE	BOOL	半字	同步运动中，只读
Homing	FALSE	BOOL	半字	原点复位中，只读
Stopping	FALSE	BOOL	半字	减速停止中，只读
ErrorStop	FALSE	BOOL	半字	错误停止中，只读
Coordinated	FALSE	BOOL	半字	轴组运动中，只读
Dir		BMC_AXIS...		指令方向信息
SrvStatus		BMC_AXIS...		伺服状态
Cmd		BMC_AXIS...		轴给定值
Act		BMC_AXIS...		轴反馈值
Cfg		BMC_AXIS...		轴基本设定
Scale		BMC_AXIS...		轴单位换算
ErrInfo		BMC_AXIS...		错误信息

4. Writing the variable members of the axis structure into the program can perform functional control (if an error occurs on axis 0, immediately perform axis clearing on axis 0).

4-5-4. Calling the operation control POU instruction

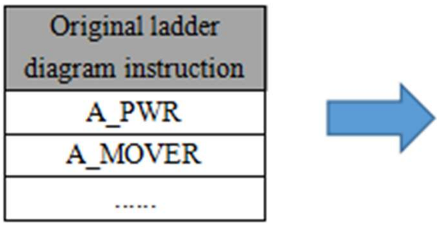
Note:

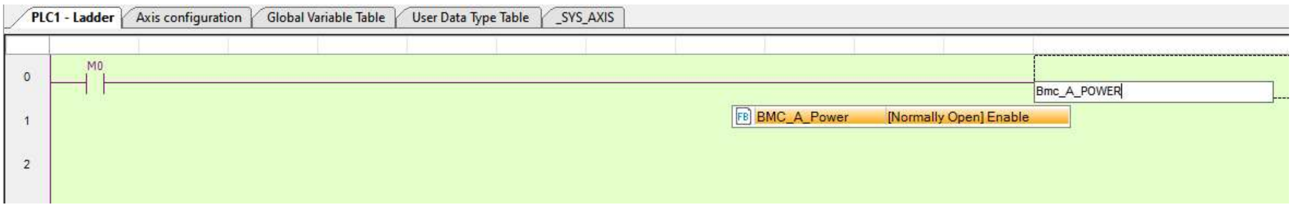
① Before calling the operation control POU command, check the (4-5-3 system variable table) first

② The call of operation control POU instructions can be done in ladder diagrams and C language

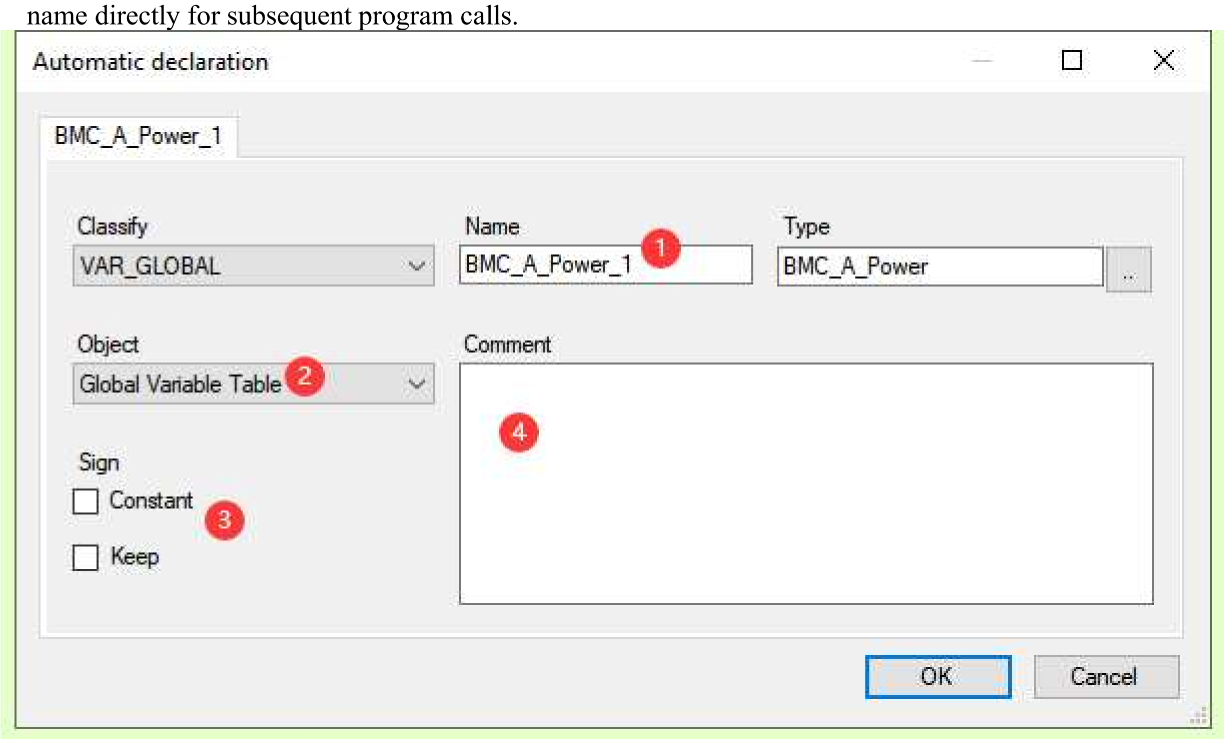
4-5-4-1. Call POU in ladder

1. Compared with the original ladder diagram instructions (5-1 single axis function, 5-2 axis group function, 5-3 cam function), the operation control POU command requires an additional BMC_ Prefix for.

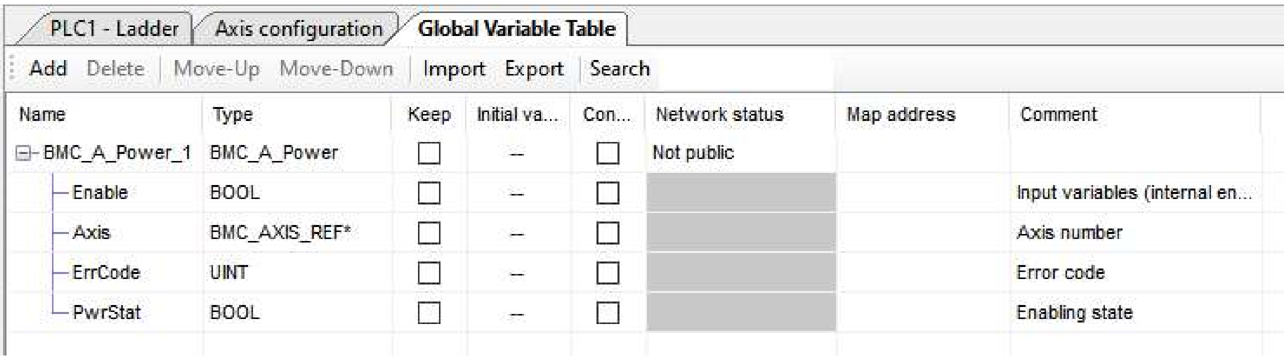




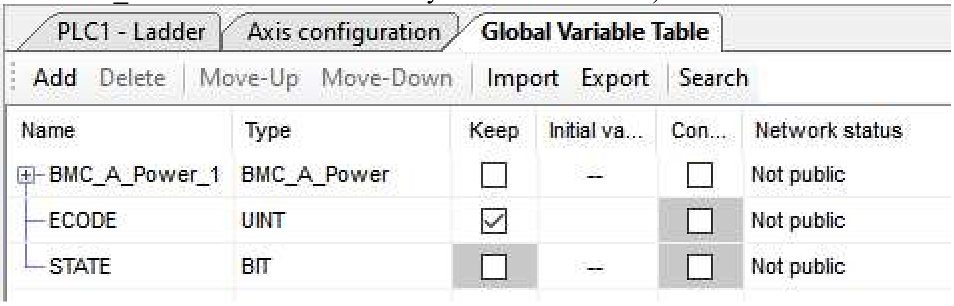
2. Declare POU definitions to instantiate POU blocks and enable instruction BMC_ A_ POWER, an automatic declaration will appear; In this interface, you can customize the name of the POU. 1. Determine the variable table where the POU block is defined. 2. Check the flag. 3. Annotate the POU block. 4. Enter the custom name directly for subsequent program calls.



3. After clicking OK on the automatic declaration in step 2, you can view the declared variables in the global variable table.



4. According to the input and output pins of the POU block, define the input and output variables of the POU block. It is important to ensure that the types of pins and variables are consistent (the input shaft pin AXIS of the associated BML_APOWER is listed in the system variable table)

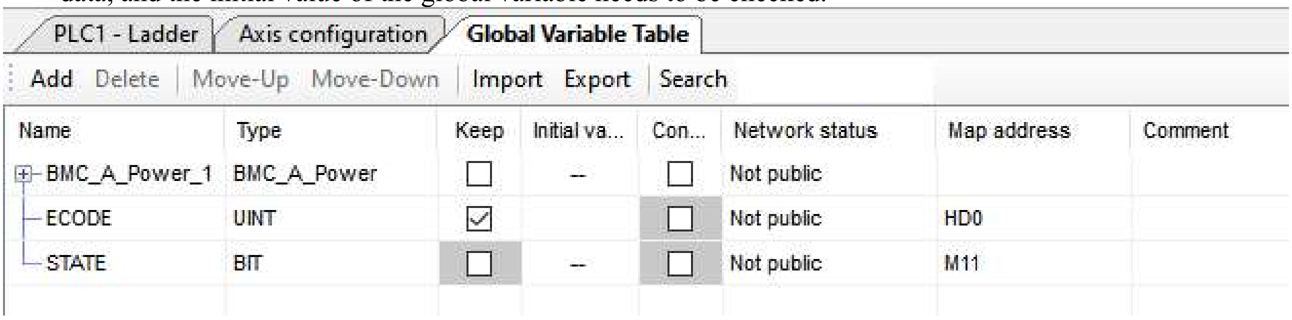


PLC1 - Ladder | Axis configuration | Global Variable Table

Add Delete Move-Up Move-Down Import Export Search

Name	Type	Keep	Initial va...	Con...	Network status
BMC_A_Power_1	BMC_A_Power	☐	--	☐	Not public
ECODE	UINT	☑		☐	Not public
STATE	BIT	☐	--	☐	Not public

5. Registers that can be mapped to POU input and output variables as needed. Subsequent operations on the corresponding register can change the input parameters, and viewing the corresponding register can view the output parameters (HD is the power-off hold register).After checking the option to keep or constant, the initial value can be written. The initial value needs to be checked when downloading the program or user data, and the initial value of the global variable needs to be checked.



PLC1 - Ladder | Axis configuration | Global Variable Table

Add Delete Move-Up Move-Down Import Export Search

Name	Type	Keep	Initial va...	Con...	Network status	Map address	Comment
BMC_A_Power_1	BMC_A_Power	☐	--	☐	Not public		
ECODE	UINT	☑		☐	Not public	HD0	
STATE	BIT	☐	--	☐	Not public	M11	

6. Enable axis 0 by conducting M0 in the ladder diagram.

Note:

① The name of the global variable does not support Chinese characters.

② Registers for global variable mapping are not allowed to be reused.

③ The pins of the POU instruction cannot be directly associated with registers and coils, and variables need to be associated to map registers or coils.

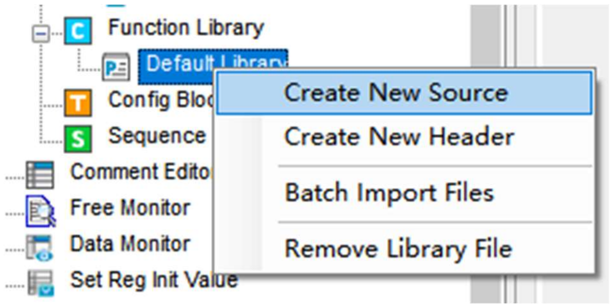
④ Some pins of the operation control POU instruction can be suspended, which will use default parameter values. The default parameters can be seen in the original trapezoidal diagram operation control instruction input parameter introduction.

⑤ FB supports compatibility of BIT&BOOL and BIT array&BOOL array value types (upper computer versions 3.7.17 and above).

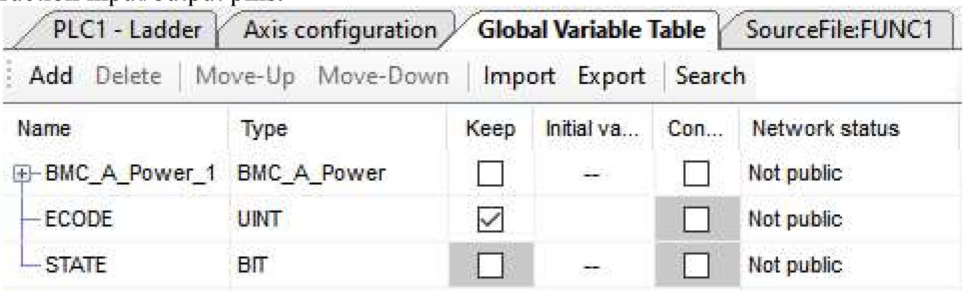
- The BOOL type input assigned to FB by BIT variable.
- Registers for global variable mapping are not allowed to be reused.
- Assign the BOOL type output of FB to the BIT type variable.
- Assign the BOOL array type output of FB to the BIT array variable.

4-5-4-2. Calling POU in C language

1. Select [Default Library] in the [Project Bar] and right-click [New Source File] to create a C programming environment in the [Function Library].



2. Declare variables in the global variable table that need to be associated with defining POU instructions and POU instruction input/output pins.



3. Directly assign the defined input-output variables to the input-output pins of the POU instruction in C language, and then instantiate them (the pins are derived using the writing method of taking structural members in C language).

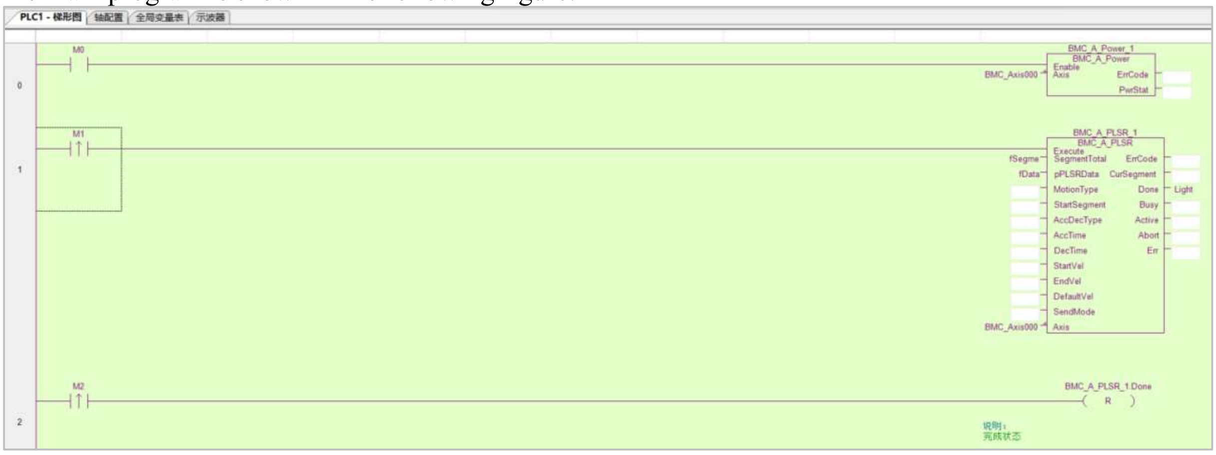
4. Call the established C language module in the ladder diagram, and turn on M0 on the basis of turning on the C language module to enable axis 0.

Note: Compatibility of BIT&BOOL and BIT array&BOOL array value types is currently not supported in C language (FC).

4-5-5. POU usage case in ladder diagram

Routine: The EtherCAT bus axis first moves relative to the 50mm position at a speed of 10mm/s, waits for 2 seconds, and then returns to the starting point at a speed of 20mm/s using BMC_ A_ PLSR command, after completion, lights up the small light and can be manually turned off.

The main program is shown in the following figure:



BMC_A_PLSR_1			
Input Pin		Input variables	
Name	Type	Name	Type
Execute rising edge enable	BOOL	M[1]	BIT
Total Segments	UDINT	fSegme	UDINT
PPLSRData input segment number structure pointer	BMC_AXIS_PLSRDATA*pointer	fDATA	BMC_AXIS_PLSRDATA[2] Array
Axis Axis Number	BMC_AXIS_REF	BMC_Axis000	BMC_AXIS_REF
Other input pins	—	Default value	—

FDATA creates two arrays here, with several arrays for each segment of velocity displacement. The suspended input pins will use default values, which can refer to A_ Introduction to PLSR Instruction Parameter Details.

BMC_A_PLSR_1			
Output Pin		Output variables	
Name	Type	Name	Type
Done completion status	BOOL	Light	BIT

If other output pins are needed, they can be directly called, such as BMC_ A_ PLS_ 1. Err obtains error status.

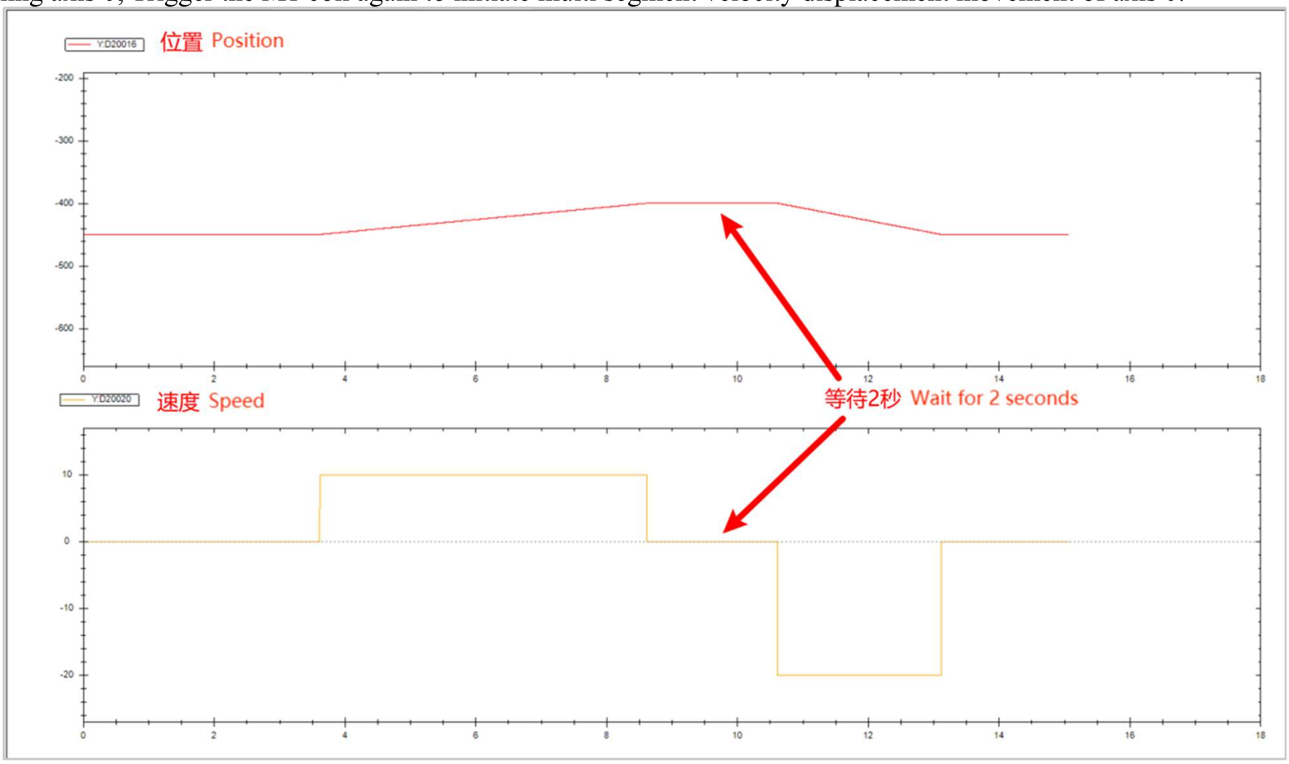
The global variable table is as follows:

PLC1 - 梯形图 | 轴配置 | 全局变量表 | 示波器 | POU库：XJBasicMotion... | 系统变量表

添加 删除 上移 下移 导入 导出 搜索

名称	类型	保持	初值	常量	映射地址	注释
BMC_A_Power_1	BMC_A_Power	☐	--	☐		
BMC_A_PLSR_1	BMC_A_PLSR	☐	--	☐		
fSegme	UDINT	☑	2	☐	HD0	
fData	BMC_AXIS_PLSRDATA[2]	☑	--	☐	[HD2,HD21]	
fData[0]	BMC_AXIS_PLSRDATA	☑	--	☐	[HD2,HD11]	
TargetVel	UDINT	☑	10	☐	HD2	目标速度
TargetDist	DINT	☑	50	☐	HD4	目标位移
WaitNum	UDINT	☑	2000	☐	HD6	等待常数值/寄存器...
WaitType	USINT	☑	00	☐	HD8L	等待条件寄存器类型
WaitSignal	USINT	☑	01	☐	HD8H	等待条件
SkipType	USINT	☑		☐	HD9L	跳转寄存器类型
SkipNum	UDINT	☑		☐	HD10	跳转常数值/寄存器...
fData[1]	BMC_AXIS_PLSRDATA	☑	--	☐	[HD12,HD21]	
TargetVel	UDINT	☑	20	☐	HD12	目标速度
TargetDist	DINT	☑	-50	☐	HD14	目标位移
WaitNum	UDINT	☑		☐	HD16	等待常数值/寄存器...
WaitType	USINT	☑		☐	HD18L	等待条件寄存器类型
WaitSignal	USINT	☑		☐	HD18H	等待条件
SkipType	USINT	☑		☐	HD19L	跳转寄存器类型
SkipNum	UDINT	☑		☐	HD20	跳转常数值/寄存器...
Light	BIT	☐	--	☐	Y0	

Wait condition 01 is the wait time, wait condition register type 00 is a constant, wait constant value/register value 2000 is 2000ms, that is, wait for 2 seconds after the first segment is completed to execute the next segment (specific meaning can refer to instruction A-PLSR). After the PLC is powered on, the pilot turns on the M0 coil, enabling axis 0; Trigger the M1 coil again to initiate multi segment velocity displacement movement of axis 0.



BMC after execution completion_ A_ PLSR_ Set the output pin Done of 1 to ON, conduct the Y0 coil mapped by the Light variable, and light up the small light on the Y0 terminal of the wiring; Trigger the M3 signal reset completion flag to turn off the small light.

4-5-6. POU usage cases in C language

Routine: The EtherCAT bus axis first moves relative to the 50mm position at a speed of 10mm/s, waits for 2 seconds, and then returns to the starting point at a speed of 20mm/s using BMC_ A_ PLSR command, after completion, lights up the small light and can be manually turned off.

Before calling POU in C language, you need to establish a C language programming environment, and create a new POU declaration and definition of the required variables in the global variable table. This example is as follows:

名称	类型	保持	初值	常量	映射地址	注释
BMC_A_Power_1	BMC_A_Power	☐	--	☐		
BMC_A_PLSR_1	BMC_A_PLSR	☐	--	☐		
fSegme	UDINT	☑	2	☐	HD0	
fData	BMC_AXIS_PLSRDATA[2]	☑	--	☐	[HD2,HD21]	
fData[0]	BMC_AXIS_PLSRDATA	☑	--	☐	[HD2,HD11]	
TargetVel	UDINT	☑	10	☐	HD2	目标速度
TargetDist	DINT	☑	50	☐	HD4	目标位移
WaitNum	UDINT	☑	2000	☐	HD6	等待常数值/寄存器...
WaitType	USINT	☑	00	☐	HD8L	等待条件寄存器类型
WaitSignal	USINT	☑	01	☐	HD8H	等待条件
SkipType	USINT	☑		☐	HD9L	跳转寄存器类型
SkipNum	UDINT	☑		☐	HD10	跳转常数值/寄存器...
fData[1]	BMC_AXIS_PLSRDATA	☑	--	☐	[HD12,HD21]	
TargetVel	UDINT	☑	20	☐	HD12	目标速度
TargetDist	DINT	☑	-50	☐	HD14	目标位移
WaitNum	UDINT	☑		☐	HD16	等待常数值/寄存器...
WaitType	USINT	☑		☐	HD18L	等待条件寄存器类型
WaitSignal	USINT	☑		☐	HD18H	等待条件
SkipType	USINT	☑		☐	HD19L	跳转寄存器类型
SkipNum	UDINT	☑		☐	HD20	跳转常数值/寄存器...
Light	BIT	☐	--	☐	Y0	

The waiting condition 01 is the wait time, the waiting condition register type 00 is a constant, and the waiting constant value/register value 2000 is 2000ms, which means waiting for 2 seconds after the first segment is completed before executing the next segment (specific meaning can be referred to A-PLSR).

BMC_A_PLSR_1			
Input Pin		Input variables	
Name	Type	Name	Type
Execute rising edge enable	BOOL	M[1]	BIT
Total Segments	UDINT	fSegme	UDINT
PPLSRData input segment number structure pointer	BMC_AXIS_PLSRDATA*pointer	fDATA	BMC_AXIS_PLSRDATA[2] Array
Axis Axis Number	BMC_AXIS_REF	BMC_Axis000	BMC_AXIS_REF
Other input pins	—	Default value	—

FDATA creates two arrays here, with several arrays for each segment of velocity displacement; The suspended input pins will use default values, which can refer to A_ Detailed introduction of PLSR instruction parameters.

BMC_A_PLSR_1			
Output Pin		Output variables	
Name	Type	Name	Type
Done completion status	BOOL	Light	BIT

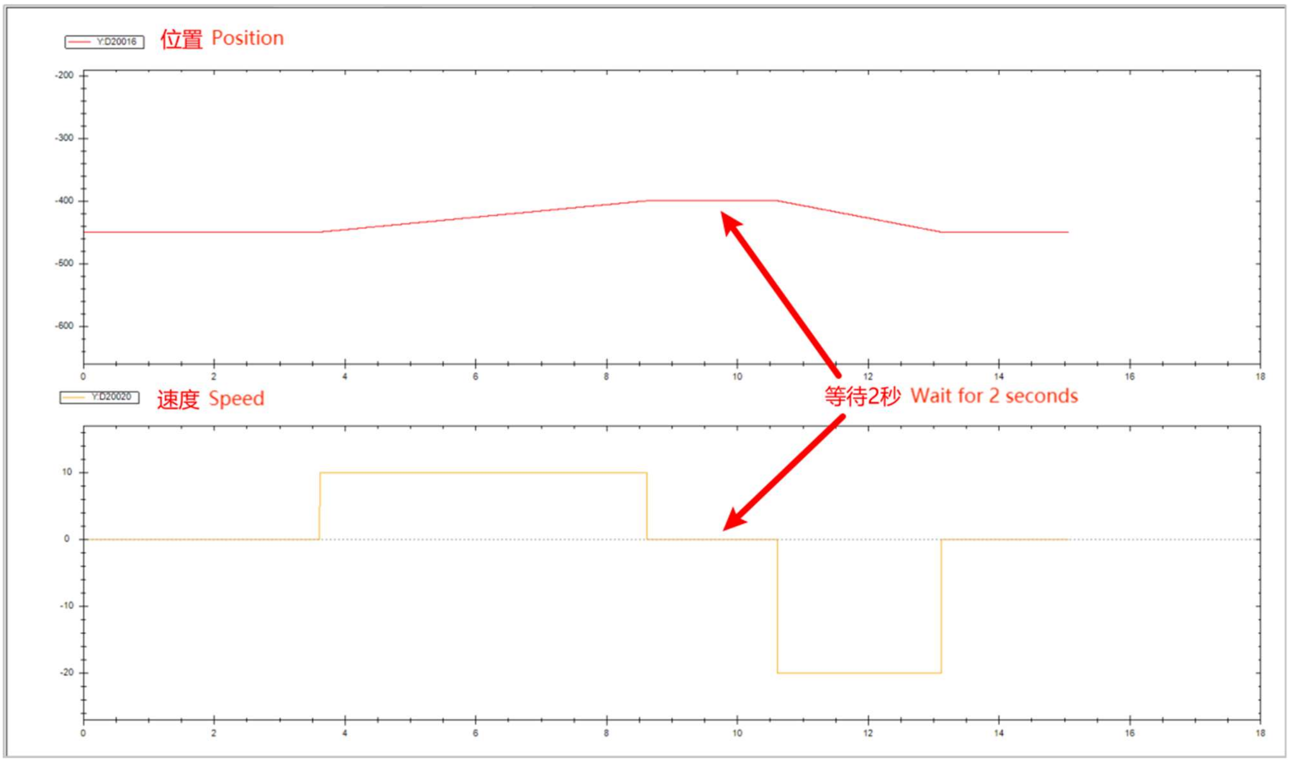
If other output pins are needed, they can be directly called, such as BMC_ A_ PLS_ 1. Err obtains error status.

The C language program is as follows:

```c
/***************************************************************************
 * FunctionBlockName:  MOTION
 * Version:            1.0.0
 * Author:
 * UpdateTime:         2023-07-15 11:27:01
 * Comment:
***************************************************************************/

/**
 * @summary
 * @param W
 * @param B
 */
void MOTION(PINT16S W,PBIT B)
{
    #define SysRegAddr_HD_D_HM_M

    BMC_A_Power_1.Enable = M[0];              //将M0线圈状态赋给轴使能POU指令的使能输入
    BMC_A_Power_1.Axis = &BMC_Axis000;        //将轴0结构体变量赋给POU轴输入引脚
    BMC_A_Power_BODY ( &BMC_A_Power_1 );      //实例化轴使能POU

    BMC_A_PLSR_1.Execute = M[1];              //将M1线圈状态赋给多段速度位移POU指令的上升沿使能触发引脚
    BMC_A_PLSR_1.SegmentTotal = fSegme;       //将总段数变量赋给POU段数输入引脚
    BMC_A_PLSR_1.pPLSRData = &fData;          //将多段速度位移结构体数组赋给POU多段指针输入引脚
    BMC_A_PLSR_1.Axis= &BMC_Axis000;          //将运动目标轴赋给POU轴输入引脚
    BMC_A_PLSR_BODY ( &BMC_A_PLSR_1 );        //实例化

}
```

The C language block needs to be called in the ladder. The ladder program is as follows:

After the PLC is powered on, the pilot activates the M0 coil to enable axis 0, and then triggers the M1 signal to start the reciprocating movement of axis 0. After the reciprocating movement is completed, the BMC_ A_ PLSR_ 1. Done completes the signal setting, conducts the Y0 terminal of the Light mapping, lights up the small light connected to the Y0 terminal, and triggers the M3 signal to turn off the small light.



5. Motion instruction

5-1. Single axis function

5-1-1. Instruction list

Instruction	Function	Chapter
A_PWR	Axis enable	5-1-2-1
A_RST	Error reset	5-1-2-2
A_WRITE	Modify the electrical position	5-1-2-3
A_MODE	Modify the control mode	5-1-2-4
A_STOP	Stop motion	5-1-2-5
A_HALT	Pause	5-1-2-6
A_MOVEA	Absolute position motion	5-1-2-7
A_MOVER	Relative position motion	5-1-2-8
A_CMOVEA	Absolute position continuous motion	5-1-2-9
A_CMOVER	Relative position continuous motion	5-1-2-10
A_VELMOVE	Speed control motion	5-1-2-11
A_MOVESUP	Superimposed motion	5-1-2-12
A_HOME	HM homing	5-1-2-13
A_ZRN	Homing	5-1-2-14
A_GEARIN	Gear binding	5-1-2-15
A_GEAROUT	Gear unbinding	5-1-2-16
A_DRVA	Simple absolute position motion	5-1-2-17
A_DRVI	Simple relative position motion	5-1-2-18
A_PROBE	Probe function	5-1-2-19
A_CYCPOS	Periodic position control motion	5-1-2-20
A_CYCVEL	Periodic speed control motion	5-1-2-21
A_CYCTRQ	Periodic torque control motion	5-1-2-22
A_PLSR	Multiple speed shift	5-1-2-23
A_PLSF	Variable speed output	5-1-2-24
A_FOLLOW	Pulse follow	5-1-2-25
A_CYCSUP	Cycle superposition	5-1-2-26
A_PITCHCOMP	Pitch compensation	5-1-2-27
A_BACKLASHCOMP	Backlash compensation	5-1-2-28
X_UPDATEPARA	Update without power off	5-1-2-29
A_COMBINEAXIS	Multi axis composite motion	5-1-2-30
A_IMMEDIATESTOP	Single axis emergency stop	5-1-2-31
A_RSTFERR	Reset deviation	5-1-2-32
A_TORQUECTRL	Torque control	5-1-2-33
XFEEDPOSFILTER	Axis position filtering	5-1-2-34
XFERRCOMP	Single axis accuracy compensation	5-1-2-35
A_POSITIONPROFILE	Position contour	5-1-2-36
A_MOVEFEED	Interrupt fixed length	5-1-2-37

5-1-2. Instructions

5-1-2-1. Axis enable【A_PWR】

(1) Overview

Enable the servo axis.

Axis enable [A_PWR]			
Execution condition	Normally open/close coil	Suitable model	XDH, XLH, XG2
Firmware	V3.6.1b and above	Software	3.7.4 and above

(2) Operand

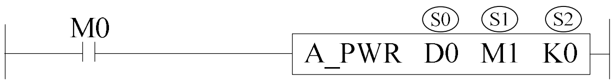
Operand	Function	Type
S0	Output state word start address	16-bit, single word
S1	Output state bit start address	Bit
S2	Axis output terminal number	16-bit, single word

(3) Suitable soft component

Operand	Word soft component											Bit soft component					
	System								Constant	Module		System					
	D*	FD	TD*	CD*	DX	DY	DM*	DS*	K/H	ID	QD	X	Y	M*	S*	T*	C*
S0	●	●	●	●													
S1														●			
S2									●								

*: D means D, HD; TD means TD and HTD; CD means CD, HCD, HSCD and HSD; DM means DM and DHM; DS means DS and DHS; M means M, HM, SM; S means S, HS; T means T, HT; C means C, HC.

(4) Function and action



- S0 specifies the output state word start address.
- S1 specifies the output state bit start address .
- S2 specifies the axis terminal number.
- When M0 is set to on, enable the specified axis of S2 and switch the axis to the operable state. When M0 is set to off, turn off the enabling of S2 specified axis and switch the axis to idle state.
- After the instruction is executed, slave station single axis state (D20000+200*N) switch to 1.

(5) Note

- If A_PWR is used more than once, it will cause double coil conflict..
- The [command related] parameters can be monitored only when the conditions in front of the ladder chart are on.
- The soft limit will be detected only when the axis is enabled.
- A_ PWR does not output axis related error codes.
- The encoder axis does not need to be enabled.

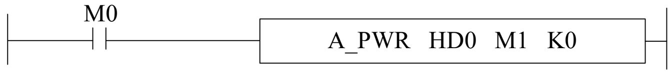
(6) Related parameters

Output parameter	Paranemter name	Data type	Unit	Note
S0	ErrCode	INT16U	-	Command error code
State parameter	Paranemter name	Data type	Unit	Note
S1	PwrStat	BOOL	-	Enabled state
Axis number	Paranemter name	Data type	Unit	Note
S2	Axis	INT16U	-	Axis number starts from 0

(7) Sequence diagram

(8) Application

For example, to enable the K0 axis servo, the ladder diagram is as follows:



When there is no axis error, when M0 is set to on, K0 axis is enabled, the enabling state bit M1 is set to on, and the state machine D20000 + 200*N of the corresponding axis is 1, indicating the enabling static state.

5-1-2-2. Error reset【A_RST】

(1) Overview

In case of single axis error, release the axis error state and switch to the normal operation state.

Error reset [A_RST]			
Execution condition	Rising/falling edge of the coil	Suitable model	XDH, XLH, XG2
Firmware	V3.6.1b and above	Software	3.7.4 and above

(2) Operand

Operand	Function	Type
S0	Output state word start address	16-bit, single word
S1	Output state bit start address	Bit
S2	Output axis terminal number	16-bit, single word

(3) Suitable soft component

Operand	Word soft component											Bit soft component					
	System								Constant	Module		System					
	D*	FD	TD*	CD*	DX	DY	DM*	DS*	K/H	ID	QD	X	Y	M*	S*	T*	C*
S0	●	●	●	●													
S1	●	●	●	●													
S2														●			
S3	●								●								

*: D means D, HD; TD means TD and HTD; CD means CD, HCD, HSCD and HSD; DM means DM and DHM; DS means DS and DHS; M means M, HM, SM; S means S, HS; T means T, HT; C means C, HC.

(4) function and action Suitable soft component

```
                         S0   S1   S2
  M0
--|↑|---------------[ A_RST  D0   M1   K0 ]
```

- S0 specifies the output state word start address.
- S1 specifies the output state bit start address, occupies the relay S1~S1+2.
- S2 specifies the axis terminal number.
- When M0 changes from off → on, release the error state of the axis specified by S2. After successfully releasing the error state, S1 is set to on.
- After the command is executed, the single axis state (D20000 + 200*N) of the slave station is switched to 0 or 1 (0: axis enable is off, 1: axis enable is on).

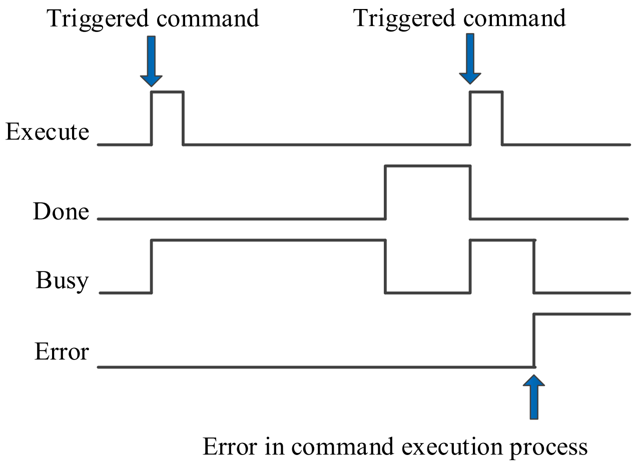
(5) Note

- The command is triggered by the rising edge, which will only perform error reset when the rising edge of the coil is triggered.
- A_RST command can clear the alarms allowed to be cleared by the driver. Some serious alarms need to clear the errors on the driver side before executing A_RST instruction.
- Please confirm that the corresponding error has been processed before executing the error reset instruction.
- After the command is executed successfully, the output status bit will not be automatically set to off. If necessary, please manually set the status bit to off.

(6) Related parameters

Output parameter	Parameter name	Data type	Unit	Note
S0	ErrCode	INT16U	-	Command error code
State parameter	Parameter name	Data type	Unit	Note
S1	Done	BOOL	-	Instruction execution complete
S1+1	Busy	BOOL	-	The instruction is being executed
S1+2	Error	BOOL	-	Instruction execution error
Axis number	Parameter name	Data type	Unit	Note
S2	Axis	INT16U		Axis number starts from 0

(7) Sequence diagram



Note:

The command is triggered and the Busy signal is set on. When the command execution is completed, the Busy signal is reset and the Done signal is set on.

When there is an error during instruction execution, the Error signal is set on, other signals are reset, and the corresponding error code is output.

(8) Application

For example, to clear the error status of the K0 axis, the ladder diagram is as follows:

When the axis has error (state machine D20000+200*N=7), the axis error can be cleared through the instruction A_RST (please check the corresponding error code D20001 + 200*N first, and then clear the alarm after confirming that the error has been removed), and the state machine can be switched to the running state.

Before A_RST	After A_RST

PLC1-自由监控1

监控窗口 添加 修改 删除 删除全部

寄存器	监控值	字长	进制	注释
D20000	7	单字	1...	
D20001	2005	单字	1...	
M1	OFF	位	-	执行成功
M2	OFF	位	-	执行中
M3	OFF	位	-	执行错误

PLC1-自由监控1

监控窗口 添加 修改 删除 删除全部

寄存器	监控值	字长	进制	注释
D20000	0	单字	1...	
D20001	0	单字	1...	
M1	ON	位	-	执行成功
M2	OFF	位	-	执行中
M3	OFF	位	-	执行错误

5-1-2-3. Modify the electrical position【A_WRITE】

(1) Overview

Modify the axis present position.

Modify the electrical position [A_WRITE]			
Execution condition	Rising/falling edge of the coil	Suitable model	XDH, XLH, XG2
Firmware	V3.6.1b and above	Software	3.7.4 and above

(2) Operand

Operand	Function	Type
S0	Input parameter start address	64-bit, 4 words
S1	Output state word start address	16-bit, single word
S2	Output state bit start address	Bit
S3	Axis output terminal number	16-bit, single word

(3) Suitable soft component

Operand	Word soft component											Bit soft component					
	System								Constant	Module		System					
	D*	FD	TD*	CD*	DX	DY	DM*	DS*	K/H	ID	QD	X	Y	M*	S*	T*	C*
S0	●	●	●	●													
S1	●	●	●	●													
S2														●			
S3	●								●								

*: D means D, HD; TD means TD and HTD; CD means CD, HCD, HSCD and HSD; DM means DM and DHM; DS means DS and DHS; M means M, HM, SM; S means S, HS; T means T, HT; C means C, HC.

(4) Function and action

- S0 specifies input parameter start address, occupies register S0~S0+5.
- S1 specifies output state word start address.
- S2 specifies output state bit start address, occupies the relay S2~S2+2.
- S3 specifies axis terminal number.
- When M0 is from OFF→ON, modify the S3 specified axis present position (D20044+200*N) to S0 (N is axis number, starts from 0).
- After executing the instruction, slave station single axis state (D20000+200*N) will not change.
- V3.7.3 and above versions support mold shafts, specific calculations can be found in the chapter 6-6. Application of mold axis

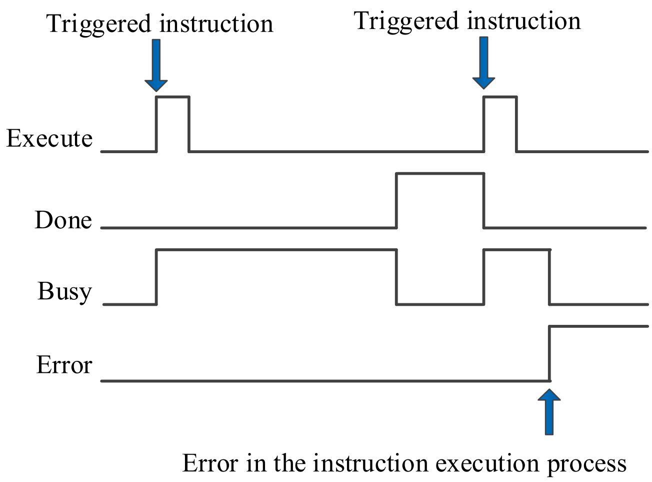
(5) Related parameters

Input parameter	Parameter name	Data type	Unit	Note
S0	Position	FP64	Command unit	Target position
S0+4	Mode	INT16U	-	Position type* 0: absolute 1: relative
S0+5	BufferMode	INT16U	-	Buffer mode* 0: break in 1: buffer Cannot support right now
Output parameter	Parameter name	Data type	Unit	Note
S1	ErrCode	INT16U	-	Command error code
State parameter	Parameter name	Data type	Unit	Note
S2	Done	BOOL	-	Instruction execution complete
S2+1	Busy	BOOL	-	The instruction is being executed

S2+2	Error	BOOL	-	Instruction execution error
Axis number	Parameter name	Data type	Unit	Note
S3	Axis	INT16U	-	Axis number starts from 0

*Note: absolute, new present position =S0 input value.
Relative, new present position = old present position +S0 input value.

(6) Sequence diagram



Note:

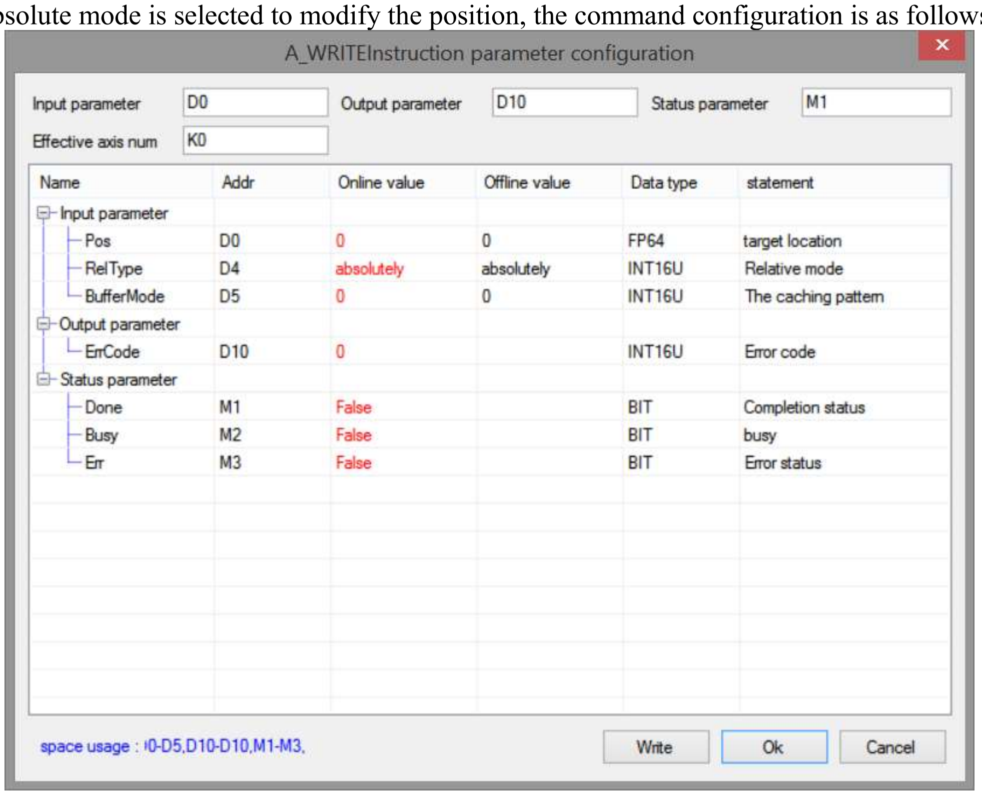
The command is triggered and the Busy signal is set on. When the command execution is completed, the Busy signal is reset and the Done signal is set on.

When there is an error during instruction execution, the Error signal is set on, other signals are reset, and the corresponding error code is output.

(7) Application

Modify the axis present position:

When absolute mode is selected to modify the position, the command configuration is as follows:



Before the instruction execution	After the instruction execution

Before the instruction execution:

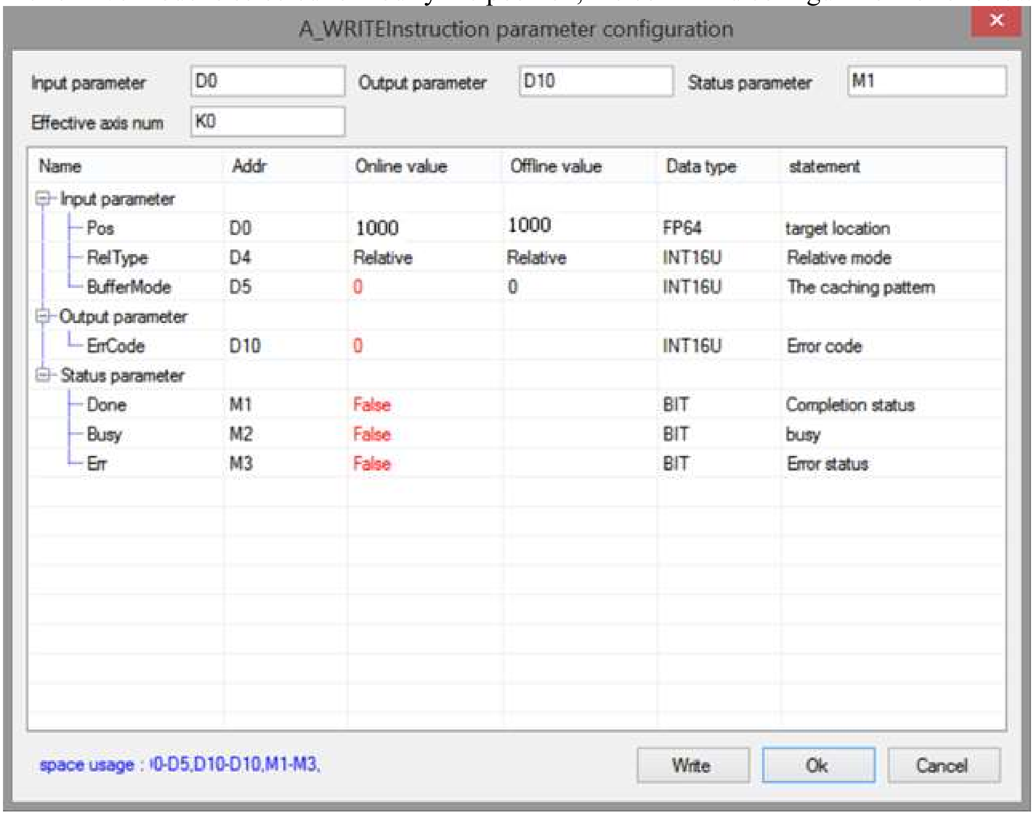
寄存器	监控值	字长	进制	注释
D20016	10000	双...	1...	轴0给定位置
D20044	10000	双...	1...	轴0反馈位置

After the instruction execution:

寄存器	监控值	字长	进制	注释
D20016	0	双...	1...	轴0给定位置
D20044	0	双...	1...	轴0反馈位置

Note: before the command is executed, the current position of the axis is 10000, after absolute mode A_WRITE is executed, write the target location parameter to the current location (the target location in this example is 0).

When the relative mode is selected to modify the position, the command configuration is as follows:



指令执行前	指令执行后

指令执行前:

寄存器	监控值	字长	进制	注释
D20016	10000	双...	1...	轴0给定位置
D20044	10000	双...	1...	轴0反馈位置

指令执行后:

寄存器	监控值	字长	进制	注释
D20016	11000	双...	1...	轴0给定位置
D20044	11000	双...	1...	轴0反馈位置

Note: Before executing the command, the current position of the axis is 10000, after executing relative mode A_WRITE, the current position changes to the original position plus the target position (in this example, the target position is 1000, plus the original position 10000, that is, the final position is 11000).

5-1-2-4. Modify the control mode【A_MODE】

(1) Overview

Modify the control mode (6060h) of specified axis.

Modify the control mode [A_MODE]			
Execution condition	Rising/falling edge of the coil	Suitable model	XDH, XLH, XG2
Firmware	V3.6.1b and above	Software	3.7.4 and above

(2) Operand

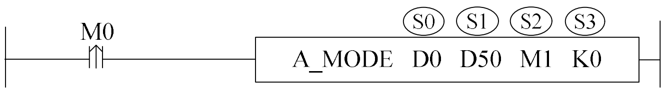
Operand	Function	Type
S0	Input parameter start address	16-bit, single word
S1	Output state word start address	16-bit, single word
S2	Output state bit start address	Bit
S3	Axis output terminal number	16-bit, single word

(3) Suitable soft component

Operand	Word soft component											Bit soft component					
	System								Constant	Module		System					
	D*	FD	TD*	CD*	DX	DY	DM*	DS*	K/H	ID	QD	X	Y	M*	S*	T*	C*
S0	●	●	●	●													
S1	●	●	●	●													
S2														●			
S3	●								●								

*: D means D, HD; TD means TD and HTD; CD means CD, HCD, HSCD and HSD; DM means DM and DHM; DS means DS and DHS; M means M, HM, SM; S means S, HS; T means T, HT; C means C, HC.

(4) Function and action



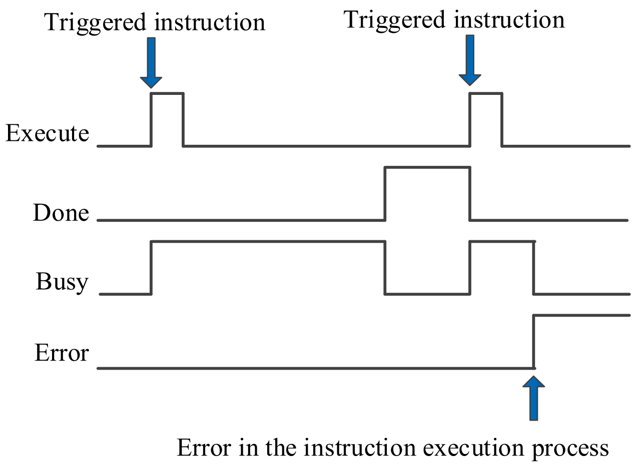
- S0 specifies input parameter start address
- S1 specifies output state word start address
- S2 specifies output state bit start address, occupies relay S2~S2+2
- S3 specifies axis terminal number, specified axis, only fit for EtherCAT bus axis
- When M0 is from OFF→ON, the control mode of S3 corresponding axis number is switched to S0 specified mode
- The control mode selection please refer to slave station Ethercat parameter 6060h
- After the instruction is executed, the single axis state (D20000+200*N) of slave station will not change.

(5) Related parameters

Input parameter	Parameter name	Data type	Unit	Note
S0	Mode	INT16U	-	Target mode The mode selection please refer to slave station Ethercat parameter 6060h
Output parameter	Parameter name	Data type	Unit	Note
S1	ErrCode	INT16U	-	Command error code
State parameter	Parameter name	Data type	Unit	Note
S2	Done	BOOL	-	Instruction execution complete
S2+1	Busy	BOOL	-	The instruction is being executed
S2+2	Error	BOOL	-	Instruction execution error
Axis number	Parameter name	Data type	Unit	Note
S3	Axis	INT16U	-	Axis number starts from 0

Note:When switching to CST mode, if PDO adds 6080h, the instruction will perform a zero initialization operation on this parameter.

(6) Sequence diagram



Note:

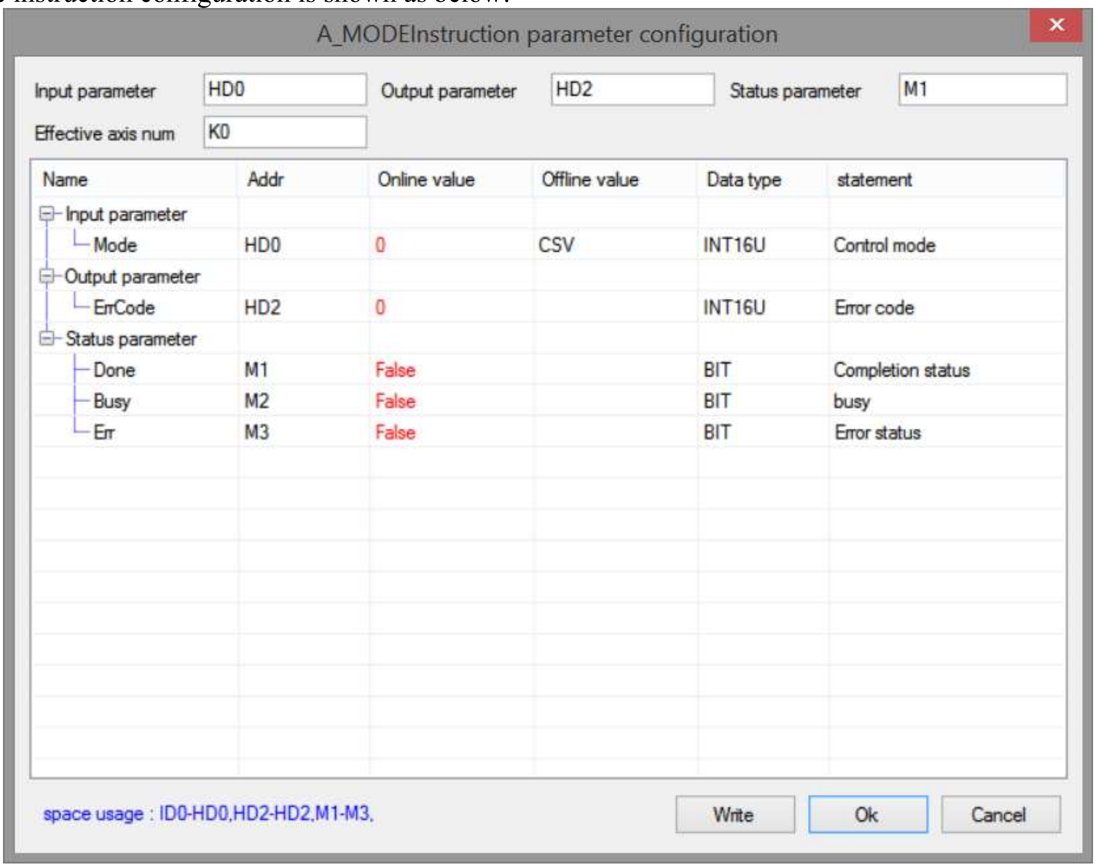
The command is triggered and the Busy signal is set on. When the command execution is completed, the Busy signal is reset and the Done signal is set on.

When there is an error during instruction execution, the Error signal is set on, other signals are reset, and the corresponding error code is output.

(7) Application

Modify the axis control mode to CSV mode:

The instruction configuration is shown as below:



Note: When the command is executed successfully, the flag M1 will change to ON, and the control mode of the specified axis will change to CSV mode (the value of 6060h is set to 9, and the details of the control mode setting can be found in 3-3-5. Control mode setting.

5-1-2-5. Stop motion【A_STOP】

(1) Overview

Deceleration stop or emergency stop the motion axis.

Stop motion [A_STOP]			
Execution condition	Rising/falling edge of the coil	Suitable model	XDH, XLH, XG2
Firmware	V3.6.1b and above	Software	3.7.4 and above

(2) Operand

Operand	Function	Type
S0	Input parameter start address	64-bit, four words
S1	Output state word start address	16-bit, single word
S2	Output state bit start address	Bit
S3	Axis output terminal number	16-bit, single word

(3) Suitable soft component

Operand	Word soft component											Bit soft component					
	System								Constant	Module		System					
	D*	FD	TD*	CD*	DX	DY	DM*	DS*	K/H	ID	QD	X	Y	M*	S*	T*	C*
S0	●	●	●	●													
S1	●	●	●	●													
S2														●			
S3	●								●								

*: D means D, HD; TD means TD and HTD; CD means CD, HCD, HSCD and HSD; DM means DM and DHM; DS means DS and DHS; M means M, HM, SM; S means S, HS; T means T, HT; C means C, HC.

(4) Function and action

- S0 specifies input parameter start address, occupies the register S0~S0+8.
- S1 sepcifies output state word start address .
- S2 specifies output state bit start address, occupies the relay S2~S2+3.
- S3 specifies the axis terminal number .
- When M0 changes from off to on, the stop action is performed for the axis specified by S3, and the stop mode is specified by S0 + 8. If it is the deceleration stop mode, the axis is in the deceleration stop state after the command is executed, and other commands are invalid in this state. After the deceleration stop is completed, the axle is in the static state, and other commands can be executed at this time.
- When it is executed in deceleration stop mode, the single axis state (D20000 + 200*N) of the slave station during deceleration stop is 6, and the single axis state after axis stop is 1.

(5) Notes

- The actual deceleration speed of the axis is the larger one beween present motion deceleration speed and A_STOP deceleration speed.
- The deceleration stop process cannot be interrupted by any other command, but can be interrupted by A_ Stop command.
- This instruction has higher priority than other instructions and will not be interrupted by any other instructions during the execution of the instruction.
- V3.7.3 and above versions add mode switching, CST mode triggers stop, and mode switches to CSP while torque is set to 0.

(6) Related parameters

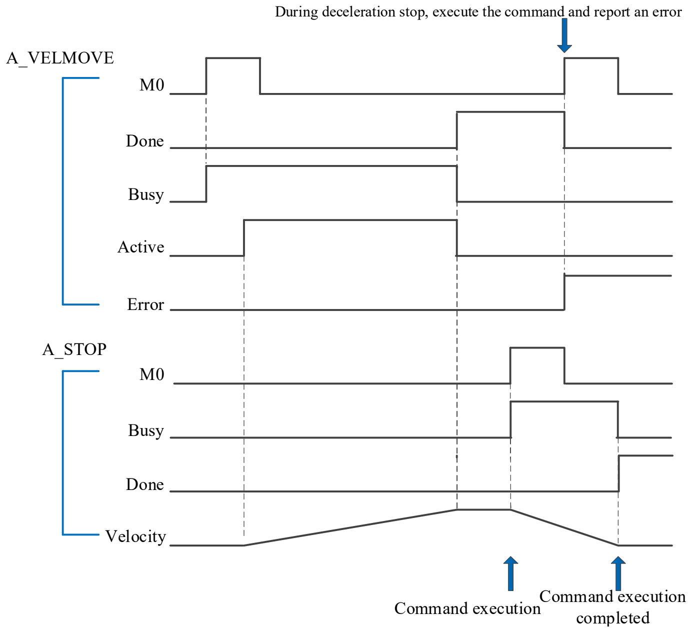
Input parameter	Parameter name	Data type	Unit	Note
S0	Deceleration	FP64	Command unit/s^2	Target deceleration
S0+4	Jerk	FP64	Command unit/s^3	Target jerk, the change speed of acceleration/deceleration
S0+8	StopMode	INT16U	-	Stop type 0: Deceleration stop

Input parameter	Parameter name	Data type	Unit	Note
				1: Emergency stop 2: Emergency stop and turn off enable
Output parameter	Parameter name	Data type	Unit	Note
S1	ErrCode	INT16U	-	Command error code
State parameter	Parameter name	Data type	Unit	Note
S2	Done	BOOL	-	Instruction execution complete
S2+1	Busy	BOOL	-	The instruction is being executed
S2+2	Abort	BOOL	-	Instruction is interrupted
S2+3	Error	BOOL	-	Instruction execution error
Axis number	Parameter name	Data type	Unit	Note
S3	Axis	INT16U	-	Axis number starts from 0

Stop type description:

① Deceleration stop

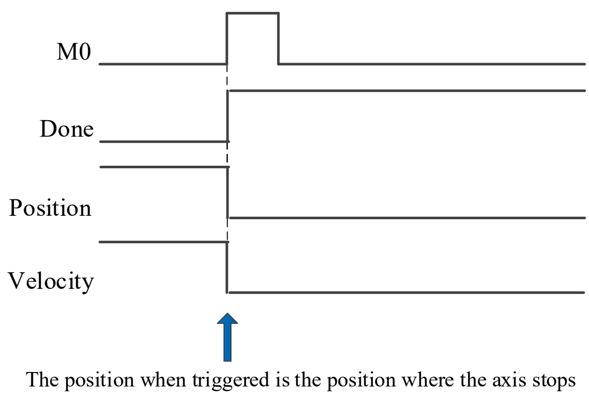
Decelerate and stop at the setting deceleration. If the deceleration is 0, execute at the default deceleration (default deceleration = default maximum deceleration SFD8088 * default deceleration percentage SFD8098). Take instruction A_VELMOVE and A_STOP as an example:



② Emergency stop

When the command is executed, stop the axis immediately.

Note: stopping the motion immediately will damage the machinery.



③ Emergency stop and turn off enable

At the same time of emergency stop, turn off the enabling of the axis.

5-1-2-6. Pause【A_HALT】

(1) Overview

Decelerate and stop the moving axis.

Pause [A_HALT]			
Execution condition	Rising/falling edge of the coil	Suitable model	XDH, XLH, XG2
Firmware	V3.6.1b and above	Software	3.7.4 and above

(2) Operand

Operand	Function	Type
S0	Input parameter start address	64-bit, four words
S1	Output state word start address	16-bit, single word
S2	Output state bit start address	Bit
S3	Axis output terminal number	16-bit, single word

(3) Suitable soft component

Operand	Word soft component											Bit soft component					
	System								Constant	Module		System					
	D*	FD	TD*	CD*	DX	DY	DM*	DS*	K/H	ID	QD	X	Y	M*	S*	T*	C*
S0	●	●	●	●													
S1	●	●	●	●													
S2														●			
S3	●								●								

*: D means D, HD; TD means TD and HTD; CD means CD, HCD, HSCD and HSD; DM means DM and DHM; DS means DS and DHS; M means M, HM, SM; S means S, HS; T means T, HT; C means C, HC.

(4) Function and action

- S0 specifies input parameter start address, occupies the register S0~S0+8.
- S1 specifies output state word start address .
- S2 specifies output state bit start address, occupies the relay S2~S2+4.
- S3 specifies axis terminal number .
- When M0 changes from off → on, the deceleration stop action is executed for the axis specified by S3, and the deceleration stop process can be interrupted.
- After the command is executed, the single axis state (D20000 + 200*N) during deceleration stop is 2, and the single axis state switches to 1 after axis stop .
- V3.7.3 and above versions have added different modes that can execute the A_HALT command, and the CST mode trigger will switch back to CSP mode when the torque is given to 0.

(5) Related parameters

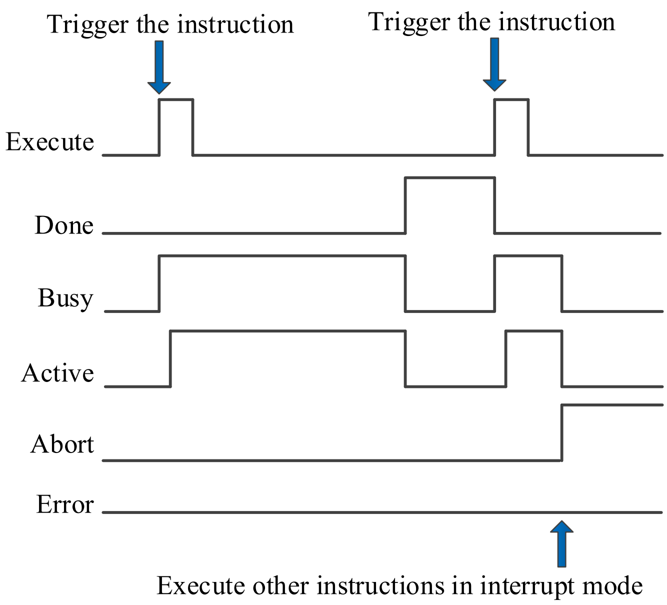
Input parameter	Parameter name	Data type	Unit	Note
S0	Deceleration	FP64	Command unit/s^2	Target deceleration
S0+4	Jerk	FP64	Command unit/s^3	Target jerk, the change speed of acceleration/deceleration
S0+8	BufferMode	INT16U	-	Buffer mode 0: interrupt mode 1: buffer mode
Output parameter	**Parameter name**	**Data type**	**Unit**	**Note**
S1	ErrCode	INT16U	-	Command error code
State parameter	**Parameter name**	**Data type**	**Unit**	**Note**
S2	Done	BOOL	-	Instruction execution complete
S2+1	Busy	BOOL	-	The instruction is being executed
S2+2	Acitve	BOOL	-	Command under control

S2+3	Abort	BOOL	-	Instruction interrupted
S2+4	Error	BOOL	-	Instruction execution error
Axis number	Parameter name	Data type	Unit	Note
S3	Axis	INT16U	-	Axis number starts from 0

Note:

The relationship between deceleration and jerk is same to A_MOVEA, please refer to chapter 5-1-2-7 item 5.

(6) Sequence diagram



Note:

Generally, after the command is triggered, the Busy and Active signals are set, and reset after the command is executed. At the same time, the Done signal is set. Done will reset only after the command is triggered again, otherwise it will not reset automatically.

When the instruction is triggered in the buffer mode and there are currently instructions being executed, the Active signal will be set immediately. The execution of the current instruction ends. When the instruction is executed, the Busy signal will be set. After the execution of the instruction ends, the Busy and Active signals will be reset and the Done signal will be set.

When a new instruction is triggered in interrupt mode during instruction execution, the Busy and Active signals are reset immediately and the Abort signal is set.

When there is an error in the command, the Error signal is set, other signals are reset, and the corresponding error code is output.

5-1-2-7. Absolute position motion【A_MOVEA】

(1) Instruction overview

The instruction moves in an absolute position, which can interrupt the current instruction and execute a new instruction during the movement.

Absolute position motion [A_MOVEA]			
Execution condition	Rising/falling edge of the coil	Suitable model	XDH, XLH, XG2
Firmware	V3.6.1b and above	Software	3.7.4 and above

(2) Operand

Operand	Function	Type
S0	Input parameter start address	64-bit, four words
S1	Output state word start address	16-bit, single word
S2	Output state bit start address	Bit
S3	Axis output terminal number	16-bit, single word

(3) Soft component

Operand	Word soft component											Bit soft component					
	System								Constant	Module		System					
	D*	FD	TD*	CD*	DX	DY	DM*	DS*	K/H	ID	QD	X	Y	M*	S*	T*	C*
S0	●	●	●	●													
S1	●	●	●	●													
S2														●			
S3	●								●								

*: D means D, HD; TD means TD and HTD; CD means CD, HCD, HSCD and HSD; DM means DM and DHM; DS means DS and DHS; M means M, HM, SM; S means S, HS; T means T, HT; C means C, HC.

(4) Function and action

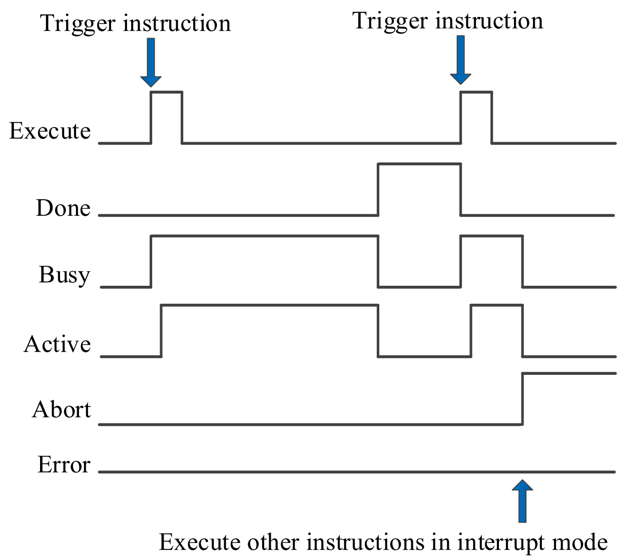
- S0 specifies input parameter start address, occupies the register S0~S0+22
- S1 specifies output state word start address
- S2 specifies output state bit start address, occupies the relay S2~S2+4
- S3 specifies axis terminal number
- Absolute position is the distance from zero point to target position
  For example, the current position is 1000 and the set absolute position is 3000. Relative to the zero point, if the motor wants to move to the target point (i.e. set the absolute position), it needs to send another 2000 pulses at the current position.
- When M0 changes from off to on, move the absolute position of the axis specified by S3. Its position is S0, the speed is S0 + 4, the acceleration is S0 + 8, the deceleration is S0 + 12, and the jerk is S0 + 16. When the command execution is completed, S2 is set to on.
- When S0 + 22 [buffer mode] parameter is set to 0, the current instruction can interrupt other moving instructions. When S0 + 22 [buffer mode] parameter is set to 1, the instruction is stored in the buffer area after triggering, and the cached instruction is executed after the execution of other currently moving instructions is completed. Only one instruction can be cached for the same axis.
- After the command is executed, the single axis state (D20000 + 200*N) of the slave station is 2 during the movement, and the single axis state (D20000 + 200*N) of the slave station is switched to 1 after the movement.
- The direction is determined by the parameter target absolute position and the current position. It is positive when the target position is greater than the current position and negative when the target position is less than the current position.
- Turn on the continuous update function, and modify the target position, speed, acceleration/deceleration and jerk will take effect in real time before setting ON the command done signal. If the modification parameter is incorrect, the continuous update function is turned off and executed according to the parameters before the error is reported.
- V3.7.3 and above versions support mold axis, specific calculations can be found in the chapter 6-6. Application of mold axis.

(5) Related parameters

Input parameter	Parameter name	Data type	Unit	Note
S0	Position	FP64	Command unit	Target absolute position
S0+4	Velocity	FP64	Command unit /s	Target speed
S0+8	Acceleration	FP64	Command unit /s^2	Target acceleration speed
S0+12	Deceleration	FP64	Command unit /s^2	Target deceleration speed
S0+16	Jerk	FP64	Command unit /s^3	Target jerk speed, which is the change speed of acceleration and deceleration
S0+20	Continueusmode	INT16U	-	Continuous update, only supported in V3.7.2 and above version
S0+21	Direction	INT16U	-	Direction (effective in mold axis mode): 0: No direction 1: Forward direction 2: Negative direction 3: Shortest path 4: Current direction
S0+22	Buffermode	INT16U	-	Buffer mode 0: Interrupt mode 1: buffer mode
Output parameter	**Parameter name**	**Data type**	**Unit**	**Note**
S1	ErrCode	INT16U	-	Command error code
State parameter	**Parameter name**	**Data type**	**Unit**	**Note**
S2	Done	BOOL	-	Instruction execution complete
S2+1	Busy	BOOL	-	The instruction is being executed
S2+2	Active	BOOL	-	Command under control
S2+3	Abort	BOOL	-	Instruction is interrupted
S2+4	Error	BOOL	-	Instruction execution error
Axis number	**Parameter name**	**Data type**	**Unit**	**Note**
S3	Axis	INT16U	-	Axis number starts from 0

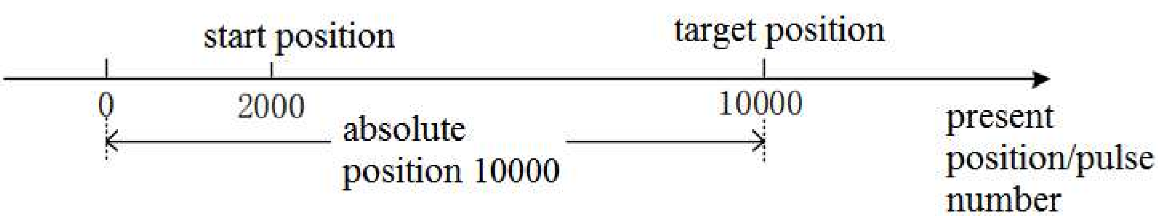
Note: Acceleration and deceleration reflect the speed change of the axis during acceleration and deceleration, that is, the change per second of the axis during acceleration and deceleration. Acceleration reflects the change ratio of acceleration and deceleration, that is, the change per second in the process of acceleration and deceleration from 0 to the target value. When in use, set appropriate parameters according to the actual situation and needs.

(6) Sequence diagram

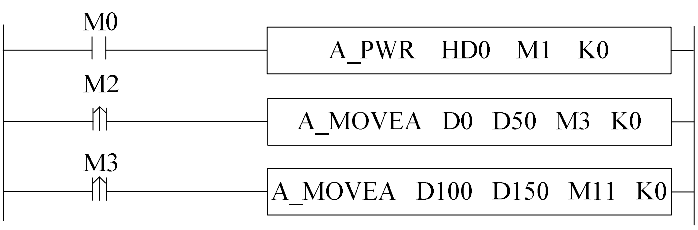


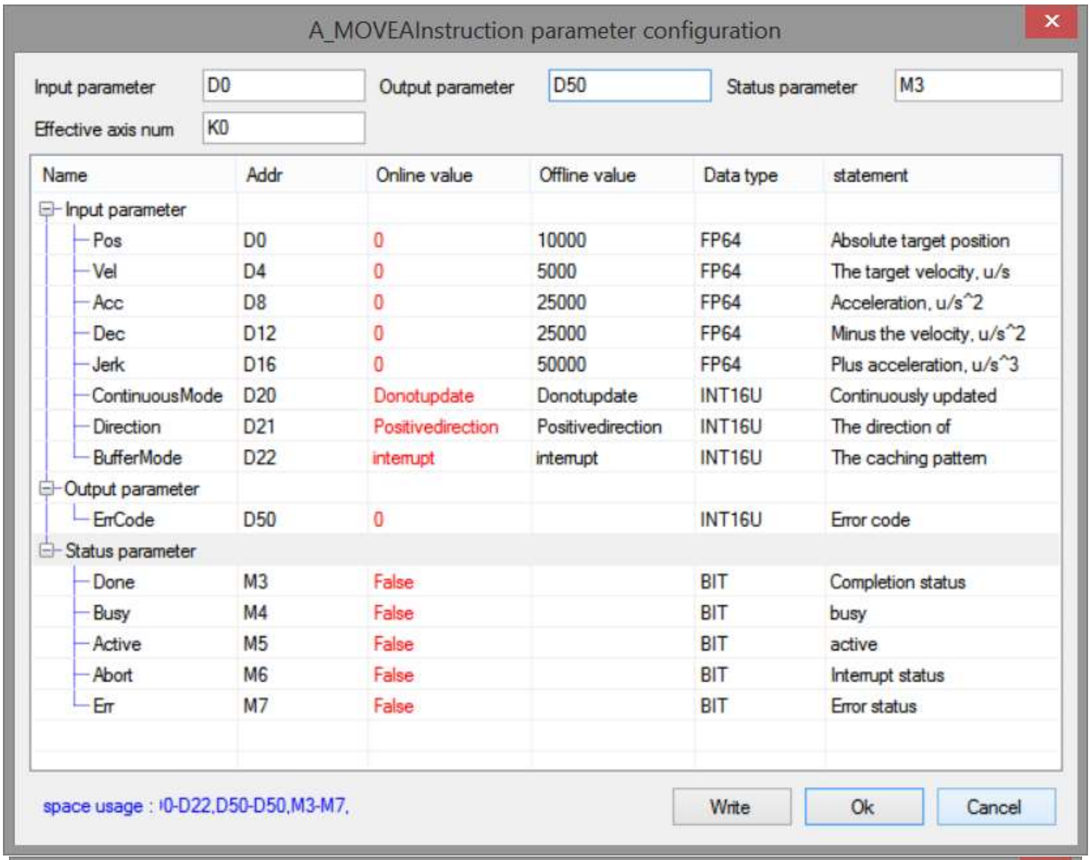
Explanation:
Generally, after the command is triggered, the Busy and Active signals are set, and reset after the command is executed. At the same time, the Done signal is set. Done will reset only after the command is triggered again, otherwise it will not reset automatically.
When the instruction is triggered in the buffer mode and there are currently instructions being executed, the Active signal will be set immediately. The execution of the current instruction ends. When the instruction is executed, the Busy signal will be set. After the execution of the instruction ends, the Busy and Active signals will be reset and the Done signal will be set.
When a new instruction is triggered in interrupt mode during instruction execution, the Busy and Active signals are reset immediately and the Abort signal is set.
When there is an error in the command, the Error signal is set, other signals are reset, and the corresponding error code is output.

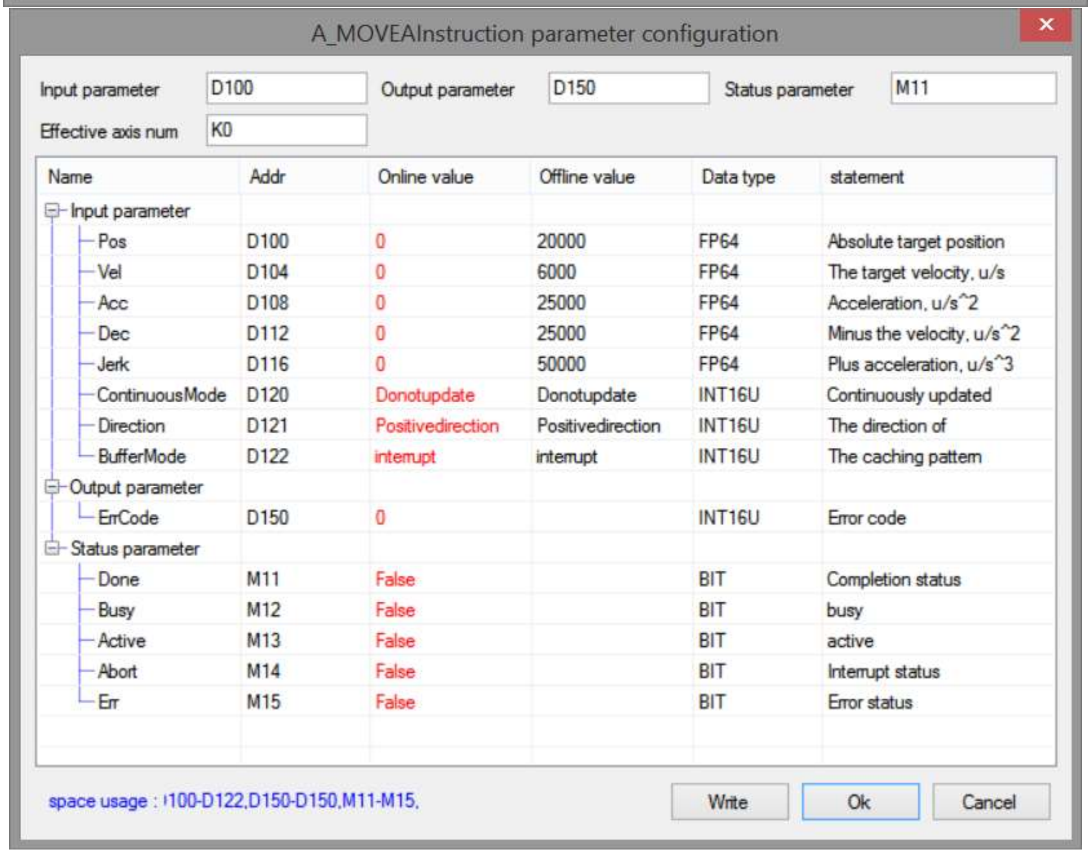
(7) Application
The current position of motor 1 is 2000, and it is required to move to the position of 10000 pulses with the instruction A_MOVEA at the speed of 5000 pulses/s. After moving to the target position, let the motor move to the position of 20000 pulses at the speed of 6000 pulses/s. The acceleration and deceleration is 25000 pulses/s^2, and the jerk speed is 50000 pulses/s^3.
In absolute position mode, the motor position diagram is as follows:



The target position in the command is the absolute position from zero point to target point, so moving to the position of 10000 pulses requires setting the target position 10000. Similarly, moving to the position of 20000 pulses requires setting the target position 20000.
The ladder diagram of absolute position mode is as follows:

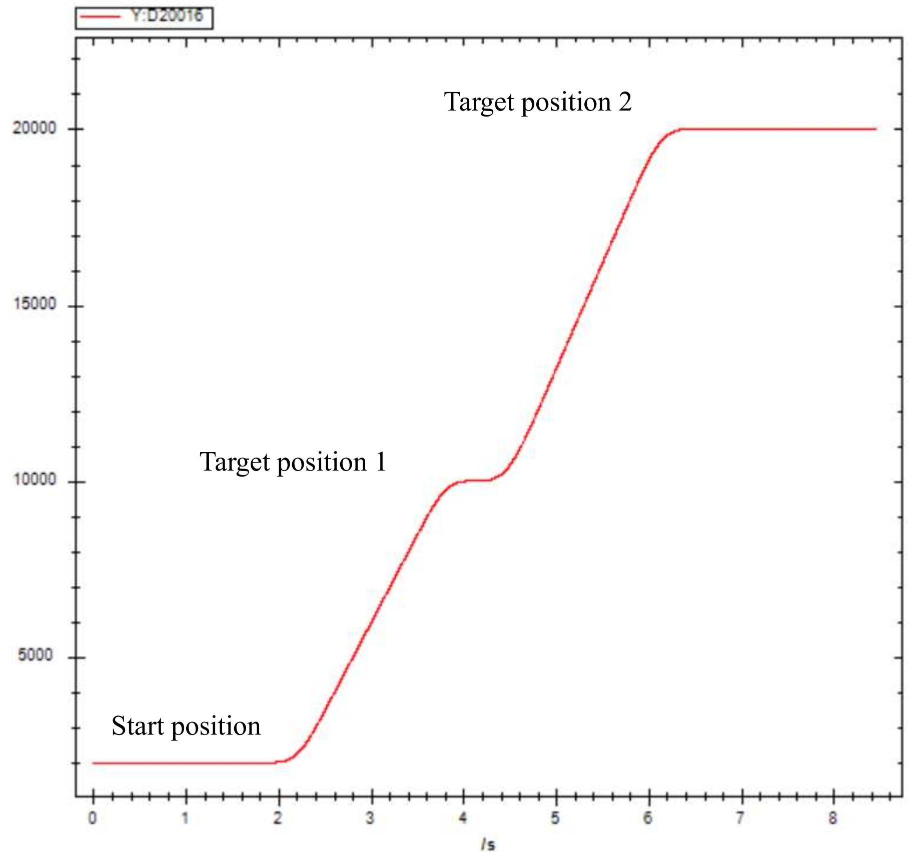




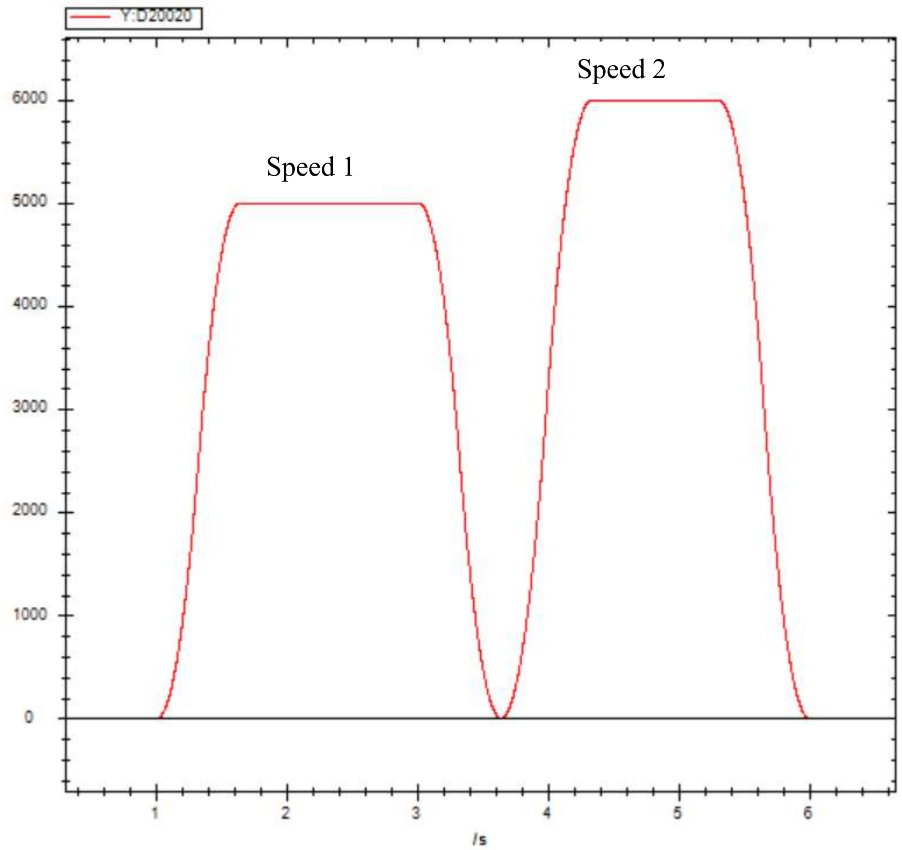


Note: first turn on the enable through A_ PWR command. When M2 is turned from off to on, it runs to target position 1 with the parameters set in the first command. After reaching the target position, the state parameter M3 of the command is turned from off to on, so the second A_MOVEA is triggered, and finally run to target position 2 with the parameters set in the second command.

The execution position curve is as follows:



The execution speed curve is as follows:



5-1-2-8. Relative position motion【A_MOVER】

(1) Overview

The instruction moves in a relative position, which can interrupt the current instruction and execute a new instruction during the movement.

Relative position motion [A_MOVER]			
Execution condition	Rising/falling edge of the coil	Suitable model	XDH, XLH, XG2
Firmware	V3.6.1b and above	Software	3.7.4 and above

(2) Operand

Operand	Function	Type
S0	Input parameter start address	64-bit, four words
S1	Output state word start address	16-bit, single word
S2	Output state bit start address	Bit
S3	Axis output terminal number	16-bit, single word

(3) Suitable soft component

Operand	Word soft component											Bit soft component					
	System								Constant	Module		System					
	D*	FD	TD*	CD*	DX	DY	DM*	DS*	K/H	ID	QD	X	Y	M*	S*	T*	C*
S0	●	●	●	●													
S1	●	●	●	●													
S2														●			
S3	●								●								

*: D means D, HD; TD means TD and HTD; CD means CD, HCD, HSCD and HSD; DM means DM and DHM; DS means DS and DHS; M means M, HM, SM; S means S, HS; T means T, HT; C means C, HC.

(4) Function and action

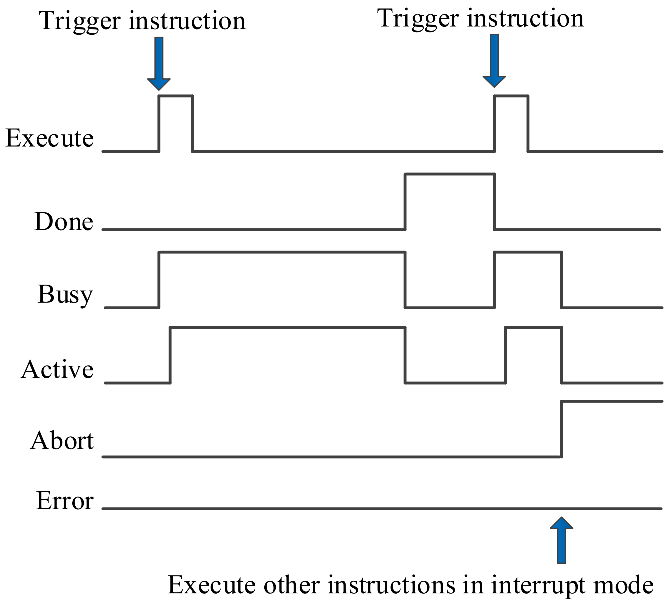
- S0 specifies input parameter start address, occupies the register S0~S0+22
- S1 specifies output state word start address
- S2 specifies output state bit start address, occupies the relay S2~S2+4
- S3 specifies axis terminal number
- The relative position is the distance from the current position to the target position;
  For example, if the current position is 1000 and the set relative position is 3000, 3000 pulses will be sent at the current position, and the final position is 4000 relative to the zero position.
- When M0 changes from off to on, move the relative position of the axis specified by S3. Its position is S0, the speed is S0 + 4, the acceleration is S0 + 8, the deceleration is S0 + 12, and the jerk is S0 + 16. When the command execution is completed, S2 is set to on;
- When S0 + 22 [buffer mode] parameter is set to 0, the current instruction can interrupt other moving instructions. When S0 + 22 [buffer mode] parameter is set to 1, the instruction is stored in the buffer area after triggering, and the cached instruction is executed after the execution of other currently moving instructions is completed. Only one instruction can be cached for the same axis
- After the command is executed, the single axis state (D20000 + 200*N) of the slave station is 2 during the movement, and the single axis state (D20000 + 200*N) of the slave station is switched to 1 after the movement.
- The direction is determined by the positive and negative of target relative position
- Turn on the continuous update function, and modify the target position, speed, acceleration/deceleration and jerk will take effect in real time before setting ON the command done signal. If the modification parameter is incorrect, the continuous update function is turned off and executed according to the parameters before the error is reported.
- V3.7.3 and above versions support mold axis, specific calculations can be found in the chapter 6-6. Application of mold axis.

(5) Related parameters

Input parameter	Parameter name	Data type	Unit	Note
S0	Position	FP64	Command unit	Target relative position
S0+4	Velocity	FP64	Command unit /s	Target speed
S0+8	Acceleration	FP64	Command unit /s^2	Target acceleration speed
S0+12	Deceleration	FP64	Command unit /s^2	Target deceleration speed
S0+16	Jerk	FP64	Command unit /s^3	Target jerk speed, the change speed of acceleration and deceleration
S0+20	Continueusmode	INT16U	-	Continuous update, only supported in V3.7.2 and above version
S0+21	Direction	INT16U	-	Direction (effective in mold axis mode): 0: No direction 1: Forward direction 2: Negative direction 3: Shortest path 4: Current direction
S0+22	Buffermode	INT16U	-	Buffer mode 0: interrupt mode 1: buffer mode
Output parameter	Parameter name	Data type	Unit	Note
S1	ErrCode	INT16U	-	Command error code
State parameter	Parameter name	Data type	Unit	Note
S2	Done	BOOL	-	Instruction execution complete
S2+1	Busy	BOOL	-	The instruction is being executed
S2+2	Active	BOOL	-	Command under control
S2+3	Abort	BOOL	-	Instruction is interrupted
S2+4	Error	BOOL	-	Instruction execution error
Axis number	Parameter name	Data type	Unit	Note
S3	Axis	INT16U	-	Axis number starts from 0

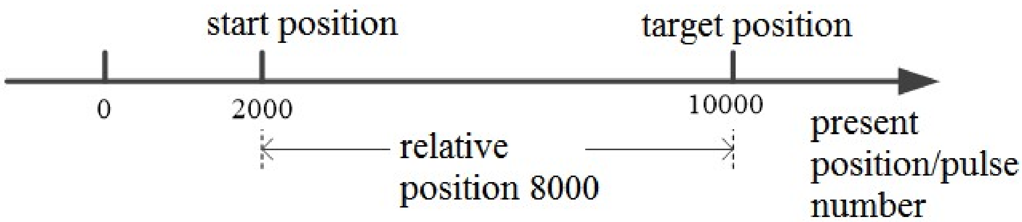
Note: the relationship between acceleration, deceleration and jerk speed is the same as that of A_MOVEA instruction, refer to chapter 5-1-2-7 item 5 related parameters for details.

(6) Sequence diagram

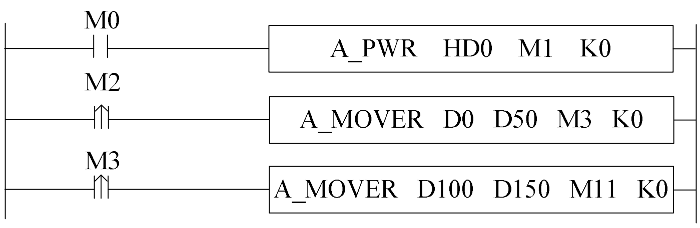


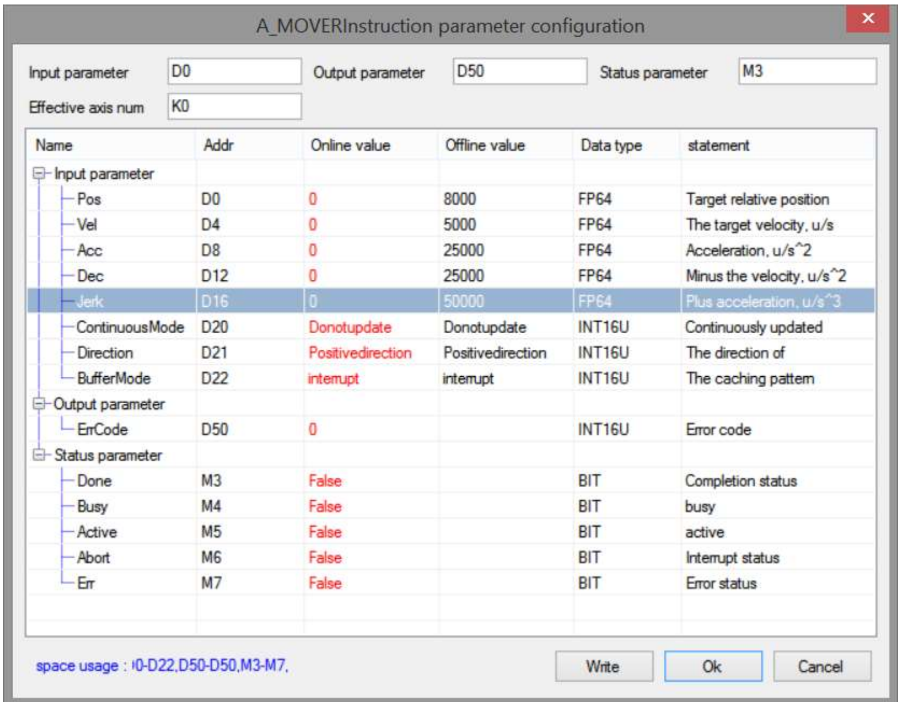
Explanation:
Generally, after the command is triggered, the Busy and Active signals are set, and reset after the command is executed. At the same time, the Done signal is set. Done will reset only after the command is triggered again, otherwise it will not reset automatically.
When the instruction is triggered in the buffer mode and there are currently instructions being executed, the Active signal will be set immediately. The execution of the current instruction ends. When the instruction is executed, the Busy signal will be set. After the execution of the instruction ends, the Busy and Active signals will be reset and the Done signal will be set.
When a new instruction is triggered in interrupt mode during instruction execution, the Busy and Active signals are reset immediately and the Abort signal is set.
When there is an error in the command, the Error signal is set, other signals are reset, and the corresponding error code is output.

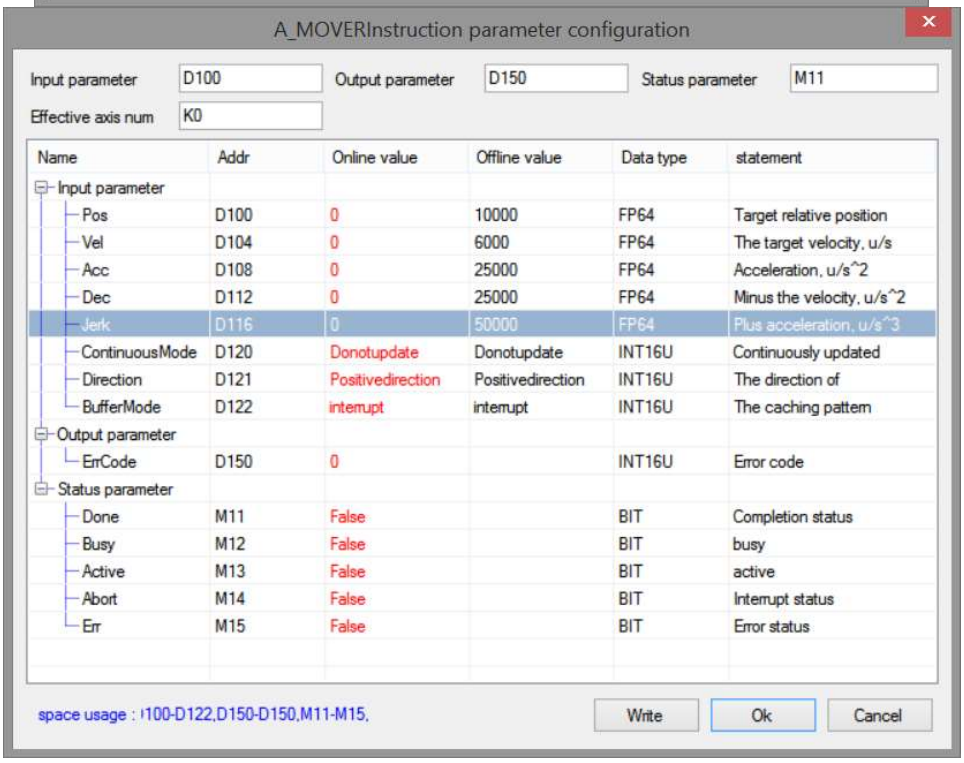
(7) Application
The current position of motor is 2000, and it is required to move to the position of 10000 pulses with the instruction A_MOVER at the speed of 5000 pulses/s. After moving to the target position, let the motor move to the position of 20000 pulses at the speed of 6000 pulses/s. The acceleration and deceleration is 25000 pulses/s^2, and the jerk speed is 50000 pulses/s^3.
In relative position mode, the motor position diagram is as follows:



At the current position 2000, 8000 pulses need to be sent to run to the 10000 pulses position in the relative position mode. Similarly, 10000 pulses need to be sent to run to the 20000 pulses position.
The ladder diagram of relative position mode is as follows:

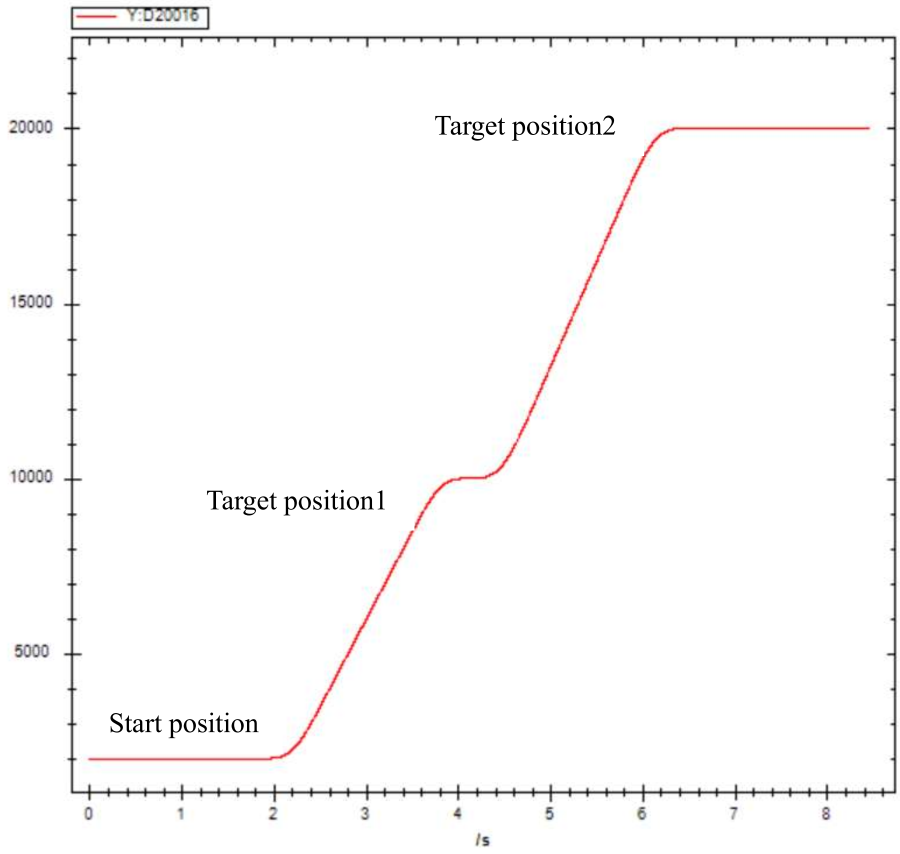




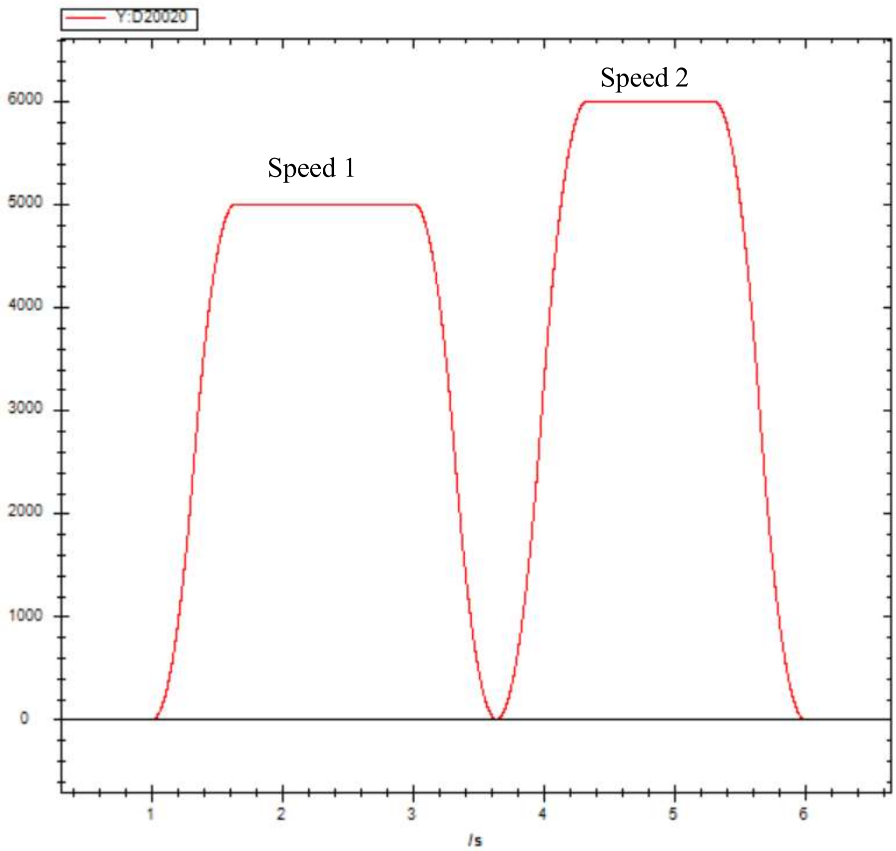


Note: first turn on the enable through A_ PWR command. When M2 is turned from off to on, it runs to target position 1 with the parameters set in the first command. After reaching the target position, the state parameter M3 of the command is turned from off to on, so the second A_MOVER is triggered, and finally run to target position 2 with the parameters set in the second command.

The execution position curve is as follows:



The execution speed is shown as below:



5-1-2-9. Absolute position continuous motion【A_CMOVEA】

(1) Overview

The command moves in the absolute position and continues to run at the set final speed after the movement is completed.

Absolute position continuous motion [A_CMOVEA]			
Execution condition	Rising/falling edge of the coil	Suitable model	XDH, XLH, XG2
Firmware	V3.6.1b and above	Software	3.7.4 and above

(2) Operand

Operand	Function	Type
S0	Input parameter start address	64-bit, four words
S1	Output state word start address	16-bit, single word
S2	Output state bit start address	Bit
S3	Axis output terminal number	16-bit, single word

(3) Suitable soft component

Operand	Word soft component											Bit soft component					
	System								Constant	Module		System					
	D*	FD	TD*	CD*	DX	DY	DM*	DS*	K/H	ID	QD	X	Y	M*	S*	T*	C*
S0	●	●	●	●													
S1	●	●	●	●													
S2														●			
S3	●								●								

*: D means D, HD; TD means TD and HTD; CD means CD, HCD, HSCD and HSD; DM means DM and DHM; DS means DS and DHS; M means M, HM, SM; S means S, HS; T means T, HT; C means C, HC.

(4) Function and action

- S0 specifies input parameter start, occupies the register S0~S0+26
- S1 specifies output state word start address
- S2 specifies output state bit start address, occupies the relay S2~S2+4
- S3 specifies the axis terminal number
- Absolute position is the distance from zero point to target position
  For example, the current position is 1000 and the set absolute position is 3000. Relative to the zero point, if the motor wants to move to the target point (i.e. the set absolute position), it needs to send another 2000 pulses at the current position.
- When M0 changes from off to on, move the absolute position of the axis specified by S3. Its position is S0, the speed is S0 + 8, the acceleration is S0 + 12, the deceleration is S0 + 16, and the jerk speed is S0 + 20. When the command execution is completed, S2 is set to on and continues to move at the speed of S0 + 4.
- When S0 + 26 [buffer mode] parameter is set to 0, the current instruction can interrupt other moving instructions. When S0 + 26 [buffer mode] parameter is set to 1, the instruction is stored in the cache area after triggering, and the cached instruction is executed after the execution of other currently moving instructions is completed. Only one instruction can be cached for the same axis.
- After the command is executed, the single axis state (D20000 + 200*N) of the slave station during the movement is 3. After reaching the end position, if the termination speed is 0, the single axis state is switched to 1. If the termination speed is not 0, the single axis state remains 3.
- The direction is determined by the parameter target absolute position and the current position. It is positive when the target position is greater than the current position and negative when the target position is less than the current position.
- Enable the continuous update function, and modify the absolute position of the target, the end speed, the target speed, the acceleration/deceleration, and the jerk of the target will take effect in real time before the command done signal is set ON. If the modification parameter is incorrect, the continuous update function is turned off and executed according to the parameters before the error is reported.
- V3.7.3 and above versions support mold axis, specific calculations can be found in the chapter 6-6. Application of mold axis.

(5) Notes

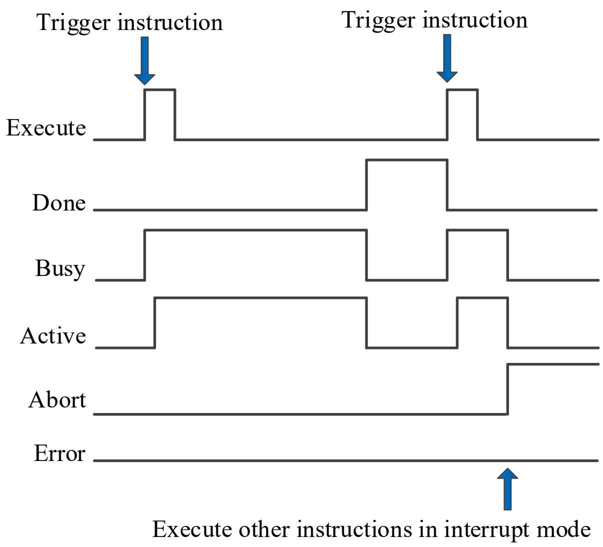
- It is necessary to set an appropriate target position. When the target position is too close to the actual position, the axis movement speed cannot reach the set value, the command will report an error and output the corresponding error code.
- The termination speed shall be less than or equal to the target speed. If the termination speed is greater than the target speed, it will continue to run at the target speed after the axis moves to the target position.

(6) Related parameters

Input parameter	Parameter name	Data type	Unit	Note
S0	Position	FP64	Command unit	Target absolute position
S0+4	Endvelocity	FP64	Command unit /s	Termination speed. The direction is consistent with the direction of motion, and the parameter value cannot be greater than the target speed.
S0+8	Velocity	FP64	Command unit /s	Target speed
S0+12	Acceleration	FP64	Command unit /s^2	Target acceleration speed
S0+16	Deceleration	FP64	Command unit /s^2	Target deceleration speed
S0+20	Jerk	FP64	Command unit /s^3	Target jerk speed, the changing speed of acceleration and deceleration.
S0+24	Continueusmode	INT16U	-	Continuously updated. Only supported in V3.7.2 and above version
S0+25	Direction	INT16U	-	Direction (effective in mold axis mode): 0: No direction 1: Forward direction 2: Negative direction 3: Shortest path 4: Current direction
S0+26	Buffermode	INT16U	-	Buffer mode 0: interrupt mode 1: buffer mode
Output parameter	**Parameter name**	**Data type**	**Unit**	**Note**
S1	ErrCode	INT16U	-	Command error code
State parameter	**Parameter name**	**Data type**	**Unit**	**Note**
S2	Done	BOOL	-	Instruction execution complete
S2+1	Busy	BOOL	-	The instruction is being executed
S2+2	Active	BOOL	-	Command under control
S2+3	Abort	BOOL	-	Instruction is interrupted
S2+4	Error	BOOL	-	Instruction execution error
Axis number	**Parameter name**	**Data type**	**Unit**	**Note**
S3	Axis	INT16U	-	Axis number starts from 0

Note: the relationship of acceleration, deceleration and jerk speed is same to A_MOVEA, please refer to chapter 5-1-2-7 item5 for details.

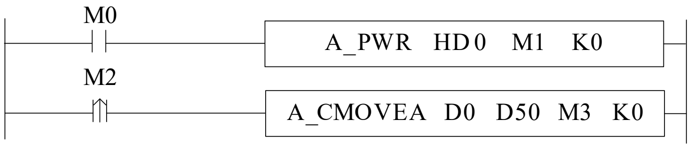
(7) Sequence diagram



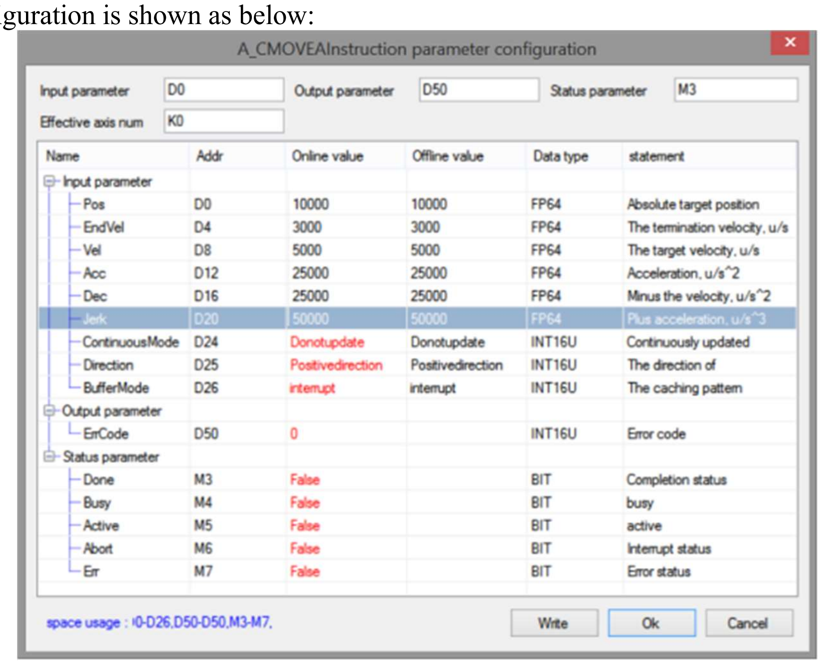
Explanation:
Generally, after the command is triggered, the Busy and Active signals are set, and reset after the command is executed. At the same time, the Done signal is set. Done will reset only after the command is triggered again, otherwise it will not reset automatically.
When the instruction is triggered in the buffer mode and there are currently instructions being executed, the Active signal will be set immediately. The execution of the current instruction ends. When the instruction is executed, the Busy signal will be set. After the execution of the instruction ends, the Busy and Active signals will be reset and the Done signal will be set.
When a new instruction is triggered in interrupt mode during instruction execution, the Busy and Active signals are reset immediately and the Abort signal is set.
When there is an error in the command, the Error signal is set, other signals are reset, and the corresponding error code is output.

(8) Application

The motor is required to move to the position of 10000 pulses at the speed of 5000 pulses/s and then move at a uniform speed at the speed of 3000 pulses/s. The acceleration and deceleration is 25000 pulses/s^2 and the jerk speed is 50000 pulses/s^3. The ladder diagram is as follows:



The command configuration is shown as below:


A_CMOVEAInstruction parameter configuration

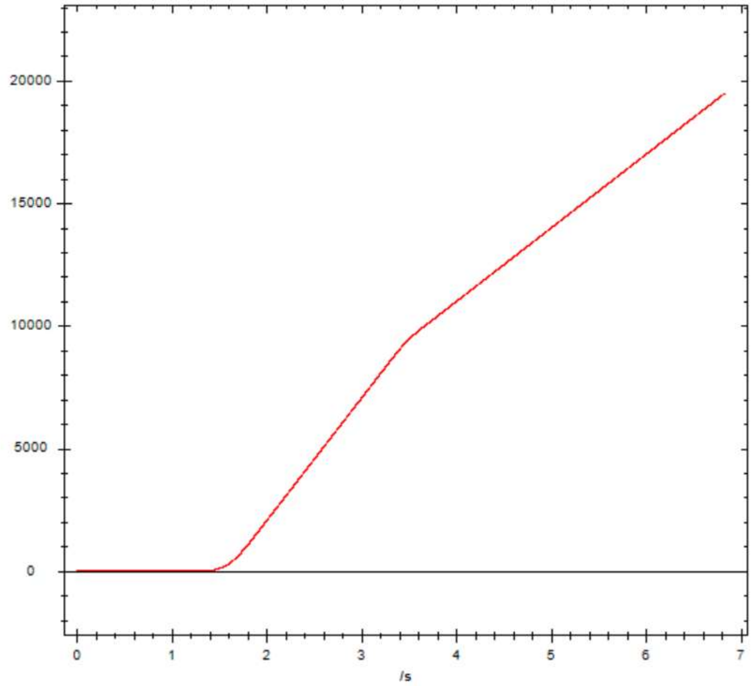
Input parameter D0 Output parameter D50 Status parameter M3
Effective axis num K0

Name	Addr	Online value	Offline value	Data type	statement
Input parameter					
Pos	D0	10000	10000	FP64	Absolute target position
EndVel	D4	3000	3000	FP64	The termination velocity, u/s
Vel	D8	5000	5000	FP64	The target velocity, u/s
Acc	D12	25000	25000	FP64	Acceleration, u/s^2
Dec	D16	25000	25000	FP64	Minus the velocity, u/s^2
Jerk	D20	50000	50000	FP64	Plus acceleration, u/s^3
ContinuousMode	D24	Donotupdate	Donotupdate	INT16U	Continuously updated
Direction	D25	Positivedirection	Positivedirection	INT16U	The direction of
BufferMode	D26	interrupt	interrupt	INT16U	The caching pattern
Output parameter					
ErrCode	D50	0		INT16U	Error code
Status parameter					
Done	M3	False		BIT	Completion status
Busy	M4	False		BIT	busy
Active	M5	False		BIT	active
Abort	M6	False		BIT	Interrupt status
Err	M7	False		BIT	Error status

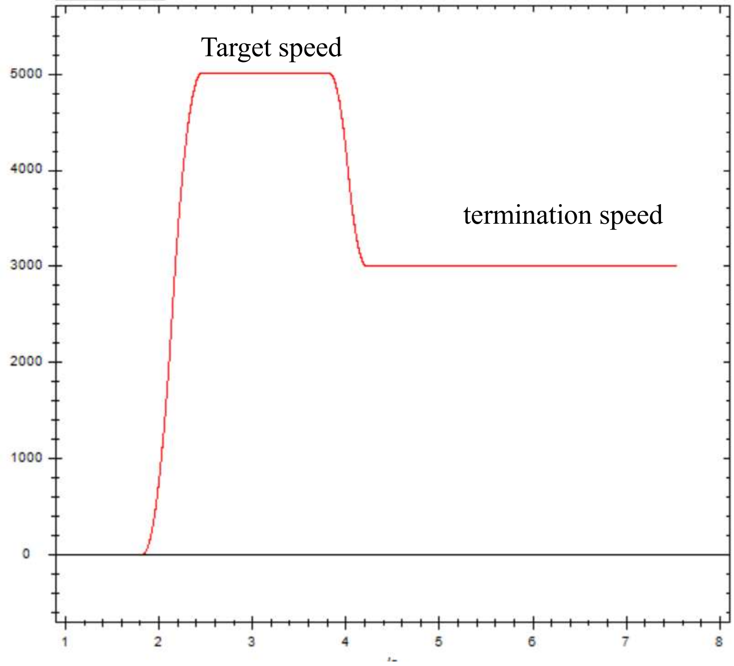
space usage : I0-D26,D50-D50,M3-M7,
Write Ok Cancel

Explanation: To enable the axis through A_PWR instruction. After confirming that the enabling is successful, turn M2 from off → on and trigger A_CMOVEA command, which runs to the target absolute position at the set speed, and then runs continuously at the termination speed. During operation, the state machine D20000+200*N of the axis is 3. Note: the direction of command termination speed is the same as that of running to the target position, and the termination speed cannot exceed the target speed.

The execution position curve:



The execution speed curve:



5-1-2-10. Relative position continuous motion【A_CMOVER】

(1) Overview

The command moves in a relative position. Run continuously at the final speed after the movement is completed.

Relative position continuous motion [A_CMOVER]			
Execution condition	Rising/falling edge of the coil	Suitable model	XDH, XLH, XG2
Firmware	V3.7.1 and above	Software	3.7.4 and above

(2) Operand

Operand	Function	Type
S0	Input parameter start address	64-bit, four words
S1	Output state word start address	16-bit, single word
S2	Output state bit start address	Bit
S3	Axis output terminal number	16-bit, single word

(3) Suitable soft component

Operand	Word soft component											Bit soft component					
	System								Constant	Module		System					
	D*	FD	TD*	CD*	DX	DY	DM*	DS*	K/H	ID	QD	X	Y	M*	S*	T*	C*
S0	●	●	●	●													
S1	●	●	●	●													
S2														●			
S3	●								●								

*: D means D, HD; TD means TD and HTD; CD means CD, HCD, HSCD and HSD; DM means DM and DHM; DS means DS and DHS; M means M, HM, SM; S means S, HS; T means T, HT; C means C, HC.

(4) Function and action

- S0 specifies the input parameter start address, occupies the register S0~S0+26
- S1 specifies the output state word start address
- S2 specifies the output state bit start address
- S3 specifies the axis output terminal number
- When M0 changes from off to on, the relative position movement is performed for the axis specified by S3, the moving distance is S0, the speed is S0 + 8, the acceleration is S0 + 12, the deceleration is S0 + 16, and the jerk speed is S0 + 20. When the command execution is completed, S2 is set to on and continues to move at the speed of S0 + 4
- When S0 + 26 [buffer mode] parameter is set to 0, the current instruction can interrupt other moving instructions. When S0 + 26 [buffer mode] parameter is set to 1, the instruction is stored in the cache area after triggering, and the cached instruction is executed after the execution of other currently moving instructions is completed. Only one instruction can be cached for the same axis.
- After the command is executed, the single axis state (D20000+200*N) of the slave station during the movement is 3. After reaching the end position, if the termination speed is 0, the single axis state is switched to 1. If the termination speed is not 0, the single axis state remains 3.
- Enable the continuous update function, and modify the relative position of the target, the end speed, the target speed, the acceleration/deceleration, and the jerk of the target will take effect in real time before the command done signal is set ON. If the modification parameter is incorrect, the continuous update function is turned off and executed according to the parameters before the error is reported.
- V3.7.3 and above versions support mold axis, specific calculations can be found in the chapter 6-6. Application of mold axis.

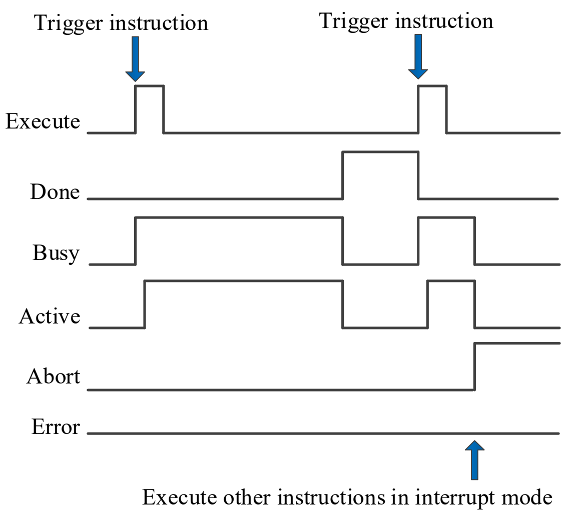
(5) Related parameters

Input parameter	Parameter name	Data type	Unit	Note
S0	Position	FP64	Command unit	Target relative position
S0+4	Endvelocity	FP64	Command	Termination speed. The direction is consistent

Input parameter	Parameter name	Data type	Unit	Note
			unit /s	with the direction of motion, and the parameter value cannot be greater than the target speed
S0+8	Velocity	FP64	Command unit /s	Target speed
S0+12	Acceleration	FP64	Command unit /s^2	Acceleration speed
S0+16	Deceleration	FP64	Command unit /s^2	Deceleration speed
S0+20	Jerk	FP64	Command unit /s^3	Jerk speed
S0+24	Continueusmode	INT16U	-	Continuous updating. Only supported in V3.7.2 and above version
S0+25	Direction	INT16U	-	Direction (effective in mold axis mode): 0: No direction 1: Forward direction 2: Negative direction 3: Shortest path 4: Current direction
S0+26	Buffermode	INT16U	-	Buffer mode 0: interrupt mode 1: buffer mode
Output parameter	Parameter name	Data type	Unit	Note
S1	ErrCode	INT16U	-	Command error code
State parameter	Parameter name	Data type	Unit	Note
S2	Done	BOOL	-	Instruction execution complete
S2+1	Busy	BOOL	-	The instruction is being executed
S2+2	Active	BOOL	-	Command under control
S2+3	Abort	BOOL	-	Instruction is interrupted
S2+4	Error	BOOL	-	Instruction execution error
Axis number	Parameter name	Data type	Unit	Note
S3	Axis	INT16U	-	Axis number starts from 0

Note: the relationship between deceleration and jerk speed is same to A_MOVEA, please refer to chapter 5-1-2-7 item 5 for details.

(6) Sequence diagram

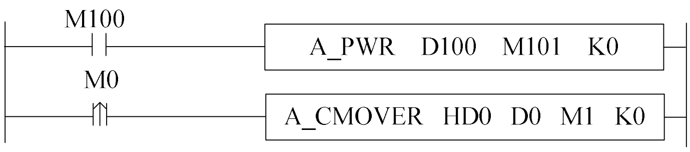


Explanation:
Generally, after the command is triggered, the Busy and Active signals are set, and reset after the command is

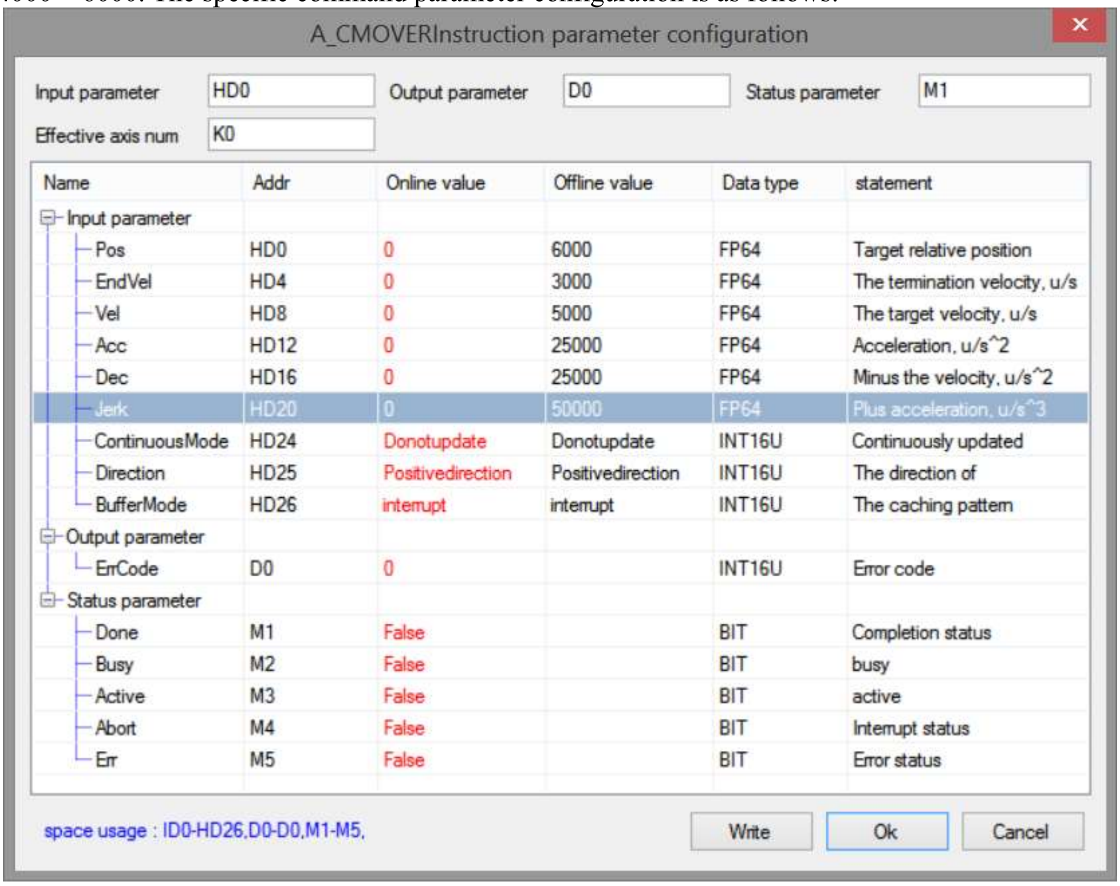
executed. At the same time, the Done signal is set. Done will reset only after the command is triggered again, otherwise it will not reset automatically.
When the instruction is triggered in the buffer mode and there are currently instructions being executed, the Active signal will be set immediately. The execution of the current instruction ends. When the instruction is executed, the Busy signal will be set. After the execution of the instruction ends, the Busy and Active signals will be reset and the Done signal will be set.
When a new instruction is triggered in interrupt mode during instruction execution, the Busy and Active signals are reset immediately and the Abort signal is set.
When there is an error in the command, the Error signal is set, other signals are reset, and the corresponding error code is output.

(7) Application

For example, the current position of the motor is 4000. It is required that the motor move to the position of 10000 pulses at the speed of 5000 pulses/s and then move at a uniform speed at the speed of 3000 pulses/s. The acceleration and deceleration is 25000 pulses/s^2 and the jerk speed is 50000 pulses/s^3. The ladder diagram is as follows:



Since the current position of the motor is 4000, the [target position] parameter in the command should be 10000-4000 = 6000. The specific command parameter configuration is as follows:


A_CMOVERInstruction parameter configuration

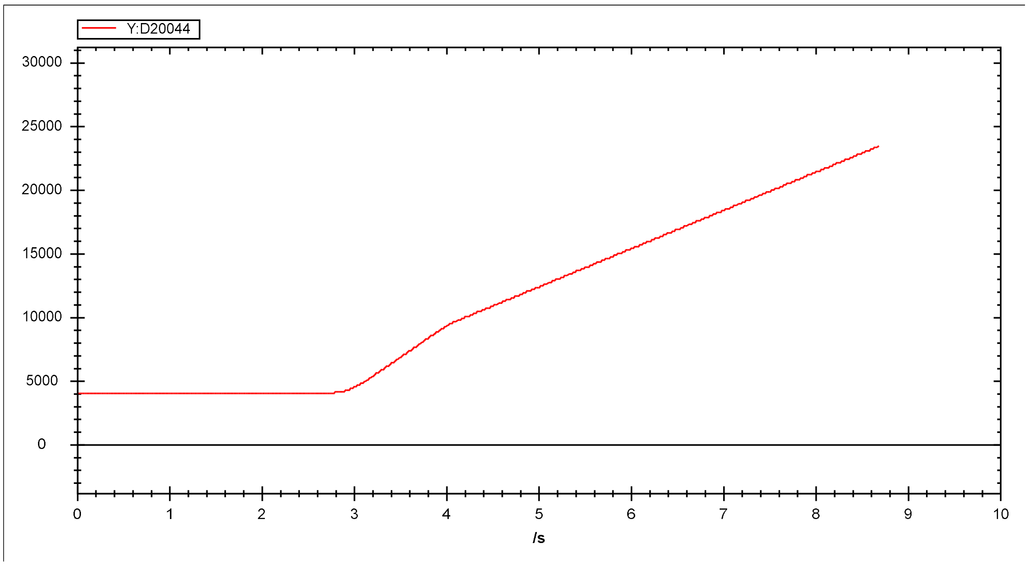
Input parameter HD0 Output parameter D0 Status parameter M1
Effective axis num K0

Name	Addr	Online value	Offline value	Data type	statement
Input parameter					
Pos	HD0	0	6000	FP64	Target relative position
EndVel	HD4	0	3000	FP64	The termination velocity, u/s
Vel	HD8	0	5000	FP64	The target velocity, u/s
Acc	HD12	0	25000	FP64	Acceleration, u/s^2
Dec	HD16	0	25000	FP64	Minus the velocity, u/s^2
Jerk	HD20	0	50000	FP64	Plus acceleration, u/s^3
ContinuousMode	HD24	Donotupdate	Donotupdate	INT16U	Continuously updated
Direction	HD25	Positivedirection	Positivedirection	INT16U	The direction of
BufferMode	HD26	interrupt	interrupt	INT16U	The caching pattern
Output parameter					
ErrCode	D0	0		INT16U	Error code
Status parameter					
Done	M1	False		BIT	Completion status
Busy	M2	False		BIT	busy
Active	M3	False		BIT	active
Abort	M4	False		BIT	Interrupt status
Err	M5	False		BIT	Error status

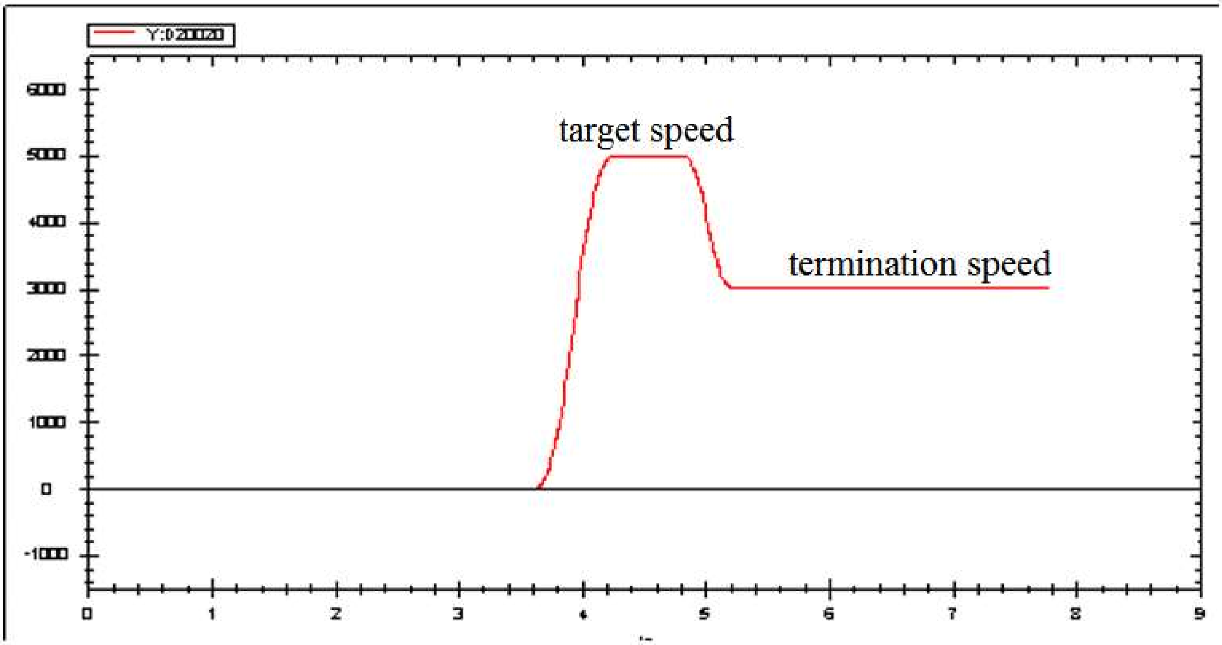
space usage : ID0-HD26,D0-D0,M1-M5,
Write Ok Cancel

Note: to enable the axis with A_PWR instruction. After confirming that the enabling is successful, M0 is turned from off → on to trigger A_CMOVER command, the command runs to the target relative position at the set speed, and then runs continuously at the termination speed. During operation, the state machine D20000+200*N of the axis is 3. Note: the direction of command termination speed is the same as that of running to the target position, and the termination speed cannot exceed the target speed.

The position curve is shown in the figure below:



The speed curve is shown as below:



5-1-2-11. Speed control motion【A_VELMOVE】

(1) Overview

The command runs continuously at the set speed.

Speed control motion [A_VELMOVE]			
Execution condition	Rising/falling edge of the coil	Suitable model	XDH, XLH, XG2
Firmware	V3.6.1b and above	Software	3.7.4 and above

(2) Operand

Operand	Function	Type
S0	Input parameter start address	64-bit, four words
S1	Output state word start address	16-bit, single word
S2	Output state bit start address	Bit
S3	Axis output terminal number	16-bit, single word

(3) Suitable soft component

Operand	Word soft component											Bit soft component					
	System								Constant	Module		System					
	D*	FD	TD*	CD*	DX	DY	DM*	DS*	K/H	ID	QD	X	Y	M*	S*	T*	C*
S0	●	●	●	●													
S1	●	●	●	●													
S2														●			
S3	●								●								

*: D means D, HD; TD means TD and HTD; CD means CD, HCD, HSCD and HSD; DM means DM and DHM; DS means DS and DHS; M means M, HM, SM; S means S, HS; T means T, HT; C means C, HC.

(4) Function and action

- S0 specifies input parameter start address, occupies the register S0~S0+18
- S1 specifies output state word start address
- S2 specifies output state bit start address, occupies the relay S2~S2+4
- S3 specifies the axis terminal number
- When M0 is from off → on, the speed control movement is carried out for the axis specified in S3, and the speed set by S0 will be maintained for continuous movement. After modifying the speed of S0, M0 is turned on again to make the modified speed effective. To stop the axis, set the value of S0 to 0 or use A_STOP/A_HALT instruction.
- When S0 + 26 [buffer mode] parameter is set to 0, the current instruction can interrupt other moving instructions. When S0 + 26 [buffer mode] parameter is set to 1, the instruction is stored in the cache area after triggering, and the cached instruction is executed after the execution of other currently moving instructions is completed. Only one instruction can be cached for the same axis.
- After the command is executed, the single axis state (D20000+200*N) of the slave station is switched to 3, and after stop by instruction A_STOP/A_HALT, the state switches to 1.
- The direction is determined by the positive/negative of the target speed of the parameter.
- Enable the continuous update function, and modify the relative position of the target, the end speed, the target speed, the acceleration/deceleration, and the jerk of the target will take effect in real time before the command done signal is set ON. If the modification parameter is incorrect, the continuous update function is turned off and executed according to the parameters before the error is reported.
- V3.7.3 and above versions support mold axis, specific calculations can be found in the chapter 6-6. Application of mold axis.

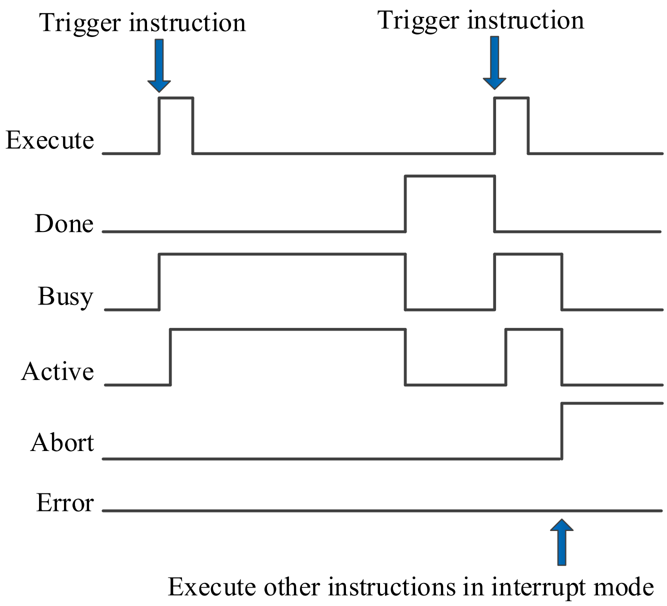
(5) Related parameters

Input parameter	Parameter name	Data type	Unit	Note
S0	Velocity	FP64	Command unit/s	Target speed
S0+4	Acceleration	FP64	Command unit /s^2	Target acceleration speed

Input parameter	Parameter name	Data type	Unit	Note
S0+8	Deceleration	FP64	Command unit /s^2	Target deceleration speed
S0+12	Jerk	FP64	Command unit /s^3	Target jerk speed, the change speed of the acceleration and deceleration
S0+16	Continueusmode	INT16U	-	Continuously updated. (Only supported in V3.7.2 and above version)
S0+17	Direction	INT16U	-	Direction (effective in mold axis mode): 0: No direction 1: Forward direction 2: Negative direction 3: Shortest path 4: Current direction
S0+18	Buffermode	INT16U	-	Buffer mode 0: interrupt mode 1: buffer mode
Output parameter	**Parameter name**	**Data type**	**Unit**	**Note**
S1	ErrCode	INT16U	-	Command error code
State parameter	**Parameter name**	**Data type**	**Unit**	**Note**
S2	Done	BOOL	-	Instruction execution complete
S2+1	Busy	BOOL	-	The instruction is being executed
S2+2	Active	BOOL	-	Command under control
S2+3	Abort	BOOL	-	Instruction is interrupted
S2+4	Error	BOOL	-	Instruction execution error
Axis number	**Parameter name**	**Data type**	**Unit**	**Note**
S3	Axis	INT16U	-	Axis number starts from 0.

Note: the relationship between acceleration/deceleration and jerk speed is same to A_MOVEA, please refer to chapter 5-1-2-7 item 5 for details.

(6) Sequence diagram

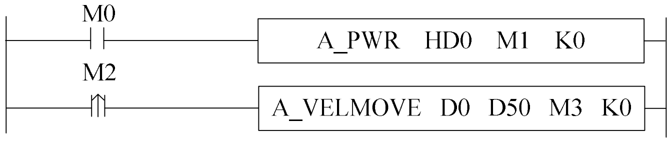


Explanation:
Generally, after the command is triggered, the Busy and Active signals are set, and reset after the command is executed. At the same time, the Done signal is set. Done will reset only after the command is triggered again, otherwise it will not reset automatically.
When the instruction is triggered in the buffer mode and there are currently instructions being executed, the Active signal will be set immediately. The execution of the current instruction ends. When the instruction is executed, the

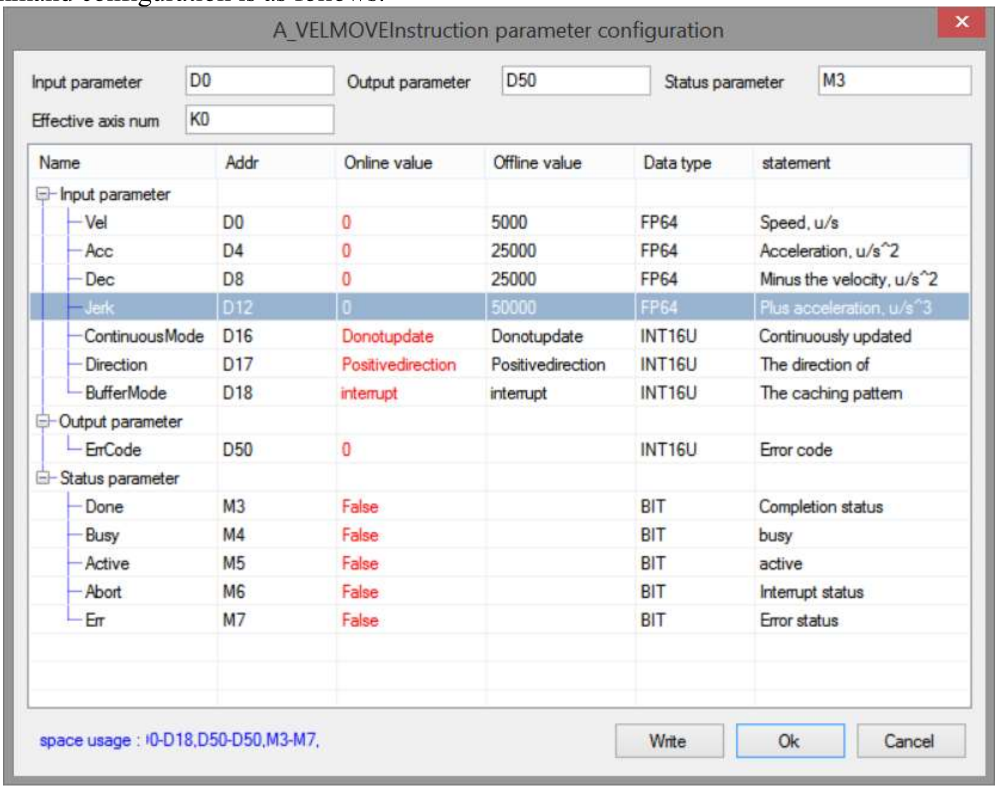
Busy signal will be set. After the execution of the instruction ends, the Busy and Active signals will be reset and the Done signal will be set.
When a new instruction is triggered in interrupt mode during instruction execution, the Busy and Active signals are reset immediately and the Abort signal is set.
When there is an error in the command, the Error signal is set, other signals are reset, and the corresponding error code is output.

(7) Application

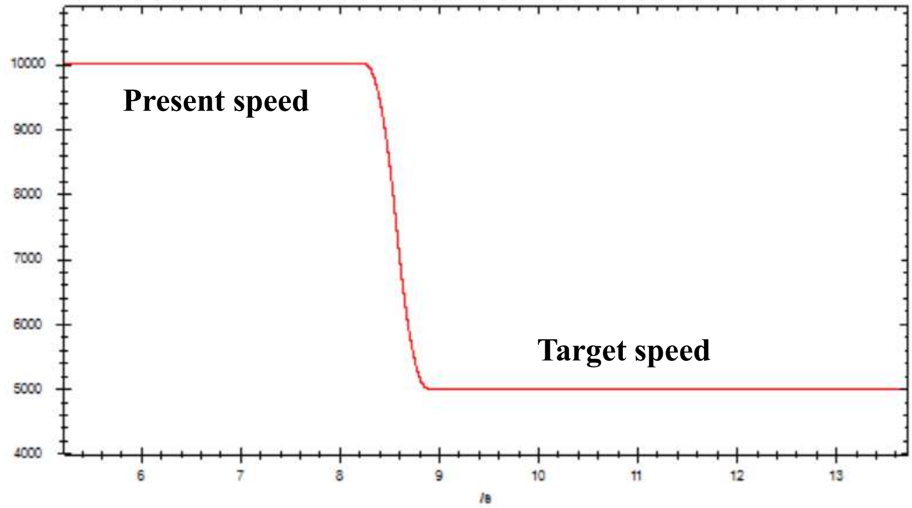
For example, the motor is required to accelerate/decelerate to the speed of 5000 pulses/s at the acceleration and deceleration of 25000 pulses/s^2 and jerk speed of 50000 pulses/s^3, and maintain this speed for continuous movement. The ladder diagram is as follows:



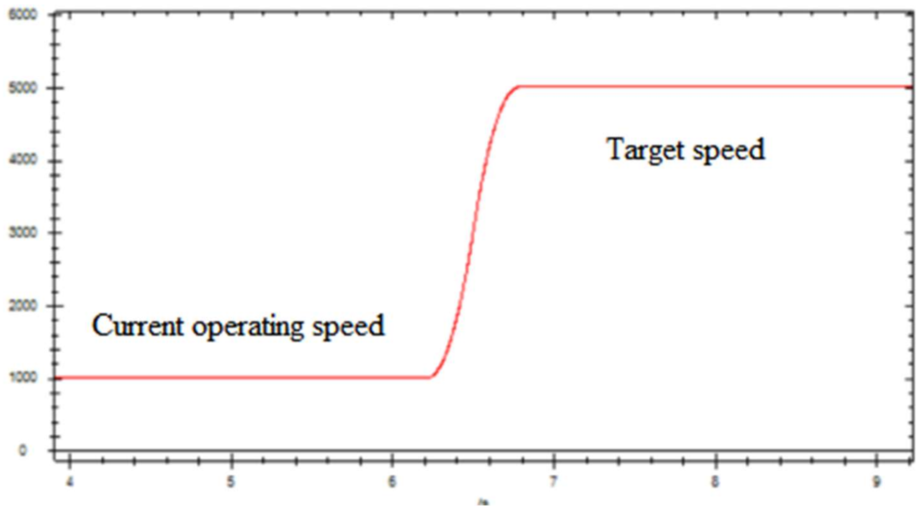
The command configuration is as follows:



Note: To enable the axis through A_ PWR command. After confirming that the enabling is successful, turn M2 from off → on and trigger A_VELMOVE command, which performs acceleration/deceleration with the set parameters, and then runs continuously at the target speed. During operation, the state machine D20000+200*N of the axis is 3.
When the running speed is greater than the target speed, the speed curve after command execution is as follows:



When the running speed is less than the target speed, the speed curve after command execution is as follows:



5-1-2-12. Superposition motion【A_MOVESUP】

(1) Overview

Performs superimposed motion control on the specified axis.

Superposition motion [A_MOVESUP]			
Execution condition	Rising/falling edge of the coil	Suitable model	XDH, XLH, XG2
Firmware	V3.7.1 and above	Software	3.7.4 and above

(2) Operand

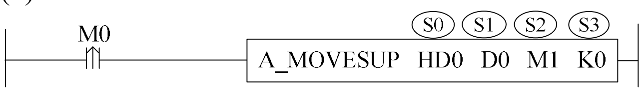
Operand	Function	Type
S0	Input parameter start address	64-bit, four words
S1	Output state word start address	16-bit, single word
S2	Output state bit start address	Bit
S3	Axis output terminal number	16-bit, single word

(3) Suitable soft component

Operand	Word soft component											Bit soft component					
	System								Constant	Module		System					
	D*	FD	TD*	CD*	DX	DY	DM*	DS*	K/H	ID	QD	X	Y	M*	S*	T*	C*
S0	●	●	●	●													
S1	●	●	●	●													
S2														●			
S3	●								●								

*: D means D, HD; TD means TD and HTD; CD means CD, HCD, HSCD and HSD; DM means DM and DHM; DS means DS and DHS; M means M, HM, SM; S means S, HS; T means T, HT; C means C, HC.

(4) Function and action



- S0 specifies input parameter start address
- S1 specifies output state word start address
- S2 specifies output state bit start address
- S3 specifies the axis terminal number
- When M0 changes from off to on, perform superimposed motion control on the designated axis of S3, with the distance of S0, the speed of S0 + 4, the acceleration of S0 + 8, the deceleration of S0 + 12 and the jerk speed of S0 + 16. When the command execution is completed, S2 is set to on.
- The command is triggered after the motion command and can be executed together with other motion commands to perform superimposed motion. The two command speeds will be superimposed. When the superimposed position is reached, the superimposed command is completed.
- When the instruction is executed separately, the effect is the same as that of A_MOVER.

(5) Notes

- The instruction can be interrupted by the latter instruction in interrupt mode, but cannot follow the buffer instruction
- The latter superposition instruction can interrupt the previous superposition instruction
- The superposition effect is only valid in the current motion, and will be invalid after the motion is completed.
- V3.7.3 and above versions support mold axis, specific calculations can be found in the chapter 6-6. Application of mold axis.

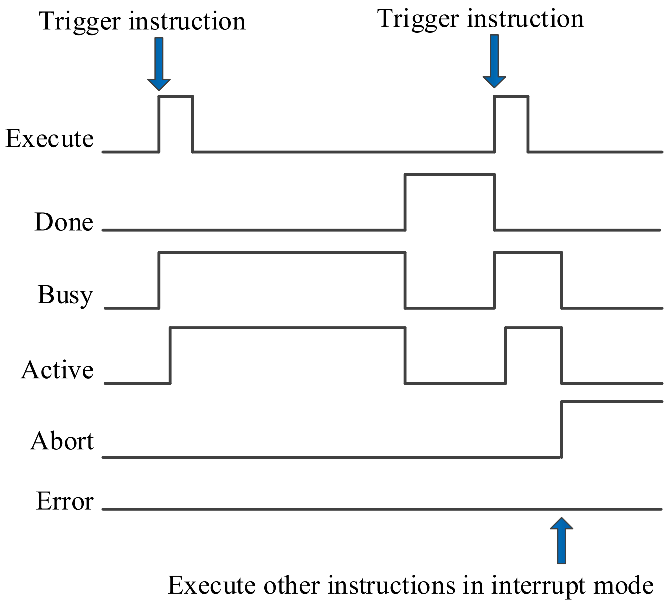
(6) Related parameters

Input parameter	Parameter name	Data type	Unit	Note
S0	Distance	FP64	Command unit	Superposition distance
S0+4	Vel	FP64	Command unit /s	Superposition speed
S0+8	Acc	FP64	Command unit /s^2	Acceleration speed
S0+12	Dec	FP64	Command	Deceleration speed

			unit /s^2	
S0+16	Jerk	FP64	Command unit /s^3	Jerk speed
Output parameter	Parameter name	Data type	Unit	Note
S1	ErrCode	INT16U	-	Command error code
State parameter	Parameter name	Data type	Unit	Note
S2	Done	BOOL	-	Instruction execution complete
S2+1	Busy	BOOL	-	The instruction is being executed
S2+2	Active	BOOL	-	Command under control
S2+3	Abort	BOOL	-	Instruction is interrupted
S2+4	Error	BOOL	-	Instruction execution error
Axis number	Parameter name	Data type	Unit	Note
S3	Axis	INT16U	-	Axis number starts from 0

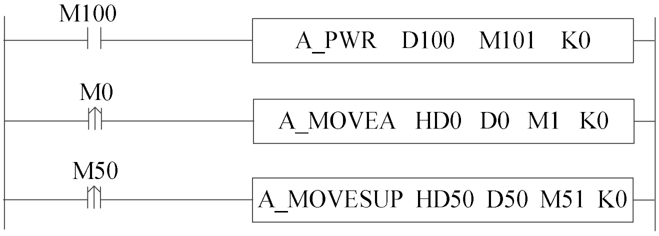
Note: the relationship between acceleration/deceleration and jerk speed is same to A_MOVEA, please refer to chapter 5-1-2-7 item 5 for details.

(7) Sequence diagram

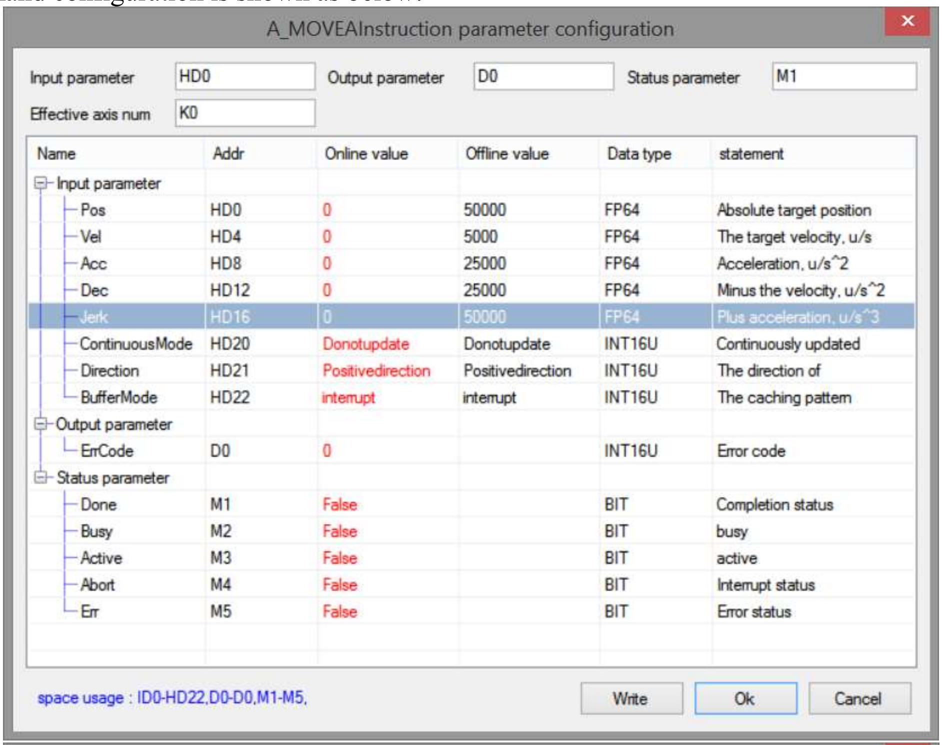


Explanation:
Generally, after the command is triggered, the Busy and Active signals are set, and reset after the command is executed. At the same time, the Done signal is set. Done will reset only after the command is triggered again, otherwise it will not reset automatically.
When a new instruction is triggered in interrupt mode during instruction execution, the Busy and Active signals are reset immediately and the Abort signal is set.
When there is an error in the command, the Error signal is set, other signals are reset, and the corresponding error code is output.

(8) Application
For example: the motor present position is 0, the motor moves to the position of 50000 at the speed of 5000 pulses/s, acceleration and deceleration of 2500 pulses/s^2, jerk speed of 50000 pulses/s^3, and in the process, the position is superimposed with 20000 at the speed of 5000 pulses/s, acceleration and deceleration of 10000 pulses/s^2, jerk speed of 20000 pulses/s^3. The ladder diagram is shown in the following figure:



The command configuration is shown as below:



A_MOVEAInstruction parameter configuration

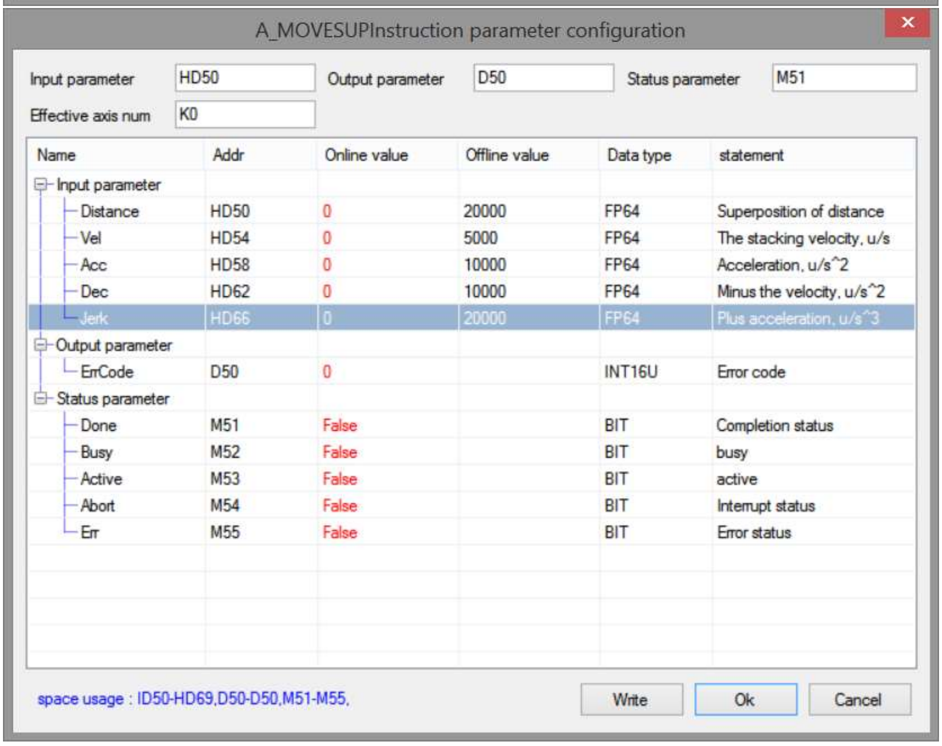
Input parameter HD0 Output parameter D0 Status parameter M1

Effective axis num K0

Name	Addr	Online value	Offline value	Data type	statement
Input parameter					
Pos	HD0	0	50000	FP64	Absolute target position
Vel	HD4	0	5000	FP64	The target velocity, u/s
Acc	HD8	0	25000	FP64	Acceleration, u/s^2
Dec	HD12	0	25000	FP64	Minus the velocity, u/s^2
Jerk	HD16	0	50000	FP64	Plus acceleration, u/s^3
ContinuousMode	HD20	Donotupdate	Donotupdate	INT16U	Continuously updated
Direction	HD21	Positivedirection	Positivedirection	INT16U	The direction of
BufferMode	HD22	interrupt	interrupt	INT16U	The caching pattern
Output parameter					
ErrCode	D0	0		INT16U	Error code
Status parameter					
Done	M1	False		BIT	Completion status
Busy	M2	False		BIT	busy
Active	M3	False		BIT	active
Abort	M4	False		BIT	Interrupt status
Err	M5	False		BIT	Error status

space usage : ID0-HD22,D0-D0,M1-M5,

Write Ok Cancel



A_MOVESUPInstruction parameter configuration

Input parameter HD50 Output parameter D50 Status parameter M51

Effective axis num K0

Name	Addr	Online value	Offline value	Data type	statement
Input parameter					
Distance	HD50	0	20000	FP64	Superposition of distance
Vel	HD54	0	5000	FP64	The stacking velocity, u/s
Acc	HD58	0	10000	FP64	Acceleration, u/s^2
Dec	HD62	0	10000	FP64	Minus the velocity, u/s^2
Jerk	HD66	0	20000	FP64	Plus acceleration, u/s^3
Output parameter					
ErrCode	D50	0		INT16U	Error code
Status parameter					
Done	M51	False		BIT	Completion status
Busy	M52	False		BIT	busy
Active	M53	False		BIT	active
Abort	M54	False		BIT	Interrupt status
Err	M55	False		BIT	Error status

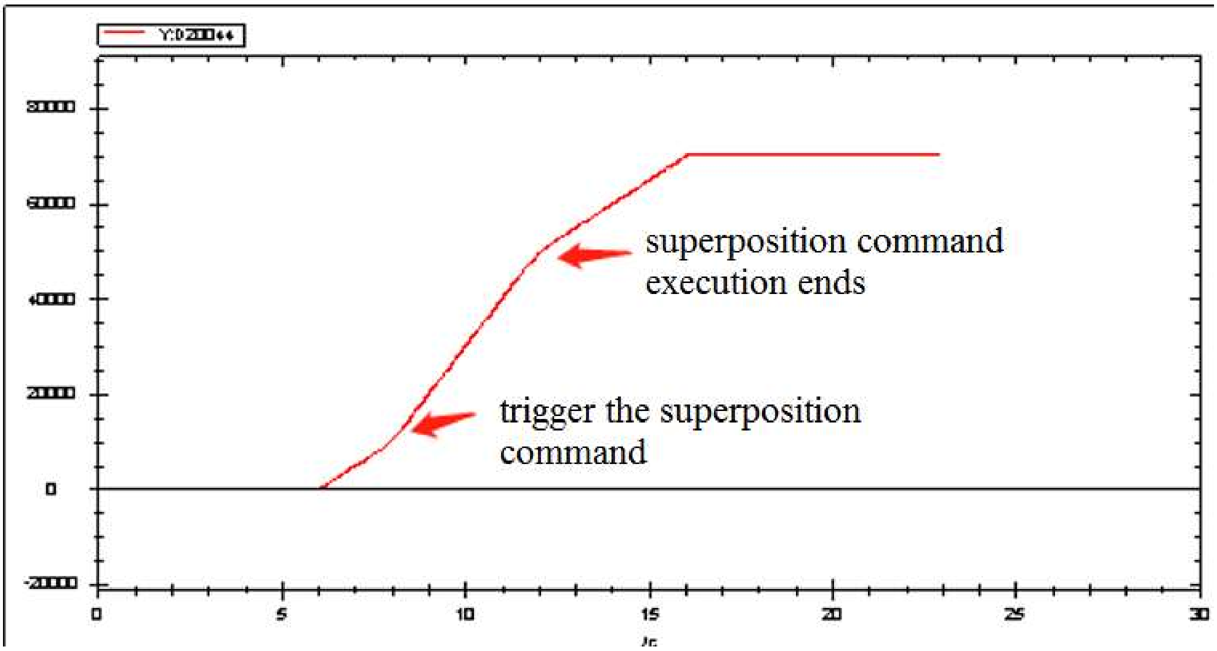
space usage : ID50-HD69,D50-D50,M51-M55,

Write Ok Cancel

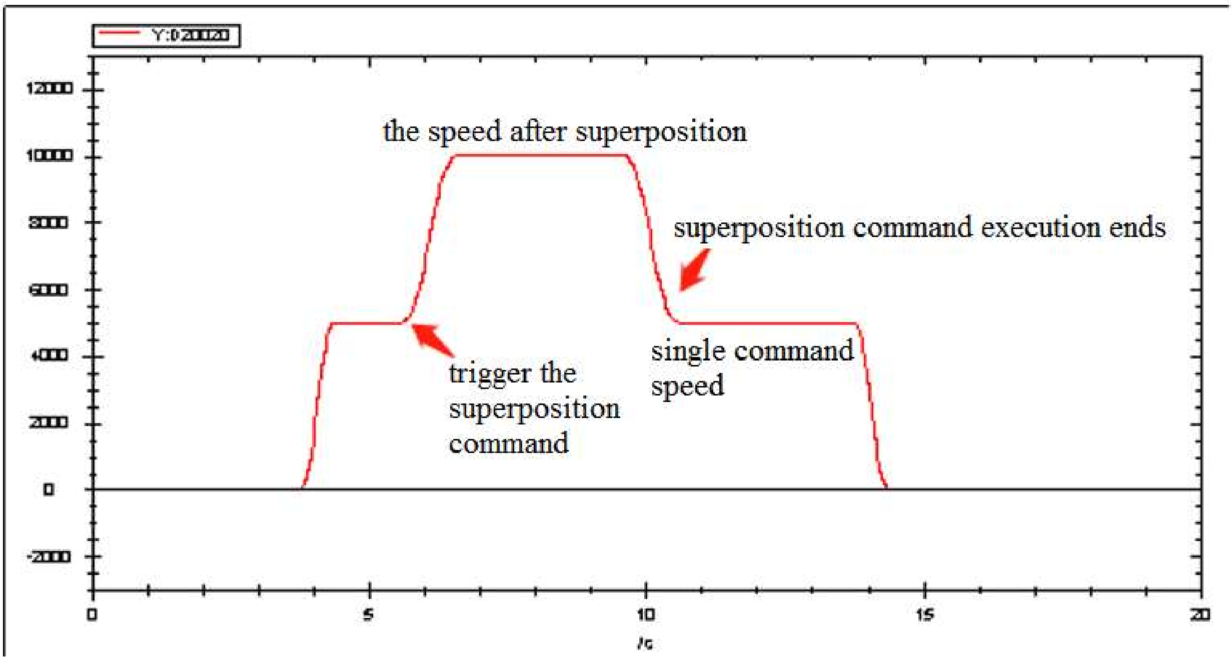
Explanation:

To enable the axis through A_PWR instruction. After confirming that the axis is enabled, turn M0 from off → on to trigger A_MOVEA command, the axis will move to 50000 with the set parameters. During the axis movement, M50 will be turned from off → on to trigger A_MOVESUP command, the axis will perform superposition motion with the set parameters.

The position curve is shown as below:



The speed curve is shown as below:



Explanation:In the process of axis movement, the superposition command is triggered, the two commands will be executed together, and the speed will be superimposed. After the superposition command is executed for the distance to be superimposed, the speed will be reduced to the speed set by the previous motion command, and the motion command will continue to be executed.

5-1-2-13. HM homing【A_HOME】

(1) Overview

Return to the origin for the specified axis, this command requires that the specified axis support the HM mode of the Ethernet bus.

HM homing [A_HOME]			
Execution condition	Rising/falling edge of the coil	Suitable model	XDH, XLH, XG2
Firmware	V3.6.1b and above	Software	3.7.4 and above

(2) Operand

Operand	Function	Type
S0	Input parameter start address	64-bit, four words
S1	Output state word start address	16-bit, single word
S2	Output state bit start address	Bit
S3	Axis output terminal number	16-bit, single word

(3) Suitable soft component

Operand	Word soft component											Bit soft component					
	System								Constant	Module		System					
	D*	FD	TD*	CD*	DX	DY	DM*	DS*	K/H	ID	QD	X	Y	M*	S*	T*	C*
S0	●	●	●	●													
S1	●	●	●	●													
S2														●			
S3	●								●								

*: D means D, HD; TD means TD and HTD; CD means CD, HCD, HSCD and HSD; DM means DM and DHM; DS means DS and DHS; M means M, HM, SM; S means S, HS; T means T, HT; C means C, HC.

(4) Function and action

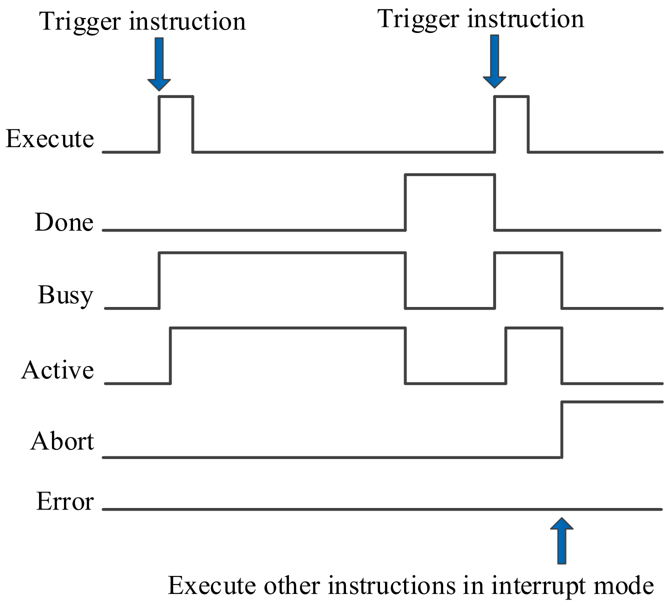
- S0 specifies input parameter start address, occupies the register S0~S0+4.
- S1 specifies output state word start address .
- S2 specifies output state bit start address, occupies the relay S2~S2+4.
- S3 specifies the axis terminal number, only for EtherCAT axis .
- When M0 is from OFF→ON, return the axis corresponding to S3 to the original point. After returning to the original point, S0 will be written to the current position (D20044+200*N) (N is axis number, which starts from 0) .
- When using the HOME command, it is necessary to set the homing mode (6098h), homing speed (6099h) and homing acceleration (609Ah) of the specified axis in advance. For the selection of homing mode, refer to the EtherCAT motion control user manual.
- When the command is executed, it will automatically switch the specified axis to HM mode (6060h is 6), and it will switch back to the original mode after returning to the origin. If the process of returning to the origin is abnormal, it will remain in HM mode and need to switch to CSP mode (6060h is 8) through A_MODE to execute other commands.
- A_STOP can be used to stop the motion during instruction execution, trigger the command again to continue to return to the origin.
- During instruction execution, A_ WRITE command, soft and hard limit are not effective.
- After the command is executed, the single axis state of the slave station (D20000+200*N) switches to 5 .
- V3.7.3 and above versions support mold axis, specific calculations can be found in the chapter 6-6. Application of mold axis.

(5) Related parameters

Input parameter	Parameter name	Data type	Unit	Note
S0	Offset	FP64	Command unit	Zero offset. That is, write the value of the current position after returning to the origin
S0+4	BufferMode	INT16U	-	Buffer mode 0: interrupt mode

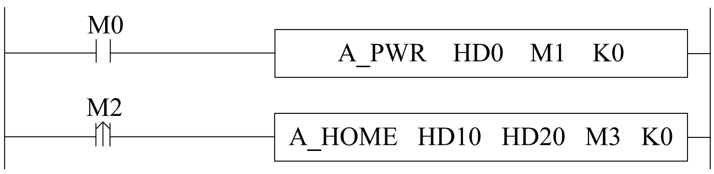
				1: buffer mode
Output parameter	Parameter name	Data type	Unit	Note
S1	ErrCode	INT16U	-	Command error code
State parameter	Parameter name	Data type	Unit	Note
S2	Done	BOOL	-	Instruction execution complete
S2+1	Busy	BOOL	-	The instruction is being executed
S2+2	Active	BOOL	-	Command under control
S2+3	Abort	BOOL	-	Instruction is interrupted
S2+4	Error	BOOL	-	Instruction execution error
Axis number	Parameter name	Data type	Unit	Note
S3	Axis	INT16U	-	Axis number starts from 0

(6) Sequence diagram

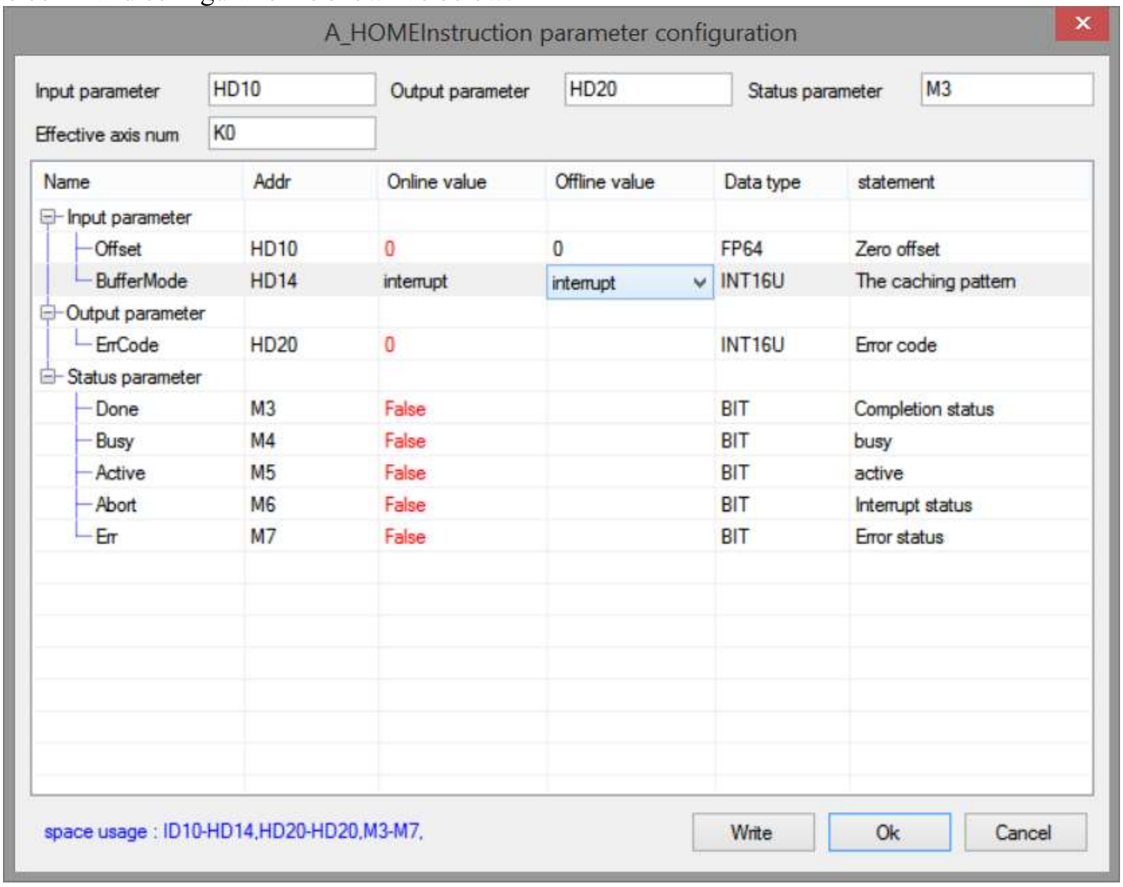


Explanation:
Generally, after the command is triggered, the Busy and Active signals are set, and reset after the command is executed. At the same time, the Done signal is set. Done will reset only after the command is triggered again, otherwise it will not reset automatically.
When the instruction is triggered in the buffer mode and there are currently instructions being executed, the Active signal will be set immediately. The execution of the current instruction ends. When the instruction is executed, the Busy signal will be set. After the execution of the instruction ends, the Busy and Active signals will be reset and the Done signal will be set.
When a new instruction is triggered in interrupt mode during instruction execution, the Busy and Active signals are reset immediately and the Abort signal is set.
When there is an error in the command, the Error signal is set, other signals are reset, and the corresponding error code is output.

(7) Application
For example, the specified axis is required to return to the origin in mode 1. The ladder diagram is as follows:



The command configuration is shown as below:

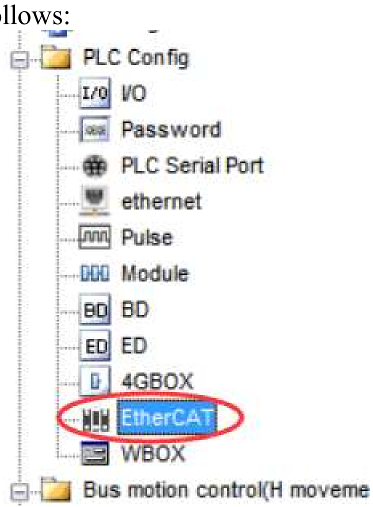


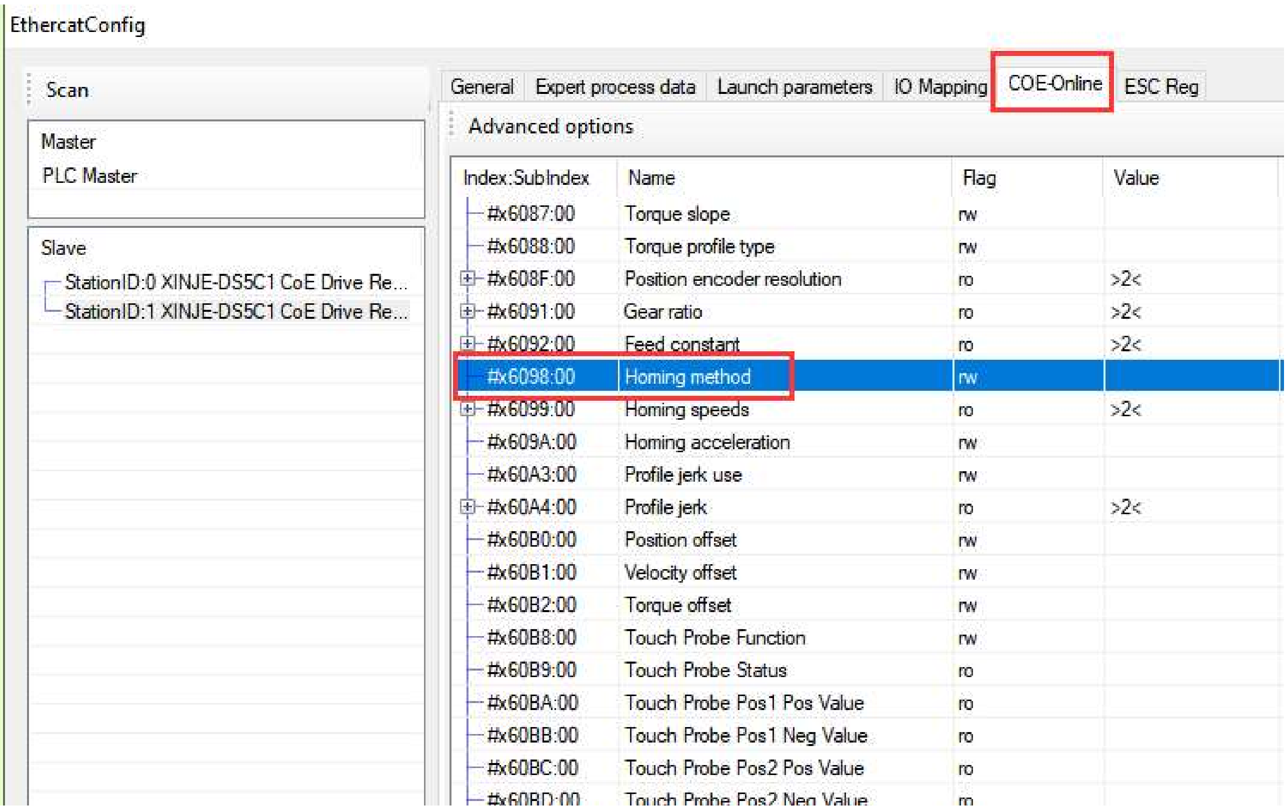
Explanation:

Before the A_HOME command is executed, it is necessary to set the home mode (6098h) to 1, modify the home speed (6099h) as required, and modify the home acceleration (609Ah) as required. Refer to item (7) home mode (6098h) for details.

The home mode can be set through COE-Online interface or modify 6098h through SDO instruction (refer to chapter 10 for SDO instruction). After the command runs, the specified axis will automatically switch the control mode (6060h) to HM mode and return to the origin. The origin signal is set by the slave station. Take DS5C as an example, P5-22 is the positive limit setting address, and the default value is 1, that is, the corresponding servo terminal SI1, P5-23 is the negative limit setting address, and the default value is 2, that is, the corresponding servo terminal SI2, P5-27 sets the address for the origin, and the default value is 3, that is, the corresponding servo terminal SI3. Whether to trigger the origin or the positive and negative limit is determined by the mode of returning to the origin. After returning to the origin, the axis will automatically switch to the mode before returning to the origin, and write the zero offset value (0 in this example) in the command to the current position D20044+200*N.

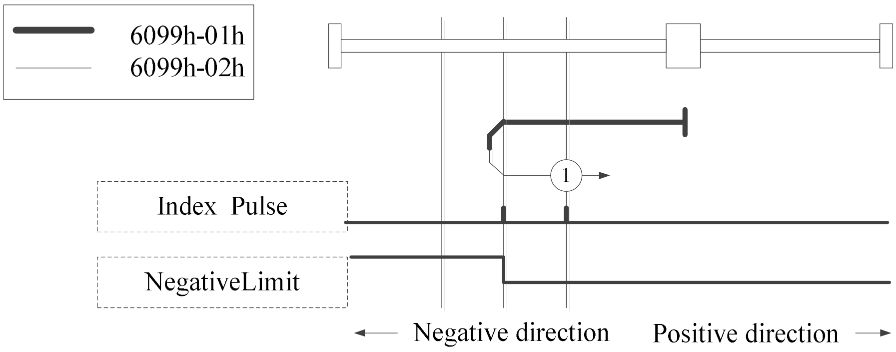
The COE-Online interface is opened as follows:





■ Mode 1:

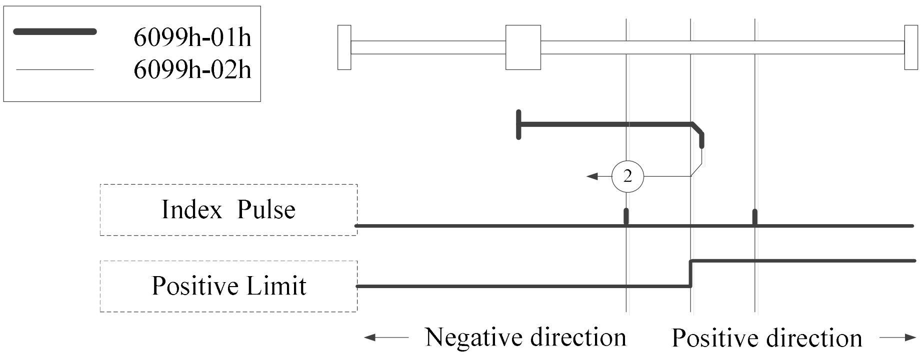
When using mode 1, if the reverse limit switch is in the non triggered state, the initial moving direction is left. The origin position is at the first Z-phase pulse on the right of the position where the negative limit switch becomes invalid.



Homing on negative limit switch and index pulse

■ Mode 2:

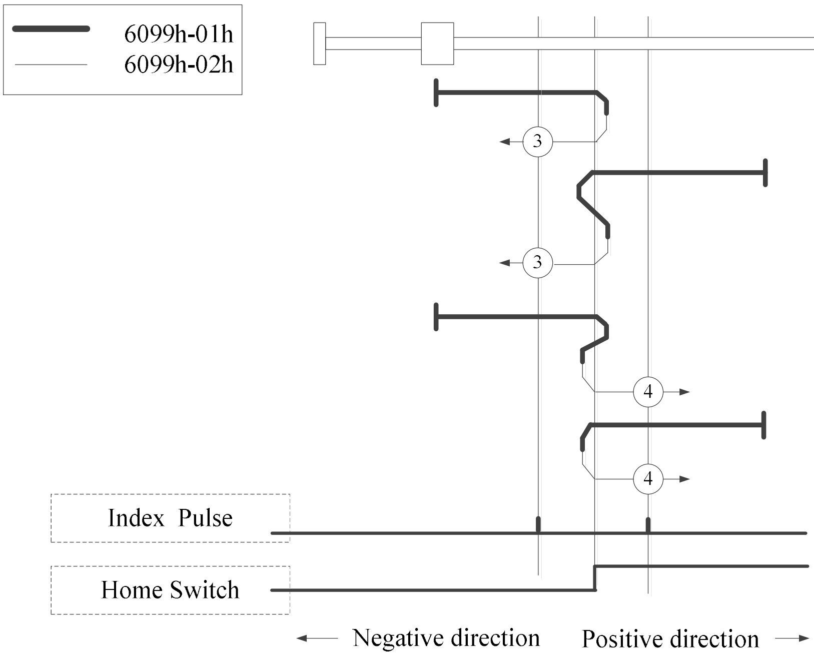
When using mode 2, if the positive limit switch is in the non triggered state, the initial moving direction is right. The origin position is at the first Z-phase pulse on the left of the position where the positive limit switch becomes invalid.



Homing on positive limit switch and index pulse

■ Mode 3, 4:

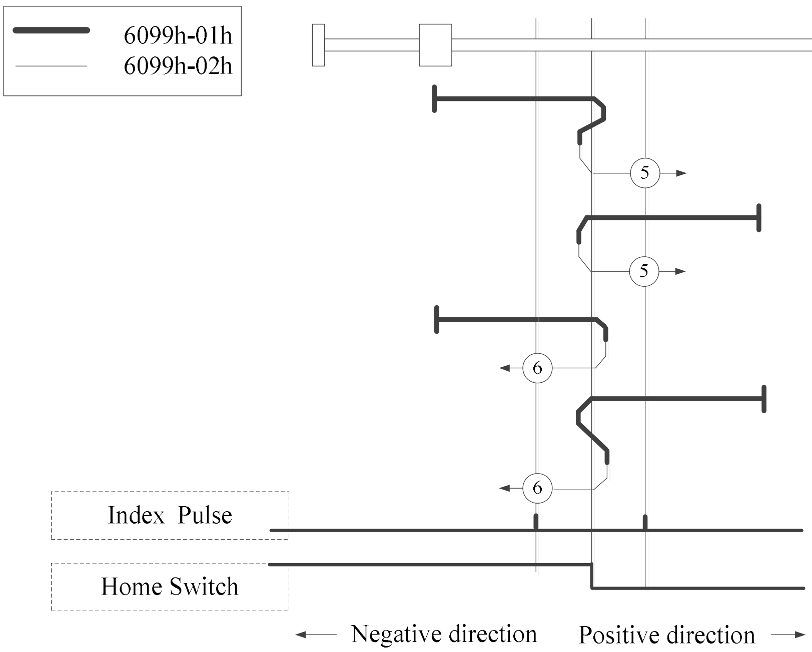
When using mode 3 or 4, the initial direction of movement depends on the state of the origin switch. The origin position is on the reverse side of the origin switch or on the initially detected Z-phase position in the forward direction.



Homing on positive home switch and index pulse

■ Mode 5, 6:

When using mode 5 or 6, the initial direction of movement depends on the state of the origin switch. The origin position is on the reverse side of the origin switch or on the initially detected Z-phase position in the forward direction.



Homing on negative home switch and index pulse

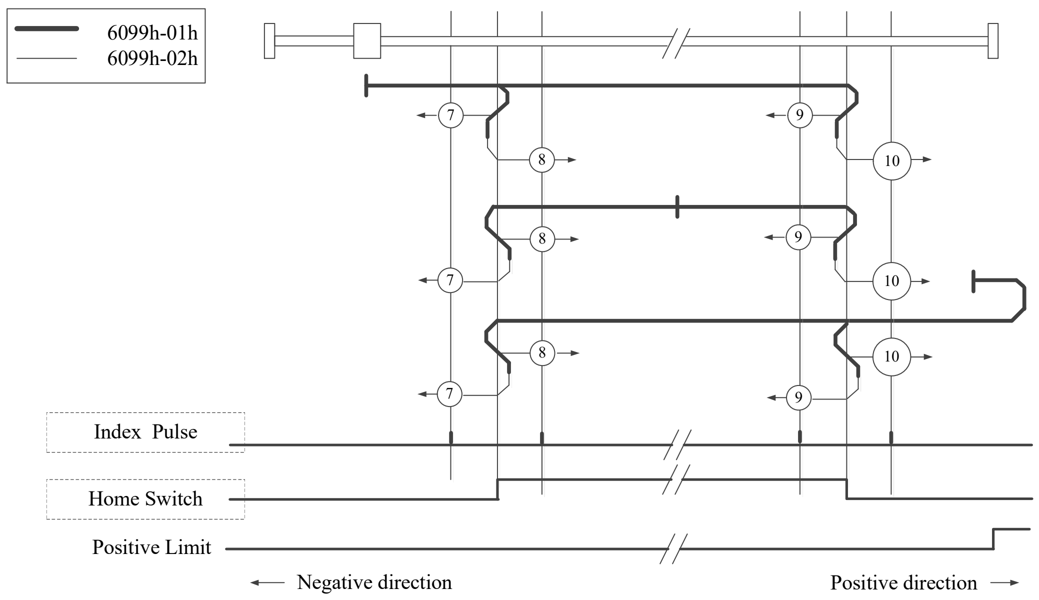
■ Mode 7~14:

Mode 7-14 all use origin switch and Z-phase signal;

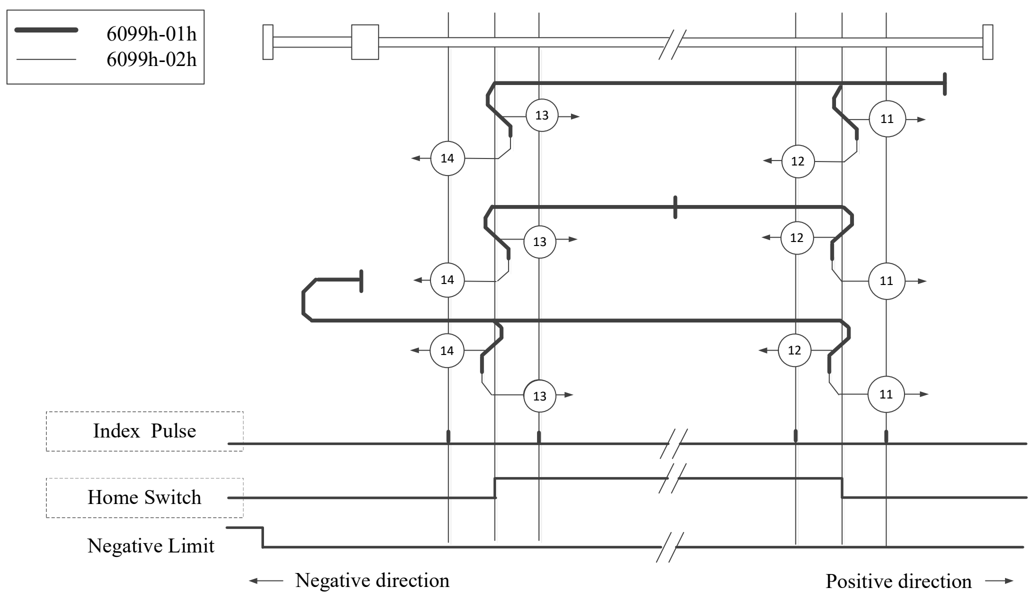
The initial action direction of modes 7 and 8 is negative if the origin switch has been activated at the beginning of action.

The initialization action direction of modes 9 and 10 is positive if the origin switch has been activated at the

beginning of the action.
The initialization action direction of modes 11 and 12 is the positive direction if the origin switch has been activated at the beginning of the action.
The initialization action direction of modes 13 and 14 is the negative direction if the origin switch has been activated at the beginning of the action.
The home position finally returning to is the Z-phase signal near the rising or falling edge of the origin switch.

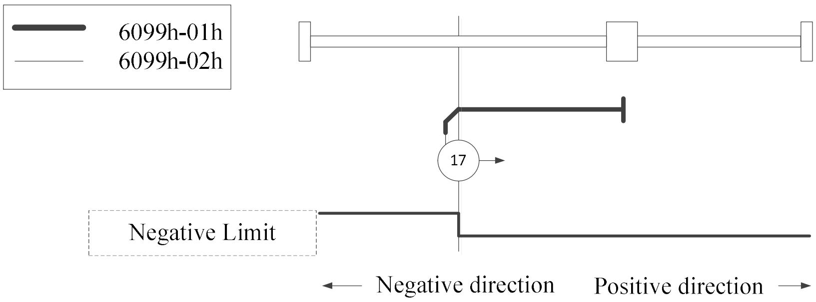


Homing on home switch and index pulse – positive initial motion



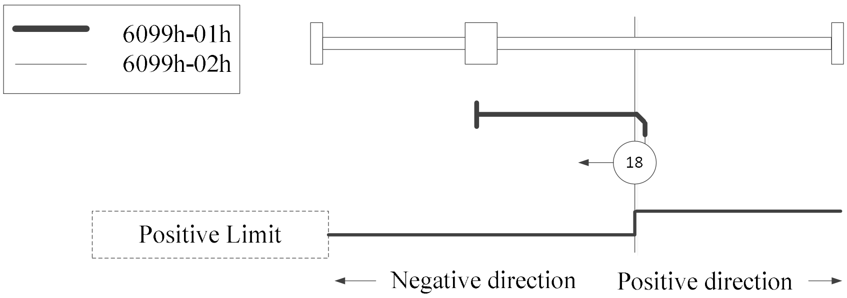
Homing on home switch and index pulse – Negative initial motion

■ Mode 17:
This mode is slimiar to mode 1.
The difference is that the origin point detection position is not Index pulse but the position where Limit switch changed. (see below diagram)
When NOT is not distributed, Homing error = 1.



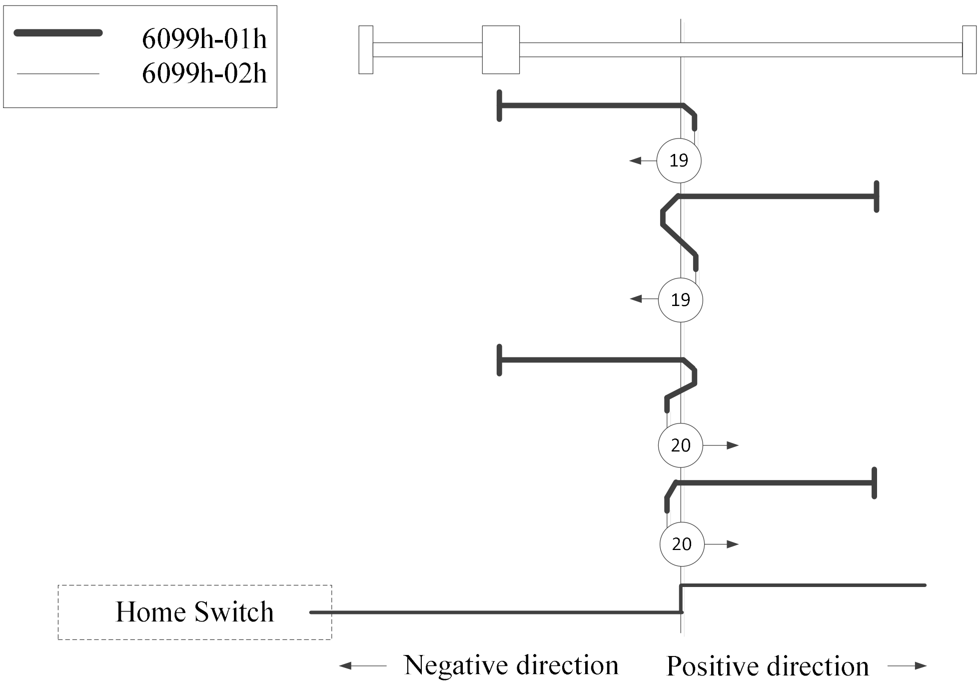
Homing on negative limit switch

■ Mode 18:
This mode is slimiar to mode 2.
The difference is that the origin point detection position is not Index pulse but the position where Limit switch changed. (see below diagram)
When POT is not distributed, Homing error = 1.



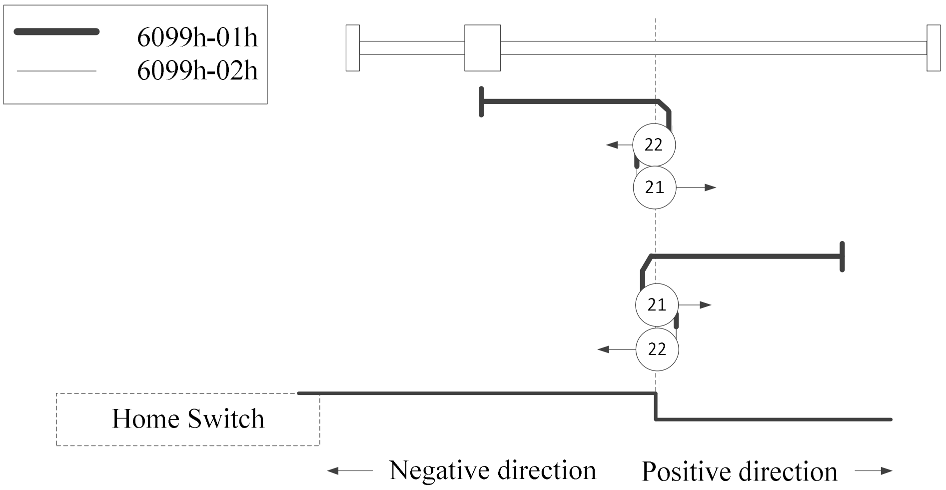
Homing on positive limit switch

■ Mode 19, 20:
This mode is slimiar to mode 3, 4.
The difference is that the origin point detection position is not Index pulse but the position where Home switch changed. (see below diagram)
When HOME is not distributed, Homing error = 1.



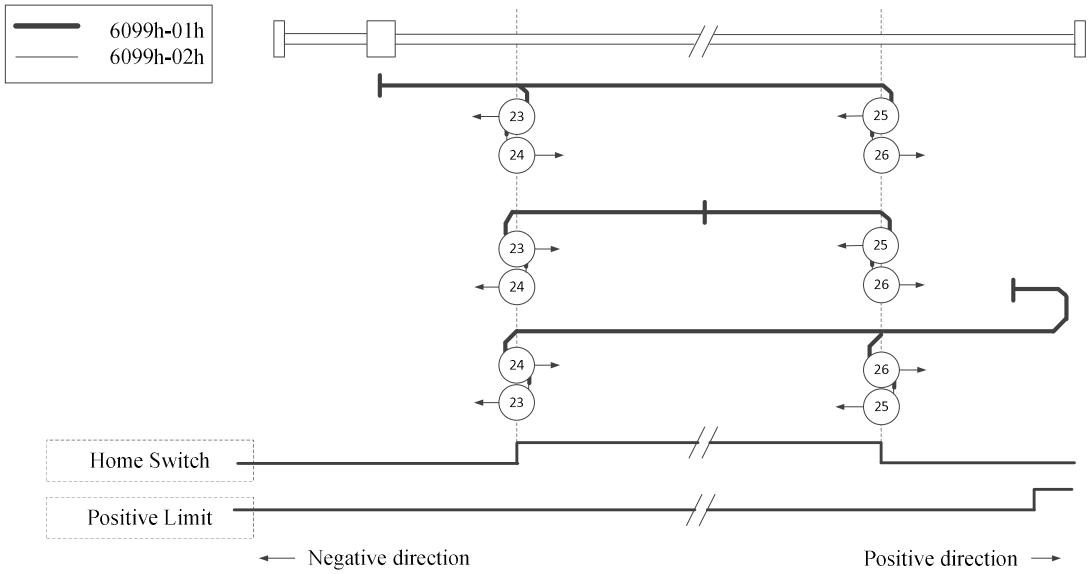
Homing on positive home switch

■ Mode 21, 22:
This mode is slimiar to mode 5, 6.
The difference is that the origin point detection position is not Index pulse but the position where Home switch changed. (see below diagram)
When HOME is not distributed, Homing error = 1.



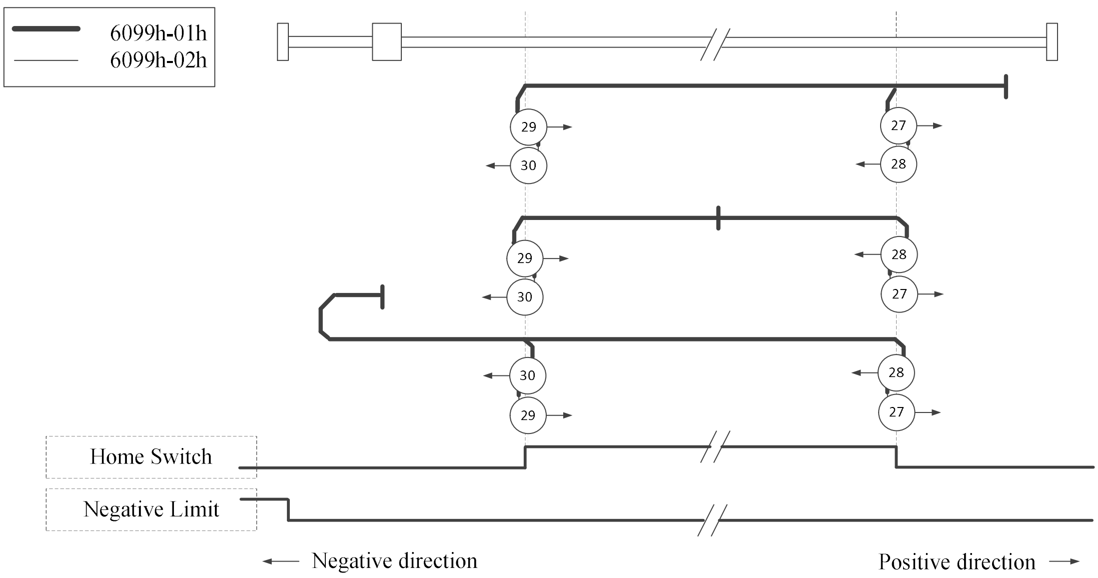
Homing on positive home switch and index pulse

■ Mode 23, 24, 25, 26:
This mode is slimiar to mode 7, 8, 9, 10.
The difference is that the origin point detection position is not Index pulse but the position where Home switch changed. (see below diagram)
When HOME, POT are not distributed, Homing error = 1.



Homing on home switch and index pulse – positive initial motion

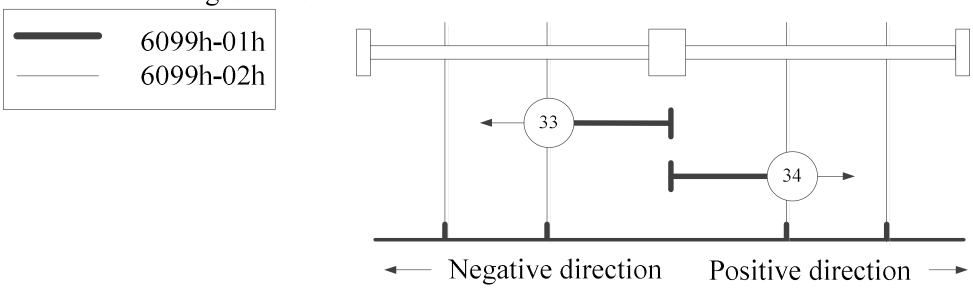
■ Mode 27, 28, 29, 30:
This mode is slimiar to mode 11, 12, 13, 14.
The difference is that the origin point detection position is not Index pulse but the position where Home switch changed. (see below diagram)
When HOME, NOT are not distributed, Homing error = 1.



Homing on home switch and index pulse – Negative initial motion

- Mode 33, 34:

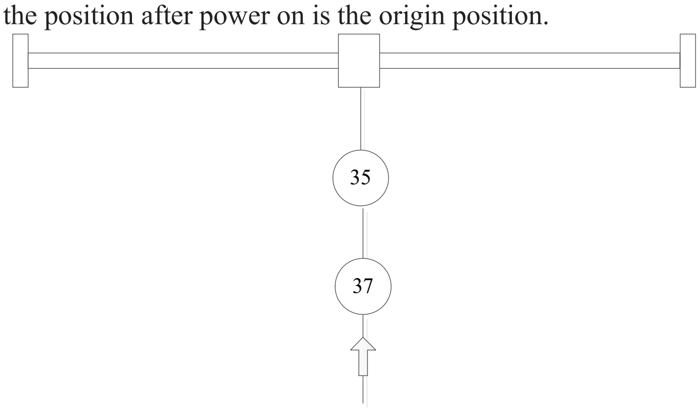
When using mode 33 or 34, the homing direction is negative or positive values, respectively. The original position is at the Z-phase near the setting direction.



Homing on index pulse

- Mode 35, 37:

In modes 35 and 37, the position after power on is the origin position.



5-1-2-14. Homing【A_ZRN】

(1) Overview

Master station homing command.

Homing [A_ZRN]			
Execution condition	Rising/falling edge of the coil	Suitable model	XDH, XLH, XG2
Firmware	V3.7.1 and above	Software	3.7.4 and above

(2) Operand

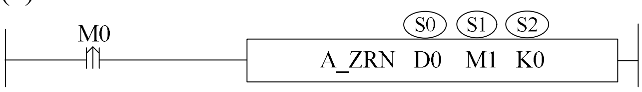
Operand	Function	Type
S0	Output state word start address	16-bit, single word
S1	Output state bit start address	Bit
S2	Axis output terminal number	16-bit, single word

(3) Suitable soft component

Operand	Word soft component											Bit soft component					
	System								Constant	Module		System					
	D*	FD	TD*	CD*	DX	DY	DM*	DS*	K/H	ID	QD	X	Y	M*	S*	T*	C*
S0	●	●	●	●													
S1														●			
S2	●								●								

*: D means D, HD; TD means TD and HTD; CD means CD, HCD, HSCD and HSD; DM means DM and DHM; DS means DS and DHS; M means M, HM, SM; S means S, HS; T means T, HT; C means C, HC.

(4) Function and action



- S1 specifies output state bit start address
- S2 specifies the axis output terminal number, occupies the relay S2~S2+1
- Trigger the command, S2 specified axis starts to return to zero at the configured speed, acceleration and jerk speed, and the parameter S1 is set after the return to zero is completed.
- Other motion commands cannot be executed during the homing process, and the homing command cannot be executed during the axis motion.

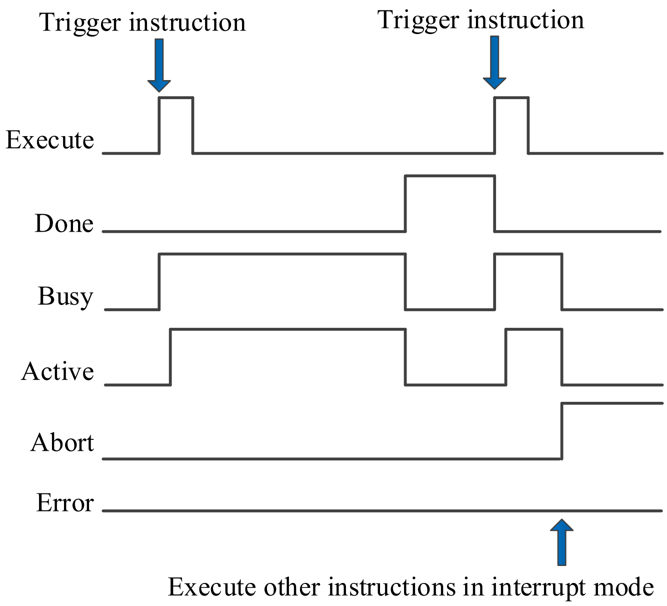
(5) Notes

- The command does not support soft limit, A_ WRITE command
- Before using, please set the positive/negative hard limit port in axis configuration, and related parameters of homing configuration.
- See (8) for the specific way of returning to the origin.
- V3.7.3 and above versions support mold axis, specific calculations can be found in the chapter 6-6. Application of mold axis.

(6) Related parameters

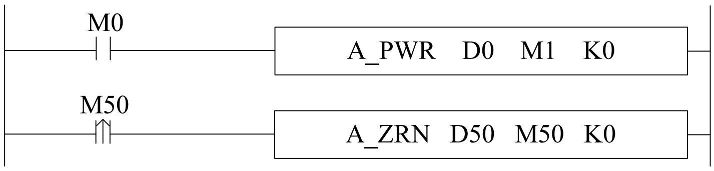
Output parameter	Parameter name	Data type	Unit	Note
S0	ErrCode	INT16U	-	Command error code
State parameter	Parameter name	Data type	Unit	Note
S1	Done	BOOL	-	Instruction execution complete
S1+1	Busy	BOOL	-	The instruction is being executed
S1+2	Active	BOOL	-	Command under control
S1+3	Abort	BOOL	-	Instruction is interrupted
S1+4	Error	BOOL	-	Instruction execution error
Axis number	Parameter name	Data type	Unit	Note
S2	Axis	INT16U	-	Axis number starts from 0

(7) Sequence diagram



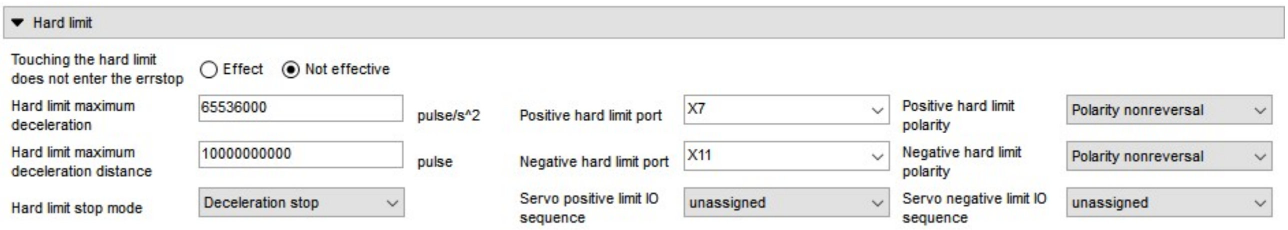
Explanation:
Generally, after the command is triggered, the Busy and Active signals are set, and reset after the command is executed. At the same time, the Done signal is set. Done will reset only after the command is triggered again, otherwise it will not reset automatically.
When a new instruction is triggered in interrupt mode during instruction execution, the Busy and Active signals are reset immediately and the Abort signal is set.
When there is an error in the command, the Error signal is set, other signals are reset, and the corresponding error code is output.

(8) Application
It is required to return to the origin of the specified axis, and the ladder diagram is as follows：

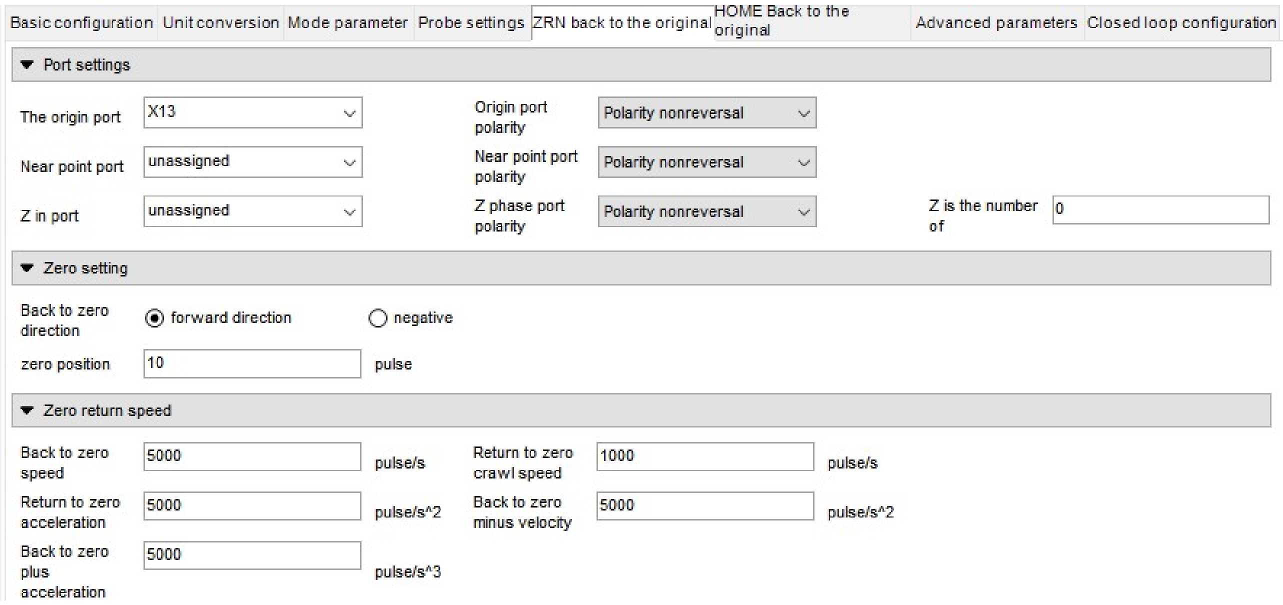


Parameter configurations:

■ Positive/negative hard limit port configuration: (axis configuration--- mode parameter --- hard limit)

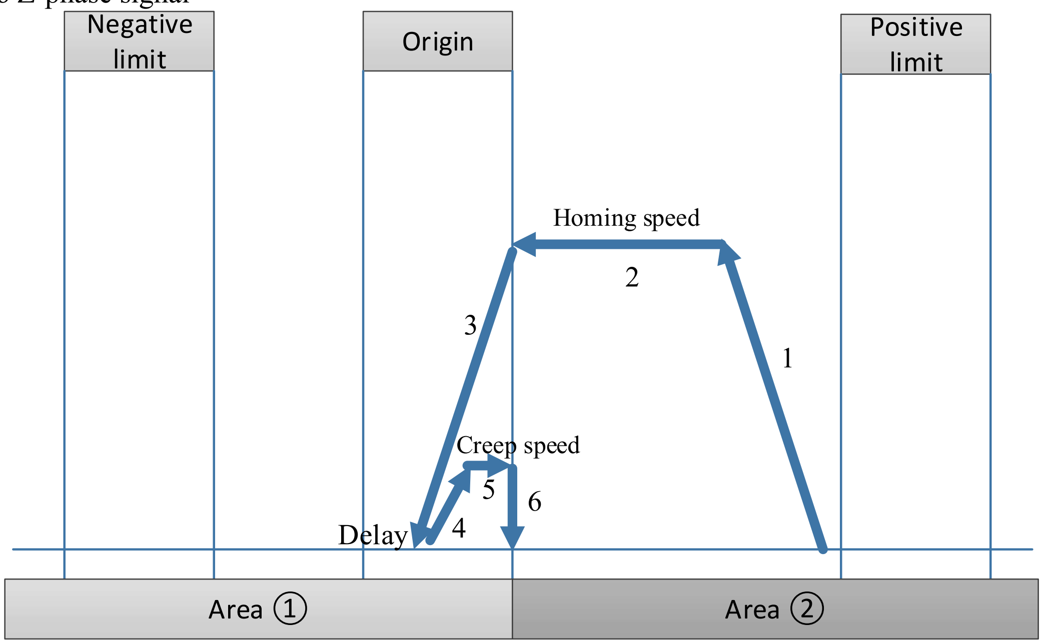


■ Homing parameter configuration (axis configuration- ZRN back to the origin)

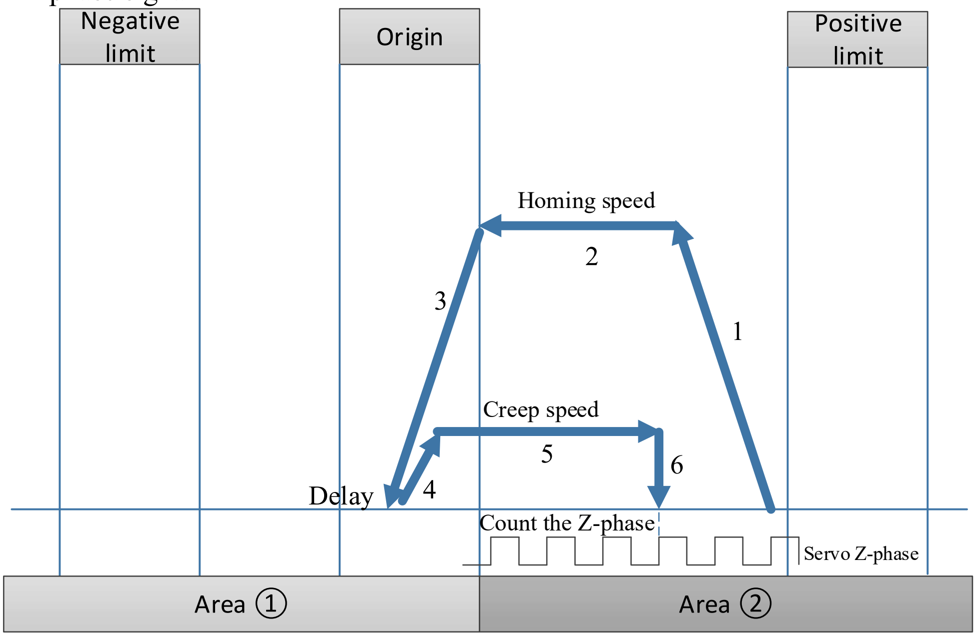


Note: input ports, speed parameters and other parameters must be configured before using the command, and the polarity of near point port and near point port is not supported temporarily.
The back to origin mode is different, if the homing method and start position are different.

- No Z-phase signal



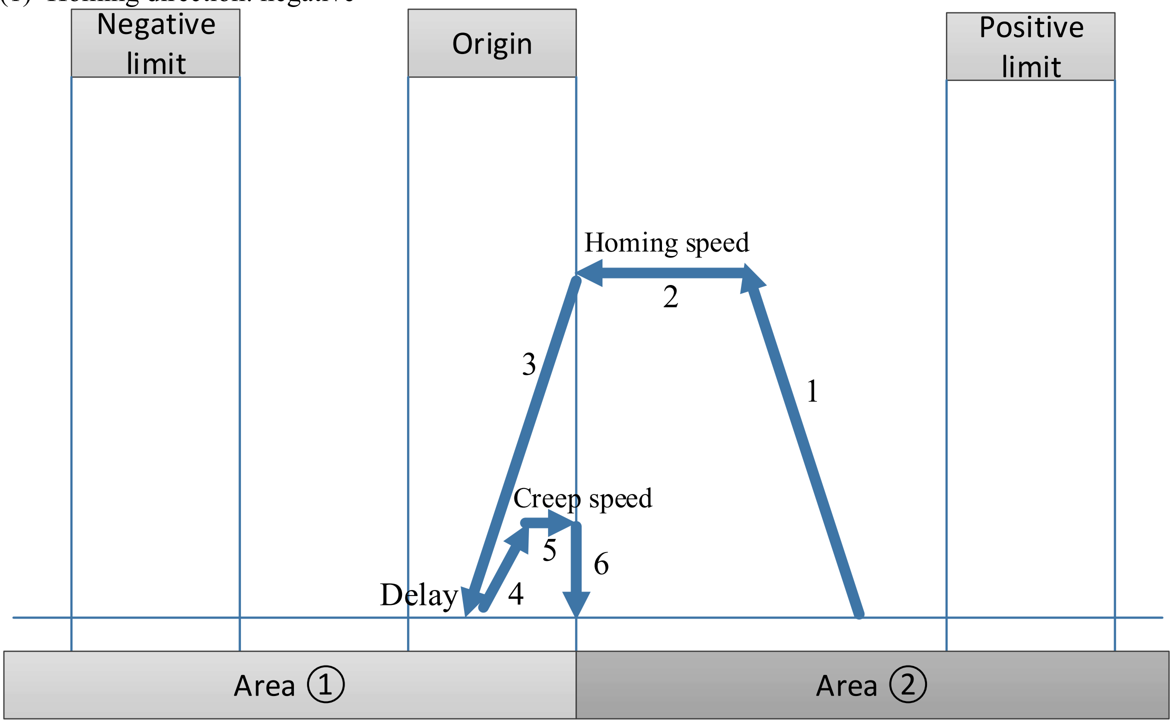
◆ With Z-phase signal



◆ Origin signal is not limit signal

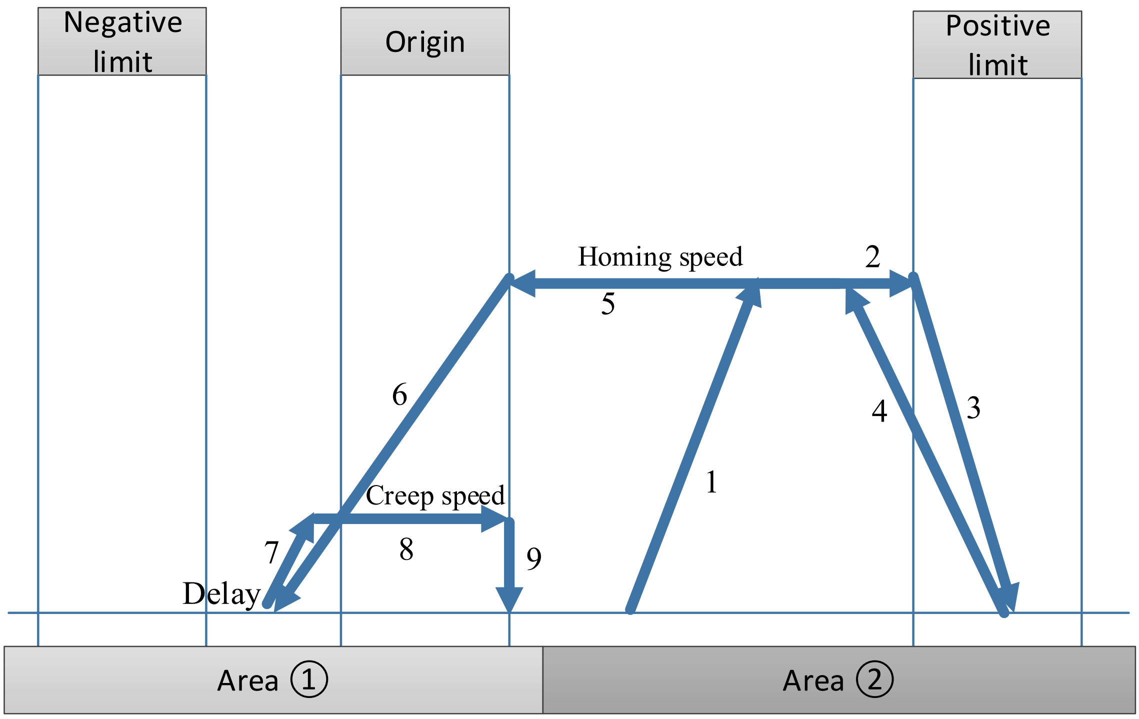
➢ **Start position is between origin and positive limit**

(1) Homing direction: negative



Homing in reverse direction

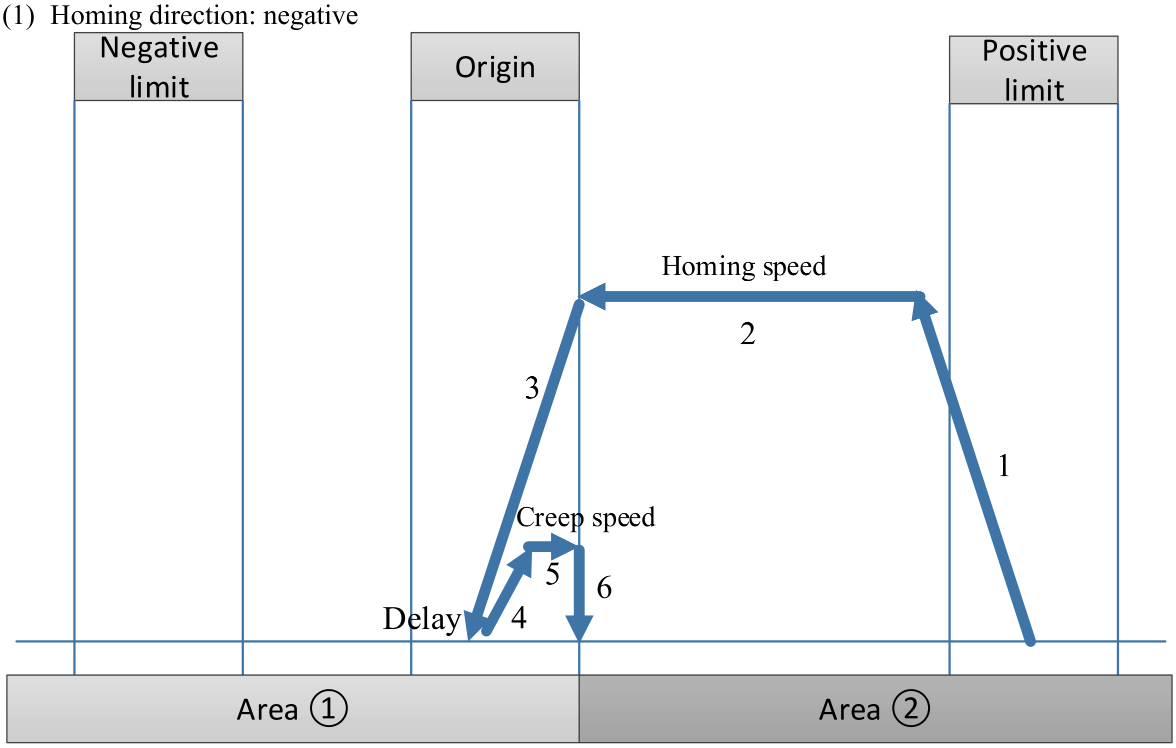
(2) Homing direction: positive



Homing in forward direction

- **Start position is at the positive limit**

(1) Homing direction: negative



Homing at positive limit

(2) Homing direction: positive

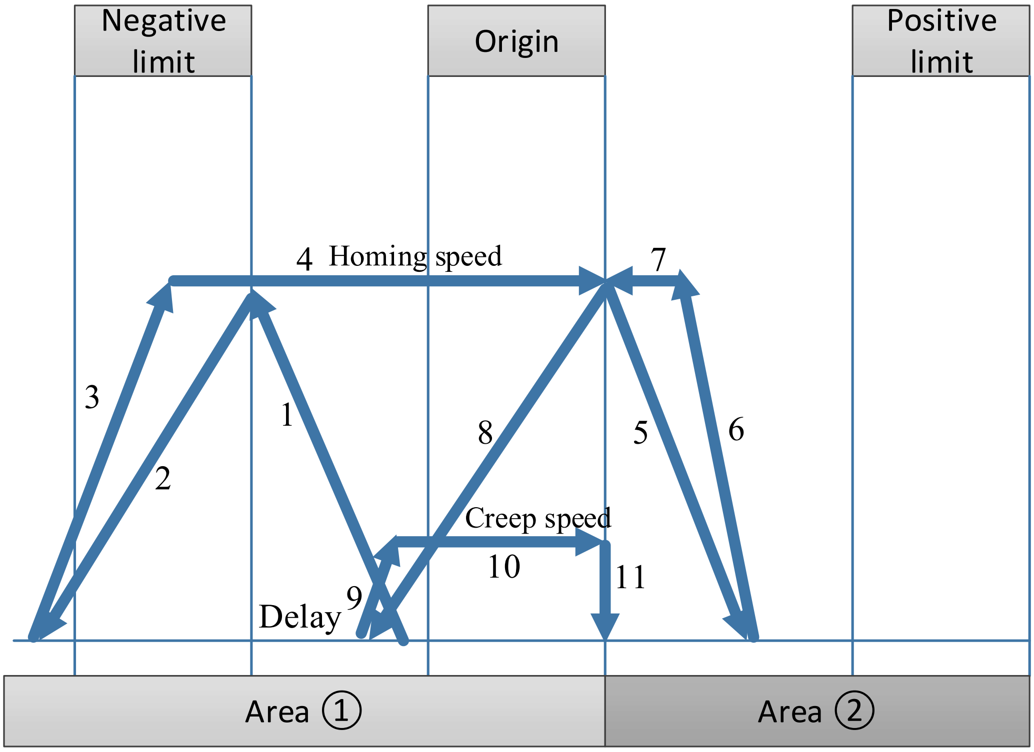
Command error: homing direction configuration error, cannot homing.

- **Start position over the hard limit**

When the starting position of the worktable exceeds the positive limit, in order to prevent the collision accident caused by the positive homing, do not perform the homing operation under this condition. The worktable must be manually moved back between the positive and negative limits before the homing operation.

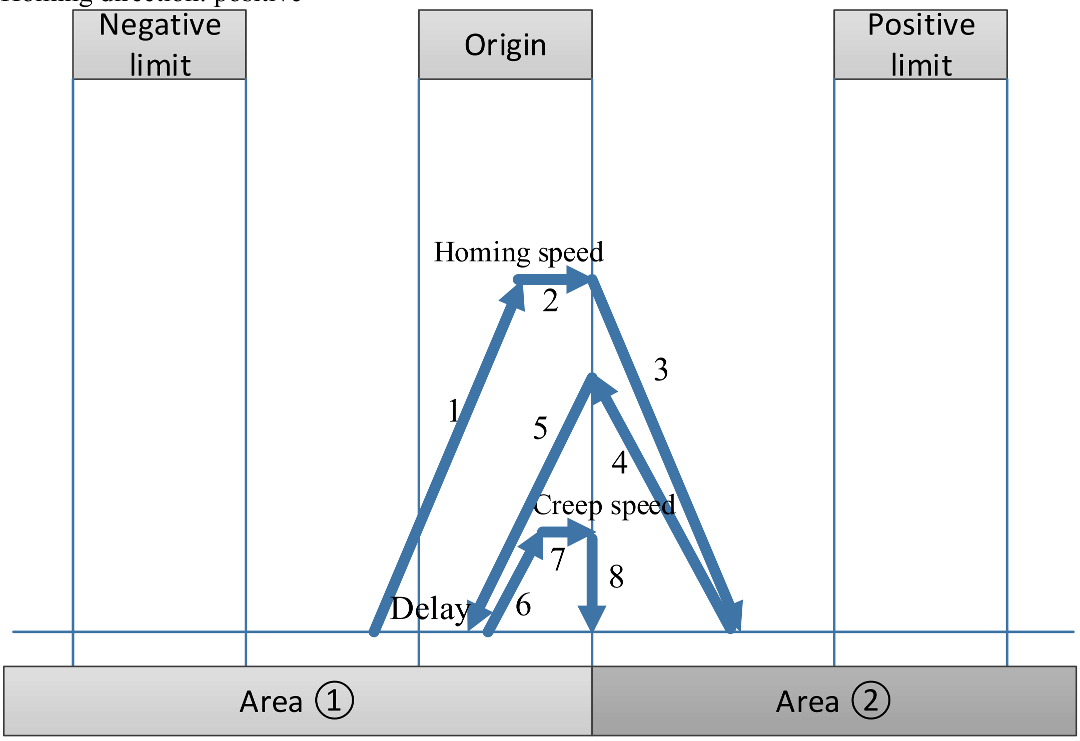
- **Start position is between origin and negative limit**

(1) Homing direction: negative



homing in reverse direction

(2) Homing direction: positive



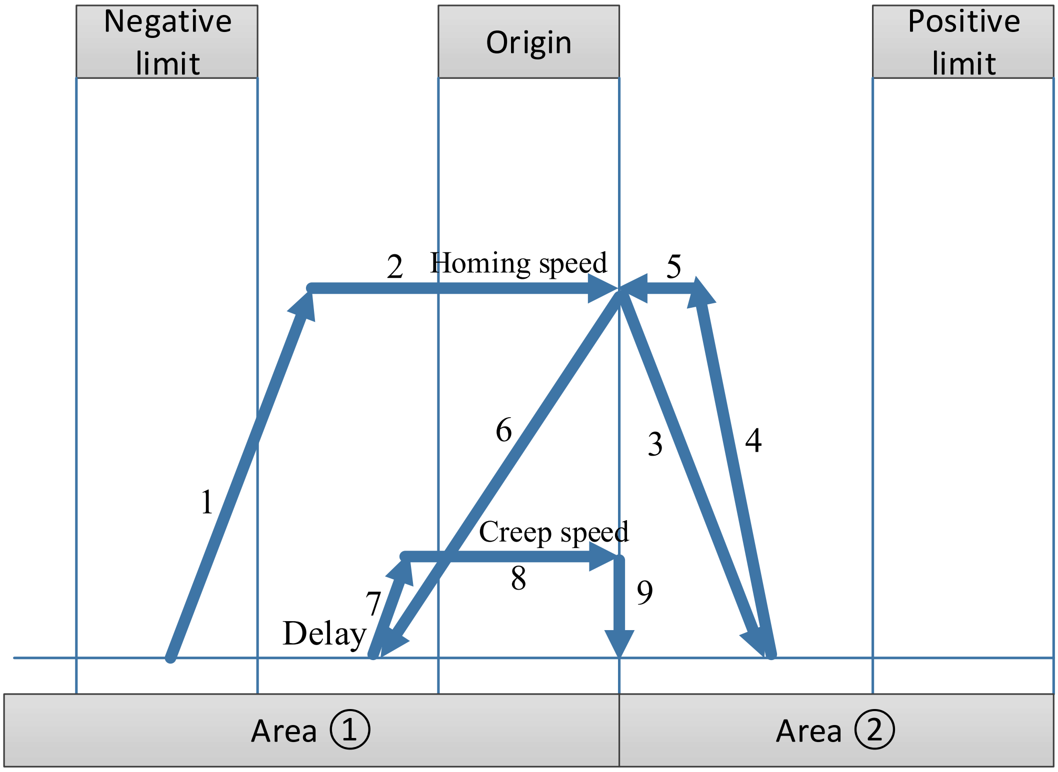
homing in forward direction

➢ **Start position is at the negative limit**

(1) Homing direction: negative

Command error: homing direction configuration is error, cannot homing.

(2) Homing direction: positive



Homing at negative limit

➢ **Start position over the negative limit**

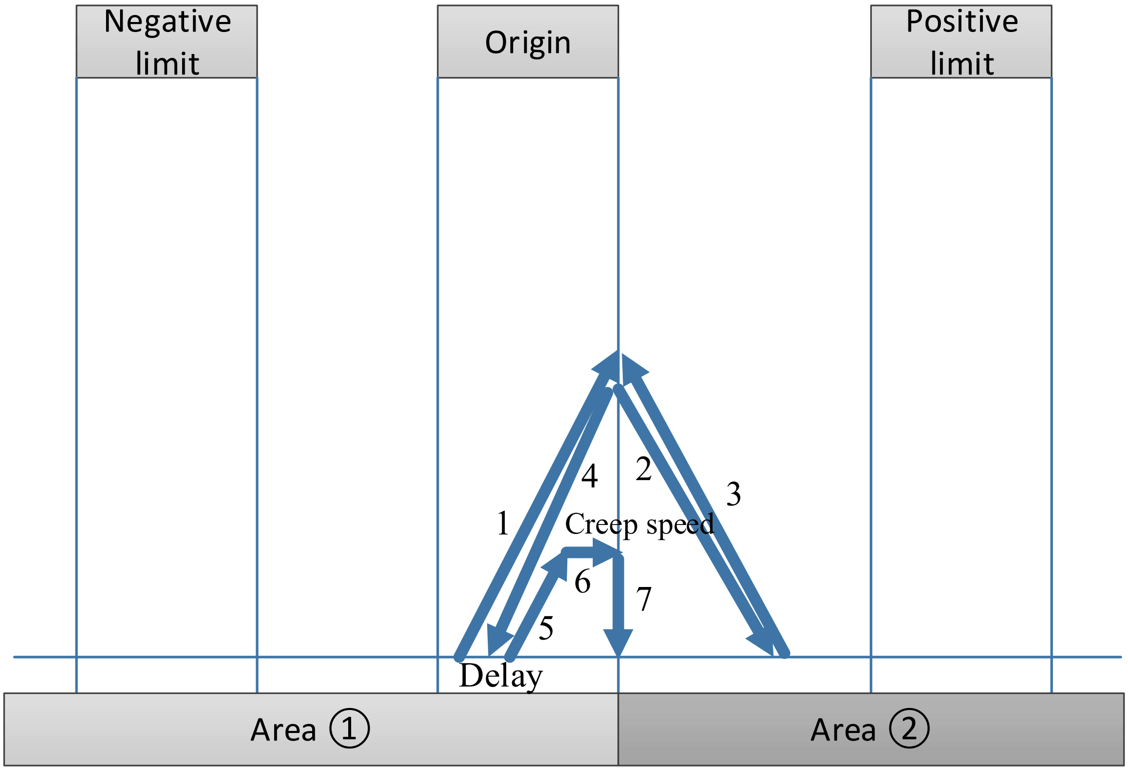
When the starting position of the workbench exceeds the negative limit, in order to prevent the negative homing leading to machine collision, do not perform the homing operation under this condition. You must manually move the workbench back between the positive and negative limits, and then do the homing operation.

➢ **Start position is at the origin**

(1) Homing direction: negative

Auto-switch to forward homing inside.

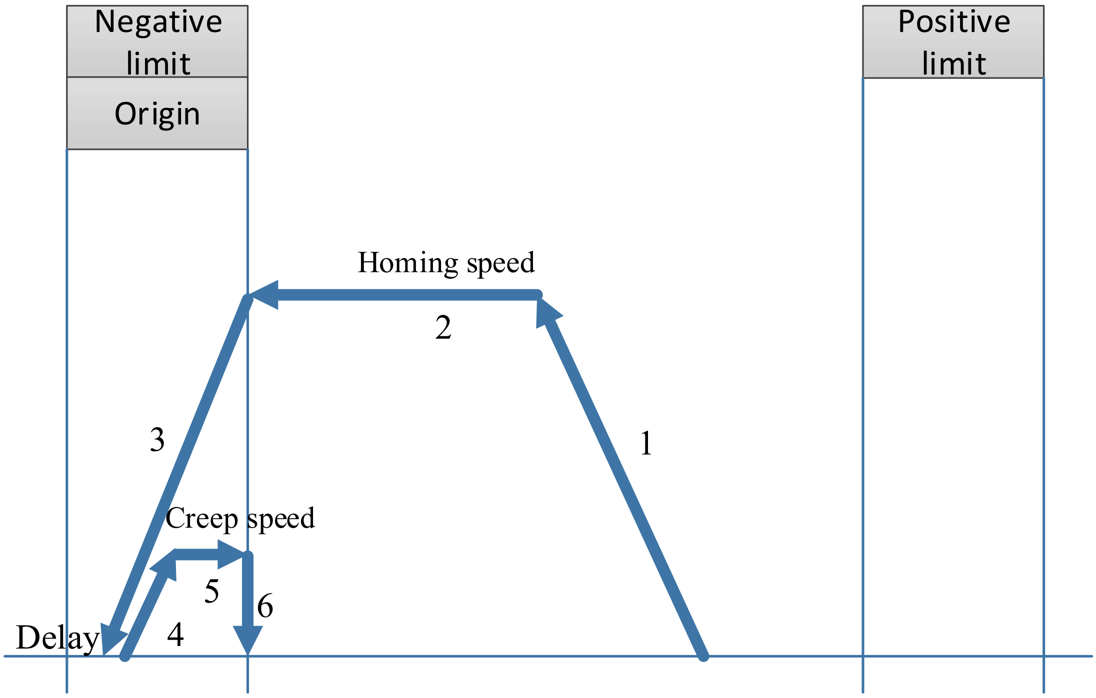
(2) Homing direction: positive



- Origin signal is limit signal

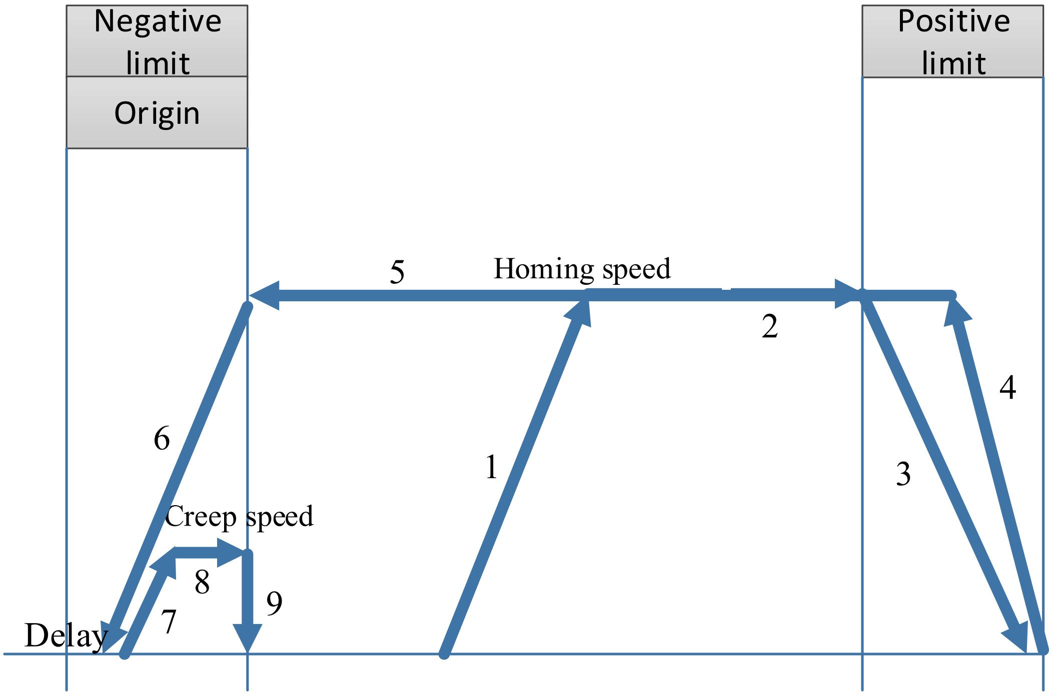
➢ **Start position is between positive limit and negative limit**

(1) Homing direction: negative



Homing in reverse direction

(2) Homing direction: positive



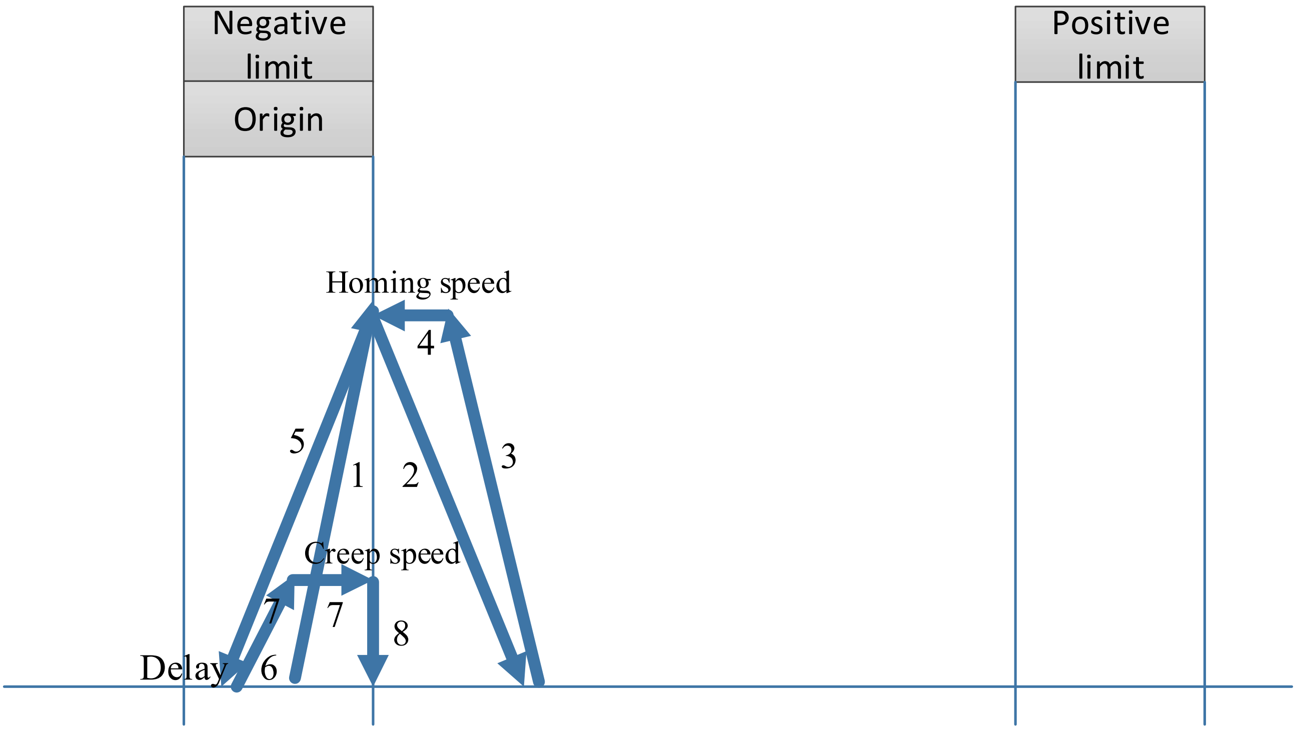
Homing in forward direction

- **Start position is at the negative limit**

(1) Homing direction: negative

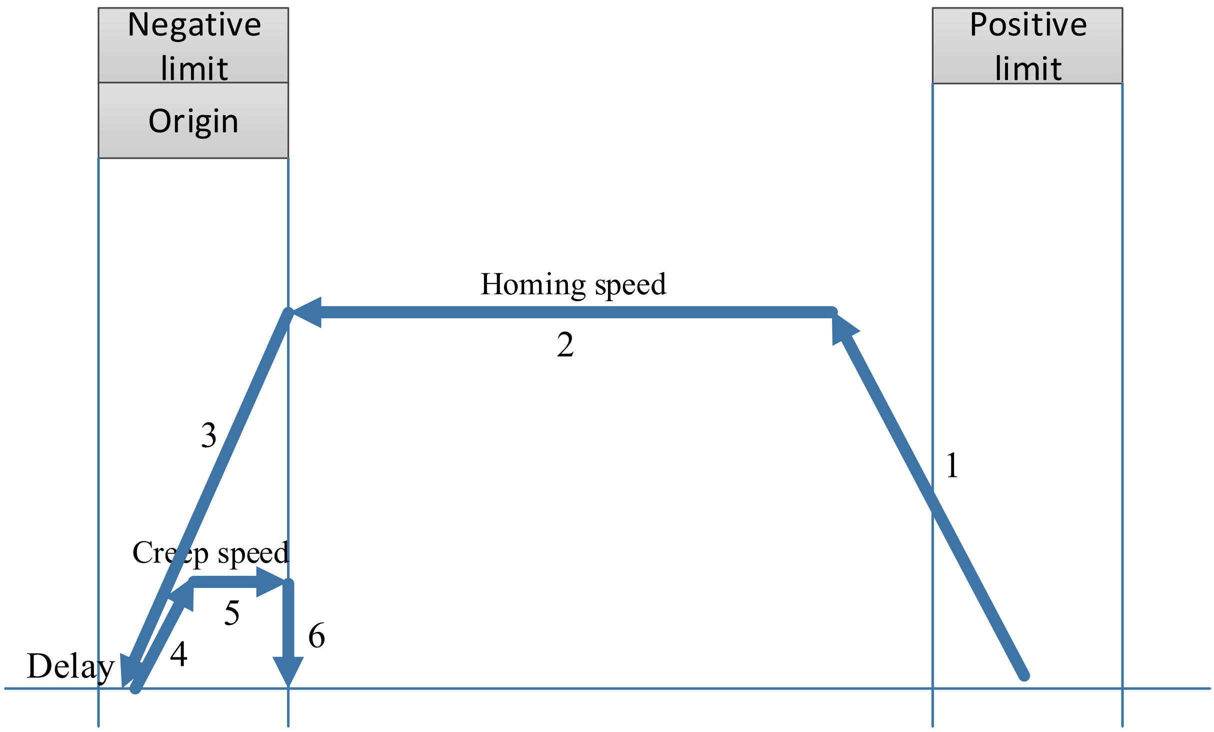
Command error: homing direction is error, cannot homing.

(2) Homing direction: positive



- **Start position is at the positive limit**

(1) Homing direction: negative



Homing at the positive limit

(2) Homing direction: positive

Command error: homing direction is error, cannot homing.

➢ **Start position over the positive limit**

When the starting position of the worktable exceeds the positive limit, in order to prevent the collision accident caused by the positive homing, do not perform the homing operation under this condition. The worktable must be manually moved back between the positive and negative limits before the homing operation.

➢ **Start position over the negative limit**

When the starting position of the worktable exceeds the negative limit, in order to prevent the collision accident caused by the positive homing, do not perform the homing operation under this condition. The worktable must be manually moved back between the positive and negative limits before the homing operation.

5-1-2-15. Gear binding【A_GEARIN】

(1) Overview

Bind the master axis (or encoder axis) to the slave axis for synchronous movement.

Gear binding [A_GEARIN]			
Execution condition	Rising/falling edge of the coil	Suitable model	XDH, XLH, XG2
Firmware	V3.6.1b and above	Software	3.7.4 and above

(2) Operand

Operand	Function	Type
S0	Input parameter start address	16-bit, single word
S1	Output state word start address	16-bit, single word
S2	Output state bit start address	Bit
S3	Axis output terminal number	16-bit, single word

(3) Suitable soft component

Operand	Word soft component											Bit soft component					
	System								Constant	Module		System					
	D*	FD	TD*	CD*	DX	DY	DM*	DS*	K/H	ID	QD	X	Y	M*	S*	T*	C*
S0	●	●	●	●													
S1	●	●	●	●													
S2														●			
S3	●								●								

*: D means D, HD; TD means TD and HTD; CD means CD, HCD, HSCD and HSD; DM means DM and DHM; DS means DS and DHS; M means M, HM, SM; S means S, HS; T means T, HT; C means C, HC.

(4) Function and action

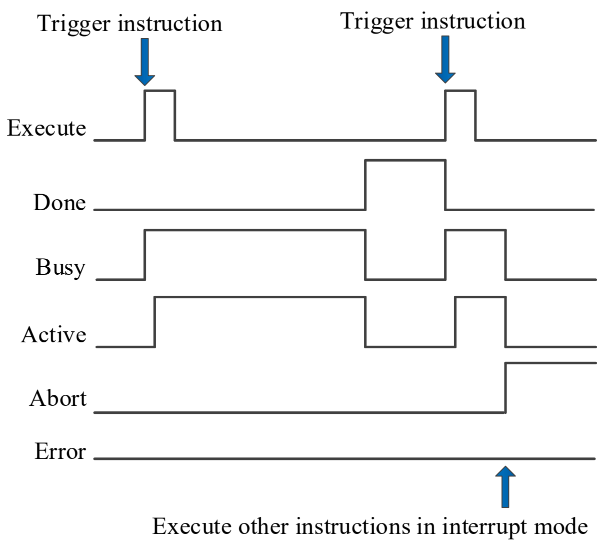
- S0 specifies the input parameter start address, occupies the register S0~S0+23
- S1 specifies output state word start address
- S2 specifies output state bit start address, occupies the relay S2~S2+4
- S3 specifies the axis terminal number
- When M0 is from OFF→ON, bind the master axis S0 to the position of the slave axis S3 for synchronous movement
- S0+1=0, the slave axis is synchronized with the given value (D20016 + 200 * N) of the master axis (N is the axis number, starts from 0)
- S0+1=1, the slave axis is synchronized with the feedback (D20044+200*N) of the master axis (N is the axis number, starts from 0)
- The axis can be bound during the axis movement, and the acceleration and deceleration of the binding process are determined by S0 + 12 and S0 + 16
- When S0 + 3 [buffer mode] is set to 0, if the slave axis executes the command during the movement, the slave axis immediately stops the current movement and synchronizes with the master axis. When S0 + 3 [buffer mode] is set to 1, if the slave axis executes the command during the movement, it will wait until the current movement of the slave axis ends to synchronize with the master axis
- During axis binding, the electrical origin can be modified at any time by the master axis, but cannot by the slave axis
- After the command is executed, the single axis state (D20000+200*N) of the master axis remains unchanged, the single axis state (D20000+200*N) of the slave axis switches to 4
- Enable the continuous update function. After the InGear signal is set ON, the modification of the numerator and denominator of the synchronization ratio takes effect in real time. If the modification parameter is incorrect, the continuous update function is turned off and executed according to the parameters before the error is reported.
- V3.7.3 and above versions support mold axis, specific calculations can be found in the chapter 6-6. Application of mold axis.

(5) Related parameters

Input parameter	Parameter name	Data type	Unit	Note
S0	Master	INT16U	-	master axis number
S0+1	SourceType	INT16U	-	Data source type 0: given 1: feedback
S0+2	ContinuousMode	INT16U	-	Continuously updated. Only supported in V3.7.2 and up version
S0+3	BufferMode	INT16U	-	Buffer mode 0: interrupt mode 1: buffer mode
S0+4	Numerator	FP64	-	Synchronous ratio numerator
S0+8	Denominator	FP64	-	Synchronous ratio denominator
S0+12	Acceleration	FP64	Command unit/s^2	Target acceleration
S0+16	Deceleration	FP64	Command unit /s^2	Target deceleration
S0+20	Jerk	FP64	Command unit /s^3	Target jerk speed, that is, the change speed of acceleration and deceleration
Output parameter	**Parameter name**	**Data type**	**Unit**	**Note**
S1	ErrCode	INT16U	-	Command error code
State parameter	**Parameter name**	**Data type**	**Unit**	**Note**
S2	Done	BOOL	-	Synchronizing
S2+1	Busy	BOOL	-	The instruction is being executed
S2+2	Active	BOOL	-	Command under control
S2+3	Abort	BOOL	-	Instruction is interrupted
S2+4	Error	BOOL	-	Instruction execution error
Axis number	**Parameter name**	**Data type**	**Unit**	**Note**
S3	Slave	INT16U	-	slave axis number

Note:
The relationship between acceleration/deceleration and jerk speed is same to A_MOVEA, please refer to chapter 5-1-2-7 item (5).

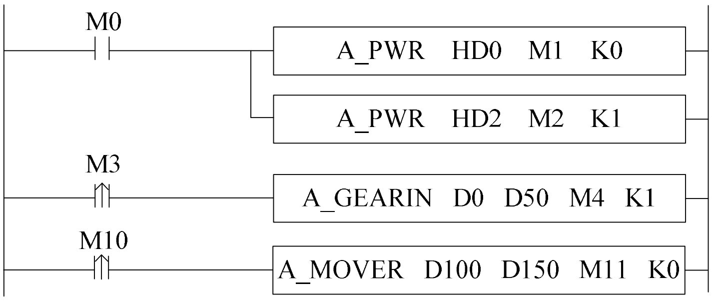
(6) Sequence diagram

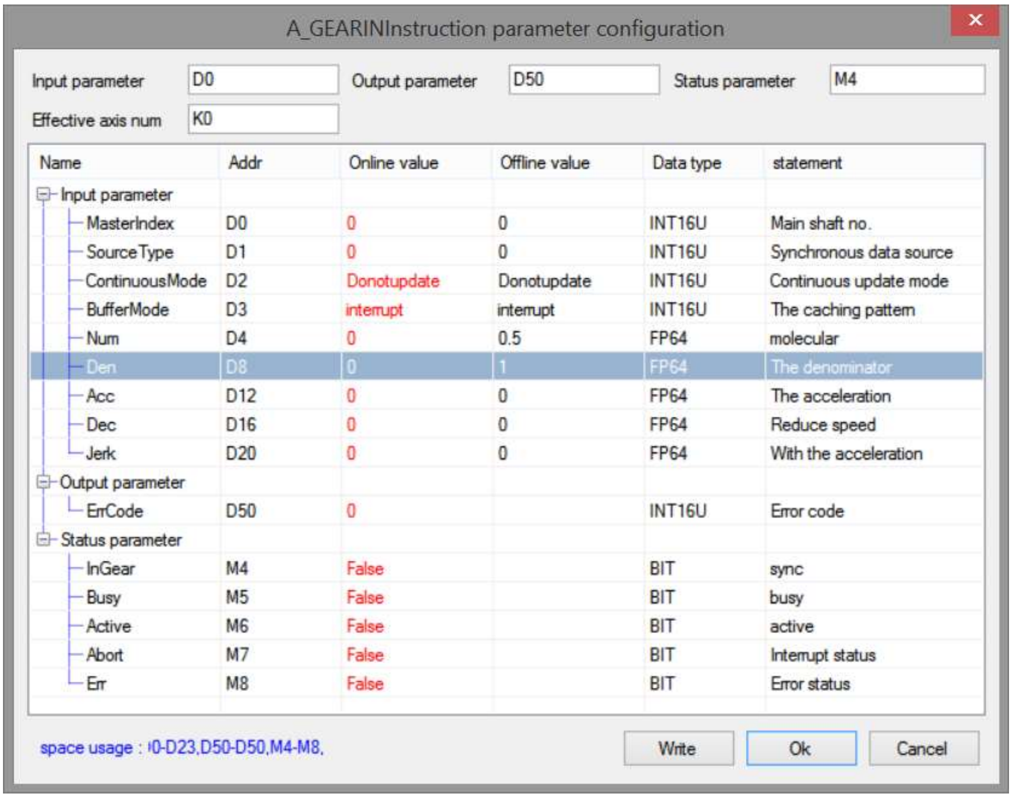


Explanation:
Generally, after the command is triggered, the Busy and Active signals are set, and reset after the command is executed. At the same time, the Done signal is set. Done will reset only after the command is triggered again, otherwise it will not reset automatically.

When the instruction is triggered in the buffer mode and there are currently instructions being executed, the Active signal will be set immediately. The execution of the current instruction ends. When the instruction is executed, the Busy signal will be set. After the execution of the instruction ends, the Busy and Active signals will be reset and the Done signal will be set.
When a new instruction is triggered in interrupt mode during instruction execution, the Busy and Active signals are reset immediately and the Abort signal is set.
When there is an error in the command, the Error signal is set, other signals are reset, and the corresponding error code is output.

(7) Application
Takes axis 0 as the master axis and axis 1 as the slave axis for given synchronous binding through A_GEARIN, so that the master axis can run 10000 command units at the speed of 5000 command unit/s. The acceleration and deceleration is 25000 command unit/s^2, and the jerk speed is 50000 command unit/s^3. The speed of the slave axis is 0.5 times of the master axis.
The ladder chart:



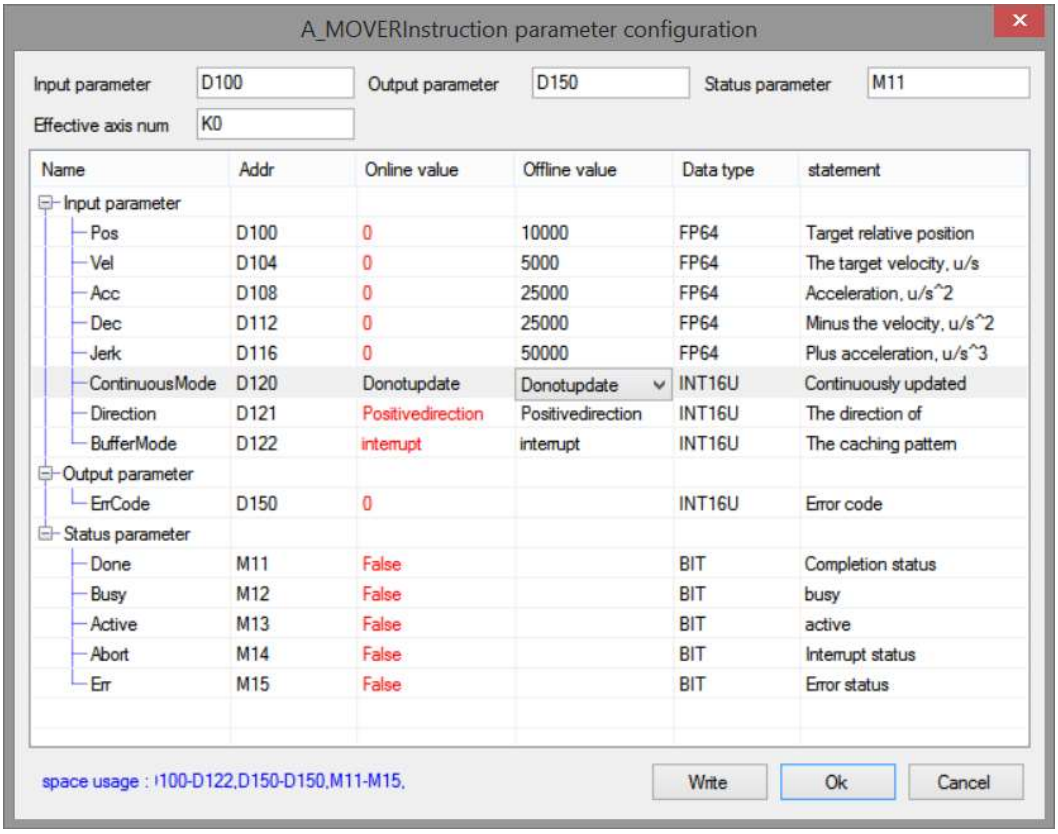

A_GEARINInstruction parameter configuration

Input parameter D0 Output parameter D50 Status parameter M4
Effective axis num K0

Name	Addr	Online value	Offline value	Data type	statement
Input parameter					
MasterIndex	D0	0	0	INT16U	Main shaft no.
SourceType	D1	0	0	INT16U	Synchronous data source
ContinuousMode	D2	Donotupdate	Donotupdate	INT16U	Continuous update mode
BufferMode	D3	interrupt	interrupt	INT16U	The caching pattern
Num	D4	0	0.5	FP64	molecular
Den	D8	0	1	FP64	The denominator
Acc	D12	0	0	FP64	The acceleration
Dec	D16	0	0	FP64	Reduce speed
Jerk	D20	0	0	FP64	With the acceleration
Output parameter					
ErrCode	D50	0		INT16U	Error code
Status parameter					
InGear	M4	False		BIT	sync
Busy	M5	False		BIT	busy
Active	M6	False		BIT	active
Abort	M7	False		BIT	Interrupt status
Err	M8	False		BIT	Error status

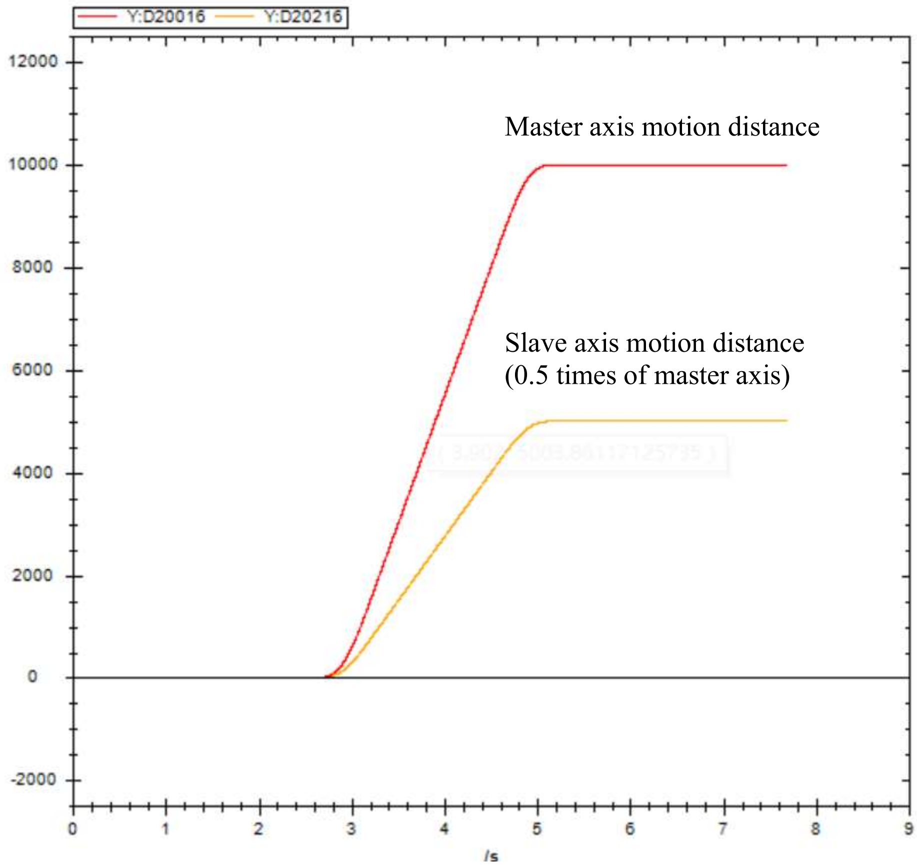
space usage : D0-D23,D50-D50,M4-M8,

Write Ok Cancel

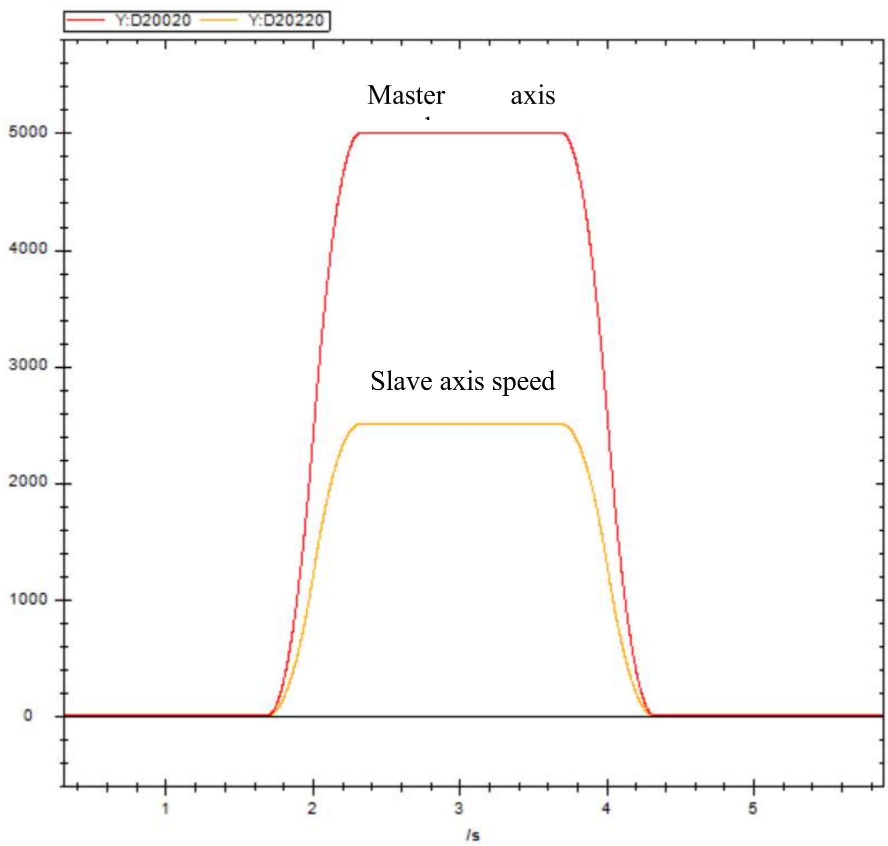


Note: first enable the axis 0 and axis 1 through A_PWR. When M3 is set from off to on, execute the synchronous binding with the parameters set by the command. M1 is set to on when the binding is successful. M10 is set from off to on, axis 0 acts as the master axis to move in relative position, and the slave axis moves in synchronous with the proportion of 0.5.

The execution position curve is as follows:



The speed curve is shown as below:



5-1-2-16. Gear unbinding【A_GEAROUT】

(1) Overview

Desynchronize the master axis (or encoder axis) with the slave axis.

Gear unbinding [A_GEAROUT]			
Execution condition	Rising/falling edge of the coil	Suitable model	XDH, XLH, XG2
Firmware	V3.6.1b and above	Software	3.7.4 and above

(2) Operand

Operand	Function	Type
S0	Input parameter start address	64-bit, four words
S1	Output state word start address	16-bit, single word
S2	Output state bit start address	Bit
S3	Axis output terminal number	16-bit, single word

(3) Suitable soft component

Operand	Word soft component											Bit soft component					
	System								Constant	Module		System					
	D*	FD	TD*	CD*	DX	DY	DM*	DS*	K/H	ID	QD	X	Y	M*	S*	T*	C*
S0	●	●	●	●													
S1	●	●	●	●													
S2														●			
S3	●								●								

*: D means D, HD; TD means TD and HTD; CD means CD, HCD, HSCD and HSD; DM means DM and DHM; DS means DS and DHS; M means M, HM, SM; S means S, HS; T means T, HT; C means C, HC.

(4) Function and action

- S0 specifies the input parameter start address, occupies the register S0~S0+7
- S1 specifies output state word start address
- S2 specifies output state bit start address, occupies the relay S2~S2+3
- S3 specifies the axis terminal number
- When M0 is from OFF→ON, unbind the master axis S0 with the slave axis S3
- The axis can be unbound during the axis movement, the slave axis will deceleration stop with the larger speed between A_GEARIN command and A_GEAROUT command
- After the command is executed, the single axis state (D20000+200*N) of the master axis remains unchanged, the single axis state (D20000+200*N) of the slave axis switches to 1.
- V3.7.3 and above versions support mold axis, specific calculations can be found in the chapter 6-6. Application of mold axis.

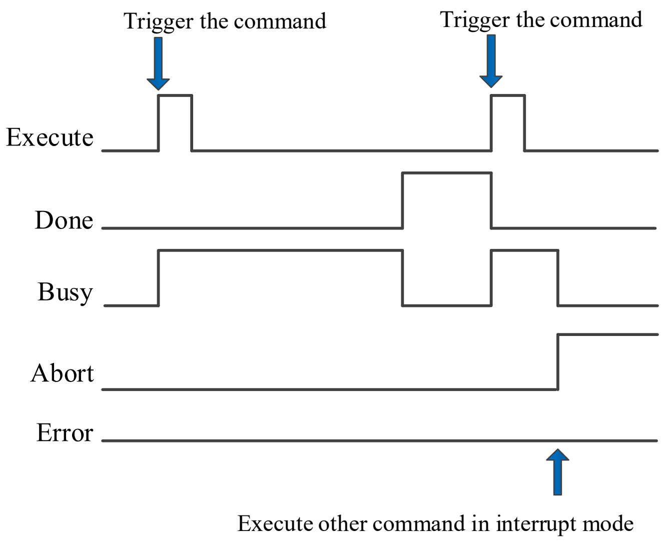
(5) Related parameters

Input parameter	Parameter name	Data type	Unit	Note
S0	Deceleration	FP64	Command unit/s^2	Target deceleration
S0+4	Jerk	FP64	Command unit /s^3	Target jerk speed, that is, the change speed of acceleration/deceleration
Output parameter	**Parameter name**	**Data type**	**Unit**	**Note**
S1	ErrCode	INT16U	-	Command error code
State parameter	**Parameter name**	**Data type**	**Unit**	**Note**
S2	Done	BOOL	-	Instruction execution completed
S2+1	Busy	BOOL	-	The instruction is being executed
S2+2	Abort	BOOL	-	Instruction is interrupted

S2+3	Error	BOOL	-	Instruction execution error
Axis number	**Parameter name**	**Data type**	**Unit**	**Note**
S3	Axis	INT16U	-	Axis number starts from 0

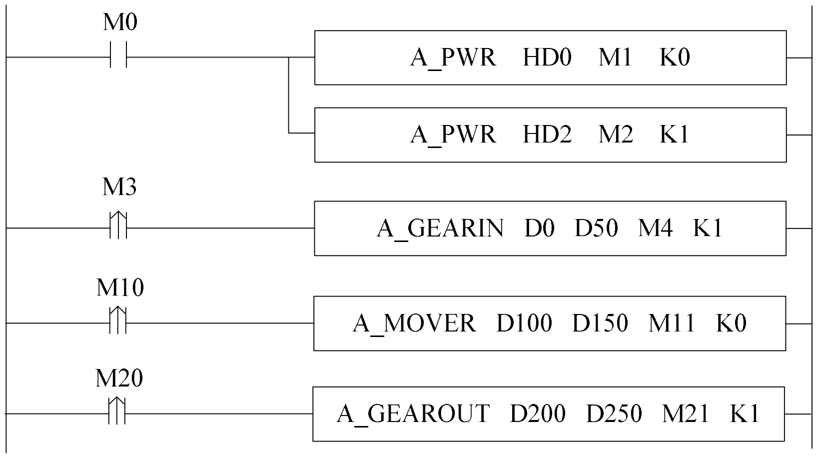
Note:
The relationship between deceleration and jerk speed is same to A_MOVEA, please refer to chapter 5-1-2-7 item (5).

(6) Sequence diagram

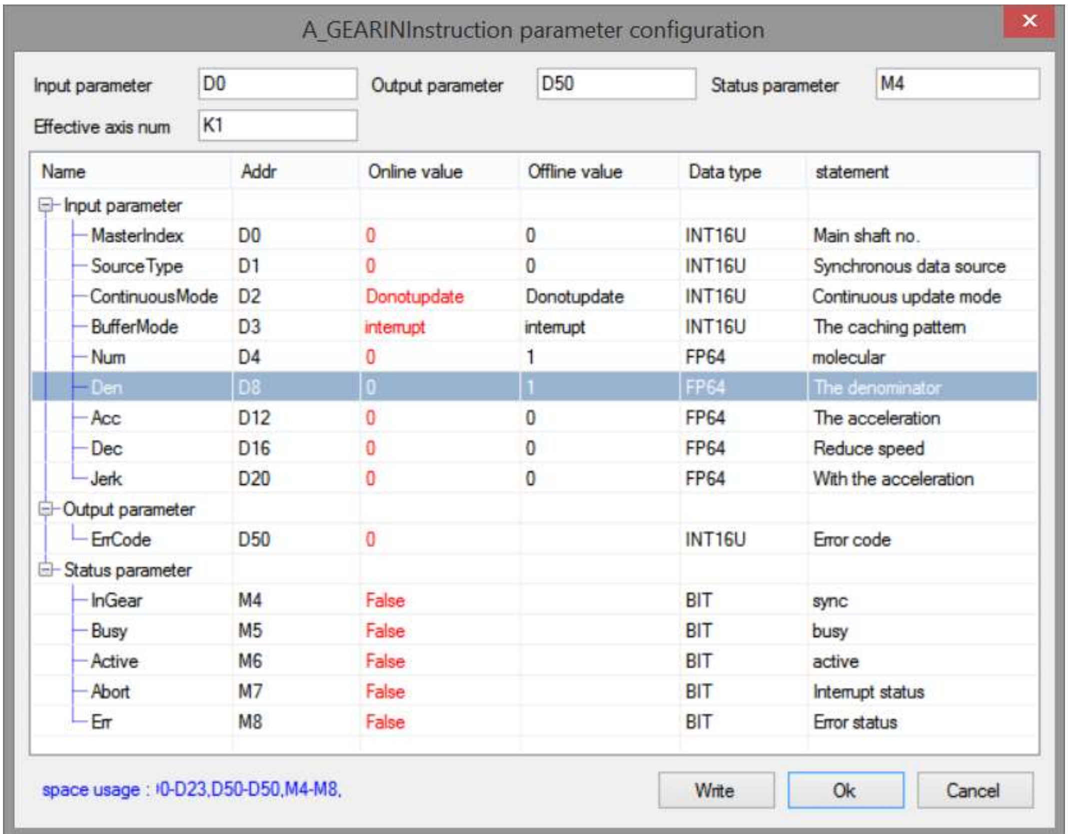


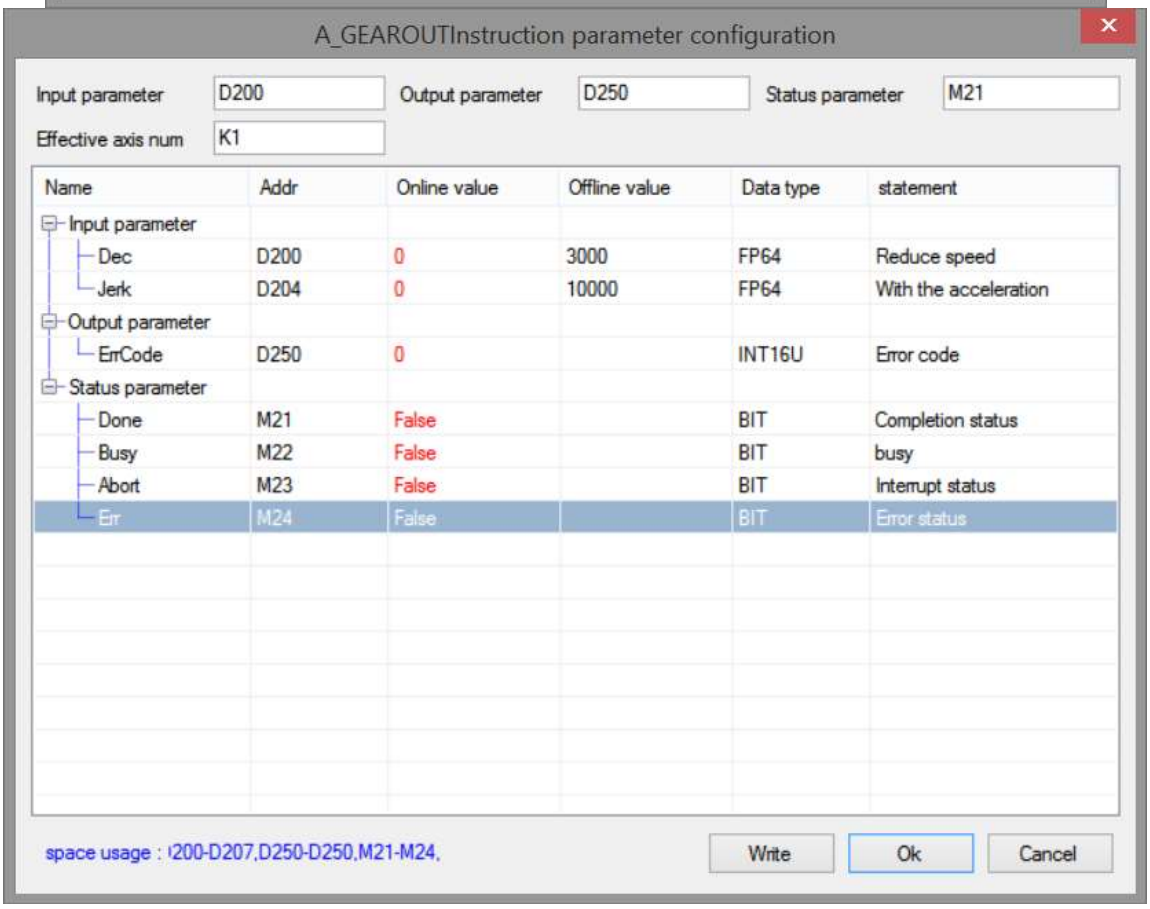
Explanation:
Generally, after the command is triggered, the Busy signal is set, and reset after the command is executed. At the same time, the Done signal is set. Done will reset only after the command is triggered again, otherwise it will not reset automatically.
When the command is interrupted or fault, Abort or Error signal will be set on, other signals will be reset. In case of error, the corresponding error code will be output.

(7) Application
Takes K0 as the master axis and K1 as the slave axis, synchronization coefficient is 1/1, the master axis runs at the speed of 5000 pulse/s. The A_GEAROUT is executed to unbind the slave axis in the motion.
The deceleration of A_GEAROUT is 3000 pulse/s^2, and the jerk speed is 10000 pulse/s^3.



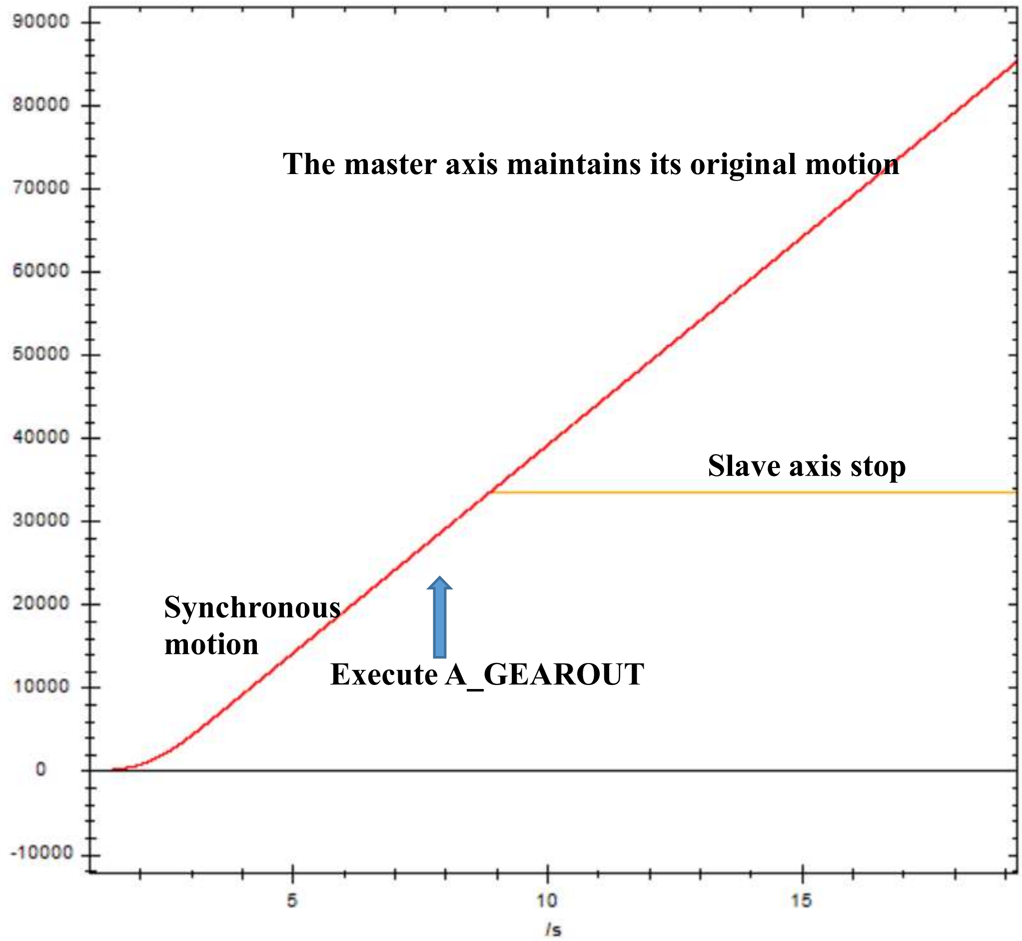
The command configuration is shown as below:





Note: first turns on the enable of axis 0 and axis 1 through A_PWR command. When M3 is from off → on, execute the A_GEARIN instruction to perform synchronous binding. After binding is successful, the instruction completion flag M4 is set to on. The master axis will move through A_MOVER. At this time, the slave axis moves synchronously with the master axis with a binding coefficient of 1/1. During operation, set on M30, A_GEAROUT instruction is executed to unbind.

The position curve is shown as below:



Red is the master axis position curve and yellow is the slave axis position curve. After executing A_GEAROUT, the master axis maintains the original motion. The slave axis stops with the larger deceleration speed between A_GEARIN and A_GEAROUT.

5-1-2-17. Simple absolute position motion【A_DRVA】

(1) Overview

The command moves in absolute position.

Simple absolute position motion [A_DRVA]			
Execution condition	Rising/falling edge of the coil	Suitable model	XDH, XLH, XG2
Firmware	V3.6.1b and above	Software	3.7.4 and above

(2) Operand

Operand	Function	Type
S0	Target position	64-bit, four words
S1	Target speed	64-bit, four words
S2	Acceleration deceleration time	64-bit, four words
S3	Output state bit start address	Bit
S4	Axis output terminal number	16-bit, single word

(3) Suitable soft component

Operand	Word soft component											Bit soft component					
	System								Constant	Module		System					
	D*	FD	TD*	CD*	DX	DY	DM*	DS*	K/H	ID	QD	X	Y	M*	S*	T*	C*
S0	●	●	●	●													
S1	●	●	●	●													
S2	●	●	●	●													
S3														●			
S4	●								●								

*: D means D, HD; TD means TD and HTD; CD means CD, HCD, HSCD and HSD; DM means DM and DHM; DS means DS and DHS; M means M, HM, SM; S means S, HS; T means T, HT; C means C, HC.

(4) Function and action

- S0 specifies the target position
- S1 sepcifies the target speed
- S2 specifies the target acceleration/deceleration time
- S3 specifies output state bit start address, occupies the relay S3~S3+1
- S4 specifies the output terminal number
- When M0 changes from off to on, perform absolute position movement for the axis specified by S3. Its position parameter is S0, speed parameter is S1, acceleration and deceleration parameter is S2 (Note: the unit of acceleration and deceleration is seconds, that is, the time from initial speed to target speed)
- The usage of A_DRVA is the same as that of A_MOVEA instruction, the difference is A_DRVA instruction can be interrupted by other motion instructions in interrupt mode, but other motion instructions cannot be cached in cache mode, and other motion instructions cannot be interrupted
- After executing the instruction, the single axis state (D20000+200*N) of slave axis is 2
- The direction is determined by the target absolute position and the current position. It is positive when the target position is greater than the current position and negative when the target position is less than the current position .
- V3.7.3 and above versions support mold axis, specific calculations can be found in the chapter 6-6. Application of mold axis.

(5) Notes
- A_STOP/A_HALT can be used to stop the motion.
- The instruction has no error code parameters. When any error occurs, state bit Error will be ON. Common errors include that the control mode is not CSP, and the acceleration and deceleration time is 0.

(6) Related parameters

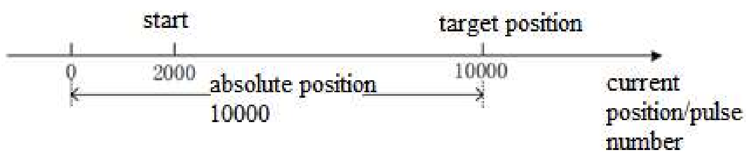
Input parameter	Parameter name	Data type	Unit	Note
S0	Position	FP64	Command	Target position

			unit	
S1	Velocity	FP64	Command unit /s	Target speed
S2	Time	FP64	s	Target acceleration/deceleration time, that is, the time from current speed to target speed
State parameter	Parameter name	Data type	Unit	Note
S3	Done	BOOL	-	Instruction execution completed
S3+1	Error	BOOL	-	Instruction execution error
Axis number	Parameter name	Data type	Unit	Note
S4	Axis	INT16U	-	Axis number starts from 0

(7) Application

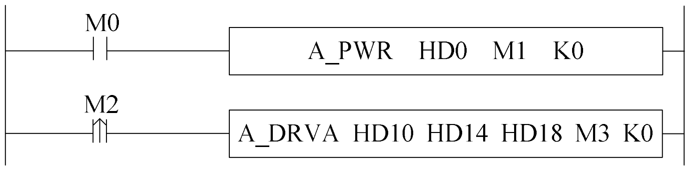
The motor current position is 2000, it requires to move to 10000 pulses position with the speed 5000 pulse/s. the acceleration/deceleration time is 0.5s.

Motor position diagram in absolute position mode:

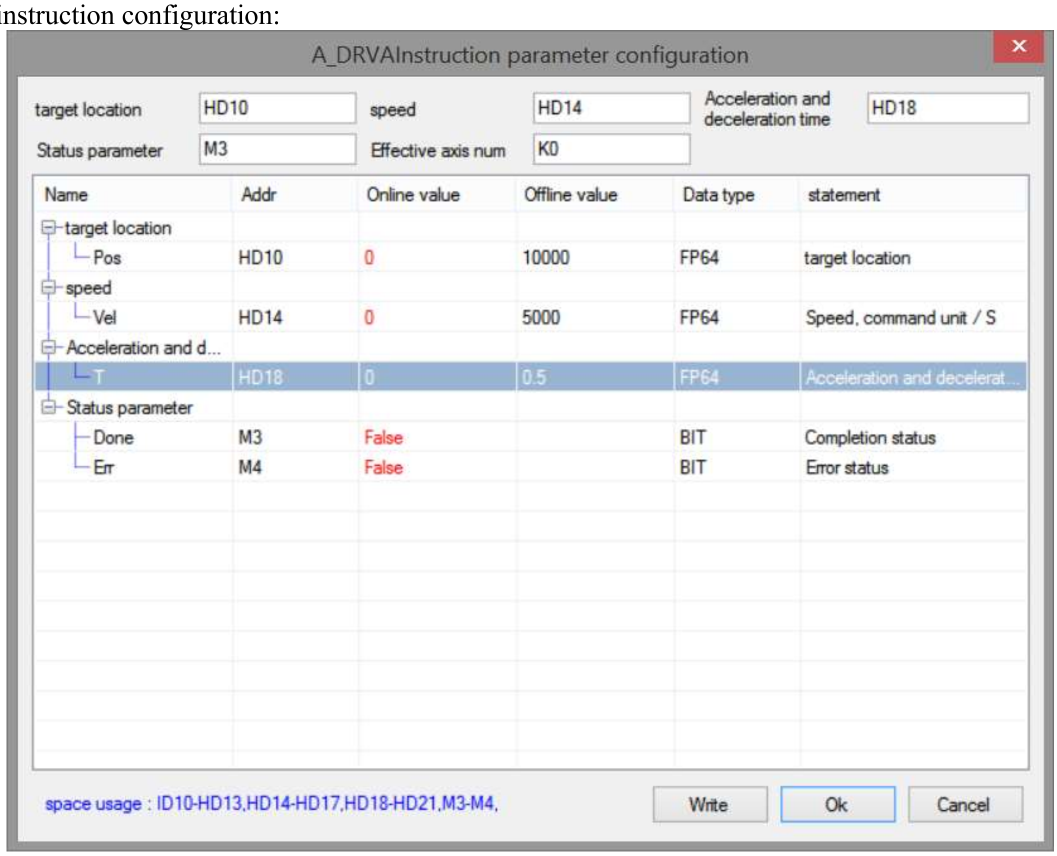


The target position in the command is the absolute position from zero point to target point, so moving to the position of 10000 pulses requires setting the target position 10000.

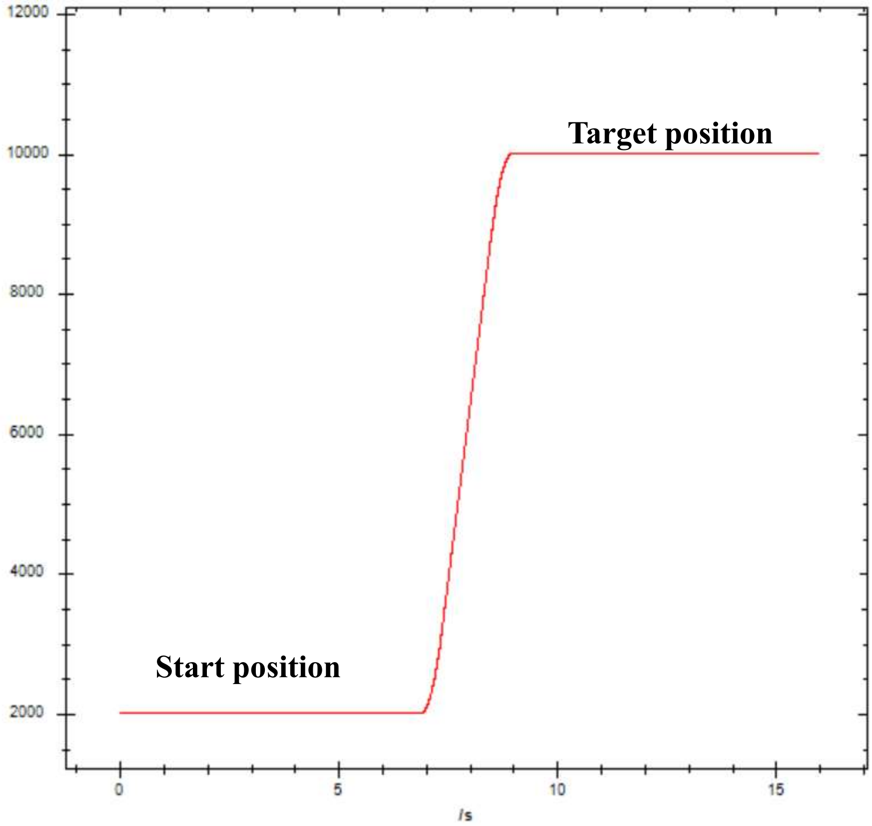
The ladder chart:



The instruction configuration:



Explanation:
First enable through A_PWR instruction, when M2 is from OFF→ON, move to the target position with setting parameters.
The execution position curve is shown as below:



5-1-2-18. Simple relative position motion【A_DRVI】

(1) Overview

The command moves in relative position.

Simple relative position motion [A_DRVI]			
Execution condition	Rising/falling edge of the coil	Suitable model	XDH, XLH, XG2
Firmware	V3.6.1b and above	Software	3.7.4 and above

(2) Operand

Operand	Function	Type
S0	Target position	64-bit, four words
S1	Target speed	64-bit, four words
S2	Acceleration deceleration time	64-bit, four words
S3	Output state bit start address	Bit
S4	Axis output terminal number	16-bit, single word

(3) Suitable soft component

Operand	Word soft component											Bit soft component					
	System								Constant	Module		System					
	D*	FD	TD*	CD*	DX	DY	DM*	DS*	K/H	ID	QD	X	Y	M*	S*	T*	C*
S0	●	●	●	●													
S1	●	●	●	●													
S2	●	●	●	●													
S3														●			
S4	●								●								

*: D means D, HD; TD means TD and HTD; CD means CD, HCD, HSCD and HSD; DM means DM and DHM; DS means DS and DHS; M means M, HM, SM; S means S, HS; T means T, HT; C means C, HC.

(4) Function and action

- S0 specifies the target position
- S1 sepcifies the target speed
- S2 specifies the target acceleration/deceleration time
- S3 specifies output state bit start address, occupies the relay S3~S3+1
- S4 specifies the output terminal number
- When M0 changes from off to on, perform relative position movement for the axis specified by S3. Its position parameter is S0, speed parameter is S1, acceleration and deceleration parameter is S2 (Note: the unit of acceleration and deceleration is seconds, that is, the time from initial speed to target speed)
- The usage of A_DRVI is the same as that of A_MOVER instruction, the difference is A_DRVI instruction can be interrupted by other motion instructions in interrupt mode, but other motion instructions cannot be cached in cache mode, and other motion instructions cannot be interrupted
- After executing the instruction, the single axis state (D20000+200*N) of slave axis is 2
- The direction is determined by the positive/negative of the target position.
- V3.7.3 and above versions support mold axis, specific calculations can be found in the chapter 6-6. Application of mold axis.

(5) Notes

- A_STOP/A_HALT can be used to stop the motion.
- The instruction has no error code parameters. When any error occurs, state bit Error will be ON. Common errors include that the control mode is not CSP, and the acceleration and deceleration time is 0.

(6) Related parameters

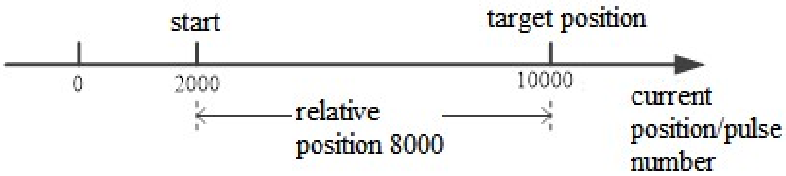
Input parameter	Parameter name	Data type	Unit	Note
S0	Position	FP64	Command unit	Target position
S1	Velocity	FP64	Command	Target speed

			unit /s	
S2	Time	FP64	s	Target acceleration/deceleration time, that is, the time from current speed to target speed
State parameter	Parameter name	Data type	Unit	Note
S3	Done	BOOL	-	Instruction execution completed
S3+1	Error	BOOL	-	Instruction execution error
Axis number	Parameter name	Data type	Unit	Note
S4	Axis	INT16U	-	Axis number starts from 0

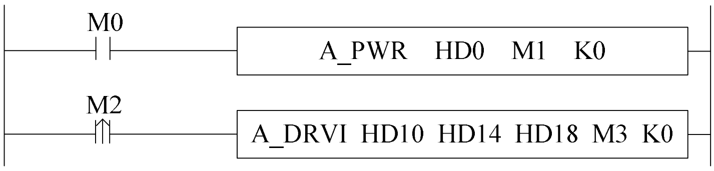
(7) Application

The motor present position is 2000, it requires to move to 10000 pulses position at the speed of 5000 pulse/s through A_DRVI instruction. The acceleration/deceleration time is 0.5s.

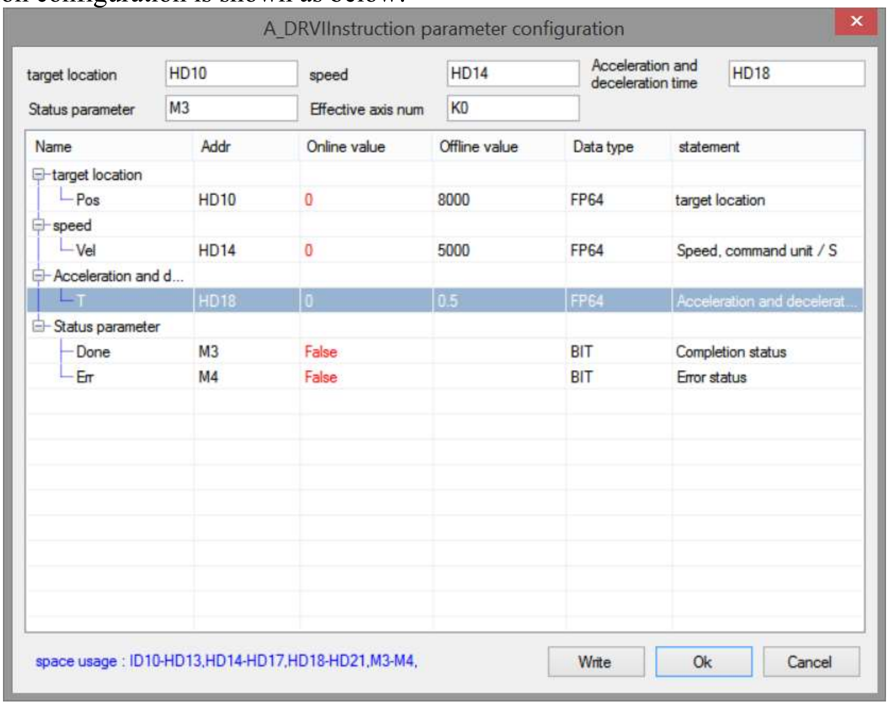
The motor position diagram in relative position mode:



The present position is 2000, it needs to send 8000 pulses to move to 10000 pulses position in relative mode. The ladder chart is shown as below:



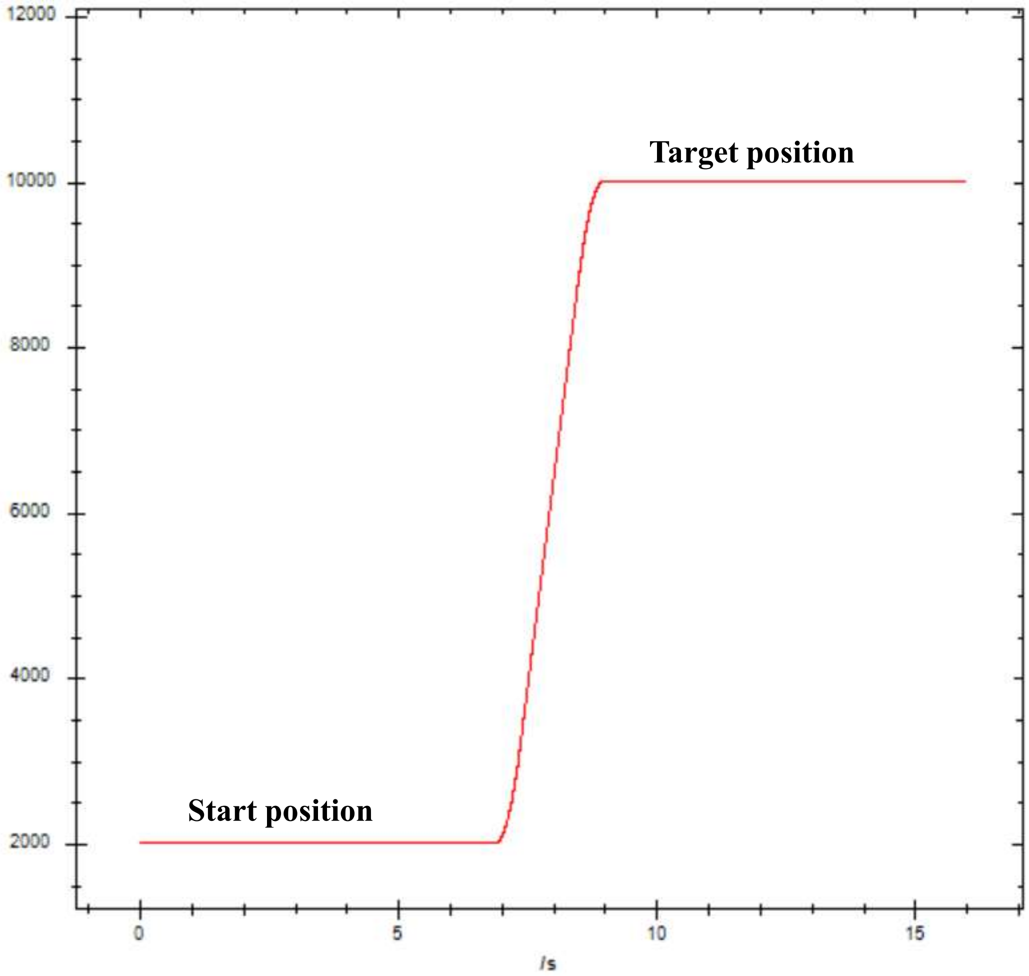
The instruction configuration is shown as below:



Explanation:

First turn on the enable through A_PWR instruction. When M2 is from OFF→ON, it moves to the target position with setting parameters.

The execution position curve is shown as the following:



Target position
Start position
12000
10000
8000
6000
4000
2000
0
5
10
15
/s

5-1-2-19. Probe function【A_PROBE, A_PROBE_1…A_PROBE_5】

(1) Overview

The probe function is the position latch function, which latches the current position when the command is triggered.

Probe function [A_PROBE]			
Execution condition	Normally ON/OFF coil	Suitable	XDH, XLH, XG2
Firmware	V3.6.1b and above	Software	3.7.4 and above
1 Probe function [A_PROBE_1]			
Execution condition	Normally ON/OFF coil	Suitable	XDH, XLH, XG2
Firmware	V3.7.2 and above	Software	3.7.14 and above
2 Probe function [A_PROBE_2]			
Execution condition	Normally ON/OFF coil	Suitable	XDH, XLH, XG2
Firmware	V3.7.2 and above	Software	3.7.14 and above
3 Probe function [A_PROBE_3]			
Execution condition	Normally ON/OFF coil	Suitable	XDH, XLH, XG2
Firmware	V3.7.3 and above	Software	3.7.16 and above
4 Probe function [A_PROBE_4]			
Execution condition	Normally ON/OFF coil	Suitable	XDH, XLH, XG2
Firmware	V3.7.3 and above	Software	3.7.16 and above
5 Probe function [A_PROBE_5]			
Execution condition	Normally ON/OFF coil	Suitable	XDH, XLH, XG2
Firmware	V3.7.3 and above	Software	3.7.16 and above
6 Probe function [A_PROBE_6]			
Execution condition	Normally ON/OFF coil	Suitable	XDH, XLH, XG2
Firmware	V3.7.3 and above	Software	3.7.16 and above

(2) Operand

Operand	Function	Type
S0	Input parameter start address	16-bit, single word
S1	Output state word start address	16-bit, single word
S2	Output state bit start address	Bit
S3	Axis output terminal number	16-bit, single word

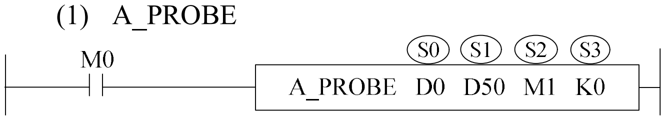
(3) Suitable soft component

Operand	Word soft component											Bit soft component					
	System								Constant	Module		System					
	D*	FD	TD*	CD*	DX	DY	DM*	DS*	K/H	ID	QD	X	Y	M*	S*	T*	C*
S0	●	●	●	●													
S1	●	●	●	●													
S2														●			
S3									●								

*: D means D, HD; TD means TD and HTD; CD means CD, HCD, HSCD and HSD; DM means DM and DHM; DS means DS and DHS; M means M, HM, SM; S means S, HS; T means T, HT; C means C, HC.

(4) Function and action

(1) A_PROBE



- S0 specifies input parameter start address, occupies the register S0~S0+24
- S1 specifies output state word start address, occupies the register S1~S1+11

- S2 specifies output state bit start address, occupies the relay S2~S2+3
- S3 specifies the axis terminal number, only can select EtherCAT axis
- When M0 is from OFF→ON, turn on the probe for the axis specified by S3. Write the current position value to the latch register
- It needs to distribute the specified axis Ethercat parameter 60B8h, 60B9h, 60Bah, 60BBh, 60BCh, 60BDh to the PDO mapping (60BAh~60BDh are distributed as the probe using condition, the PDO size cannot over 32 bytes). At present, only the signal from the slave station is supported as the probe trigger source. See EtherCAT motion control manual for the configuration mode of PDO.
- It takes a certain time from the generation of external trigger signal to the driver receiving signal and position locking. Therefore, the value of probe locking must have an error with the theoretical value. The error is related to the motor speed, hardware performance and software processing
- After executing the instruction, the slave station single axis state (D20000+200*N) keeps unchanged
- Software versions 3.7.16 and above require PDO parameters to be assigned in the axis configuration probe configuration, as shown in the example.

(2) A_PROBE_1

- To use the command, 60B8h, 60B9h, 60BAh and 60BBh in the EtherCAT parameters of the specified axis need to be assigned to the PDO mapping
- Others are the same as A_ PROBE instruction
- Software versions 3.7.16 and above require PDO parameters to be assigned in the axis configuration probe configuration, as shown in the example.

(3) A_PROBE_2

- To use the command, 60B8h, 60B9h, 60BAh and 60BBh in the EtherCAT parameters of the specified axis need to be assigned to the PDO mapping
- Others are the same as A_ PROBE instruction
- Software versions 3.7.16 and above require PDO parameters to be assigned in the axis configuration probe configuration, as shown in the example.

(4) A_PROBE_3

- When selecting a slave station as the trigger source for the probe, taking DS5C as an example, the default servo probe 3 is used. To use the command, A000h, A001h, A002h, and A003h in the EtherCAT parameters of the specified axis need to be assigned to the PDO mapping
- Others are the same as A_ PROBE instruction
- Software versions 3.7.16 and above require PDO parameters to be assigned in the axis configuration probe configuration, as shown in the example.

(5) A_PROBE_4

- When selecting a slave station as the trigger source for the probe, taking DS5C as an example, the default servo probe 4 is used. To use the command, A000h, A001h, A002h, and A003h in the EtherCAT parameters of the specified axis need to be assigned to the PDO mapping
- Others are the same as A_ PROBE instruction
- Software versions 3.7.16 and above require PDO parameters to be assigned in the axis configuration probe configuration, as shown in the example.

(6) A_PROBE_5

- When selecting a slave station as the trigger source for the probe, taking DS5C as an example, the default servo probe 5 is used. To use the command, A000h, A001h, A002h, and A003h in the EtherCAT parameters of the specified axis need to be assigned to the PDO mapping

- Others are the same as A_ PROBE instruction
- Software versions 3.7.16 and above require PDO parameters to be assigned in the axis configuration probe configuration, as shown in the example.

(7) A_PROBE_6

- Others are the same as A_ PROBE instruction
- Software versions 3.7.16 and above require PDO parameters to be assigned in the axis configuration probe configuration, as shown in the example.

(5) Notes

- Only one probe command can be written for the same axis, otherwise double coils will be generated
- When probe 1 and probe 2 are enabled at the same time, the position will not be refreshed until both probes are triggered
- When the trigger source is the master station, the trigger signal needs to select the corresponding external interrupt port, and there needs to be a corresponding external interrupt program in the program (see the example at the end of this section for specific use)
- When the pulse axis and encoder axis use this command, they need to connect the encoder externally and use the high-speed counting command, and need to set the parameters of the probe in the axis configuration (only V3.7.2 and above versions support the encoder axis).
- V3.7.3 and above versions support mold axis, specific calculations can be found in the chapter 6-6. Application of mold axis.

(6) Related parameters

A_PROBE

Input parameter	Parameter name	Data type	Unit	Note
S0	Index	INT16U	-	Probe number 0: probe 1 1: probe 2 2: probe 1 and probe 2
S0+1	Source1	INT16U	-	Probe 1 trigger source 0: slave station 1: master station (Only V3.7.1 and above versions support the master station as the trigger source)
S0+2	Edge1	INT16U	-	Probe 1 trigger edge 0: rising edge 1: falling edge
S0+3	Signal1	INT16U	-	Probe 1 trigger signal 0: external signal 1: Z phase signal 2: external interrupt 0, X2 3: external interrupt 1, X3 4: external interrupt 2, X4 5: external interrupt 3, X5 6: external interrupt 4, X6 7: external interrupt 5, X7 8: external interrupt 6, X10 9: external interrupt 7, X11 10: external interrupt 8, X12 11: external interrupt 9, X13
S0+4	WindowStart1	FP64	Command unit	Probe 1 window start position
S0+8	WindowEnd1	FP64	Command unit	Probe 1 window end position
S0+12	WindowUsed1	INT16U	-	Window index 0: not use window 1: use window

Input parameter	Parameter name	Data type	Unit	Note
S0+13	Source2	INT16U	-	Probe 2 trigger source 0: slave station 1: master station
S0+14	Edge2	INT16U	-	Probe 2 trigger edge 0: rising edge 1: falling edge
S0+15	Signal2	INT16U	-	Probe 2 trigger signal 0: external signal 1: Z phase signal 2: external interrupt 0, X2 3: external interrupt 1, X3 4: external interrupt 2, X4 5: external interrupt 3, X5 6: external interrupt 4, X6 7: external interrupt 5, X7 8: external interrupt 6, X10 9: external interrupt 7, X11 10: external interrupt 8, X12 11: external interrupt 9, X13
S0+16	WindowStart2	FP64	Command unit	Probe 2 window start position
S0+20	WindowEnd2	FP64	Command unit	Probe 2 window end position
S0+24	WindowUsed2	INT16U	-	Window index 0: not use window 1: use window
Output parameter	Parameter name	Data type	Unit	Note
S1	ErrCode	INT16U	-	Command error code
S1+4	Position1	FP64	Command unit	Probe 1 latch position
S1+8	Position2	FP64	Command unit	Probe 2 latch position
State parameter	Parameter name	Data type	Unit	Note
S2	Done	BOOL	-	Instruction execution completed
S2+1	Busy	BOOL	-	The instruction is being executed
S2+2	Abort	BOOL	-	Instruction is interrupted
S2+3	Error	BOOL	-	Instruction execution error
Axis number	Parameter name	Data type	Unit	Note
S3	Axis	INT16U	-	The axis number starts from 0

Note:
The window of the probe represents the range of the latch position. When the window is enabled, only the current position when the probe is triggered is written to the latch position within the window range.

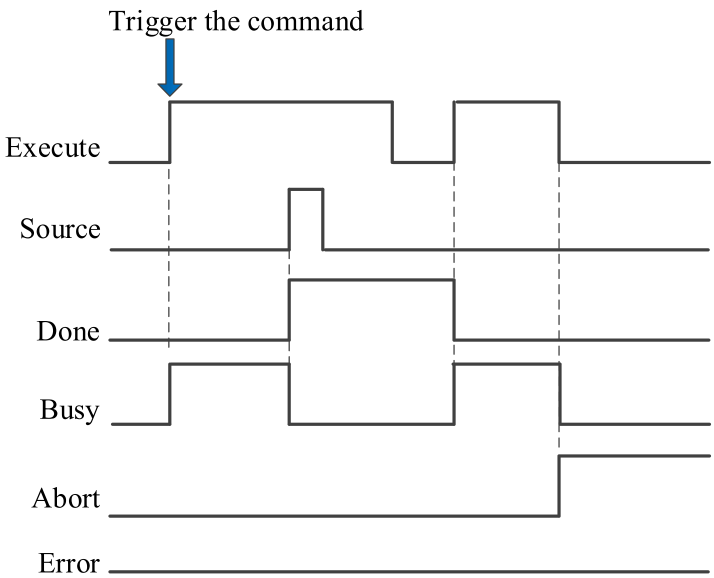
A_PROBE_1, A_PROBE_2

Input parameter	Name	Data type	Unit	Note
S0	Source	INT16U	-	trigger source 0: slave station 1: master station
S0+1	Edge	INT16U	-	trigger edge 0: rising edge 1: falling edge
S0+2	Signal	INT16U	-	trigger signal

Input parameter	Name	Data type	Unit	Note
				0: external signal 1: Z phase signal 2: external interrupt 0, X2 3: external interrupt 1, X3 4: external interrupt 2, X4 5: external interrupt 3, X5 6: external interrupt 4, X6 7: external interrupt 5, X7 8: external interrupt 6, X10 9: external interrupt 7, X11 10: external interrupt 8, X12 11: external interrupt 9, X13
S0+3	WindowUsed	INT16U	-	Window index* 0: not use window 1: use window
S0+4	WindowStart	FP64	Command unit	window start position
S0+8	WindowEnd	FP64	Command unit	window end position
Output parameter	**Parameter name**	**Data type**	**Unit**	**Note**
S1	ErrCode	INT16U	-	Command error code
S1+4	Position	FP64	Command unit	Latch position
S1+8	Vel	FP64	Command unit/s	Latch speed
State parameter	**Parameter name**	**Data type**	**Unit**	**Note**
S2	Done	BOOL	-	Instruction execution completed
S2+1	Busy	BOOL	-	The instruction is being executed
S2+2	Abort	BOOL	-	Instruction is interrupted
S2+3	Error	BOOL	-	Instruction execution error
Axis number	**Parameter name**	**Data type**	**Unit**	**Note**
S3	Axis	INT16U	-	The axis number starts from 0

* Note: The window of the probe represents the range of the latch position. When the window is enabled, only the current position when the probe is triggered will be written to the latch position within the range of the window.

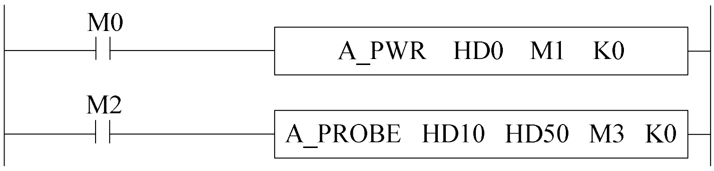
(7) Sequence diagram



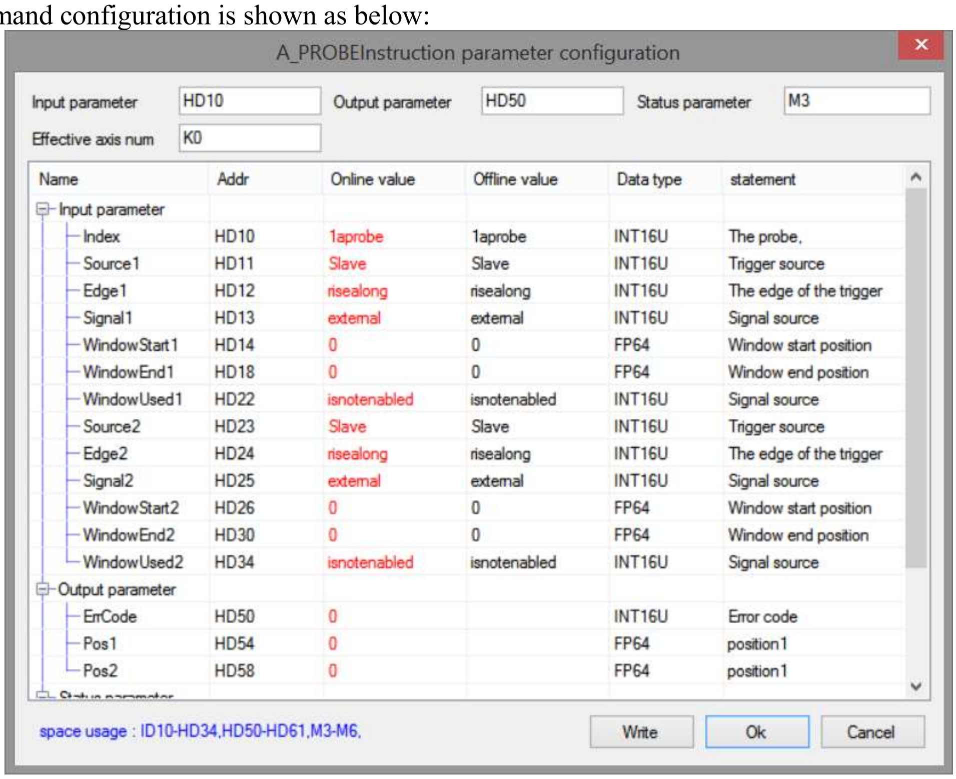
Explanation:
Generally, after the command is triggered, the Busy signal is set. Only after the edge signal of the trigger source is detected to refresh the position, the Done signal is set and the Busy signal is reset. Only after the command is triggered and executed again, the Done will be reset, otherwise it will not be reset automatically.
When there is an error in the instruction or the instruction is interrupted, the Error or Abort signal is set, other signals are reset, and the corresponding error code will be output in case of error.

(8) Application

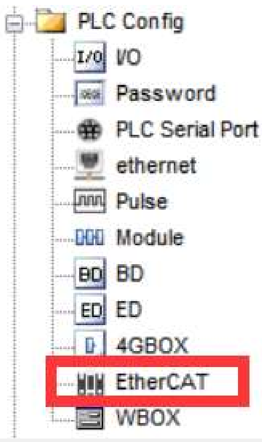
Eg1: The specified axis is required to turn on the probe function, the probe trigger source is the slave station, and the probe trigger records the current position. The ladder diagram is as follows

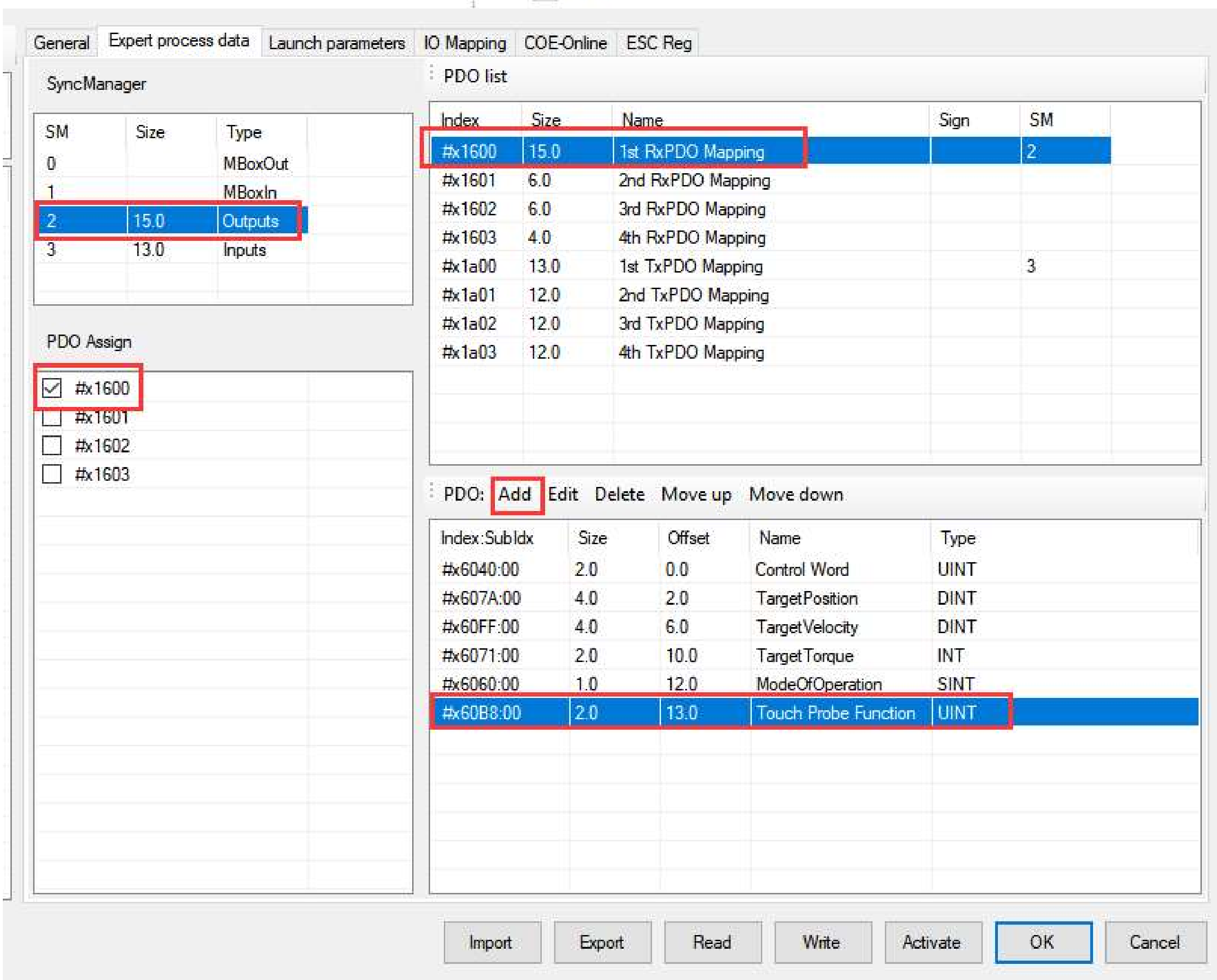


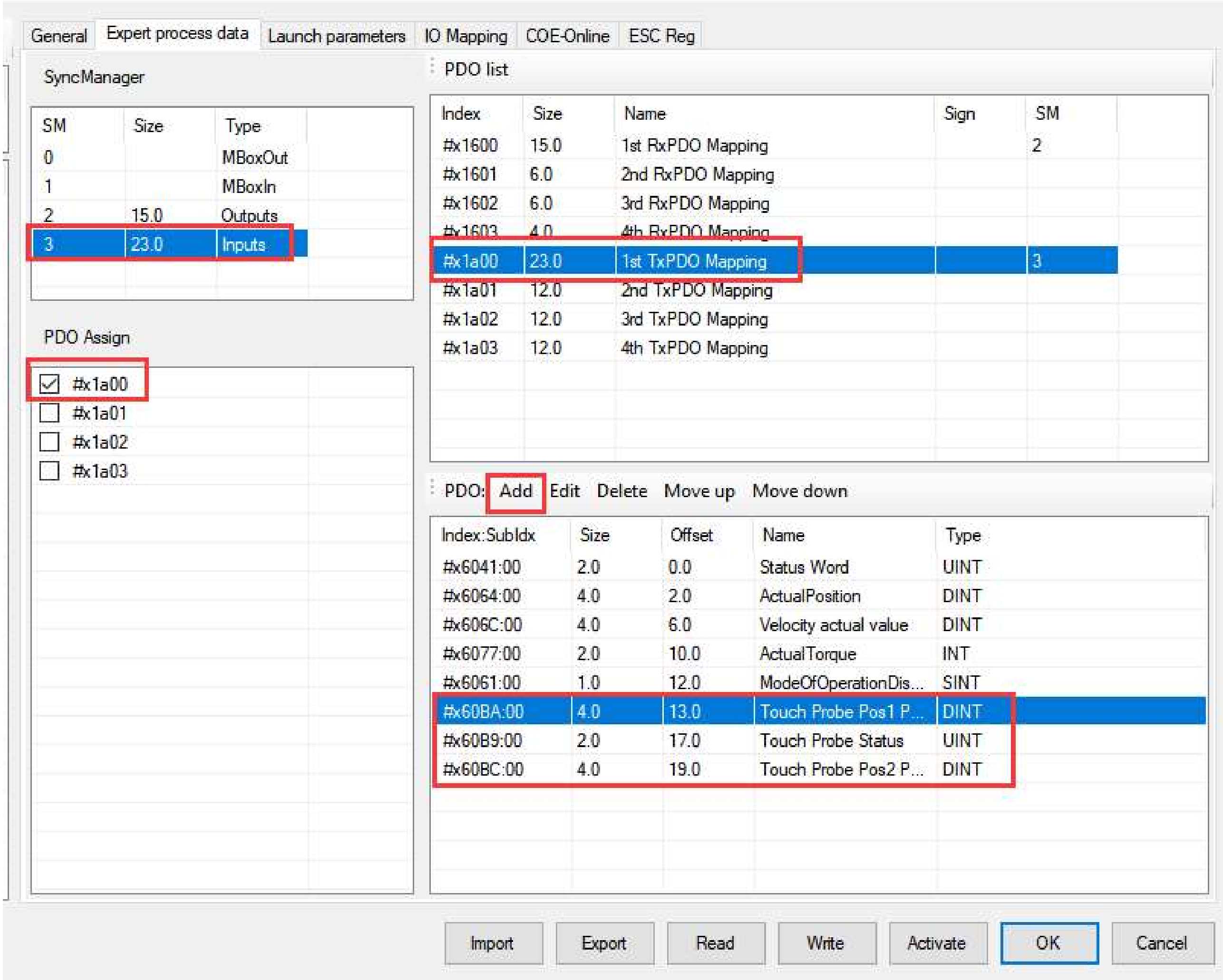
The command configuration is shown as below:



Explanation:
When selecting the slave station for the probe trigger source, the expert process data is required to configure the parameters related to the probe function 60B8h, 60B9h, 60Bah, 60BCh. After setting, trigger A_PROBE command can start the probe, and the probe signal terminal is set by the slave station.
Take DS5C as an example, P5-62 and P5-63 are used for terminal allocation of probe function. The default value of P5-62 is 5, that is, the terminal of probe 1 is P-, and the default value of P5-63 is 6, that is, the terminal of probe 2 is D-, probe 1 can only be allocated to P-, and probe 2 can only be allocated to D-.
When the probe is turned on, whenever the level signal of the probe terminal jumps, the probe will be triggered. At this time, the current position value will be stored in the probe latch position (register address specified by S1 + 4 and S1 + 8 in the instruction)
Expert process data configuration is shown as below:

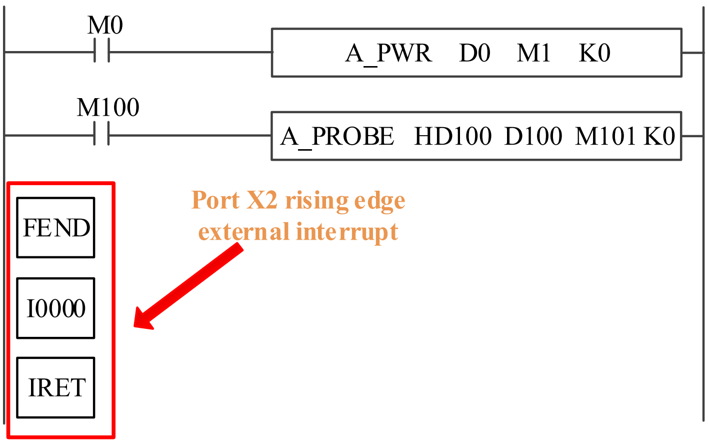

PLC Config
I/O
Password
PLC Serial Port
ethernet
Pulse
Module
BD
ED
4GBOX
EtherCAT
WBOX


General
Expert process data
Launch parameters
IO Mapping
COE-Online
ESC Reg
SyncManager
SM Size Type
0 MBoxOut
1 MBoxIn
2 15.0 Outputs
3 13.0 Inputs
PDO list
Index Size Name Sign SM
#x1600 15.0 1st RxPDO Mapping 2
#x1601 6.0 2nd RxPDO Mapping
#x1602 6.0 3rd RxPDO Mapping
#x1603 4.0 4th RxPDO Mapping
#x1a00 13.0 1st TxPDO Mapping 3
#x1a01 12.0 2nd TxPDO Mapping
#x1a02 12.0 3rd TxPDO Mapping
#x1a03 12.0 4th TxPDO Mapping
PDO Assign
#x1600
#x1601
#x1602
#x1603
PDO: Add Edit Delete Move up Move down
Index:SubIdx Size Offset Name Type
#x6040:00 2.0 0.0 Control Word UINT
#x607A:00 4.0 2.0 TargetPosition DINT
#x60FF:00 4.0 6.0 TargetVelocity DINT
#x6071:00 2.0 10.0 TargetTorque INT
#x6060:00 1.0 12.0 ModeOfOperation SINT
#x60B8:00 2.0 13.0 Touch Probe Function UINT
Import
Export
Read
Write
Activate
OK
Cancel

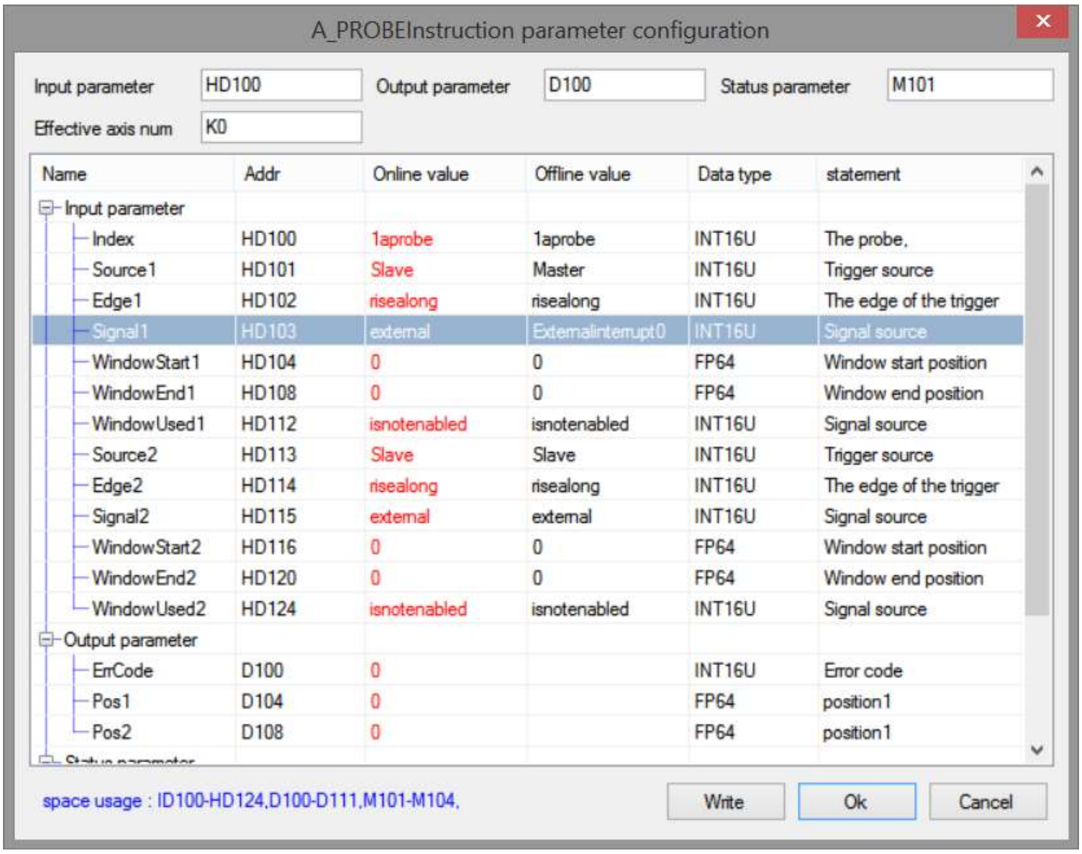


Please add the PDO parameters according to the related index. As the above photo, 60B8h is added in RxPDO #x1600. 60B9h, 60Bah, 60BCh are added in TxPDO #x1a00. (this example uses the rising edge of the probe signal, if the falling edge is used, please add 60B9h, 60BBh, 60BDh in #x1a00)

Eg2: The specified axis is required to turn on the probe function, use the rising edge of X2 port of the master station as the trigger source, and the probe is triggered to record the current position. The ladder diagram is as follows:

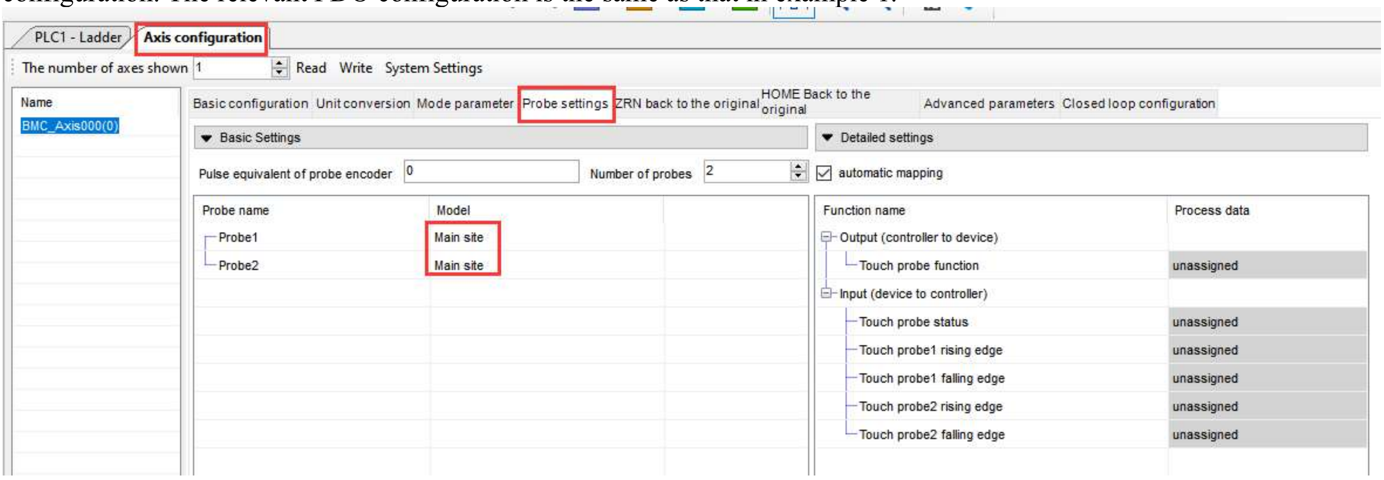


The command configuration is shown as below:



Explanation:

Since the master station is used as the trigger source, there should be an external interrupt program of the corresponding port in the program, and the corresponding external interrupt needs to be selected during instruction configuration. The relevant PDO configuration is the same as that in example 1.



After triggering the instruction and generating a rising edge at port X2, the instruction will latch the position of the specified axis into the corresponding register.

5-1-2-20. Periodic position control motion【A_CYCPOS】

(1) Overview

Performs periodic position control on the specified axis.

Periodic position control motion [A_CYCPOS]			
Execution condition	Rising/falling edge of the coil	Suitable model	XDH, XLH, XG2
Firmware	V3.6.1b and above	Software	3.7.4 and above

(2) Operand

Operand	Function	Type
S0	Input parameter start address	64-bit, four words
S1	Output state word start address	16-bit, single word
S2	Output state bit start address	Bit
S3	Axis output terminal number	16-bit, single word

(3) Suitable soft component

Operand	Word soft component											Bit soft component					
	System								Constant	Module		System					
	D*	FD	TD*	CD*	DX	DY	DM*	DS*	K/H	ID	QD	X	Y	M*	S*	T*	C*
S0	●	●	●	●													
S1	●	●	●	●													
S2														●			
S3	●								●								

*: D means D, HD; TD means TD and HTD; CD means CD, HCD, HSCD and HSD; DM means DM and DHM; DS means DS and DHS; M means M, HM, SM; S means S, HS; T means T, HT; C means C, HC.

(4) Function and action

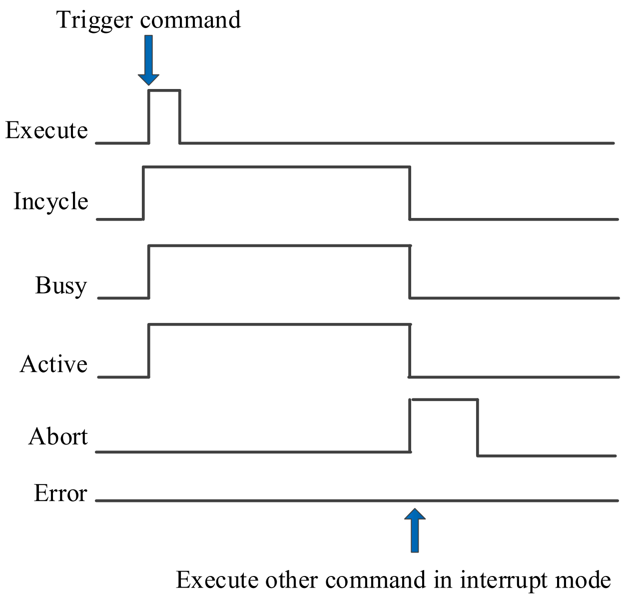
- S0 specifies input parameter start address, occupies the register S0~S0+5
- S1 specifies output state word start address
- S2 specifies output state bit start address, occupies the relay S2~S2+4
- S3 specifies the axis terminal number
- When M0 changes from off to on, perform periodic position control on the axis specified by S3. After successful execution, S2 is set to on, indicating that the axis is in periodic control state. The axis is controlled by periodically assigning values to S0
- Before triggering the command, please ensure that the value of S0 is the same as the current position, otherwise the position will produce a step
- The periodic position control needs to periodically write the target position value into the register, and the position change should not be too large to avoid the flying of the slave axis due to the large difference between the given periodic position and the previous periodic position.
- A_WRITE command can be used to change the target location or in combination with I9900 cycle interrupt. After executing the instruction, set on SM1995 to trigger the interrupt and continuously accumulate the values in the position register, so as to realize that the periodic position control. The direction is jointly determined by the parameter target position and the current position. It is positive when the target position is greater than the current position and negative when the target position is less than the current position.
- V3.7.3 and above versions support mold axis, specific calculations can be found in the chapter 6-6. Application of mold axis.

(5) Related parameters

Input parameters	Parameter name	Data type	Unit	Note
S0	Position	FP64	Command unit	Target position
S0+4	Direction	INT16U	-	Direction (effective in mold axis mode): 0: No direction 1: Forward direction

				2: Negative direction 3: Shortest path 4: Current direction
S0+5	BufferMode	INT16U	-	Buffer mode 0: interrupt mode 1: buffer mode
Output parameter	Parameter name	Data type	Unit	Note
S1	ErrCode	INT16U	-	Command error code
State parameter	Parameter name	Data type	Unit	Note
S2	Incycle	BOOL	-	Periodic control
S2+1	Busy	BOOL	-	The instruction is being executed
S2+2	Active	BOOL	-	Command under control
S2+3	Abort	BOOL	-	Instruction is interrupted
S2+4	Error	BOOL	-	Instruction execution error
Axis number	Parameter name	Data type	Unit	Note
S3	Axis	INT16U	-	Axis number starts from 0

(6) Sequence diagram



Explanation:
Trigger command, Busy and Active signals are set, and Incycle signal is set when the axis reaches periodic control.
During cycle control, other commands are executed in interrupt mode, Abort signal is set, and Incycle, Busy and Active signals are reset.

5-1-2-21. Periodic speed control motion【A_CYCVEL】

(1) Overview

Switch the servo mode to CSV mode and output the given target speed to the servo in the task cycle.

Periodic speed control motion [A_CYCVEL]			
Execution condition	Rising/falling edge of the coil	Suitable model	XDH, XLH, XG2
Firmware	V3.7.1 and above	Software	3.7.4 and above

(2) Operand

Operand	Function	Type
S0	Input parameter start address	64-bit, four words
S1	Output state word start address	16-bit, single word
S2	Output state bit start address	Bit
S3	Axis output terminal number	16-bit, single word

(3) Suitable soft component

Operand	Word soft component											Bit soft component					
	System								Constant	Module		System					
	D*	FD	TD*	CD*	DX	DY	DM*	DS*	K/H	ID	QD	X	Y	M*	S*	T*	C*
S0	●	●	●	●													
S1	●	●	●	●													
S2														●			
S3	●								●								

*: D means D, HD; TD means TD and HTD; CD means CD, HCD, HSCD and HSD; DM means DM and DHM; DS means DS and DHS; M means M, HM, SM; S means S, HS; T means T, HT; C means C, HC.

(4) Function and action

- S0 specifies input parameter start address.
- S1 specifies output state word start address.
- S2 specifies output state bit start address.
- S3 specifies the axis terminal number .
- When M0 changes from off → on, perform periodic speed motion control on the axis specified by S3. After successful execution, S2 is set, indicating that the target axis is in periodic control state, and the axis speed is controlled by periodically assigning values to S0.

(5) Notes

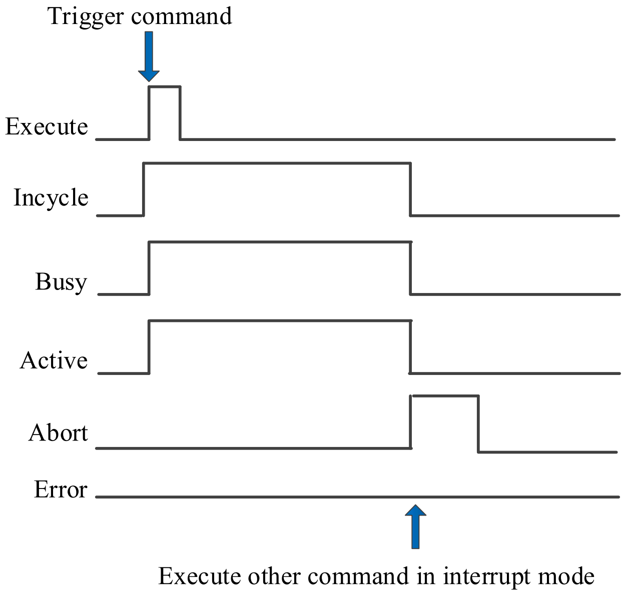
- The switching mode is issued by the controller, but the actual switching time is determined by the servo.
- Executing the motion command can switch the servo to CSP mode, but it needs to meet the current feedback speed of three cycles <= maximum speed * 0.1.
- The last mode is still running between the start of mode switching and the success of mode switching.
- The command is not supported by the pulse axis.
- V3.7.3 and above versions support mold axis, specific calculations can be found in the chapter 6-6. Application of mold axis.

(6) Related parameters

Input parameter	Parameter name	Data type	Unit	Note
S0	Velocity	FP64	Command unit/s	Target speed
S0+4	Buffermode	INT16U	-	Buffer mode 0: interrupt mode 1: buffer mode
Output parameter	Parameter name	Data type	Unit	Note
S1	ErrCode	INT16U	-	Command error code

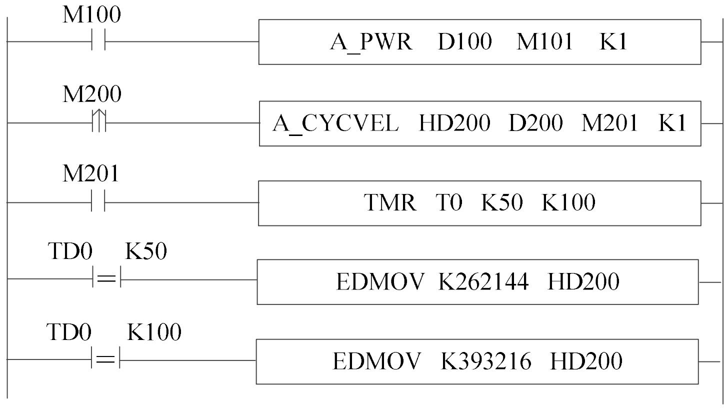
State parameter	Parameter name	Data type	Unit	Note
S2	Incycle	BOOL	-	Periodic control
S2+1	Busy	BOOL	-	The instruction is being executed
S2+2	Active	BOOL	-	Command under control
S2+3	Abort	BOOL	-	Instruction is interrupted
S2+4	Error	BOOL	-	Instruction execution error
Axis number	**Parameter name**	**Data type**	**Unit**	**Note**
S3	Axis	INT16U	-	Axis number starts from 0

(7) Sequence diagram

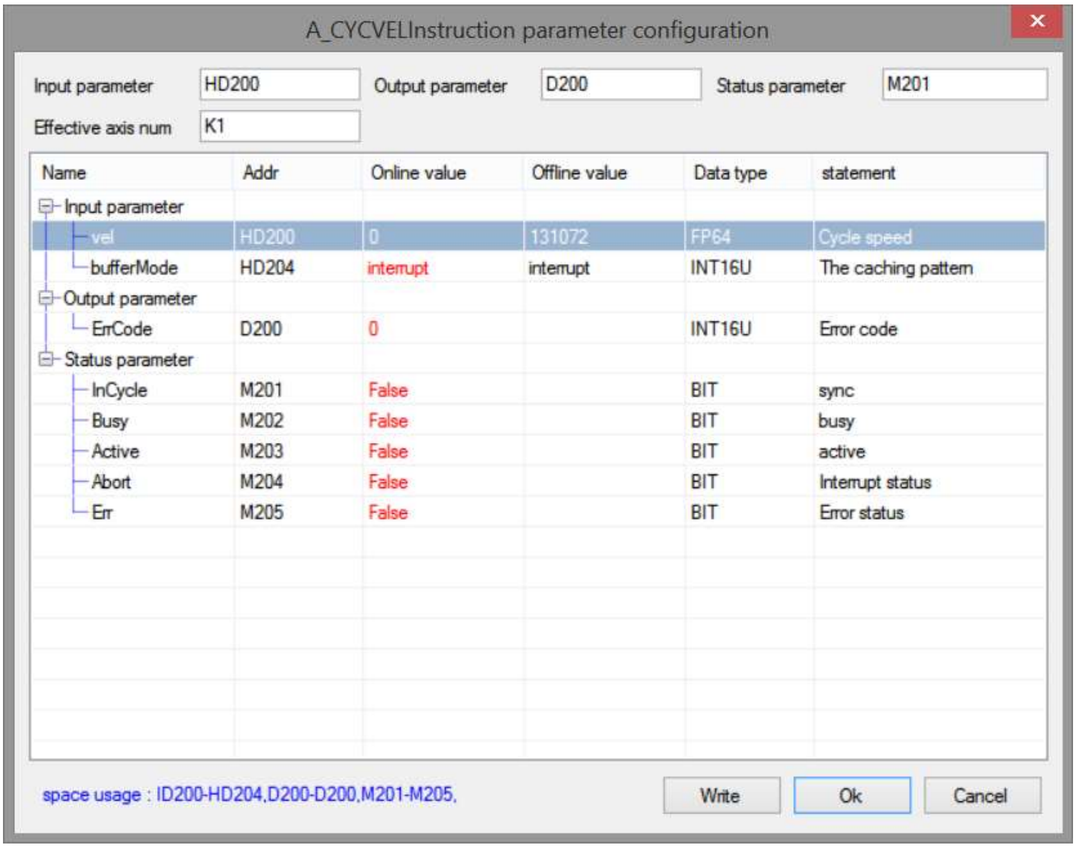


Explanation:
Trigger command, Busy and Active signals are set, and Incycle signal is set when the axis reaches periodic control.
During cycle control, other commands are executed in interrupt mode, Abort signal is set, and Incycle signal is reset.

(8) Application
For example, the servo is required to run at the speed of 131072 pulse/s in CSV mode, and then increase the speed by 131072 pulse/s every 5 seconds. When the speed reaches 3 times the initial speed, it will continue to run at this speed. The ladder diagram is shown in the following figure:



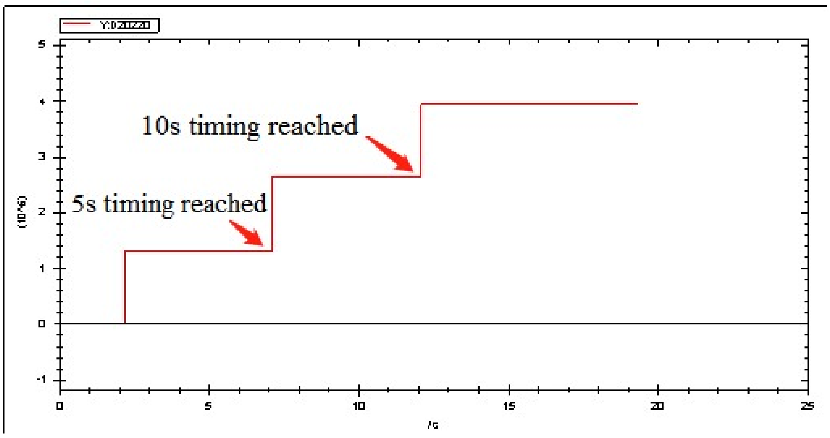
The command configuration is shown as below:



Explanation:

Turn M100 from off → on to enable the axis. When M200 from off → on, trigger the periodic speed control command, the axis switches to CSV mode and runs at a uniform speed of 131072. When the axis reaches the synchronous state, start timing. When 5s timing reached, assign the speed 262144 to the register of the corresponding cycle speed of CYCVEL command. The axis immediately accelerates to the speed value and runs at a uniform speed. When 10s timing reached, the operation and axis action are the same as above.

The speed curve is shown as below:



5-1-2-22. Periodic torque control motion【A_CYCTRQ】

(1) Overview

Switch the servo mode to CST mode and output the given target torque to the servo in the task cycle.

Periodic torque control motion [A_CYCTRQ]			
Execution condition	Rising/falling edge of the coil	Suitable model	XDH, XLH, XG2
Firmware	V3.7.1 and above	Software	3.7.4 and above

(2) Operand

Operand	Function	Type
S0	Input parameter start address	64-bit, four words
S1	Output state word start address	16-bit, single word
S2	Output state bit start address	Bit
S3	Axis output terminal number	16-bit, single word

(3) Suitable soft component

Operand	Word soft component											Bit soft component					
	System								Constant	Module		System					
	D*	FD	TD*	CD*	DX	DY	DM*	DS*	K/H	ID	QD	X	Y	M*	S*	T*	C*
S0	●	●	●	●													
S1	●	●	●	●													
S2														●			
S3	●								●								

*: D means D, HD; TD means TD and HTD; CD means CD, HCD, HSCD and HSD; DM means DM and DHM; DS means DS and DHS; M means M, HM, SM; S means S, HS; T means T, HT; C means C, HC.

(4) Function and action

```
                          S0   S1  S2  S3
   M0
|--|↑|------------[ A_CYCTRQ  HD0  D0  M1  K0 ]--|
```

- S0 specifies input parameter start address
- S1 specifies output state word start address
- S2 specifies output state bit start address
- S3 specifies the axis terminal number
- When M0 changes from off to on, perform periodic torque motion control on the axis specified by S3. After successful execution, S2 is set on, indicating that the target axis is in periodic control state, and the control of the axis is achieved by periodically assigning values to S0.
- It needs to assign 6080h in EtherCAT parameters of the specified axis to PDO mapping to make [maximum speed limit] effective,When switching back to CSP mode, the speed limit needs to be released.
- V3.7.3 and above versions support mold axis, specific calculations can be found in the chapter 6-6. Application of mold axis.

(5) Notes

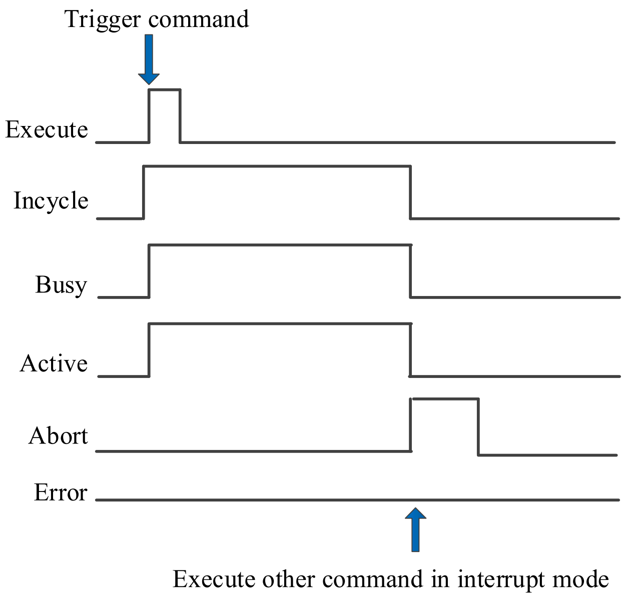
- The switching mode is issued by the controller, but the actual switching time is determined by the servo
- Executing the motion command can switch the servo to CSP mode, which needs to meet the current feedback speed of three cycles <= maximum speed*0.1
- The previous mode is still running between the start and successful mode switching
- The command is not supported by the pulse axis

(6) Related parameters

Input parameter	Parameter name	Data type	Unit	Note
S0	Trq	FP64	0.1%	Target torque
S0+4	Maxvel	FP64	Rpm	Max speed limit
S0+8	BufferMode	INT16U	-	Buffer mode
Output parameter	**Parameter name**	**Data type**	**Unit**	**Note**
S1	ErrCode	INT16U	-	Command error code

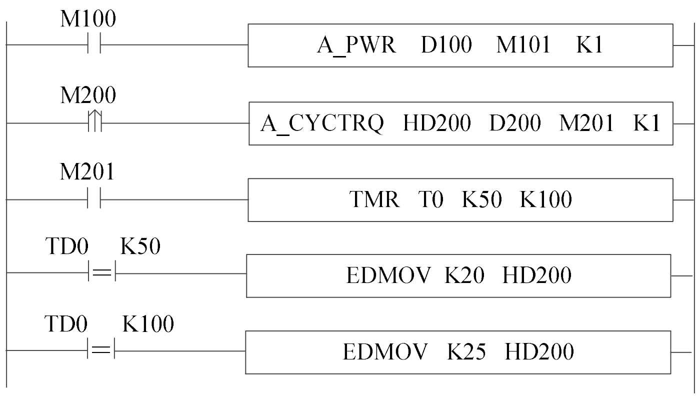
State parameter	Parameter name	Data type	Unit	Note
S2	Incycle	BOOL	-	Periodic control
S2+1	Busy	BOOL	-	The instruction is being executed
S2+2	Active	BOOL	-	Command under control
S2+3	Abort	BOOL	-	Instruction is interrupted
S2+4	Error	BOOL	-	Instruction execution error
Axis number	Parameter name	Data type	Unit	Note
S3	Axis	INT16U	-	Axis number starts from 0

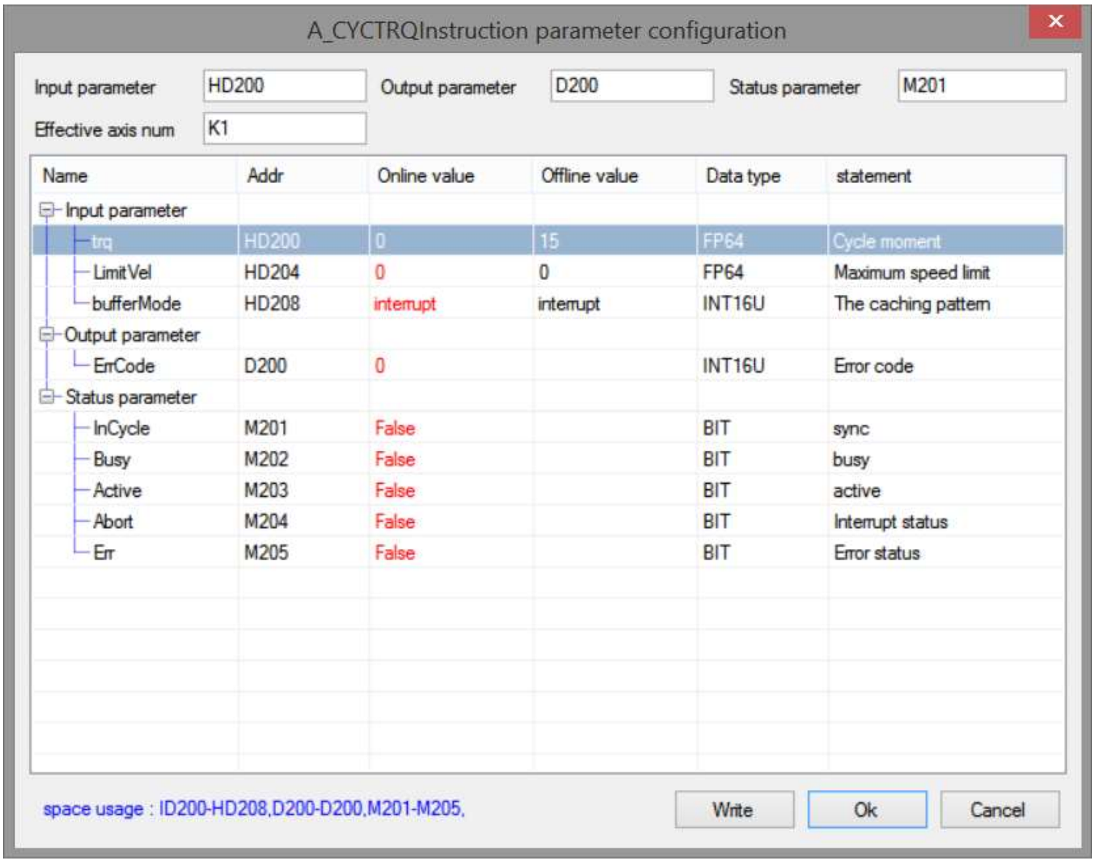
(7) Sequence diagram



Explanation:
Trigger command, set Busy and Active signals, and set InCycle signal when the axis reaches cycle control.
During cycle control, other commands are executed in interrupt mode, Abort signal is set, and Incycle signal is reset.

(8) Application
For example, the servo is required to operate at 15% of the rated torque in CST mode, and then increase the speed by 5% of the rated torque every 5 seconds. When the torque reaches 3 times of the initial speed, it will continue to operate at this torque. The ladder diagram is shown in the following figure:





A_CYCTRQInstruction parameter configuration

Input parameter: HD200 Output parameter: D200 Status parameter: M201

Effective axis num: K1

Name	Addr	Online value	Offline value	Data type	statement
Input parameter					
trq	HD200	0	15	FP64	Cycle moment
LimitVel	HD204	0	0	FP64	Maximum speed limit
bufferMode	HD208	interrupt	interrupt	INT16U	The caching pattern
Output parameter					
ErrCode	D200	0		INT16U	Error code
Status parameter					
InCycle	M201	False		BIT	sync
Busy	M202	False		BIT	busy
Active	M203	False		BIT	active
Abort	M204	False		BIT	Interrupt status
Err	M205	False		BIT	Error status

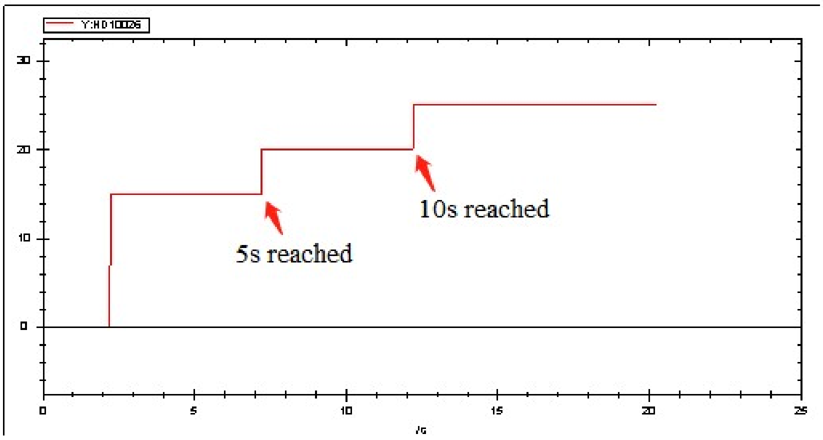
space usage : ID200-HD208,D200-D200,M201-M205,

Write Ok Cancel

Explanation:

Turn M100 from off → on and enable the axis. When M200 is from off → on, trigger the periodic torque control command, the axis switches to CST mode and runs at a uniform speed of 15% of the rated torque. When the axis reaches the synchronous state, the timing starts. When 5s is timed, assign 20% of the rated torque to the register of the corresponding periodic torque of CYCTRQ command, and the axis immediately accelerates to the torque value and runs at a uniform speed. When 10s is counted, the operation and axis action are the same as above.

The speed curve is shown as below:



5-1-2-23. Multiple speed shift【A_PLSR】

(1) Overview

The command will perform multiple speed motion as the setting parameters.

Multiple speed shift [A_PLSR]			
Execution condition	Rising/falling edge of the coil	Suitable model	XDH, XLH, XG2
Firmware	V3.7.2 and above	Software	3.7.14 and above

(2) Operand

Operand	Function	Type
S0	Input parameter start address of each section of motion	32-bit, double words
S1	Input public parameter start address	32-bit, double words
S2	Output parameter start address	16-bit, single word
S3	Output state bit start address	bit
S4	Axis output terminal number	16-bit, single word

(3) Suitable soft component

Operand	Word soft component											Bit soft component					
	System								Constant	Module		System					
	D*	FD	TD*	CD*	DX	DY	DM*	DS*	K/H	ID	QD	X	Y	M*	S*	T*	C*
S0	●	●	●	●													
S1	●	●	●	●													
S2	●	●	●	●													
S3														●			
S4	●								●								

*: D means D, HD; TD means TD and HTD; CD means CD, HCD, HSCD and HSD; DM means DM and DHM; DS means DS and DHS; M means M, HM, SM; S means S, HS; T means T, HT; C means C, HC.

(4) Function and action

```
                       (S0)  (S1)   (S2)  (S3)(S4)
   M0
──┤↑├──────────── A_PLSR  HD0  HD10  HD20  M1  K0
```

- S0 specifies [input start address of each segment of motion] and occupies the registers S0~S0+18+10*N
- S1 specifies [input public parameter start address] and occupies registers S1~S1+20
- S2 specifies [start address of output parameter]
- S3 specifies [start address of output state]
- S4 specifies [axis port number]

(5) Note

- When the speed is set to 0, it is executed at the default speed
- If the start and end speeds are set, the speed will generate a step at the start and end of the movement
- Acceleration and deceleration time refers to the time when the speed accelerates from 0 to the default speed or decelerates from the default speed to 0
- At present, only 10 axes (axis 0~9) are supported, and the maximum number of segments for each axis is 100.(V3.7.3 and above versions support all axes with a maximum of 500 segments per axis)
- The instruction does not support cache mode, but can be interrupted.

(6) Related parameters

Input parameter	Parameter name	Data type	Unit	Note
S0	Position	INT32U	-	Total motion segments
S0+10+10*(N-1)	Velocity	INT32U	Command unit/s	Target speed
S0+12+10*(N-1)	Acceleration	INT32U	Command unit	Target displacement
S0+14+10*(N-1)	Deceleration	INT16U	-	High 8-bit【waiting condition】*1 H00：Motion completion H01：wait time, unit: ms H02：wait signal H03：ACT time, unit: ms

				H04：EXT signal H05：EXT signal or motion completion
				Low 8-bit【Wait condition register type】 H00：constant H01：D H02：HD H03：FD H04：X H05：M H06：HM
S0+15+10*(N-1)	Value	INT32U	-	Constant value/register value
S0+17+10*(N-1)	RegisterType	INT16U	-	Low 8-bit【Jump register type】 H00：constant H01：D H02：HD H03：FD
S0+18+10*(N-1)	Value	INT32U	-	Constant value
Public parameter	Parameter name	Data type	Unit	Note
S1	MotionType	INT32U	-	Motion mode 0-relative 1-absolute
S1+2	StartSegment	INT32U	-	Number of starting execution segments
S1+4	AccDecType	INT16U	-	Acceleration/deceleration type 0-straight line 1-S curve
S1+5	AccT	INT16U	ms	Acceleration time
S1+6	DecT	INT16U	ms	Deceleration time
S1+8	Vs	FP64	Command unit/s	Start speed
S1+12	Ve	FP64	Command unit/s	End speed
S1+16	DefaultV	FP64	Command unit/s	Default speed
S1+20	SendMode	INT16U	-	Sending mode *2 0-completion mode 1-Follow-up mode
Output parameter	Parameter name	Data type	Unit	Note
S2	ErrCode	INT16U	-	Command error code
S2+1	cursegment	INT16U	-	Current execution segment number
State parameter	Parameter name	Data type	Unit	Note
S3	Done	BOOL	-	Command execution completed
S3+1	Busy	BOOL	-	Instruction is executing
S3+2	Active	BOOL	-	Command under control
S3+3	Abort	BOOL	-	Instruction interrupted
S3+4	Error	BOOL	-	Command execution error
Axis number	Parameter name	Data type	Unit	Note
S3	Axis	INT16U	-	Axis number. start from 0

***1: Waiting condition: high 8 bits [Waiting condition]: used to specify when to enter the next motion segment.**

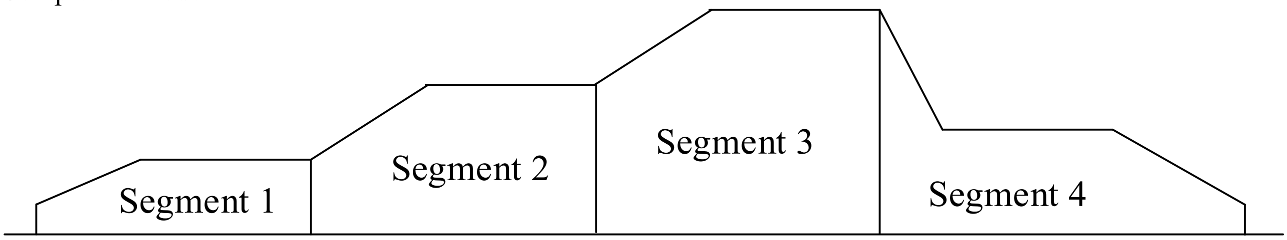
H00: Motion completion: After executing the set position of this segment, immediately jump to the next specified motion segment.

H01: wait time: start timing after the current movement is completed, and immediately jump to the specified movement segment when the time arrived.

H02: wait signal: after the current movement is completed, start to wait for the bit signal. When the bit signal is set to ON, immediately jump to the specified movement segment.

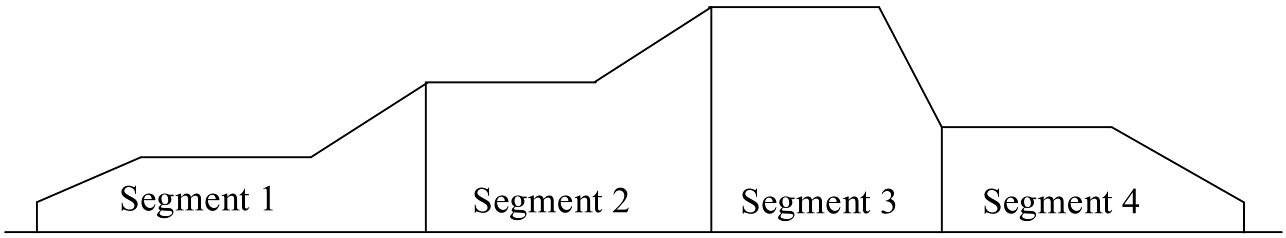
H03: ACT time: after the current motion segment executes the motion specified by ACT time, whether the current

motion is completed or not, it immediately jumps to the specified motion segment.
H04: EXT signal: in the current movement, if the external signal is set to ON, it will immediately jump to the specified movement. If the external signal has not been set to ON after the completion of the current motion segment, continue to wait for the signal.
H05: EXT signal or motion completion: set the bit signal to ON, or the motion is completed, and jump to the specified motion segment.
***2: Sending mode:**
Completion mode:



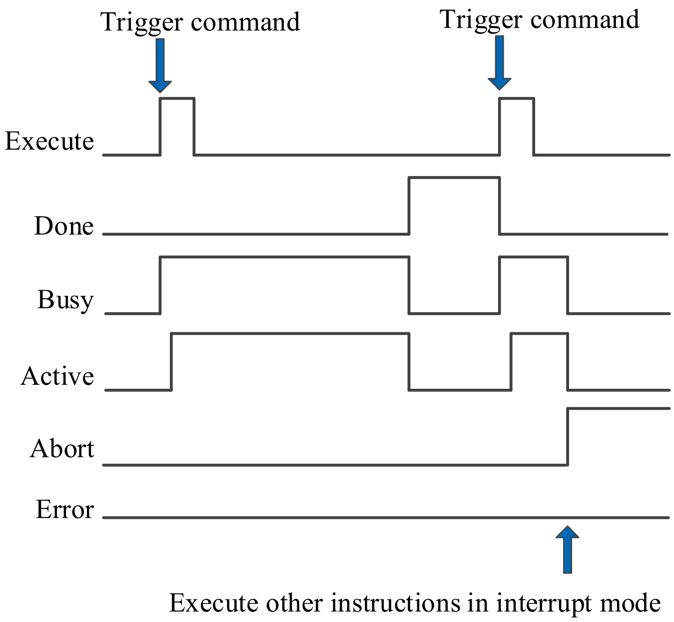
Except for the last segment of pulse, each pulse segment is composed of rising or falling part and stable part.
The last segment of pulse consists of rising or falling part, stable part.

Follow-up mode:



When the number of pulses in this segment is sent, it has switched to the speed of the subsequent segment. Except for the first pulse segment, each pulse segment is composed of a stable part, an rising or falling part.
The first pulse segment consists of rising or falling part, stable part.

(7) Sequence diagram



Explain:
In general, after the command is triggered, Busy and Active signals are set ON, and reset after the command is executed. At the same time, the Done signal is set ON. Only after the command is triggered again can Done be reset, otherwise it will not be reset automatically.

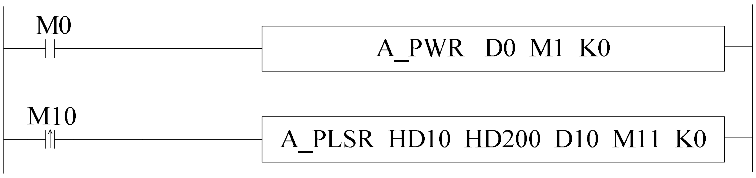
During the execution of the command, if a new command is triggered in the interrupt mode, the Busy and Active signals are immediately reset and the Abort signal is set ON.
When there is an error in the command, the Error signal is set ON, other signals are reset, and the corresponding error code is output.

(8) Application

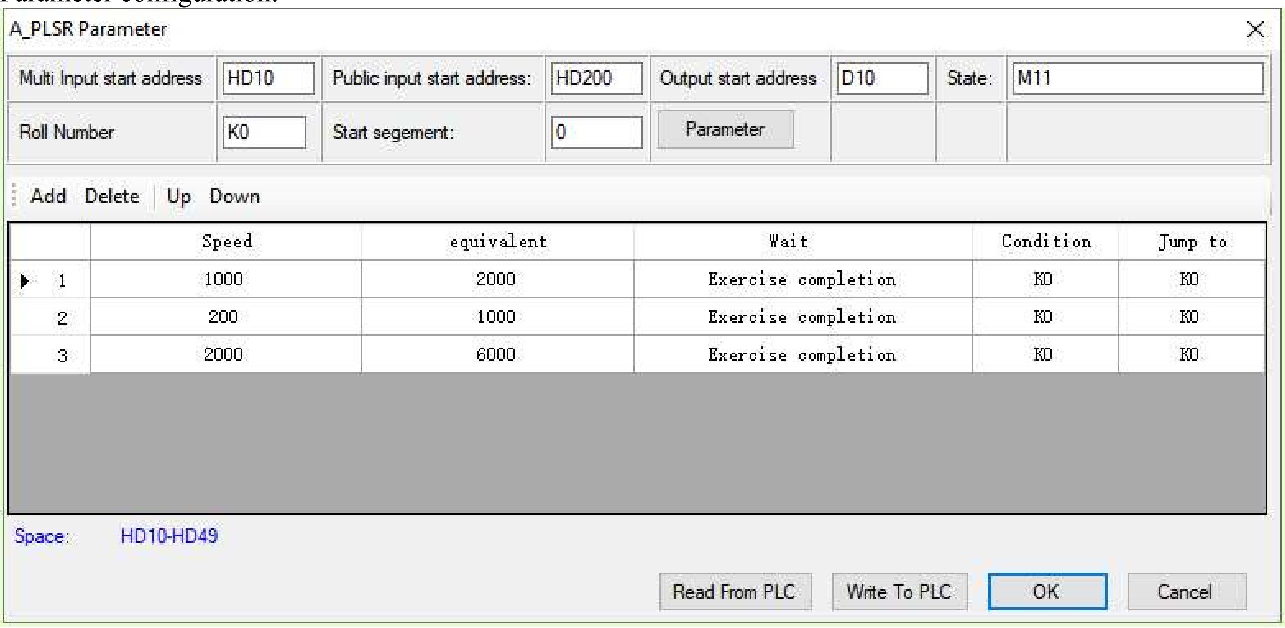
For example, it is necessary to send three segments of consecutive pulses to axis 0. The pulse frequency, pulse number, acceleration and deceleration of each segment are shown in the following table:

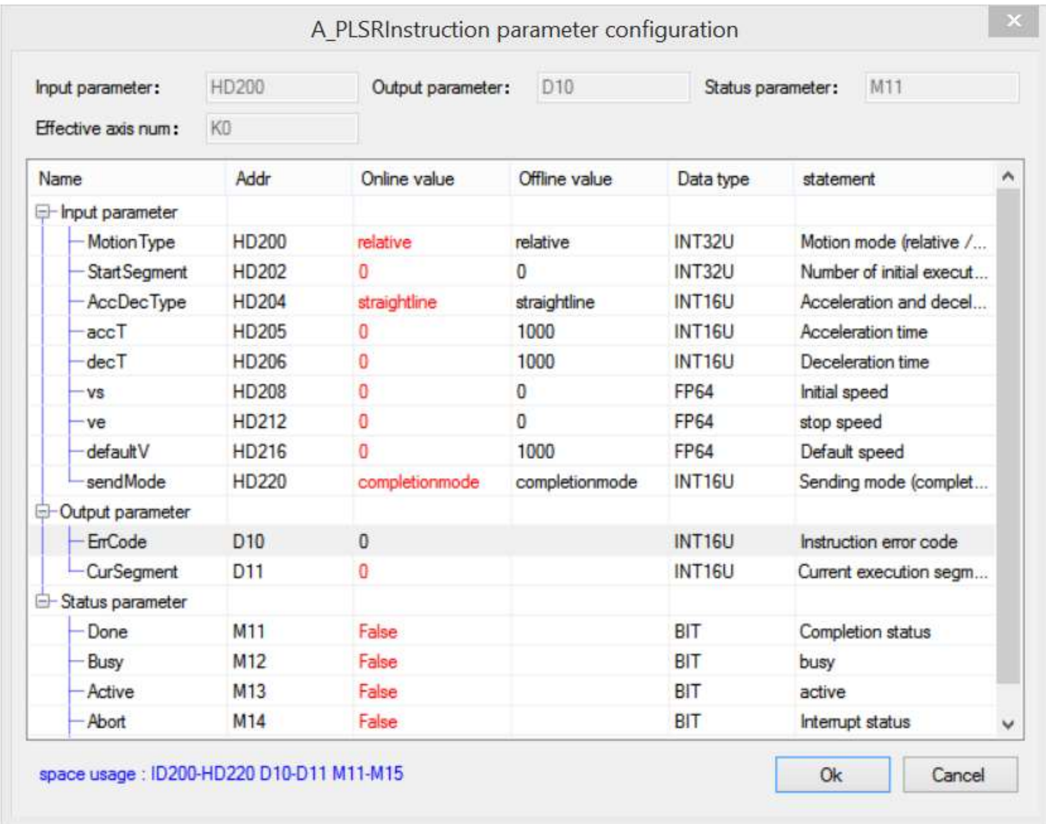
Name	Frequency	Pulse number
Segment 1	1000	2000
Segment 2	200	1000
Segment 3	2000	6000
Acceleration/deceleration	accelerate to 1000 in 1000ms	

The ladder chart:



Parameter configuration:





A_PLSRInstruction parameter configuration

Input parameter: HD200 Output parameter: D10 Status parameter: M11

Effective axis num: K0

Name	Addr	Online value	Offline value	Data type	statement
Input parameter					
MotionType	HD200	relative	relative	INT32U	Motion mode (relative /...
StartSegment	HD202	0	0	INT32U	Number of initial execut...
AccDecType	HD204	straightline	straightline	INT16U	Acceleration and decel...
accT	HD205	0	1000	INT16U	Acceleration time
decT	HD206	0	1000	INT16U	Deceleration time
vs	HD208	0	0	FP64	Initial speed
ve	HD212	0	0	FP64	stop speed
defaultV	HD216	0	1000	FP64	Default speed
sendMode	HD220	completionmode	completionmode	INT16U	Sending mode (complet...
Output parameter					
ErrCode	D10	0		INT16U	Instruction error code
CurSegment	D11	0		INT16U	Current execution segm...
Status parameter					
Done	M11	False		BIT	Completion status
Busy	M12	False		BIT	busy
Active	M13	False		BIT	active
Abort	M14	False		BIT	Interrupt status

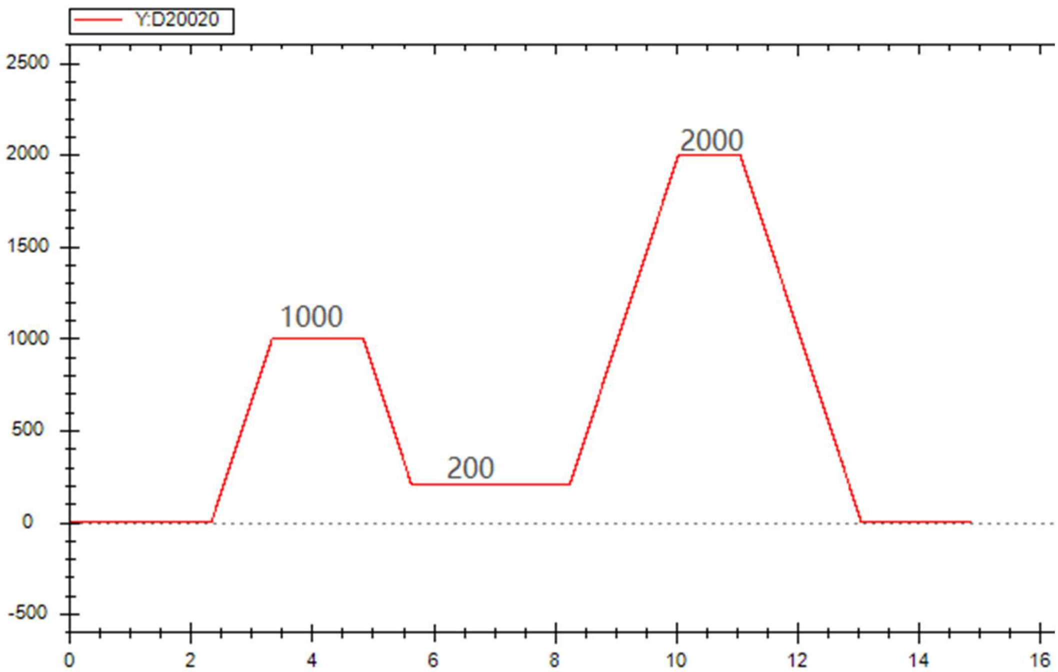
space usage : ID200-HD220 D10-D11 M11-M15

Ok Cancel

Note: Acceleration and deceleration time refers to the time when the speed accelerates from 0 to the default speed.

Enable the axis through A_PWR. After the enabling is successful, turn M10 from OFF to ON, and trigger A_PLSR command, which will execute three pulse segments according to the set parameters. If the start speed and the end speed are set, the speed will generate a step during and after execution, from 0 to the start speed, and from the end speed to 0. Acceleration and deceleration time refers to the time it takes for the axis speed 0 to the default speed and from the default speed to 0.

The setting speed curve during execution is shown in the following figure:



5-1-2-24. Variable speed output【A_PLSF】

(1) Overview

The Command will move at the set speed.

Variable speed output [A_PLSF]			
Execution condition	Rising/falling edge of the coil	Suitable model	XDH, XLH, XG2
Firmware	V3.7.2 and above	Software	3.7.14 and above

(2) Operand

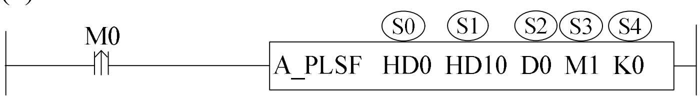
Operand	Function	Type
S0	Motion speed register address	32-bit, double words
S1	Input parameter start address	16-bit, single word
S2	Output state word start address	16-bit, single word
S3	Output state bit start address	bit
S4	Axis output terminal number	16-bit, single word

(3) Suitable soft component

Operand	Word soft component											Bit soft component					
	System								Constant	Module		System					
	D*	FD	TD*	CD*	DX	DY	DM*	DS*	K/H	ID	QD	X	Y	M*	S*	T*	C*
S0	●	●	●	●													
S1	●	●	●	●													
S2	●	●	●	●													
S3														●			
S4	●								●								

*: D means D, HD; TD means TD and HTD; CD means CD, HCD, HSCD and HSD; DM means DM and DHM; DS means DS and DHS; M means M, HM, SM; S means S, HS; T means T, HT; C means C, HC.

(4) Function and action



- S0 specify the【motion speed】
- S1 specify the【input parameter start address】, occupy the register S1~S1+4
- S2 specify the【output state word start address】
- S3 specify the【output state bit start address】, occupy the register S3~S3+4
- S4 specify the【axis terminal number】

(5) Note

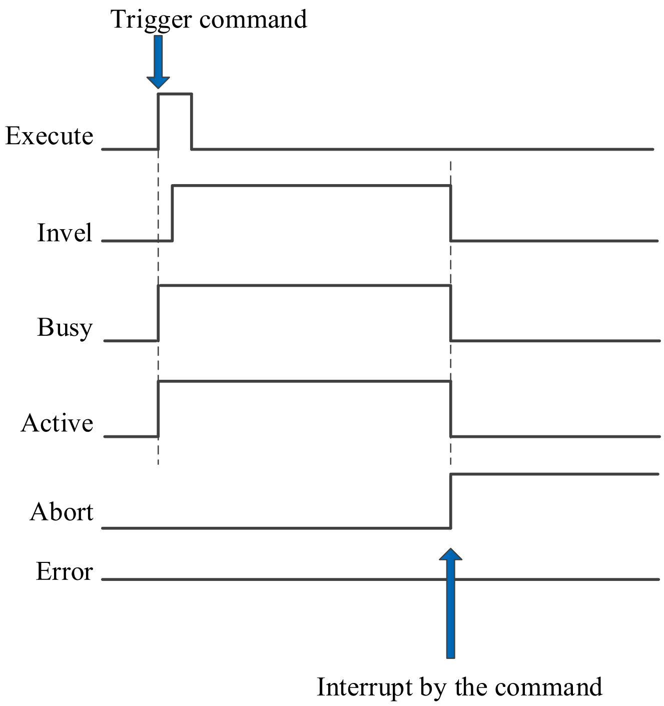
- Speed value takes effect in real time
- If the default speed is set to 0, the step method is used for speed planning
- Acceleration and deceleration time refers to the time when the speed accelerates to the default speed or decelerates from the default speed to 0
- The instruction does not support cache mode, but can be interrupted

(6) Related parameters

Input parameter	Parameter name	Data type	Unit	Note
S0	Vel	INT32S	Command unit/s	Motion speed value
S1	AccDecType	INT16U	-	Acceleration/deceleration type 0-straight line 1-S curve
S1+1	AccT	INT16U	ms	Acceleration time
S1+2	DecT	INT16U	ms	Deceleration time
S1+4	DefaultVel	INT32U	Command unit/s	Default speed
Output	Parameter name	Data type	Unit	Note

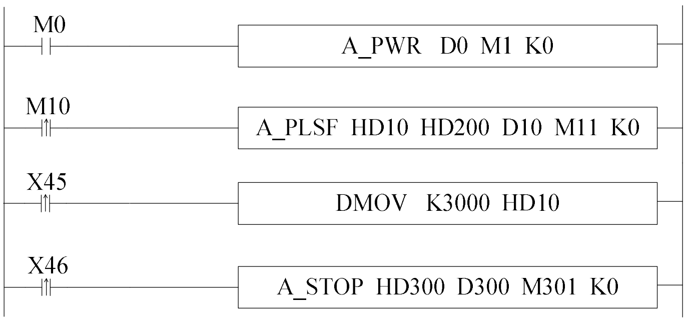
parameter				
S2	ErrCode	INT16U	-	Command error code
State parameter	Parameter name	Data type	Unit	Note
S3	Invel	BOOL	-	Command execution completed
S3+1	Busy	BOOL	-	Instruction is executing
S3+2	Active	BOOL	-	Command under control
S3+3	Abort	BOOL	-	Instruction interrupted
S3+4	Error	BOOL	-	Command execution error
Axis number	Parameter name	Data type	Unit	Note
S4	Axis	INT16U	-	Axis number. Start from 0

(7) Sequence diagram

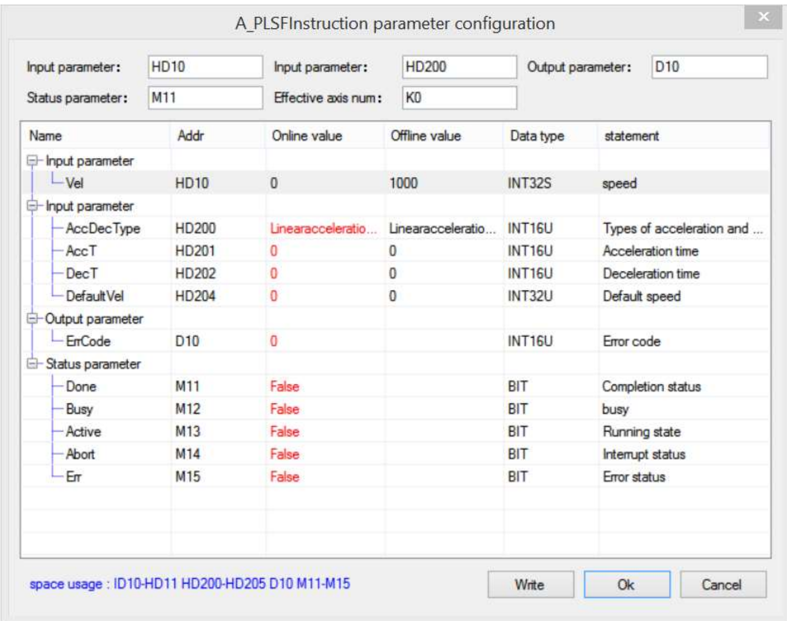


Explain:
In general, after the command is triggered, Busy and Active signals are set ON. When the speed reaches the target speed set by the parameter, the Invel is set ON, while Busy and Active also remain ON.
In the process of instruction execution, if a new instruction is triggered in the interrupt mode, the Invel, Busy and Active signals are immediately reset and the Abort signal is set ON.
When there is an error in the command, the Error signal is set ON, other signals are reset, and the corresponding error code is output.

(8) Application
Example: axis 0 moved to point B at a speed of 1000, move from point B to point C at a speed of 3000, and stop at point C. Three points A, B and C are on the same screw rod, and both points B and C are equipped with proximity switches.
The ladder diagram is as follows:



Parameter configurations:


A_PLSFInstruction parameter configuration

Input parameter: HD10 Input parameter: HD200 Output parameter: D10

Status parameter: M11 Effective axis num: K0

Name	Addr	Online value	Offline value	Data type	statement
Input parameter					
Vel	HD10	0	1000	INT32S	speed
Input parameter					
AccDecType	HD200	Linearaccelerati...	Linearacceleratio...	INT16U	Types of acceleration and ...
AccT	HD201	0	0	INT16U	Acceleration time
DecT	HD202	0	0	INT16U	Deceleration time
DefaultVel	HD204	0	0	INT32U	Default speed
Output parameter					
ErrCode	D10	0		INT16U	Error code
Status parameter					
Done	M11	False		BIT	Completion status
Busy	M12	False		BIT	busy
Active	M13	False		BIT	Running state
Abort	M14	False		BIT	Interrupt status
Err	M15	False		BIT	Error status

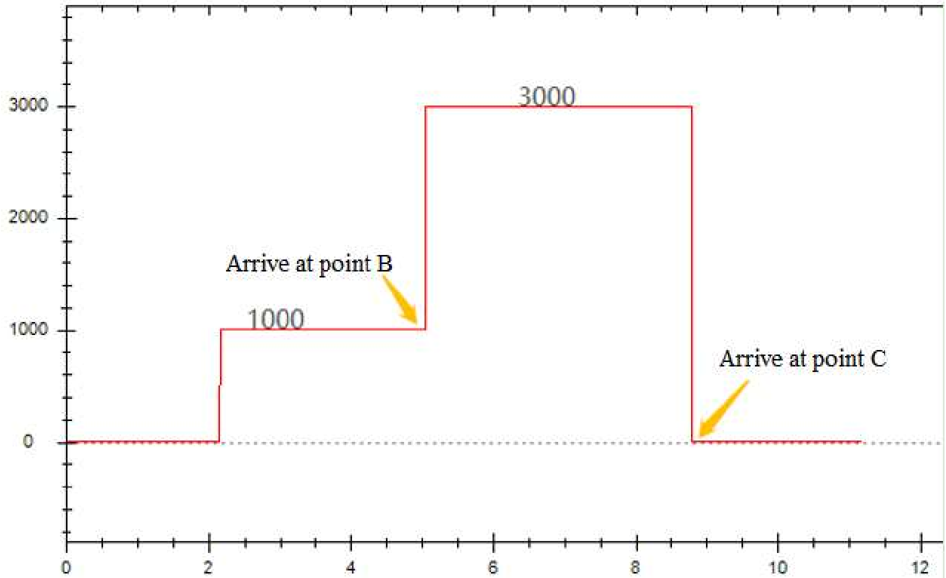
space usage : ID10-HD11 HD200-HD205 D10 M11-M15

Write Ok Cancel

Explanation:

Use the virtual X terminal inside the PLC as the proximity switch of B and C points, enable the axis through A_ PWR commands. After confirming that the enabling is successful, turn M10 from OFF to ON, and trigger A_ PLSF instruction, the instruction will move at a constant speed according to the set speed. After reaching point B, the speed of the second segment will be transferred to the corresponding register through the data transmission instruction, and the parameters will take effect in real time. After arriving at point C. Trigger A_ STOP command to stop the action of the axis.

The speed setting is shown in the figure below:



5-1-2-25. Pulse follow【A_FOLLOW】

(1) Overview

The Command will move as the high speed counter value.

Pulse follow [A_FOLLOW]			
Execution condition	Rising/falling edge of the coil	Suitable model	XDH, XLH, XG2
Firmware	V3.7.2 and above	Software	3.7.14 and above

(2) Operand

Operand	Function	Type
S0	High speed counter register	
S1	Function coefficient register start address	16-bit, single word
S2	Output state word start address	16-bit, single word
S3	Output state bit start address	bit
S4	Axis output terminal number	16-bit, single word

(3) Suitable soft component

Operand	Word soft component											Bit soft component					
	System								Constant	Module		System					
	D*	FD	TD*	CD*	DX	DY	DM*	DS*	K/H	ID	QD	X	Y	M*	S*	T*	C*
S0	Only can be high speed counter																
S1	●	●	●	●													
S2	●	●	●	●													
S3														●			
S4	●								●								

*: D means D, HD; TD means TD and HTD; CD means CD, HCD, HSCD and HSD; DM means DM and DHM; DS means DS and DHS; M means M, HM, SM; S means S, HS; T means T, HT; C means C, HC.

(4) Function and action

```
        M0                S0    S1   S2  S3  S4
|------|↑|-------[A_FOLLOW  HSC0  HD0  D0  M1  K0]--|
```

- S0 specifies high-speed counting register
- S1 specifies [input parameter start address] and occupies registers S1~S1+3
- S2 specifies [start address of output status word]
- S3 specifies [start address of output status bit] and occupies relay S3~S3+4
- S4 specifies [axis port number]
- Trigger command, which moves the axis specified by S4 according to the parameters set in S1 through the count value of high-speed counting port.

(5) Note

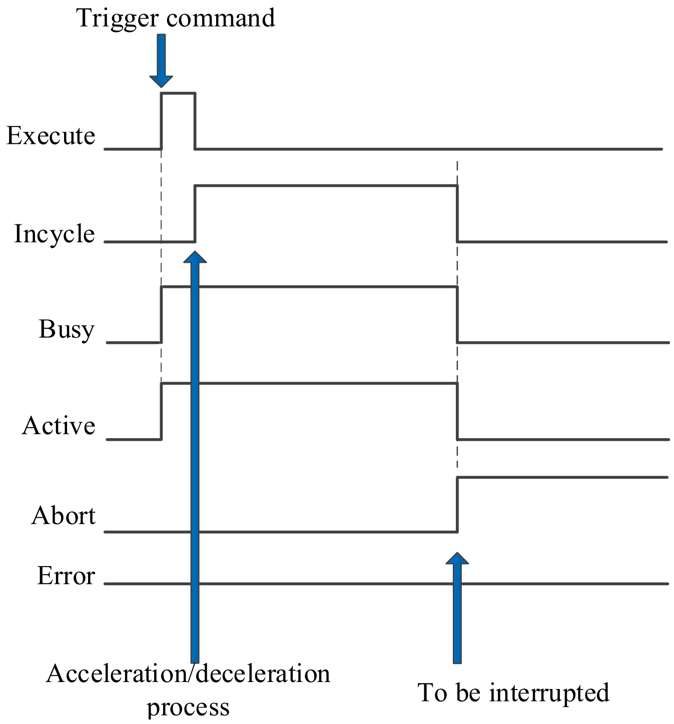
- Multiplication coefficient/division coefficient range: -1000~1000, and not 0. Follow-up instructions beyond this range will not be executed. The value is positive, positive motion; negative, reverse motion, and the modification takes effect in real time.
- When modify the multiplication/division coefficient during the synchronization process through upper computer, there will be a lag in writing through the upper computer window. So the modification should be performed through the I9900 interrupt.
- FOLLOW performance parameters: 1~100, the smaller the parameter value, the smaller the follow-up stiffness (greater delay); the larger the parameter value, the greater the stiffness (less delay).
- PLC measures the input position in real time, obtains the position information through the encoder or register, and outputs the corresponding position through the multiplication/division coefficient proportional relationship.
- This command should be used together with high-speed counting command (CNT/CNT_AB).

(6) Related parameters

Input parameter	Parameter name	Data type	Unit	Note
S0	Count	INT32S	-	Specify high-speed counter
S1	Multiplier	INT16S	-	Multiplication coefficient
S1+1	Divisor	INT16S	-	Division coefficient

S1+2	FollowProperty	INT16U	-	Follow performance parameters
S1+3	FeedForward	INT16U	-	Follow feedforward parameters. Not supported temporarily
Output parameter	Parameter name	Data type	Unit	Note
S2	ErrCode		-	Error code
State parameter	Parameter name	Data type	Unit	Note
S3	InCycle	BOOL	-	Synchronous controlling
S3+1	Busy	BOOL	-	Instruction is executing
S3+2	Active	BOOL	-	Command under control
S3+3	Abort	BOOL	-	Instruction interrupted
S3+4	Error	BOOL	-	Command execution error
Axis number	Parameter name	Data type	Unit	Note
S4	Axis	INT16U	-	Axis number, start from 0

(7) Sequence diagram



Description: trigger command, busy and active are set ON. When the axis output is synchronized with the high-speed count, the Incycle signal is set ON.
When the command is interrupted, abort is set ON and other signals are reset.

5-1-2-26. Cycle superposition【A_CYCSUP】

(1) Overview

The compensation value is compensated in place in a synchronous period.

Cycle superposition [A_CYCSUP]			
Execution condition	Rising/falling edge of the coil	Suitable model	XDH, XLH, XG2
Firmware	V3.7.2 and above	Software	3.7.14 and above

(2) Operand

Operand	Function	Type
S0	Input parameter start address	64-bit, four words
S1	Output state word start address	16-bit, single word
S2	Output state bit start address	bit
S3	Axis output terminal number	16-bit, single word

(3) Suitable soft component

Operand	Word soft component											Bit soft component					
	System								Constant	Module		System					
	D*	FD	TD*	CD*	DX	DY	DM*	DS*	K/H	ID	QD	X	Y	M*	S*	T*	C*
S0	●	●	●	●													
S1	●	●	●	●													
S2														●			
S3									●								

*: D means D, HD; TD means TD and HTD; CD means CD, HCD, HSCD and HSD; DM means DM and DHM; DS means DS and DHS; M means M, HM, SM; S means S, HS; T means T, HT; C means C, HC.

(4) Function and action

- S0 specifies [input parameter start address] and occupies registers S0~S0+3
- S1 specifies [start address of output status word]
- S2 specifies [start address of output status bit] and occupies relay S2~S2+3
- S3 specifies [axis port number]
- When M0 is turned from OFF to ON, the cycle superposition control is performed on the axis specified by S3, and the command will superimpose the cycle position to the current position D20016 in a synchronization cycle
- The position shall not be too large, otherwise the axis step will occur.

(5) Note

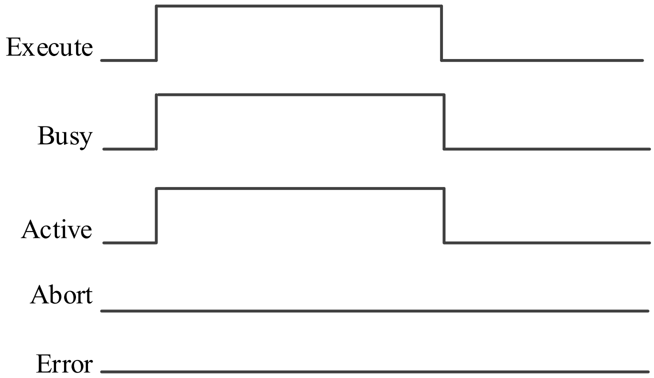
- The superimposed value will be given to the given position of the command in a cycle.
- The command is executed once and only superimposed once. The superimposed value can be modified in real time, and the superimposed value of multiple execution commands will be accumulated.
- Only one command can be used for the same axis.
- Enable is shut down, compensation value is canceled, and compensation value can be viewed in register D[20188+200 * N].

(6) Related parameters

Input parameter	Parameter name	Data type	Unit	Note
S0	Pos	FP64	Command unit	Cycle position
Output parameter	Parameter name	Data type	Unit	Note
S1	ErrCode	INT16U	-	Command error code
Status parameter	Parameter name	Data type	Unit	Note
S2	Busy	BOOL	-	Instruction is executing
S2+1	Active	BOOL	-	Command under control

S2+2	Abort	BOOL	-	Instruction interrupted
S2+3	Error	BOOL	-	Command execution error
Axis number	Parameter name	Data type	Unit	Note
S3	Axis	INT16U	-	Axis number, start from 0

(7) Sequence diagram



Explain:

Trigger the instruction, the busy and active are set ON, and the instruction starts to carry out periodic superposition.

Trigger signal is OFF, busy and active are reset, abort is set ON, and cycle superposition stop.

5-1-2-27. Pitch compensation【A_PITCHCOMP】

(1) Overview

Compensate the axis in real time with the set compensation value.

Pitch compensation [A_PITCHCOMP]			
Execution condition	Rising/falling edge of the coil	Suitable model	XDH, XLH, XG2
Firmware	V3.7.2 and above	Software	3.7.14 and above

(2) Operand

Operand	Function	Type
S0	Input parameter start address	16-bit, single word
S1	Output state word start address	16-bit, single word
S2	Output state bit start address	bit
S3	Axis output terminal number	16-bit, single word

(3) Suitable soft component

Operand	Word soft component											Bit soft component					
	System								Constant	Module		System					
	D*	FD	TD*	CD*	DX	DY	DM*	DS*	K/H	ID	QD	X	Y	M*	S*	T*	C*
S0	●	●	●	●													
S1	●	●	●	●													
S2														●			
S3									●								

*: D means D, HD; TD means TD and HTD; CD means CD, HCD, HSCD and HSD; DM means DM and DHM; DS means DS and DHS; M means M, HM, SM; S means S, HS; T means T, HT; C means C, HC.

(4) Function and action

```
                                   S0    S1   S2   S3
 M10
--| |------[A_PITCHCOMP  HD10  D10  M11  K0]
```

- S0 specifies [input parameter start address] and occupies registers S0~S0+7
- S1 specifies [start address of output status word]
- S2 specifies [start address of output status bit] and occupies relay S2~S2+2
- S3 specifies [axis port number]
- After the command is successfully executed, the output pulse will be compensated according to the set compensation table at all times when the axis moves.
- When the user selects homing, the compensation value will be added to the position output after the homing operation (A_ZRN, A_HOME) is completed after the pitch compensation function is enabled.
- When the user selects enable to take effect, after the pitch compensation function is enabled, the compensation value will be added to the position output after the enable operation (A_PWR) is successfully executed. If enabled, it needs to be re-enabled to make it take effect again.
- When the user chooses to take effect immediately, the compensation value will be added to the position input/output immediately after the pitch compensation function is enabled, which may cause sudden changes in the position display value (such as D20016 and D20044), but the position of the actual servo motor will not change.

(5) Note

- At present, the first address data input range of FD register is positive integer 0~65535.
- No matter what effective mode, the axis state machine is required to be standstil or AxisDisabled when the command is running.
- There can only be one command for the same axis of this command.
- The change of reverse clearance compensation cannot be set to 0, but only takes effect when the direction is two directions.
- When one direction is selected, the forward and reverse motions are compensated only according to the forward compensation value.
- If the configuration parameters such as the compensation table are changed, it is necessary to execute A_PITCHCOMP again to make the changes effective.
- After returning to the original point, after enabling and immediately taking effect, the three situations will not cause the position step of the actual output to the servo position.

- Execute the homing function during the effective period of compensation, signal busy is set ON, the incomp is reset, and the compensation will not take effect. When the homing is completed, the compensation will take effect again.
- Limitation of compensation table: a total of 10 compensation tables are allowed, and the table is one-to-one correspondence with the axis, that is, at most 10 axes have the pitch compensation function at the same time. The format of compensation table is as follows:

S0	Number of compensation points	INT16U
S0+4+12*(N-1)	Compensation point position	FP64
S0+8+12*(N-1)	Positive compensation value	FP64
S0+12+12*(N-1)	Reverse compensation value	FP64

- For the axis with synchronous binding relationship, the position of the slave axis will not change after the pitch compensation function of the master axis takes effect (because the effect of pitch compensation directly affects the input and output of the controller and driver, and the internal planning of the controller and the interaction parameters with the user will not be affected).
- After the pitch compensation function takes effect, the position obtained by the probe command may be different from D20016 or D20044, and the consistency of the position is not guaranteed (the actual encoder feedback read from the motor section is applied with the pitch compensation effect, while the user position parameters are not affected).

(6) Related parameters

Input parameter	Parameter name	Data type	Unit	Note
S0	ActiveMode	INT16U	-	Effective time * 0：take effect after homing 1：take effect after enabling 2：take effect at once
S0+1	CompDir	INT16U	-	direction 0：single direction 1：double directions
S0+2	FirstAddressOffdregister	INT32U	-	First address of compensation table
S0+4	CompScale	FP64	-	Reverse clearance compensation variation
Output parameter	Parameter name	Data type	Unit	Note
S1	ErrCode	INT16U	-	Command error code
State parameter	Parameter name	Data type	Unit	Note
S2	Incomp	BOOL	-	In compensation
S2+1	Busy	BOOL	-	Instruction is executing
S2+2	Error	BOOL	-	Command execution error
Axis number	Parameter name	Data type	Unit	Note
S3	Axis	INT16U	-	Axis number start from 0

Real time compensation calculation:

5 compensation points, compensation table information is as follows:

Compensation point position (absolute)	0	20	30	35	40
Positive compensation value	0	1(19)	-1(31)	1(34)	2(38)
Negative compensation value	0	2(22)	1(31)	1(36)	2(42)

The pitch compensation command is set in both directions, and the actual motor position x is calculated when the command is executed from 0 to 32:

$$\frac{35-30}{34-31}=\frac{x-30}{32-31}$$

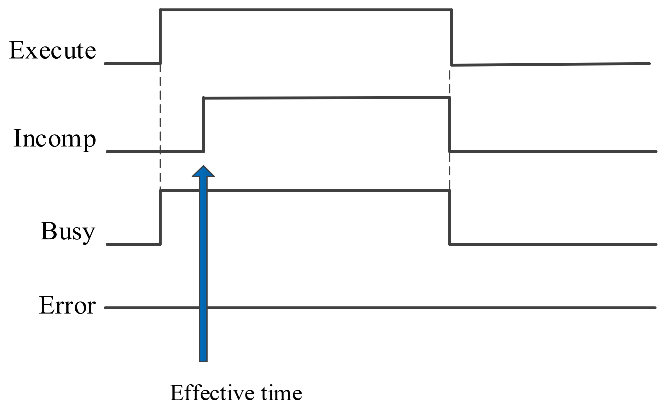
Calculate x ≈ 31.667.

At this time, when executing the command to move from 32 to 21, calculate the actual position y of the motor:

$$\frac{30-20}{31-1}=\frac{x-20}{21-19}$$

Calculate y≈21.667.

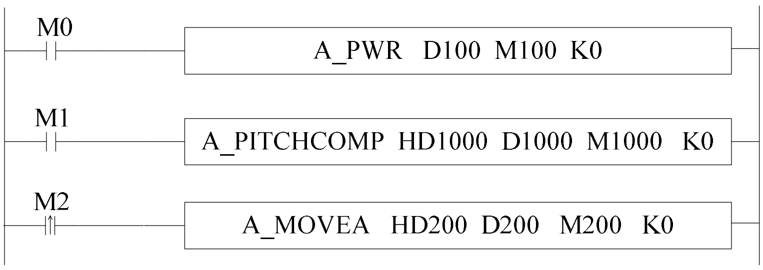
(7) Sequence diagram



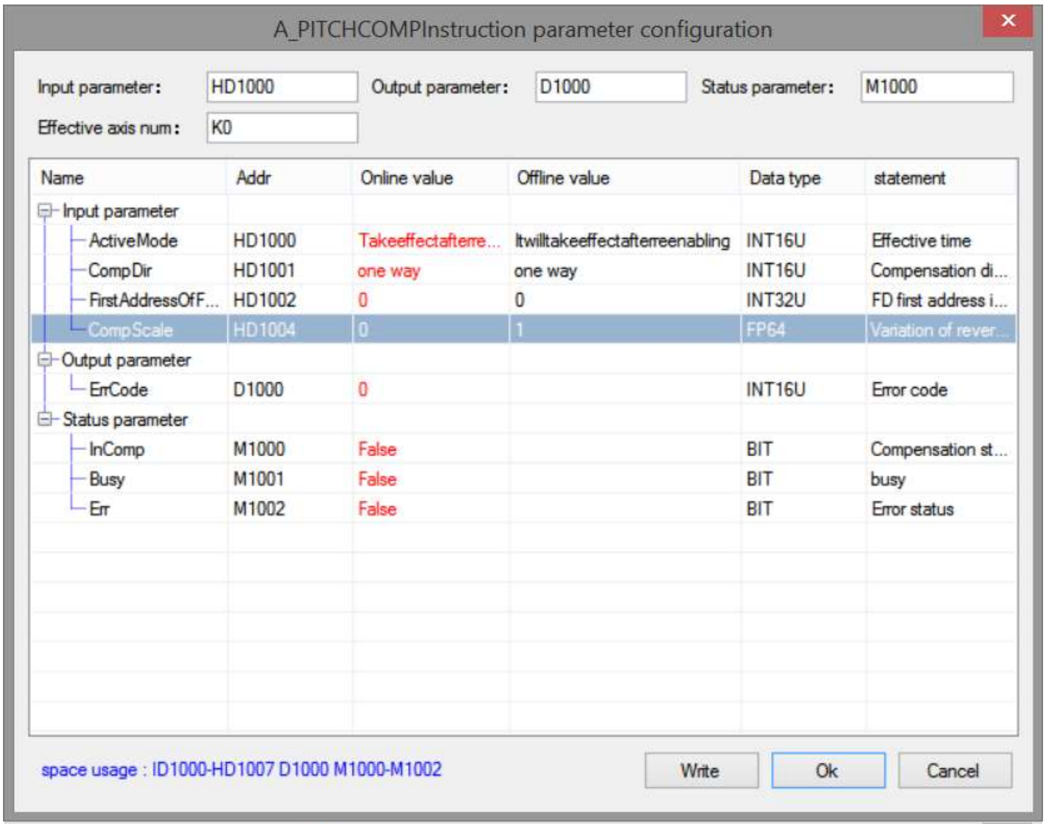
Explain:
Generally, when the command is triggered, the command BUSY signal is set ON. When the effective time of the command setting comes, the incomp compensation signal is set ON, and the busy signal is still ON and will not be reset.
The trigger condition is OFF, the other states are reset and the compensation stop.

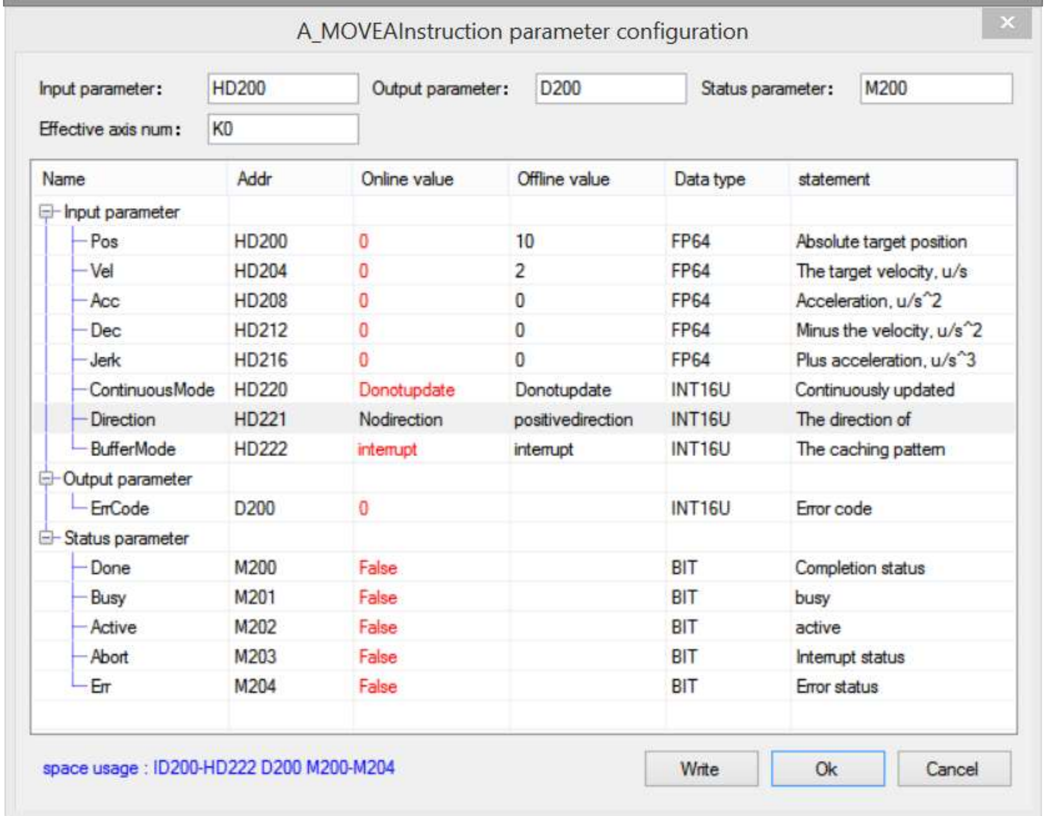
(8) Application

Set the effective time to take effect after enabling, the direction is one direction (at this time, the reverse clearance compensation change is not effective), the first address of the compensation table FD is set to 0, and the reverse clearance compensation change is set to 1 (not effective), and execute A_ MOVEA moves from 0 to positions 8, 18 and 24 respectively, and observe the actual motor position.
The ladder diagram is as follows:



The command configuration:

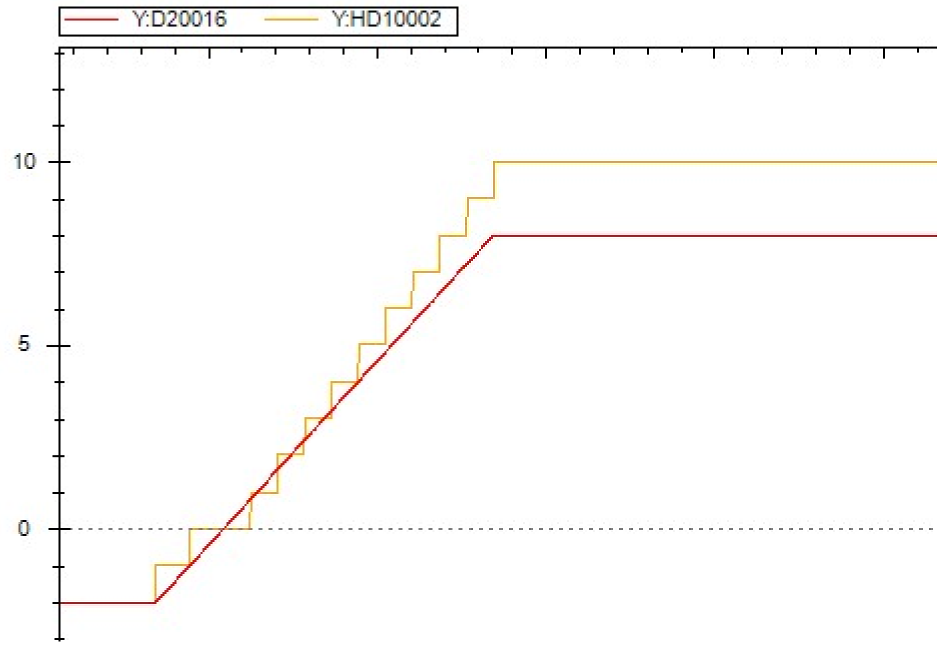


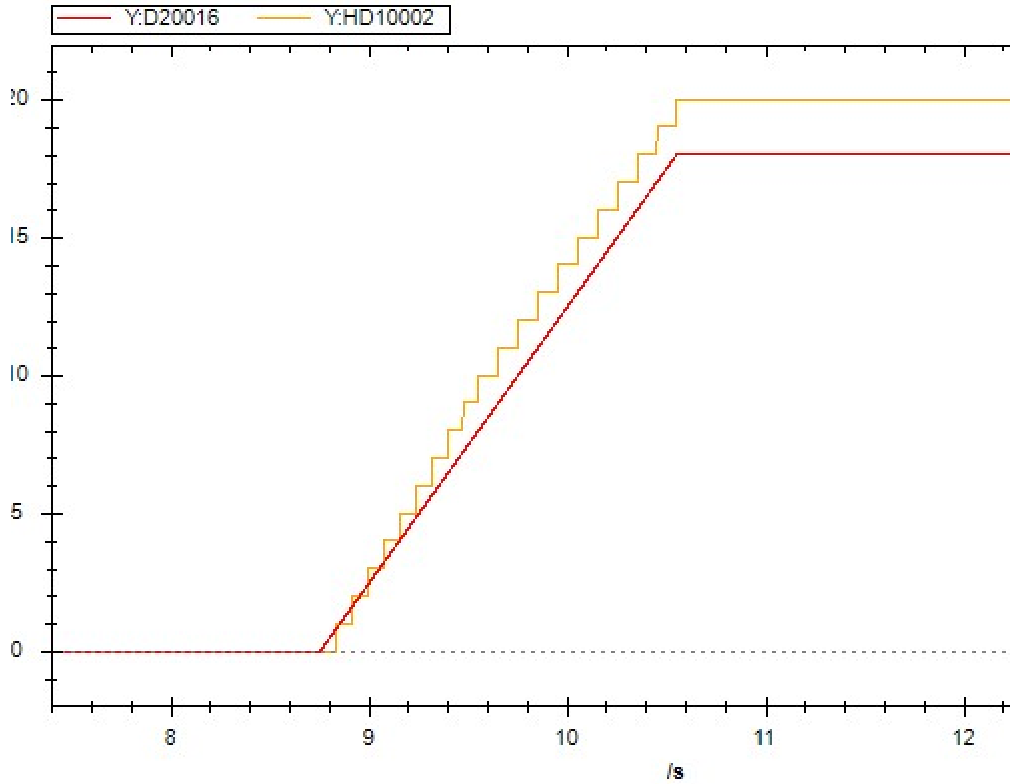


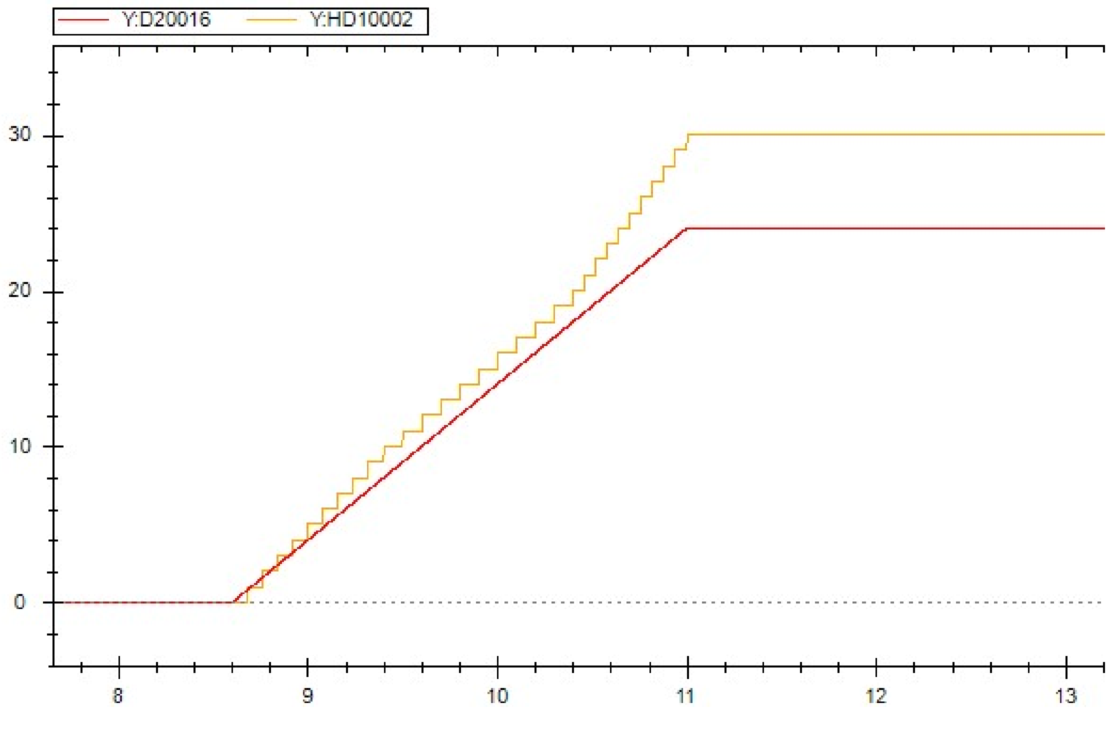
The compensation table:

FD0	4	单字	1...	补偿点个数
FD4	0	双...	1...	补偿点位置 1
FD8	0	双...	1...	正向补偿值
FD12	0	双...	1...	负向补偿值
FD16	10	双...	1...	补偿点位置 2
FD20	2	双...	1...	正向补偿值
FD24	-1	双...	1...	负向补偿值
FD28	20	双...	1...	补偿点位置 3
FD32	2	双...	1...	正向补偿值
FD36	1	双...	1...	负向补偿值
FD40	30	双...	1...	补偿点位置 4
FD44	6	双...	1...	正向补偿值
FD48	1	双...	1...	负向补偿值

Note: Busy is set ON after the command is executed, and InComp is set ON after the enable is turned on. The compensation is in effect. At this time, the compensation value is compensated to the actual motor side according to the planning of the compensation table (the set 6064 value is consistent with the D20044 value starting from 0. Since the number of pulses is small and 6064 fluctuates significantly, the 607A position given to replace 6064; the D20016 command position replaces D20044 as a more obvious curve observation). Move to the target positions of 8, 18 and 24 respectively through A_MOVEA, and its actual feedback after the pitch compensation is 10, 20 and 30 (corresponding to the compensation table). After the compensation is turned off, the value of D20044 changes to be consistent with the actual 6064 (that is, the actual position of the servo does not have a step).
The actual position curve when it moves to 8,18,24 is shown in the figure:




Y:D20016
Y:HD10002
20
15
10
5
0
8
9
10
11
12
/s


Y:D20016
Y:HD10002
30
20
10
0
8
9
10
11
12
13

5-1-2-28. Back lash compensation【A_BACKLASHCOMP】

(1) Overview

Compensate when the axis changing direction as the set parameters.

Back lash compensation [A_BACKLASHCOMP]			
Execution condition	Rising/falling edge of the coil	Suitable model	XDH, XLH, XG2
Firmware	V3.7.2 and above	Software	3.7.14 and above

(2) Operand

Operand	Function	Type
S0	Input parameter start address	64-bit, four words
S1	Output state word start address	16-bit, single word
S2	Output state bit start address	bit
S3	Axis output terminal number	16-bit, single word

(3) Suitable soft component

Operand	Word soft component											Bit soft component					
	System								Constant	Module		System					
	D*	FD	TD*	CD*	DX	DY	DM*	DS*	K/H	ID	QD	X	Y	M*	S*	T*	C*
S0	●	●	●	●													
S1	●	●	●	●													
S2														●			
S3									●								

*: D means D, HD; TD means TD and HTD; CD means CD, HCD, HSCD and HSD; DM means DM and DHM; DS means DS and DHS; M means M, HM, SM; S means S, HS; T means T, HT; C means C, HC.

(4) Function and action

- S0 specifies [input parameter start address] and occupies registers S0~S0+11
- S1 specifies [start address of output status word]
- S2 specifies [start address of output status bit] and occupies relay S2~S2+2
- S3 specifies [axis port number]
- After the command is executed successfully, the actual output pulse will be compensated according to the set S0 parameter during each reversing movement of the axis

(5) Note

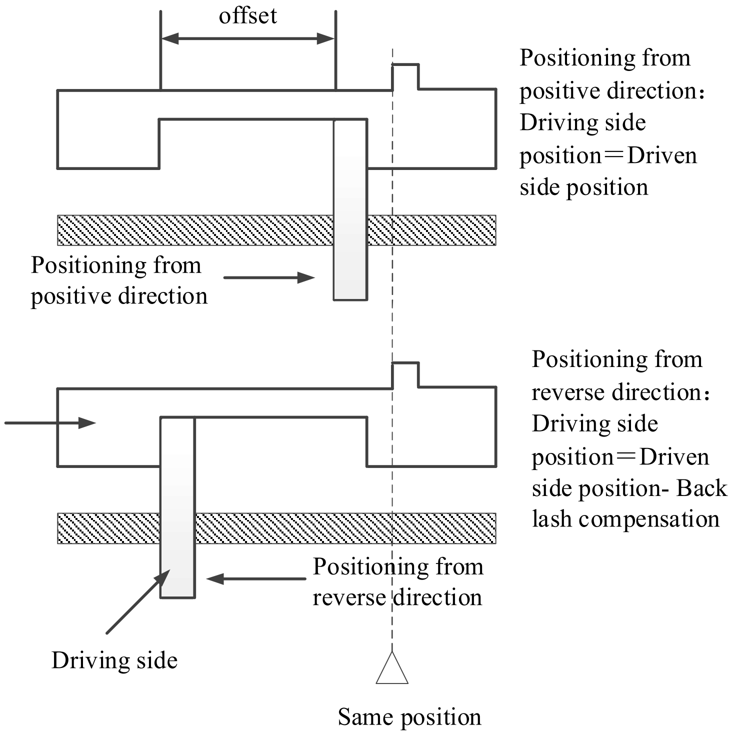
- The execution shall be triggered when the axis is not enabled.
- One axis only can have one back lash comensation command.
- The command can be OFF at any time, but the compensation effect can be removed only after the axis is disabled.
- During the compensation process is not finished, the user and the actual position are inaccurate.
- During the effective period of compensation, execute the homing function, the signal busy is set ON, incomp is reset, and the compensation will not take effect. When the homing is completed, the compensation will take effect again.
- The function is only effective when the axis control mode is CSP, or the axis is in closed-loop control mode, and other situations are not effective.

(6) Related parameters

Input parameter	Parameter name	Data type	Unit	Note
S0	BecklashCompValue	FP64	Command unit	Back lash compensation value*
S0+4	BacklashCompScale	FP64	-	Back lash compensation value variation *
S0+8	ActiveMode	INT16U	-	Effective time 0：take effect after homing

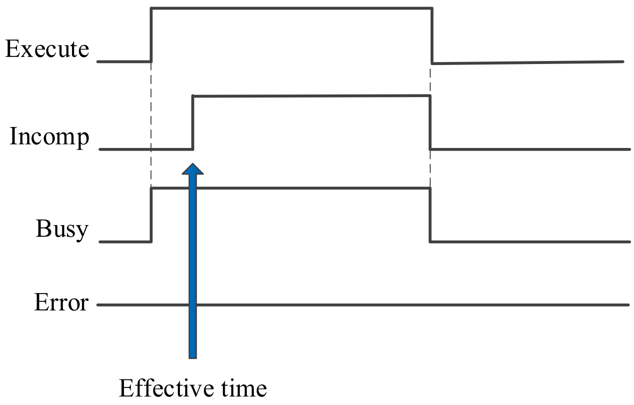
Input parameter	Parameter name	Data type	Unit	Note
				1：take effect after enabled
S0+9	FirstCompDir	INT16U	-	Motion direction 0：not compensate 1：negative compensation 2：positive compensation
S0+10	Reserved	INT32U	-	-
Output parameter	Parameter name	Data type	Unit	Note
S1	ErrCode	INT16U	-	Command error code
State parameter	Parameter name	Data type	Unit	Note
S2	Incomp	BOOL	-	In compensation
S2+1	Busy	BOOL	-	Instruction is executing
S2+2	Error	BOOL	-	Command execution error
Axis number	Parameter name	Data type	Unit	Note
S3	Axis	INT16U	-	Axis number start from 0

Note: Back lash compensation value refers to the fixed gap value between the drive side and the driven side, as shown in the following figure:



The variation of the back lash compensation value (gap value) represents the ratio of the gap value and the displacement of the main motion after the reverse direction. For example, the back lash compensation value is 4, and the variation of the back lash compensation value is 0.5. When the main movement displacement is 6, the corresponding gap value should be 3. When the gap value reaches the set value of 4, the gap value will remain unchanged regardless of the main motion moving.

(7) Sequence diagram



Explain:

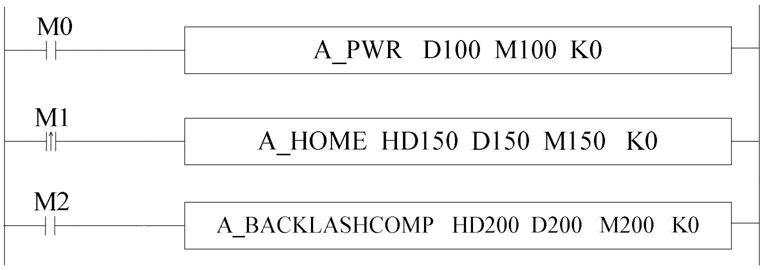
In general, when the command is triggered, the command BUSY signal is set ON. When the effective time of the command setting comes, the incomp compensation signal is set ON, while the busy signal is still set and will not be reset.

The trigger condition is OFF, the other states are reset and the compensation is stop.

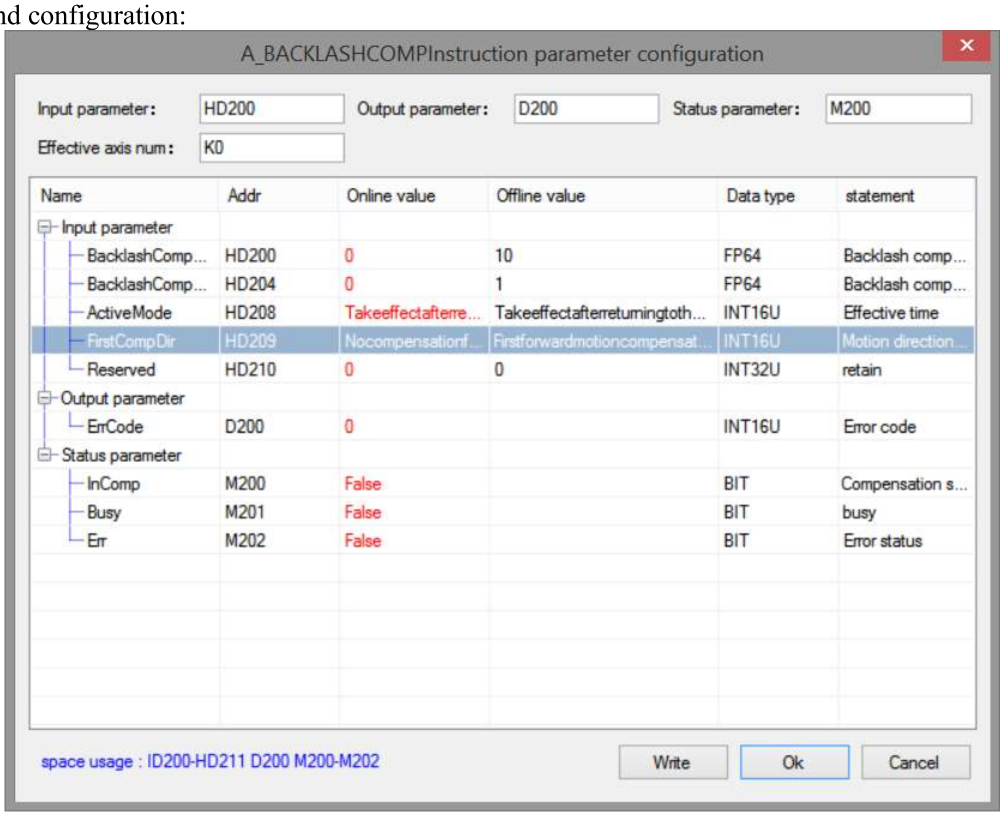
(8) Application

When the back lash compensation value is set to 10 and the back lash compensation coefficient is 1, it will take effect after homing, and the motion direction of the first compensation is positive. When its initial position is 0, execute A_ MOVEA and move to 100.

The ladder diagram is as follows:



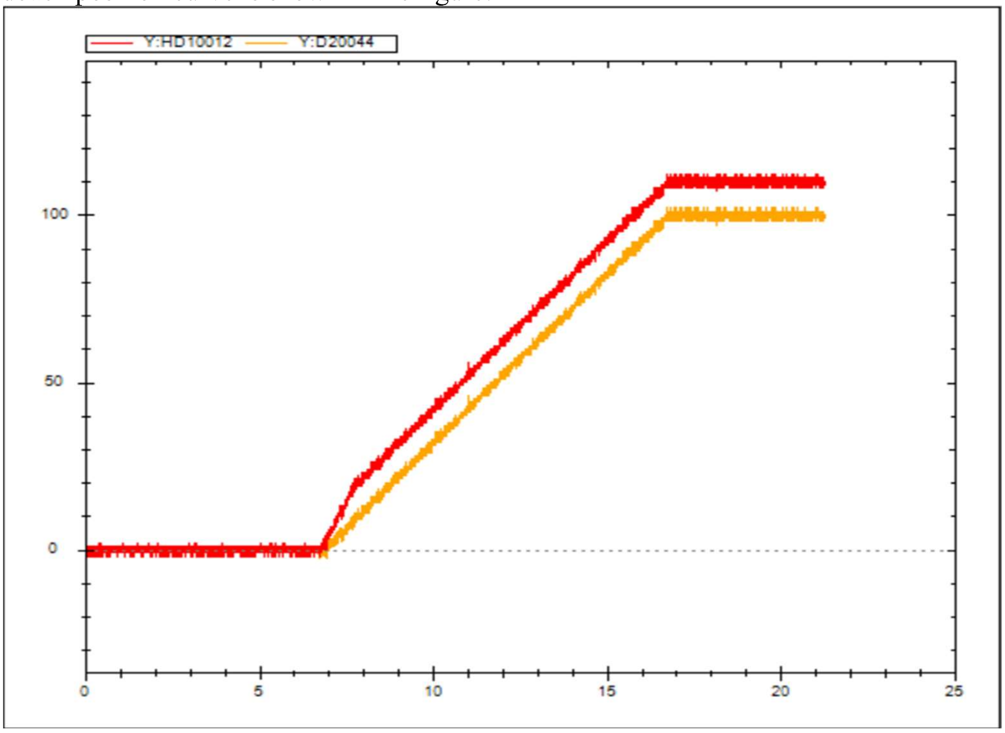
The command configuration:



Description:

Execute the instruction in the non-enabled state, the busy signal is set ON, and execute homing A_HOME/A_ZRN after enabling. After the homing is completed, the command InComp is set ON, indicating that it is in the compensation state. At this time, it is moving in forward direction, the compensation value will be continuously added according to the compensation coefficient. It can be seen from the changes in the user feedback position (such as D20044) and the actual motor position (such as 6064) that the compensation is effective. After the enable is turned off, the compensation will be eliminated, and the user feedback position (such as D20044) and the actual motor position (such as 6064) will also have corresponding changes.

The feedback position curve is shown in the figure:



5-1-2-29. Update without power off【X_UPDATEPARA】

(1) Overview

After modifying the SFD parameters of axis and axis group, the parameters can be updated without power off.

Update without power off [X_UPDATEPARA]			
Execution condition	Rising/falling edge of the coil	Suitable model	XDH, XLH, XG2
Firmware	V3.7.2 and above	Software	3.7.14 and above

(2) Operand

Operand	Function	Type
S0	Output state word start address	16-bit, single word
S1	Output state bit start address	bit

(3) Suitable soft component

Operand	Word soft component											Bit soft component					
	System								Constant	Module		System					
	D*	FD	TD*	CD*	DX	DY	DM*	DS*	K/H	ID	QD	X	Y	M*	S*	T*	C*
S0	●	●	●	●													
S1														●			

*: D means D, HD; TD means TD and HTD; CD means CD, HCD, HSCD and HSD; DM means DM and DHM; DS means DS and DHS; M means M, HM, SM; S means S, HS; T means T, HT; C means C, HC.

(4) Function and action

- S0 specifies [start address of output status word]
- S1 specifies [start address of output status bit] and occupies relay S1~S1+2
- Execute the command and constantly refresh the modified parameters
- The command can only be executed when the axis state machine is invalid (V3.7.3 adds some parameters that can be updated when enabled or when the instruction is running).
- This command can only modify the axis configuration and axis group configuration parameters.

(5) Note

- The SFD parameter that triggers X_UPDATEPARA update in the enabled and instruction running states will not take effect immediately, but will take effect the next time the relevant parameter is called for planning.
- Add real-time updates of some SFD parameters in enabled or instruction running states, supporting parameter enumeration as follows:

Definition	Address
Axis configuration	
Emergency stop mode	SFD8036 + 300*N
Stop curve type	SFD8037 + 300*N
Maximum deceleration of hard limit position	SFD8048 + 300*N
Maximum deceleration distance of hard limit	SFD8052 + 300*N
Maximum speed	SFD8080 + 300*N
Maximum acceleration	SFD8084 + 300*N
Maximum deceleration	SFD8088 + 300*N
Maximum acceleration speed	SFD8092 + 300*N
Default speed percentage	SFD8096 + 300*N
Default acceleration percentage	SFD8097 + 300*N
Default deceleration percentage	SFD8098 + 300*N
Default acceleration percentage	SFD8099 + 300*N
Starting speed	SFD8108 + 300*N
Position deviation alarm value	SFD8120+300*N
Positioning completion width	SFD8124+300*N
Zero detection width	SFD8128+300*N
Motion detection speed value	SFD8132+300*N
Speed warning percentage	SFD8137+300*N
Acceleration warning percentage	SFD8138+300*N

Deceleration warning percentage	SFD8139+300*N
Zero return high-speed	SFD8168 + 300*N
Return to zero crawling speed	SFD8172 + 300*N
Zero return acceleration	SFD8176 + 300*N
Zero return deceleration	SFD8180 + 300*N
Zero return acceleration	SFD8184 + 300*N
Zero position	SFD8188 + 300*N
Zero return direction	SFD8192 + 300*N
Axis group configuration	
Emergency stop mode	SFD48008 + 300*N|
XYZ maximum speed	SFD48020 + 300*N
XYZ maximum acceleration	SFD48024 + 300*N
XYZ maximum deceleration	SFD48028 + 300*N
XYZ maximum acceleration speed	SFD48032 + 300*N
ABC maximum speed	SFD48036 + 300*N
ABC maximum acceleration	SFD48040 + 300*N
ABC maximum deceleration	SFD48044 + 300*N
ABC maximum acceleration speed	SFD48048 + 300*N
XYZ default speed percentage	SFD48052 + 300*N
XYZ default acceleration percentage	SFD48053 + 300*N
XYZ default deceleration percentage	SFD48054 + 300*N
XYZ default acceleration percentage	SFD48055 + 300*N
ABC default speed percentage	SFD48056 + 300*N
ABC default acceleration percentage	SFD48057 + 300*N
ABC default deceleration percentage	SFD48058 + 300*N
ABC default acceleration percentage	SFD48059 + 300*N
XYZ alarm speed percentage	SFD48100 + 300*N
XYZ alarm acceleration percentage	SFD48101 + 300*N
XYZ alarm deceleration percentage	SFD48102 + 300*N
ABC alarm speed percentage	SFD48103 + 300*N
ABC alarm acceleration percentage	SFD48104 + 300*N
ABC alarm deceleration percentage	SFD48105 + 300*N
Allowable radius error	SFD48146 + 300*N
Forward looking corner acceleration	SFD48240+300*N
Centrifugal acceleration	SFD48244+300*N
Maximum speed of handwheel	SFD48248+300*N
Maximum acceleration of handwheel	SFD48252+300*N
Forward straight line transition error	SFD48256+300*N
Forward looking bow height error	SFD48260+300*N
Arc transition error limit	SFD48264+300*N
Hand wheel Z-axis feed rate	SFD48273+300*N
Minimum angle limit for the prospective segment	SFD48274+300*N
Forward transition angle limitation	SFD48275+300*N
Hand wheel high-speed counting port	SFD48276+300*N
Number of handwheel filtering cycles	SFD48277+300*N
Handwheel pulse equivalent	SFD48280+300*N

- The execution status of real-time parameter update instructions is listed as follows:

(1) All configured axes (axis groups) are disabled, triggering the parameter update command X_UPDATEPARA, which will update all modified SFD parameters of unachieved axes (axis groups) and perform parameter verification. For corresponding error axes (axis groups), an error message will be reported, and the parameters in the internal data config of the axes (axis groups) will not be modified.

(2) The configured axes (axis groups) have enabled axes that have not been disconnected. Adding or deleting axes (axis groups), modifying the number of axes (axis groups) (SFD810, etc.), modifying the axis type, command channel, and station number of enabled axes, triggering the parameter update command X_UPDATEPARA to not take effect, will not update the effective axes (axis groups); Modify the SFD parameters of the ineffective axis, and the instruction will not report an error (no modification verification will be performed); To modify the effective axis (axis group), all configured axes (axis groups) must be disabled.

(3) The configured axis has an enabled axis that has not been disconnected, triggering the parameter update command X_UPDATEPARA. All axes can only refresh the modifiable parameters under the enabled state, and parameter verification is performed on the modifiable values. For the corresponding error command, an error is reported, and the axis does not report an error; Modifying SFD parameter instructions that do not allow refreshing will also result in an error; To modify the modifiable parameters under break enable, all configured axes must be broken enable; When the axis is enabled, priority is given to reporting parameter validation errors, followed by reporting errors in modifying SFD parameters that do not allow refreshing.

(4) The configured axis group has an enabled axis group that has not been disconnected. The parameter update command X_UPDATEARA is triggered, and all axis groups can only refresh the modifiable parameters under the enabled state. At the same time, parameter verification is performed on the modifiable values. For the corresponding error command, an error is reported, and the axis group does not report an error; An error occurred when modifying SFD parameter instructions that do not allow refreshing; To modify the modifiable parameters under break enable, all configured axis groups must be disabled; When the axis group is enabled, priority is given to reporting parameter validation errors, followed by reporting errors in modifying SFD parameters that do not allow refreshing.

(5) The configured axis (axis group) has enabled axes that have not been disconnected. When performing parameter verification, only the parameters that can be updated under the enabled state will be verified. For other parameters, only the modification verification will be performed.

- The real-time parameter update instruction execution will verify the parameter values and report errors. The parameter enumeration is as follows:

Definition	Address
Axis configuration	
Axis type*	SFD8000+300*N
Instruction output channel	SFD8001+300*N
Slave station number*	SFD8002+300*N
Pulse count per cycle	SFD8004+300*N
Encoder input port	SFD8006+300*N
Movement per lap	SFD8008+300*N
Side coefficient of reducer workpiece*	SFD8014+300*N
Side coefficient of reducer motor*	SFD8016+300*N
Direction of movement	SFD8018+300*N
Count Type	SFD8020+300*N
Upper limit of rotation count	SFD8024+300*N
Lower limit of rotation count	SFD8028+300*N
Emergency stop mode	SFD8036+300*N
Stop curve type	SFD8037+300*N
Curve type	SFD8038+300*N
Hard limit stop method	SFD8040+300*N
Forward hard limit port	SFD8041+300*N
Negative hard limit port	SFD8043+300*N
Servo positive limit IO sequence	SFD8045+300*N
Servo negative limit IO sequence	SFD8046+300*N
Maximum deceleration of hard limit position	SFD8048+300*N
Maximum deceleration distance of hard limit	SFD8052+300*N
Soft limit stop method	SFD8061+300*N
Soft limit positive value	SFD8064+300*N
Negative value of soft limit	SFD8068+300*N
Soft limit maximum deceleration	SFD8072+300*N
Maximum deceleration distance of soft limit	SFD8076+300*N
Maximum speed	SFD8080+300*N
Maximum acceleration	SFD8084+300*N
Maximum deceleration	SFD8088+300*N
Maximum acceleration speed	SFD8092+300*N
Default speed percentage	SFD8096+300*N
Default acceleration percentage	SFD8097+300*N
Default deceleration percentage	SFD8098+300*N
Default acceleration percentage	SFD8099+300*N

Starting speed	SFD8108+300*N
Position deviation alarm value	SFD8120+300*N
Positioning completion width	SFD8124+300*N
Zero detection width	SFD8128+300*N
Motion detection speed value	SFD8132+300*N
Origin port	SFD8160+300*N
Z-phase port	SFD8164+300*N
Zero return high-speed	SFD8168+300*N
Return to zero crawling speed	SFD8172+300*N
Zero return acceleration	SFD8176+300*N
Zero return deceleration	SFD8180+300*N
Zero return acceleration	SFD8184+300*N
Zero position	SFD8188+300*N
Zero return direction	SFD8192+300*N
Probe encoder pulse equivalent	SFD8194+300*N
Pulse port	SFD8200+300*N
Pulse direction port	SFD8201+300*N
Pulse port polarity	SFD8202+300*N
Pulse direction port polarity	SFD8203+300*N
Encoder equivalent value	SFD8206+300*N
Proportional gain	SFD8210+300*N
Integral gain	SFD8214+300*N
Differential gain	SFD8218+300*N
Speed feedforward gain	SFD8222+300*N
Feedback speed feedforward gain	SFD8226+300*N
Maximum closed-loop position gain	SFD8230+300*N
2 degrees of freedom alpha	SFD8236+300*N
2 degrees of freedom integration time	SFD8240+300*N
Axis group configuration	
Kinematic types	SFD48000+300*N
Configure axis number 1	SFD48001+300*N
Configure axis number 2	SFD48002+300*N
Configure axis number 3	SFD48003+300*N
Configure axis number 4	SFD48004+300*N
Configure axis number 5	SFD48005+300*N
Configure axis number 6	SFD48006+300*N
Emergency stop mode	SFD48008+300*N
XYZ maximum speed	SFD48020+300*N
XYZ maximum acceleration	SFD48024+300*N
XYZ maximum deceleration	SFD48028+300*N
XYZ maximum acceleration speed	SFD48032+300*N
ABC maximum speed	SFD48036+300*N
ABC maximum acceleration	SFD48040+300*N
ABC maximum deceleration	SFD48044+300*N
ABC maximum acceleration speed	SFD48048+300*N
XYZ default speed percentage	SFD48052+300*N
XYZ default acceleration percentage	SFD48053+300*N
XYZ default deceleration percentage	SFD48054+300*N
XYZ default acceleration percentage	SFD48055+300*N
ABC default speed percentage	SFD48056+300*N
ABC default acceleration percentage	SFD48057+300*N
ABC default deceleration percentage	SFD48058+300*N
ABC default acceleration percentage	SFD48059+300*N
Maximum soft limit of X-axis	SFD48120+300*N
Y-axis maximum soft limit	SFD48124+300*N
Z-axis maximum soft limit	SFD48128+300*N
Minimum soft limit of X-axis	SFD48132+300*N

Y-axis minimum soft limit	SFD48136+300*N
Z-axis minimum soft limit	SFD48140+300*N
Soft limit stop type	SFD48145+300*N
Allowable radius error	SFD48146+300*N
The distance between the rotation center and the translation axis	SFD48162+300*N
The offset of the rotation center based on the X-direction of the base mark	SFD48166+300*N
The offset of the rotation center based on the Y direction of the base mark	SFD48170+300*N
Forward looking corner acceleration	SFD48240+300*N
Centrifugal acceleration	SFD48244+300*N
Maximum speed of handwheel	SFD48248+300*N
Maximum acceleration of handwheel	SFD48252+300*N
Forward straight line transition error	SFD48256+300*N
Forward looking bow height error	SFD48260+300*N
Arc transition error limit	SFD48264+300*N

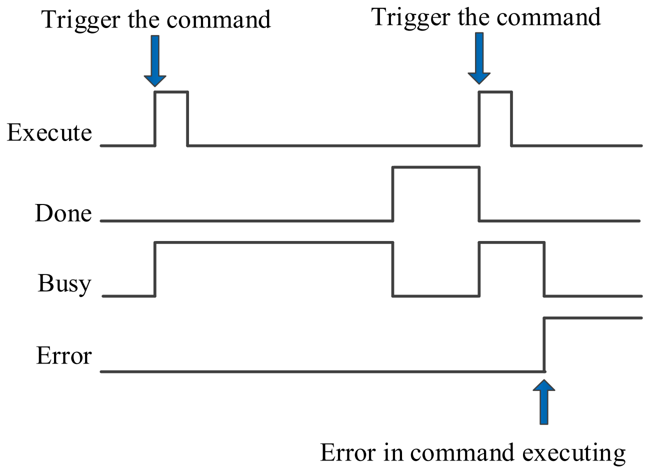
- After some parameter modifications exceed the limit, executing the real-time parameter update command will automatically correct the parameter values (below the lower limit, it will be corrected to the lower limit value (in some cases, it will be corrected to 1 or other values), and above the upper limit, it will be corrected to the upper limit value), as listed below:

Definition	Address	Upper and lower limits and correction values
Position instruction filtering	SFD8019 + 200*N	0-1000 (equals 0 corrected to 1)
Motion detection filtering	SFD8136 + 200*N	0-10000 (equals 0 corrected to 1)
Speed feedforward filtering time	SFD8234 + 200*N	0-200 (equals 0 corrected to 1)
Feedback speed filtering time	SFD8235 + 200*N	0-200 (equals 0 corrected to 1)
Forward minimum angle	SFD48274 + 300*N	0-180 (corrected to 0.0001 for values less than 0)
Forward transition angle limitation	SFD48275 + 300*N	0-180 (if the bow height error or arc transition error is set to 0, adjust the transition angle to 0)
Forward straight line transition error	SFD48256 + 300*N	0.0001-0.5 (corrected to 0.001 if less than 0.0001)
Arc transition error limit	SFD48264 + 300*N	Greater than or equal to 0
Forward looking bow height error	SFD48260 + 300*N	0-0.5
Number of hand wheel cycle filters	SFD48277 + 300*N	Upper limit 200 (negative value takes absolute value)

(6) Related parameters

Output parameter	Parameter name	Data type	Unit	Note
S0	ErrCode	INT16U	-	Command error code
State parameter	Parameter name	Data type	Unit	Note
S1	Done	BOOL	-	Command execution completed
S1+1	Busy	BOOL	-	Instruction is executing
S1+2	Error	BOOL	-	Command execution error

(7) Sequence diagram



Explain:
When the command is triggered, the Busy signal is set ON. When the command is completed, the Busy signal is reset and the Done signal is set ON.
When there is an error in the command execution, the Error signal is set ON, other signals are reset, and the corresponding error code is output.

5-1-2-30. Multi axis composite motion【A_COMBINEAXIS】

(1) Overview

Multiply the positions of the two axes by their respective scaling ratios, and then add or subtract the values as the current command position output.

Multi axis composite motion [A_COMBINEAXIS]			
Execution condition	Rising/falling edge of the coil	Suitable model	XDH, XLH, XG2
Firmware	V3.7.3 and above	Software	3.7.16 and above

(2) Operand

Operand	Function	Type
S0	Input parameter starting address	16-bit, single word
S1	Starting address of output status word	16-bit, single word
S2	Starting address of output status bit	Bit
S3	Axis output port number	16-bit, single word

(3) Suitable soft component

Operand	Word soft component											Bit soft component					
	System								Constant	Module		System					
	D*	FD	TD*	CD*	DX	DY	DM*	DS*	K/H	ID	QD	X	Y	M*	S*	T*	C*
S0	●	●	●	●													
S1	●	●	●	●													
S2														●			
S3	●								●								

*: D means D, HD; TD means TD and HTD; CD means CD, HCD, HSCD and HSD; DM means DM and DHM; DS means DS and DHS; M means M, HM, SM; S means S, HS; T means T, HT; C means C, HC.

(4) Function and action

- S0 specifies the [input parameter start address], occupying registers S0~S0+13;
- S1 specifies the starting address of the output status word;
- S2 specifies the starting address of the output status bit, occupying relays S2~S2+4;
- S3 specifies [axis port number];
- When M0 changes from OFF to ON, execute superimposed motion control on the axis specified by S3 according to the two axes specified by S0, S0+1. After successful execution, S2 is set to indicate that the target axis is in synchronous motion state;
- Multiply the positions of the two axes by their respective scaling ratios, and then add or subtract the values as the current command position output. The two axes can choose their own data sources;
- The position and speed of the axis are combined by two main axes.

(5) Note

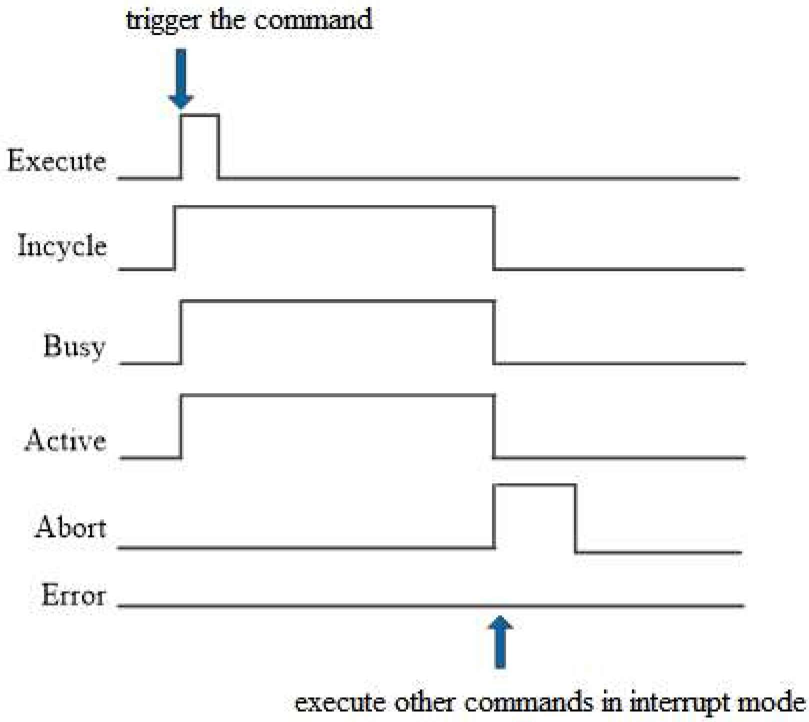
- Only supports CSP mode, parameters do not support real-time updates;
- The position of the slave axis is calculated by the difference in the position of the master axis. During operation, changing the position of the master axis will prevent the slave axis from stepping;
- The operation of the master axis (error, stop, etc.) has no impact on the slave axis;
- Encoder axis not supported, can be executed together with additional motion, supports mold axis;
- When the denominator of the spindle is 0, it defaults to 1.

(6) Related parameters

Input parameter	Parameter name	Data type	Unit	Note
S0	Master1	INT16S	-	Master axis 1 index
S0+1	Master2	INT16S	-	Master axis 2 index
S0+2	CombineMode	INT16S	-	calculation mode: 0: Addition 1: Subtraction
S0+3	BufferMode	INT16S	-	Caching mode: 0: Interrupt

Input parameter	Parameter name	Data type	Unit	Note
				1: Cache
S0+4	MasterId1_NUM	INT32S	-	Master axis 1 proportional numerator
S0+6	MasterId1_DEN	INT32S	-	Master axis 1 proportional denominator
S0+8	MasterId2_NUM	INT32S	-	Master axis 2 proportional numerator
S0+10	MasterId2_DEN	INT32S	-	Master axis 2 proportional denominator
S0+12	MasterId1Source	INT16S	-	Master axis 1 data source 0: Given position 1: Feedback position
S0+13	MasterId2Source	INT16S	-	Master axis 2 data source 0: Given position 1: Feedback position
Output parameter	**Parameter name**	**Data type**	**Unit**	**Note**
S1	ErrCode	INT16U	-	Command error code
Status parameter	**Parameter name**	**Data type**	**Unit**	**Note**
S2	Incycle	BOOL	-	In instruction synchronization control
S2+1	Busy	BOOL	-	Instruction is currently being executed
S2+2	Active	BOOL	-	Instruction under control
S2+3	Abort	BOOL	-	Instruction interrupted
S2+4	Error	BOOL	-	Instruction execution error
Axis number	**Parameter name**	**Data type**	**Unit**	**Note**
S3	Axis	INT16U	-	Axis number. Starting from 0

(7) Sequence diagram

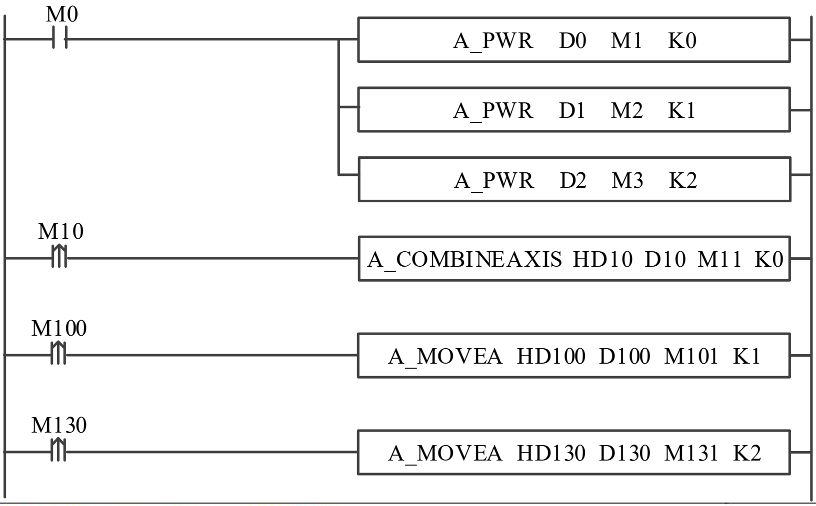


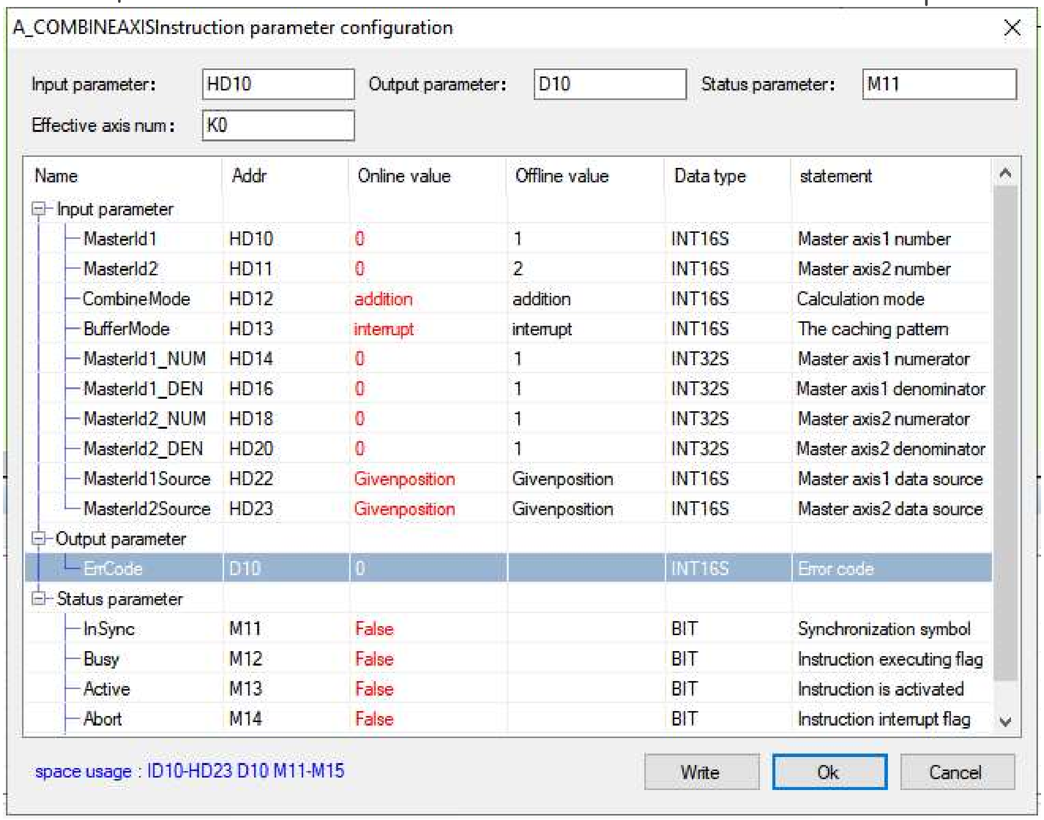
Explanation:
Trigger command, set on Busy and Active signals, and set on InCycle signal when the axis reaches synchronization state;
During cycle control, execute other instructions in interrupt mode, set on the Abort signal, and reset the InCycle, Busy, and Active signals.

(8) Application
Start multi axis synthesis in addition mode, with the numerator 1 and denominator 1 on both axes, and the given position as the data source. Spindle 1 uses A_MOVEA instruction moves from a speed of 1000 pulses/s to a

position of 10000 pulses, with an acceleration/deceleration of 5000 pulses/s^2 and a jerk of 5000 pulses/s^3. A_MOVEA is used for spindle 2 moves from a speed of 3000 pulses/s to a position of 6000 pulses, with an acceleration and deceleration of 15000 pulses/s^2 and a jerk of 150000 pulses/s^3.

The ladder diagram is as follows:





A_COMBINEAXISInstruction parameter configuration

Input parameter: HD10 Output parameter: D10 Status parameter: M11

Effective axis num: K0

Name	Addr	Online value	Offline value	Data type	statement
Input parameter					
MasterId1	HD10	0	1	INT16S	Master axis1 number
MasterId2	HD11	0	2	INT16S	Master axis2 number
CombineMode	HD12	addition	addition	INT16S	Calculation mode
BufferMode	HD13	interrupt	interrupt	INT16S	The caching pattern
MasterId1_NUM	HD14	0	1	INT32S	Master axis1 numerator
MasterId1_DEN	HD16	0	1	INT32S	Master axis1 denominator
MasterId2_NUM	HD18	0	1	INT32S	Master axis2 numerator
MasterId2_DEN	HD20	0	1	INT32S	Master axis2 denominator
MasterId1Source	HD22	Givenposition	Givenposition	INT16S	Master axis1 data source
MasterId2Source	HD23	Givenposition	Givenposition	INT16S	Master axis2 data source
Output parameter					
ErrCode	D10	0		INT16S	Error code
Status parameter					
InSync	M11	False		BIT	Synchronization symbol
Busy	M12	False		BIT	Instruction executing flag
Active	M13	False		BIT	Instruction is activated
Abort	M14	False		BIT	Instruction interrupt flag

space usage : ID10-HD23 D10 M11-M15

Write Ok Cancel

A_MOVEAInstruction parameter configuration

Input parameter: HD100 Output parameter: D100 Status parameter: M101

Effective axis num: K1

Name	Addr	Online value	Offline value	Data type	statement
Input parameter					
Pos	HD100	0	10000	FP64	Absolute target position
Vel	HD104	0	1000	FP64	The target velocity, u/s
Acc	HD108	0	5000	FP64	Acceleration, u/s^2
Dec	HD112	0	5000	FP64	Minus the velocity, u/s^2
Jerk	HD116	0	5000	FP64	Plus acceleration, u/s^3
ContinuousMode	HD120	Donotupdate	Donotupdate	INT16U	Continuously updated
Direction	HD121	Nodirection	Nodirection	INT16U	The direction of
BufferMode	HD122	interrupt	interrupt	INT16U	The caching pattern
Output parameter					
ErrCode	D100	0		INT16U	Error code
Status parameter					
Done	M101	False		BIT	Completion status
Busy	M102	False		BIT	busy
Active	M103	False		BIT	active
Abort	M104	False		BIT	Interrupt status
Err	M105	False		BIT	Error status

space usage : ID100-HD122 D100 M101-M105

Write Ok Cancel

A_MOVEAInstruction parameter configuration

Input parameter: HD130 Output parameter: D130 Status parameter: M131

Effective axis num: K2

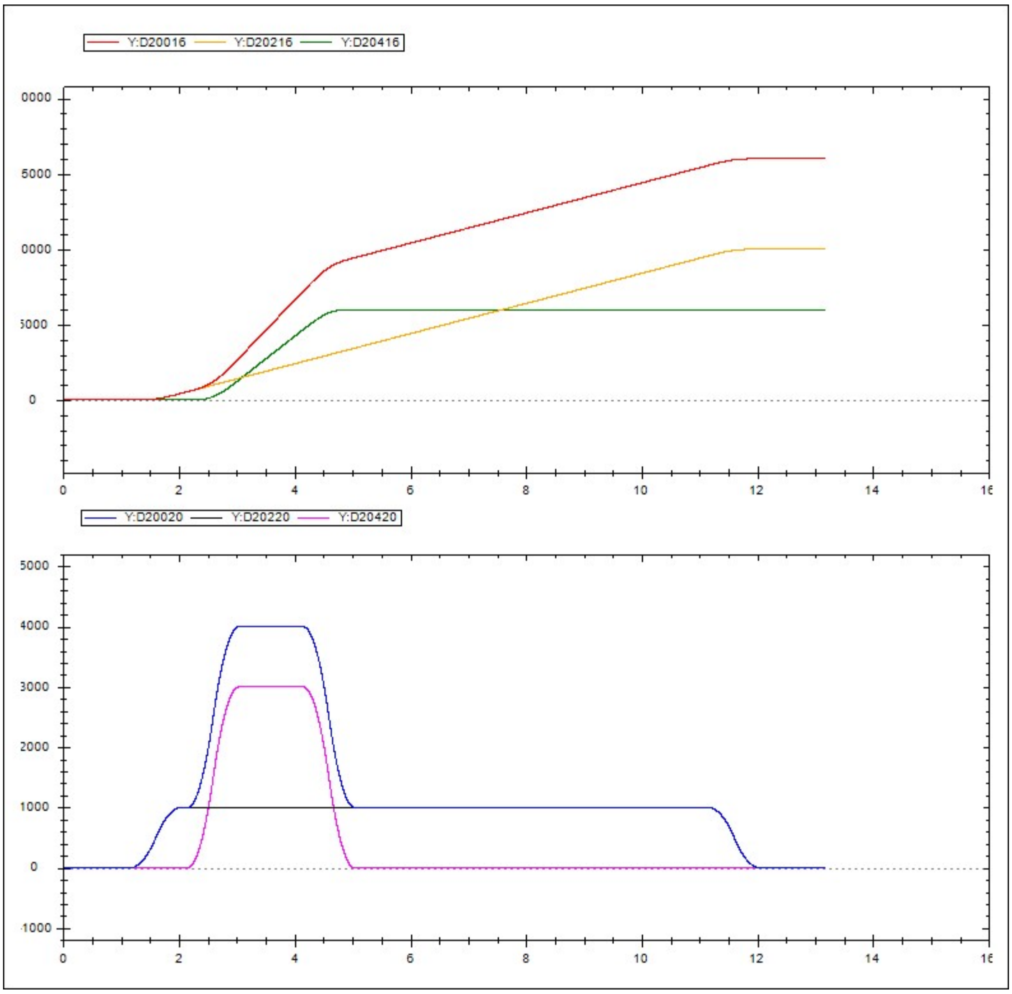
Name	Addr	Online value	Offline value	Data type	statement
Input parameter					
Pos	HD130	0	6000	FP64	Absolute target position
Vel	HD134	0	3000	FP64	The target velocity, u/s
Acc	HD138	0	15000	FP64	Acceleration, u/s^2
Dec	HD142	0	15000	FP64	Minus the velocity, u/s^2
Jerk	HD146	0	15000	FP64	Plus acceleration, u/s^3
ContinuousMode	HD150	Donotupdate	Donotupdate	INT16U	Continuously updated
Direction	HD151	Nodirection	Nodirection	INT16U	The direction of
BufferMode	HD152	interrupt	interrupt	INT16U	The caching pattern
Output parameter					
ErrCode	D130	0		INT16U	Error code
Status parameter					
Done	M131	False		BIT	Completion status
Busy	M132	False		BIT	busy
Active	M133	False		BIT	active
Abort	M134	False		BIT	Interrupt status
Err	M135	False		BIT	Error status

space usage : ID130-HD152 D130 M131-M135

Write Ok Cancel

Explanation: First, use A_PWR command to turn on the enabled. When M10 switches from OFF to ON, the multi axis synthesis command is activated. Then, M100 switches from OFF to ON and spindle 1 runs with the set parameters. M130 switches from OFF to ON and spindle 2 runs with the set parameters. After reaching the target position, the state parameter M3 of the command switches from OFF to ON.

The execution position curve is as follows:



Y:D20016
Y:D20216
Y:D20416
0000
5000
0000
5000
0
0
2
4
6
8
10
12
14
16
Y:D20020
Y:D20220
Y:D20420
5000
4000
3000
2000
1000
0
-1000

5-1-2-31. Single axis emergency stop【A_IMMEDIATESTOP】

(1) Overview

Immediate stop command for single axis may cause mechanical damage.

Single axis emergency stop [A_IMMEDIATESTOP]			
Execution condition	Normally open/close coil	Suitable model	XDH, XLH, XG2
Firmware	V3.7.3 and above	Software	3.7.16 and above

(2) Operand

Operand	Function	Type
S0	Input parameter starting address	16-bit, single word
S1	Starting address of output status word	16-bit, single word
S2	Starting address of output status bit	Bit
S3	Axis output port number	16-bit, single word

(3) Suitable soft component

Operand	Word soft component											Bit soft component					
	System								Constant	Module		System					
	D*	FD	TD*	CD*	DX	DY	DM*	DS*	K/H	ID	QD	X	Y	M*	S*	T*	C*
S0	●	●	●	●													
S1	●	●	●	●													
S2														●			
S3									●								

*: D means D, HD; TD means TD and HTD; CD means CD, HCD, HSCD and HSD; DM means DM and DHM; DS means DS and DHS; M means M, HM, SM; S means S, HS; T means T, HT; C means C, HC.

(4) Function and action,

```
M0                  (S0) (S1) (S2) (S3)
--| |-----[A_IMMEDIATESTOP  D0  D50  M1  K0]
```

- S0 specifies the [input parameter start address].
- S1 specifies the starting address of the output status word.
- S2 specifies the starting address of the output status bit, occupying relays S2~S2+3.
- S3 specifies [axis port number].
- When M0 changes from OFF to ON, a stop action is performed on the axis specified by S3. The stopping method is specified by S0, and three stopping methods can be achieved: emergency stop, emergency stop and close enable, and emergency stop and reset position deviation.
- After executing this command, the single axis state machine (D20000+200 * N) switches to 7, and other motion commands can only be used after the emergency stop is turned off and the error is cleared.

(5) Note

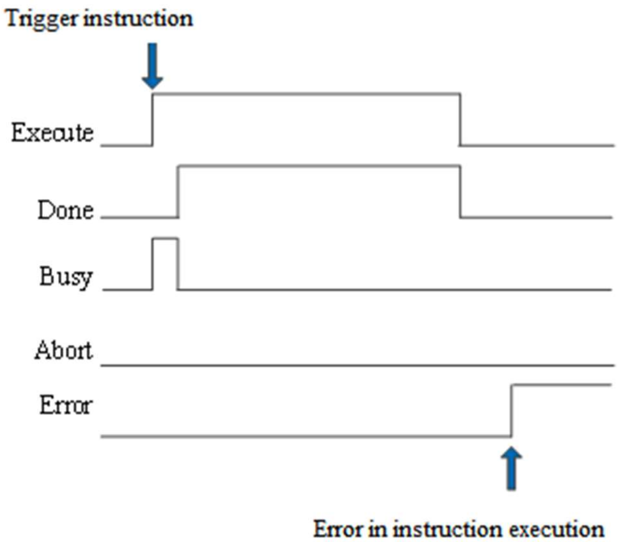
- This command can be triggered even if the axis is not enabled. It can be executed on other axis machines and does not support encoder axes.
- When the axis group operates, when this command is executed on the specified axis, the axis immediately stops, and the axis group also stops immediately.
- Trigger this command in CSP mode to maintain CSP mode; Trigger this command in CSV mode to maintain CSV mode; Trigger this command in CST/HM mode and switch back to CSP mode.
- This command will interrupt all running motion commands, additional motion commands such as A-MOVESUP, A_HALT, and A_STOP.
- Use the emergency stop and reset position deviation mode for emergency stop. If there is a servo error, the servo needs to be cleared.

(6) Related parameters

Input parameter	Parameter name	Data type	Unit	Note
S0	Mode	INT16S	-	Stop type: 0: Emergency stop 1: Emergency stop and shutdown enable 2: Emergency stop and reset position deviation
Output	Parameter name	Data type	Unit	Note

Input parameter	Parameter name	Data type	Unit	Note
parameter				
S1	ErrCode	INT16U	-	Command error code
Status parameter	Parameter name	Data type	Unit	Note
S2	Done	BOOL	-	Instruction execution completed
S2+1	Busy	BOOL	-	Instruction is currently being executed
S2+2	Abort	BOOL	-	Instruction interrupted
S2+3	Error	BOOL	-	Instruction execution error
Axis number	Parameter name	Data type	Unit	Note
S3	Axis	INT16U	-	Axis number. Starting from 0

(7) Sequence diagram

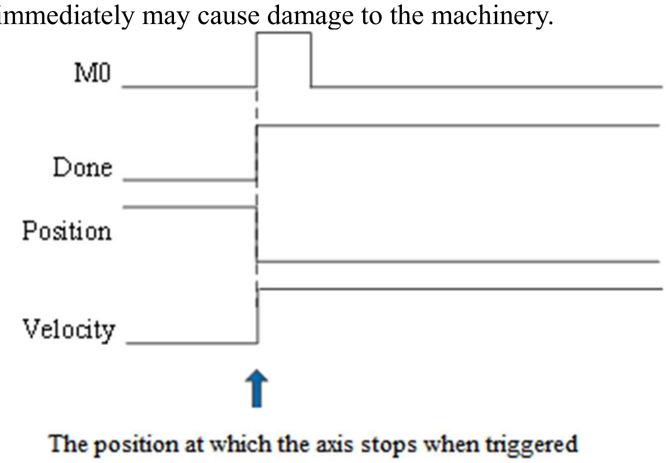


Explanation:
Trigger command, Busy signal set, when command execution is completed, Busy signal reset, Done signal set. When there is an error during instruction execution, the Error signal is set, all other signals are reset, and the corresponding error code is output.

(8) Application

① Emergency stop

When the command is executed, immediately stop the axis.
Attention: Stopping exercise immediately may cause damage to the machinery.



② Emergency stop and shutdown enable

At the same time of emergency stop, turn off the enable of the shaft.

③ Emergency stop and reset position deviation

At the same time of emergency stop, reset the position deviation, and D20016 becomes D20044 at the same position.

5-1-2-32. Reset deviation【A_RSTFERR】

(1) Overview

The feedback position of the motor deviates from the given positioning position, and it is necessary to clear the deviation between the two.

Reset deviation [A_RSTFERR]			
Execution condition	Rising/falling edge of the coil	Suitable model	XDH, XLH, XG2
Firmware	V3.7.3 and above	Software	3.7.16 and above

(2) Operand

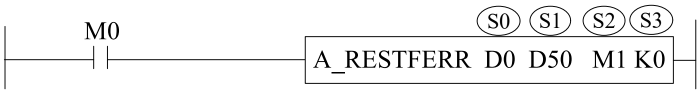
Operand	Function	Type
S0	Input parameter starting address	16-bit, single word
S1	Starting address of output status word	16-bit, single word
S2	Starting address of output status bit	Bit
S3	Axis output port number	16-bit, single word

(3) Suitable soft component

Operand	Word soft component											Bit soft component					
	System								Constant	Module		System					
	D*	FD	TD*	CD*	DX	DY	DM*	DS*	K/H	ID	QD	X	Y	M*	S*	T*	C*
S0	●	●	●	●													
S1	●	●	●	●													
S2														●			
S3	●								●								

*: D means D, HD; TD means TD and HTD; CD means CD, HCD, HSCD and HSD; DM means DM and DHM; DS means DS and DHS; M means M, HM, SM; S means S, HS; T means T, HT; C means C, HC.

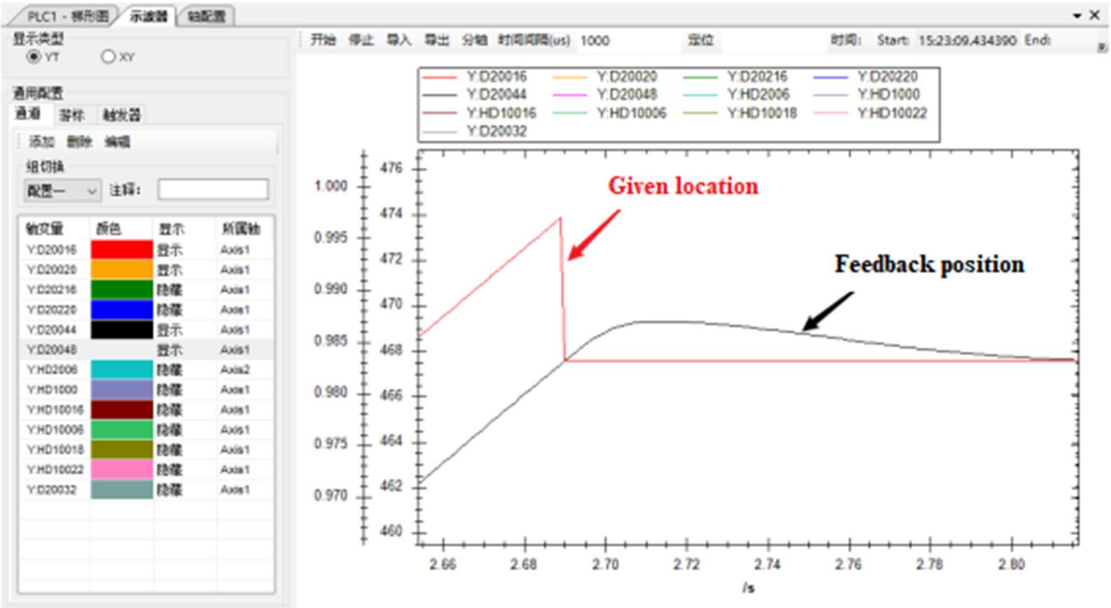
(4) Function and action

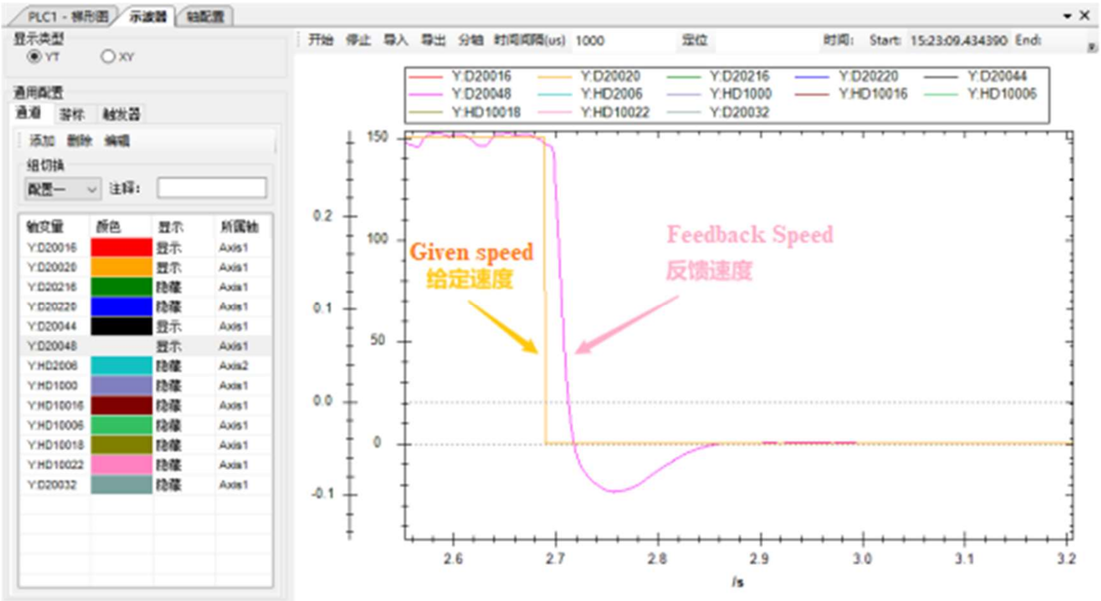


- S0 specifies the [input parameter start address].
- S1 specifies the starting address of the output status word.
- S2 specifies the starting address of the output status bit, occupying relays S2~S2+4.
- S3 specifies [axis port number].
- When M0 changes from OFF to ON, a stop action is performed on the axis specified in S3, and the deviation between the motor feedback position and the given positioning position is cleared, so that the deviation between the given position and the feedback position is "0".
- The instruction will be completed within one cycle, and after completion, the single axis state machine D20000+200 * N=1.

(5) Note

- Please run this command at low speed on the shaft, otherwise it may cause impact on the machine.
- This instruction will interrupt the moving instruction and the instruction in the cache area.
- The feedback position at the time of triggering the command is triggered by the step of the axis positioning set. The deviation between the feedback position and the positioning set is "0", which may cause the motor to reverse. The position and speed schematic diagram is as follows:





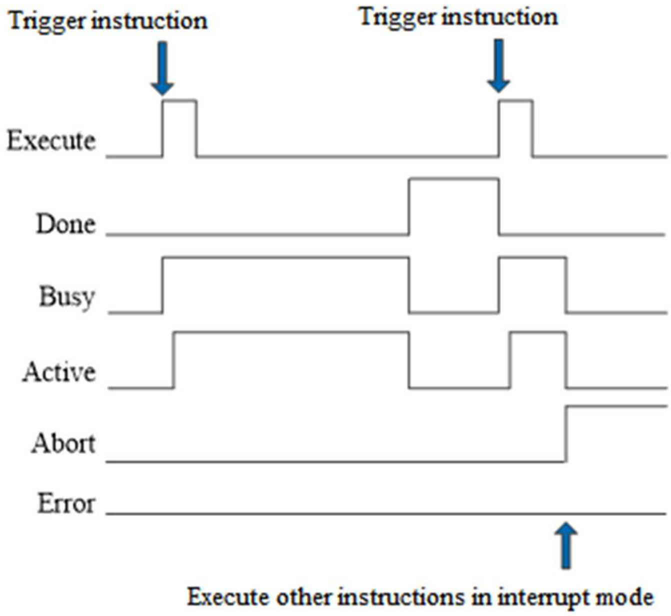
- Can only be triggered in CSP mode, error message when running this command in other modes.
- This instruction does not allow following cache instructions and does not support encoder axes.
- When the spindle uses this command and uses the command position as synchronous data, the spindle will start this command. The slave shaft will reverse according to the gear ratio and cam data variables, and the binding relationship is not affected. Using this command from the axis, the binding relationship is released, the deviation is reset from the axis, and the spindle is not affected.
- In the case of the mold axis, both the given position and feedback position are within the counting range during the execution of the command.
- For vertical axes and other axes that require continuous torque application, it is necessary to confirm that there will be no insufficient torque after starting this command before using it.

(6) Related parameters

Input parameter	Parameter name	Data type	Unit	Note
S0	Buffermode	INT16u	-	Caching mode: 0: Interrupt 1: Caching (currently not supported)
Output parameter	Parameter name	Data type	Unit	Note
S1	ErrCode	INT16U	-	Command error code
Status parameter	Parameter name	Data type	Unit	Note

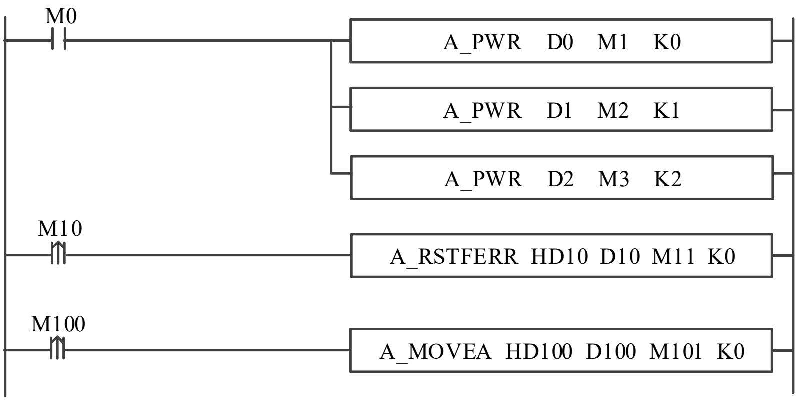
S2	Done	BOOL	-	Instruction execution completed
S2+1	Busy	BOOL	-	Instruction is currently being executed
S2+2	Active	BOOL	-	Instruction under control
S2+3	Abort	BOOL	-	Instruction interrupted
S2+4	Error	BOOL	-	Instruction execution error
Axis number	Parameter name	Data type	Unit	Note
S3	Axis	INT16U	-	Axis number. Starting from 0

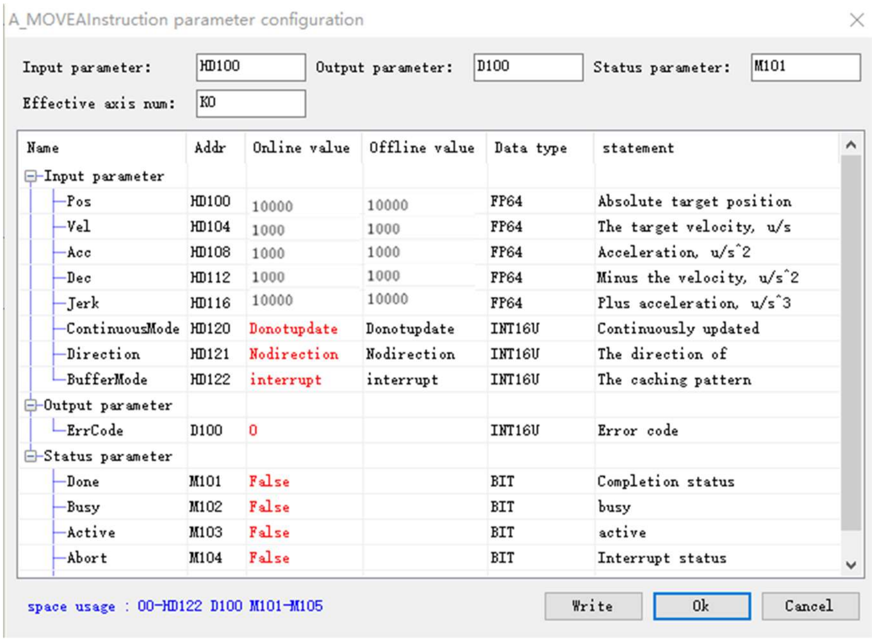
(7) Sequence diagram



Explanation:
After triggering the command, the Busy and Active signals are set, reset after one cycle, and the Done signal is set at the same time. The Done signal will only reset after triggering the command again, otherwise it will not automatically reset.
During the instruction execution process, if a new instruction is triggered in interrupt mode, the Busy and Active signals will immediately reset, and the Abort signal will be set.
When there is an error in the instruction, the Error signal is set, other signals are reset, and the corresponding error code is output.

(8) Application
The motor moves at a speed of 1000 pulses/s using the A_MOVEA command, with an acceleration and deceleration of 1000 pulses/s², The acceleration size is 10000 pulses/s³, execute the A_RSTFERR command during motion to eliminate deviations.
The ladder diagram is as follows:





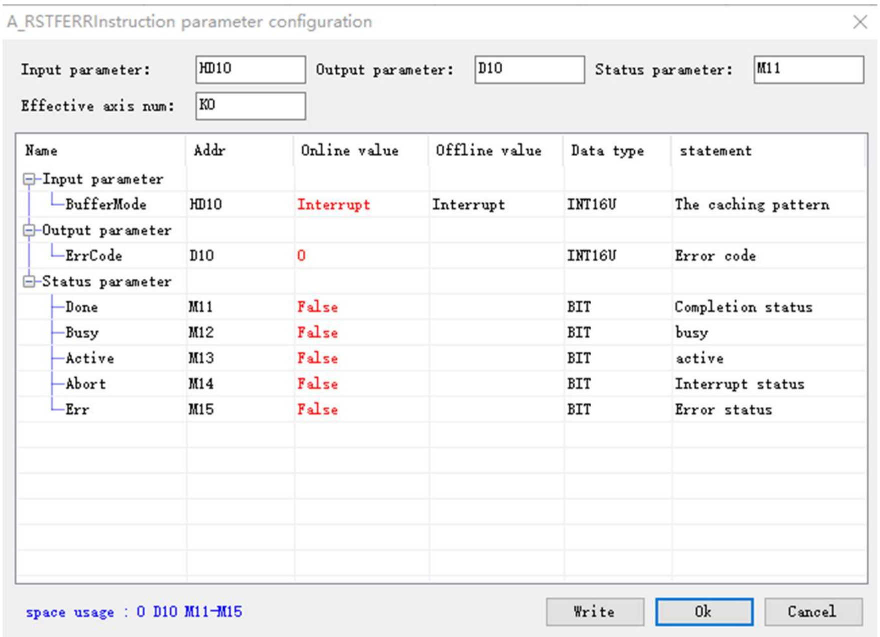
A_MOVEAInstruction parameter configuration

Input parameter: HD100 Output parameter: D100 Status parameter: M101

Effective axis num: K0

Name	Addr	Online value	Offline value	Data type	statement
Input parameter					
Pos	HD100	10000	10000	FP64	Absolute target position
Vel	HD104	1000	1000	FP64	The target velocity, u/s
Acc	HD108	1000	1000	FP64	Acceleration, u/s^2
Dec	HD112	1000	1000	FP64	Minus the velocity, u/s^2
Jerk	HD116	10000	10000	FP64	Plus acceleration, u/s^3
ContinuousMode	HD120	Donotupdate	Donotupdate	INT16U	Continuously updated
Direction	HD121	Nodirection	Nodirection	INT16U	The direction of
BufferMode	HD122	interrupt	interrupt	INT16U	The caching pattern
Output parameter					
ErrCode	D100	0		INT16U	Error code
Status parameter					
Done	M101	False		BIT	Completion status
Busy	M102	False		BIT	busy
Active	M103	False		BIT	active
Abort	M104	False		BIT	Interrupt status

space usage : 00-HD122 D100 M101-M105 Write Ok Cancel



A_RSTFERRInstruction parameter configuration

Input parameter: HD10 Output parameter: D10 Status parameter: M11

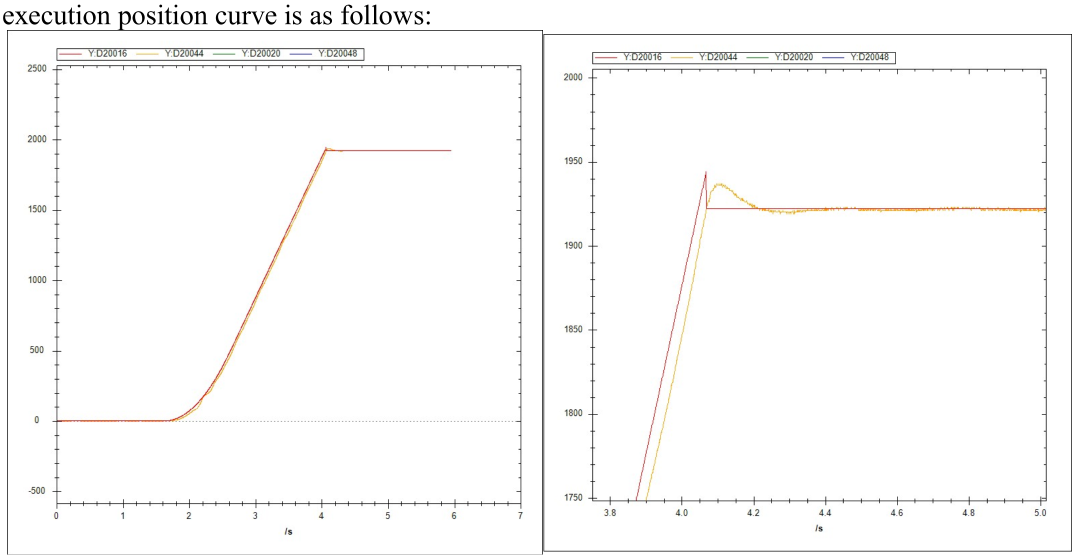
Effective axis num: K0

Name	Addr	Online value	Offline value	Data type	statement
Input parameter					
BufferMode	HD10	Interrupt	Interrupt	INT16U	The caching pattern
Output parameter					
ErrCode	D10	0		INT16U	Error code
Status parameter					
Done	M11	False		BIT	Completion status
Busy	M12	False		BIT	busy
Active	M13	False		BIT	active
Abort	M14	False		BIT	Interrupt status
Err	M15	False		BIT	Error status

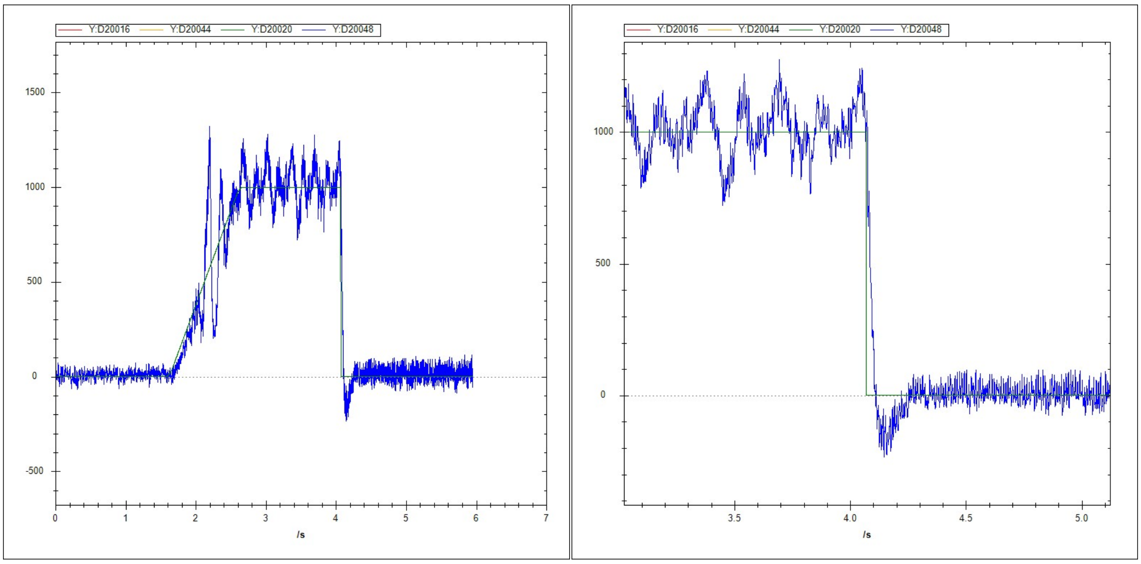
space usage : 0 D10 M11-M15 Write Ok Cancel

Firstly, turn on the enable function through the A6PWR command. When M100 switches from OFF to ON, it starts running with the parameters set by the command. Before reaching the target position, the A-RSTFREE command is triggered, and the motion immediately stops and position deviation is eliminated.

The execution position curve is as follows:



The execution speed curve is shown below:



5-1-2-33. Torque control【A_TORQUECTRL】

(1) Overview

Switch the servo mode to CST mode, plan the target torque in real-time according to the torque change rate, and output it to the servo, suitable for situations with strict torque control.

Torque control [A_TORQUECTRL]			
Execution condition	Rising/falling edge of the coil	Suitable model	XDH, XLH, XG2
Firmware	V3.7.3 and above	Software	3.7.16 and above

(2) Operand

Operand	Function	Type
S0	Input parameter starting address	16-bit, single word
S1	Starting address of output status word	16-bit, single word
S2	Starting address of output status bit	Bit
S3	Axis output port number	16-bit, single word

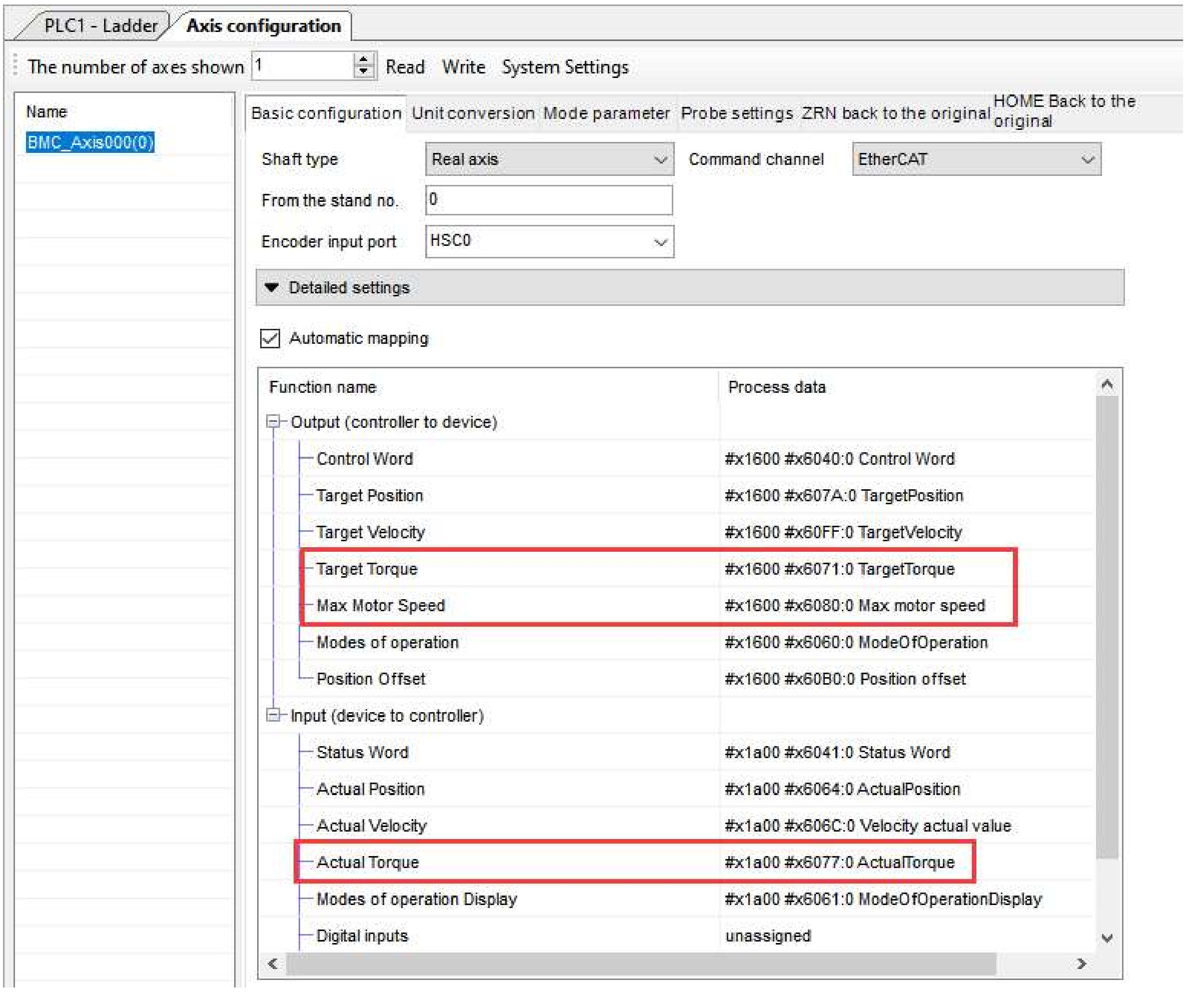
(3) Suitable soft component

Operand	Word soft component											Bit soft component					
	System								Constant	Module		System					
	D*	FD	TD*	CD*	DX	DY	DM*	DS*	K/H	ID	QD	X	Y	M*	S*	T*	C*
S0	●	●	●	●													
S1	●	●	●	●													
S2														●			
S3	●								●								

*: D means D, HD; TD means TD and HTD; CD means CD, HCD, HSCD and HSD; DM means DM and DHM; DS means DS and DHS; M means M, HM, SM; S means S, HS; T means T, HT; C means C, HC.

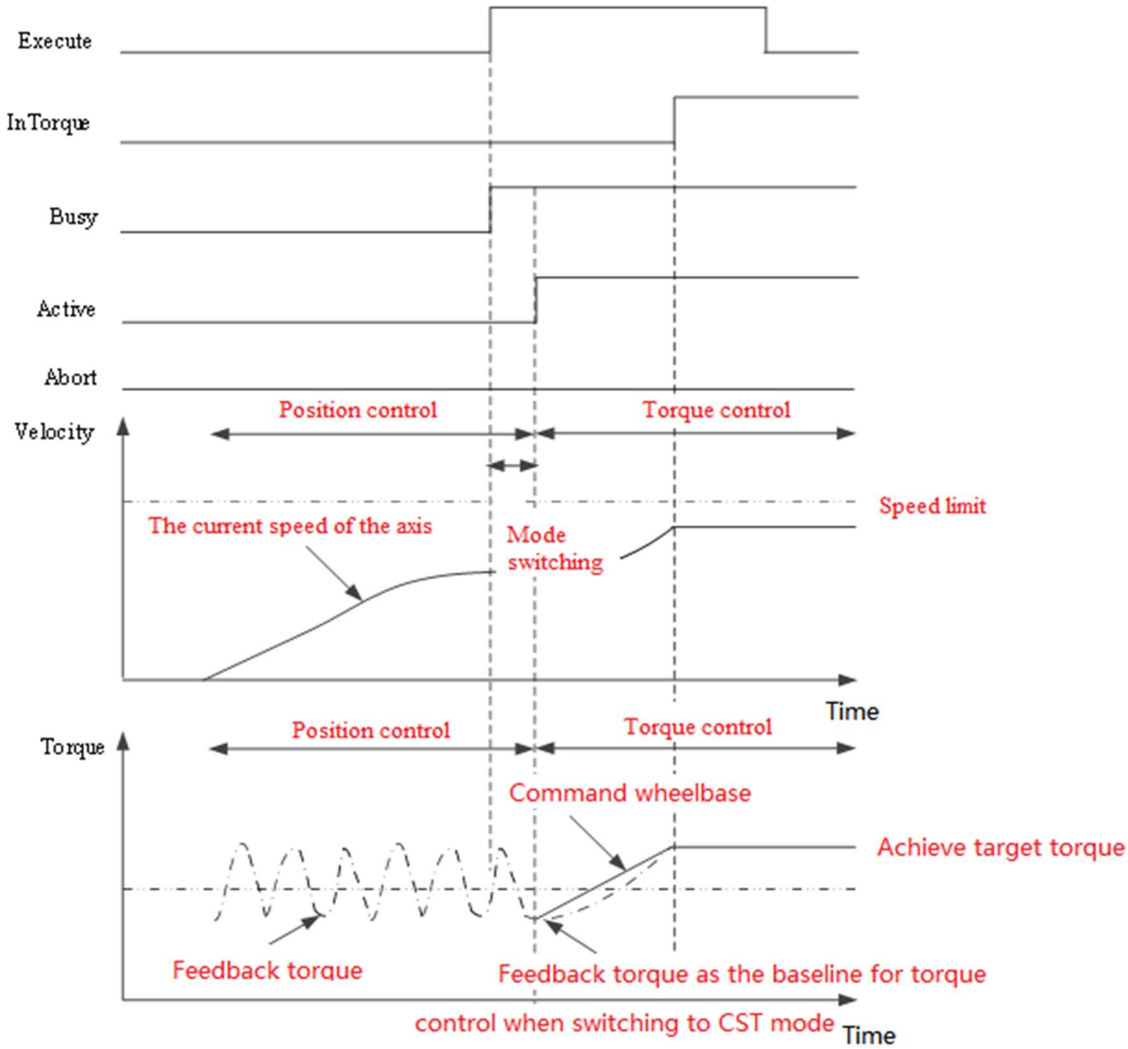
(4) Function and action

- S0 specifies the starting address of the input parameter, occupying registers S0~S0+17.
- S1 specifies the starting address of the output status word.
- S2 specifies the starting address of the output status bit, occupying relays S2~S2+4.
- S3 specifies axis port number.
- When M0 changes from OFF to ON, torque motion control is performed on the axis specified by S3. After successful execution, S2 is set, indicating that the target axis is in a periodic control state.
- To use the command, allocate 6071h and 6077h in the EtherCAT parameters of the specified axis to the PDO mapping, so that the [maximum speed limit] takes effect. DS5C/DS5C1 needs to allocate 6080h to the PDO mapping (please refer to the manual for the maximum speed limit of other brand servos), and the PDO needs to be mapped to the detailed address settings of the axis configuration basic configuration as shown in the following figure:



(5) Note

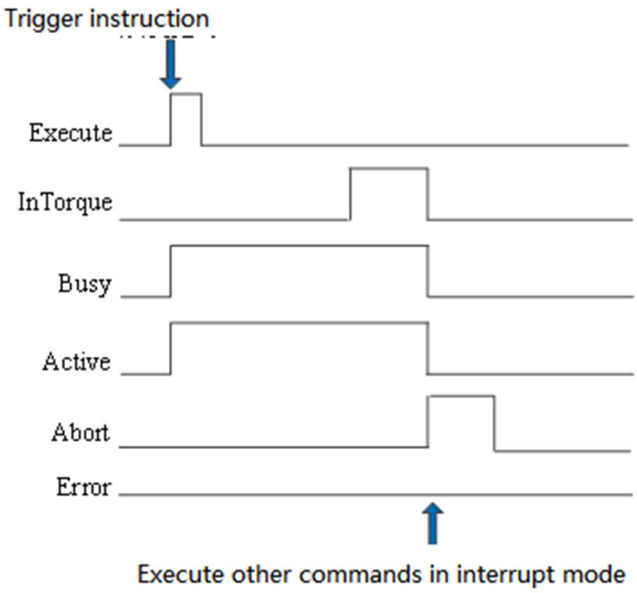
- The switching mode is issued by the controller, but the actual switching time is determined by the servo. Servo requires time for mode switching, during which the previous command will continue to be executed until the mode switch is successful.
- Executing motion commands can switch the servo to CSP mode, which requires the following conditions: the current feedback speed for three cycles is ⩽ the highest speed * 0.1.
- The torque base value when executing this command is the torque of the axis at the time of successful mode switching.
- In continuous update mode, the target torque and torque change rate can be modified. During instruction execution, changing the target torque in continuous update mode will use the actual torque value of the current instruction as the base value for torque control according to the set torque change rate.
- When triggering the command, switch from other modes to CST mode, and the torque base value is the feedback torque before the successful mode switching; When no mode switching occurs when triggering the command, the torque base value is the feedback torque value at the time of triggering the command.
- Calculation formula: Current torque=torque base value+(torque change rate * t), target torque and feedback torque error coefficient=| Target torque - Feedback torque |/| Target torque| .
- When the torque change rate is not set or set to 0, after executing this command, the given torque will step up to the value of the target torque.
- The threshold represents the range within which the feedback torque can fluctuate near the target value.
- When the intorque command is set to busy and active, it will update in real-time according to the conditions met. After the intorque is set, continuous parameter updates are invalid. When the intorque is reset, the input parameters can be modified for updating.
- Virtual axis, encoder axis, and pulse axis do not support this command.
- Instruction execution diagram:



(6) Related parameters

Input parameter	Parameter name	Data type	Unit	Note
S0	TargetTorque	FP64	0.1%	Target torque
S0+4	TorqueRamp	FP64	0.1%/S	Torque ramp
S0+8	MaxSpeedLimit	FP64	RPM	Maximum speed limit
S0+12	Range	FP64	1%	Threshold
S0+16	ContinuousMode	INT16U	-	Continuous updates: 0: Do not update 1: Update
S0+17	BufferMode	INT16U	-	Caching mode: 0: Interrupt 1: Cache
Output parameter	**Parameter name**	**Data type**	**Unit**	**Note**
S1	ErrCode	INT16U	-	Command error code
Status parameter	**Parameter name**	**Data type**	**Unit**	**Note**
S2	InTorque	BOOL	-	Torque reached
S2+1	Busy	BOOL	-	Instruction is currently being executed
S2+2	Active	BOOL	-	Instruction under control
S2+3	Abort	BOOL	-	Instruction interrupted
S2+4	Error	BOOL	-	Instruction execution error
Axis number	**Parameter name**	**Data type**	**Unit**	**Note**
S3	Axis	INT16U	-	Axis number. Starting from 0

(7) Sequence diagram



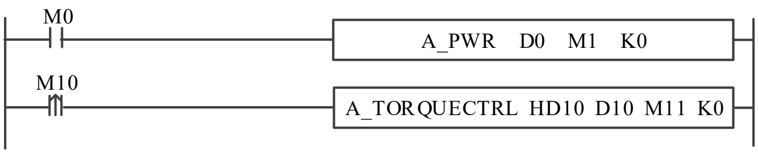
Explanation:

Trigger command, Busy and Active signals are set. When the torque set value is equal to the target torque and the ratio of the absolute difference between the feedback torque and the target torque to the absolute value of the target torque is less than or equal to the set threshold, the InTorque signal is set, and Busy and Active signals are reset.

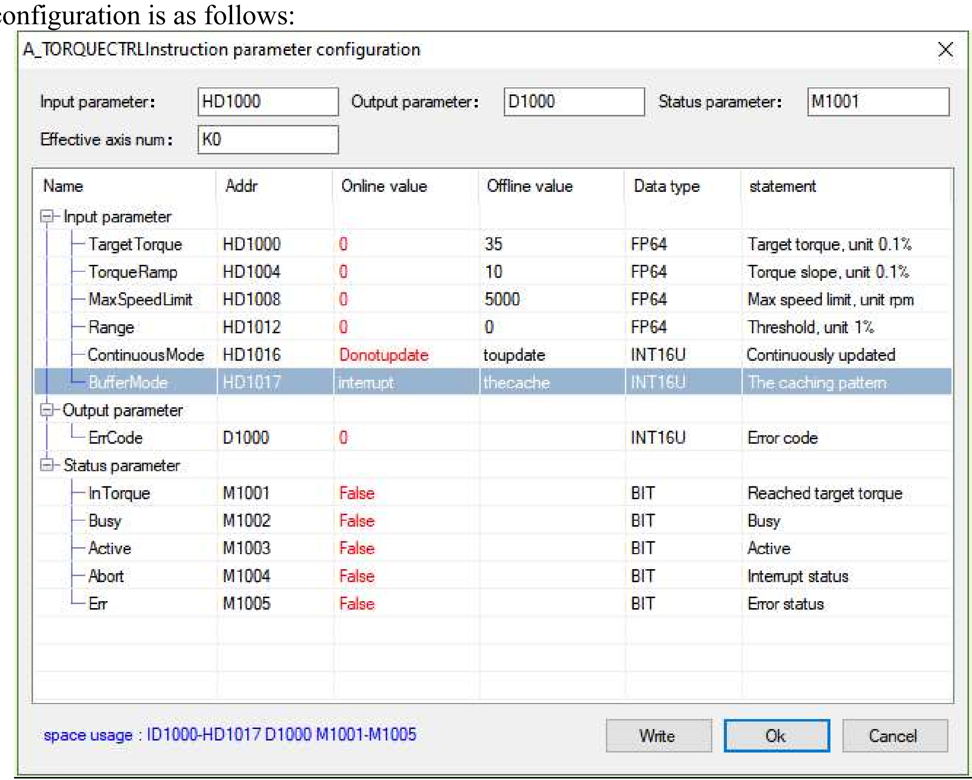
During torque control, execute other commands in interrupt mode, set the Abort signal, and reset the InTorque signal.

(8) Application

Example: Require the motor to accelerate to the target torque of 35 on a torque slope of 10 and maintain this torque for continuous motion. The ladder diagram is as follows:



The command configuration is as follows:



A_TORQUECTRLInstruction parameter configuration

Input parameter: HD1000 Output parameter: D1000 Status parameter: M1001

Effective axis num: K0

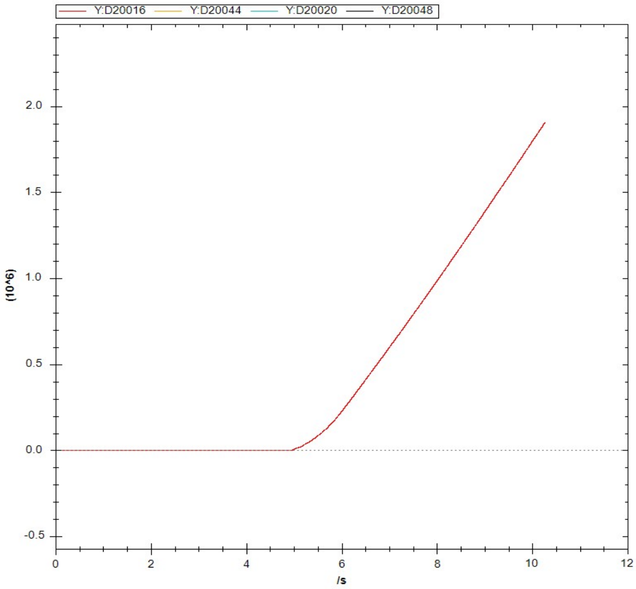
Name	Addr	Online value	Offline value	Data type	statement
Input parameter					
TargetTorque	HD1000	0	35	FP64	Target torque, unit 0.1%
TorqueRamp	HD1004	0	10	FP64	Torque slope, unit 0.1%
MaxSpeedLimit	HD1008	0	5000	FP64	Max speed limit, unit rpm
Range	HD1012	0	0	FP64	Threshold, unit 1%
ContinuousMode	HD1016	Donotupdate	toupdate	INT16U	Continuously updated
BufferMode	HD1017	interrupt	thecache	INT16U	The caching pattern
Output parameter					
ErrCode	D1000	0		INT16U	Error code
Status parameter					
InTorque	M1001	False		BIT	Reached target torque
Busy	M1002	False		BIT	Busy
Active	M1003	False		BIT	Active
Abort	M1004	False		BIT	Interrupt status
Err	M1005	False		BIT	Error status

space usage : ID1000-HD1017 D1000 M1001-M1005

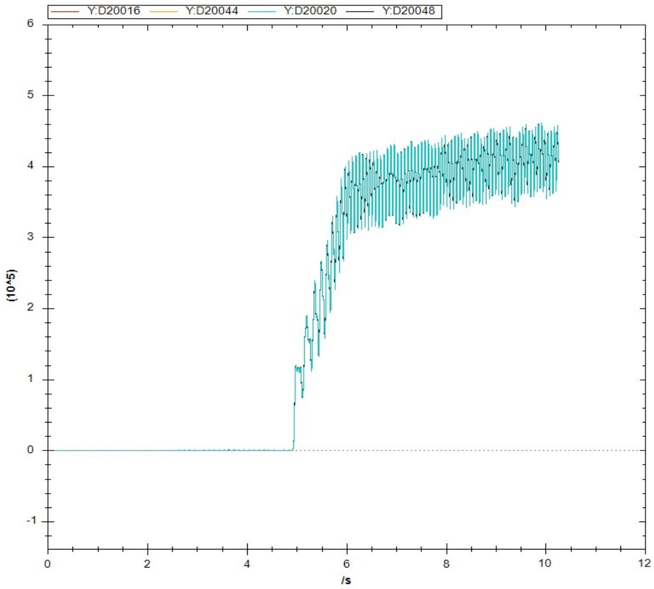
Write Ok Cancel

Explanation: Enable the axis through the A6PWR command. After confirming successful activation, turn M10 from OFF to ON and trigger the A-TORQUECTRL command. The command will accelerate/decelerate according to the set parameters, and then continue to run at the target torque. The state machine D20000+200 * N of the shaft during operation is 3.

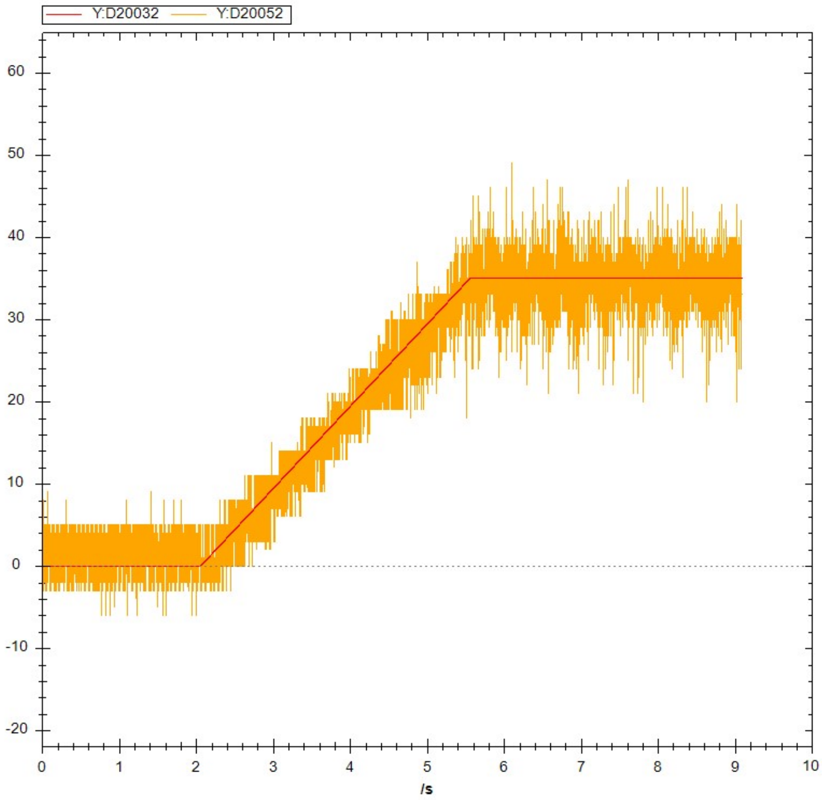
The execution position curve is as follows:



The execution speed curve is shown below:

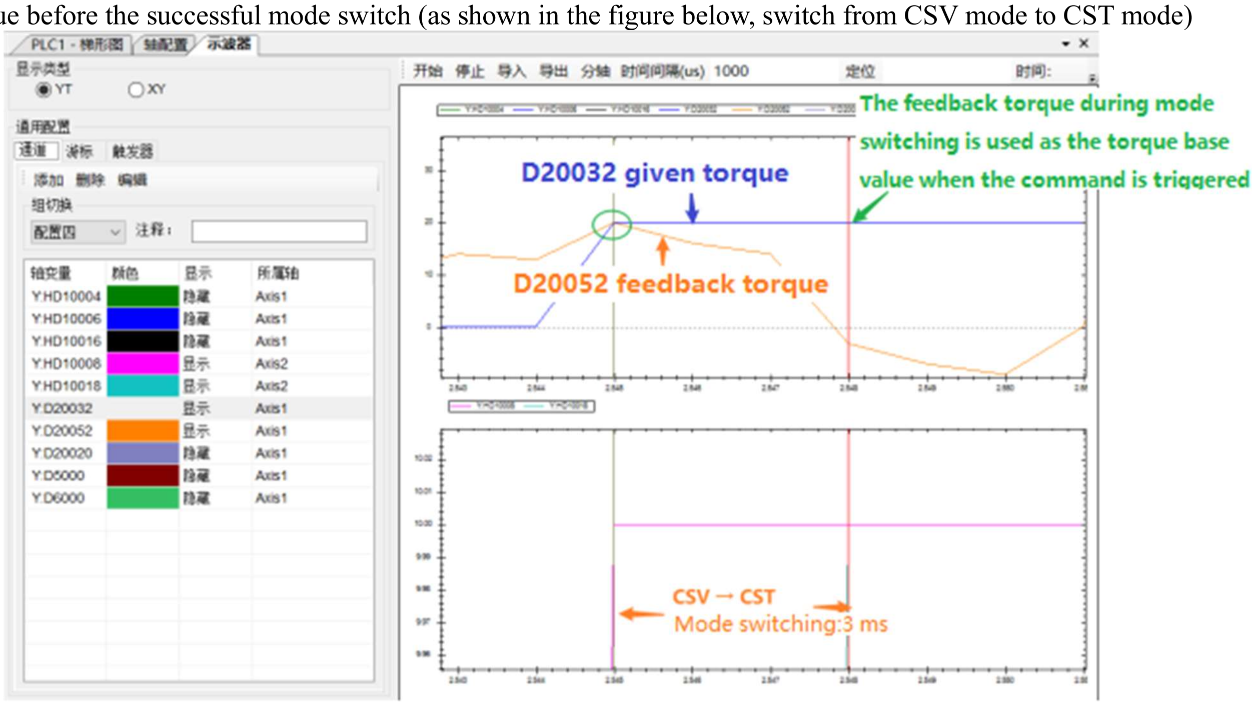


The execution torque curve is shown below:

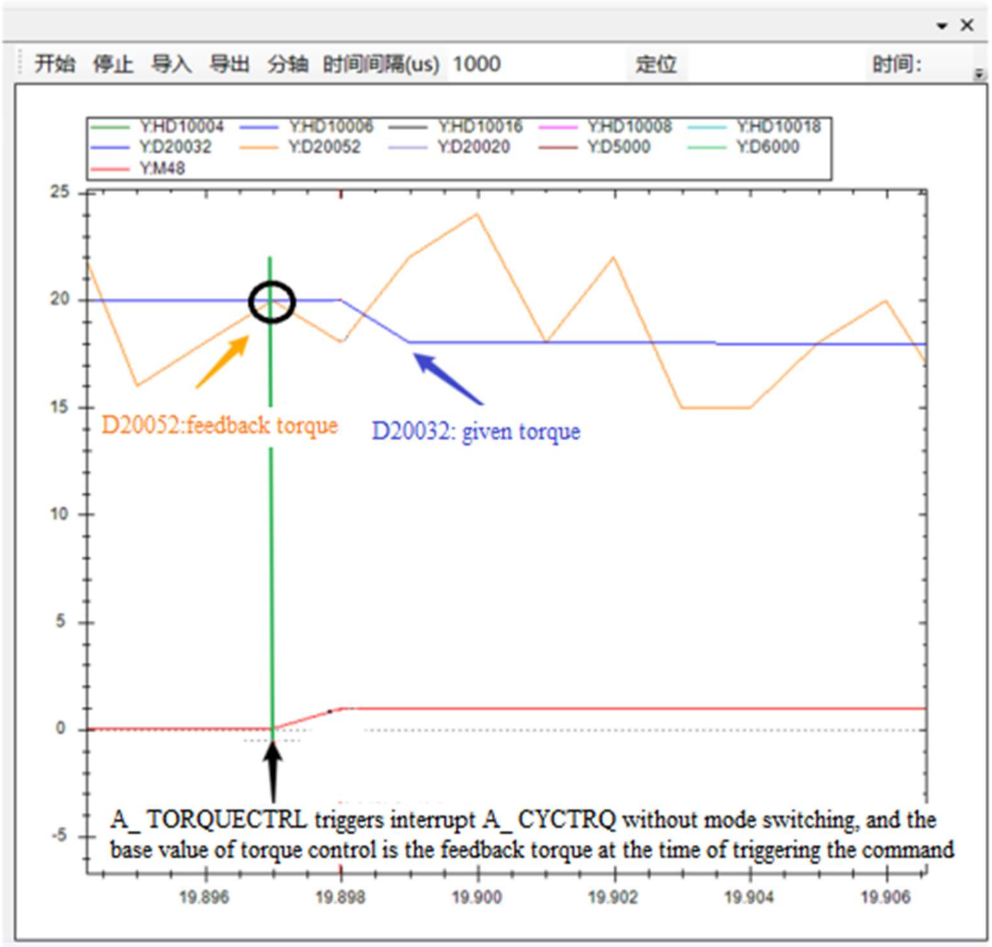


Torque base value:

When triggering the command, switch from other modes to CST mode, and the torque base value is the feedback torque before the successful mode switch (as shown in the figure below, switch from CSV mode to CST mode)



When no mode switching occurs when triggering the command, the torque base value is the feedback torque value at the time of triggering the command (as shown in the following figure: A_TORQUECTRL interrupts A_CYCTRQ)


开始 停止 导入 导出 分轴 时间间隔(us) 1000 定位 时间:
Y:HD10004
Y:HD10006
Y:HD10016
Y:HD10008
Y:HD10018
Y:D20032
Y:D20052
Y:D20020
Y:D5000
Y:D6000
Y:M48
D20052:feedback torque
D20032: given torque
A_ TORQUECTRL triggers interrupt A_ CYCTRQ without mode switching, and the base value of torque control is the feedback torque at the time of triggering the command
25
20
15
10
5
0
-5
19.896
19.898
19.900
19.902
19.904
19.906

5-1-2-34. Axis position filtering【XFEEDPOSFILTER】

(1) Overview

Axis position filtering [XFEEDPOSFILTER]			
Execution condition	Normally open/close coil	Suitable model	XDH, XLH, XG2
Firmware	V3.7.3 and above	Software	3.7.16 and above

(2) Operand

Operand	Function	Type
S0	Input parameter starting address	16-bit, single word
S1	Starting address of output status word	16-bit, single word
S2	Starting address of output status bit	Bit
S3	Axis output port number	16-bit, single word

(3) Suitable soft component

Operand	Word soft component											Bit soft component					
	System								Constant	Module		System					
	D*	FD	TD*	CD*	DX	DY	DM*	DS*	K/H	ID	QD	X	Y	M*	S*	T*	C*
S0	●	●	●	●													
S1	●	●	●	●													
S2														●			
S3	●								●								

*: D means D, HD; TD means TD and HTD; CD means CD, HCD, HSCD and HSD; DM means DM and DHM; DS means DS and DHS; M means M, HM, SM; S means S, HS; T means T, HT; C means C, HC.

(4) Function and action

```
             S0  S1   S2  S3
 M0
─┤├────XFEEDPOSFILTER D0 D50 M1 K0
```

- S0 specifies the starting address of the input parameter, occupying registers S0~S0+1.
- S1 specifies the starting address of the output status word.
- S2 specifies the starting address of the output status bit, occupying relays S2~S2+2.
- S3 specifies axis port number.
- When M0 changes from OFF to ON, position filtering is performed on the specified axis of S3, with a filtering type of S0 and filtering parameters of S0+1. When the command is executed, S2 is set to ON.
- When the filtering type is (0: first-order lag filtering), this parameter is the filtering coefficient, ranging from 0 to 9999; When the filtering type is (1: recursive average filtering), this parameter is the number of samples, ranging from 1 to 1000.

(5) Note

- Before conducting this command, please select the filtering type and set the filtering parameters and corresponding axis numbers.
- During the use of this instruction, the filtering coefficients can be modified in real time, but the filtering type cannot be modified. Only when triggered again can it take effect.
- If this command is not conducting or interrupted during the conducting process, stop filtering.
- This instruction filters the feedback position of the real axis, virtual axis, and encoder axis based on the type of axis, and the filtering does not require the enable state of the axis.
- This command does not switch the motion mode of the axis, and different motion modes have no effect on filtering. It only filters the feedback position.
- It is not supported to write two or more instructions for filtering the same axis in the program.
- After disconnecting the feedback position filtering command, the data source will directly switch back to the actual feedback position from the filtering position, resulting in a position step.
- During the motion process, when axis position filtering is turned on, the data source will directly switch from the actual feedback position to the filtering position, resulting in a position step.

(6) Related parameters

Input parameter	Parameter name	Data type	Unit	Note
S0	FilterType	INT16U	-	TFilter type: 0: First order lag filtering

				1: Recursive average filtering
S0+1	Filt	INT16U	-	Filter parameters (when filtering type is 0, parameter range: 0-9999; when filtering type is 1, parameter range: 1-1000)
Output parameter	Parameter name	Data type	Unit	Note
S1	ErrCode	INT16U	-	Command error code
Status parameter	Parameter name	Data type	Unit	Note
S2	Done	BOOL	-	Instruction execution completed
S2+1	Busy	BOOL	-	Instruction is currently being executed
S2+2	Error	BOOL	-	Instruction under control
Axis number	Parameter name	Data type	Unit	Note
S3	Axis	INT16U	-	Axis number. Starting from 0

Filter algorithm description:

(1) First order lag filtering method

● Method

Taking a=0~0.9999 (a=Filt/10000), the current filtering result is (1-a) * the current sampling value+a * the last filtering result. Please note the following:

① The default filtering coefficient is 0, and no filtering is performed.

② The larger the filtering coefficient, the smoother the filtering result, but the lower the sensitivity.

③ The smaller the filtering coefficient, the higher the sensitivity, but the more unstable the filtering result is.

● Advantage

① Has a good inhibitory effect on periodic interference.

② Suitable for situations with high fluctuation frequency.

● Disadvantage

① Phase lag, low sensitivity.

② The degree of lag depends on the magnitude of the a value.

③ Unable to eliminate interference signals with filtering frequency higher than half of the sampling frequency.

(2) Recursive average filtering method

● Method

Consider the N consecutive sampling values as a queue, with a fixed length of N. Each time a new data is sampled, it is placed at the end of the queue, and the original data at the beginning of the queue is discarded (first in, first out principle). The N data in the queue are arithmetic averaged to obtain a new filtering result.

● Advantage

① Has a good inhibitory effect on periodic interference and high smoothness.

② Systems suitable for high-frequency oscillations.

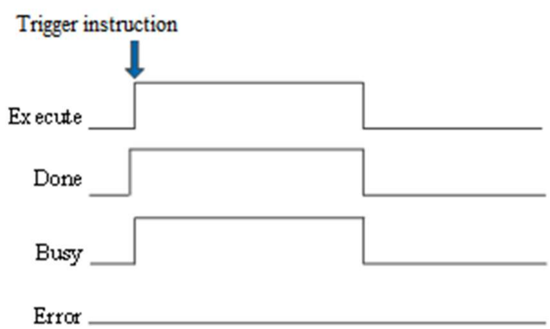
● Disadvantage

① PLow sensitivity and poor suppression of occasional pulse interference.

② TDifficult to eliminate sampling value deviation caused by pulse interference.

③ Not suitable for situations with severe pulse interference. Compared to wasting RAM.

(7) Sequence diagram



Explanation:

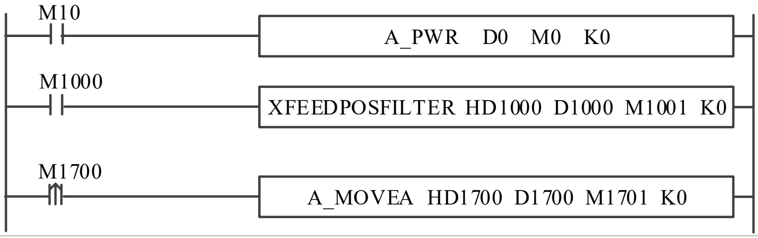
Trigger command, set Done and Busy signals, axis position filtering takes effect.

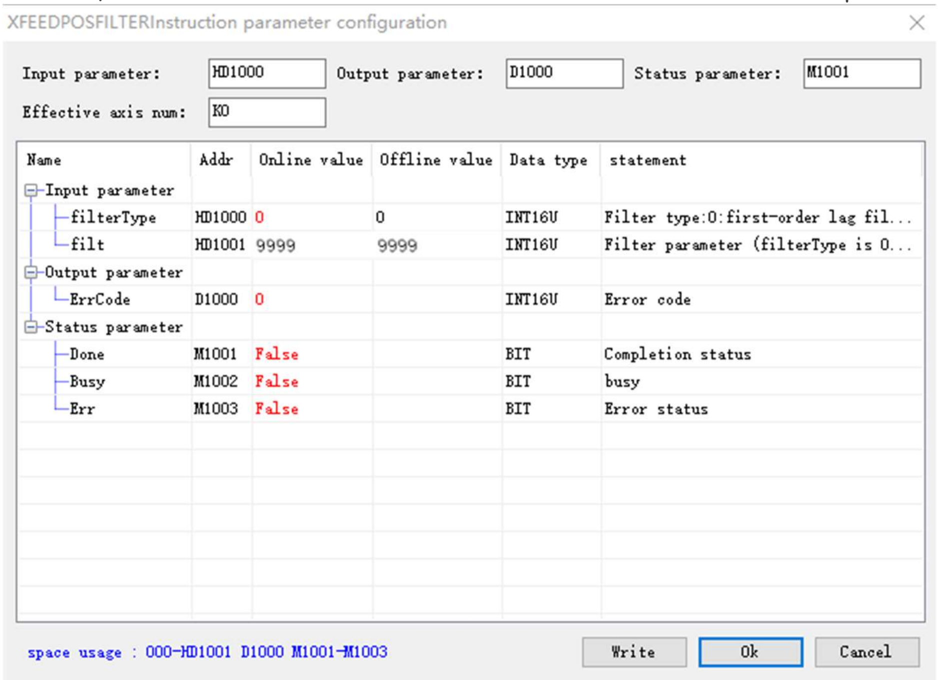
Close command, reset Done and Busy signals, and turn off axis position filtering.

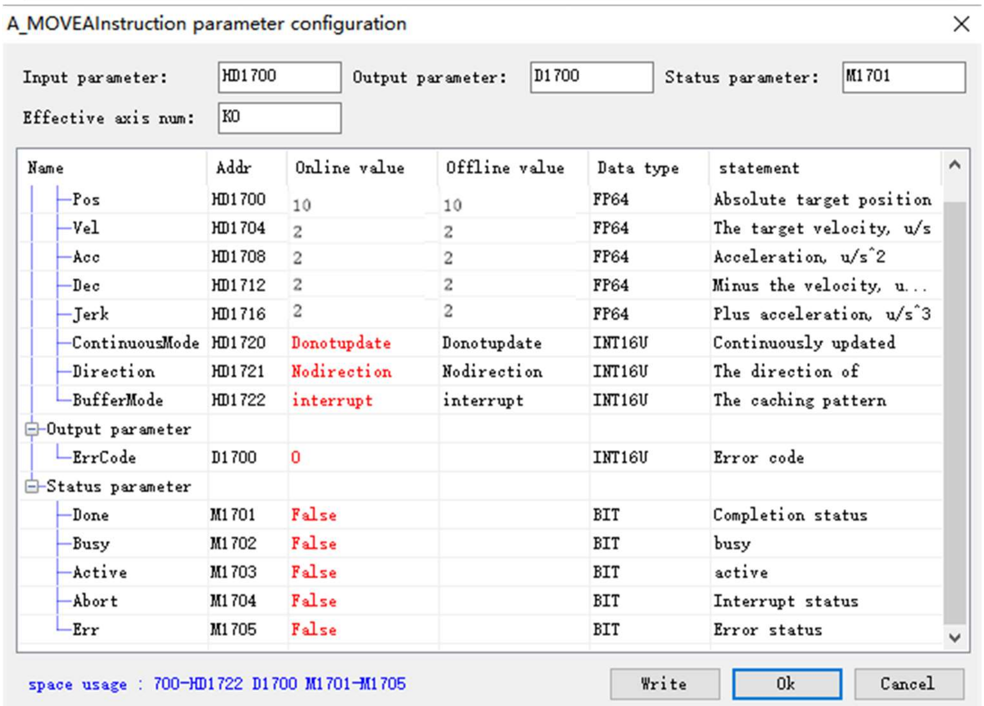
(8) Application

Set the filtering type to 0 and the filtering parameter to 9999. Use the A_MOVEA command to move at a speed of 2 pulses/s to the position of 10 pulses, with an acceleration/deceleration of 2 pulses/s^2 and an acceleration of 2 pulses/s^3. Observe the position filtering situation.

The ladder diagram is as follows:

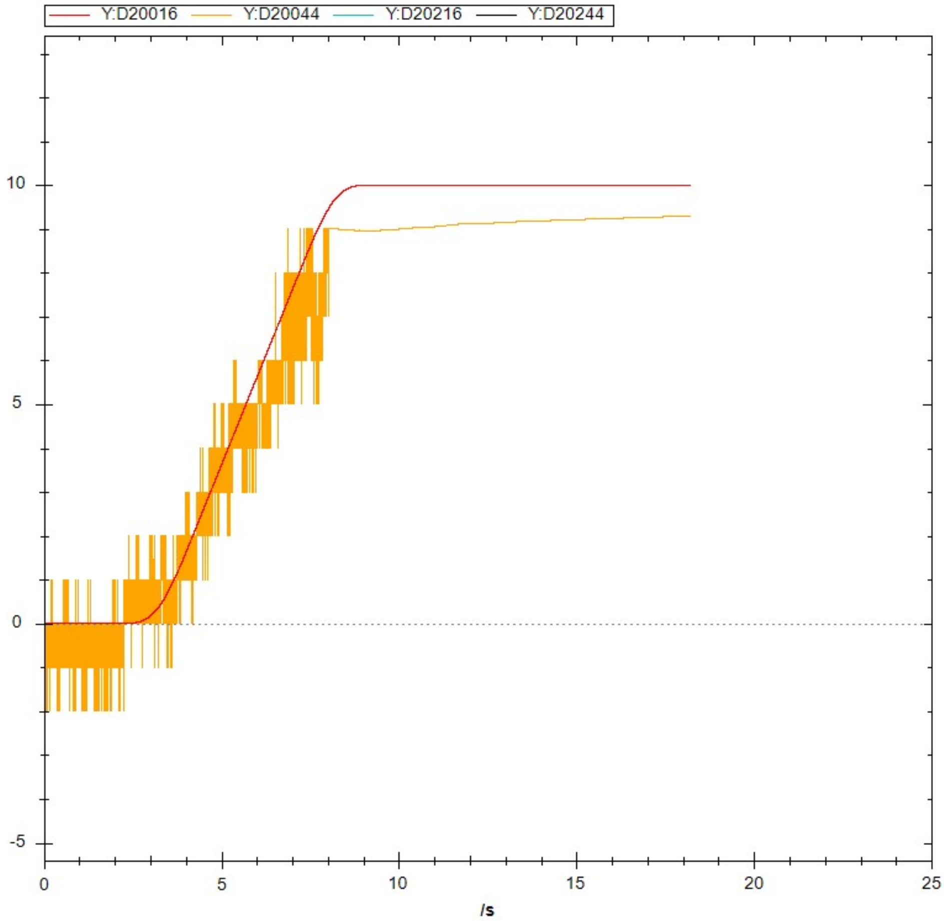






Explanation: Firstly, enable the M1700 by using the A_PWR command. When the M1700 switches from OFF to ON and runs with the parameters set by the command, M1000 switches on position filtering from OFF to ON

during operation, and finally runs to the target position of 10.
The execution position curve is as follows:



5-1-2-35. Single axis accuracy compensation【XFERRCOMP】

(1) Overview

Single axis accuracy compensation [XFERRCOMP]			
Execution condition	Normally open/close coil	Suitable model	XDH, XLH, XG2
Firmware	V3.7.3 and above	Software	3.7.16 and above

(2) Operand

Operand	Function	Type
S0	Input parameter starting address	16-bit, single word
S1	Starting address of output status word	16-bit, single word
S2	Starting address of output status bit	Bit
S3	Axis output port number	16-bit, single word

(3) Suitable soft component

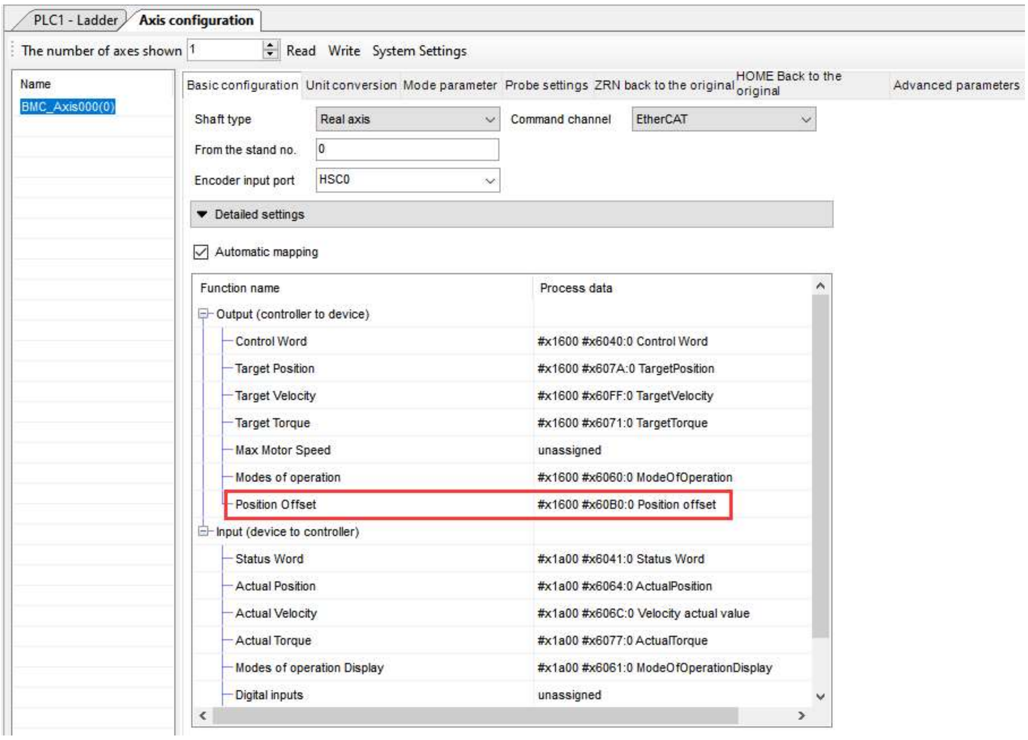
Operand	Word soft component											Bit soft component					
	System								Constant	Module		System					
	D*	FD	TD*	CD*	DX	DY	DM*	DS*	K/H	ID	QD	X	Y	M*	S*	T*	C*
S0	●	●	●	●													
S1	●	●	●	●													
S2														●			
S3	●								●								

*: D means D, HD; TD means TD and HTD; CD means CD, HCD, HSCD and HSD; DM means DM and DHM; DS means DS and DHS; M means M, HM, SM; S means S, HS; T means T, HT; C means C, HC.

(4) Function and action

```
                        S0  S1  S2  S3
   M0
|--| |------------[XFERRCOMP  D0  D50  M1  K0]--|
```

- S0 specifies the starting address of the input parameter, occupying registers S0~S0+1.
- S1 specifies the starting address of the output status word, occupying registers S1~S1+11.
- S2 specifies the starting address of the output status bit, occupying relays S2~S2+2.
- S3 specifies axis port number.
- When M0 changes from OFF to ON, precision compensation is applied to the specified axis of S3. When the command execution is completed, S2 is set to ON, indicating entering the compensation state.
- S0+1 specifies the axis number, which only takes effect in the specified axis mode. S0+4 to S0+24 takes effect in the internal and specified axis modes. S0+28 specifies the compensation amount that only takes effect in the external mode. S0+32 and S0+33 take effect except for the external mode.
- 60B0 needs to be added to the PDO and mapped to the detailed address settings of the axis configuration basic configuration. After the instruction is triggered, the value of 60B0 mapped to IO will be modified by the output value of the instruction. Each interpolation cycle will be assigned a value through operation, as shown in the following configuration:



- This command is a normally open and normally closed trigger. When precision compensation is required for the axis, conduct this command. The main usage scenario is that there is a lag relationship between the given and feedback positions, which does not meet the current equipment process requirements. This instruction can be used to compensate for this lag by providing feedforward parameters to the driver, which can improve the following effect.

(5) Note

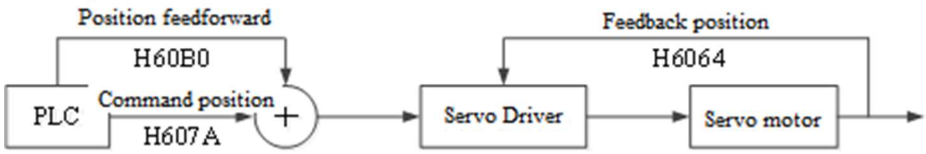
- During the use of this instruction, the speed, acceleration feedforward coefficient and proportion, integration coefficient, integrator accumulation limit, compensation limit feedforward output coefficient, Pi feedforward output coefficient, and dead zone width can be modified in real time. However, the mode cannot be modified and can only be triggered again to take effect.
- If this command is not conducting or is interrupted during the conducting process, precision compensation will stop and the feedforward value will be reset, which may cause a position step.
- During the motion process, when compensation is turned on, the feedforward value will directly change from zero to the calculated feedforward value of the current position, which may result in a position step.
- This command does not switch the motion mode of the axis and only works in CSP mode. This command will not change the state machine mode of the axis.
- If the command is successfully executed and then disabled, error 1001 will be reported, and the command will be reset to compensate. To continue compensation, the axis needs to be enabled and the command needs to be reconnected.
- The given speed of the encoder shaft is the same as the feedback speed, and the given acceleration is calculated based on the given speed. Attention should be paid when using it.
- Adjusting to proportional integral parameters requires adjusting from small to large according to actual conditions. Excessive feedforward may cause position overshoot.
- Suggest turning off the command after the axis stops moving.
- The acceleration feedforward calculation in the specified axis mode (feedback) is processed as 0.
- If the absolute value of the dead zone width (non-zero) is greater than or equal to the absolute value of the compensation limit (non-zero), the compensation value is 0.
- DS5C/DS5C1 requires servo 3791 and above for 60B0 to take effect. For other brands of servos, please refer to their manual.

(6) Related parameters

Input parameter	Parameter name	Data type	Unit	Note
S0	Mode	INT16U	-	Mode: 0: Internal 1: External 2: Specify axis (given)

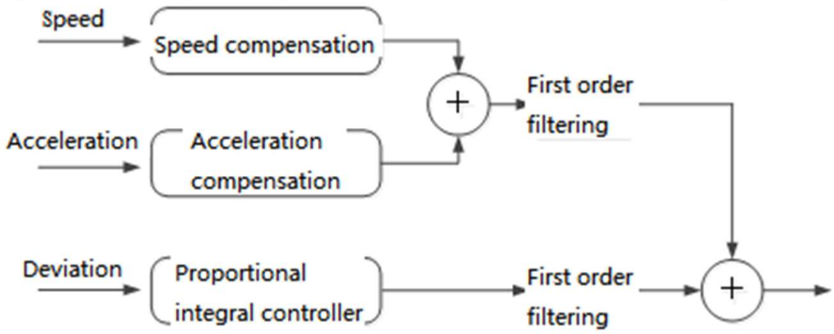
				3: Designated axis (feedback)
S0+1	AppointAxis	INT16U	-	Specify axis number
S0+4	VelFFCoe	FP64	-	Speed feedforward coefficient
S0+8	AccFFCoe	FP64	-	Acceleration feedforward coefficient
S0+12	PCoe	FP64	-	Scale
S0+16	ICoe	FP64	-	Integration coefficient
S0+20	ErrSumLimit	FP64	-	Accumulator accumulation limit
S0+24	CompValLimit	FP64	-	Compensation limit
S0+28	ExterCompVal	FP64	-	External given compensation amount
S0+32	FFOutputFilt	INT16U	-	Feedforward output filtering coefficient: 0~9999
S0+33	PiOutputFilt	INT16U	-	PID output filtering coefficient: 0~9999
S0+36	DeadZone	FP64	-	Dead band width
Output parameter	Parameter name	Data type	Unit	Note
S1	ErrCode	INT16U	-	Command error code
S1+4	FollowErr	FP64	-	Following error
S1+8	PosCompval	FP64	-	Position compensation amount
Status parameter	Parameter name	Data type	Unit	Note
S2	InComp	BOOL	-	In instruction compensation
S2+1	Busy	BOOL	-	Instruction is currently being executed
S2+2	Error	BOOL	-	Instruction execution error
Axis number	Parameter name	Data type	Unit	Note
S3	Axis	INT16U	-	Axis number. Starting from 0

- Compensation diagram



- Internal Mode Description

Calculate the deviation between the current axis's velocity acceleration and the actual position, and write the resulting feedforward into 60B0 and the output parameter PosFFVal. One part is speed feedforward compensation, and the other part is proportional+integral compensation. As shown in the following figure:



The specific algorithm is: 60B0=(Error value * ScaleCoe+Integrator value * Integral Coe+Velocity * Velocity feedforward coefficient (VelFFCoe)+Acceleration * Acceleration feedforward coefficient (AccFFCoe)) * Conversion amount per revolution.

- External Mode Description

The external feedforward parameters are calculated by the user's own formula, and the feedback value is directly assigned to ExterCompPos, which can also achieve compensation.

- Description of specified axis (given) mode

The data used for speed compensation and acceleration compensation is the given speed and acceleration of the specified axis.

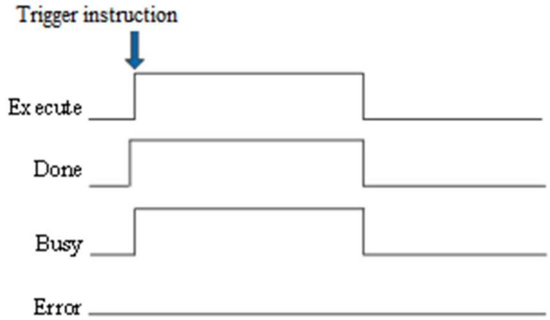
- Description of specified axis (given) mode

The data used for speed compensation is the specified axis feedback speed.

- Filtering instructions

A first-order low-pass filter is set for the output of the Pi controller and the feedforward control output respectively to prevent excessive data fluctuations.

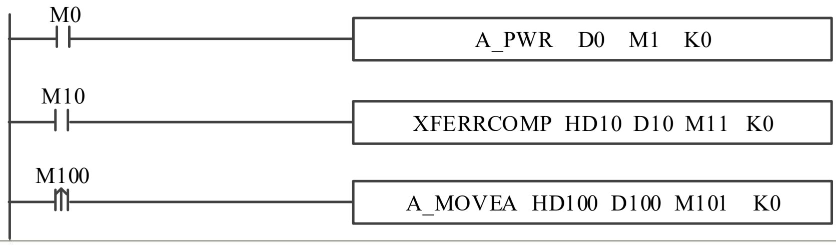
(7) Sequence diagram

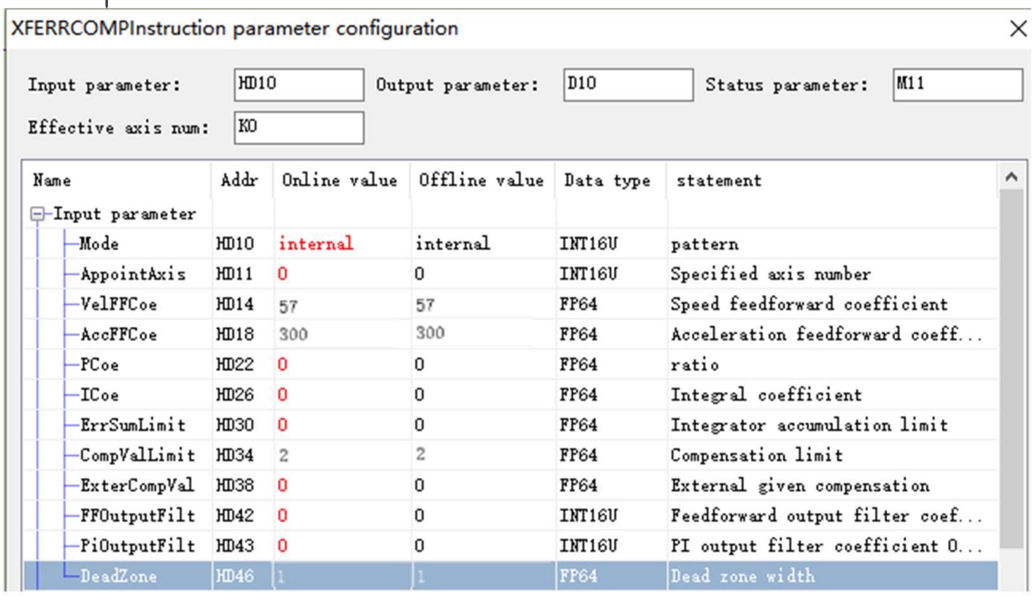


Explanation:
Trigger command, Incomp and Busy signals set, single axis accuracy compensation takes effect, real-time output of follow-up error and position compensation amount.
Close the command, set Incomp, Busy, and Err to off, stop accuracy compensation, reset the feedforward value, and do not affect the execution of motion commands.

(8) Application

Turn on single axis accuracy compensation, and the motor moves at a speed of 100 pulses/s using the A_MOVEA command to a position of 1000 pulses, with an acceleration of less than 10 pulses/s^2, a deceleration of 100 pulses/s^2, and an acceleration of 100 pulses/s^3.
The ladder diagram is as follows:



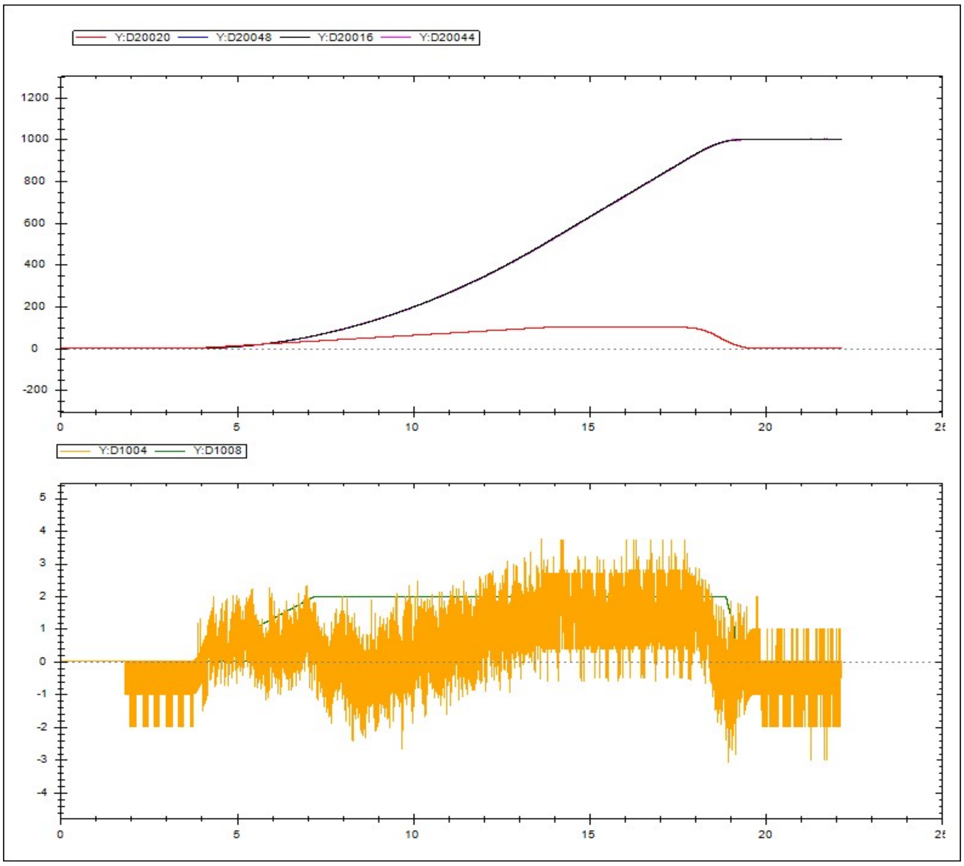


XFERRCOMPInstruction parameter configuration

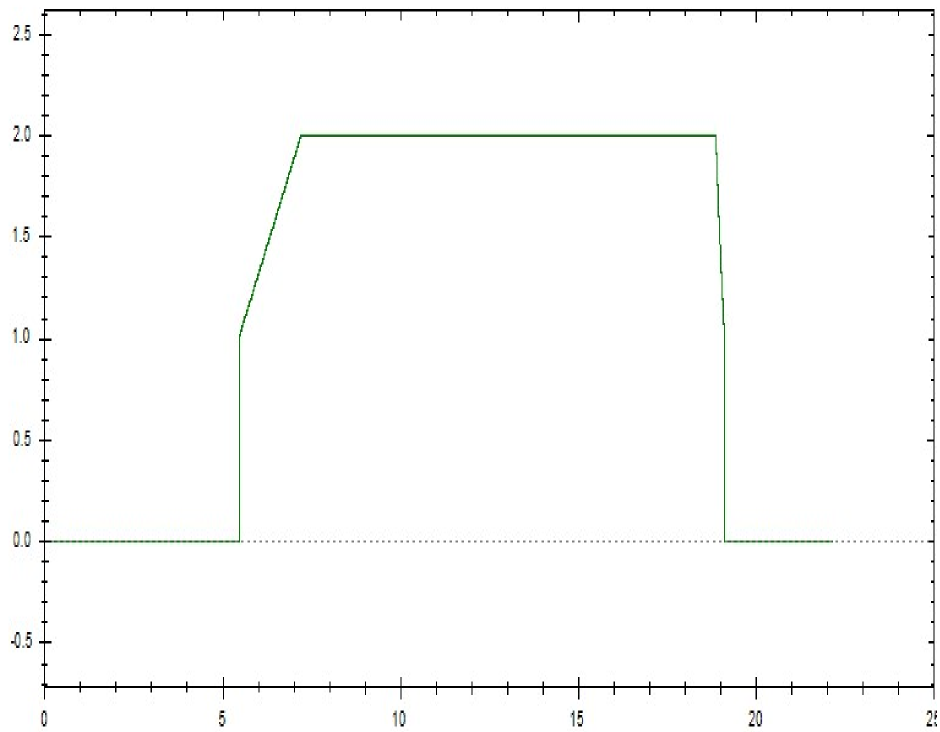
Input parameter: HD10 Output parameter: D10 Status parameter: M11
Effective axis num: K0

Name	Addr	Online value	Offline value	Data type	statement
Input parameter					
Mode	HD10	internal	internal	INT16U	pattern
AppointAxis	HD11	0	0	INT16U	Specified axis number
VelFFCoe	HD14	57	57	FP64	Speed feedforward coefficient
AccFFCoe	HD18	300	300	FP64	Acceleration feedforward coeff...
PCoe	HD22	0	0	FP64	ratio
ICoe	HD26	0	0	FP64	Integral coefficient
ErrSumLimit	HD30	0	0	FP64	Integrator accumulation limit
CompValLimit	HD34	2	2	FP64	Compensation limit
ExterCompVal	HD38	0	0	FP64	External given compensation
FFOutputFilt	HD42	0	0	INT16U	Feedforward output filter coef...
PiOutputFilt	HD43	0	0	INT16U	PI output filter coefficient 0...
DeadZone	HD46	1	1	FP64	Dead zone width

The execution position curve is as follows:



Y:D20020
Y:D20048
Y:D20016
Y:D20044
1200
1000
800
600
400
200
0
-200
0
5
10
15
20
Y:D1004
Y:D1008
5
4
3
2
1
0
-1
-2
-3
-4
0
5
10
15
20


2.5
2.0
1.5
1.0
0.5
0.0
-0.5
0
5
10
15
20

5-1-2-36. Position contour【A_POSITIONPROFILE】

(1) Overview

Position contour [A_POSITIONPROFILE]			
Execution condition	Rising/falling edge of the coil	Suitable model	XDH, XLH, XG2
Firmware	V3.7.3 and above	Software	3.7.16 and above

(2) Operand

Operand	Function	Type
S0	Input parameter starting address	16-bit, single word
S1	Starting address of output status word	16-bit, single word
S2	Starting address of output status bit	Bit
S3	Axis output port number	16-bit, single word

(3) Suitable soft component

Operand	Word soft component											Bit soft component					
	System								Constant	Module		System					
	D*	FD	TD*	CD*	DX	DY	DM*	DS*	K/H	ID	QD	X	Y	M*	S*	T*	C*
S0	●	●	●	●													
S1	●	●	●	●													
S2														●			
S3	●								●								

*: D means D, HD; TD means TD and HTD; CD means CD, HCD, HSCD and HSD; DM means DM and DHM; DS means DS and DHS; M means M, HM, SM; S means S, HS; T means T, HT; C means C, HC.

(4) Function and action

- S0 specifies the starting address of the input parameter, occupying registers S0~S0+23+8 * (N-1).
- S1 specifies the starting address of the output status word, occupying registers S1~S1+1.
- S2 specifies the starting address of the output status bit, occupying relays S2~S2+4.
- S3 specifies axis port number.
- When M0 goes from OFF to ON, it performs position contour motion on the axis specified by S3, with a total number of segments of S0. The position and time parameters starting from the second segment need to be configured with corresponding registers after the offset address. When the instruction is completed, S2 is set to ON.
- Command edge triggered, running in CSP mode, other modes will automatically switch to CSP during operation.

(5) Note

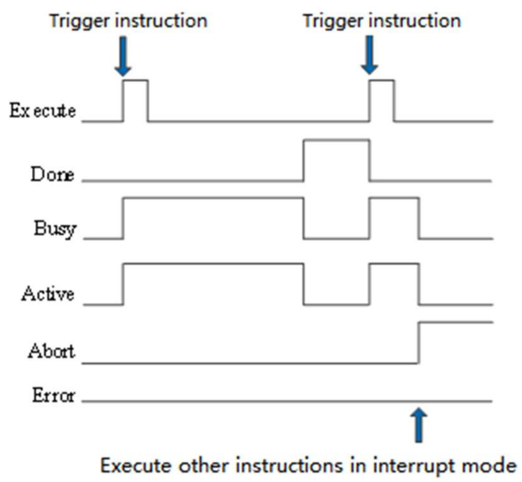
- All points after the current point can be modified in real-time, ensuring continuous speed. Modifying the current point will not take effect.
- Modifying point errors (non numeric, time 0) during operation will slow down and stop.
- When the command is triggered, the soft and hard limits are not judged, and an alarm will be triggered when encountering the soft and hard limits during operation.
- Support real axis/virtual axis/pulse axis modes; Support closed-loop, gantry, and mold axis; Unsupported startup speed.
- The planned speed is continuous, but the acceleration is discontinuous. If the maximum speed of the axis is exceeded during operation, the axis will alarm and slow down to stop. If the positions of adjacent two points are the same during operation, they will be treated as stationary segments.
- V3.7.3 and above versions support mold axis, specific calculations can be found in 6-6. Application of mold axis.

(6) Related parameters

Input parameter	Parameter name	Data type	Unit	Note
S0	Num	INT16U	-	Maximum number of segments (greater than 0)
S0+1	Mode	INT16U	-	Mode: 0: Relative

				1: Absolute
S0+2	BufferMode	INT16U	-	Caching mode: 0: Break 1: Cache
S0+3	Dir	INT16U	-	Direction (effective in axis mode): 0: No direction 1: Forward 2: Negative direction 3: Shortest path 4: Current direction
S0+4	PosScale	FP64	-	Position scaling ratio
S0+8	TimeScale	FP64	-	Time scaling ratio
S0+12	Offset	FP64	-	Position offset
S0+16+8*(N-1)	Pos	FP64	Instruction Unit	Position
S0+20+8*(N-1)	Time	FP64	ms	Time
Output parameter	Parameter name	Data type	Unit	Note
S1	ErrCode	INT16U	-	Command error code
S1+1	Section	INT16U	–	Current segment number
Status parameter	Parameter name	Data type	Unit	Note
S2	Done	BOOL	–	Instruction execution completed
S2+1	Busy	BOOL	–	Instruction is currently being executed
S2+2	Active	BOOL	–	Instruction under control
S2+3	Abort	BOOL	–	Instruction interrupted
S2+4	Err	BOOL	–	Instruction execution error
Axis number	Parameter name	Data type	Unit	Note
S3	Axis	INT16U	-	Axis number. Starting from 0

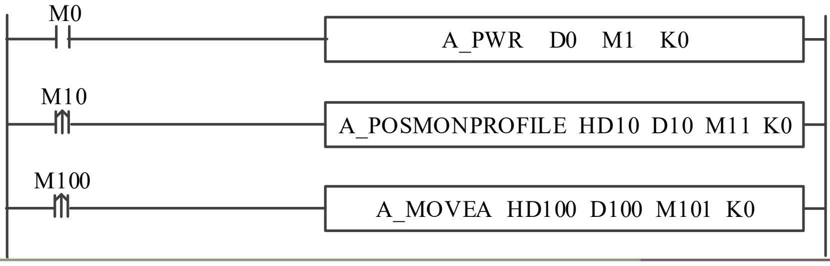
(7) Sequence diagram

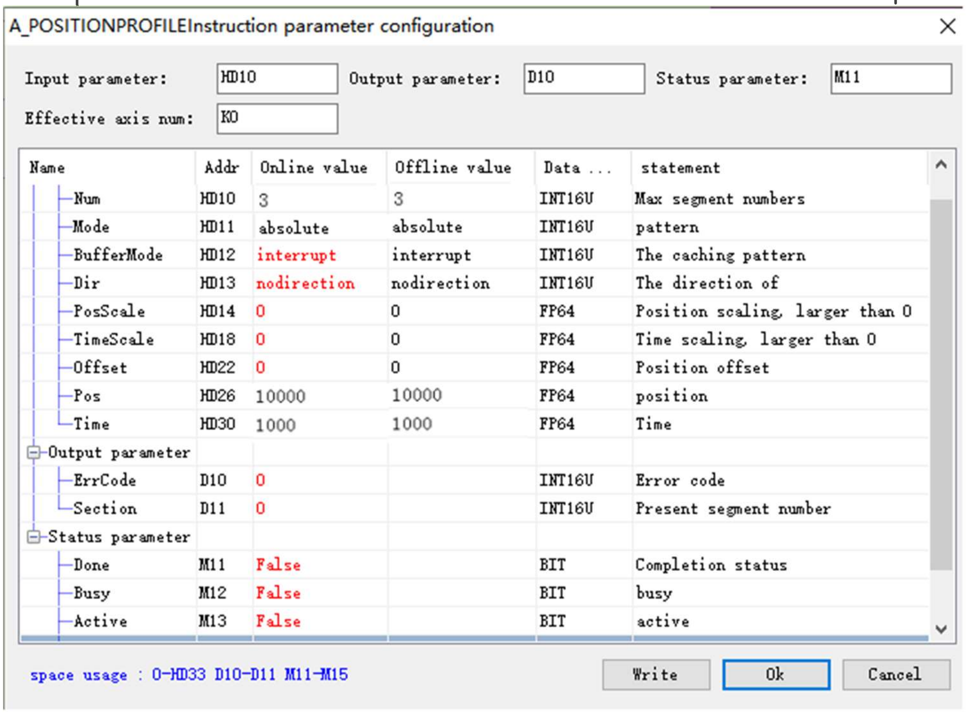


Explanation:
In general, after triggering the command, the Busy and Active signals are set, reset after the command execution is completed, and the Done signal is set at the same time. Only when the command is executed again will Done reset, otherwise it will not automatically reset.
During the instruction execution process, if a new instruction is triggered in interrupt mode, the Busy and Active signals will immediately reset, and the Abort signal will be set.
When there is an error in the instruction, the Error signal is set, other signals are reset, and the corresponding error code is output.

(8) Application
Run three positions in absolute mode, with the first segment moving to a position of 10000 pulses in 100ms, the second segment moving to a position of 30000 pulses in 1000ms, and the third segment moving to a position of -1000 pulses in 3000ms.

The ladder diagram is as follows:





A_POSITIONPROFILEInstruction parameter configuration

Input parameter: HD10 Output parameter: D10 Status parameter: M11

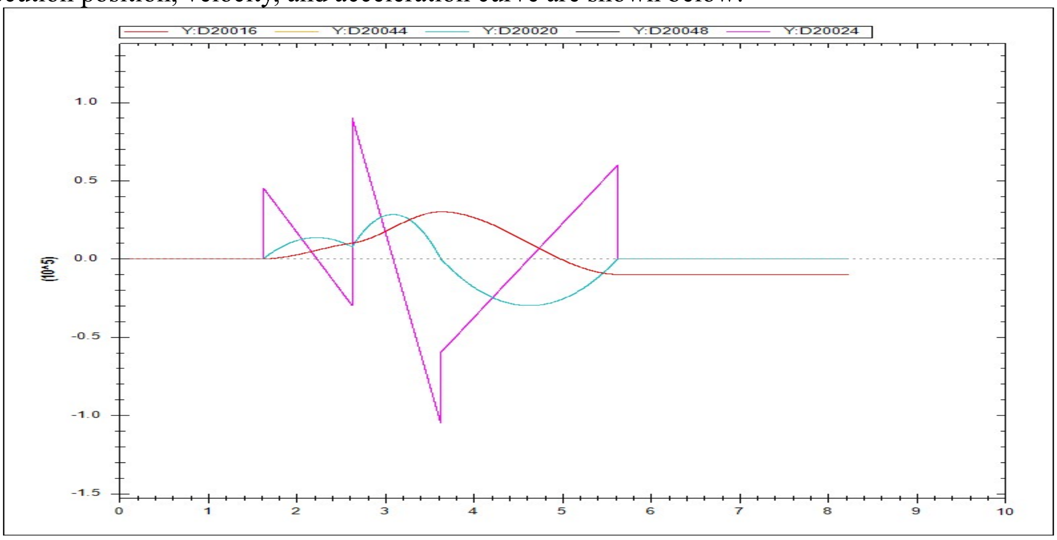
Effective axis num: K0

Name	Addr	Online value	Offline value	Data ...	statement
Num	HD10	3	3	INT16U	Max segment numbers
Mode	HD11	absolute	absolute	INT16U	pattern
BufferMode	HD12	interrupt	interrupt	INT16U	The caching pattern
Dir	HD13	nodirection	nodirection	INT16U	The direction of
PosScale	HD14	0	0	FP64	Position scaling, larger than 0
TimeScale	HD18	0	0	FP64	Time scaling, larger than 0
Offset	HD22	0	0	FP64	Position offset
Pos	HD26	10000	10000	FP64	position
Time	HD30	1000	1000	FP64	Time
Output parameter					
ErrCode	D10	0		INT16U	Error code
Section	D11	0		INT16U	Present segment number
Status parameter					
Done	M11	False		BIT	Completion status
Busy	M12	False		BIT	busy
Active	M13	False		BIT	active

space usage : 0-HD33 D10-D11 M11-M15

Write Ok Cancel

The execution position, velocity, and acceleration curve are shown below:



5-1-2-37. Interrupt fixed length【A_MOVEFEED】

(1) Overview

Interrupt fixed length [A_MOVEFEED]			
Execution condition	Rising/falling edge of the coil	Suitable model	XDH, XLH, XG2
Firmware	V3.7.3 and above	Software	3.7.16 and above

(2) Operand

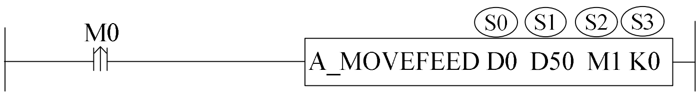
Operand	Function	Type
S0	Input parameter starting address	16-bit, single word
S1	Starting address of output status word	16-bit, single word
S2	Starting address of output status bit	Bit
S3	Axis output port number	16-bit, single word

(3) Suitable soft component

Operand	Word soft component											Bit soft component					
	System								Constant	Module		System					
	D*	FD	TD*	CD*	DX	DY	DM*	DS*	K/H	ID	QD	X	Y	M*	S*	T*	C*
S0	●	●	●	●													
S1	●	●	●	●													
S2														●			
S3	●								●								

*: D means D, HD; TD means TD and HTD; CD means CD, HCD, HSCD and HSD; DM means DM and DHM; DS means DS and DHS; M means M, HM, SM; S means S, HS; T means T, HT; C means C, HC.

(4) Function and action



- S0 specifies the starting address of the input parameter, occupying registers S0~S0+47.
- S1 specifies the starting address of the output status word, occupying registers S1~S1+7.
- S2 specifies the starting address of the output status bit, occupying relays S2~S2+5.
- S3 specifies axis port number.
- When M0 is OFF ->ON, according to the MoveMode setting, it moves according to an absolute value, relative value, or a certain movement method in speed control. Regardless of the movement method, it moves according to Velocity (target speed).
- During the movement process, perform relative positioning actions when the rising or falling edge of external input (interrupt input) approaches. Starting from the latch position (signal input position) at FeedVelocity, move the distance specified by FeedDistance (standard distance) for relative movement. When specifying a positive number for FeedDistance, perform the standard distance action in the same direction as before the interrupt input; When specifying a negative number, perform a standard distance action in the opposite direction.
- Using absolute or relative value movement instructions for interrupt standard transmission, stop the action at the original target position without inputting an interrupt signal before reaching the target position. When stopping the action without interrupting input, you can specify whether there is abnormal output through ErrorDetect (error detection selection). When specifying abnormal output, Error becomes True and Busy and Active become FALSE.
- Instructions need to be used in conjunction with probes, and probe configuration should refer to probe instructions.

(5) Note

- The probe being used in this instruction is not allowed to be triggered by other instructions that configure the probe. If triggered, other instructions will report an error, indicating that the probe is in use. If the probe is occupied, using this command with the probe will also trigger a failure.
- Support the mold axis, and refer to the mold axis instructions for the running trajectory below the mold axis.
- If the current high-speed operation is set to a standard distance that is too small, the probe will be locked in position, and then stopped at a fixed distance according to the interrupt. Due to the possibility of exceeding the target position given, the actual position of the motor has already exceeded or will exceed the target position, and the motor will reverse to the target position.

- This instruction involves axis motion, so the encoder axis is invalid.

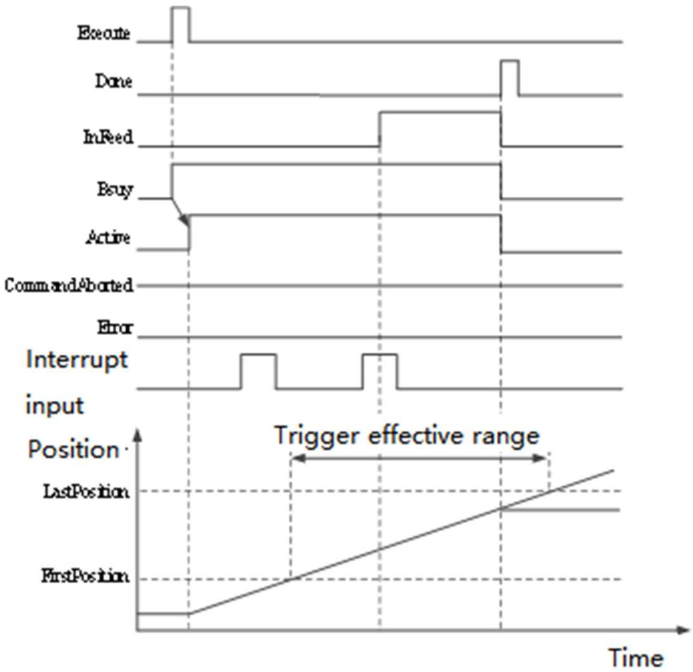
(6) Related parameters

Input parameter	Parameter name	Data type	Unit	Note
S0	Index	INT16U	-	Probe number: 0: Probe 1 1: Probe 2 2: Probe 3 3: Probe 4
S0+1	Source	INT16U	-	Trigger source: 0: Slave Station 1: Main Station
S0+2	Edge	INT16U	-	Trigger edge: 0: Rising edge 1: Descending edge
S0+3	Signal	INT16U	-	Signal source: 0: External signal 1: Z-phase signal 2: External interrupt 0, X2 3: External interrupt 1, X3 4: External interrupt 2, X4 5: External interrupt 3, X5 6: External interrupt 4, X6 7: External interrupt 5, X7 8: External interrupt 6, X10 9: External interrupt 7, X11 10: External interrupt 8, X12 11: External interrupt 9, X13
S0+4	WindowStart	FP64	-	Window start position
S0+8	WindowEnd	FP64	-	Window End Position
S0+12	WindowUsed	INT16U	-	Window Index 0: Not enabled 1: Enable
S0+16	Pos	FP64	Instruction Unit	Target position
S0+20	Vel	FP64	Instruction Unit/s	Target speed
S0+24	Acc	FP64	Instruction Unit/s^2	Acceleration
S0+28	Dec	FP64	Instruction Unit/s^2	Deceleration
S0+32	Jerk	FP64	Instruction Unit/s^3	Jerk
S0+36	FeedDis	FP64	Instruction Unit	Standard distance
S0+40	FeedVel	FP64	Instruction Unit/s	Standard speed
S0+44	Direction	INT16U	-	Direction (effective in mold axis mode) 0: No direction 1: Forward 2: Negative direction 3: Shortest path 4: Current direction
S0+45	MoveMode	INT16U	-	Sports mode 0: Absolute value positioning 1: Relative value positioning 2: Speed control
S0+46	BufferMode	INT16U	-	Caching mode 0: Interrupt 1: Cache

S0+47	ErrorDetect	INT16U	-	Error detection selection 0: Do not perform anomaly detection 1: Perform anomaly detection
Output parameter	Parameter name	Data type	Unit	Note
S1	ErrCode	INT16U	-	Command error code
S1+1	RecordPosition	FP64	Instruction Unit	Probe latch position
Status parameter	Parameter name	Data type	Unit	Note
S2	Done	BOOL	–	Instruction execution completed
S2+1	InFeed	BOOL	–	Standard transmission in progress
S2+2	Busy	BOOL	–	Instruction is currently being executed
S2+3	Active	BOOL	–	Instruction under control
S2+4	Abort	BOOL	–	Instruction interrupted
S2+5	Err	BOOL	–	Instruction execution error
Axis number	Parameter name	Data type	Unit	Note
S3	Axis	INT16U	-	Axis number. Starting from 0

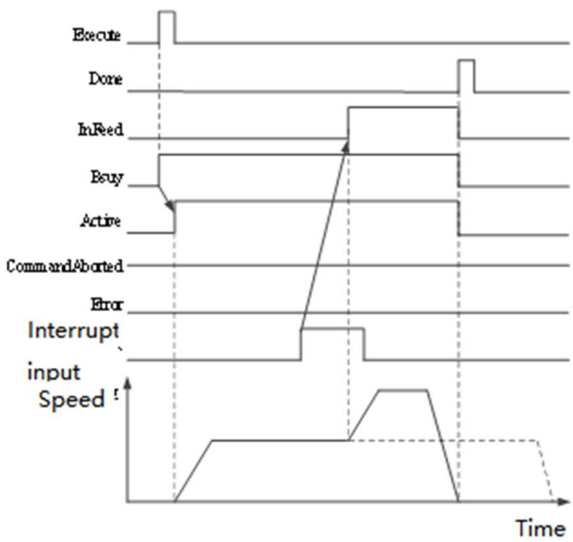
① Window Mode Description:

In window mode, the signal detection triggers the input only within the window range to obtain the axis position.

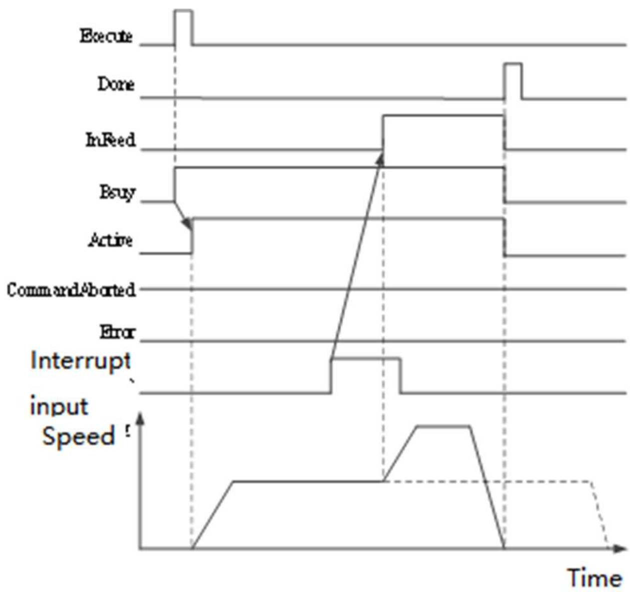


② MoveMode (move method selection) for absolute value positioning and relative value positioning

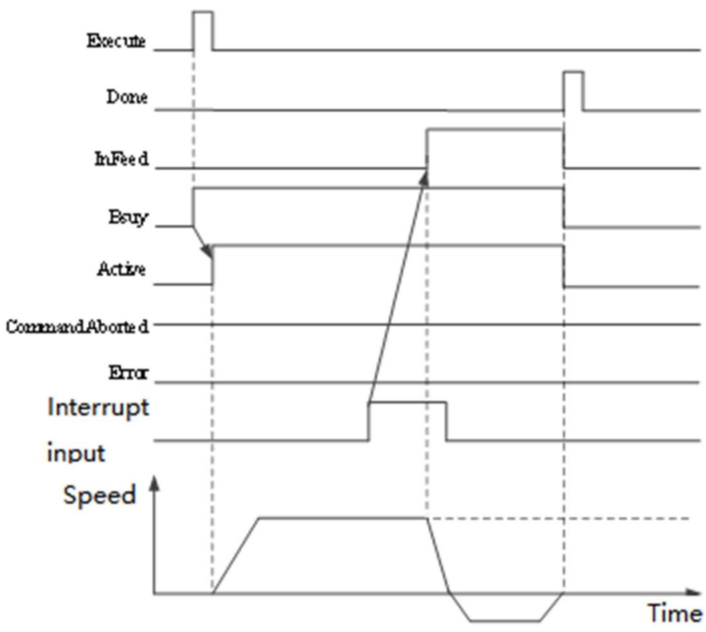
There may be a delay of one task cycle before the interrupt signal becomes "ON" and InFeed becomes true.



③ MoveMode is speed control

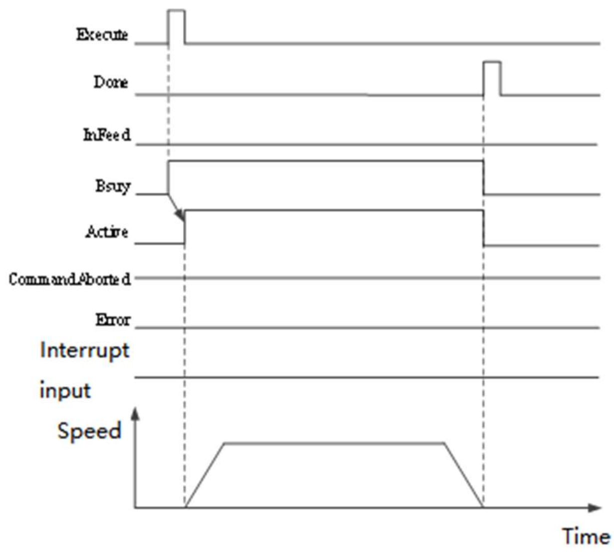


④ Reverse action

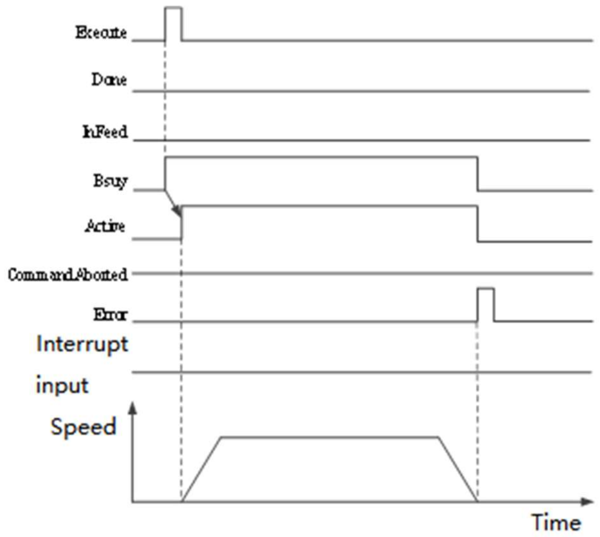


⑤ MoveMode is an absolute positioning method with uninterrupted input

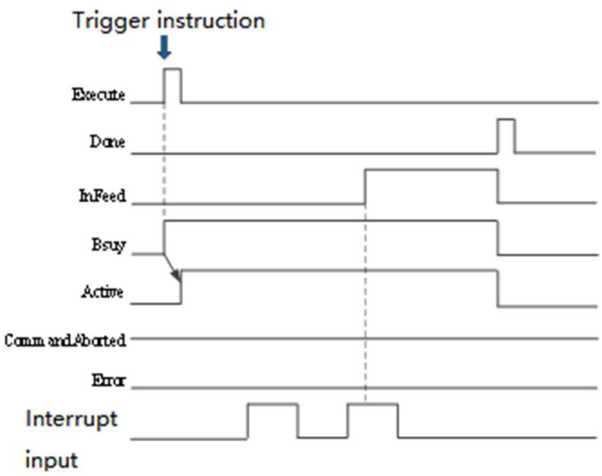
ErrorDetect (error detection selection): No abnormal detection mode, when the motion ends without interruption input, the command Done is set.



ErrorDetect (Error Detection Selection): When there is an anomaly detection mode and the motion ends without interruption input, the instruction Error is set.

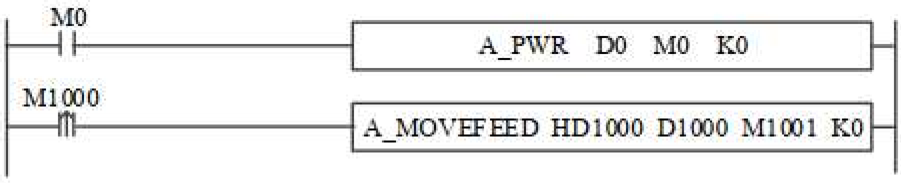


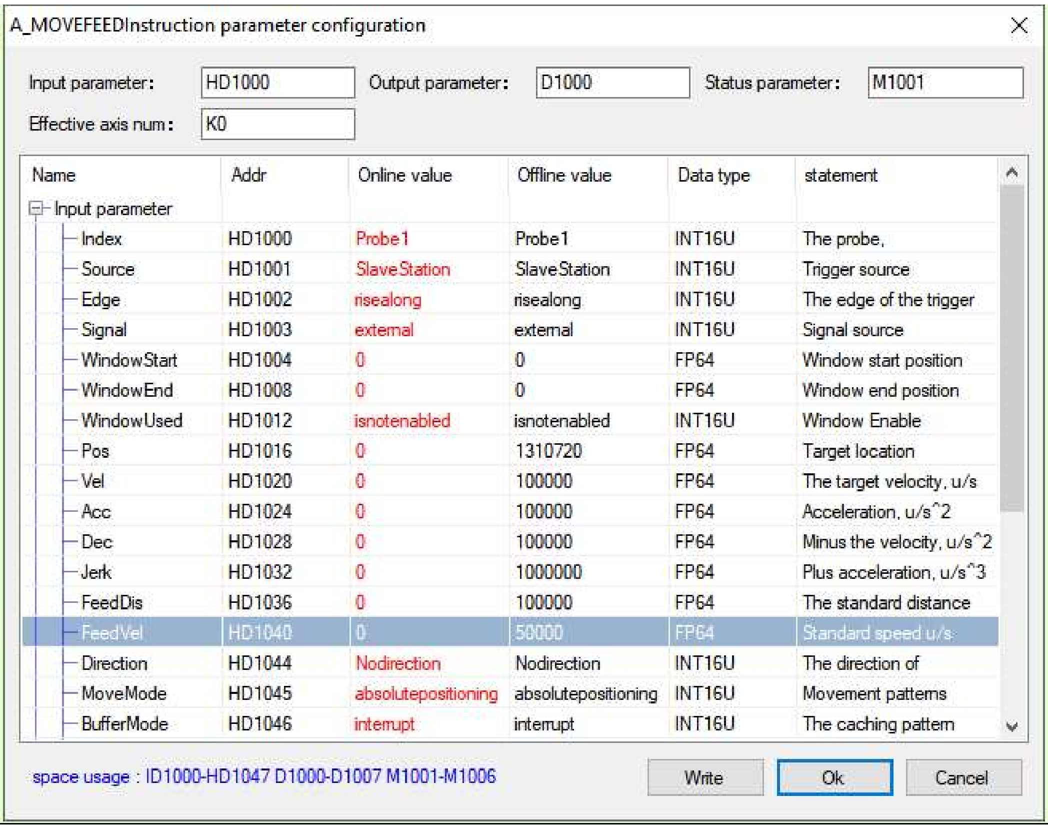
(7) Sequence diagram



Explanation:
In general, after the instruction is triggered, the Busy and Active signals are set, and the interrupt input is triggered during the instruction execution process. The InFeed signal is set (there may be a delay of 1 task cycle from the interrupt signal becoming "ON" to the InFeed becoming true), and after the positioning is completed, the Done signal is set. Other flags are reset, and Done will only reset after the instruction is executed again. Otherwise, it will not automatically reset.
During instruction execution, if a new instruction is triggered in interrupt mode, the InFeed, Busy, and Active signals will immediately reset, and the Abort signal will be set.
When there is an error in the instruction, the Error signal is set, other signals are reset, and the corresponding error code is output.

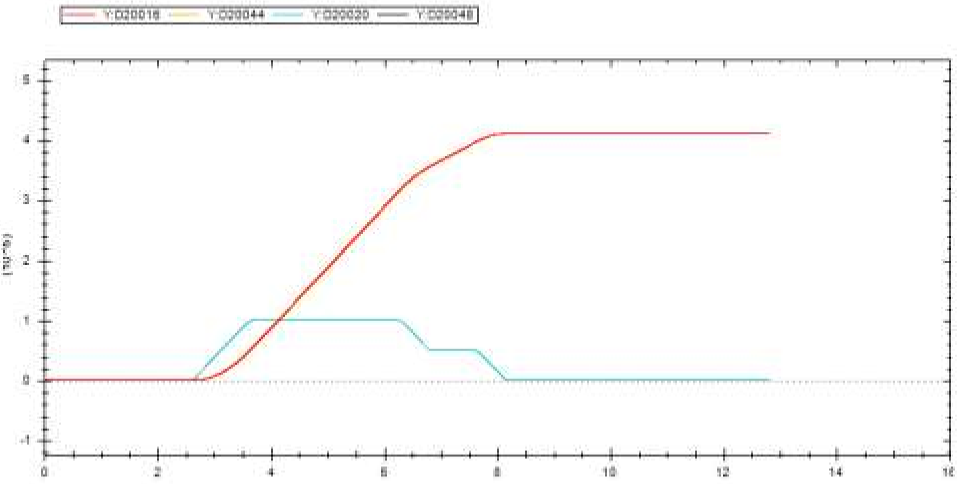
(8) Application
Require absolute positioning mode, with a target speed of 100000 pulses/s moving to a target position of 1310720 pulses, with an acceleration and deceleration of 100000 pulses/s^2 and an acceleration of 1000000 pulses/s^3. When probe 1 from the slave station triggers an interrupt, it moves a standard distance of 100000 pulses at a standard speed of 50000 pulses/s.
The ladder diagram is as follows:





Name	Addr	Online value	Offline value	Data type	statement
Index	HD1000	Probe1	Probe1	INT16U	The probe,
Source	HD1001	SlaveStation	SlaveStation	INT16U	Trigger source
Edge	HD1002	risealong	risealong	INT16U	The edge of the trigger
Signal	HD1003	external	external	INT16U	Signal source
WindowStart	HD1004	0	0	FP64	Window start position
WindowEnd	HD1008	0	0	FP64	Window end position
WindowUsed	HD1012	isnotenabled	isnotenabled	INT16U	Window Enable
Pos	HD1016	0	1310720	FP64	Target location
Vel	HD1020	0	100000	FP64	The target velocity, u/s
Acc	HD1024	0	100000	FP64	Acceleration, u/s^2
Dec	HD1028	0	100000	FP64	Minus the velocity, u/s^2
Jerk	HD1032	0	1000000	FP64	Plus acceleration, u/s^3
FeedDis	HD1036	0	100000	FP64	The standard distance
FeedVel	HD1040	0	50000	FP64	Standard speed u/s
Direction	HD1044	Nodirection	Nodirection	INT16U	The direction of
MoveMode	HD1045	absolutepositioning	absolutepositioning	INT16U	Movement patterns
BufferMode	HD1046	interrupt	interrupt	INT16U	The caching pattern

Explanation: Firstly, enable through the A_PWR command. When M1000 goes from OFF to ON, the A_MOVEFEED command runs with the set parameters. Trigger probe 1 when it does not reach the target position. At the standard speed, and command setting acceleration and deceleration speed, moves the specified distance from the trigger probe position.
The execution position velocity curve is shown below:


Y:D20016
Y:D20044
Y:D20020
Y:D20048
5
4
3
2
1
0
-1
0
2
4
6
8
10
12
14
16

5-1-3. Related coil and register

After the relevant register is modified, it will take effect after power on again.

System parameters

Address	Definition	Data type	Initial value	Note
SFD810	Axis number	INT16U	32	Setting value ≥ Actual number of connected axis
SFD811	Motion control mode startup mode	INT16U	0	0: C motion*1 1: H motion 2: userdefine mode*2
SFD814	Axis bit state start address	INT32U	20000	Axis related coil start address
SFD816	Axis word state start address	INT32U	20000	Axis related register start address

*1: C motion does not support all commands and parameters in this manual. See EtherCAT motion control user manual for specific usage.

*2: In userdefine mode, all servos will be switched to user-defined mode, and the user can change the object word at will.

Basic parameters(N is the corresponding axis number, N=0~63)

Address	Definition	Data type	Unit	Initial value	Note
SFD8000+300*N	Axis type*	INT16U	-	0	0: Real axis 1: Virtual axis 2: Encoder axis
SFD8001+300*N	Command output channel	INT16U	-	0	0: EtherCAT 1: pulse
SFD8002+300*N	Corresponding slave station no. *	INT16U	-	N	Corresponding function mapping number
SFD8003+300*N	Display unit	INT16U	-	0	0: pulse 1: mm 2: °
SFD8004+300N	Pulse per rotate	INT32U	Pulse number	131072	The count value feedback by one revolution of the encoder is set according to the actual number of motor encoder lines (for example, if the motor encoder is a 17-bit encoder, i.e. 131072 revolution, this parameter is set to 131072)
SFD8006+300*N	Encoder input terminal	INT16U	-	0	When the axis is set as the encoder axis, it is set as the number of the encoder corresponding to the high-speed counting port (if it is connected to high-speed counting HSC0, it is set as 0; if it is connected to high-speed counting HSC2, it is set as 1; if it is connected to high-speed counting HSC4, it is set as 2)
SFD8007+300*N	Gantry slave axis enable	INT16U	-	0	0: disable 1: enable In synchronous binding, an error from the slave axis will not cancel the binding

Address	Definition	Data type	Unit	Initial value	Note
					relationship V3.7.3 add servo alarm processing
SFD8008+300*N	Movement per turn	FP64	Command unit	131072	Equivalent of motion. That is, how many pulses are sent in the command to turn the motor for one turn
SFD8012+300*N	Enable the reducer	INT16U	-	0	0: disable 1: enable
SFD8014+300*N	Workpiece side coefficient of reducer *	INT32U	-	0	SFD8012 set to 1, this parameter will take effect
SFD8016+300*N	Motor side coefficient of reducer *	INT32U	-	0	SFD8012 set to 1, this parameter will take effect
SFD8018+300*N	Motion direction	INT16U	-	0	0: Pulse increment direction motor forward rotation 1: Pulse increment direction motor reverse rotation
SFD8019+300*N	Position command output filter time	INT16U	ms	0	Position given filtering. This will cause the actual axis motion to lag
SFD8020+300*N	Count type	INT16U	-	0	0: Linear Count (Linear axis, if soft limit is enabled, over limit alarm) 1: Rotation counting (mold axis, counting within a limited range) V3.7.3 and above support
SFD8024+300*N	Rotation count upper limit	FP64	Command unit	0	V3.7.3 and above support
SFD8028+300*N	Rotation count lower limit	FP64	Command unit	0	V3.7.3 and above support
SFD8036+300*N	Emergency stop mode	INT16U	-	0	Emergency stop mode when triggering emergency stop 0: given stop 1: feedback stop. When the speed is high, the use of feedback stop emergency stop may lead to servo alarm
SFD8037+300*N	Stop curve type	INT16U	-	0	0: Acceleration step (speed directly decelerates and stops) 1: Continuous acceleration (ensuring continuous acceleration during the stopping process)
SFD8038+300*N	Curve type	ENUM	-	0	0: Quadratic curve 1: Quadratic smoothing curve 2: Trapezoidal curve 3: Sin^2 Curve (supported in versions V3.7.3 and above)
SFD8040+300*N	Hard limit stop method	ENUM	-	0	1: Stop immediately 3: Deceleration stop
SFD8041+300*N	Forward hard limit port	INT16U	-	65535	The X terminal corresponding to the

Address	Definition	Data type	Unit	Initial value	Note
					forward hard limit signal. The parameter is octal, which means that the X10 terminal corresponds to octal as 10 and decimal as 8
SFD8042+300*N	Positive hard limit polarity	ENUM	-	0	0: Polarity not reversed 1: Polarity reversal
SFD8043+300*N	Negative hard limit port	INT16U	-	65535	The X terminal corresponding to the negative hard limit signal. The parameter is octal, which means that the X10 terminal corresponds to octal as 10 and decimal as 8
SFD8044+300*N	Negative hard limit polarity	ENUM	-	0	0: Polarity not reversed 1: Polarity reversal
SFD8045+300*N	Servo positive limit IO sequence	INT16U	-	65535	The servo positive limit is at the Nth position of 60FD (only V3.7.2 and above versions support the use of servo limit signals)
SFD8046+300*N	Servo negative limit IO sequence	INT16U	-	65535	The servo negative limit is at the Nth position of 60FD (only V3.7.2 and above versions support the use of servo limit signals)
SFD8048+300*N	Maximum deceleration of hard limit position	FP64	Command unit/s	65536000	
SFD8052+300*N	Maximum deceleration distance of hard limit	FP64	Command unit	10000000000	The maximum stopping distance after triggering the hard limit. (If the deceleration is greater, stop with deceleration; if the deceleration distance is shorter, stop with deceleration distance)
SFD8060+300*N	Is the soft limit enabled	ENUM	-	0	0: Not enabled 1: Enable
SFD8061+300*N	Soft limit stop method	ENUM	-	0	0: Detection command, deceleration stop 1: Detection command, emergency stop When the detection command D20016+200 * N reaches the soft limit, perform deceleration stop/emergency stop
SFD8064+300*N	Soft limit positive value	FP64	Command unit	10000000000	
SFD8068+300*N	Negative value of soft limit	FP64	Command unit	-10000000000	
SFD8072+300*N	Soft limit maximum deceleration	FP64	Command unit	10000000000	The actual stop deceleration is the larger value of this parameter compared to the deceleration of the motion command
SFD8076+300*N	Maximum	FP64	Command	-10000000000	The maximum stopping

Address	Definition	Data type	Unit	Initial value	Note
	deceleration distance of soft limit		unit		distance of the soft limit. (If the deceleration is greater, stop with deceleration, and if the deceleration distance is shorter, stop with deceleration distance, ultimately ensuring that it stops within the soft limit.)
SFD8080+300*N	Maximum speed	FP64	Command unit/s	6553600	If the speed parameter in the instruction is higher than the maximum speed, it will run at the maximum speed
SFD8084+300*N	Maximum acceleration	FP64	Command unit/s^2	65536000	If the acceleration parameter in the command is higher than the maximum acceleration, it will run at the maximum acceleration
SFD8088+300*N	Maximum deceleration	FP64	Command unit/s^2	65536000	If the deceleration parameter in the command is higher than the maximum deceleration, it will run at the maximum deceleration degree
SFD8092+300*N	Maximum acceleration speed	FP64	Command unit/s^3	655360000	If the acceleration parameter in the instruction is higher than the maximum acceleration speed, it will run at the maximum acceleration speed
SFD8096+300*N	Default speed percentage	INT16U	-	100	Single axis mode does not take effect
SFD8097+300*N	Default acceleration percentage	INT16U	-	100	When the acceleration in the command is set to 0, execute at the highest acceleration * default acceleration percentage
SFD8098+300*N	Default deceleration percentage	INT16U	-	100	When the deceleration in the command is set to 0, execute at the maximum deceleration * default deceleration percentage
SFD8099+300*N	Default acceleration percentage	INT16U	-	100	When the acceleration speed in the instruction is set to 0, execute at the maximum acceleration speed * default acceleration percentage
SFD8108+300*N	Starting speed	FP64	Command unit/s	0	Within the range of starting speed values (taking absolute values), plan using a step (speed step, position step does not occur) approach; In order to respond quickly; (Supported in versions V3.7.3 and above)
SFD8120+300*N	Position deviation	FP64	Command	0	When the deviation

Address	Definition	Data type	Unit	Initial value	Note
	alarm value		unit		between the given position of the instruction and the feedback position exceeds this value, error 2006 will be reported. When the parameter is set to 0, position deviation alarm is not enabled.
SFD8124+300*N	Positioning completion width	FP64	Command unit	100	When the target position of the instruction reaches the set value and the difference with the actual encoder position does not exceed the positioning completion width, the completion flag is set to ON
SFD8128+300*N	Zero detection width	FP64	Command unit	100	If the current position is within the range of the electrical origin, M20004+50 * N is set to ON
SFD8132+300*N	Motion detection speed value	FP64	Command unit/s	100	When the current speed is detected to be greater than the set value, M20002+50 * N is set to ON
SFD8136+300*N	Motion detection filtering	INT16U	ms	10	The filtering of motion detection means that after the detection speed is greater than the set value and the filtering time is continuously detected, the position of the motion flag is ON. Maximum value 10000
SFD8137+300*N	Speed warning percentage	INT16U	-	100	Not currently supported
SFD8138+300*N	Acceleration warning percentage	INT16U	-	100	Not currently supported
SFD8139+300*N	Deceleration warning percentage	INT16U	-	100	Not currently supported
SFD8160+300*N	Origin port	INT16U		65535	Origin signal input port number
SFD8161+300*N	Origin port polarity	ENUM		0	0-Polarity does not reverse 1- Polarity reversal
SFD8162+300*N	Near Point Port	INT16U		65535	Near point signal input port number. Not currently supported
SFD8163+300*N	Proximal port polarity	ENUM		0	Not currently supported
SFD8164+300*N	Z-phase port	INT16U		65535	Z-phase signal input port signal
SFD8165+300*N	Z-phase port polarity	ENUM		0	0-Polarity does not reverse 1- Polarity reversal
SFD8166+300*N	Number of Z phases	INT16U		0	Number of z-phase signals to be detected at the origin
SFD8168+300*N	Zero return high-speed	FP64	Command unit/s	655350	
SFD8172+300*N	Return to zero	FP64	Command	65535	The value must be less than

Address	Definition	Data type	Unit	Initial value	Note
	crawling speed		unit/s		the high-speed speed of returning to zero, but must be greater than zero
SFD8176+300*N	Zero return acceleration	FP64	Command unit/s^2	0	
SFD8180+300*N	Zero return deceleration	FP64	Command unit/s^2	0	
SFD8184+300*N	Zero return acceleration	FP64	Command unit/s^3	0	
SFD8188+300*N	Zero position	FP64	Command unit	0	The position set after the completion of the zero return action
SFD8192+300*N	Zero return direction	ENUM		0	The direction at which the zeroing action begins 0-Forward 1- Negative direction
SFD8194+300*N	Probe encoder pulse equivalent	FP64	Command unit	0	When using the probe command on the encoder axis, the equivalent value needs to be set
SFD8200+300*N	Pulse port	INT16U		65535	Pulse output port number
SFD8201+300*N	Pulse direction port	INT16U		65535	Pulse direction output port number
SFD8202+300*N	Pulse port polarity	ENUM		0	0-Polarity does not reverse 1- Polarity reversal
SFD8203+300*N	Pulse direction port polarity	ENUM		0	0-Polarity does not reverse 1- Polarity reversal
SFD8204+300*N	Closed loop switch	ENUM		0	The switch for the closed-loop function. 0: Close 1: Open
SFD8205+300*N	Closed loop feedback data source type	ENUM		0	Closed loop position feedback source: 0: Bus position feedback 1: High speed counting. The high-speed counting terminal is set through SFD8006+300 * N
SFD8206+300*N	Encoder equivalent value	FP64	Equivalent unit	0	Only effective when the closed-loop position feedback source is high-speed counting. The encoder inputs the amount of movement for each pulse. That is, the amount of movement per revolution (SFD8008+300 * N)/the number of pulses per revolution of the encoder. Example: The PLC sets a movement of 10000 per revolution, the closed-loop position feedback source is a grating ruler or encoder counting, and the high-speed counting value for each revolution of the motor is 2500. Set the

Address	Definition	Data type	Unit	Initial value	Note
					encoder equivalent value to 4
SFD8210+300*N	Proportional gain	FP64		0	Proportional gain of PID in full closed loop control
SFD8214+300*N	Integral gain	FP64		0	Integral gain of PID in full closed loop control
SFD8218+300*N	Differential gain	FP64		0	Differential gain of PID in full closed loop control
SFD8222+300*N	Speed feedforward gain	FP64		0	Full closed loop speed feedforward gain
SFD8226+300*N	Feedback speed feedforward gain	FP64		0	Full closed loop speed feedback gain
SFD8230+300*N	Closed loop maximum position gain	FP64		0	Error code 2018 is returned when the closed-loop position deviation exceeds this limit value. When set to 0, it does not take effect.
SFD8234+300*N	Speed forward looking filtering time	INT16U		0	Full closed loop speed feedforward filtering time
SFD8235+300*N	Feedback velocity filtering time	INT16U		0	Full closed loop speed feedback filtering time
SFD8236+300*N	2 degree free alpha	FP64		0	Full closed loop 2 free degree alpha. The range is 0 ~ 1. When the setting value is 0, instruction filtering is not performed. When the setting value is greater than 1, it is processed as 1.
SFD8240+300*N	2 degree free integral time	FP64		0	Full closed loop 2 free degree integration time.

Axis state coil (coil start address is decided by SFD814)

Address	Definition	Note
M20000+50*N	Axis enable	ON: axis enable state
M20001+50*N	Axis error	ON: axis error state
M20002+50*N	Axis motion	ON: the axis is in motion, the current speed of the axis is greater than the motion speed detection value and exceeds the motion detection filtering time, and the end of the motion is set to off
M20003+50*N	At the position	ON: the command movement is completed, and the deviation between the given and feedback is within the positioning completion width
M20004+50*N	At the origin	ON: the axis is within the electrical origin range
M20005+50*N	Speed warning	Not support at the moment
M20006+50*N	Acceleration warning	Not support at the moment
M20007+50*N	Deceleration warning	Not support at the moment
M20008+50*N	Axis motion completion	ON: command movement completion

Axis state register (register start address is decided by SFD816)

Address	Definition	Data type	Unit	Note
D20000+200*N	Axis state	INT16U	-	0: axis disable 1: axis enabled, not move 2: axis in motion (end speed is 0, include

Address	Definition	Data type	Unit	Note
				A_HALT) 3: axis in continuous motion 4: axis in synchronous motion 5: axis in homing 6: axis in deceleration stop (A_STOP) 7: axis error 8: the axis is in axis group motion
D20001+200*N	Error code	INT16U	-	Refer to the error code
D20008+200*N	Command given pulse	FP64	Pulse	Current given pulse of motion command
D20012+200*N	Command end position	FP64	Command unit	Target position of motion command
D20016+200*N	Axis given position	FP64	Command unit	Current given position of motion command
D20020+200*N	Axis given speed	FP64	Command unit /s	Current given speed of motion command
D20024+200*N	Axis given acceleration/deceleration	FP64	Command unit /s^2	Current given acceleration and deceleration of motion command
D20040+200*N	Axis feedback pulse	FP64	Pulse	Axis actual motion pulse
D20044+200*N	Axis feedback position	FP64	Command unit	Axis actual motion position
D20048+200*N	Axis feedback speed	FP64	Command unit /s	Axis actual motion speed
D20188+200*N	CYCSUP absolute position	FP64	Command unit	Total compensation amount of CYCSUP command

5-2. Axis group function

5-2-1. Command list

Command	Function	Chapter
G_PWR	Axis group enable	5-2-2-1
G_CFGAXIS	Modify the composition axis	5-2-2-2
G_PTP	point-to-point motion	5-2-2-3
G_LINE	Linear interpolation	5-2-2-4
G_CIRCLE	Arc interpolation	5-2-2-5
G_HELICAL	Spiral motion	5-2-2-6
G_MOVSUP	Superimposed motion	5-2-2-7
G_COMPON	Compensation motion	5-2-2-8
G_COMPOFF	Cancel compensation	5-2-2-9
G_INTR	Interrupt the motion	5-2-2-10
G_GOON	Continue the motion	5-2-2-11
G_PATHMODE	Specify path mode selection	5-2-2-12
G_PATHSEL	Select machining path	5-2-2-13
G_PATHMOV	Path motion	5-2-2-14
G_SETOVRD	Modify magnification	5-2-2-15
G_ELLIPSE	Ellipse interpolation	5-2-2-16
G_STOP	Axis group stop	5-2-2-17
G_IMMEDIATESTOP	Axis group emergency stop	5-2-2-18
G_RST	Axis group cleaning error	5-2-2-19
G_WRITE	Axis group modification position	5-2-2-20
G_CYCPOS	Axis group cycle control position	5-2-2-21
G_BEZIER	Bessel interpolation	5-2-2-22
G_PTP_MUL	Axis group rapid proportional positioning motion	5-2-2-23
G_ROTCUTON	Axis group rotary cutting interpolation enabled	5-2-2-24
G_ROTCUTOFF	Axis group rotary cutting interpolation off	5-2-2-25
G_PATHSEL_2	Axis group selection machining path 2	5-2-2-26
G_TOOLWR	Tool value writing	5-2-2-27
G_TOOLRD	Tool value reading	5-2-2-28
G_TOOLSEL	Tool value loading	5-2-2-29

5-2-2. Command introduction

5-2-2-1. Axis group enable【G_PWR】

(1) Overview

turn on the axis group enable, make the axis group in operation state.

Axis group enable [G_PWR]			
Execution condition	Normally ON/OFF coil	Suitable model	XDH, XLH, XG2
Firmware	V3.6.1b and above	Software	3.7.4 and above

(2) Operand

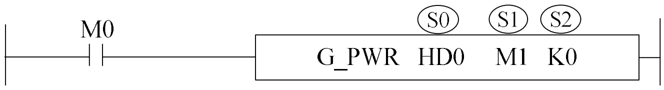
Operand	Function	Type
S0	Specify the output state word start address	16-bit, single word
S1	Specify the output state bit start address	Bit
S2	Specify axis group number	16-bit, single word

(3) Suitable soft component

Operand	Word soft component											Bit soft component					
	System								Constant	Module		System					
	D*	FD	TD*	CD*	DX	DY	DM*	DS*	K/H	ID	QD	X	Y	M*	S*	T*	C*
S0	●	●	●	●													
S1														●			
S2									●								

*: D means D, HD; TD means TD and HTD; CD means CD, HCD, HSCD and HSD; DM means DM and DHM; DS means DS and DHS; M means M, HM, SM; S means S, HS; T means T, HT; C means C, HC.

(4) Function and action



- S0 specifies output state word start address
- S1 specifies output state bit start address
- S2 specifies axis group number, starts from 0. The axis number in the axis group is set through SFD48001+300*N~SFD48006+300*N, N is axis group number.
- When M0 is set to on, enable the S2 specified axis group and switch the axis group to the operable state. Relevant axis group commands can be used only after the axis group is enabled
- After the command is executed, the single axis state of axis group (D20000+200*N) is 8, axis group state (D46000+300*N) is 1

(5) Notes

- Enabling the axis group requires that each single axis in the axis group is in the enabled state and the axis is in the unbound state
- After the axis group is enabled, the single axis specified by the axis group will not be able to use the single axis command
- The single axis number specified by the axis group cannot be repeated, the axis communication channels are consistent, the axis is in CSP mode, does not support encoder axis, and virtual axis can be set.
- Turn off the axis group enable to achieve the effect of emergency stop. When you use the axis group function again, you need to turn on the enable again.

(6) Related parameters

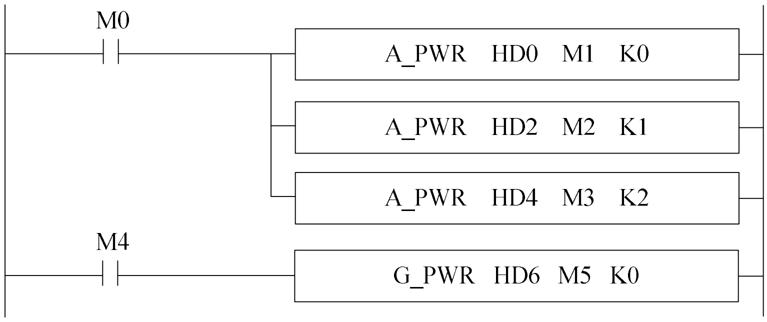
Output parameter	Parameter name	Data type	Unit	Note
S0	ErrCode	INT16U	-	Command error code
State parameter	Parameter name	Data type	Unit	Note
S1	PwrStat	BOOL	-	Axis group enable state
Axis number	Parameter name	Data type	Unit	Note

S2	Axis	INT16U	-	Axis group number starts from 0

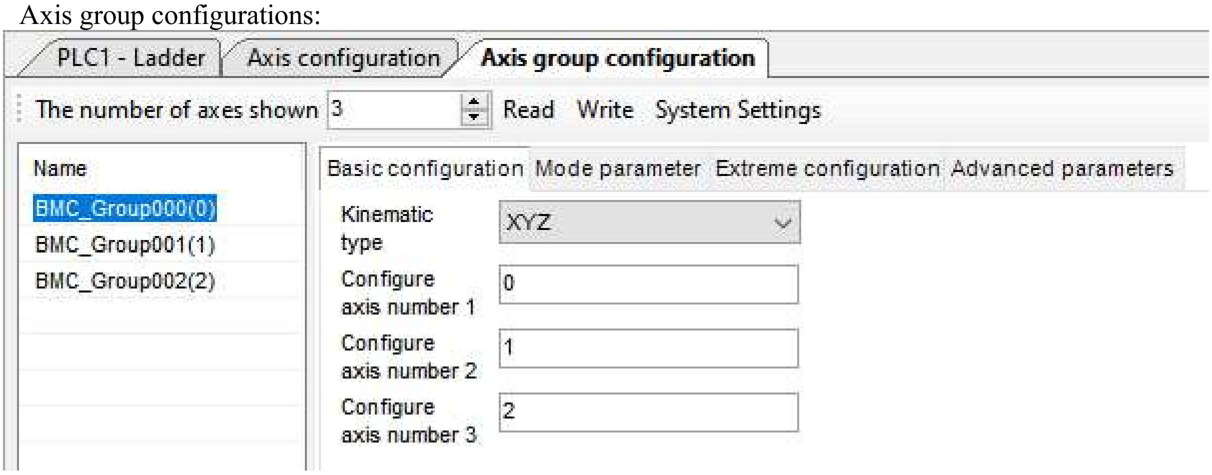
(7) Sequence diagram

(8) Application

For example, the axis group consists of axis 0, axis 1 and axis 2. It is required to enable the axis group. The ladder diagram is as follows:



Axis group configurations:



The constituent axes of axis group 0 are set through SFD48001, SFD48002 and SFD48003. The axis group can be enabled only after all constituent axes of the axis group are enabled. After the axis group is enabled, the corresponding axis group state machine D46000 + 300*N changes to 1, indicating that the axis group is enabled. The single axis state machine D20000 + 200*N of the axis group changes to 8, indicating that the axis is in the axis group. Refer to chapter 5-1-3 for single axis related registers and 5-2-3 for axis group related registers.

寄存器	监控值	字长	进制	注释
D20000	8	单...	1...	轴0状态机
D20200	8	单...	1...	轴1状态机
D20400	8	单...	1...	轴2状态机
D46000	1	单...	1...	轴组状态机

5-2-2-2. Modify the composition axis【G_CFGAXIS】

(1) Overview

Modify the composition axis of the axis group.

Modify the composition axis [G_CFGAXIS]			
Execution condition	Rising/falling edge of the coil	Suitable model	XDH, XLH, XG2
Firmware	V3.6.1b and above	Software	3.7.4 and above

(2) Operand

Operand	Function	Type
S0	Sepcify the input parameter start address	16-bit, single word
S1	Specify the output state word start address	16-bit, single word
S2	Specify the output state bit start address	Bit
S3	Specify axis group number	16-bit, single word

(3) Suitable soft component

Operand	Word soft component											Bit soft component					
	System								Constant	Module		System					
	D*	FD	TD*	CD*	DX	DY	DM*	DS*	K/H	ID	QD	X	Y	M*	S*	T*	C*
S0	●	●	●	●													
S1	●	●	●	●													
S2														●			
S3	●								●								

*: D means D, HD; TD means TD and HTD; CD means CD, HCD, HSCD and HSD; DM means DM and DHM; DS means DS and DHS; M means M, HM, SM; S means S, HS; T means T, HT; C means C, HC.

(4) Function and action

- S0 specifies the input parameter start address, occupies the register S0~S0+5
- S1 specifies the output state word start address
- S2 specifies the output state bit start address, occupies the relay S2~S2+3
- S3 specifies the axis group number
- When M0 is from off → on, S3 specifies the axis group and modifies the constituent axis of the axis group with the parameters set by the user

(5) Notes

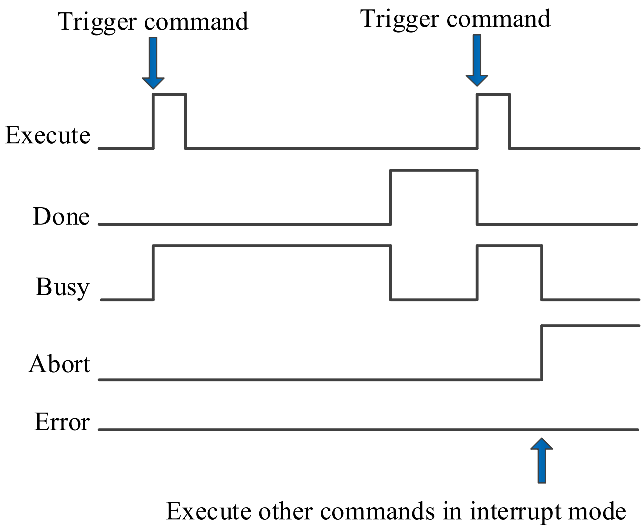
- The constituent axis does not support encoder axis and duplicate axis number, and the communication channels of each axis of the axis group need to be consistent
- The axis group is in motion and cannot perform G_ CFGAXIS
- The constituent axis cannot be the same as the axis number in other enabled axis groups
- The modified composition axis will be restored after PLC stop and power failure.
- After the execution of X_UPDATEPARA, the modification constitutes axis failure.

(6) Related parameters

Input parameter	Parameter name	Data type	Unit	Note
S0	AxisX	INT16U		X axis composition axis number
S0+1	AxisY	INT16U		Y axis composition axis number
S0+2	AxisZ	INT16U		Z axis composition axis number
S0+3	AxisA	INT16U		A axis composition axis number
S0+4	AxisB	INT16U		B axis composition axis number
S0+5	AxisC	INT16U		C axis composition axis number
Output parameter	Parameter name	Data type	Unit	Note
S1	ErrCode	INT16U	-	Command error code
State parameter	Parameter name	Data type	Unit	Note

S2	Done	BOOL		Instruction execution completed
S2+1	Busy	BOOL		The instruction is being executed
S2+2	Abort	BOOL		Instruction is interrupted
S2+3	Error	BOOL		Instruction execution error
Axis number	Parameter name	Data type	Unit	Note
S3	Axis	INT16U		Axis group number starts from 0

(7) Sequence diagram



Explanation:
Generally, after the command is triggered, the Busy signal is set, reset after the command is executed, and the Done signal is set. Done is reset only after the command is triggered again, otherwise it will not be reset automatically.
When the instruction is interrupted or has an error, the corresponding Abort or Error signal is set, other signals are reset, and the corresponding error code will be output in case of error.

5-2-2-3. Point to point motion【G_PTP】

(1) Overview

Each axis runs to the target position at the fastest speed.

Point to point motion [G_PTP]			
Execution condition	Rising/falling edge of the coil	Suitable model	XDH, XLH, XG2
Firmware	V3.6.1b and above	Software	3.7.4 and above

(2) Operand

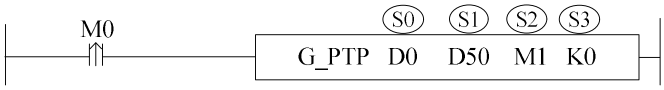
Operand	Function	Type
S0	Sepcify the input parameter start address	64-bit, four words
S1	Specify the output state word start address	16-bit, single word
S2	Specify the output state bit start address	Bit
S3	Specify axis group number	16-bit, single word

(3) Suitable soft component

Operand	Word soft component											Bit soft component					
	System								Constant	Module		System					
	D*	FD	TD*	CD*	DX	DY	DM*	DS*	K/H	ID	QD	X	Y	M*	S*	T*	C*
S0	●	●	●	●													
S1	●	●	●	●													
S2														●			
S3	●								●								

*: D means D, HD; TD means TD and HTD; CD means CD, HCD, HSCD and HSD; DM means DM and DHM; DS means DS and DHS; M means M, HM, SM; S means S, HS; T means T, HT; C means C, HC.

(4) Function and action



- S0 specifies the input parameter start address, occupies the register S0~S0+31
- S1 specifies the output state word start address
- S2 specifies output state bit start address, occupies the relay S2~S2+4
- S3 specifies the axis group number
- When M0 changes from off → on, each axis of the axis group reaches the target position at the fastest speed, and the speed uses the default speed configuration of single axis. The axis speed = max speed (SFD8080+300*N)*default speed percentage (SFD8096+300*N).
- After executing the command, the single axis state of axis group (D20000+200*N) is 8, axis group state (D46000+300*N) is 2.

(5) Notes

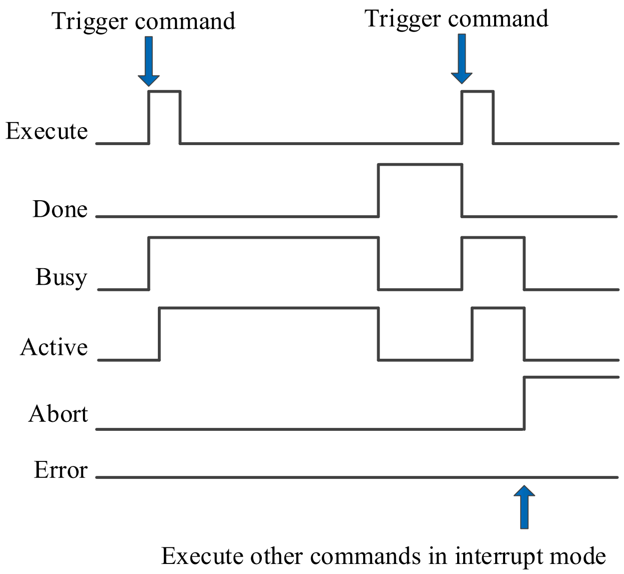
- When the G_PTP command is executed, each axis in its axis group is separated and moves to the target position with its own track
- The instruction supports buffer. At most one instruction can be cached. When the instruction is executed in buffer mode, it will wait for all axes in the current axis group to finish moving before executing the cached instruction.

(6) Related parameters

Input parameter	Parameter name	Data type	Unit	Note
S0	PositionX	FP64	Command unit	X axis position. X axis number is set through SFD48001+300*N.
S0+4	PositionY	FP64	Command unit	Y axis position. Y axis number is set through SFD48002+300*N.
S0+8	PositionZ	FP64	Command unit	Z axis position. Z axis number is set through SFD48003+300*N.
S0+12	PositionA	FP64	Command unit	A axis position. Not supported at the moment.
S0+16	PositionB	FP64	Command	B axis position. Not supported at the moment.

			unit	
S0+20	PositionC	FP64	Command unit	C axis position. Not supported at the moment.
S0+24	Coordinate	INT16U	-	Coordinate system. Not supported at the moment.
S0+25	Buffermode	INT16U	-	Buffer mode 0: interrupt mode 1: buffer mode
S0+26	TransitionMode	INT16U	-	Transition mode. Not supported at the moment
S0+27	posMode	INT16U	-	Position mode 0: absolution 1: relative (3.7.3 and above version supported)
S0+28	TransitionVel	FP64	-	Transition speed. Not support by now
Output parameter	Parameter name	Data type	Unit	Note
S1	ErrCode	INT16U	-	Command error code
State parameter	Parameter name	Data type	Unit	Note
S2	Done	BOOL	-	Instruction execution completed
S2+1	Busy	BOOL	-	The instruction is being executed
S2+2	Active	BOOL	-	Command under control
S2+3	Abort	BOOL	-	Instruction is interrupted
S2+4	Error	BOOL	-	Instruction execution error
Axis number	Parameter name	Data type	Unit	Note
S3	Axis	INT16U	-	Axis group number starts from 0

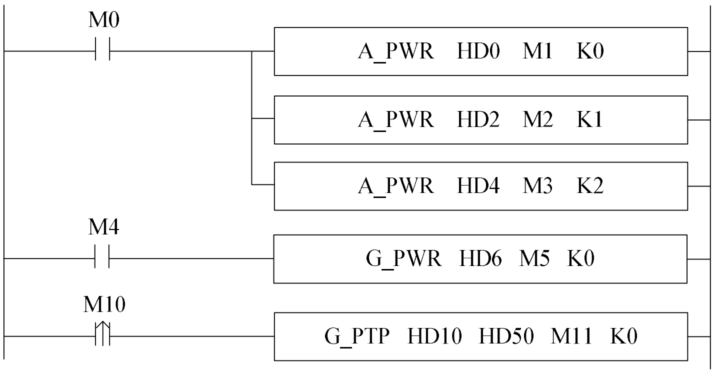
(7) Sequence diagram



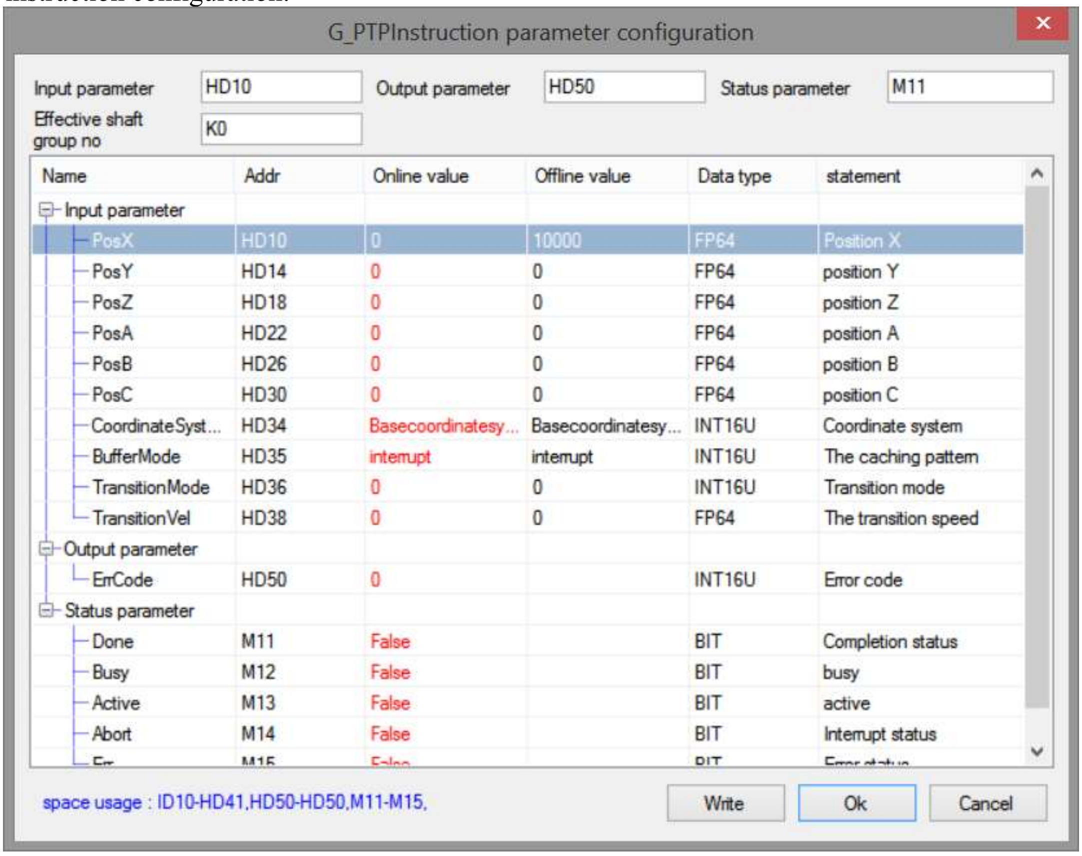
Explanation:
Generally, after the command is triggered, the Busy and Active signals are set, and reset after the command is executed. At the same time, the Done signal is set. Done will reset only after the command is triggered again, otherwise it will not reset automatically.
When the instruction is triggered in the buffer mode and there are currently instructions being executed, the Active signal will be set immediately. The execution of the current instruction ends. When the instruction is executed, the Busy signal will be set. After the execution of the instruction ends, the Busy and Active signals will be reset and the Done signal will be set.
When a new instruction is triggered in interrupt mode during instruction execution, the Busy and Active signals are reset immediately and the Abort signal is set.
When there is an error in the command, the Error signal is set, other signals are reset, and the corresponding error code is output.

(8) Application

For example, it requires the axis group moves to the point (10000,0,0) with command G_PTP. The ladder chart is shown as below:



The instruction configuration:



G_PTPInstruction parameter configuration

Input parameter: HD10 | Output parameter: HD50 | Status parameter: M11

Effective shaft group no: K0

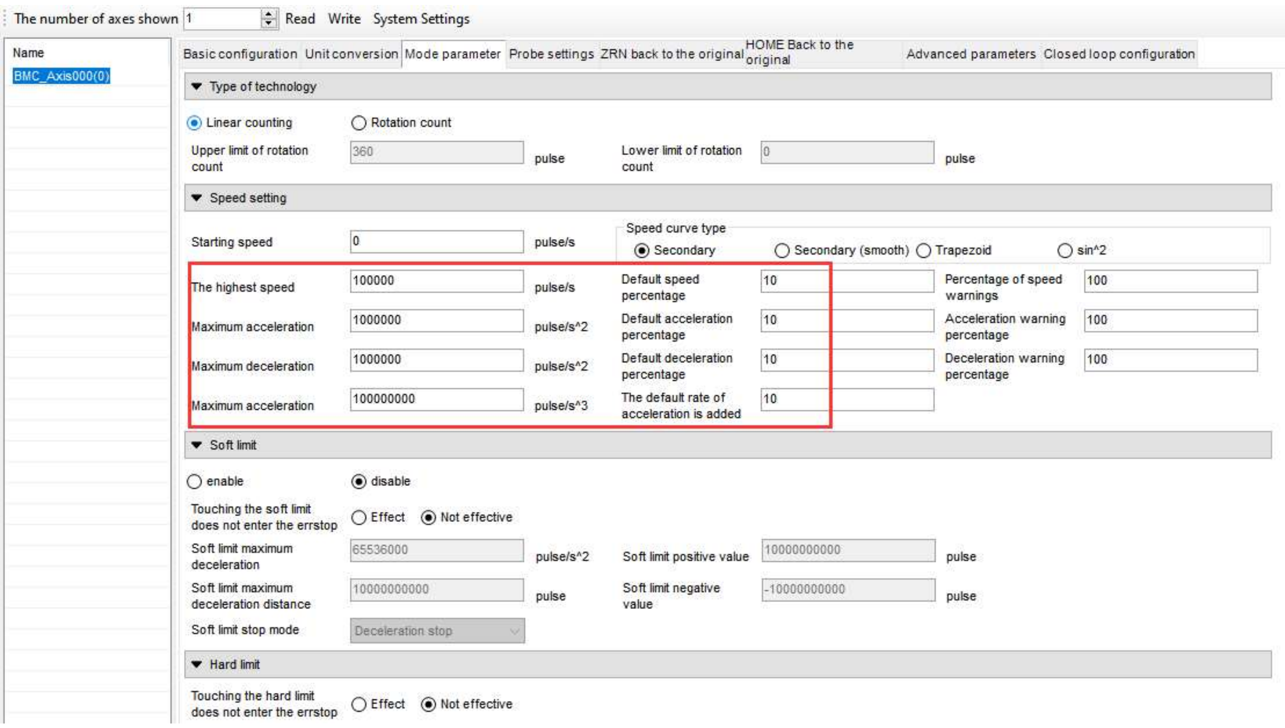
Name	Addr	Online value	Offline value	Data type	statement
Input parameter					
PosX	HD10	0	10000	FP64	Position X
PosY	HD14	0	0	FP64	position Y
PosZ	HD18	0	0	FP64	position Z
PosA	HD22	0	0	FP64	position A
PosB	HD26	0	0	FP64	position B
PosC	HD30	0	0	FP64	position C
CoordinateSyst...	HD34	Basecoordinatesy...	Basecoordinatesy...	INT16U	Coordinate system
BufferMode	HD35	interrupt	interrupt	INT16U	The caching pattern
TransitionMode	HD36	0	0	INT16U	Transition mode
TransitionVel	HD38	0	0	FP64	The transition speed
Output parameter					
ErrCode	HD50	0		INT16U	Error code
Status parameter					
Done	M11	False		BIT	Completion status
Busy	M12	False		BIT	busy
Active	M13	False		BIT	active
Abort	M14	False		BIT	Interrupt status
Err	M15	False		BIT	Error status

space usage : ID10-HD41,HD50-HD50,M11-M15,

Write | Ok | Cancel

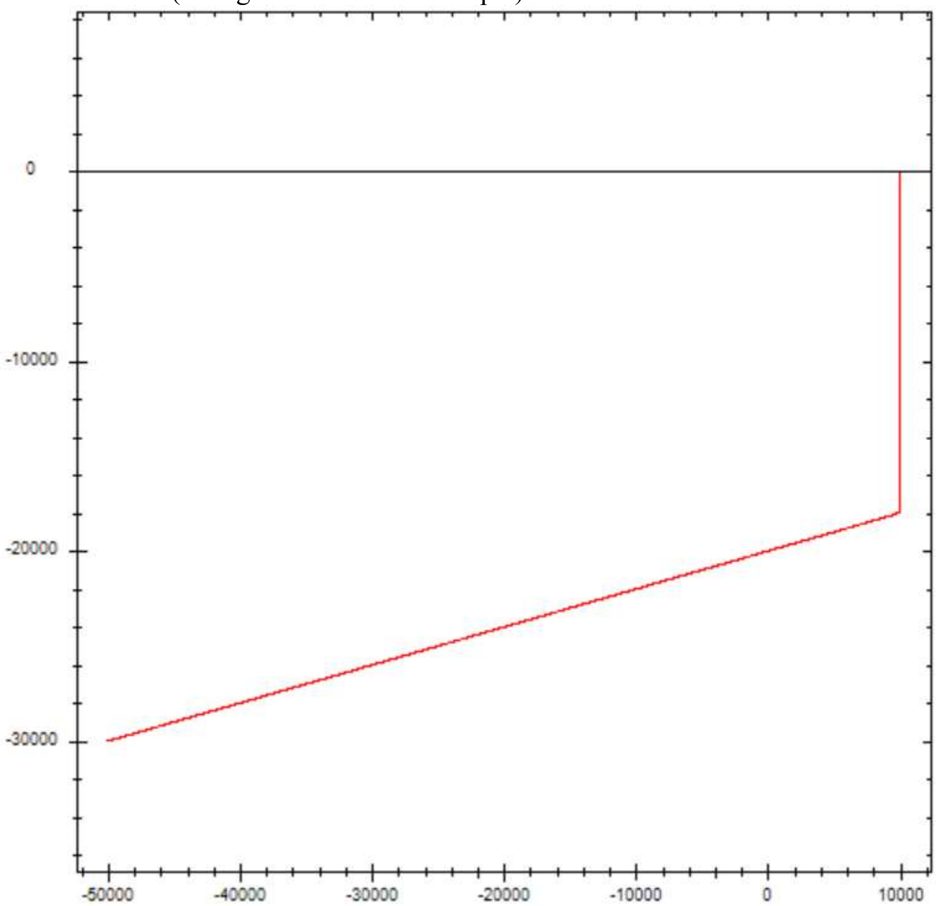
Explanation:

The relevant axis group movement command can be executed only after the axis group is enabled. The axis group enabling requires each component axis to be enabled first. Refer to chapter 5-2-2-1 command G_PWR for details. G_ PTP command runs to the specified point at the default speed of each constituent axis, refer to chapter 5-1-3.



As the above figure, the default speed=100000 (max speed) *10% (default speed percentage) =10000. If the maximum speed of the single axis is set low, the axis group will calculate the linear speed according to the maximum speed of the single axis, so that the linear speed of the axis group cannot reach the target speed set in the command.

Its running track is as follows (taking XY axis as an example):



In the figure, the abscissa is X axis and the ordinate is Y axis. Coordinate starting point (- 50000, - 30000), after G_PTP motion, the X and Y axes move to the target position (10000,0) at their respective default speeds.

5-2-2-4. Linear interpolation【G_LINE】

(1) Overview

The axis group performs spatial linear motion with the set parameters.

Linear interpolation [G_LINE]			
Execution condition	Rising/falling edge of the coil	Suitable model	XDH, XLH, XG2
Firmware	V3.6.1b and above	Software	V3.7.4 and above

(2) Operand

Operand	Function	Type
S0	Sepcify the input parameter start address	64-bit, four words
S1	Specify the output state word start address	16-bit, single word
S2	Specify the output state bit start address	Bit
S3	Specify axis group number	16-bit, single word

(3) Suitable soft component

Operand	Word soft component											Bit soft component					
	System								Constant	Module		System					
	D*	FD	TD*	CD*	DX	DY	DM*	DS*	K/H	ID	QD	X	Y	M*	S*	T*	C*
S0	●	●	●	●													
S1	●	●	●	●													
S2														●			
S3	●								●								

*: D means D, HD; TD means TD and HTD; CD means CD, HCD, HSCD and HSD; DM means DM and DHM; DS means DS and DHS; M means M, HM, SM; S means S, HS; T means T, HT; C means C, HC.

(4) Function and action

```
                          (S0) (S1) (S2) (S3)
   M0
|--|↑|-------[ G_LINE  D0   D60  M1   K0 ]--|
```

- S0 specifies the input parameter start address, occupies the register S0~S0+51
- S1 specifies the output state word start address
- S2 specifies output state bit start address, occupies the relay S2~S2+4
- S3 specifies the axis group number
- When M0 changes from off → on, the axis group specified by S3 performs linear interpolation at the speed, acceleration/deceleration and jerk speed set by the user
- After the command is executed, single axis state of axis group (D20000+200*N) is 8, axis group state (D46000+300*N) is 2.

(5) Related parameters

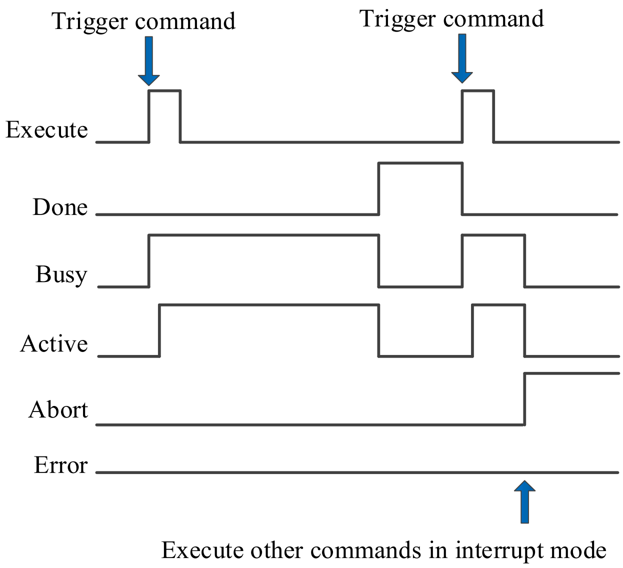
Input parameter	Parameter name	Data type	Unit	Note
S0	PositionX	FP64	Command unit	X axis position. X axis number is set through SFD48001+300*N
S0+4	PositionY	FP64	Command unit	Y axis position. Y axis number is set through SFD48002+300*N
S0+8	PositionZ	FP64	Command unit	Z axis position. Z axis number is set through SFD48003+300*N
S0+12	PositionA	FP64	Command unit	A axis position. Not supported at the moment
S0+16	PositionB	FP64	Command unit	B axis position. Not supported at the moment
S0+20	PositionC	FP64	Command unit	C axis position. Not supported at the moment
S0+24	Velocity	FP64	Command unit /s	Target speed
S0+28	Acceleration	FP64	Command unit /s^2	Target acceleration speed
S0+32	Deceleration	FP64	Command	Target deceleration speed

Input parameter	Parameter name	Data type	Unit	Note
			unit /s^2	
S0+36	Jerk	FP64	Command unit /s^3	Target jerk speed, the change rate of acceleration/deceleration
S0+40	Coordinate	INT16U	-	Coordinate system. Not supported at the moment
S0+41	Buffermode	INT16U	-	Buffer mode 0: interrupt mode 1: buffer mode
S0+42	TransitionMode	INT16U	-	Transition method (currently only speed transition is supported) 0: speed transition
S0+43	posMode	INT16U	-	Position mode 0: Absolute 1: Relative (supported by V3.7.3 and above versions)
S0+44	Endvel	FP64	Command unit /s	End speed. Not supported at the moment
S0+48	TransitionVel	FP64	Command unit /s	Transition speed
Output parameter	**Parameter name**	**Data type**	**Unit**	**Note**
S1	ErrCode	INT16U	-	Command error code
State parameter	**Parameter name**	**Data type**	**Unit**	**Note**
S2	Done	BOOL	-	Instruction execution completed
S2+1	Busy	BOOL	-	The instruction is being executed
S2+2	Active	BOOL	-	Command under control
S2+3	Abort	BOOL	-	Instruction is interrupted
S2+4	Error	BOOL	-	Instruction execution error
Axis number	**Parameter name**	**Data type**	**Unit**	**Note**
S3	Axis	INT16U	-	Axis group number starts from 0

- The relationship between acceleration, deceleration and jerk speed is the same as A_ MOVEA instruction, see relevant parameters in chapter 5-1-2-7 (5) for details.
- The speed, acceleration/deceleration and jerk speed parameters set by the user are all parameters of the axis group. If the parameter set by the user is greater than the maximum parameter value of the axis group, it will be treated as the maximum parameter value of the axis group. If the parameter value set by the user is greater than the maximum parameter value of each single axis, the linear speed and other parameters of the axis group will be calculated based on the maximum parameter value of the single axis.
- The trajectory of G_LINE is a straight line in space, and its acceleration and deceleration parameters are the acceleration and deceleration of axis group, which is independent of the speed direction of each single axis.
- Support buffer instruction. When the buffer mode is set to 0, the instruction will interrupt the axis group instruction in the current motion and execute a new instruction immediately. When the buffer mode is set to 1, the instruction will enter the buffer area and wait for the execution of the currently moving instruction to end before executing a new instruction. If the buffer is full, the buffer cannot be cached and error code 5011 is returned.
- If the acceleration, deceleration and jerk speed entered by the user are 0, the default values of the axis group will be used:
  Acceleration speed = XYZ max acceleration (SFD48024+300*N) *XYZ default acceleration percentage (SFD48053+300*N)
  Deceleration speed = XYZ max deceleration (SFD48028+300*N) *XYZ default deceleration percentage (SFD48054+300*N)
  Jerk speed = XYZ max jerk speed (SFD48032+300*N) *XYZ default jerk speed percentage (SFD48055+300*N)
  N is axis group number.
- The transition speed parameter is only valid in the buffer mode when there are instructions in the buffer area

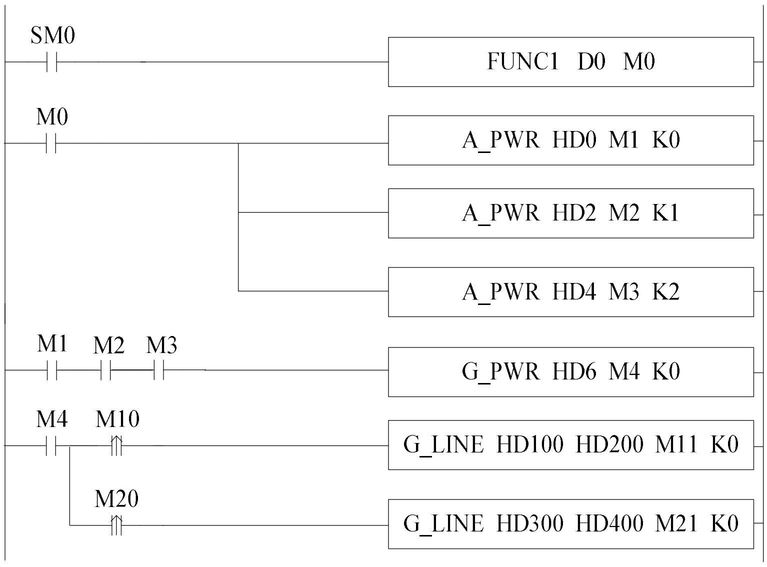
(the cached instructions cannot be G_PTP, and the currently executed instructions cannot be G_PTP). When the moving instructions reach the deceleration stage and the speed is less than the transition speed, the cached instructions will be triggered automatically, so there will be deviation from the specified track. The greater the transition speed, the smoother the inflection point between the two lines.

(6) Sequence diagram



Explanation:
Generally, after the command is triggered, the Busy and Active signals are set, and reset after the command is executed. At the same time, the Done signal is set. Done will reset only after the command is triggered again, otherwise it will not reset automatically.
When the instruction is triggered in the buffer mode and there are currently instructions being executed, the Active signal will be set immediately. The execution of the current instruction ends. When the instruction is executed, the Busy signal will be set. After the execution of the instruction ends, the Busy and Active signals will be reset and the Done signal will be set.
When a new instruction is triggered in interrupt mode during instruction execution, the Busy and Active signals are reset immediately and the Abort signal is set.
When there is an error in the command, the Error signal is set, other signals are reset, and the corresponding error code is output.

(7) Application
① ladder chart:



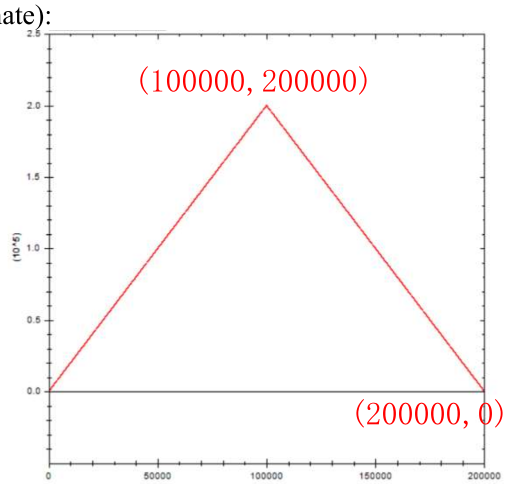
Among them, FUNC1 function block is used to set value for G_ LINE command, M0 turns on the enabling of each axis. When all three axes enabling are turned on (flag bits M1, M2 and M3 are on), turn on the axis group enabling. After the axis group is enabled (the flag M4 is on), execute the first G_LINE command when M10 is set to on, execute the second G_LINE command when M20 is set to on.

② set value for command G_LINE (right click the command to set the value, or set value through C program):

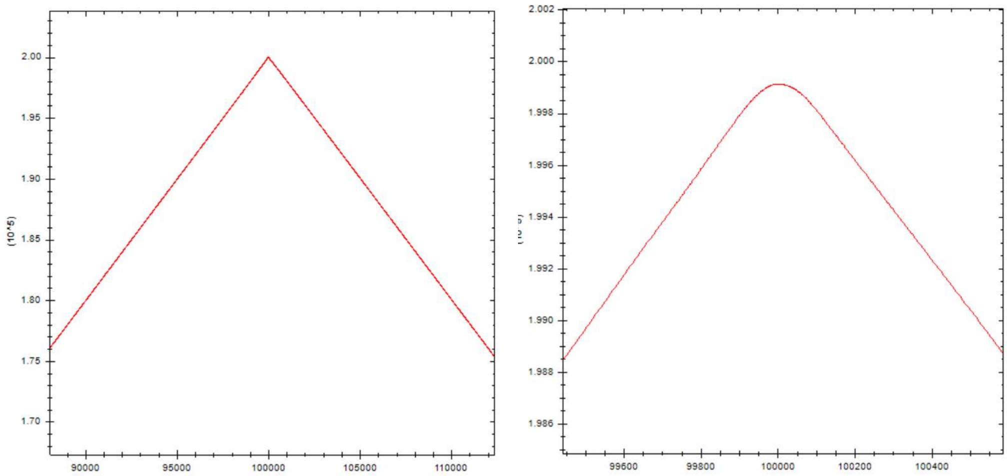
```
void FUNC1( WORD W , BIT B )
{
#define SysRegAddr_HD_D_HM_M
#define DFHD *(FP64*)&HD //DFHD represents a double precision floating-point number HD register

//the first G_LINE command value setting
DFHD[100] = 100000;//command position X
DFHD[104] = 200000;//command position Y
DFHD[124] = 20000;//command speed
DFHD[128] = 100000;//command acceleration
DFHD[132] = 100000;//command deceleration
DFHD[136] = 200000;//command jerk speed
HD[141] = 0;//command buffer mode
DFHD[148] = 0;//command transition speed

//second G-LINE command value setting
DFHD[300] = 200000;//command position X
DFHD[304] = 0;//command position Y
DFHD[324] = 20000;//command speed
DFHD[328] = 100000;//command acceleration
DFHD[332] = 100000;//command deceleration
DFHD[336] = 200000;//command jerk speed
HD[341] = 1;//command buffer mode
DFHD[348] = 0;//command transition speed
}
```

The instruction demonstrated in this example is the linear interpolation of XY axis (the axis group type only supports XYZ type, and the axis group of XY axis can be realized by setting the corresponding axis configuration of Z axis as virtual axis). The movement amount of X and Y axes per cycle is 10000. The axis group can run to (100000, 200000) at the speed of 20000 command unit/s by setting values to the parameters as shown in the figure and turning on M10 and M20 in turn. Then run to the position (20000,0) at the speed of 20000 command unit/s.

③ The operation track of the axis group is shown in the figure below (where the x-axis position is the abscissa and the y-axis position is the ordinate):



When the transition speed of the second command is set to different values, the effect is as follows:



transition speed = 0 transition speed = 5000

5-2-2-5. Circular interpolation【G_CIRCLE】

(1) Overview

The axis group performs spatial arc motion with the set parameters.

Circular interpolation [G_CIRCLE]			
Execution condition	Rising/falling edge of the coil	Suitable model	XDH, XLH, XG2
Firmware	V3.6.1b and above	Software	V3.7.4 and above

(2) Operand

Operand	Function	Type
S0	Sepcify the input parameter start address	64-bit, four words
S1	Specify the output state word start address	16-bit, single word
S2	Specify the output state bit start address	Bit
S3	Specify axis group number	16-bit, single word

(3) Suitable soft component

Operand	Word soft component											Bit soft component					
	System								Constant	Module		System					
	D*	FD	TD*	CD*	DX	DY	DM*	DS*	K/H	ID	QD	X	Y	M*	S*	T*	C*
S0	●	●	●	●													
S1	●	●	●	●													
S2														●			
S3	●								●								

*: D means D, HD; TD means TD and HTD; CD means CD, HCD, HSCD and HSD; DM means DM and DHM; DS means DS and DHS; M means M, HM, SM; S means S, HS; T means T, HT; C means C, HC.

(4) Function and action

```
        M0                  (S0)    (S1)   (S2) (S3)
|───────|↑|────────────[G_CIRCLE  HD0  HD100  M1  K0]─|
```

- S0 specifies the input parameter start address, occupies the register S0~S0+79
- S1 specifies the output state word start address
- S2 specifies output state bit start address, occupies the relay S2~S2+4
- S3 specifies the axis group number
- When M0 changes from off → on, the axis group specified by S3 performs arc interpolation at the speed, acceleration/deceleration and jerk speed set by the user
- After the command is executed, the single axis state of axis group (D20000+200*N) is 8, the axis group state (D46000+300*N) is 2.

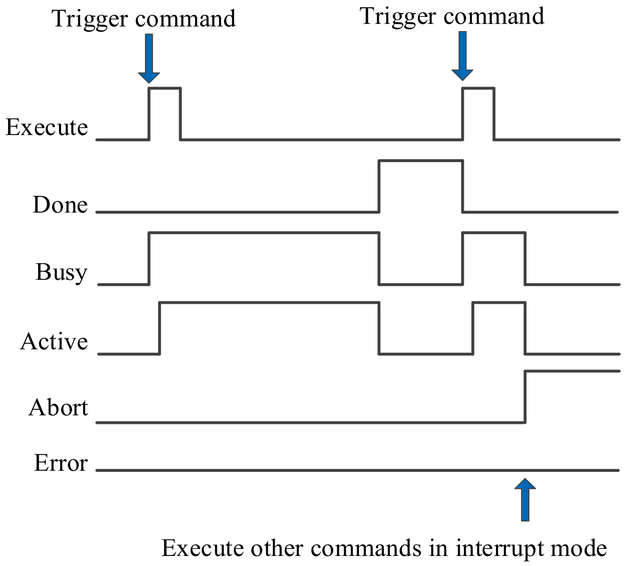
(5) Related parameters

Input parameter	Parameter name	Data type	Unit	Note
S0	Mode	INT16U	-	Arc mode (currently only three-point arc is supported) 0: three-point arc 1: Center arc 2: Radius arc
S0+1	PathSelected	INT16U	-	Path selection. Center/radius: 0-inferior arc, 1-superior arc
S0+4	AuxiliaryX	FP64	Command unit	Three points: X-axis auxiliary point position Center: X-axis center position Radius: X-axis normal vector position
S0+8	AuxiliaryY	FP64	Command unit	Three points: Y-axis auxiliary point position Center: Y-axis center position Radius: Y-axis normal vector position
S0+12	AuxiliaryZ	FP64	Command unit	Three points: Z-axis auxiliary point position Center: Z-axis center position Radius: Z-axis normal vector position
S0+16	AuxiliaryA	FP64	Command unit	A axis auxiliary point position, not supported at the moment
S0+20	AuxiliaryB	FP64	Command unit	B axis auxiliary point position, not supported at the moment
S0+24	AuxiliaryC	FP64	Command unit	C axis auxiliary point position, not supported at the moment
S0+28	PositionX	FP64	Command unit	X axis target position. X axis number is set through SFD48001+300*N
S0+32	PositionY	FP64	Command unit	Y axis target position. Y axis number is set through SFD48002+300*N
S0+36	PositionZ	FP64	Command unit	Z axis target position. Z axis number is set through SFD48003+300*N
S0+40	PositionA	FP64	Command unit	A axis target position. Not supported at the moment
S0+44	PositionB	FP64	Command unit	B axis target position. Not supported at the moment
S0+48	PositionC	FP64	Command unit	C axis target position. Not supported at the moment
S0+52	Velocity	FP64	Command unit /s	Target speed
S0+56	Acceleration	FP64	Command unit /s^2	Target acceleration speed
S0+60	Deceleration	FP64	Command unit /s^2	Target deceleration speed
S0+64	Jerk	FP64	Command unit /s^2	Target jerk speed, the change rate of acceleration and deceleration
S0+68	Coordinate	INT16U	-	Coordinate system. Not supported at the moment
S0+69	Buffermode	INT16U	-	Buffer mode 0: interrupt mode 1: buffer mode
S0+70	TransitionMode	INT16U	-	Transition method (only support speed transition) 0: speed transition
S0+71	posMode	INT16U	-	Position mode 0: Absolute 1: Relative (supported by V3.7.3 and above versions)

Input parameter	Parameter name	Data type	Unit	Note
S0+72	Endvel	FP64	Command unit /s	End speed. Not supported at the moment
S0+76	TransitionVel	FP64	Command speed/s	Transition speed
Output parameter	Parameter name	Data type	Unit	Note
S1	ErrCode	INT16U	-	Command error code
State parameter	Parameter name	Data type	Unit	Note
S2	Done	BOOL	-	Instruction execution completed
S2+1	Busy	BOOL	-	The instruction is being executed
S2+2	Active	BOOL	-	Command under control
S2+3	Abort	BOOL	-	Instruction is interrupted
S2+4	Error	BOOL	-	Instruction execution error
Axis number	Parameter name	Data type	Unit	Note
S3	Axis	INT16U	-	Axis group number starts from 0

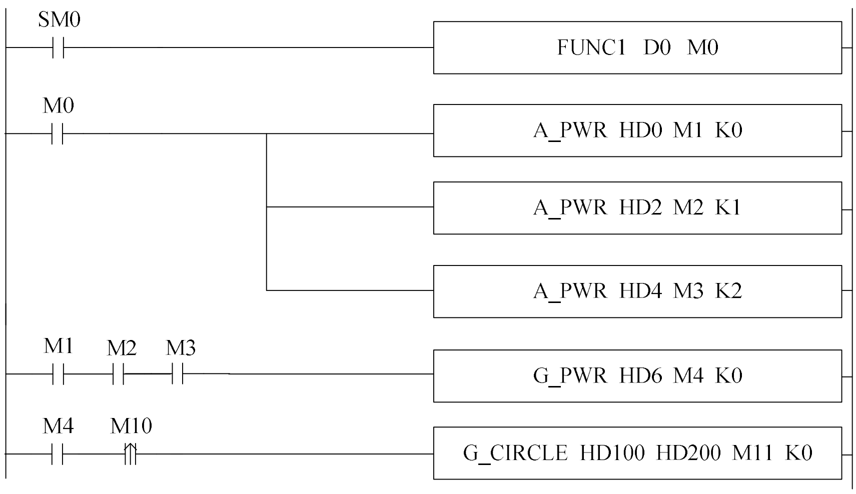
- The relationship between acceleration, deceleration and jerk speed is the same as A_ MOVEA instruction, see relevant parameters in chapter 5-1-2-7 (5) for details.
- The speed, acceleration/deceleration and jerk speed parameters set by the user are all parameters of the axis group. If the parameter set by the user is greater than the maximum parameter value of the axis group, it will be treated as the maximum parameter value of the axis group. If the parameter value set by the user is greater than the maximum parameter value of each single axis, the linear speed and other parameters of the axis group will be calculated based on the maximum parameter value of the single axis.
- The trajectory of G_CIECLE is a arc in space, and its acceleration and deceleration parameters are the acceleration and deceleration of axis group, which is independent of the speed direction of each single axis.
- The three points of the three-point arc are the current point, auxiliary point and end point respectively. The arc will pass through the auxiliary point and finally reach the end position. The three points cannot be on the same straight line and do not support the whole circle (that is, the current point and end point are the same point).
- Support buffer instruction. When the buffer mode is set to 0, the instruction will interrupt the axis group instruction in the current motion and execute a new instruction immediately. When the buffer mode is set to 1, the instruction will enter the buffer area and wait for the execution of the currently moving instruction to end before executing a new instruction. If the buffer is full, the buffer cannot be cached and error code 5011 is returned.
- If the acceleration, deceleration and jerk speed entered by the user are 0, the default values of the axis group will be used:
  Acceleration speed = XYZ max acceleration (SFD48024+300*N) *XYZ default acceleration percentage (SFD48053+300*N)
  Deceleration speed = XYZ max deceleration (SFD48028+300*N) *XYZ default deceleration percentage (SFD48054+300*N)
  Jerk speed = XYZ max jerk speed (SFD48032+300*N) *XYZ default jerk speed percentage (SFD48055+300*N).
  N is axis group number.
- The transition speed parameter is only valid in the buffer mode when there are instructions in the buffer area. When the moving instructions reach the deceleration stage and the speed is less than the transition speed, the cached instructions will be triggered automatically, so there will be deviation from the specified track. The greater the transition speed, the smoother the inflection point between the two curves.

(6) Sequence diagram



Explanation:
Generally, after the command is triggered, the Busy and Active signals are set, and reset after the command is executed. At the same time, the Done signal is set. Done will reset only after the command is triggered again, otherwise it will not reset automatically.
When the instruction is triggered in the buffer mode and there are currently instructions being executed, the Active signal will be set immediately. The execution of the current instruction ends. When the instruction is executed, the Busy signal will be set. After the execution of the instruction ends, the Busy and Active signals will be reset and the Done signal will be set.
When a new instruction is triggered in interrupt mode during instruction execution, the Busy and Active signals are reset immediately and the Abort signal is set.
When there is an error in the command, the Error signal is set, other signals are reset, and the corresponding error code is output.

(7) Application
① ladder diagram

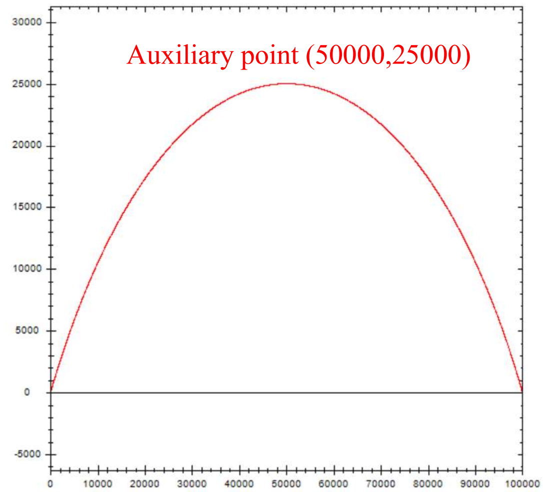


Among them, FUNC1 function block is used to set value for G_ CIRCLE command, M0 turns on the enabling of each axis. When all three axes enabling are turned on (flag bits M1, M2 and M3 are on), turn on the axis group enabling. After the axis group is enabled (the flag M4 is on), when M10 is set to on, execute the G_CIRCLE command.
② set value for command G_CIRCLE (right click the command to set the value, or set value through C program):

```
void FUNC1( WORD W , BIT B )
{
#define SysRegAddr_HD_D_HM_M
#define DFHD *(FP64*)&HD //DFHD represents a double precision floating-point number HD register

//G_CIRCLE command value setting
DFHD[104] = 50000;//auxiliary position X
DFHD[108] = 25000;//auxiliary position Y
DFHD[128] = 100000;//target position X
DFHD[132] = 0;//target position Y
DFHD[152] = 20000;//command speed
DFHD[156] = 100000;//command acceleration
DFHD[160] = 100000;//command deceleration
DFHD[164] = 200000;//command jerk speed
```

The instruction demonstrated in this example is the circular arc interpolation of XY axis (the axis group type only supports XYZ type, and the axis group of XY axis can be realized by setting the corresponding axis configuration of Z axis as virtual axis). The movement of X and Y axes per cycle is 10000. The axis group can run at the speed of 20000 command units/s, passing through the auxiliary point (50000, 25000) to the end point (100000,0) by assigning values to the parameters as shown in the figure and set ON M10.

③ The operation track of the axis group is shown in the figure below (where the X-axis position is the abscissa and the Y-axis position is the ordinate):



5-2-2-6. Spiral motion【G_HELICAL】

(1) Overview

Performs spiral motion control on the specified axis group.

Spiral motion [G_HELICAL]			
Execution condition	Rising/falling edge of the coil	Suitable model	XDH, XLH, XG2
Firmware	V3.7.1 and above	Software	V3.7.4 and above

(2) Operand

Operand	Function	Type
S0	Sepcify the input parameter start address	64-bit, four words
S1	Specify the output state word start address	16-bit, single word
S2	Specify the output state bit start address	Bit
S3	Specify axis group number	16-bit, single word

(3) Suitable soft component

Operand	Word soft component											Bit soft component					
	System								Constant	Module		System					
	D*	FD	TD*	CD*	DX	DY	DM*	DS*	K/H	ID	QD	X	Y	M*	S*	T*	C*
S0	●	●	●	●													
S1	●	●	●	●													
S2														●			
S3	●								●								

*: D means D, HD; TD means TD and HTD; CD means CD, HCD, HSCD and HSD; DM means DM and DHM; DS means DS and DHS; M means M, HM, SM; S means S, HS; T means T, HT; C means C, HC.

(4) Function and action

- S0 specifies the input parameter start address
- S1 specifies the output state word start address
- S2 specifies output state bit start address
- S3 specifies the axis group number

  When M0 switches from OFF to ON, spiral motion control is applied to the designated axis group of S3. The mode is determined by the [Arc Mode], the trajectory direction is jointly determined by the [Path Selection] and [Plane Selection], the spiral height is jointly determined by the [Pitch] and [Cycles], the speed is [Speed], the acceleration and deceleration are [Acceleration] and [Deceleration], and the acceleration is [Acceleration].

(5) Related parameters

Input parameter	Parameter name	Data type	Unit	Note
S0	Mode	INT16U	-	Arc mode 0: three points 1: circle center 2: radius
S0+1	Pathselected	INT16U	-	Path selection 0: Clockwise, radius mode inferior arc 1: Counterclockwise, radius mode, superior arc
S0+2	Planeselected	INT16U	-	Plane selection 0: XOY plane 1: ZOX plane 2: YOZ plane
S0+3	Velselected	INT16U	-	Speed mode 0: linear speed 1: arc speed 2: axis speed

S0+4	AuxX	FP64	Command unit	Auxiliary point X1
S0+8	AuxY	FP64	Command unit	Auxiliary point Y1
S0+12	AuxZ	FP64	Command unit	Auxiliary point Z1
S0+16	PosX	FP64	Command unit	Target point X2
S0+20	PosY	FP64	Command unit	Target point Y2
S0+24	PosZ	FP64	Command unit	Target point Z2
S0+28	PosA	FP64	Command unit	Target point A
S0+32	PosB	FP64	Command unit	Target point B
S0+36	PosC	FP64	Command unit	Target point C
S0+40	Pitch	FP64	Command unit	Pitch P
S0+44	Count	FP64	-	Turns N
S0+48	Vel	FP64	Command unit /s	Speed
S0+52	Acc	FP64	Command unit /s^2	Acceleration
S0+56	Dec	FP64	Command unit /s^2	Deceleration
S0+60	Jerk	FP64	Command unit /s^3	Jerk speed
S0+64	CoordinatSystem	INT16U	-	Coordinate system. Not supported at the moment
S0+65	Buffer	INT16U	-	Buffer mode 0: interrupt 1: buffer
S0+66	TransitionMode	INT16U	-	Transition method. Not supported at the moment
S0+68	EndVel	FP64	Command unit /s	End speed. Not supported at the moment
S0+72	TransitionVel	FP64	Command unit /s	Transition speed
Output parameter	Parameter name	Data type	Unit	Note
S1	ErrCode	INT16U	-	Command error code
State parameter	Parameter name	Data type	Unit	Note
S2	Done	BOOL	-	Instruction execution completed
S2+1	Busy	BOOL	-	The instruction is being executed
S2+2	Active	BOOL	-	Command under control
S2+3	Abort	BOOL	-	Instruction is interrupted
S2+4	Error	BOOL	-	Instruction execution error
Axis number	Parameter name	Data type	Unit	Note
S3	Axis	INT16U	-	Axis number starts from 0

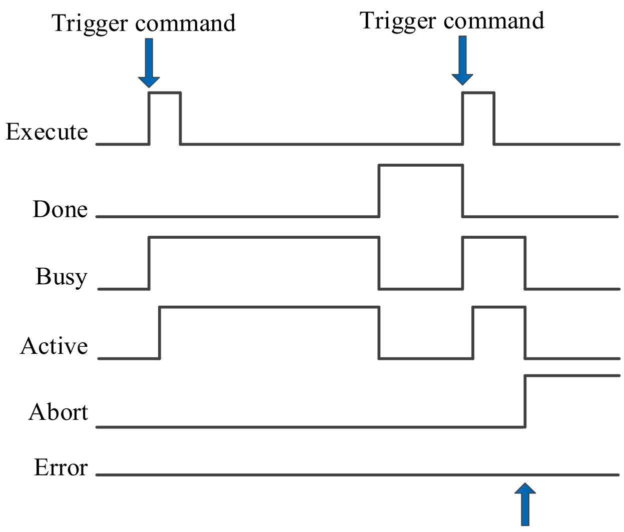
Note: the relationship between deceleration and jerk speed is same to command A_MOVEA, refer to chapter 5-1-2-7 item (5) for details.

- Parameter [plane selection] determines the plane of the arc, and the other direction is radial.
- The parameter [pitch] is the lead of one revolution.
- When the parameter [number of turns] is 0, the arc moves synchronously with the axial direction, and the end

point is the target point. When it is greater than 0, the system calculates the end point according to the number of turns, pitch and starting point.

- Arc mode 0 3-points:
  The spiral trajectory is determined by the current position (X, Y, Z), auxiliary point (X1, Y1, Z1) and target point (X2, Y2, Z2). In this mode, the [path selection] parameter is not effective, and the radial position in the auxiliary point is invalid.
  Taking the XOY plane as an example, the unique arc is determined on the plane according to the current position (X, Y), auxiliary point (X1, Y1) and target point (X2, Y2) (at this time, the z-axis coordinate is invalid), and the arc track of XOY plane is determined. After the plane trajectory is defined, the radial motion direction is determined according to the radial coordinates, that is, the current coordinate Z of the Z axis and the target point coordinate Z2 (the current position is in the direction of the target position). Finally, the start point and end point distance of a single rotation in the Z-axis direction is determined by the pitch P, and the movement stops after repeating the number of turns N times. The pitch and the number of turns jointly determine the Z-axis coordinate of the stop position. Please refer to examples for detailed effects.
- Arc mode 1 circle center:
  The spiral track is determined by plane selection, path selection and axial direction. In this mode, the radial position of auxiliary point is invalid.
  Taking the XOY plane as an example, two arcs can be determined on the plane according to the current position coordinates (X, Y), the center coordinates of auxiliary points (X1, Y1) and the end coordinates (X2, Y2) (at this time, the Z-axis coordinates are invalid), and then the arc trajectory of the final XOY plane is determined by the path selection parameters. After the plane trajectory is defined, the radial motion direction is determined by the radial coordinates, that is, the current coordinate Z of the Z axis and the target point coordinate Z2 (the current position is in the direction of the target position). Finally, the start point and end point distance of a single rotation in the Z-axis direction is determined by the pitch P, and the movement stops after repeating the number of turns N times. The pitch and the number of turns jointly determine the Z-axis coordinate of the stop position. Please refer to examples for detailed effects.
  The judgment rules of clockwise and counterclockwise are: make a fist with your right hand.
  The thumb is in the radial direction, the four fingers are counter-clockwise and the reverse direction is clockwise.
- Arc mode 2 radius:
  The spiral track is determined by user input parameters, plane selection and path selection. In this mode, the auxiliary point is only valid for the radial vector value.
  Taking the XOY plane as an example, the Z axis coordinate absolute value (0,0, Z) is set as radius | Z | by the auxiliary point. On the plane, two semicircles or four arcs (two superior arcs and two inferior arcs) can be determined by the current position coordinates (X, Y), radius and end point coordinates (X2, Y2) (at this time, the Z axis coordinates are invalid), and then the superior and inferior arcs can be selected by the path selection parameters. The positive and negative values of the Z-axis of the auxiliary point determine the trajectory rotation direction (positive counter-clockwise/negative closewise), which determines the final XOY plane arc trajectory. After the plane trajectory is defined, the radial motion direction is determined by the radial coordinates, that is, the current coordinate Z of the Z axis and the target point coordinate Z2 (the current position is in the direction of the target position). Finally, the start point and end point distance of a single rotation in the Z-axis direction is determined by the pitch P, and the movement stops after repeating the number of turns N times. The pitch and the number of turns jointly determine the Z-axis coordinate of the stop position. Please refer to examples for detailed effects.
  The judgment rules of clockwise and counterclockwise are: make a fist with your right hand.
  The thumb is in the radial direction, the four fingers are counter-clockwise and the reverse direction is clockwise.

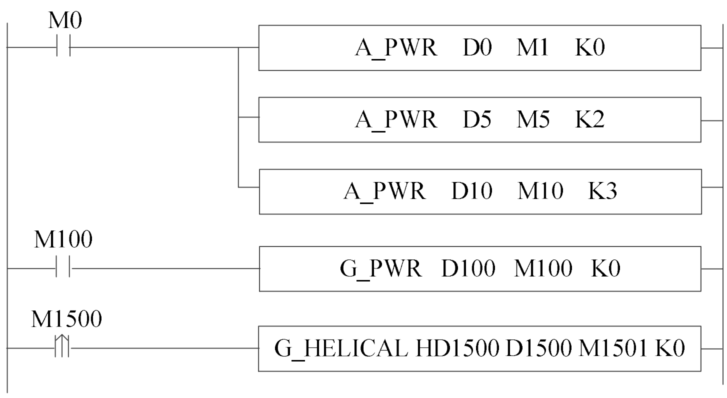
(6) Sequence diagram



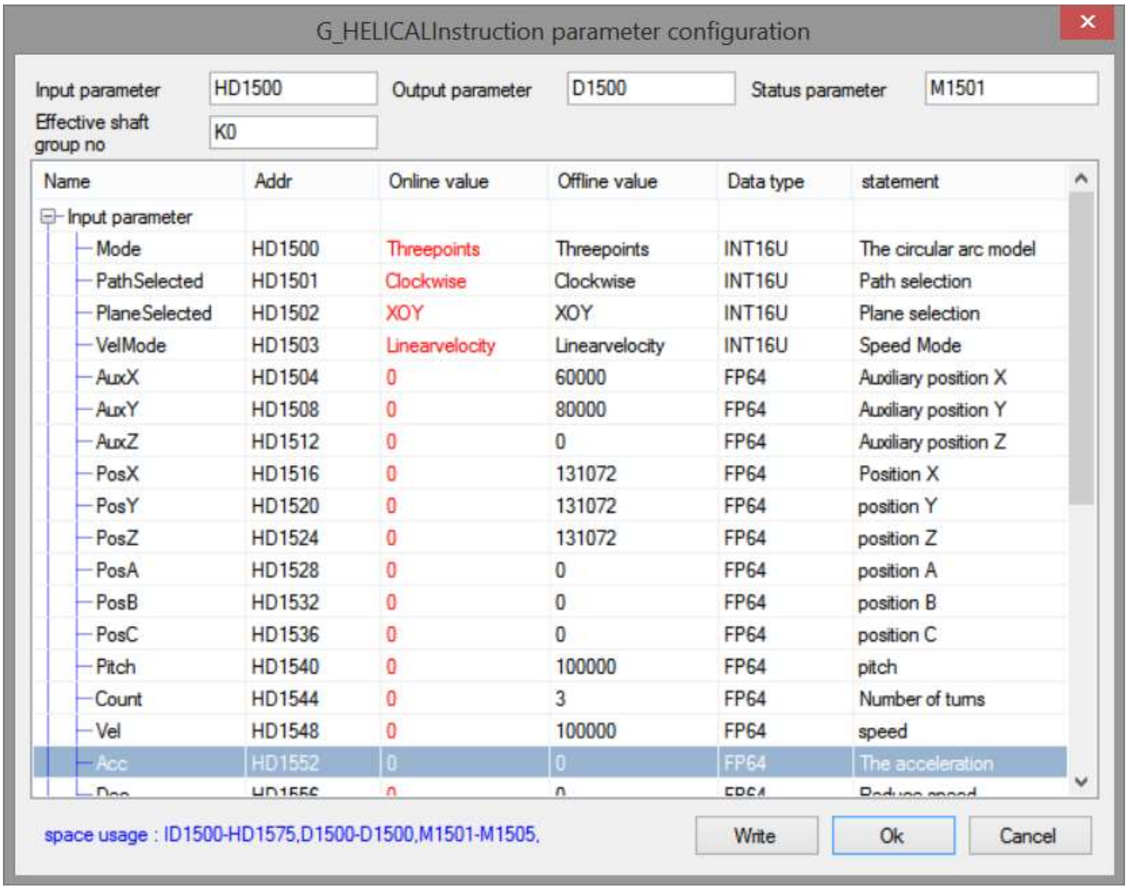
Explanation:
Generally, after the command is triggered, the Busy and Active signals are set, and reset after the command is executed. At the same time, the Done signal is set. Done will reset only after the command is triggered again, otherwise it will not reset automatically.
When the instruction is triggered in the buffer mode and there are currently instructions being executed, the Active signal will be set immediately. The execution of the current instruction ends. When the instruction is executed, the Busy signal will be set. After the execution of the instruction ends, the Busy and Active signals will be reset and the Done signal will be set.
When a new instruction is triggered in interrupt mode during instruction execution, the Busy and Active signals are reset immediately and the Abort signal is set.
When there is an error in the command, the Error signal is set, other signals are reset, and the corresponding error code is output.

(7) Application

- Arc mode 0 3-points:
  Start point (0,0,0), target point (131072,131072,131072), auxiliary point (60000, 80000, Z1), pitch 100000, turns number 3, perform spiral at the linear speed 100000. The ladder diagram is shown as below:



The command parameters:



G_HELICALInstruction parameter configuration

Input parameter: HD1500　Output parameter: D1500　Status parameter: M1501

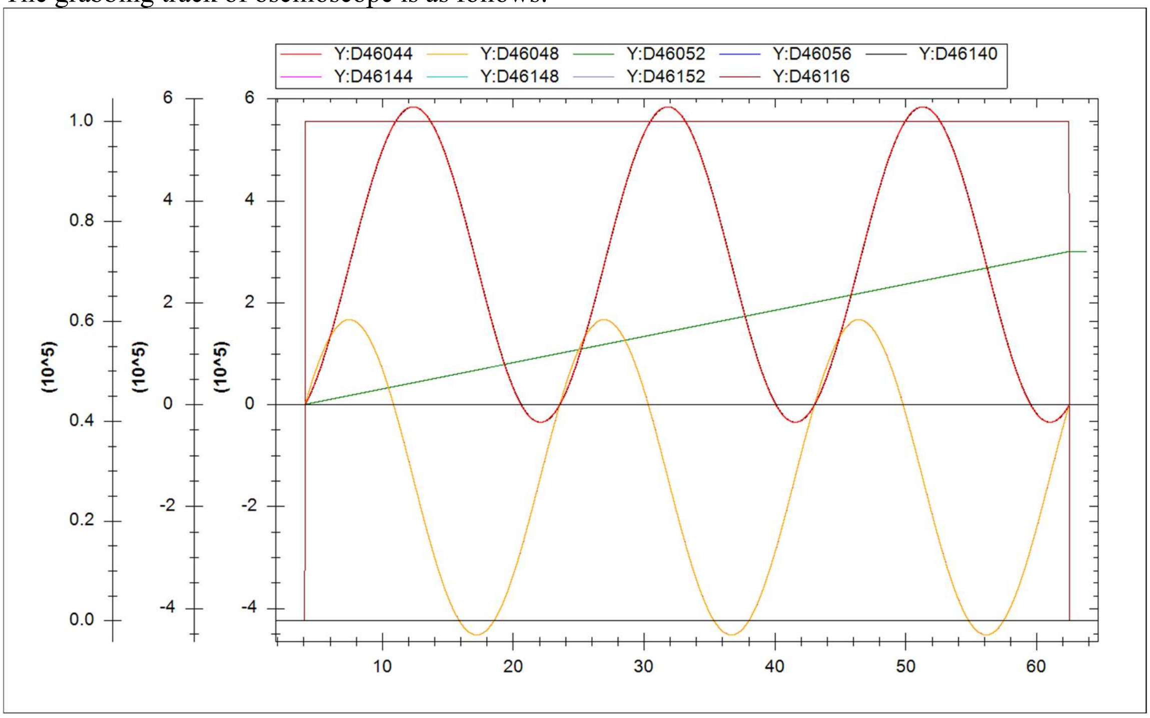
Effective shaft group no: K0

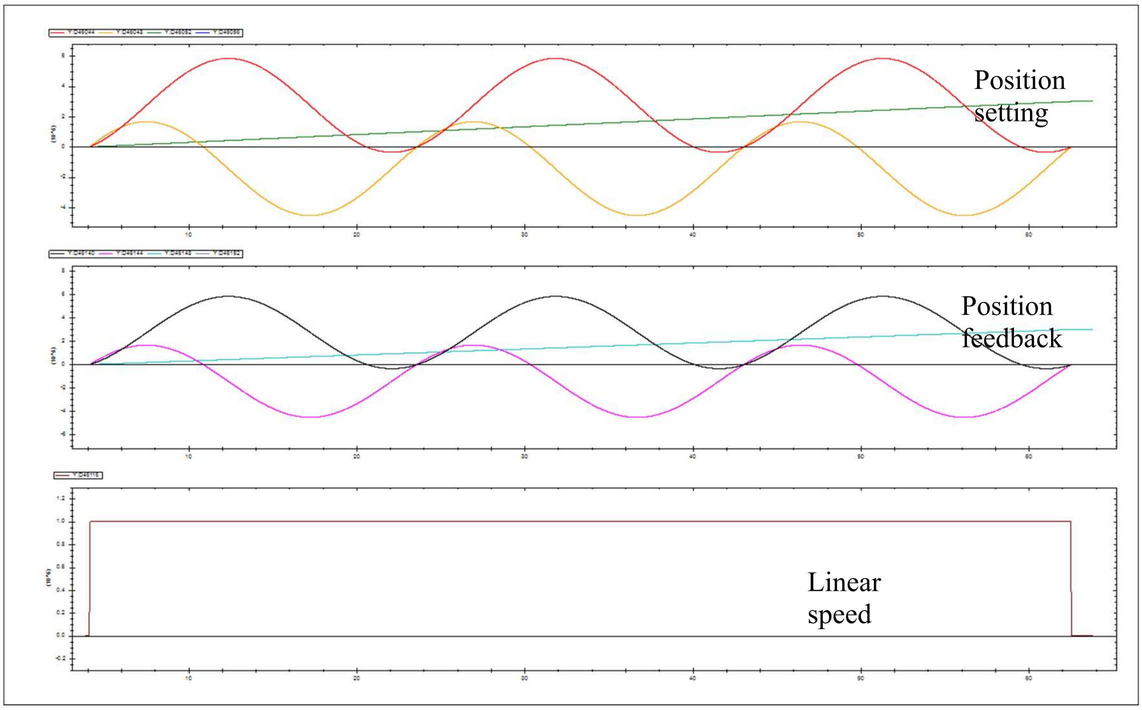
Name	Addr	Online value	Offline value	Data type	statement
Input parameter					
Mode	HD1500	Threepoints	Threepoints	INT16U	The circular arc model
PathSelected	HD1501	Clockwise	Clockwise	INT16U	Path selection
PlaneSelected	HD1502	XOY	XOY	INT16U	Plane selection
VelMode	HD1503	Linearvelocity	Linearvelocity	INT16U	Speed Mode
AuxX	HD1504	0	60000	FP64	Auxiliary position X
AuxY	HD1508	0	80000	FP64	Auxiliary position Y
AuxZ	HD1512	0	0	FP64	Auxiliary position Z
PosX	HD1516	0	131072	FP64	Position X
PosY	HD1520	0	131072	FP64	position Y
PosZ	HD1524	0	131072	FP64	position Z
PosA	HD1528	0	0	FP64	position A
PosB	HD1532	0	0	FP64	position B
PosC	HD1536	0	0	FP64	position C
Pitch	HD1540	0	100000	FP64	pitch
Count	HD1544	0	3	FP64	Number of turns
Vel	HD1548	0	100000	FP64	speed
Acc	HD1552	0	0	FP64	The acceleration

space usage : ID1500-HD1575,D1500-D1500,M1501-M1505,

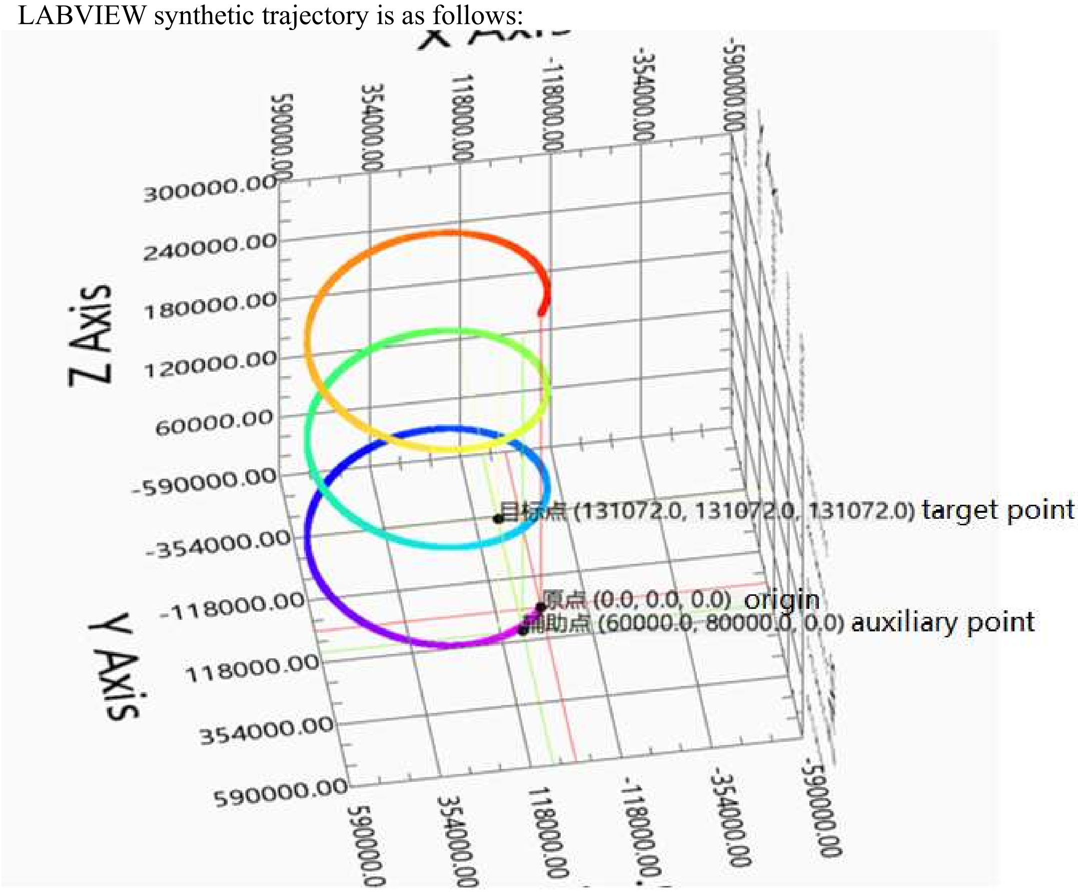
Write　Ok　Cancel

The grabbing track of oscilloscope is as follows:

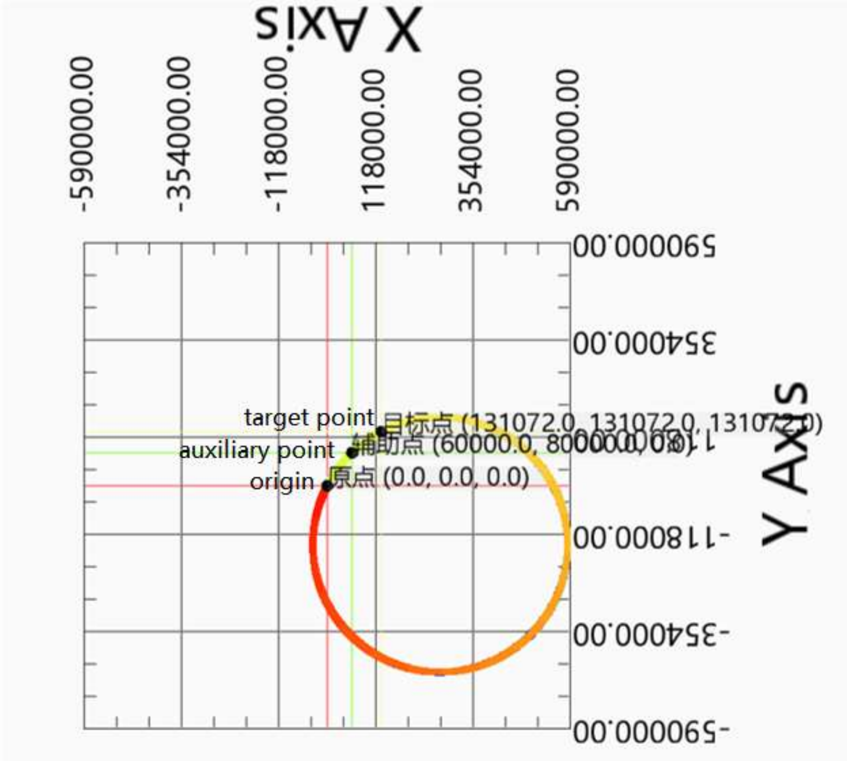


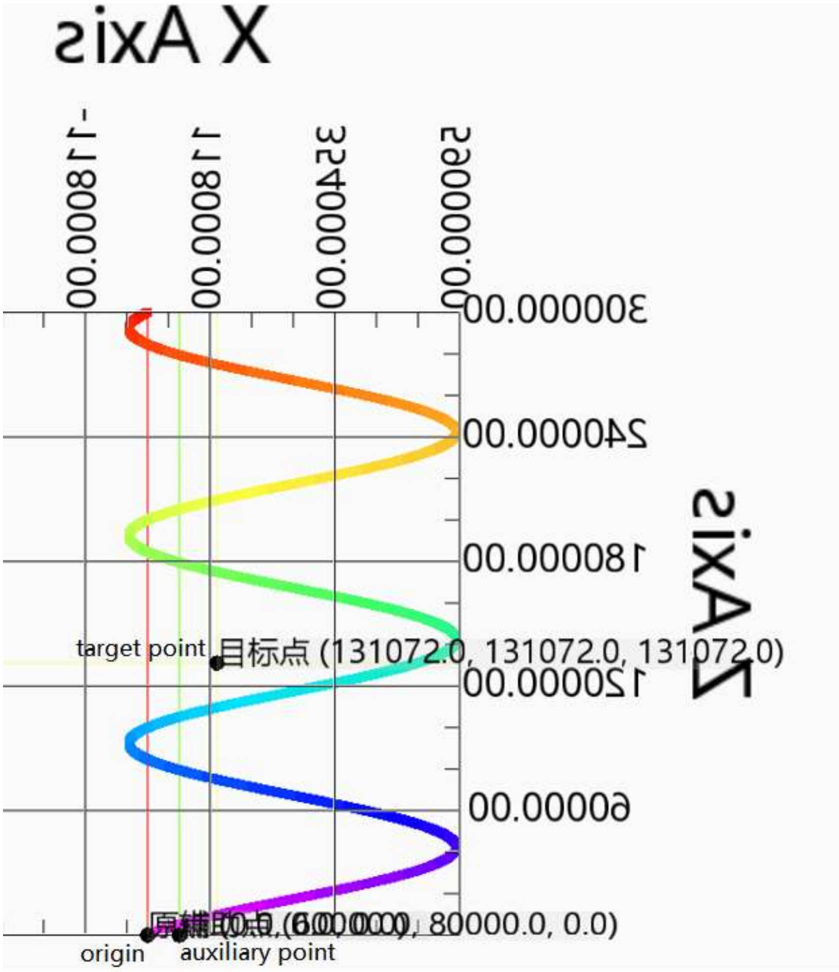


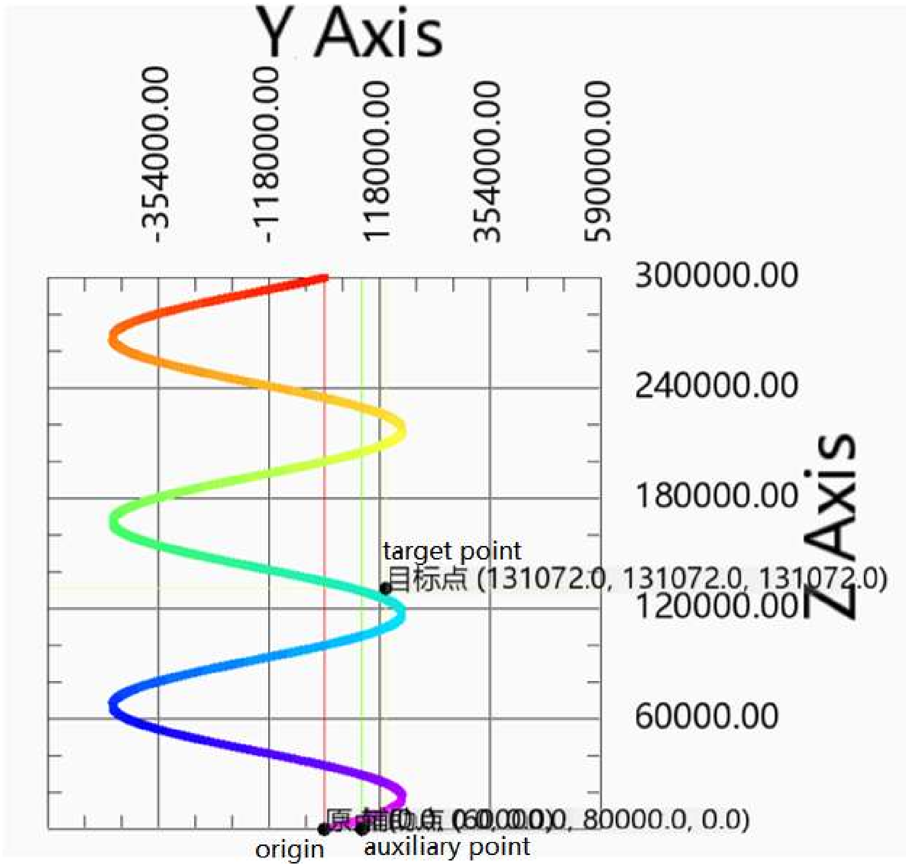
LABVIEW synthetic trajectory is as follows:



The exploded views of each plan are as follows:



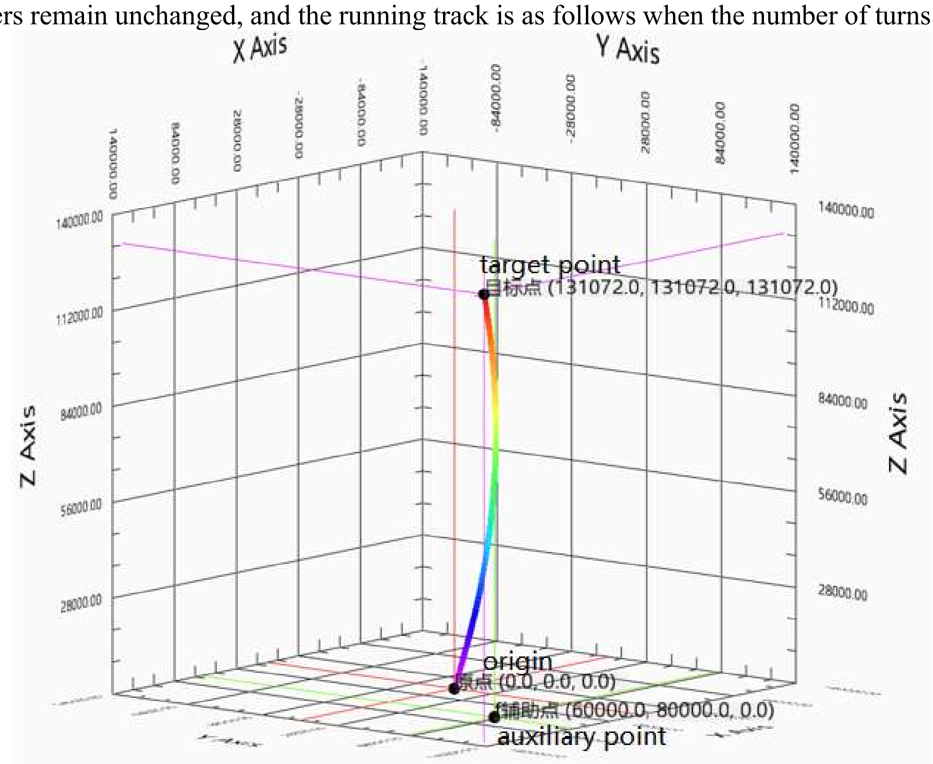




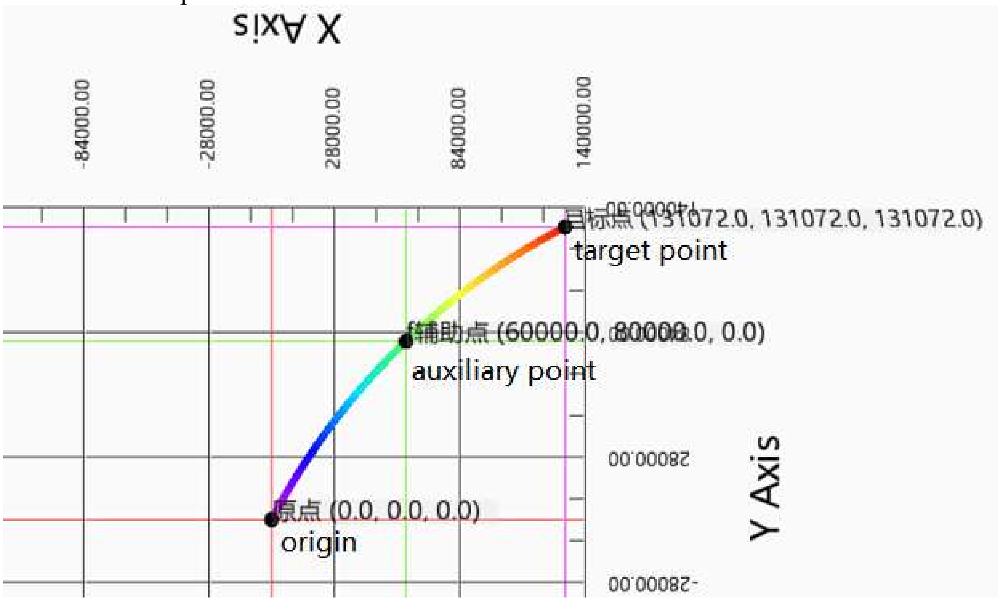
Action decomposition: the two axes of the XOY plane perform the plane circle action. The circle track is determined by the coordinates of the starting point, auxiliary point and target point on the selected plane. The circle motion is repeated for 3 times. The Z-axis moves in a straight line at a uniform speed, and the moving distance is the number of turns × Pitch. The three axes start and stop at the same time, and the three-axis speed is decomposed into XOY plane linear speed and Z-axis linear speed.

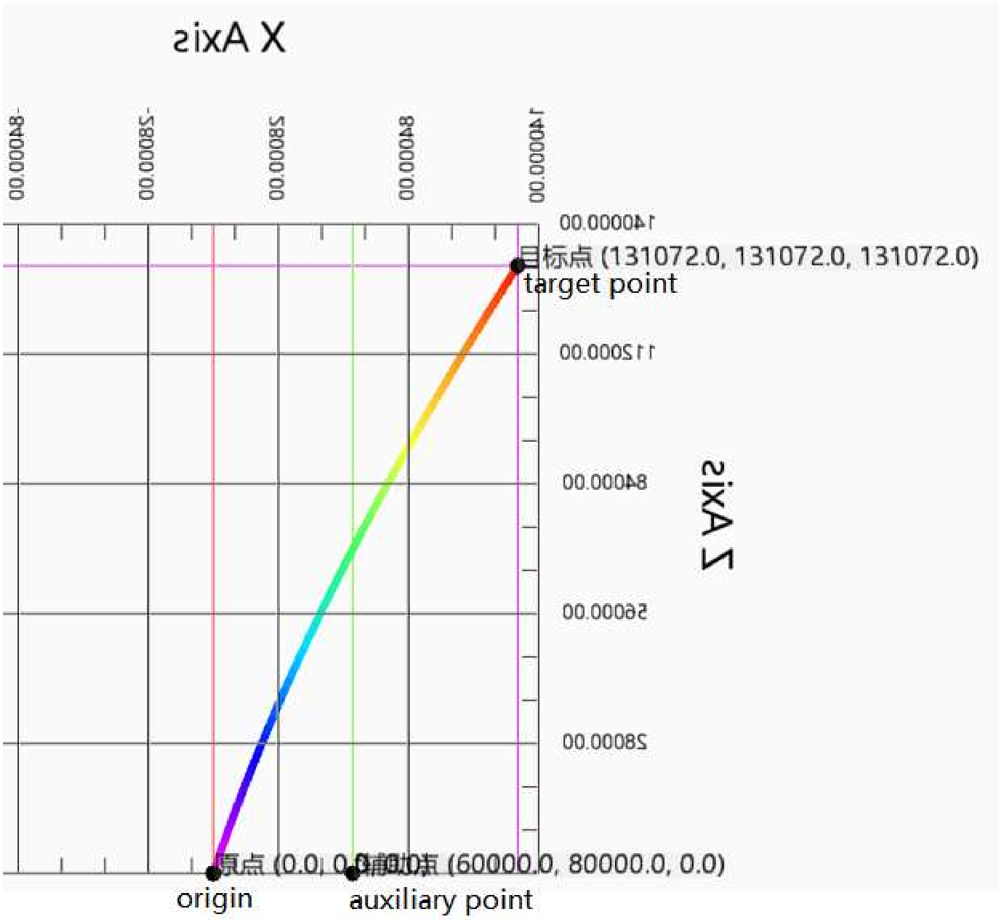
Note: if the number of turns is greater than 0, the actual motion trajectory of the curve does not necessarily pass through the auxiliary point and target point.

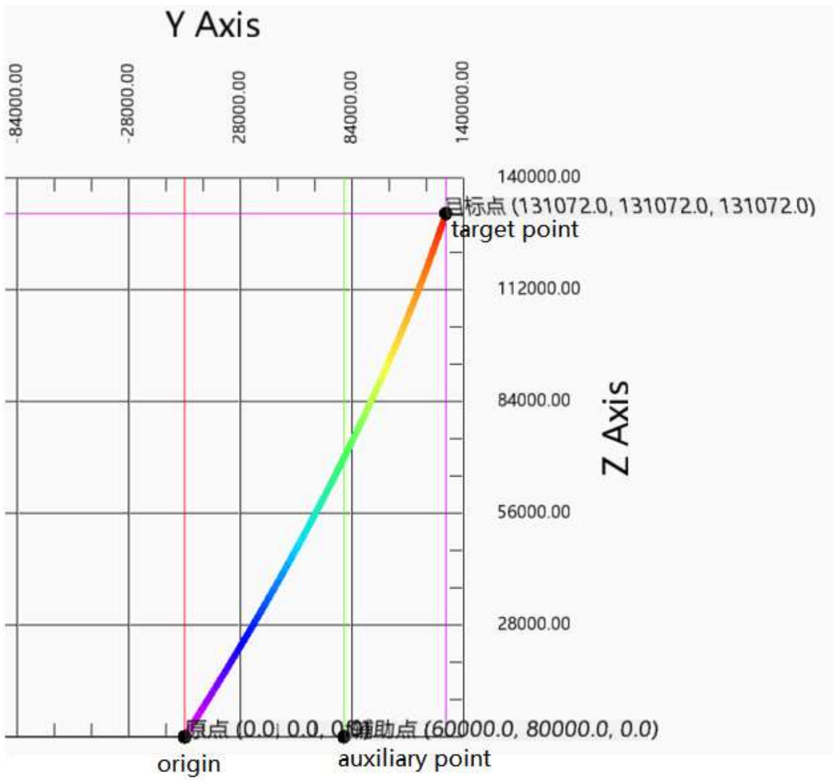
Other parameters remain unchanged, and the running track is as follows when the number of turns is 0:



The exploded views of each plan are as follows:



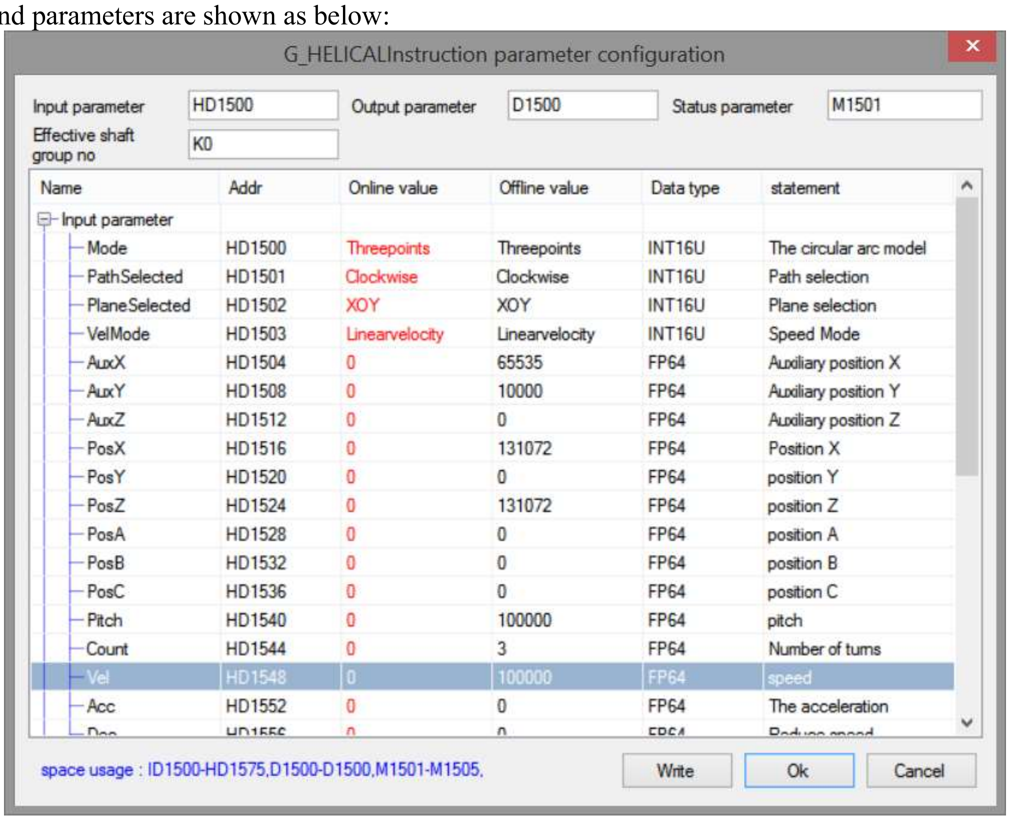




Action decomposition: the two axes of XOY plane perform plane arc action, and the arc track is determined by the coordinates of the starting point, auxiliary point and target point on the selected plane. The Z-axis moves in a straight line at a uniform speed, and the moving distance is the difference between the starting point of the Z-axis and the target point. The three axes start and stop at the same time, and the three-axis speed is decomposed into XOY plane linear speed and Z-axis linear speed.

- Arc mode 1 circle center:
  Start point (0,0,0), target point (131072,0,131072), circle center (65536,10000, Z1), pitch 100000, turn numbers 3, execute the spiral at 100000 linear speed, and the spiral line rotates clockwise.

The command parameters are shown as below:



G_HELICALInstruction parameter configuration

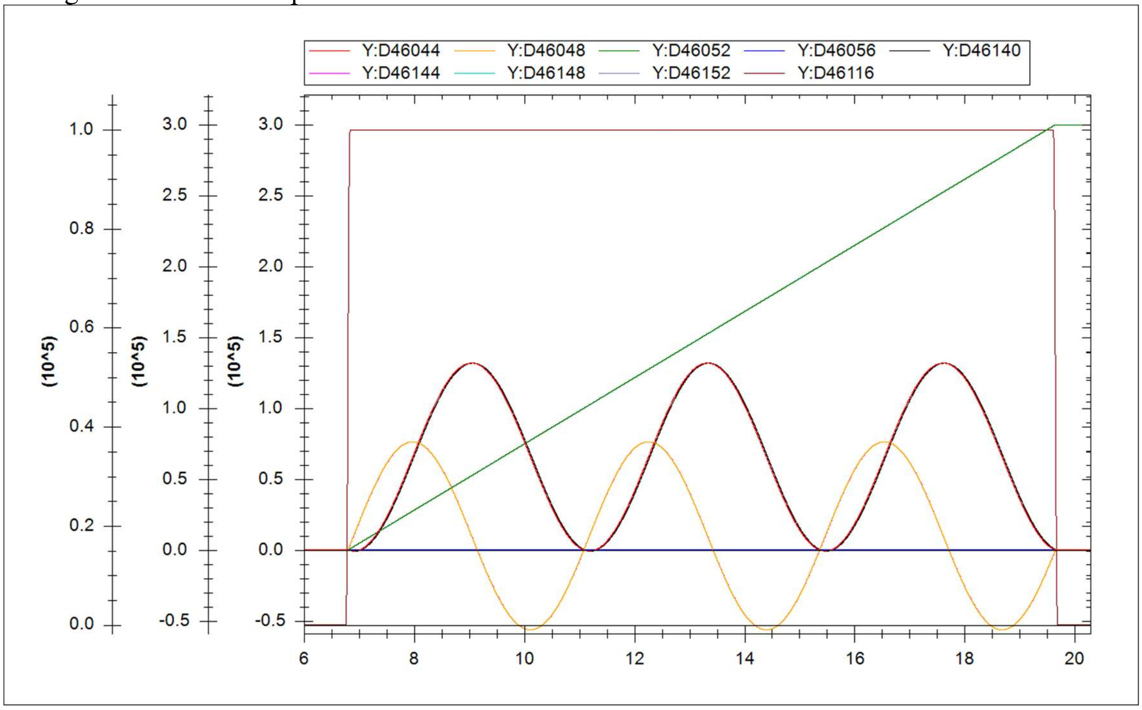
Input parameter: HD1500 Output parameter: D1500 Status parameter: M1501
Effective shaft group no: K0

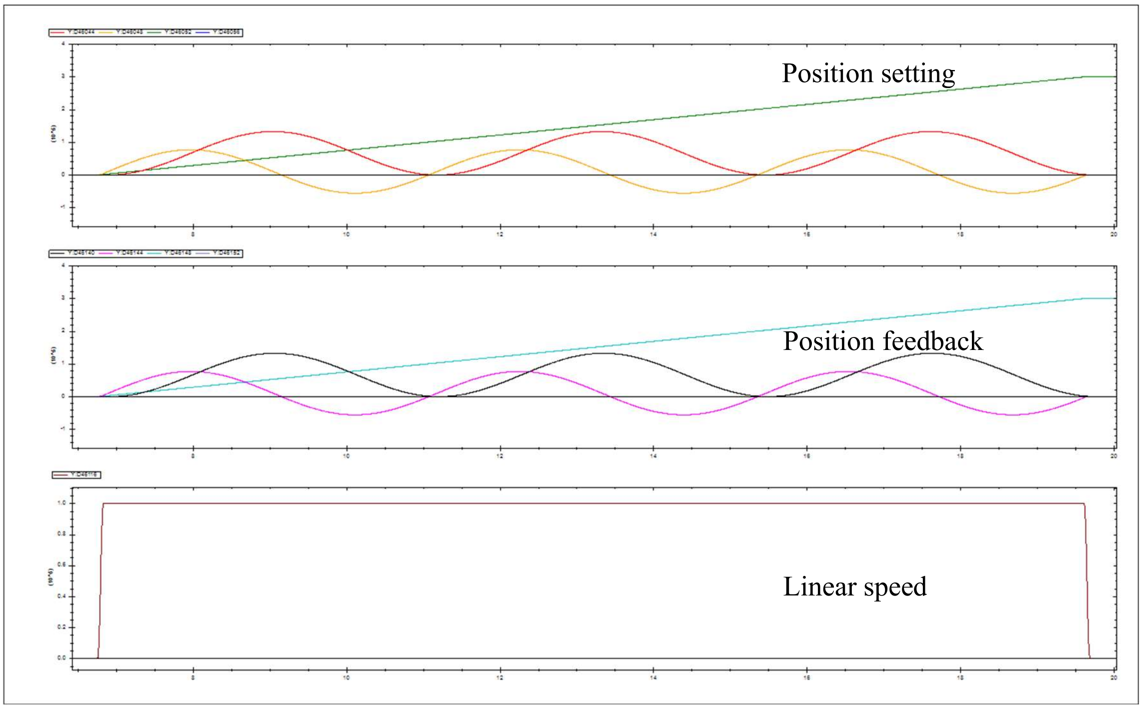
Name	Addr	Online value	Offline value	Data type	statement
Input parameter					
Mode	HD1500	Threepoints	Threepoints	INT16U	The circular arc model
PathSelected	HD1501	Clockwise	Clockwise	INT16U	Path selection
PlaneSelected	HD1502	XOY	XOY	INT16U	Plane selection
VelMode	HD1503	Linearvelocity	Linearvelocity	INT16U	Speed Mode
AuxX	HD1504	0	65535	FP64	Auxiliary position X
AuxY	HD1508	0	10000	FP64	Auxiliary position Y
AuxZ	HD1512	0	0	FP64	Auxiliary position Z
PosX	HD1516	0	131072	FP64	Position X
PosY	HD1520	0	0	FP64	position Y
PosZ	HD1524	0	131072	FP64	position Z
PosA	HD1528	0	0	FP64	position A
PosB	HD1532	0	0	FP64	position B
PosC	HD1536	0	0	FP64	position C
Pitch	HD1540	0	100000	FP64	pitch
Count	HD1544	0	3	FP64	Number of turns
Vel	HD1548	0	100000	FP64	speed
Acc	HD1552	0	0	FP64	The acceleration
Dec	HD1556	0	0	FP64	Reduce speed

space usage : ID1500-HD1575,D1500-D1500,M1501-M1505,

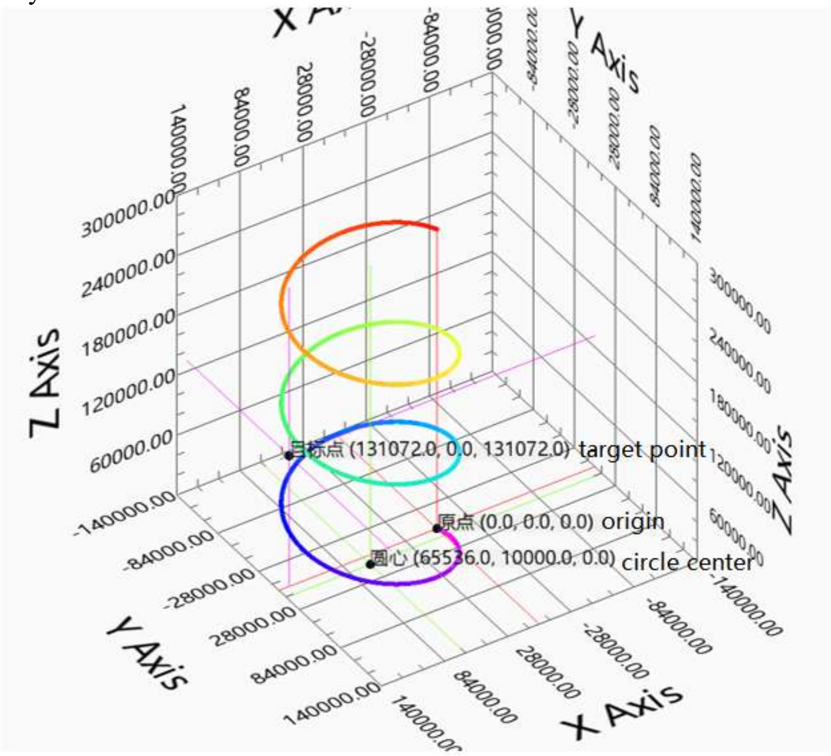
Write Ok Cancel

The grabbing track of oscilloscope is as follows:

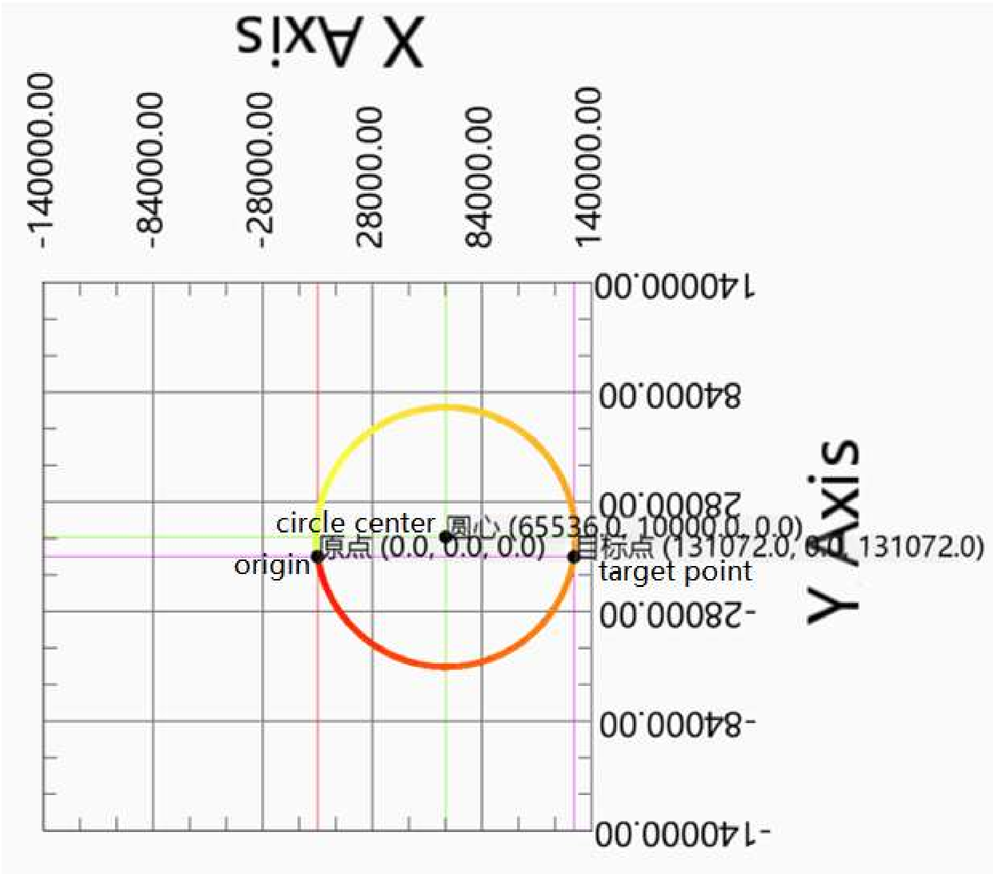


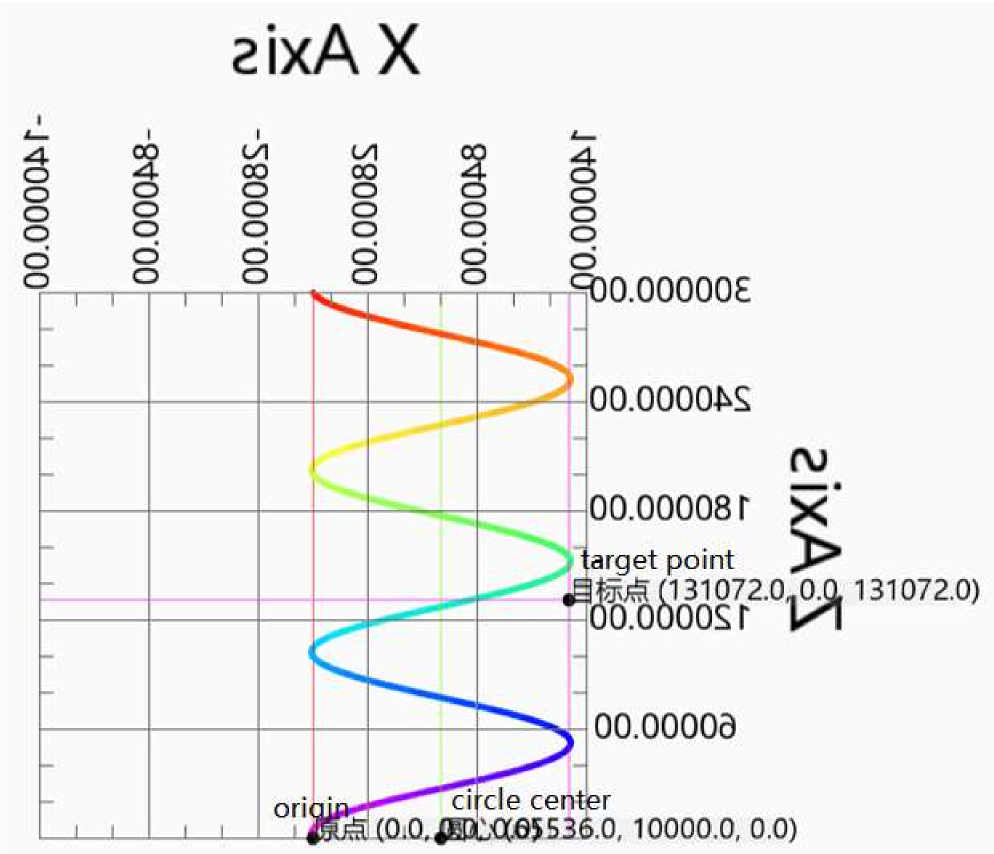


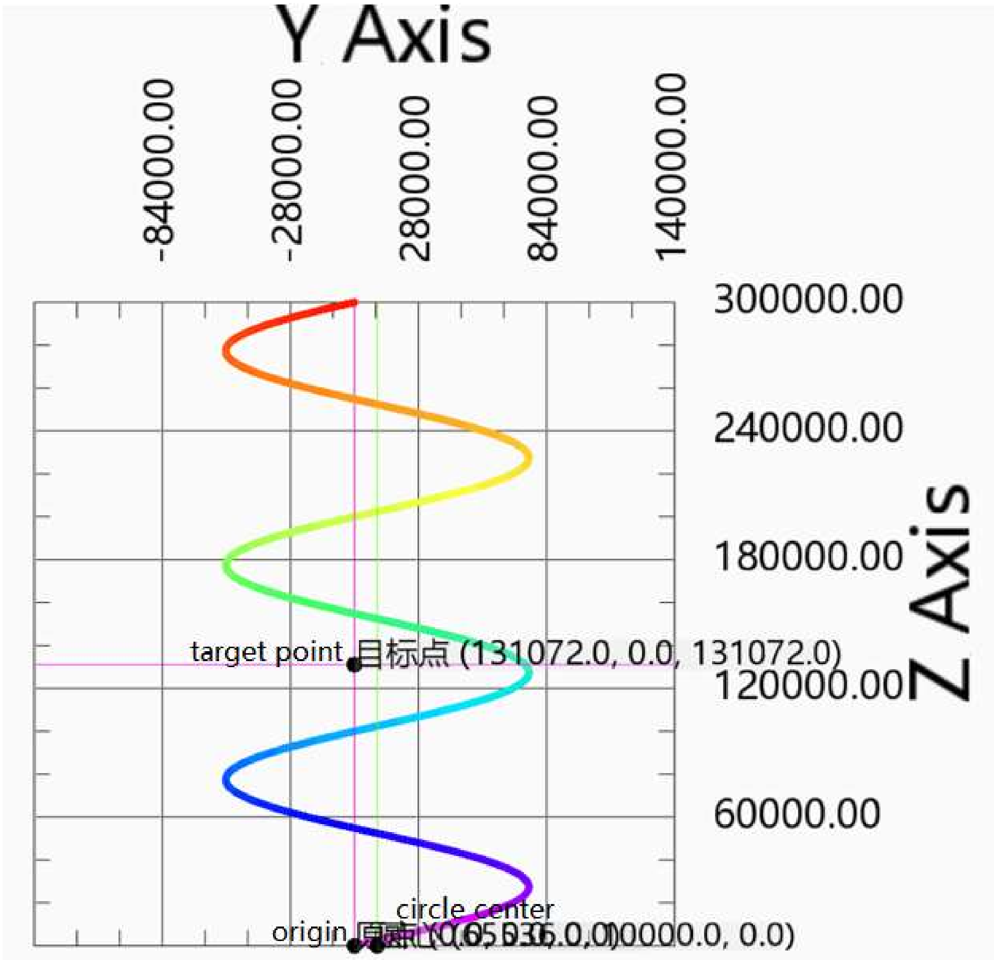
The synthesis trajectory of LabVIEW is as follows:



The breakdown drawing of each plane:



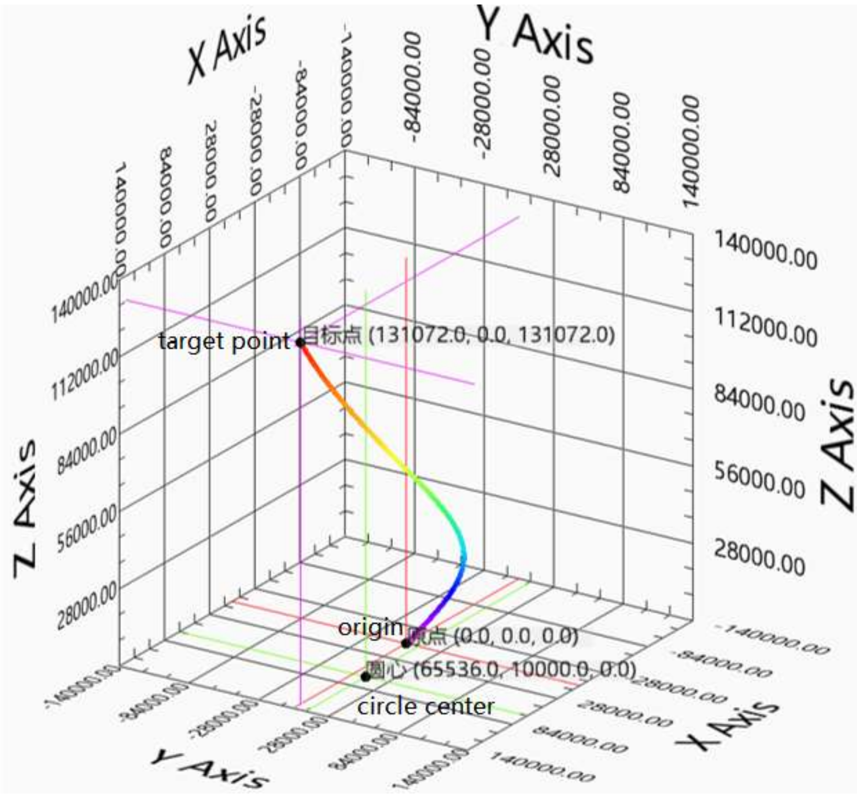




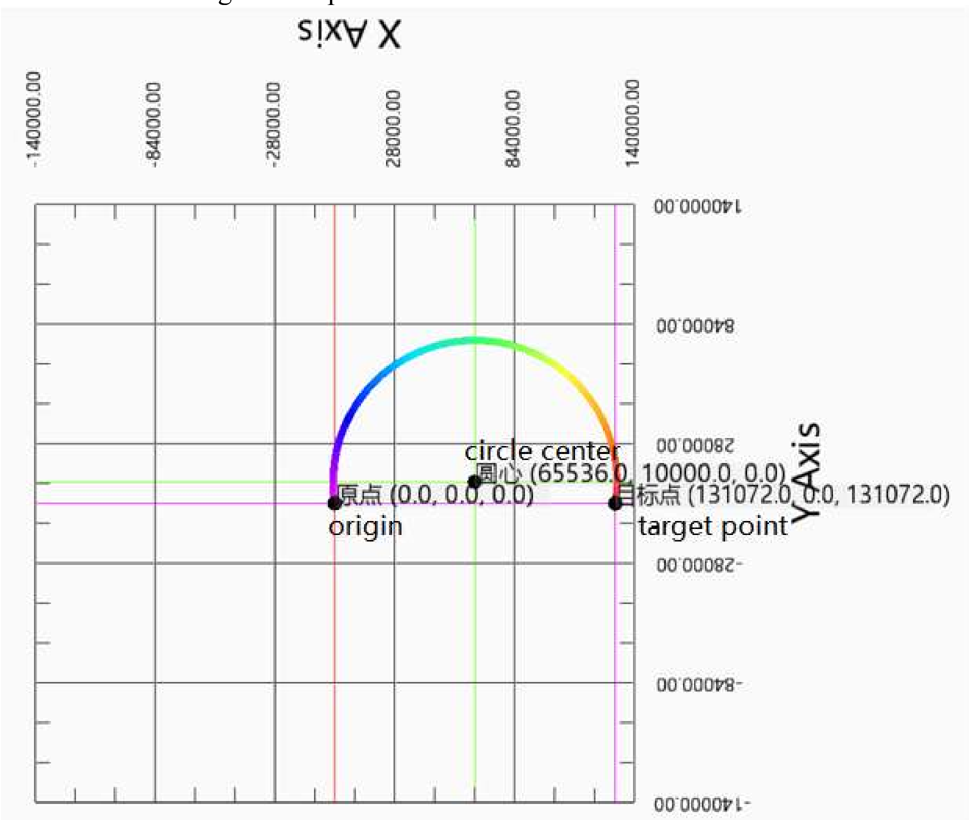
Action decomposition: the two axes of the XOY plane do the plane circle action. The circle track is determined by the starting point, center, target coordinates and path selection on the selected plane. The circle motion is repeated for 3 times. The Z-axis moves in a straight line at a uniform speed, and the moving distance is the number of turns × Pitch. The three axes start and stop at the same time, and the three-axis speed is decomposed into XOY plane linear speed and Z-axis linear speed.

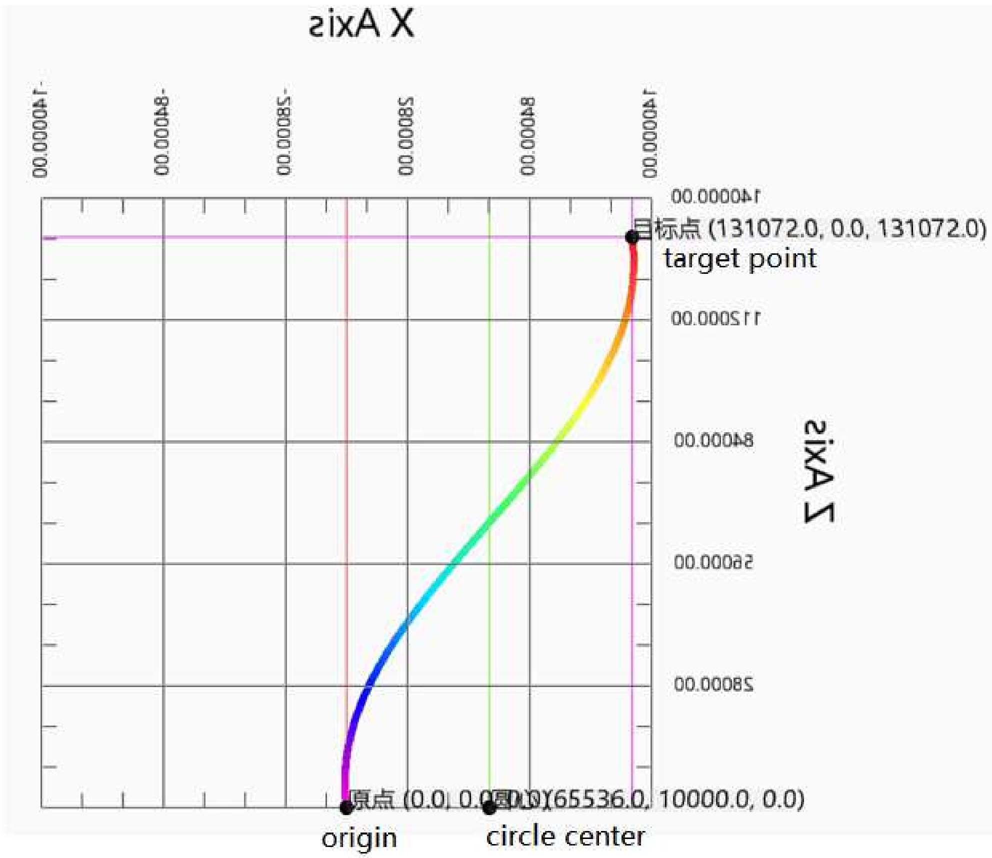
Note: If the number of turns is greater than 0, the actual motion trajectory of the curve does not necessarily pass through the target point.

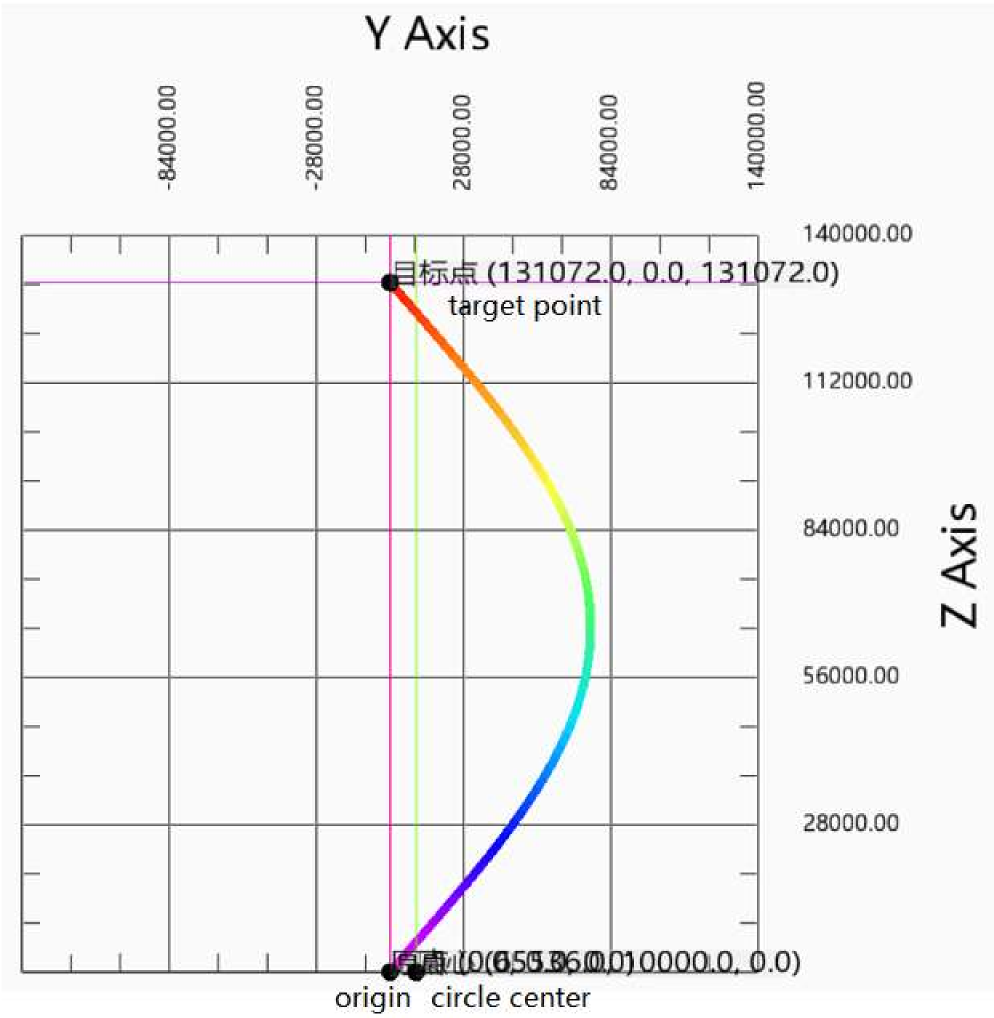
Other parameters remain unchanged. When the number of turns is 0, the running track is as follows:



The breakdown drawing of each plane:

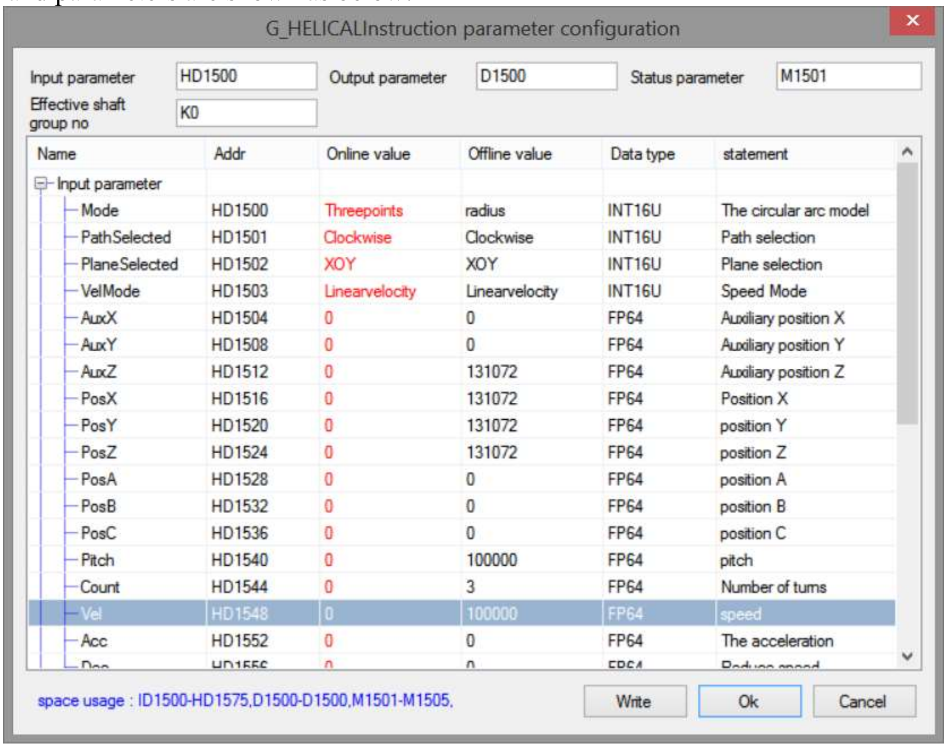



X Axis
Z Axis
目标点 (131072.0, 0.0, 131072.0)
target point
origin
circle center


Y Axis
-84000.00
-28000.00
28000.00
84000.00
140000.00
140000.00
112000.00
84000.00
56000.00
28000.00
Z Axis
目标点 (131072.0, 0.0, 131072.0)
target point
origin
circle center

Action decomposition: the two axes of XOY plane do plane arc action, and the arc track is determined by the starting point, center, target coordinates and path selection on the selected plane. The Z-axis moves in a straight line at a uniform speed, and the moving distance is the difference between the starting point of the Z-axis and the target point. The three axes start and stop at the same time, and the three-axis speed is decomposed into XOY plane linear speed and Z-axis linear speed.
Note: when the number of turns is 0 and the starting and ending points are consistent, the track is a plane circle.

- Arc mode 2 radius:
  Start point (0,0,0), target point (131072,131072,131072), radius 131072, pitch 100000, turns number 3, execute the helix at 100000 linear speed, and the helix rotates counterclockwise and moves towards the target point through the inferior arc.
  The command parameters are shown as below:



G_HELICALInstruction parameter configuration

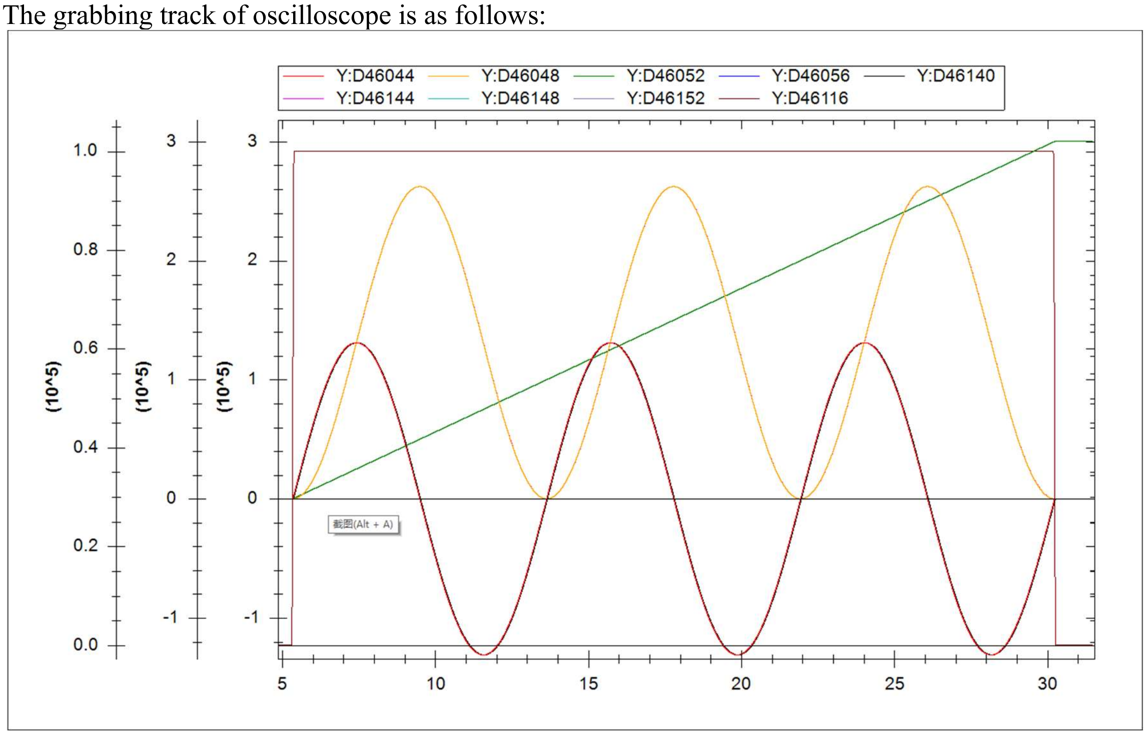
Input parameter HD1500 Output parameter D1500 Status parameter M1501
Effective shaft group no K0

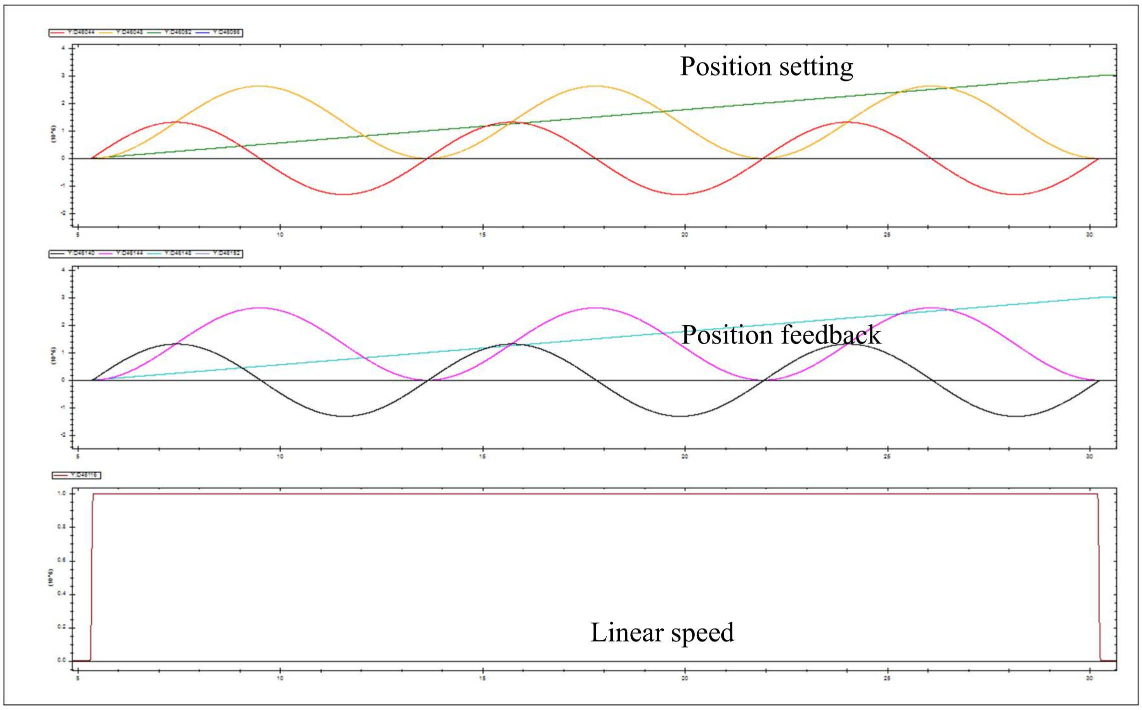
Name	Addr	Online value	Offline value	Data type	statement
Input parameter					
Mode	HD1500	Threepoints	radius	INT16U	The circular arc model
PathSelected	HD1501	Clockwise	Clockwise	INT16U	Path selection
PlaneSelected	HD1502	XOY	XOY	INT16U	Plane selection
VelMode	HD1503	Linearvelocity	Linearvelocity	INT16U	Speed Mode
AuxX	HD1504	0	0	FP64	Auxiliary position X
AuxY	HD1508	0	0	FP64	Auxiliary position Y
AuxZ	HD1512	0	131072	FP64	Auxiliary position Z
PosX	HD1516	0	131072	FP64	Position X
PosY	HD1520	0	131072	FP64	position Y
PosZ	HD1524	0	131072	FP64	position Z
PosA	HD1528	0	0	FP64	position A
PosB	HD1532	0	0	FP64	position B
PosC	HD1536	0	0	FP64	position C
Pitch	HD1540	0	100000	FP64	pitch
Count	HD1544	0	3	FP64	Number of turns
Vel	HD1548	0	100000	FP64	speed
Acc	HD1552	0	0	FP64	The acceleration

space usage : ID1500-HD1575,D1500-D1500,M1501-M1505.

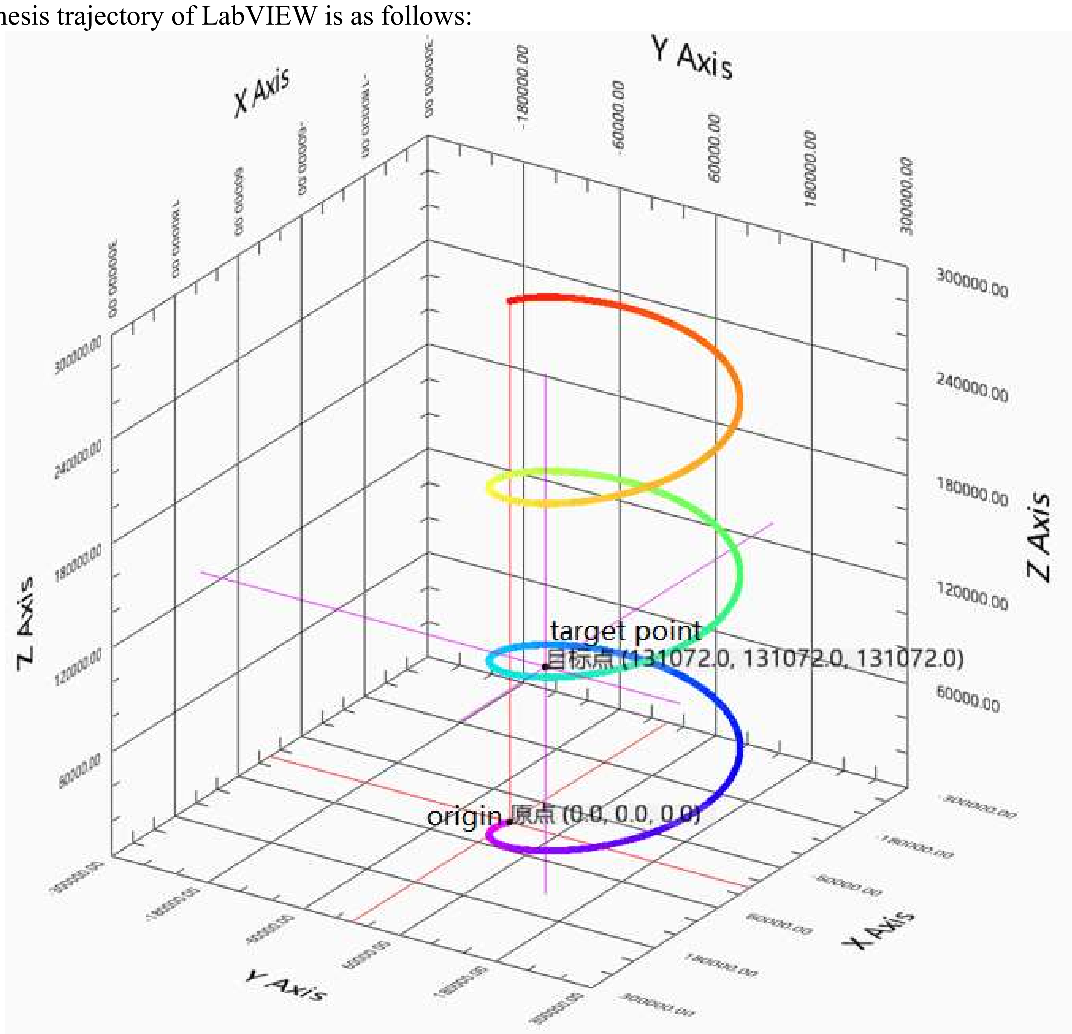
Write Ok Cancel

The grabbing track of oscilloscope is as follows:

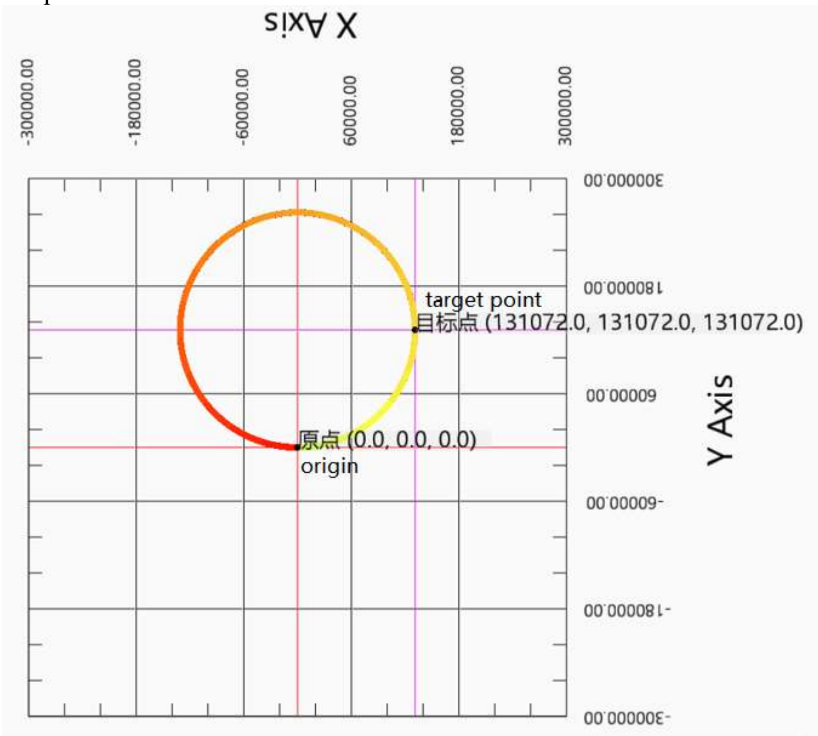


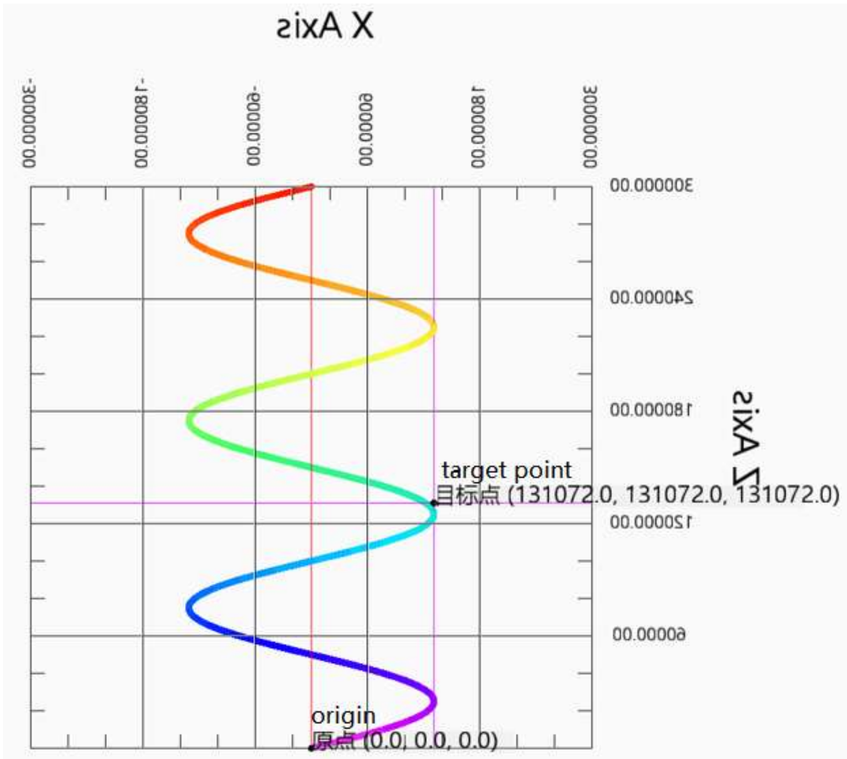


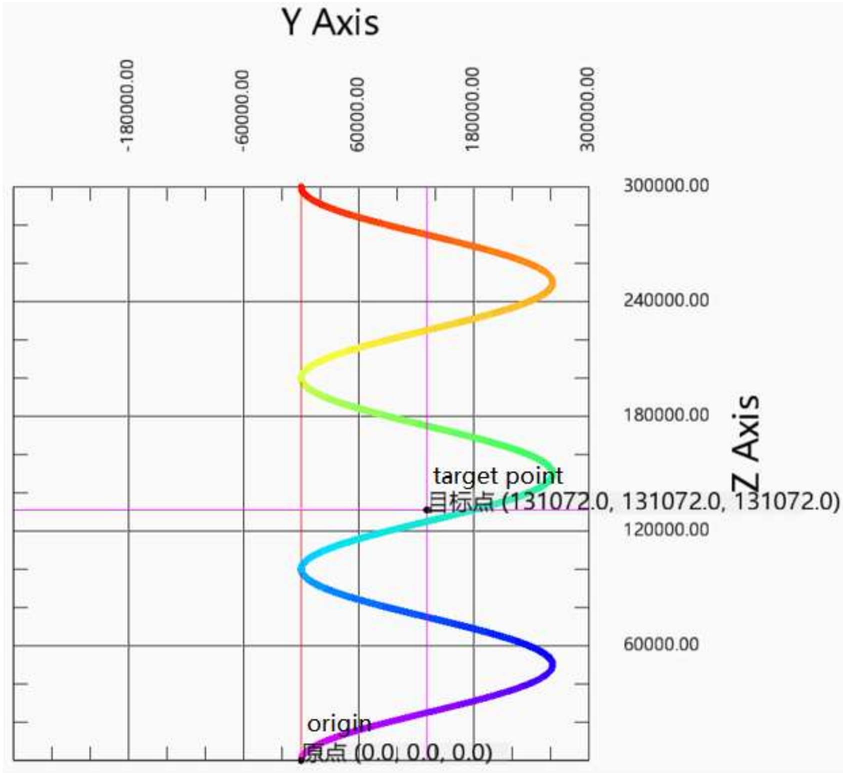
The synthesis trajectory of LabVIEW is as follows:



Exploded views of each plan are as follows:

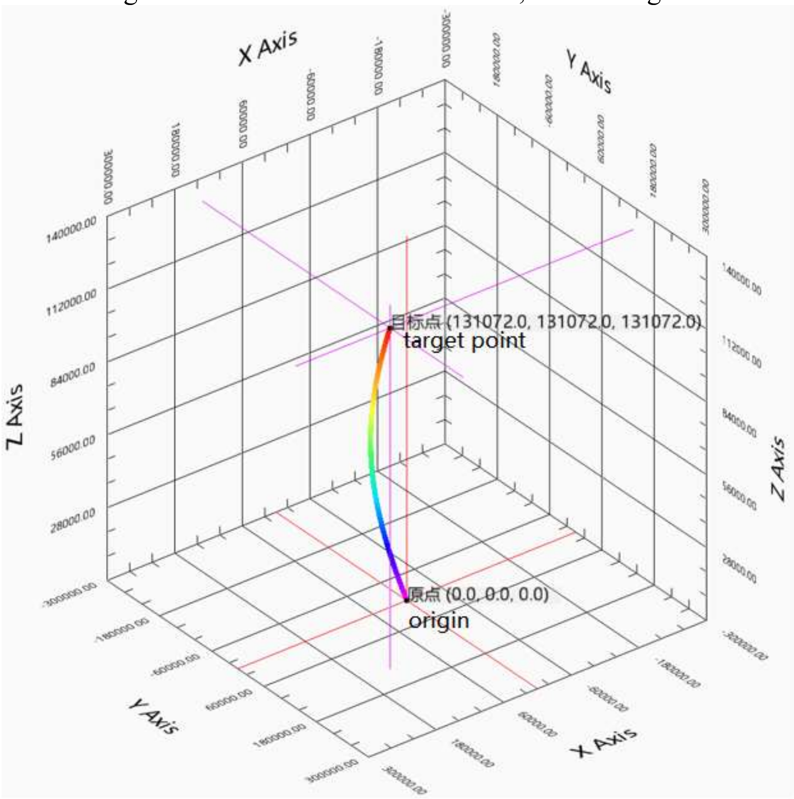




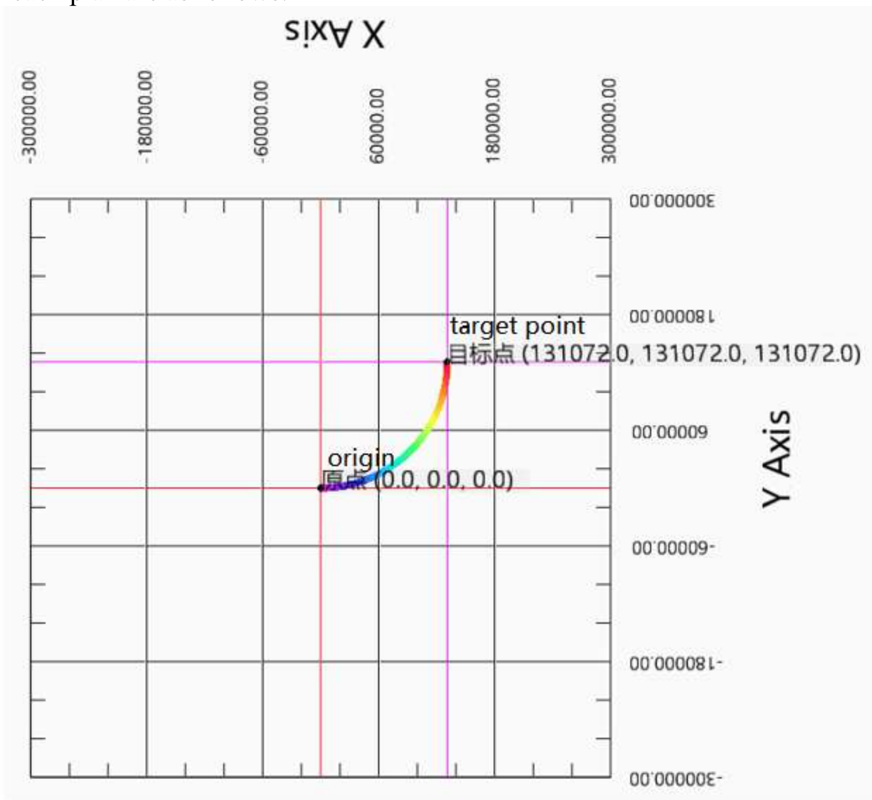


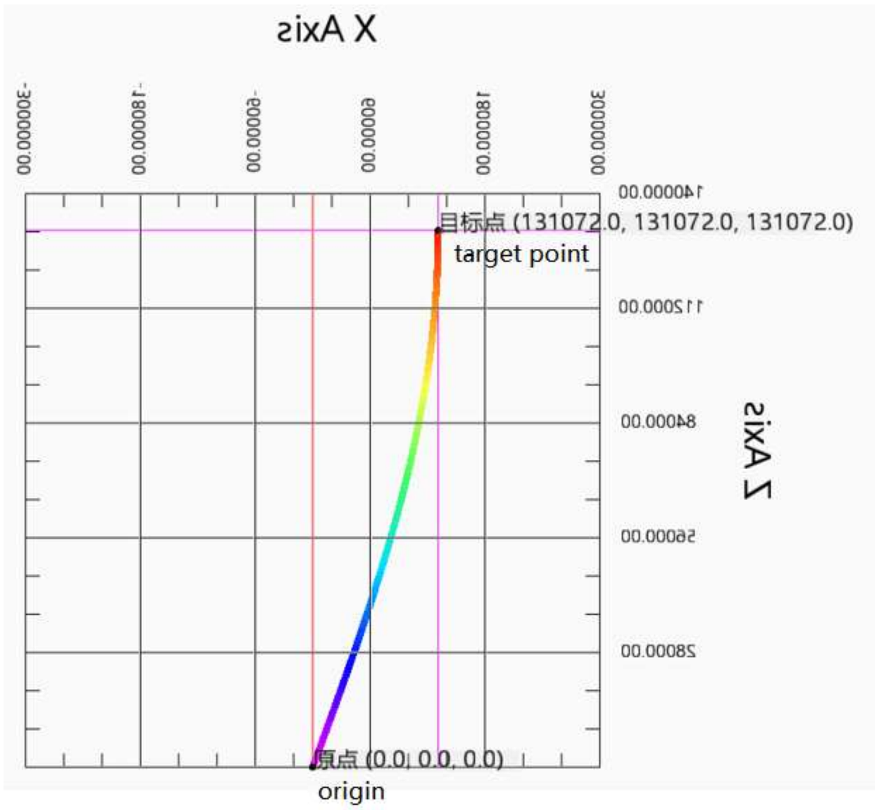
Action decomposition: the two axes of the XOY plane do the plane circle action. The circle track consists of the starting point, radius, target coordinates, rotation direction (positive and negative of Z axis) and arc type on the selected plane. The circle motion is repeated for 3 times. The Z-axis moves in a straight line at a uniform speed, and the moving distance is the number of turns × Pitch. The three axes start and stop at the same time, and the three-axis speed is decomposed into XOY plane linear speed and Z-axis linear speed.
Note: if the number of turns is greater than 0, the actual motion trajectory of the curve does not necessarily pass through the target point.

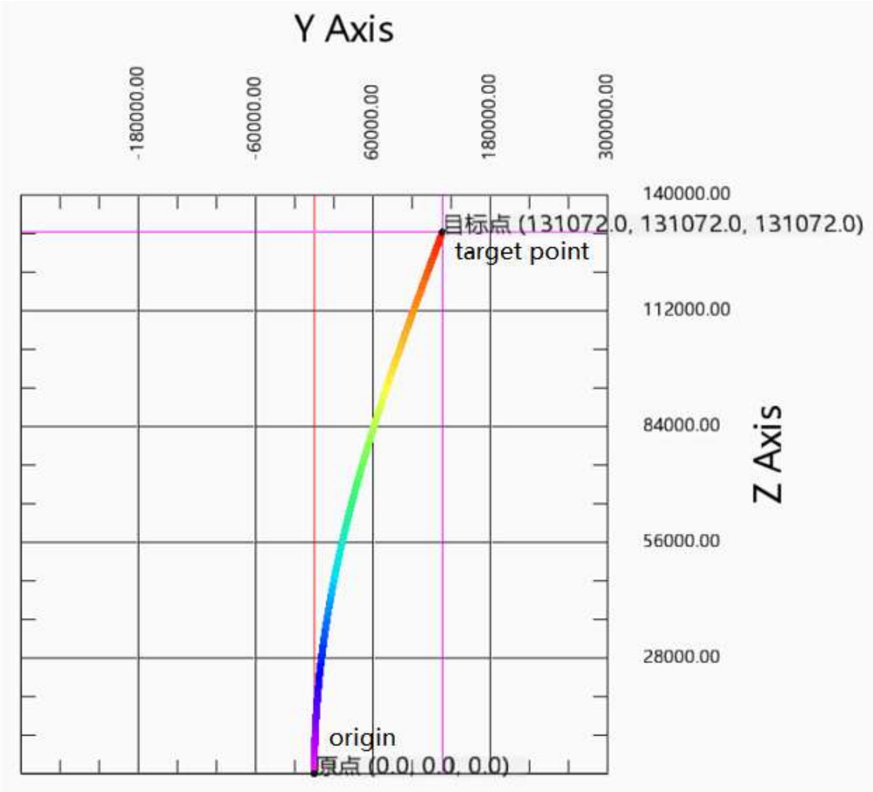
Other parameters remain unchanged. When the number of turns is 0, the running track is as follows:



Exploded views of each plan are as follows:







Action decomposition: the two axes of XOY plane perform plane arc action. The arc track consists of the starting point, radius, target coordinates, rotation direction (positive and negative of Z axis) and arc type on the selected plane. The Z-axis moves in a straight line at a uniform speed, and the moving distance is the difference between the starting point of the Z-axis and the target point. The three axes start and stop at the same time, and the three-axis speed is decomposed into XOY plane linear speed and Z-axis linear speed

5-2-2-7. Superimposed motion【G_MOVSUP】

(1) Overview

Performs superimposed motion control on the specified axis group.

Superimposed motion [G_MOVSUP]			
Execution condition	Rising/falling edge of the coil	Suitable model	XDH, XLH, XG2
Firmware	V3.7.1 and above	Software	V3.7.4 and above

(2) Operand

Operand	Function	Type
S0	Sepcify the input parameter start address	64-bit, four words
S1	Specify the output state word start address	16-bit, single word
S2	Specify the output state bit start address	Bit
S3	Specify axis output terminal number	16-bit, single word

(3) Suitable soft component

Operand	Word soft component											Bit soft component					
	System								Constant	Module		System					
	D*	FD	TD*	CD*	DX	DY	DM*	DS*	K/H	ID	QD	X	Y	M*	S*	T*	C*
S0	●	●	●	●													
S1	●	●	●	●													
S2														●			
S3	●								●								

*: D means D, HD; TD means TD and HTD; CD means CD, HCD, HSCD and HSD; DM means DM and DHM; DS means DS and DHS; M means M, HM, SM; S means S, HS; T means T, HT; C means C, HC.

(4) Function and action

- S0 specifies the input parameter start address
- S1 specifies the output state word start address
- S2 specifies output state bit start address
- S3 specifies the axis output terminal number
- When M0 changes from off to on, the superposition motion control is performed for the specified axis group of S3. The distances of each axis are S0, S0 + 4 and S0 + 8 respectively, the speed is S0 + 24, the acceleration is S0 + 28, the deceleration is S0 + 32 and the jerk speed is S0 + 36. When the command execution is completed, S2 is set to on.

(5) Notes

- The command can be carried out simultaneously with the motion command to superimpose the positions of each axis, and the speeds of the two commands will also be superimposed at the same time.
- The compensation value for each axis only takes effect in the current motion, and is invalid after the command ends.
- The instruction can be interrupted by the interrupted mode of the latter instruction, and it is also allowed to follow the cached instruction.
- The effect of executing the instruction alone is consistent with that of LINE instruction.
- The latter instruction can interrupt the previous superimposed instruction.

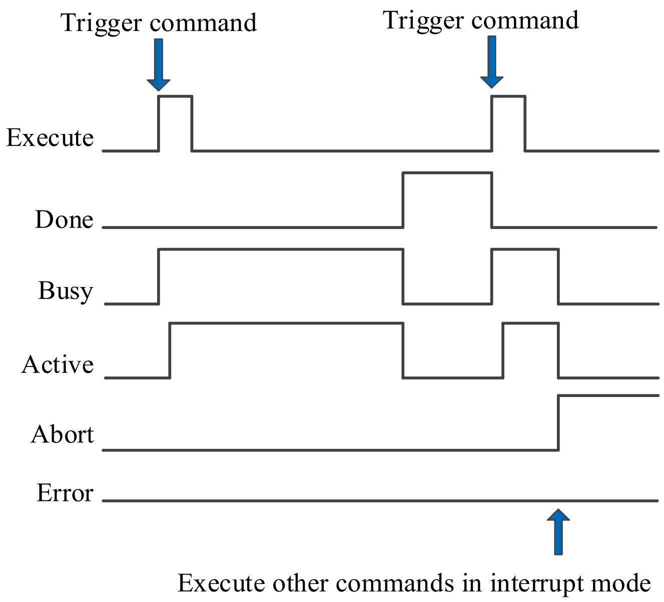
(6) Related parameters

Input parameter	Parameter name	Data type	Unit	Note
S0	PosX	FP64	-	Position X. The axis number can be set thorugh SFD48001+300*N
S0+4	PosY	FP64	-	Position Y. The axis number can be set thorugh SFD48002+300*N
S0+8	PosZ	FP64	-	Position Z. The axis number can be set thorugh SFD48003+300*N
S0+12	PosA	FP64	-	Position A. Not support at the moment

S0+16	PosB	FP64	-	Position B. Not support at the moment
S0+20	PosZ	FP64	-	Position C. Not support at the moment
S0+24	Vel	FP64	Command unit/s	Speed
S0+28	Acc	FP64	Command unit/s^2	Acceleration
S0+32	Dec	FP64	Command unit/s^2	Deceleration
S0+36	Jerk	FP64	Command unit/s^3	Jerk speed
Output parameter	Parameter name	Data type	Unit	Note
S1	ErrCode	INT16U	-	Command error code
Status parameter	Parameter name	Data type	Unit	Note
S2	Done	BOOL	-	Instruction execution completed
S2+1	Busy	BOOL	-	The instruction is being executed
S2+2	Active	BOOL	-	Command under control
S2+3	Abort	BOOL	-	Instruction is interrupted
S2+4	Error	BOOL	-	Instruction execution error
Axis number	Parameter name	Data type	Unit	Note
S3	Axis	INT16U	-	Axis number starts from 0

***Note:** the relationship between deceleration and jerk speed is same to instruction A_MOVEA, refer to chapter 5-1-2-7 item (5).

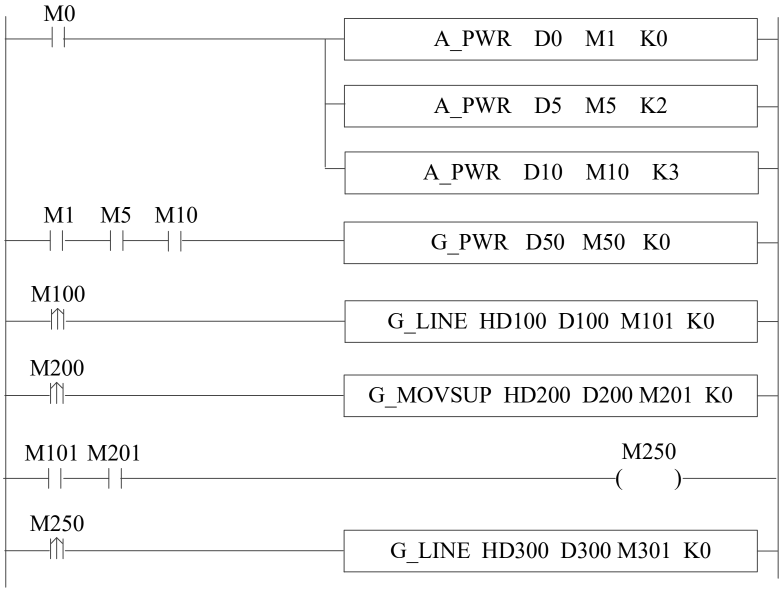
(7) Sequence diagram



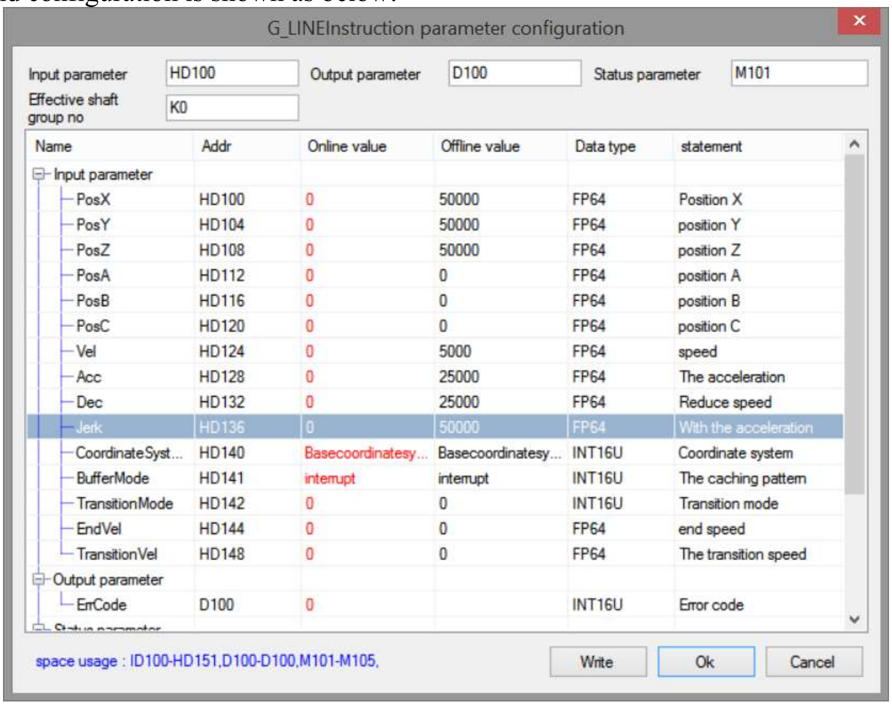
Explanation:
Generally, after the command is triggered, the Busy and Active signals are set, and reset after the command is executed. At the same time, the Done signal is set. Done signal will reset only after the command is triggered again, otherwise it will not reset automatically.
When a new instruction is triggered in interrupt mode during instruction execution, the Busy and Active signals are reset immediately and the Abort signal is set.
When there is an error in the command, the Error signal is set, other signals are reset, and the corresponding error code is output.

(8) Application
For example, the current position of each axis of the axis group is 0, the linear speed 5000 pulse/s, acceleration and deceleration 25000 pulse/s^2, jerk speed 50000 pulse/s^3, move each axis to the position of 50000, and in the

process, the position is superimposed with 20000 by linear speed 5000 pulse/s, acceleration and deceleration 10000 pulse/s^2, jerk speed 20000 pulse/s^3. After the above movement, move to the position of 60000 at the speed of 5000 pulses/s, acceleration and deceleration 25000 pulses/s^2 and jerk speed 50000 pulses/s^3. The ladder diagram is shown in the following figure:



The command configuration is shown as below:



G_LINEInstruction parameter configuration

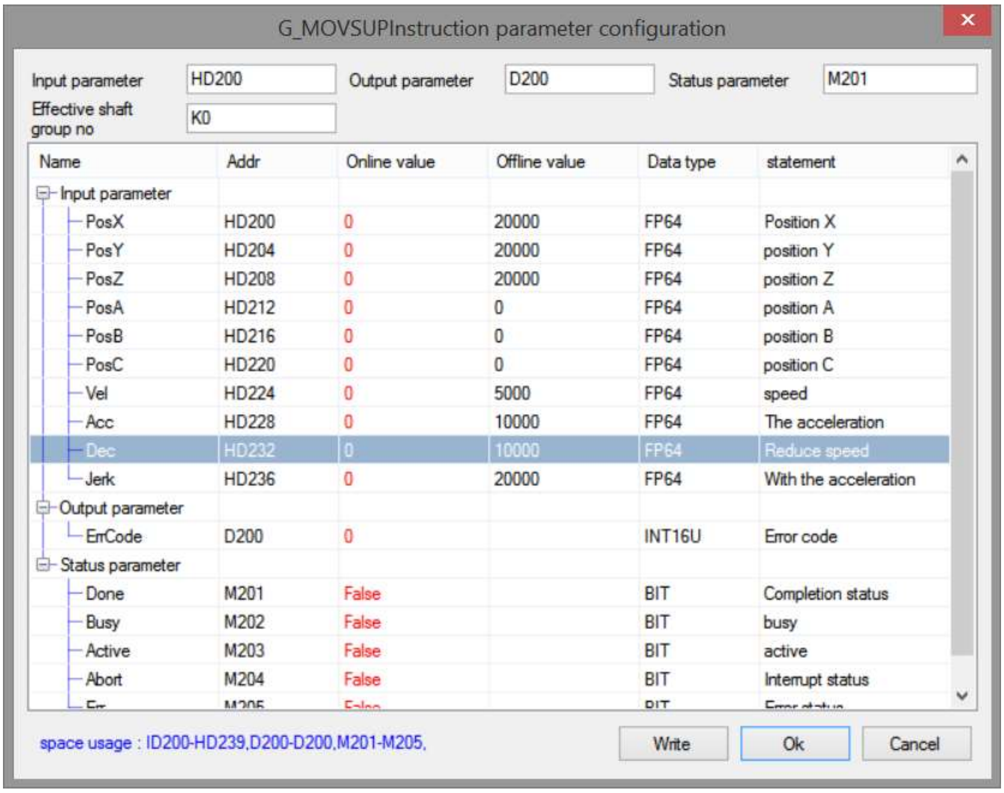
Input parameter: HD100 | Output parameter: D100 | Status parameter: M101

Effective shaft group no: K0

Name	Addr	Online value	Offline value	Data type	statement
Input parameter					
PosX	HD100	0	50000	FP64	Position X
PosY	HD104	0	50000	FP64	position Y
PosZ	HD108	0	50000	FP64	position Z
PosA	HD112	0	0	FP64	position A
PosB	HD116	0	0	FP64	position B
PosC	HD120	0	0	FP64	position C
Vel	HD124	0	5000	FP64	speed
Acc	HD128	0	25000	FP64	The acceleration
Dec	HD132	0	25000	FP64	Reduce speed
Jerk	HD136	0	50000	FP64	With the acceleration
CoordinateSyst...	HD140	Basecoordinatesy...	Basecoordinatesy...	INT16U	Coordinate system
BufferMode	HD141	interrupt	interrupt	INT16U	The caching pattern
TransitionMode	HD142	0	0	INT16U	Transition mode
EndVel	HD144	0	0	FP64	end speed
TransitionVel	HD148	0	0	FP64	The transition speed
Output parameter					
ErrCode	D100	0		INT16U	Error code

space usage : ID100-HD151,D100-D100,M101-M105,

Write | Ok | Cancel



G_MOVSUPInstruction parameter configuration

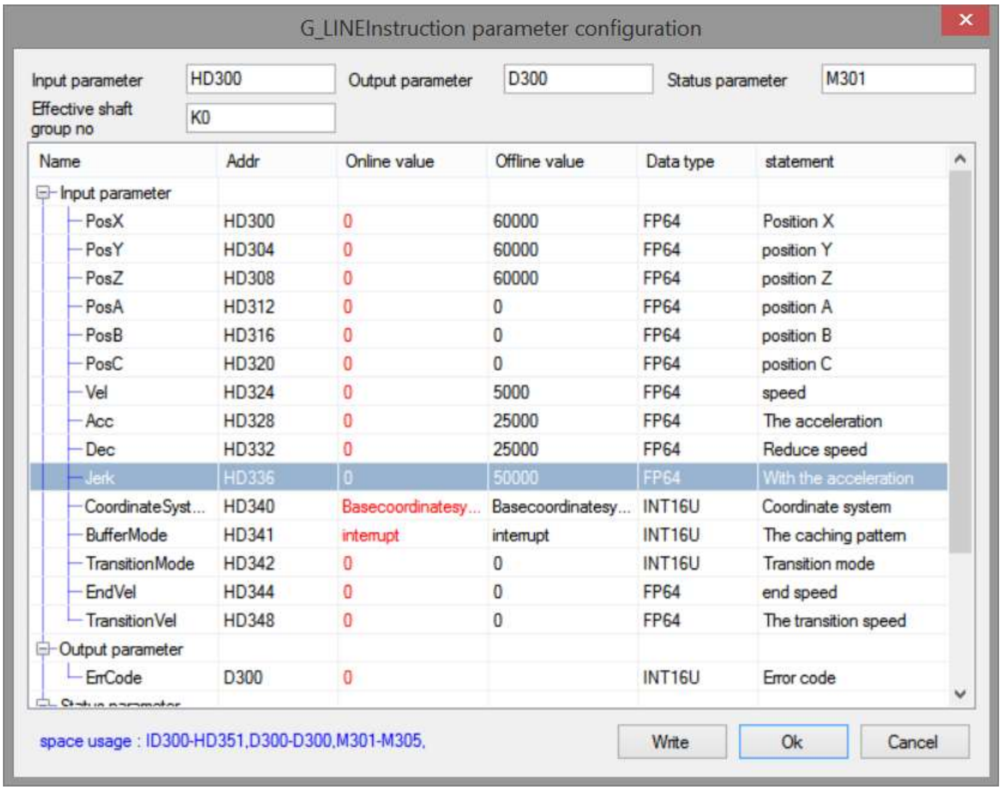
Input parameter HD200 | Output parameter D200 | Status parameter M201

Effective shaft group no K0

Name	Addr	Online value	Offline value	Data type	statement
Input parameter					
PosX	HD200	0	20000	FP64	Position X
PosY	HD204	0	20000	FP64	position Y
PosZ	HD208	0	20000	FP64	position Z
PosA	HD212	0	0	FP64	position A
PosB	HD216	0	0	FP64	position B
PosC	HD220	0	0	FP64	position C
Vel	HD224	0	5000	FP64	speed
Acc	HD228	0	10000	FP64	The acceleration
Dec	HD232	0	10000	FP64	Reduce speed
Jerk	HD236	0	20000	FP64	With the acceleration
Output parameter					
ErrCode	D200	0		INT16U	Error code
Status parameter					
Done	M201	False		BIT	Completion status
Busy	M202	False		BIT	busy
Active	M203	False		BIT	active
Abort	M204	False		BIT	Interrupt status

space usage：ID200-HD239,D200-D200,M201-M205,

Write Ok Cancel



G_LINEInstruction parameter configuration

Input parameter HD300 | Output parameter D300 | Status parameter M301

Effective shaft group no K0

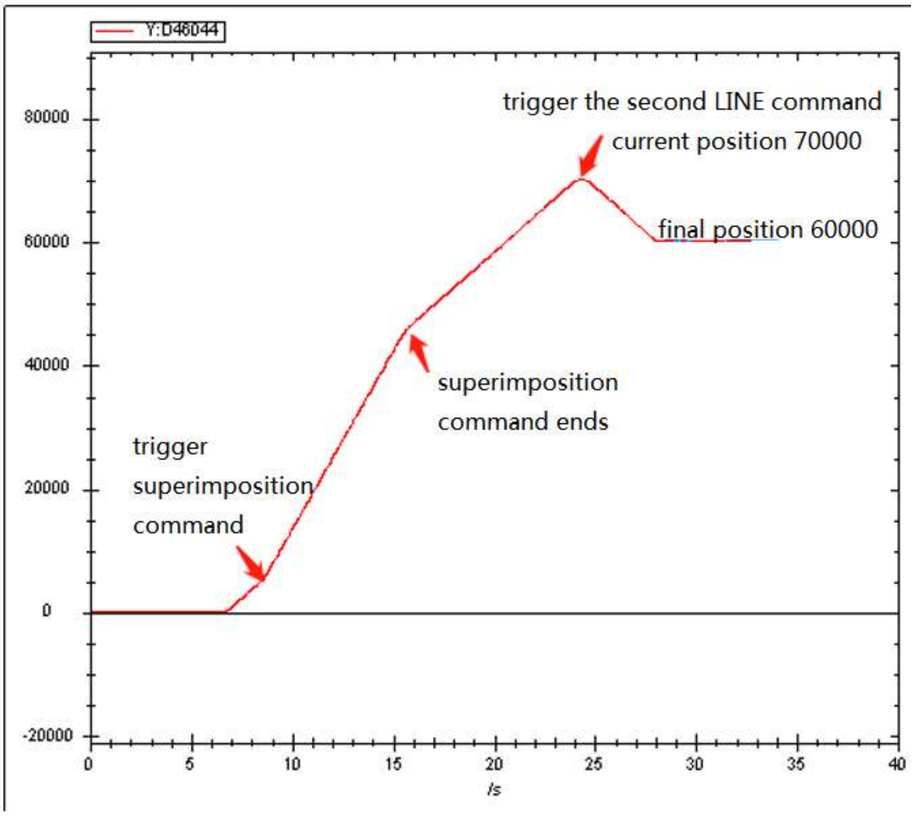
Name	Addr	Online value	Offline value	Data type	statement
Input parameter					
PosX	HD300	0	60000	FP64	Position X
PosY	HD304	0	60000	FP64	position Y
PosZ	HD308	0	60000	FP64	position Z
PosA	HD312	0	0	FP64	position A
PosB	HD316	0	0	FP64	position B
PosC	HD320	0	0	FP64	position C
Vel	HD324	0	5000	FP64	speed
Acc	HD328	0	25000	FP64	The acceleration
Dec	HD332	0	25000	FP64	Reduce speed
Jerk	HD336	0	50000	FP64	With the acceleration
CoordinateSyst...	HD340	Basecoordinatesy...	Basecoordinatesy...	INT16U	Coordinate system
BufferMode	HD341	interrupt	interrupt	INT16U	The caching pattern
TransitionMode	HD342	0	0	INT16U	Transition mode
EndVel	HD344	0	0	FP64	end speed
TransitionVel	HD348	0	0	FP64	The transition speed
Output parameter					
ErrCode	D300	0		INT16U	Error code

space usage：ID300-HD351,D300-D300,M301-M305,

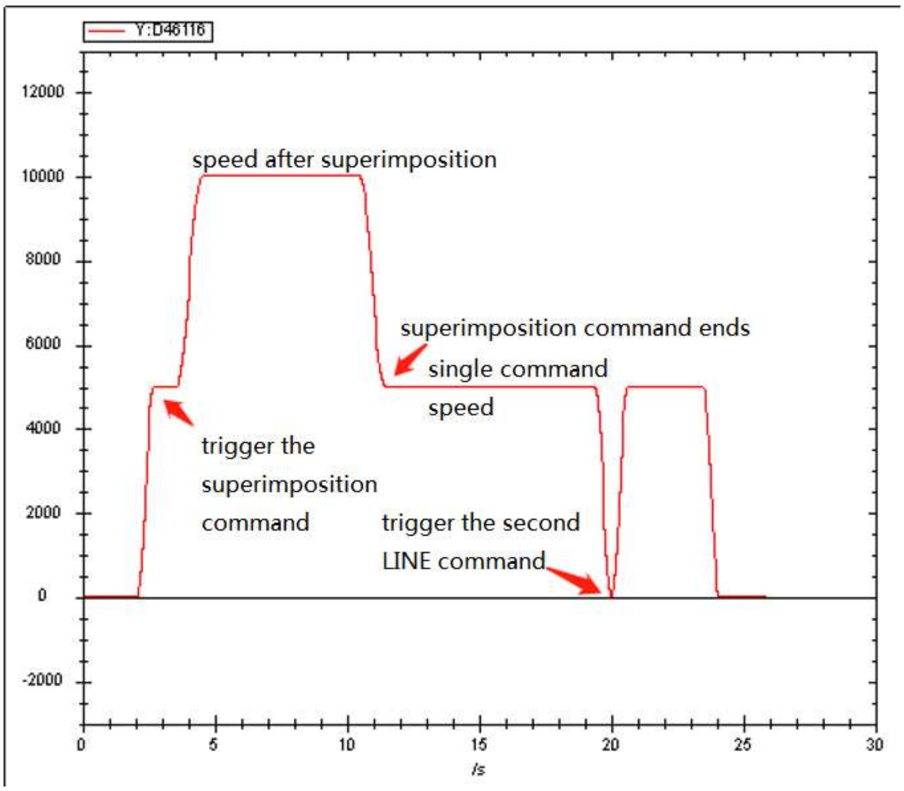
Write Ok Cancel

Note: turn on the axis enable through A_PWR. When all the constituent axes of the axis group are enabled, G_PWR is triggered to enable the axis group, turn M100 from off → on, and trigger G_LINE, each axis will move to the position of 50000 with the set parameters. During the axis movement, turn M200 from off → on and trigger G_ MOVSUP command, each axis will perform superposition movement with the set parameters. When the movement is over, another G_LINE command will be triggered again immediately.

The position curve is shown as below:



The speed curve is shown as below:



It can be seen from the speed curve that when the superposition instruction is executed, the speed will be superimposed on the basis of the original speed. After the execution of the superposition instruction, the previous speed will continue to execute until the execution of the instruction ends and the speed decreases to 0.

It can be seen from the position curve that after the execution of the first instruction and the superimposed instruction, the position is 70000 (including the compensation value of the superimposed instruction to the position of 20000). After the execution of the second LINE instruction, the final position is reduced to 60000, which is consistent with the instruction parameters. Therefore, it can be seen that the compensation of the superimposed instruction to the position is only effective during the current movement.

5-2-2-8. Compensation motion【G_COMPON】

(1) Overview

Compensation motion control for the specified axis.

Compensation motion [G_COMPON]			
Execution condition	Rising/falling edge of the coil	Suitable model	XDH, XLH, XG2
Firmware	V3.7.1 and above	Software	V3.7.4 and above

(2) Operand

Operand	Function	Type
S0	Sepcify the input parameter start address	64-bit, four words
S1	Specify the output state word start address	16-bit, single word
S2	Specify the output state bit start address	Bit
S3	Specify axis output terminal number	16-bit, single word

(3) Suitable soft component

Operand	Word soft component											Bit soft component					
	System								Constant	Module		System					
	D*	FD	TD*	CD*	DX	DY	DM*	DS*	K/H	ID	QD	X	Y	M*	S*	T*	C*
S0	●	●	●	●													
S1	●	●	●	●													
S2														●			
S3	●								●								

*: D means D, HD; TD means TD and HTD; CD means CD, HCD, HSCD and HSD; DM means DM and DHM; DS means DS and DHS; M means M, HM, SM; S means S, HS; T means T, HT; C means C, HC.

(4) Action and function

- S0 specifies the input parameter start address
- S1 specifies the output state word start address
- S2 specifies output state bit start address
- S3 specifies the axis output terminal number
- Trigger the command to perform compensation motion control on the designated axis of S3. The distance of each axis is S0, S0 + 4 and S0 + 8, the speed is S0 + 24, the acceleration is S0 + 28, the deceleration is S0 + 32 and the jerk speed is S0 + 36. When the command is executed, S2 is set to on.

(5) Notes

- The command is triggered after the motion command and can be executed together with other motion commands to make compensation motion for each axis position, and the two command speeds will be superimposed at the same time. When the instruction is executed separately, the effect is the same as that of the LINE instruction.
- After the command movement is completed, it will compensate all subsequent movements, and the compensation value can only be cancelled by the compensation cancellation command COMPON.
- Other commands cannot interrupt the compensation movement of this command and will move together with the compensation command. Only the compensation instruction itself can interrupt the compensation instruction.
- The compensation position type can be divided into absolute value and relative value.
- When the instruction is interrupted, the compensation amount of the current segment will be written into the system.

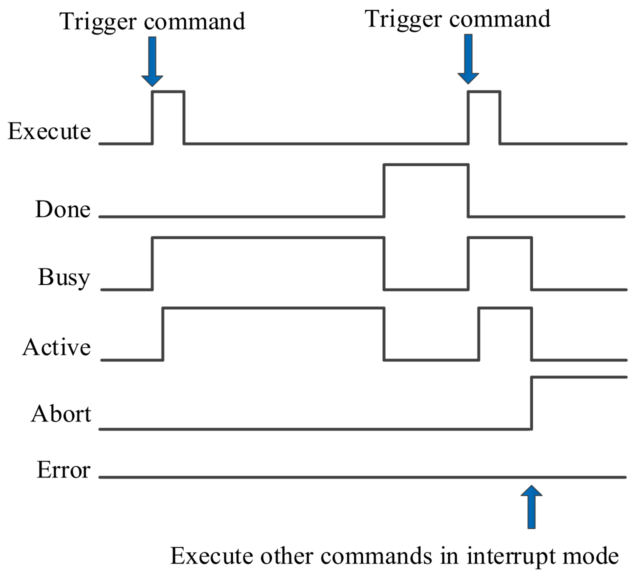
(6) Related parameters

Input parameter	Parameter name	Data type	Unit	Note
S0	PosX	FP64	-	Position X. The axis number is set through SFD48001+300*N
S0+4	PosY	FP64	-	Position Y. The axis number is set through SFD48002+300*N

Input parameter	Parameter name	Data type	Unit	Note
S0+8	PosZ	FP64	-	Position Z. The axis number is set through SFD48003+300*N
S0+12	PosA	FP64	-	Position A. Not support at the moment
S0+16	PosB	FP64	-	Position B. Not support at the moment
S0+20	PosC	FP64	-	Position C. Not support at the moment
S0+24	Vel	FP64	Command unit/s	Speed
S0+28	Acc	FP64	Command unit /s^2	Acceleration
S0+32	Dec	FP64	Command unit /s^2	Deceleration
S0+36	Jerk	FP64	Command unit /s^3	Jerk speed
S0+40	MotionType	INT16U	-	Position type
Output parameter	**Parameter name**	**Data type**	**Unit**	**Note**
S1	ErrCode	INT16U	-	Command error code
Status parameter	**Parameter name**	**Data type**	**Unit**	**Note**
S2	Done	BOOL	-	Instruction execution completed
S2+1	Busy	BOOL	-	The instruction is being executed
S2+2	Active	BOOL	-	Command under control
S2+3	Abort	BOOL	-	Instruction is interrupted
S2+4	Error	BOOL	-	Instruction execution error
Axis number	**Parameter name**	**Data type**	**Unit**	**Note**
S3	Axis	INT16U	-	Axis number starts from 0

***Note:** the relationship between deceleration and jerk speed is same to instruction A_MOVEA, refer to chapter 5-1-2-7 item (5).

(7) Sequence diagram

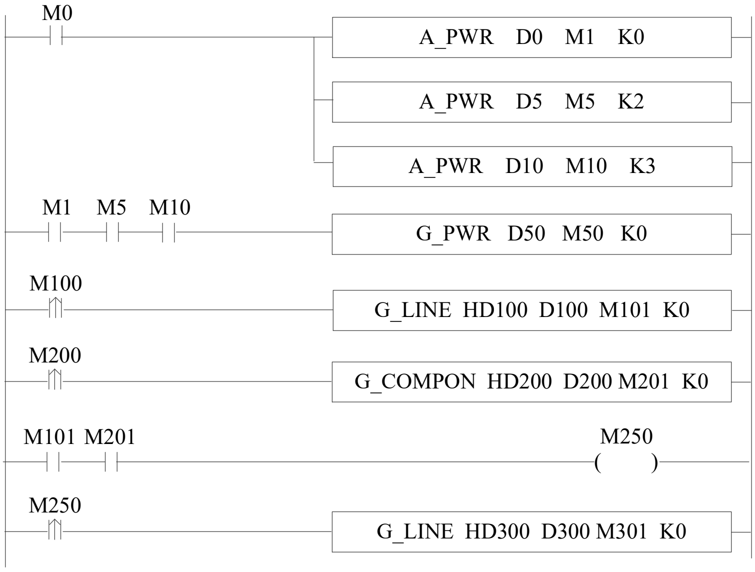


Explanation:
Generally, after the command is triggered, the Busy and Active signals are set, and reset after the command is executed. At the same time, the Done signal is set. Done signal will reset only after the command is triggered again, otherwise it will not reset automatically.
When a new instruction is triggered in interrupt mode during instruction execution, the Busy and Active signals are reset immediately and the Abort signal is set.
When there is an error in the command, the Error signal is set, other signals are reset, and the corresponding error

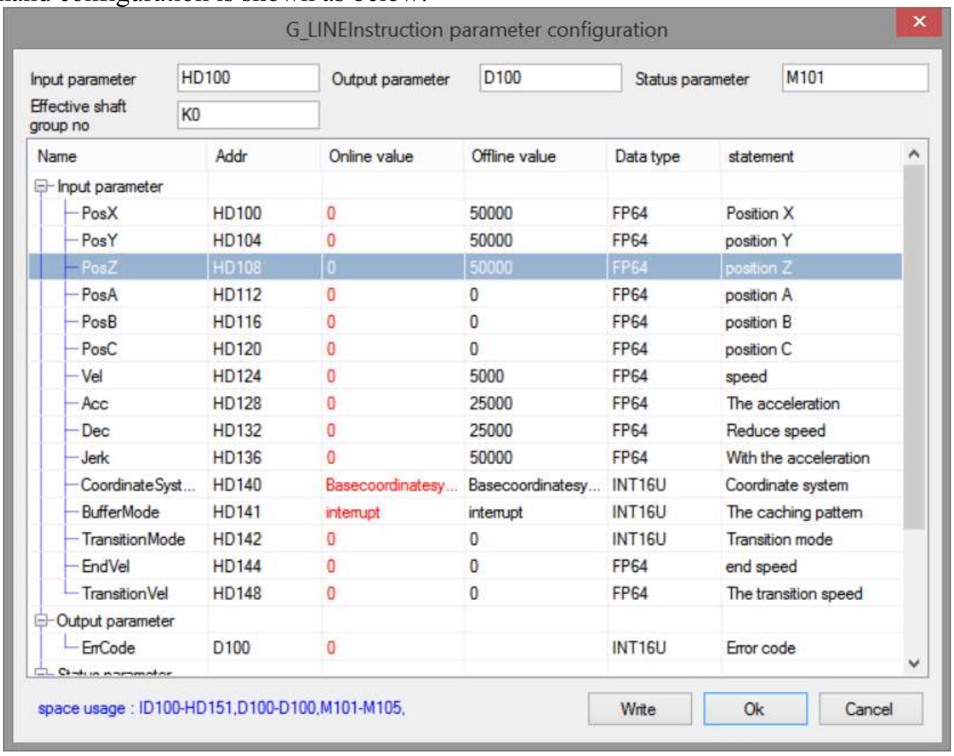
code is output.

(8) Application

For example, the current position of each axis of the axis group is 0, the linear speed is 5000 pulse/s, the acceleration and deceleration is 2500 pulse/s^2, and the jerk speed is 50000 pulse/s^3, and each axis moves to the position of 50000. In the process, the position is superimposed with 20000 by the linear speed of 5000 pulse/s, the acceleration and deceleration 10000 pulse/s^2, and the jerk speed 20000 pulse/s^3. After the above movement, it moves to the position of 60000 at the speed of 5000 pulses/s, acceleration and deceleration 2500 pulses/s^2 and jerk speed 50000 pulses/s^3. The ladder diagram is shown in the following figure:



The command configuration is shown as below:



G_LINEInstruction parameter configuration

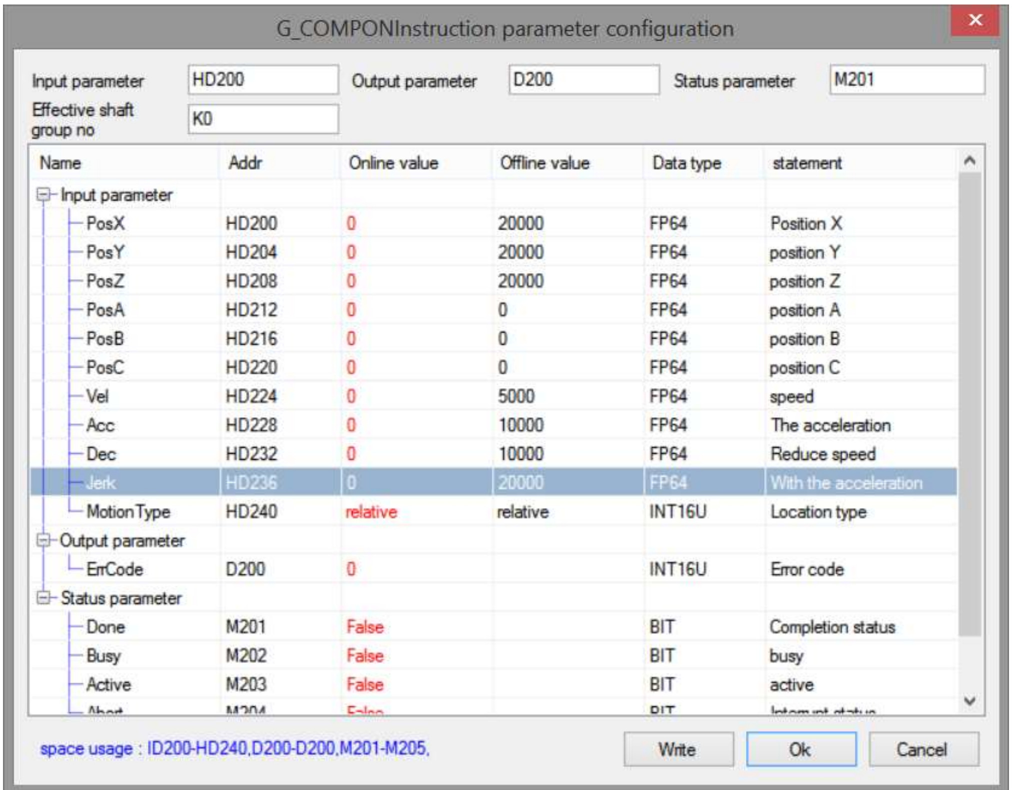
Input parameter HD100 Output parameter D100 Status parameter M101

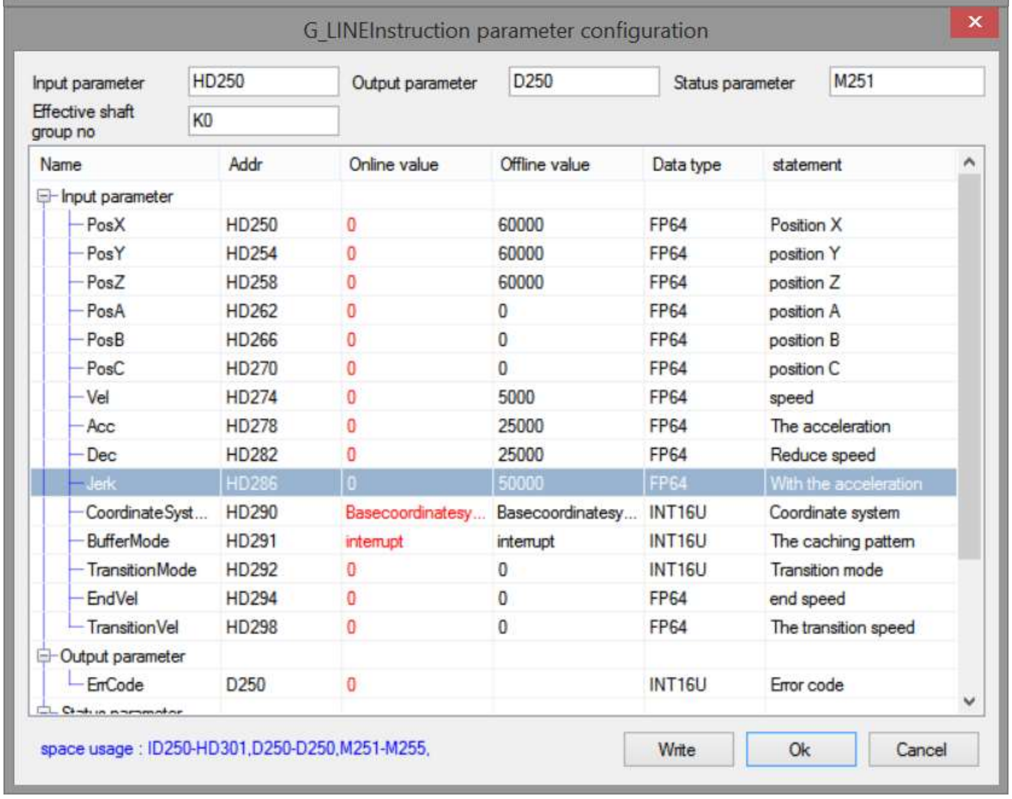
Effective shaft group no K0

Name	Addr	Online value	Offline value	Data type	statement
Input parameter					
PosX	HD100	0	50000	FP64	Position X
PosY	HD104	0	50000	FP64	position Y
PosZ	HD108	0	50000	FP64	position Z
PosA	HD112	0	0	FP64	position A
PosB	HD116	0	0	FP64	position B
PosC	HD120	0	0	FP64	position C
Vel	HD124	0	5000	FP64	speed
Acc	HD128	0	25000	FP64	The acceleration
Dec	HD132	0	25000	FP64	Reduce speed
Jerk	HD136	0	50000	FP64	With the acceleration
CoordinateSyst...	HD140	Basecoordinatesy...	Basecoordinatesy...	INT16U	Coordinate system
BufferMode	HD141	interrupt	interrupt	INT16U	The caching pattern
TransitionMode	HD142	0	0	INT16U	Transition mode
EndVel	HD144	0	0	FP64	end speed
TransitionVel	HD148	0	0	FP64	The transition speed
Output parameter					
ErrCode	D100	0		INT16U	Error code

space usage : ID100-HD151,D100-D100,M101-M105,

Write Ok Cancel

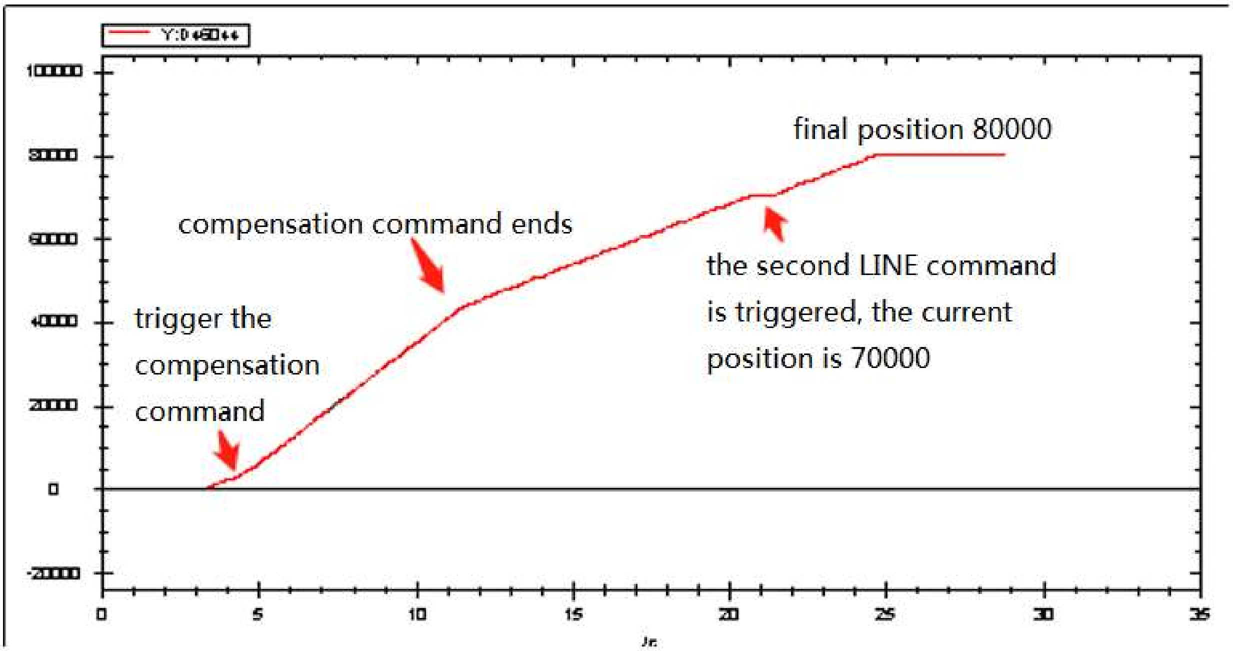




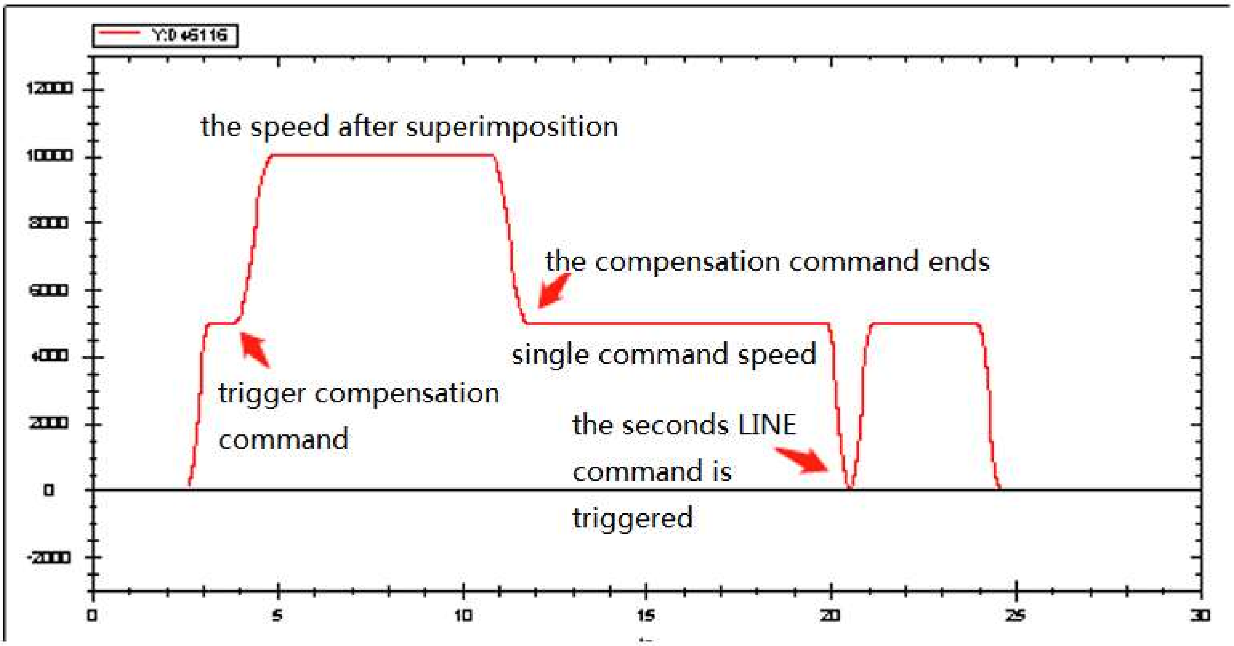
Explanation:

Turn on the axis enable through A_PWR, when all the constituent axes of the axis group are enabled, G_PWR is triggered to enable the axis group. M100 is from OFF→ON, command G_LINE is triggered, each axis moves to position 50000 with the set parameters. In the axis motion process, M200 is from OFF→ON, command G_COMPON is triggered, each axis will perform superimposed motion with the set parameters. When the movement is over, another G_LINE will be triggered again immediately.

The position curve is shown as below:



The speed curve is shown as below:



It can be seen from the position curve that after the execution of the first instruction and the superimposed instruction, the position is 70000 (including the compensation value of the superimposed instruction to the position of 20000), and after the execution of the second line instruction, the final position is 80000 (the instruction parameter is 60000), so it can be seen that the compensation of the compensation instruction to the position is always effective.

5-2-2-9. Compensation cancellation【G_COMPOFF】

(1) Overview

Cancel the compensation value for the specified axis group.

Cancel the compensation [G_COMPOFF]			
Execution condition	Rising/falling edge of the coil	Suitable model	XDH, XLH, XG2
Firmware	V3.7.1 and above	Software	V3.7.4 and above

(2) Operand

Operand	Function	Type
S0	Specify the output state word start address	16-bit, single word
S1	Specify the output state bit start address	Bit
S2	Specify axis output terminal number	16-bit, single word

(3) Suitable soft component

Operand	Word soft component											Bit soft component					
	System								Constant	Module		System					
	D*	FD	TD*	CD*	DX	DY	DM*	DS*	K/H	ID	QD	X	Y	M*	S*	T*	C*
S0	●	●	●	●													
S1														●			
S2	●								●								

*: D means D, HD; TD means TD and HTD; CD means CD, HCD, HSCD and HSD; DM means DM and DHM; DS means DS and DHS; M means M, HM, SM; S means S, HS; T means T, HT; C means C, HC.

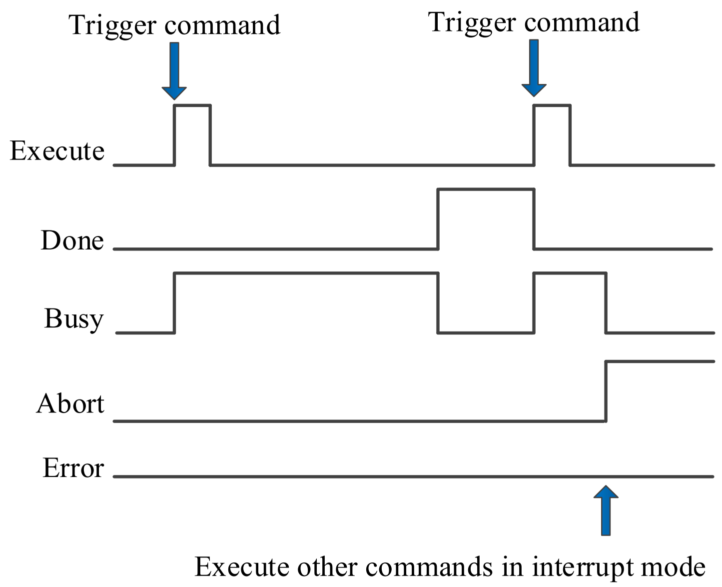
(4) Function and action

- S0 specifies the output state word start address
- S1 specifies output state bit start address
- S2 specifies the axis output terminal number
- When M0 is from off → on, cancel the internal compensation value of each component axis of the axis group specified by S3 and reset to 0
- This command can only be executed when the axis group is idle, otherwise the command will report an error.

(5) Related parameters

Output parameter	Parameter name	Data type	Unit	Note
S0	ErrCode	INT16U	-	Command error code
State parameter	Parameter name	Data type	Unit	Note
S1	Done	BOOL	-	Instruction execution completed
S1+1	Busy	BOOL	-	The instruction is being executed
S1+2	Abort	BOOL	-	Instruction is interrupted
S1+3	Error	BOOL	-	Instruction execution error
Axis number	Parameter name	Data type	Unit	Note
S2	Axis	INT16U	-	Axis number starts from 0

(6) Sequence diagram



Explanation:
Generally, after the command is triggered, the Busy signal is set, reset after the command is completed, and the Done signal is set. Done is reset only after the command is triggered again, otherwise it will not be reset automatically.
When the instruction is interrupted or has an error, the corresponding Abort or Error signal is set, other signals are reset, and the corresponding error code will be output in case of error.

5-2-2-10. Interrupt motion【G_INTR】

(1) Overview

The axis group pauses with the set parameters.

Interrupt motion [G_INTR]			
Execution condition	Rising/falling edge of the coil	Suitable model	XDH, XLH, XG2
Firmware	V3.6.1b and above	Software	V3.7.4 and above

(2) Operand

Operand	Function	Type
S0	Sepcify the input parameter start address	64-bit, four words
S1	Specify the output state word start address	16-bit, single word
S2	Specify the output state bit start address	Bit
S3	Specify axis group number	16-bit, single word

(3) Suitable soft component

Operand	Word soft component											Bit soft component					
	System								Constant	Module		System					
	D*	FD	TD*	CD*	DX	DY	DM*	DS*	K/H	ID	QD	X	Y	M*	S*	T*	C*
S0	●	●	●	●													
S1	●	●	●	●													
S2														●			
S3	●								●								

*: D means D, HD; TD means TD and HTD; CD means CD, HCD, HSCD and HSD; DM means DM and DHM; DS means DS and DHS; M means M, HM, SM; S means S, HS; T means T, HT; C means C, HC.

(4) Function and action

- S0 specifies the input parameter start address, occupies the register S0~S0+7
- S1 specifies the output state word start address
- S2 specifies output state bit start address, occupies the relay S2~S2+4
- S3 specifies the axis group number, starts from 0. The axis number in the axis group is set through SFD48001+300*N~SFD48006+300*N, N is axis group number
- When M0 is from OFF→ON, the axis group specified by S3 performs arc interpolation with the deceleration, acceleration and jerk speed set by the user

(5) Notes

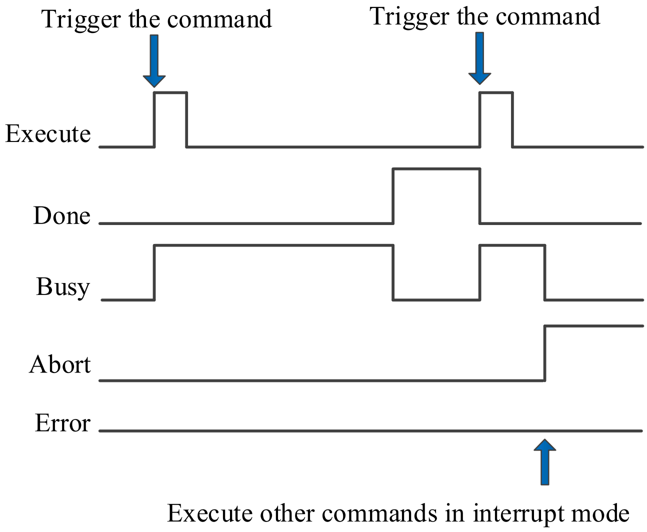
- G_INTR can pause the command in motion and let the command state output Abort, and the actual deceleration is the larger value between G_INTR and the command in motion.
- G_INTR does not support buffer mode and cannot execute other command in buffer mode when G_INTR is being executed.

(6) Related parameters

Input parameter	Parameter name	Data type	Unit	Note
S0	Deceleration	FP64	Command unit/s^2	Target deceleration
S0+4	Jerk	FP64	Command unit/s^3	Target jerk speed, the change rate of acceleration/deceleration
Output parameter	**Parameter name**	**Data type**	**Unit**	**Note**
S1	ErrCode	INT16U	-	Command error code
State parameter	**Parameter name**	**Data type**	**Unit**	**Note**
S2	Done	BOOL	-	Instruction execution completed
S2+1	Busy	BOOL	-	The instruction is being executed
S2+2	Abort	BOOL	-	Instruction is interrupted

S2+3	Error	BOOL	-	Instruction execution error
Axis number	Parameter name	Data type	Unit	Note
S3	Axis	INT16U	-	Axis group number starts from 0

(7) Sequence diagram



Explanation:
Generally, after the command is triggered, the Busy signal is set, reset after the command is completed, and the Done signal is set. Done is reset only after the command is triggered again, otherwise it will not be reset automatically.
When the instruction is interrupted or has an error, the corresponding Abort or Error signal is set, other signals are reset, and the corresponding error code will be output in case of error.

5-2-2-11. Continue the motion【G_GOON】

(1) Overview

The suspended axis group continues its original motion.

Continue the motion [G_GOON]			
Execution condition	Rising/falling edge of the coil	Suitable model	XDH, XLH, XG2
Firmware	V3.6.1b and above	Software	V3.7.4 and above

(2) Operand

Operand	Function	Type
S0	Specify the output state word start address	16-bit, single word
S1	Specify the output state bit start address	Bit
S2	Specify axis group number	16-bit, single word

(3) Suitable soft component

Operand	Word soft component											Bit soft component					
	System								Constant	Module		System					
	D*	FD	TD*	CD*	DX	DY	DM*	DS*	K/H	ID	QD	X	Y	M*	S*	T*	C*
S0	●	●	●	●													
S1														●			
S2	●								●								

*: D means D, HD; TD means TD and HTD; CD means CD, HCD, HSCD and HSD; DM means DM and DHM; DS means DS and DHS; M means M, HM, SM; S means S, HS; T means T, HT; C means C, HC.

(4) Function and action

- S0 specifies the output state word start address
- S1 specifies output state bit start address, occupies the relay S2~S2+3
- S2 specifies the axis group number
- When M0 is from OFF→ON, the axis group sepcified by S2 continues the motion according to the original curve
- After the command is executed, the single axis state of axis group (D20000+200*N) is 8, the axis group state (D46000+300*N) is 2

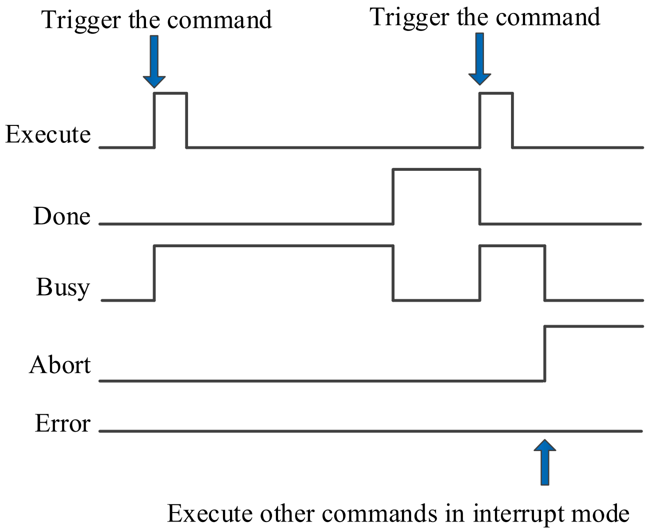
(5) Notes

- G_GOON must be used together with G_INTR, G_GOON can be used only after the axis group is suspended.
- G_GOON cannot make G_PATHMOV continues to move and can trigger G_PATHMOV instruction to realize continuous movement.
- G_GOON does not support buffer mode and other commands cannot be executed in buffer mode when G_GOON is running.
- The acceleration and deceleration when continuing the movement shall be carried out according to the original track.

(6) Related parameters

Output parameter	Parameter name	Data type	Unit	Note
S0	ErrCode	INT16U	-	Command error code
State parameter	Parameter name	Data type	Unit	Note
S1	Done	BOOL	-	Instruction execution completed
S1+1	Busy	BOOL	-	The instruction is being executed
S1+2	Abort	BOOL	-	Instruction is interrupted
S1+3	Error	BOOL	-	Instruction execution error
Axis number	Parameter name	Data type	Unit	Note
S2	Axis	INT16U	-	The axis group number starts from 0

(7) Sequence diagram



Explanation:
Generally, after the command is triggered, the Busy signal is set, reset after the command is completed, and the Done signal is set. Done is reset only after the command is triggered again, otherwise it will not be reset automatically.
When the instruction is interrupted or has an error, the corresponding Abort or Error signal is set, other signals are reset, and the corresponding error code will be output in case of error.

5-2-2-12. Specified path mode selection【G_PATHMODE】

(1) Overview

Specify the motion mode when the axis group path moves.

Specified path mode selection [G_PATHMODE]			
Execution condition	Rising/falling edge of the coil	Suitable model	XDH, XLH, XG2
Firmware	V3.7.1 and above	Software	V3.7.4 and above

(2) Operand

Operand	Function	Type
S0	Sepcify the input parameter start address	64-bit, four words
S1	Specify the output state word start address	16-bit, single word
S2	Specify the output state bit start address	Bit
S3	Specify axis output terminal number	16-bit, single word

(3) Suitable soft component

Operand	Word soft component											Bit soft component					
	System								Constant	Module		System					
	D*	FD	TD*	CD*	DX	DY	DM*	DS*	K/H	ID	QD	X	Y	M*	S*	T*	C*
S0	●	●	●	●													
S1	●	●	●	●													
S2														●			
S3	●								●								

*: D means D, HD; TD means TD and HTD; CD means CD, HCD, HSCD and HSD; DM means DM and DHM; DS means DS and DHS; M means M, HM, SM; S means S, HS; T means T, HT; C means C, HC.

(4) Function and action

- S0 specifies the input parameter start address
- S1 specifies the output state word start address
- S2 specifies output state bit start address
- S3 specifies the axis output terminal number
- When M0 is from OFF→ON, select the execution mode of PATHMOV, the mode is decided by the command parameter [mode selection] of PATHMODE.

(5) Notes

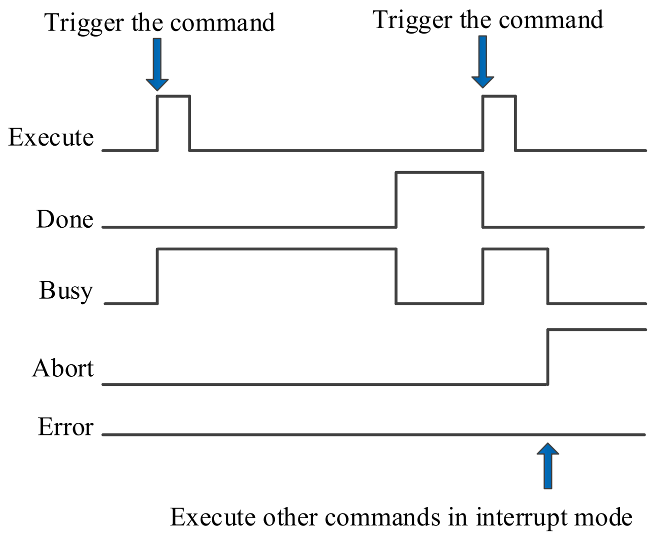
- When the mode is handwheel mode, the forward-looking parameters [handwheel maximum speed], [handwheel maximum acceleration], [handwheel high speed counting port], [handwheel pulse equivalent] in the axis group configuration need to be configured.
- In the handwheel mode, the hand pulse needs to be connected to the corresponding high-speed counting port, the PATHMOV command is triggered, the hand pulse is rotated, and the axis starts to move in the specified path.
- When the mode is not selected through this command, the PATHMOV command is executed in the automatic mode by default, that is, after the command is triggered, the axis will execute automatically according to the planned path.

(6) Related parameters

Input parameter	Parameter name	Data type	Unit	Note
S0	Mode	INT16U	Command unit/s	Mode selection 0: Automatic mode 1: Handwheel mode 2: Single step mode (V3.7.3 and above versions support single step)
Output parameter	**Parameter name**	**Data type**	**Unit**	**Note**
S1	ErrCode	INT16U	-	Command error code

State parameter	Parameter name	Data type	Unit	Note
S2	Done	BOOL	-	Instruction execution completed
S2+1	Busy	BOOL	-	The instruction is being executed
S2+2	Abort	BOOL	-	Instruction is interrupted
S2+3	Error	BOOL	-	Instruction execution error
Axis number	Parameter name	Data type	Unit	Note
S3	Axis	INT16U	-	Axis number starts from 0

(7) Sequence diagram



Explanation:
Generally, after the command is triggered, the Busy signal is set, reset after the command is completed, and the Done signal is set. Done is reset only after the command is triggered again, otherwise it will not be reset automatically.
When the instruction is interrupted or has an error, the corresponding Abort or Error signal is set, other signals are reset, and the corresponding error code will be output in case of error.

5-2-2-13. Select machining path【G_PATHSEL】

(1) Overview

Set the machining path, moves through the command G_PATHMOV.

Select machining path [G_PATHSEL]			
Execution condition	Rising/falling edge of the coil	Suitable model	XDH, XLH, XG2
Firmware	V3.6.1b and above	Software	V3.7.4 and above

(2) Operand

Operand	Function	Type
S0	Sepcify the input parameter start address	16-bit, single word
S1	Specify the output state word start address	16-bit, single word
S2	Specify the output state bit start address	Bit
S3	Specify axis group number	16-bit, single word

(3) Suitable soft component

Operand	Word soft component											Bit soft component					
	System								Constant	Module		System					
	D*	FD	TD*	CD*	DX	DY	DM*	DS*	K/H	ID	QD	X	Y	M*	S*	T*	C*
S0	●	●	●	●													
S1	●	●	●	●													
S2														●			
S3	●								●								

*: D means D, HD; TD means TD and HTD; CD means CD, HCD, HSCD and HSD; DM means DM and DHM; DS means DS and DHS; M means M, HM, SM; S means S, HS; T means T, HT; C means C, HC.

(4) Function and action

- S0 specifies the input parameter start address, occupies the register S0~S0+10+60*n, n is the data row numbers
- S1 specifies the output state word start address
- S2 specifies output state bit start address, occupies the relay S2~S2+3
- S3 specifies the axis group number
- When M0 is from OFF→ON, set the machining path as the set parameters, run the machining path through the command G_PATHMOV

(5) Related parameters

Input parameter	Parameter name	Data type	Unit	Note
S0	Quantity	INT16U	-	Data row numbers n
S0+1	Reload	INT16U	-	Reload 0: continue loading 1: reload
S0+10+60*(n-1)	Index	INT32U	-	The row number of this segment track data. The parameter value shall be greater than the previous row number and greater than 0.
S0+12+60*(n-1)	Type	INT16U	-	Data type 0: PTP 1: LINE 2: CIRCLR 90：ELLIPSE 91：BEZIER 100: user defined 200: end row
S0+13+60*(n-1)	Parameter1	INT16U	-	Parameter 1: When the type is 2 arc mode, it indicates the arc type: 0-three-point arc, 1-center

Input parameter	Parameter name	Data type	Unit	Note
				arc, 2-radius arc. When the type is 90 elliptical mode, it indicates the plane selection: 0-XOY plane, 1-ZOX plane, 2-YOZ plane. When the type is 91 Bessel curve, it represents the degree of the curve, p=2/3/4. When the type is 100 custom segments, it represents the serial number and is greater than or equal to 100. Other types are meaningless (specific configurations can be found in the newly added section of V3.7.3 below)
S0+14+60*(n-1)	Parameter2	INT16U		Parameter 2: When the type is 2 arc mode, parameter 1 arc type is set to 1-center arc, 2-radius arc, indicating: 0-inferior arc, 1-superior arc; When the type is 90, it indicates path selection, 0- clockwise, 1-counterclockwise. When the type is 91, it indicates the current control point number (starting from 2, with a maximum value of p+1). Other types are meaningless (specific configurations can be found in the newly added section of V3.7.3 below)
S0+15+60*(n-1)	Coordinatesystenm	INT16U	-	Coordinate system. Not supported at the moment
S0+16+60*(n-1)	PositionX	FP64	Command unit	X axis target position. N is data row numbers
S0+20+60*(n-1)	PositionY	FP64	Command unit	Y axis target position. N is data row numbers
S0+24+60*(n-1)	PositionZ	FP64	Command unit	Z axis target position. N is data row numbers
S0+28+60*(n-1)	PositionA	FP64	Command unit	A axis target position.
S0+32+60*(n-1)	PositionB	FP64	Command unit	B axis target position.
S0+36+60*(n-1)	PositionC	FP64	Command unit	C axis target position.
S0+40+60*(n-1)	AuxiliaryX	FP64	Command unit	X axis auxiliary point position. N is data row numbers. Only valid in data type CIRCLE
S0+44+60*(n-1)	AuxiliaryY	FP64	Command unit	Y axis auxiliary point position. N is data row numbers. Only valid in data type CIRCLE
S0+48+60*(n-1)	AuxiliaryZ	FP64	Command unit	Z axis auxiliary point position. N is data row numbers. Only valid in data type CIRCLE
S0+52+60*(n-1)	AuxiliaryA	FP64	Command unit	A axis auxiliary point position.
S0+56+60*(n-1)	AuxiliaryB	FP64	Command unit	B axis auxiliary point position. N is data row numbers
S0+60+60*(n-1)	AuxiliaryC	FP64	Command unit	C axis auxiliary point position. N is data row numbers
S0+64+60*(n-1)	Velocity	FP64	Command unit /s	Target speed
Output parameter	**Parameter name**	**Data type**	**Unit**	**Note**

Input parameter	Parameter name	Data type	Unit	Note
S1	ErrCode	INT16U	-	Command error code
State parameter	Parameter name	Data type	Unit	Note
S2	Done	BOOL	-	Instruction execution completed
S2+1	Busy	BOOL	-	The instruction is being executed
S2+2	Abort	BOOL	-	Instruction is interrupted
S2+3	Error	BOOL	-	Instruction execution error
Axis number	Parameter name	Data type	Unit	Note
S3	AxesGroup	INT16U	-	Axis group number starts from 0

- The speed set by the user is the parameter of the axis group. If the parameter set by the user is greater than the maximum parameter value of the axis group, it will be treated as the maximum parameter value of the axis group. If the parameter value set by the user is greater than the maximum parameter value of each single axis, the linear speed and other parameters of the axis group will be calculated based on the maximum parameter value of the single axis.
- The data row value must be greater than or equal to 0, but not exceed the remaining size of the buffer. The remaining size of the buffer can be determined by D46226. This register takes effect after the axis group is enabled.
- When the parameter is set to 0, the instruction execution will store the data in the buffer, when the G_PATHMOV instruction is executed, it will move with the data in the buffer. When the parameter is set to 1, the instruction execution will clear the data in the buffer and reload the current data. When the number of data rows is set to 0 and whether to reload is set to 1, instruction execution will empty the buffer. The remaining space of the buffer is determined by D46226+300*N.
- The row number is set by the customer, but the row number must be monotonically increasing, and the row number of the first line cannot be 0.
- When the data type is PTP, it will move separately at the default speed of each axis (the same as G_PTP).
- The data type 100 is a user-defined type. It takes effect when the set parameter is greater than 100. When the parameter is set to 1000 ~ 1999, it is a non-stop M code, that is, when moving to this point, the axis group will not stop moving and continue to execute the next track. The M code will follow the previous track and be stored in the corresponding register. When the parameter is not within the range of 1000 ~ 1999, this point is non-motion. When the command is executed to this point, it will stop and set on M28010. Manually set M28010 to off and continue to execute the following points.
- If the data type is set to 200, it indicates the end row of the current behavior, G_PATHSELcan be loaded multiple times, or all points can be set for loading at one time. New point can be loaded when G_PATHSEL is running, and setting the data type to 200 indicates the end of operation. Executing G_PATHSEL must have a end row.
- The auxiliary point parameter is valid only when the data type is CIRCLE.
- Effective parameter configuration for three-point arc mode:
  S0+0: INT16U, number of data rows
  S0+1: INT16U, data reloading (0- continue insertion, 1- reload)
  S0+10+60 * (n-1): INT32U, line number (monotonically increasing)
  S0+12+60 * (n-1): INT16U, type (2-circle)
  S0+13+60 * (n-1): INT16U, arc type (0-three-point arc)
  S0+15+60 * (n-1): INT16U, coordinate system selection (not currently supported)
  S0+16, 20, 24+60 * (n-1): FP64, target positions X, Y, Z
  S0+28, 32, 36+60 * (n-1): FP64, target positions A, B, C
  S0+40, 44, 48+60 * (n-1): FP64, auxiliary point positions X, Y, Z
  S0+64+60 * (n-1): FP64, target speed

Note: The three points of a three-point arc are the current point, auxiliary point, and endpoint. The arc will pass through the auxiliary point and finally reach the endpoint position. The three points cannot be on the same line and do not support the entire circle (i.e. the current point and endpoint are the same point).

- New features added in V3.7.3 and above:

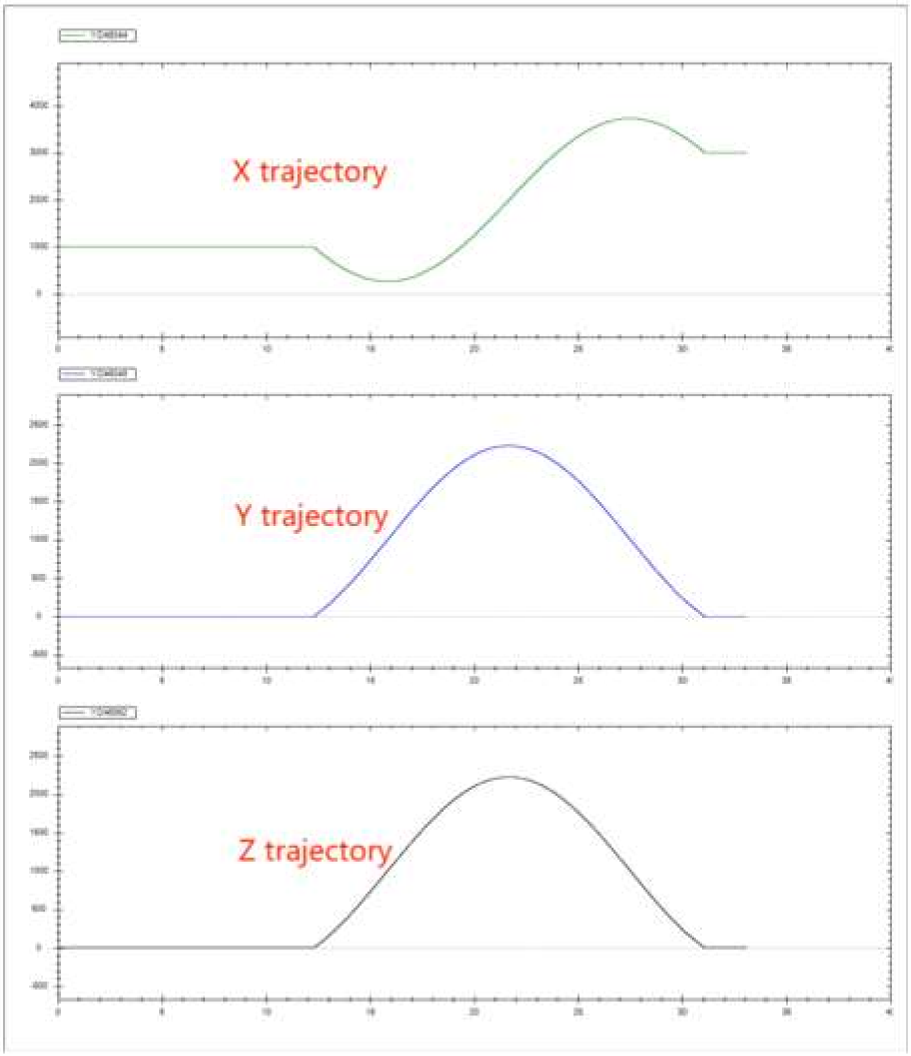
1) New arc types added in arc mode: 1- Center arc; 2- radius arc; 3- radius plus rotation, specific introduction as follows:

   ① Effective parameter configuration for center mode:

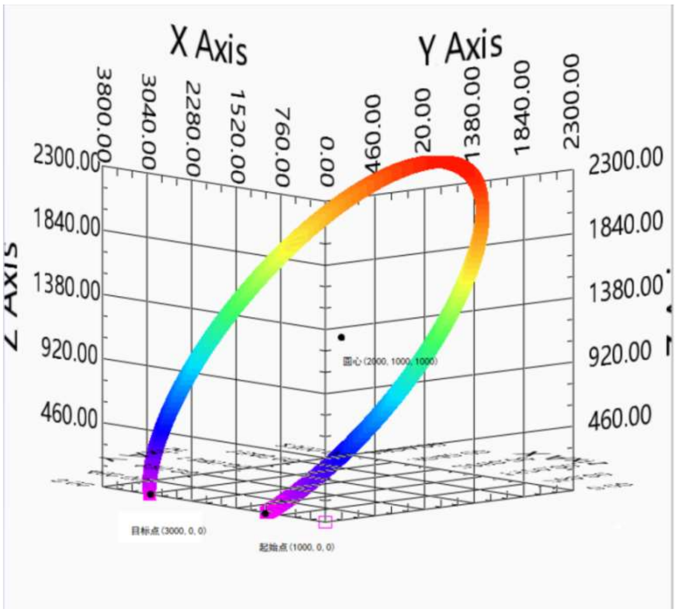
S0+0: INT16U, number of data rows
S0+1: INT16U, data reloading (0- continue insertion, 1- reload)
S0+10+60 * (n-1): INT32U, line number (monotonically increasing)
S0+12+60 * (n-1): INT16U, type (2-circle)
S0+13+60 * (n-1): INT16U, arc type (1)
S0+14+60 * (n-1): INT16U, path selection: 0-inferior arc 1-superior arc
S0+15+60 * (n-1): INT16U, coordinate system selection (not currently supported)
S0+16, 20, 24+60 * (n-1): FP64, target positions X, Y, Z
S0+28, 32, 36+60 * (n-1): FP64, target positions A, B, C
S0+40, 44, 48+60 * (n-1): FP64, center position X, Y, Z
S0+64+60 * (n-1): FP64, target speed

Note: The arc of this method instruction is smaller than the entire circle and cannot be a semicircle.

For example: starting point position (1000,0,0), center position (200010001000), endpoint position (3000,0,0), select the optimal arc. The three-axis running trajectory is as follows:



The Labview synthesis trajectory is as follows:



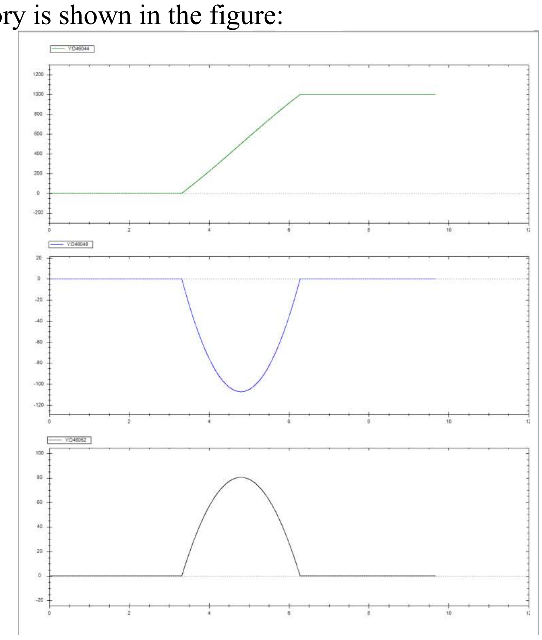
② Effective parameter configuration for radius mode:
S0+0: INT16U, number of data rows
S0+1: INT16U, data reloading (0- continue insertion, 1- reload)
S0+10+60 * (n-1): INT32U, line number (monotonically increasing)
S0+12+60 * (n-1): INT16U, type (2-circle)
S0+13+60 * (n-1): INT16U, arc type (2)
S0+14+60 * (n-1): INT16U, path selection: 0-inferior arc 1-superior arc
S0+15+60 * (n-1): INT16U, coordinate system selection (not currently supported)
S0+16, 20, 24+60 * (n-1): FP64, target positions X, Y, Z
S0+28, 32, 36+60 * (n-1): FP64, target positions A, B, C
S0+40, 44, 48+60 * (n-1): FP64, normal vectors X, Y, Z
S0+64+60 * (n-1): FP64, target speed

Note: The method knows that the arc is smaller than the entire circle, and the length of the normal vector is the radius length. The direction of rotation is determined by the direction of the normal vector.

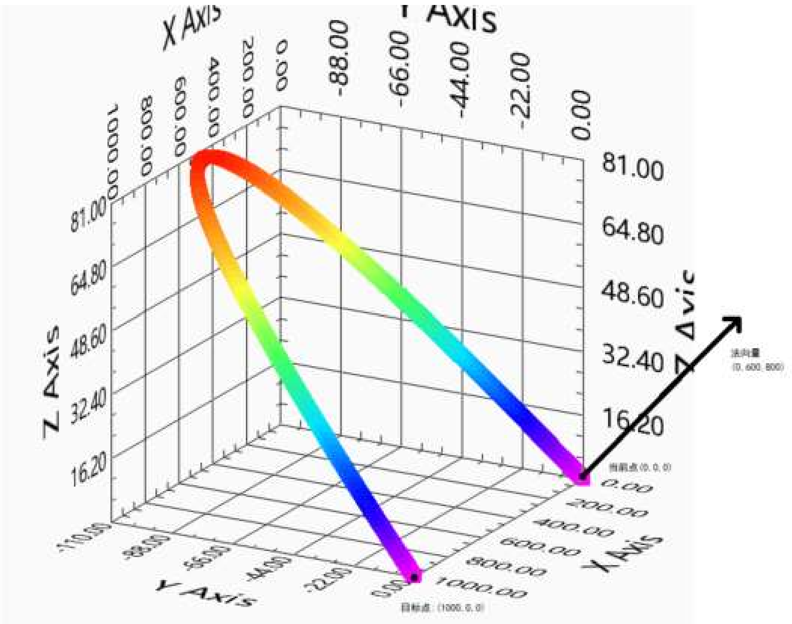
For example: starting point position (0,0,0), ending point position (1000,0,0), normal vector position (0600800), select the inferior arc.

Running result: radius=$\sqrt{0^2+600^2+800^2}$=1000, the direction of rotation determined by the normal vector is counterclockwise.

The XYZ operation trajectory is shown in the figure:



The Labview synthesis trajectory is as follows:



2) PATHSEL new type: 90- Elliptical interpolation
When selecting elliptical interpolation
S0+0: INT16U, number of data rows
S0+1: INT16U, data reloading (0- continue insertion, 1- reload)
S0+10+60 * (n-1): INT32U, line number (monotonically increasing)
S0 + 12+ 60 *(n-1): INT16U, types of (90-ELLIPSE)
S0+13+60 * (n-1): INT16U, representing plane selection (0-XOY plane, 1-ZOX plane, 2-YOZ plane)
S0+14+60 * (n-1): INT16U, indicating path selection (0-clockwise, 1-counterclockwise)
S0+16, 20, 24+60 * (n-1): FP64, target positions X, Y, Z
S0+28, 32, 36+60 * (n-1): FP64, target positions A, B, C
S0+40, 44, 48+60 * (n-1): FP64, representing the positions X, Y, and Z of the rotation center (depending on the plane selection, for example, the XOY plane only takes the X and Y positions)
S0+52, 56, 60+60 * (n-1): FP64, representing major half axis, minor half axis, and rotation angle (in degrees)
S0+64+60 * (n-1): FP64, target speed
S0+68+60 * (n-1): INT16U, representing the rotation center position mode (0-relative, 1-absolute)
Note:
① S0+68+60 * (n-1): The rotation center position mode is effective for the rotation center.
② The detailed functions and use cases of ellipses can be found in 5-2-16 Ellipse Interpolation.

3) PATHSEL new type: 91 Bessel interpolation
When selecting Bessel interpolation
S0+0: INT16U, number of data rows
S0+1: INT16U, data reloading (0- continue insertion, 1- reload)
S0+10+60 * (n-1): INT32U, line number (monotonically increasing)
S0+12+60 * (n-1): INT16U, type (91-BEZIER)
S0+13+60 * (n-1): INT16U, representing the degree of curve, (p=2/3/4)
S0+14+60 * (n-1): INT16U, indicating the current control point number (starting from 2, with a maximum of p+1, and each line being 1 larger than the previous line)
S0+15+60 * (n-1): INT16U, coordinate system selection (not currently supported)
S0+16, 20, 24+60 * (n-1): FP64, representing X, Y, Z of the Nth control point (N=2~P)
S0+64+60 * (n-1): FP64, target speed

Note:

① Ellipse and Bessel interpolation are used as prospective segments, but path smoothing is not performed. They only participate in acceleration and deceleration parameter limitations and node speed calculations.

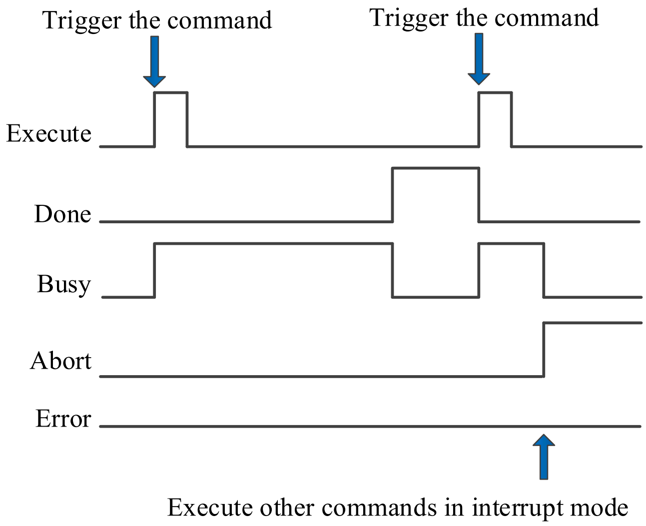
② When the type is Bessel interpolation, multiple rows of input are used, with each row containing control point information (including control point numbers and positions), and the curve is divided into as many rows of input as needed. And during this period, other types cannot be inserted until all control point information for Bessel interpolation is entered, otherwise an error will be reported.

③ When the type is Bessel interpolation and the degree of the curve is p, there are a total of p+1 control points, which are inputted in p rows. Taking p=2 as an example, the control point number entered in the first row is 2 (because the default starting point position is the first control point), and the control point number entered in the second row is 3.

④ When the type is Bessel interpolation, except for the first row where all parameters need to be accurately entered (i.e. when entering the second control point), the remaining row numbers, current control point numbers, and control point target positions (X, Y, Z) will not take effect.

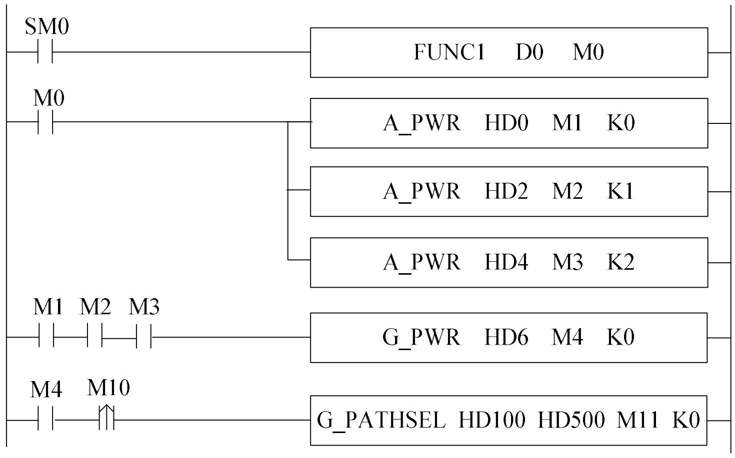
⑤ Detailed functions and use cases of Bessel can be found in 5-2-22 Bessel interpolation.

(6) Sequence diagram



Explanation:
Generally, after the command is triggered, the Busy signal is set, reset after the command is completed, and the Done signal is set. Done is reset only after the command is triggered again, otherwise it will not be reset automatically.
When the instruction is interrupted or has an error, the corresponding Abort or Error signal is set, other signals are reset, and the corresponding error code will be output in case of error.

(7) Application
Load 3 rows of data (the third row is end row). The ladder diagram is as the following:



Among them, FUNC1 is to set the value for command G_PATHSEL. When M0 is on, each axis of axis group is enabled, after all three axis enable are turned on successfully (M1, M2 and M3 are on), the axis group is enabled. After the axis group is enabled successfully (M4 is on), M10 is from off → on, G_PATHSEL instruction is triggered. The instruction can load all points in a single time or a certain number of points in multiple times, but there must be at least one end row to execute G_PATHMOV.

Single time loading:

```
void FUNC1( WORD W , BIT B )
{
#define SysRegAddr_HD_D_HM_M
#define DFHD *(FP64*)&HD

//set value for G_PATHSEL
HD[100] = 3;//data row numbers
HD[101] = 0;//0: continue insert  1:reload

HD[110] = 1;//row number 1
HD[112] = 1;//type (0:PTP 1:LINE 2:CIRCLE 100:user defined 200:end row)
HD[113] = 0;//parameter
DFHD[116] = 100000;//target position X
DFHD[120] = 100000;//target position Y
DFHD[124] = 0;//target position Z
DFHD[164] = 20000;//target speed

HD[170] = 2;//row number 2
HD[172] = 1;//type (0:PTP 1:LINE 2:CIRCLE 100:user defined 200:end row)
HD[173] = 0;//parameters
DFHD[176] = 200000;//target position X
DFHD[180] = 150000;//target position Y
DFHD[184] = 0;//target position Z
DFHD[224] = 20000;//target speed

HD[230] = 3;//row number 3
HD[232] = 200;//type (0:PTP 1:LINE 2:CIRCLE 100:user defined 200:end row)
HD[233] = 0;//parameters
```

After setting the parameters, trigger the command G_PATHSEL to load 3 rows of data.

Multiple loading:

```
void FUNC1( WORD W , BIT B )
{
#define SysRegAddr_HD_D_HM_M
#define DFHD *(FP64*)&HD //DFHD represents double precision floating-point HD register

//set value for G_PATHSEL
HD[100] = 1;//data row numbers
HD[101] = 0;//0: continue insert  1:reload

HD[110] = 1;//row number 1
HD[112] = 1;//type (0:PTP 1:LINE 2:CIRCLE 100:user defined 200:end row)
HD[113] = 0;//parameter
DFHD[116] = 100000;//target position X
DFHD[120] = 100000;//target position Y
DFHD[124] = 0;//target position Z
DFHD[164] = 20000;//target speed
```

Set the data row to 1, execute command G_PATHSEL to load one point, then modify the command parameters.

```
void FUNC1( WORD W , BIT B )
{
#define SysRegAddr_HD_D_HM_M
#define DFHD *(FP64*)&HD //DFHD represents double precision floating-point HD register

//set value for G_PATHSEL
HD[100] = 2;//data row numbers
HD[101] = 0;//0: continue insert  1:reload

HD[110] = 2;//row number 2
HD[112] = 1;//type (0:PTP 1:LINE 2:CIRCLE 100:user defined 200:end row)
HD[113] = 0;//parameter
DFHD[116] = 200000;//target position X
DFHD[120] = 150000;//target position Y
DFHD[124] = 0;//target position Z
DFHD[164] = 20000;//target speed

HD[170] = 3;//row number 3
HD[172] = 200;//type (0:PTP 1:LINE 2:CIRCLE 100:user defined 200:end row)
HD[173] = 0;//parameters
```

The data row numbers are 2, the row number starts from 2 (larger than the first row number), trigger the command G_PATHSEL again to load two points, that is, 3 rows of data are loaded.

5-2-2-14. Path motion【G_PATHMOV】

(1) Overview

The axis group will move as the path specified by G_PATHSEL.

Path motion [G_PATHMOV]			
Execution condition	Rising/falling edge of the coil	Suitable model	XDH, XLH, XG2
Firmware	V3.6.1b and above	Software	V3.7.4 and above

(2) Operand

Operand	Function	Type
S0	Specify the input parameter start address	16-bit, single word
S1	Specify the output state word start address	16-bit, single word
S2	Specify the output position start address	32-bit, double words
S3	Specify the output state bit start address	Bit
S4	Specify the axis group number	16-bit, single word

(3) Suitable soft component

Operand	Word soft component											Bit soft component					
	System								Constant	Module		System					
	D*	FD	TD*	CD*	DX	DY	DM*	DS*	K/H	ID	QD	X	Y	M*	S*	T*	C*
S0	●	●	●	●													
S1	●	●	●	●													
S2	●	●	●	●													
S3														●			
S4	●								●								

*: D means D, HD; TD means TD and HTD; CD means CD, HCD, HSCD and HSD; DM means DM and DHM; DS means DS and DHS; M means M, HM, SM; S means S, HS; T means T, HT; C means C, HC.

(4) Function and action

```
                        (S0) (S1)  (S2) (S3)(S4)
     M0
 |---|↑|--------[G_PATHMOV HD0 HD5 HD10 M1 K0]-|
```

- S0 specifies the input parameter start address, occupies the register S0~S0+1
- S1 specifies the output state word start address
- S2 specifies the output position start address, occupies the register S2~S2+79
- S3 specifies the output state bit start address, occupies the relay S3~S3+4
- S4 specifies the axis group number
- When M0 is from OFF→ON, it will move as the path specified by G_PATHSEL
- After executing the command, the single axis state of axis group (D20000+200*N) is 8, the axis group state (D46000+300*N) is 2.

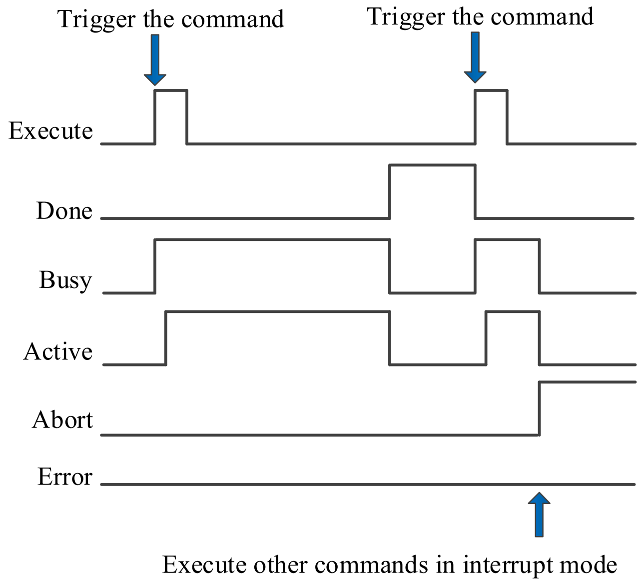
(5) Related parameters

Input parameter	Parameter name	Data type	Unit	Note
S0	Coordinatesystemn	INT16U	-	Coordinate system. Not supported at the moment
S0+1	BufferMode	INT16U	-	Buffer mode 0: interrupt mode 1: buffer mode
Output parameter	Parameter name	Data type	Unit	Note
S1	ErrCode	INT16U	-	Command error code
Position output	Parameter name	Data type	Unit	Note
S2	Row 1	INT32U	-	Row 1
S2+2	PositionX	FP32	Command unit	History location X1
S2+4	PositionY	FP32	Command unit	History location Y1
S2+6	PositionZ	FP32	Command unit	History location Z1
Position output	Parameter name	Data type	Unit	Note

S2+8	PositionA	FP32	Command unit	History location A1
S2+10	PositionB	FP32	Command unit	History location B1
S2+12	PositionC	FP32	Command unit	History location C1
....				
S2+126	Row 10	INT32U	-	Row 10
S2+128	PositionX	FP32	Command unit	History location X10
S2+130	PositionY	FP32	Command unit	History location Y10
S2+132	PositionZ	FP32	Command unit	History location Z10
S2+134	PositionA	FP32	Command unit	History location A10
S2+136	PositionB	FP32	Command unit	History location B10
S2+138	PositionC	FP32	Command unit	History location C10
S2+140	Next running row 11	INT32U	-	Row 11
S2+142	X11	FP32	Command unit	Ready to run position X11
S2+144	Y11	FP32	Command unit	Ready to run position Y11
S2+146	Z11	FP32	Command unit	Ready to run position Z11
S2+148	A11	FP32	Command unit	Ready to run position A11
S2+150	B11	FP32	Command unit	Ready to run position B11
S2+152	C11	FP32	Command unit	Ready to run position C11
S2+154	M code 1	INT16U	-	9999: no M code 1000-1999: non-stop M code Others are stop M code
S2+155	M code 2	INT16U	-	
S2+156	M code 3	INT16U	-	
S2+157	M code 4	INT16U	-	
S2+158	M code 5	INT16U	-	
S2+159	M code 6	INT16U	-	
S2+160	M code 7	INT16U	-	
S2+161	M code 8	INT16U	-	
S2+162	M code 9	INT16U	-	
State parameter	Parameter name	Data type	Unit	Note
S3	Done	BOOL	-	Instruction execution completed
S3+1	Busy	BOOL	-	The instruction is being executed
S3+2	Active	BOOL	-	The instruction is under control
S3+3	Abort	BOOL	-	Instruction is interrupted
S3+4	Error	BOOL	-	Instruction execution error
Axis number	Parameter name	Data type	Unit	Note
S4	Axis	INT16U	-	Axis group number starts from 0

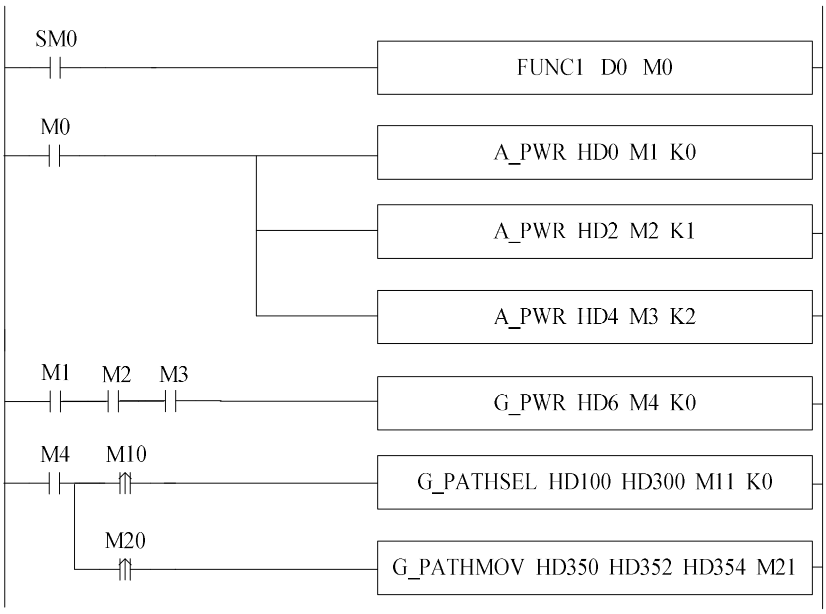
- The output position data will record the points that have been executed. The point recording starts from the historical record position 10. When there is a new point recording, the historical point will be moved up, that is, after executing G_PATHSEL, the point of row number 1 in pathsel instruction is recorded in S2 + 72 ~ S2 + 78. After executing the point of row number 2, move the originally recorded point to S2 + 64 ~ S2 + 70, and write the new point to S2 + 72 ~ S2 + 78, and so on.
- G_PATHMOV can be paused by command G_INTR, but it cannot continue moving through the command G_GOON. Execute the command G_PATHMOV again to continue the original motion (other axis group commands can be executed in the pause process).
- G_PATHMOV is different from other motion commands, the command is affected by forward-looking parameters, and the connection between curves is smoother.
- For the data to be run, the interface only displays one row of data, but it will actually occupy more registers later. The instruction output parameters need about 440 registers in total. Please avoid them during planning to prevent data conflict.

(6) Sequence diagram



Explanation:
Generally, after the command is triggered, the Busy and Active signals are set, and reset after the command is completed. At the same time, the Done signal is set. Done will reset only after the command is triggered again, otherwise it will not reset automatically.
When the instruction is triggered in the buffer mode and there are currently instructions being executed, the Active signal will be set immediately. The execution of the current instruction ends. When the instruction is executed, the Busy signal will be set. After the execution of the instruction ends, the Busy and Active signals will be reset and the Done signal will be set.
When a new instruction is triggered in interrupt mode during instruction execution, the Busy and Active signals are reset immediately and the Abort signal is set.
When there is an error in the command, the Error signal is set, other signals are reset, and the corresponding error code is output.

(7) Application
① make the ladder diagram



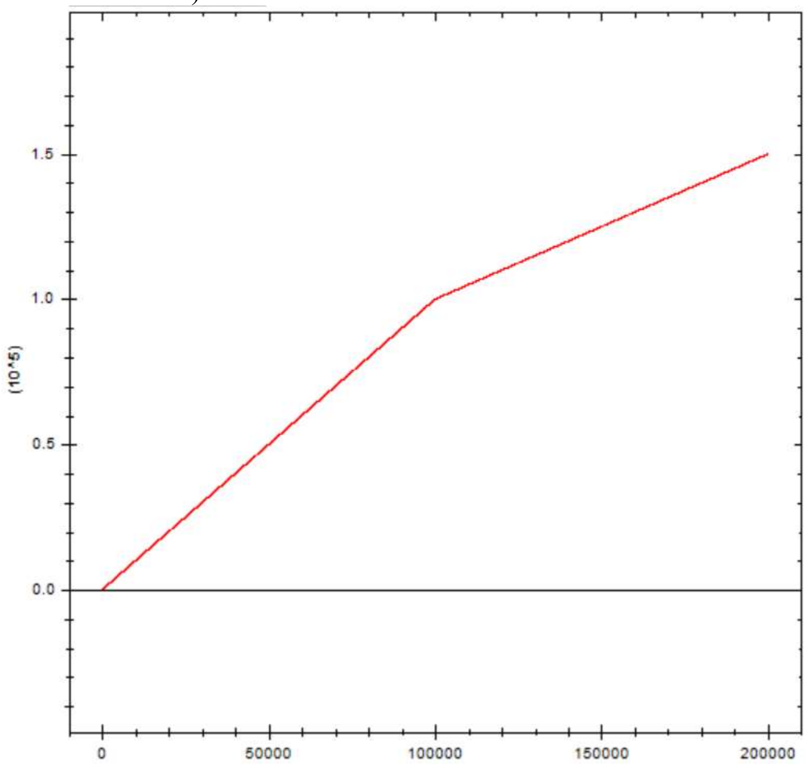
FUNC1 is used to set the value for the command G_PATHSEL, M0 turns on each axis enable, when the three axes are enabled (M1, M2, M3 are ON, turns on the axis group enable. After the axis group enabled (M4 is ON). When M10 is ON, the command G_PATHSEL is executed. When command completion flag M11 is ON, set ON M20 to trigger the command G_PATHMOV.

② set the value for G_PATHSEL (right click the command to set the value, or set the value through C program):

```
void FUNC1( WORD W , BIT B )
{
#define SysRegAddr_HD_D_HM_M
#define DFHD *(FP64*)&HD //DFHD represents double precision floating-point HD register

//set value for G_PATHSEL
HD[100] = 3;//data row numbers
HD[101] = 0;//0: continue insert  1:reload

HD[110] = 1;//row number 1
HD[112] = 1;//type (0:PTP 1:LINE 2:CIRCLE 100:user defined 200:end row)
HD[113] = 0;//parameter
DFHD[116] = 100000;//target position X
DFHD[120] = 100000;//target position Y
DFHD[124] = 0;//target position Z
DFHD[164] = 20000;//target speed


HD[170] = 2;//row number 2
HD[172] = 1;//type (0:PTP 1:LINE 2:CIRCLE 100:user defined 200:end row)
HD[173] = 0;//parameters
DFHD[176] = 200000;//target position X
DFHD[180] = 150000;//target position Y
DFHD[184] = 0;//target position Z
DFHD[224] = 20000;//target speed

HD[230] = 3;//row number 3
HD[232] = 200;//type (0:PTP 1:LINE 2:CIRCLE 100:user defined 200:end row)
HD[233] = 0;//parameters
```

The instruction demonstrated in this example is the path planning movement of XY axis (the axis group type only supports XYZ type, and the axis group of XY axis can be realized by setting the corresponding axis configuration of Z axis as virtual axis). The planning path is two lines, and the movement amount of each turn of X and Y axes is 10000. Assign values to the parameters as shown in the figure and trigger G_PATHSEL command can insert into the point, the first point is (100000,100000), the second point is (200000, 150000), and the running speed of the axis group is 20000 command unit/s.

③ The operation track of the axis group is shown in the figure below (where the x-axis position is the abscissa and the y-axis position is the ordinate):



5-2-2-15. Modify the multiplying power【G_SETOVRD】

(1) Overview

Modify the multiplying power of the parameters.

Modify the multiplying power [G_SETOVRD]			
Execution condition	Rising/falling edge of the coil	Suitable model	XDH, XLH, XG2
Firmware	V3.6.1b and above	Software	V3.7.4 and above

(2) Operand

Operand	Function	Type
S0	Specify the input parameter start address	64-bit, four words
S1	Specify the output state word start address	16-bit, single word
S2	Specify the output state bit start address	Bit
S3	Specify the axis group number	16-bit, single word

(3) Suitable soft component

Operand	Word soft component											Bit soft component					
	System								Constant	Module		System					
	D*	FD	TD*	CD*	DX	DY	DM*	DS*	K/H	ID	QD	X	Y	M*	S*	T*	C*
S0	●	●	●	●													
S1	●	●	●	●													
S2														●			
S3	●								●								

*: D means D, HD; TD means TD and HTD; CD means CD, HCD, HSCD and HSD; DM means DM and DHM; DS means DS and DHS; M means M, HM, SM; S means S, HS; T means T, HT; C means C, HC.

(4) Function and action

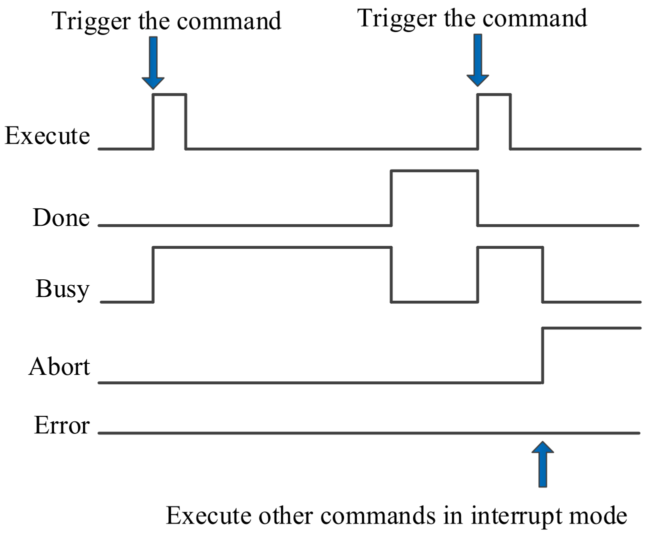
- S0 specifies the input parameter start address, occupies the register S0~S0+11
- S1 specifies the output state word start address
- S2 specifies the output state bit start address, occupies the relay S2~S2+3
- S3 specifies the axis group number
- When M0 is from OFF→ON, the axis group specified by S3 will modify the multiplying power of speed, acceleration, jerk speed as user setting
- When the speed ratio exceeds 200%, the system takes effect according to the maximum 200%
- It only takes effect in the motion process of G_PATHMOV

(5) Related parameters

Input parameter	Parameter name	Data type	Unit	Note
S0	VelFactor	FP64	%	The target speed multiplier cannot be less than 1%. When the set value is less than 1%, it will be treated as 1% (excluding 0. If the speed multiplier is set to 0, an error code will be returned)
S0+4	AccFactor	FP64	-	Target acceleration magnification (not supported temporarily)
S0+8	JerkFactor	FP64	-	Target jerk speed magnification (not supported temporarily)
Output parameter	**Parameter name**	**Data type**	**Unit**	**Note**
S1	ErrCode	INT16U	-	Command error code
State parameter	**Parameter name**	**Data type**	**Unit**	**Note**
S2	Done	BOOL	-	Instruction execution is completed
S2+1	Busy	BOOL	-	Instruction is being executed
S2+2	Abort	BOOL	-	Instruction is interrupted
S2+3	Error	BOOL	-	Instruction execution error

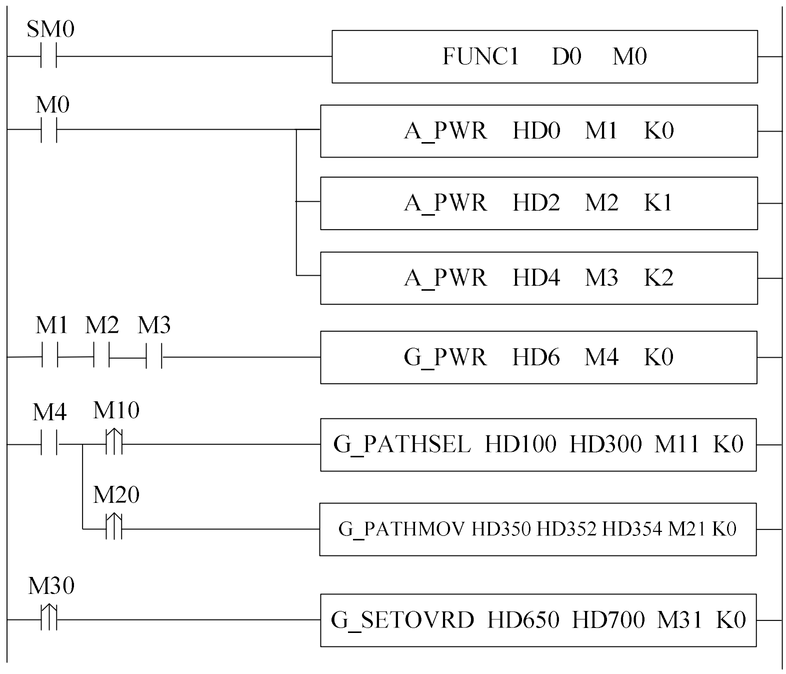
Axis number	Parameter name	Data type	Unit	Note
S3	Axis	INT16U	-	Axis group number starts from 0

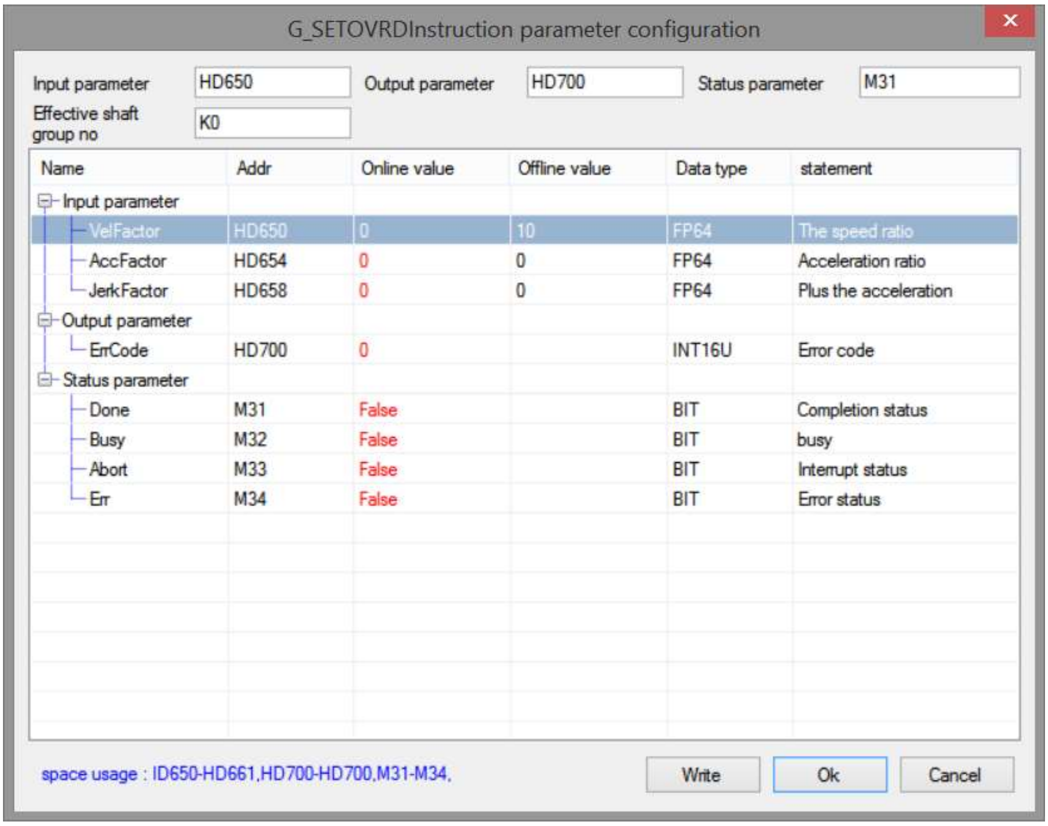
(6) Sequence diagram



Explanation:
Generally, after the command is triggered, the Busy signal is set, reset after the command is completed, and the Done signal is set. Done is reset only after the command is triggered again, otherwise it will not be reset automatically.
When the instruction is interrupted or has an error, the corresponding Abort or Error signal is set, other signals are reset, and the corresponding error code will be output in case of error.

(7) Application
The running speed of G_PATHMOV instruction becomes one tenth of the original speed, and the ladder diagram is as follows:



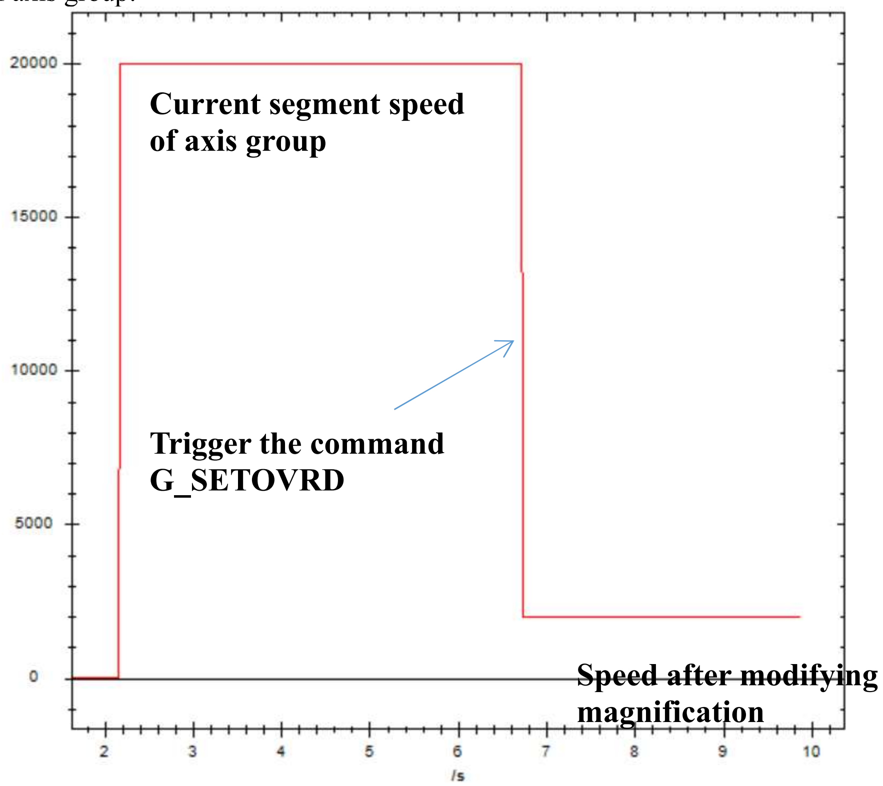


Name	Addr	Online value	Offline value	Data type	statement
Input parameter					
VelFactor	HD650	0	10	FP64	The speed ratio
AccFactor	HD654	0	0	FP64	Acceleration ratio
JerkFactor	HD658	0	0	FP64	Plus the acceleration
Output parameter					
ErrCode	HD700	0		INT16U	Error code
Status parameter					
Done	M31	False		BIT	Completion status
Busy	M32	False		BIT	busy
Abort	M33	False		BIT	Interrupt status
Err	M34	False		BIT	Error status

Explanation:

The running speed of G_PATHMOV is changed to one tenth of the original speed, that is, the speed magnification is 10%. In this example, G_PATHSEL and G_PATHMOV instruction configurations is the same as G_PATHMOV application example, refer to chapter 5-2-2-8. When G_PATHMOV is in normal operation, the axis group speed can be changed through G_SETOVRD. The speed parameter of the axis group is D46116+300*N. (Note: the modified magnification is based on the target speed of G_PATHMOV, that is, the speed of the current operating section of G_PATHMOV is 20000, the speed magnification is 10%, and the speed of the axis group becomes 2000 after the command is triggered).

The speed curve of axis group:



5-2-2-16. Ellipse interpolation【G_ELLIPSE】

(1) Overview

Elliptical interpolation motion control for specified axis group.

Ellipse interpolation [G_ELLIPSE]			
Execution condition	Rising/falling edge of the coil	Suitable model	XDH, XLH, XG2
Firmware	V3.7.2 and above	Software	V3.7.14 and above

(2) Operand

Operand	Function	Type
S0	Specify the input parameter start address	64-bit, four words
S1	Specify the output state word start address	16-bit, single word
S2	Specify the output state bit start address	Bit
S3	Specify the axis output terminal	16-bit, single word

(3) Suitable soft component

Operand	Word soft component											Bit soft component					
	System								Constant	Module		System					
	D*	FD	TD*	CD*	DX	DY	DM*	DS*	K/H	ID	QD	X	Y	M*	S*	T*	C*
S0	●	●	●	●													
S1	●	●	●	●													
S2														●			
S3	●								●								

*: D means D, HD; TD means TD and HTD; CD means CD, HCD, HSCD and HSD; DM means DM and DHM; DS means DS and DHS; M means M, HM, SM; S means S, HS; T means T, HT; C means C, HC.

(4) Function and action

- S0 specifies the input parameter start address, occupies the register S0~S0+79
- S1 specifies the output state word start address
- S2 specifies the output state bit start address, occupies the relay S2~S2+4
- S3 specifies the axis terminal

(5) Note

- Determination of rotation center
  - Rotation center position mode: relative
  - Absolute position=rotation center+starting point position
  - Rotation center position mode: absolute
  - The user directly specifies the absolute position
- Determination of long axis and short axis (the length is the length of semi-long axis and semi-short axis)
  - XOY plane: the long axis is on the X axis
  - YOZ plane: the long axis is on the Y axis
  - ZOX plane: the long axis is on the Z axis
- If the long axis should be on the Y axis in the XOY plane, the rotation angle should be set to 90, or – 90.
- The user can also set other rotation angles so that there is a certain angle between the ellipse and the axis. The counterclockwise rotation angle is positive, and the clockwise rotation angle is negative.
- The consistent trajectory of the starting point and the ending point is the whole ellipse.
- At present, only plane interpolation is supported.
- New forward-looking planning, affected by inflection point acceleration.

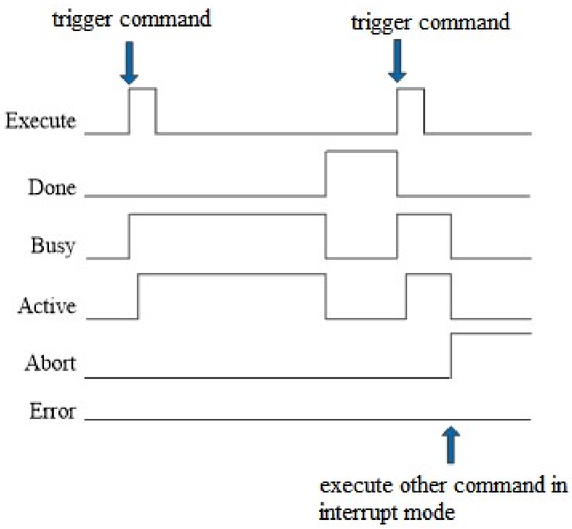
(6) Related parameters

Input parameter	Parameter name	Data type	Unit	Note
S0	Mode	INT16U	-	Path choice 0-clockwise 1-counterclockwise
S0+1	PathSelected	INT16U	-	Plane selection 0-XOY plane

				1-ZOX plane 2-YOZ plane
S0+2	MotionMode	INT16U	-	Rotation center position mode 0-relative 1-absolute
S0+4	A	FP64	Command unit	Long axis
S0+8	B	FP64	Command unit	Short axis
S0+12	Theta	FP64	-	Rotation angle
S0+16	AuxX	FP64	Command unit	Rotation center X
S0+20	AuxY	FP64	Command unit	Rotation center Y
S0+24	AuxZ	FP64	Command unit	Rotation center Z
S0+28	PosX	FP64	Command unit	Target point X
S0+32	PosY	FP64	Command unit	Target point Y
S0+36	PosZ	FP64	Command unit	Target point Z
S0+40	PosA	FP64	Command unit	Target point A
S0+44	PosB	FP64	Command unit	Target point B
S0+48	PosC	FP64	Command unit	Target point C
S0+52	Vel	FP64	Command unit /s	Speed
S0+56	Acc	FP64	Command unit /s^2	Acceleration
S0+60	Dec	FP64	Command unit /s^2	Deceleration
S0+64	Jerk	FP64	Command unit /s^3	Jerk speed
S0+68	CoordinateSystem	INT16U	-	Coordinate system. Not supported temporarily
S0+69	BufferMode	INT16U	-	Buffer mode 1: interrupt 2: buffer
S0+70	TransitionMode	INT16U	-	Transition method. Currently, only speed transition is supported
S0+72	EndVel	FP64	Command unit /s	End speed. Not supported temporarily
S0+76	TransitionVel	FP64	Command unit /s	Transition speed
Output parameter	Parameter name	Data type	Unit	Note
S1	ErrCode	INT16U	-	Command error code
State parameter	Parameter name	Data type	Unit	Note
S2	Done	BOOL	-	Command execution completed
S2+1	Busy	BOOL	-	Instruction is executing
S2+2	Active	BOOL	-	Command under control
S2+3	Abort	BOOL	-	Instruction interrupted
S2+4	Error	BOOL	-	Command execution error
Axis number	Parameter name	Data type	Unit	Note

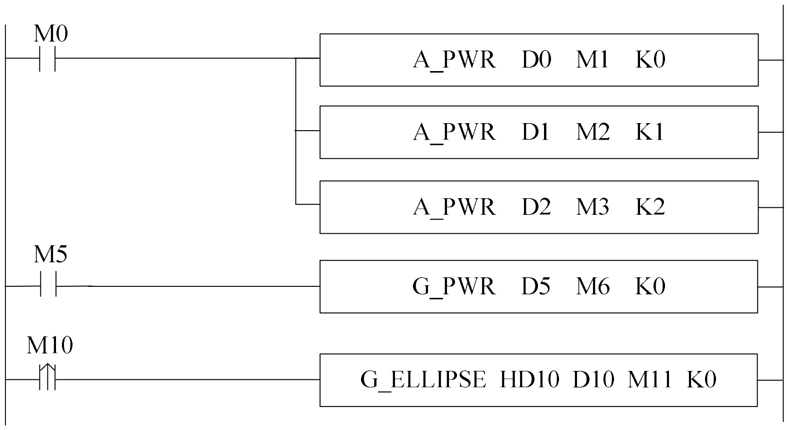
S3	Axis	INT16U	-	Axis number starts from 0

(7) Sequence diagram

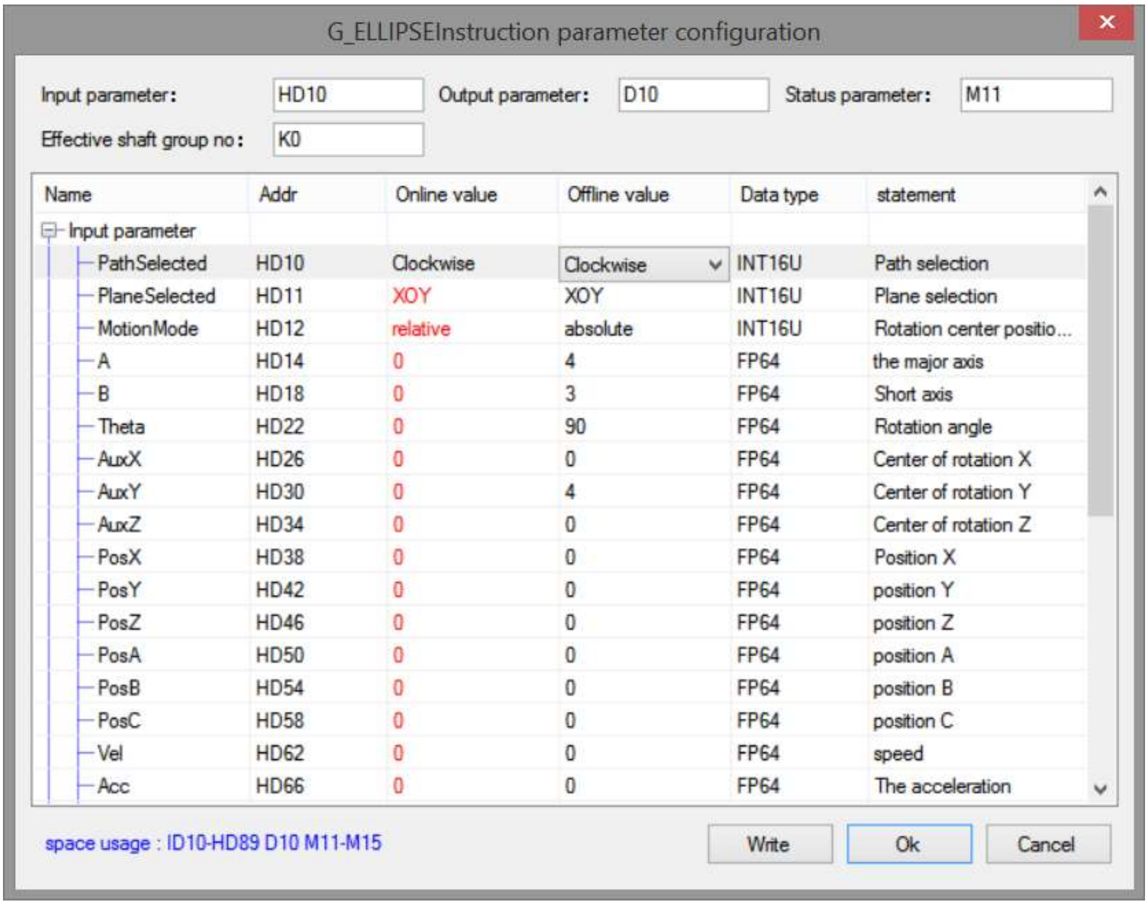


Explanation:
In general, after the command is triggered, Busy and Active signals are set ON, and reset after the command is executed. At the same time, the Done signal is set ON. Only after the command is triggered again can Done be reset, otherwise it will not be reset automatically.
When the instruction is triggered in cache mode and there is currently an instruction being executed, the Busy signal will be set ON immediately. When the current instruction is executed, the Active signal will be set ON. When the instruction is executed, the Busy and Active signals will be reset and the Done signal will be set ON.
During the execution of the command, if a new command is triggered in the interrupt mode, the Busy and Active signals are immediately reset and the Abort signal is set ON.
When there is an error in the command, the Error signal is set ON, other signals are reset, and the corresponding error code is output.

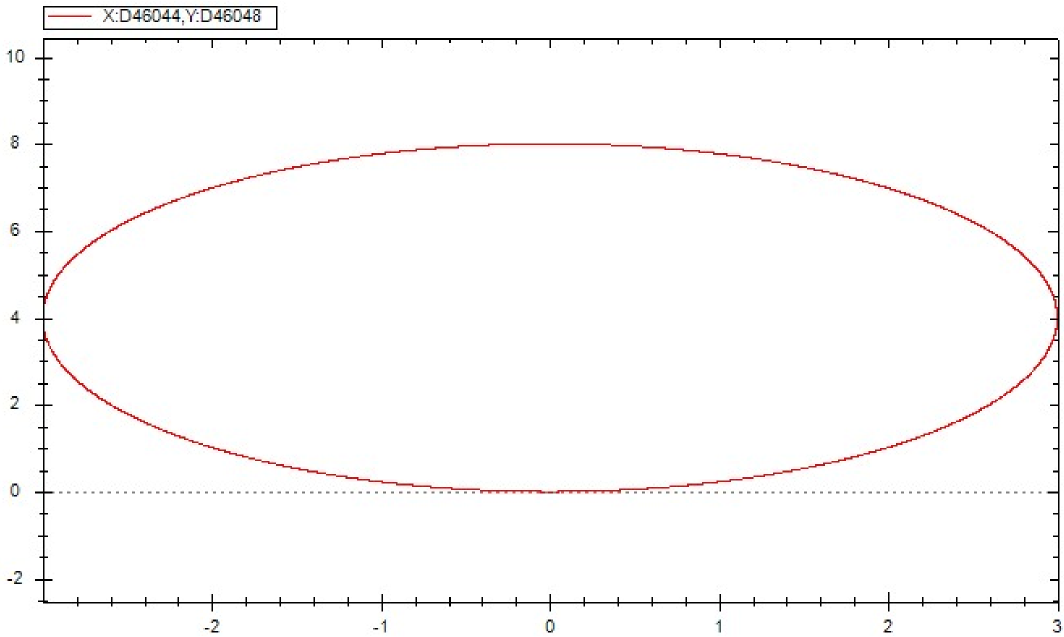
(8) Application
For example, taking (0,0) as the starting point, the long axis is 8, the short axis is 6, and the complete ellipse ladder diagram of the long axis on the Y axis is shown in the following figure:



The parameter configuration:



The track is shown in the following figure:



5-2-2-17. Axis group stop 【G_STOP】

(1) Overview

The axis group stops, stopping the current motion command.

Axis group stop [G_STOP]			
Execution condition	Rising/falling edge of the coil	Suitable model	XDH, XLH, XG2
Firmware	V3.7.3 and above	Software	V3.7.16 and above

(2) Operand

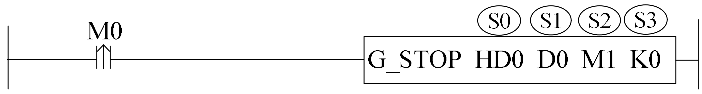
Operand	Function	Type
S0	Specify the input parameter start address	64-bit, four words
S1	Specify the output state word start address	16-bit, single word
S2	Specify the output state bit start address	Bit
S3	Specify the shaft output port number	16-bit, single word

(3) Suitable soft component

Operand	Word soft component											Bit soft component					
	System								Constant	Module		System					
	D*	FD	TD*	CD*	DX	DY	DM*	DS*	K/H	ID	QD	X	Y	M*	S*	T*	C*
S0	●	●	●	●													
S1	●	●	●	●													
S2														●			
S3	●								●								

*: D means D, HD; TD means TD and HTD; CD means CD, HCD, HSCD and HSD; DM means DM and DHM; DS means DS and DHS; M means M, HM, SM; S means S, HS; T means T, HT; C means C, HC.

(4) Function and action



- S0 specifies the starting address of the input parameter, occupying registers S0~S0+7.
- S1 specifies the starting address of the output status word.
- S2 specifies the starting address of the output status bit, occupying relays S2~S2+4.
- S3 specifies axis port number.
- When M0 goes from OFF to ON, a stop action is executed on the axis group specified in S3. After the command is executed, the axis group is in a deceleration stop state. In this state, other commands are invalid. After the deceleration stop is completed, the axis group is in a stationary state, and other commands can be executed at this time.
- When executed in a deceleration stop mode, during the deceleration stop process, the axis group status (D4600+300 * N) is 3, and after the axis stops, the single axis status is 1.

(5) Note

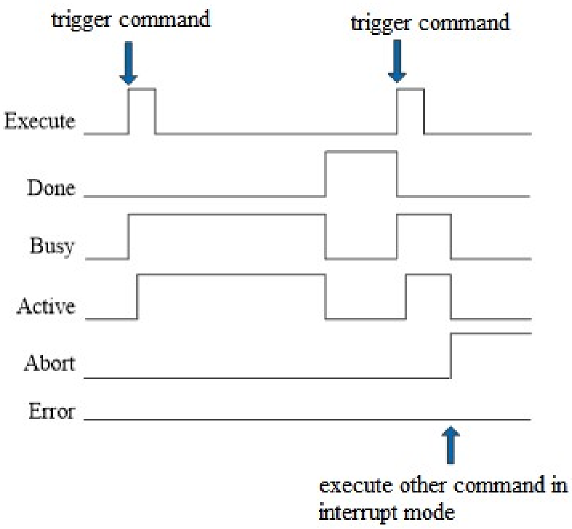
- Command edge triggered, which can interrupt the current motion command (including additional motion: stacking, compensation).
- Plan by axis group deceleration and the larger value of the deceleration configured for this command.
- If this command is executed while executing the interpolation command, it will slow down and stop on the original interpolation trajectory; After G_stop (G_Goon, G-PATHMOV), it cannot continue to run and will prompt an error message.
- Instruction priority is second only to emergency stop and can be interrupted by emergency stop or G_stop.

(6) Related parameters

Input parameter	Parameter name	Data type	Unit	Note
S0	Dec	FP64	-	Deceleration
S0+4	Jerk	FP64	-	Jerk
Output parameter	Parameter name	Data type	Unit	Note
S1	ErrCode	INT16U	-	Command error code
State	Parameter name	Data type	Unit	Note

parameter				
S2	Done	BOOL	-	Command execution completed
S2+1	Busy	BOOL	-	Instruction is executing
S2+2	Active	BOOL	-	Command under control
S2+3	Abort	BOOL	-	Instruction interrupted
S2+4	Error	BOOL	-	Command execution error
Axis number	Parameter name	Data type	Unit	Note
S3	AxesGroup	INT16U	-	Axis group number. Starting from 0

(7) Sequence diagram



Note:
In general, after triggering the command, the Busy and Active signals are set, reset after the command execution is completed, and the Done signal is set at the same time. Only when the command is executed again will Done reset, otherwise it will not automatically reset.
During the instruction execution process, if a new instruction is triggered in interrupt mode, the Busy and Active signals will immediately reset, and the Abort signal will be set.
When there is an error in the instruction, the Error signal is set, other signals are reset, and the corresponding error code is output.

5-2-2-18. Axis group emergency stop 【G_IMMEDIATESTOP】

(1) Overview

The axis group immediately stops moving.

Axis group emergency stop [G_IMMEDIATESTOP]			
Execution condition	Normally open/close coil	Suitable model	XDH, XLH, XG2
Firmware	V3.7.3 and above	Software	V3.7.16 and above

(2) Operand

Operand	Function	Type
S0	Specify the starting address of the output status word	16-bit, single word
S1	Specify the starting address of the output status bit	Bit
S2	Specify the output port number for the shaft group	16-bit, single word

(3) Suitable soft component

Operand	Word soft component											Bit soft component					
	System								Constant	Module		System					
	D*	FD	TD*	CD*	DX	DY	DM*	DS*	K/H	ID	QD	X	Y	M*	S*	T*	C*
S0	●	●	●	●													
S1														●			
S2									●								

*: D means D, HD; TD means TD and HTD; CD means CD, HCD, HSCD and HSD; DM means DM and DHM; DS means DS and DHS; M means M, HM, SM; S means S, HS; T means T, HT; C means C, HC.

(4) Function and action

M0 — G_IMMEDIATESTOP HD0 M1 K0 (S0 S1 S2)

- S0 specifies [specify the starting address of the output status word].
- S1 specifies the starting address of the output status bit, occupying relays S1~S1+2.
- S2 specifies [axis port number].
- When M0 goes from OFF to ON, an emergency stop action is executed on the axis group specified by S2 according to the SFD48008 setting (given, feedback). After the command is executed, the axis group is in an error stop state, and other commands are invalid in this state. After M0 goes from ON to OFF, the G-RST command can be executed.
- After the error is cleared, other axis group commands can continue to be executed. After the instruction is executed, the axis group is in an error stop state, and the axis group state (D4600+300 * N) is 4. In this state, other instructions are invalid, and M0 needs to be turned from ON to OFF. At this time, the G-RST instruction can be executed, and after the error is cleared, other axis group instructions can continue to be executed.

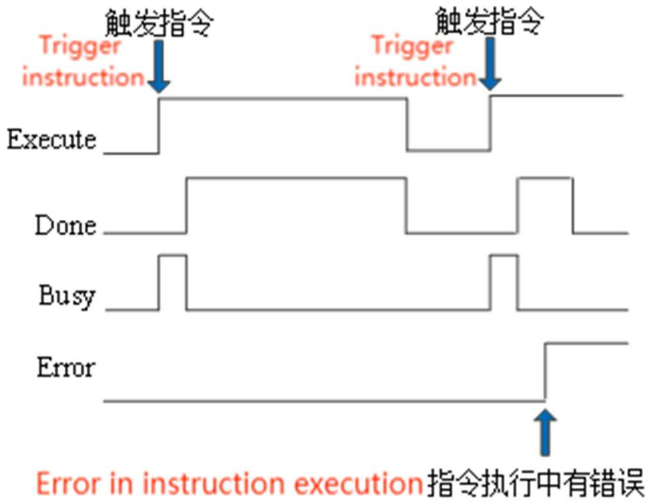
(5) Note

- Instruction is triggered normally, and there can only be one instruction within the same axis group.
- The axis group can be triggered in all states.
- It can only be reset after the emergency stop is triggered.

(6) Related parameters

Output parameter	Parameter name	Data type	Unit	Note
S0	ErrCode	INT16U	-	Instruction error code
State parameter	Parameter name	Data type	Unit	Note
S1	Done	BOOL	-	Command execution completed
S1+1	Busy	BOOL	-	Instruction is executing
S1+2	Err	BOOL	-	Instruction execution error
Axis number	Parameter name	Data type	Unit	Note
S2	AxesGroup	INT16U	-	Axis group number. Starting from 0

(7) Sequence diagram



Note:
In general, after triggering the command, Busy is set and reset after the command execution is completed. At the same time, the Done signal is set and the trigger condition is closed before Done is reset. Otherwise, it will not automatically reset.
When there is an error in the instruction, the Error signal is set, other signals are reset, and the corresponding error code is output.

5-2-2-19. Axis group cleaning error 【G_RST】

(1) Overview

Clearing axis group error.

Axis group emergency stop [G_IMMEDIATESTOP]			
Execution condition	Normally open/close coil	Suitable model	XDH, XLH, XG2
Firmware	V3.7.3 and above	Software	V3.7.16 and above

(2) Operand

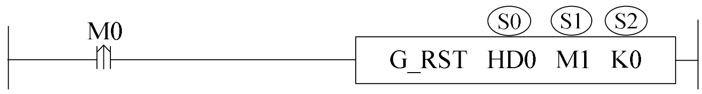
Operand	Function	Type
S0	Specify the starting address of the output status word	16-bit, single word
S1	Specify the starting address of the output status bit	Bit
S2	Specify the shaft output port number	16-bit, single word

(3) Suitable soft component

Operand	Word soft component											Bit soft component					
	System								Constant	Module		System					
	D*	FD	TD*	CD*	DX	DY	DM*	DS*	K/H	ID	QD	X	Y	M*	S*	T*	C*
S0	●	●	●	●													
S1														●			
S2	●								●								

*: D means D, HD; TD means TD and HTD; CD means CD, HCD, HSCD and HSD; DM means DM and DHM; DS means DS and DHS; M means M, HM, SM; S means S, HS; T means T, HT; C means C, HC.

(4) Function and action



- S0 specifies [specify the starting address of the output status word].
- S1 specifies the starting address of the output status bit, occupying relays S1~S1+2.
- S2 specifies [axis port number].
- When M0 goes from OFF to ON, the error state is released for the axis group specified by S2. After successfully releasing the error state, S1 is set to ON.
- After the command is executed, the axis group status (D4600+300 * N) switches to 0 or 1 (if the axis group is enabled to close, it is 0, and if the axis group is enabled to open, it is 1).

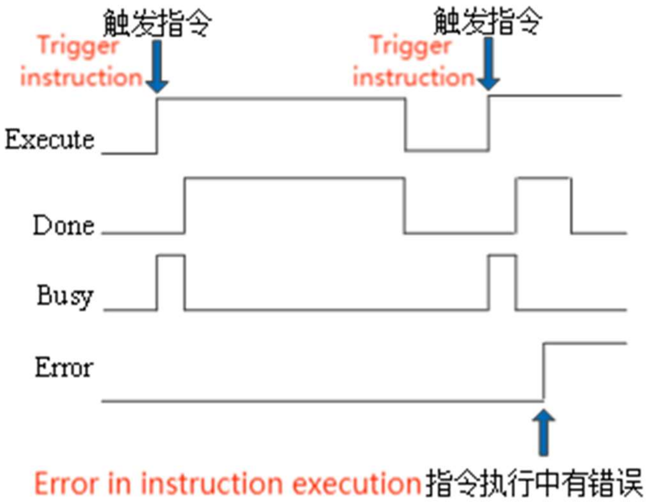
(5) Note

- The command can only be triggered when the axis group is not enabled or stopped incorrectly; Execute in other states, the instruction is done directly without any other processing.
- Clear single axis errors in the axis group during instruction execution.
- If the error cannot be cleared, the instruction will continue to BUSY.
- When there is a servo error, the servo problem should be resolved first before executing this command.
- During the process of error stopping or emergency stop taking effect, the error cannot be cleared.

(6) Related parameters

Output parameter	Parameter name	Data type	Unit	Note
S0	ErrCode	INT16U	-	Instruction error code
State parameter	Parameter name	Data type	Unit	Note
S1	Done	BOOL	-	Command execution completed
S1+1	Busy	BOOL	-	Instruction is executing
S1+2	Err	BOOL	-	Instruction execution error
Axis number	Parameter name	Data type	Unit	Note
S2	AxesGroup	INT16U	-	Axis group number. Starting from 0

(7) Sequence diagram



Note:
In general, after triggering the command, Busy is set and reset after the command is executed. At the same time, the Done signal is set. Only when the command is executed again will Done reset, otherwise it will not automatically reset.
When there is an error in the instruction, the Error signal is set, other signals are reset, and the corresponding error code is output.

5-2-2-20. Axis group modification position【G_WRITE】

(1) Overview

Implement modification of the current axis group position, calibration coordinate system position, and single axis position.

Axis group modification position [G_WRITE]			
Execution condition	Rising/falling edge of the coil	Suitable model	XDH, XLH, XG2
Firmware	V3.7.3 and above	Software	V3.7.16 and above

(2) Operand

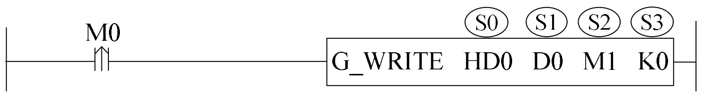
Operand	Function	Type
S0	Specify the input parameter start address	64-bit, four words
S1	Specify the output state word start address	16-bit, single word
S2	Specify the output state bit start address	Bit
S3	Specify the shaft output port number	16-bit, single word

(3) Suitable soft component

Operand	Word soft component											Bit soft component					
	System								Constant	Module		System					
	D*	FD	TD*	CD*	DX	DY	DM*	DS*	K/H	ID	QD	X	Y	M*	S*	T*	C*
S0	●	●	●	●													
S1	●	●	●	●													
S2														●			
S3	●								●								

*: D means D, HD; TD means TD and HTD; CD means CD, HCD, HSCD and HSD; DM means DM and DHM; DS means DS and DHS; M means M, HM, SM; S means S, HS; T means T, HT; C means C, HC.

(4) Function and action



- S0 specifies the starting address of the input parameter, occupying registers S0~S0+25.
- S1 specifies the starting address of the output status word.
- S2 specifies the starting address of the output status bit, occupying relays S2~S2+3.
- S3 specifies [axis port number].
- When M0 changes from OFF to ON, modify the current given position of the axis group specified in S3 (six double precision registers D46044+300 * N~D46064+300 * N, please refer to the introduction of the axis group status register for details) and the position of each single axis.
- After the instruction is executed, the axis group status (D4600+300 * N) does not change.

(5) Note

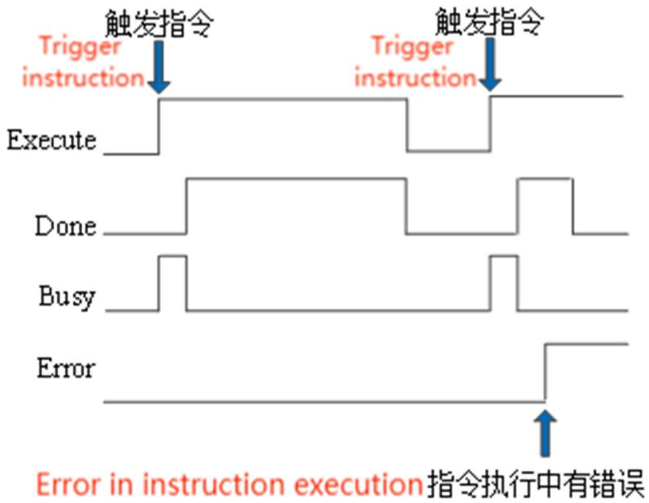
- This command can only be executed when the axis group status (D4600+300 * N) is 1.
- Currently, only position writing in the base coordinate system is supported. Choosing another coordinate system will trigger an alarm of 5008.
- After being interrupted by the G_INTR command during the execution of the motion command, executing this command can modify the current axis group position, but executing the G_Goon command will alarm 5095 (pause and continue need to be paired).

(6) Related parameters

Input parameter	Parameter name	Data type	Unit	Note
S0	PosX	FP64	-	Position X
S0+4	PosY	FP64	-	Position Y
S0+8	PosZ	FP64	-	Position Z
S0+12	PosA	FP64	-	Position A
S0+16	PosB	FP64	-	Position B
S0+20	PosC	FP64	-	Position C
S0+24	CoorDinateSystem	INT16U	-	Coordinate system: (not currently supported)
S0+25	RelativeMode	INT16U	-	Absolute/Relative:

				0: Absolute position 1: Relative position
Output parameter	Parameter name	Data type	Unit	Note
S1	ErrCode	INT16U	-	Command error code
State parameter	Parameter name	Data type	Unit	Note
S2	Done	BOOL	-	Command execution completed
S2+1	Busy	BOOL	-	Instruction is executing
S2+2	Err	BOOL	-	Instruction execution error
Axis number	Parameter name	Data type	Unit	Note
S3	AxesGroup	INT16U	-	Axis group number. Starting from 0

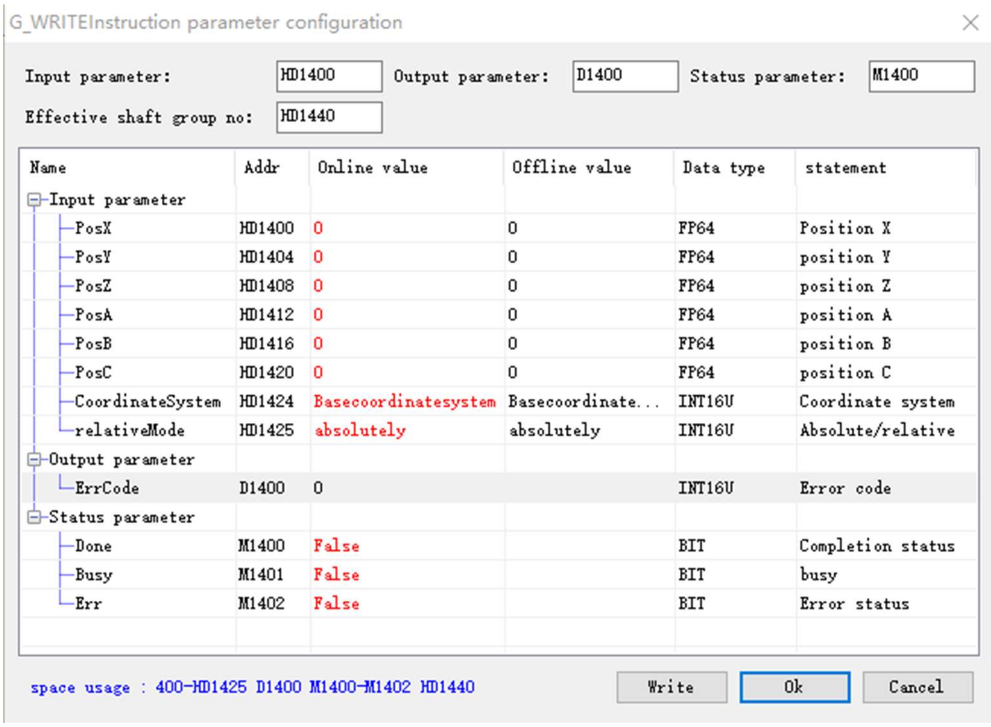
(7) Sequence diagram



Explanation:
In general, after triggering the command, Busy is set and reset after the command is executed. At the same time, the Done signal is set. Only when the command is executed again will Done reset, otherwise it will not automatically reset.
When there is an error in the instruction, the Error signal is set, other signals are reset, and the corresponding error code is output.

(8) Application
Example: Request to modify the current position of the axis group. The ladder diagram is as follows:

When using absolute mode to modify the position, the command configuration is as follows:



G_WRITEInstruction parameter configuration

Input parameter: HD1400 Output parameter: D1400 Status parameter: M1400

Effective shaft group no: HD1440

Name	Addr	Online value	Offline value	Data type	statement
Input parameter					
PosX	HD1400	0	0	FP64	Position X
PosY	HD1404	0	0	FP64	position Y
PosZ	HD1408	0	0	FP64	position Z
PosA	HD1412	0	0	FP64	position A
PosB	HD1416	0	0	FP64	position B
PosC	HD1420	0	0	FP64	position C
CoordinateSystem	HD1424	Basecoordinatesystem	Basecoordinate...	INT16U	Coordinate system
relativeMode	HD1425	absolutely	absolutely	INT16U	Absolute/relative
Output parameter					
ErrCode	D1400	0		INT16U	Error code
Status parameter					
Done	M1400	False		BIT	Completion status
Busy	M1401	False		BIT	busy
Err	M1402	False		BIT	Error status

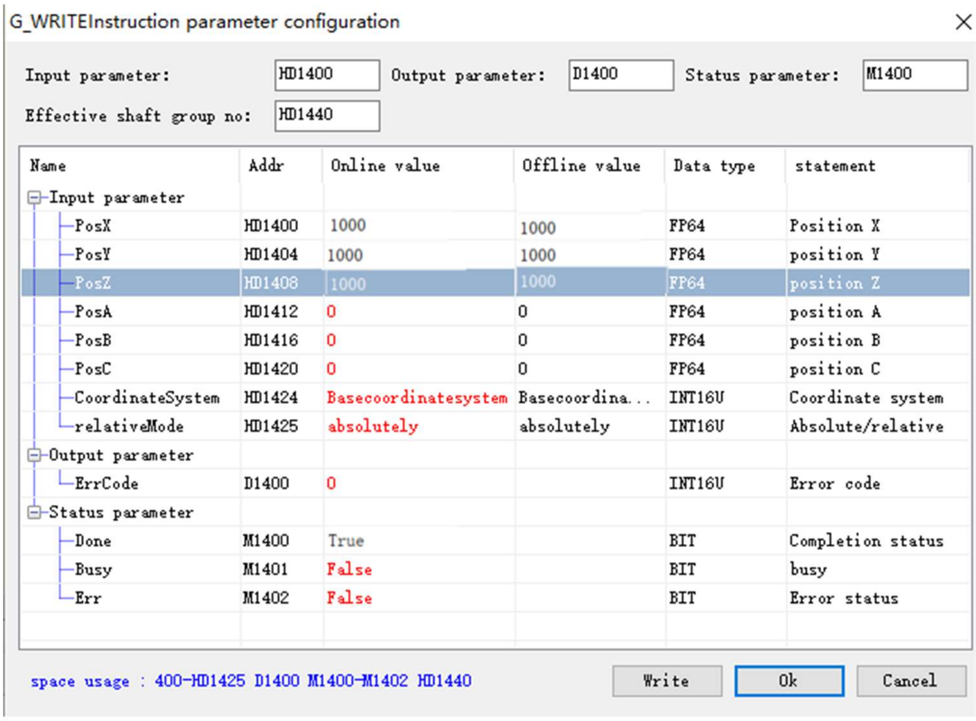
space usage : 400-HD1425 D1400 M1400-M1402 HD1440

Write Ok Cancel

Before instruction execution					After instruction execution				
Name	Value	Type	Map-Address/...	Comment	Name	Value	Type	Map-Address/...	Comment
D46044	10000	LREAL	QWord	Given position of X-axis current motion	D46044	0	LREAL	QWord	Given position of X-axis current motion
D46048	10000	LREAL	QWord	Given position of Y-axis current motion	D46048	0	LREAL	QWord	Given position of Y-axis current motion
D46052	10000	LREAL	QWord	Given position of Z-axis current motion	D46052	0	LREAL	QWord	Given position of Z-axis current motion
D46056	0	LREAL	QWord	Given position of A-axis current motion	D46056	0	LREAL	QWord	Given position of A-axis current motion
D46060	0	LREAL	QWord	Given position of B-axis current motion	D46060	0	LREAL	QWord	Given position of B-axis current motion
D46064	0	LREAL	QWord	Given position of C-axis current motion	D46064	0	LREAL	QWord	Given position of C-axis current motion

Explanation: Before executing the command, the current position of the axis group (XYZ model) is (100001000001000010000). After executing the absolute mode G_WRITE, the target position parameter is written to the current position (in this example, the target position is 0).

When using relative mode to modify the position, the command configuration is as follows:



G_WRITEInstruction parameter configuration

Input parameter: HD1400 Output parameter: D1400 Status parameter: M1400

Effective shaft group no: HD1440

Name	Addr	Online value	Offline value	Data type	statement
Input parameter					
PosX	HD1400	1000	1000	FP64	Position X
PosY	HD1404	1000	1000	FP64	position Y
PosZ	HD1408	1000	1000	FP64	position Z
PosA	HD1412	0	0	FP64	position A
PosB	HD1416	0	0	FP64	position B
PosC	HD1420	0	0	FP64	position C
CoordinateSystem	HD1424	Basecoordinatesystem	Basecoordina...	INT16U	Coordinate system
relativeMode	HD1425	absolutely	absolutely	INT16U	Absolute/relative
Output parameter					
ErrCode	D1400	0		INT16U	Error code
Status parameter					
Done	M1400	True		BIT	Completion status
Busy	M1401	False		BIT	busy
Err	M1402	False		BIT	Error status

space usage : 400-HD1425 D1400 M1400-M1402 HD1440

Write Ok Cancel

Before instruction execution	After instruction execution

Before instruction execution:

Name	Value	Type	Map-Address/...	Comment
D46044	10000	LREAL	QWord	Given position of X-axis current motion
D46048	10000	LREAL	QWord	Given position of Y-axis current motion
D46052	10000	LREAL	QWord	Given position of Z-axis current motion
D46056	0	LREAL	QWord	Given position of A-axis current motion
D46060	0	LREAL	QWord	Given position of B-axis current motion
D46064	0	LREAL	QWord	Given position of C-axis current motion

After instruction execution:

Name	Value	Type	Map-Address/...	Comment
D46044	11000	LREAL	QWord	Given position of X-axis current motion
D46048	11000	LREAL	QWord	Given position of Y-axis current motion
D46052	11000	LREAL	QWord	Given position of Z-axis current motion
D46056	0	LREAL	QWord	Given position of A-axis current motion
D46060	0	LREAL	QWord	Given position of B-axis current motion
D46064	0	LREAL	QWord	Given position of C-axis current motion

Explanation:

Before executing the command, the current position of the axis group (XYZ model) is (10000,10000,10000), after executing the relative mode G_WRITE, the current position changes to the original position plus the target position, the target location for this example is (1000,10001,000), add original position (10000,10000,10000), that is the final position (11000,11000,11000).

5-2-2-21. Axis group cycle control position【G_CYCPOS】

(1) Overview

Output the absolute target position given by the user program to the servo driver in cycle synchronization position mode (CSP) according to the task cycle.

Axis group cycle control position [G_CYCPOS]			
Execution condition	Rising/falling edge of the coil	Suitable model	XDH, XLH, XG2
Firmware	V3.7.3 and above	Software	V3.7.16 and above

(2) Operand

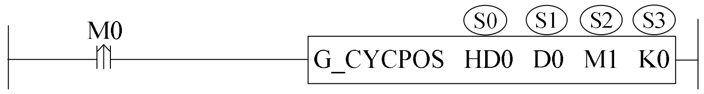
Operand	Function	Type
S0	Specify the input parameter start address	64-bit, four words
S1	Specify the output state word start address	16-bit, single word
S2	Specify the output state bit start address	Bit
S3	Specify the shaft output port number	16-bit, single word

(3) Suitable soft component

Operand	Word soft component											Bit soft component					
	System								Constant	Module		System					
	D*	FD	TD*	CD*	DX	DY	DM*	DS*	K/H	ID	QD	X	Y	M*	S*	T*	C*
S0	●	●	●	●													
S1	●	●	●	●													
S2														●			
S3	●								●								

*: D means D, HD; TD means TD and HTD; CD means CD, HCD, HSCD and HSD; DM means DM and DHM; DS means DS and DHS; M means M, HM, SM; S means S, HS; T means T, HT; C means C, HC.

(4) Function and action



- S0 specifies the starting address of the input parameter, occupying registers S0~S0+25.
- S1 specifies the starting address of the output status word.
- S2 specifies the starting address of the output status bit, occupying relays S2~S2+4.
- S3 specifies the axis port number.
- When M0 changes from OFF to ON, periodic position control is applied to the axis group specified by S3. After successful execution, S2 is set to ON to indicate that the axis is in a periodic control state. By periodically assigning values to S0, control of the axis is achieved.
- Before triggering the command, please ensure that the value of S0 is the same as the current position, otherwise the position will generate a step.

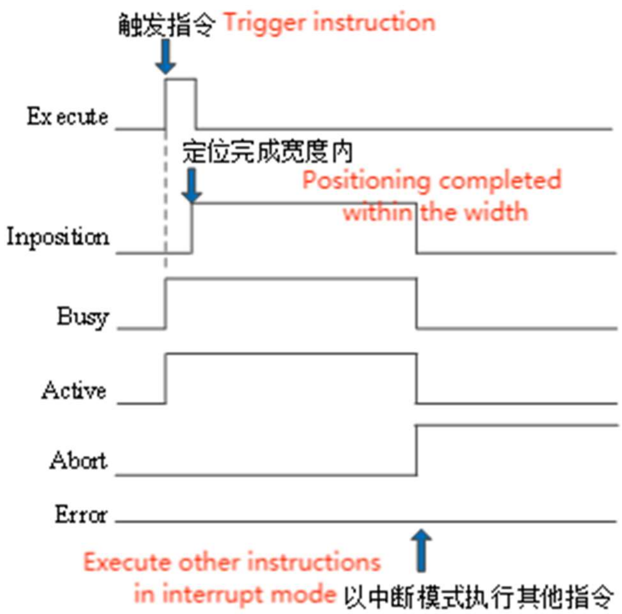
(5) Note

- This command can only be executed when the axis group status (D4600+300 * N) is 1 or 2.
- Periodic position control requires periodic writing of the target position value into the register, with no significant changes in position, to avoid shaft spin or overspeed alarms caused by a large difference between the given cycle position and the previous cycle position.
- Input parameters PosX, PosY, PosZ, PosA, PosB, and PosC support continuous updates.
- When the Active&Busy of the instruction is set, regardless of whether the Inposition is set or not, the input positional parameters can be continuously updated and checked for parameter validity.
- The feedback positions of each single axis in the axis group are within the given positioning completion width range (the positioning completion width can be set in the axis configuration, with a default value of 100 instruction units), and the Inposition is set.
- When used in conjunction with I9900 cycle interrupt, after executing the instruction, SM1995 is set to ON to trigger the interrupt, continuously accumulating the values in the position register to achieve cycle position control direction. The direction is determined by both the target position and current position parameters. When the target position is greater than the current position, it is positive, and when the target position is less than the current position, it is negative.
- This instruction currently only supports interrupt mode operation. Entering other numbers will result in an error, and it is not allowed to follow cache instructions.

(6) Related parameters

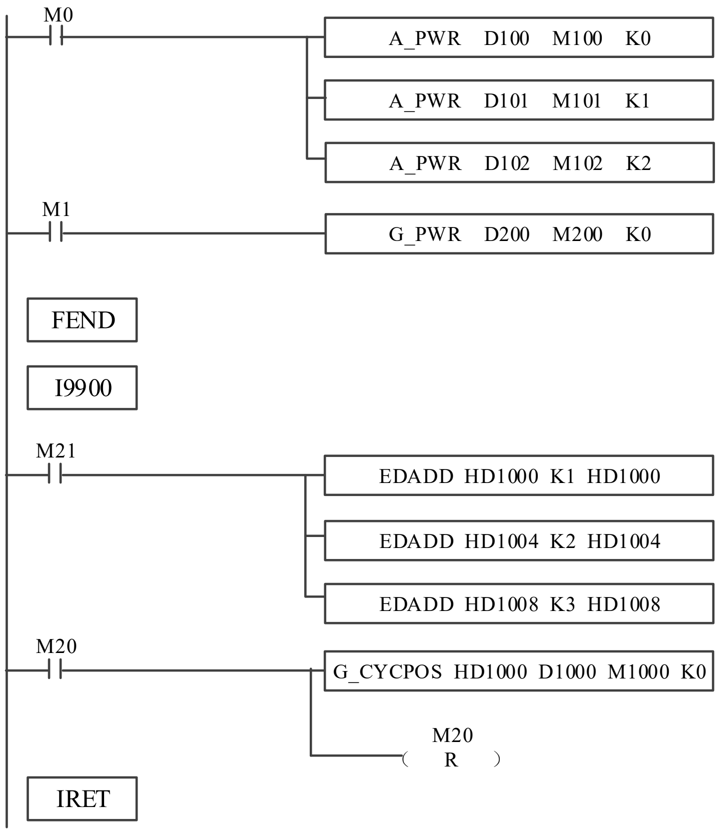
Input parameter	Parameter name	Data type	Unit	Note
S0	PosX	FP64	-	Position X
S0+4	PosY	FP64	-	Position Y
S0+8	PosZ	FP64	-	Position Z
S0+12	PosA	FP64	-	Position A
S0+16	PosB	FP64	-	Position B
S0+20	PosC	FP64	-	Position C
S0+24	CoorDinateSystem	INT16U	-	Coordinate system: (not currently supported)
S0+25	BufferMode	INT16U	-	Caching mode: 0: Break mode 1: Caching mode (currently not supported)
Output parameter	**Parameter name**	**Data type**	**Unit**	**Note**
S1	ErrCode	INT16U	-	Command error code
State parameter	**Parameter name**	**Data type**	**Unit**	**Note**
S2	InPosition	BOOL	-	In-position
S2+1	Busy	BOOL	-	Instruction is currently being executed
S2+2	Active	BOOL	-	Instruction under control
S2+3	Abort	BOOL	-	Instruction interrupted
S2+4	Err	BOOL	-	Instruction execution error
Axis number	**Parameter name**	**Data type**	**Unit**	**Note**
S3	AxesGroup	INT16U	-	Axis group number. Starting from 0

(7) Sequence diagram



Explanation:
Trigger command, set Busy and Active signals, and set InPosition signal when the actual feedback position of the axis is within the given positioning width range.
During the cycle control period, execute other instructions in interrupt mode, set the Abort signal, and reset the InPosition, Busy, and Active signals.

(8) Application
Example: Request to use the axis group cycle control position command and customize the planned axis position. The ladder diagram is as follows:



The parameter configuration is as follows:

G_CYCPOSInstruction parameter configuration

Input parameter: HD1000 Output parameter: D1000 Status parameter: M1000

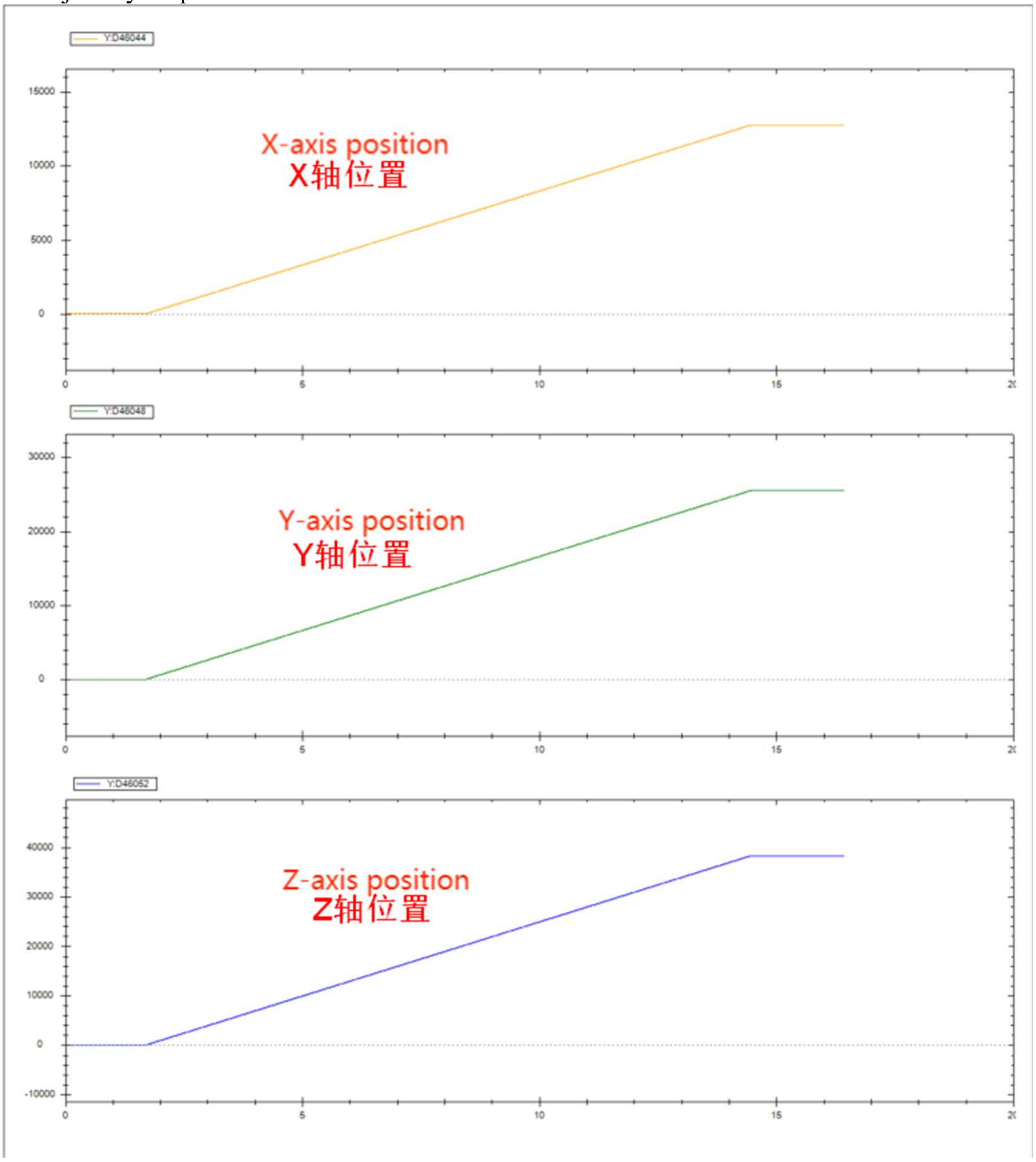
Effective shaft group no: K0

Name	Addr	Online value	Offline value	Data type	statement
Input parameter					
PosX	HD1000	0	0	FP64	Position X
PosY	HD1004	0	0	FP64	position Y
PosZ	HD1008	0	0	FP64	position Z
PosA	HD1012	0	0	FP64	position A
PosB	HD1016	0	0	FP64	position B
PosC	HD1020	0	0	FP64	position C
CoordinateSystem	HD1024	Basecoordina...	Basecoordina...	INT16U	Coordinate system
BufferMode	HD1025	interrupt	interrupt	INT16U	The caching pattern
Output parameter					
ErrCode	D1000	0		INT16U	Error code
Status parameter					
InPosition	M1000	False		BIT	Reached position
Busy	M1001	False		BIT	busy
Active	M1002	False		BIT	active
Abort	M1003	False		BIT	Interrupt status

space usage : 000-HD1025 D1000 M1000-M1004

Write Ok Cancel

Operation trajectory map:



Explanation: After enabling the three-axis system through A_PWR and confirming successful activation, enable the axis group through G_PWR. Set SM1995 to activate I9900 interrupt, and switch M20 from OFF to ON. After successful execution of the command, M21 switches from OFF to ON. During each bus cycle, the X-axis increases by 1, the Y-axis increases by 2, and the Z-axis increases by 3. The positions of each axis in the axis group move in real-time according to the instructions. (If there is a significant deviation in the position of the two cycles before and after, it can cause a step in the axis position or servo alarm. Please pay attention to position planning to avoid this situation.)

5-2-2-22. Axis group Bessel interpolation【G_BEZIER】

(1) Overview

Axis group Bessel interpolation [G_BEZIER]			
Execution condition	Rising/falling edge of the coil	Suitable model	XDH, XLH, XG2
Firmware	V3.7.3 and above	Software	V3.7.16 and above

(2) Operand

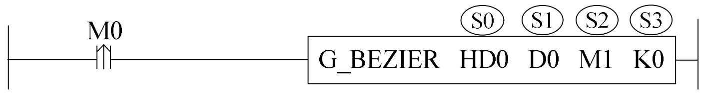
Operand	Function	Type
S0	Specify the input parameter start address	64-bit, four words
S1	Specify the output state word start address	16-bit, single word
S2	Specify the output state bit start address	Bit
S3	Specify the shaft output port number	16-bit, single word

(3) Suitable soft component

Operand	Word soft component											Bit soft component					
	System								Constant	Module		System					
	D*	FD	TD*	CD*	DX	DY	DM*	DS*	K/H	ID	QD	X	Y	M*	S*	T*	C*
S0	●	●	●	●													
S1	●	●	●	●													
S2														●			
S3	●								●								

*: D means D, HD; TD means TD and HTD; CD means CD, HCD, HSCD and HSD; DM means DM and DHM; DS means DS and DHS; M means M, HM, SM; S means S, HS; T means T, HT; C means C, HC.

(4) Function and action



- S0 specifies the starting address of the input parameter, occupying registers S0~S0+75.
- S1 specifies the starting address of the output status word.
- S2 specifies the starting address of the output status bit, occupying relays S2~S2+4.
- S3 specifies axis port number .
- When M0 goes from OFF to ON, perform Bezier curve motion on the axis group specified by S3.
- After successful command execution, the axis group status (D4600+300 * N) is 2.

(5) Note

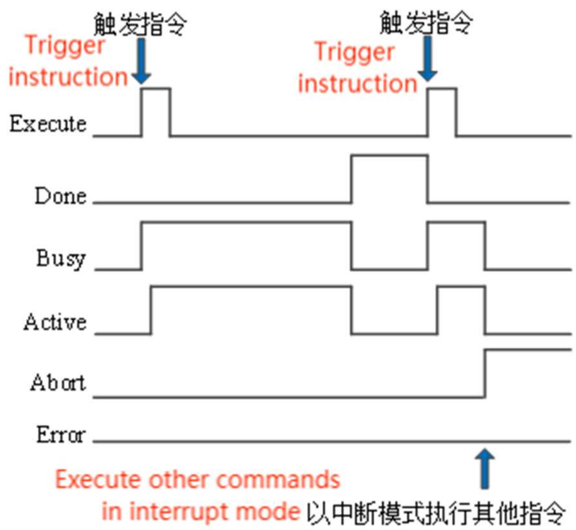
- Instructions only support triggering in cache mode.
- Curve degree range: 2-4, set to other values for error reporting.

(6) Related parameters

Input parameter	Parameter name	Data type	Unit	Note
S0	Count	INT16U	-	Curve degree: 2-4
S0+1	MotionMode	INT16U	-	Rotation center position mode: 0: Absolute 1: Relative
S0+2	BufferMode	INT16U	-	Caching mode: 0: Break mode 1: Caching mode
S0+12	Vel	FP64	Instruction unit/s	Speed
S0+16	Acc	FP64	Instruction unit/s^2	Acceleration
S0+20	Dec	FP64	Instruction unit/s^2	Deceleration

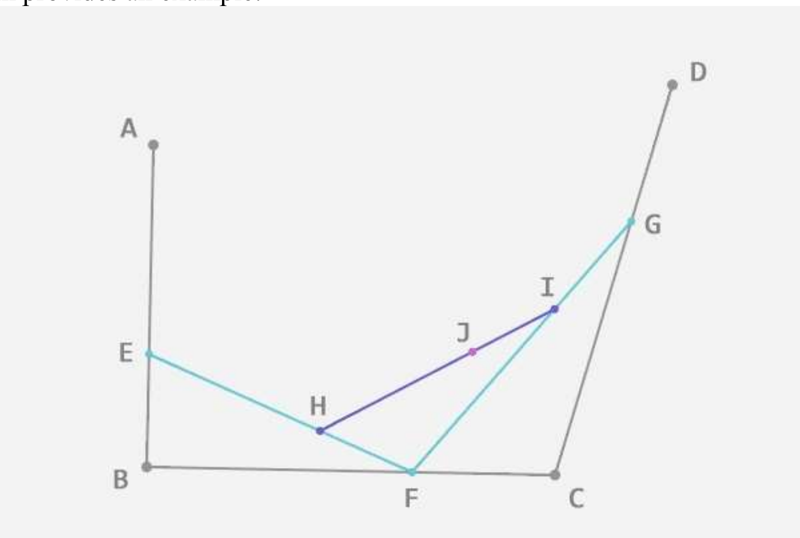
S0+24	Jerk	FP64	Instruction unit/s^3	Jerk
S0+28	PosX_1	FP64	Instruction Unit	Position X_1
S0+32	PosY_1	FP64	Instruction Unit	Position Y_1
S0+36	PosZ_1	FP64	Instruction Unit	Position Z_1
S0+40	PosX_2	FP64	Instruction Unit	Position X_2
S0+44	PosY_2	FP64	Instruction Unit	Position Y_2
S0+48	PosZ_2	FP64	Instruction Unit	Position Z_2
S0+52	PosX_3	FP64	Instruction Unit	Position X_3
S0+56	PosY_3	FP64	Instruction Unit	Position Y_3
S0+60	PosZ_3	FP64	Instruction Unit	Position Z_3
S0+64	PosX_4	FP64	Instruction Unit	Position X_4
S0+68	PosY_4	FP64	Instruction Unit	Position Y_4
S0+72	PosZ_4	FP64	Instruction Unit	Position Z_4
Output parameter	Parameter name	Data type	Unit	Note
S1	ErrCode	INT16U	-	Command error code
State parameter	Parameter name	Data type	Unit	Note
S2	Done	BOOL	-	Instruction execution completed
S2+1	Busy	BOOL	-	Instruction is currently being executed
S2+2	Active	BOOL	-	Instruction under control
S2+3	Abort	BOOL	-	Instruction interrupted
S2+4	Err	BOOL	-	Instruction execution error
Axis number	Parameter name	Data type	Unit	Note
S3	AxesGroup	INT16U	-	Axis group number. Starting from 0

(7) Sequence diagram



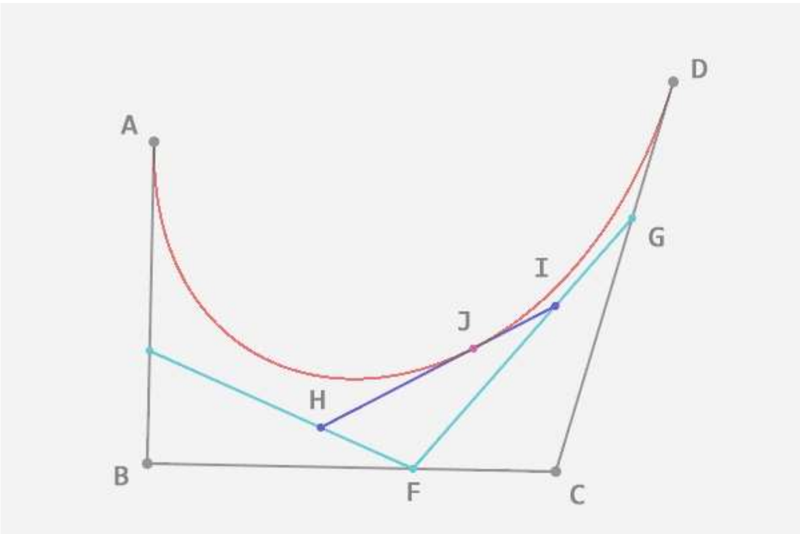
Explanation:
In general, when there is no instruction running, it is triggered in cache mode. The Busy and Active signals are set to reset after the instruction is executed, while the Done signal is set. Only when the instruction is executed again will Done reset, otherwise it will not automatically reset.
When the instruction is triggered in cache mode and there is currently an instruction being executed, the Busy signal will be immediately set. When the current instruction is executed, the Active signal will be set. When the instruction is executed, the Busy and Active signals will be reset, and the Done signal will be set.
During the instruction execution process, if a new instruction is triggered in interrupt mode, the Busy and Active signals will immediately reset, and the Abort signal will be set.
When there is an error in the instruction, the Error signal is set, other signals are reset, and the corresponding error code is output.

(8) Application
The following diagram provides an example:

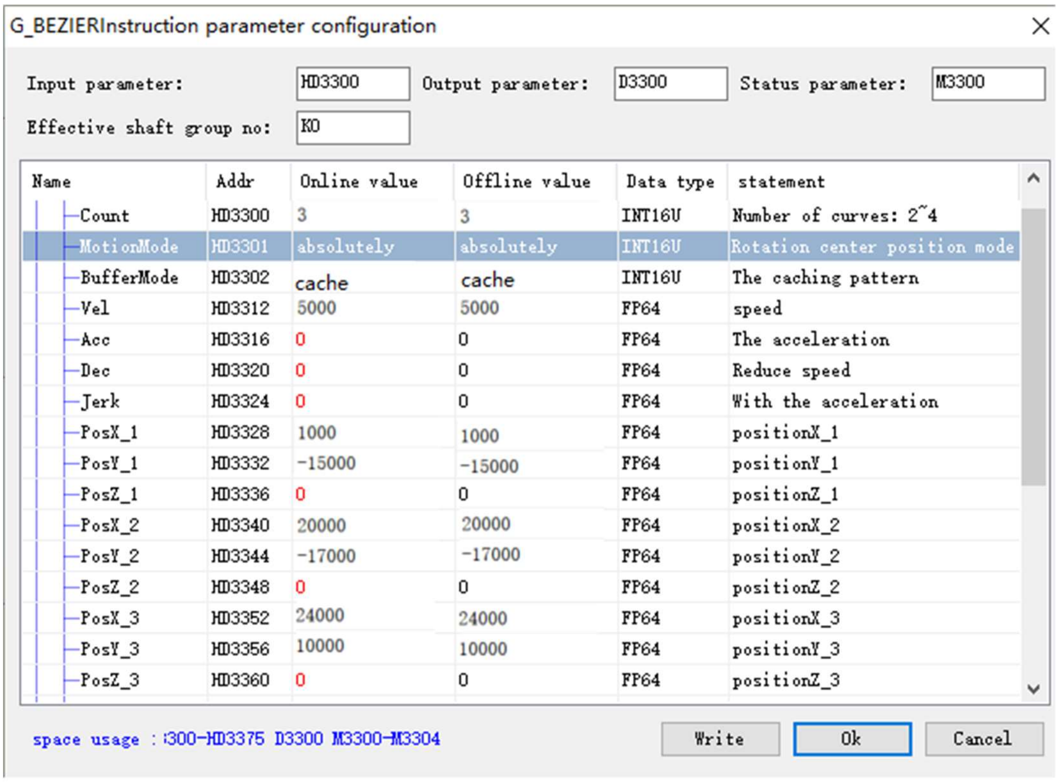


1) Take any point E, F, or G on line segments AB, BC, or CD to satisfy AE: AB=BF: BC=CG: CD.
2) Take points H and I on line segments EF and FG respectively, so that AE: AB=BF: BC=CG: CD=EH: EF=FI: FG.
3) Take point J on line segment HI, such that AE:AB = BF:BC = CG:CD=EH:EF = HJ:HI.

The obtained point J is a point on the Bessel curve, and the trajectory formed by the set of all J points that meet the conditions is the Bessel curve.



Based on the XY model, the Bessel parameter configuration is as follows, which is also a third-order curve:



G_BEZIERInstruction parameter configuration

Input parameter: HD3300 Output parameter: D3300 Status parameter: M3300

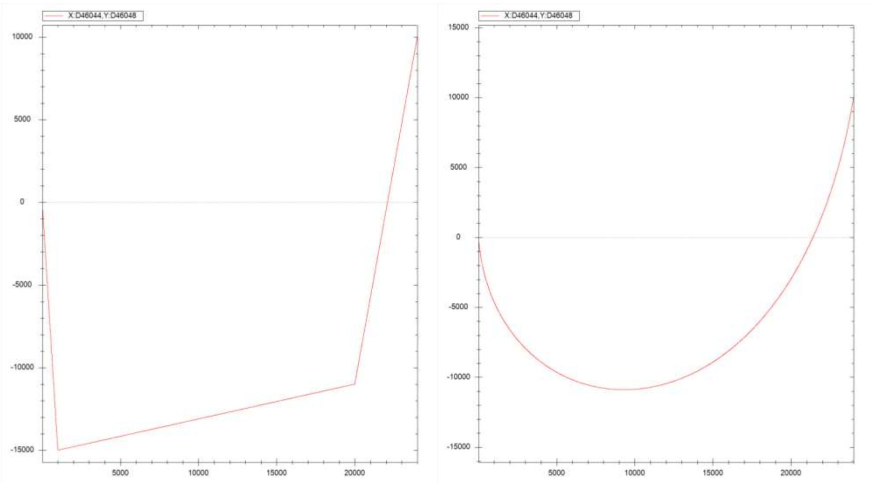
Effective shaft group no: K0

Name	Addr	Online value	Offline value	Data type	statement
Count	HD3300	3	3	INT16U	Number of curves: 2~4
MotionMode	HD3301	absolutely	absolutely	INT16U	Rotation center position mode
BufferMode	HD3302	cache	cache	INT16U	The caching pattern
Vel	HD3312	5000	5000	FP64	speed
Acc	HD3316	0	0	FP64	The acceleration
Dec	HD3320	0	0	FP64	Reduce speed
Jerk	HD3324	0	0	FP64	With the acceleration
PosX_1	HD3328	1000	1000	FP64	positionX_1
PosY_1	HD3332	-15000	-15000	FP64	positionY_1
PosZ_1	HD3336	0	0	FP64	positionZ_1
PosX_2	HD3340	20000	20000	FP64	positionX_2
PosY_2	HD3344	-17000	-17000	FP64	positionY_2
PosZ_2	HD3348	0	0	FP64	positionZ_2
PosX_3	HD3352	24000	24000	FP64	positionX_3
PosY_3	HD3356	10000	10000	FP64	positionY_3
PosZ_3	HD3360	0	0	FP64	positionZ_3

space usage : 3300-HD3375 D3300 M3300-M3304

Write Ok Cancel

At the current point (0,0), the three destination points are (1000,-15000), (20000,-11000), (24000,10000), the comparison results between running three target points using three lines and running Bessel are as follows:



5-2-2-23. Axis group rapid proportional positioning motion【G_PTP_MUL】

(1) Overview

In order to meet the on-site use of this command, the operating speed, acceleration, and acceleration can be adjusted, and the machining path can be set (adjustable forward).

Axis group rapid proportional positioning motion [G_PTP_MUL]			
Execution condition	Rising/falling edge of the coil	Suitable model	XDH, XLH, XG2
Firmware	V3.7.3 and above	Software	V3.7.16 and above

(2) Operand

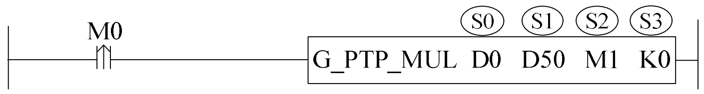
Operand	Function	Type
S0	Specify the input parameter start address	64-bit, four words
S1	Specify the output state word start address	16-bit, single word
S2	Specify the output state bit start address	Bit
S3	Specify the shaft output port number	16-bit, single word

(3) Suitable soft component

Operand	Word soft component											Bit soft component					
	System								Constant	Module		System					
	D*	FD	TD*	CD*	DX	DY	DM*	DS*	K/H	ID	QD	X	Y	M*	S*	T*	C*
S0	●	●	●	●													
S1	●	●	●	●													
S2														●			
S3	●								●								

*: D means D, HD; TD means TD and HTD; CD means CD, HCD, HSCD and HSD; DM means DM and DHM; DS means DS and DHS; M means M, HM, SM; S means S, HS; T means T, HT; C means C, HC.

(4) Function and action



- S0 specifies the starting address of the input parameter, occupying registers S0~S0+43.
- S1 specifies the starting address of the output status word.
- S2 specifies the starting address of the output status bit, occupying relays S2~S2+4.
- S3 specifies axis port number.
- When M0 goes from OFF to ON, each axis of the axis group reaches the target position at the fastest speed, using the default speed configuration for a single axis. Axis speed=VelFactor * Maximum speed (SFD8080+300 * N).
- After the instruction is executed, the single axis state (D20000+200 * N) of the axis group is 8, and the axis group state (D4600+300 * N) is 2.

(5) Note

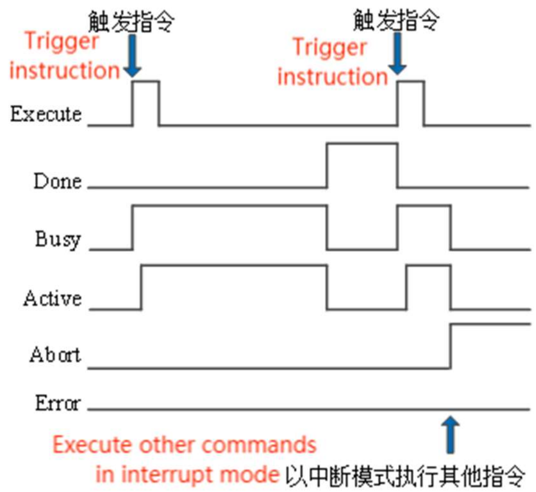
- Compared with G-PTP, three new parameters VelFactor, AccFactor, and JerkFactor have been added to adjust the magnification on the original corresponding base, achieving the effect of VelFactor * single axis maximum speed. Acceleration=AccFactor * Single axis maximum acceleration. Acceleration=JerkFactor * Maximum single axis acceleration.
- Parameter VelFactor, AccFactor, JerkFactor adjustment range (0,1), command error if not within range.
- This instruction does not support real-time parameter updates.
- This command can be interrupted by axis group motion commands other than G_PATHMOV.
- X_UPDATEPARA parameter update supports updating axis and axis group configuration parameters. The updated parameters will only take effect when the command is triggered again.

(6) Related parameters

Input parameter	Parameter name	Data type	Unit	Note
S0	PosX	FP64	Instruction Unit	Target position X
S0+4	PosY	FP64	Instruction Unit	Target position Y

S0+8	PosZ	FP64	Instruction Unit	Target position Z
S0+12	PosA	FP64	Instruction Unit	Target position A
S0+16	PosB	FP64	Instruction Unit	Target position B
S0+20	PosC	FP64	Instruction Unit	Target position C
S0+24	CoorDinateSystem	INT16U	-	Coordinate system (not currently supported)
S0+25	BufferMode	INT16U	-	Caching mode: 0: Break mode 1: Caching mode
S0+26	TransitionMode	INT16U	-	Transition method (not currently supported)
S0+27	PosMode	INT16U	-	Location mode: 0: Absolute position 1: Relative position
S0+28	TransitionVel	FP64	-	Transition speed (not currently supported)
S0+32	VelFactor	FP64	-	Speed factor
S0+36	AccFactor	FP64	-	Acceleration Factor
S0+40	JerkFactor	FP64	-	Acceleration factor
Output parameter	Parameter name	Data type	Unit	Note
S1	ErrCode	INT16U	-	Command error code
State parameter	Parameter name	Data type	Unit	Note
S2	Done	BOOL	-	Instruction execution completed
S2+1	Busy	BOOL	-	Instruction is currently being executed
S2+2	Active	BOOL	-	Instruction under control
S2+3	Abort	BOOL	-	Instruction interrupted
S2+4	Err	BOOL	-	Instruction execution error
Axis number	Parameter name	Data type	Unit	Note
S3	AxesGroup	INT16U	-	Axis group number. Starting from 0

(7) Sequence diagram

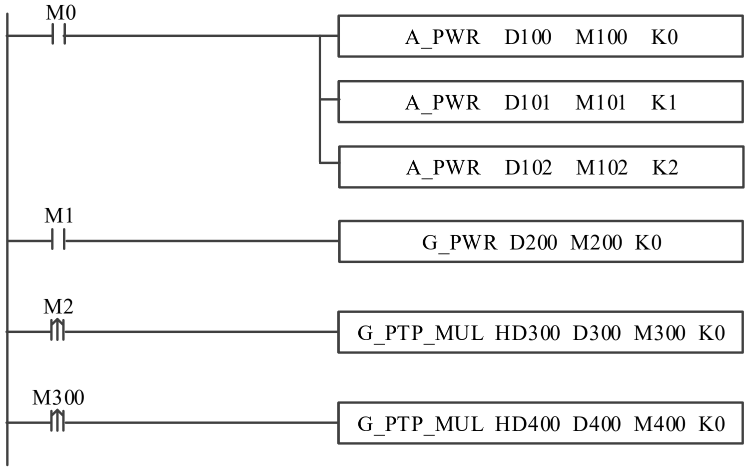


Explanation:
In general, after triggering the command, the Busy and Active signals are set, reset after the command execution is completed, and the Done signal is set at the same time. Only when the command is executed again will Done reset, otherwise it will not automatically reset.
When the instruction is triggered in cache mode and there is currently an instruction being executed, the Busy signal will be immediately set. When the current instruction is executed, the Active signal will be set. When the instruction is executed, the Busy and Active signals will be reset, and the Done signal will be set.
During the instruction execution process, if a new instruction is triggered in interrupt mode, the Busy and Active

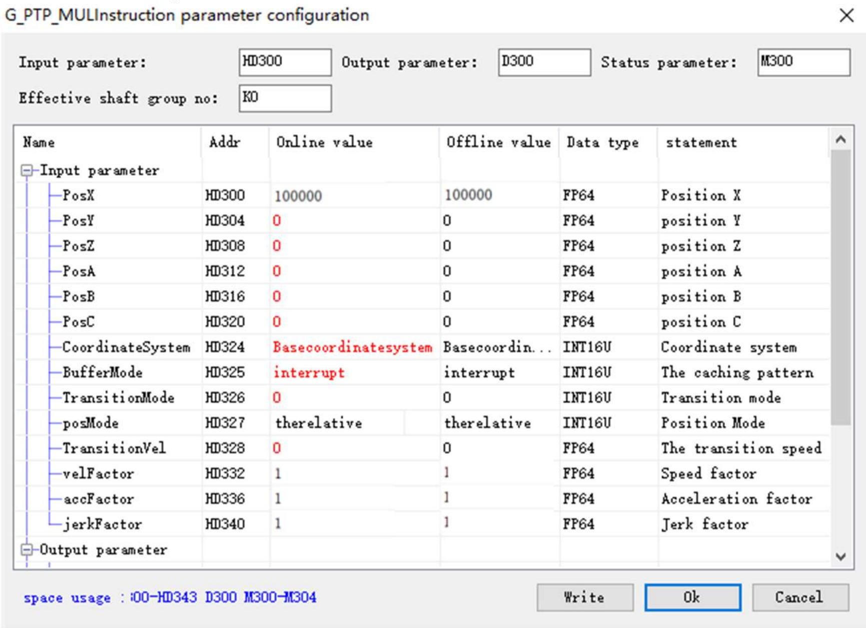
signals will immediately reset, and the Abort signal will be set.
When there is an error in the instruction, the Error signal is set, other signals are reset, and the corresponding error code is output.

(8) Application

For example, it is required that the axis group has two G_ PTP_MUL commands that run relative to each other at different speeds (100000,0,0). The ladder diagram is as follows:



The command parameter configuration is as follows:

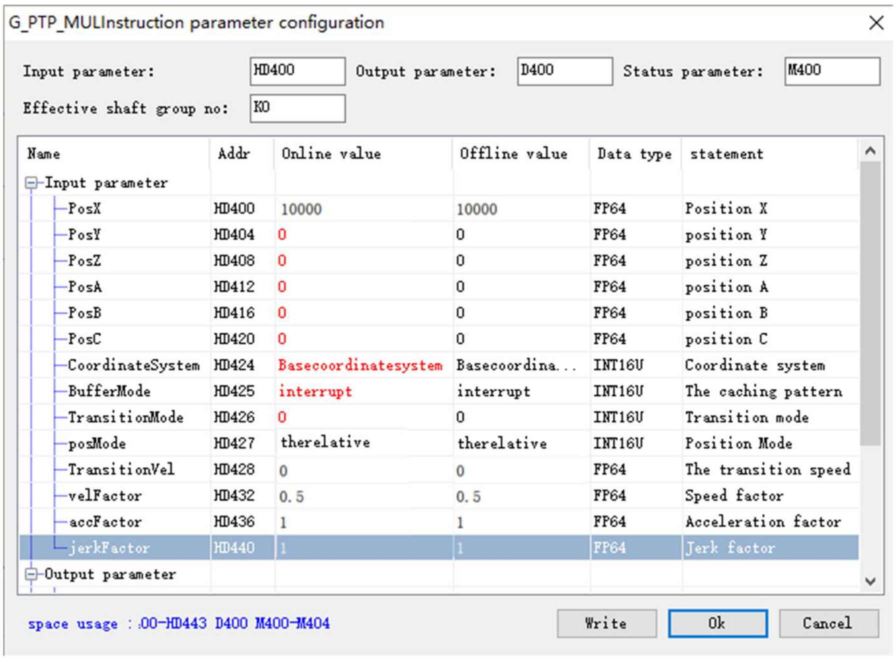

G_PTP_MULInstruction parameter configuration

Input parameter: HD300 Output parameter: D300 Status parameter: M300
Effective shaft group no: K0

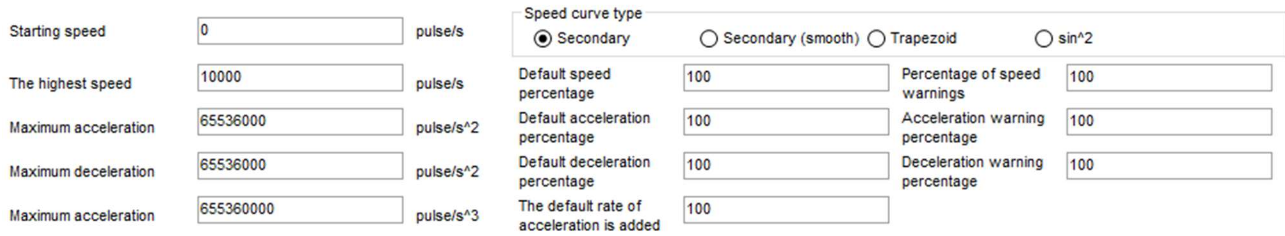
Name	Addr	Online value	Offline value	Data type	statement
Input parameter					
PosX	HD300	100000	100000	FP64	Position X
PosY	HD304	0	0	FP64	position Y
PosZ	HD308	0	0	FP64	position Z
PosA	HD312	0	0	FP64	position A
PosB	HD316	0	0	FP64	position B
PosC	HD320	0	0	FP64	position C
CoordinateSystem	HD324	Basecoordinatesystem	Basecoordin...	INT16U	Coordinate system
BufferMode	HD325	interrupt	interrupt	INT16U	The caching pattern
TransitionMode	HD326	0	0	INT16U	Transition mode
posMode	HD327	therelative	therelative	INT16U	Position Mode
TransitionVel	HD328	0	0	FP64	The transition speed
velFactor	HD332	1	1	FP64	Speed factor
accFactor	HD336	1	1	FP64	Acceleration factor
jerkFactor	HD340	1	1	FP64	Jerk factor
Output parameter					

space usage : :00-HD343 D300 M300-M304

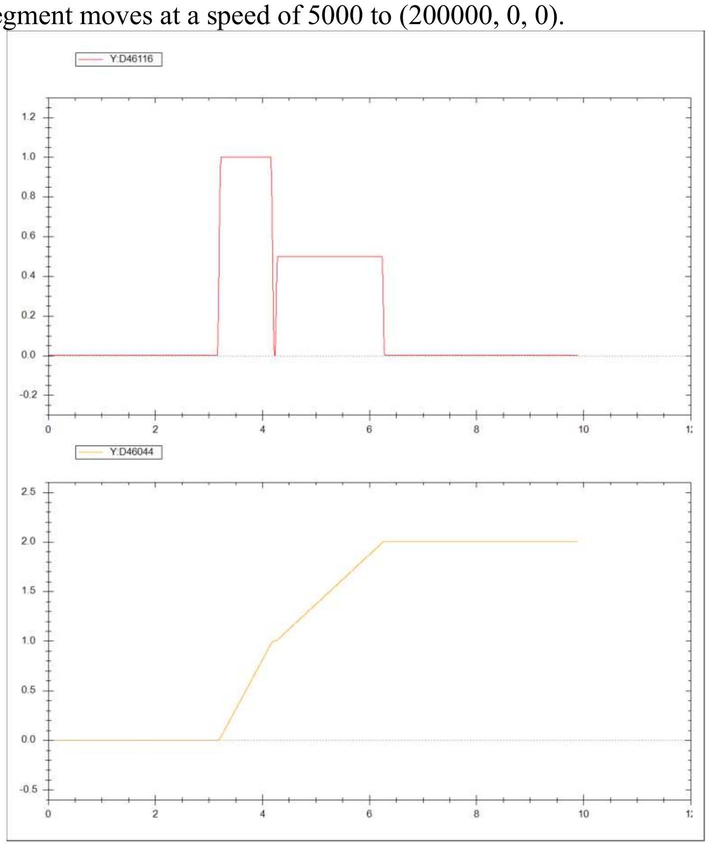
Write Ok Cancel



The axis configuration parameters are as follows:



Explanation: After enabling the three-axis system through A_PWR and confirming successful activation, enable the axis group through G_PWR. Execute the G_ PTP_MUL command when M2 from OFF to ON, and after the first successful execution, output the DONE signal to trigger the second G_ PTP_MUL command. The default speed of each component axis runs to the specified point, with the default speed=VelFactor * maximum speed (SFD8080+300 * N), as shown in the first segment of the following figure, moving at a default speed of 10000 to (100000,0,0). The second segment moves at a speed of 5000 to (200000, 0, 0).



5-2-2-24. Axis group rotary cutting interpolation enabled【G_ROTCUTON】

(1) Overview

Axis group rotary cutting interpolation enabled [G_ROTCUTON]			
Execution condition	Rising/falling edge of the coil	Suitable model	XDH, XLH, XG2
Firmware	V3.7.3 and above	Software	V3.7.16 and above

(2) Operand

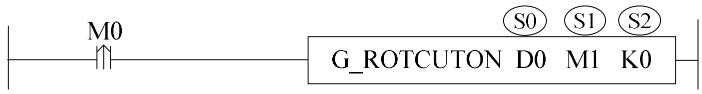
Operand	Function	Type
S0	Specify the output state word start address	16-bit, single word
S1	Specify the output state bit start address	Bit
S2	Specify the shaft output port number	16-bit, single word

(3) Suitable soft component

Operand	Word soft component											Bit soft component					
	System								Constant	Module		System					
	D*	FD	TD*	CD*	DX	DY	DM*	DS*	K/H	ID	QD	X	Y	M*	S*	T*	C*
S1	●	●	●	●													
S2														●			
S3	●								●								

*: D means D, HD; TD means TD and HTD; CD means CD, HCD, HSCD and HSD; DM means DM and DHM; DS means DS and DHS; M means M, HM, SM; S means S, HS; T means T, HT; C means C, HC.

(4) Function and action



- S0 specifies the starting address of the output status word.
- S1 specifies the starting address of the output status bit, occupying relays S1~S1+3.
- S2 specifies axis port number.
- When M0 changes from OFF to ON, the axis group activates the rotary cutting function.

(5) Note

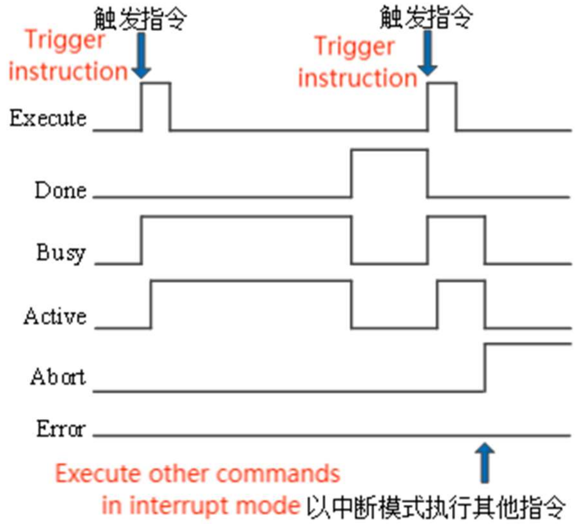
- The execution condition of the instruction is that the axis group is in a standby state, and other states return error codes.
- The supported instructions for the rotary cutting function are: G_CIRCLE/G_HELICAL/G_ELLIPSE/G_PATHMOV (type is arc).
- The unsupported instructions for rotary cutting include: G_PTP/G_LINE/G_MOVSUP/G_COMPON/G_PATHMOV(Non circular arc instruction).
- The currently supported rotary cutting plane is XOY, and other planes are not supported.
- INTR and GOON judge based on executing motion commands. If the previous command supports rotary cutting, triggering the Intr command to stop and turning off the rotary cutting function, GOON motion will continue to support the rotary cutting function until the motion ends.
- When running instructions that are not supported by the rotary cutting function: the user can specify the target point of XYZC and automatically interpolate the motion internally.
- When running the instructions supported by the rotary cutting function: the user can specify the target position of XYZ and automatically calculate the angle value of C internally. The starting position of the C-axis serves as the cutting angle, which is maintained throughout the entire command operation.
- Currently supported kinematic model for rotary cutting: XYZC.
- After the axis group is turned off and enabled, the rotary cutting function will automatically turn off.

(6) Related parameters

Output parameter	Parameter name	Data type	Unit	Note
S0	ErrCode	INT16U	-	Command error code
State parameter	Parameter name	Data type	Unit	Note
S1	Done	BOOL	-	Instruction execution completed
S1+1	Busy	BOOL	-	Instruction is currently being executed

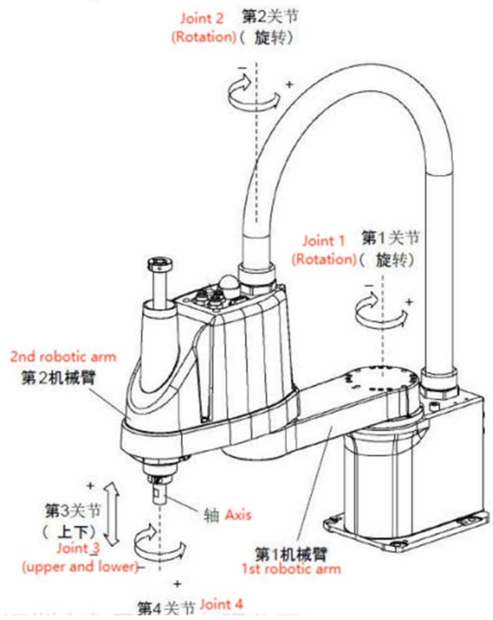
S1+2	Abort	BOOL	-	Instruction interrupted
S1+3	Err	BOOL	-	Instruction execution error
Axis number	Parameter name	Data type	Unit	Note
S2	AxesGroup	INT16U	-	Axis group number. Starting from 0

(7) Sequence diagram



Explanation:
In general, after triggering the command, the Busy signal is set and reset after the command is executed. At the same time, the Done signal is set. Only when the command is executed again, the Done signal is reset. Otherwise, it will not automatically reset.
When an instruction is interrupted or there is an error, the corresponding Abort or Error signal is set, and other signals are reset. When an error occurs, the corresponding error code will be output.

(8) Application
Taking horizontal joint SCARA as an example:



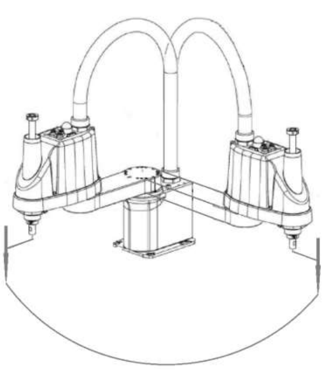


Figure 1

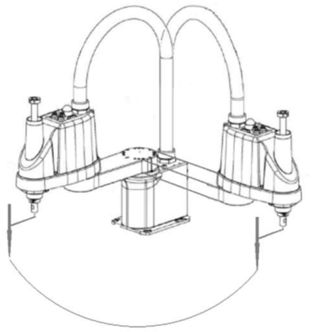


Figure 2

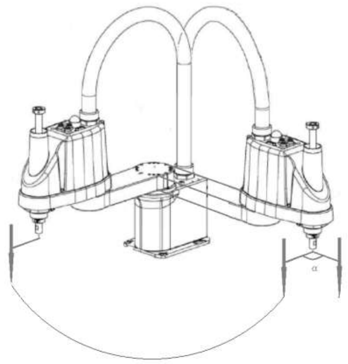


Figure 3

① After adding tools, drawing arcs on the XY plane does not enable rotary cutting, and the actual C-axis does not rotate. The running effect is shown in Figure 1.

② After adding tools, draw an arc on the XY plane to start rotary cutting. The actual C-axis is based on the starting angle as the rotary cutting angle, which is maintained throughout the entire command execution, as shown in Figure 3 α is the cutting angle.

5-2-2-25. Axis group rotary cutting interpolation off 【G_ROTCUTOFF】

(1) Overview

Axis group rotary cutting interpolation off [G_ROTCUTOFF]			
Execution condition	Rising/falling edge of the coil	Suitable model	XDH, XLH, XG2
Firmware	V3.7.3 and above	Software	V3.7.16 and above

(2) Operand

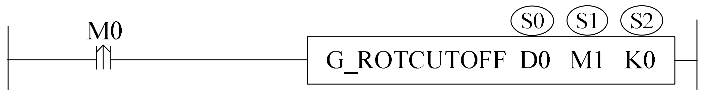
Operand	Function	Type
S0	Specify the output state word start address	16-bit, single word
S1	Specify the output state bit start address	Bit
S2	Specify the shaft output port number	16-bit, single word

(3) Suitable soft component

Operand	Word soft component											Bit soft component					
	System								Constant	Module		System					
	D*	FD	TD*	CD*	DX	DY	DM*	DS*	K/H	ID	QD	X	Y	M*	S*	T*	C*
S1	●	●	●	●													
S2														●			
S3	●								●								

*: D means D, HD; TD means TD and HTD; CD means CD, HCD, HSCD and HSD; DM means DM and DHM; DS means DS and DHS; M means M, HM, SM; S means S, HS; T means T, HT; C means C, HC.

(4) Function and action



- S0 specifies the starting address of the output status word.
- S1 specifies the starting address of the output status bit, occupying relays S1~S1+3.
- S2 specifies axis port number.
- When M0 changes from OFF to ON, the rotary cutting function of the shaft group is turned off.

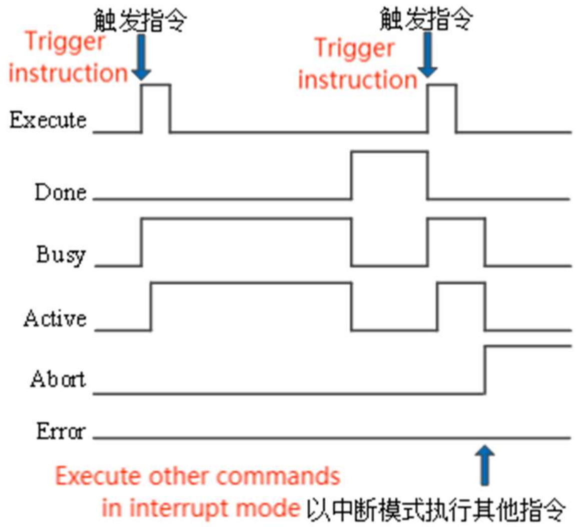
(5) Note

- The execution condition of the instruction is D4600=1, and other states return error codes.
- After successful execution of the command, DONE is set to cancel the rotary cutting function.

(6) Related parameters

Output parameter	Parameter name	Data type	Unit	Note
S0	ErrCode	INT16U	-	Command error code
State parameter	Parameter name	Data type	Unit	Note
S1	Done	BOOL	-	Instruction execution completed
S1+1	Busy	BOOL	-	Instruction is currently being executed
S1+2	Abort	BOOL	-	Instruction interrupted
S1+3	Err	BOOL	-	Instruction execution error
Axis number	Parameter name	Data type	Unit	Note
S2	AxesGroup	INT16U	-	Axis group number. Starting from 0

(7) Sequence diagram



Explanation:

In general, after triggering the command, the Busy signal is set and reset after the command is executed. At the same time, the Done signal is set. Only when the command is executed again, the Done signal is reset. Otherwise, it will not automatically reset.

When an instruction is interrupted or there is an error, the corresponding Abort or Error signal is set, and other signals are reset. When an error occurs, the corresponding error code will be output.

5-2-2-26. Axis group selection machining path_2【G_PATHSEL_2】

(1) Overview

Set the machining path (adjustable forward-looking) and perform motion through the G_PATHMOV command.

Select machining path_2 [G_PATHSEL_2]			
Execution condition	Rising/falling edge of the coil	Suitable model	XDH, XLH, XG2
Firmware	V3.7.3 and above	Software	V3.7.16 and above

(2) Operand

Operand	Function	Type
S0	Specify the starting address of input parameters	16-bit, single word
S1	Specify the output state word start address	16-bit, single word
S2	Specify the output state bit start address	Bit
S3	Specify the shaft output port number	16-bit, single word

(3) Suitable soft component

Operand	Word soft component											Bit soft component					
	System								Constant	Module		System					
	D*	FD	TD*	CD*	DX	DY	DM*	DS*	K/H	ID	QD	X	Y	M*	S*	T*	C*
S0	●	●	●	●													
S1	●	●	●	●													
S2														●			
S3	●								●								

*: D means D, HD; TD means TD and HTD; CD means CD, HCD, HSCD and HSD; DM means DM and DHM; DS means DS and DHS; M means M, HM, SM; S means S, HS; T means T, HT; C means C, HC.

(4) Function and action

- S0 specifies the starting address of the input parameter, occupying registers S0~S0+94+100 * (N-1).
- S1 specifies the starting address of the output status word.
- S2 specifies the starting address of the output status bit, occupying relays S2~S2+3.
- S3 specifies axis port number.
- When M0 changes from OFF to ON, the machining path can be set according to the set parameters, and the corresponding machining path can be run through the G_PATHMOV command.

(5) Note

- The kinematic modes supported by this command are XY/XYZ/XYZC models.
- The row number for each row of data must be monotonically increasing. The first line must be greater than 0.
- Compared to G_PATHSEL, adding forward-looking parameter planning for each row, if set to 0, it will take effect according to the axis group configuration.
- Each row, except for the forward-looking parameters, has the same data type and related parameters as G_PATHSEL. Please refer to G_PATHSEL for specific configurations
- This instruction is a management type instruction and does not support caching mode.

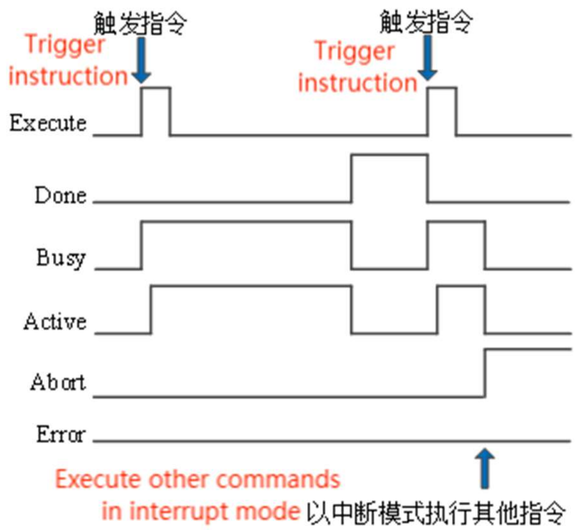
(6) Related parameters

Input parameter	Parameter name	Data type	Unit	Note
S0	Quantity	INT16U	-	Number of data rows
S0+1	Reload	INT16U	-	Whether to reload: 0: Continue loading 1: Reload
S0+10+100*(n-1)	Index	INT32U	-	Line number

S0+12+100*(n-1)	Type	INT16U	-	Data type. 0：PTP 1：LINE 2：CIRCLR 90：ELLIPSE 91：BEZIER 100：custom 200：END line
S0+13+100*(n-1)	Parameter	INT16U	-	Parameter 1: When the type is 2 arc mode, it indicates the arc type: 0-three-point arc, 1-center arc, 2-radius arc. When the type is 90 elliptical mode, it indicates the plane selection: 0-XOY plane, 1-ZOX plane, 2-YOZ plane. When the type is 91 Bessel curve, it represents the degree of the curve, p=2/3/4. When the type is 100 custom segment, it represents the serial number and is greater than or equal to 100. Other types are meaningless (specific configurations can be found in the newly added section of V3.7.3 below)
S0+15+100*(n-1)	CoorDinateSystem	INT16U	-	Coordinate system (not currently supported)
S0+16+100*(n-1)	PosX	FP64	Instruction Unit	Target Position X
S0+20+100*(n-1)	PosY	FP64	Instruction Unit	Target Position Y
S0+24+100*(n-1)	PosZ	FP64	Instruction Unit	Target Position Z
S0+28+100*(n-1)	PosA	FP64	Instruction Unit	Target Position A
S0+32+100*(n-1)	PosB	FP64	Instruction Unit	Target Position B
S0+36+100*(n-1)	PosC	FP64	Instruction Unit	Target Position C
S0+40+100*(n-1)	AuxX	FP64	Instruction Unit	Auxiliary position X
S0+44+100*(n-1)	AuxY	FP64	Instruction Unit	Auxiliary position Y
S0+48+100*(n-1)	AuxZ	FP64	Instruction Unit	Auxiliary position Z
S0+52+100*(n-1)	AuxA	FP64	Instruction Unit	Auxiliary position A
S0+56+100*(n-1)	AuxB	FP64	Instruction Unit	Auxiliary position B
S0+60+100*(n-1)	AuxC	FP64	Instruction Unit	Auxiliary position C
S0+64+100*(n-1)	Vel	FP64	Instruction Unit/s	Target speed
S0+72+100*(n-1)	MaxError	FP64	-	Linear transition error
S0+76+100*(n-1)	TransError	FP64	-	Arc transition error
S0+80+100*(n-1)	BowHeightError	FP64	-	Chord error
S0+84+10	CentriAcc	FP64	Instruction	Centrifugal acceleration

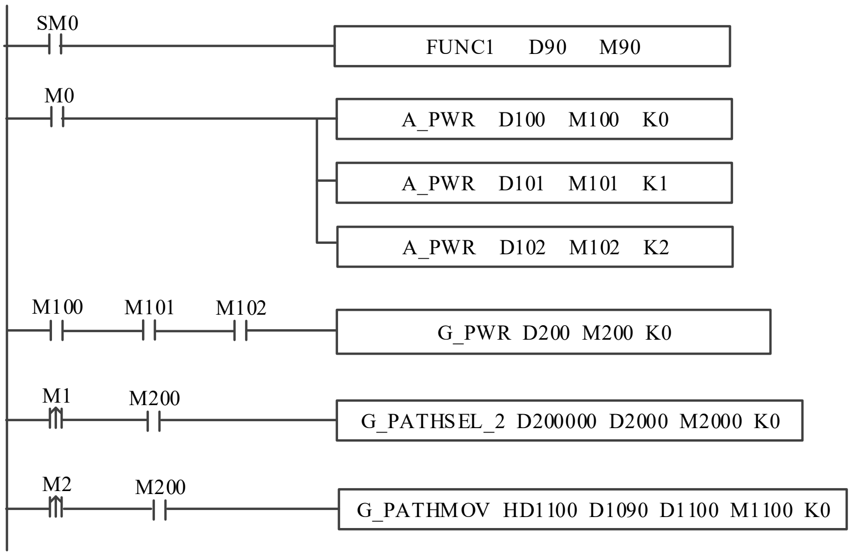
0*(n-1)			Unit/s²	
S0+88+10 0*(n-1)	CornerAcc	FP64	Instruction Unit/s²	Corner acceleration
S0+92+10 0*(n-1)	AccPercent	INT16U	-	Acceleration percentage
S0+93+10 0*(n-1)	DecPercent	INT16U	-	Deceleration percentage
S0+94+10 0*(n-1)	JerkPercent	INT16U	-	Acceleration percentage
Output parameter	Parameter name	Data type	Unit	Note
S1	ErrCode	INT16U	-	Command error code
State parameter	Parameter name	Data type	Unit	Note
S2	Done	BOOL	-	Instruction execution completed
S2+1	Busy	BOOL	-	Instruction is currently being executed
S2+2	Abort	BOOL	-	Instruction interrupted
S2+3	Err	BOOL	-	Instruction execution error
Axis number	Parameter name	Data type	Unit	Note
S3	AxesGroup	INT16U	-	Axis group number. Starting from 0

(7) Sequence diagram



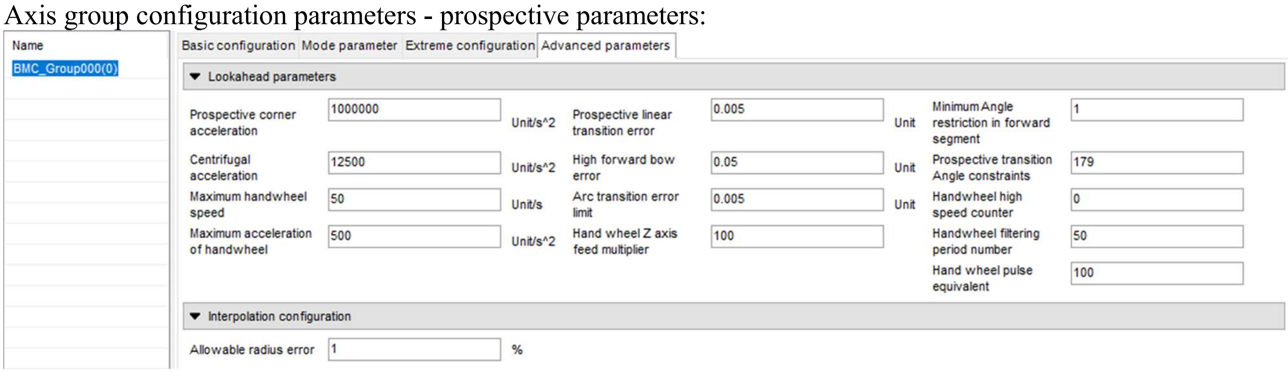
Explanation:
In general, after triggering the command, the Busy signal is set and reset after the command is executed. At the same time, the Done signal is set. Only when the command is executed again, the Done signal is reset. Otherwise, it will not automatically reset.
When an instruction is interrupted or there is an error, the corresponding Abort or Error signal is set, and other signals are reset. When an error occurs, the corresponding error code will be output.

(8) Application
Example: Load 5 rows of data (the 5th row terminates). The ladder diagram is as follows:



The function block FUNC1 is used to assign a value to the G-PATHSEL command. When M0 enables the axis group to form an axis, and all three axes are successfully enabled (M100, M101, and M102 are ON), the axis group is enabled. After the axis group is successfully enabled (M200 is ON), M1 can trigger the G_PATHSEL command, and M2 can trigger the G_PATHMOV command.

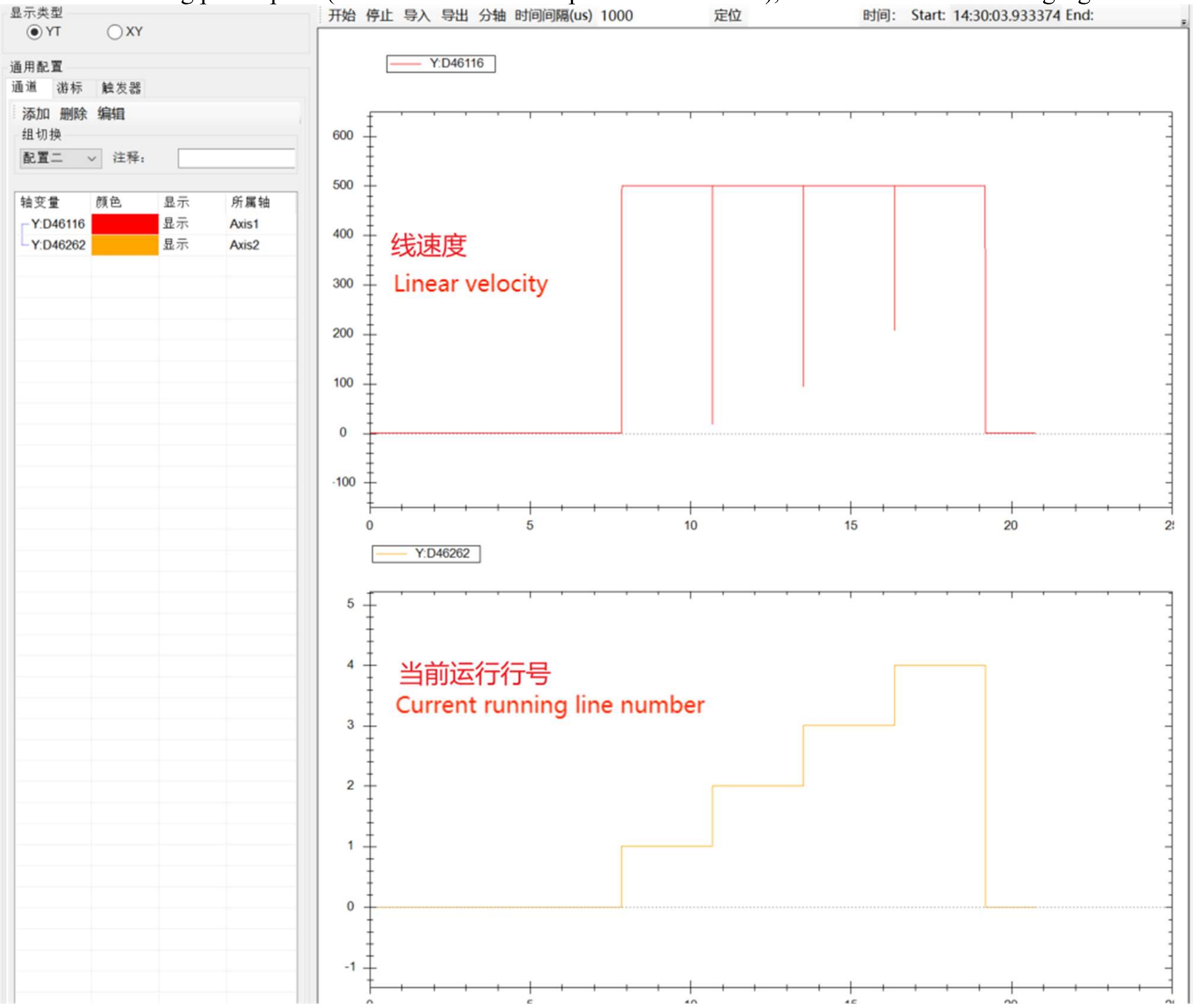
Axis group configuration parameters - prospective parameters:



The configuration parameters of the FUNC1 function block are as follows:

```
void FUNC1 ( PINT16S W, PBIT B )
{
#define SysRegAddr_HD_D_HM_M
#define DIND *(INT32U*)&D
#define DAD *(FP64*)&D
#define FHD *(FP64*)&HD


    D[200000] = 5;
    for (  int j = 1; j <= D[200000]; j++ )
    {
        if ( 1 == j  )                                                        //1
        {
            DIND[200010 + ( j - 1 ) * 100] = j;                                                      END line
            D[200012 + ( j - 1 ) * 100] = 1;                    //0---PTP;1---LINE;2---CIRCLE;200---终止行
            DAD[200016 + ( j - 1 ) * 100] = 1000  ;          //X-目标 X-Target
            DAD[200020 + ( j - 1 ) * 100] = 1000 ;        //Y-目标 Y-Target
            DAD[200024 + ( j - 1 ) * 100] = 0;                  //Z-目标 Z-Target
            DAD[200064 + ( j - 1 ) * 100] = 500;                //速度 Speed
            //---------新增前瞻部分
            DAD[200072 + ( j - 1 ) * 100] = 0;                  //直线过渡误差 Line transition error
            DAD[200076 + ( j - 1 ) * 100] = 0;              //圆弧过渡误差 Arc transition error
            DAD[200080 + ( j - 1 ) * 100] = 0;                  //圆弧弓高误差 Arc bow height error
            DAD[200084 + ( j - 1 ) * 100] = 0;                  //离心加速度 Centrifugal acceleration
            DAD[200088 + ( j - 1 ) * 100] = 0;                  //拐角加速度 Corner acceleration
            D[200092 + ( j - 1 ) * 100] = 0;                    //加速度百分比 Acceleration percentage
            D[200093 + ( j - 1 ) * 100] = 0;                    //减速度百分比 Deceleration percentage
            D[200094 + ( j - 1 ) * 100] = 0;                    //加加速度百分比 Acceleration percentage
        }
        else if ( 2 == j  )                                                   //2
        {
            DIND[200010 + ( j - 1 ) * 100] = j;
            D[200012 + ( j - 1 ) * 100] = 1;                    //0---PTP;1---LINE;2---CIRCLE;200---终止行
            DAD[200016 + ( j - 1 ) * 100] = 2000  ;          //X-目标
            DAD[200020 + ( j - 1 ) * 100] = 0;          //Y-目标
            DAD[200024 + ( j - 1 ) * 100] = 0;                  //Z-目标
            DAD[200064 + ( j - 1 ) * 100] = 500;                //速度
            //---------新增前瞻部分
            DAD[200072 + ( j - 1 ) * 100] = 0;                  //直线过渡误差
            DAD[200076 + ( j - 1 ) * 100] = 0.025;              //圆弧过渡误差
            DAD[200080 + ( j - 1 ) * 100] = 0;                 //圆弧弓高误差
            DAD[200084 + ( j - 1 ) * 100] = 0;                  //离心加速度
            DAD[200088 + ( j - 1 ) * 100] = 0;                  //拐角加速度
            D[200092 + ( j - 1 ) * 100] = 0;                    //加速度百分比
            D[200093 + ( j - 1 ) * 100] = 0;                    //减速度百分比
            D[200094 + ( j - 1 ) * 100] = 0;                    //加加速度百分比
        }

        else if ( 3 == j  )                                              //3
        {
            DIND[200010 + ( j - 1 ) * 100] = j;
            D[200012 + ( j - 1 ) * 100] = 1;                //0---PTP;1---LINE;2---CIRCLE;200---终止行
            DAD[200016 + ( j - 1 ) * 100] = 3000;        //X-目标
            DAD[200020 + ( j - 1 ) * 100] = 1000 ;    //Y-目标
            DAD[200024 + ( j - 1 ) * 100] = 0;              //Z-目标
            DAD[200064 + ( j - 1 ) * 100] = 500;            //速度
            //---------新增前瞻部分
            DAD[200072 + ( j - 1 ) * 100] = 0;              //直线过渡误差
            DAD[200076 + ( j - 1 ) * 100] = 0.055;          //圆弧过渡误差
            DAD[200080 + ( j - 1 ) * 100] = 0;              //圆弧弓高误差
            DAD[200084 + ( j - 1 ) * 100] = 0;              //离心加速度
            DAD[200088 + ( j - 1 ) * 100] = 0;              //拐角加速度
            D[200092 + ( j - 1 ) * 100] = 0;                //加速度百分比
            D[200093 + ( j - 1 ) * 100] = 0;                //减速度百分比
            D[200094 + ( j - 1 ) * 100] = 0;                //加加速度百分比
        }
        else if ( 4 == j  )                                              //4
        {
            DIND[200010 + ( j - 1 ) * 100] = j;
            D[200012 + ( j - 1 ) * 100] = 1;                //0---PTP;1---LINE;2---CIRCLE;200---终止行
            DAD[200016 + ( j - 1 ) * 100] = 4000 ;      //X-目标
            DAD[200020 + ( j - 1 ) * 100] = 0;      //Y-目标
            DAD[200024 + ( j - 1 ) * 100] = 0;              //Z-目标
            DAD[200064 + ( j - 1 ) * 100] = 500;            //速度
            //---------新增前瞻部分
            DAD[200072 + ( j - 1 ) * 100] = 0;              //直线过渡误差
            DAD[200076 + ( j - 1 ) * 100] = 0.105;          //圆弧过渡误差
            DAD[200080 + ( j - 1 ) * 100] = 0;              //圆弧弓高误差
            DAD[200084 + ( j - 1 ) * 100] = 0;              //离心加速度
            DAD[200088 + ( j - 1 ) * 100] = 0;              //拐角加速度
            D[200092 + ( j - 1 ) * 100] = 0;                //加速度百分比
            D[200093 + ( j - 1 ) * 100] = 0;                //减速度百分比
            D[200094 + ( j - 1 ) * 100] = 0;                //加加速度百分比
        }
        else
        {
            DIND[200010 + ( j - 1 ) * 100] = j;                 //行号
            D[200012 + ( j - 1 ) * 100] = 200;                  //0---PTP;1---LINE;2---CIRCLE;200---终止行
        }

    }
```

Operation result: The angle between the four segments of LINE is 90°. The forward looking parameter in the first segment G_PATHSEL is set to 0, and the forward looking parameter is set to run according to the axis group configuration by default. The arc transition error is continuously increased in the second, third, and fourth segments, and other parameters are set to 0 using the axis group default parameters; The running result shows an increase in turning point speed (with the arc transition parameter in effect), as shown in the following figure:



5-2-2-27. Tool value writing 【G_TOOLWR】

(1) Overview

Write tool values for the specified axis group.

Tool value writing [G_TOOLWR]			
Execution condition	Rising/falling edge of the coil	Suitable model	XDH, XLH, XG2
Firmware	V3.7.1 and above	Software	V3.7.4 and above

(2) Operand

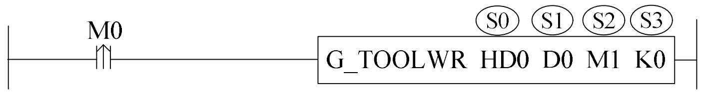
Operand	Function	Type
S0	Specify the starting address of input parameters	64-bit, quadword
S1	Specify the output state word start address	16-bit, single word
S2	Specify the output state bit start address	Bit
S3	Specify the shaft output port number	16-bit, single word

(3) Suitable soft component

Operand	Word soft component											Bit soft component					
	System								Constant	Module		System					
	D*	FD	TD*	CD*	DX	DY	DM*	DS*	K/H	ID	QD	X	Y	M*	S*	T*	C*
S0	●	●	●	●													
S1	●	●	●	●													
S2														●			
S3	●								●								

*: D means D, HD; TD means TD and HTD; CD means CD, HCD, HSCD and HSD; DM means DM and DHM; DS means DS and DHS; M means M, HM, SM; S means S, HS; T means T, HT; C means C, HC.

(4) Function and action



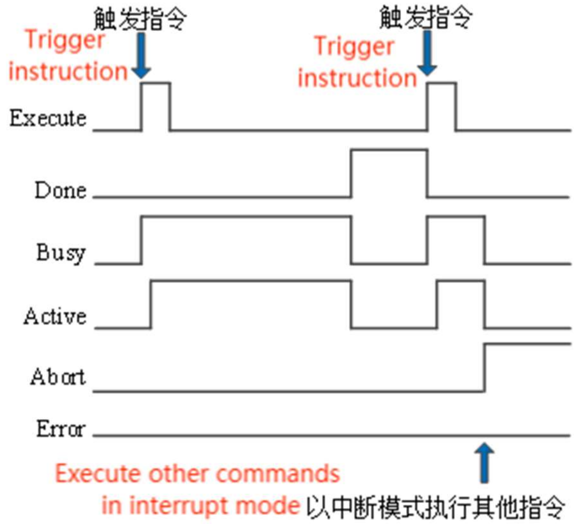
- When M0 changes from OFF to ON, write the tool value for the tool corresponding to the axis group specified in S3.
- Kinematic model selection
  - When in XYZ: S0+4 \ S0+8 \ S0+12 is valid.
  - When in XYZC: S0+4 \ S0+8 \ S0+12 \ S0+16 is valid.
- Tool number is less than or equal to the system's maximum tool number of 9 (default to 10 groups).
- Tool number 0: System default tool value, cannot be modified.

(5) Sequence diagram

Input parameter	Parameter name	Data type	Unit	Note
S0	ToolNo	INT16U	-	TOOL No
S0+4	OffsetX	FP64	Instruction Unit	X-direction offset
S0+8	OffsetY	FP64	Instruction Unit	Y-direction offset
S0+12	OffsetZ	FP64	Instruction Unit	Z-direction offset
S0+16	A0	FP64	Instruction Unit	A0 offset
S0+20	A1	FP64	-	A1 offset (not currently supported)
S0+24	A2	FP64	-	A2 offset (not currently supported)
Output parameter	Parameter name	Data type	Unit	Note
S1	ErrCode	INT16U	-	Command error code
State parameter	Parameter name	Data type	Unit	Note
S2	Done	BOOL	-	Instruction execution completed
S2+1	Busy	BOOL	-	Instruction is currently being executed

S2+2	Abort	BOOL	-	Instruction interrupted
S2+3	Err	BOOL	-	Instruction execution error
Axis number	Parameter name	Data type	Unit	Note
S3	Axis	INT16U	-	Axis number. Starting from 0

(6) Timing Diagram



Explanation:

After triggering the command, the Busy signal is set and reset after the command execution is completed. At the same time, the Done signal is set. Only when the command is executed again will the Done signal be reset, otherwise it will not automatically reset.

When there is an error in the instruction, the Error signal is set, other signals are reset, and the corresponding error code is output.

5-2-2-28. Tool value reading 【G_TOOLRD】

(1) Overview

Read the tool value of the corresponding tool number for the specified axis group.

Tool value writing [G_TOOLWR]			
Execution condition	Rising/falling edge of the coil	Suitable model	XDH, XLH, XG2
Firmware	V3.7.1 and above	Software	V3.7.4 and above

(2) Operand

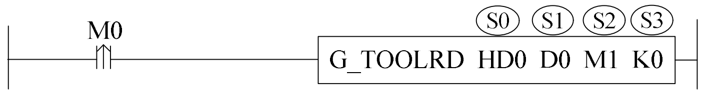
Operand	Function	Type
S0	Specify the starting address of input parameters	64-bit, quadword
S1	Specify the output state word start address	16-bit, single word
S2	Specify the output state bit start address	Bit
S3	Specify the shaft output port number	16-bit, single word

(3) Suitable soft component

Operand	Word soft component											Bit soft component					
	System								Constant	Module		System					
	D*	FD	TD*	CD*	DX	DY	DM*	DS*	K/H	ID	QD	X	Y	M*	S*	T*	C*
S0	●	●	●	●													
S1	●	●	●	●													
S2														●			
S3	●								●								

*: D means D, HD; TD means TD and HTD; CD means CD, HCD, HSCD and HSD; DM means DM and DHM; DS means DS and DHS; M means M, HM, SM; S means S, HS; T means T, HT; C means C, HC.

(4) Function and action



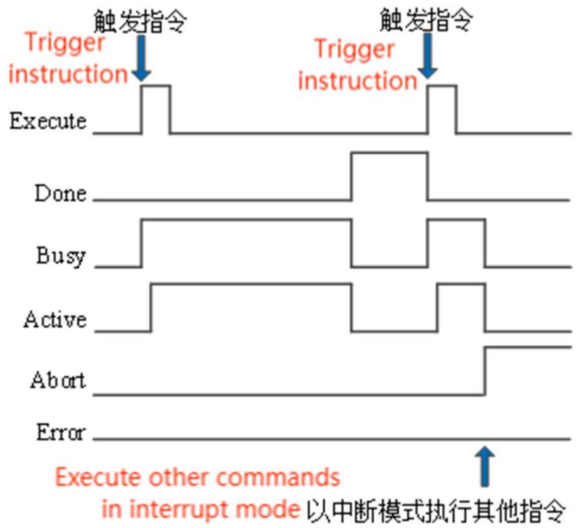
- When M0 changes from OFF to ON, read the tool value corresponding to the tool number of the specified axis group in S3.
- Kinematic model selection
  - When in XYZ: S1+4\S1+8\S1+12 is valid.
  - When in XYZC: S0+4 \ S0+8 \ S0+12 \ S0+16 is valid.
- S0+16: a0 is the offset of the C-axis. For a0=0, the direction of the TCP coordinate system is equal to the direction of the flange coordinate system.
- The tool number should be less than or equal to the system's maximum tool number of 9.

(5) Sequence diagram

Input parameter	Parameter name	Data type	Unit	Note
S0	ToolNo	INT16U	-	TOOL No
Output parameter	Parameter name	Data type	Unit	Note
S1	ErrCode	INT16U	-	Command error code
S1+4	OffsetX	FP64	Instruction Unit	X-direction offset
S1+8	OffsetY	FP64	Instruction Unit	Y-direction offset
S1+12	OffsetZ	FP64	Instruction Unit	Z-direction offset
S1+16	A0	FP64	Instruction Unit	A0 offset
S1+20	A1	FP64	Instruction Unit	A1 offset (not currently supported)
S1+24	A2	FP64	Instruction Unit	A2 offset (not currently supported)
State	Parameter name	Data type	Unit	Note

parameter				
S2	Done	BOOL	-	Instruction execution completed
S2+1	Busy	BOOL	-	Instruction is currently being executed
S2+2	Abort	BOOL	-	Instruction interrupted
S2+3	Err	BOOL	-	Instruction execution error
Axis number	Parameter name	Data type	Unit	Note
S3	Axis	INT16U	-	Axis number. Starting from 0

(6) Timing Diagram



Explanation:
After triggering the command, the Busy signal is set and reset after the command execution is completed. At the same time, the Done signal is set. Only when the command is executed again will the Done signal be reset, otherwise it will not automatically reset.
When there is an error in the instruction, the Error signal is set, other signals are reset, and the corresponding error code is output.

5-2-2-29. Tool value loading 【G_TOOLSEL】

(1) Overview

Load tool values for the specified axis group.

Tool value loading[G_TOOLSEL]			
Execution condition	Rising/falling edge of the coil	Suitable model	XDH, XLH, XG2
Firmware	V3.7.1 and above	Software	V3.7.4 and above

(2) Operand

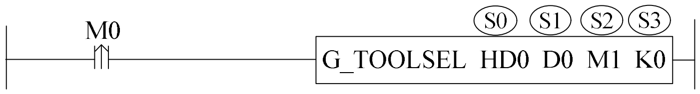
Operand	Function	Type
S0	Specify the starting address of input parameters	64-bit, quadword
S1	Specify the output state word start address	16-bit, single word
S2	Specify the output state bit start address	Bit
S3	Specify the shaft output port number	16-bit, single word

(3) Suitable soft component

Operand	Word soft component											Bit soft component					
	System								Constant	Module		System					
	D*	FD	TD*	CD*	DX	DY	DM*	DS*	K/H	ID	QD	X	Y	M*	S*	T*	C*
S0	●	●	●	●													
S1	●	●	●	●													
S2														●			
S3	●								●								

*: D means D, HD; TD means TD and HTD; CD means CD, HCD, HSCD and HSD; DM means DM and DHM; DS means DS and DHS; M means M, HM, SM; S means S, HS; T means T, HT; C means C, HC.

(4) Function and action

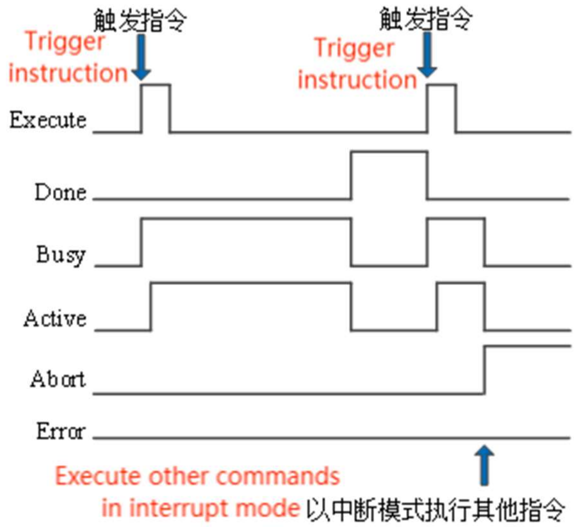


- S0 specifies [specify input parameter start address].
- S1 specifies [specify the starting address of the output status word].
- S2 specifies [specify the starting address of the output status bit].
- S3 specifies [specify shaft output port number].
- When M0 goes from OFF to ON, the tool value corresponding to the tool number will be compensated to each axis (current position of each axis+tool value) for the axis group specified in S3. All subsequent motion commands will use this tool. If the tool value needs to be replaced, the command will need to be triggered again.

(5) Related parameters

Input parameter	Parameter name	Data type	Unit	Note
S0	Vel	INT16U	-	TOOL No
Output parameter	Parameter name	Data type	Unit	Note
S1	ErrCode	INT16U	-	Command error code
State parameter	Parameter name	Data type	Unit	Note
S2	Done	BOOL	-	Instruction execution completed
S2+1	Busy	BOOL	-	Instruction is currently being executed
S2+2	Abort	BOOL	-	Instruction interrupted
S2+3	Err	BOOL	-	Instruction execution error
Axis number	Parameter name	Data type	Unit	Note
S3	Axis	INT16U	-	Axis number. Starting from 0

(6) Sequence diagram



Explanation:
After triggering the command, the Busy signal is set and reset after the command execution is completed. At the same time, the Done signal is set. Only when the command is executed again will the Done signal be reset, otherwise it will not automatically reset.
When there is an error in the instruction, the Error signal is set, other signals are reset, and the corresponding error code is output.

(7) Application

■ XYZ model:

Compensate the tool value corresponding to the tool number to each axis (current position of each axis+tool value).
Example: Set the current positions of each axis to (100200300), use Tool 1 with tool values of (20,30,40), and the ladder diagram is shown in the following figure:

M0

A_PWR D0 M1 K0

A_PWR D5 M5 K2

A_PWR D10 M10 K3

M1 M5 M10

G_PWR D50 M50 K0

M100

G_TOOLWR HD10 D100 M101 K0

M101

G_TOOLSEL HD150 D150 M151 K0

Before executing tool commands, set the positioning of each axis to:

D46044	100	双...	10...	Given x position
D46048	200	双...	10...	Given y position
D46052	300	双...	10...	Given z position

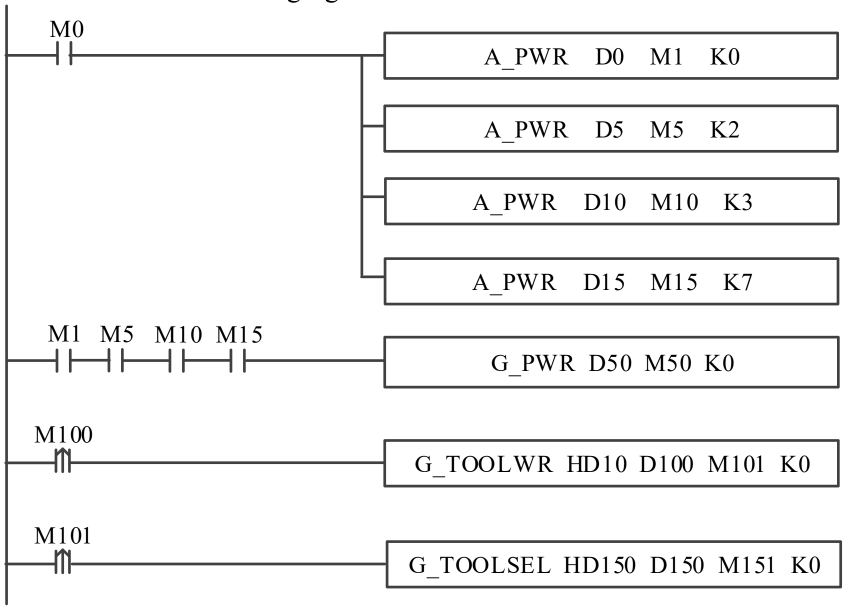
After using the tool commands, each axis is positioned as shown in the following figure:

D46044	120	双...	10...	Given x position
D46048	230	双...	10...	Given y position
D46052	340	双...	10...	Given z position

It can be seen that the position of each axis after using the tool is the current position of each axis plus the tool value.

■ XYZC model:

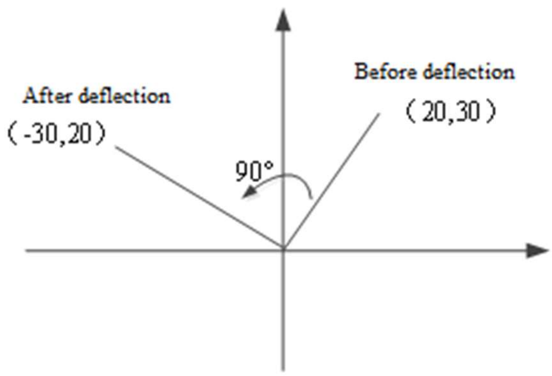
When there is no angle on the c-axis before using the tool, the effect of using the tool value is consistent with the xyz model.
When there is an angle on the c-axis before using the tool, because the tool value is not deviated from the c-axis, when there is a certain angle on the c-axis itself, after executing the tool command, the tool value will be first deviated according to the angle on the c-axis, and then the deviated tool value will be added to the current position of each axis to obtain the position of each axis after using the tool.
Example: Set the current positions of each axis to (100, 200, 300, 90), use Tool 1 with tool values of (20, 30, 40), and the ladder diagram is shown in the following figure:



Before executing the tool command, the given position and flange position are shown in the following figure:

D46044	100	双...	10...	Given x position
D46048	200	双...	10...	Given y position
D46052	300	双...	10...	Given z position
D46056	90	双...	10...	Given c position
D46092	100	双...	10...	X flange position
D46096	200	双...	10...	Y flange position
D46100	300	双...	10...	Z flange position
D46104	90	双...	10...	C flange position

The calculation method for tool value deviation during instruction execution is shown in the following figure (as the deviation of the c-axis only affects the x-axis and y-axis, the following discussion will only focus on the x-axis and y-axis):



As shown in the figure, the tool value obtained after a 90 ° deflection is (-30,20). After receiving the tool command, the positions of each axis are shown in the following figure:

D46044	70	双...	10...	Given x position
D46048	220	双...	10...	Given y position
D46052	340	双...	10...	Given z position
D46056	90	双...	10...	Given c position
D46092	100	双...	10...	X flange position
D46096	200	双...	10...	Y flange position
D46100	300	双...	10...	Z flange position
D46104	90	双...	10...	C flange position

5-2-3. Related coil and register

After the relevant register is modified, it will take effect after power on again.

System parameters

Address	Definition	Data type	Initial value	Note
SFD811	Motion control function activation mode	INT16U	0	0: C motion * 1: H motion
SFD820	Axis group numbers	INT32U	0	Set the number of axis groups as needed, currently supporting a maximum of 4 axis groups
SFD824	Axis group bit state start address	INT32U	28000	Axis group related coil start address
SFD826	Axis group word state start address	INT32U	46000	Axis group related register start address

***Note:**

C motion does not support all commands and parameters in this manual. Please refer to EtherCAT motion control user manual for specific usage.

Axis configuration parameter (N is axis group number)

Address	Definition	Data type	Unit	Initial value	Note
SFD48000+300*N	Kinematic type	ENUM	-	1	0: XY 1: XYZ 2:XYZC 4:Polar coordinates
SFD48001+300*N	Set axis number 1	INT16U	-	0	axis X number of the axis group
SFD48002+300*N	Set axis number 2	INT16U	-	1	axis Y number of the axis group
SFD48003+300*N	Set axis number 3	INT16U	-	2	axis Z number of the axis group
SFD48004+300*N	Set axis number 4	INT16U	-	65535	axis A number of the axis group
SFD48005+300*N	Set axis number 5	INT16U	-	65535	axis B number of the axis group
SFD48006+300*N	Set axis number 6	INT16U	-	65535	axis C number of the axis group
SFD48007+300*N	Axis group error stop method	ENUM	-	0	0: deceleration stop 1: emergency stop. Not currently supported
SFD48008+300*N	Emergency stop mode	ENUM	-	0	0: given stop 1: feedback stop. When the speed is high, the use of feedback stop may lead to servo alarm

Address	Definition	Data type	Unit	Initial value	Note
SFD48020+300*N	XYZ max speed	FP64	Command unit/s	6553600	If the speed parameter in the command is higher than the maximum speed, it will run at the maximum speed
SFD48024+300*N	XYZ max acceleration	FP64	Command unit/s^2	65536000	If the acceleration parameter in the command is higher than the maximum acceleration, it will run at the maximum acceleration
SFD48028+300*N	XYZ max deceleration	FP64	Command unit/s^2	65536000	If the deceleration parameter in the command is higher than the maximum deceleration, it will run at the maximum deceleration
SFD48032+300*N	XYZ max jerk speed	FP64	Command unit/s^3	655360000	If the jerk speed parameter in the command is higher

Address	Definition	Data type	Unit	Initial value	Note
					than the maximum jerk speed, it will run at the maximum jerk speed
SFD48036+300*N	ABC max speed	FP64	Command unit/s	6553600	If the speed parameter in the command is higher than the maximum speed, it will run at the maximum speed
SFD48040+300*N	ABC max acceleration	FP64	Command unit/s^2	65536000	If the acceleration parameter in the command is higher than the maximum acceleration, it will run at the maximum acceleration
SFD48044+300*N	ABC max deceleration	FP64	Command unit/s^2	65536000	If the deceleration parameter in the command is higher than the maximum deceleration, it will run at the maximum deceleration
SFD48048+300*N	ABC max jerk speed	FP64	Command unit/s^3	655360000	If the jerk speed parameter in the command is higher than the maximum jerk speed, it will run at the maximum jerk speed
SFD48052+300*N	XYZ default speed percentage	INT16U	-	10	When the speed in the instruction exceeds the speed limit, execute at the maximum speed * default speed percentage; When the instruction speed is 0, the instruction reports an error
SFD48053+300*N	XYZ default acceleration percentage	INT16U	-	10	When the acceleration in the command is set to 0, execute at the highest acceleration * default acceleration percentage
SFD48054+300*N	XYZ default deceleration percentage	INT16U	-	10	When the deceleration in the command is set to 0, the maximum deceleration * default deceleration percentage is executed
SFD48055+300*N	XYZ default jerk speed percentage	INT16U	-	10	When the jerk speed in the command is set to 0, it is executed as the highest jerk speed * default jerk speed percentage
SFD48056+300*N	ABC default speed percentage	INT16U	-	10	When the speed in the command is set to 0, it is executed with the highest acceleration * default acceleration percentage
SFD48057+300*N	ABC default acceleration percentage	INT16U	-	10	When the acceleration in the command is set to 0, it is executed as the highest acceleration * default acceleration percentage
SFD48058+300*N	ABC default deceleration percentage	INT16U	-	10	When the deceleration in the command is set to 0, the maximum deceleration *

Address	Definition	Data type	Unit	Initial value	Note
					default deceleration percentage is executed
SFD48059+300*N	ABC default jerk speed percentage	INT16U	-	10	When the jerk speed in the command is set to 0, it is executed as the highest jerk speed * default jerk speed percentage

Address	Definition	Data type	Unit	Initial value	Note
SFD48100+300*N	XYZ speed alarm percentage	INT16U		100	When XYZ axis group linear speed is over the alarm value, the axis group will alarm
SFD48101+300*N	XYZ acceleration alarm percentage	INT16U		100	Not supported at the moment
SFD48102+300*N	XYZ deceleration alarm percentage	INT16U		100	Not supported at the moment
SFD48103+300*N	ABC speed alarm percentage	INT16U		100	When ABC axis group linear speed is over the alarm value, the axis group will alarm
SFD48104+300*N	ABC acceleration alarm percentage	INT16U	-	100	Not supported at the moment
SFD48105+300*N	ABC deceleration alarm percentage	INT16U	-	100	Not supported at the moment
SFD48120+300*N	X axis max soft limit	FP64	Command unit	1000000000	

Address	Definition	Data type	Unit	Initial value	Note
SFD48124+300*N	Y axis max soft limit	FP64	Command unit	1000000000	
SFD48128+300*N	Z axis max soft limit	FP64	Command unit	1000000000	
SFD48132+300*N	X axis min soft limit	FP64	Command unit	-1000000000	
SFD48136+300*N	Y axis min soft limit	FP64	Command unit	-1000000000	
SFD48140+300*N	Z axis min soft limit	FP64	Command unit	-1000000000	
SFD48144+300*N	Start the soft limit	ENUM	-	0	0: not enable 1: enable
SFD48145+300*N	Soft limit stop type	ENUM	-	0	0: slow stop 1: emergency stop
SFD48146+300*N	Allowable radius error	FP64	%	0	
SFD48162+300*N	Distance between rotation center and translation axis	FP64	%	0	Polar coordinate parameters
SFD48166+300*N	The center of the turntable is offset in the X direction based on the base marker	FP64	%	0	Polar coordinate parameters
SFD48170+300*N	The Y-direction offset of the turntable center based on the base marker	FP64	%	0	Polar coordinate parameters
SFD48240+300*N	Forward looking corner acceleration	FP64	Command unit/s^2	10000	

Address	Definition	Data type	Unit	Initial value	Note
SFD48244+300*N	Centrifugal acceleration	FP64	Command unit /s^2	125	
SFD48248+300*N	Maximum handwheel speed	FP64	Command unit /s	50	
SFD48252+300*N	Maximum handwheel acceleration	FP64	Command unit /s^2	500	
SFD48256+300*N	Forward looking straight line transition error	FP64	Command unit	0.005	
SFD48260+300*N	Forward looking arch height error	FP64	Command unit	0.0025	
SFD48264+300*N	Arc transition error limit	FP64	Command unit	0.005	
SFD48269+300*N	G00 change to G01	INT16U	-	0	
SFD48270+300*N	Emergency stop mode	INT16U	-	0	
SFD48271+300*N	Stop time ratio	INT16U	-	10	
SFD48272+300*N	Stop mode	INT16U	-	0	
SFD48273+300*N	Z-axis feed rate of handwheel	INT16U	-	100	
SFD48274+300*N	Minimum included angle limit of forward-looking section	INT16U	-	60	
SFD48275+300*N	Forward looking transition angle limit	INT16U	-	160	
SFD48276+300*N	Handwheel high speed counting port	INT16U	-	0	
SFD48277+300*N	Handwheel filtering cycles	INT16U	-	50	
SFD48278+300*N	Use default feed rate	INT16U	-	0	
SFD48280+300*N	Handwheel pulse equivalent	INT32U	-	100	

Axis group state coil (the coil start address is decided by SFD824)

Address	Definition	Note
M28000+100*N	Axis group enable	ON: axis group enable state
M28001+100*N	Axis group motion	ON: axis group motion state
M28003+100*N	Axis group error	ON: axis group error state
M28004+100*N	Axis group buffer state	ON: the axis group commands are saved in the buffer
M28010+100*N	MST interactive	ON: G_PATHMOV moves to the user defined operation row specified by G_PATHSEL

Axis group state register (the register start address is decided by SFD826)

Address	Definition	Data type	Unit	Note
D46000+300*N	axis group state machine	ENUM	-	0: the axis group is not enabled 1: axis group enabled, not moving 2: Axis group in motion 3: axis group stop 4: Axis group error
D46001+300*N	Axis group error code	INT16U	-	Display the axis group error code
D46020+300*N	Current motion segment end point X	FP64	Command unit	X axis current motion end position
D46024+300*N	Current motion segment end point Y	FP64	Command unit	Y axis current motion end position
D46028+300*N	Current motion segment end point Z	FP64	Command unit	Z axis current motion end position
D46032+300*N	Current motion segment end	FP64	Command	A axis current motion end position

Address	Definition	Data type	Unit	Note
	point A		unit	
D46036+300*N	Current motion segment end point B	FP64	Command unit	B axis current motion end position
D46040+300*N	Current motion segment end point C	FP64	Command unit	C axis current motion end position
D46044+300*N	Current motion given position X	FP64	Command unit	X axis current motion give position
D46048+300*N	Current motion given position Y	FP64	Command unit	Y axis current motion give position
D46052+300*N	Current motion given position Z	FP64	Command unit	Z axis current motion give position
D46056+300*N	Current motion given position A	FP64	Command unit	A axis current motion give position
D46060+300*N	Current motion given position B	FP64	Command unit	B axis current motion give position
D46064+300*N	Current motion given position C	FP64	Command unit	C axis current motion give position
D46068+300*N	Current motion given joint speed X	FP64	Command unit	X axis current motion given speed
D46072+300*N	Current motion given joint speed Y	FP64	Command unit	Y axis current motion given speed
D46076+300*N	Current motion given joint speed Z	FP64	Command unit	Z axis current motion given speed
D46080+300*N	Current motion given joint speed A	FP64	Command unit	A axis current motion given speed
D46084+300*N	Current motion given joint speed B	FP64	Command unit	B axis current motion given speed
D46088+300*N	Current motion given joint speed C	FP64	Command unit	C axis current motion given speed
D46092+300*N	Current motion given flange position X	FP64	Command unit	X axis current motion given flange position
D46096+300*N	Current motion given flange position Y	FP64	Command unit	Y axis current motion given flange position
D46100+300*N	Current motion given flange position Z	FP64	Command unit	Z axis current motion given flange position
D46104+300*N	Current motion given flange position A	FP64	Command unit	A axis current motion given flange position
D46108+300*N	Current motion given flange position B	FP64	Command unit	B axis current motion given flange position
D46112+300*N	Current motion given flange position C	FP64	Command unit	C axis current motion given flange position
D46116+300*N	Current motion linear speed	FP64	Command unit	Composite speed of axis group
D46140+300*N	Current motion feedback position X	FP64	Command unit	X axis current motion feedback position
D46144+300*N	Current motion feedback position Y	FP64	Command unit	Y axis current motion feedback position
D46148+300*N	Current motion feedback position Z	FP64	Command unit	Z axis current motion feedback position
D46152+300*N	Current motion feedback position A	FP64	Command unit	A axis current motion feedback position
D46156+300*N	Current motion feedback position B	FP64	Command unit	B axis current motion feedback position
D46160+300*N	Current motion feedback position C	FP64	Command unit	C axis current motion feedback position
D46226+300*N	PATHSEL buffer remaining space	INT32S		PATHSEL buffer remaining space

Address	Definition	Data type	Unit	Note
D46249+300*N	M code	INT16U		PATHMOV mapping
D46262+300*N	PATHMOV row number	INT16U		PATHMOV row number

5-3. Cam function

Electronic cam is a software system that uses the constructed cam curve to simulate the mechanical cam, so as to achieve the relative movement between the camshaft and the main shaft of the same mechanical cam system. In machining, electronic cams are used to replace heavy mechanical cams. The system using electronic cam has higher machining accuracy and flexibility and improves production efficiency.
As for the command positions of the main shaft and the slave shaft, the two cams data are interpolated in a straight line mode(the mode can be changed) to obtain the displacement(slave shaft) equivalent to the phase (main shaft). When there are few cam points, the accuracy is low, but the amount of data is small. The more points, the smaller the phase interval and the higher the accuracy.

5-3-1. Command list

Command	Function	Chapter
CAMTBLSEL	Cam table loading	5-3-2-1
CAMIN	Cam start	5-3-2-2
CAMOUT	Cam release	5-3-2-3
CAMPHASE	Phase compensation	5-3-2-4
CAMRD	Read cam table	5-3-2-5
CAMWR	Write cam table	5-3-2-6
CAMPOINTADD	Add key point	5-3-2-7
CAMPOINTDEL	Delete key point	5-3-2-8
CAMTBLDEL	Cam table unloading	5-3-2-9
CAMWRMUL	Cam table batch modification	5-3-2-10
CAMTBLGEN	Cam table generation	5-3-2-11
CAMMASTERPOSGET	Master axis position calculation	5-3-2-12
CAMSLAVEPOSGET	Slave axis position calculation	5-3-2-13
CAMCLUTCHON CAMCLUTCHOFF	Cam clutch	5-3-2-14
CAMTRANSLATE	Cam table offset	5-3-2-15
X_FLYSAW	Follow cut	5-3-2-16
X_ROTARYCUT	Fly cut	5-3-2-17
CAMSKIPWR	Cam skip write	5-3-2-18
CAMSKIPRD	Cam skip read	5-3-2-19
CAMBOUNDS	Cam range	5-3-2-20
-	User defined cam	5-3-2-21
CAMCOMP	Master-slave compensation	5-3-2-22
CAMEASYTTBLGE	Easy to use T-curve generation	5-3-2-23
CAMTAP	Cam tappet	5-3-2-24
CAMADD	Cam overlay	5-3-2-25
CAMECCTBLGEN	Eccentric cam table generation	5-3-2-26
CAMECCCALC	Calculation of eccentric wheel key points	5-3-2-27
CAMINMARK	Photoelectric trigger cam	5-3-2-28
CAMANTIREVTBLGEN	Special curve generation	5-3-2-29

5-3-2. Command introduction

5-3-2-1. Cam table loading【CAMTBLSEL】

(1) Overview

Load the set cam table and generate an example of the cam table.

Cam table loading [CAMTBLSEL]			
Execution condition	Rising/falling edge of the coil	Suitable model	XDH, XLH, XG2
Firmware	V3.6.1b and above	Software	V3.7.4 and above

Note: XDH、XLH series -L models cannot support this instruction.

(2) Operand

Operand	Function	Type
S0	Specify the input parameter start address	16-bit, single word
S1	Specify the output state word start address	16-bit, single word
S2	Sepcify the output state bit start address	Bit

(3) Suitable soft component

Operand	Word soft component											Bit soft component					
	System								Constant	Module		System					
	D*	FD	TD*	CD*	DX	DY	DM*	DS*	K/H	ID	QD	X	Y	M*	S*	T*	C*
S0	●	●	●	●													
S1	●	●	●	●													
S2														●			

*: D means D, HD; TD means TD and HTD; CD means CD, HCD, HSCD and HSD; DM means DM and DHM; DS means DS and DHS; M means M, HM, SM; S means S, HS; T means T, HT; C means C, HC.

(4) Function and action

- S0 specifies the input parameters start address, occupies the register S0~S0+3
- S1 specifies the output parameters start address, occupies the register S1~S1+1
- S2 specifies the output state bit start address, occupies the register S2~S2+2
- When M0 is from OFF→ON, load the cam table according to the set cam table number. After successful loading, a cam table instance will be generated and stored in the corresponding register of S1.

(5) Notes

- Before using the command CAMIN and CAMRD, it needs to get the cam table instance through the CAMTBLSEL, which is the output parameter
- The loaded cam table instance fails after the PLC stops and power is off. It needs to be loaded again after the next power on
- The CAMTBLSEL command can be executed multiple times for the same cam table number, and the generated cam table instances will be valid and irrelevant to each other. The maximum number of cam table instances shall not exceed 32, and the total number of points inside all cam table instances shall not exceed 65536. When the loaded cam table instance is not needed, it is unloaded through CAMTBLDEL command.
- In version V3.7.3, when loading the cam instance ID, real-time cam point information can be read from the [Oscilloscope - Cam Real time Curve Reading]. The modified cam table can be read by changing, deleting, or generating instructions. Please refer to chapters 7-4-3 for specific usage.

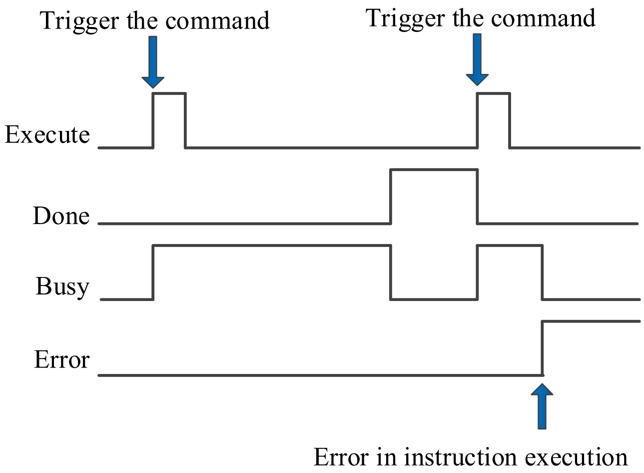
(6) Related parameters

Input parameter	Parameter name	Data type	Unit	Note
S0	Camtbl	INT16S	-	Cam table number. which is the CamProfile ID on the cam configuration interface
S0+1	Periodic	INT16S	-	Loop execution 0: OFF 1: ON
S0+2	MasterAbs	INT16S	-	Master axis mode

Input parameter	Parameter name	Data type	Unit	Note
				0: relative 1: absolute
S0+3	SlaverAbs	INT16S	-	Slave axis mode 0: relative 1: absolute
Output parameter	**Parameter name**	**Data type**	**Unit**	**Note**
S1	CamtblID	INT16S	-	Cam table instance. One of the input variables of other cam table commands
S1+1	ErrCode	INT16S	-	Command error code
Output state	**Parameter name**	**Data type**	**Unit**	**Note**
S2	Done	BOOL	-	The command execution completed
S2+1	Busy	BOOL	-	The command is being executed
S2+2	Error	BOOL	-	The command execution is error

- The master axis adopts relative / absolute mode, which affects the initial position of internal latch when CAMIN command is triggered, and only the attributes of the cam table are given when CAMTBLSEL is triggered. The final mode of the master axis is only determined by the MasterAbs and is not affected by the StartMode in the CAMIN command. It should be noted that the master axis absolute mode may cause a step from the slave axis position.
- The slave axis adopts relative / absolute mode, which affects the initial position of internal latch when CAMIN command is triggered, and only the attributes of the cam table are given when CAMTBLSEL is triggered. The final mode of the slave axis is affected by the StartMode in the CAMIN command. It should be noted that the slave axis absolute mode may cause a step from the slave axis position.
- Cam table instance is one of the input parameters of other cam commands. It is randomly generated by CAMTBLSEL command and has nothing to do with the cam ID of cam configuration interface. The same cam table can be loaded multiple times. The generated cam table instances are different and do not affect each other.

(7) Sequence diagram



Explanation:
The command is triggered and the Busy signal is set. When the command execution is completed, the Busy signal is reset and the Done signal is set.
When there is an error during instruction execution, the Error signal is set, other signals are reset, and the corresponding error code is output.

5-3-2-2. CAM start【CAMIN】

(1) Overview

Perform cam movement according to the set parameters according to the loaded cam table.

CAM start [CAMIN]			
Execution condition	Rising/falling edge of the coil	Suitable model	XDH, XLH, XG2
Firmware	V3.6.1b and above	Software	V3.7.4 and above

Note: XDH、XLH series -L models cannot support this instruction.

(2) Operand

Operand	Function	Type
S0	Specify the input parameter start address	16-bit, single word
S1	Specify the output state word start address	16-bit, single word
S2	Sepcify the output state bit start address	Bit

(3) Suitable soft component

Operand	Word soft component											Bit soft component					
	System								Constant	Module		System					
	D*	FD	TD*	CD*	DX	DY	DM*	DS*	K/H	ID	QD	X	Y	M*	S*	T*	C*
S0	●	●	●	●													
S1	●	●	●	●													
S2														●			

*: D means D, HD; TD means TD and HTD; CD means CD, HCD, HSCD and HSD; DM means DM and DHM; DS means DS and DHS; M means M, HM, SM; S means S, HS; T means T, HT; C means C, HC.

(4) Function and action

- S0 specifies the input parameters start address, occupies the register S0~S0+47
- S1 specifies the output parameters start address, occupies the register S1~S1+1
- S2 specifies the output state bit start address, occupies the register S2~S2+5
- When M0 is from OFF→ON, execute the CAM motion as the input parameters
- The 16-axis model supports up to 8 master-slave relationships; 32-axis and 64-axis models support up to 16 master-slave relationships.

(5) Related parameters

Input parameter	Parameter name	Data type	Unit	Note
S0	Master	INT16S	-	Master axis number starts from 0
S0+1	Slaver	INT16S	-	Slave axis number starts from 0
S0+2	CamtblID	INT16S	-	CAM table instance is generated by CAMTBLSEL
S0+3	StartMode	INT16S	-	Start mode of main and slave axis 0: relative mode 1: absolute mode 2: tracking mode
S0+4	MasterSource	INT16S	-	master axis data source type 0: master axis current position given 1: master axis last position given 2: master axis current position feedback 3: master axis last position feedback
S0+5	BufferMode	INT16S	-	Buffer mode 0: interrupt mode 1: buffer mode (Only V3.7.1 and above support cache function)
S0+6	Dir	INT16S	-	Synchronous direction (Only V3.7.2 and above support single direction function) 0: both direction 1: Forward direction

Input parameter	Parameter name	Data type	Unit	Note
				2: Reverse direction
S0+8	MasterOffset	FP64	-	Master axis offset
S0+12	SlaverOffset	FP64	-	Slave axis offset
S0+16	MasterScaling	FP64	-	Master axis ratio
S0+20	SlaverScaling	FP64	-	Slave axis ratio
S0+32	VecDiff	FP64	Command unit/s	Max tracking speed in tracking mode
S0+36	Acc	FP64	Command unit /s^2	Tracking acceleration in tracking mode
S0+40	Dec	FP64	Command unit /s^2	Tracking deceleration in tracking mode
S0+44	Jerk	FP64	Command unit /s^3	Tracking jerk speed in tracking mode. Jerk speed is the acceleration/deceleration change rate
Output parameter	**Parameter name**	**Data type**	**Unit**	**Note**
S1	Index	INT16S	-	Current executed cam table segment number, the segment number is the point number which is going to
S1+1	ErrCode	INT16S	-	Command error code
Output state	**Parameter name**	**Data type**	**Unit**	**Note**
S2	InSync	BOOL	-	Establishment of cam relationship between master and slave axis
S2+1	Busy	BOOL	-	The command is being executed
S2+2	Active	BOOL	-	The command is under control (affected by buffer mode)
S2+3	Abort	BOOL	-	The command is interrupted
S2+4	Error	BOOL	-	The command execution is error
S2+5	EndOfProfile	BOOL	-	Cam execution completed. When the cam adopts the cycle mode, it will set an Ethercat communication cycle after the end of the current cycle of the cam table, and then reset. When the cam does not adopt the cycle mode, it will be set after the execution of the cam and will not reset automatically.

- The InSync status bit is set to on when the slave axis reaches the slave axis position corresponding to the master axis cam table. Generally, when the slave axis is in the relative mode, execute the CAMIN command, and the status bit will be set to on immediately. When the slave axis is in the absolute or tracking mode, it will be set to on after the slave axis steps or catches up to the slave axis position corresponding to the master axis cam table
- EndOfProfile status bit will be set to on after the slave axis follows the master axis to execute a complete cam table
- StartMode parameter and MasterAbs/SlaverAbs in command CAMTBLSEL decide the main/slave axis motion mode. The master axis mode is only determined by MasterAbs and is not affected by the value in Startmode. The slave axis mode is shown as follows:

StartMode	CAMTBLSEL.SlaveAbs	Slave axis mode
Absolute	Relative	Relative
Absolute	Absolute	Absolute
Relative	Relative	Relative
Relative	Absolute	Relative
Tracking	Relative	Relative
Tracking	Absolute	Absolute

- The result of the absolute/relative mode of the master-slave axis when executing the CAMIN command

Master axis mode	Slave axis mode	Result
Relative	Relative	After CAMIN is executed, the slave axis position does not change. After the master

Master axis mode	Slave axis mode	Result
		axis runs, the slave axis moves in relative mode as the corresponding points of the cam table
	Absolute	After CAMIN is executed, the slave axis position steps to the starting position of the cam table (i.e. 0). After the master axis runs, the slave axis moves according to the corresponding points of the cam table
	Relative tracking	After CAMIN is executed, the slave axis position doesn't change. After the master axis rus, the slave axis moves in relative mode as the corresponding points of the cam table
	Absolute tracking	After CAMIN is executed, the slave axis tracks to the starting position of cam table (i.e. 0). After the master axis runs, the slave axis moves according to the corresponding points of the cam table
Absolute	Relative	After CAMIN is executed, the slave axis position doesn't change. After the master axis rus, the slave axis moves in relative mode as the corresponding points of the cam table
	Absolute	After CAMIN is executed, the slave axis position steps to the slave position corresponding to the master axis current position in the cam table (eg. Master axis current position is 100, master axis point 100 corresponds to the slave axis point 200 in the cam table. After CAMIN is executed, the slave axis steps to 200). After the master axis runs, the slave axis moves according to the corresponding points of the cam table
	Relative tracking	After CAMIN is executed, the slave axis position doesn't change. After the master axis rus, the slave axis moves in relative mode as the corresponding points of the cam table
	Absolute tracking	After CAMIN is executed, the slave axis tracks to the slave axis position corresponding to the master axis current position in the cam table (eg. The master axis current position is 100, the master axis point corresponds to the slave axis point 200 in the cam table. After CAMIN is executed, the slave axis steps to 200). After the master axis runs, the slave axis moves according to the corresponding points of the cam table

- When the master axis is in absolute mode, if the current position of the master axis is not within the master axis range of the cam table, the automatic action will be processed periodically. For example, if the current position of the master axis is 110 and the position of the master axis in the cam table is 0 ~ 100, the default master axis position after CAMIN is executed is 10 (the actual master axis position does not change).
- The master-slave axis ratio and master-slave axis offset parameters take effect when CAMIN is executed, and modification in the process is not supported. Inappropriate parameters will lead to slave axis position step. The position relationship between the master and slave axis is (where CAM( ) represents the slave axis position corresponding to the master axis on the cam table):
  Slave axis position = slave axis ratio× CAM ((master axis position+master axis offset) /master axis ratio) + slave axis offset
- The main-slave axis ratio canno be 0 (For V3.7.2 and above, the master-slave ratio is allowed to be 0, and the default is 1). When the start mode is tracking mode, S0+32~S0+44 cannot be 0. If these parameters are not set, it will return error code 1009 when the CAMIN is executed.
- Follow buffer command after CAMIN
  - Follow the command CAMIN

(1) Multi-cycle: when the EOP signal of the current cam cycle arrives, start the cam movement of the second CAMIN command, and the slave axis position steps to the actual position corresponding to the cam slave axis module value.

(2) Single cycle: the second CAMIN instruction is executed during movement, and the processing is the same as that of single cycle. The second CAMIN command is triggered after the end of the movement without any special processing

  - Follow motion command

(1) Multi-cycle: after the EOP signal of the current cam cycle arrives, start to execute the motion command, and calculate with the actual position of the slave axis as the reference value.

(2) Single cycle: trigger the motion command in the cam motion, and the processing is the same as that of multi-cycle. The motion command is triggered after the cam motion is completed without any special treatment

- CAMIN single direction function
  - Slave axis motion description

(1) Dual directions: When the cam master axis moves forward and backward, the cam slave axis follows the master axis.

(2) Forward direction: When the cam master axis moves forward, the cam slave axis follows the master axis. When the cam master axis moves in reverse direction, when the cam slave axis is stationary and the cam

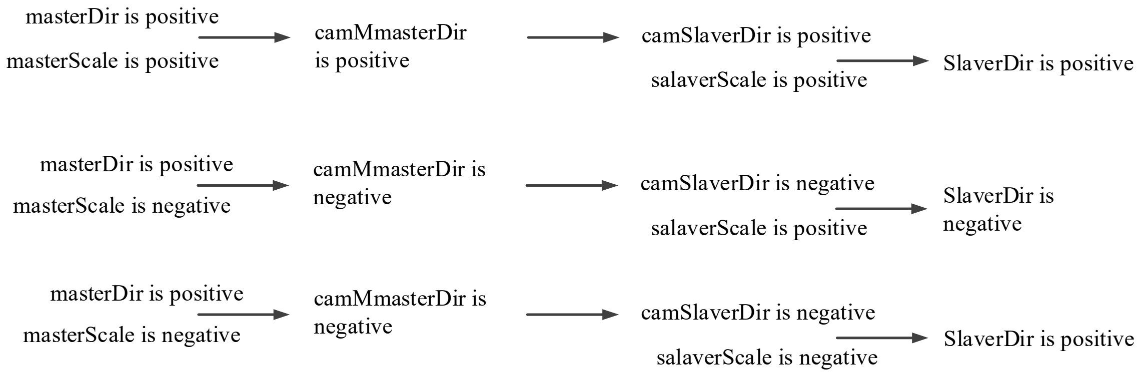
master axis moves in the negative direction, the Insync signal is false. When the cam master axis moves in non-negative direction, the Insync signal processing remains unchanged.

(3) Reverse direction: When the cam master axis moves in reverse direction, the cam slave axis follows the master axis. When the cam master axis moves forward and the cam slave axis is stationary, when the cam master axis moves forward, the Insync signal is false. When the cam master axis moves in a non-forward direction, the Insync signal processing remains unchanged.

➢ Slave axis motion direction confirming

The movement direction of the actual slave axis is determined by the movement direction of the actual master axis, the master axis scaling ratio and the slave axis scaling ratio:

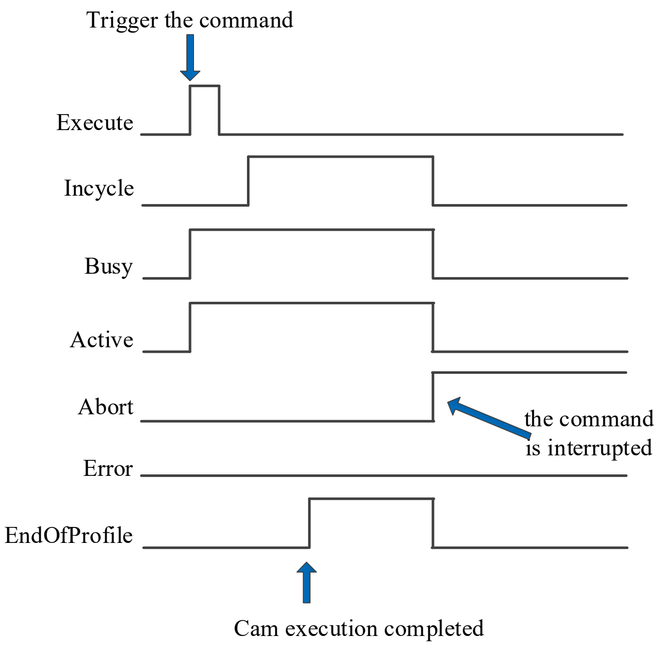
MasterDir: actual master axis movement direction (determined according to target position, not movement direction)
MasterScale: master axis scale ratio
CamMasterDir: movement direction of cam master axis
SlaverDir: actual movement direction from slave axis
SlaverScale: slave axis scale ratio
CamSlaverDir: cam slave axis movement direction



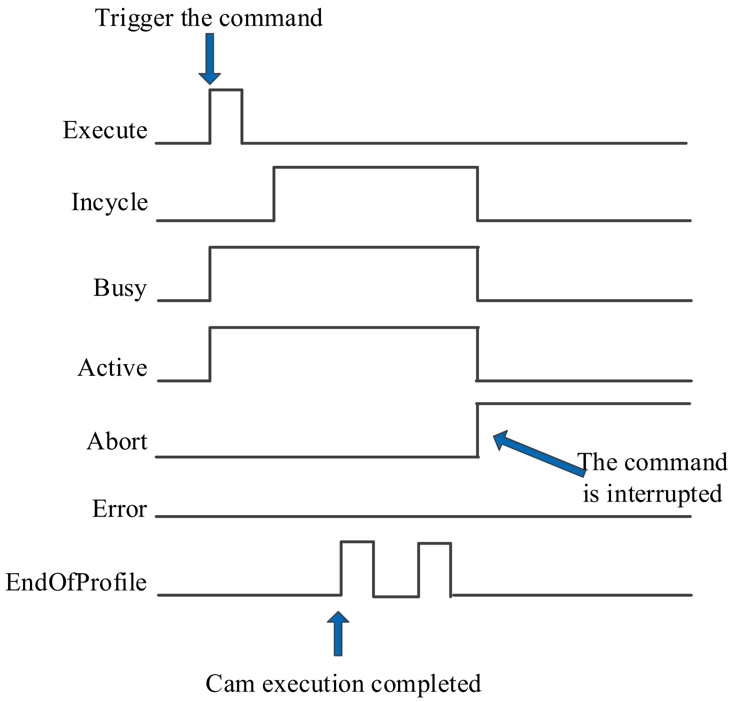
- EOP counting function (Only V3.7.2 and above versions support EOP counting function)

In the electronic cam, the EOP signal is divided into positive and negative directions, and the relevant registers D[20172] and D[20176]:
D[20172]: forward counting register. When a forward EOP signal is generated, the register value is added by 1.
D[20176]: negative counting register. When a negative EOP signal is generated, the register value is added by 1.
When a forward EOP signal is generated, the forward EOP counter is added by one. When a negative EOP signal is generated, the negative EOP counter is added by one.
The EOP signal count value only increases and does not decrease, but can be set as a non-negative integer value by the user.

(6) Sequence diagram

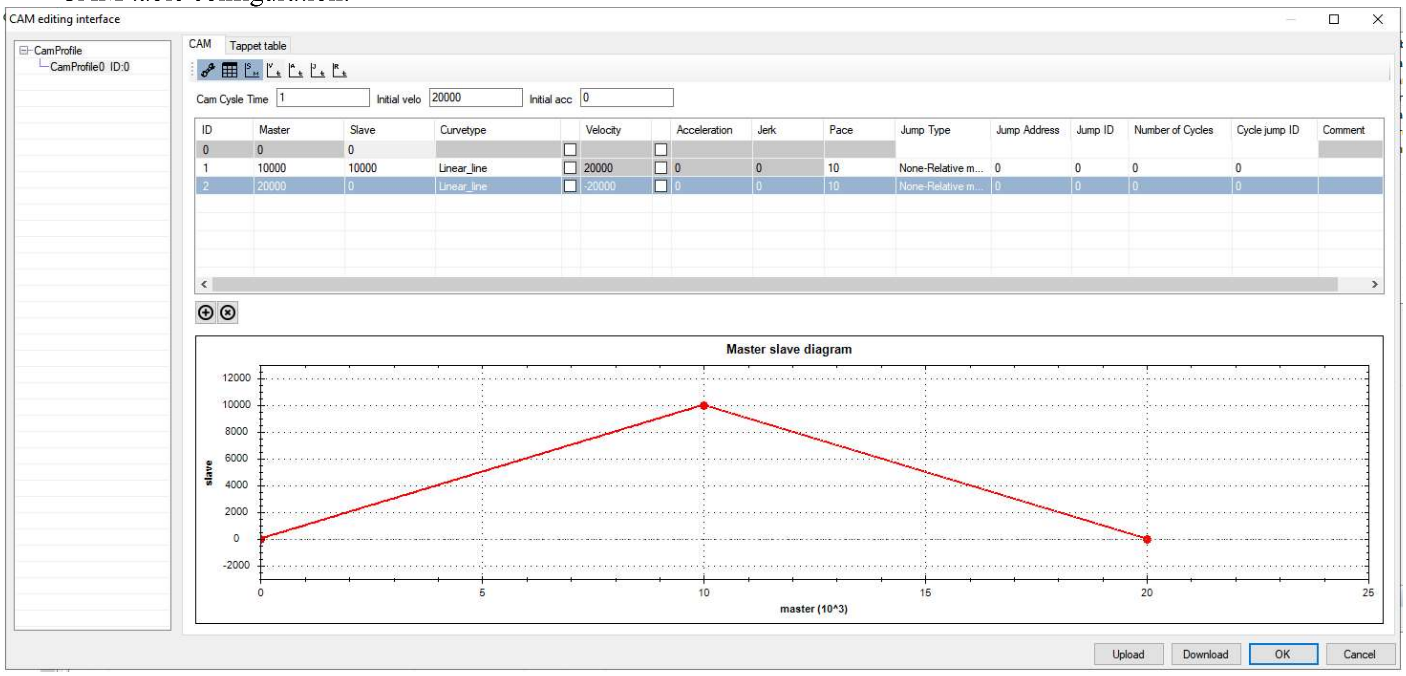


Explanation:
When the cam is not executed periodically, the busy and active signals are set ON after the command is triggered, and the incycle signal is set ON after the cam is synchronously bound successfully. If the operation of a single cam cycle is completed, the EOP signal is set ON. At this time, other motion commands, stop commands or camout commands are triggered for the slave axis, the increment, busy, active and EOP signals are reset, and the abort signal is set ON.

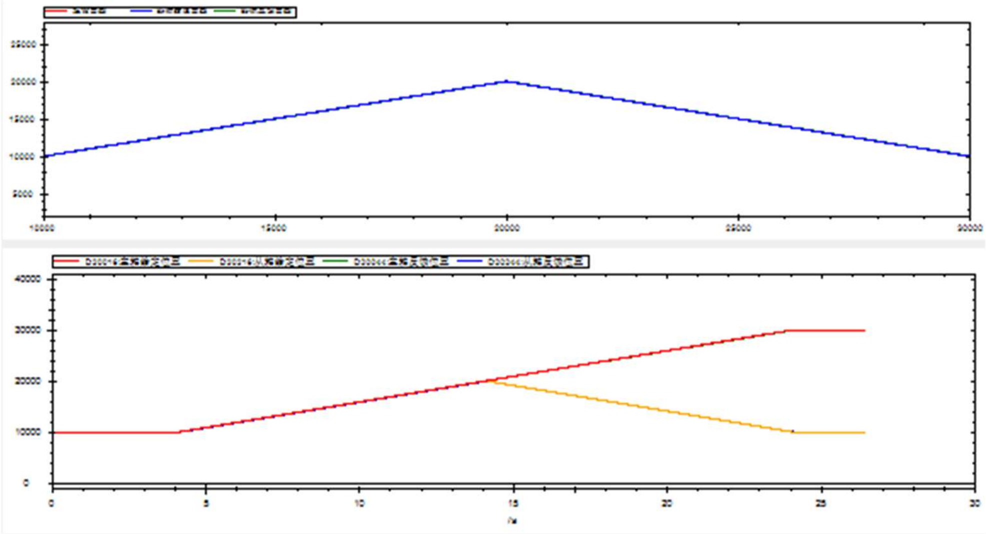


Explanation:
When the cam adopts periodic execution, the EOP signal will be set ON once, and the other signal states are consistent with non-periodic.

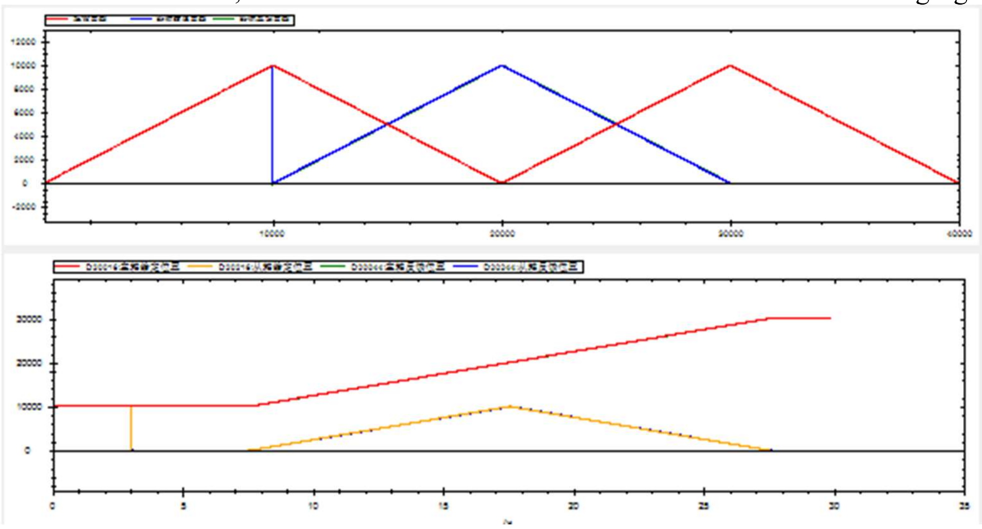
(7) Operation example
CAM table configuration:



When both the master axis and the slave axis adopt the relative mode, and the starting position of the master axis and the slave axis is 10000, execute the cam table, and its track is shown in the following figure

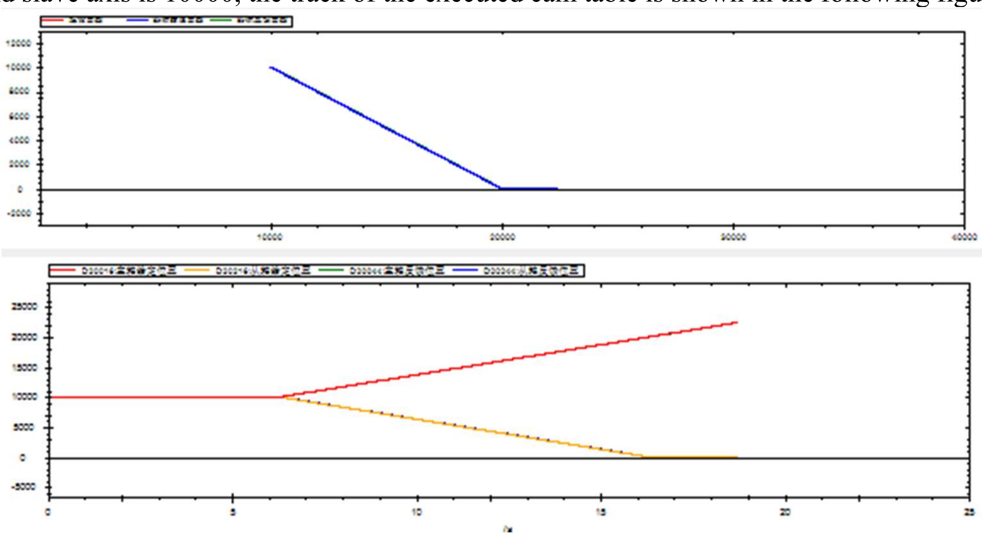


It can be seen that the starting point of the track is (10000,10000), and the entire cam table is executed.
When the master axis adopts relative mode and the slave axis adopts absolute mode, and the starting position of the master and slave axis is 10000, the track of the executed cam table is shown in the following figure



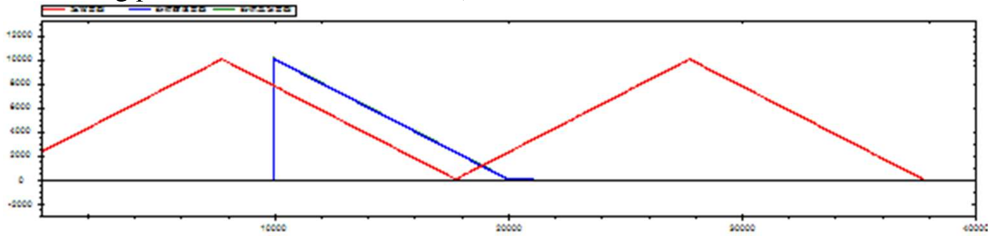
It can be seen that the starting point of the track is (10000,0), and the entire cam table is executed, and the slave axis position produces a step from 10000 to 0 at the beginning.

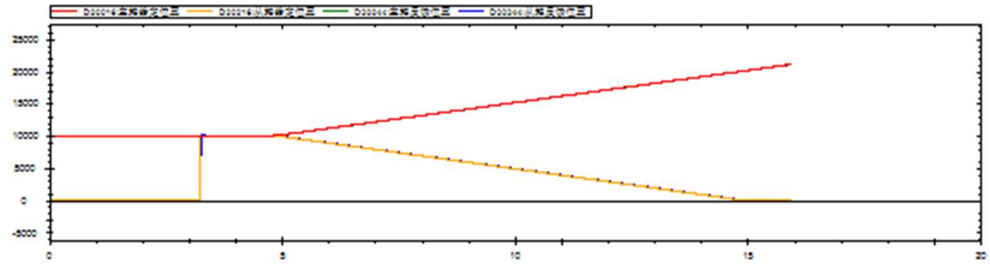
When the master axis adopts absolute mode and the slave axis adopts relative mode, and the starting position of the master and slave axis is 10000, the track of the executed cam table is shown in the following figure:



It can be seen that the starting position of the axis does not change, and the subsequent cam table starting from the master axis position 10000 is executed.

When both the master axis and the slave axis adopt the absolute mode, and the starting position of the master axis is 10000 and the starting position of the slave axis is 0, the track of the executed cam table is as follows:

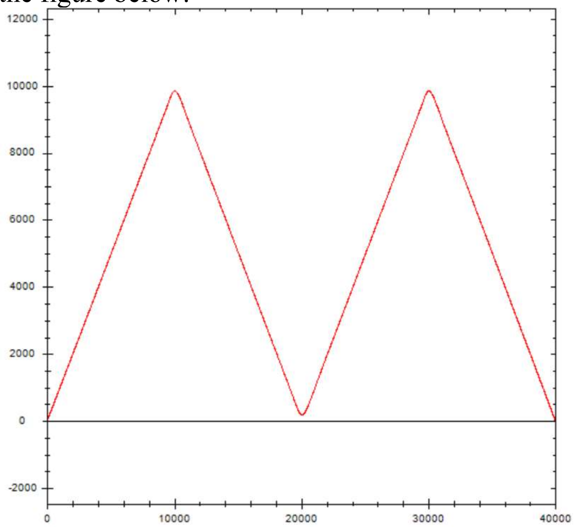




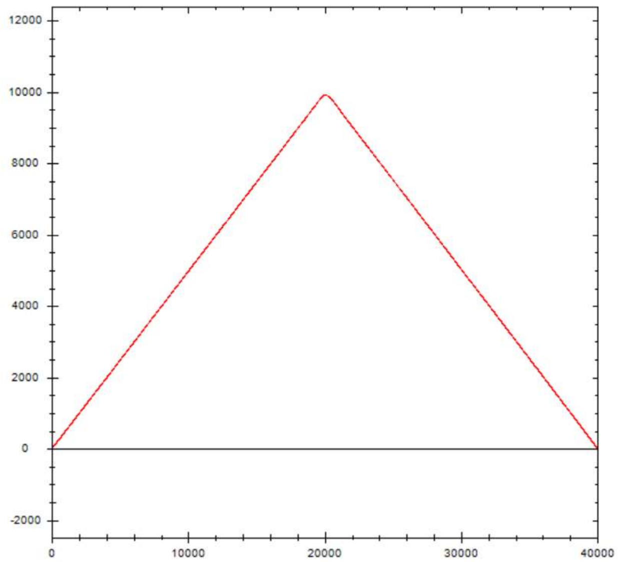
It can be seen that the slave axis position steps from 0 to 10000, the starting point of the track is (10000,10000), the cam table starting from master axis position 10000 is executed.

The tracking mode is similar to the absolute mode, except that if it is in the tracking mode, the slave axis will catch up with the set speed, acceleration and jerk speed without step.

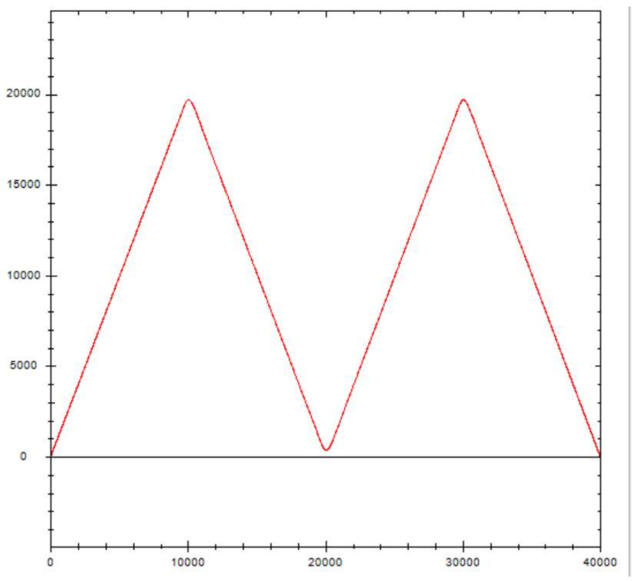
When the movement of the master-slave axis is 10000 per turn, the CAMTBLSEL command adopts the cycle mode. The ratio of the master-slave axis in the CAMIN command is 1 and the offset of the master-slave axis is 0. After the cam is bound, the master axis uses the relative motion command to run the position of 40000 command units. Its trajectory is shown in the figure below:



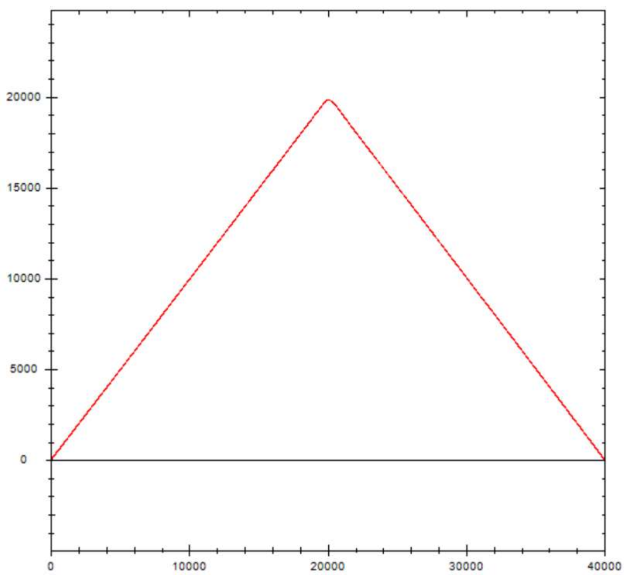
When the master axis ratio is 2, the slave axis ratio is 1 (the master axis becomes twice the original and the slave axis remains the same):



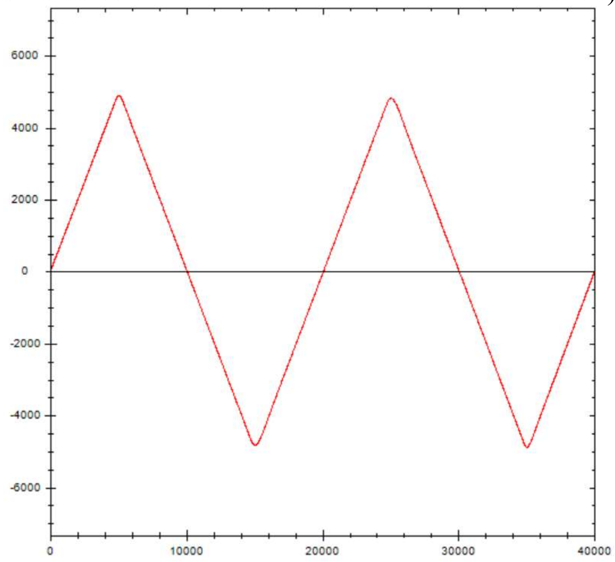
When the master axis ratio is 1, the slave axis ratio is 2 (the slave axis becomes twice the original and the master axis remains the same):



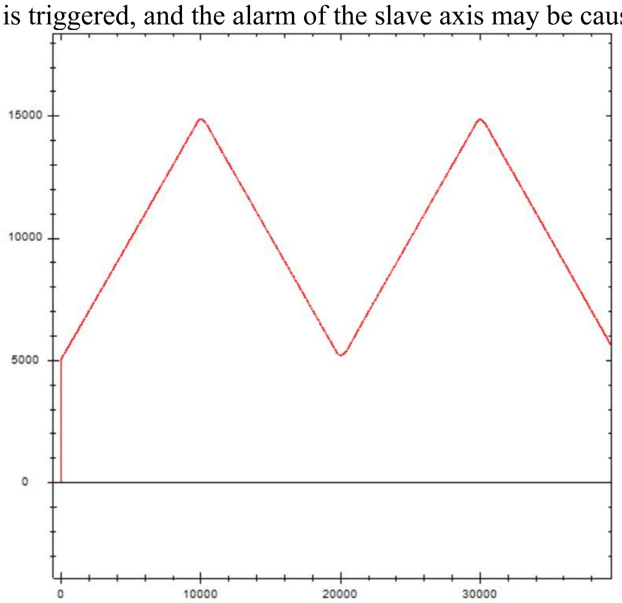
When the master axis ratio is 2, the slave axis ratio is 2 (the master axis and slave axis all become twice the original):



When the ratio of the master-slave axis is 1 and the master axis offset is 5000 (the master axis point of the cam table is offset 5000 to the right, that is, the starting position of the master axis is the position of the master axis 5000 of the original curve, and the curve of the master-slave axis is offset to the left):



When the ratio of the master and slave axis is 1 and the offset of the slave axis is 5000 (the offset of the slave axis is valid only when the slave axis is in absolute or tracking mode, which will step/catch-up to the offset position when the CAMIN command is triggered, and the alarm of the slave axis may be caused in absolute mode):



5-3-2-3. CAM release【CAMOUT】

(1) Overview

Release the CAM relationship between the main and slave axis.

CAM release [CAMOUT]			
Execution condition	Rising/falling edge of the coil	Suitable model	XDH, XLH, XG2
Firmware	V3.6.1b and above	Software	V3.7.4 and above

Note: XDH、XLH series -L models cannot support this instruction.

(2) Operand

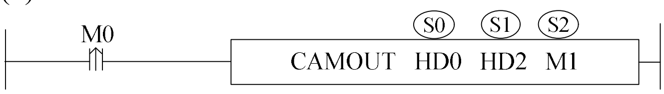
Operand	Function	Type
S0	Specify the input parameter start address	16-bit, single word
S1	Specify the output state word start address	16-bit, single word
S2	Sepcify the output state bit start address	Bit

(3) Suitable soft component

Operand	Word soft component											Bit soft component					
	System								Constant	Module		System					
	D*	FD	TD*	CD*	DX	DY	DM*	DS*	K/H	ID	QD	X	Y	M*	S*	T*	C*
S0	●	●	●	●													
S1	●	●	●	●													
S2														●			

*: D means D, HD; TD means TD and HTD; CD means CD, HCD, HSCD and HSD; DM means DM and DHM; DS means DS and DHS; M means M, HM, SM; S means S, HS; T means T, HT; C means C, HC.

(4) Function and action



- S0 specifies the input parameter start address
- S1 specifies the output parameter start address
- S2 specifies the output state bit start address, occupies the register S2~S2+1
- When M0 is from OFF→ON, release the cam relationship of the slave axis specified by S0

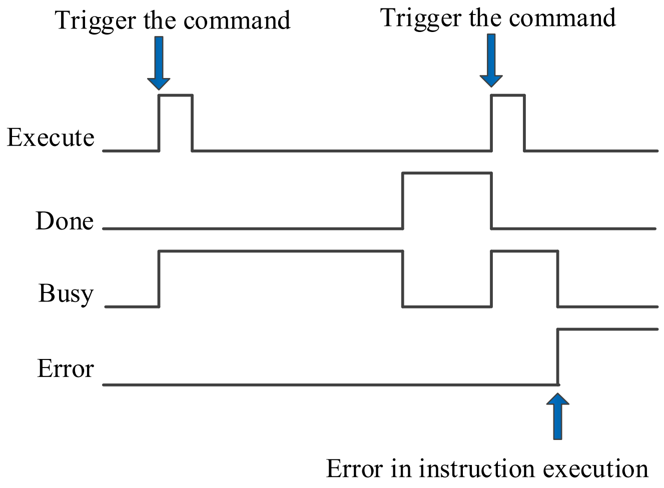
(5) Notes

- If the slave axis is in motion during the execution of CAMOUT, the slave axis will maintain the original speed and continue to run after the command is executed. You can use A_ STOP and A_HALT command to stop
- Whether periodic operation or non-periodic operation is adopted, the master and slave axis of CAMIN need to unload the cam table through CAMOUT.

(6) Related parameters

Input parameter	Parameter name	Data type	Unit	Note
S0	Slaver	INT16S	-	CAM slave axis number
Output parameter	Parameter name	Data type	Unit	Note
S1	ErrCode	INT16S	-	Command error code
Output state	Parameter name	Data type	Unit	Note
S2	Done	BOOL	-	The command execution is successful
S2+1	Busy	BOOL	-	The command is being executed
S2+2	Error	BOOL	-	The command execution is error

(7) Sequence diagram



Explanation:
The command is triggered and the Busy signal is set. When the command execution is completed, the Busy signal is reset and the Done signal is set.
When there is an error during instruction execution, the Error signal is set, other signals are reset, and the corresponding error code is output.

5-3-2-4. Phase compensation【CAMPHASE】

(1) Overview

Plan a smooth curve to complete the phase offset of the slave axis relative to the master axis.

Phase compensation [CAMPHASE]			
Execution condition	Rising/falling edge of the coil	Suitable model	XDH, XLH, XG2
Firmware	V3.6.1b and above	Software	V3.7.4 and above

Note: XDH、XLH series -L models cannot support this instruction.

(2) Operand

Operand	Function	Type
S0	Specify the input parameter start address	16-bit, single word
S1	Specify the output state word start address	16-bit, single word
S2	Sepcify the output state bit start address	Bit

(3) Suitable soft component

Operand	Word soft component											Bit soft component					
	System								Constant	Module		System					
	D*	FD	TD*	CD*	DX	DY	DM*	DS*	K/H	ID	QD	X	Y	M*	S*	T*	C*
S0	●	●	●	●													
S1	●	●	●	●													
S2														●			

*: D means D, HD; TD means TD and HTD; CD means CD, HCD, HSCD and HSD; DM means DM and DHM; DS means DS and DHS; M means M, HM, SM; S means S, HS; T means T, HT; C means C, HC.

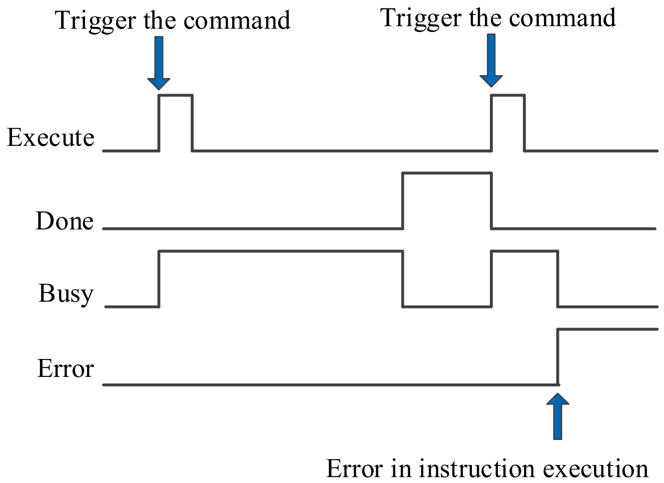
(4) Function and action

- S0 specifies the input parameter start address, occupies the register S0~S0+23
- S1 specifies the output parameter start address
- S2 specifies the output state bit start address, occupies the register S2~S2+2
- When M0 is from OFF→ON, when the phase offset of the slave axis to the master axis is executed, the actual position of the master axis will not be affected, and the slave axis will compensate the position according to the offset.

(5) Related parameters

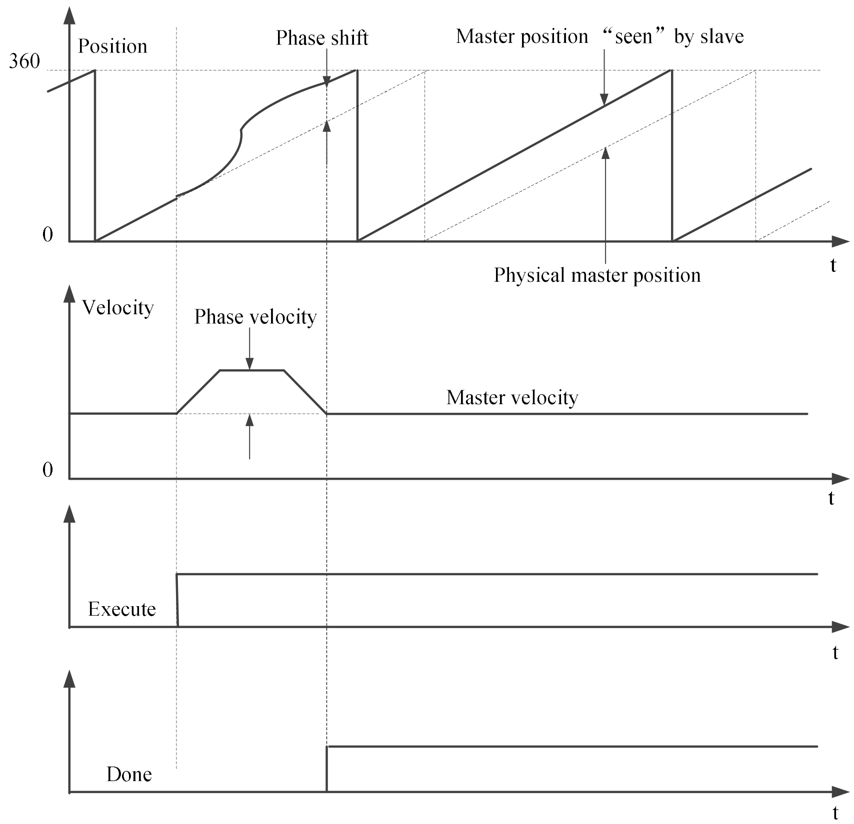
Input parameter	Parameter name	Data type	Unit	Note
S0	Slaver	INT16S	-	CAM slave axis number
S0+1	Master	INT16S	-	CAM master axis number
S0+4	PhaseShift	FP64	Command unit	Phase offset
S0+8	Velocity	FP64	Command unit /s	Phase compensation speed
S0+12	Acc	FP64	Command unit /s^2	Phase compensation acceleration
S0+16	Dec	FP64	Command unit /s^2	Phase compensation deceleration
S0+20	Jerk	FP64	Command unit /s^3	Phase compensation jerk speed, which is the acceleration/deceleration change rate
Output parameter	Parameter name	Data type	Unit	Note
S1	ErrCode	INT16S	-	Command error code
Output state	Parameter name	Data type	Unit	Note
S2	Done	BOOL		The command execution is successful
S2+1	Busy	BOOL		The command is being executed
S2+2	Error	BOOL		The command execution is error

(6) Sequence diagram



Explanation:
The command is triggered and the Busy signal is set. When the command execution is completed, the Busy signal is reset and the Done signal is set.
When there is an error during instruction execution, the Error signal is set, other signals are reset, and the corresponding error code is output.

(7) Sketch diagram
Dotted line: it is the original curve of the slave axis. Solid line: it is the curve after phase compensation of the slave axis.



5-3-2-5. CAM table read【CAMRD】

(1) Overview

Read the point of the cam table.

CAM table read [CAMRD]			
Execution condition	Rising/falling edge of the coil	Suitable model	XDH, XLH, XG2
Firmware	V3.6.1b and above	Software	V3.7.4 and above

Note: XDH、XLH series -L models cannot support this instruction.

(2) Operand

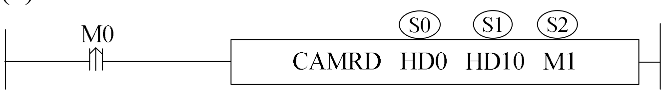
Operand	Function	Type
S0	Specify the input parameter start address	16-bit, single word
S1	Specify the output state word start address	16-bit, single word
S2	Sepcify the output state bit start address	Bit

(3) Suitable soft component

Operand	Word soft component											Bit soft component					
	System								Constant	Module		System					
	D*	FD	TD*	CD*	DX	DY	DM*	DS*	K/H	ID	QD	X	Y	M*	S*	T*	C*
S0	●	●	●	●													
S1	●	●	●	●													
S2														●			

*: D means D, HD; TD means TD and HTD; CD means CD, HCD, HSCD and HSD; DM means DM and DHM; DS means DS and DHS; M means M, HM, SM; S means S, HS; T means T, HT; C means C, HC.

(4) Function and action



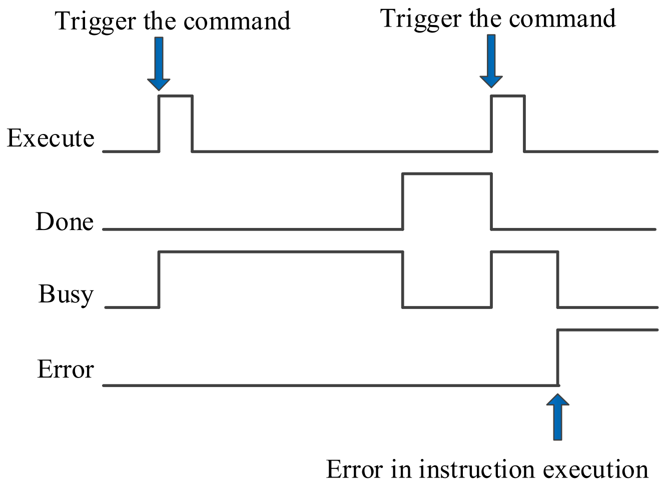
- S0 specifies the input parameter start address, occupies the register S0~S0+1
- S1 specifies the output parameter start address, occupies the register S1~S1+18
- S2 specifies the output state bit start address, occupies the register S2~S2+2
- When M0 is from OFF→ON, read the points of the corresponding cam table according to the cam table instance, and store the read parameters such as position, speed, acceleration and connection type into the register with S1 as the starting address.

(5) Related parameters

Input parameter	Parameter name	Data type	Unit	Note
S0	CamTblID	INT16S	-	CAM table instance. Obtain through CAMTBLSEL
S0+1	PointID	INT16S	-	Read key point number (starting from 0)
Output parameter	Parameter name	Data type	Unit	Note
S1	ErrCode	INT16S	-	Command error code
S1+1	Cnt	INT16S	-	Read key point quantity
S1+2	MasterPos	FP64	Command unit	Key point master axis position
S1+6	SlaverPos	FP64	Command unit	Key point slave axis position
S1+10	Vel	FP64	Command unit /s	Key point speed
S1+14	Acc	FP64	Command unit /s^2	Key point acceleration
S1+18	TrajType	INT16S	-	Join type at key point (curve type from previous key point to current key point)*
Output state	Parameter name	Data type	Unit	Note
S2	Done	BOOL	-	The command execution is successful
S2+1	Busy	BOOL	-	The command is being executed
S2+2	Error	BOOL	-	The command execution is error

*Note: join type: 1: Cubic curve 2: quintic curve 3: parabola 4: straight line 5: simple harmonic 6: Cycloid 7: deformation sine 8: deformation trapezoid 9: constant 10: deformation constant velocity 11: double harmonic 12: inverse double harmonic.

(6) Sequence diagram



Explanation:
The command is triggered and the Busy signal is set. When the command execution is completed, the Busy signal is reset and the Done signal is set.
When there is an error during instruction execution, the Error signal is set, other signals are reset, and the corresponding error code is output.

5-3-2-6. CAM table write【CAMWR】

(1) Overview

Change the point in the cam table.

CAM table write [CAMWR]			
Execution condition	Rising/falling edge of the coil	Suitable model	XDH, XLH, XG2
Firmware	V3.6.1b and above	Software	V3.7.4 and above

Note: XDH、XLH series -L models cannot support this instruction.

(2) Operand

Operand	Function	Type
S0	Specify the input parameter start address	16-bit, single word
S1	Specify the output state word start address	16-bit, single word
S2	Sepcify the output state bit start address	Bit

(3) Suitable soft component

Operand	Word soft component											Bit soft component					
	System								Constant	Module		System					
	D*	FD	TD*	CD*	DX	DY	DM*	DS*	K/H	ID	QD	X	Y	M*	S*	T*	C*
S0	●	●	●	●													
S1	●	●	●	●													
S2														●			

*: D means D, HD; TD means TD and HTD; CD means CD, HCD, HSCD and HSD; DM means DM and DHM; DS means DS and DHS; M means M, HM, SM; S means S, HS; T means T, HT; C means C, HC.

(4) Function and action

- S0 specifies the input parameter start address, occupies the register S0~S0+18
- S1 specifies the output parameter start address, occupies the register S1~S1+1
- S2 specifies the output state bit start address, occupies the register S2~S2+2
- When M0 is from OFF→ON, modify the point in the cam table instance.

(5) Notes

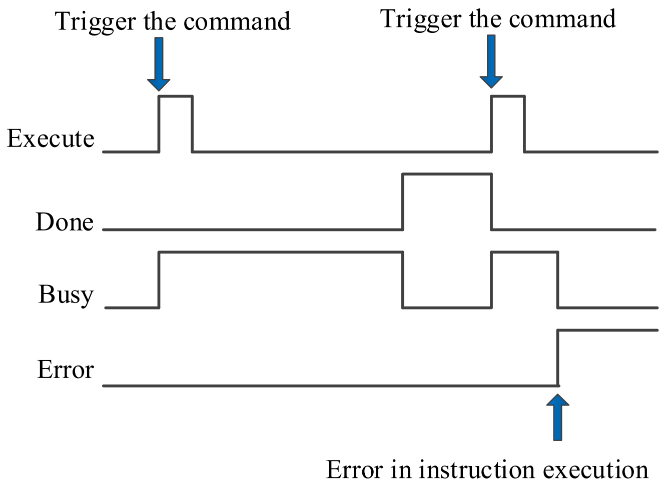
- Except that the first point (i.e. 0,0) cannot be changed, all other points support modification
- When the curves in the cam table are cubic or quintic curves and straight lines, modifying the point position will affect the trajectories of the before and after curves at most. Improper modified point position may lead to sudden change of slave axis position
- The written point cannot be read by the programming software and becomes invalid after power on again
- The modified point master axis position can only be between the before and after points.

(6) Related parameters

Input parameter	Parameter name	Data type	Unit	Note
S0	CamTblID	INT16S	-	CAM table instance. Obtain through the command CAMTBLSEL
S0+1	PointID	INT16S	-	Read the key point number (starts from 0)
S0+2	MasterPos	FP64	Command unit	Key point master axis position
S0+6	SlaverPos	FP64	Command unit	Key point slave axis position
S0+10	Vel	FP64	Command unit /s	Key point speed. Not support at the moment.
S0+14	Acc	FP64	Command unit /s^2	Key point acceleration. Not support at the moment.
S0+18	TrajType	INT16S	-	Join type at the key point. (Modification of curve type is not supported. Version 3.7.2 and above need to write the corresponding curve type. The previous version 0 defaults to not modifying the type)
Output	Parameter	Data type	Unit	Note

parameter	name			
S1	ErrCode	INT16S	-	Command error code
S1+1	Cnt	INT16S	-	Write in key point quantity
Output state	Parameter name	Data type	Unit	Note
S2	Done	BOOL	-	The command execution is successful
S2+1	Busy	BOOL	-	The command is being executed
S2+2	Error	BOOL	-	The command execution is error

(7) Sequence diagram



Explanation:

The command is triggered and the Busy signal is set. When the command execution is completed, the Busy signal is reset and the Done signal is set.

When there is an error during instruction execution, the Error signal is set, other signals are reset, and the corresponding error code is output.

5-3-2-7. Add key point【CAMPOINTADD】

(1) Overview

Add the key point in the specified cam table.

Add key point [CAMPOINTADD]			
Execution condition	Rising/falling edge of the coil	Suitable model	XDH, XLH, XG2
Firmware	V3.7.1 and above	Software	V3.7.4 and above

Note: XDH、XLH series -L models cannot support this instruction.

(2) Operand

Operand	Function	Type
S0	Specify the input parameter start address	64-bit, four words
S1	Specify the output state word start address	16-bit, single word
S2	Sepcify the output state bit start address	Bit

(3) Suitable soft component

Operand	Word soft component											Bit soft component					
	System								Constant	Module		System					
	D*	FD	TD*	CD*	DX	DY	DM*	DS*	K/H	ID	QD	X	Y	M*	S*	T*	C*
S0	●	●	●	●													
S1	●	●	●	●													
S2														●			

*: D means D, HD; TD means TD and HTD; CD means CD, HCD, HSCD and HSD; DM means DM and DHM; DS means DS and DHS; M means M, HM, SM; S means S, HS; T means T, HT; C means C, HC.

(4) Function and action

- S0 specifies the input parameter start address, occupies the register S0~S0+20.
- S1 specifies the output state word start address, occupies the register S1~S1+1.
- S2 specifies the output state bit start address, occupies the register S2~S2+2.
- When M0 is from OFF→ON, [cam table instance] specifies the cam table and add corresponding key points. After the command is executed, the end index of the cam table is output.

(5) Notes

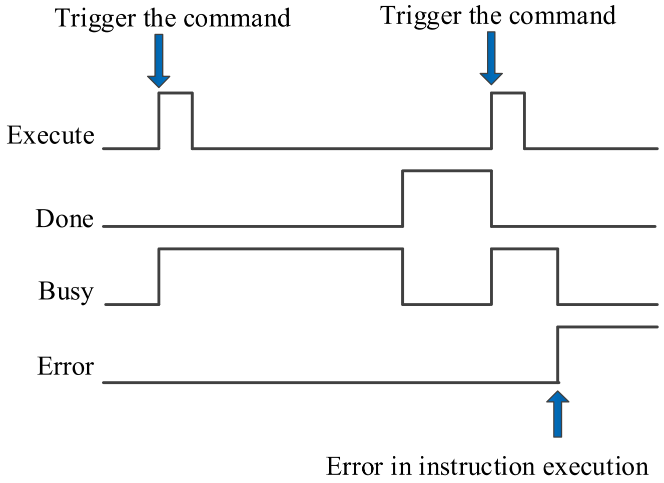
- You can only add a key point after the first key point in the cam table
- If pointid does not exist in the cam table, a key point is added after the last key point in the cam table by default. If pointid exists, the key points of cam table need to be increased by one bit in turn.
- The master axis position of the new key point in the middle of cam table can only be within the curve of the current section. Adding the master axis position of the key point at the end of the cam table can only be greater than the master axis position of the termination key point, otherwise the command will report an error
- A cam table can store up to 1000 key points.

(6) Related parameters

Input parameter	Parameter name	Data type	Unit	Note
S0	CamTblId	INT16S	-	CAM table instance number
S0+1	PointId	INT16U	-	Cam table key point number
S0+2	Mode	INT16	-	Effective mode 0: take effect at once 1: take effect in the next cam period
S0+4	MasterPos	FP64	-	Master axis position
S0+8	SlaverPos	FP64	-	Slave axis position
S0+12	Vel	FP64	-	Reference speed
S0+16	Acc	FP64	-	Reference acceleration
S0+20	Type	INT16U	-	Join trajectory type
Output parameter	Parameter name	Data type	Unit	Note

Input parameter	Parameter name	Data type	Unit	Note
S1	ErrCode	INT16U	-	Command error code
S1+1	EndPointIndex	INT16U	-	Cam table end point index
State parameter	Parameter name	Data type	Unit	Note
S2	Done	BOOL	-	The command execution completed
S2+1	Busy	BOOL	-	The command is being executed
S2+2	Error	BOOL	-	The command execution is error

(7) Sequence diagram



Explanation:
The command is triggered and the Busy signal is set. When the command execution is completed, the Busy signal is reset and the Done signal is set.
When there is an error during instruction execution, the Error signal is set, other signals are reset, and the corresponding error code is output.

5-3-2-8. Key point delete【CAMPOINTDEL】

(1) Overview

Delete the key point in the specified cam table.

Key point delete [CAMPOINTDEL]			
Execution condition	Rising/falling edge of the coil	Suitable model	XDH, XLH, XG2
Firmware	V3.7.1 and above	Software	V3.7.4 and above

Note: XDH、XLH series -L models cannot support this instruction.

(2) Operand

Operand	Function	Type
S0	Specify the input parameter start address	64-bit, four words
S1	Specify the output state word start address	16-bit, single word
S2	Sepcify the output state bit start address	Bit

(3) Suitable soft component

Operand	Word soft component											Bit soft component					
	System								Constant	Module		System					
	D*	FD	TD*	CD*	DX	DY	DM*	DS*	K/H	ID	QD	X	Y	M*	S*	T*	C*
S0	●	●	●	●													
S1	●	●	●	●													
S2														●			

*: D means D, HD; TD means TD and HTD; CD means CD, HCD, HSCD and HSD; DM means DM and DHM; DS means DS and DHS; M means M, HM, SM; S means S, HS; T means T, HT; C means C, HC.

(4) Function and action

- S0 specifies the input parameter start address, occupies the register S0~S0+2.
- S1 specifies the output state word start address, occupies the register S1~S1+1.
- S2 specifies the output state bit start address, occupies the register S2~S2+2.
- When M0 is from OFF→ON, for the cam table specified in the [cam table instance], delete the key point specified in the [key point serial number], and output the end point index of the cam table after the command is executed.

(5) Notes

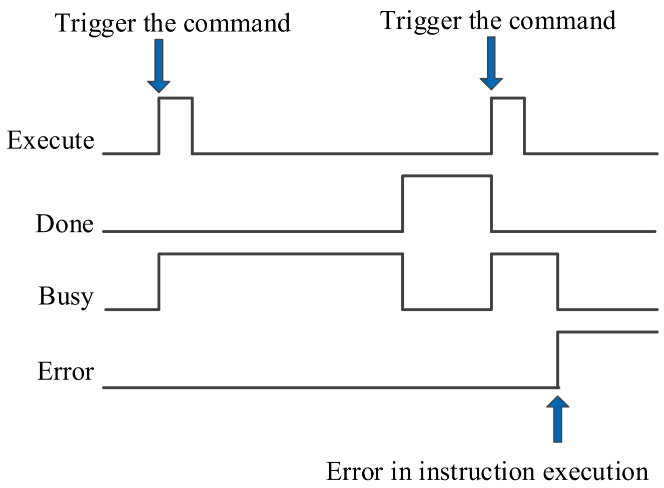
- You can only delete a key point after the first key point in the cam table
- Deleting the key points in the middle of the cam table needs to ensure the continuous speed of the previous section and the last two sections of the curve. Deleting key points at the end of the cam table needs to ensure that the speed of the previous curve is continuous
- After deleting key points, if the starting and ending slave axis position of cubic and quintic curves are equal, the command will report an error (3.7.2 and above versions support the same location, so will not report the error)
- PointId can be found in the cam table. Delete the corresponding key point, and the key point serial number after the key point needs to be backward one bit in turn. If pointid cannot be found in the cam table, the command will report an error.

(6) Related parameters

Input parameter	Parameter name	Data type	Unit	Note
S0	CamTblId	INT16S	-	Cam table instance number
S0+1	PointId	INT16U	-	Cam table key point number
S0+2	Mode	INT16U	-	Take effect mode 0: take effect at once 1: take effect in next cam cycle, not support at the moment
Output parameter	Parameter name	Data type	Unit	Note

S1	ErrCode	INT16U	-	Command error code
S1+1	EndPointIndex	INT16U	-	Cam table end point index
State parameter	Parameter name	Data type	Unit	Note
S2	Done	BOOL	-	The command execution completed
S2+1	Busy	BOOL	-	The command is being executed
S2+2	Error	BOOL	-	The command execution is error

(7) Sequence diagram



Explanation:
The command is triggered and the Busy signal is set. When the command execution is completed, the Busy signal is reset and the Done signal is set.
When there is an error during instruction execution, the Error signal is set, other signals are reset, and the corresponding error code is output.

5-3-2-9. CAM table unload【CAMTBLDEL】

(1) Overview

Unload the loaded cam table, release the buffer space.

CAM table unload [CAMTBLDEL]			
Execution condition	Rising/falling edge of the coil	Suitable model	XDH, XLH, XG2
Firmware	V3.6.1b and above	Software	V3.7.4 and above

Note: XDH、XLH series -L models cannot support this instruction.

(2) Operand

Operand	Function	Type
S0	Specify the input parameter start address	16-bit, single word
S1	Specify the output parameter start address	16-bit, single word
S2	Sepcify the output state bit start address	Bit

(3) Suitable soft component

Operand	Word soft component											Bit soft component					
	System								Constant	Module		System					
	D*	FD	TD*	CD*	DX	DY	DM*	DS*	K/H	ID	QD	X	Y	M*	S*	T*	C*
S0	●	●	●	●													
S1	●	●	●	●													
S2														●			

*: D means D, HD; TD means TD and HTD; CD means CD, HCD, HSCD and HSD; DM means DM and DHM; DS means DS and DHS; M means M, HM, SM; S means S, HS; T means T, HT; C means C, HC.

(4) Function and action

- S0 specifies the input parameter start address
- S1 specifies the output parameter start address
- S2 specifies the output state bit start address, occupies the register S2~S2+2
- When M0 is from OFF→ON, unload the cam table instance specified by S0.

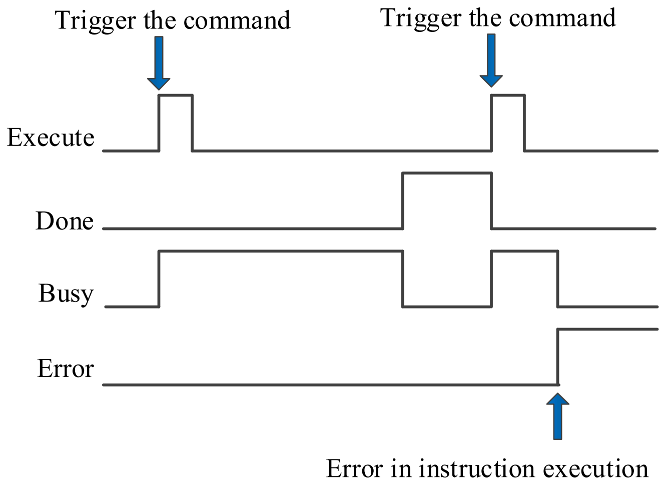
(5) Notes

- No matter whether the cam is executed periodically or not, CAMOUT is required before CAMTBLDEL can be executed after CAMIN is executed
- The running cam cannot be unloaded
- Cam table unloading only deletes the corresponding cam table instance number to free the buffer space. You can load a new cam table instance through CAMTBLSE instruction.
- If the slave axis is stop or broken by the command A_STOP or A_HALT, the cam binding state of the slave axis will also be released. At this time, the CAMTBLDEL command can be executed without the CAMOUT command.

(6) Related parameters

Input parameter	Parameter name	Data type	Unit	Note
S0	CamTblID	INT16S	-	CAM table instance, obtain through the command CAMTBLSEL
Output parameter	Parameter name	Data type	Unit	Note
S1	ErrCode	INT16S	-	Command error code
Output state	Parameter name	Data type	Unit	Note
S2	Done	BOOL	-	The command execution is successful
S2+1	Busy	BOOL	-	The command is being executed
S2+2	Error	BOOL	-	The command execution is error

(7) Sequence diagram



Explanation:

The command is triggered and the Busy signal is set. When the command execution is completed, the Busy signal is reset and the Done signal is set.

When there is an error during instruction execution, the Error signal is set, other signals are reset, and the corresponding error code is output.

5-3-2-10. CAM table batch modification【CAMWRMUL】

(1) Overview

Modify mutiple points in the cam table.

CAM table batch modification [CAMWRMUL]			
Execution condition	Rising/falling edge of the coil	Suitable model	XDH, XLH, XG2
Firmware	V3.7.2 and above	Software	V3.7.14 and above

(2) Operand

Operand	Function	Type
S0	Specify the input parameter start address	16-bit, single word
S1	Specify the output state word start address	16-bit, single word
S2	Sepcify the output state bit start address	Bit

(3) Suitable soft component

Operand	Word soft component											Bit soft component					
	System								Constant	Module		System					
	D*	FD	TD*	CD*	DX	DY	DM*	DS*	K/H	ID	QD	X	Y	M*	S*	T*	C*
S0	●	●	●	●													
S1	●	●	●	●													
S2														●			

*: D means D, HD; TD means TD and HTD; CD means CD, HCD, HSCD and HSD; DM means DM and DHM; DS means DS and DHS; M means M, HM, SM; S means S, HS; T means T, HT; C means C, HC.

(4) Function and action

- S0 specifies [input parameter start address] and occupies registers S0~S0+28+24 * (N-1).
- S1 specifies [start address of output status word] and occupies registers S1~S1+1.
- S2 specifies [start address of output status bit] and occupies relay S2~S2+2.

(5) Note

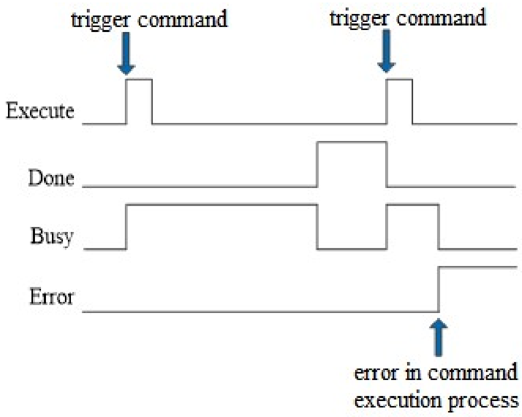
- It supports the execution of the cam at rest or in motion, and the modification of the key point in motion. If the key point is in the current motion segment, it will generate a step from the axis.
- The modified master axis position of the key point must meet the requirement that the current key point master axis position is greater than the previous key point master axis position and less than the next key point master axis position, otherwise an error 3017 will be reported.
- The quintic curve supports the modification of speed and acceleration, and the cubic curve supports the modification of speed.
- The total number of key points should be greater than 0.
- There is no error in execution. The error source ID is 65535 by default.
- Supports modifying the position of (0,0) points. Only in spindle absolute mode can the spindle position be modified, while in slave axis absolute mode can the slave axis position be modified.
- The range for modifying the starting position of the spindle (0, spindle modulus). When the modified position exceeds the spindle position of the keypoint, the keypoint will be automatically deleted, leaving the starting point and remaining keypoints.
- After modifying the starting position to (x, y), keep the spindle position within the range of 0-x, keep the spindle stationary, move to x, step from the spindle to the corresponding position of y, and start the cam movement.
- The function of modifying the starting point position is only supported in V3.7.3 and above versions.

(6) Related parameters

Input parameter	Parameter name	Data type	Unit	Note
S0	Count	INT16U	-	Total number of modified keys
S0+1	CamTblID	INT16S	-	Cam table instance number
S0+2	Mode	INT16U	-	Mode 0: Effective immediately 1: The next cam cycle takes effect

Input parameter	Parameter name	Data type	Unit	Note
S0+8+24*(N-1)	PointID	INT16S	-	cam table key point ID
S0+12+24*(N-1)	MasterPos	FP64	Command unit	Master axis position
S0+16+24*(N-1)	SlavePos	FP64	Command unit	Slave axis position
S0+20+24*(N-1)	Vel	FP64	Command unit /s	Reference speed
S0+24+24*(N-1)	Acc	FP64	Command unit /s^2	Reference acceleration speed
S0+28+24*(N-1)	Type	INT16U	-	Track type
Output parameter	Parameter name	Data type	Unit	Note
S1	ErrCode	INT16U	-	Command error code
S1+1	ErrCodeID	INT16U	-	Error source ID
State parameter	Parameter name	Data type	Unit	Note
S2	Done	BOOL	-	Command execution completed
S2+1	Busy	BOOL	-	Instruction is executing
S2+2	Error	BOOL	-	Command execution error

(7) Sequence diagram



Explanation:
When the command is triggered, the Busy signal is set ON. When the command is executed, the Busy signal is reset and the Done signal is set ON.
When there is an error in the command execution, the Error signal is set ON, other signals are reset, and the corresponding error code is output.

5-3-2-11. CAM table generation【CAMTBLGEN】

(1) Overview

Generate a new cam table according to the input points.

CAM table generation [CAMTBLGEN]			
Execution condition	Rising/falling edge of the coil	Suitable model	XDH, XLH, XG2
Firmware	V3.7.2 and above	Software	V3.7.14 and above

(2) Operand

Operand	Function	Type
S0	Specify the input parameter start address	16-bit, single word
S1	Specify the output state word start address	16-bit, single word
S2	Sepcify the output state bit start address	Bit

(3) Suitable soft component

Operand	Word soft component											Bit soft component					
	System								Constant	Module		System					
	D*	FD	TD*	CD*	DX	DY	DM*	DS*	K/H	ID	QD	X	Y	M*	S*	T*	C*
S0	●	●	●	●													
S1	●	●	●	●													
S2														●			

*: D means D, HD; TD means TD and HTD; CD means CD, HCD, HSCD and HSD; DM means DM and DHM; DS means DS and DHS; M means M, HM, SM; S means S, HS; T means T, HT; C means C, HC.

(4) Function and action

- S0 specifies [input parameter start address] and occupies registers S0~S0+28+24 * (N-1).
- S1 specifies [start address of output status word] and occupies registers S1~S1+1.
- S2 specifies [start address of output status bit] and occupies relay S2~S2+2.

(5) Note

- When the cam is in use, only the next cam cycle takes effect, and when it is not in use, both modes are supported.
- PointId starts from 0 and increases in sequence, and the position of the main and slave axes of the 0th key point must be (0,0), and the curve type of the 0th key point is invalid.
- The total number of key points shall be greater than or equal to 2.
- The error source ID is 65535 by default when the command is executed without error.

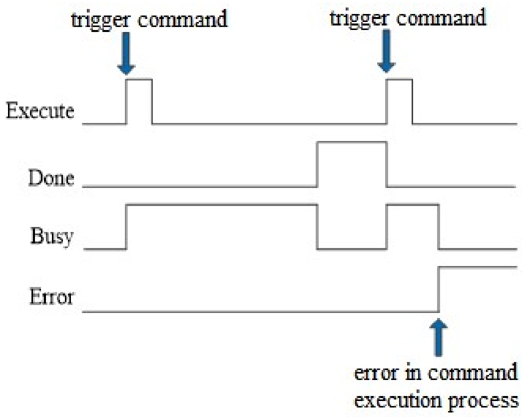
(6) Related parameters

Input parameter	Parameter name	Data type	Unit	Note
S0	Count	INT16U		Key point numbers
S0+1	CamTblID	INT16S		Cam table instance ID
S0+2	Mode	INT16U	-	Mode 0: Effective immediately 1: The next cam cycle takes effect
S0+4	CamPeriod	FP64	-	Cam period*
S0+8+24*(N-1)	PointID	INT16U	-	Key point ID
S0+12+24*(N-1)	MasterPos	FP64	Command unit	Master axis position
S0+16+24*(N-1)	SlavePos	FP64	Command position	Slave axis position
S0+20+24*(N-1)	Vel	FP64	Command position /s	Reference speed
S0+24+24*(N-1)	Acc	FP64	Command position /s^2	Reference acceleration speed
S0+28+24*(N-1)	Type	INT16U	-	Track type

Input parameter	Parameter name	Data type	Unit	Note
Output parameter	Parameter name	Data type	Unit	Note
S1	ErrCode	INT16U	-	Command error code
S1+1	ErrCodeID		-	Error source ID
State parameter	Parameter name	Data type	Unit	Note
S2	Done	BOOL	-	Command execution completed
S2+1	Busy	BOOL	-	Instruction is executing
S2+2	Error	BOOL	-	Command execution error

*Note: The cam cycle corresponds to the CAM cycle time in the cam table editing interface. 0 is the cam cycle of the current cam table instance by default. This parameter will affect the trajectory and key point speed of the curve with cubic and quintic, and it is not recommended to modify it.

(7) Sequence diagram



Explanation:

When the command is triggered, the Busy signal is set ON. When the command is executed, the Busy signal is reset and the Done signal is set ON.

When there is an error in the command execution, the Error signal is set ON, other signals are reset, and the corresponding error code is output.

5-3-2-12. Master axis position calculation【CAMMASTERPOSGET】

(1) Overview

Calculate the master axis position as the slave axis.

Master axis position calculation [CAMMASTERPOSGET]			
Execution condition	Rising/falling edge of the coil	Suitable model	XDH, XLH, XG2
Firmware	V3.7.2 and above	Software	V3.7.14 and above

(2) Operand

Operand	Function	Type
S0	Specify the input parameter start address	16-bit, single word
S1	Specify the output state word start address	16-bit, single word
S2	Sepcify the output state bit start address	Bit

(3) Suitable soft component

Operand	Word soft component											Bit soft component					
	System								Constant	Module		System					
	D*	FD	TD*	CD*	DX	DY	DM*	DS*	K/H	ID	QD	X	Y	M*	S*	T*	C*
S0	●	●	●	●													
S1	●	●	●	●													
S2														●			

*: D means D, HD; TD means TD and HTD; CD means CD, HCD, HSCD and HSD; DM means DM and DHM; DS means DS and DHS; M means M, HM, SM; S means S, HS; T means T, HT; C means C, HC.

(4) Function and action

- S0 specifies [input parameter start address] and occupies registers S0~S0+7
- S1 specifies [start address of output status word] and occupies registers S1~S1+23.
- S2 specifies [start address of output status bit] and occupies relay S2~S2+2.

(5) Note
- At present, only 0, 1, 3 and 5th curves are supported.
- If the curve in the cam table is a 0th curve and there are countless solutions, only the two endpoints of the segment are taken.

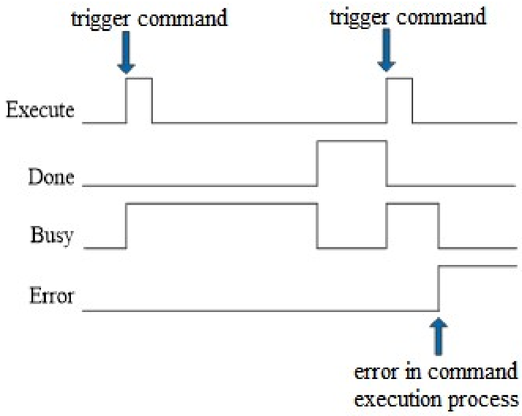
(6) Related parameters

Input parameter	Parameter name	Data type	Unit	Note
S0	TblID	INT16S	-	Cam table instance ID
S0+1	Size	INT16U	-	Maximum number of solutions
S0+2	Mode	INT16U	-	Mode 0-Original cam table 1-cam table after scale and offset.(3.7.3 and above versions supported)
S0+3	SlaveId	INT16U	-	Slave axis ID
S0+4	SlavePos	FP64	Command unit	Slave axis phase

Output parameter	Parameter name	Data type	Unit	Note
S1	ErrCode	INT16S	-	Command error code
S1+1	ActRootCnt	INT16U	-	Number of actual solutions
S1+4	MasterPos1	FP64	Command unit	Master axis phase 1
S1+8	MasterPos2	FP64	Command unit	Master axis phase 2
S1+12	MasterPos3	FP64	Command	Master axis phase 3

			unit	
S1+16	MasterPos4	FP64	Command unit	Master axis phase 4
S1+20	MasterPos5	FP64	Command unit	Master axis phase 5
State parameter	Parameter name	Data type	Unit	Note
S2	Done	BOOL	-	Command execution completed
S2+1	Busy	BOOL	-	Instruction is executing
S2+2	Error	BOOL	-	Command execution error

(7) Sequence diagram



Explanation:
When the command is triggered, the Busy signal is set ON. When the command is executed, the Busy signal is reset and the Done signal is set ON.
When there is an error in the command execution, the Error signal is set ON, other signals are reset, and the corresponding error code is output.

5-3-2-13. Slave axis position calculation【CAMSLAVEPOSGET】

(1) Overview

Calculate the slave axis position as the master axis.

Slave axis position calculation [CAMSLAVEPOSGET]			
Execution condition	Rising/falling edge of the coil	Suitable model	XDH, XLH, XG2
Firmware	V3.7.2 and above	Software	V3.7.14 and above

(2) Operand

Operand	Function	Type
S0	Specify the input parameter start address	16-bit, single word
S1	Specify the output state word start address	16-bit, single word
S2	Sepcify the output state bit start address	Bit

(3) Suitable soft component

Operand	Word soft component											Bit soft component					
	System								Constant	Module		System					
	D*	FD	TD*	CD*	DX	DY	DM*	DS*	K/H	ID	QD	X	Y	M*	S*	T*	C*
S0	●	●	●	●													
S1	●	●	●	●													
S2														●			

*: D means D, HD; TD means TD and HTD; CD means CD, HCD, HSCD and HSD; DM means DM and DHM; DS means DS and DHS; M means M, HM, SM; S means S, HS; T means T, HT; C means C, HC.

(4) Function and action

- S0 specifies [input parameter start address] and occupies registers S0~S0+7
- S1 specifies [start address of output status word] and occupies registers S1~S1+7.
- S2 specifies [start address of output status bit] and occupies relay S2~S2+2.

(5) Note

- By default, the calculation is based on multiple cycles.
- In Mode 2, the input spindle phase will first undergo the multiplication and offset calculation in the CAMIN command, and then the corresponding slave axis phase will be calculated.

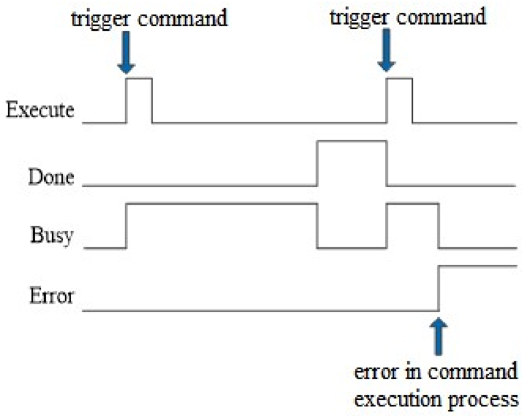
(6) Related parameters

Input parameter	Parameter name	Data type	Unit	Note
S0	Mode	INT16U	-	Mode 0 - Calculate the actual position of the slave axis according to the actual position of the master axis 1 - Calculate the slave axis phase according to the actual position of the master axis 2 - Calculate the slave axis phase according to the master axis phase
S0+1	Slaveid	INT16U	-	Slave axis ID
S0+4	MasterPos	FP64	Command unit	Master axis position
Output parameter	**Parameter name**	**Data type**	**Unit**	**Note**
S1	ErrCode	INT16U	-	Command error code
S1+4	SlavePos	FP64	Command unit	Slave axis position

State parameter	Parameter name	Data type	Unit	Note

S2	Done	BOOL	-	Command execution completed
S2+1	Busy	BOOL	-	Instruction is executing
S2+2	Error	BOOL	-	Command execution error

(7) Sequence diagram



Explanation:
When the command is triggered, the Busy signal is set ON. When the command is executed, the Busy signal is reset and the Done signal is set ON.
When there is an error in the command execution, the Error signal is set ON, other signals are reset, and the corresponding error code is output.

5-3-2-14. CAM clutch【CAMCLUTCHON, CAMCLUTCHOFF】

(1) Overview

According to the input parameters, the slave axis disengage or engage during cam execution.

CAM clutch ON [CAMCLUTCHON]			
Execution condition	Rising/falling edge of the coil	Suitable model	XDH, XLH, XG2
Firmware	V3.7.2 and above	Software	V3.7.14 and above
CAM clutch OFF [CAMCLUTCHOFF]			
Execution condition	Rising/falling edge of the coil	Suitable model	XDH, XLH, XG2
Firmware	V3.7.2 and above	Software	V3.7.14 and above

(2) Operand

Operand	Function	Type
S0	Specify the input parameter start address	16-bit, single word
S1	Specify the output state word start address	16-bit, single word
S2	Sepcify the output state bit start address	Bit

(3) Suitable soft component

Operand	Word soft component											Bit soft component					
	System								Constant	Module		System					
	D*	FD	TD*	CD*	DX	DY	DM*	DS*	K/H	ID	QD	X	Y	M*	S*	T*	C*
S0	●	●	●	●													
S1	●	●	●	●													
S2														●			

*: D means D, HD; TD means TD and HTD; CD means CD, HCD, HSCD and HSD; DM means DM and DHM; DS means DS and DHS; M means M, HM, SM; S means S, HS; T means T, HT; C means C, HC.

(4) Function and action

(1) CAMCLUTCHOFF

```
         M0                                      S0   S1   S2
|--------|↑|-----------[ CAMCLUTCHOFF   HD0   D0   M1 ]---|
```

- S0 specifies [input parameter start address] and occupies registers S0~S0+35
- S1 specifies [start address of output status word]
- S2 specifies [start address of output status bit] and occupies relay S2~S2+4.
- After the command is triggered, when the starting conditions are met, the master and slave axes are disengaged.

(2) CAMCLUTCHON

```
         M0                                     S0   S1   S2
|--------|↑|-----------[ CAMCLUTCHON   HD0   D0   M1 ]---|
```

- S0 specifies [input parameter start address] and occupies registers S0~S0+51
- S1 specifies [start address of output status word]
- S2 specifies [start address of output status bit] and occupies relay S2~S2+4.
- After the command is triggered, when the starting conditions are met, the master and slave axes are engaged.

(5) Note

- CAMCLUTCHOFF needs to be executed after the execution of CAMIN, and CAMCLUTCHON needs to be executed after the execution of clutch OFF.
- The rising edge of the instruction refers to the M register; The external rising edge refers to the X signal; The CAMCLUTCHOFF instruction immediately executes the OFF operation upon detecting the rising edge, while the CAMCLUTCHON instruction only executes the ON operation when the cam moves to the phase of CAMCLUTCHOFF execution upon detecting the rising edge;
- When the mode is master axis phase, the master axis phase range [0, master axis phase modulus).
- When the mode is slave axis phase, only the slave axis phase monotonically increaseing is supported, and the range is [0, the slave axis phase modulus value).
- In the slave axis movement amount start mode, when the set slave axis movement amount is greater than 0, it

is necessary to ensure that the current slave axis movement amount (current slave axis position - slave axis position when clutch is ON) < the set slave axis movement amount. When the set slave axis movement amount is less than 0, ensure that the current slave axis movement amount (current slave axis position - slave axis position at CAMIN moment) > the set slave axis movement amount.

- Clutch on inhibit mode and delayed movement amount only take effect when the mode is command and external rising edge.
- During the control of the CAMCLUTCHOFF command, the slave axis can be moved independently, the CAMIN synchronization flag is reset, and then the master and slave binding can be performed again by executing the CAMCLUTCHON command, and the CAMIN synchronization flag is set ON.
- During the execution of CAMCLUTCHOFF, the execution segment number and other parameters stop refreshing. After the execution of CAMCLUTCHON, the parameters start refreshing.

(6) Related parameters

CAMCLUTCHON

Input parameter	Parameter name	Data type	Unit	Note
S0	SlaveIndex	INT16U	-	Slave axis ID
S0+1	StartMode	INT16U	-	Start mode 0-command rising edge 1-external rising edge 2-master axis phase 3-slave axis phase 4-Immediate engagement (supported by V3.7.3 and above)
S0+2	StartRegIndex	INT32U	-	Register index when start
S0+4	StartMasterPos	FP64	Command unit	Master axis phase
S0+8	StartSlaverPos	FP64	Command unit	Slave axis phase
S0+12	ProhibitMode	INT16U	-	Clutch on inhibit mode 0-none 1-register 2-external signal
S0+14	ProhibitRegIndex	INT32U	-	Clutch on inhibit register index
S0+16	DelayMovement	FP64	Command unit	Delay movement amount
S0+20	LinkMethod	INT16U	-	Link mode 0-directly 1-Slide. (supported by 3.7.3 and above versions) 2-follow-up. Not supported temporarily 3-pursuit
S0+21	SlideType	INT16U	-	Sliding mode. Not supported temporarily 0-time 1-Slip amount
S0+22	SlideCurve	INT16U	-	Sliding curve. Not supported temporarily. 0-straight line 1-exponential (not supported temporarily)
S0+24	SlideTime	INT32U	ms	Sliding time. Not supported temporarily
S0+26	FollowTime	INT32U	ms	Follow-up time. Not supported temporarily
S0+28	SlidePos	FP64	Command unit	Sliding amount.
S0+32	FollowPos	FP64	Command unit	Follow-up amount. Not supported temporarily
S0+36	VelDiff	FP64	Command unit /s	Pursuit speed
S0+40	Acc	FP64	Command unit /s^2	Pursuit acceleration
S0+44	Dec	FP64	Command	Pursuit deceleration

Input parameter	Parameter name	Data type	Unit	Note
			unit /s^2	
S0+48	Jerk	FP64	Command unit /s^3	Pursuit jerk
Output parameter	**Parameter name**	**Data type**	**Unit**	**Note**
S1	ErrCode	INT16U	-	Command error code
State parameter	**Parameter name**	**Data type**	**Unit**	**Note**
S2	Done	BOOL	-	Command execution completed
S2+1	Busy	BOOL	-	Instruction is executing
S2+2	Active	BOOL	-	Command under control
S2+3	Abort	BOOL	-	Instruction interrupted
S2+4	Error	BOOL	-	Command execution error

CAMCLUTCHOFF

Input parameter	Parameter name	Data type	Unit	Note
S0	SlaverIndex	INT16U	-	Slave axis ID
S0+1	StartMode	INT16U	-	Start mode 0-command rising edge 1-external rising edge 2-master axis phase 3-slave axis movement amount 4-slave axis phase
S0+2	StartRegIndex	INT32U	-	Starting register index
S0+4	StartMasterPos	FP64	Command unit	Master axis phase
S0+8	SlaverMovement	FP64	Command unit	Slave axis movement amount
S0+12	StartSlaverPos	FP64	Command unit	Slave axis phase
S0+16	ProhibitMode	INT16U	-	Clutch OFF inhibit mode 0-none 1-register 2-external signal
S0+18	ProhibitRegIndex	INT32U	-	Clutch OFF inhibit register index
S0+20	DelayMovement	FP64	Command unit	Master axis delay movement amount
S0+24	LinkMethod	INT16U	-	Link method 0-directly 1-slide
S0+25	SlideType	INT16U	-	Sliding type 0-time 1-sliding amount
S0+26	SlideCurve	INT16U	-	Sliding curve 0-straight line 1-exponential
S0+28	SlideTime	INT32U	ms	Sliding time
S0+32	SlidePos	FP64	Command unit	Sliding amount
Output parameter	**Parameter name**	**Data type**	**Unit**	**Note**
S1	ErrCode	INT16U	-	Command error code
State parameter	**Parameter name**	**Data type**	**Unit**	**Note**
S2	Done	BOOL	-	Command execution completed

S2+1	Busy	BOOL	-	Instruction is executing
S2+2	Active	BOOL	-	Command under control
S2+3	Abort	BOOL	-	Instruction interrupted
S2+4	Error	BOOL	-	Command execution error

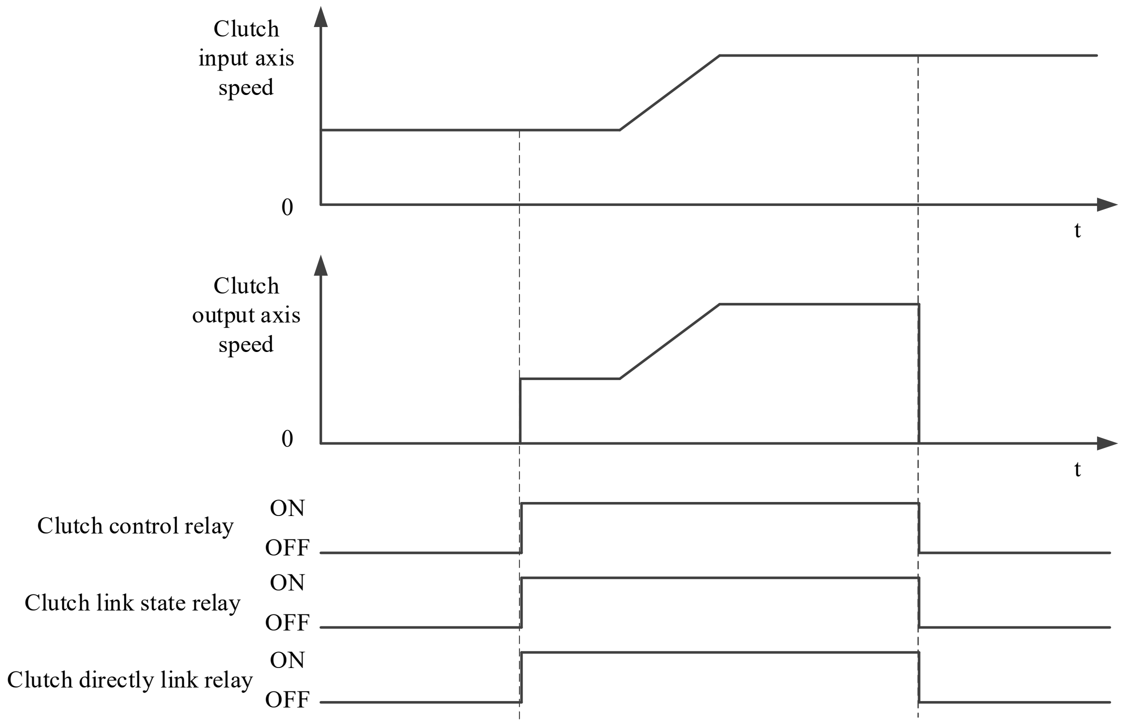
Clutch link method

- Enable and disable related parameters

Parameter name	Effective (√)/ invalid(×)			
Clutch ON/OFF link method	Directly	Sliding		Follow (only when ON)
Clutch ON/OFF sliding method	×	√		×
		Time assignment	Specify sliding amount	
Clutch ON/OFF sliding amount	×	×	√	×
Clutch ON/OFF sliding curve	×	√	√	×
Clutch ON/OFF sliding time	×	√	×	×
Clutch ON/OFF follow-up time	×	×	×	√
Clutch ON/OFF follow-up amount	×	×	×	√

- Link directly

When the clutch is ON/OFF, directly connect/disconnect the input axis and output axis. The speed of the output axis changes rapidly when the clutch is engaged/disengaged.

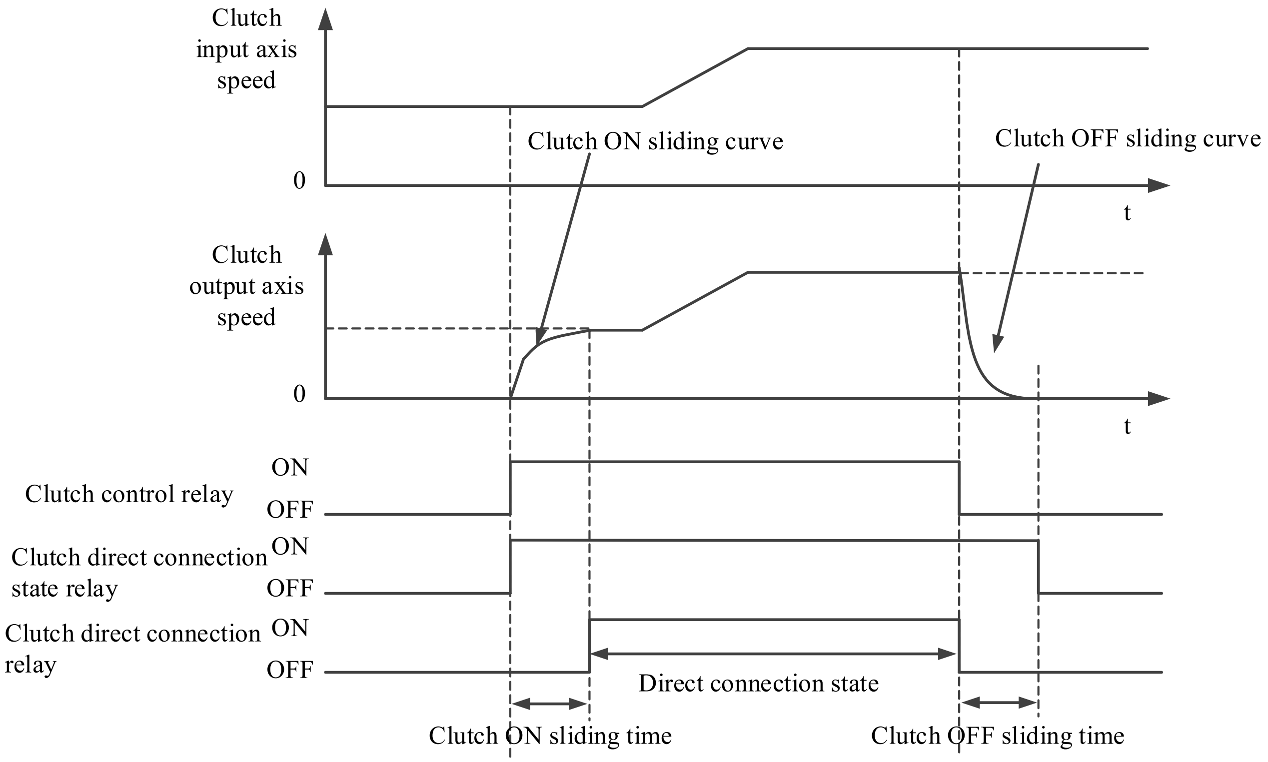


- Sliding link

There are two sliding modes: 0-time, 1-sliding amount.
The setting parameter corresponding to the time option is sliding time, and the setting parameter corresponding to the sliding amount option is sliding amount.
Make the output axis move smoothly when the clutch is engaged/disengaged. When the clutch is ON, the output axis speed accelerates from 0 and links. When the clutch is OFF, the output axis speed is reduced to 0 before it is disconnected.

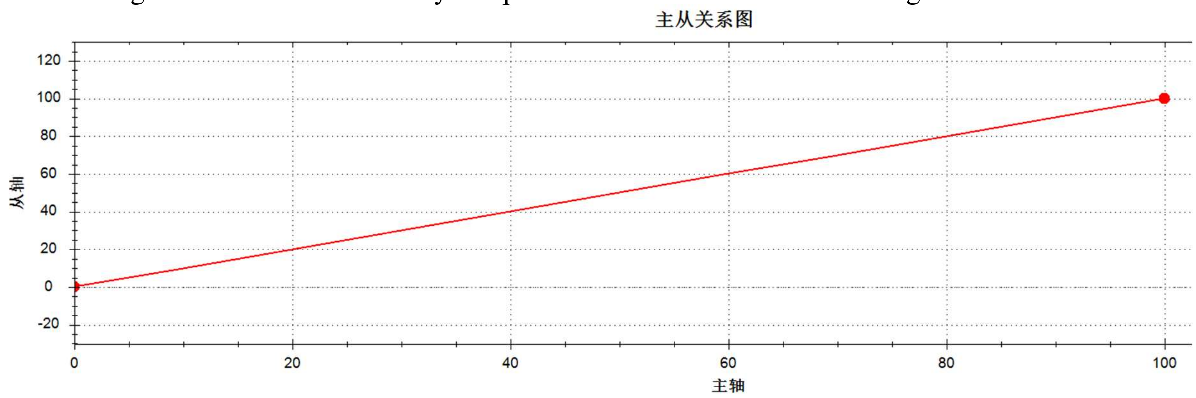
(1) When clutch ON/OFF sliding mode is specified by the time

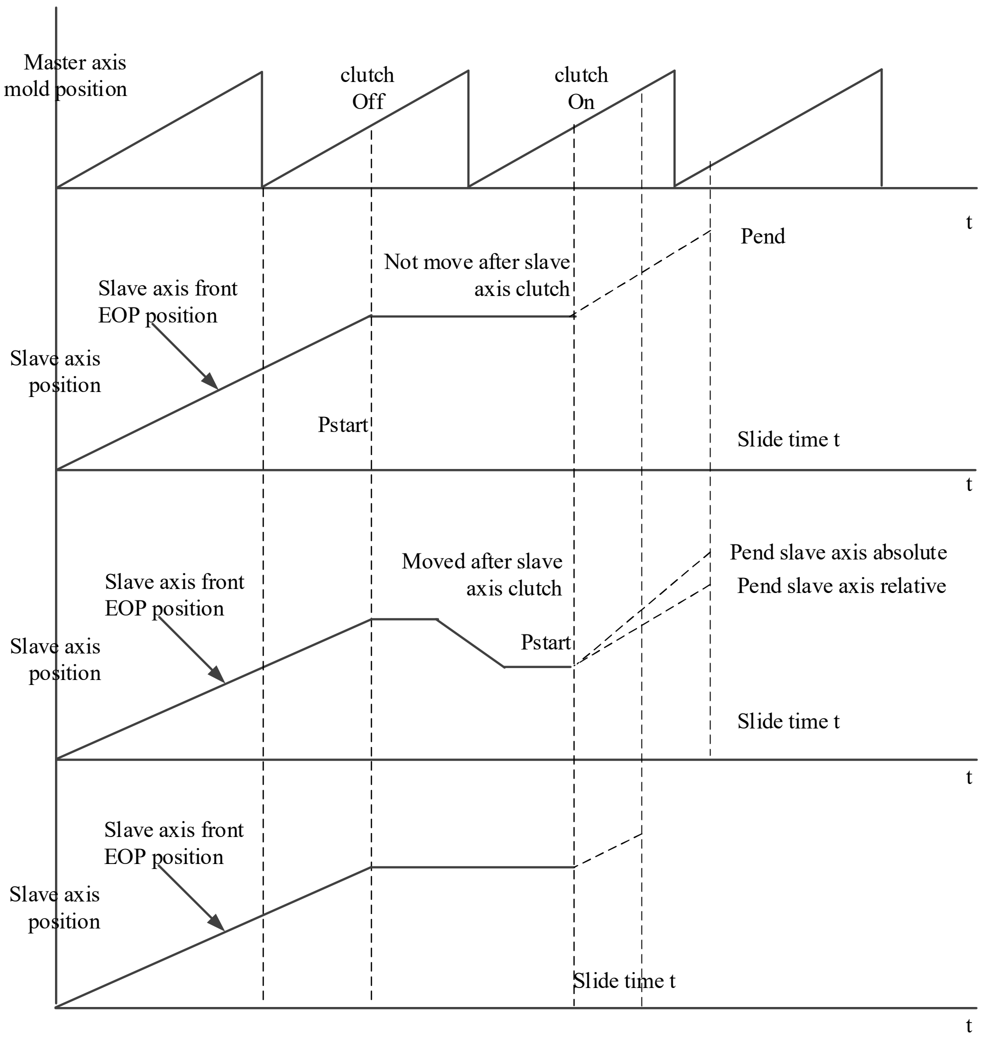
When the clutch is ON, the output axis reaches the direct-connected state after the specified sliding time. When the clutch is OFF, the output axis reaches the stop state after the specified sliding time.



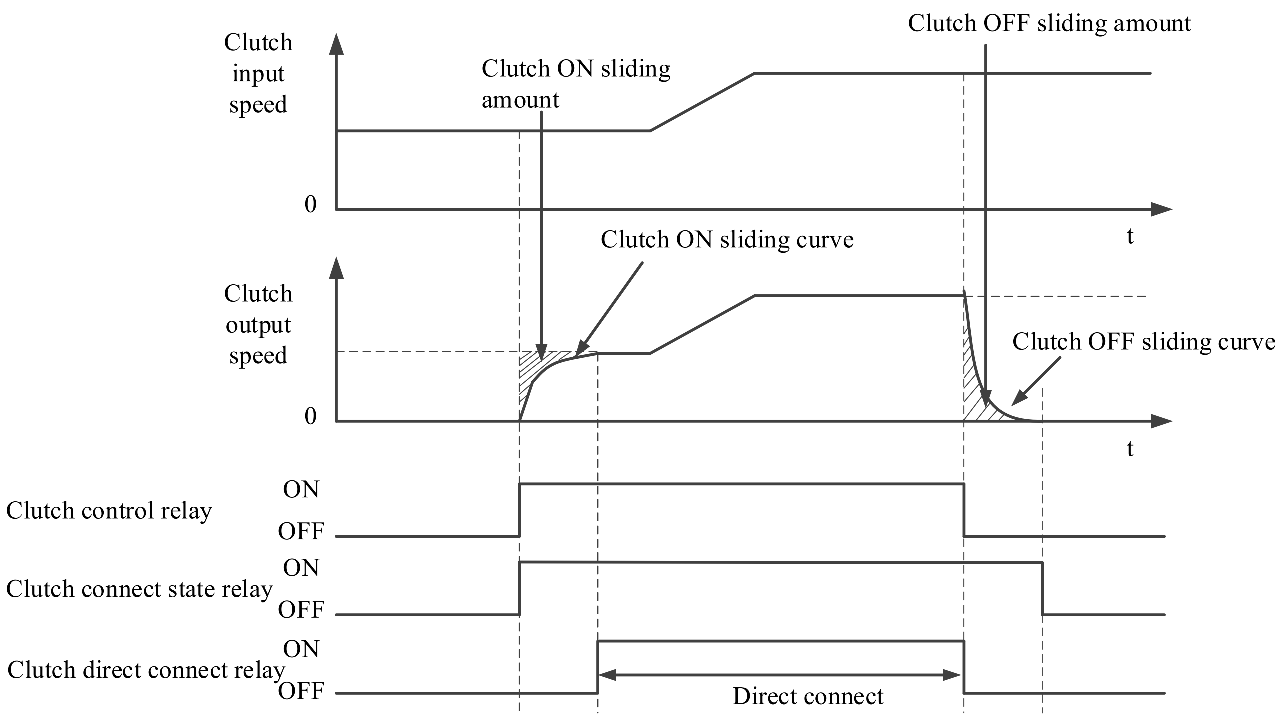
When the sliding mode of the clutch ON is set to time, after the set sliding time, the output shaft reaches synchronous state.

- After successfully triggering the clutch, the real-time calculation of the spindle position (Pm) after the sliding time is based on the spindle speed. Pm=sliding time * the given speed of the spindle at the current time+the actual position of the spindle at the time of clutch on triggering.
- The target position of the slave axis (Pend) is the slave axis position corresponding to the the main axis position (Pm) after sliding, slave axis target position (Pend)=cam table slave axis postion calculated by master axis position (Pm)+front EOP slave axis position-current slave axis position (tart)+slave axis mold value* the number of times EOP has passed during sliding time.
- Plan the sliding curve of the slave axis based on the (Pend-Pstart) slave axis displacement difference, ensuring that the slave axis velocity and position are reached when the sliding time is reached.



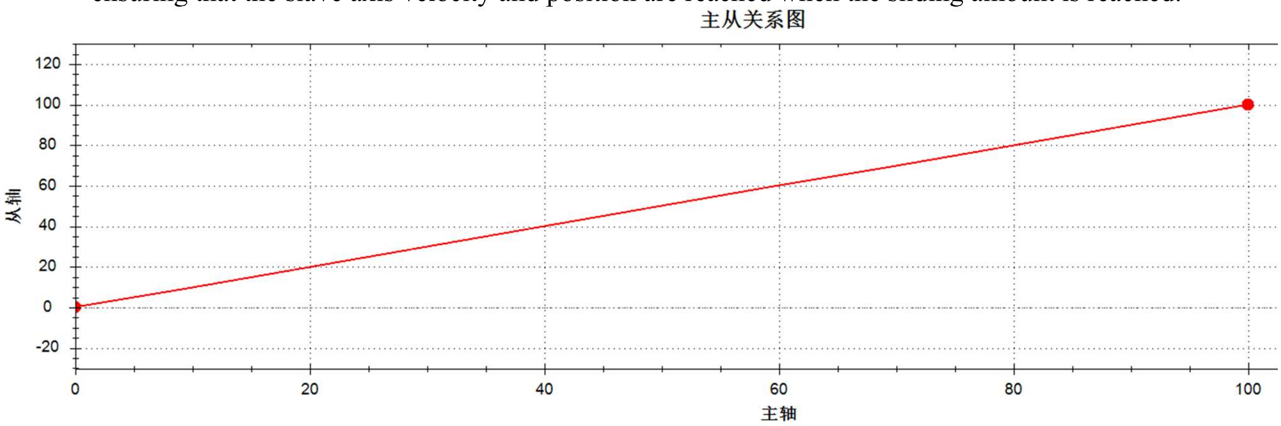


(2) When clutch ON/OFF sliding mode is specified by sliding amount



When the clutch is turned on, the input shaft undergoes a specified amount of sliding and the output shaft reaches a synchronized state.

- After successfully triggering the clutch, obtain the spindle position (Pm) after the sliding amount is reached based on the current position of the spindle and the sliding amount added. Pm=sliding amount * the actual position of the spindle at the time of triggering the clutch on
- The target position of the slave axis (Pend) is the slave axis position corresponding to the the main axis position (Pm) after sliding, slave axis target position (Pend)=cam table slave axis postion calculated by master axis position (Pm)+front EOP slave axis position-current slave axis position (Ptart)+slave axis mold value* the number of times EOP has passed during sliding time.
- Plan the sliding curve of the slave axis based on the (Pend-Pstart) slave axis displacement difference, ensuring that the slave axis velocity and position are reached when the sliding amount is reached.



Master axis mold position

clutch Off

clutch On

Slide length

Pend

t

Slave axis position

Not move after slave axis clutch

Pstart

t

Pend slave axis absolute

Pend slave axis relative

Slave axis position

Moved after slave axis clutch

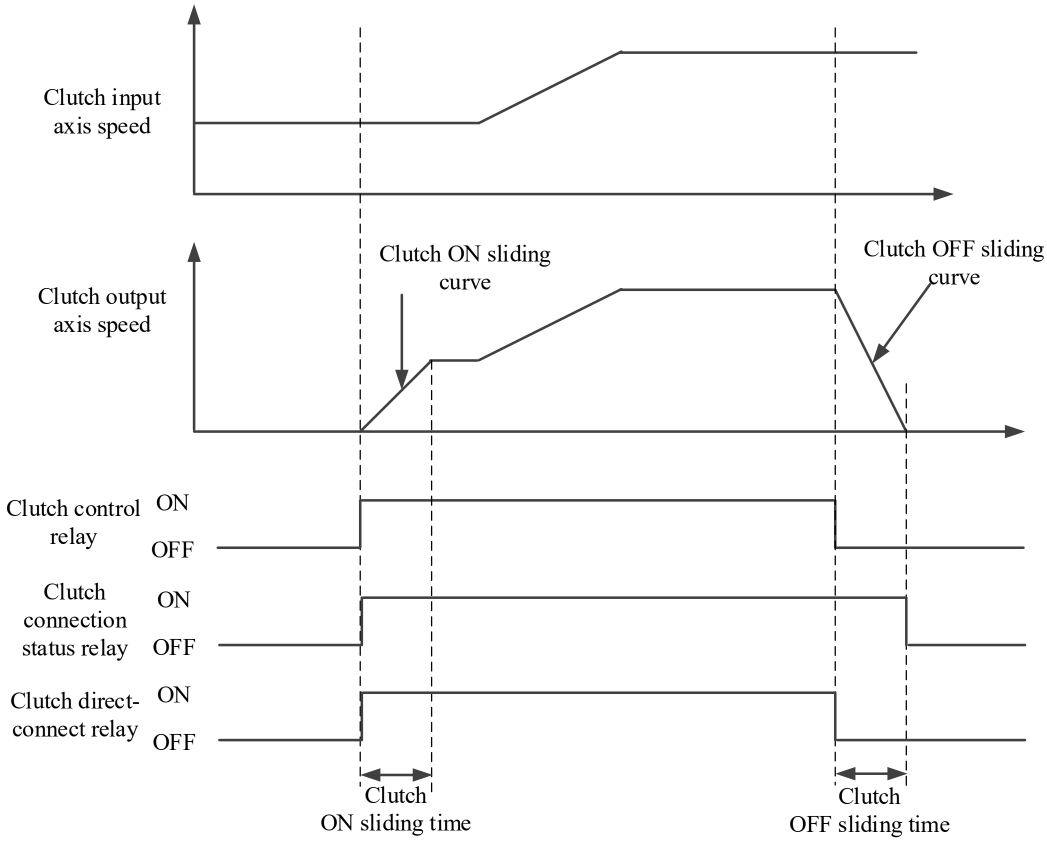
Pstart

t

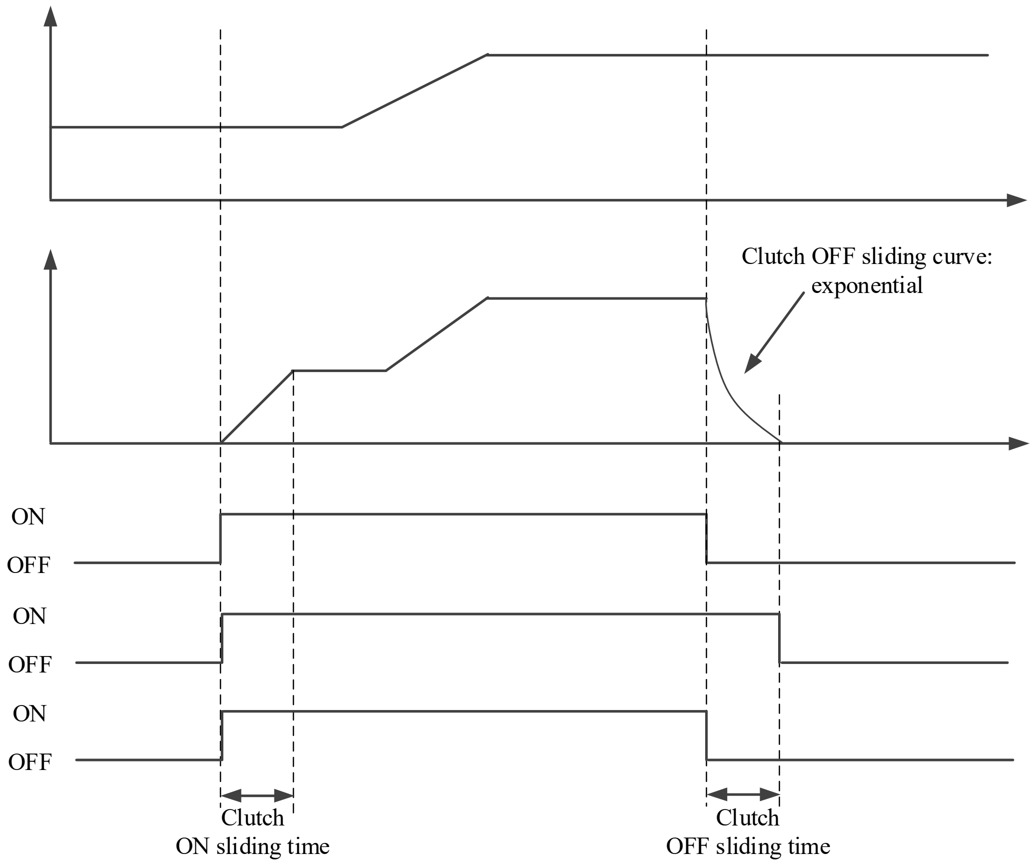
- Sliding curve

The sliding curve has 0- straight line, 1- exponential;

0- straight line: The slave axis velocity curve during sliding is a straight line.



1- Exponential (only supports clutch OFF, not supports clutch ON): The slave axis speed curve during sliding is exponential.



- Pursuit

The pursuit parameters include pursuit speed, pursuit acceleration, pursuit deceleration, and pursuit jerk. Chasing refers to the successful engagement of the ON clutch of the slave axis in a chasing manner during the spindle movement. The success flag for pursuit is that the Done signal of the clutch ON command is set to ON, and the synchronization signal of CamIn is set to ON. The higher the spindle speed set, the smaller the pursuit speed, and the longer the time for successful pursuit.

Clutch input
axis speed

Clutch output
axis speed

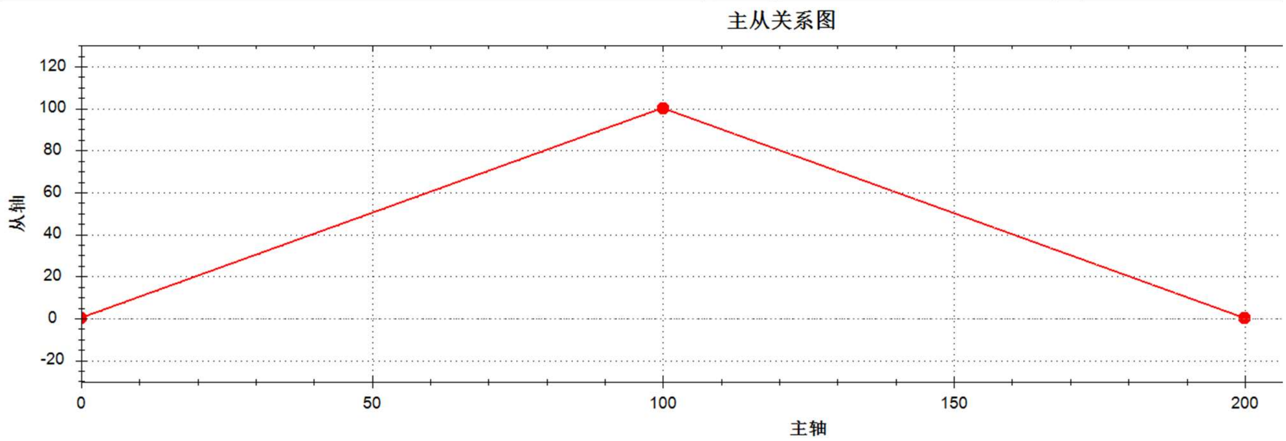
Clutch control relay ON OFF

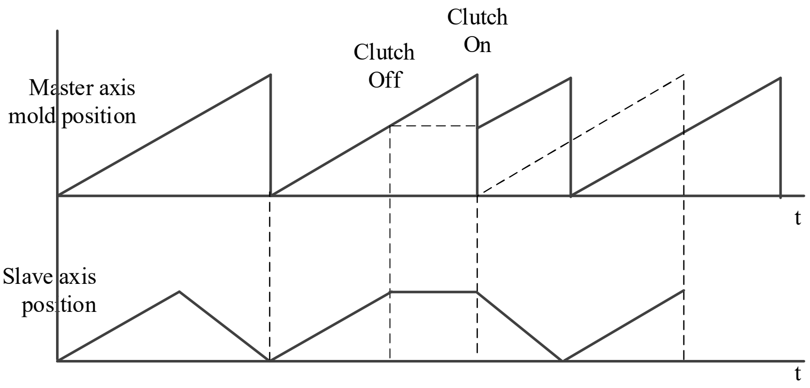
Clutch direct-connect relay ON OFF

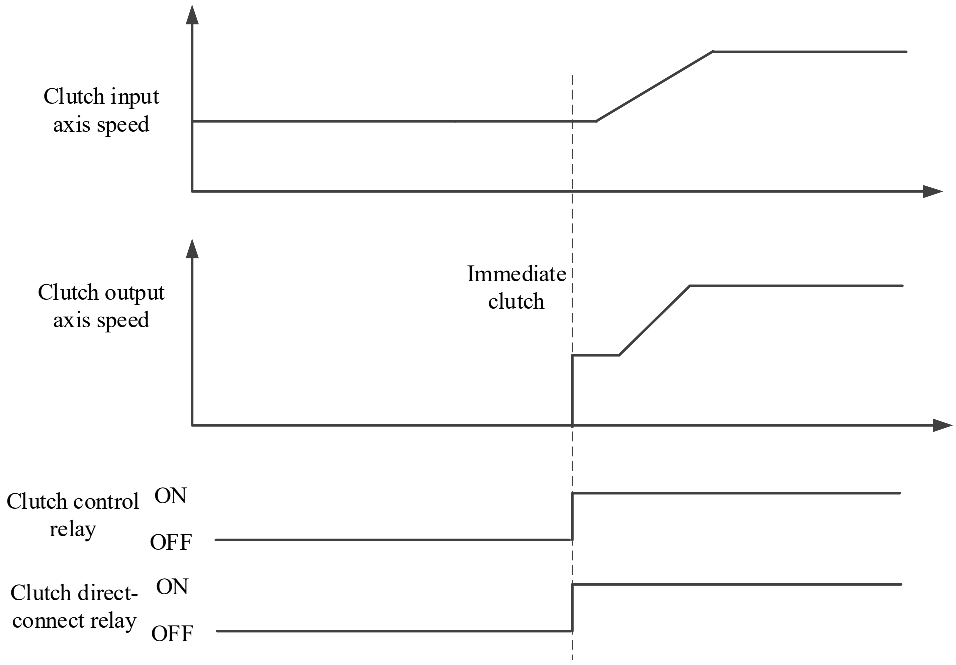
Pursuit process

- Immediately engage

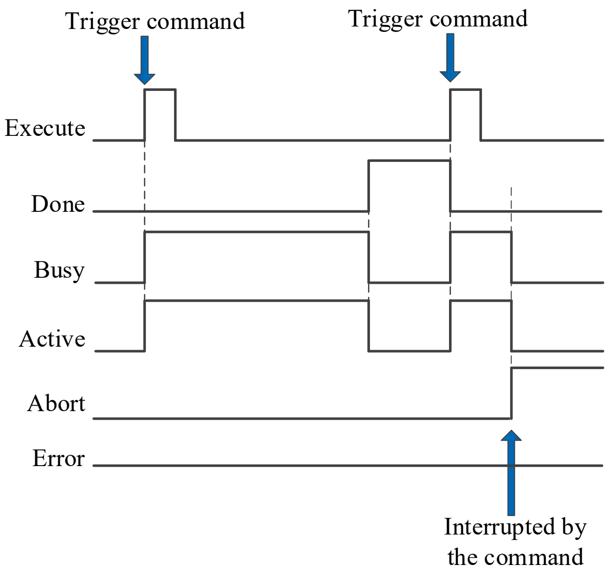
Immediate engagement refers to slave axis restores clutch as the current position.
After successfully triggering the clutch, the slave axis modes move in relative mode. The current position of the slave axis is the corresponding slave axis phase when successfully triggering the clutch OFF, and the current position of the spindle is the spindle phase when successfully triggering the clutch OFF. If absolute mode is selected for the slave axis, it also operates in relative mode.
Taking direct connection as an example, the speed step reaches the slave axis speed corresponding to the master axis of cam table at the moment of clutch ON conduction, completing the clutch and achieving synchronization.







(6) Sequence diagram



Explain:

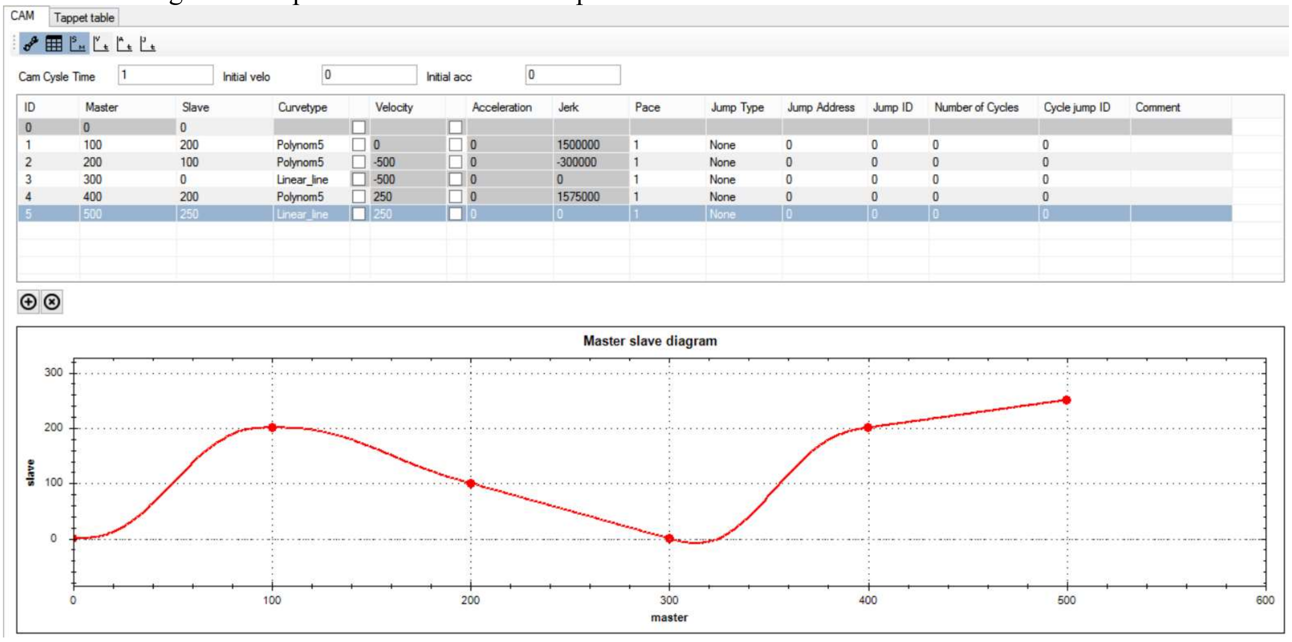
Trigger command, busy and active signals are set ON. When the set start mode signal comes, done is set ON, and busy and active are reset.

When the command is interrupted, abort is set ON and other signals are set ON.

(7) Application

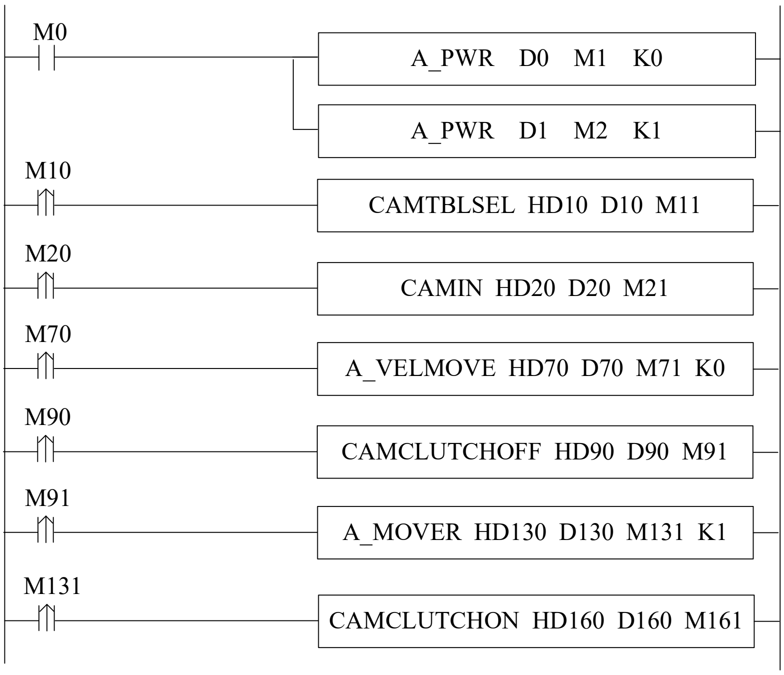
Example1:

Carry out the cam table in the following figure. It is required to separate the gear at the position of the main axis phase 240 and move the slave axis independently. After the position of the relative movement 300, the gear mesh is carried out again at the position of the main axis phase 360.

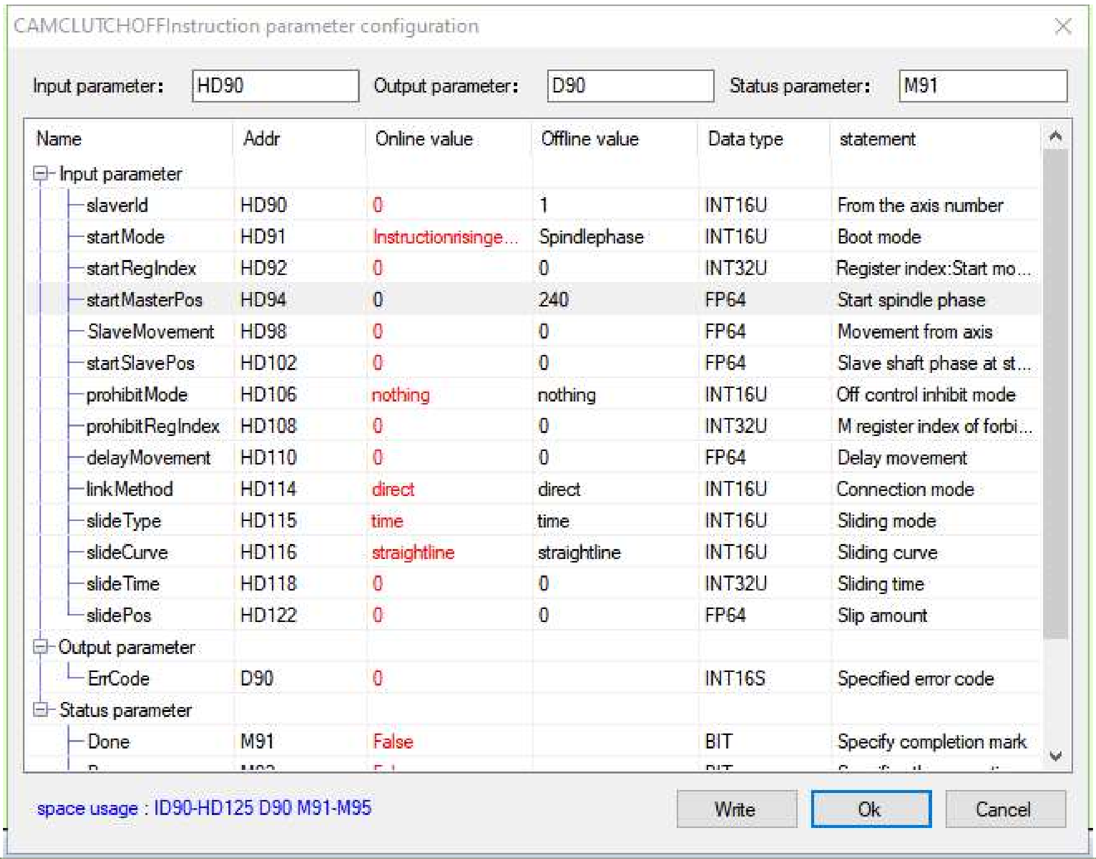


ID	Master	Slave	Curvetype	Velocity	Acceleration	Jerk	Pace	Jump Type	Jump Address	Jump ID	Number of Cycles	Cycle jump ID	Comment
0	0	0											
1	100	200	Polynom5	0	0	1500000	1	None	0	0	0	0	
2	200	100	Polynom5	-500	0	-300000	1	None	0	0	0	0	
3	300	0	Linear_line	-500	0	0	1	None	0	0	0	0	
4	400	200	Polynom5	250	0	1575000	1	None	0	0	0	0	
5	500	250	Linear_line	250	0	0	1	None	0	0	0	0	

The ladder chart:



The instruction configurations:



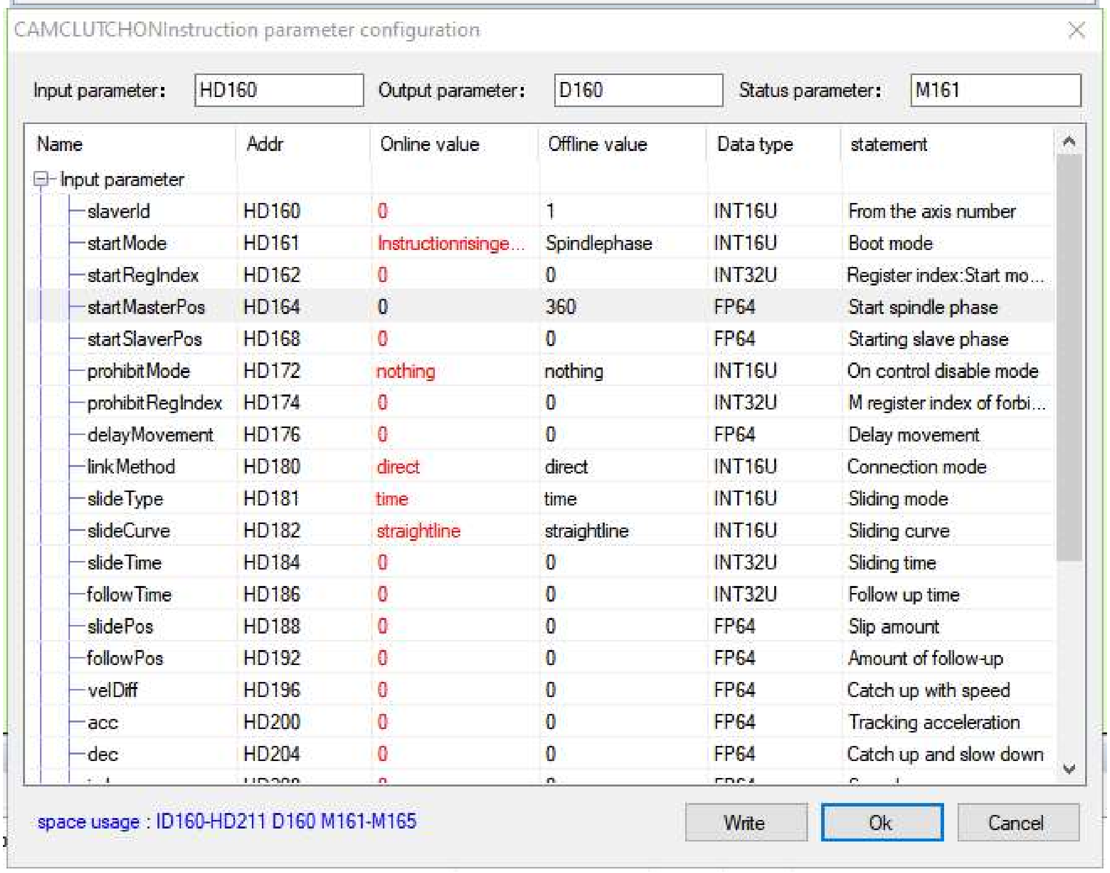
CAMCLUTCHOFFInstruction parameter configuration

Input parameter: HD90 Output parameter: D90 Status parameter: M91

Name	Addr	Online value	Offline value	Data type	statement
Input parameter					
slaverId	HD90	0	1	INT16U	From the axis number
startMode	HD91	Instructionrisinge...	Spindlephase	INT16U	Boot mode
startRegIndex	HD92	0	0	INT32U	Register index:Start mo...
startMasterPos	HD94	0	240	FP64	Start spindle phase
SlaveMovement	HD98	0	0	FP64	Movement from axis
startSlavePos	HD102	0	0	FP64	Slave shaft phase at st...
prohibitMode	HD106	nothing	nothing	INT16U	Off control inhibit mode
prohibitRegIndex	HD108	0	0	INT32U	M register index of forbi...
delayMovement	HD110	0	0	FP64	Delay movement
linkMethod	HD114	direct	direct	INT16U	Connection mode
slideType	HD115	time	time	INT16U	Sliding mode
slideCurve	HD116	straightline	straightline	INT16U	Sliding curve
slideTime	HD118	0	0	INT32U	Sliding time
slidePos	HD122	0	0	FP64	Slip amount
Output parameter					
ErrCode	D90	0		INT16S	Specified error code
Status parameter					
Done	M91	False		BIT	Specify completion mark

space usage : ID90-HD125 D90 M91-M95

Write Ok Cancel



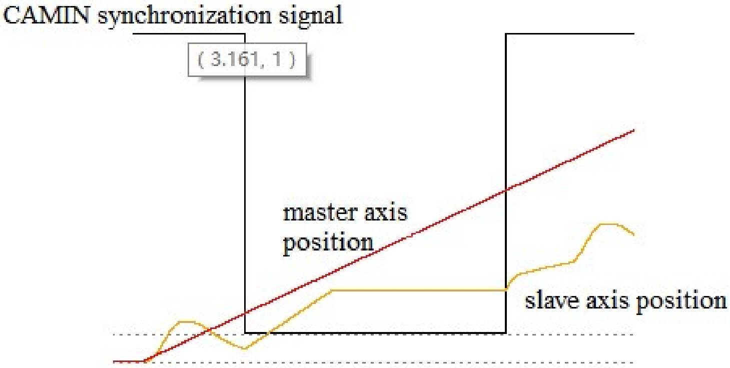
CAMCLUTCHONInstruction parameter configuration

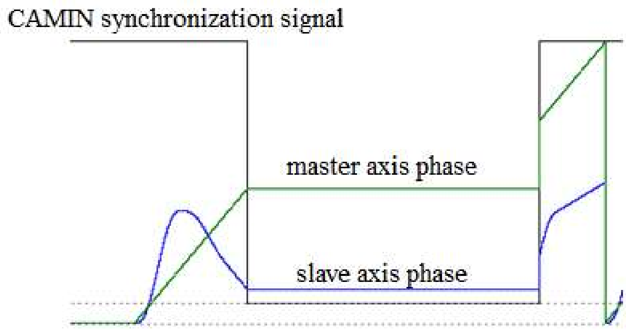
Input parameter: HD160 Output parameter: D160 Status parameter: M161

Name	Addr	Online value	Offline value	Data type	statement
Input parameter					
slaverId	HD160	0	1	INT16U	From the axis number
startMode	HD161	Instructionrisinge...	Spindlephase	INT16U	Boot mode
startRegIndex	HD162	0	0	INT32U	Register index:Start mo...
startMasterPos	HD164	0	360	FP64	Start spindle phase
startSlaverPos	HD168	0	0	FP64	Starting slave phase
prohibitMode	HD172	nothing	nothing	INT16U	On control disable mode
prohibitRegIndex	HD174	0	0	INT32U	M register index of forbi...
delayMovement	HD176	0	0	FP64	Delay movement
linkMethod	HD180	direct	direct	INT16U	Connection mode
slideType	HD181	time	time	INT16U	Sliding mode
slideCurve	HD182	straightline	straightline	INT16U	Sliding curve
slideTime	HD184	0	0	INT32U	Sliding time
followTime	HD186	0	0	INT32U	Follow up time
slidePos	HD188	0	0	FP64	Slip amount
followPos	HD192	0	0	FP64	Amount of follow-up
velDiff	HD196	0	0	FP64	Catch up with speed
acc	HD200	0	0	FP64	Tracking acceleration
dec	HD204	0	0	FP64	Catch up and slow down

space usage : ID160-HD211 D160 M161-M165

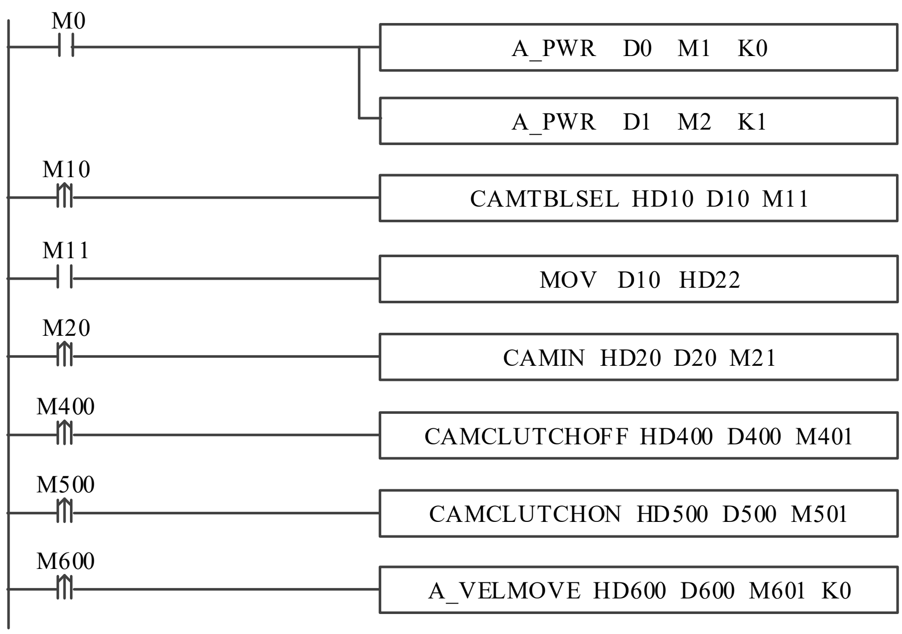
Write Ok Cancel

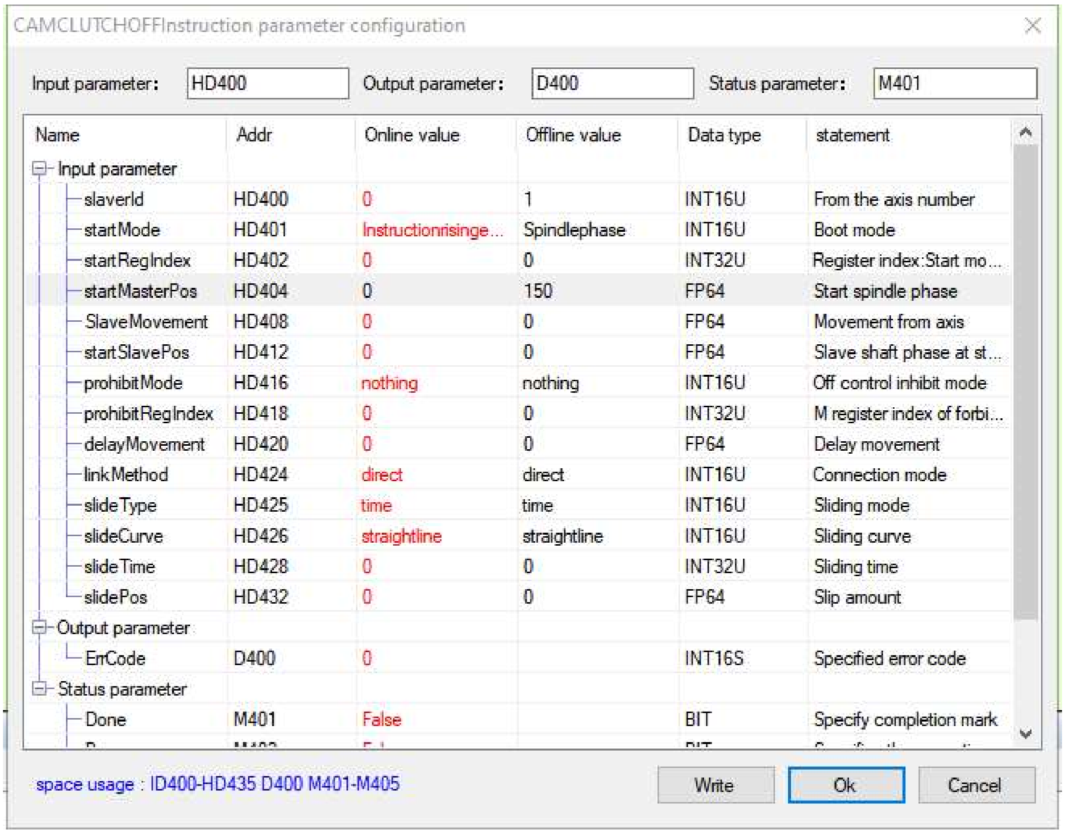




Explanation:
After the successful execution of camin, the clutch OFF command will be triggered. After the main axis is moved, when the main axis phase reaches 240 set by the command, the master and slave axes will disengage. At this time, the main axis movement will remain unchanged, and the relative movement of the slave axis will be 300. When the command is completed, the clutch ON command will be triggered. When the main axis phase reaches 360, the slave axis will re-engage the main axis, and immediately follow the main axis to execute according to the cam table.

Example 2:
Using the cam table in Example 1, slave axis immediately detach when the spindle phase is 150, and slave axis gradually binds the spindle when the spindle phase is 450. When the spindle movement reaches 100, fully binding (select relative and absolute for the slave axis mode, and compare the difference in trajectory curves)
The ladder diagram is shown in the following figure:





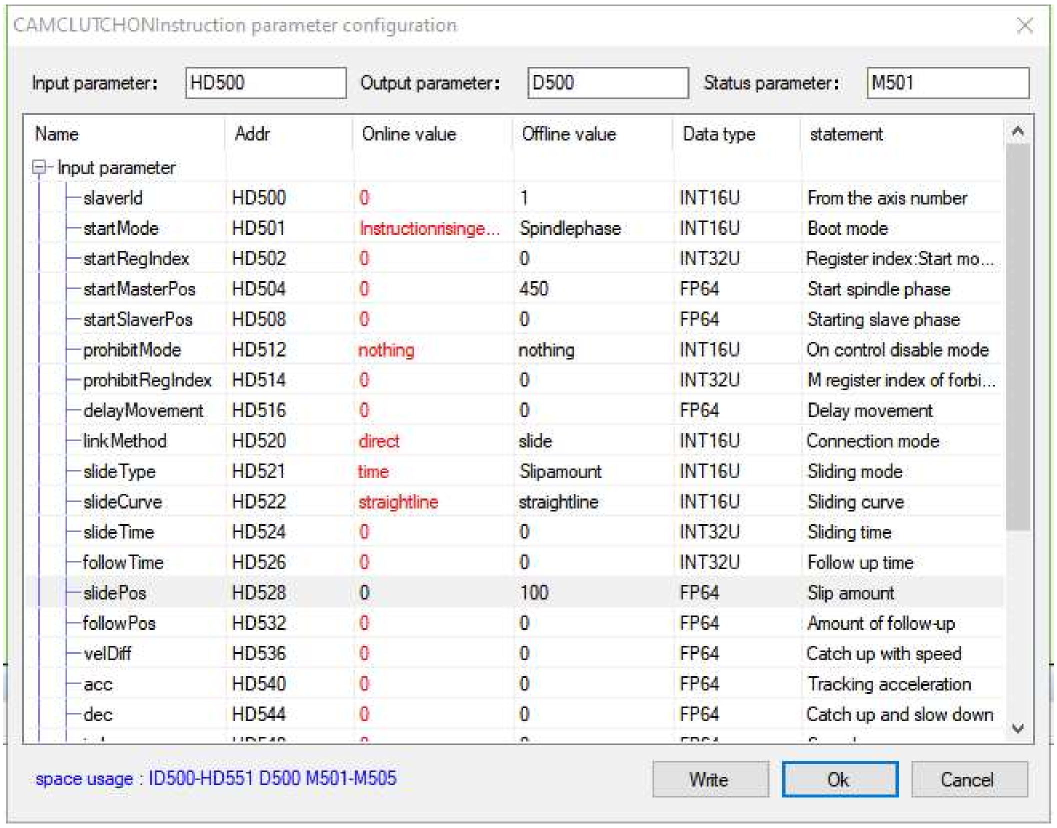
CAMCLUTCHOFFInstruction parameter configuration

Input parameter: HD400 Output parameter: D400 Status parameter: M401

Name	Addr	Online value	Offline value	Data type	statement
Input parameter					
slaverId	HD400	0	1	INT16U	From the axis number
startMode	HD401	Instructionrisinge...	Spindlephase	INT16U	Boot mode
startRegIndex	HD402	0	0	INT32U	Register index:Start mo...
startMasterPos	HD404	0	150	FP64	Start spindle phase
SlaveMovement	HD408	0	0	FP64	Movement from axis
startSlavePos	HD412	0	0	FP64	Slave shaft phase at st...
prohibitMode	HD416	nothing	nothing	INT16U	Off control inhibit mode
prohibitRegIndex	HD418	0	0	INT32U	M register index of forbi...
delayMovement	HD420	0	0	FP64	Delay movement
linkMethod	HD424	direct	direct	INT16U	Connection mode
slideType	HD425	time	time	INT16U	Sliding mode
slideCurve	HD426	straightline	straightline	INT16U	Sliding curve
slideTime	HD428	0	0	INT32U	Sliding time
slidePos	HD432	0	0	FP64	Slip amount
Output parameter					
ErrCode	D400	0		INT16S	Specified error code
Status parameter					
Done	M401	False		BIT	Specify completion mark

space usage : ID400-HD435 D400 M401-M405

Write Ok Cancel



CAMCLUTCHONInstruction parameter configuration

Input parameter: HD500 Output parameter: D500 Status parameter: M501

Name	Addr	Online value	Offline value	Data type	statement
Input parameter					
slaverId	HD500	0	1	INT16U	From the axis number
startMode	HD501	Instructionrisinge...	Spindlephase	INT16U	Boot mode
startRegIndex	HD502	0	0	INT32U	Register index:Start mo...
startMasterPos	HD504	0	450	FP64	Start spindle phase
startSlaverPos	HD508	0	0	FP64	Starting slave phase
prohibitMode	HD512	nothing	nothing	INT16U	On control disable mode
prohibitRegIndex	HD514	0	0	INT32U	M register index of forbi...
delayMovement	HD516	0	0	FP64	Delay movement
linkMethod	HD520	direct	slide	INT16U	Connection mode
slideType	HD521	time	Slipamount	INT16U	Sliding mode
slideCurve	HD522	straightline	straightline	INT16U	Sliding curve
slideTime	HD524	0	0	INT32U	Sliding time
followTime	HD526	0	0	INT32U	Follow up time
slidePos	HD528	0	100	FP64	Slip amount
followPos	HD532	0	0	FP64	Amount of follow-up
velDiff	HD536	0	0	FP64	Catch up with speed
acc	HD540	0	0	FP64	Tracking acceleration
dec	HD544	0	0	FP64	Catch up and slow down

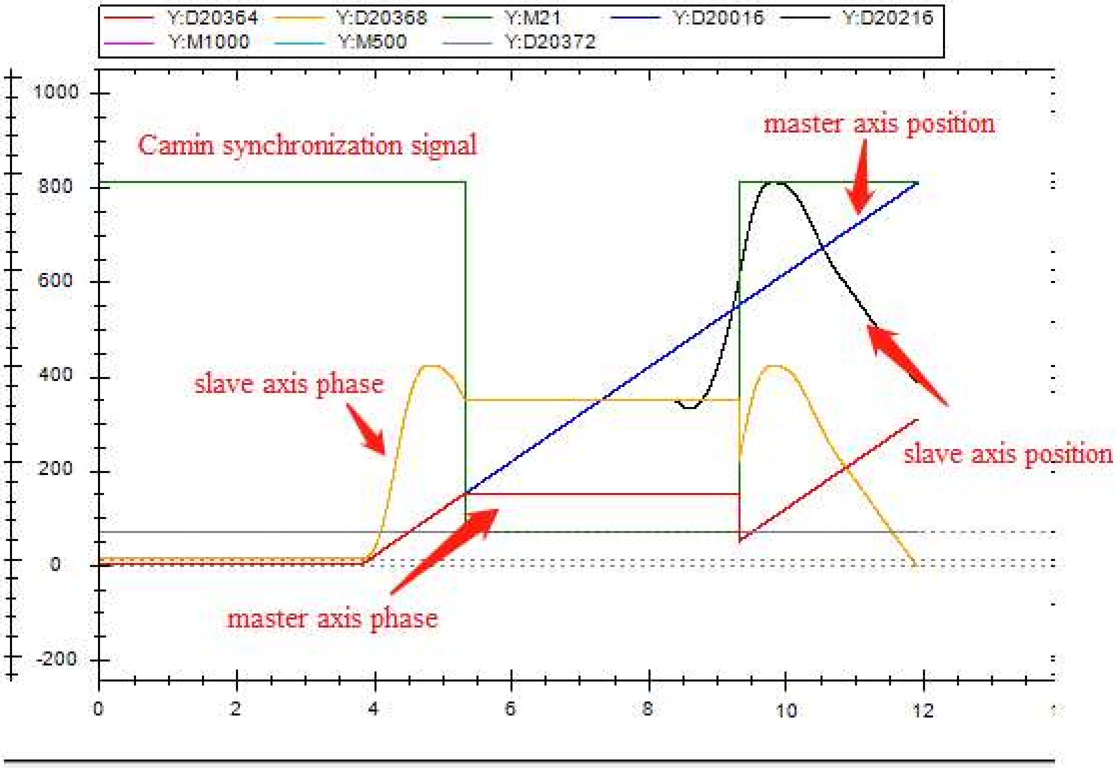
space usage : ID500-HD551 D500 M501-M505

Write Ok Cancel

Explanation:

Firstly, turn on the enable command through the A_PWR command, then execute the CAMTBLSEL command to generate a cam table instance. Then, execute the CAMIN command to start the cam, and then execute the CAMCLUTCHOFF command. Finally, execute the A_VELMOVE to move the spindle. After the clutch off command is completed, trigger the CAMCLUTCHON command.

Oscilloscope monitoring waveform:



According to the cursor, when the camin synchronization signal is reset, the position of the slave shaft is around 165. When the camin synchronization signal is set, the position of the slave shaft is around 290. The starting condition for the clutch on is the spindle phase of 450, and the sliding amount is 100. That is, after sliding, the spindle phase will cross one cam cycle to reach the position of 50. According to the cam table, the spindle phase will move from 450 to the next cycle of 50, and the slave shaft will move relative to about 125. Therefore, after sliding, the position of the slave shaft will reach the position of 290 (125+165).

5-3-2-15. CAM table offset【CAMTRANSLATE】

(1) Overview

The cam table performs the point offset according to the set offset.

CAM table offset [CAMTRANSLATE]			
Execution condition	Rising/falling edge of the coil	Suitable model	XDH, XLH, XG2
Firmware	V3.7.2 and above	Software	V3.7.14 and above

(2) Operand

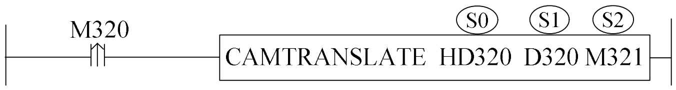
Operand	Function	Type
S0	Specify the input parameter start address	16-bit, single word
S1	Specify the output state word start address	16-bit, single word
S2	Sepcify the output state bit start address	Bit

(3) Suitable soft component

Operand	Word soft component											Bit soft component					
	System								Constant	Module		System					
	D*	FD	TD*	CD*	DX	DY	DM*	DS*	K/H	ID	QD	X	Y	M*	S*	T*	C*
S0	●	●	●	●													
S1	●	●	●	●													
S2														●			

*: D means D, HD; TD means TD and HTD; CD means CD, HCD, HSCD and HSD; DM means DM and DHM; DS means DS and DHS; M means M, HM, SM; S means S, HS; T means T, HT; C means C, HC.

(4) Function and action



- S0 specifies [input parameter start address] and occupies registers S0~S0+11
- S1 specifies [start address of output status word]
- S2 specifies [start address of output status bit] and occupies relay S2~S2+2

(5) Note

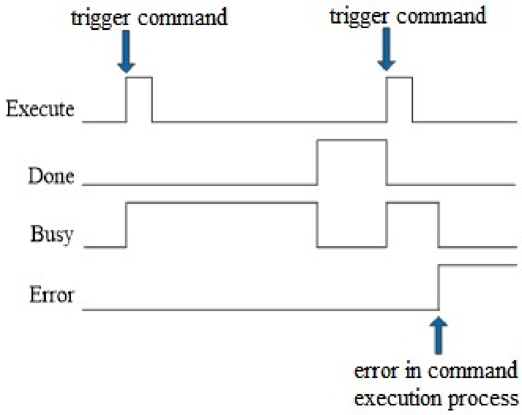
- When count is equal to 0, it is modified to the last key point according to the set offset from startpointid.
- 0<key point id<=the last key point id.
- The total number of modified key points count<the total number of key points in the cam table.

(6) Related parameters

Input parameter	Parameter name	Data type	Unit	Note
S0	Count	INT16U	Command unit	Key point total number
S0+1	CamTblId	INT16S	Command unit /s	cam table instance
S0+2	StartPointId	INT16U	Command unit /s^2	start key point ID
S0+3	Type	INT16U		Mode 0: take effect at once 1: take effect in next cam cycle
S0+4	MasterPosOffset	FP64	Command unit /s^2	master axis offset
S0+8	SlaverPosOffset	FP64	Command unit	slave axis offset
Output parameter	**Parameter name**	**Data type**	**Unit**	**Note**
S1	ErrCode	INT16U	-	Command error code
State parameter	**Parameter name**	**Data type**	**Unit**	**Note**
S2	Done	BOOL	-	Command execution completed

S2+1	Busy	BOOL	-	Instruction is executing
S2+2	Error	BOOL	-	Command execution error
Axis number	Parameter name	Data type	Unit	Note
S3	Axis	INT16U	-	Axis number starts from 0

(7) Sequence diagram



Explain:
When the command is triggered, the Busy signal is set ON. When the command is executed, the Busy signal is reset and the Done signal is set ON.
When there is an error in the command execution, the Error signal is set ON, other signals are reset, and the corresponding error code is output.

5-3-2-16. Follow cutting【X_FLYSAW】

(1) Overview

Generate simple follow cutting curve.

Follow cutting [X_FLYSAW]			
Execution condition	Rising/falling edge of the coil	Suitable model	XDH, XLH, XG2
Firmware	V3.7.2 and above	Software	V3.7.14 and above

(2) Operand

Operand	Function	Type
S0	Specify the input parameter start address	16-bit, single word
S1	Specify the output state word start address	16-bit, single word
S2	Sepcify the output state bit start address	Bit

(3) Suitable soft component

Operand	Word soft component											Bit soft component					
	System								Constant	Module		System					
	D*	FD	TD*	CD*	DX	DY	DM*	DS*	K/H	ID	QD	X	Y	M*	S*	T*	C*
S0	●	●	●	●													
S1	●	●	●	●													
S2														●			

*: D means D, HD; TD means TD and HTD; CD means CD, HCD, HSCD and HSD; DM means DM and DHM; DS means DS and DHS; M means M, HM, SM; S means S, HS; T means T, HT; C means C, HC.

(4) Function and action

```
         M370          S0     S1    S2
|---------|↑|-------[X_FLYSAW  HD370  D370  M371]---|
```

- S0 specifies [input parameter start address] and occupies registers S0~S0+27
- S1 specifies [start address of output status word] and occupies registers S1~S1+7
- S2 specifies [start address of output status bit] and occupies relay S2~S2+5.

(5) Note

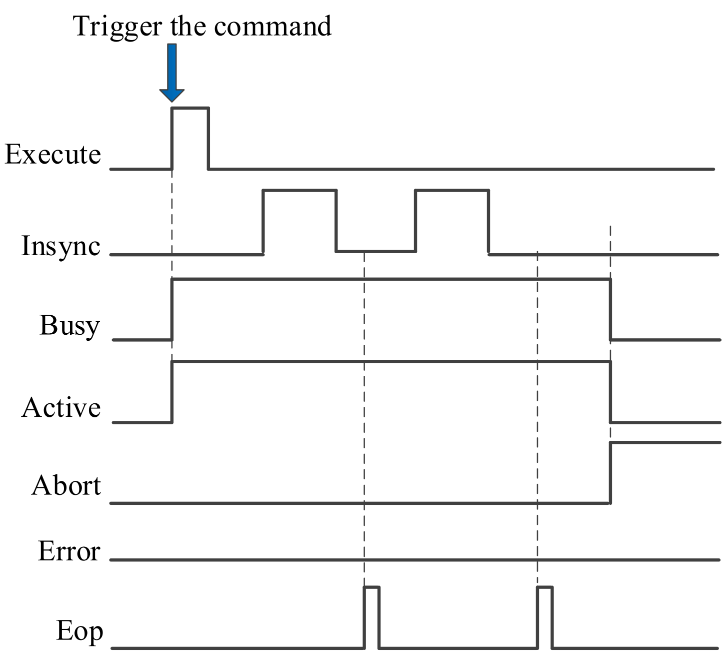
- Master-slave synchronous proportion refers to the proportion relationship between the master-slave axis in the synchronous zone, syncScale=displacement of the slave axis/displacement of the main axis, and the setting of the proportion value needs to consider whether the acceleration zone and deceleration zone will reverse.
- Return distance=material length - acceleration distance - synchronization distance - deceleration distance - waiting distance.
- When continuous update is selected, the cutting length, acceleration distance, synchronization distance, deceleration distance, waiting distance and synchronization area proportion can be updated during operation, and will take effect in the next cutting cam cycle.

(6) Related parameters

Input parameter	Parameter name	Data type	Unit	Note
S0	masterID	INT16U	-	Master axis ID
S0+1	slaveID	INT16U	-	Slave axis ID
S0+2	continueUpdate	INT16U	-	Continue update 0: invalid 1: valid
S0+3	reserved	INT16U	-	-
S0+4	cutLength	FP64	Command unit	Cutting length
S0+8	accDistance	FP64	Command unit	Acceleration distance
S0+12	syncDistance	FP64	Command unit	Synchronization distance
S0+16	decDistance	FP64	Command unit	Deceleration distance

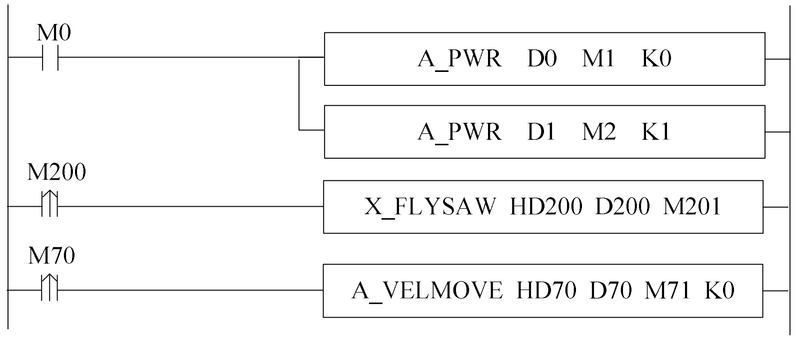
Input parameter	Parameter name	Data type	Unit	Note
S0+20	waitDistance	FP64	Command unit	Waiting distance
S0+24	syncScaling	FP64	-	Proportion of master-slave synchronization zone
Output parameter	**Parameter name**	**Data type**	**Unit**	**Note**
S1	ErrCode	INT16U	-	Command error code
S1+1	num	INT16U	-	Segment number
S1+2	reserved	INT16U	-	-
S1+3	Reserved2	INT16U	-	-
S1+4	backDistance	FP64	Command unit	Return distance
State parameter	**Parameter name**	**Data type**	**Unit**	**Note**
S2	InSync	BOOL	-	In the synchronization area
S2+1	Busy	BOOL	-	Instruction is executing
S2+2	Active	BOOL	-	Command under control
S2+3	Abort	BOOL	-	Instruction interrupted
S2+4	Error	BOOL	-	Command execution error
S2+5	endProfile	BOOL	-	Cam cycle completed

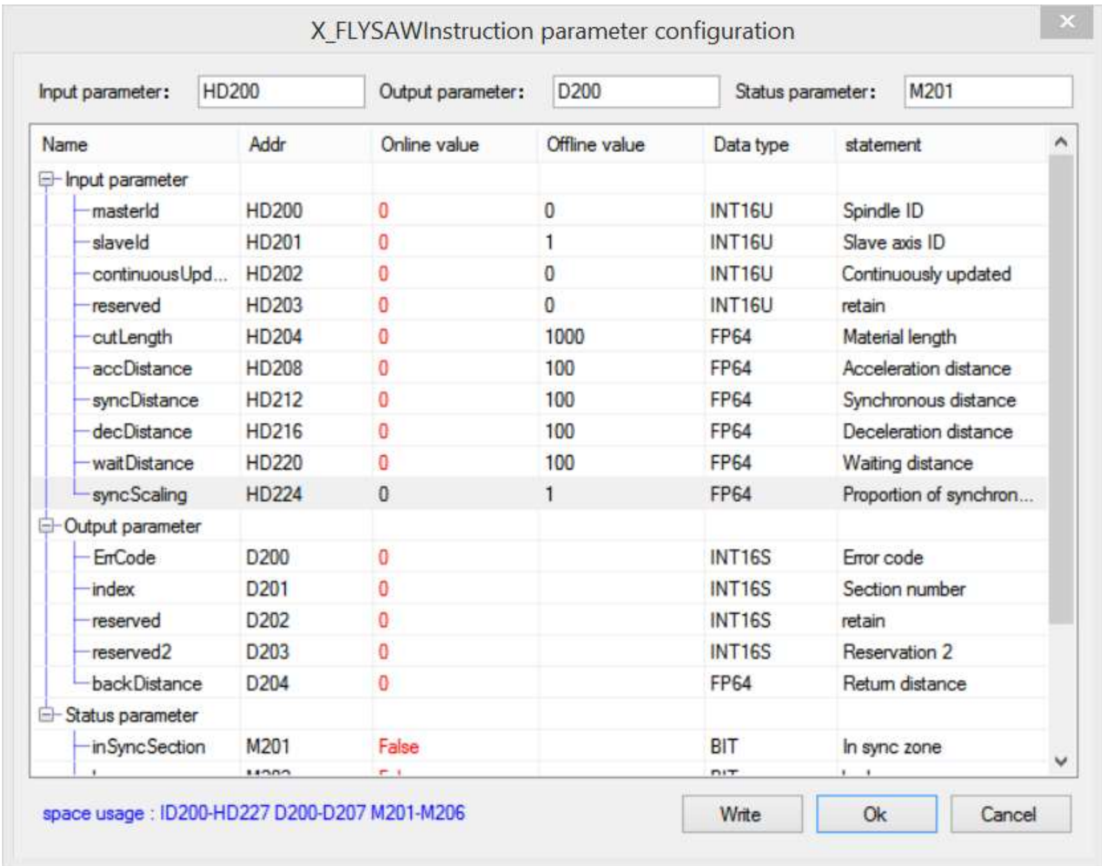
(7) Sequence diagram



Explain:
Trigger the command, and set ON the busy and active signals. After moving the main axis, start the follow cutting movement. When the movement reaches the synchronization zone, the insync signal is set ON. There will be an EOP signal at the end of each follow cutting cycle.
If the command is interrupted, abort is set ON and other signals are reset.

(8) Application
Plan the follow cutting curve through the simple follow cutting command.




X_FLYSAWInstruction parameter configuration

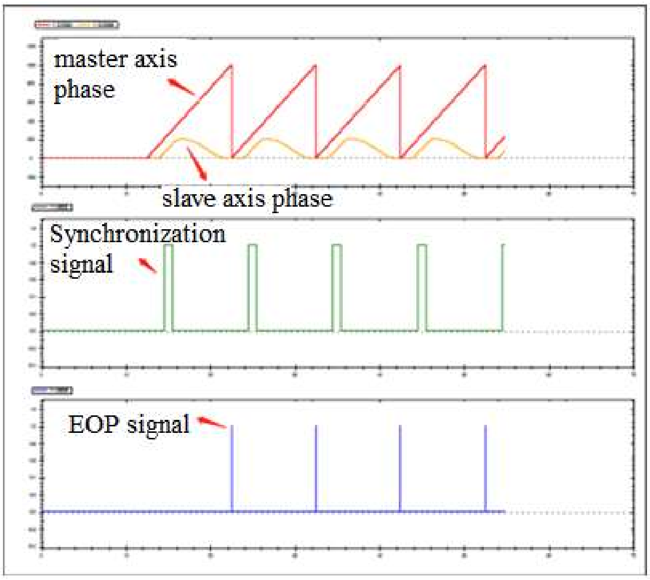
Input parameter: HD200 Output parameter: D200 Status parameter: M201

Name	Addr	Online value	Offline value	Data type	statement
Input parameter					
masterId	HD200	0	0	INT16U	Spindle ID
slaveId	HD201	0	1	INT16U	Slave axis ID
continuousUpd...	HD202	0	0	INT16U	Continuously updated
reserved	HD203	0	0	INT16U	retain
cutLength	HD204	0	1000	FP64	Material length
accDistance	HD208	0	100	FP64	Acceleration distance
syncDistance	HD212	0	100	FP64	Synchronous distance
decDistance	HD216	0	100	FP64	Deceleration distance
waitDistance	HD220	0	100	FP64	Waiting distance
syncScaling	HD224	0	1	FP64	Proportion of synchron...
Output parameter					
ErrCode	D200	0		INT16S	Error code
index	D201	0		INT16S	Section number
reserved	D202	0		INT16S	retain
reserved2	D203	0		INT16S	Reservation 2
backDistance	D204	0		FP64	Return distance
Status parameter					
inSyncSection	M201	False		BIT	In sync zone

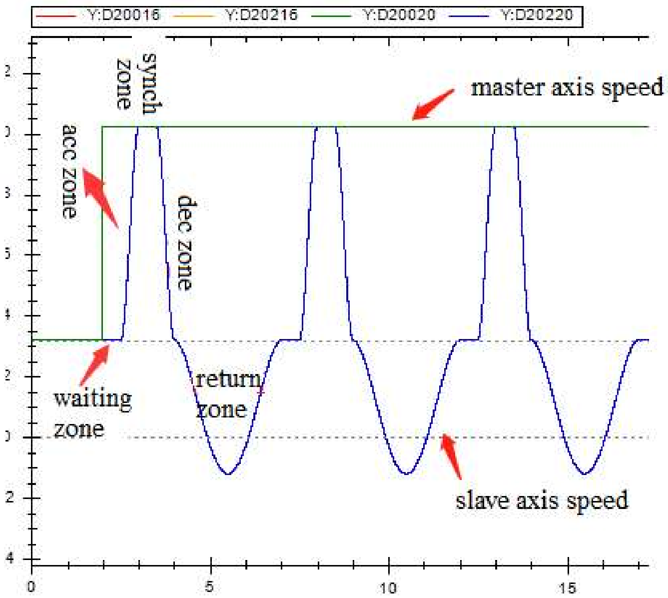
space usage : ID200-HD227 D200-D207 M201-M206

Write Ok Cancel

Note: After triggering the command, the current segment number and return distance will be obtained. After moving the main axis, the slave axis will carry out periodic reciprocating movement. The track can be divided into five segments, namely, waiting zone, acceleration zone, synchronization zone, deceleration zone and return zone. When the slave axis is in the synchronization zone, the insyncsection signal is set ON. The specific position and speed curve are shown in the figure below.



master axis phase
slave axis phase
Synchronization signal
EOP signal



Y:D20016
Y:D20216
Y:D20020
Y:D20220
synch zone
master axis speed
acc zone
dec zone
waiting zone
return zone
slave axis speed
0
5
10
15

5-3-2-17. Fly cutting【X_ROTARYCUT】

(1) Overview

Generate simple fly cutting curve.

Fly cutting [X_ROTARYCUT]			
Execution condition	Rising/falling edge of the coil	Suitable model	XDH, XLH, XG2
Firmware	V3.7.2 and above	Software	V3.7.14 and above

(2) Operand

Operand	Function	Type
S0	Specify the input parameter start address	16-bit, single word
S1	Specify the output state word start address	16-bit, single word
S2	Sepcify the output state bit start address	Bit

(3) Suitable soft component

Operand	Word soft component											Bit soft component					
	System								Constant	Module		System					
	D*	FD	TD*	CD*	DX	DY	DM*	DS*	K/H	ID	QD	X	Y	M*	S*	T*	C*
S0	●	●	●	●													
S1	●	●	●	●													
S2														●			

*: D means D, HD; TD means TD and HTD; CD means CD, HCD, HSCD and HSD; DM means DM and DHM; DS means DS and DHS; M means M, HM, SM; S means S, HS; T means T, HT; C means C, HC.

(4) Function and action

- S0 specifies [input parameter start address] and occupies registers S0~S0+19
- S1 specifies [start address of output status word] and occupies registers S1~S1+1
- S2 specifies [start address of output status bit] and occupies relay S2~S2+6

(5) Note

- During operation, it is necessary to ensure that the cutting blade is at a position where the length of the cutting point is half of the distance traveled by cutting a section of material from the axis.
- The material length is relatively short, and there is no waiting area. Integrate cam segments 1.2.3 into the synchronization area.

(6) Related parameters

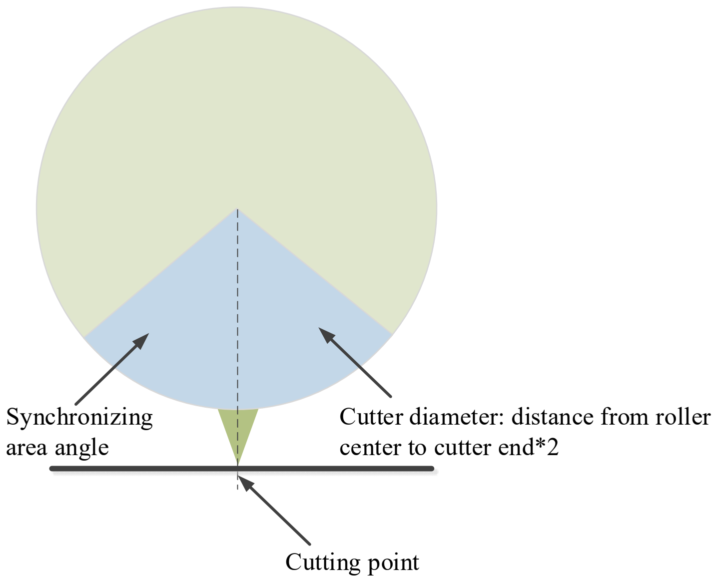
Input parameter	Parameter name	Data type	Unit	Note
S0	masterId	INT16U	-	Master axis ID
S0+1	slaveId	INT16U	-	Slave axis ID
S0+2	continuousUpdate	INT16U	-	Continuous update 0: valid 1: invalid
S0+3	cutterNum	INT16U	Instruction Unit	Cutter numbers
S0+4	cutterDiameter	FP64	Instruction Unit	Cutter diameter
S0+8	syncAngle	FP64	-	Synchronizing area angle
S0+12	cutLen	FP64	Instruction Unit	Cutting length
S0+16	mode	INT16U	-	Fly cutting mode. Not supported temporarily
S0+17	dir	INT16U		Synchronous mode. Not supported temporarily
S0+18	reserve1	INT16U		Reserve
S0+19	reserve2	INT16U		Reserve
Output parameter	Parameter name	Data type	Unit	Note

Input parameter	Parameter name	Data type	Unit	Note
S1	ErrCode	INT16S	-	Instruction error code
S1+1	Index	INT16S		Segment number
State parameter	Parameter name	Data type	Unit	Note
S2	inSync	BOOL	-	Command execution completed
S2+1	Busy	BOOL	-	Instruction is executing
S2+2	Active	BOOL	-	Command under control
S2+3	Abort	BOOL	-	Instruction interrupted
S2+4	Error	BOOL	-	Command execution error
S2+5	syncFlag	BOOL		Synchronization zone flag
S2+6	endOfProfile	BOOL		Cam cycle completion flag

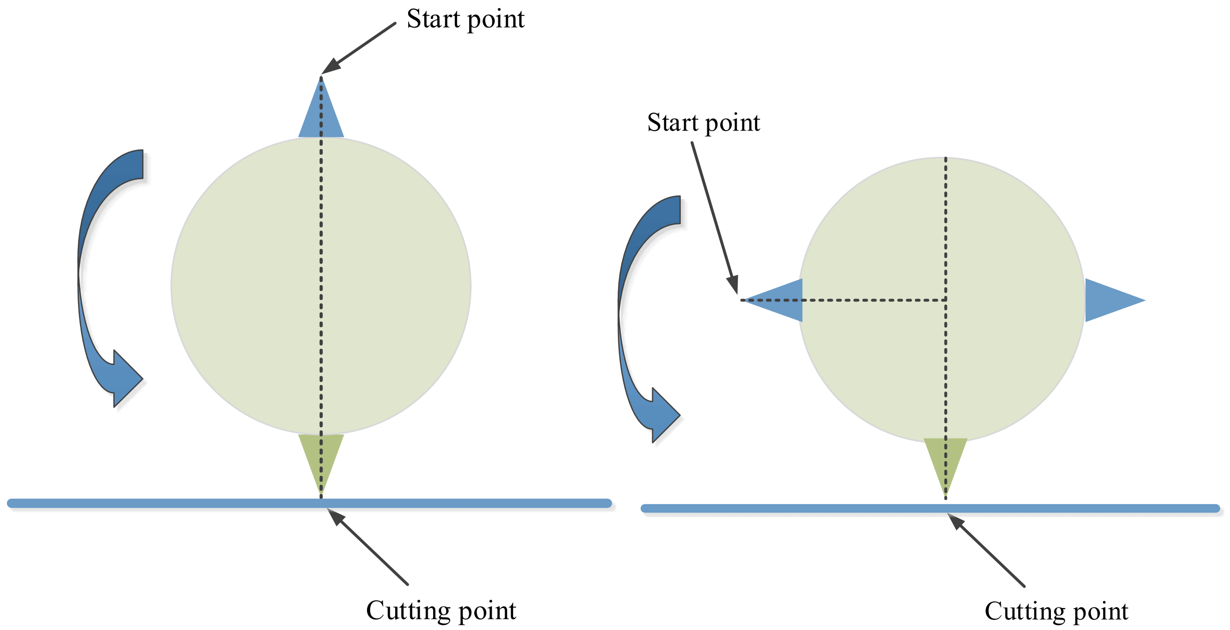
[Continuously updated]: The updated synchronization area angle and shear length will take effect in the next cycle after modification.

[Knife diameter]: The diameter of the flying shear knife is twice the distance from the center point of the knife roller to the end, and can be used to calculate the distance of one circle of movement of the flying shear shaft. The movement distance of the flying shear shaft in one circle=cutter diameter * pi..

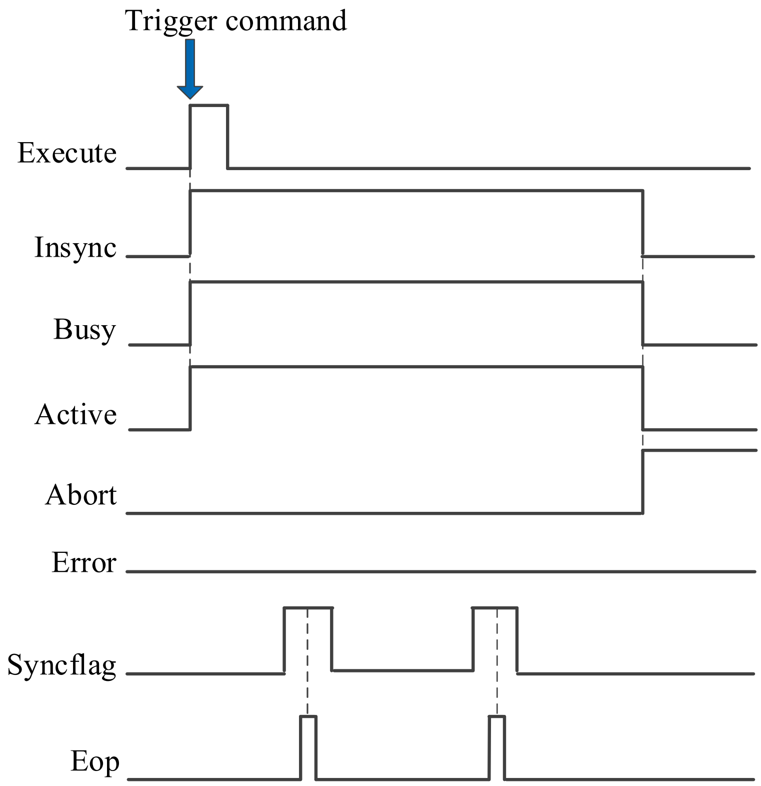
[Synchronizing area angle]: Synchronizing area angle is the angle that the cutter and material keep synchronous motion during the cutting process set by the user. The unit of the input value is the angle value. Through this parameter, the length of the synchronizing area of the cutter and material movement can be calculated. The cutting process occurs in the synchronizing area, and the cutter and material move synchronously during this process. Length of synchronization zone = angle of synchronization zone/360 * slave axis one rotation moving distance/number of cutters.



[Number of cutters]: the number of cutters on the cutter roller. The default value is 0. According to the actual tool setting, if there is only one cutter on the cutter roller, set it to 1, and the cutter axis rotates 360 degrees for one cutting; Then it is necessary to adjust the starting position of the cutter to the right above the cutting point (180° position). If there are two cutters on the cutter roller, and slave axis only needs to rotate half a circle to cut a section of material length, it is necessary to adjust the starting position of the cutter to the 90 degree position of the cutting point, and then adjust the multiple cutters in turn. If there is a deviation in the position of the cutter starting point, the cutting process cannot be guaranteed to be carried out in the synchronous zone.



(7) Sequence diagram



Explain:

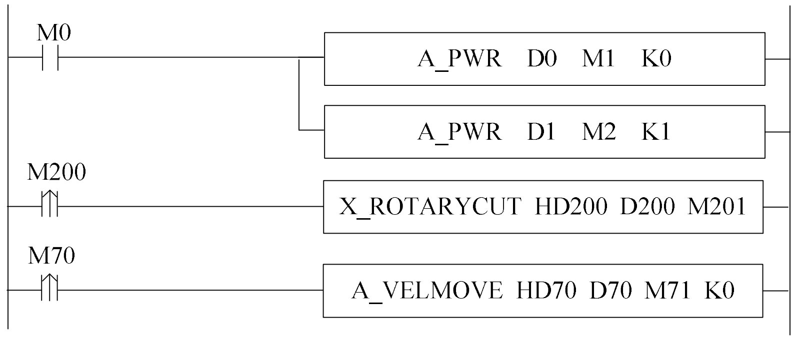
When the trigger command is triggered, busy, active and insync are always set ON. When running to the synchronization section, syncflag is set.

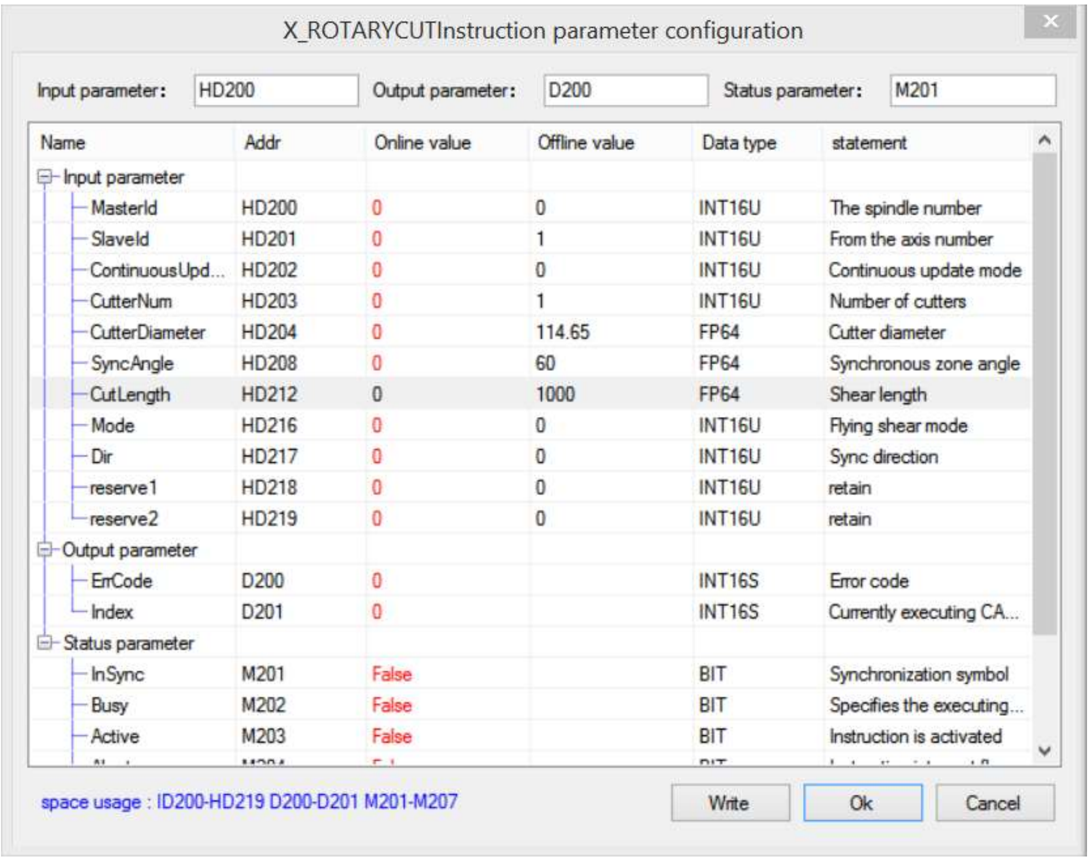
When the cam cycle is finished, the EOP signal is set and reset after maintaining a communication cycle.

When the command is interrupted by other commands, abort is set and other signals are reset.

(8) Application

Use simple fly cutting command to execute the fly cutting cam.




X_ROTARYCUTInstruction parameter configuration

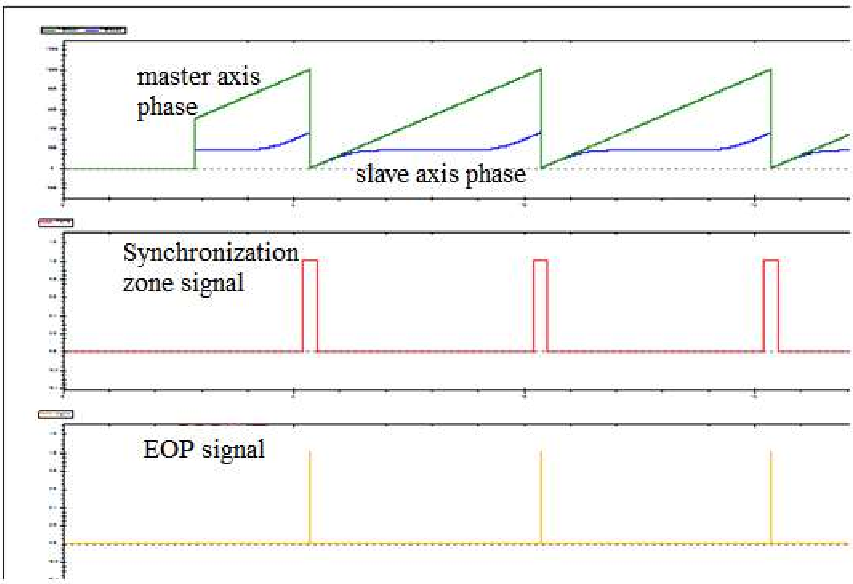
Input parameter: HD200 Output parameter: D200 Status parameter: M201

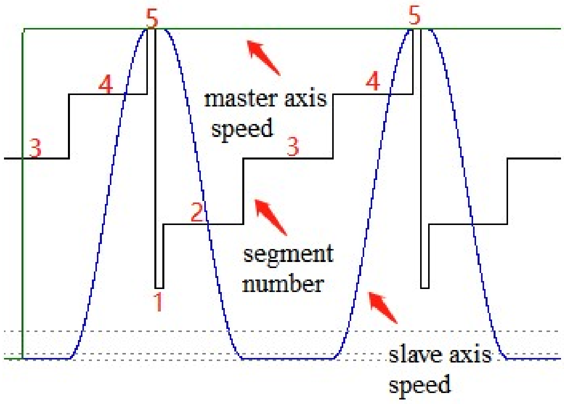
Name	Addr	Online value	Offline value	Data type	statement
Input parameter					
MasterId	HD200	0	0	INT16U	The spindle number
SlaveId	HD201	0	1	INT16U	From the axis number
ContinuousUpd...	HD202	0	0	INT16U	Continuous update mode
CutterNum	HD203	0	1	INT16U	Number of cutters
CutterDiameter	HD204	0	114.65	FP64	Cutter diameter
SyncAngle	HD208	0	60	FP64	Synchronous zone angle
CutLength	HD212	0	1000	FP64	Shear length
Mode	HD216	0	0	INT16U	Flying shear mode
Dir	HD217	0	0	INT16U	Sync direction
reserve1	HD218	0	0	INT16U	retain
reserve2	HD219	0	0	INT16U	retain
Output parameter					
ErrCode	D200	0		INT16S	Error code
Index	D201	0		INT16S	Currently executing CA...
Status parameter					
InSync	M201	False		BIT	Synchronization symbol
Busy	M202	False		BIT	Specifies the executing...
Active	M203	False		BIT	Instruction is activated

space usage : ID200-HD219 D200-D201 M201-M207

Write Ok Cancel

Note: When the command is triggered, the current segment number will be obtained, and the synchronization mark will be set ON at the same time. The fly cutting curve is divided into five segments, namely, 1-the second half of the synchronization zone, 2-the adjustment zone, 3-the waiting zone, 4-the adjustment zone, 5-the first half of the synchronization zone. When running to the synchronization zone, the synchronization zone operation mark will be set ON, and the speed track is shown in the following figure:


master axis phase
slave axis phase
Synchronization zone signal
EOP signal


5
5
4
4
master axis speed
3
3
2
segment number
1
slave axis speed

5-3-2-18. CAM skip write【CAMSKIPWR】

(1) Overview

The cam table skips as specified parameters.

CAM skip write [CAMSKIPWR]			
Execution condition	Rising/falling edge of the coil	Suitable model	XDH, XLH, XG2
Firmware	V3.7.2 and above	Software	V3.7.14 and above

(2) Operand

Operand	Function	Type
S0	Specify the input parameter start address	16-bit, single word
S1	Specify the output state word start address	16-bit, single word
S2	Sepcify the output state bit start address	Bit

(3) Suitable soft component

Operand	Word soft component											Bit soft component					
	System								Constant	Module		System					
	D*	FD	TD*	CD*	DX	DY	DM*	DS*	K/H	ID	QD	X	Y	M*	S*	T*	C*
S0	●	●	●	●													
S1	●	●	●	●													
S2														●			

*: D means D, HD; TD means TD and HTD; CD means CD, HCD, HSCD and HSD; DM means DM and DHM; DS means DS and DHS; M means M, HM, SM; S means S, HS; T means T, HT; C means C, HC.

(4) Function and action

- S0 specifies [input parameter start address] and occupies registers S0~S0+10
- S1 specifies [start address of output status word] and occupies registers S1~S1+1
- S2 specifies [start address of output status bit] and occupies relay S2~S2+2

(5) Note

- Cycle jump and conditional jump can be used together, and the operation priority of conditional jump is higher than that of cycle jump.
- The jump function will make the cam slave axis position jumping, which may cause the step of the position/speed of the slave axis. The user needs to avoid the step problem.
- The jump action will only be performed during the synchronous operation of the cam, and the jump action will not be performed in the non-synchronous state.
- The relative jump function requires support from V3.7.3 and above versions.

(6) Related parameter

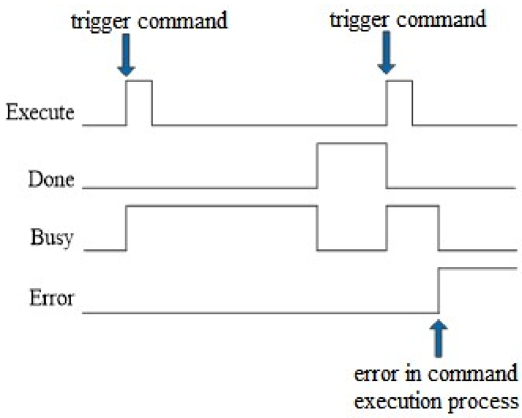
Input parameter	Parameter name	Data type	Unit	Note
S0	count	INT16U	-	Jump key point numbers
S0+1	camTblId	INT16S	-	Cam table instance
S0+2	mode	INT16S	-	Effective mode 0-take effect at once 1-take effect in the next cycle. Not supported temporarily
S0+4+8*(N-1)	pointId	INT16U	-	Key point id
S0+5+8*(N-1)	flagtype	INT16U	-	Flag jump type. V3.7.3 version 0: Relative jump not jump 1: M is on, relative jump 2: X is on, relative jump 3: Absolute jump not jump 4: M is on, absolute jump 5: X is on, absolute jump Jump type. V3.7.2 version 0: not jump

Input parameter	Parameter name	Data type	Unit	Note
				1: M is on, jump 2: X is on, jump
S0+6+8*(N-1)	flagAddr	INT32U	-	Flag bit address index
S0+8+8*(N-1)	flagId	INT16U	-	Flag bit jump key point id
S0+9+8*(N-1)	periodCnt	INT16S	-	Cycle jump numbers 0-not jump >=1-appointed jump numbers -1- Infinite jump
S0+10+8*(N-1)	periodId	INT16U	-	Cycle jump key point id
Output parameter	Parameter name	Data type	Unit	Note
S1	ErrCode	INT16U	-	command error code
S1+1	ErrPointID	INT16U		Error key point ID
State parameter	Parameter name	Data type	Unit	Note
S2	Done	BOOL	-	Command execution completed
S2+1	Busy	BOOL	-	Instruction is executing
S2+2	Error	BOOL	-	Command execution error

Conditional jump: when running to the current segment, if the flag bit M or X of conditional jump is set to ON, it will jump to the starting point of the specified segment. After the jump is completed, the configured flag bits will not be reset, and the flag bits need to be reset manually. If the conditional jump flag is always ON in the current segment, it will always jump.

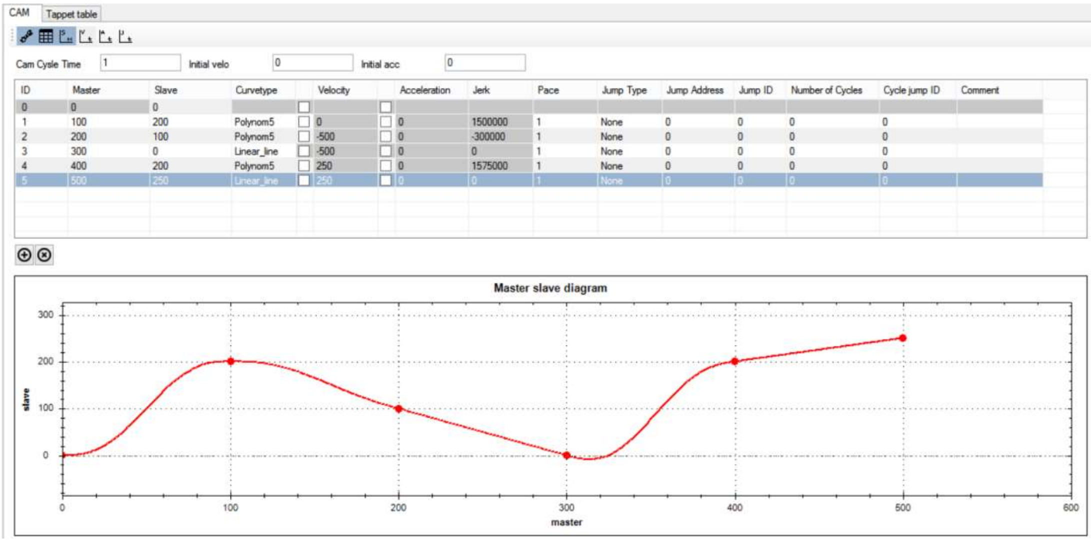
Cycle jump: after running a segment, it will judge whether the cycle jump is required after the segment is executed. If the set cycle jump number is greater than 0, it will jump according to the cycle jump number, and jump to the starting point of the set segment. When the jump number is completed, the next run of this segment will not jump. After the normal execution is completed, the next run of this segment will restart the cycle jump.

(7) Sequence diagram



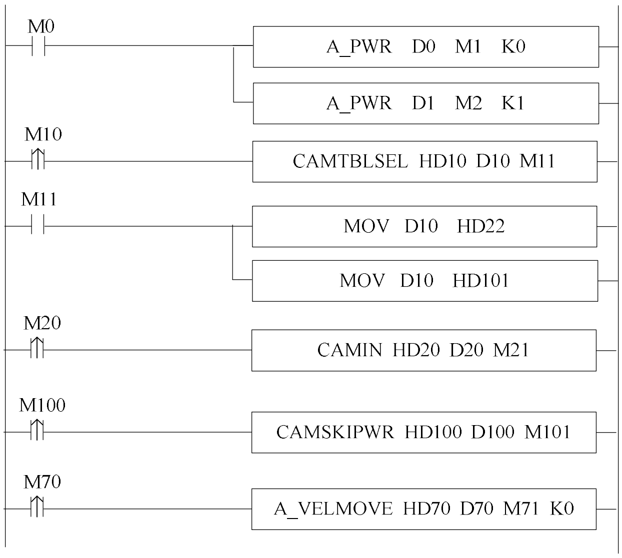
Explain:
When the command is triggered, the Busy signal is set ON. When the command is executed, the Busy signal is reset and the Done signal is set ON.
When there is an error in the command execution, the Error signal is set ON, other signals are reset, and the corresponding error code is output.

(8) Application
Execute the cam table as shown in the following figure. It is required to perform two cycle jumps at the end of the second segment, and jump to the first segment. In the process of the third segment, if the signal comes, immediately jump to the fifth segment curve.



ID	Master	Slave	Curvetype	Velocity	Acceleration	Jerk	Pace	Jump Type	Jump Address	Jump ID	Number of Cycles	Cycle jump ID	Comment
0	0	0											
1	100	200	Polynom5	0	0	1500000	1	None	0	0	0	0	
2	200	100	Polynom5	-500	0	-300000	1	None	0	0	0	0	
3	300	0	Linear_line	-500	0	0	1	None	0	0	0	0	
4	400	200	Polynom5	250	0	1575000	1	None	0	0	0	0	
5	500	250	Linear_line	250	0	0	1	None	0	0	0	0	

The ladder chart:



There are two ways to write jump information to the system

(1) Write jump information in cam editing interface

ID	Master	Slave	Curvetype	Velocity	Acceleration	Jerk	Pace	Jump Type	Jump Address	Jump ID	Nu
0	0	0									
1	100	200	Polynom5	0	0	1500000	1	None	0	0	0
2	200	100	Polynom5	-500	0	-300000	1	None	0	0	0
3	300	0	Linear_line	-500	0	0	1	X is ON jump	0	0	0
4	400	200	Polynom5	250	0	1575000	1	None	0	0	0
5	500	250	Linear_line	250	0	0	1	None	0	0	0

(2) Write in through the jump command CAMSKIPWR

CAMSKIPWR指令参数配置

输入参数: HD100 输出参数: D100 状态参数: M101

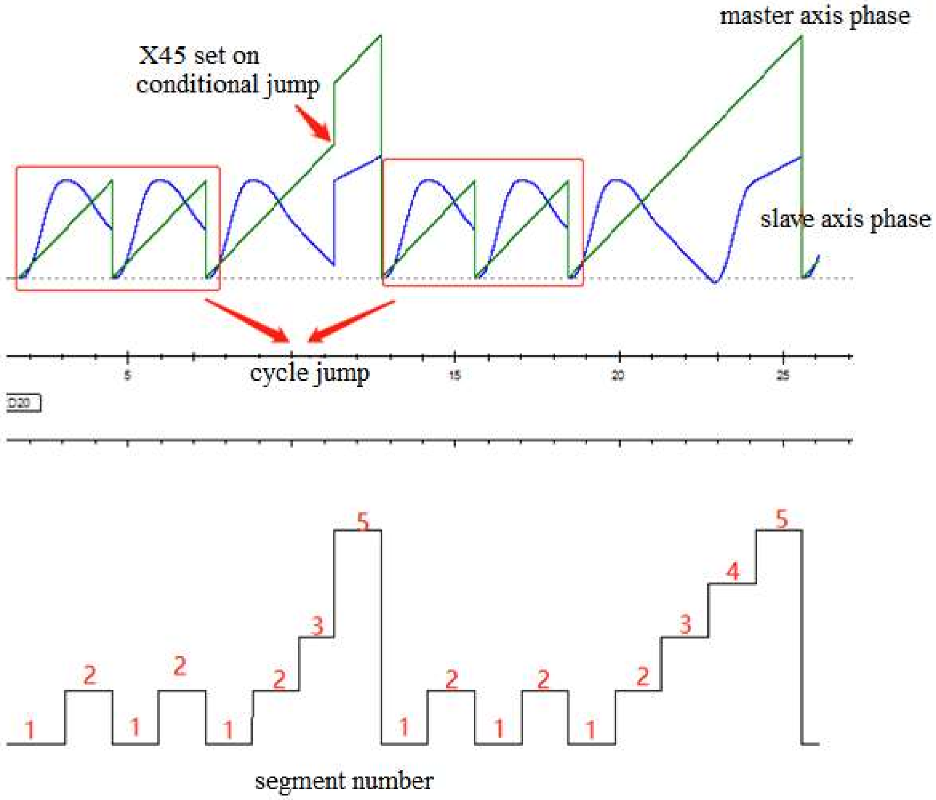
参数名	地址	在线值	离线值	类型	说明
输入参数					
count	HD100	2	2	INT16U	跳转关键点总数
camTblId	HD101	-12571	-12571	INT16S	凸轮表实例id
mode	HD102	0	0	INT16U	0-立即生...
pointId	HD104	2	2	INT16U	关键点id
flagType	HD105	0	0	INT16U	0-不跳转...
flagAddr	HD106	0	0	INT32U	标志位跳转地址
flagId	HD108	0	0	INT16U	标志位跳转的关键点id
periodCnt	HD109	2	2	INT16S	周期跳转次数
periodId	HD110	1	1	INT16U	周期跳转的关键点id
输出参数					
ErrCode	D100	0		INT16S	指定错误码
ErrPointId	D101	0		INT16U	错误的关键点id
状态参数					
Done	M101	False		BIT	指定完成标志
Busy	M102	False		BIT	指定正在执行标志
Err	M103	False		BIT	指定错误

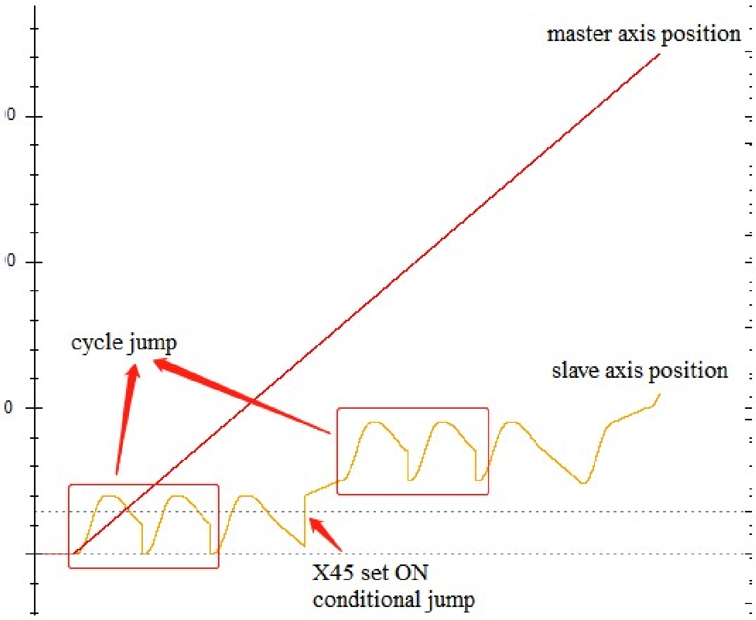
占用空间: HD100-HD110, D100-D101, M101-M103

写入 确定 取消

寄存	监控值	字长	进制	注释
HD112	3	单字	10进制	关键点2
HD113	2	单字	10进制	是否跳转
HD114	45	双字	10进制	跳转标志
HD116	5	单字	10进制	跳转id
HD117	0	单字	10进制	周期次数
HD118	0	单字	10进制	周期id

Note: Before moving the spindle





5-3-2-19. CAM skip read【CAMSKIPRD】

(1) Overview

Read the cam jump information.

CAM skip read [CAMSKIPRD]			
Execution condition	Rising/falling edge of the coil	Suitable model	XDH, XLH, XG2
Firmware	V3.7.2 and above	Software	V3.7.14 and above

Note: XDH and XLH series L-shaped Lite Edition products do not support this command.

(2) Operand

Operand	Function	Type
S0	Specify the input parameter start address	16-bit, single word
S1	Specify the output state word start address	16-bit, single word
S2	Sepcify the output state bit start address	Bit

(3) Suitable soft component

Operand	Word soft component											Bit soft component					
	System								Constant	Module		System					
	D*	FD	TD*	CD*	DX	DY	DM*	DS*	K/H	ID	QD	X	Y	M*	S*	T*	C*
S0	●	●	●	●													
S1	●	●	●	●													
S2														●			

*: D means D, HD; TD means TD and HTD; CD means CD, HCD, HSCD and HSD; DM means DM and DHM; DS means DS and DHS; M means M, HM, SM; S means S, HS; T means T, HT; C means C, HC.

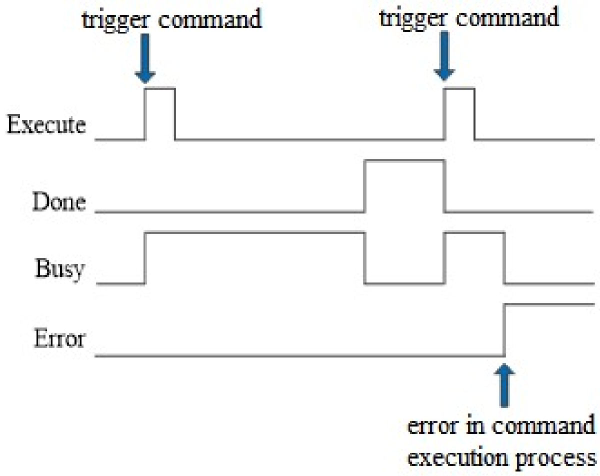
(4) Function and action

- S0 specifies [input parameter start address] and occupies registers S0~S0+1
- S1 specifies [start address of output status word] and occupies registers S1~S1+6
- S2 specifies [start address of output status bit] and occupies relay S2~S2+2

(5) Related parameter

Input parameter	Parameter name	Data type	Unit	Note
S0	count	INT16S	Command unit	Cam table instance number
S0+1	camTblId	INT16U	Command unit/s	Key point id
Output parameter	Parameter name	Data type	Unit	Note
S1	ErrCode	INT16S	-	Command error code
S1+1	flagtype	INT16U	-	Flag bit jump type
S1+2	flagAddr	INT32U	-	Flag bit jump address
S1+4	flagId	INT16U	-	Flag bit jump key point id
S1+5	periodCnt	INT16S	-	Cycle jump times
S1+6	periodId	INT16U	-	Cycle jump key point id
State parameter	Parameter name	Data type	Unit	Note
S2	Done	BOOL	-	Command execution completed
S2+1	Busy	BOOL	-	Instruction is executing
S2+2	Error	BOOL	-	Command execution error

(6) Sequence diagram



Explain:
When the command is triggered, the Busy signal is set ON. When the command is executed, the Busy signal is reset and the Done signal is set ON.
When there is an error in the command execution, the Error signal is set ON, other signals are reset, and the corresponding error code is output.

5-3-2-20. CAM range【CAMBOUNDS】

(1) Overview

Calculate the cam slave axis limit value.

CAM range [CAMBOUNDS]			
Execution condition	Rising/falling edge of the coil	Suitable model	XDH, XLH, XG2
Firmware	V3.7.2 and above	Software	V3.7.14 and above

Note: XDH and XLH series L-shaped Lite Edition products do not support this command.

(2) Operand

Operand	Function	Type
S0	Specify the input parameter start address	16-bit, single word
S1	Specify the output state word start address	16-bit, single word
S2	Sepcify the output state bit start address	Bit

(3) Suitable soft component

Operand	Word soft component											Bit soft component					
	System								Constant	Module		System					
	D*	FD	TD*	CD*	DX	DY	DM*	DS*	K/H	ID	QD	X	Y	M*	S*	T*	C*
S0	●	●	●	●													
S1	●	●	●	●													
S2														●			

*: D means D, HD; TD means TD and HTD; CD means CD, HCD, HSCD and HSD; DM means DM and DHM; DS means DS and DHS; M means M, HM, SM; S means S, HS; T means T, HT; C means C, HC.

(4) Function and action

- S0 specifies [input parameter start address] and occupies registers S0~S0+7
- S1 specifies [start address of output status word] and occupies registers S1~S1+27
- S2 specifies [start address of output status bit] and occupies relay S2~S2+2

(5) Note

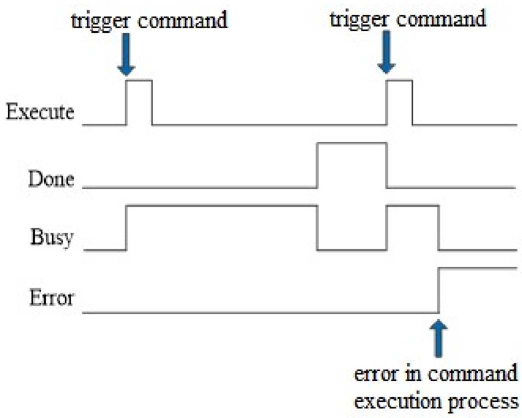
- When CAMIN binding, the spindle scaling ratio does not affect the maximum/minimum position of the slave axis, and is inversely proportional to the maximum/minimum speed of the slave axis, and the square value is inversely proportional to the maximum/minimum acceleration limit value.
- When CAMIN is bound, the scaling ratio of the slave axis is in direct proportion to the maximum/minimum position of the slave axis, and the maximum/minimum speed and maximum/minimum acceleration limits of the slave axis.

(6) Related parameters

Input parameter	Parameter name	Data type	Unit	Note
S0	masterID	INT16U	-	slave axis ID
S0+4	slaveID	FP64	Command unit/s	Master axis operation speed
Output parameter	**Parameter name**	**Data type**	**Unit**	**Note**
S1	ErrCode	INT16U	-	Command error code
S1+4	MaxPos	FP64	Command unit	Max position
S1+8	MinPos	FP64	Command unit	Min position
S1+12	MaxVel	FP64	Command unit /s	Max speed
S1+16	MinVel	FP64	Command unit /s	Min speed

S1+20	MaxAcc	FP64	Command unit /s^2	Max acceleration
S1+24	MinAcc	FP64	Command unit /s^2	Min acceleration
State parameter	Parameter name	Data type	Unit	Note
S2	Done	BOOL	-	Command execution completed
S2+1	Busy	BOOL	-	Instruction is executing
S2+2	Error	BOOL	-	Command execution error

(7) Sequence diagram



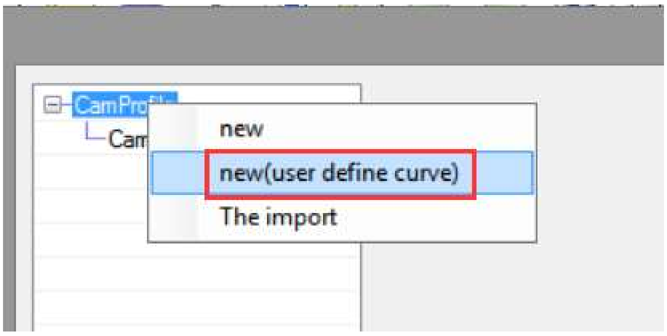
Explain:
When the command is triggered, the Busy signal is set ON. When the command is executed, the Busy signal is reset and the Done signal is set ON.
When there is an error in the command execution, the Error signal is set ON, other signals are reset, and the corresponding error code is output.

5-3-2-21. User-defined cam

Note: XDH and XLH series L-shaped simplified versions do not support custom cams.

(1) Implementation steps:

(1) Create a user-defined cam table in the cam editing interface.



(2) Set the master-slave position.

CAM(UserDefine) | Tappet table

Master	Slave	Cam curve type	Pace	Comment
0	0			
200	400	UserDefine	0.01	
400	0	UserDefine	0.01	

(3) Make C program for the user defined cam

```c
void FUNC1(PINT16S W,BIT B)
{
    #define SysRegAddr_HD_D_HM_M
    #define DHD *(FP64*)&D
    FP64 X,Y;

    X = DHD[20380];
    if(0<X && X<=200)
    {
        Y = 2 * X ;
    }
    else if(200<X && X<400)
    {
        Y = (-2) * X + 800;
    }

    DHD[20384] = Y;


}
```

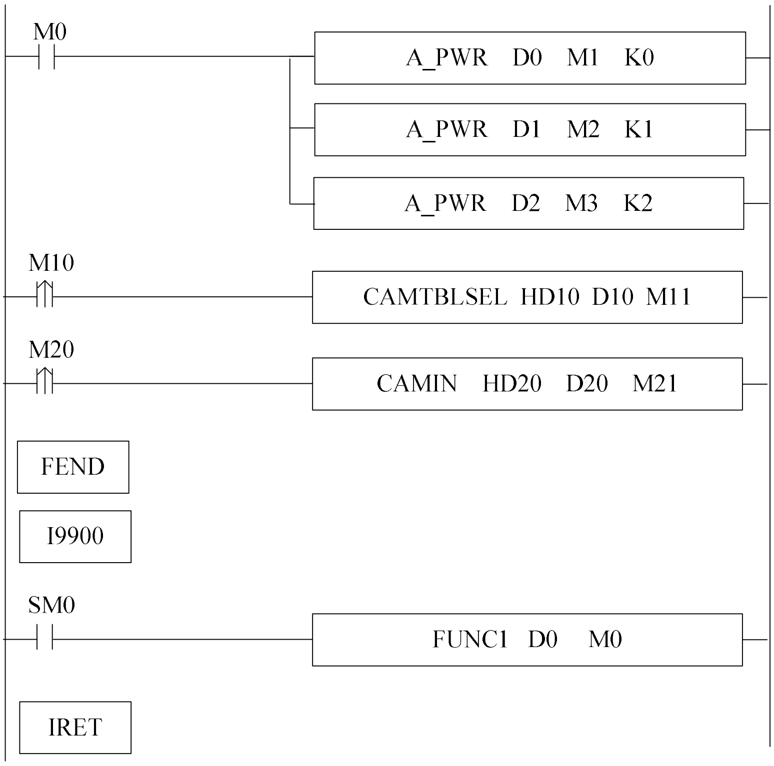
Fixed D register of master/slave axis position in slave axis user defined cam (take axis 1 as an example):

FP64 D [20380]: Custom cam function master axis position x

FP64 D [20384]: Custom cam function slave axis position y

Get the master/slave position of the custom cam function of other axes by offsetting 200 from the D register.

(4) Make PLC program



2) Note:

- Because the D register is related to the axis number, the cam table and the axis number need to correspond one by one.
- For custom cams, the curve type parameter in the CAMTBLGEN instruction should be set to 100 (custom curve type).
- The C function needs to be placed in the I9900 interrupt, and SM1995 needs to be set when using it.
- V3.7.2 version can only execute CAMIN, CAMPHASE, CAMTBLSEL, CAMTBLGEN, and CAMOUT commands, all other cam commands are invalid.
- V3.7.3 and above versions support all instructions except for the jump instruction and special curve generation instruction, which are not supported.
- When modifying the (0,0) position of a custom cam, the curve type needs to be the custom type (100). The custom curve can only obtain the starting and ending points of the curve from the axis position. The cam clutch does not support the starting mode from the shaft phase, and the clutch ON command does not support the connection mode of sliding and chasing.
- V3.7.2 version custom cam does not support single direction and chasing functions; V3.7.3 and above support single direction functionality and scaling offset, but still do not support chasing.

5-3-2-22. Master Slave Compensation 【CAMCOMP】

1) Instruction Overview

Electronic cam master-slave compensation function.

Master-slave compensation [CAMCOMP]			
Conditions for execution	Normally open/closed coil	Application	XDH, XLH, XG2
Firmware requirements	V3.7.3 and above	Software requirements	V 3.7.16 and above

Note: XDH and XLH series L-shaped Lite Edition products do not support this command.

2) Operand

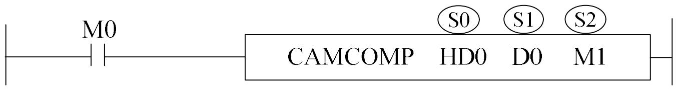
Operand	Role	Types
S0	Specify the starting address of input parameters	16 bits, single word
S1	Specify the starting address of the output status word	16 bits, single word
S2	Specify the starting address of the output status bit	Bit

3) Applicable soft components

Operand	Word soft component											Bit soft component					
	System								Constant	Module		System					
	D*	FD	TD*	CD*	DX	DY	DM*	DS*	K/H	ID	QD	X	Y	M*	S*	T*	C*
S0	●	●	●	●													
S1	●	●	●	●													
S2														●			

Note: D represents D and HD. TD represents TD and HTD. CD represents CD, HCD, HSCD, HSD. DM stands for DM and DHM. DS represents DS and DHS. M represents M, HM, SM. S represents S and HS. T represents T and HT. C represents C and HC.

4) Function and Action



- S0 specifies the starting address of the input parameter, occupying registers S0~S0+23.
- S1 specifies the starting address of the output status word, occupying registers S1~S1+15.
- S2 specifies the starting address of the output status bit, occupying registers S2~S2+3.
- When M0 goes from OFF to ON, compensate the spindle or slave axis based on the output parameters.

5) Note

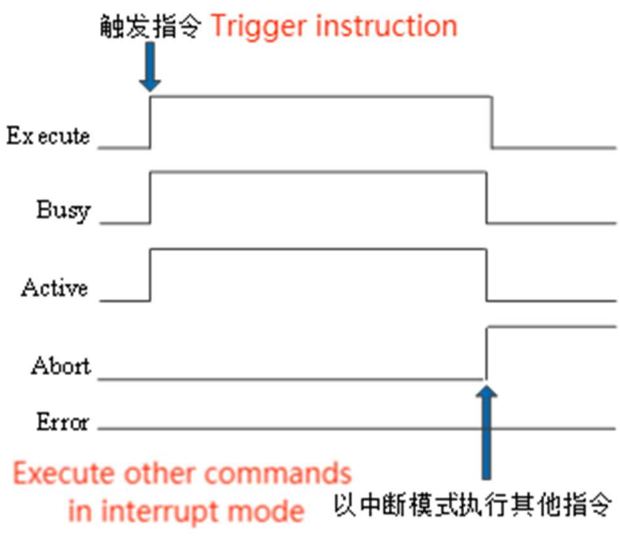
- [Compensation Mode] 0-Monitoring Mode, in which no compensation function is performed, the current error value can be monitored in real-time in the output parameters (from axis setting to axis feedback). 1. Compensation mode, in which compensation will be carried out according to the set compensation parameters, and real-time errors and actual compensation values can be viewed.
- [Number of Filters] Input range [0200], 0 defaults to not enabling the function. The speed data of the filtering function spindle is filtered. In order to reduce the interference of input data, the more filters there are, the more average the input data will be.
- The spindle feedforward compensation coefficient is used to calculate the spindle compensation value. When the command is triggered, the compensation coefficient gradually changes to the target compensation coefficient, with each change of 0.1 of the target (increasing or decreasing at a ratio of 0.1 when the command is turned on and off; updating the feedforward coefficient in real time during the command takes effect, and one cycle takes effect immediately). The spindle compensation value will be converted based on the cam table and actually act on the slave shaft.
- The slave axis feedforward compensation coefficient is used to calculate the compensation value of slave axis. When the command is triggered, the compensation coefficient gradually changes to the target compensation coefficient, with each change of 0.1 of the target (increasing or decreasing at a ratio of 0.1 when the command is turned on and off; updating the feedforward coefficient in real-time during the command takes effect, and one cycle takes effect immediately). The compensation value directly acts on the slave axis.
- Proportional coefficient in PID, used to adjust the proportional coefficient P. Increasing the value of coefficient P will: reduce deviation, accelerate corresponding speed, shorten adjustment time, but it will damage the stability of the system.

- The integral coefficient in PID is used to adjust the integral coefficient I. Increasing the value of coefficient I will eliminate steady-state errors, but it will disrupt stability, cause overshoot, and increase adjustment time.
- The differential coefficient in PID is used to adjust the differential coefficient D. Increasing the value of coefficient D will accelerate system response, reduce overshoot, increase stability, but it will decrease anti-interference ability.
- During the execution of the command, the spindle feedforward coefficient, slave axis feedforward coefficient, proportional coefficient, integral coefficient, and differential coefficient support real-time updates, which take effect immediately after modification. Other parameters need to be triggered again to take effect.

6) Related parameters

Input parameter	Parameter Name	Data type	Unit	Notes
S0	SlaveId	INT16U	-	From axis ID
S0+1	Mode	INT16U	-	Compensation mode: 0: Monitoring mode 1: Compensation mode
S0+2	Cnt	INT16U	-	Number of filters
S0+4	mCompRatio	FP64	-	Spindle feedforward coefficient
S0+8	sCompRatio	FP64	-	From axis feedforward coefficient
S0+12	Kp	FP64	-	Scale
S0+16	Ki	FP64	-	Integration coefficient
S0+20	Kd	FP64	-	Differential coefficient
Output parameter	Parameter Name	Data type	Unit	Notes
S1	ErrCode	INT16U	-	Instruction error code
S1+4	Error	FP64	Instruction Unit	Deviation value
S1+8	mCompVaule	FP64	Instruction Unit	Spindle compensation value
S1+12	sCompVaule	FP64	Instruction Unit	Compensation value from axis
State parameters	Parameter Name	Data type	Unit	Notes
S2	Busy	BOOL	-	Instruction is currently being executed
S2+1	Active	BOOL	-	Instruction under control
S2+2	Abort	BOOL	-	Instruction interrupted
S2+3	Err	BOOL	-	Instruction execution error

7) Timing Diagram



Note:
Trigger command, set the busy and active signals, start executing the command, and compensate the cam.
When the instruction is interrupted, the abort signal is set and other status bits are reset.

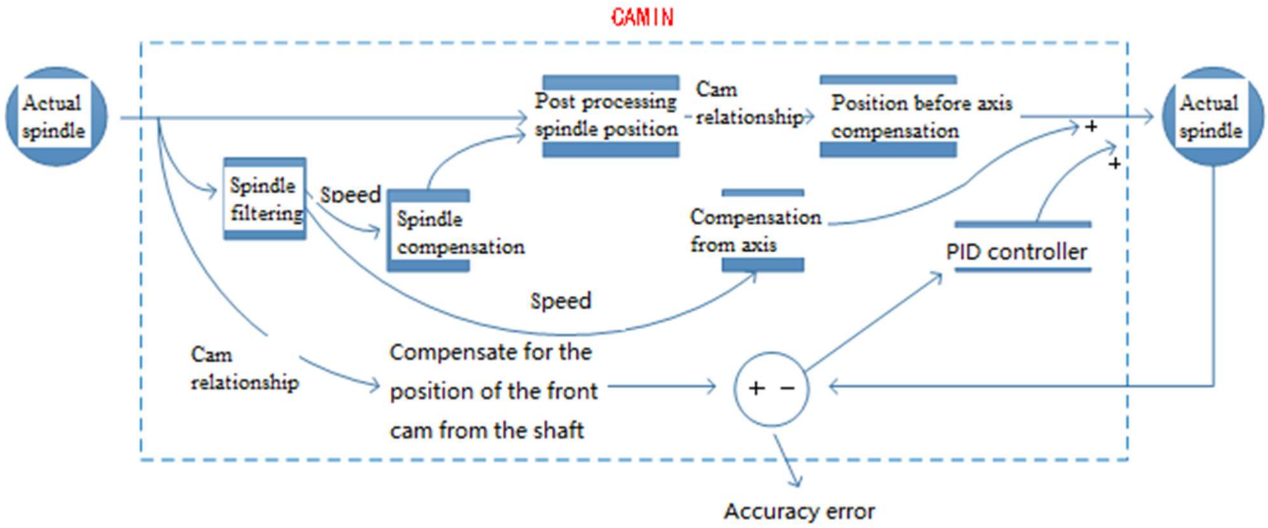
8) Give an example

The master-slave compensation is mainly divided into three compensation parts: spindle compensation, slave axis compensation, and PID compensation.

Spindle compensation compensates the spindle speed * compensation coefficient to the position of the cam spindle, offsetting the overall relationship of the cam.

Compensating the spindle speed * compensation coefficient to the slave shaft position through axis compensation, achieving compensation for the slave shaft position.

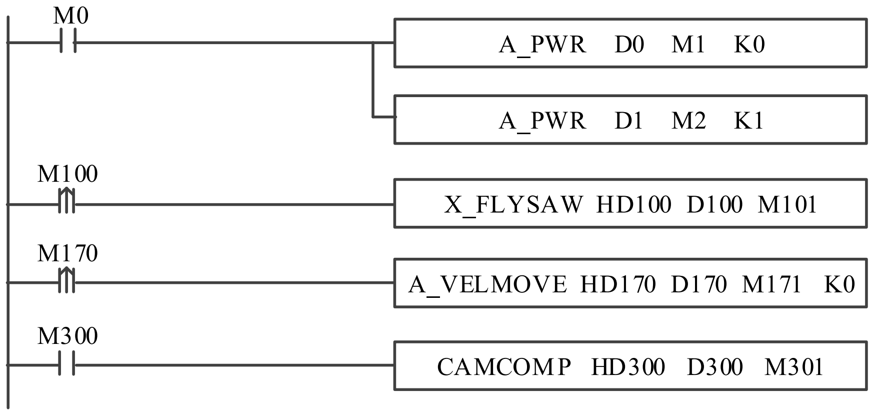
The PID controller compensates for the deviation between the ideal and actual slave axis positions onto the slave axis.



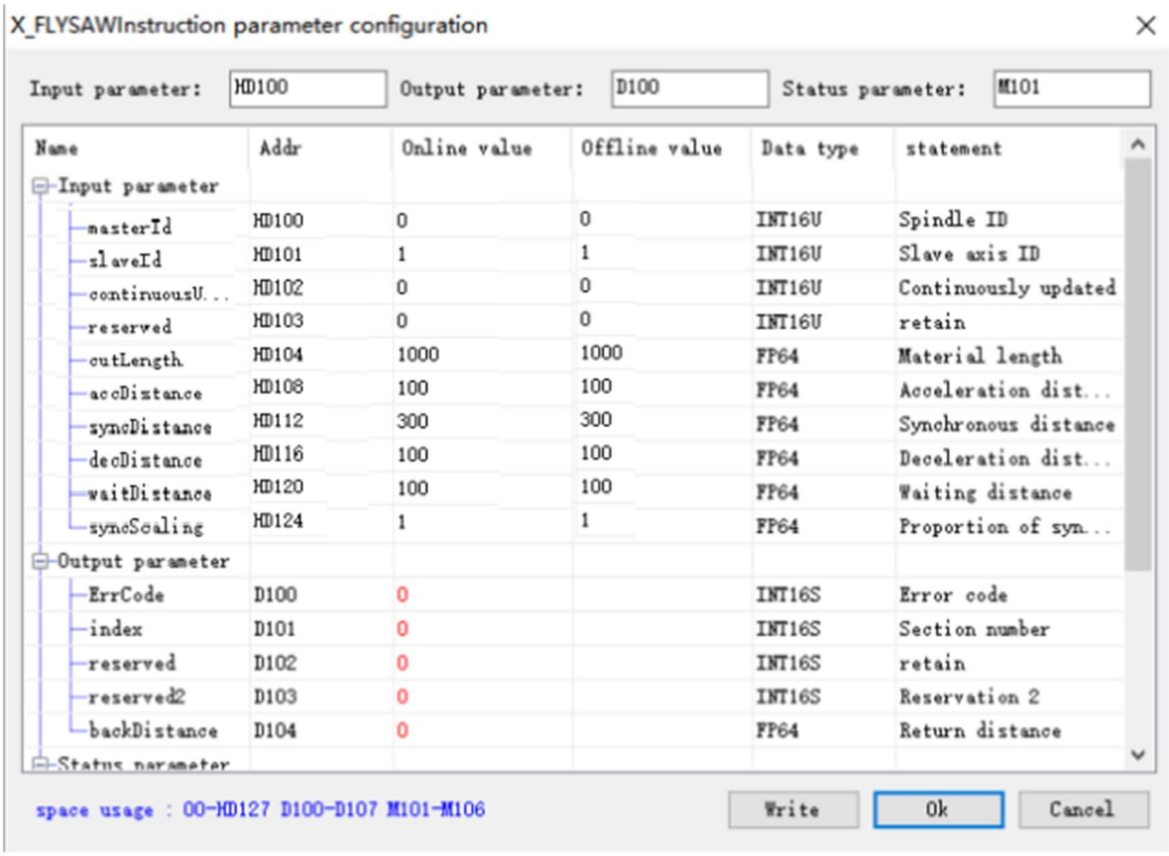
Below is an explanation of the flying shear cam

Flying shear and follow shear are common cam movements, and due to different cam parameters, there may be significant speed and acceleration in the variable speed zone. If speed feedforward is directly used, it will lead to speed overshoot in the synchronous zone. Combining the process of chasing and flying shear, the accuracy at the synchronization zone affects the final accuracy, so only the accuracy in the synchronization zone needs to be ensured.

The ladder diagram instruction is shown in the following figure:



The command parameters are shown in the following figure:

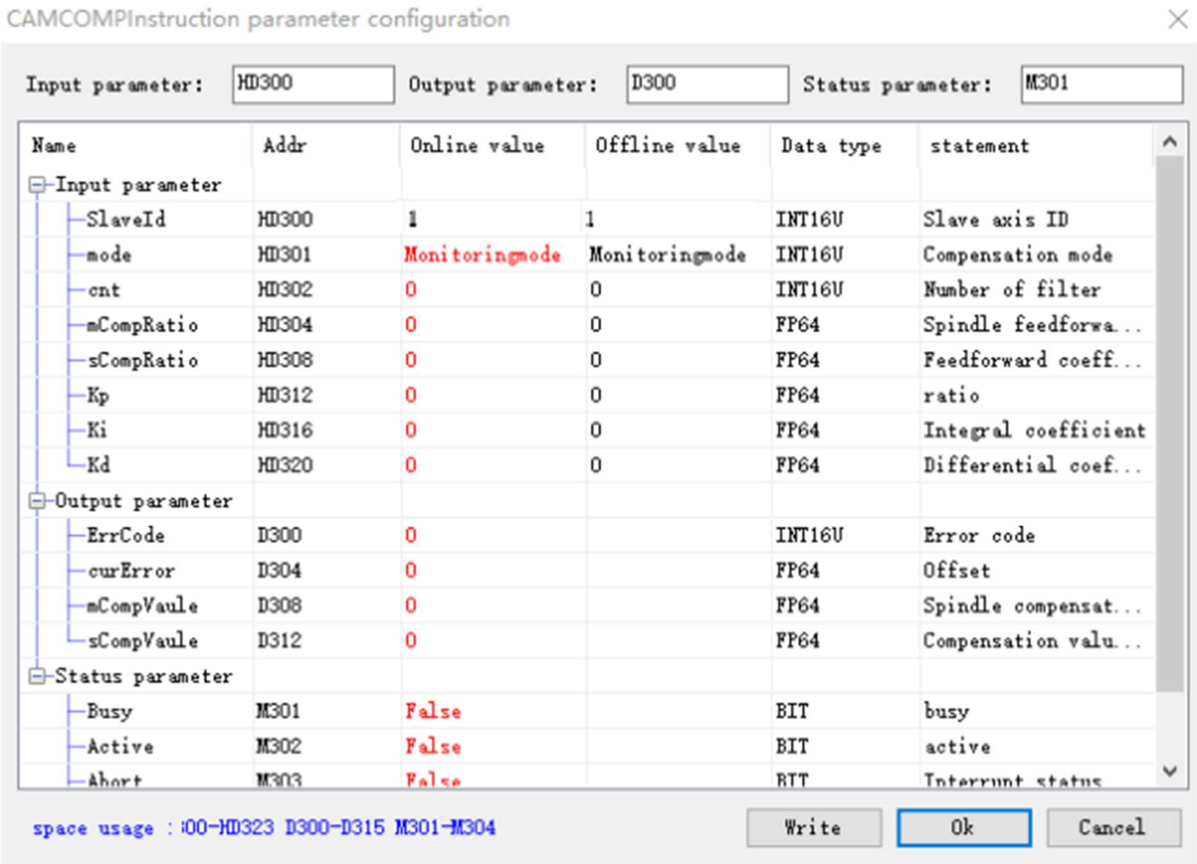


X_FLYSAWInstruction parameter configuration

Input parameter: HD100 Output parameter: D100 Status parameter: M101

Name	Addr	Online value	Offline value	Data type	statement
Input parameter					
masterId	HD100	0	0	INT16U	Spindle ID
slaveId	HD101	1	1	INT16U	Slave axis ID
continuousU...	HD102	0	0	INT16U	Continuously updated
reserved	HD103	0	0	INT16U	retain
cutLength	HD104	1000	1000	FP64	Material length
accDistance	HD108	100	100	FP64	Acceleration dist...
syncDistance	HD112	300	300	FP64	Synchronous distance
decDistance	HD116	100	100	FP64	Deceleration dist...
waitDistance	HD120	100	100	FP64	Waiting distance
syncScaling	HD124	1	1	FP64	Proportion of syn...
Output parameter					
ErrCode	D100	0		INT16S	Error code
index	D101	0		INT16S	Section number
reserved	D102	0		INT16S	retain
reserved2	D103	0		INT16S	Reservation 2
backDistance	D104	0		FP64	Return distance
Status parameter					

space usage : 00-HD127 D100-D107 M101-M106 Write Ok Cancel



CAMCOMPInstruction parameter configuration

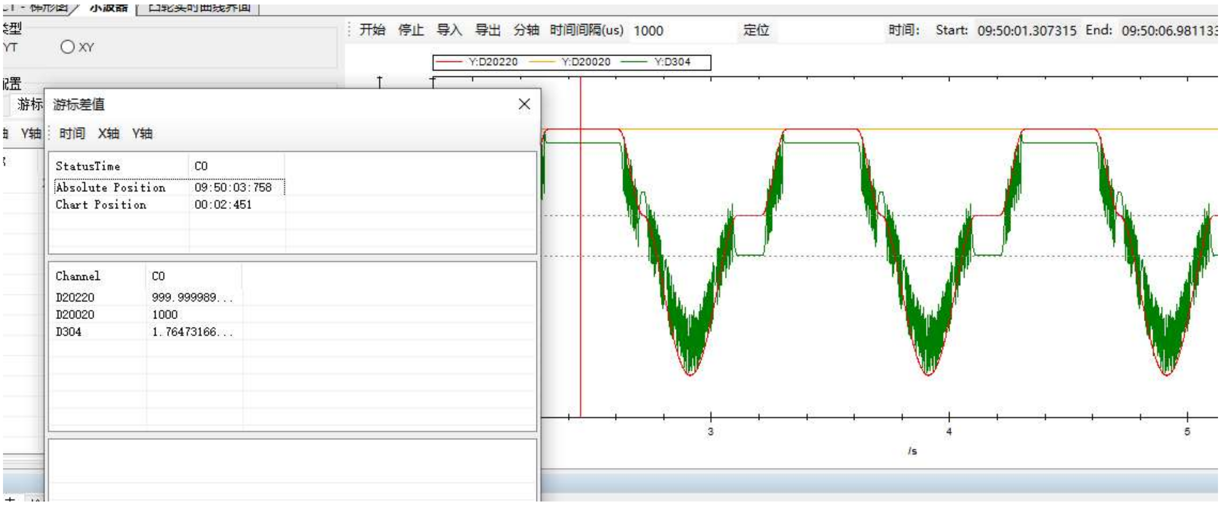
Input parameter: HD300 Output parameter: D300 Status parameter: M301

Name	Addr	Online value	Offline value	Data type	statement
Input parameter					
SlaveId	HD300	1	1	INT16U	Slave axis ID
mode	HD301	Monitoringmode	Monitoringmode	INT16U	Compensation mode
cnt	HD302	0	0	INT16U	Number of filter
mCompRatio	HD304	0	0	FP64	Spindle feedforwa...
sCompRatio	HD308	0	0	FP64	Feedforward coeff...
Kp	HD312	0	0	FP64	ratio
Ki	HD316	0	0	FP64	Integral coefficient
Kd	HD320	0	0	FP64	Differential coef...
Output parameter					
ErrCode	D300	0		INT16U	Error code
curError	D304	0		FP64	Offset
mCompVaule	D308	0		FP64	Spindle compensat...
sCompVaule	D312	0		FP64	Compensation valu...
Status parameter					
Busy	M301	False		BIT	busy
Active	M302	False		BIT	active
Abort	M303	False		BIT	Interrupt status

space usage : 00-HD323 D300-D315 M301-M304 Write Ok Cancel

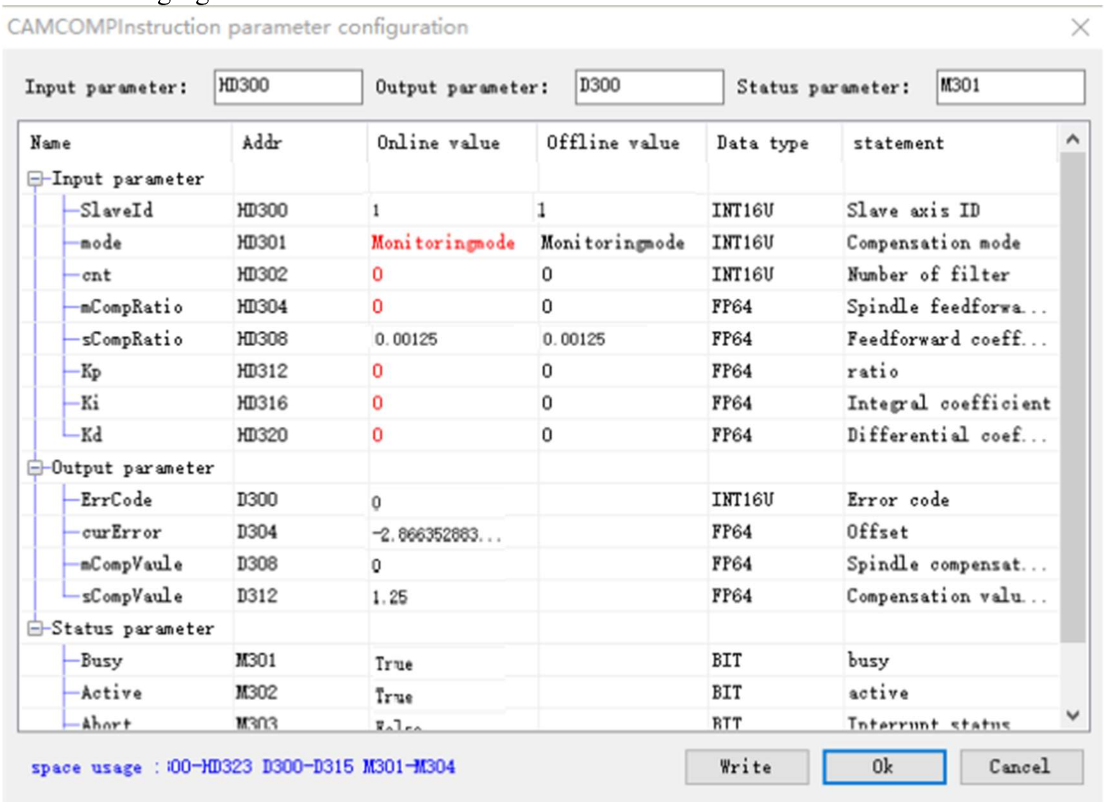
Explanation: First, use A_ PWR command, enable axis, execute X_FLYSAW command, execute CAMCOMP to enable master-slave compensation function, and finally execute A_ VELMOVE to move spindle (spindle speed set to 1000).

The execution effect without compensation is shown in the following figure:



From the graph, it can be seen that there is an error between the given and feedback of the slave shaft in the synchronous zone, which is approximately stable at around 1.76 (D304 is the cam error value=current feedback from the shaft - current feedback from the shaft).

Using slave axis compensation, modify the slave axis feedforward coefficient to 0.00125, and the execution result is shown in the following figure:



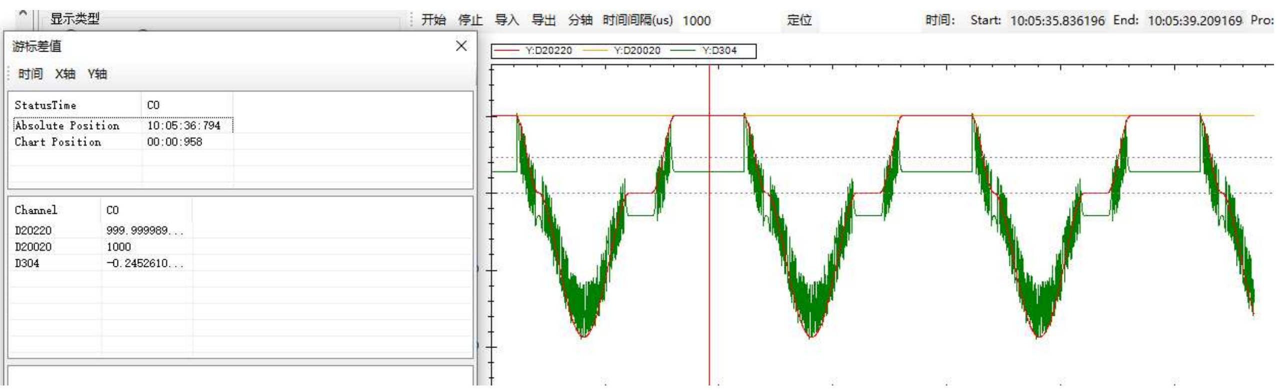
CAMCOMPInstruction parameter configuration

Input parameter: HD300 Output parameter: D300 Status parameter: M301

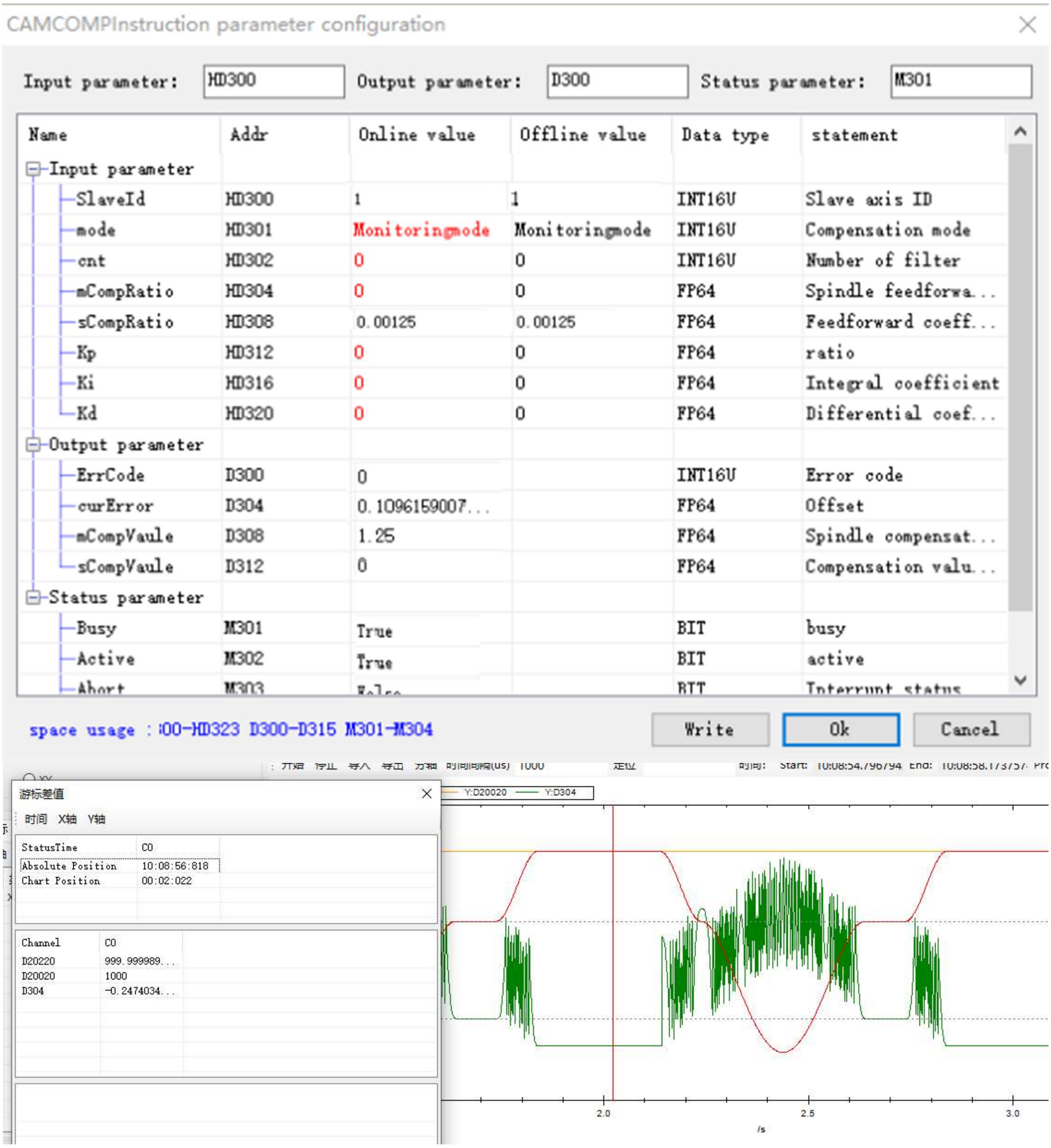
Name	Addr	Online value	Offline value	Data type	statement
Input parameter					
SlaveId	HD300	1	1	INT16U	Slave axis ID
mode	HD301	Monitoringmode	Monitoringmode	INT16U	Compensation mode
cnt	HD302	0	0	INT16U	Number of filter
mCompRatio	HD304	0	0	FP64	Spindle feedforwa...
sCompRatio	HD308	0.00125	0.00125	FP64	Feedforward coeff...
Kp	HD312	0	0	FP64	ratio
Ki	HD316	0	0	FP64	Integral coefficient
Kd	HD320	0	0	FP64	Differential coef...
Output parameter					
ErrCode	D300	0		INT16U	Error code
curError	D304	-2.866352883...		FP64	Offset
mCompVaule	D308	0		FP64	Spindle compensat...
sCompVaule	D312	1.25		FP64	Compensation valu...
Status parameter					
Busy	M301	True		BIT	busy
Active	M302	True		BIT	active
Abort	M303	False		BIT	Interrupt status

space usage : HD300-HD323 D300-D315 M301-M304

Write Ok Cancel



After using spindle compensation and modifying the spindle feedforward compensation coefficient to 0.00125, the execution effect is shown in the following figure:



The above comparison shows that in this case, under the same compensation coefficient, the cam error in the synchronous zone is basically the same, and there is a significant improvement compared to when not compensated. However, from the overall cam operation effect, spindle compensation will be better than slave compensation.

5-3-2-23. Easy to use T-curve generation【CAMEASYTTBLGEN】

1) Instruction Overview

Electronic cam master-slave compensation function.

Easy to use T-curve generation [CAMEASYTTBLGEN]			
Conditions for execution	Normally open/closed coil	Application	XDH, XLH, XG2
Firmware requirements	V3.7.3 and above	Software requirements	V 3.7.16 and above

Note: XDH and XLH series L-shaped Lite Edition products do not support this command.

2) Operand

Operand	Role	Types
S0	Specify the starting address of input parameters	16 bits, single word
S1	Specify the starting address of the output status word	16 bits, single word
S2	Specify the starting address of the output status bit	Bit

3) Applicable soft components

Operand	Word soft component											Bit soft component					
	System								Constant	Module		System					
	D*	FD	TD*	CD*	DX	DY	DM*	DS*	K/H	ID	QD	X	Y	M*	S*	T*	C*
S0	●	●	●	●													
S1	●	●	●	●													
S2														●			

Note: D represents D and HD. TD represents TD and HTD. CD represents CD, HCD, HSCD, HSD. DM stands for DM and DHM. DS represents DS and DHS. M represents M, HM, SM. S represents S and HS. T represents T and HT. C represents C and HC.

4) Function and Action

- S0 specifies the starting address of the input parameter, occupying registers S0~S0+43+40 * (N-1).
- S1 specifies the starting address of the output status word, occupying registers S1~S1+15.
- S2 specifies the starting address of the output status bit, occupying registers S2~S2+2.

5) Note

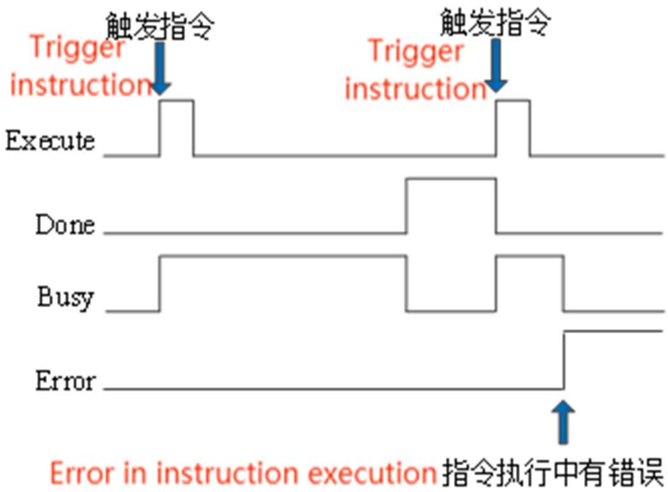
- When the cam is in use, it only supports the cam cycle to take effect. When not in use, both modes are supported.
- PointId starts from 0 and increases sequentially, and the position of the primary and secondary axes of the 0th keypoint must be (0,0), and the curve type of the 0th keypoint is invalid.
- The total number of key points must be greater than or equal to 2.
- The error source ID defaults to 65535 when there are no errors during instruction execution.
- The easy-to-use trapezoidal curve type is 50.
- The proportion of acceleration and deceleration segments is the proportion of acceleration and deceleration segments to the T-shaped curve, which must be greater than 0 and less than 1, and the sum of the two values must be less than 1.
- The starting and ending speed ratios are the ratio of the starting and ending speeds of the section to the spindle speed

6) Related parameters

Input parameter	Parameter Name	Data type	Unit	Note
S0	Count	INT16U	-	Number of key points on the cam gauge
S0+1	CamTblID	INT16S	-	Camometer instance ID
S0+2	Mode	INT16U	-	Effective mode: 0: Effective immediately 1: Effective in the next cycle
S0+4+40*(N-1)	PointID	INT16U	-	Key point number
S0+8+40*(N-1)	MasterPos	FP64	Instruction Unit	Spindle position
S0+12+40*(N-1)	SlavePos	FP64	Instruction Unit	From axis position
S0+16+40*(N-1)	Vel	FP64	Instruction	Reference speed

			Unit/s	
S0+20+40*(N-1)	Acc	FP64	Instruction Unit/s^2	Reference acceleration
S0+24+40*(N-1)	Type	INT16U	-	Track Type
S0+28+40*(N-1)	AccRatio	FP64	-	Acceleration section ratio
S0+32+40*(N-1)	DecRatio	FP64	-	Reduction section ratio
S0+36+40*(N-1)	VsRatio	FP64	-	Starting speed ratio
S0+40+40*(N-1)	VeRatio	FP64	-	Termination speed ratio
Output parameter	Parameter Name	Data type	Unit	Note
S1	ErrCode	INT16U	-	Instruction error code
S1+1	ErrCodeID	INT16U	-	Error source ID
State parameters	Parameter Name	Data type	Unit	Note
S2	Done	BOOL	-	Instruction execution completed
S2+1	Busy	BOOL	-	Instruction is currently being executed
S2+2	Err	BOOL	-	Instruction execution error

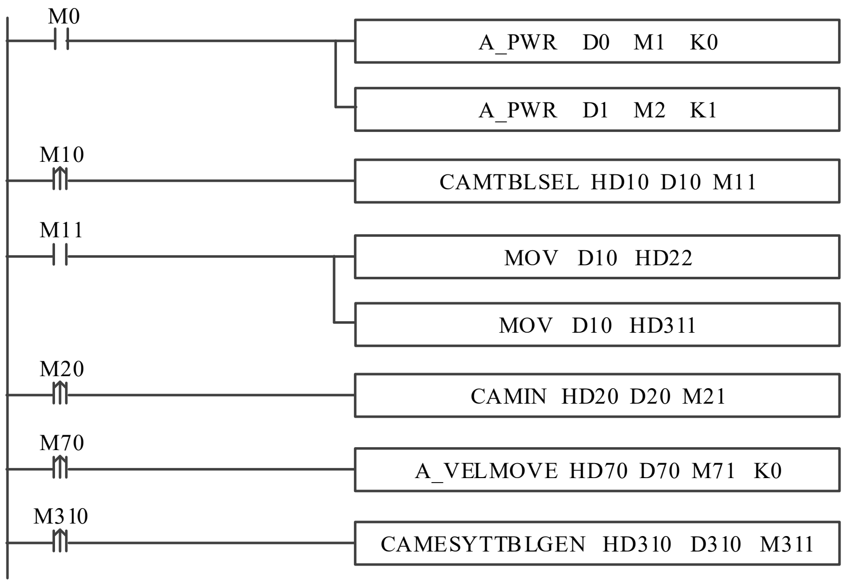
7) Time series diagram



Note:
Trigger the command, set the Busy signal, and when the command is completed, the Busy signal resets and the Done signal is set.
When there is an error during instruction execution, the Error signal is set, all other signals are reset, and the corresponding error code is output.

8) Example

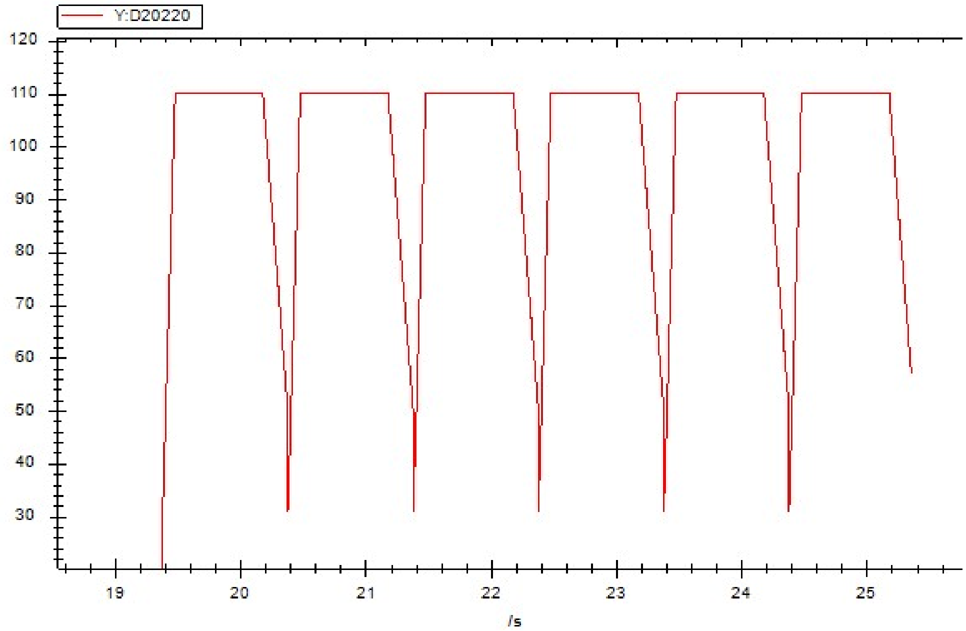
Use easy-to-use T-curve generation instructions to generate T-curves and analyze parameters.
The ladder program is shown in the following figure:



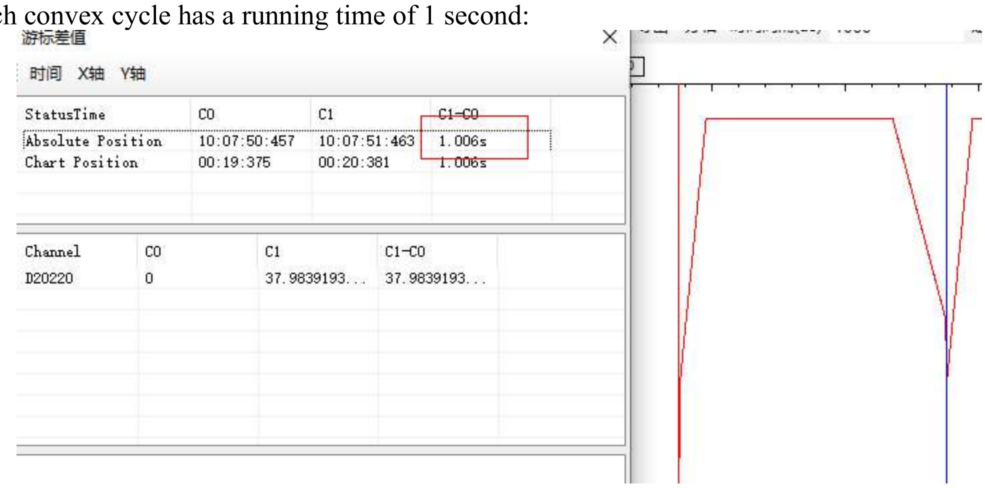
The command parameters are shown in the following figure (spindle speed set to 100):

Name	Value	Type	Map-Addres...	Comment
HD354	1	INT	SWord	Key point number
HD358	100	LREAL	QWord	Spindle position
HD362	100	LREAL	QWord	From axis position
HD374	50	INT	SWord	Track Type
HD378	0.1	LREAL	QWord	Acceleration section ratio
HD382	0.2	LREAL	QWord	Reduction section ratio
HD386	0.3	LREAL	QWord	Starting speed ratio
HD390	0.5	LREAL	QWord	Termination speed ratio

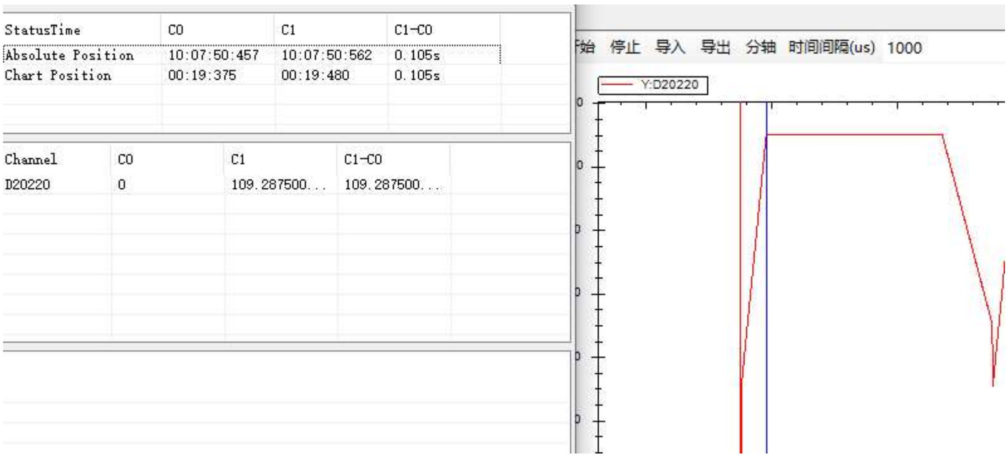
Explanation: First, use A_ PWR command, enable axis, then execute CAMTBLSEL to load cam table instance, then execute CAMEASYTTBLSEL to generate simple T-shaped curve, then execute camin to start cam, and finally execute A_ VELMOVE to move spindle.
After the command is executed, monitor the speed curve of the slave shaft with an oscilloscope as shown in the following figure (the cam is executed in multiple cycles):



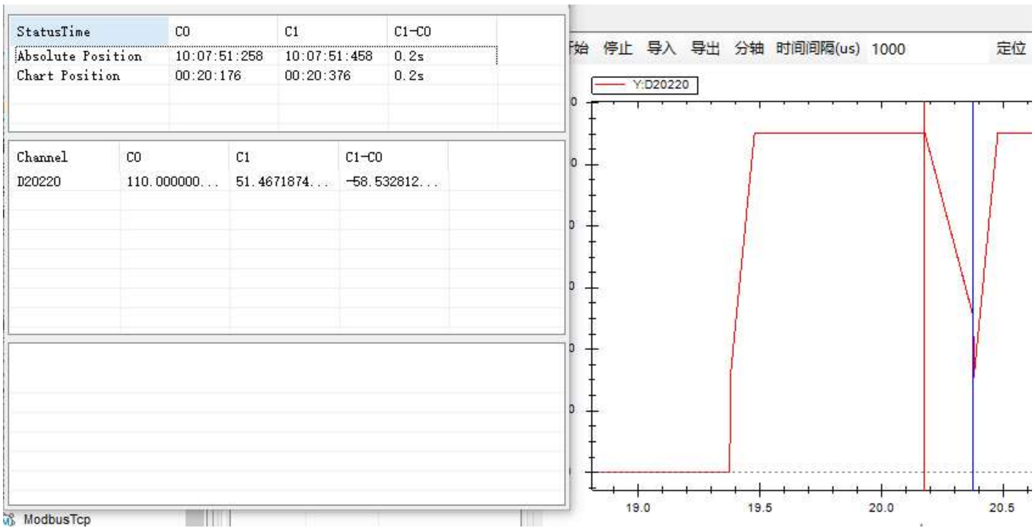
According to the oscilloscope range, the starting speed from the axis is 30 and the ending speed is 50 (reached in a step manner).
Each convex cycle has a running time of 1 second:



Acceleration time of 0.1s:



The deceleration time is 0.2s:



5-3-2-24. Cam tappet 【CAMTAP】

1) Instruction Overview

The tappet provides a high or low level at the specified position of the cam spindle, acting as a switch.

Cam tappet [CAMTAP]			
Conditions for execution	Normally open/closed coil	Application	XDH, XLH, XG2
Firmware requirements	V3.7.3 and above	Software requirements	V 3.7.16 and above

Note: XDH and XLH series L-shaped Lite Edition products do not support this command.

2) Operand

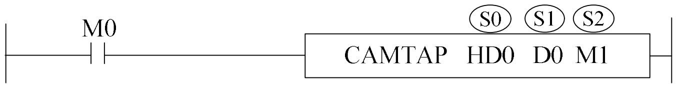
Operand	Role	Types
S0	Specify the starting address of input parameters	16 bits, single word
S1	Specify the starting address of the output status word	16 bits, single word
S2	Specify the starting address of the output status bit	Bit

3) Applicable soft components

Operand	Word soft component											Bit soft component					
	System								Constant	Module		System					
	D*	FD	TD*	CD*	DX	DY	DM*	DS*	K/H	ID	QD	X	Y	M*	S*	T*	C*
S0	●	●	●	●													
S1	●	●	●	●													
S2														●			

Note: D represents D and HD. TD represents TD and HTD. CD represents CD, HCD, HSCD, HSD. DM stands for DM and DHM. DS represents DS and DHS. M represents M, HM, SM. S represents S and HS. T represents T and HT. C represents C and HC.

4) Function and Action



- S0 specifies the starting address of the input parameter, occupying registers S0~S0+2.
- S1 specifies the starting address of the output status word.
- S2 specifies the starting address of the output status bit, occupying registers S2~S2+2.

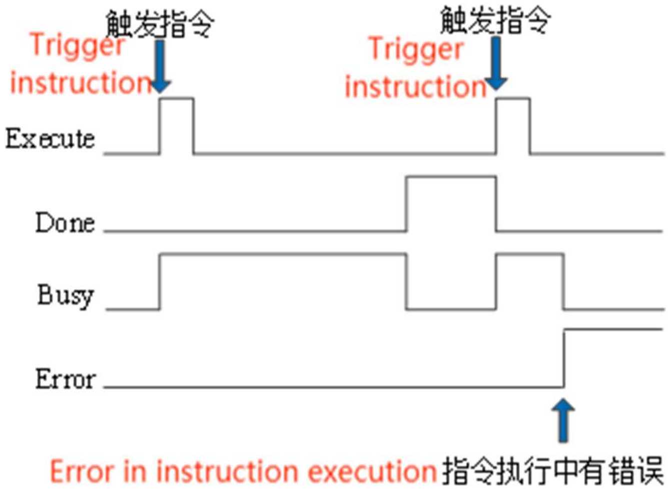
5) Note

- The starting and ending positions in the tappet table correspond to the spindle phase in the cam table. If the position exceeds the mold axis, it will automatically undergo periodic processing.
- Cannot have two instructions for the same slave axis.
- Must be executed after CAMIN takes effect.
- After the CAMIN command is triggered and the insync signal is set, the configuration signal of the tappet table will only have an output.
- The tappet table is configured with both positive and negative actions (such as when the camin command selects positive, the spindle can only move in a positive direction, and the tappet table will have a positive action signal output. The spindle moves in a negative direction, and there is no tappet action output).
- If the compensation time is set: based on the main axis speed V, the output position P of the tappet, and the compensation time T (unit: S), then the actual output position of the tappet=P+T * V.
- The establishment of the tappet table can be found in chapters 4-4-5.

6) Related parameters

Input parameter	Parameter Name	Data type	Unit	Note
S0	MasterID	INT16U	-	Spindle ID
S0+1	SlaveID	INT16U	-	From axis ID
S0+2	CamTblID	INT16S	-	Camometer instance ID
Output parameter	Parameter Name	Data type	Unit	Note
S1	ErrCode	INT16U	-	Instruction error code
State parameters	Parameter Name	Data type	Unit	Note
S2	Done	BOOL	-	Instruction execution completed
S2+1	Busy	BOOL	-	Instruction is currently being executed
S2+2	Err	BOOL	-	Instruction execution error

7) Time series diagram

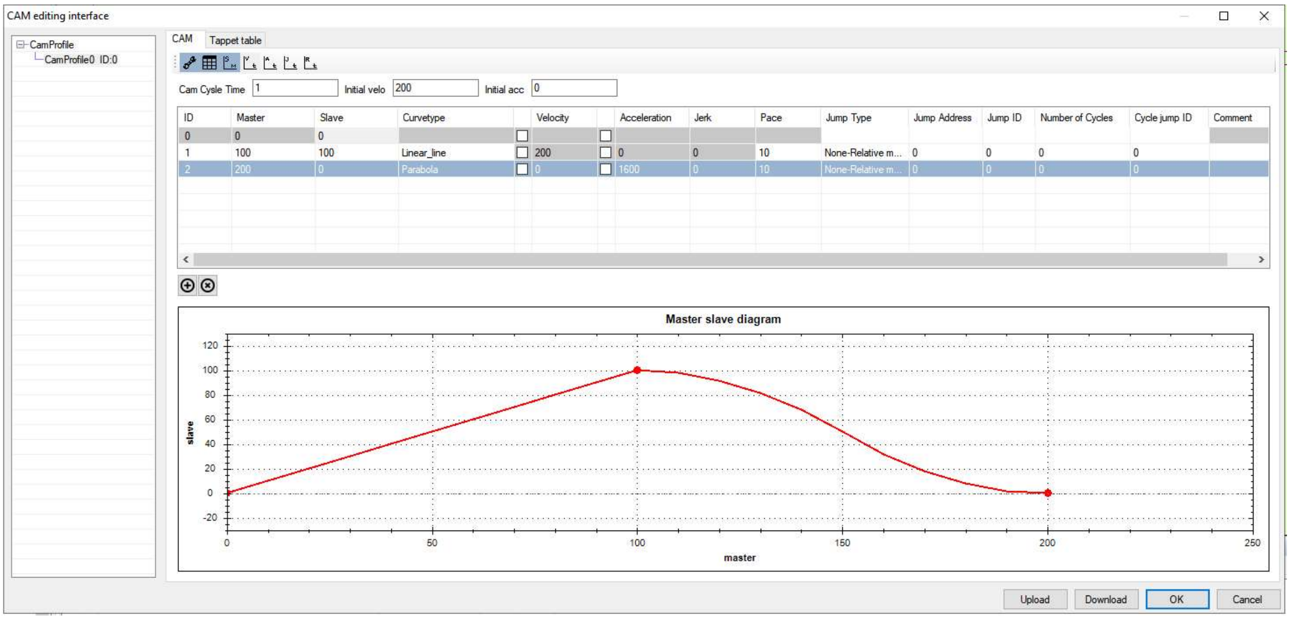


Note:

Trigger the command, set the Busy signal, and when the command is completed, the Busy signal resets and the Done signal is set.

When there is an error during instruction execution, the Error signal is set, all other signals are reset, and the corresponding error code is output.

8) Example



During the operation of the cam in the above diagram, it is necessary to output M1000 and Y10 at fixed positions. The specific information is:

① M1000: Phase 51 set to ON, 2 seconds later set to OFF.

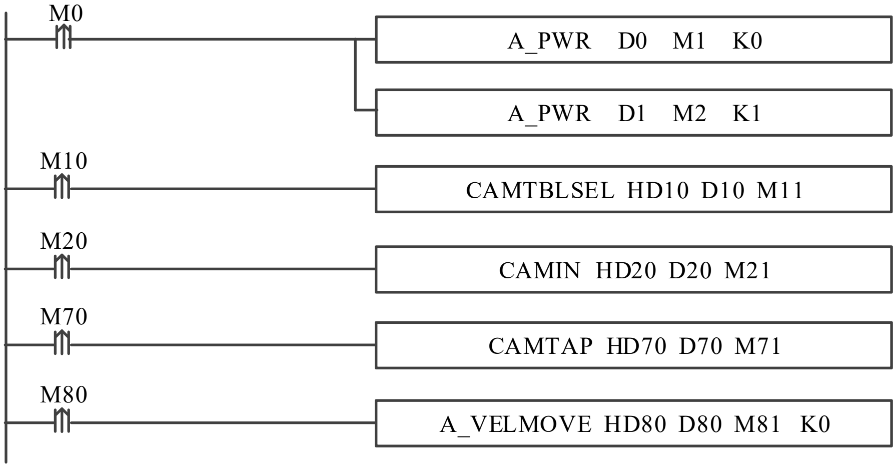
② Y10: Maintain constant ON in the latter half of the cam execution.

The configuration of the tappet table is as follows:

CAM | Tappet table

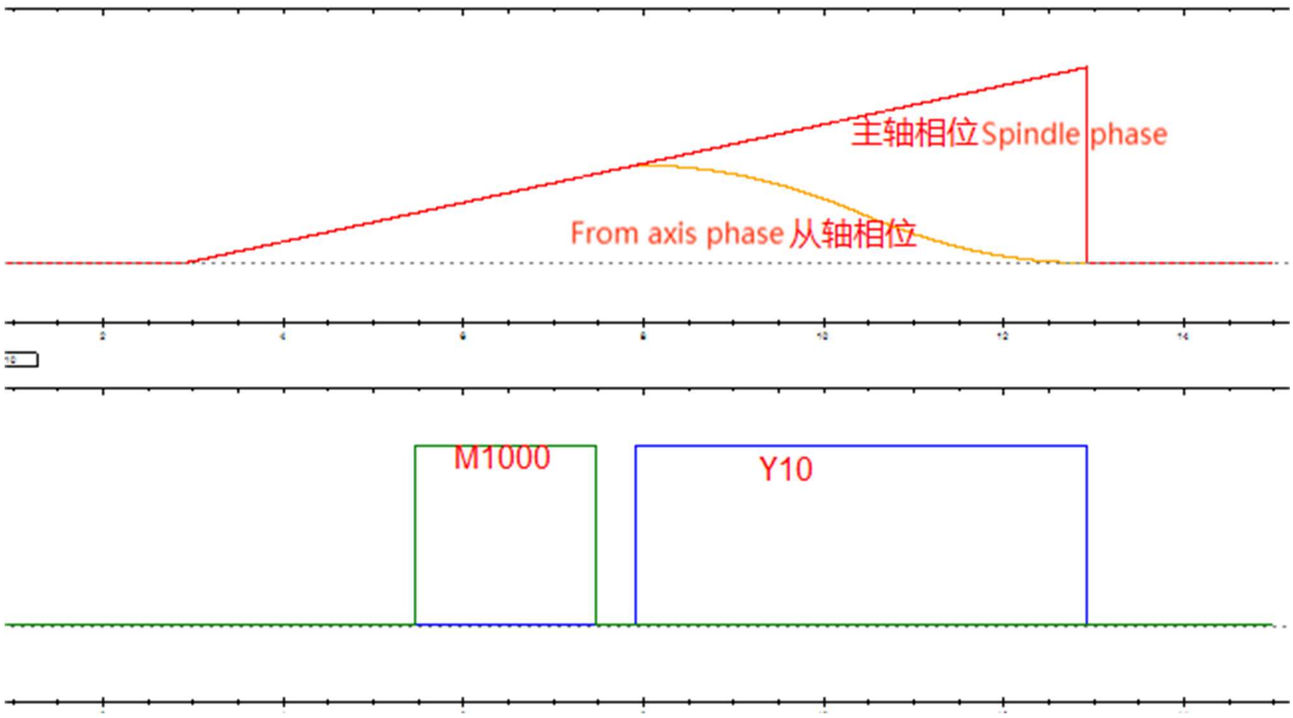
Num...	Register	Start position	Forward start action	Reverse start action	Start compensation time(S)	End position/time(S)	End Type	Positive end action	Reverse end acti
0	M1000	51	ON	NA	0	0	time	OFF	NA
1	Y10	100	ON	NA	0	200	Position	LDI	NA

The ladder diagram is shown in the following figure:



Note:
First, through A_ PWR command, enable shaft, then execute CAMTBLSEL to load cam table instance (without loop enabled), then execute camin to start cam, then command camtap to execute tappet, and finally execute A_ VELMOVE to move spindle (spindle speed 20).

Use an oscilloscope to monitor the relevant oscilloscopes:



5-3-2-25. Cam overlay【CAMADD】

1) Instruction Overview

Cam overlay [CAMADD]			
Conditions for execution	Normally open/closed coil	Application	XDH, XLH, XG2
Firmware requirements	V3.7.3 and above	Software requirements	V 3.7.16 and above

Note: XDH and XLH -L series products do not support this command.

2) Operand

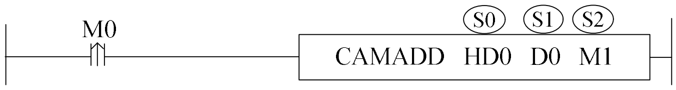
Operand	Role	Types
S0	Specify the starting address of input parameters	16 bits, single word
S1	Specify the starting address of the output status word	16 bits, single word
S2	Specify the starting address of the output status bit	Bit

3) Applicable soft components

Operand	Word soft component											Bit soft component					
	System								Constant	Module		System					
	D*	FD	TD*	CD*	DX	DY	DM*	DS*	K/H	ID	QD	X	Y	M*	S*	T*	C*
S0	●	●	●	●													
S1	●	●	●	●													
S2														●			

Note: D represents D and HD. TD represents TD and HTD. CD represents CD, HCD, HSCD, HSD. DM stands for DM and DHM. DS represents DS and DHS. M represents M, HM, SM. S represents S and HS. T represents T and HT. C represents C and HC.

4) Function and Action



- S0 specifies the starting address of the input parameter, occupying registers S0~S0+27.
- S1 specifies the starting address of the output status word, occupying registers S1~S1+11.
- S2 specifies the starting address of the output status bit, occupying registers S2~S2+2.

5) Note

- In the spindle position mode, the set compensation value will be compensated within the set spindle movement amount. The compensation speed is the maximum limit of the compensation speed. If the actual compensation speed exceeds the set value, compensation will be executed according to the set speed. At this time, when the spindle movement is completed, compensation will not be carried out, and it is not guaranteed that the actual compensation value will reach the set compensation value.
- In spindle speed mode, compensation is carried out according to the set compensation speed within the set spindle movement amount. At this time, the actual compensation amount is calculated based on the actual compensation time and compensation speed. The compensation amount parameter is not effective in this mode.
- In the spindle position and slave axis position modes, the compensation amount determines the direction of compensation. If the compensation amount is greater than or equal to 0, it is positive compensation. If the compensation amount is less than 0, it is negative compensation; In spindle speed mode, the compensation direction is determined by the compensation speed, which is greater than 0, positive compensation, less than 0, negative compensation.
- When in spindle position and spindle speed mode, the anti reverse function is invalid, and the internal automatic anti reverse processing is carried out. When reverse occurs, the instruction error compensation stops. When in the axis position mode, if an anti reverse function is required, the corresponding anti reverse mode needs to be set. When reverse occurs, the axis remains stationary.
- In no reference mode, this instruction needs to be executed in the I9900 interrupt, once per control cycle, i.e. compensation, and only supports forward anti reversal.
- When the curve type is a T-shaped curve, the proportion of the T-shaped constant speed segment refers to the proportion of the constant speed segment to the compensation movement, and the proportion of the T-shaped acceleration and deceleration segment refers to the acceleration/deceleration segment of the remaining distance after removing the constant speed segment. The proportional coefficient is effective in both position mode and speed mode.
- The current compensation amount is the actual compensation amount for the current compensation; The cumulative compensation amount is the sum of the compensation values for compensating the cam by

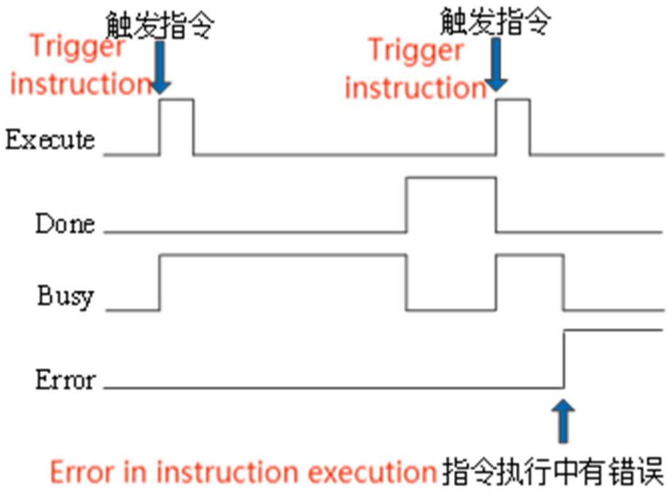
changing the overlay command.

- In single cycle mode, the execution of the cam ends, the execution of this command ends, and the compensation ends. The actual compensation distance shall prevail.
- During the compensation process, the cam clutch OFF command is executed, and the compensation in the master slave clutch also enters a pause (the compensation command status is reset). After the clutch is turned on, the compensation is redrawn according to the remaining spindle movement at the time of clutch off completion and the remaining compensation value according to the selected curve type.

6) Related parameters

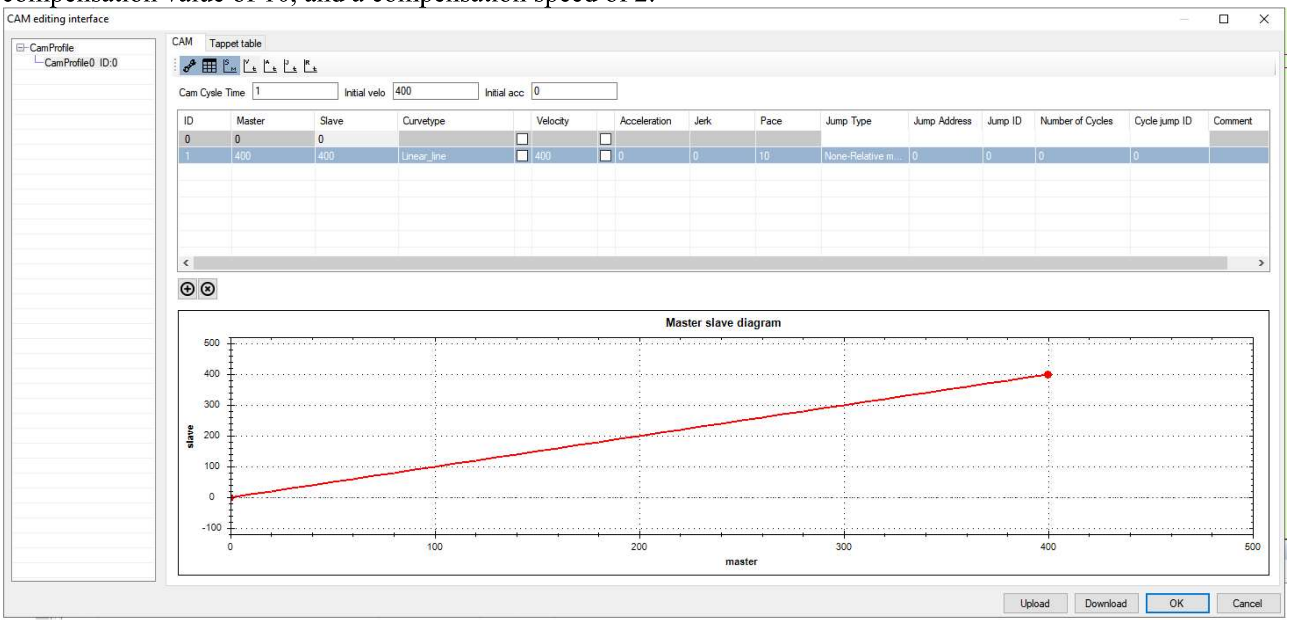
Input parameter	Parameter Name	Data type	Unit	Note
S0	SlaveID	INT16U	-	From axis ID
S0+1	BaseMode	INT16U	-	Benchmark mode: 0: Spindle position mode 1: Spindle speed mode 2: No benchmark mode 3: From axis position mode
S0+2	CurveType	INT16U	-	Curve type: 0: Cubic curve 1: Quintic curve 2: T-shaped curve
S0+3	ReversalMode	INT16U	-	Anti reverse mode: 0: No anti reverse 1: Forward anti reverse 2: Reverse anti reverse
S0+8	MasterDistance	FP64	Instruction Unit	Spindle movement amount
S0+12	PhaseShift	FP64	Instruction Unit	Compensation amount
S0+16	Vel	FP64	Instruction Unit/s	Compensation target speed
S0+20	ConstantRatio	FP64	-	T-shaped constant speed section ratio
S0+24	AccDecRatio	FP64	-	T-shaped acceleration and deceleration section ratio
Output parameter	Parameter Name	Data type	Unit	Note
S1	ErrCode	INT16U	-	Instruction error code
S1+4	CurPhaseShift	FP64	Instruction Unit	Current compensation amount
S1+8	AccPhaseShift	FP64	Instruction Unit	Accumulated compensation amount
State parameters	Parameter Name	Data type	Unit	Note
S2	Done	BOOL	-	Instruction execution completed
S2+1	Busy	BOOL	-	Instruction is currently being executed
S2+2	Err	BOOL	-	Instruction execution error

7) Time series diagram

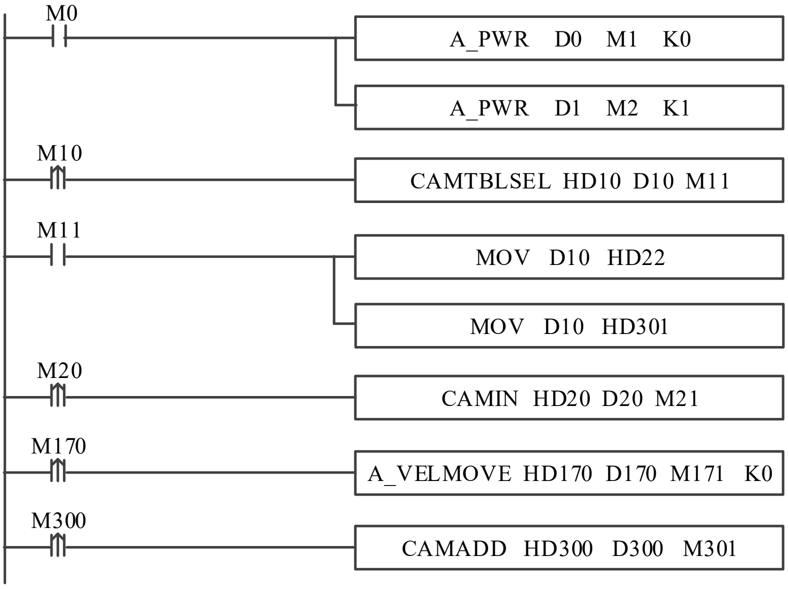


Note:
Trigger the command, set the Busy signal, and when the command is completed, the Busy signal resets and the Done signal is set.
When there is an error during instruction execution, the Error signal is set, all other signals are reset, and the corresponding error code is output.

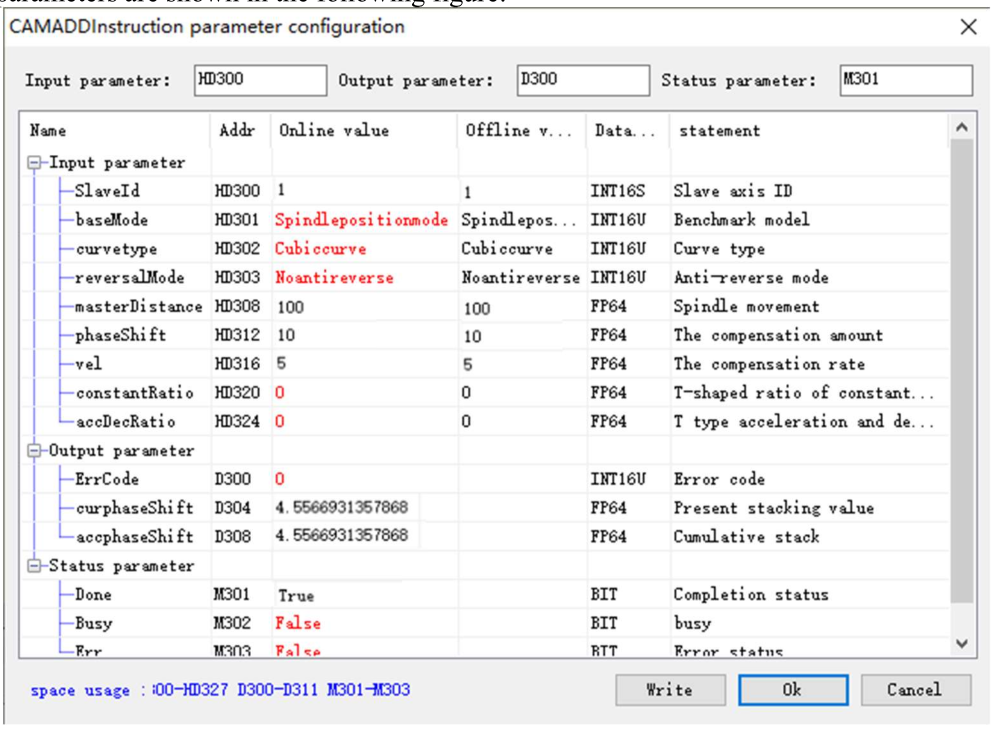
8) Example
For the following cam table, compensate the spindle during cam execution with a compensation distance of 100, a compensation value of 10, and a compensation speed of 2.



The ladder program is shown in the following figure:



The command parameters are shown in the following figure:


CAMADDInstruction parameter configuration

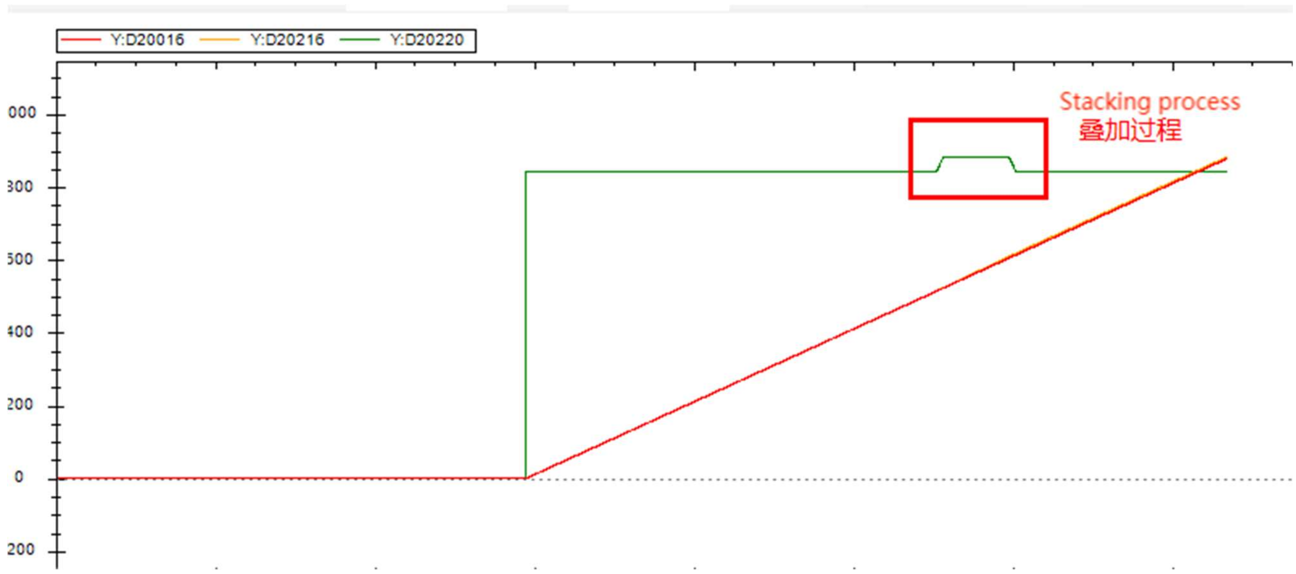
Input parameter: HD300 Output parameter: D300 Status parameter: M301

Name	Addr	Online value	Offline v...	Data...	statement
Input parameter					
SlaveId	HD300	1	1	INT16S	Slave axis ID
baseMode	HD301	Spindlepositionmode	Spindlepos...	INT16U	Benchmark model
curvetype	HD302	Cubiccurve	Cubiccurve	INT16U	Curve type
reversalMode	HD303	Noantireverse	Noantireverse	INT16U	Anti-reverse mode
masterDistance	HD308	100	100	FP64	Spindle movement
phaseShift	HD312	10	10	FP64	The compensation amount
vel	HD316	5	5	FP64	The compensation rate
constantRatio	HD320	0	0	FP64	T-shaped ratio of constant...
accDecRatio	HD324	0	0	FP64	T type acceleration and de...
Output parameter					
ErrCode	D300	0		INT16U	Error code
curphaseShift	D304	4.5566931357868		FP64	Present stacking value
accphaseShift	D308	4.5566931357868		FP64	Cumulative stack
Status parameter					
Done	M301	True		BIT	Completion status
Busy	M302	False		BIT	busy
Err	M303	False		BIT	Error status

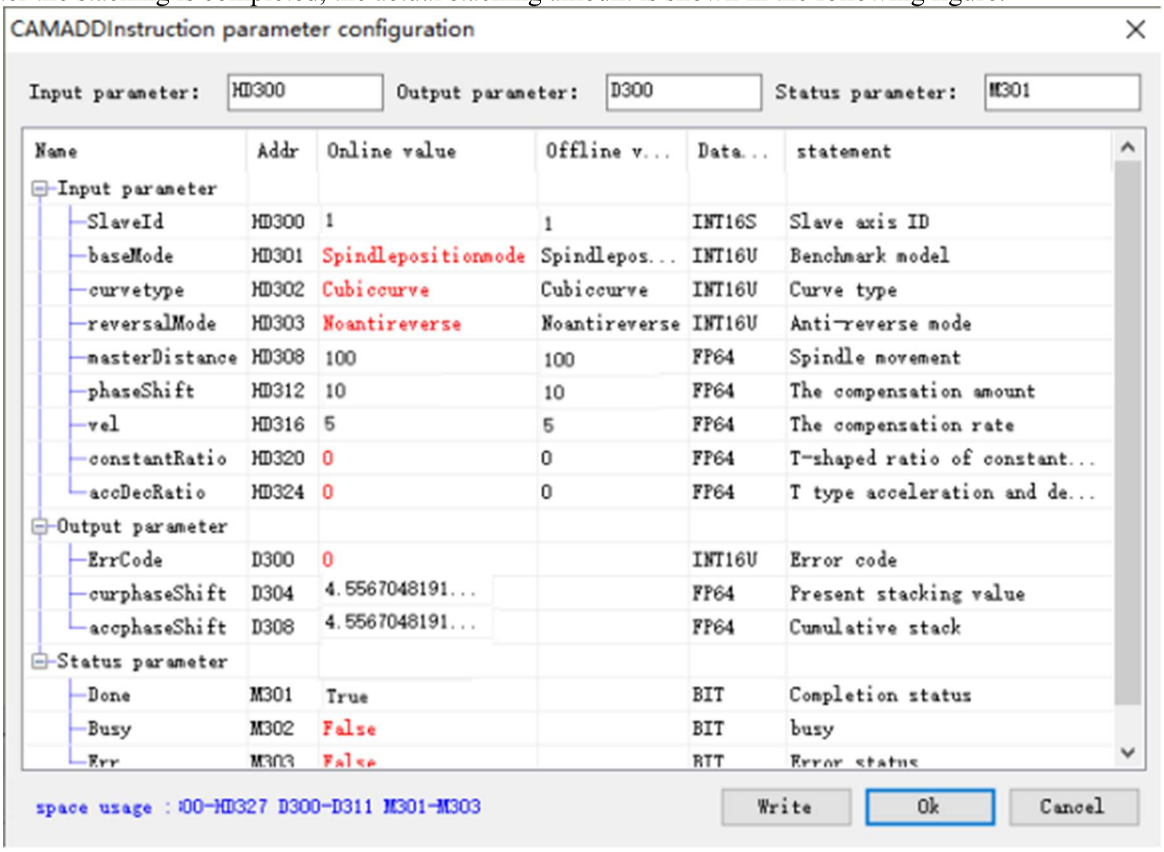
space usage : ł00-HD327 D300-D311 M301-M303 Write Ok Cancel

Explanation: First, use A_ PWR command, enable shaft, then execute CAMTBLSEL to load cam table instance, then execute camin to start cam, and then execute A_ VELMOVE to move spindle, and finally execute CAMADD to superimpose the cam motion.

After executing the program, use an oscilloscope to monitor the position of the master and slave axes, as well as the velocity curve of the slave axis, as shown in the following figure:



After the stacking is completed, the actual stacking amount is shown in the following figure:


CAMADDInstruction parameter configuration

Input parameter: HD300 Output parameter: D300 Status parameter: M301

Name	Addr	Online value	Offline v...	Data...	statement
Input parameter					
SlaveId	HD300	1	1	INT16S	Slave axis ID
baseMode	HD301	Spindlepositionmode	Spindlepos...	INT16U	Benchmark model
curvetype	HD302	Cubiccurve	Cubiccurve	INT16U	Curve type
reversalMode	HD303	Noantireverse	Noantireverse	INT16U	Anti-reverse mode
masterDistance	HD308	100	100	FP64	Spindle movement
phaseShift	HD312	10	10	FP64	The compensation amount
vel	HD316	5	5	FP64	The compensation rate
constantRatio	HD320	0	0	FP64	T-shaped ratio of constant...
accDecRatio	HD324	0	0	FP64	T type acceleration and de...
Output parameter					
ErrCode	D300	0		INT16U	Error code
curphaseShift	D304	4.5567048191...		FP64	Present stacking value
accphaseShift	D308	4.5567048191...		FP64	Cumulative stack
Status parameter					
Done	M301	True		BIT	Completion status
Busy	M302	False		BIT	busy
Err	M303	False		BIT	Error status

space usage :00-HD327 D300-D311 M301-M303

Write Ok Cancel

As can be seen from the above, in position mode, the actual compensation speed will be calculated based on the set movement and compensation amount, and the actual compensation amount will be determined based on the actual compensation speed and compensation time.

5-3-2-26. Eccentric cam table generation 【CAMECCTBLGEN】

1) Instruction Overview

Eccentric cam table generation [CAMECCTBLGEN]			
Conditions for execution	Normally open/closed coil	Application	XDH, XLH, XG2
Firmware requirements	V3.7.3 and above	Software requirements	V 3.7.16 and above

Note: XDH and XLH -L series products do not support this command.

2) Operand

Operand	Role	Types
S0	Specify the starting address of input parameters	16 bits, single word
S1	Specify the starting address of the output status word	16 bits, single word
S2	Specify the starting address of the output status bit	Bit

3) Applicable soft components

Operand	Word soft component											Bit soft component					
	System								Constant	Module		System					
	D*	FD	TD*	CD*	DX	DY	DM*	DS*	K/H	ID	QD	X	Y	M*	S*	T*	C*
S0	●	●	●	●													
S1	●	●	●	●													
S2														●			

Note: D represents D and HD. TD represents TD and HTD. CD represents CD, HCD, HSCD, HSD. DM stands for DM and DHM. DS represents DS and DHS. M represents M, HM, SM. S represents S and HS. T represents T and HT. C represents C and HC.

4) Function and Action

- S0 specifies the starting address of the input parameter, occupying registers S0~S0+36+36 * (N-1).
- S1 specifies the starting address of the output status word, occupying registers S1~S1+1.
- S2 specifies the starting address of the output status bit, occupying registers S2~S2+2.

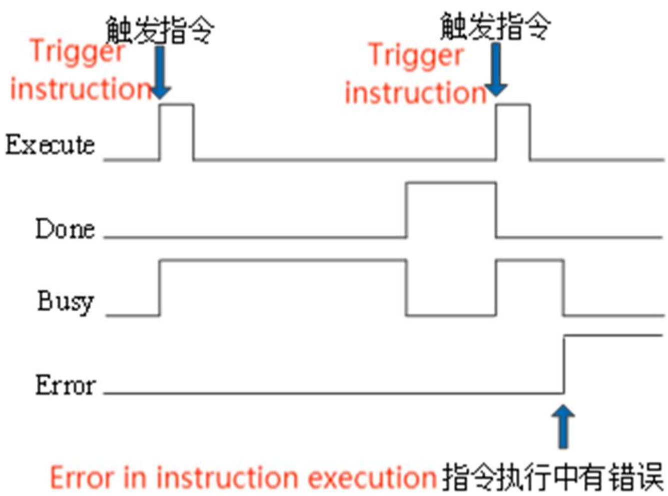
5) Note

- When the cam is in use, it only supports the cam cycle to take effect. When not in use, both modes are supported.
- PointId starts from 0 and increases sequentially, and the position of the primary and secondary axes of the 0th keypoint must be (0,0), and the curve type of the 0th keypoint is invalid.
- The total number of key points must be greater than or equal to 2.
- The error source ID defaults to 65535 when there are no errors during instruction execution.
- The eccentric wheel is divided into the synchronous curve after the eccentric wheel (51) and the synchronous curve before the eccentric wheel (52).
- The synchronization curve after the eccentric wheel must be the first key point of the cam table and can only be connected to the fifth degree curve after it. The synchronization curve before the eccentric wheel can only be the last point of the cam table and only the fifth degree curve can be connected to it.
- The endpoint of the synchronization curve after the eccentric wheel needs to be calculated based on the length of the connecting rod, the angle of the eccentric wheel, and the proportion of the connecting rod.
- The starting point of the synchronization curve before the eccentric wheel (the endpoint of the fifth degree curve connected to it) can only be calculated by the length of the connecting rod, the angle of the eccentric wheel, the proportion of the connecting rod, and the position of the endpoint of the curve.
- A cam table with an eccentric wheel synchronization curve must ensure that it monotonically increases from the shaft position.
- The length of the connecting rod must be greater than 0; The input range of eccentric wheel angle is (0 °, 90 °); Link ratio input range [50%, 200%].
- This command can only generate general curves and eccentric wheel curves.
- The length of the eccentric wheel connecting rod and the ratio of the eccentric wheel connecting rod in the front synchronization curve and the rear synchronization curve of the eccentric wheel in a cam table need to be consistent.
- There can be only one type of eccentric wheel curve in a cam table, with a maximum of one eccentric wheel rear synchronization curve and one eccentric wheel front synchronization curve.
- This command can only generate general curves and eccentric wheel curves.

6) Related parameters

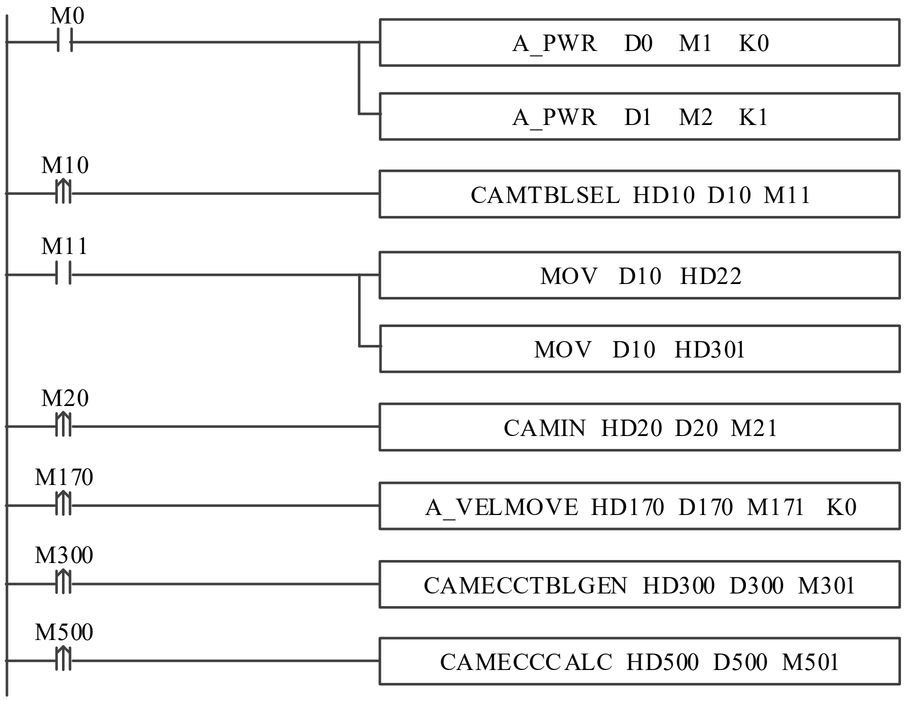
Input parameter	Parameter Name	Data type	Unit	Note
S0	Count	INT16U	-	Number of key points
S0+1	CamtblID	INT16S	-	Camometer instance ID
S0+2	Mode	INT16U	-	Effective mode: 0: Effective immediately 1: Effective in the next cycle
S0+4+36*(N-1)	PointID	INT16U	-	Key point ID
S0+8+36*(N-1)	MasterPos	FP64	Instruction Unit	Spindle position
S0+12+36*(N-1)	SlavePos	FP64	Instruction Unit	From axis position
S0+16+36*(N-1)	Vel	FP64	Instruction Unit/s	Reference speed
S0+20+36*(N-1)	Acc	FP64	Instruction Unit/s²	Reference acceleration
S0+24+36*(N-1)	R	FP64	Instruction Unit	Eccentric wheel connecting rod length
S0+28+36*(N-1)	Theta	FP64	°	Eccentric wheel angle
S0+32+36*(N-1)	Coff	FP64	%	Eccentric wheel connecting rod ratio
S0+36+36*(N-1)	Type	INT16U	-	Track Type
Output parameter	Parameter Name	Data type	Unit	Note
S1	ErrCode	INT16S	-	Instruction error code
S1+1	ErrCodeID	INT16U	-	Error source ID
State parameters	Parameter Name	Data type	Unit	Note
S2	Done	BOOL	-	Instruction execution completed
S2+1	Busy	BOOL	-	Instruction is currently being executed
S2+2	Err	BOOL	-	Instruction execution error

7) Time series diagram

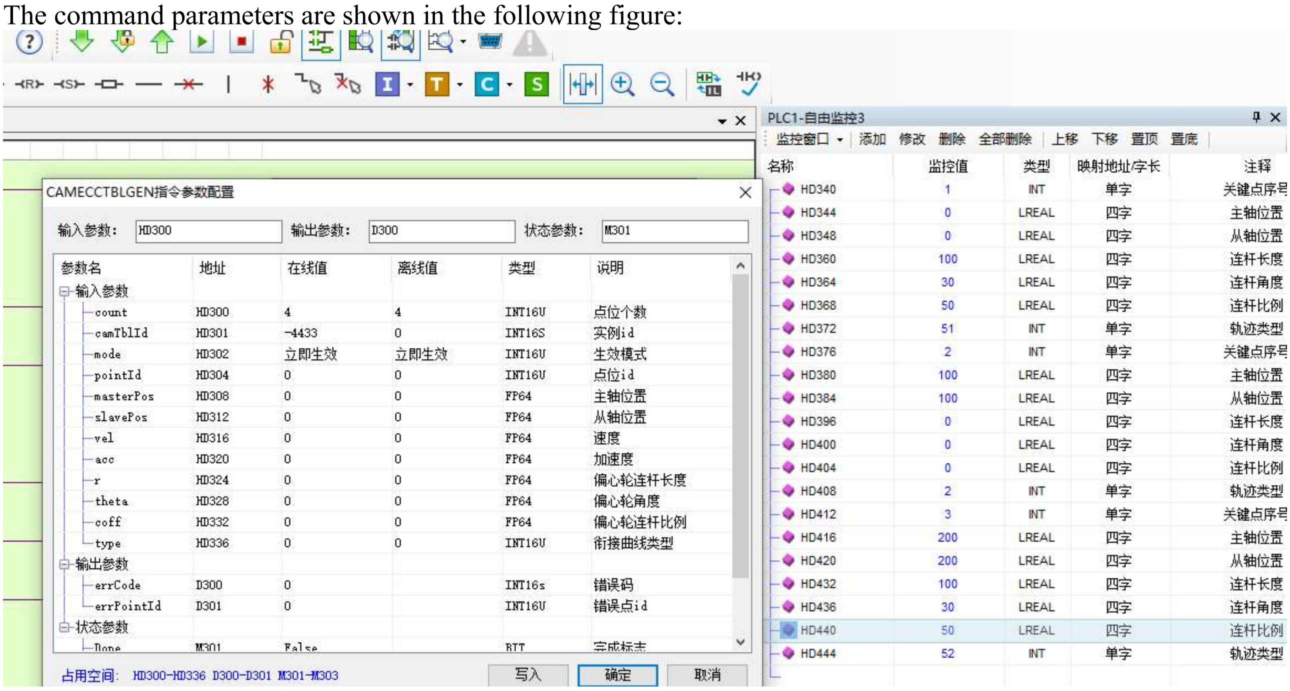


Note:
Trigger the command, set the Busy signal, and when the command is completed, the Busy signal resets and the Done signal is set.
When there is an error during instruction execution, the Error signal is set, all other signals are reset, and the corresponding error code is output.

8) Example
Generate a cam table containing the front synchronization curve of the eccentric wheel and the rear synchronization curve of the eccentric wheel.
The ladder program is shown in the following figure:

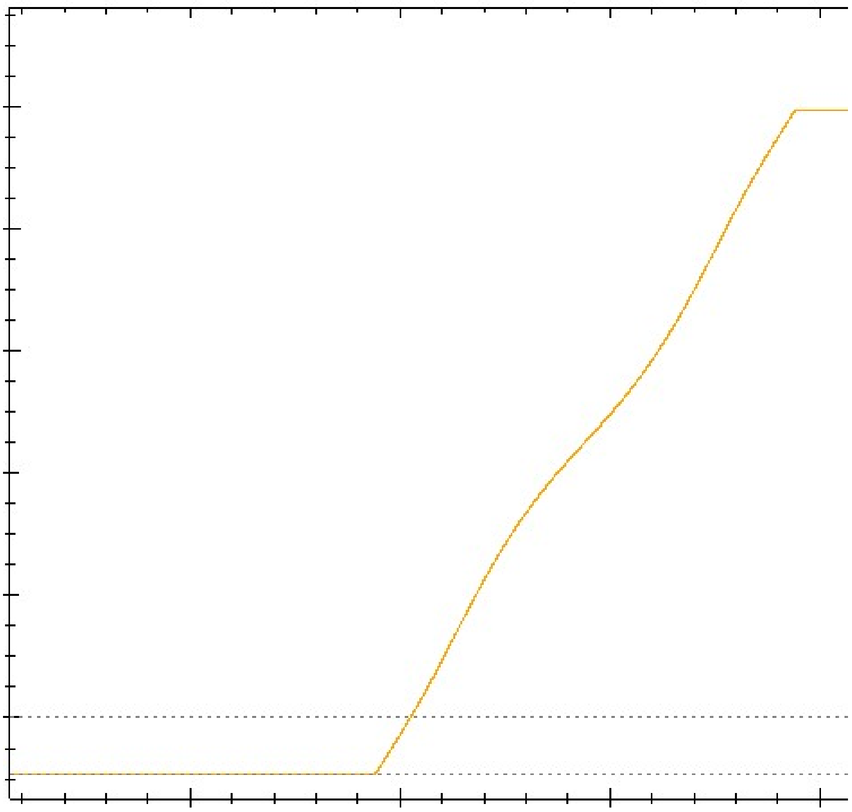


The command parameters are shown in the following figure:

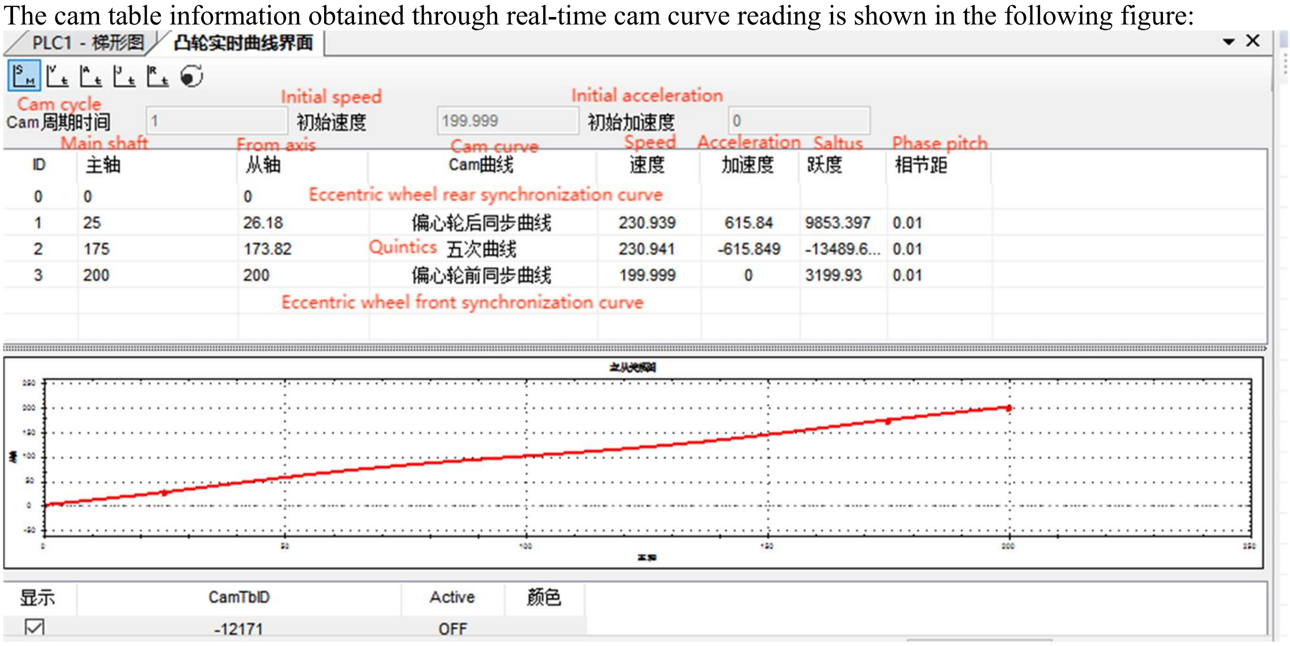


Explanation: First, use A_ PWR command enables the master-slave axis, then executes the CAMTBLSEL command to load an instance of the cam table. Afterwards, CAMECCTBLSEL is executed to generate the eccentric cam table, followed by CAMIN to start the cam, and then A _VELMOVE is executed to move spindle (spindle speed set to 100), and finally execute CAMECCCALC to calculate the eccentric wheel point information and compare it with the read cam table point information.

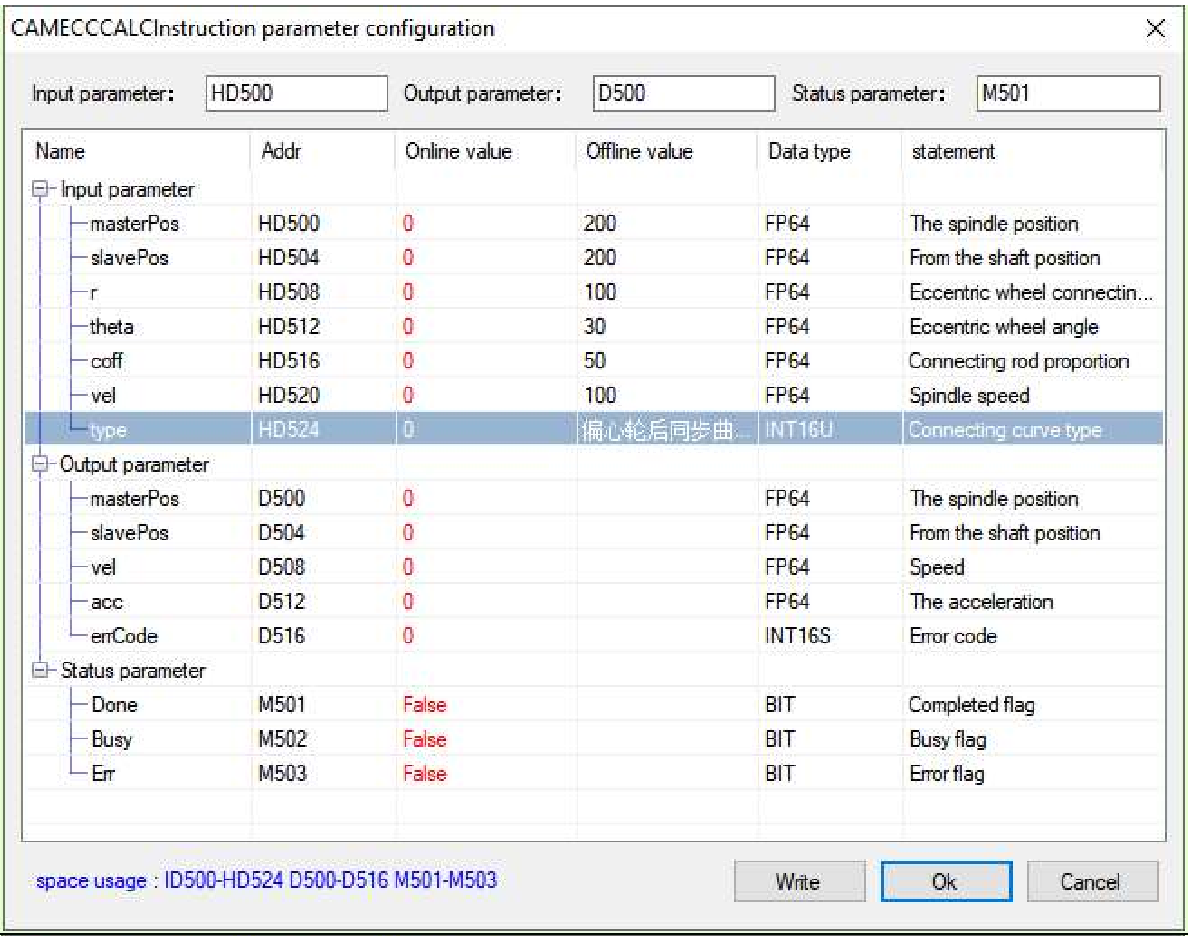
Execute the cam, and the cam trajectory is shown in the following figure:

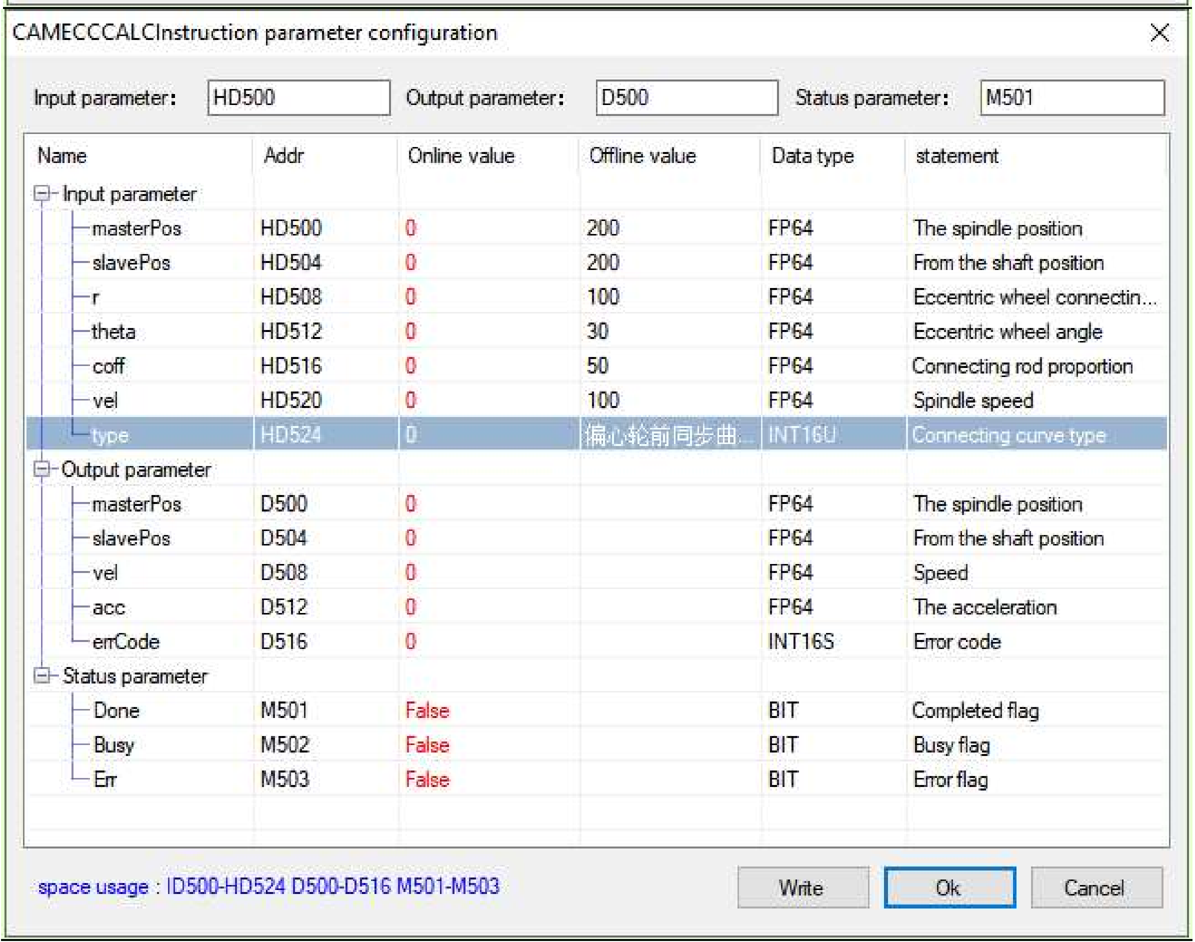


The cam table information obtained through real-time cam curve reading is shown in the following figure:



At this point, by using the eccentric wheel calculation command and inputting the corresponding connecting rod parameters, the corresponding eccentric wheel curve position can be calculated.





From this, it can be concluded that the position of the synchronization curve after the eccentric wheel is only determined by the parameters of the eccentric wheel. The position of the fifth degree curve connected to the synchronization curve before the eccentric wheel is determined by the position of the synchronization curve before the eccentric wheel and the parameters of the eccentric wheel at that point.

5-3-2-27. Calculation of eccentric wheel key points【CAMECCCALC】

1) Instruction Overview

Eccentric cam table generation [CAMECCCALC]			
Conditions for execution	Normally open/closed coil	Application	XDH, XLH, XG2
Firmware requirements	V3.7.3 and above	Software requirements	V 3.7.16 and above

Note: XDH and XLH -L series products do not support this command.

2) Operand

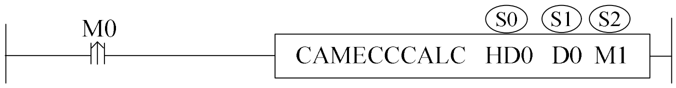
Operand	Role	Types
S0	Specify the starting address of input parameters	64 bit, quadword
S1	Specify the starting address of the output status word	64 bit, quadword
S2	Specify the starting address of the output status bit	Bit

3) Applicable soft components

Operand	Word soft component											Bit soft component					
	System								Constant	Module		System					
	D*	FD	TD*	CD*	DX	DY	DM*	DS*	K/H	ID	QD	X	Y	M*	S*	T*	C*
S0	●	●	●	●													
S1	●	●	●	●													
S2														●			

Note: D represents D and HD. TD represents TD and HTD. CD represents CD, HCD, HSCD, HSD. DM stands for DM and DHM. DS represents DS and DHS. M represents M, HM, SM. S represents S and HS. T represents T and HT. C represents C and HC.

4) Function and Action



- S0 specifies the starting address of the input parameter, occupying registers S0~S0+24.
- S1 specifies the starting address of the output status word, occupying registers S1~S1+16.
- S2 specifies the starting address of the output status bit, occupying registers S2~S2+2.

5) Note

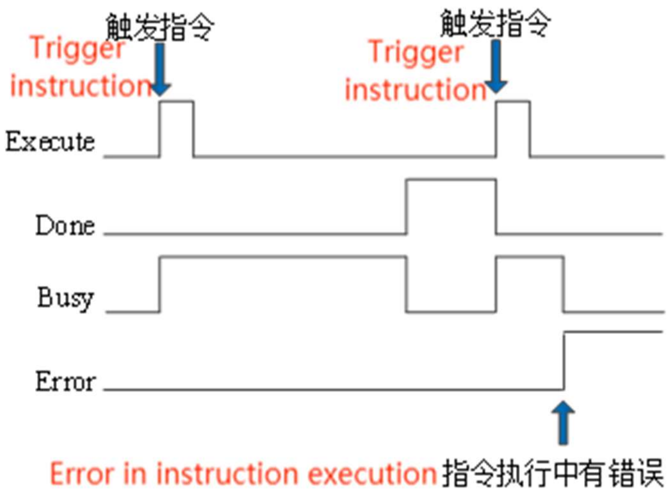
- The length of the connecting rod must be greater than 0. The input range of eccentric wheel angle is (0°, 90°). Link ratio input range [50%, 200%].
- The curve types can only be eccentric wheel rear synchronization curve (51) and eccentric wheel front synchronization curve (52).
- The output parameters [speed] and [acceleration] are the termination speed and acceleration of this segment of the curve calculated based on the spindle operating speed.

6) Related parameters

Input parameter	Parameter Name	Data type	Unit	Note
S0	MasterPos	FP64	Instruction Unit	Spindle position
S0+4	SlavePos	FP64	Instruction Unit	From axis position
S0+8	R	FP64	Instruction Unit	Eccentric wheel connecting rod length
S0+12	Theta	FP64	°	Eccentric wheel angle
S0+16	Coff	FP64	%	Link length ratio

S0+20	Vel	FP64	Instruction Unit/s	Spindle running speed
S0+24	Type	INT16U	-	Curve type: 51: Eccentric wheel rear synchronization curve 52: Eccentric wheel front synchronization curve
Output parameter	Parameter Name	Data type	Unit	Note
S1	MasterPos	FP64	Instruction Unit	Spindle position
S1+4	SlavePos	FP64	Instruction Unit	From axis position
S1+8	Vel	FP64	Instruction Unit/s^2	Speed
S1+12	Acc	FP64	Instruction Unit/s^2	Acceleration
S1+16	ErrCode	INT16s	-	Error code
State parameters	Parameter Name	Data type	Unit	Note
S2	Done	BOOL	-	Instruction execution completed
S2+1	Busy	BOOL	-	Instruction is currently being executed
S2+2	Err	BOOL	-	Instruction execution error

7) Time series diagram



Note:
Trigger the command, set the Busy signal, and when the command is completed, the Busy signal resets and the Done signal is set.
When there is an error during instruction execution, the Error signal is set, all other signals are reset, and the corresponding error code is output.

5-3-2-28. Photoelectric trigger cam【CAMINMARK】

1) Instruction Overview

Photoelectric trigger cam [CAMINMARK]			
Conditions for execution	Normally open/closed coil	Application	XDH, XLH, XG2
Firmware requirements	V3.7.3 and above	Software requirements	V 3.7.16 and above

Note: XDH and XLH -L series products do not support this command.

2) Operand

Operand	Role	Types
S0	Specify the starting address of input parameters	64 bit, quadword
S1	Specify the starting address of the output status word	16 bit, quadword
S2	Specify the starting address of the output status bit	Bit

3) Applicable soft components

Operand	Word soft component											Bit soft component					
	System								Constant	Module		System					
	D*	FD	TD*	CD*	DX	DY	DM*	DS*	K/H	ID	QD	X	Y	M*	S*	T*	C*
S0	●	●	●	●													
S1	●	●	●	●													
S2														●			

Note: D represents D and HD. TD represents TD and HTD. CD represents CD, HCD, HSCD, HSD. DM stands for DM and DHM. DS represents DS and DHS. M represents M, HM, SM. S represents S and HS. T represents T and HT. C represents C and HC.

4) Function and Action

- S0 specifies the starting address of the input parameter, occupying registers S0~S0+67.
- S1 specifies the starting address of the output status word, occupying registers S1~S1+7.
- S2 specifies the starting address of the output status bit, occupying registers S2~S2+6.

5) Note

- This chapter only introduces the usage of the combination of the probe and CAMIN. The usage and parameter description of the CAMIN instruction can be found in Chapters 5-3-2, while the usage and parameter description of the probe can be found in Chapters 5-1-2-19.
- [Trigger Mode] 0- Immediate Trigger: After the cam command is executed, the probe execution is completed and the cam start is immediately executed. 1-Distance trigger: After the cam command is executed, wait for the spindle to move to the set trigger distance before executing the cam start after the probe is completed.
- Color code sampling delay time: Compensates for the delay in the probe latch position compared to the color code position due to hardware time delay. 0 is not used, and in general, only minor adjustments are needed, and the effect of use cannot be seen.

6) Related parameters

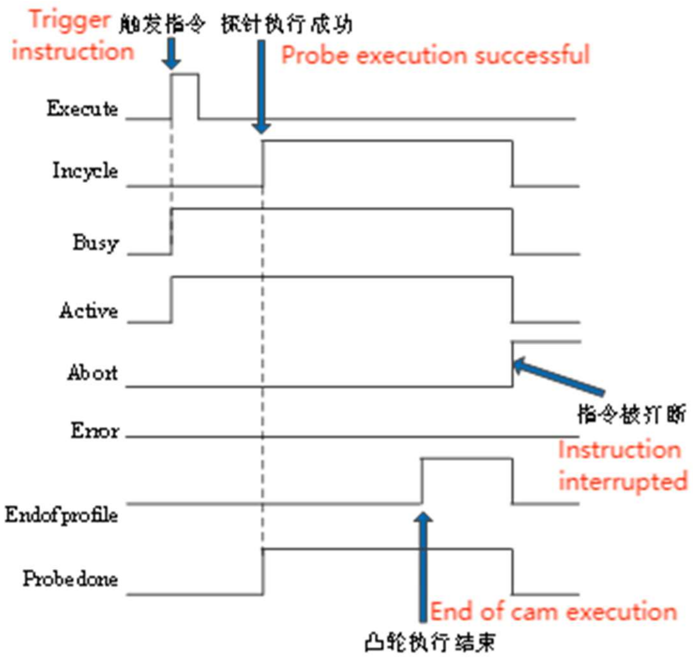
Input parameter	Parameter Name	Data type	Unit	Note
S0	Master	INT16S	-	Spindle number. Axis number starts from 0
S0+1	Slaver	INT16S	-	Number from axis. Axis number starts from 0
S0+2	CamtblID	INT16S	-	Example of a cam gauge. Generated by CAMTBLSEL
S0+3	StartMode	INT16S	-	Starting mode of master and slave axes 0: Relative mode 1: Absolute mode 2: Follow up mode
S0+4	MasterSource	INT16S	-	Spindle data source type 0: Given the current position of the spindle

				1: Last spindle position given 2: Feedback on the current position of the spindle 3: Last spindle position feedback
S0+5	BufferMode	INT16S	-	Caching mode 0: Interrupt mode 1: Caching mode
S0+6	Dir	INT16S	-	Synchronous direction 0: Bidirectional 1: Forward 2: Reverse
S0+8	MasterOffset	FP64	-	Spindle offset
S0+12	SlaverOffset	FP64	-	Offset from axis
S0+16	MasterScaling	FP64	-	Spindle override
S0+20	SlaverScaling	FP64	-	From axis magnification
S0+32	VecDiff	FP64	Instruction Unit/s	Maximum chasing speed in chasing mode
S0+36	Acc	FP64	Instruction Unit/s^2	Pursuit acceleration in pursuit mode
S0+40	Dec	FP64	Instruction Unit/s^2	Chasing and Deceleration in Chasing Mode
S0+44	Jerk	FP64	Instruction Unit/s^3	The acceleration speed of the chasing mode. Acceleration refers to the speed of change in acceleration and deceleration
S0+48	Index	INT16S	-	Probe number 0: Probe 1 1: Probe 2 3: Probe 3 4: Probe 4
S0+49	Source	INT16S	-	Probe trigger source 0: Slave Station 1: Main Station 2: Single time from the station
S0+50	Edge	INT16S	-	Probe triggered edge 0: Rising edge 1: Descending edge
S0+51	Singnal	INT16S	-	Probe trigger signal
S0+52	Windowstart	FP64	Instruction Unit	Probe window start position
S0+56	Windowend	FP64	Instruction Unit	End position of probe window
S0+60	Windowused	INT16S	-	Window Index 0: Do not enable windows 1: Enable Window
S0+61	Tiegmode	INT16S	-	Trigger mode 0: Immediately trigger 1: Distance trigger
S0+62	Probelagtime	FP32	Ms	Color code sampling lag time
S0+64	Tirgdistance	FP64	Instruction Unit	Trigger distance
Output parameter	Parameter Name	Data type	Unit	Note
S1	Index	INT16S	-	Current execution of cam segment number
S1+1	Errcode	INT16S	-	Error code
S1+4	Recordposition	FP64	Instruction Unit	Probe latch position
State parameters	Parameter Name	Data type	Unit	Note
S2	Insync	BOOL	-	Synchronization flag

S2+1	Busy	BOOL	-	Instruction is currently being executed
S2+2	Active	BOOL	-	Command activated
S2+3	Abort	BOOL	-	Instruction interrupt flag
S2+4	Err	BOOL	-	Specify error
S2+5	Endofprofile	BOOL	-	End mark of camshaft cycle
S2+6	Probedone	BOOL	-	Probe latch completed

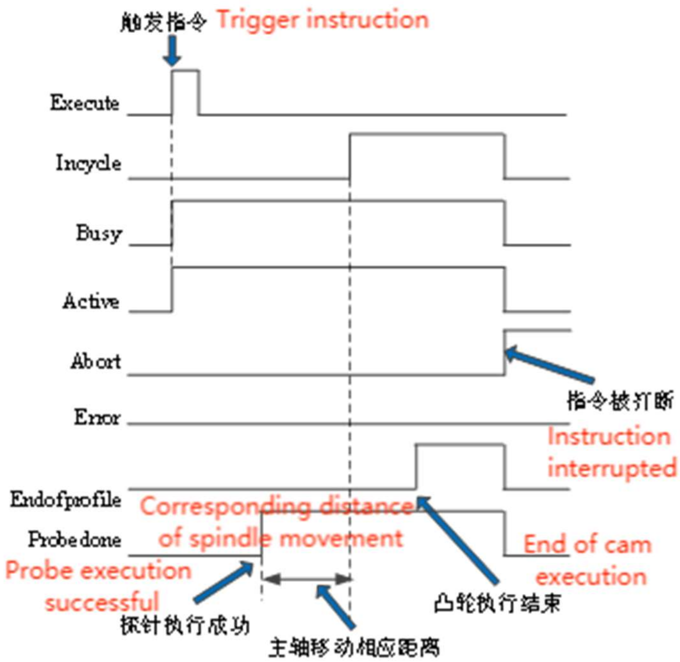
7) Time series diagram

■ The timing diagram in immediate trigger mode is shown in the following figure (taking a single cycle cam as an example)



Note:
Trigger command, set the busy and active signals, and wait for the probe to complete the signal.
After the probe execution is completed, the probe and insync signals are set simultaneously, and the cam movement begins at this point.
When the single cycle cam execution ends, the endofprofile signal is set.
When the instruction is interrupted, the abort signal is set and all other states are reset.
When there is an error in the instruction, execute the instruction, set err, and output the corresponding error code.

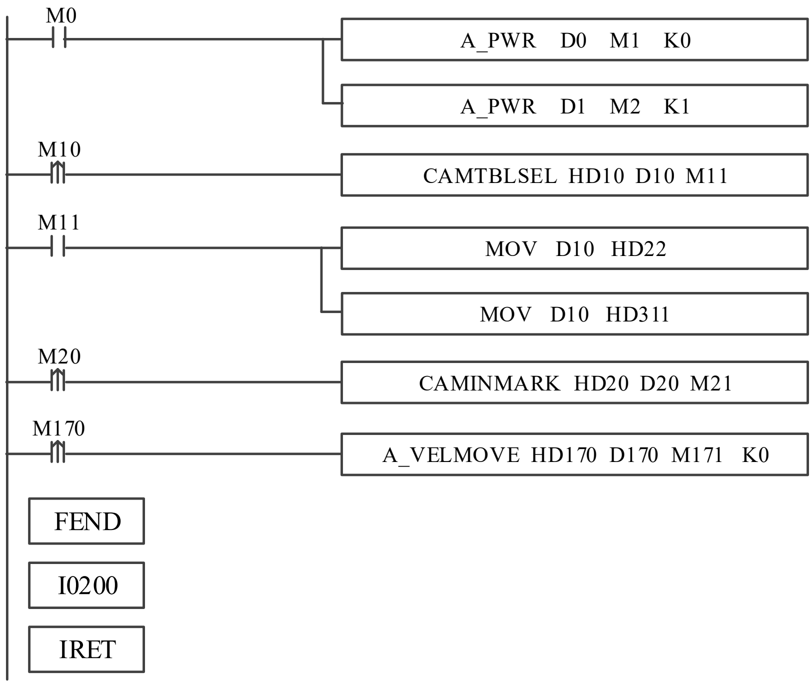
■ The timing diagram under distance triggering mode is shown in the following figure (taking a single cycle cam as an example)



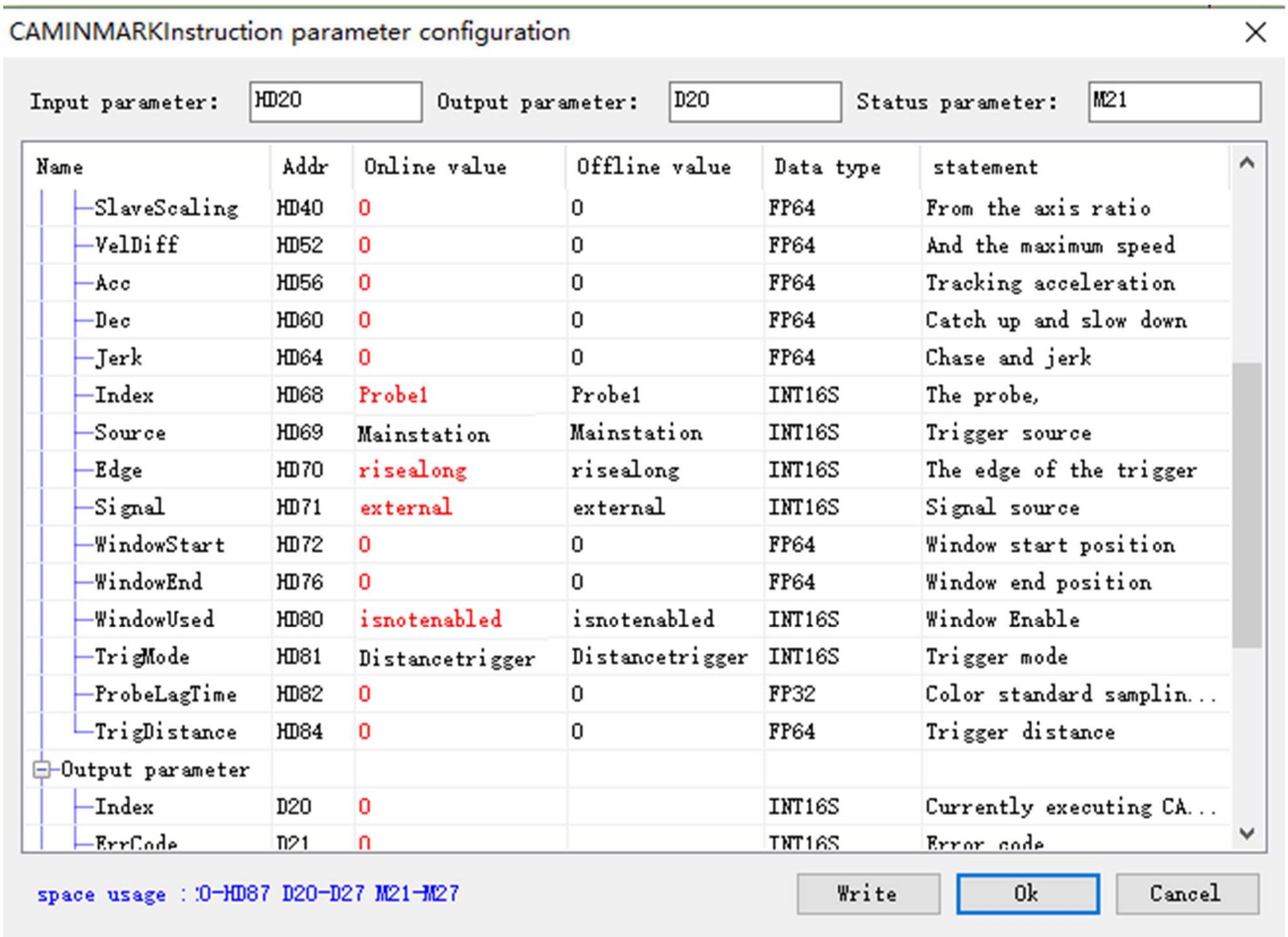
Note:
Trigger command, set the busy and active signals, and wait for the probe to complete the signal.
After the probe execution is completed, the probe is set to position.
When the spindle continues to move after the probe is completed and the trigger distance is set, the insync signal is set to start cam motion.
When the single cycle cam execution ends, the endofprofile signal is set.
When the instruction is interrupted, the abort signal is set and all other states are reset.
When there is an error in the instruction, execute the instruction, set err, and output the corresponding error code.

8) Example

There is a photoelectric signal connected to the main shaft, which causes the main shaft to touch the photoelectric signal and continue to move for a distance of 100. Immediately, the cam relationship binding is performed, and the cam movement starts from the shaft (the probe signal is received from the Y signal to the X signal, simulating the probe signal in the main station mode).
The ladder program is shown in the following figure:



The command parameters are shown in the following figure:


CAMINMARKInstruction parameter configuration

Input parameter: HD20 Output parameter: D20 Status parameter: M21

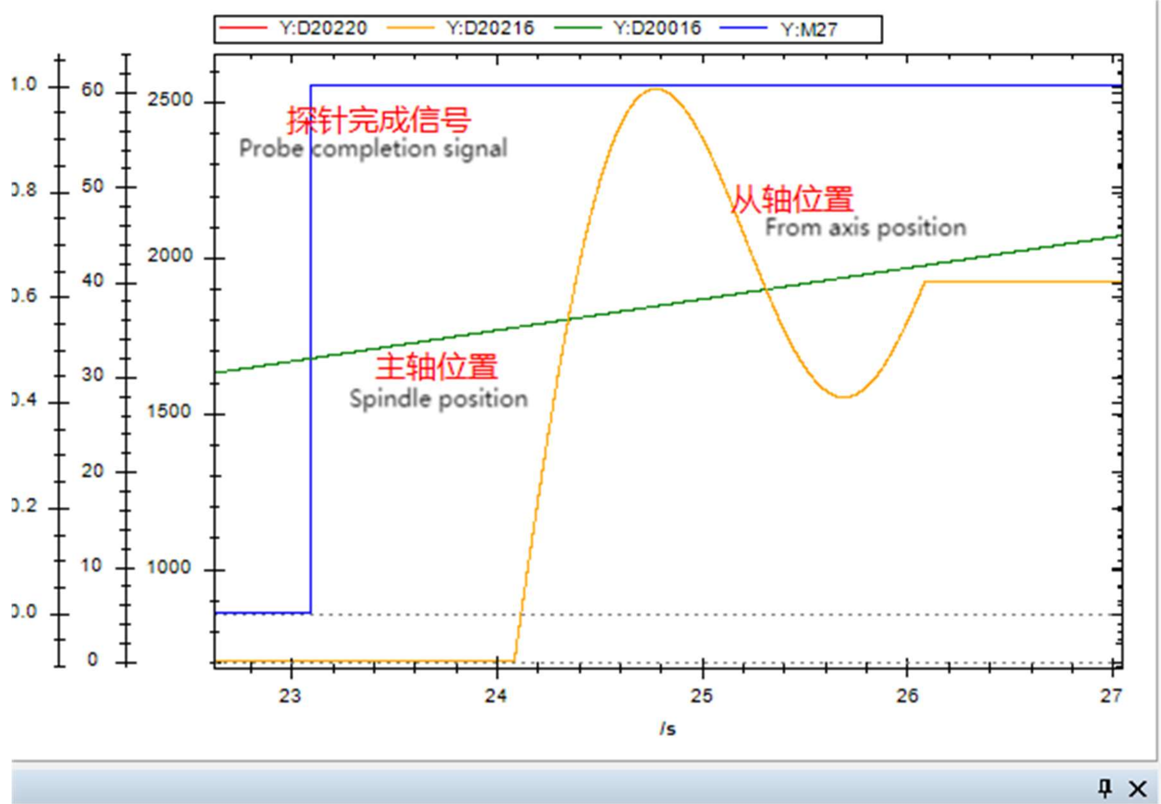
Name	Addr	Online value	Offline value	Data type	statement
SlaveScaling	HD40	0	0	FP64	From the axis ratio
VelDiff	HD52	0	0	FP64	And the maximum speed
Acc	HD56	0	0	FP64	Tracking acceleration
Dec	HD60	0	0	FP64	Catch up and slow down
Jerk	HD64	0	0	FP64	Chase and jerk
Index	HD68	Probe1	Probe1	INT16S	The probe,
Source	HD69	Mainstation	Mainstation	INT16S	Trigger source
Edge	HD70	risealong	risealong	INT16S	The edge of the trigger
Signal	HD71	external	external	INT16S	Signal source
WindowStart	HD72	0	0	FP64	Window start position
WindowEnd	HD76	0	0	FP64	Window end position
WindowUsed	HD80	isnotenabled	isnotenabled	INT16S	Window Enable
TrigMode	HD81	Distancetrigger	Distancetrigger	INT16S	Trigger mode
ProbeLagTime	HD82	0	0	FP32	Color standard samplin...
TrigDistance	HD84	0	0	FP64	Trigger distance
Output parameter					
Index	D20	0		INT16S	Currently executing CA...
ErrCode	D21	0		INT16S	Error code

space usage :0-HD87 D20-D27 M21-M27

Write Ok Cancel

Explanation: First, execute the A_PWR to enable the axis, then execute CAMTBLSEL to generate a cam table instance, then execute CAMIN to start the cam, and finally execute the A_VELMOVE to move spindle.

Execute the command and use an oscilloscope to capture the relevant parameters as shown in the following figure:



From the above figure, it is evident that there is a significant lag between the completion of the probe and the start of the cam movement from the shaft. By using a cursor to obtain the difference in time, it can be observed that during this period, the main shaft has just moved by the distance set in the command of 100.

CAMINMARKInstruction parameter configuration

Input parameter: HD20 Output parameter: D20 Status parameter: M21

Name	Addr	Online value	Offline value	Dat...	statement
WindowEnd	HD76	0	0	FP64	Window end position
WindowUsed	HD80	isnotenabled	isnotenabled	INT16S	Window Enable
TrigMode	HD81	Distancetrigger	Distancetrigger	INT16S	Trigger mode
ProbeLagTime	HD82	0	0	FP32	Color standard sampling lag ...
TrigDistance	HD84	100	100	FP64	Trigger distance
Output parameter					
Index	D20	1		INT16S	Currently executing CAM segm...
ErrCode	D21	0		INT16S	Error code
RecordPosition	D24	1674.0256409...		FP64	Probe latch position
Status parameter					
InSync	M21	True		BIT	Synchronization symbol
Busy	M22	True		BIT	Instruction executing flag
Active	M23	True		BIT	Instruction is activated
CmdAbt	M24	False		BIT	Instruction interrupt flag
Err	M25	False		BIT	Instruction error
EndOfProfile	M26	True		BIT	The end of the CAM table cyc...
ProbeDone	M27	True		BIT	Probe latch completed

space usage : 0-HD87 D20-D27 M21-M27

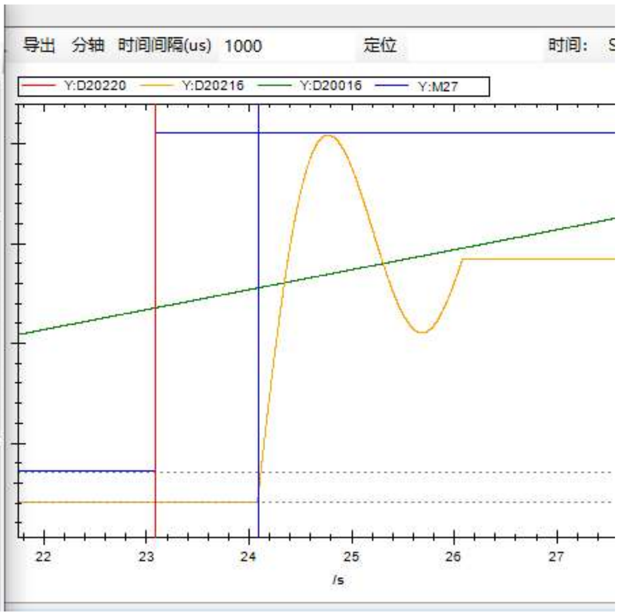
Write Ok Cancel

游标差值

时间 X轴 Y轴

StatusTime	C0	C1	C1-C0
Absolute Position	04:06:45:540	04:06:46:546	1.006s
Chart Position	00:23:087	00:24:093	1.006s

Channel	C0	C1	C1-C0
D20220	0	149.984118...	149.984118...
D20216	0	0.80291072...	0.80291072...
D20016	1673.96093...	1774.56093...	100.600000...
M27	0	1	1



5-3-2-29. Anti reversal curve generation 【CAMANTIREVTBLGEN】

1) Instruction Overview

Photoelectric trigger cam [CAMINMARK]			
Conditions for execution	Normally open/closed coil	Application	XDH, XLH, XG2
Firmware requirements	V3.7.3 and above	Software requirements	V 3.7.16 and above

Note: XDH and XLH -L series products do not support this command.

2) Operand

Operand	Role	Types
S0	Specify the starting address of input parameters	64 bit, quadword
S1	Specify the starting address of the output status word	16 bit, quadword
S2	Specify the starting address of the output status bit	Bit

3) Applicable soft components

Operand	Word soft component											Bit soft component					
	System								Constant	Module		System					
	D*	FD	TD*	CD*	DX	DY	DM*	DS*	K/H	ID	QD	X	Y	M*	S*	T*	C*
S0	●	●	●	●													
S1	●	●	●	●													
S2														●			

Note: D represents D and HD. TD represents TD and HTD. CD represents CD, HCD, HSCD, HSD. DM stands for DM and DHM. DS represents DS and DHS. M represents M, HM, SM. S represents S and HS. T represents T and HT. C represents C and HC.

4) Function and Action

- S0 specifies the starting address of the input parameter, occupying registers S0~S0+32.
- S1 specifies the starting address of the output status word, occupying registers S1~S1+1.
- S2 specifies the starting address of the output status bit, occupying registers S2~S2+2.

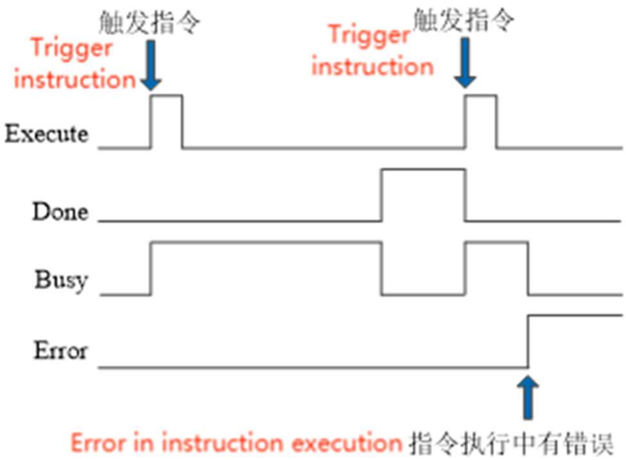
5) Note

- When the cam is in use, it only supports the cam cycle to take effect. When not in use, both modes are supported.
- PointId starts from 0 and increases sequentially, and the position of the primary and secondary axes of the 0th keypoint must be (0,0), and the curve type of the 0th keypoint is invalid.
- The total number of key points must be greater than or equal to 2.
- The error source ID defaults to 65535 when there are no errors during instruction execution.
- The anti reversal curve (53) is designed to prevent inversion during trajectory planning of cubic or quintic curves. If the curve does not undergo inversion, it is treated as a regular cubic or quintic curve. If inversion occurs, it is treated as an anti reversal curve. The type of cubic or quintic curve is determined by the parameter [anti reversal curve type].
- When there is a starting or ending speed of 0, the speed is divided into two stages for planning: when the starting speed is 0, the shaft comes to a standstill first and then changes speed; When the termination speed is 0, shift the speed from the shaft first and then come to a standstill.
- When the starting and ending speeds are not 0, a three-stage processing will be performed from the axis speed, with a uniform speed processing in the middle, which is linearly related to the minimum speed ratio. The anti reverse minimum speed will only take effect in this case, and will not participate in the verification in other cases.
- Anti reverse minimum speed=Anti reverse minimum speed ratio * Cam table spindle mold value/Cam cycle.
- There are limitations to modifying curves - there may be misjudgments, and curves that will not produce reversals should be treated with anti reversal measures.
- This instruction can only generate universal curves and anti reversal curves.

6) Related parameters

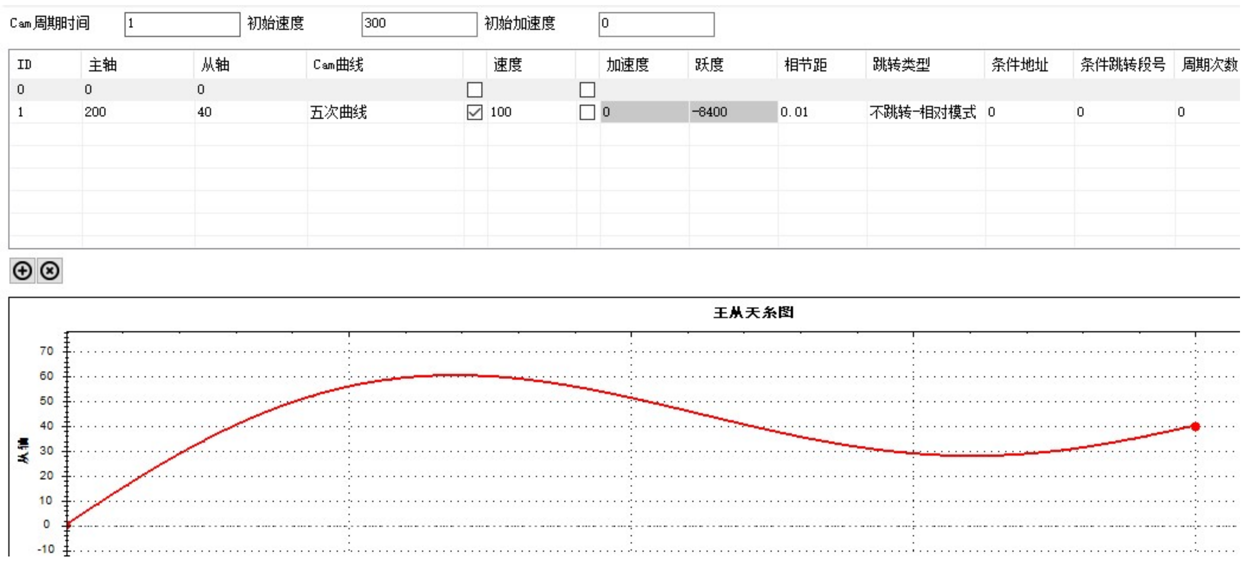
Input parameter	Parameter Name	Data type	Unit	Note
S0	Count	INT16U	-	Number of key points
S0+1	Camtblid	INT16S	-	Camometer instance ID
S0+2	Mode	INT16U	-	Effective mode 0: Effective immediately 1: Effective in the next cycle
S0+4	Pointid:	INT16U	-	Spindle position
S0+8	Masterpos	FP64	-	From axis position
S0+12	Slaverpos	FP64	-	From axis position
S0+16	Vel	FP64	-	Reference speed
S0+20	Acc	FP64	-	Reference acceleration
S0+24	Type	INT16U	-	Curve type
S0+28	Antirevvelmi	FP64	-	Minimum anti reverse speed ratio
S0+32	Antirevtype	INT16U	-	Anti reversal curve type 0: Triple anti reverse 1: Five times anti reversal
Output parameter	Parameter Name	Data type	Unit	Note
S1	Errcode	INT16S	-	Error code
S1+1	Errcodeid	INT16S	-	Error Key ID
State parameters	Parameter Name	Data type	Unit	Note
S2	Insync	BOOL	-	Instruction execution completed
S2+1	Busy	BOOL	-	Instruction is currently being executed
S2+2	Active	BOOL	-	Instruction execution error

7) Time series diagram



Note:
Trigger the command, set the Busy signal, and when the command is completed, the Busy signal resets and the Done signal is set.
When there is an error during instruction execution, the Error signal is set, all other signals are reset, and the corresponding error code is output.

8) Example
Modify the fifth degree curve that produces inversion as shown in the following figure to a curve that does not reverse.



The ladder diagram is shown in the following figure:

M0 A_PWR D0 M1 K0

A_PWR D1 M2 K1

M10 CAMTBLSEL HD10 D10 M11

M11 MOV D10 HD22

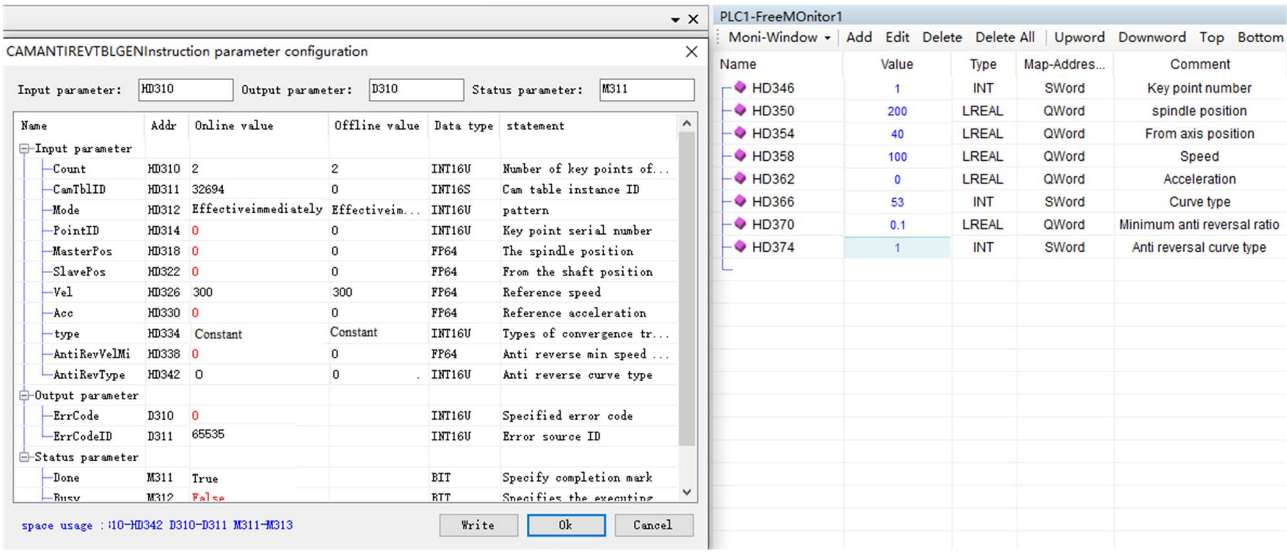
MOV D10 HD311

M20 CAMIN HD20 D20 M21

M70 A_VELMOVE HD70 D70 M71 K0

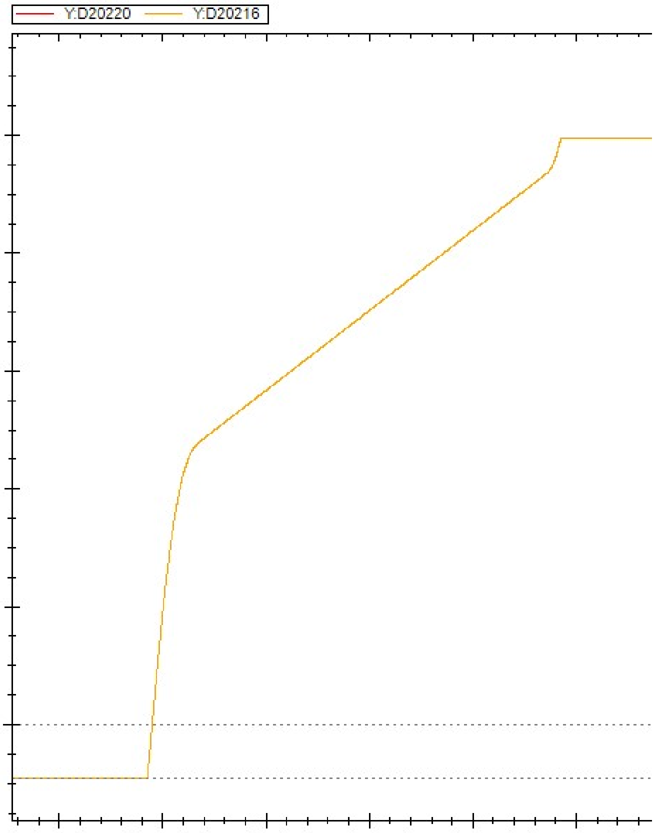
M310 CAMANTIREVTBLGEN HD310 D310 M311

The command parameters are shown in the following figure:

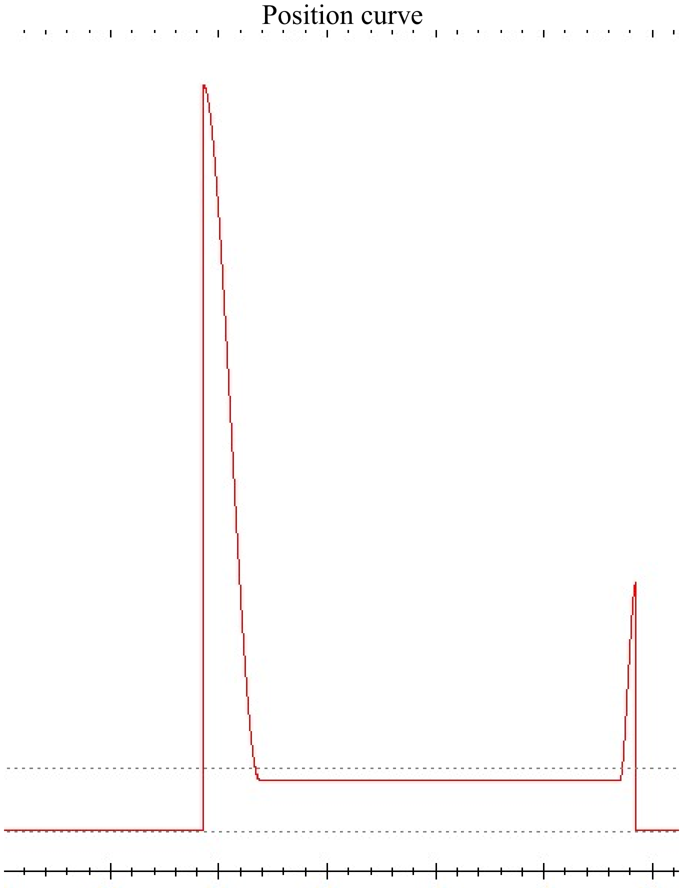


Note:Firstly, execute the enabling of the A_ PWR to activate the axis, then execute CAMTBLSEL to generate an instance of the cam table, then execute CAMANTIREVTBLSEL to generate the anti reverse curve, then execute

CAMIN to activate the cam, and finally execute the A_VELMOVE to move spindle.
Single cycle execution of the cam, using an oscilloscope to monitor the position and speed curve of the slave shaft as shown in the following figure:



Position curve



Velocity curve

From the above curve, it can be seen that under the anti reverse curve, with the same parameters, the cam trajectory will not reverse. It can be clearly seen from the speed curve that the anti reverse curve has processed the speed in three stages.

5-3-3. Related registers

(V3.7.2 and later versions can support, N: slave axis number)

Address	Definition	Data type	Unit	Note
D20148+200*N	Cycle jump counting	INT16U	-	Cycle jump times of each segment
D20152+200*N	Master axis absolute position when camin	FP64	Command unit	
D20156+200*N	Slave axis given position when camin	FP64	Command unit	
D20160+200*N	Slave axis feedback position when camin	FP64	Command unit	
D20164+200*N	Cam master axis phase	FP64	Command unit	The position of the master axis relative to the cam table
D20168+200*N	Cam slave axis phase	FP64	Command unit	The position of the slave axis relative to the cam table
D20172+200*N	EOP positive direction counting value	INT64U		Number of EOP generated when the master axis moves forward
D20176+200*N	EOP negative direction counting value	INT64U		Number of EOP generated when the master axis moves reverse
D20180+200*N	User defined cam master axis position	FP64	Command unit	
D20184+200*N	User defined cam slave axis position	FP64	Command unit	

5-4. EtherCAT read and write instructions

5-4-1. Instruction Overview

Instruction mnemonic	Function	Chapter
EC_SDORD	SDO Read Instruction	5-4-2-1
EC_SDOWR	SDO Write instructions	5-4-2-2
EC_REGRD	ESC Read Instruction	5-4-2-3
EC_ESCWR	ESC Write Instruction	5-4-2-4
EC_SETSS	ESM state switching command	5-4-2-5

5-4-2. Instruction Introduction

5-4-2-1. SDO Read Instruction【EC_SDORD】

1) Instruction Overview

Read the SDO value from the target station and store it in the local register.

SDO object read [EC_SDORD]			
Conditions for execution	Edge trigger	Application	XDH, XLH, XG2
Firmware requirements	V3.6.1b and above	Software requirements	V3.7.4 and above

2) Operand

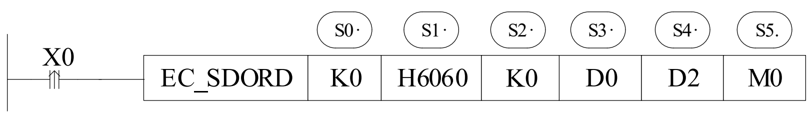
Operand	Role	Particular range	Types
S0	EtherCAT slave station number Station ID	0~63	16 bit constant or single word register
S1	Object Index	0x1000~0xffff	16 bit constant or single word register
S2	Object subindex subIndex	0~255	16 bit constant or single word register
S3	Stored value register		Single word register
S4	Status register		Single word register
S5	Completion Flag		Bit

3) Applicable soft components

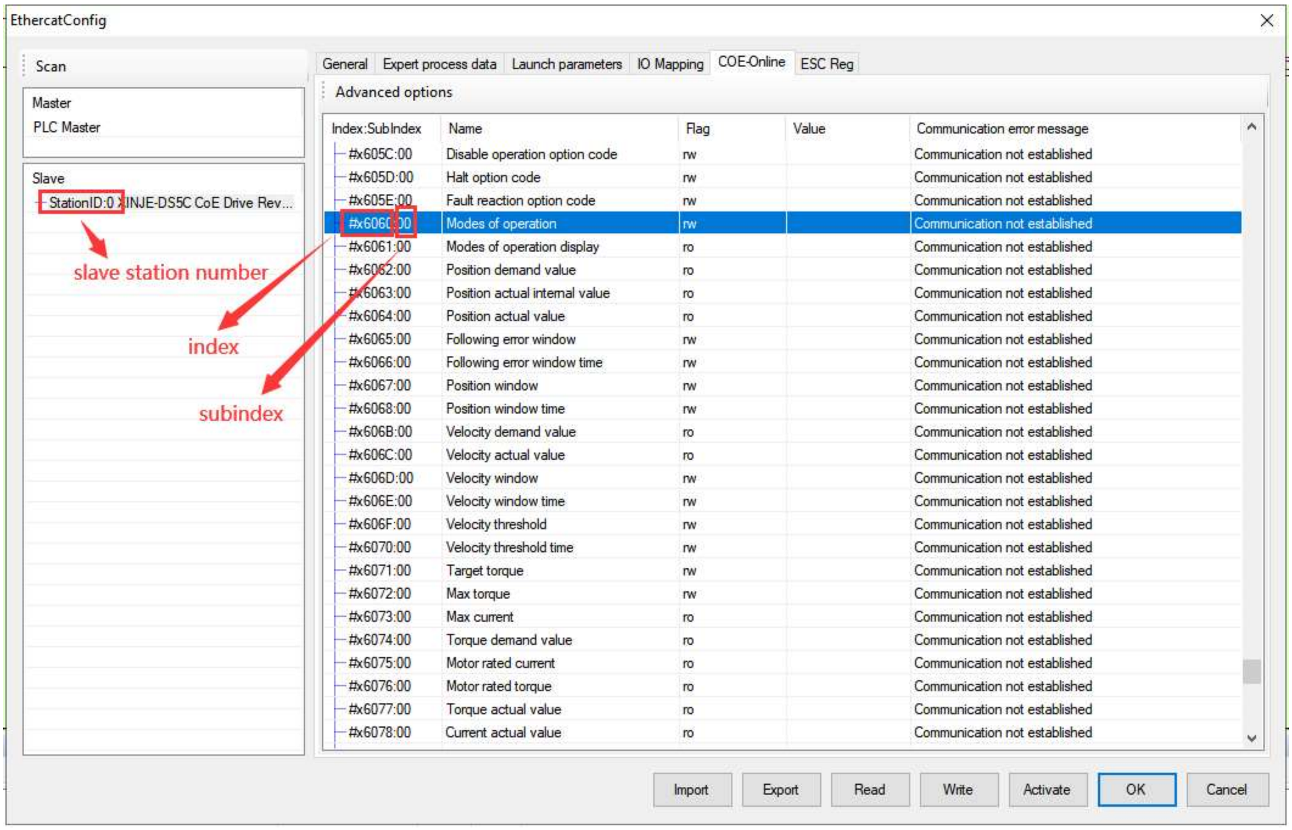
Operand	Word soft components											Bit soft components						
	System								Constant	Module		System						
	D	FD	TD	CD	DX	DY	DM	DS	K/H	ID	QD	X	Y	M	S	T	C	Dn.m
S0	●								●									
S1	●								●									
S2	●								●									
S3	●																	
S4	●																	
S5												●	●	●	●	●	●	

Note: D represents D and HD. TD represents TD and HTD. CD represents CD, HCD, HSCD, HSD. DM stands for DM and DHM. DS represents DS and DHS. M represents M, HM, SM. S represents S and HS. T represents T and HT. C represents C and HC.

4) Function and Action



- Read the value from the slave object dictionary 0x6060:00 with StationID 0 to D0.
- The EC_SDORD instruction is used to read values from the station object dictionary.



The diagram shows the slave station and its corresponding object dictionary index. If it is necessary to read the value from the current 0x6060:00 of the slave station with StationID 0 to D0, the following figure is an example:

X0		S0·	S1·	S2·	S3·	S4·	S5.
	EC_SDORD	K0	H6060	K0	D0	D2	M0

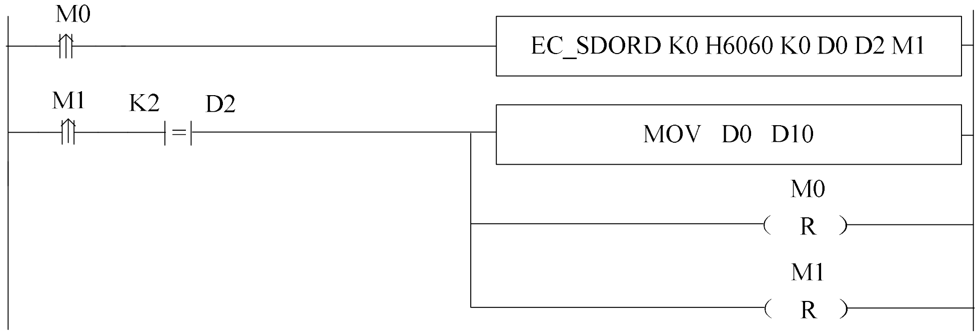
S0: K0 or write 0 in the corresponding register. **Note: The first station ID is 0 instead of 1.**
S1: H6060 or write K24672 (H6060) in the corresponding register.
S2: Currently 00, therefore write K0 or write 0 in the corresponding register.
S3: The read value is stored locally in D0.
S4: Display the current processing status of instructions.
S5: Instruction processing completion flag, **Regardless of whether the read value is successful or not, it only indicates that the instruction processing has ended and will not be actively reset.**

The meaning of each status code for the corresponding Operand S4 in the table:

Operand	Status	Meaning of status	Note
S4	0	Waiting for processing	Set to 0 immediately after the instruction is triggered
	1	Processing	
	2	Instruction processing successful	
	3	No such command	Confirm whether the upper computer version matches the lower computer version
	4	No such slave station	Confirm if the S0 parameters are correct, or check if the slave station connection is normal
	5	Slave Station Busy	
	6	Instruction processing timeout	
	7	Parameter error	Check S1 and S2 parameters
	8	Unknown error	Check the rationality of programming
	20	Write value too large	Check S1 and S2 parameters
	21	Slave in unreadable state	
	22	This object only writes	
	23	This object is read-only	

	24	No such SDO	
	25	No sub indexes for this SDO	

When using EC_SDORD for programming, it is necessary to standardize according to the meaning of the instruction Operand. The completion flag of the S5 instruction in the instruction indicates that the processing of the instruction has been completed, and other EtherCAT communication instructions can be read and written at this time. Regardless of whether the current read/write is successful or not, S5 will be set, so other EtherCAT communication instructions need to wait for them to be set before executing during programming, as shown in the following figure:



After setting the Operand S5 (M1), check the status of S4 (D2). Based on the status code, if the instruction is successfully processed, the read register can be assigned values and other operations can be performed. Due to the completion flag M1 not actively resetting and requiring manual resetting, RST M1.

5-4-2-2. SDO Write Instruction 【EC_SDOWR】

1) Instruction Overview

Write the value from the local register to the target slave's object SD0.

SDO object read [EC_SDORD]			
Conditions for execution	Edge trigger	Application	XDH, XLH, XG2
Firmware requirements	V3.6.1b and above	Software requirements	V 3.7.4 and above

2) Operand

Operand	Role	Particular range	Types
S0	EtherCAT slave station number : Station ID	0~63	16 bit constant or single word register
S1	Object Index	0x1000~0xffff	16 bit constant or single word register
S2	Object subindex subIndex	0~255	16 bit constant or single word register
S3	Write value register		Single word register
S4	Write value byte length		16 bit constant or single word register
S5	Status register		Single word register
S6	Completion Flag		Bit

3) Applicable soft components

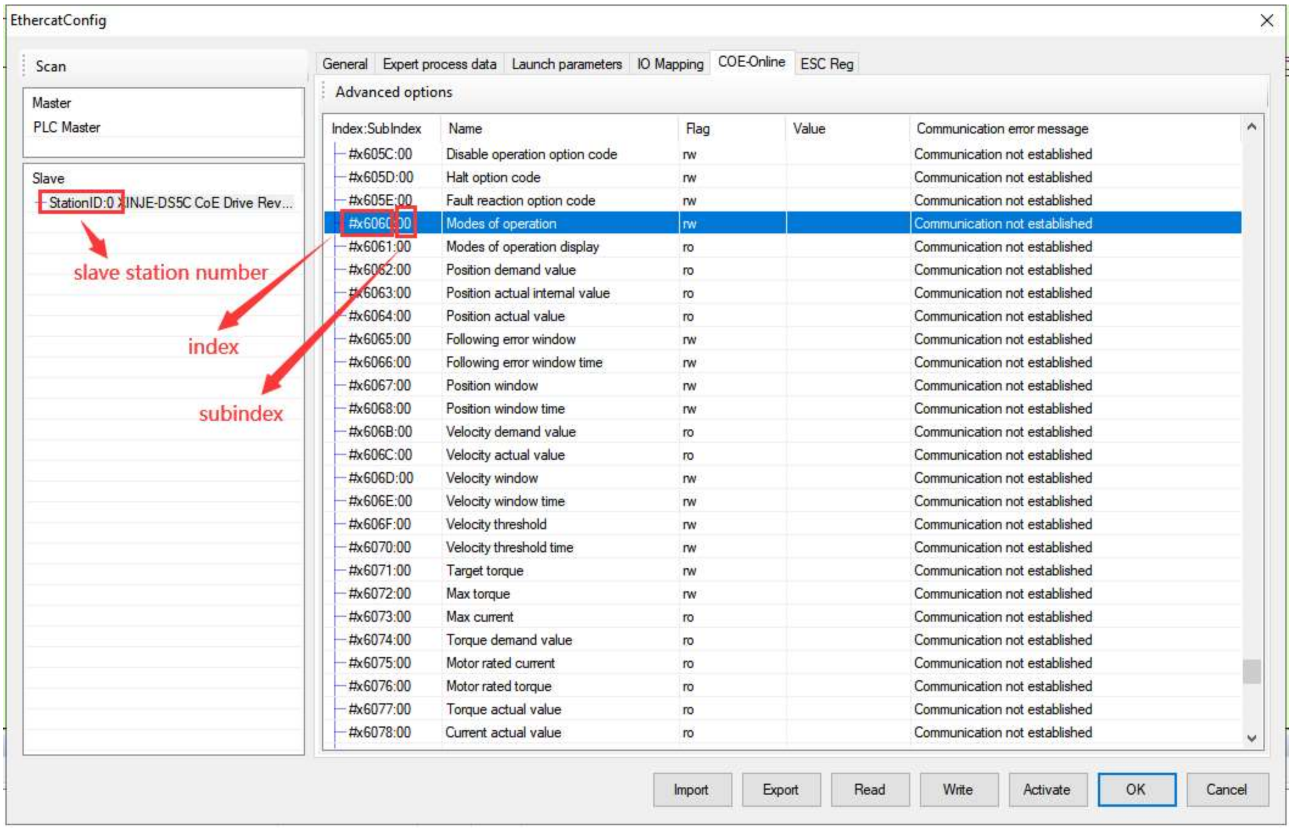
Operand	Word soft components											Bit soft components						
	System								Constant	Module		System						
	D	FD	TD	CD	DX	DY	DM	DS	K/H	ID	QD	X	Y	M	S	T	C	Dn.m
S0	●								●									
S1	●								●									
S2	●								●									
S3	●																	
S4	●								●									
S5	●																	
S6												●	●	●	●	●	●	

Note: D represents D and HD. TD represents TD and HTD. CD represents CD, HCD, HSCD, HSD. DM stands for DM and DHM. DS represents DS and DHS. M represents M, HM, SM. S represents S and HS. T represents T and HT. C represents C and HC.

4) Function and Action

X0		S0·	S1·	S2·	S3·	S4·	S5·	S6·
⫛	EC_SDOWR	K0	H6060	K0	D0	K2	D2	M0

- Write the two bytes value with the starting address D0 into the slave object dictionary 0x60600:00 with StationID 0.
- The EC_SDOWR instruction is used to write the value of the slave object dictionary.



The diagram shows the slave station and its corresponding object dictionary index. The following figure is an example:

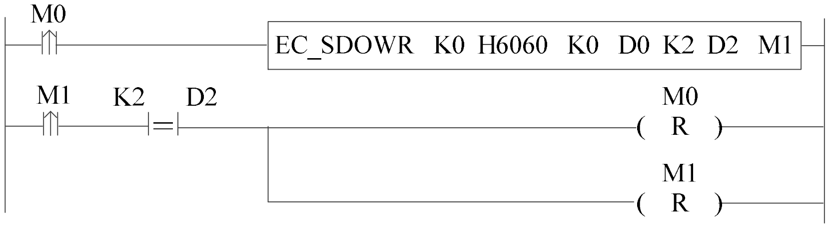
X0		S0·	S1·	S2·	S3·	S4·	S5·	S6·
	EC_SDOWR	K0	H6060	K0	D0	K2	D2	M0

S0: K0 or write 0 in the corresponding register.Note: The first station ID is 0 instead of 1.
S1: H6060 or write K24672 (H6060) in the corresponding register.
S2: Currently 00, therefore write K0 or write 0 in the corresponding register.
S3: The value starting from register D0 will be written to the object SDO.
S4: Write length, for example, K2 writes 2 bytes, which is the length of a single word register. If K4 is written, it occupies the D0 D1 register in this example.
S5: Display the current processing status of instructions.
S6: Instruction processing completion flag, regardless of whether the read value is successful or not, it only indicates that the instruction processing has ended and will not be actively reset.
The meaning of each status code for the corresponding Operand S5 in the table:

Operand	Status	Meaning of status	Note
S5	0	Waiting for processing	Set to 0 immediately after the instruction is triggered
	1	Processing	
	2	Instruction processing successful	
	3	No such command	Confirm whether the upper computer version matches the lower computer version
	4	No such slave station	Confirm if the S0 parameters are correct, or check if the slave station connection is normal
	5	Slave Station Busy	
	6	Instruction processing timeout	
	7	Parameter error	Check S1 and S2 parameters
	8	Unknown error	Check the rationality of programming
	20	Write value too large	Check S1 and S2 parameters
	21	Slave in unreadable state	
	22	This object only writes	
	23	This object is read-only	

	24	No such SDO	
	25	No sub indexes for this SDO	

When programming with EC_SDOWR, it is necessary to standardize according to the meaning of the instruction Operand. The completion flag of the S6 instruction in the instruction indicates that the processing of the instruction has been completed, and other EtherCAT communication instructions can be read and written at this time. Regardless of whether the current read/write is successful, S6 will be set, so other EtherCAT communication instructions need to wait for them to be set before executing during programming, as shown in the following figure:



After setting the Operand S6 (M1), check the status of S5 (D2). Based on the status code, if the instruction is successfully processed, the read register can be assigned values and other operations can be performed. Due to the completion flag M1 not actively resetting and requiring manual resetting, RST M1.

5-4-2-3. ESC Read Instruction【EC_REGRD】

1) Instruction Overview

Read the value of the ESC register from the target station and store it in the local register.

SDO object read [EC_SDORD]			
Conditions for execution	Edge trigger	Application	XDH, XLH, XG2
Firmware requirements	V3.6.1b and above	Software requirements	V 3.7.4 and above

2) Operand

Operand	Role	Particular range	Types
S0	EtherCAT slave station number : Station ID	0~63	16 bit constant or single word register
S1	ESC register start address	0x1000~0xffff	16 bit constant or single word register
S2	Read Byte Length	0~255	Single word register
S3	Store value start register		Single word register
S4	Status register		Single word register
S5	Completion Flag		Bit

3) Applicable soft components

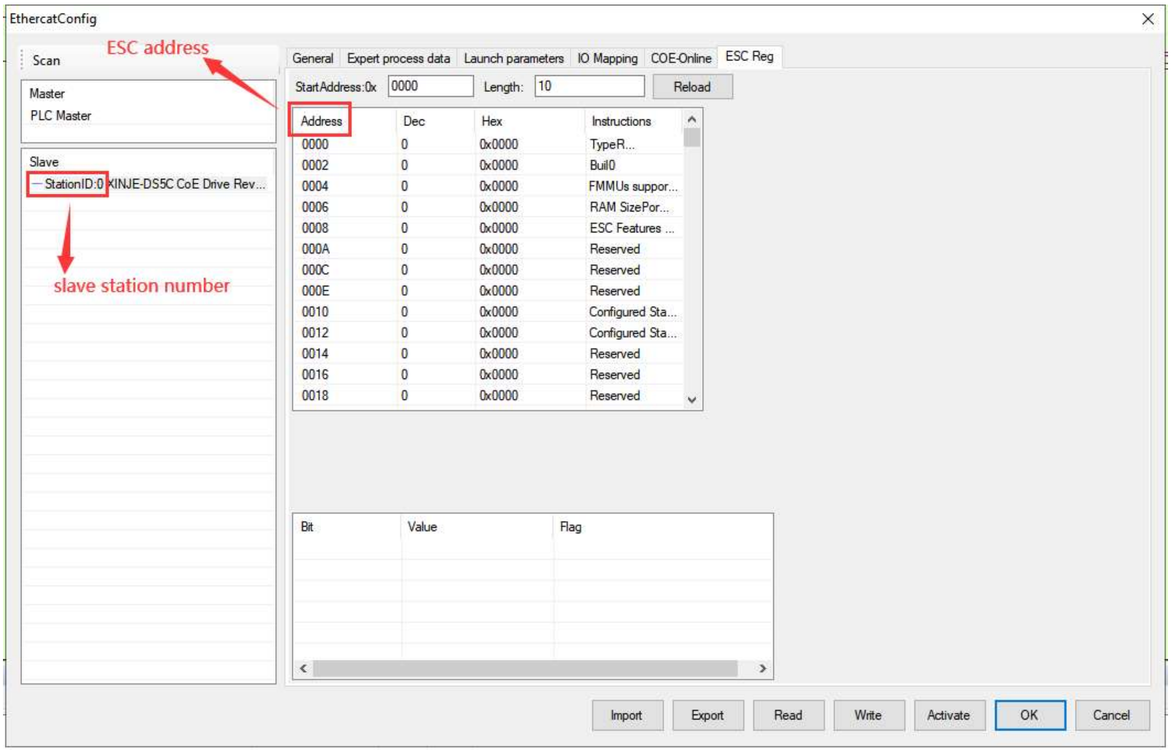
Operand	Word soft components											Bit soft components						
	System								Constant	Module		System						
	D	FD	TD	CD	DX	DY	DM	DS	K/H	ID	QD	X	Y	M	S	T	C	Dn.m
S0	●								●									
S1	●								●									
S2	●																	
S3	●																	
S4	●																	
S5												●	●	●	●	●	●	

Note: D represents D and HD. TD represents TD and HTD. CD represents CD, HCD, HSCD, HSD. DM stands for DM and DHM. DS represents DS and DHS. M represents M, HM, SM. S represents S and HS. T represents T and HT. C represents C and HC.

4) Function and Action

X0		S0·	S1·	S2·	S3·	S4·	S5.
	EC_REGRD	K0	H100	D4	D0	D2	M0

- Read the value of the slave ESC register address with StationID 0 into D0.
- The EC_REGRD instruction is used to read slave station ESC address.



The diagram shows the ESC parameter interface. If it is necessary to read the value of the current ESC address H100 of the slave station with StationID 0, the following figure is an example:

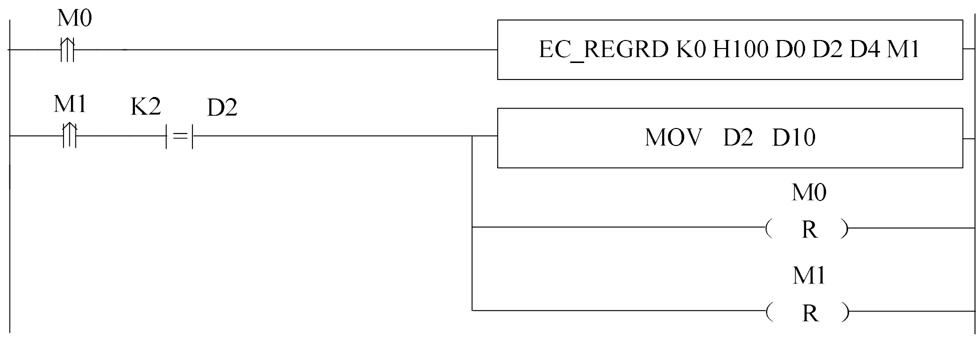
		S0·	S1·	S2·	S3·	S4·	S5.
X0	EC_REGRD	K0	H100	D4	D0	D2	M0

S0: K0 or write 0 in the corresponding register. **Note: The first station ID is 0 instead of 1**.
S1: H100 or write K256 (H100) in the corresponding register.
S2: The ESC address corresponds to a byte. If D4 is written as 1, it means reading the value of H100 to D0. If 2 is written, it means reading the value of H100 H102 to D0 D1, and so on.
S3: The read value is stored locally in D0.
S4: Display the current processing status of instructions.
S5: Instruction processing completion flag, **regardless of whether the read value is successful or not, it only indicates that the instruction processing has ended and will not be actively reset**.

The meaning of each status code for the corresponding Operand S4 in the table:

Operand	Status	Meaning of status	Note
S4	0	Waiting for processing	Set to 0 immediately after the instruction is triggered
	1	Processing	
	2	Instruction processing successful	
	3	No such command	Confirm whether the upper computer version matches the lower computer version
	4	No such slave station	Confirm if the S0 parameters are correct, or check if the slave station connection is normal
	5	Slave Station Busy	
	6	Instruction processing timeout	
	7	Parameter error	Check S1 and S2 parameters
	8	Unknown error	Check the rationality of programming
	20	Address parameter exceeded limit	Check if S1 is reasonable
	21	Invalid length	Check if S1 and S2 are reasonable
	22	Incorrect slave station position	Check if there is a slave station available
	23	Request failure	Retry

When using EC_REGRD for programming, it is necessary to standardize according to the meaning of instruction Operands. The completion flag of the S5 instruction in the instruction indicates that the processing of the instruction has been completed, and other EtherCAT communication instructions can be read and written at this time. Regardless of whether the current read/write is successful or not, S5 will be set, so other EtherCAT communication instructions need to wait for them to be set before executing during programming, as shown in the following figure:



After setting the Operand S5 (M1), check the status of S4 (D2). Based on the status code, if the instruction is successfully processed, the read register can be assigned values and other operations can be performed. Due to the completion flag M1 not actively resetting and requiring manual resetting, RST M1.

5-4-2-4. ESC Write Instruction【EC_REGWR】

1) Instruction Overview

Write the value from the local register to the ESC address of the target slave station.

SDO object read [EC_SDORD]			
Conditions for execution	Edge trigger	Application	XDH, XLH, XG2
Firmware requirements	V3.6.1b and above	Software requirements	V 3.7.4 and above

2) Operand

Operand	Role	Particular range	Types
S0	EtherCAT slave station number : Station ID	0~63	16 bit constant or single word register
S1	ESC register start address	0x1000~0xffff	16 bit constant or single word register
S2	Write value start register		Single word register
S3	Write value byte length		16 bit constant or single word register
S4	Status register		Single word register
S5	Completion Flag		Bit

3) Applicable soft components

Operand	Word soft components											Bit soft components						
	System								Constant	Module		System						
	D	FD	TD	CD	DX	DY	DM	DS	K/H	ID	QD	X	Y	M	S	T	C	Dn.m
S0	●								●									
S1	●								●									
S2	●																	
S3	●								●									
S4	●																	
S5												●	●	●	●	●	●	

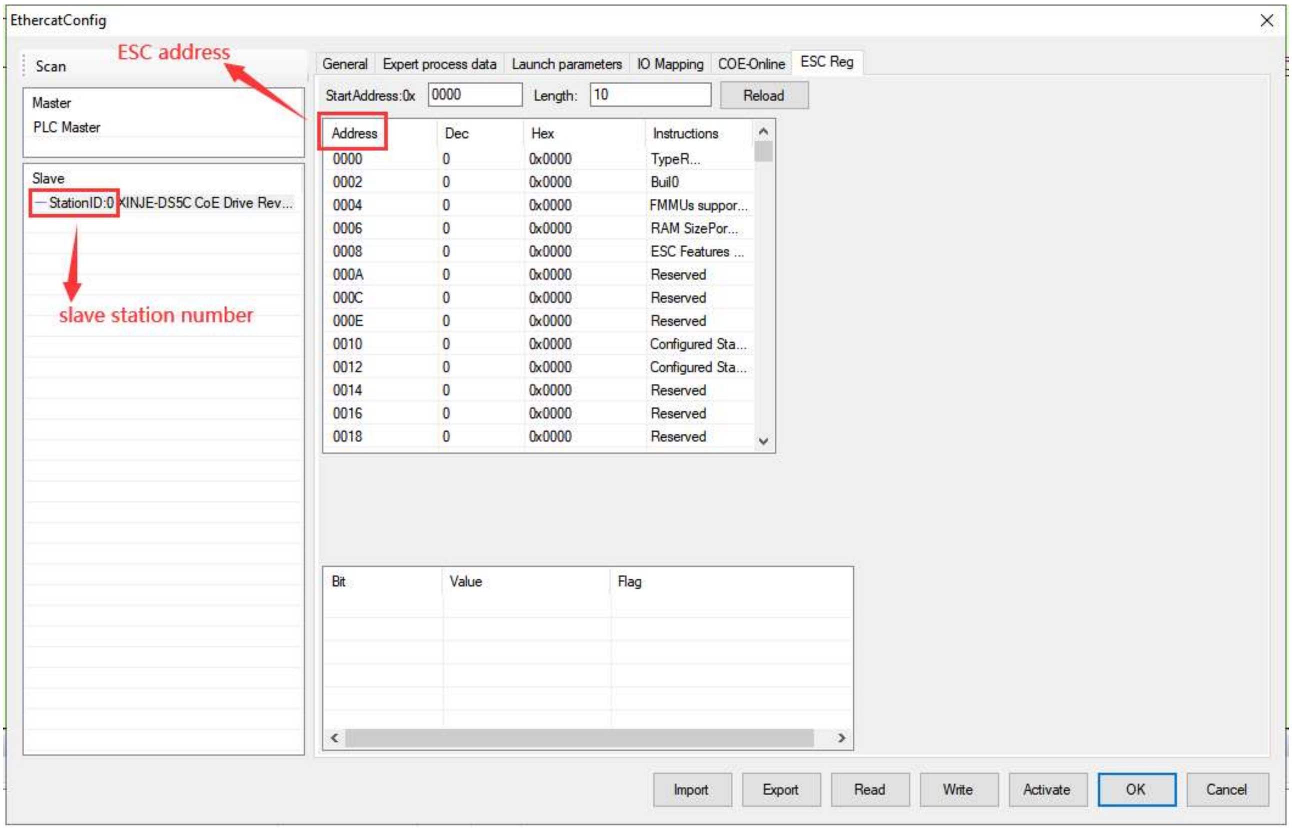
Note: D represents D and HD. TD represents TD and HTD. CD represents CD, HCD, HSCD, HSD. DM stands for DM and DHM. DS represents DS and DHS. M represents M, HM, SM. S represents S and HS. T represents T and HT. C represents C and HC.

4) Function and Action

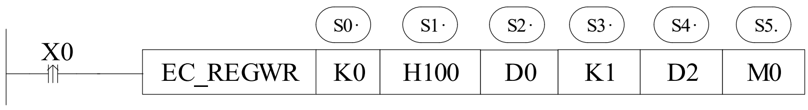
X0

	S0·	S1·	S2·	S3·	S4·	S5.
EC_REGWR	K0	H100	D0	K1	D2	M0

- Write the value of D0 as the starting address into the slave ESC register address with StationID 0.
- The EC_REGWR instruction is used to write the ESC address of the slave station.



The diagram shows the ESC parameter interface. If it is necessary to write a value to the current ESC address H100 of the slave station with StationID 0, the following figure is an example:



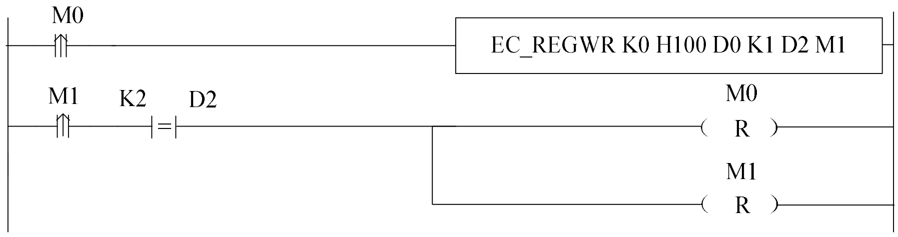
S0: K0 or write 0 in the corresponding register. **Note: The first station ID is 0 instead of 1.**
S1: H100 or write K256 (H100) in the corresponding register.
S2: Write register start address.
S3: The ESC address corresponds to a byte, where K1 represents the value of D0 written to H100. If K2 represents the value of D0 and D1 written to H100, H102, and so on.
S4: Display the current processing status of instructions.
S5: Instruction processing completion flag, **regardless of whether the read value is successful or not, it only indicates that the instruction processing has ended and will not be actively reset.**

The meaning of each status code for the corresponding Operand S4 in the table:

Operand	Status	Meaning of status	Note
S4	0	Waiting for processing	Set to 0 immediately after the instruction is triggered
	1	Processing	
	2	Instruction processing successful	
	3	No such command	Confirm whether the upper computer version matches the lower computer version
	4	No such slave station	Confirm if the S0 parameters are correct, or check if the slave station connection is normal
	5	Slave Station Busy	
	6	Instruction processing timeout	
	7	Parameter error	Check S1 and S2 parameters
	8	Unknown error	Check the rationality of programming
	20	Address parameter exceeded limit	Check if S1 is reasonable
	21	Invalid length	Check if S1 and S2 are reasonable
	22	Incorrect slave station position	Check if there is a slave station available

	23	Request failure	Retry

When using EC_REGRD for programming, it is necessary to standardize according to the meaning of instruction Operands. The completion flag of the S5 instruction in the instruction indicates that the processing of the instruction has been completed, and other EtherCAT communication instructions can be read and written at this time. Regardless of whether the current read/write is successful or not, S5 will be set, so other EtherCAT communication instructions need to wait for them to be set before executing during programming, as shown in the following figure:



After setting the Operand S5 (M1), check the status of S4 (D2). Based on the status code, if the instruction is successfully processed, the read register can be assigned values and other operations can be performed. Due to the completion flag M1 not actively resetting and requiring manual resetting, RST M1.

5-4-2-5. ESM state switching instruction【EC_SETSS】

1) Instruction Overview

Switching from Station State Machine Instruction.

SDO object read [EC_SDORD]			
Conditions for execution	Edge trigger	Application	XDH, XLH, XG2
Firmware requirements	V3.6.1b and above	Software requirements	V 3.7.4 and above

2) Operand

Operand	Role	Particular range	Types
S0	EtherCAT slave station number : Station ID	0~63, 0xFFFF indicates switching all slave stations	16 bit constant or single word register
S1	ESM status	1、2、4、8	16 bit constant or single word register

3) Applicable soft components

Operand	Word soft components											Bit soft components						
	System								Constant	Module		System						
	D	FD	TD	CD	DX	DY	DM	DS	K/H	ID	QD	X	Y	M	S	T	C	Dn.m
S0	●								●									
S1	●								●									

Note: D represents D and HD. TD represents TD and HTD. CD represents CD, HCD, HSCD, HSD. DM stands for DM and DHM. DS represents DS and DHS. M represents M, HM, SM. S represents S and HS. T represents T and HT. C represents C and HC.

4) Function and Action

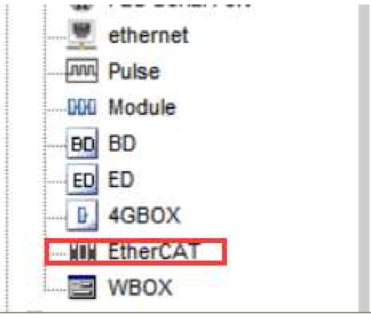
- Switch the slave ESM state machine with StationID 0 to 8.
- The slave ESM (EtherCAT Status Machine) can be switched through commands. The states are: 1: INT, 2: Pre OP, 4: Safe OP, 8: OP.
- The command must be triggered through the rising edge. After the instruction is executed, request a switch to the specified state from the slave station. It is not possible to guarantee immediate switching or successful switching. The switching status can be confirmed through SD [8021+20 * i]. If switching is not possible, the status switching error message can be confirmed through SD [8028+20 * i].

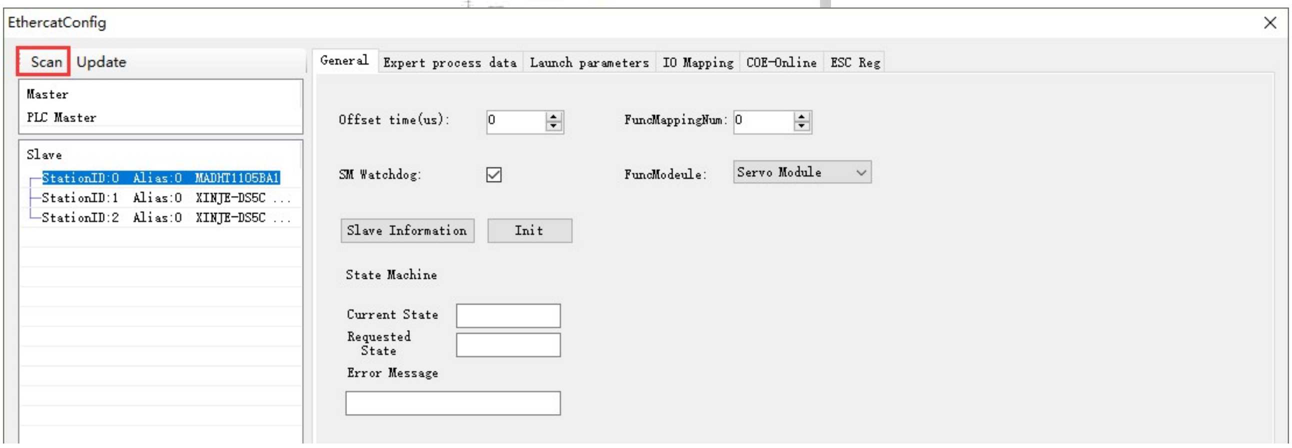
6. Motion command application

6-1. Single axis function application

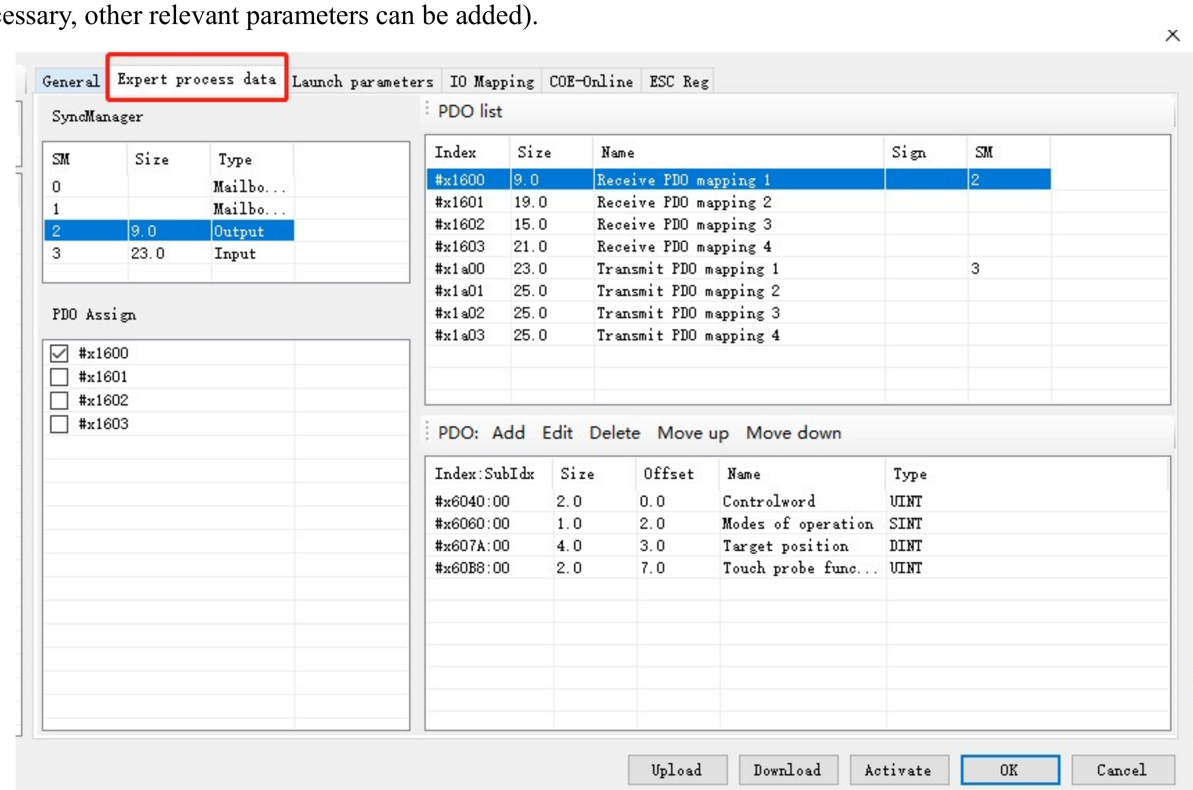
Taking Xinje DS5C as an example, the slave station runs 1310720 distance based on the current position at the speed of 131072. The operation method is as follows:

① When the slave station is an EtherCAT device, EtherCAT configuration is required first. Click [scan] in EtherCAT configuration interface:

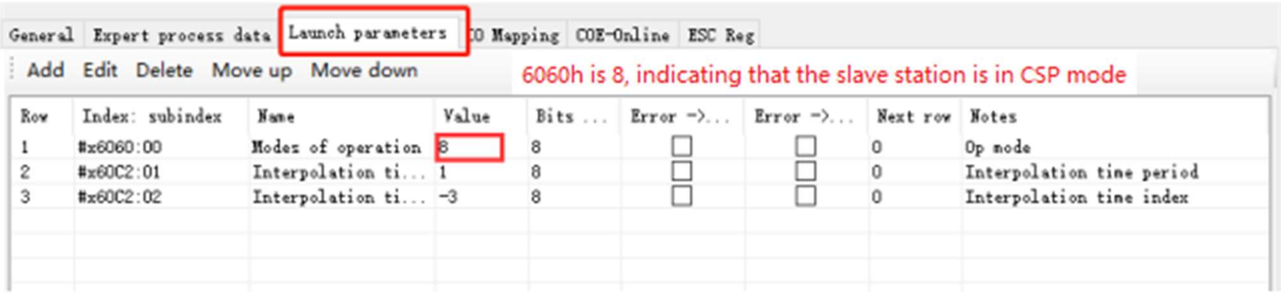




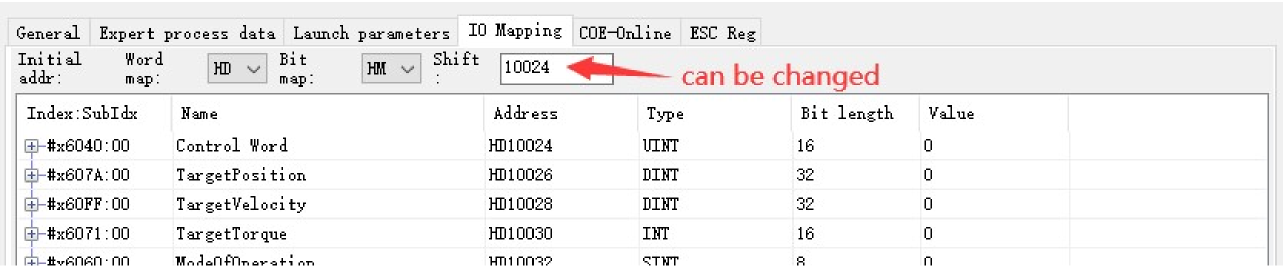
② confirm the PDO in the [expert process data] (The default configuration can meet the use of instructions. If necessary, other relevant parameters can be added).



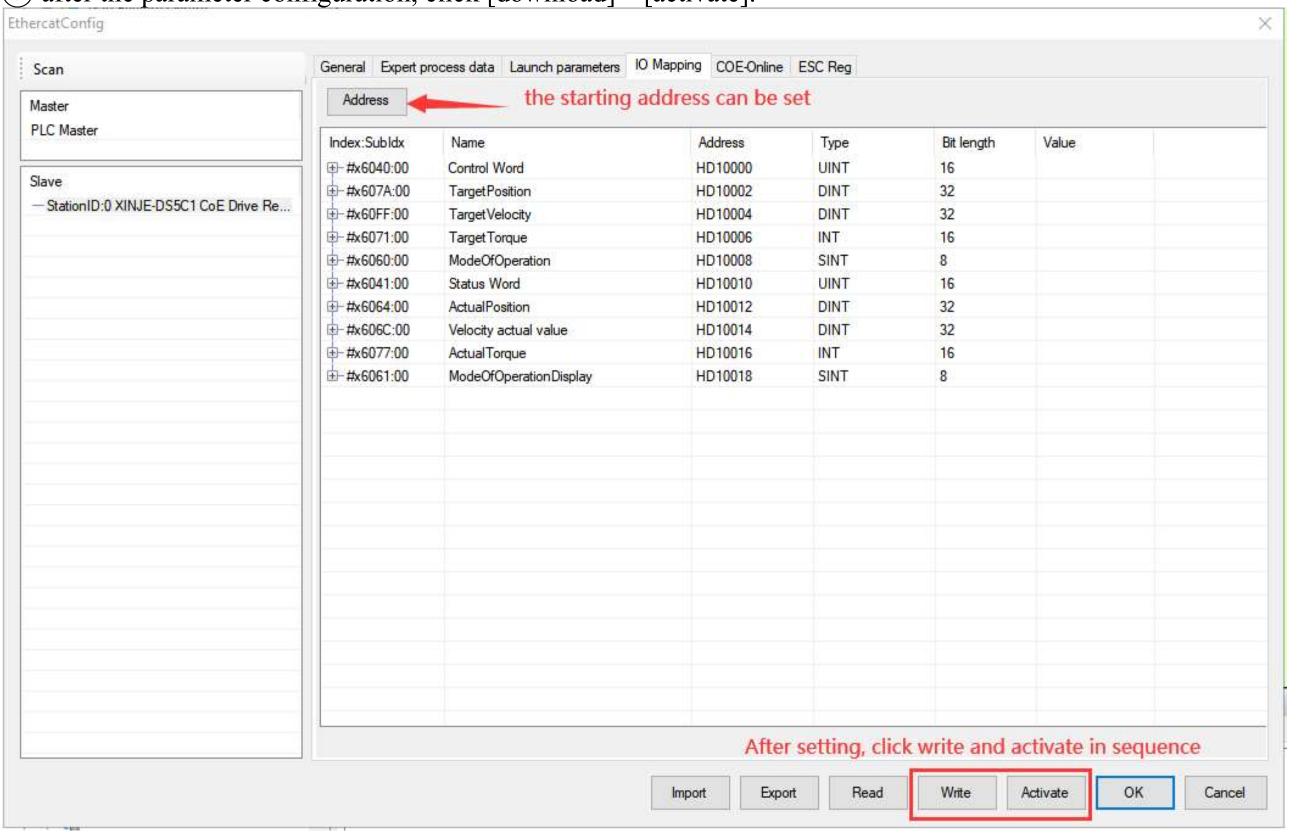
③ confirm the value of 6060h is 8 in [launch parameters]. 6060h value 8 represents the slave station is CSP mode.

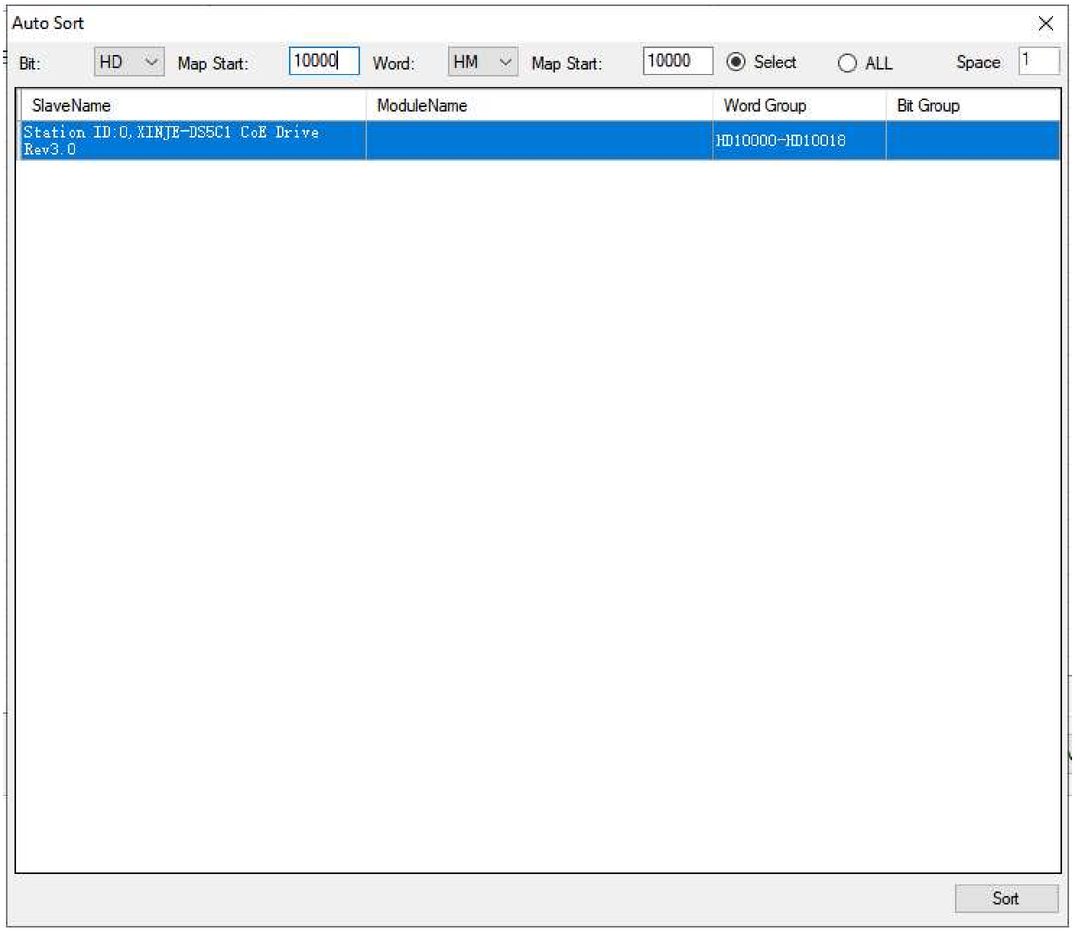


④ [IO mapping] is the PDO mapping register address, the default starting address is HD10000, they can be modified as needs.



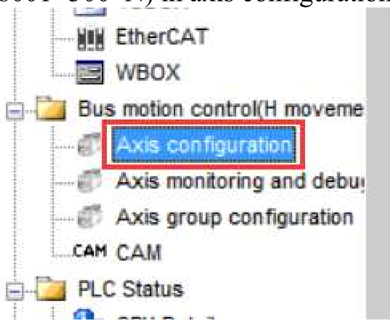
⑤ after the parameter configuration, click [download]→[activate].

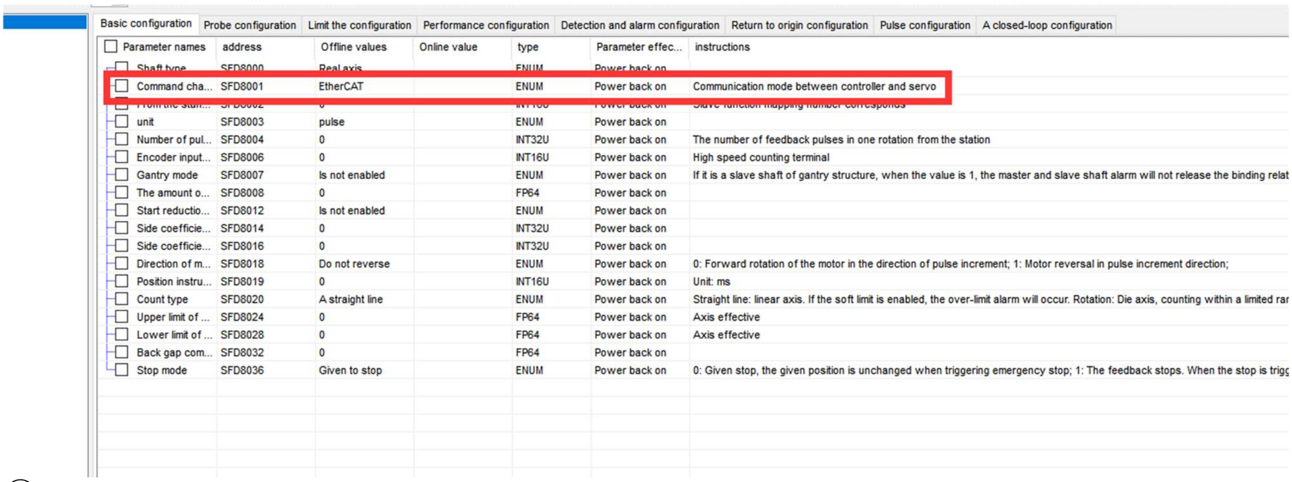




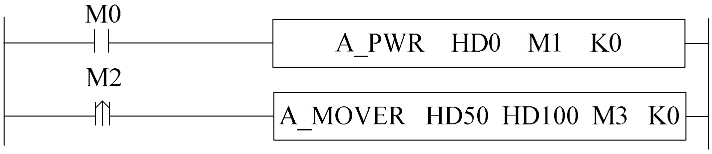
⑥ after activating, slave station state machine (SD8021) is from 1→2→4→8, 8 means OP state. At this time, SDO, PDO can send and receive data, the communication connection is built.

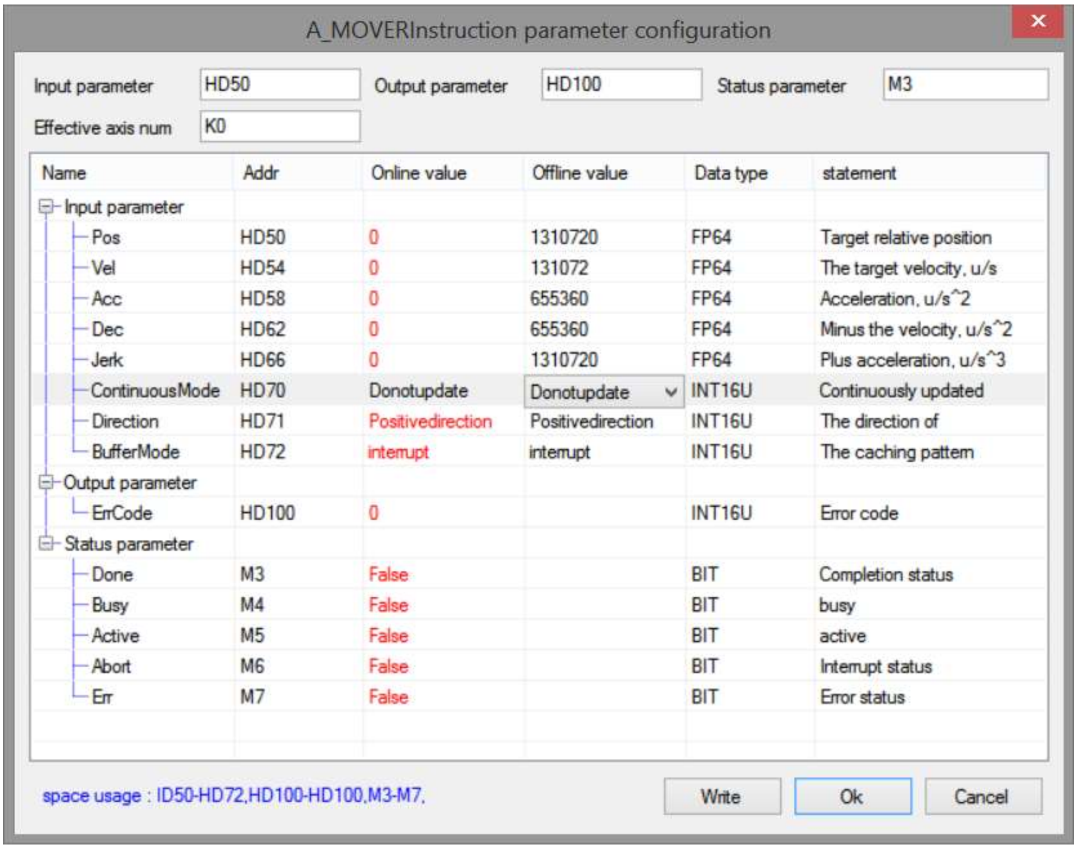
⑦ confirm the command channel (SFD8001+300*N) in axis configuration is Ethercat (register value is 0).





⑧ After confirming the parameters, enables the specified axis through A_PWR command. After successful enabling, the axis will move through the corresponding single axis command (take A_MOVER as an example here). During operation, the current axis state is monitored through D20000 + 200*N (single word), the current given position is monitored through D20016 + 200*N (double precision), the current feedback position is monitored through D20044 + 200*N (double precision), and the current given speed is monitored through D20020 + 200*N (double precision).




A_MOVERInstruction parameter configuration

Input parameter HD50 Output parameter HD100 Status parameter M3
Effective axis num K0

Name	Addr	Online value	Offline value	Data type	statement
Input parameter					
Pos	HD50	0	1310720	FP64	Target relative position
Vel	HD54	0	131072	FP64	The target velocity, u/s
Acc	HD58	0	655360	FP64	Acceleration, u/s^2
Dec	HD62	0	655360	FP64	Minus the velocity, u/s^2
Jerk	HD66	0	1310720	FP64	Plus acceleration, u/s^3
ContinuousMode	HD70	Donotupdate	Donotupdate	INT16U	Continuously updated
Direction	HD71	Positivedirection	Positivedirection	INT16U	The direction of
BufferMode	HD72	interrupt	interrupt	INT16U	The caching pattern
Output parameter					
ErrCode	HD100	0		INT16U	Error code
Status parameter					
Done	M3	False		BIT	Completion status
Busy	M4	False		BIT	busy
Active	M5	False		BIT	active
Abort	M6	False		BIT	Interrupt status
Err	M7	False		BIT	Error status

space usage : ID50-HD72,HD100-HD100,M3-M7,

Write Ok Cancel

In motion:


PLC1-自由监控1

监控窗口 添加 修改 删除 删除全部

寄存器	监控值	字长	进制	注释
D20016	229244.92799148	双...	...	
D20044	225423	双...	...	
D20020	131072	双...	...	
D20000	2	单...	...	

The given position (D20016) and the current position (D20044) are constantly changing. The current given speed (D20020) is the speed 131072 set in the command, and the current axis state (D20000) is 2, indicating that the axis is in the motion state with the termination speed of 0.

After motion:

The given position (D20016) and the current position (D20044) are the final position 1310720 set in the command, the current given speed (D20020) is 0, and the current axis state (D20000) is 1, indicating that the axis is in the enabled static state.

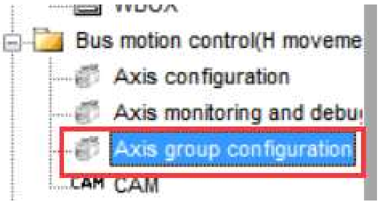
Note: the current position (D20044) is the actual feedback position, which will fluctuate up and down around the final position, and the fluctuation is affected by the number of pulses per cycle.

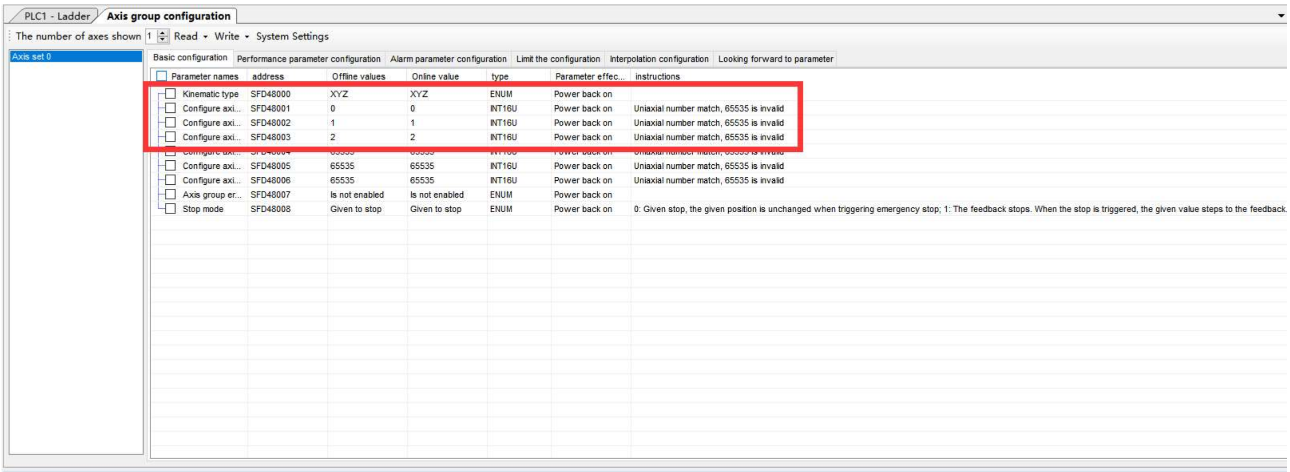
6-2. Axis group function application

Take Xinje DS5C as an example, the axis group contains axis 0,1,2, the motion track is a line from (0,0,0) to (100000,150000,0) connecting an arc passing the point (150000,130000,0), the end point is (200000,0,0). The operation method is as the following:

Ethercat configuration is same to chapter 6-1 step ①~⑦.

⑧ set the axis group kinematics type and axis number.

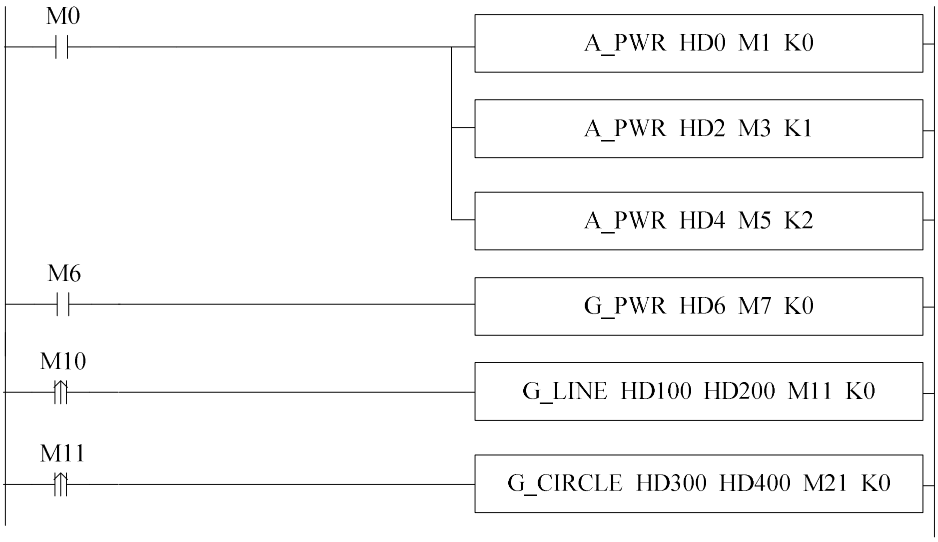




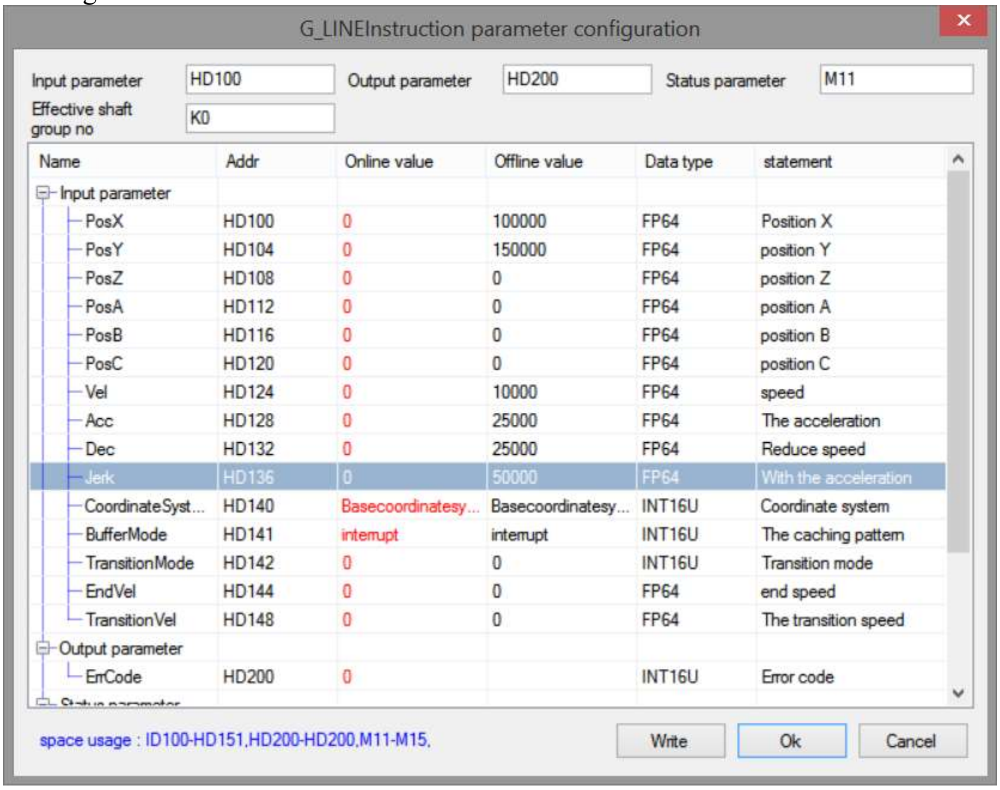
At present, the kinematics type only supports XYZ. If the XY type is required, the axis type SFD8000 + 300*N of the single axis corresponding to the Z axis can be modified to a virtual axis).

⑨ after configuration, enable each axis of the axis group through A_PWR. After each axis in the axis group is enabled, enable the axis group through G_PWR. After the axis group is enabled, the axis group commands can be executed.During the operation of the axis group, the state of the axis group can be monitored through D46000+300*N (single word), the current given position of the axis group can be monitored through D46044~D46064+300*N (double precision), the linear speed of the axis group can be monitored through D46116+300*N (double precision), and the current feedback position of the axis group can be monitored through D46140~D46160+300*N (double precision).

The ladder diagram:



The command configuration:



G_LINEInstruction parameter configuration

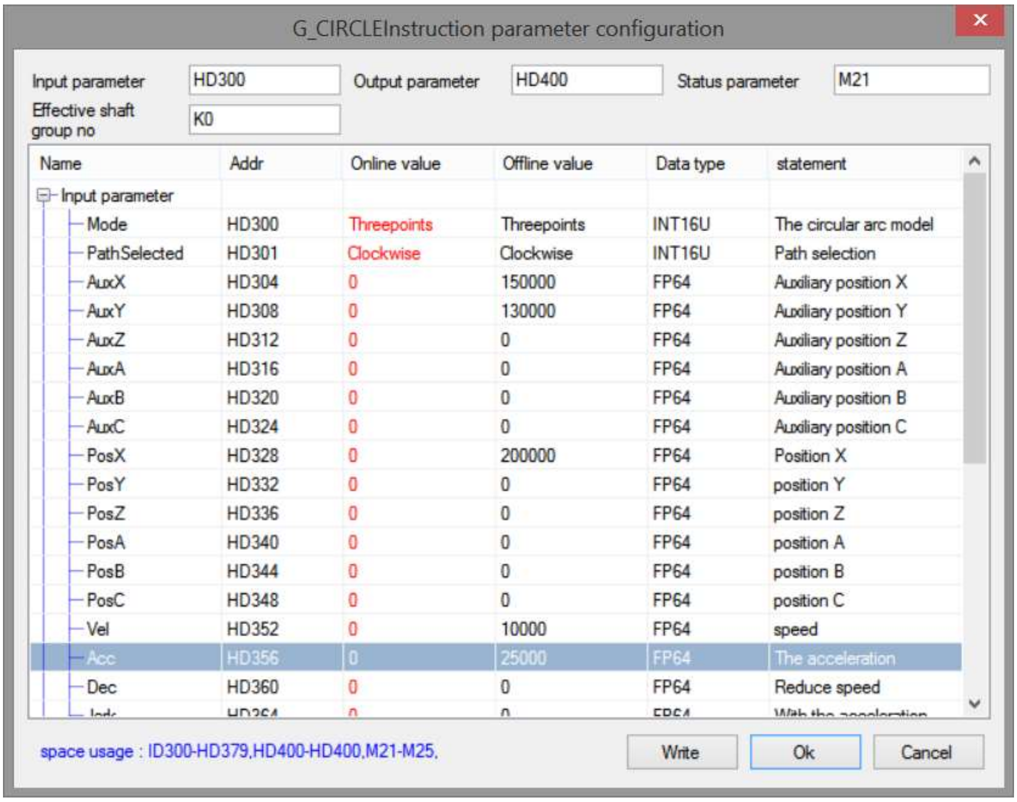
Input parameter: HD100 | Output parameter: HD200 | Status parameter: M11

Effective shaft group no: K0

Name	Addr	Online value	Offline value	Data type	statement
Input parameter					
PosX	HD100	0	100000	FP64	Position X
PosY	HD104	0	150000	FP64	position Y
PosZ	HD108	0	0	FP64	position Z
PosA	HD112	0	0	FP64	position A
PosB	HD116	0	0	FP64	position B
PosC	HD120	0	0	FP64	position C
Vel	HD124	0	10000	FP64	speed
Acc	HD128	0	25000	FP64	The acceleration
Dec	HD132	0	25000	FP64	Reduce speed
Jerk	HD136	0	50000	FP64	With the acceleration
CoordinateSyst...	HD140	Basecoordinatesy...	Basecoordinatesy...	INT16U	Coordinate system
BufferMode	HD141	interrupt	interrupt	INT16U	The caching pattern
TransitionMode	HD142	0	0	INT16U	Transition mode
EndVel	HD144	0	0	FP64	end speed
TransitionVel	HD148	0	0	FP64	The transition speed
Output parameter					
ErrCode	HD200	0		INT16U	Error code
Status parameter					

space usage : ID100-HD151,HD200-HD200,M11-M15.

Write | Ok | Cancel



G_CIRCLEInstruction parameter configuration

Input parameter: HD300 | Output parameter: HD400 | Status parameter: M21

Effective shaft group no: K0

Name	Addr	Online value	Offline value	Data type	statement
Input parameter					
Mode	HD300	Threepoints	Threepoints	INT16U	The circular arc model
PathSelected	HD301	Clockwise	Clockwise	INT16U	Path selection
AuxX	HD304	0	150000	FP64	Auxiliary position X
AuxY	HD308	0	130000	FP64	Auxiliary position Y
AuxZ	HD312	0	0	FP64	Auxiliary position Z
AuxA	HD316	0	0	FP64	Auxiliary position A
AuxB	HD320	0	0	FP64	Auxiliary position B
AuxC	HD324	0	0	FP64	Auxiliary position C
PosX	HD328	0	200000	FP64	Position X
PosY	HD332	0	0	FP64	position Y
PosZ	HD336	0	0	FP64	position Z
PosA	HD340	0	0	FP64	position A
PosB	HD344	0	0	FP64	position B
PosC	HD348	0	0	FP64	position C
Vel	HD352	0	10000	FP64	speed
Acc	HD356	0	25000	FP64	The acceleration
Dec	HD360	0	0	FP64	Reduce speed
Jerk	HD364	0	0	FP64	With the acceleration

space usage : ID300-HD379,HD400-HD400,M21-M25.

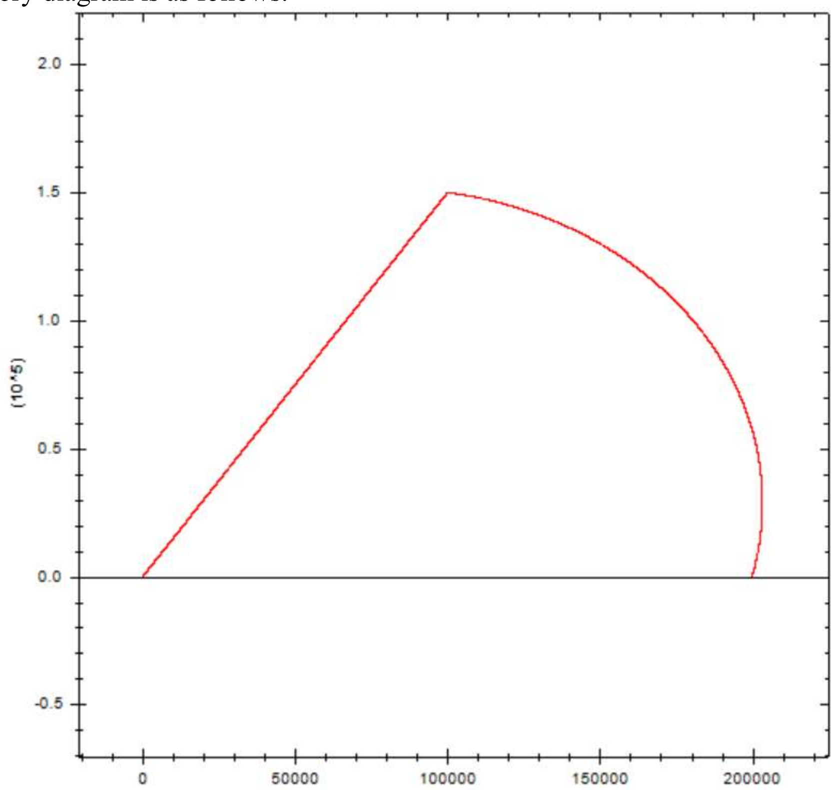
Write | Ok | Cancel

The command is being executed:

寄存器	监控值	字长	进制	注释
D20000	8	单...	1...	轴1状态
D20200	8	单...	1...	轴2状态
D20400	8	单...	1...	轴3状态
D46000	2	单...	1...	轴组状态
D46044	83514.476...	双...	1...	X轴给定位置
D46048	125271.71...	双...	1...	Y轴给定位置
D46052	0	双...	1...	Z轴给定位置
D46116	10000	双...	1...	轴组线速度
D46140	83507	双...	1...	X轴反馈位置
D46144	125102	双...	1...	Y轴反馈位置
D46148	0	双...	1...	Z轴反馈位置

At this time, the single axis state D20000+200*N in the axis group is 8 (in the axis group), and the state D4600 of the axis group is 2 (in the axis group movement). Its running track is a straight line + arc (the completion flag M11 of the G_LINE command triggers the G_CIRCLE command), the end point of the straight line is (10000,150000,0), the end point of the arc is (200000,0,0), and the arc passes through the auxiliary point (150000, 130000,0).

The motion trajectory diagram is as follows:

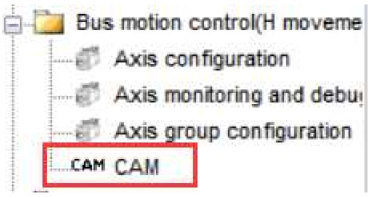


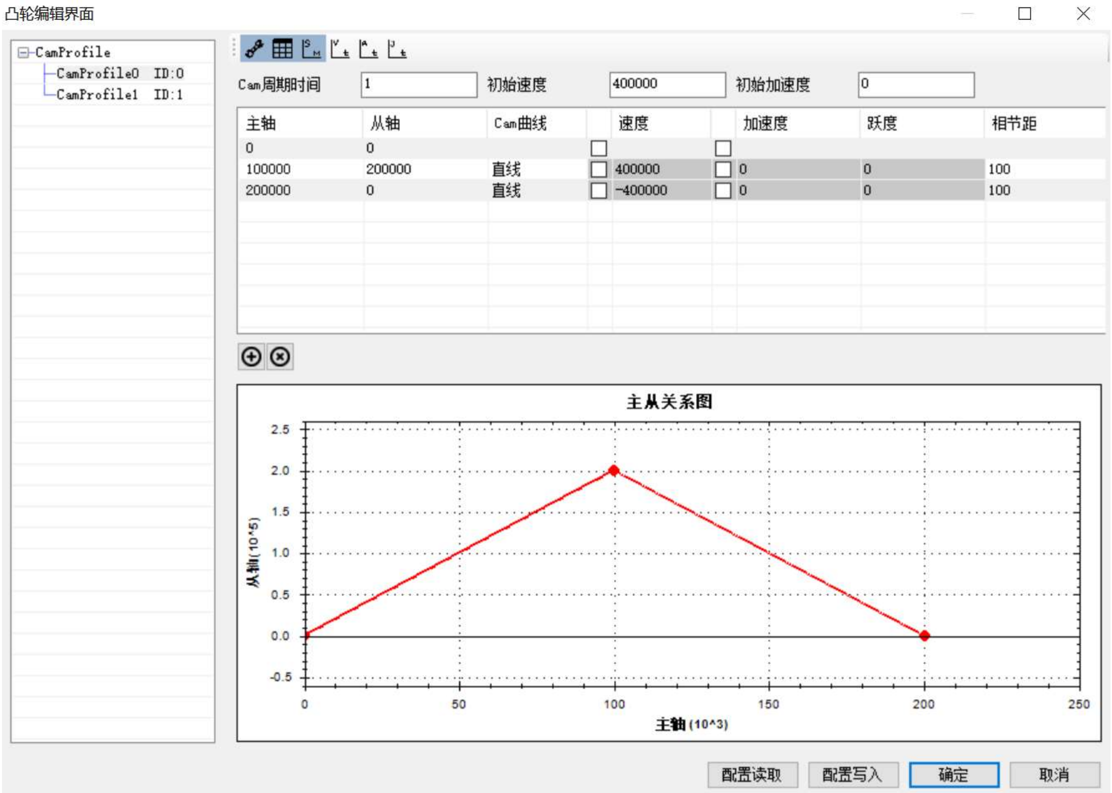
6-3. CAM function application

Take Xinje DS5C servo as an example, perform the cam movement of the master-slave axis relationship as shown in the figure in non cyclic mode and cyclic mode respectively:

EtherCAT configuration is same to chapter 6-1 step ①~⑦.

⑧ Configure the CAM table:

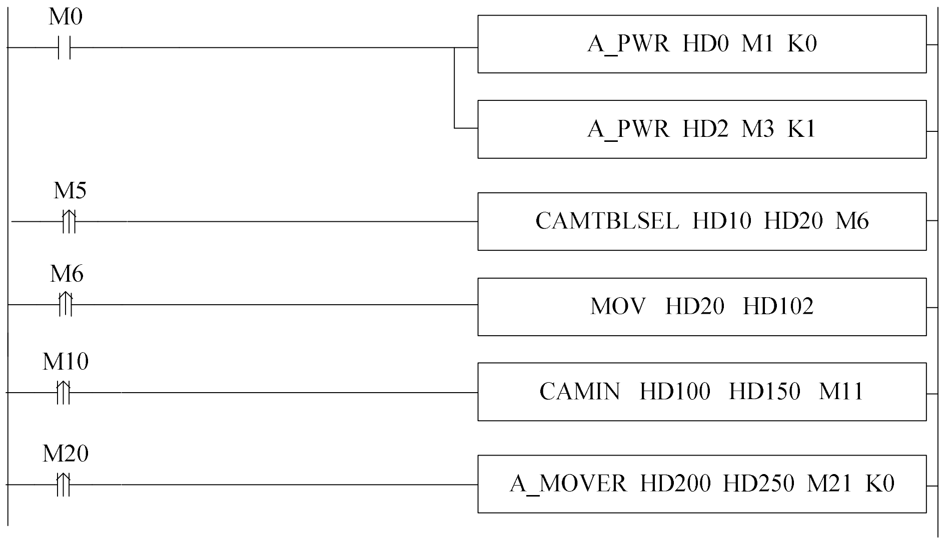




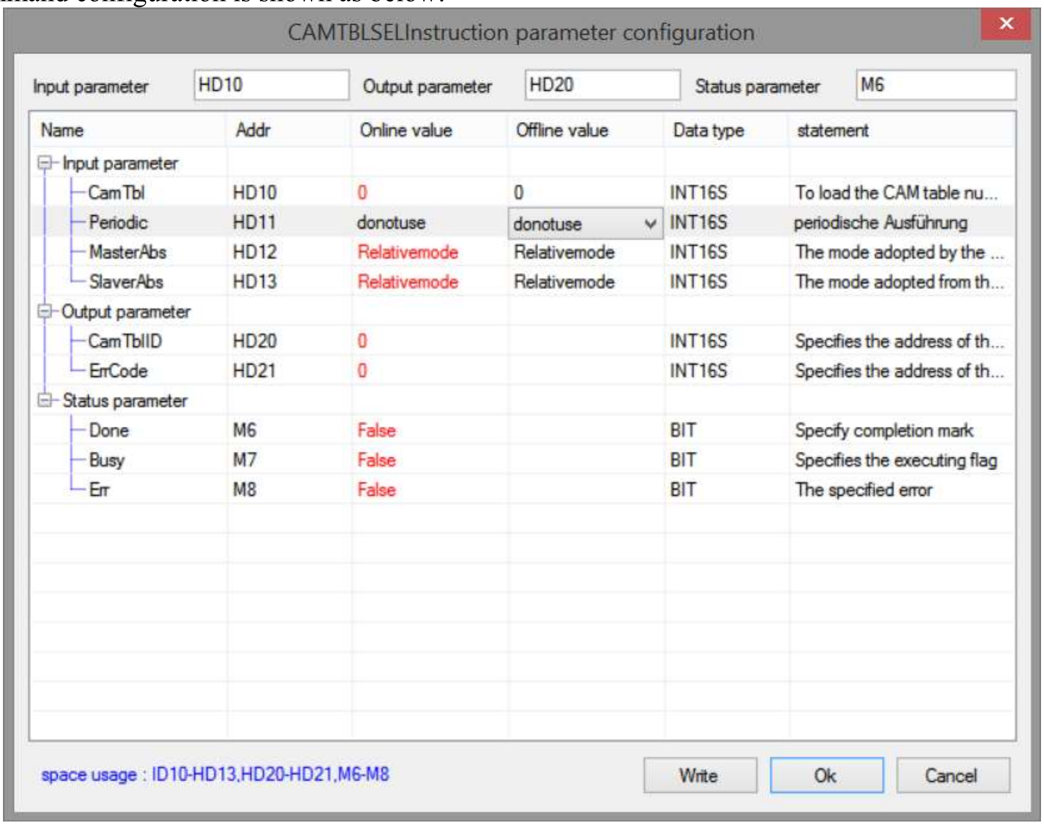
(after configuration of cam table, click download)

⑨ Enable the master-slave axis of the cam through A_PWR. Load the corresponding cam table through CAMTBLSEL. After successful loading, execute CAMIN command to bind the cam. After successful cam binding, run the cam master axis through single axis command, and the cam slave station will move according to the corresponding cam table. (the cam can be bound during the operation of the axis, the master axis will maintain the current motion, and the slave axis will stop the current motion and move the point corresponding to the cam table).

The ladder diagram:



When the CAM is in non-cycle mode:
The command configuration is shown as below:



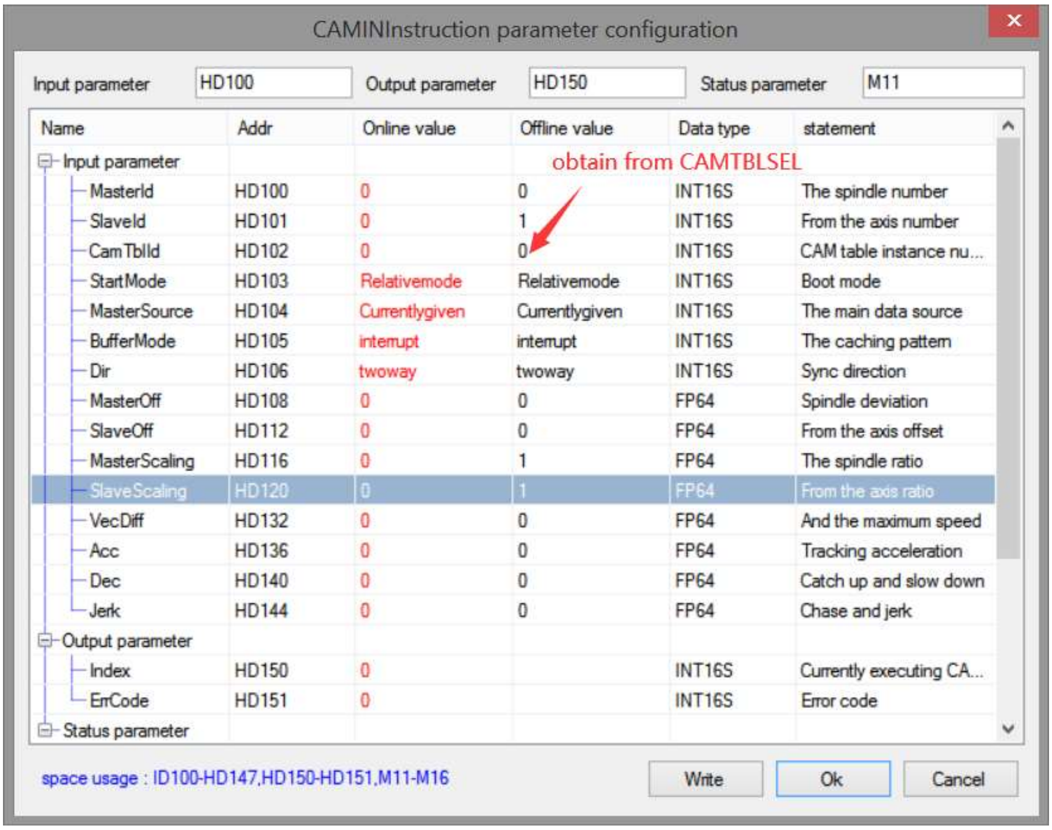
CAMTBLSELInstruction parameter configuration

Input parameter HD10 Output parameter HD20 Status parameter M6

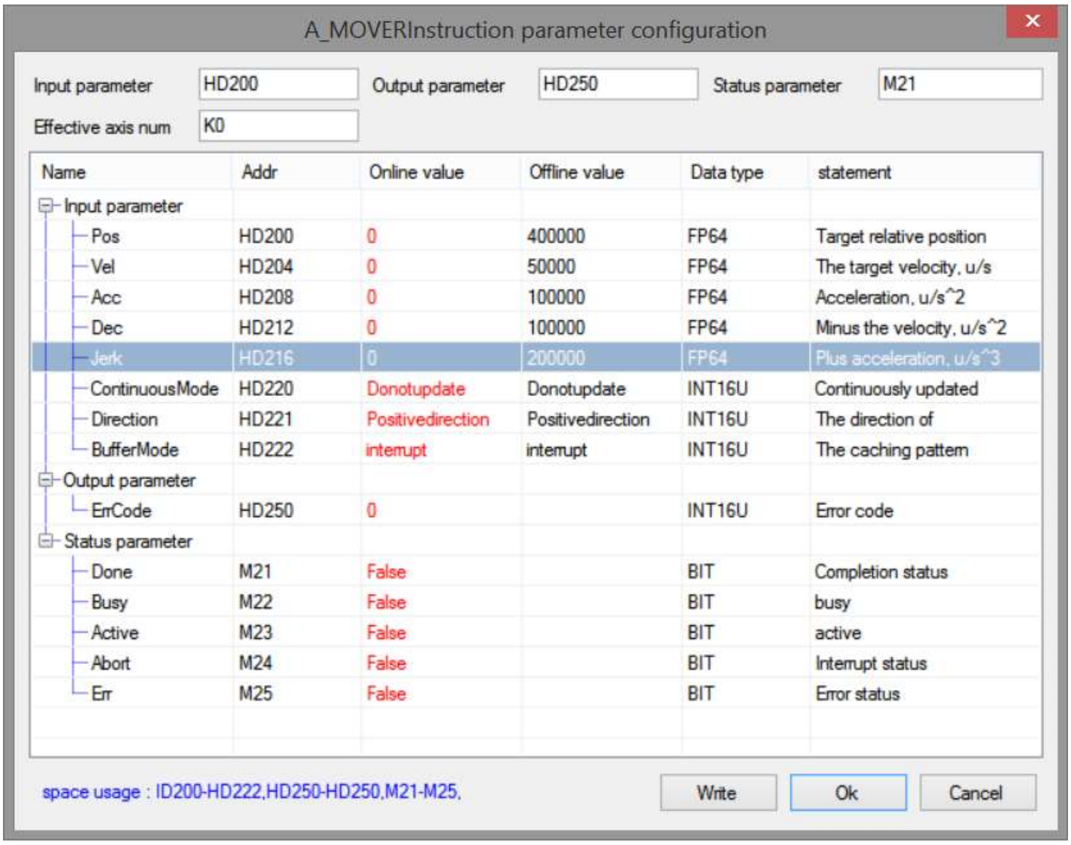
Name	Addr	Online value	Offline value	Data type	statement
Input parameter					
CamTbl	HD10	0	0	INT16S	To load the CAM table nu...
Periodic	HD11	donotuse	donotuse	INT16S	periodische Ausführung
MasterAbs	HD12	Relativemode	Relativemode	INT16S	The mode adopted by the ...
SlaverAbs	HD13	Relativemode	Relativemode	INT16S	The mode adopted from th...
Output parameter					
CamTblID	HD20	0		INT16S	Specifies the address of th...
ErrCode	HD21	0		INT16S	Specifies the address of th...
Status parameter					
Done	M6	False		BIT	Specify completion mark
Busy	M7	False		BIT	Specifies the executing flag
Err	M8	False		BIT	The specified error

space usage : ID10-HD13,HD20-HD21,M6-M8

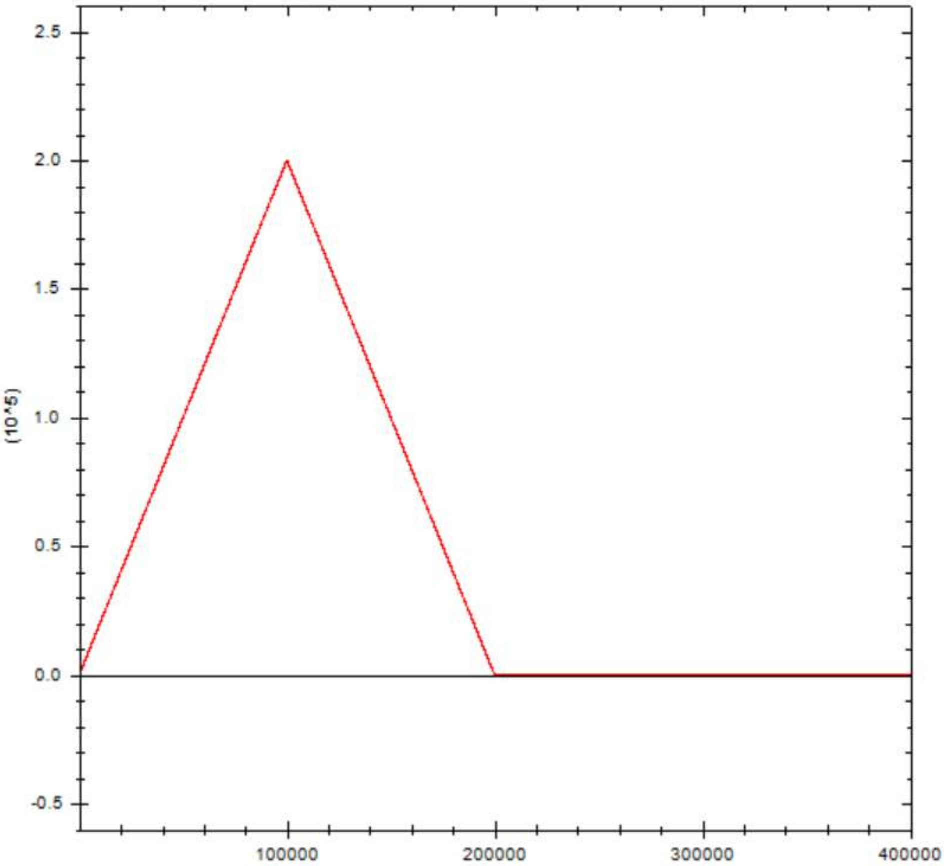
Write Ok Cancel



The cam table instance number parameter of CAMIN command is obtained by executing CAMTBLSEL command. After the parameter setting is completed, execute the CAMIN command. After the CAMIN command is successfully executed, its synchronization flag is set to on, indicating that the cam binding state has been entered at this time. The master axis movement is controlled by single axis command. The command configuration is as follows:

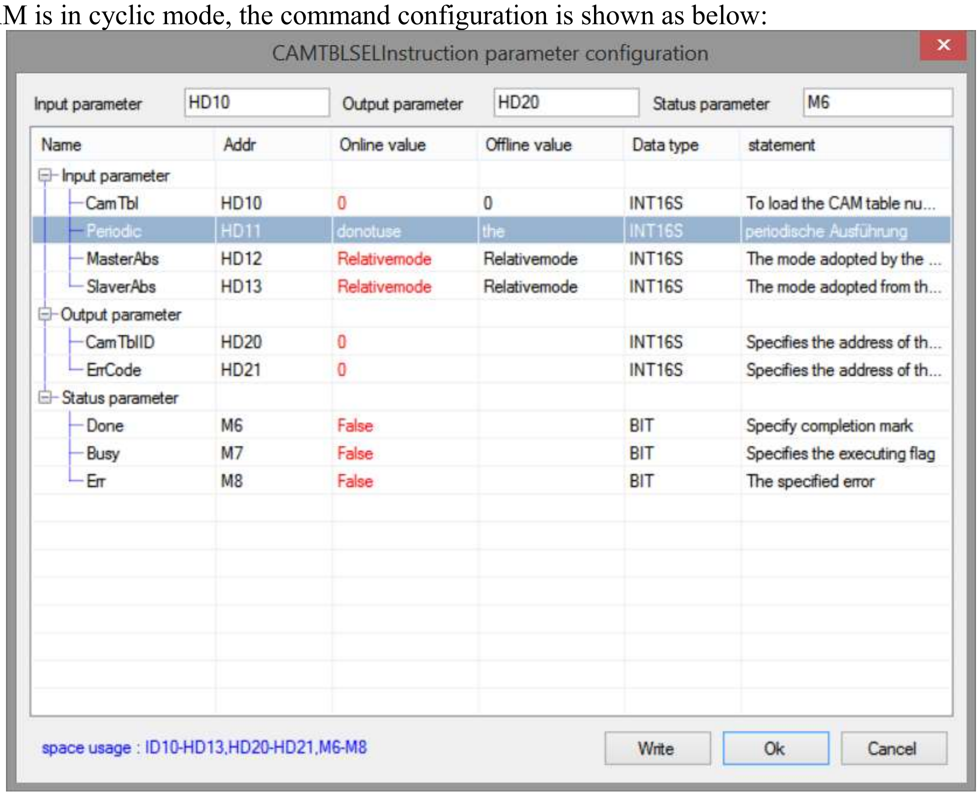


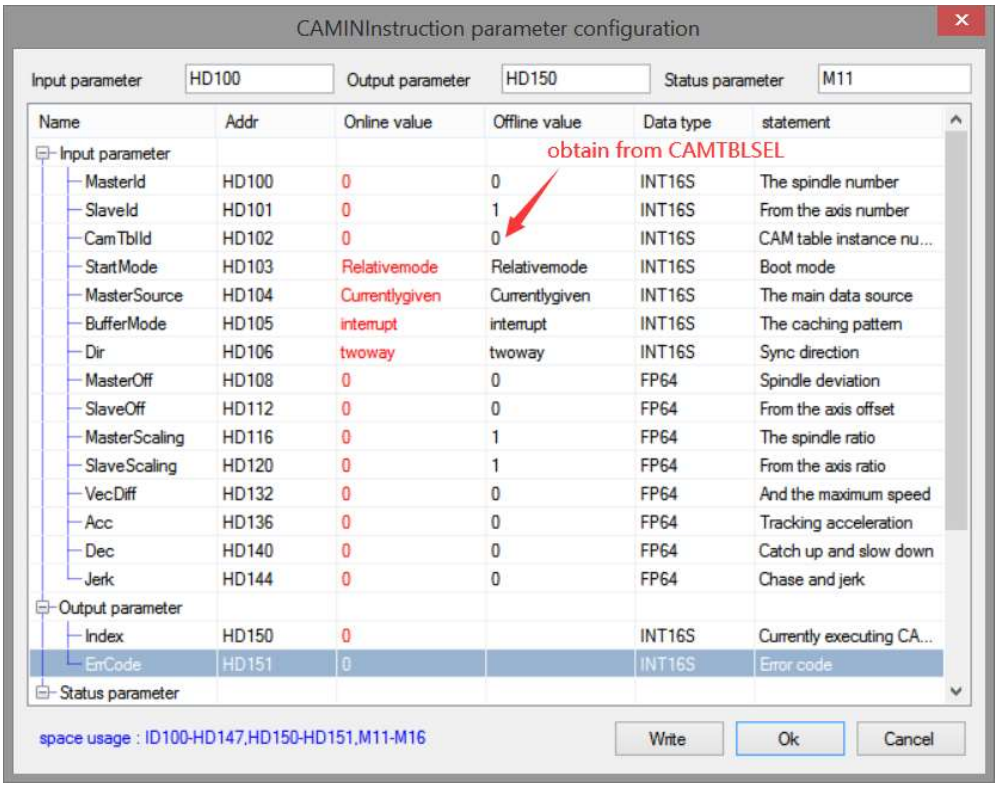
After the master axis runs, the given position is monitored through D20016+200*N, and the feedback position is monitored through D20044+200*N. The running track of its cam is shown in the figure below:



In the figure, axis X is the master axis position and axis Y is the slave axis position. When the master axis position is from 0 to 200000, the slave axis makes corresponding movement according to the point position of the cam table. When the master axis position is from 200000 to 400000, at this time, because the cam table is non-cyclic execution, the cam operation has ended and the slave axis position does not change.

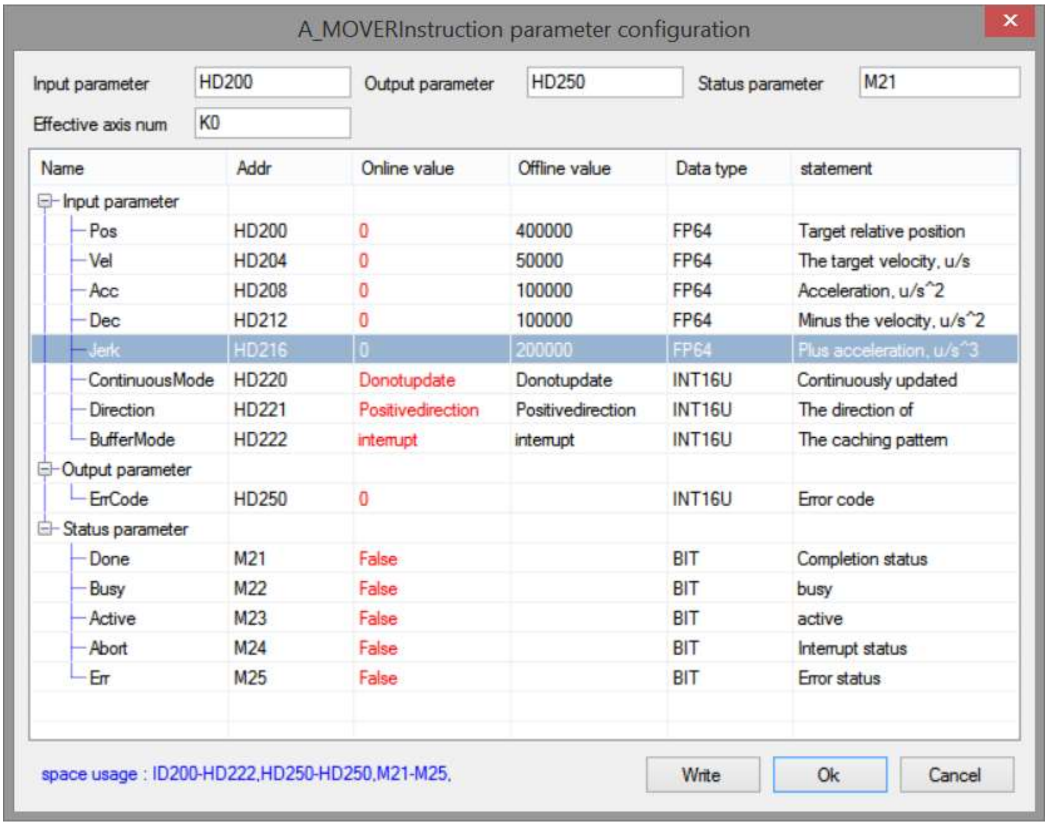
When the CAM is in cyclic mode, the command configuration is shown as below:



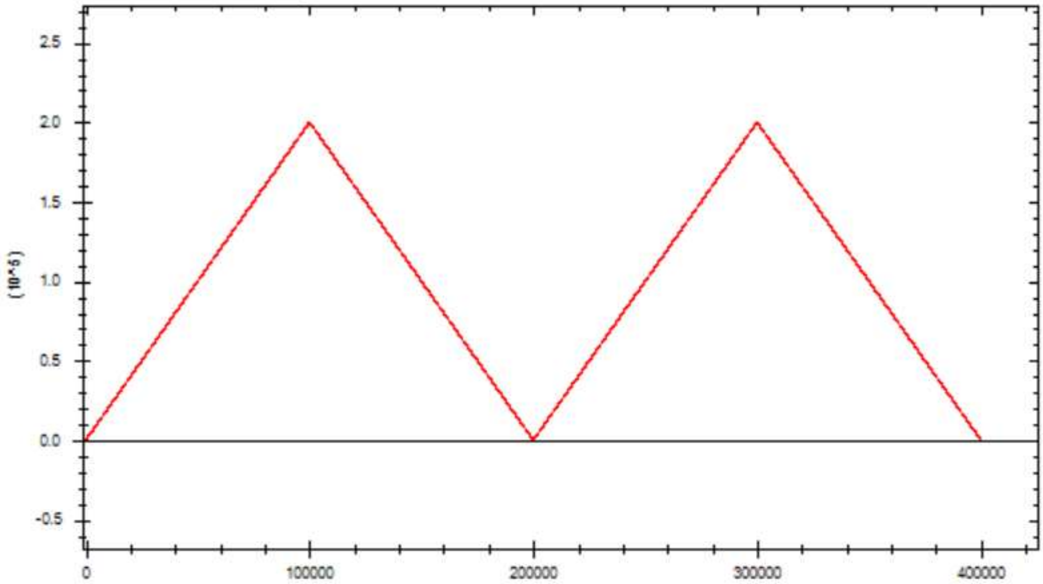


In the loop mode, only the CAMTBLSEL instruction parameters changed, and the CAMIN instruction parameters are the same.

The cam table instance number parameter of CAMIN command is obtained by executing CAMTBLSEL command. After the parameter setting is completed, execute the CAMIN command. After the CAMIN command is successfully executed, its synchronization flag is set to on, indicating that the cam binding state has been entered at this time. The master axis movement is controlled by single axis command. The command configuration is as follows:

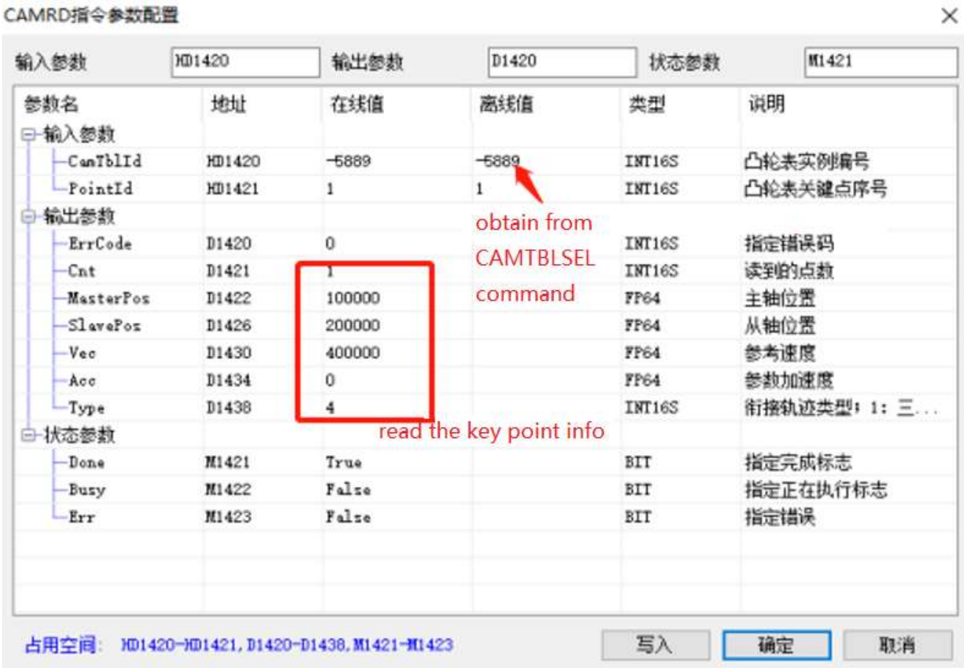


After the master axis runs, monitor the given position through D20016+200*N, monitor the feedback position through D20044+200*N. The CAM motion track is shown as below:

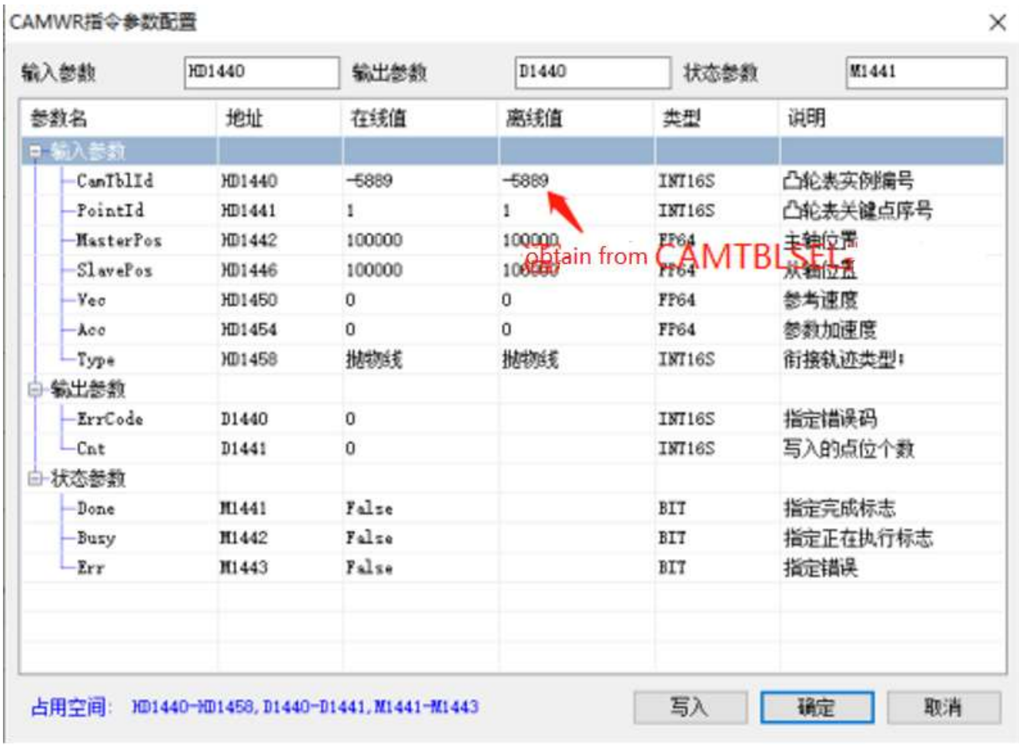


In the figure, axis X is the master axis position and axis Y is the slave axis position. When the master axis position is from 0 to 200000, the slave axis makes corresponding movement according to the point position of the cam table. When the master axis position is from 200000 to 400000, the slave axis makes a new cycle of cam movement.

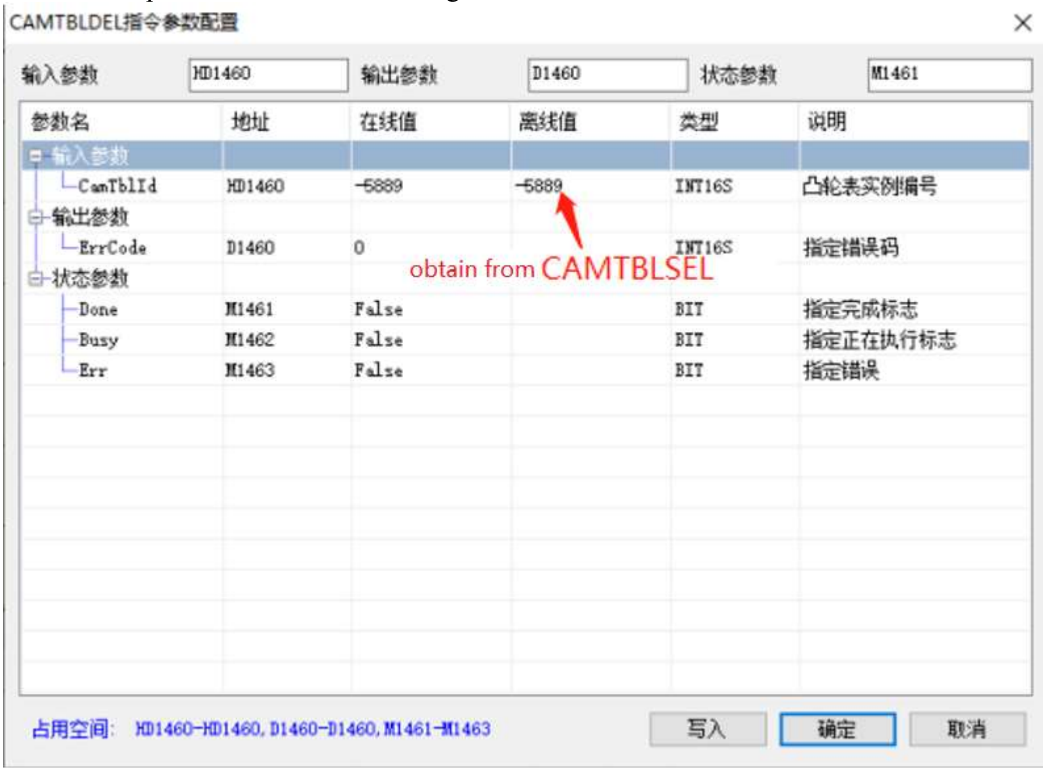
If you want to know the master-slave axis position, speed, acceleration, connection track type and other information of a key point, you can read out the information of the point through CAMRD cam table reading command. The command configuration is as follows:



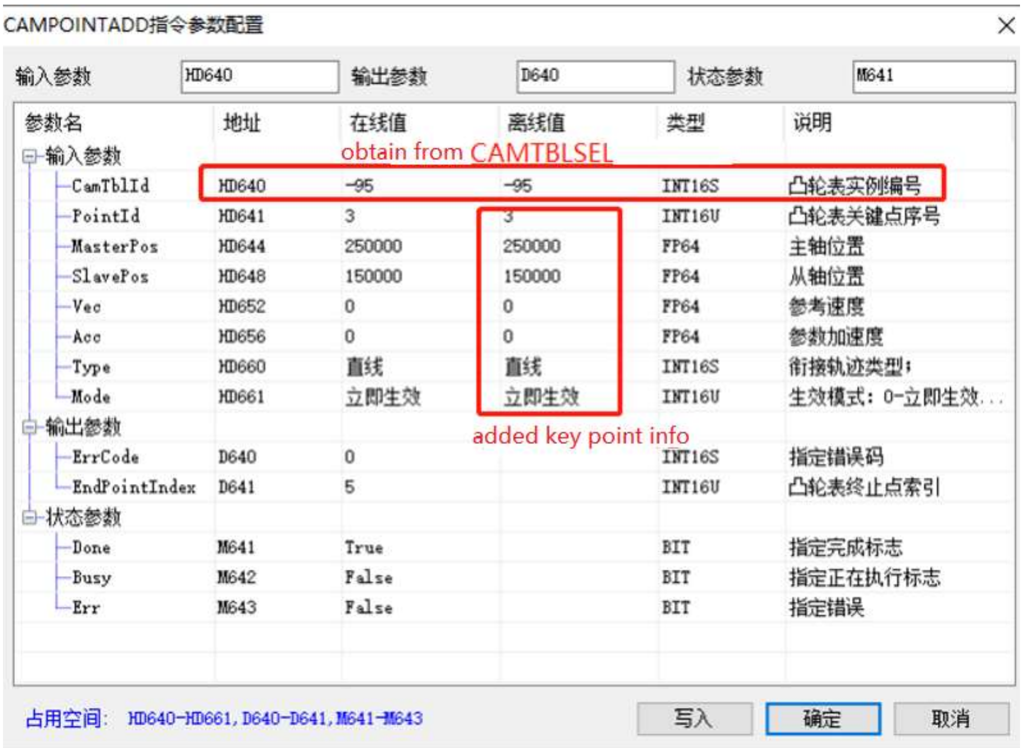
The cam table instance number is obtained through CAMTBLSEL command. The key point sequence number should start from 0, and 0 represents the first point (0,0) of the cam table.
The key information read out will be displayed in the output parameters.
If it is necessary to modify a key point in the cam table, it can be realized through the CAMWR cam table write command (will invalid when power failure). The command configuration is as follows:



Among them, the cam table instance number is obtained through CAMTBLSEL, and the key point serial number shall start from 1, that is, the second key point (the first key point (0,0) cannot be modified).
When the generated cam table instance is not needed, it can be unloaded through the CAMTBLDEL instruction to free the internal cache space. The instruction configuration is as follows:



The cam table instance number is generated by the CANTBLSEL command. After the command is executed, the instance will be unloaded. If the instance number has been started by the CAMIN command, you need to execute the CAMOUT command to release the cam relationship, and then execute the unloading command.
If A_STOP comman is used to stop the slave axis during the cam table motion process, you can directly execute the unloading command to unload the instance number without executing the CAMOUT command.
When you need to add a key point to the cam table, you can use the CAMPOINTADD key point addition command. The command configuration is shown in the following figure:


CAMPOINTADD指令参数配置

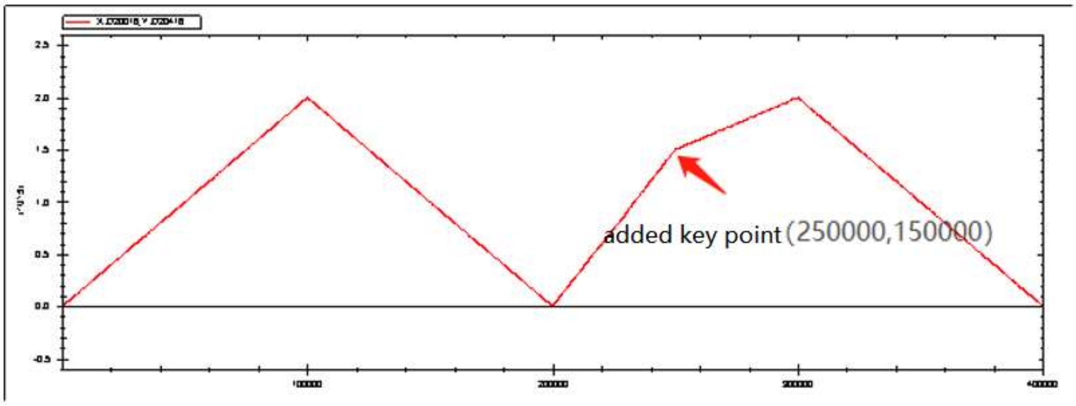
输入参数 HD640 输出参数 D640 状态参数 M641

参数名	地址	在线值	离线值	类型	说明
输入参数					
CamTblId	HD640	-95	-95	INT16S	凸轮表实例编号
PointId	HD641	3	3	INT16U	凸轮表关键点序号
MasterPos	HD644	250000	250000	FP64	主轴位置
SlavePos	HD648	150000	150000	FP64	从轴位置
Vec	HD652	0	0	FP64	参考速度
Acc	HD656	0	0	FP64	参数加速度
Type	HD660	直线	直线	INT16S	衔接轨迹类型;
Mode	HD661	立即生效	立即生效	INT16U	生效模式：0-立即生效...
输出参数					
ErrCode	D640	0		INT16S	指定错误码
EndPointIndex	D641	5		INT16U	凸轮表终止点索引
状态参数					
Done	M641	True		BIT	指定完成标志
Busy	M642	False		BIT	指定正在执行标志
Err	M643	False		BIT	指定错误

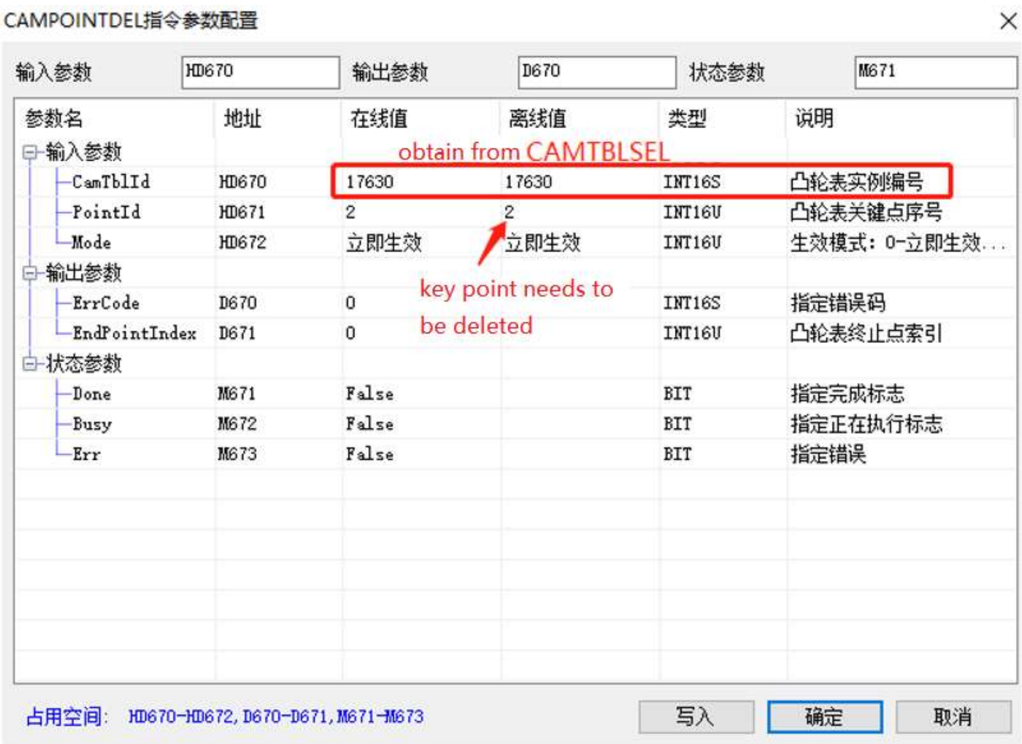
占用空间: HD640-HD661, D640-D641, M641-M643

写入 确定 取消

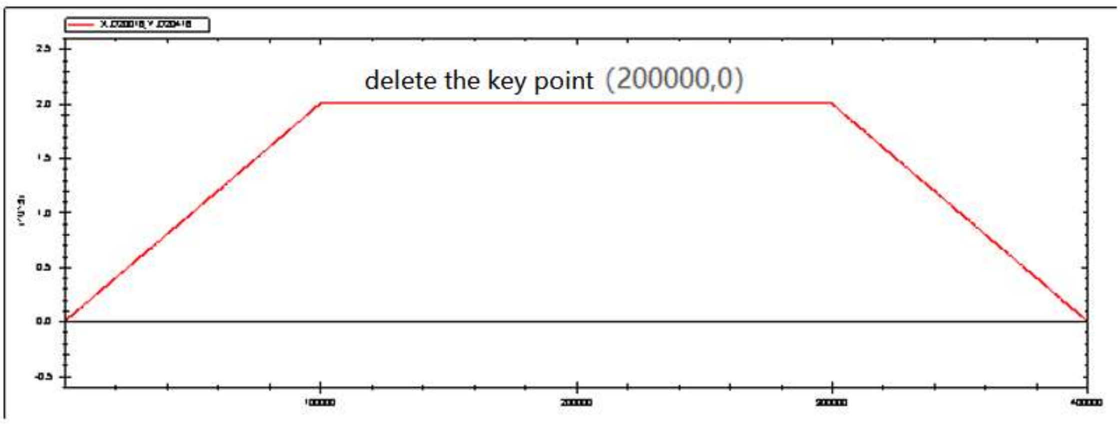
After the master axis runs, the cam master-slave relationship is as shown in the following figure:



If a point in the cam table needs to be deleted, it can be realized through the CAMPOINTDEL key point deletion command. The command parameter configuration is shown in the following figure:



After the master axis runs, the cam master-slave relationship is as shown in the following figure:

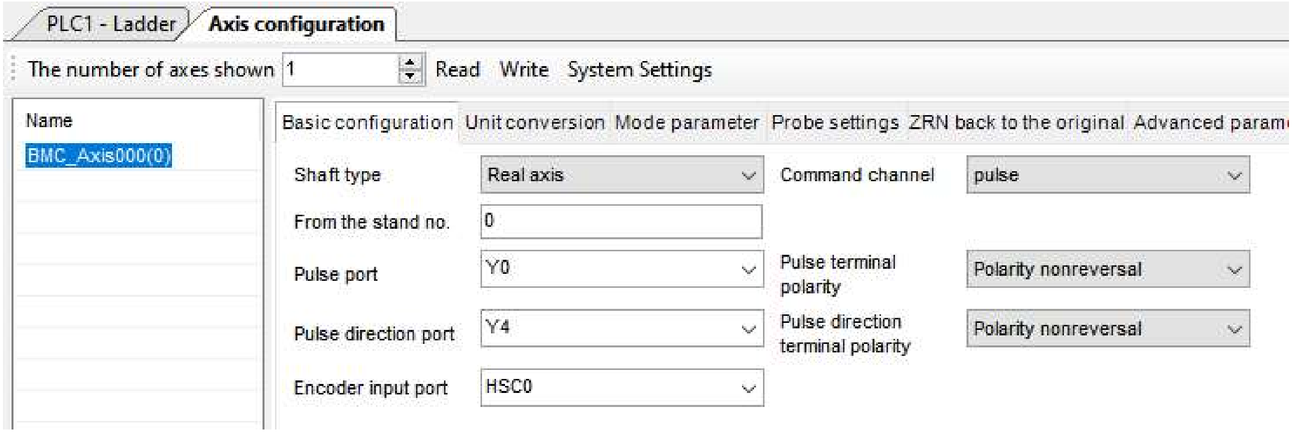


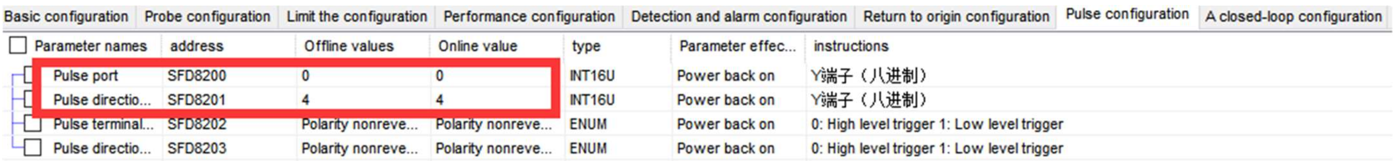
6-4. Pulse channel application

Operation steps of pulse output function.

(1) Modify the command channel to pulse in axis configuration-basic configuration.

(2) Configure pulse ports and directional ports in the axis configuration pulse configuration, and the configuration range is automatically matched to a selectable range based on the model.





(3) modify the servo parameter to normal pulse control type, please refer to servo manual.
(4) enable the servo by manual.
(5) execute other motion commands after enabled.

Note:

(1) Pulse port range is [0,3], direction port range is [0,7], [10,17], [20,27].
(2) When there are multiple pulse axes, the pulse and direction port configurations cannot conflict.
(3) The command A_MODE, A_HOME, A_PROBE, A_CYCVEL, A_CYCTRQ cannot support pulse channel.
(4) In the pulse channel, it needs to enable the servo by manual. A_PWR cannot enable the servo, but all the motion commands can be executed after A_PWR is executed.
(5) Since the pulse channel cannot directly control the servo, A_RST command can only clear the error report of the master station, but cannot clear the servo alarm.
(6) For the axis group function, the constituent axis of the shaft group must be the same channel, that is, all are pulse channels or bus channels, otherwise the axis group enable command will report an error.
(7) The use of other commands is the same as that of EtherCAT axis.
(8) SD992 dual word hexadecimal monitoring in PLC, FPGA version 20211026 and above.

6-5. Full closed-loop function application

In some applications, it is necessary to carry out high-precision position control according to the actual position of the equipment. The full closed-loop function is to form a position loop through servo feedback position or high-speed counting position to achieve the purpose of control.

Set the parameters (take effective after power on again)

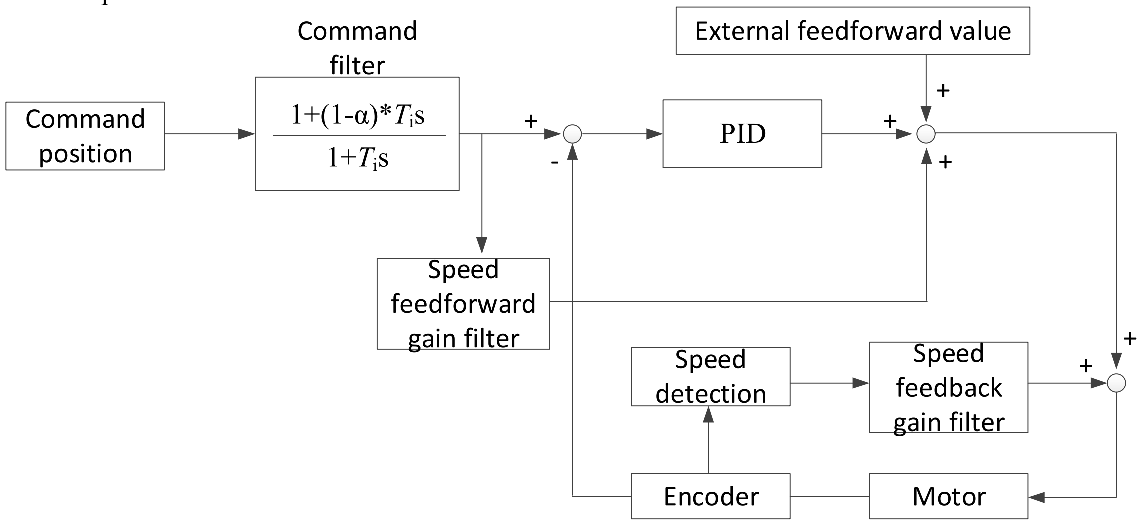
Address	Definition	Data type	Unit	Initial value	Note
SFD8204+300*N	closed loop switch	ENUM		0	Closed loop switch 0: OFF 1: ON
SFD8205+300*N	Closed loop feedback data source type	ENUM		0	Closed loop position feedback source: 0: bus position feedback 1: high speed counting terminal. Set through SFD8006+300*N
SFD8206+300*N	Encoder equivalent	FP64	Equivalent unit	0	It only takes effect when the closed-loop position feedback source is high-speed counting. The encoder inputs the movement of each pulse. That is movement per turn (SFD8008 + 300*N)/encoder pulse number per turn. Eg. PLC sets the movement per turn is 10000, the closed-loop position feedback source is a grating ruler or encoder for counting, and the high-speed counting value of each turn of the motor is 2500. Then the encoder equivalent value is set to 4.
SFD8210+300*N	Proportional gain	FP64		0	Proportional gain of PID in full closed loop control
SFD8214+300*N	Integral gain	FP64	ms	0	Integral gain of PID in full closed loop control
SFD8218+300*N	Differential gain	FP64		0	Differential gain of PID in full closed loop control
SFD8222+300*N	Speed feedforward gain	FP64	0.1%	0	Full closed loop speed feedforward gain
SFD8226+300*N	Feedback speed feedforward gain	FP64	0.1%	0	Full closed loop speed feedback gain
SFD8230+300*N	Closed loop maximum position gain	FP64	Command unit	0	Error code 2018 is returned when the closed-loop position deviation exceeds this limit value. When set to 0, it does not take effect.
SFD8234+300*N	Speed forward looking filtering time	INT16U	ms	0	Full closed loop speed feedforward filtering time
SFD8235+300*N	Feedback velocity filtering time	INT16U	ms	0	Full closed loop speed feedback filtering time
SFD8236+300*N	2 degree free alpha	FP64		0	Full closed loop 2 free degree alpha. Range 0~1, When the setting value is 0, no instruction

Address	Definition	Data type	Unit	Initial value	Note
					filtering is performed, and when the setting value is greater than 1, it is processed as 1.
SFD8240+300*N	2 degrees of freedom integration time	FP64	ms	0	Full closed loop 2 free degree integration time.

Dynamic parameters (take effective at once after modification. When the PLC runs again, it will write the SFD value of the corresponding parameter in the [set parameter])

Address	Definition	Data type	Unit	Initial value	Note
D20060+200*N	Proportional gain	FP64		0	Corresponding parameter SFD8210+300*N. The modification takes effect in real time.
D20064+200*N	Integral gain	FP64	ms	0	Corresponding parameter SFD8214+300*N. The modification takes effect in real time.
D20068+200*N	Differential gain	FP64		0	Corresponding parameter SFD8218+300*N. The modification takes effect in real time.
D20072+200*N	Speed feedforward gain	FP64	0.1%	0	Corresponding parameter SFD8222+300*N. The modification takes effect in real time.
D20076+200*N	Speed feedback gain	FP64	0.1%	0	Corresponding parameter SFD8226+300*N. The modification takes effect in real time.
D20080+200*N	External speed feedforward value	FP64	Command unit	0	Full closed loop external speed feedforward value.
D20084+200*N	2 free degree alpha	FP64		0	Corresponding parameter SFD8236+300*N. The modification takes effect in real time. The range is 0 ~ 1. When the setting value is 0, instruction filtering is not performed. When the setting value is greater than 1, it is processed as 1.
D20088+200*N	2 degree of freedom integration time	FP64	ms	0	Corresponding parameter SFD8240+300*N. The modification takes effect in real time.

Full closed loop control model



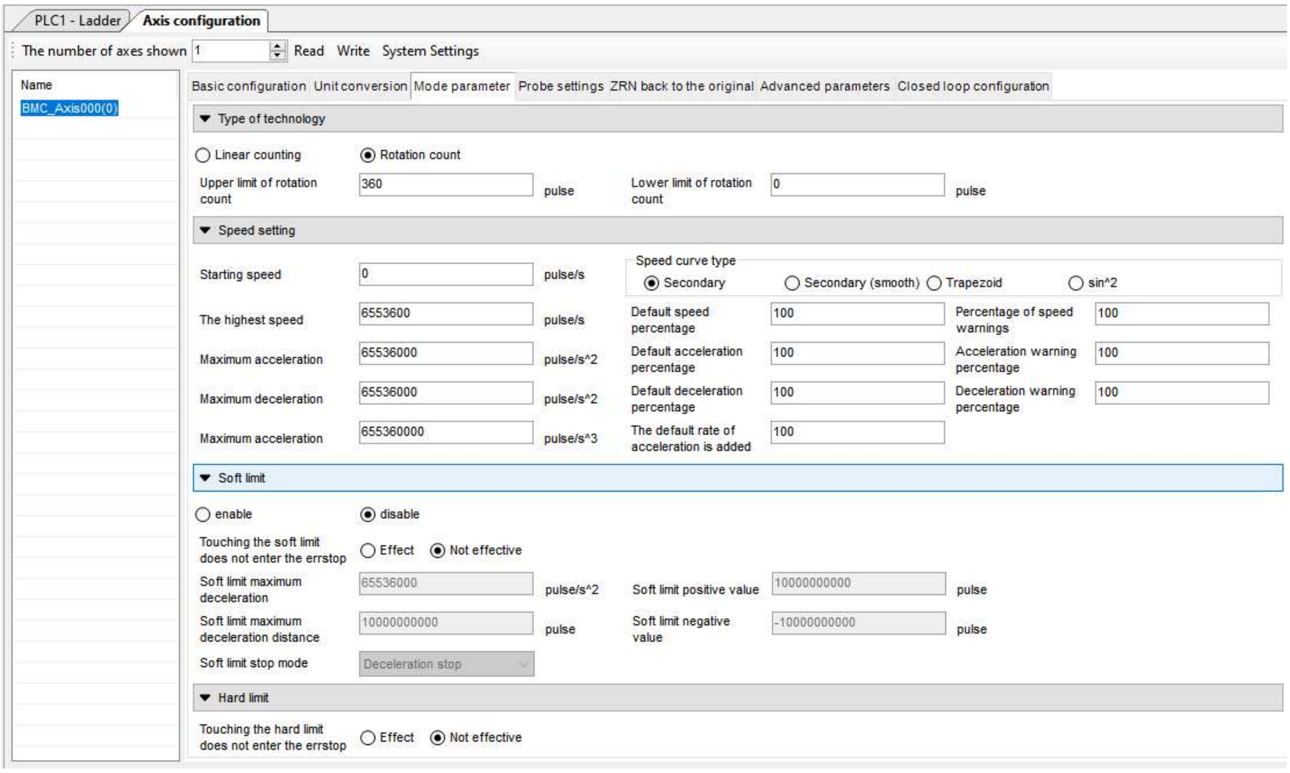
Usage and precautions:

- The full closed loop mode needs to operate in CSV mode. After the full closed loop mode is ON, it needs to switch to CSV mode through A_MODE command. After the full closed loop is ON, the command of the original CSP mode can be used in CSV mode. (instructions other than A_HOME, A_CYCVEL, A_CYCTRQ)
- When the closed-loop position feedback source SFD8205 + 300*N is set to 0, the full closed-loop takes the servo feedback position and feedback speed as the closed-loop input, and the full closed-loop position value is obtained through operation. See [full closed-loop control model] for the operation process.
- When the closed loop position feedback source SFD8205+300*N is set to 1, it needs to set the encoder input terminal SFD8006+300*N, encoder equivalent value SFD8206+300*N, closed loop takes high speed counting as closed loop input, and gets the closed loop position value through operation, the operation process refers to [full closed loop control model].
- After the full closed loop is on, the gain of the full closed loop can be adjusted in real time through [dynamic parameters]. When PLC is powered on again, the value in [set parameters] will be written into the register corresponding to [dynamic parameters].
- The higher the gain, the smaller the difference between the given position and the feedback. However, excessive gain will cause motor vibration. At this time, the gain value should be appropriately reduced.
- When using high-speed counting as the closed-loop position feedback source, please ensure that the mechanical principle meets the conditions of full closed-loop (whether the grating ruler or encoder synchronizes the current axis correctly, and whether the encoder equivalent value is set correctly).
- PLC firmware version is v3.7.1 and above.
- Pulse axis supports full closed-loop, requiring SD992 dual word hexadecimal monitoring, for 20211026 and above versions.

6-6. Application of mold axis

Steps for operating the mold axis function

1. Configure the count type as rotation count in the axis configuration mode parameters, and set the upper and lower limits of rotation count according to the requirements (default 0-360, if the lower limit value is greater than or equal to the upper limit value, an error code will be returned).



2. After setting to rotation count, the soft limit does not take effect
3. Conversion of command units and pulses when activating the gearbox:

- Count type is linear count:

$$\text{Pulse count[pulse]} = (\text{Pulse count per cycle}(1) * \text{Electric side coefficient of reducer}(3)) \div (\text{Pulse count per cycle}(1) * \text{Electric side coefficient of reducer}(3))$$

$$\text{Pulse count[pulse]} = \frac{\text{Pulse count per cycle}(1) * \text{Electric side coefficient of reducer}(3)}{\text{Movement per lap}(2) * \text{Side coefficient of reducer workpiece}(4)} \times \text{Moving distance}$$

- Count type is rotation count:

$$\text{Pulse count[pulse]} = \frac{\text{Pulse count per cycle}(1) * \text{Electric side coefficient of reducer}(3)}{\text{Movement per lap}(2) * \text{Side coefficient of reducer workpiece}(4)} \times \text{Moving distance}$$

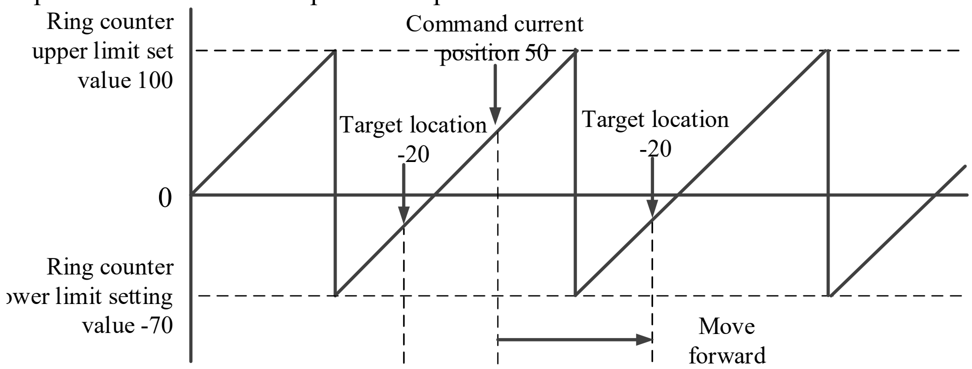
4. After enabling the mold axis: D20016+200 * N/D20044+200 * N display position value is always between [lower limit value, upper limit value].
5. The motion direction only takes effect in the case of the mold axis, and the current motion direction of the axis M20009: ON represents forward direction. OFF indicates negative direction.

1) The axis only updates its direction of motion after it has generated motion. If there is no motion, the direction of motion will not be updated.
2) CSP mode: If the displacement increases in a positive direction, the direction is positive; If the displacement increases in a negative direction, the direction is negative.
3) CSV mode: If the given speed is positive, the direction is positive; If the given speed is negative, then the direction is negative.
4) CST mode: If the given torque is positive, the direction is positive; Given a negative torque, the direction is negative.
5) HM mode: does not change the direction of movement, maintains the previous mode's direction of movement.

6. Modular axis counting diagram

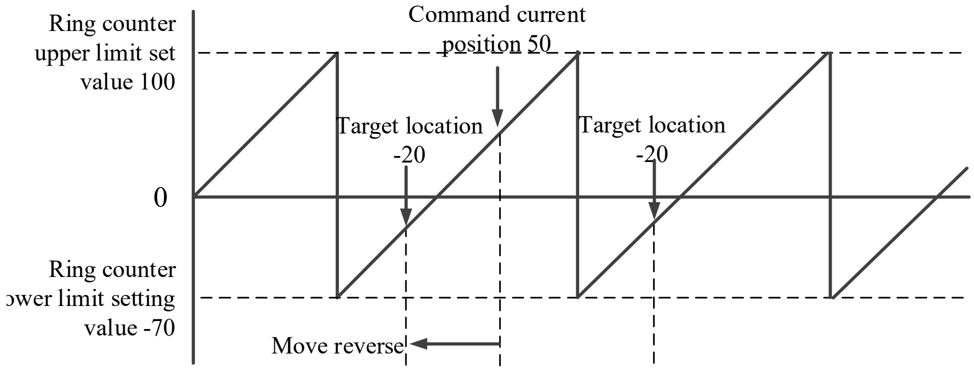
1) Forward direction

When Direction is set to "specify as positive direction", locate the target position in the positive direction.
The action example when the instruction position is positioned from "50" to "-20" is as follows:



2) Negative direction

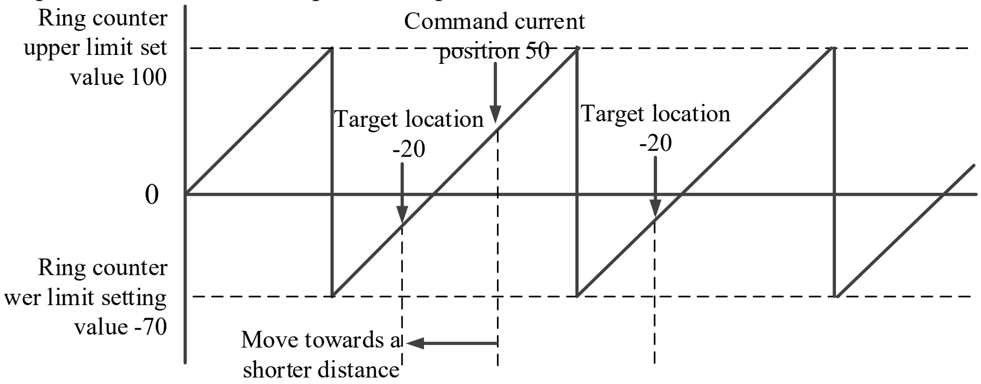
When Direction is specified as negative, locate the target position in the negative direction.
The action example when the instruction position is positioned from "50" to "-20" is as follows:



3) Minimum distance

When Direction is set to "shortest path", locate in the opposite direction to the direction where the distance between the current position and the target position is shorter.

The action example when the instruction position is positioned from "50" to "-20" is as follows:



The movement distance in both positive and negative directions is the same, and the action is the same as when "specified as the current direction".

4) Current direction

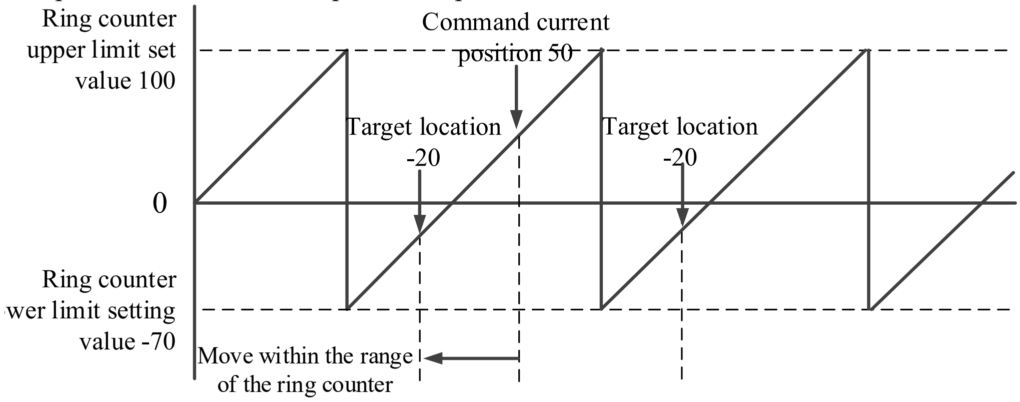
The direction of axis movement this time is consistent with the direction of last movement.

5) No direction

- Absolute Direction

When the Direction selection is "no direction specified", locate the target position within the range of the ring counter. Therefore, the direction of movement depends on the size relationship between the current position of the instruction and the target position.

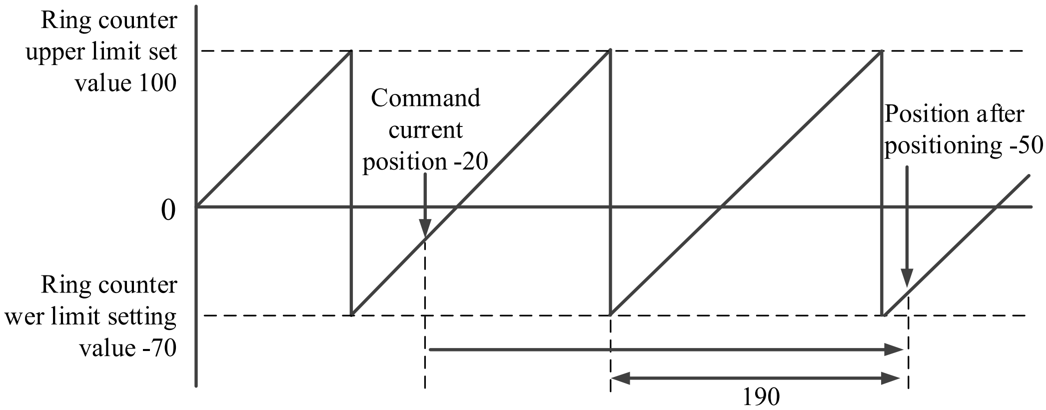
The action example when the instruction position is positioned from "50" to "-20" is as follows:



When the Direction selection is set to "no direction specified", the Position (target position) that exceeds the upper and lower limit set values of the ring counter can be specified. When the Position (target position) that exceeds the upper limit set value of the ring counter is specified, the amount of movement beyond the set value will be used as the relative quantity for positioning after the argument. Therefore, multi circle positioning can be achieved.

When the Position (target position) exceeds the lower limit set value of the ring counter, positioning is also performed.

The action example when the current position of the instruction is "-20" and the Position (target position) is specified as "290" is as follows:

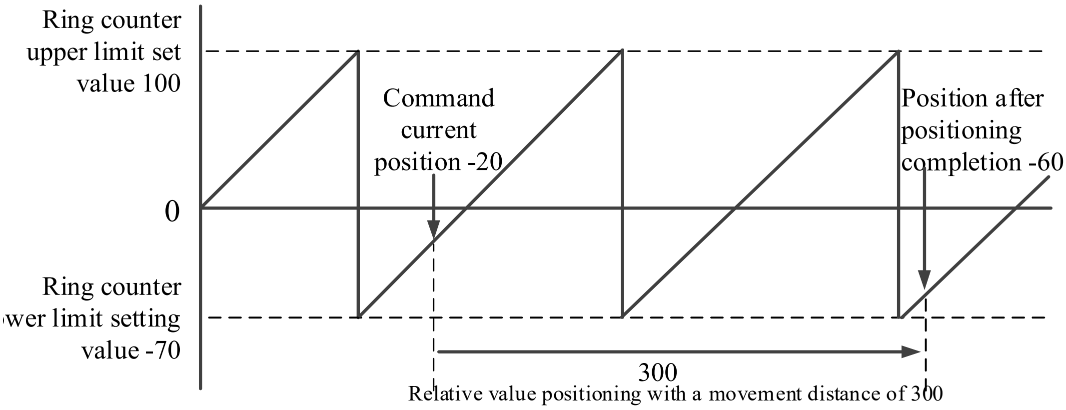


Target distance (290 (target position)-100(upper limit))=190 relative positioning

If the target position is -290, the calculation method is similar to forward direction: because -290 is less than the lower limit value, the current position:
-290-(-70)= -220.
-220+170= -50.
-50+100= 50.
The final position is 50.

- Relative positioning

When the counting mode is [rotation mode], the distance (travel distance) that exceeds the relative distance range of the axis parameter's [lower limit setting value of the ring counter] to [upper limit setting value of the ring counter] can be specified to achieve multi turn positioning of the ring.
The action example when the current position of the command is "-20" and the Distance is specified as "300" is as follows:

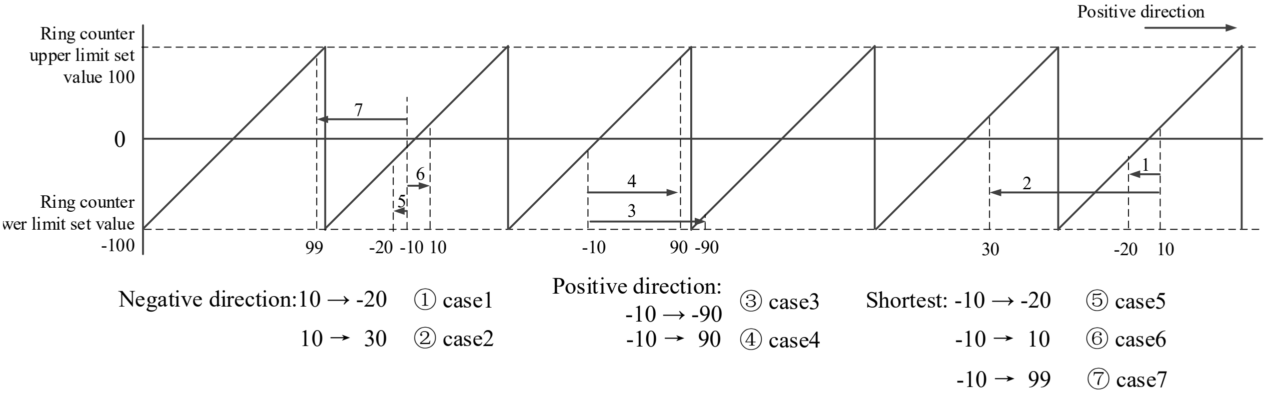


After specifying Distance as "0" and starting, the axis does not move, but Done will become True.
7. The impact of instruction inputs
1) PWR
- After the command is enabled, the axis direction is in the positive direction.

2) MOVEA
- If the user selects the direction as: positive, negative, shortest, or current: the target position entered by the user cannot exceed the lower and upper limits, an error code will be returned.
- When the user selects the direction as: no direction: the calculation method refers to "6. Mold axis counting diagram - no direction - absolute direction".

3) MOVER
- The direction selected by the user is invalid.
- The calculation method refers to "6. Axis counting diagram - no direction - relative positioning".

4) CYCPOS



- The calculation method is consistent with MOVEA.
- Direction input: positive, negative, shortest, current, no direction.
- MOVEA's calculation method is used for every position change

5) CYCVEL
- Input without directional selection.
- Convert the feedback position to the given position within the range of the mold axis.
- Determine direction based on the positive or negative values of the given speed.

6) CYCTRQ

- Input without directional selection.
- Convert the feedback position to the given position within the range of the mold axis.
- Determine direction based on the positive and negative values of the given torque.

7) MOVSUP

- Input without directional selection.
- The calculation method refers to "6. Axis counting diagram - no direction - relative positioning".

8) ZRN

- Input without directional selection.
- Convert the feedback position to the given position within the range of the mold axis.
- Model axis mode: The zero offset value must be between the upper and lower limits; In linear mode (with soft limit enabled): The zero offset position cannot exceed the minimum and maximum limit.

9) VELMOVE

- The direction input parameters are valid: positive, negative, and current. Choosing other is illegal.
- Direction selection is only effective at the mold axis.

10) DRVA

- Input without directional selection.
- The calculation method refers to "6. Modular axis counting diagram - no direction - absolute direction"

11) DRVI

- Input without directional selection.
- The calculation method refers to "6. Axis counting diagram - no direction - relative positioning".

12) CMOVA

- The calculation method is consistent with MOVEA.

13) CMOVR

- The calculation method is consistent with MOVER.

14) STOP

- Convert the feedback position to the given position within the range of the mold axis.

15) WRITE

Relative mode

- The calculation method refers to "6. Axis counting diagram - no direction - relative positioning".
- Set the current position as the user input value; The user input value must be within the upper and lower limits.

16) GEARIN

- Convert the feedback position to the given position within the range of the mold axis.

17) GEAROUT

- Convert the feedback position to the given position within the range of the mold axis.

18) HOME

- Convert the feedback position to the given position within the range of the mold axis.

19) HALT

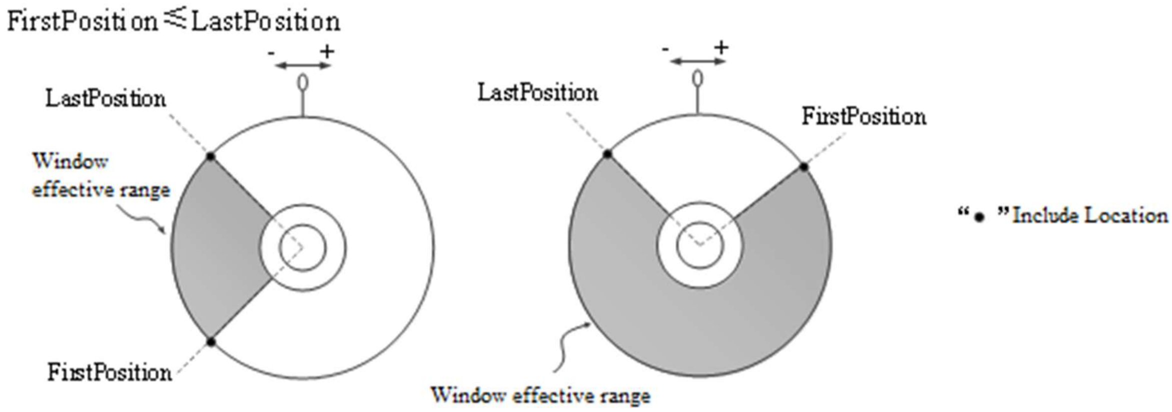
- Convert the feedback position to the given position within the range of the mold axis.
- The direction of axis movement is based on the above motion, and if it does not move, the direction changes.

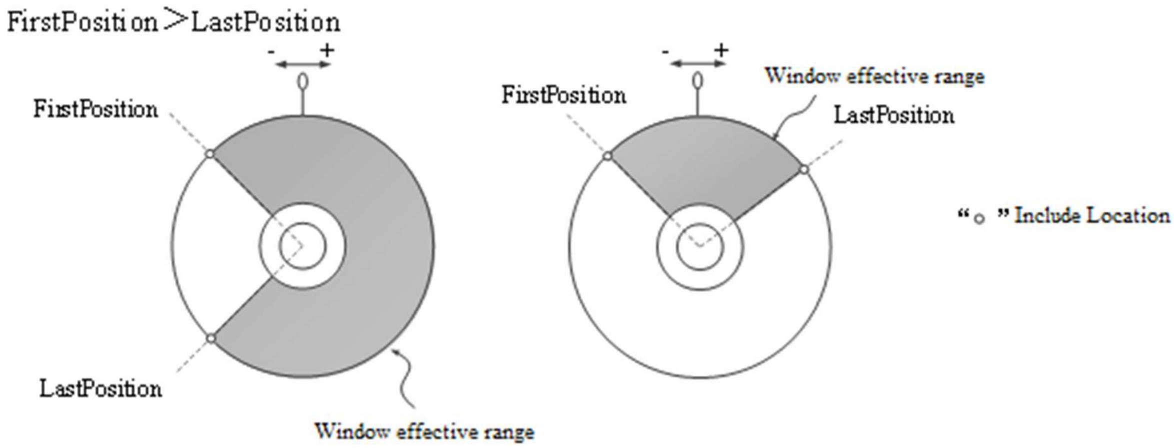
20) TouchProbe

When the window is enabled during the mold axis:

Rotation mode

- Both FirstPosition ≤ LastPosition and FirstPosition>LastPosition can be specified.
- When FirstPosition>LastPosition, the set value crosses the upper and lower limits of the loop counter.
- When the upper and lower limits of the ring counter are exceeded, an exception will occur.





21) CYCSUP
- The direction selected by the user is invalid.
- The calculation method refers to "6. Axis counting diagram - no direction - relative positioning".
- The above method is used for calculation every time the data is updated.

22) CAMIN
- Convert the feedback position to the given position within the range of the mold axis.

23) CAMOUT
- Convert the feedback position to the given position within the range of the mold axis.

24) CAMPHASING
- Input without directional selection.
- The calculation method refers to "6. Axis counting diagram - no direction - relative positioning".

25) Clutch on
- Convert the feedback position to the given position within the range of the mold axis.

26) Clutch off
- Convert the feedback position to the given position within the range of the mold axis.

27) XCAMPHASE
- Input without directional selection.
- The calculation method refers to "6. Axis counting diagram - no direction - relative positioning".
- The above method is used for calculation every time the data is updated.

28) Follow up cutting
- Convert the feedback position to the given position within the range of the mold axis.

29) Flying shear
- Convert the feedback position to the given position within the range of the mold axis.

30) Unsupported instruction, returning error code
- PLSR
- PLSF
- FOLLOW

8. Note

The lower limit of the mold axis is -100, and the upper limit is 100.

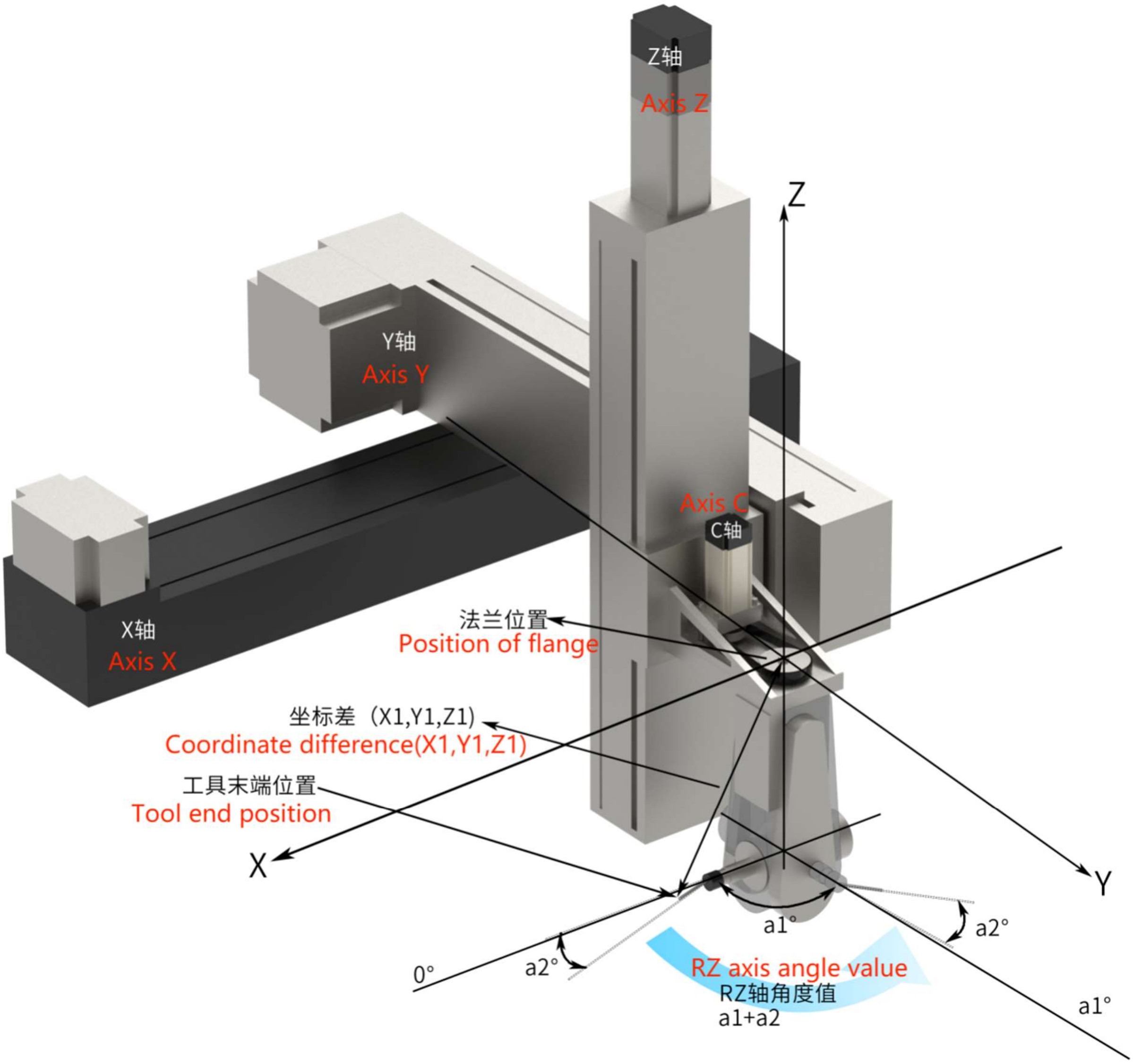
Example 1:
When MOVEA and cycsup run simultaneously: The target position calculation of MOVEA takes into account the current position of cycsup, but subsequent cycsups have no impact on the target position.
When triggered: When the cycsup runs, the mold axis position is 10 (linear position is -190), and the movea target position is -20 (positive direction). If the cycsup position no longer changes, the final target point is -20 (linear position is -20).

Example 2:
When MOVEA triggers movsup during runtime: movsup calculates normally.
The movea target position is -20 (linear position is 180), and the movesup target position is 90; When both movements end, the position is 70 (linear position is 270).

Example 3:
When movsup triggers movea during runtime: movea is only calculated after the completion of movup runtime.
When the target position of movsup is 90 (linear position is 290), and the target position of movea is -20 (positive direction), the final target point is -20 (linear position is 380).

9. Axis group
1) 123 axis only supports linear axis.
2) 456 axis supports rotation counting.
3) If the 123 axis enables the mold axis:
- Cartesian space is still a linear pattern, and there are no restrictions on the angle of ABC.
- Command input supports axis space in order to input modular data; If not supported, input is not possible.
- Model data determines the displacement of movement based on the shortest path.

6-7. XYZC mechanical model



6-7-1. Principle

The XYZC model adds a rotating axis C-axis on the basis of the XYZ three-axis, which is equipped with relevant tools through the transmission structure. The rotation unit for the C-axis needs to be set in degrees, with a movement of 360 degrees per revolution.The spatial point position of the XYZ three-axis composition is the flange position (given X: D46092+300 * N, Y: D46096+300 * N, Z: D46100+300 * N), The spatial coordinates of the tool end are given at the given position (given X: D46044+300 * N, Y: D46048+300 * N, Z: D46052+300 * N), Feedback position (given X: D46140+300 * N, Y: D46144+300 * N, Z: D46148+300 * N), The C-axis position is independent, the flange position is C: D46104+300 * N, the tool end position is given as C: D46056+300 * N, and feedback is given as C: D46152+300 * N. The initial default is tool 0, and the flange position is consistent with the tool end position.
Through tool instruction G_ TOOLWR writes different tools into the PLC, G_TOOLSEL command modifies the end position of the tool.If G_TOOLWR command parameter XYZ three axis input flange position and tool end position coordinate difference X1, Y1, Z1, C-axis input tool offset angle a2.The position of the tool loading flange remains unchanged, and only the end position of the tool is processed. The processing method is:

1) Divide the current angle of the C-axis by 360 to obtain the remaining relative deflection angle of the C-axis. Based on the deflection angle, deflect the X1 and Y1 coordinates to X2 and Y2.
2) XYZ three-axis position plus position deviation X2, Y2, Z1, C-axis current position plus compensation value a2.
3) The final coordinates are (X+X2, Y+Y2, Z+Z1, C+a2).

The working trajectory of the XYZC model under the axis group motion command is: while the C-axis is moving at a constant speed, the XYZ three-axis flange position is interpolated with it to execute spatial trajectory actions at the tool end position, and the velocities of each axis are combined into linear velocities.

6-7-2. Example

Functional requirements: The current flange position of the machinery is 3000070005000, the C-axis position is 90°, the coordinate difference between the tool end position and the flange position is (1002000,30), the tool head is deflected by 15°, and the action requires the tool end space to move in a straight line to the (0,0,0) position, with a linear speed of 5000, and the tool to rotate 360° in a forward direction at the same time.

The basic configuration of the C-axis and axis group is as follows:

参数名	地址	离线值	在线值	类型	参数生效时机	说明
轴类型	SFD8900	实轴	实轴	ENUM	重新上电生效	
指令通道	SFD8901	EtherCAT	EtherCAT	ENUM	重新上电生效	控制器与伺服通信方式
从站号	SFD8902	3	3	INT16U	重新上电生效	从站stationID对应
单位	SFD8903	脉冲	脉冲	ENUM	重新上电生效	
每圈脉冲数	SFD8904	131072	131072	INT32U	重新上电生效	从站旋转一圈反馈的脉冲数 (The actual number of pulses required for one servo turn)
编码器轴输...	SFD8906	0	0	INT16U	重新上电生效	编码器输入的X端子
龙门模式	SFD8907	不启用	不启用	ENUM	重新上电生效	若为龙门架结构的从轴，[illegible]绑定关系
每圈移动量	SFD8908	360	360	FP64	重新上电生效	The instruction unit needs to be set to 360 degrees
启用减速机	SFD8912	不启用	不启用	ENUM	重新上电生效	Based on the mechanical structure, it is confirmed whether a reducer is used
减速机工件...	SFD8914	0	0	INT32U	重新上电生效	
减速机电机...	SFD8916	0	0	INT32U	重新上电生效	
运动方向	SFD8918	不反向	不反向	ENUM	重新上电生效	0：脉冲增量方向电机正转；1：脉冲增量方向电机反转；
位置指令滤波	SFD8919	0	0	INT16U	重新上电生效	单位：ms
计数类型	SFD8920	直线	直线	ENUM	重新上电生效	直线：线性轴，若启用软限位则超限报警；旋转：模轴，计数在限...
旋转计数上限	SFD8924	0	0	FP64	重新上电生效	模轴有效
旋转计数下限	SFD8928	0	0	FP64	重新上电生效	模轴有效
背隙补偿值	SFD8932	0	0	FP64	重新上电生效	
急停模式	SFD8936	给定停止	给定停止	ENUM	重新上电生效	0：给定停止，触发急停时给定位置不变；1：反馈停止，触发停止...

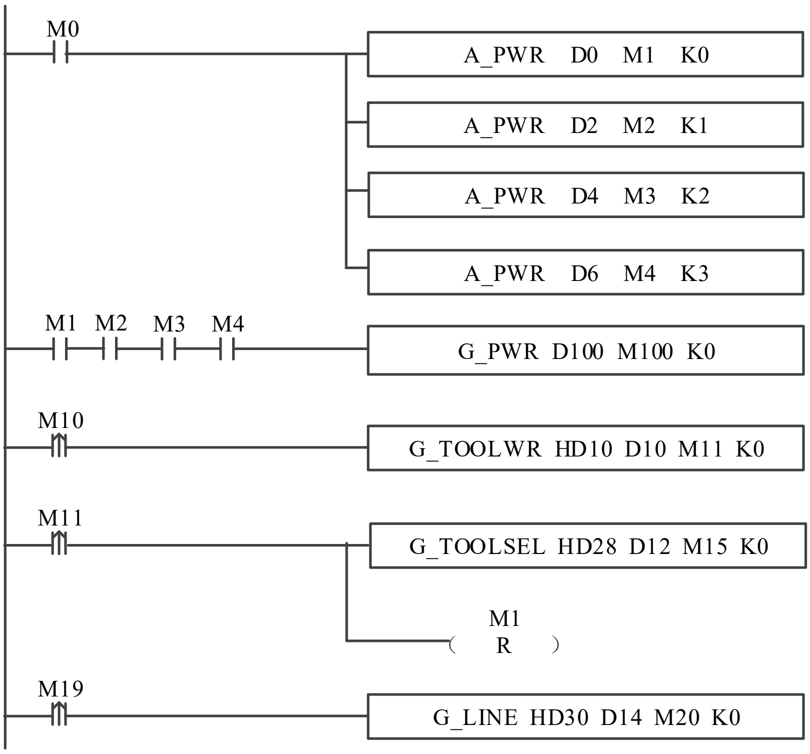
显示轴数 读取 写入 系统设置

轴组0 轴组1 轴组2 轴组3

基础配置 性能参数配置 报警参数配置 极限配置 插补配置 前瞻参数

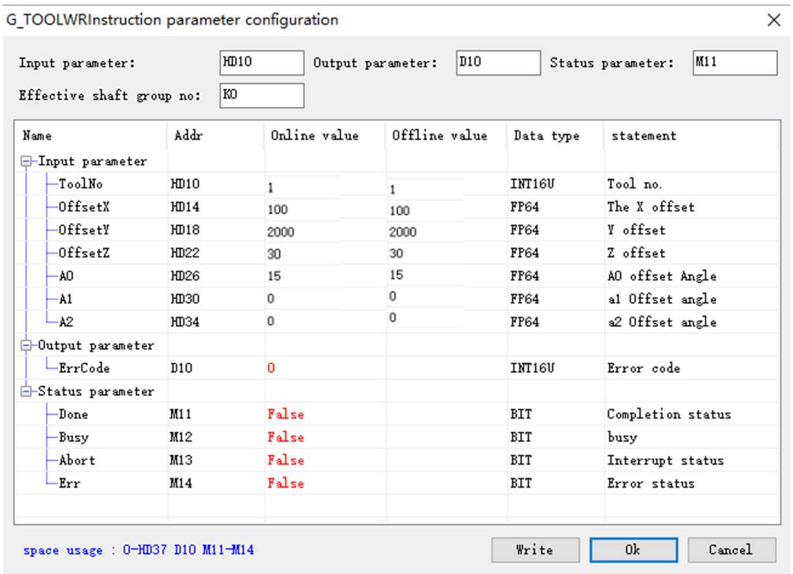
参数名	地址	离线值	在线值	类型	参数生效时机	说明
运动学类型	SFD48000	XYZC	XYZC	ENUM	重新上电生效	工作模型 Working model
配置轴号1	SFD48001	0	0	INT16U	重新上电生效	X 单轴轴号匹配，65535为无效值
配置轴号2	SFD48002	1	1	INT16U	重新上电生效	Y 单轴轴号匹配，65535为无效值
配置轴号3	SFD48003	2	2	INT16U	重新上电生效	Z 单轴轴号匹配，65535为无效值
配置轴号4	SFD48004	3	3	INT16U	重新上电生效	C 单轴轴号匹配，65535为无效值
配置轴号5	SFD48005	65535	65535	INT16U	重新上电生效	单轴轴号匹配，65535为无效值
配置轴号6	SFD48006	65535	65535	INT16U	重新上电生效	单轴轴号匹配，65535为无效值
轴组错误停...	SFD48007	不启用	不启用	ENUM	重新上电生效	
急停模式	SFD48008	给定停止	给定停止	ENUM	重新上电生效	0：给定停止，触发急停时给定位置不变；1：反馈停止，触发停止...

The instructions are as follows:



The command configuration parameters are as follows:

G_TOOLWR:



G_TOOLWRInstruction parameter configuration

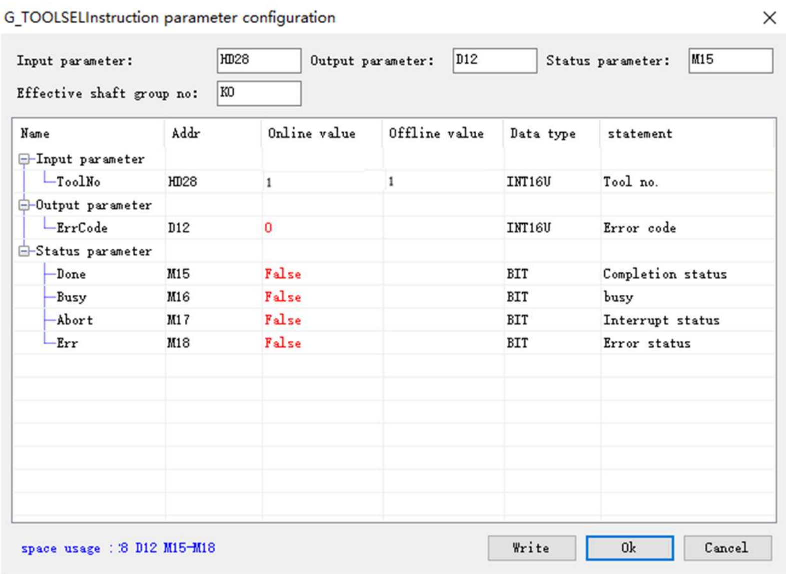
Input parameter: HD10 Output parameter: D10 Status parameter: M11

Effective shaft group no: K0

Name	Addr	Online value	Offline value	Data type	statement
Input parameter					
ToolNo	HD10	1	1	INT16U	Tool no.
OffsetX	HD14	100	100	FP64	The X offset
OffsetY	HD18	2000	2000	FP64	Y offset
OffsetZ	HD22	30	30	FP64	Z offset
A0	HD26	15	15	FP64	A0 offset Angle
A1	HD30	0	0	FP64	a1 Offset angle
A2	HD34	0	0	FP64	a2 Offset angle
Output parameter					
ErrCode	D10	0		INT16U	Error code
Status parameter					
Done	M11	False		BIT	Completion status
Busy	M12	False		BIT	busy
Abort	M13	False		BIT	Interrupt status
Err	M14	False		BIT	Error status

space usage : 0-HD37 D10 M11-M14 Write Ok Cancel

G_TOOLSEL:



G_TOOLSELInstruction parameter configuration

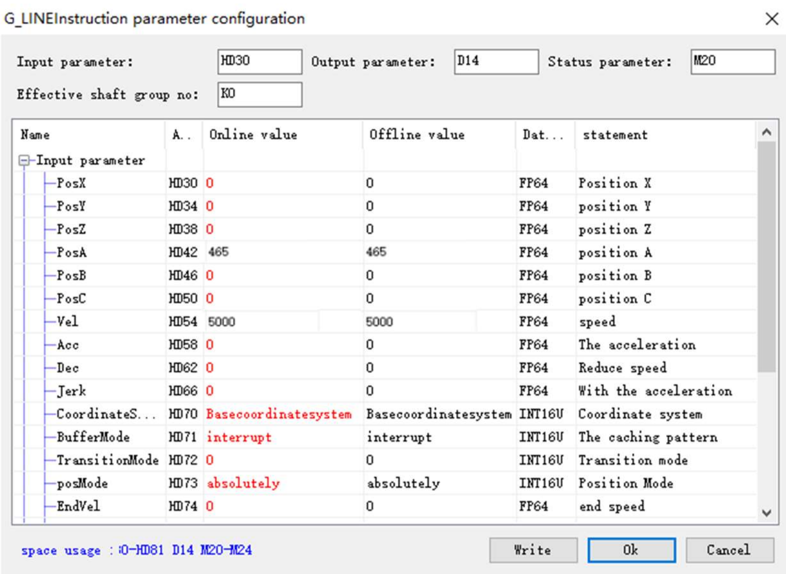
Input parameter: HD28 Output parameter: D12 Status parameter: M15

Effective shaft group no: K0

Name	Addr	Online value	Offline value	Data type	statement
Input parameter					
ToolNo	HD28	1	1	INT16U	Tool no.
Output parameter					
ErrCode	D12	0		INT16U	Error code
Status parameter					
Done	M15	False		BIT	Completion status
Busy	M16	False		BIT	busy
Abort	M17	False		BIT	Interrupt status
Err	M18	False		BIT	Error status

space usage : :8 D12 M15-M18 Write Ok Cancel

G_LINE:



G_LINEInstruction parameter configuration

Input parameter: HD30 Output parameter: D14 Status parameter: M20

Effective shaft group no: K0

Name	A..	Online value	Offline value	Dat...	statement
Input parameter					
PosX	HD30	0	0	FP64	Position X
PosY	HD34	0	0	FP64	position Y
PosZ	HD38	0	0	FP64	position Z
PosA	HD42	465	465	FP64	position A
PosB	HD46	0	0	FP64	position B
PosC	HD50	0	0	FP64	position C
Vel	HD54	5000	5000	FP64	speed
Acc	HD58	0	0	FP64	The acceleration
Dec	HD62	0	0	FP64	Reduce speed
Jerk	HD66	0	0	FP64	With the acceleration
CoordinateS...	HD70	Basecoordinatesystem	Basecoordinatesystem	INT16U	Coordinate system
BufferMode	HD71	interrupt	interrupt	INT16U	The caching pattern
TransitionMode	HD72	0	0	INT16U	Transition mode
posMode	HD73	absolutely	absolutely	INT16U	Position Mode
EndVel	HD74	0	0	FP64	end speed

space usage : :0-HD81 D14 M20-M24 Write Ok Cancel

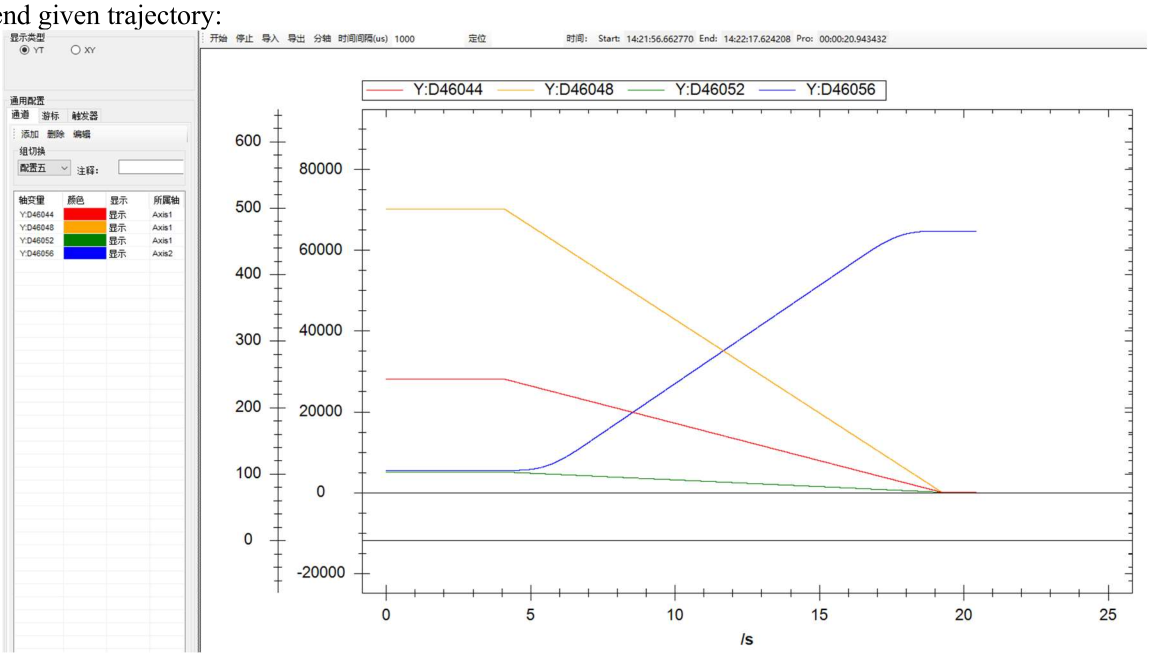
Explanation:
When M0 enables the axis and all four axes are successfully enabled (M1, M2, M3, M4 are ON), the axis group is enabled. Afterwards, turn M10 from OFF to ON and G_TOOLWR instruction writes the tool value to the corresponding tool, and when the instruction execution ends (M11 is ON), execute G_TOOLSEL command loads the tool into the system, and then manually switches M19 from OFF to ON, with command G_LINE command performs spatial linear interpolation motion control on a specified axis group. Due to the use of tools, the execution trajectory at the end of the tool is a spatial straight line. However, due to the need for constant compensation at the end of the flange (compensation rules are explained at the end of this section), the trajectory is an irregular spatial curve.
Given position and flange position before using tools:

D46044	30000	Double	Dec	X position given
D46048	70000	Double	Dec	y
D46052	5000	Double	Dec	z
D46056	90	Double	Dec	c
D46092	30000	Double	Dec	X Given flange position
D46096	70000	Double	Dec	y
D46100	5000	Double	Dec	z
D46104	90	Double	Dec	c
D46140	30000	Double	Dec	X position feedback
D46144	70000	Double	Dec	y
D46148	5000	Double	Dec	z
D46152	90	Double	Dec	c

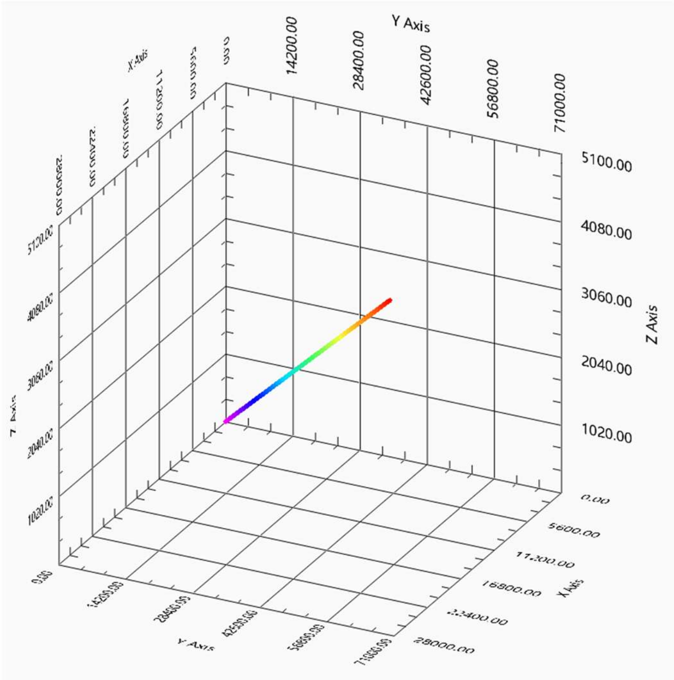
Given the position and flange position after using the tool:

D46044	28000	Double	Dec	X position given
D46048	70100	Double	Dec	y
D46052	5030	Double	Dec	z
D46056	104.99999999999999	Double	Dec	c
D46092	30000	Double	Dec	X Given flange position
D46096	70000	Double	Dec	y
D46100	5000	Double	Dec	z
D46104	89.99999999999972	Double	Dec	c
D46140	28000	Double	Dec	X position feedback
D46144	70100	Double	Dec	y
D46148	5030	Double	Dec	z
D46152	104.999999999997	Double	Dec	c

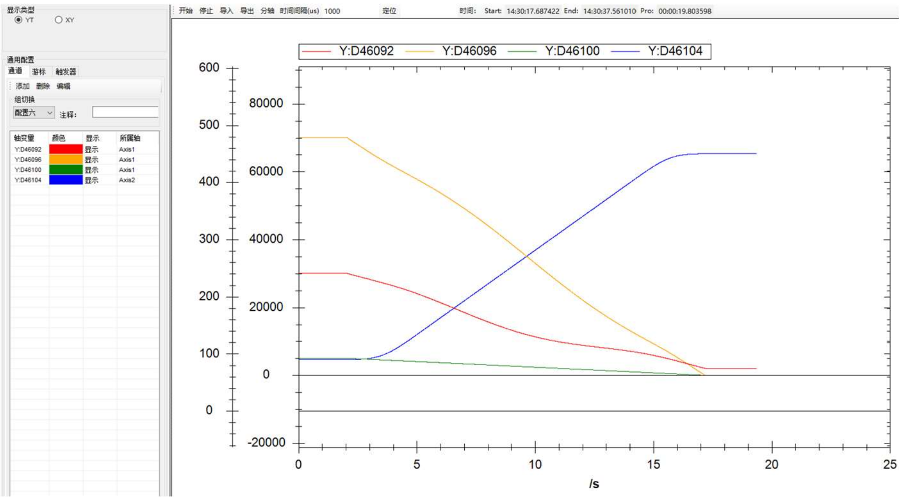
Note:
Due to the inherent 90° deviation of the C-axis, the tool end position of the shaft assembly after using the tool is (2800070100). Please refer to sections 5-2-18 for specific calculations.
Execute G_ LINE command oscilloscope captures data as follows:
Tool end given trajectory:



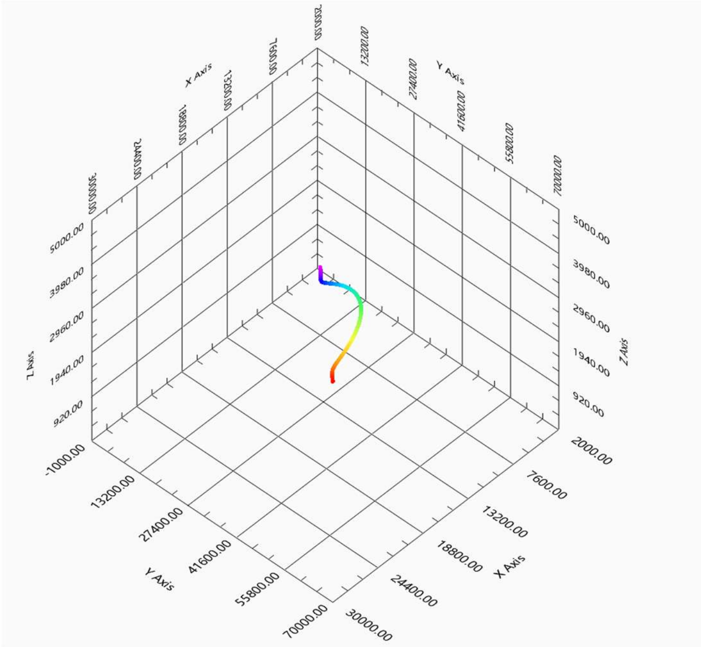
LABVIEW synthesized XYZ trajectory:



Position trajectory of flange end:



LABVIEW synthesized XYZ trajectory:

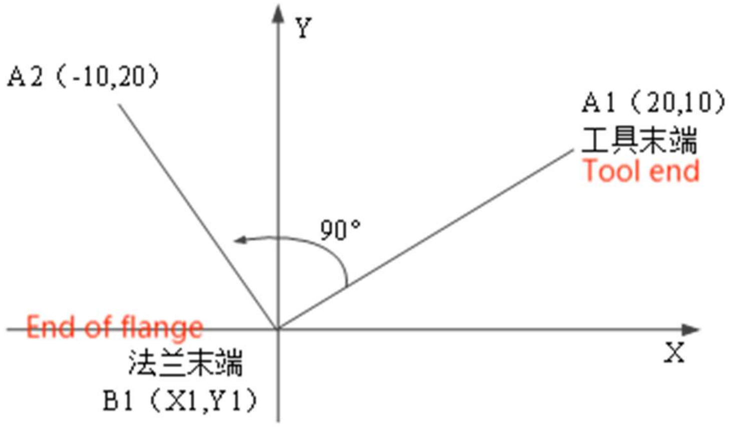


X Axis
Y Axis
13200.00
27400.00
41600.00
55800.00
70000.00
5000.00
3980.00
2960.00
1940.00
920.00
-1000.00
Z Axis
13200.00
27400.00
41600.00
55800.00
70000.00
Y Axis
2000.00
7600.00
13200.00
18800.00
24400.00
30000.00
X Axis

6-7-3. Imputation rule

When the motion command is executed, causing rotation of the c-axis will affect the deviation between the trajectory of the tool end and the target trajectory. In this case, the flange end needs to compensate for the x-axis and y-axis of the tool end in real time. The compensation value is related to the rotation angle. Taking the c-axis rotation of 90 ° as an example, specific explanations will be provided below.

Assuming that the position of the axis group is (0,0,0,0) before using the tool, and the coordinates are (20,10,0,0) after using the tool, but the value at the end of the flange remains unchanged and remains (0,0,0), if G is executed at this time_ LINE motion command causes the axis to run to position B (20,10,0,90), and the position change of the tool end is shown in the following figure:



From the figure, it can be seen that after the tool end is rotated 90 ° in the XOY plane, its coordinate value is (-10,20,90), which is inconsistent with the target position in the instruction. At this time, the flange end needs to compensate for the tool end: XB=XA2+X1, YB=YA2+Y1. Finally, through calculation, X1=30, Y1=-10, which is the value of x and y at the flange end after rotating 90°. The coordinate value at the end of the flange at this time.

6-8. Polar coordinate model

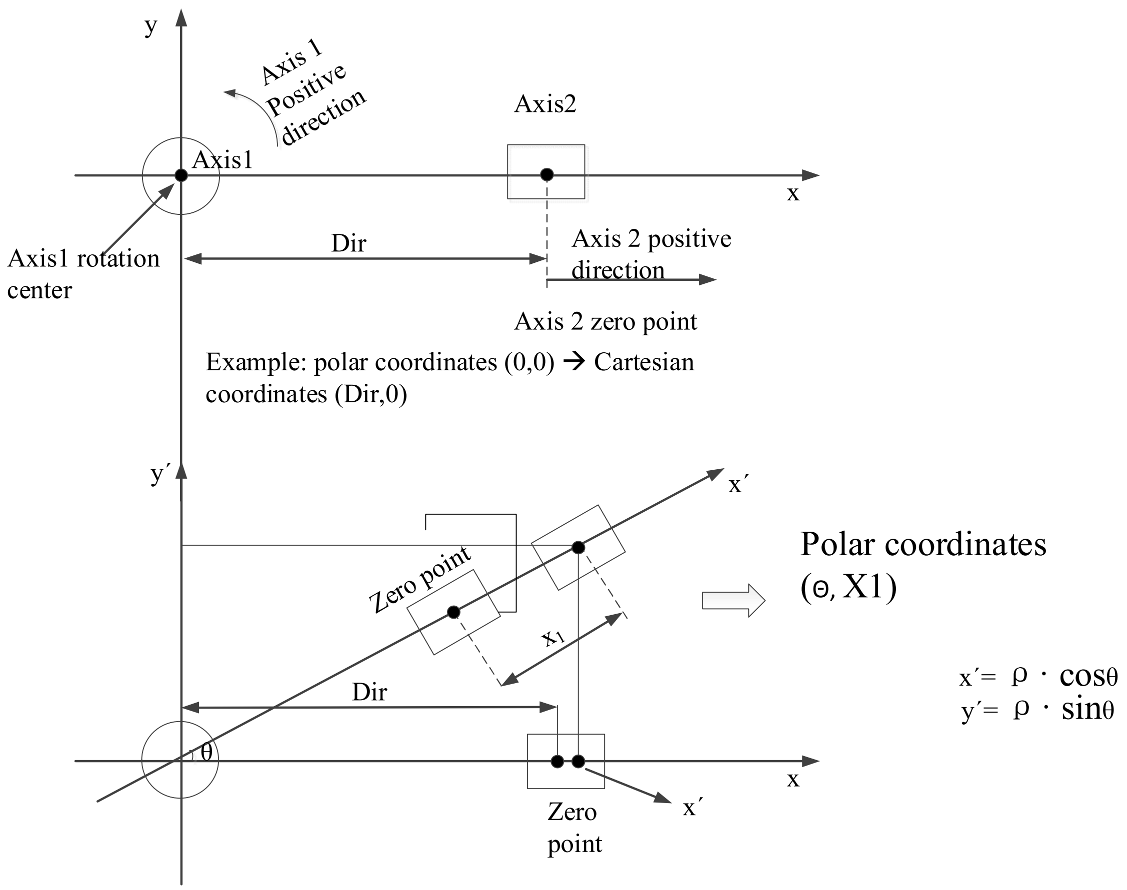
1) Supported Instructions

Number	Instruct	Number	Instruct
1	G_PWR	9	G_SETOVRD
2	G_PTP	10	G_CFGAXIS
3	G_LINE	11	G_MOVSUP
4	G_CIRCLE	12	G_COMPON
5	G_INTR	13	G_COMPOFF
6	G_GOON	14	G_BEZIER
7	G_PATHSEL	15	G_ELLIPSE(Only supports XOY plane)
8	G_PATHMOV		

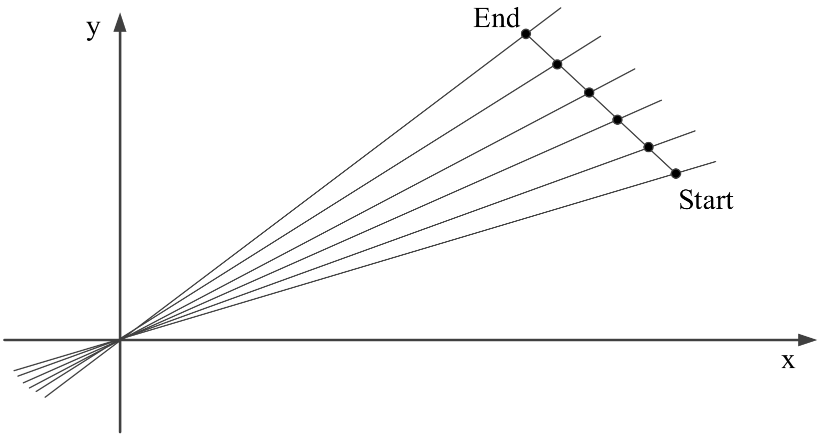
2) Configuration

- Polar coordinate model setting SFD48000=4.
- The axis number can only be configured for SFD48001 rotation axis and SFD48002 translation axis.
- Distance between the rotation center of the turntable and the translation axis: SFD48162 (FP64).
- The offset of the turntable center based on base coordinates:
  X-direction offset: SFD48166 (FP64).
  Y-direction offset: SFD48170 (FP64).

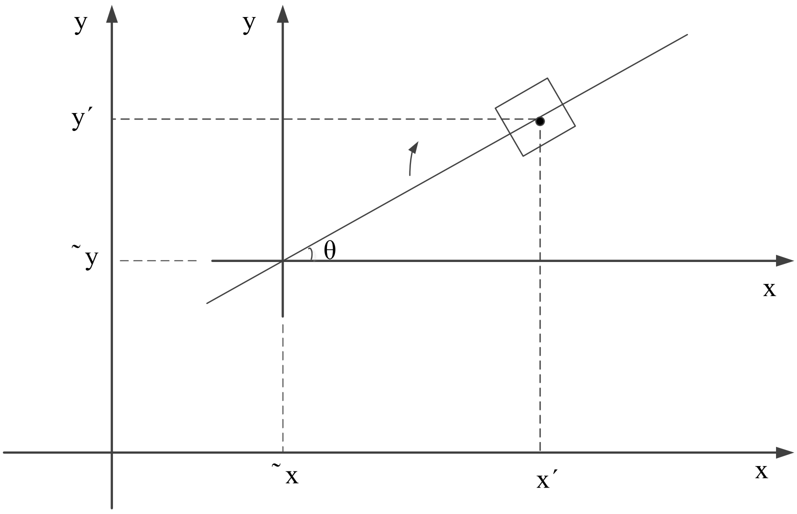
3) Model schematic diagram



4) Schematic diagram of linear interpolation



There is an offset between the rotation center and the base coordinate:



$$x' = \tilde{x} + \rho \cdot \cos\theta$$
$$y' = \tilde{y} + \rho \cdot \sin\theta$$

7. Bus motion control function choice

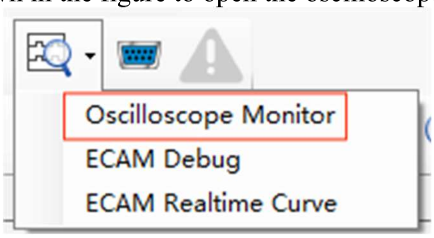
7-1. The conditions for using an oscilloscope

The oscilloscope function can only be used when connected to an EtherCAT slave station and the programming software is in X-NET monitoring mode.

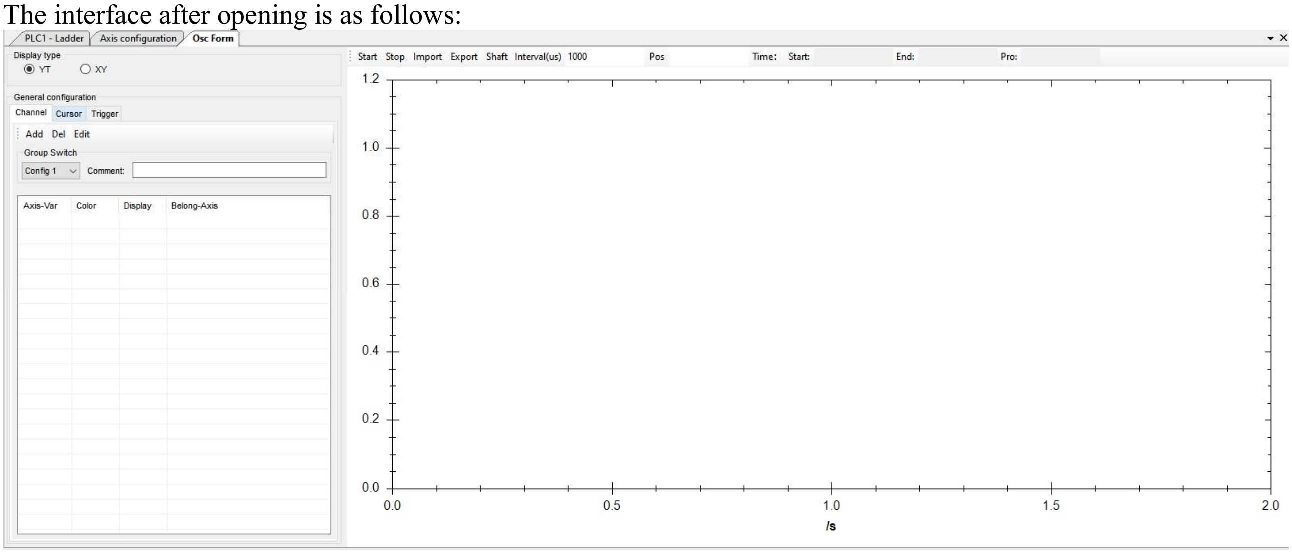
Note: EtherCAT models have PLC version V3.7.2 and above, software version 3.7.14b and above, can be disconnected from the slave station, and support Modbus TCP and Modbus RTU protocols.Upper computer version 3.7.16 and above,ordinary models also support oscilloscope function.

7-2. Opening the oscilloscope interface

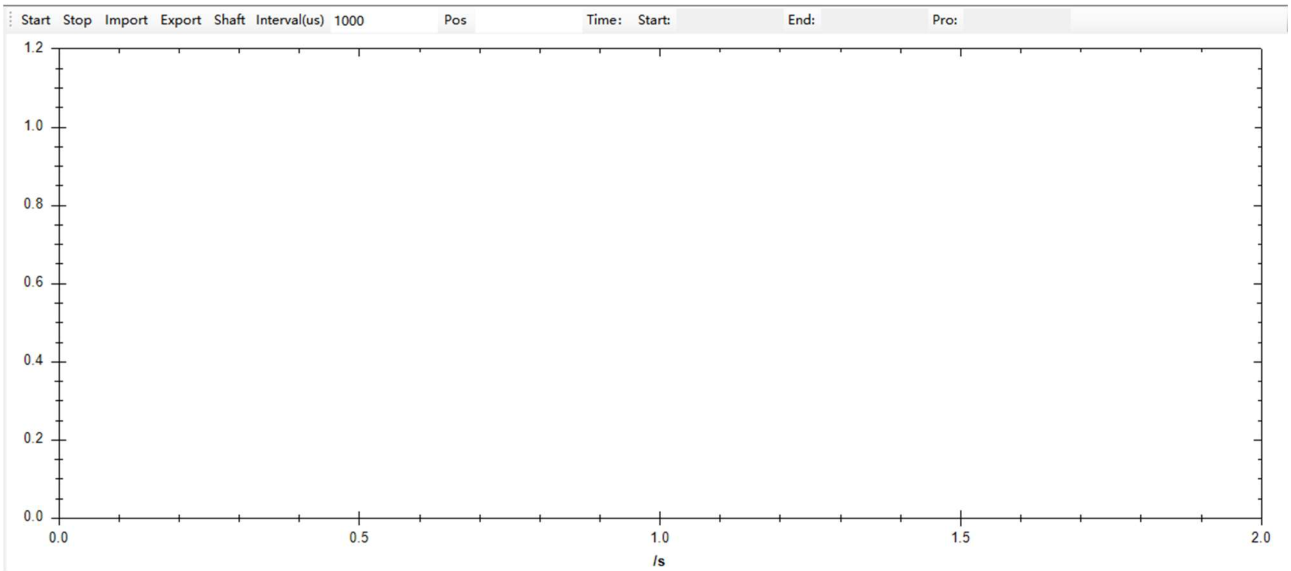
Click on the oscilloscope icon as shown in the figure to open the oscilloscope interface.



The interface after opening is as follows:



7-3 Oscilloscope main interface



Parameter	Description
Start	Oscilloscope starts working
Cease	Oscilloscope stops working
Leading-in	Open saved oscilloscope data
Leading-out	Save all data of the oscilloscope in the current scenario (curve configuration, cursor, trigger, image data, oscilloscope working time, etc.)
Split axle	Display different Y-axis regions of the same display area in different regions. **Note**: This function is only effective when the curve configuration belongs to different axes.When there is only one axis to which it belongs, axis splitting cannot be achieved. When users configure different axes, multiple Y-axes will be displayed. The split axis function can only be achieved when there are multiple Y-axes.
Time interval (us)	The time interval displayed between two sampling points, in microseconds (default to the value of the synchronization unit cycle in EtherCAT)
Locate	Positioning a curve at a certain point in time (measured in seconds) or starting with a numerical value
Time	Display start, end, and oscilloscope working time

Interface operation instructions

Parameter	Description
Amplify	Hold down the left mouse button and drag to select the area that needs to be enlarged. The default zoom method is to enlarge horizontally and vertically in both directions (region enlargement). Modify the magnification method (horizontal or vertical) by right clicking on the menu displayed in the display area
Shrink	Right click on the display area and click on "Restore to original scaling ratio/Restore to previous scaling ratio" in the display menu to zoom out
Drag	There are three ways to drag : ① Hold down Ctrl+left button, the cursor changes to a hand shape, and drag the image.② Hold down the middle mouse button (scroll wheel) and drag the image.③ When both horizontal and vertical scaling in the right-click menu are not selected (there is no scaling function at this time), hold down the left mouse button and drag the image

Right click menu

Parameter	Description
Save as Chart	Save as Chart
Export Data	Save image data in Excel format
Display node values	When the mouse moves to a node on the curve, display the coordinate axis value of that node
Display cursor values	When the mouse moves, the real-time display of the coordinate axis value of the point where the cursor is located

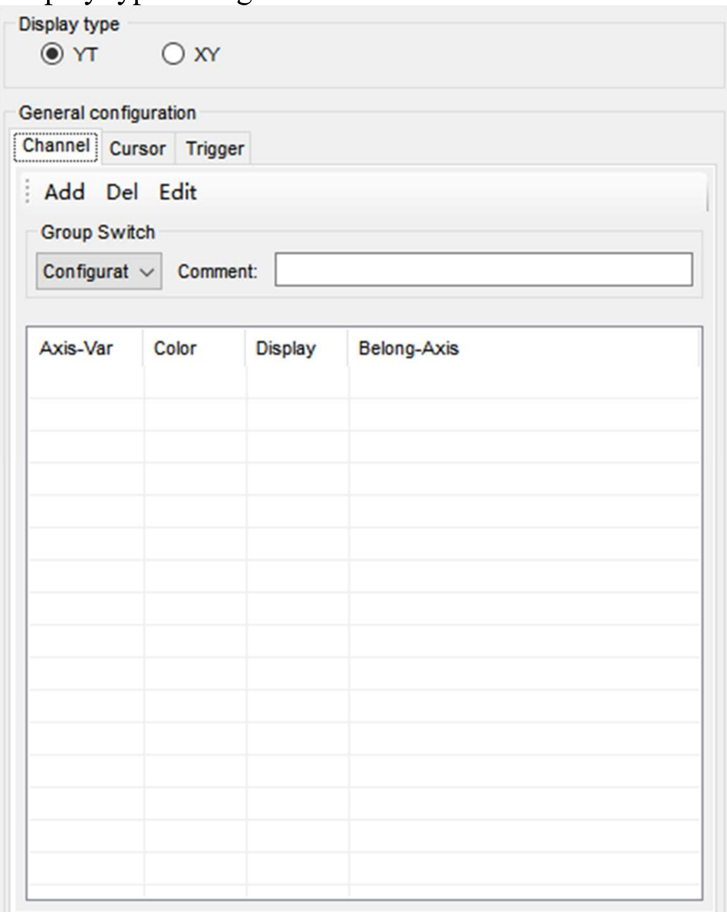
Horizontal scaling	Only zoom in/out on the X-axis
Vertical scaling	Only zoom in/out on the Y-axis (a certain area can only be scaled when both horizontal and vertical scaling are checked)
Restore to previous scaling ratio	Zoom out the image to the previous display scale and display area
Restore to original scaling ratio	Display the entire curve

Note: When the interface displays data for more than one minute, the data curve from one minute ago will be cleared, but the data still exists. Users need to click on Export Data in the right-click menu to view all data.

7-4. Oscilloscope configuration interface

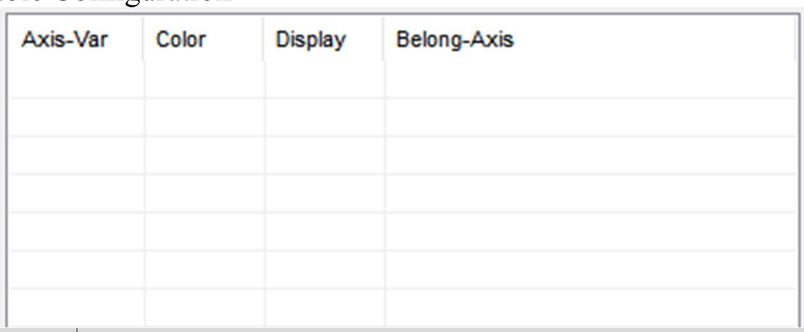
7-4-1. Oscilloscope monitoring

7-4-1-1. Oscilloscope display type configuration



Parameter	Description
YT	The horizontal axis represents the time variable, and the vertical axis represents a single register variable. When configuring the curve, only a single register variable needs to be configured
XY	The horizontal and vertical coordinates are both register variables. When configuring a curve, two register variables need to be configured

7-4-1-2. Axis Variable Configuration

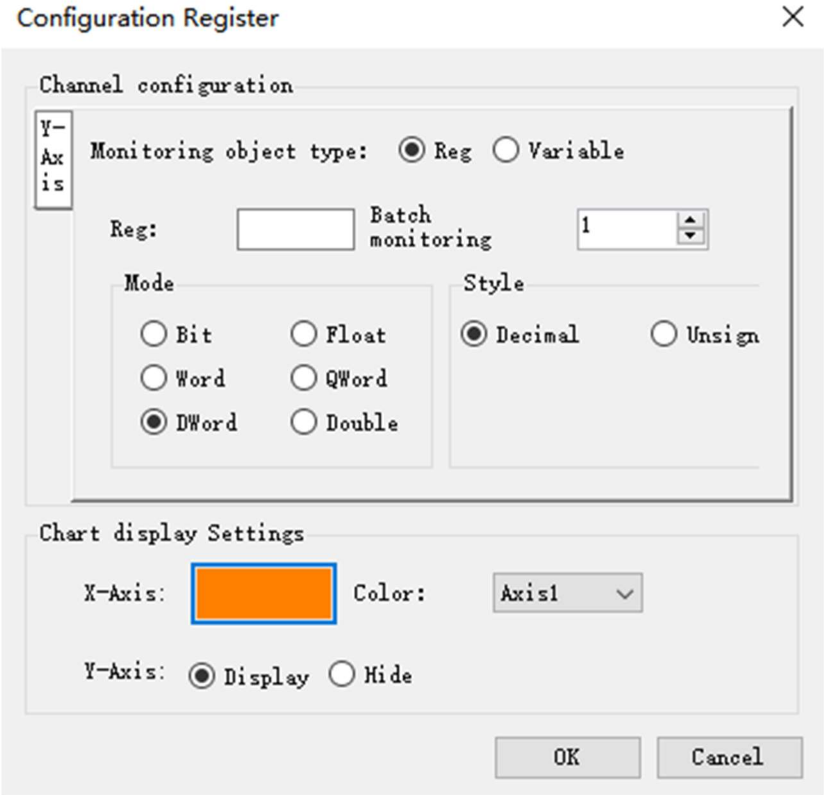


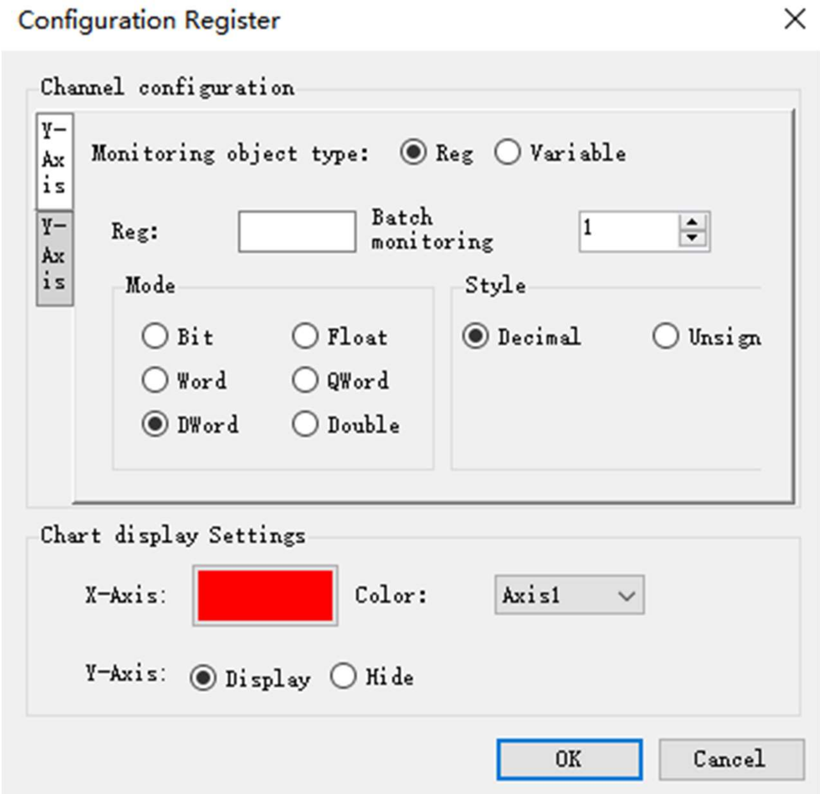
Parameter	Description
Add	Add Curve
Delete	Delete Curve
Edit	Edit curve attributes

Note: When the oscilloscope starts working, curves cannot be added or deleted, only curve properties can be edited.

7-4-1-3. Channel Configuration

Click on 【 Channel 】 - 【 Add 】 to open the configuration register window:





Parameter	Description
X-axis	Register type (HD, D, SD)+Register offset (numeric)+Register data type
Y-axis	Register type (HD, D, SD)+Register offset (numeric)+Register data type
Monitoring node type	Optional monitoring registers or variables
Colour	The color of the curve display (click on the color block to modify the curve color)
Display	Is the curve displayed on the oscilloscope display interface
Axis	On which axis is the curve displayed on the oscilloscope display interface (for

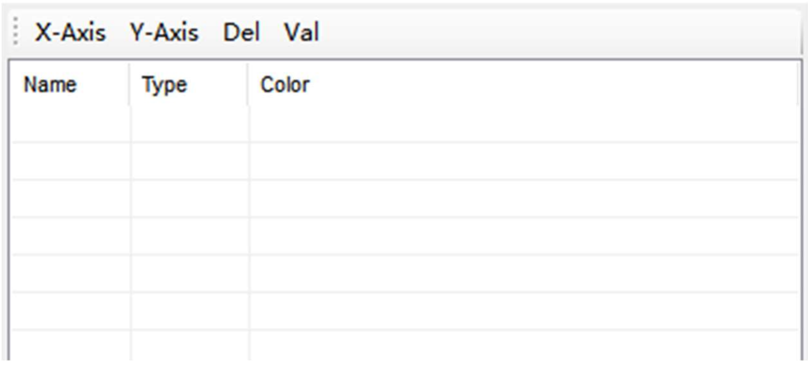
	implementing the split axis function)
Group switching	Can configure multiple sets of different configurations

Note:

① When the oscilloscope type is YT, the 【 X-axis 】 cannot be configured, and the time displayed on the horizontal axis.

② When the oscilloscope starts working, only the color, display, and axis attributes of the curve can be adjusted, and the registers of the XY axis cannot be modified.

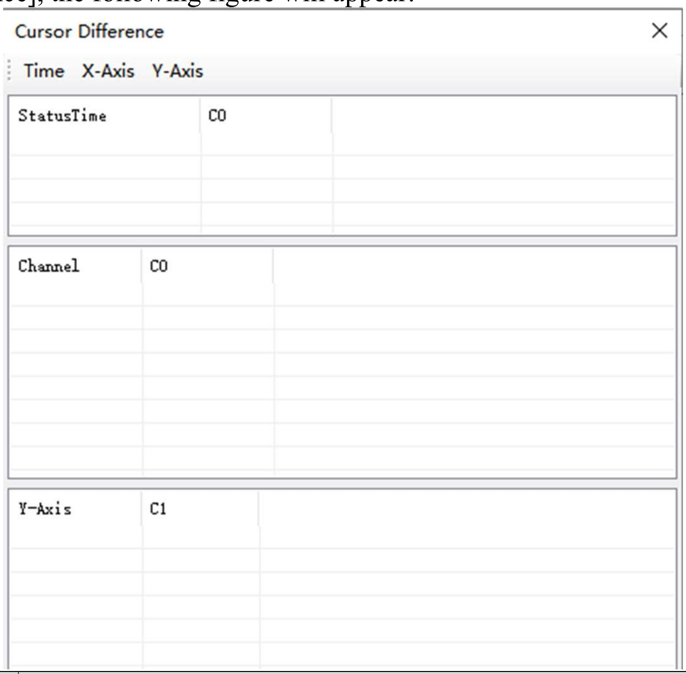
7-4-1-4. Cursor configuration



Parameter	Description
X-axis	Add X-axis cursor (vertical cursor, perpendicular to X-axis)
Y-axis	Add Y-axis cursor (vertical cursor, perpendicular to Y-axis)
Delete	Delete cursor
Numerical value	Display cursor difference data

7-4-1-5. Difference interface

After clicking on [Difference], the following figure will appear:



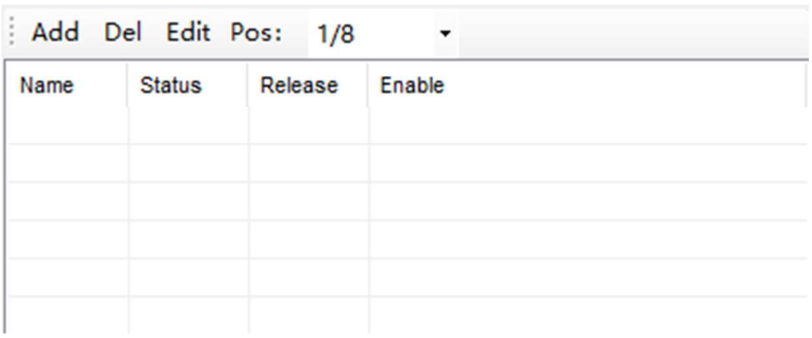
Parameter	Description
Time	Show/hide the StatusTime area (this area only exists when the oscilloscope type is YT)
X-axis	Show/hide Channel/X-Axes area
Y-axis	Show/hide Y-Axes area

Note:

① StatusTime area display rules:

A. Display two times: computer time (PC time).The oscilloscope displays the working time.
B. Time data source: The value of the X-axis cursor on the X-axis (timeline).
② Channel area display rules:
A. Data source: Y-axis register data corresponding to the X-axis cursor (data on the Y-axis corresponding to the X-axis in the coordinate system).For example: The time of the X-axis cursor on the X-axis is 1 second, and the data of the Y-axis register variable at 1 second is used as the display data source.
B. Channel column: displays all register variables monitored on the oscilloscope.
③ Y-Axes region display rules
A. Data source: Y-axis cursor data on the vertical axis
B. For each additional Y-axis, the table adds a data display.

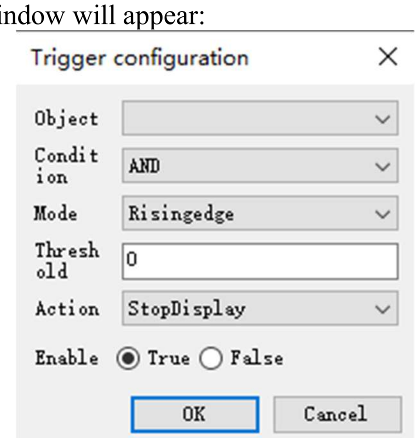
7-4-1-6. Trigger configuration



Parameter	Description
Add	Add trigger
Delete	Delete selected trigger
Edit	Edit selected triggers
Position	The position displayed on the screen after the trigger is triggered

Note:
① Trigger position description: For example, if the trigger position is 1/8, the trigger will stop and will not immediately stop. When the data obtained after the trigger is triggered can occupy 7/8 of the current interface, the display will stop.
② After the trigger is triggered, the status changes to red, and a dashed line is displayed on the interface indicating the trigger position.
③ When its version is XY, the trigger stops immediately after triggering.

After clicking [Add], the following window will appear:

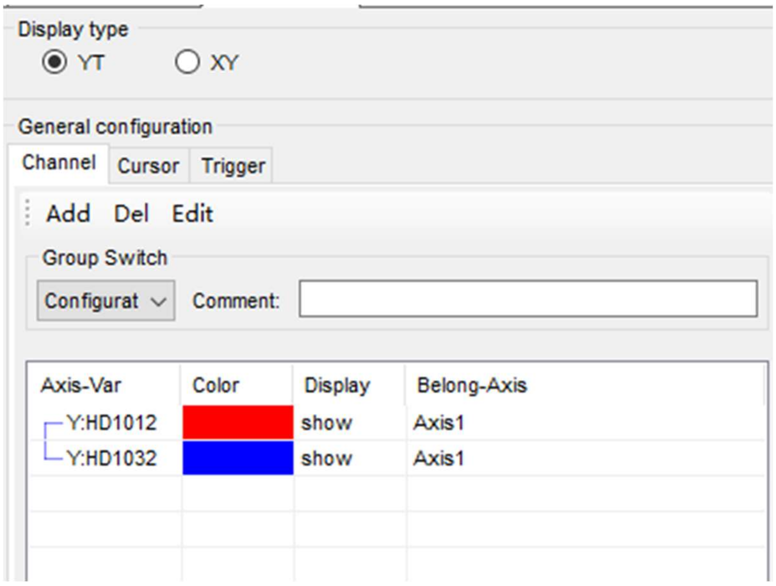


Parameter	Description
Object	Configure register variables
Condition	The logical relationship between triggers with the same register object
Mode	Trigger edge (Rising edge; Falling edge)
Threshold	Trigger threshold
Act	Behavior after trigger triggering (StopDisplay: stop displaying. ReStartDisplay: restart displaying)

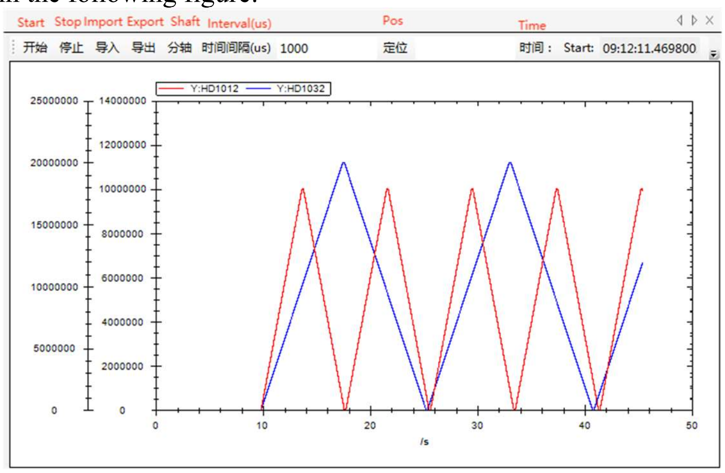
Enable	Does the trigger work

7-4-1-7. Example of using an oscilloscope

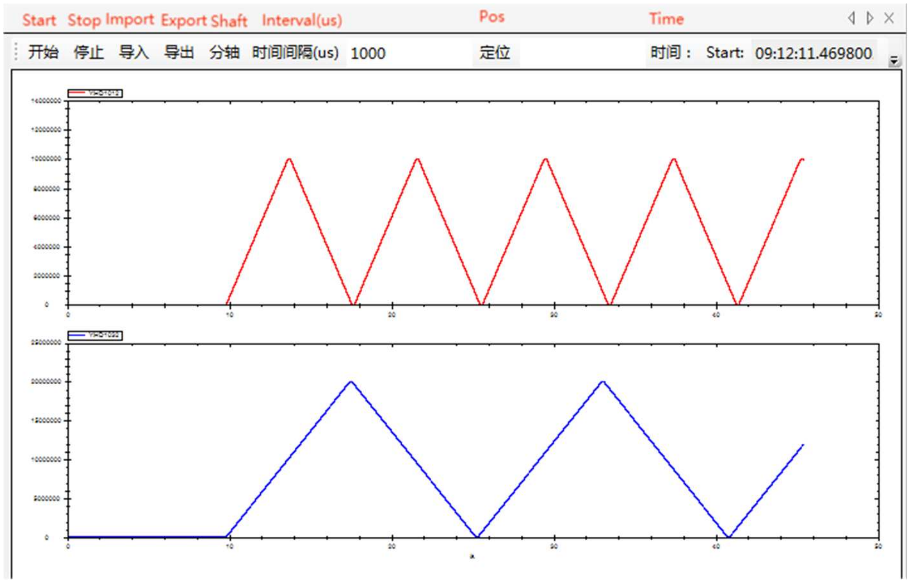
Example: Taking the Xinjie XG2 series PLC controlling two DS5C servo drives as an example, the CSP mode is used to make the motor forward and reverse, and the actual position waveform is monitored.
The oscilloscope interface configuration is as follows:



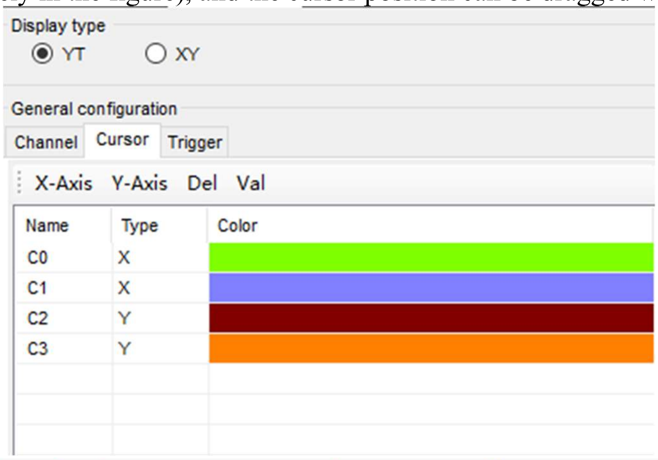
Among them, HD1012 represents the mapping of axes 1-6064h, and HD1032 represents the mapping of axes 2-6064h.
Click [Start] to run the oscilloscope. At this time, the oscilloscope displays the current positions of the two axes. When the axes are not running, they are two straight lines (the waveform will have a slight jitter, and the vertical coordinate ratio is small and obvious). After the two axes run, the waveform begins to change. The oscilloscope will automatically adjust the coordinate ratio during operation. If you need to watch the waveform, click [Stop] and click [Restore to Original Scale Ratio] in the right-click menu, You can view the complete waveform (the waveform will only display within 60 seconds, but all data will be saved. The right-click menu [Export Data] can display the data in Excel spreadsheet format).
The waveform is shown in the following figure:

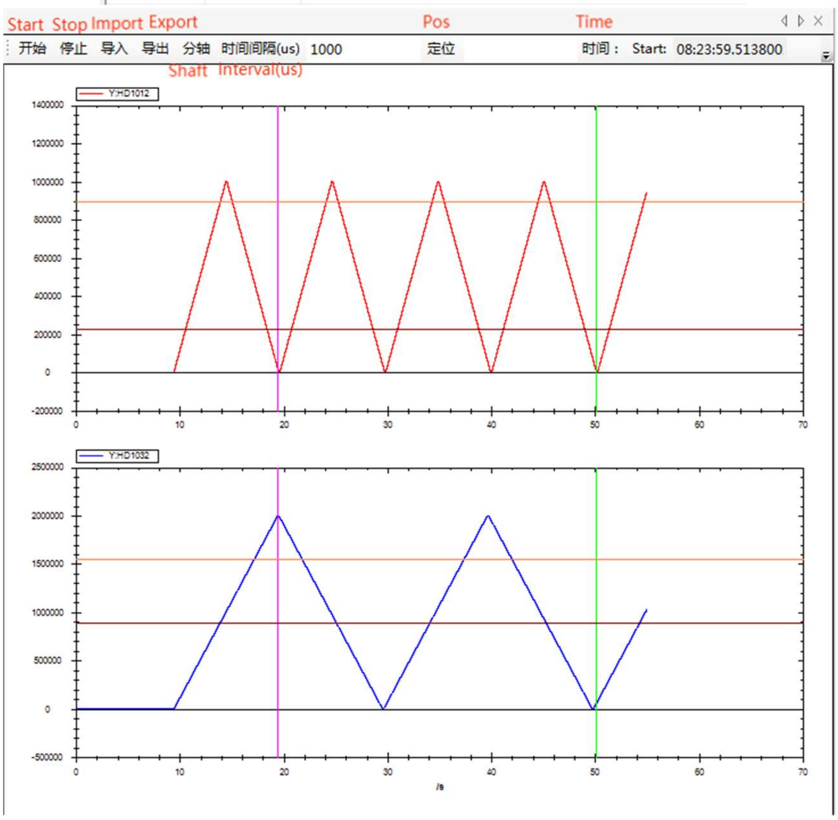


There are two coordinate axes on the left, the one on the left is axis 2 ordinate, and the one on the right is axis 1 ordinate.
If you need to divide it into two coordinate axes, click [Split Axis] (the axis variable needs to be set to two different axes).
After the split axis, the graph is as follows:

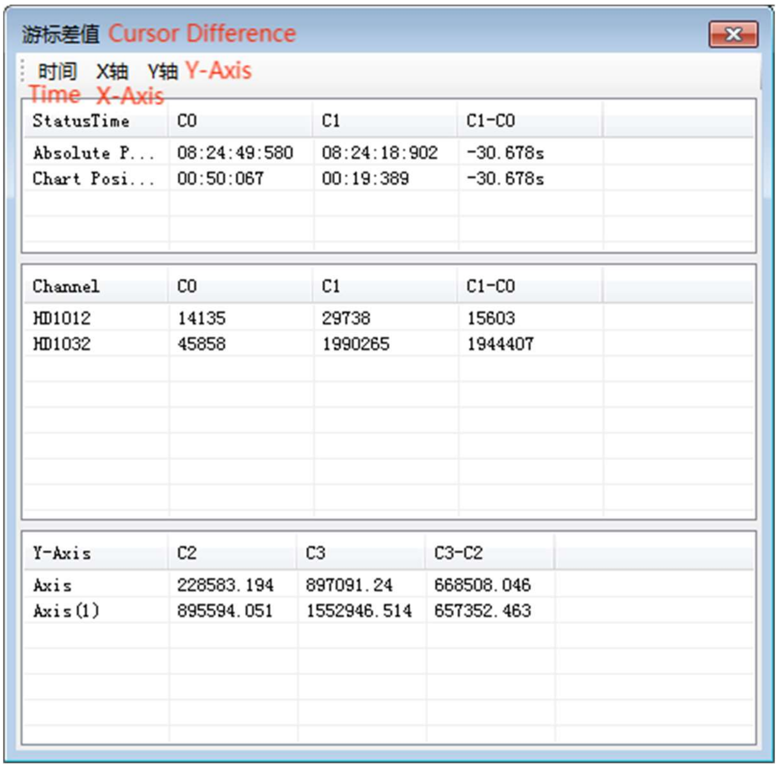


Click on the cursor configuration [X-axis] and [Y-axis] to generate a cursor (two cursors are configured for the X-axis and Y-axis respectively in the figure), and the cursor position can be dragged with the mouse.





Click on the cursor configuration 【 Value 】 to enter the cursor difference interface, which can be used in conjunction with the cursor to monitor the specific value of the register.

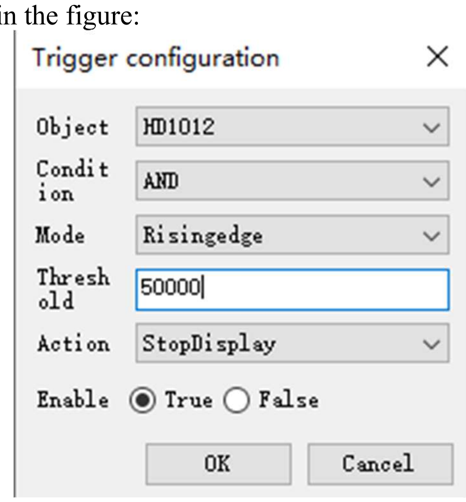


StatusTime area:
Absolute Position represents the current actual time indicated by the cursor (i.e. computer time).
Chart Position represents the working time of the oscilloscope (i.e. the horizontal axis of the cursor position).

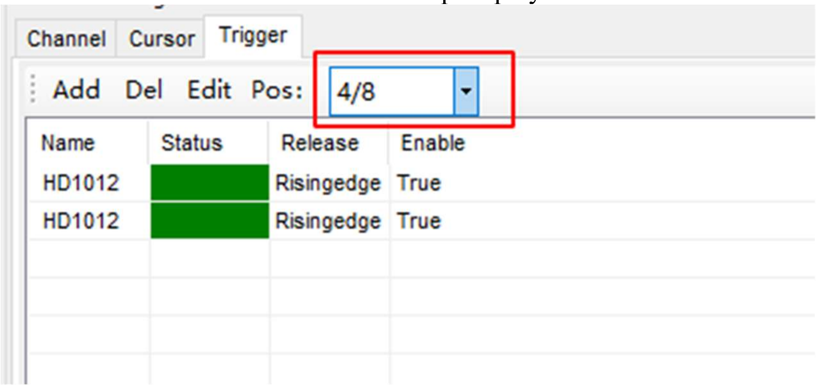
Channel area:
The data within the region represents the value of the register corresponding to the cursor position, and combined with the [StatusTime] region, the real-time value of the register can be monitored.As shown in the figure, it indicates that at 50.067s, the value of register HD1012 is 14135, and the value of register HD1032 is 45858.At 19.389s, the value of register HD1012 is 29738, and the value of register HD1032 is 1990265. [C1-C0] represents the difference between the positions of two cursors (note: when the number of cursors set on an axis is greater than or equal to 2, the cursor difference interface will automatically generate cursor difference data).

Axis area:
The data within the region represents the value corresponding to the Y-axis cursor, as shown in the figure. The value of C2 in Axis1 is 228583.194, and in Axis2 it is 895594.051. The value of C3 in Axis1 is 897091.24, and the value in Axis2 is 1552946.514. C3-C2 represents the difference between the corresponding values of two cursors.

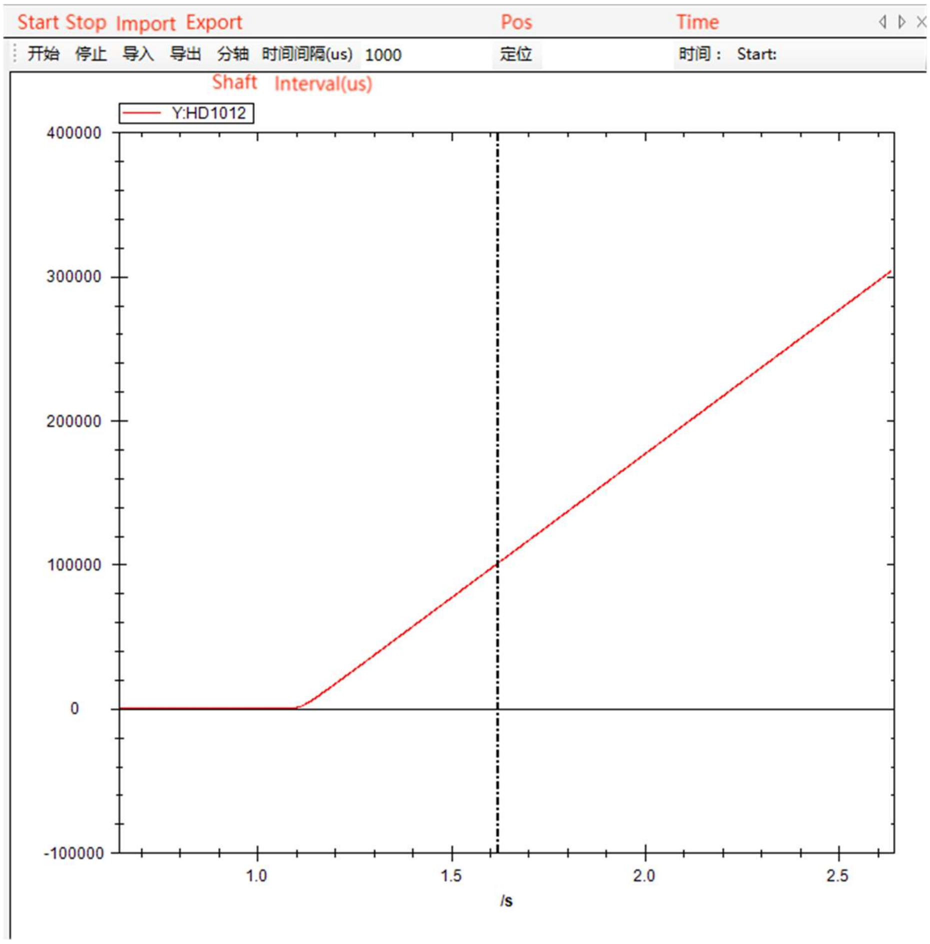
The trigger configuration is shown in the figure:



Configure two triggers, both with HD1012 as the object, AND as the condition, Risingedge as the method, with a threshold of 50000 and 100000 as the threshold. Choose StopDisplay as the behavior and True as the enable.



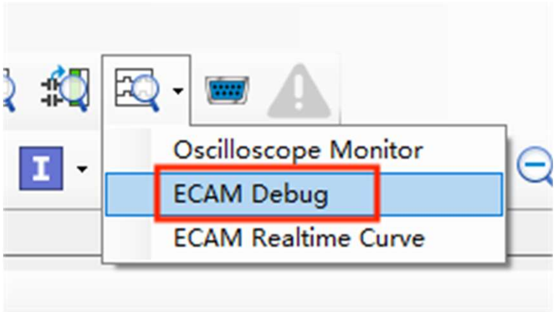
The trigger position is selected as 4/8, and the results after the oscilloscope runs are as follows:



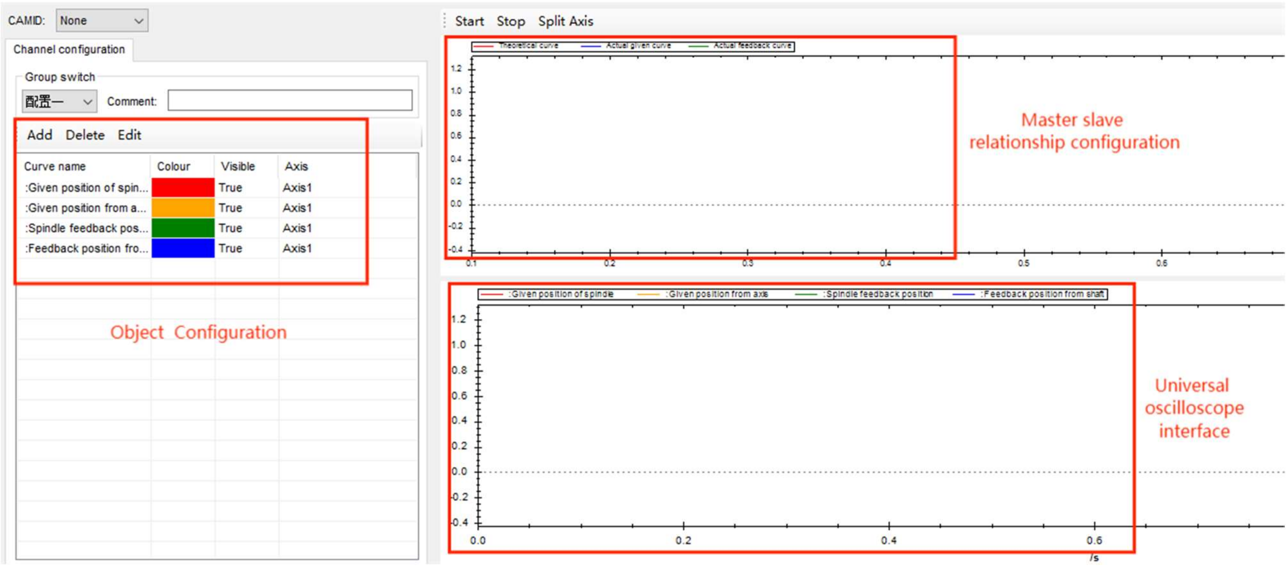
The dashed line in the figure represents the triggering position of the trigger. When the trigger is triggered, the triggering position accounts for 4/8 of the current waveform, and the oscilloscope will stop (i.e. the dashed line position accounts for half of the current waveform). It can be seen that the status of the trigger has turned red, indicating that both have been triggered. If AND is selected as the triggering condition, both triggers will be triggered before stopping, So the value of the trigger position register is 100000 (if the trigger condition is selected as OR, either trigger will stop when triggered, and if the trigger condition of two triggers is selected as AND and OR, the trigger condition will be judged as OR).

7-4-2. Electronic cam debugging

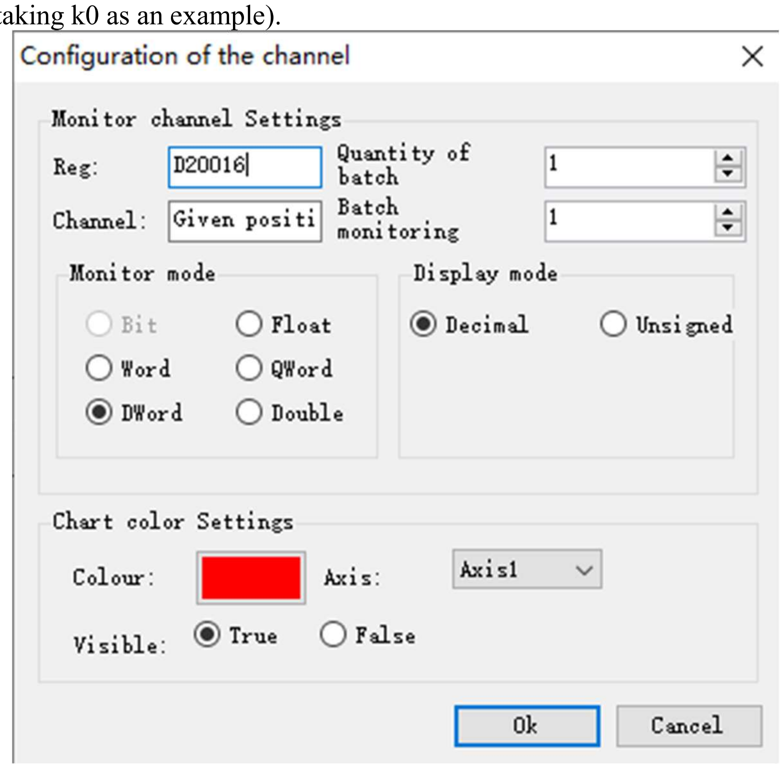
Click on the oscilloscope icon as shown in the figure to open the [Electronic Cam Debugging] interface:



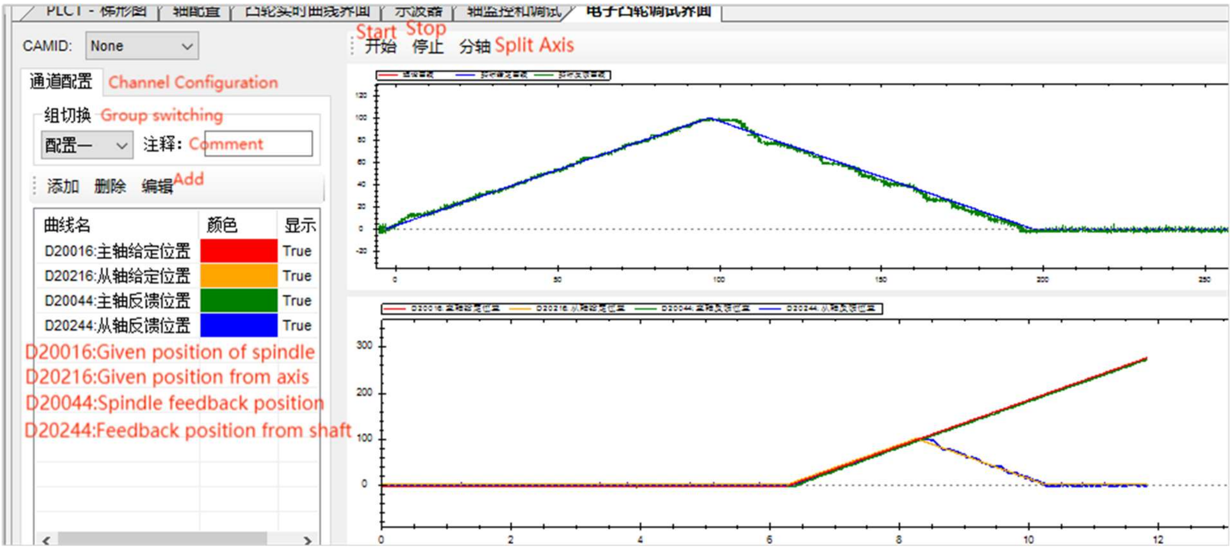
The interface after opening is shown in the following figure:



Object configuration: Before execution, corresponding registers need to be configured for each curve, as shown in the following figure (taking k0 as an example).



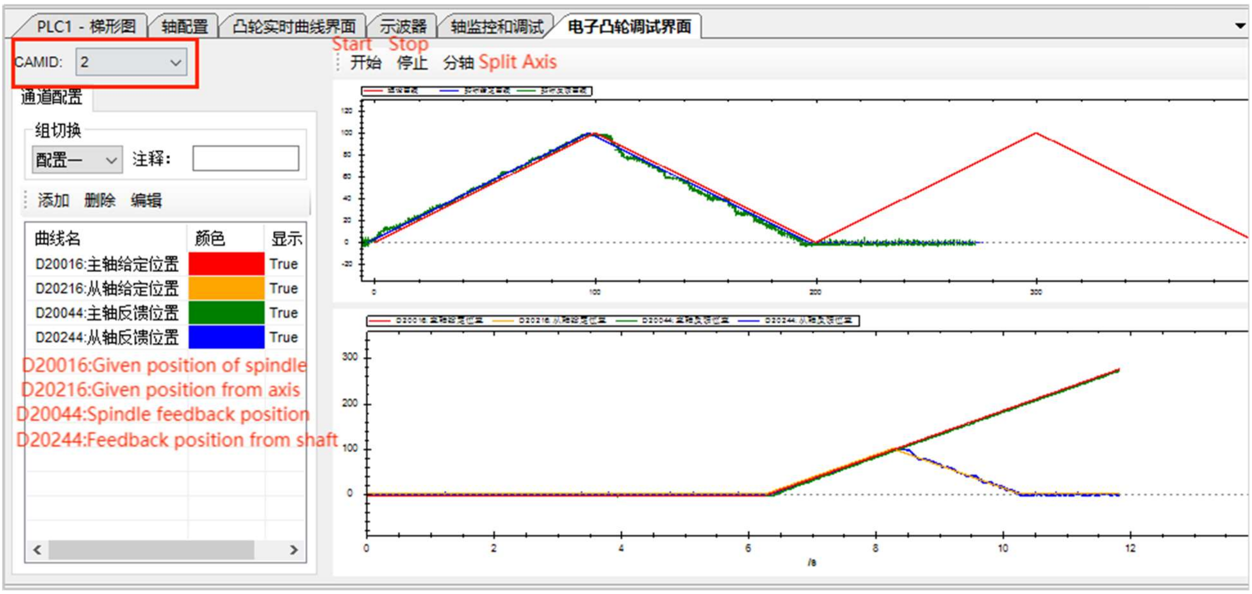
After the configuration is completed, click start. As the cam moves, the corresponding waveform will be displayed in real-time on the master-slave relationship interface and oscilloscope interface:



In the master-slave relationship diagram, the horizontal axis represents the position of the main axis and the vertical axis represents the position of the secondary axis.

In the oscilloscope diagram, the horizontal axis represents time and the vertical axis represents the numerical values of each object.

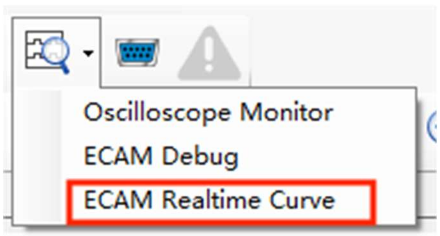
In the CAMID column above the channel configuration, you can select the ID number corresponding to the cam table. After selection, the original curve of the cam will be displayed on the master-slave relationship interface, as shown in the following figure:



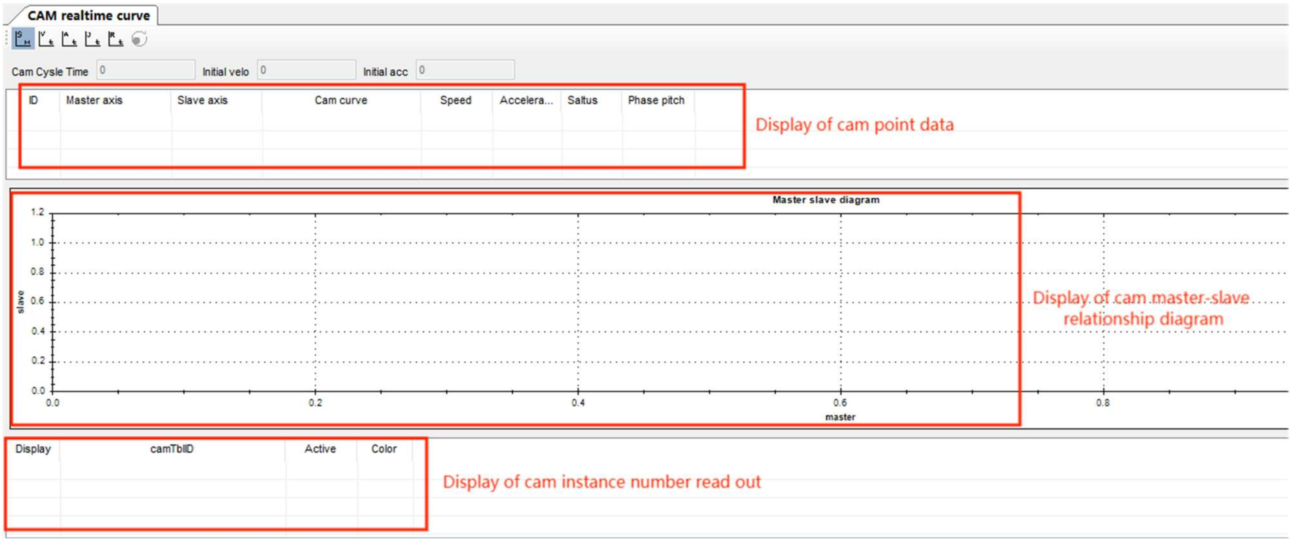
During the cam debugging process, it is possible to visually observe the difference between the actual operating cam curve and the ideal trajectory.

7-4-3. Real time curve reading of cam

Click on the oscilloscope icon as shown in the figure to open the [Cam Motion Setting Curve] interface:



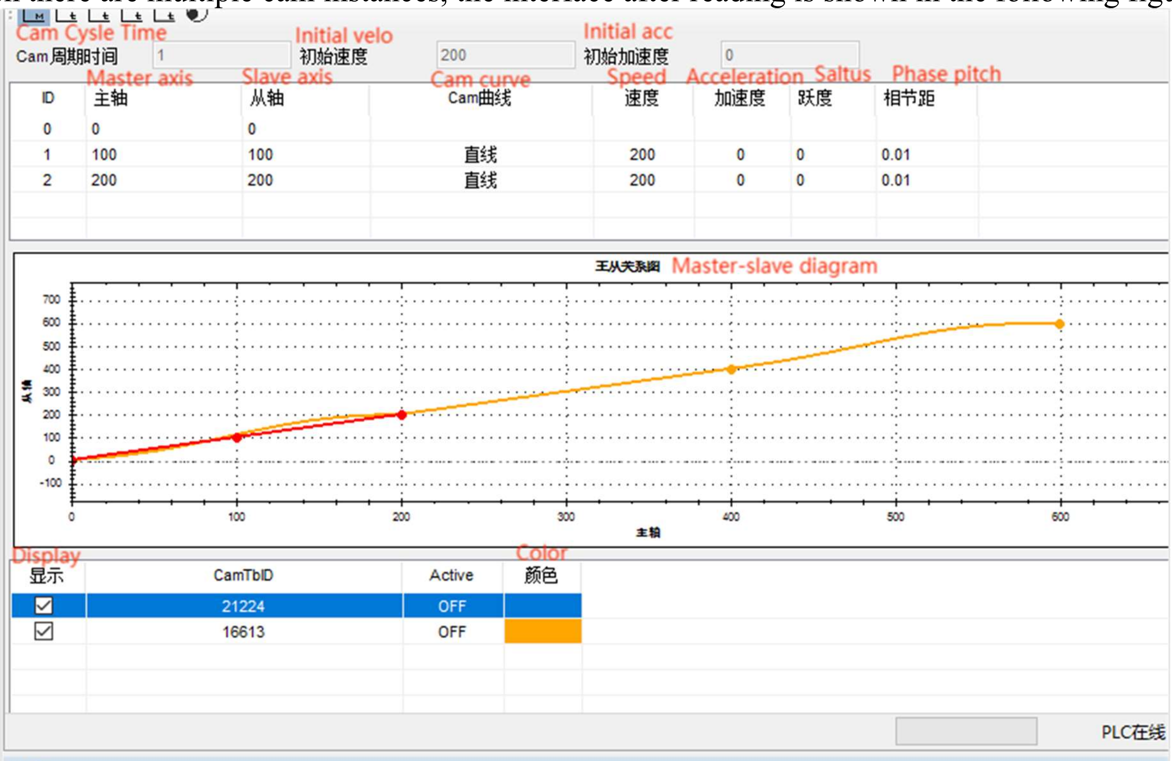
The interface after opening is shown in the following figure:



The meanings of the icons on this interface are as follows:

①	Master-slave relationship diagram	②	From axis velocity time graph
③	Time graph of axial acceleration	④	Time graph of acceleration from axis
⑤	Master-slave speed ratio diagram	⑥	Cam curve refresh

When there are multiple cam instances, the interface after reading is shown in the following figure:



Select the corresponding camTblID, and in the point data display section, the corresponding cam point information will be displayed.

Check the 【 Display 】 in front of the camTblID column to determine whether to display the corresponding master-slave relationship diagram.

Appendix

Appendix 1. Command error code

Code	Explanation	Solution
100	Servo cannot be enabled	Confirm the slave status and whether it can be enabled through the bus
101	Duplicate slave station number	Check whether the setting of SFD8002+300*N is repeated
102	Pulse per turn is 0	Check whether the setting of SFD8004+300*N is suitable
103	Movement per turn ≤0	Check whether the setting of SFD8008+300*N is suitable
104	Abnormal reducer parameters	Check whether the setting of SFD8014+300*N, SFD8016+300*N is suitable
105	Abnormal port polarity setting	Check whether the setting of SFD8202+300*N, SFD8203+300*N is suitable
106	Port number conflict	Check whether the setting of SFD8200+300*N, SFD8201+300*N is suitable
107	Invalid port number	Check whether the setting of SFD8200+300*N, SFD8201+300*N is suitable
108	Encoder terminal configuration overlimit	Check whether the setting of SFD8006+300*N is suitable
109	Positive and negative hard limit sequence error of EtherCAT servo	Check whether the SFD8045+300*N and SFD8046+300*N settings are reasonable
110	Axis type invalid	Check whether the configuration parameters are set reasonably
111	Software and hardware types invalid	Check whether the configuration parameters are set reasonably
112	Parameter is configured as non-numeric	Check whether the configuration parameters are set reasonably
1000	Axis in error stop	A_RST clear the error or close axis enabling reopen
1001	Axis is not enabled	Confirm whether there is A_PWR instruction and whether the instruction was successfully executed
1002	Axis is homing	The axis is in the state of returning to the original point, and will automatically return to the operable state after returning to the original point. If it is not restored to the operational state correctly, please check whether there is an error in the process of returning to the original point
1003	Axis is in stop process	The axis executes A_STOP command and is in the process of stop, you can use the new A_STOP command to interrupt and other motion commands cannot be executed
1004	Specified axis is axis group bound axis	Verify that the specified axis is already a component axis of the axis group and that the axis group is enabled
1005	The axis is in static status	The current command cannot be used when the axis is stationary
1006	The axis is in discrete motion	The current command cannot be used in axis discrete motion
1007	The axis is in continuous motion	The current command cannot be used in continuous axis motion
1008	The axis is in synchronous motion	Verify that the specified axis is in A_GEARIN binding status
1009	The command input parameter error	Check whether the necessary parameters of the instruction are set (some parameters can only be non-negative numbers, and 1009 will be reported when the value is abnormal)

Code	Explanation	Solution
1010	At the soft/hard limit	At the positive limit, it can move to the negative direction; At the negative limit, it can move forward
1011	Abnormal position of modification instruction	Confirm the A_WRITE command position is in the range of soft limit
1012	At the soft/hard limit	At the positive limit, it can move to the negative direction; At the negative limit, it can move forward
1020	The command cannot support buffer	This instruction does not support execution in buffer mode
1021	The command cannot support buffer	The previous instruction does not support the execution of this instruction in buffer mode
1022	The cache is full	One instruction has been cached. No more instructions can be cached
1023	Buffer mode parameter error	Buffer mode error
1030	Axis has no error	Repeat executing A_RST instruction returns this error code
1031	Homing process error	Check whether the parameters related to the homing are set correctly (homing mode is not set, homing speed is not set, etc.)
1032	Not supported control mode	A_MODE specified mode is not supported by the slave station
1033	The denominator is 0	GEARIN command denominator cannot be 0
1034	The current axis is rotation counting	The rotation counting axis only supports A_MOVEA, A_CMOVEA command motion
1035	Axis is in motion	The current command cannot be executed during axis motion
1036	Non CSP mode	The current instruction only supports CSP mode. Confirm whether the 6060h parameter of IO mapping is 8. If not, please switch the mode to CSP through A_MODE command
1037	The current axis is a virtual axis	The current instruction does not support virtual axis execution
1038	The current axis is an encoder axis	The current command does not support encoder axis execution
1039	Same master-slave axis index	Confirm whether the master-slave axis parameters of the command are set correctly
1040	The axis index over limit	Confirm whether the specified axis number of the command exceeds the limit (0 ~ 31) and whether it exceeds the actual real axis, virtual axis and encoder axis numbers
1041	Probe window value error	Confirm whether the window is enabled in the probe instruction A_PROBE. If the window is enabled, whether the window end position is greater than the window start position
1042	Non CSV mode	The current command only supports CSV mode usage
1043	Non CST mode	The current command only supports CST mode usage
1044	GEAROUT invalid	A_GEAROUT cannot be executed in the current state. Example: the specified axis is unbound
1046	Instruction specifies that the register address is an odd number	The specified register address does not support odd numbers
1047	Invalid execution of speed stacking command	The command is not allowed to be executed in the current state
1048	The ZRN command is invalid. It can only return to zero in the opposite direction at the limit	Please set a reasonable homing direction

Code	Explanation	Solution
1049	Error in motion parameter of return to zero configuration	Check whether the parameters in the homing configuration are reasonable
1050	Error in port parameter of return to zero configuration	Check whether the parameters in the homing configuration are reasonable
1051	Z phase numbers configuration error	Check whether the parameters in the homing configuration are reasonable
1052	The zero point signal is too close to the positive and negative limit	Check whether the signal spacing is too short or the equipment fault signal is triggered by mistake
1053	The command is not supported in closed loop mode	The current instruction does not support execution in closed-loop mode
1054	The terminal configurations of the two probes are inconsistent	Check whether the probe parameters are set reasonably
1055	Only when the trigger source is invalid can the Ethernet axis support the slave mode	The pulse axis does not support probe commands, take the slave station as the trigger source
1056	Communication between master station and slave station is not established	Check whether the value of 4041h is correct or whether the master-slave configuration is reasonable
1057	When the instruction is continuously updated, the parameter update error of the previous instruction	Parameter error during continuous update, following cache instructions is not supported
1058	The command is not supported by the pulse axis	The current command only supports EtherCAT axis
1059	Illegal target location	Check whether the parameter SFD8188+300*N setting is reasonable
1060	Invalid homing direction	Check whether the parameter SFD8192+300*N setting is reasonable
1061	Probe command overload	Check whether the command for the same axis is triggered repeatedly
1062	PLSR motion parameter error	Check whether the parameters are set incorrectly
1063	PLSR linked list is not allocated enough memory	PLSR linked list is not allocated enough memory
1064	Error occurred when creating node and linked list	Error occurred when creating node and linked list
1065	Error in creating PLSR motion	Error in creating PLSR motion
1066	An error occurred when connecting PLSR motion	An error occurred when connecting PLSR motion
1067	Use unsupported register type	Check the register type corresponding to parameter change
1068	Get wait signal error	Check whether the parameters are set incorrectly
1069	Register address is odd	Modify the corresponding register address
1070	Error occurred in updating calculation information	Error occurred in updating calculation information
1071	Maximum time limit exceeded	Maximum time limit exceeded
1072	The current instruction does not support overlay instruction	The current instruction does not support overlay instruction
1073	There is a single axis in the enabled state	There is a single axis in the enabled state
1074	There is axis group in the enabled state	There is axis group in the enabled state

Code	Explanation	Solution
1075	Single axis update parameter error	Single axis update parameter error
1076	Axis group update parameter error	Axis group update parameter error
1077	There is instruction in running	There is instruction in running
1078	There are single-axis instructions in the cache	There are single-axis instructions in the cache
1079	There are axis group instructions in the cache	There are axis group instructions in the cache
1080	Input of effective time parameter error	Check whether the command parameters are correct
1081	Input compensation direction parameter error	Check whether the command parameters are correct
1082	Input register first address error	Check whether the command parameters are correct
1083	Wrong number of input compensation points	The number of compensation list should be greater than 0 and less than 1024
1084	Input register address overrun error	Register address range 0~65535
1085	Compensation table data initialization error	Compensation table data initialization error
1086	The number of loaded compensation tables exceeds the limit error	Only ten axes are supported at most
1087	Compensation table data memory allocation error	Compensation table data memory allocation error
1088	Compensation table nominal position not increasing error	The compensation point position needs to be monotonically increased
1089	The instruction is not supported when the compensation is in effect	A_WRITE command is not allowed to execute in compensation process
1090	Compensation table data calculation error	Compensation table data calculation error
1091	Compensation validation failure error	Check whether the axis has error
1092	Compensation data calculation failure error	
1093	The trigger time of cycle superposition instruction is wrong, and the mode switch or HALT instruction is currently in progress	Check the trigger time of the command
1094	During CYCSUP operation, non-CSP instructions are not allowed to be executed	During CYCSUP operation, non-CSP instructions are not allowed to be executed
1095	Compensation table repeated loading error	Corresponding to the same axis, only one command can be executed
1096	Backgap command is not	Backgap command is not supported during screw pitch compensation

Code	Explanation	Solution
	supported during screw pitch compensation command execution	command execution
1097	Input parameter reverse clearance compensation value is illegal	Check whether the parameters are set incorrectly
1098	Illegal change of input parameter reverse clearance compensation value	Negative value of reverse clearance variation is not allowed
1099	Illegal input parameter compensation effective time	Check whether the parameters are set incorrectly
1100	The motion direction of the first compensation of the input parameter is illegal	Check whether the parameters are set incorrectly
1101	The multiplication or division factor of the follow instruction is 0	Check whether the parameters are set incorrectly
1102	The calculation coefficient of the follow instruction is out of range	Check whether the parameters are set incorrectly
1103	The performance parameter of the follow instruction is not between [1~100]	Check whether the parameters are set incorrectly
1104	Not in the port number range of high-speed counting	Check whether the parameters are set incorrectly
1105	Circular binding	Binding of master and slave axes is not supported
1106	Probe missing object word	Add corresponding PDO parameters
1107	The total number of PLSR motion segments is 0	Check whether the parameters are set incorrectly
1108	The total number of PLSR motion segments exceeds the maximum number of segments	Check whether the parameters are set incorrectly
1109	Command input value is non-numeric	Check if the parameters are set reasonably
1110	Invalid module position	Check whether the parameters are set incorrectly
1111	Invalid direction of the mold axis	Check if the parameters are set reasonably
1112	The number of positive and negative jogs is equal	Check whether the parameters are set incorrectly
1113	The instruction is not supported in axis filtering	Check if the instruction supports triggering
1114	Non etherCAT real axis	Detection axis type
1115	Missing 60B0 object word	Detect ETHERCAT-PDO configuration and axis configuration PDO allocation
1116	Single axis accuracy compensation is currently being executed	Single axis accuracy is currently being executed, this command is not allowed to be executed
1117	Instruction maximum cache	Check if the parameters are set reasonably

Code	Explanation	Solution
	full	
1118	Calculation error in the previous instruction	Check if the parameters are set incorrectly
1119	The gantry mode does not allow chain binding	Check if A_GEARIN has chain binding (0 binding 1, 1 binding 2, 2 binding 0) and loop binding (1 binding 0, 2 binding 0, 3 binding 2)
1120	Emergency stop ON, unable to execute rst	Check if the emergency stop is still in effect
1121	No probe signal detected	Interrupt fixed length instruction to enable error detection, but no probe signal detected
1122	There are parameters in the basic configuration of the axis configuration that do not support updates when the axis is enabled	Check if the axis configuration parameters are set reasonably
1123	When the axis is enabled, the unit configuration does not support updated parameters	Check if the axis configuration parameters are set reasonably
1124	There are parameters in the mechanical reset configuration that do not support updates when the axis is enabled	Check if the axis configuration parameters are set reasonably
1125	There are parameters in the axis configuration limit configuration that do not support updates when the axis is enabled	Check if the axis configuration parameters are set reasonably
1126	There are parameters in the detection and alarm configuration that do not support updates when the axis is enabled	Check if the axis configuration parameters are set reasonably
1127	The position count configuration does not support updated parameters when the axis is enabled	Check if the axis configuration parameters are set reasonably
1128	The closed-loop configuration does not support updated parameters when the axis is enabled	Check if the axis configuration parameters are set reasonably
1129	Other configurations do not support updated parameters when axis is enabled	Check if the axis configuration parameters are set reasonably
1130	There are parameters in the basic configuration that do not support updates when the axis group is enabled	Check if the axis configuration parameters are set reasonably
1131	There are parameters in the limit configuration of the axis	Check if the axis configuration parameters are set reasonably

Code	Explanation	Solution
	group that do not support updating when the axis group is enabled	
1132	When the axis group is enabled, the kinematic model is MPLS and does not support updating parameters	Check if the axis configuration parameters are set reasonably
1133	The kinematic parameters do not support updating when the axis group is enabled	Check if the axis configuration parameters are set reasonably
1134	Axis configuration basic configuration parameter verification error	Check if the axis configuration parameters are set incorrectly
1135	Axis configuration performance configuration parameter verification error	Check if the axis configuration parameters are set incorrectly
1136	Axis configuration mechanical zero return configuration parameter verification error	Check if the axis configuration parameters are set incorrectly
1137	Axis configuration limit configuration parameter verification error	Check if the axis configuration parameters are set incorrectly
1138	Axis configuration detection and alarm configuration parameter verification error	Check if the axis configuration parameters are set incorrectly
1139	Axis group configuration basic configuration verification error	Check if the axis configuration parameters are set incorrectly
1140	Axis group configuration performance parameter verification error	Check if the axis configuration parameters are set incorrectly
1141	Axis assembly interpolation configuration verification error	Check if the axis configuration parameters are set incorrectly
1142	Axis group configuration prospective parameter verification error	Check if the axis configuration parameters are set incorrectly
1143	Single axis SFD configuration parameter error cannot be cleared	Check if the axis configuration parameters are set incorrectly
1144	Same spindle number	Multi axis composite motion command cannot set the same spindle number
1145	Points with incorrect contour command input	Check if the position contour command parameters are set incorrectly
1146	Instructions cannot be executed in axis debugging mode	Check if axis debugging is enabled (axis debugging and instructions are mutually exclusive)
1147	During the spindle synchronization process, the step exceeds the	During the spindle synchronization process, the step exceeds the synchronization position, and the curve cannot be planned

Code	Explanation	Solution
	synchronization position, and the curve cannot be planned	
2000	Max hard limit	The current axis is in the maximum hard limit. First, use A_ The RST command clears the error and then runs in reverse to exit the hard limit position
2001	Min hard limit	The current axis is in the minimum hard limit position. First, use A_ The RST command clears the error and then runs in reverse to exit the hard limit position
2002	Max soft limit	The current axis position is greater than or equal to the maximum soft limit. First, use A_ The RST command clears the error and then runs in reverse until it reaches the soft limit
2003	Min soft limit	The current axis position is less than or equal to the minimum soft limit. First, use A_ The RST command clears the error and then runs in reverse until it reaches the soft limit
2004	Illegal soft limit value	Confirm whether the maximum soft limit is greater than the minimum soft limit
2005	Servo error	After confirming that the servo error has been removed, execute A_RST to clear error code
2006	Excessive position deviation	The deviation between the given position and the feedback position is too large. Please check whether the position and speed values are set reasonably
2007	Illegal rotation count setting	Confirm whether the rotation counting max value SFD8024+300*N is larger than min value SFD8028+300*N
2008	The rotation count setting exceeds the soft limit	Confirm that the upper / lower limit of rotation count does not exceed the soft limit maximum / minimum value
2009	Unsupported control mode	A_MODE specified mode is not supported by the slave station
2010	Position increment value exceeds the limit	If the axis position changes suddenly, please confirm whether the parameters are reasonable (for example, the position change caused by the absolute mode of the master-slave axis of the CAMIN command)
2011	Servo disconnection	Check the servo connection status and whether the slave station ESM status is OP
2012	Illegal hard limit stop mode	SFD8040+300*N setting value is not supported
2013	Illegal soft limit stop mode	SFD8061+300*N setting value is not supported
2014	When the master and slave is moving, the servo is disconnected	Check the servo connection status and whether the slave station ESM status is OP
2015	Mode modification timeout	Check if the command parameter settings are correct, check the status of the axis and whether the value of 6041 or the actual mode switching time exceeds 1 second
2016	CST\CSV switch to CSP mode timeout	Check if the command parameter settings are correct, check the status of the shaft and the value of 6041 or the feedback speed of the shaft
2017	Instruction buffer full	Instruction buffer full
2018	In closed-loop mode, the following error is greater than the set value	Check whether the relevant parameters are set reasonably
2019	Invalid acceleration and deceleration parameters	Invalid acceleration and deceleration parameters
2020	Invalid	Invalid acceleration/deceleration percentage parameter

Code	Explanation	Solution
	acceleration/deceleration percentage parameter	
2021	Invalid axis count type	Check whether the configuration parameters are reasonable
2022	Invalid emergency stop type	Check whether the configuration parameters are reasonable
2023	Invalid stop curve type	Check whether the configuration parameters are reasonable
2024	Parameter input is not numeric	Check whether the configuration parameters are reasonable
2025	Dragon Gate Slave Axis Error	Dragon Gate Slave Axis Error, Check for Slave Axis Error Information
2026	Gantry spindle error	Dragon Gate Spindle Error, Check Spindle Error Information
2027	Emergency stop axis error code	Activate single axis emergency stop
2028	Axis error stopping	In error stop state, unable to execute instructions
2029	Startup speed setting error	Check if the starting speed setting of the axis configuration is reasonable (starting speed<=maximum speed)
2030	Axis speed exceeds the limit	Check if the parameter settings for the position contour command are reasonable
2031	Axis configuration file version error	Axis configuration file version error
2032	Invalid acceleration and deceleration curve type	Check if the axis configuration and acceleration curve similar settings are reasonable
2033	"Touching the hard limit, the state machine does not enter ERRTOP" configuration parameter error	Check if the shaft configuration is reasonable
2034	"Touching the soft limit, the state machine does not enter ERRTOP" configuration parameter error	Check if the shaft configuration is reasonable
3000	There is not enough space to create a cam table instance	The number of cam table instances created cannot exceed 32 (version 3.7.2 cannot exceed 64), and space can be freed up through the CAMTBLDEL command
3001	There is not enough space to create a cam table point	The number of cam table points cannot exceed 65536, and the space can be released through CAMTBLDEL command
3002	There are no points in the cam table	Confirm whether the cam table is downloaded (click download in the cam editing interface of the programming software)
3003	Cam table is in use	Confirm whether the cam table is in motion
3004	Cam function not initialized	Cam table not initialized
3005	Cam table instance does not exist	The cam table instance parameter set in the command does not exist. Please confirm whether the parameter is consistent with the cam table instance parameter obtained by the execution of CAMTBLSEL command
3007	The slave axis is not synchronized	Determines whether the slave axis is in CAMIN motion
3008	Cam table key point does not exist	Confirm whether the key point parameters set in the command are less than the number of points in the corresponding cam table
3009	CAMOUT is invalid	The CAMOUT instruction cannot be executed in the current state. Example: the command axis is in unbound state
3012	Cam table key point write invalid	The specified key point does not support writing

Code	Explanation	Solution
3013	Cam time acquisition failed	Cam time acquisition failed
3014	Key point search failed	The specified key point does not exist
3015	The starting point and ending point of the cubic or quintic curve are the same	Check whether the command parameter setting is reasonable
3016	The current moves to the last point, and the last point cannot be deleted	Check whether the command parameter setting is reasonable
3017	Master axis position setting error	Check whether the command parameter setting is reasonable
3018	Add delete key point trigger mode error	Check whether the instruction trigger mode is correct
3019	Cam curve type error	Check whether the command parameter setting is reasonable
3020	CAMIN direction input error	Check whether the command parameter setting is reasonable
3021	The start mode of cam clutch ON OFF control is not supported	Check whether the command parameter setting is reasonable
3022	Before the cam clutch command is triggered, the CAMIN command must be triggered first	Trigger the clutch OFF command under the control of the camin command
3023	The cam clutch ON control must be in the clutch OFF state	The clutch on command is triggered after the clutch off command is executed
3024	The cam clutch OFF control must be in the clutch ON state	Trigger the clutch OFF command under the control of the camin command
3025	Master axis phase setting error in cam clutch function	Check whether the parameter configuration is reasonable
3026	When the clutch ON is triggered, ensure that there is no movement command other than camin in the buffer	Instruction does not support cache mode
3027	After the clutch OFF control, the camin command trigger is invalid	Cannot execute the camin command after the clutch off command
3028	Master axis ID error	Check whether the command parameter setting is reasonable
3029	Wrong connection mode of clutch	Check whether the command parameter setting is reasonable
3030	Point ID error of CAMTBLGEN instruction	Check whether the command parameter setting is reasonable
3031	Key point no.0 must be (0,0)	Check whether the command parameter setting is reasonable
3032	Count error	Check whether the command parameter setting is reasonable
3033	Key point ID is the same	Check whether the command parameter setting is reasonable
3034	Slave axis position setting error	Check whether the command parameter setting is reasonable
3035	Cam command mode error	Check whether the command parameter setting is reasonable
3036	The camIn instruction is not triggered	The command needs to be triggered after the cam is executed

Code	Explanation	Solution
3037	The slave axis phase in the cam table is not incremental	Check whether the command parameter setting is reasonable
3038	The slave axis phase setting error in the cam clutch function	Check whether the command parameter setting is reasonable
3039	Inhibit mode error in cam clutch	Check whether the command parameter setting is reasonable
3040	Wrong sliding type in cam clutch	Check whether the command parameter setting is reasonable
3041	Sliding curve error in cam clutch	Check whether the command parameter setting is reasonable
3042	the slave axis amount movement setting error in the cam clutch	Check whether the command parameter setting is reasonable
3043	Cam clutch catch up parameter setting error	Check whether the command parameter setting is reasonable
3044	Cam clutch ON status, clutch OFF cannot be interrupted	The clutch on command is completed, and the clutch off command is not allowed
3045	Clutch slip cannot be zero	Check whether the command parameter setting is reasonable
3046	Clutch OFF trigger error	Check whether the command parameter setting is reasonable
3047	Custom cam is not supported	The command is not supported when customizing cams
3048	RapIn is not supported for custom cams	Custom cam does not support catch-up mode
3049	Error in generation of follow cutting curve	Check whether the command parameter setting is reasonable
3050	Error in generation of fly cutting curve	Check whether the command parameter setting is reasonable
3051	Flag bit jump type error	Check whether the command parameter setting is reasonable
3052	Jump ID error	Check whether the command parameter setting is reasonable
3053	Cycle jump times error	Check whether the command parameter setting is reasonable
3054	Cam file version error	Check whether the upper and lower computers version matched
3055	The data source of single-cycle mode is feedback, and the movement direction does not support dual directions	The data source of single-cycle mode is feedback, and the movement direction does not support dual directions
3056	The master and slave axis in gear cannot be turned as the master slave axis in camin	The master and slave axis in gear cannot be turned as the master slave axis in camin
3057	Camin interrupts camin, and the master axis number cannot be greater than the slave axis number	Camin interrupts camin, and the master axis number cannot be greater than the slave axis number
3058	CAMBound command input master axis speed is negative	CAMBound command input master axis speed is negative
3059	Cam table single segment parameter value error in CAMBound calculation	Cam table single segment parameter value error in CAMBound calculation

Code	Explanation	Solution
3060	CAMBound calculated single segment position error	CAMBound calculated single segment position error
3061	CAMBound calculated single segment speed error	CAMBound calculated single segment speed error
3062	CAMBound calculated single segment acceleration error	CAMBound calculated single segment acceleration error
3063	CAMBound calculated CAMIN scale value error	CAMBound calculated CAMIN scale value error
3064	T-type cam curve acquiring proportion information error	T-type cam curve acquiring proportion information error
3065	This command is invalid in clutch	This command is invalid in clutch
3066	Conditional jump X terminal address error	Check whether the command parameter setting is reasonable
3067	The number of cams exceeds the limit (the master-slave relationship exceeds 16)	The cam master-slave relationship cannot exceed 16 (16-axis models can support up to 8 master-slave relationships)
3068	No further clutch is allowed at the end of single cycle operation	No further clutch is allowed at the end of single cycle operation
3069	Clutch slip time is less than or equal to 0	Check whether the command parameter setting is reasonable
3070	Master slave compensation mode selection error	Check if the command parameter settings are reasonable
3071	The master-slave compensation is currently being executed	Master slave compensation is being executed, instruction triggering is invalid
3072	Modify the corresponding mode of the 0-point spindle position to non absolute mode	To modify the starting spindle position, it is necessary to change the spindle mode to absolute
3073	Modify the non absolute mode corresponding to the axis position at point 0	To modify the starting spindle position, it is necessary to change the slave axis mode to absolute
3074	The zero point spindle position is greater than or equal to the last point on the cam table	Check if the zero axis position has been modified too much
3075	Modifying zero points resulted in too many points being deleted at once	Check if the zero axis position has been modified too much
3076	CAMIN not executed	CAMIN not executed
3077	The cam instance of the input slave shaft does not match the actual slave shaft instance	Cam instance mismatch
3078	Not enough space to create a tappet table	Tappet points cannot be further added
3079	There are no tappet points in the cam gauge	Position configuration of the internal tappet of the additive cam gauge
3080	This anti reverse mode is	Check if the command parameter settings are reasonable

Code	Explanation	Solution
	invalid	
3081	Repeatedly triggering compensation in position or speed compensation mode	Do not support repeated triggering
3082	The spindle movement is less than 0	Check if the command parameter settings are reasonable
3083	Compensation target speed value is less than or equal to 0	Check if the command parameter settings are reasonable
3084	Compensation curve type error	Check if the command parameter settings are reasonable
3085	T-shaped speed compensation ratio parameter error	Check if the command parameter settings are reasonable
3086	Compensation value violates compensation speed	Check if the command parameter settings are reasonable
3087	Unable to perform master-slave compensation in axis compensation	Invalid command execution in axis compensation
3088	Spindle reversal in CAMADD	Spindle reversal in CAMADD
3089	In speed mode, the spindle speed is 0	Check if the command parameter settings are reasonable
3090	The direction of the sliding amount is opposite to the synchronization direction of CAMIN	Check if the command parameter settings are reasonable
3091	Easy to use T-shaped acceleration and deceleration ratio setting error	Check if the command parameter settings are reasonable
3092	This special curve is not supported	This special curve is not supported
3093	Unreasonable setting of eccentric wheel parameters leads to unsatisfactory calculation position	Check if the command parameter settings are reasonable
3094	Eccentric wheel cam gauge eccentric wheel curve layout abnormality	Check if the command parameter settings are reasonable
3095	Two or more occurrences of the same eccentric wheel curve in a cam table	Check if the command parameter settings are reasonable
3096	The curve connected to the eccentric wheel must be a fifth degree curve	The front or rear connecting curve of the eccentric wheel curve must be a fifth degree curve
3097	Eccentric wheel input linkage, proportion, and angle parameters are abnormal	Check if the command parameter settings are reasonable
3098	Unable to obtain custom curve position	Check if the command parameter settings are reasonable
3099	The connection method does not support custom cams	Check if the command parameter settings are reasonable

Code	Explanation	Solution
3100	The clutch slave shaft phase mode does not support custom camshafts	Custom cam does not support clutch slave shaft phase mode
3101	Adaptive spindle position less than 1	Check if the command parameter settings are reasonable
3102	Anti reversal curve type error (non 0 and 1)	Check if the command parameter settings are reasonable
3103	Connection point speed error (reverse starting and ending speeds	Check if the command parameter settings are reasonable
3104	The direction of motion is inconsistent with the initial and final velocity directions	Check if the command parameter settings are reasonable
3105	Error in setting the minimum anti reverse speed ratio	Check if the command parameter settings are reasonable
3106	The parameter settings are unreasonable and cannot be split into three sections for anti reversal	Check if the command parameter settings are reasonable
3107	The target jump segment has been deleted	Jump segment number has been deleted
3108	Spindle position acquisition failed	Unable to obtain spindle position
5000	Axis group is not enabled	Confirm whether G_PWR command execution is successful
5001	Axis group error stop	After the axis group stops, disable the axis group then enable again
5002	Axis group stop	The axis group is in the process of deceleration stop, and a new movement can be performed after stop
5003	Axis group is in motion	The current command does not support execution in axis group motion
5004	Axis is not enabled	Confirm whether the constituent axes in the axis group have been enabled
5005	Axis has error	Confirm whether there is an error in the constituent axis in the axis group, and perform A_RST command for the specified axis after the error is removed, then enable the axis group again
5006	Axis is in motion	Confirm whether the constituent axes in the axis group are in motion. If they are in motion, wait for the end of the current motion or stop the axis and then enable the axis group through A_STOP/A_HALT command
5007	Axis is not in standstill status	Confirm whether the constituent axes in the axis group are in standstill state. Example: after the axis triggers the hard limit, go out of the hard limit in the opposite direction. At this time, the axis is still in the error state and needs to clear the error through A_RST command, then enable the axis group again
5008	Command input parameter error	Confirm whether the necessary parameters in the instruction have been set (some parameters only support non-negative numbers, and an error will be reported when the parameters are abnormal)
5009	Execution does not support buffer	The current instruction does not support execution in buffer mode
5010	The previous instruction does not support this instruction	The previous instruction does not support the execution of this instruction in buffer mode

Code	Explanation	Solution
	buffer	
5011	The buffer is full	An instruction has been cached. Caching again is not supported
5012	Buffer mode parameter error	Buffer mode parameter error
5013	The buffer is full	An instruction has been cached. Caching again is not supported
5015	Axis group index over limit	The axis group number entered in the command is greater than the supported number of axis groups (different models support different number of axis groups, and the supported number of axis groups can be viewed according to the "System Configuration Parameters" of the axis group)
5016	Axis group is in motion	Confirm whether the constituent axes in the axis group are in motion. If they are in motion, wait for the end of the current motion or stop the axis and then enable the axis group through A_STOP/A_HALT command
5017	Axis status abnormal	The axis group is enabled, and the single axis in the configured axis is not enabled and stationary
5018	Command input register address error	The specified register address does not support odd numbers
5019	The component axis is in the limit position	Check whether the constituent axes in the axis group are at the limit position
5020	Pathsel buffer operation invalid	PATHSEL parameter abnormal
5021	Pathsel cannot support reset action	PATHMOV is in motion
5022	The distributed data is larger than the buffer size	Check D46226 (Buffer remaining space), ensure that the data in the instruction does not exceed the buffer size
5023	Invalid curve type	Check whether the curve type parameter in the command is legal
5024	G_PATHSEL command parameter abnormal	The command sets the user-defined curve type, and the parameter value must be greater than 100
5025	G_PATHSEL input speed abnormal	Check the target speed in the command
5026	The row number is not monotonic increasing	Ensure the row number of G_PATHSEL command is monotonic increasing
5027	Invalid arc mode	The current arc only supports three-point mode
5030	There are currently other instructions running	There are currently instructions in motion
5031	The buffer has no data	Confirm whether the G_PATHSELexecution is successful
5040	Unable to continue with the original track	G_GOON cannot be executed after forward-looking paused
5041	Axis number not support	Confirm that the constituent axes of the axis group are connected and the ESM status of the specified axis is normal
5050	The command is invalid	The constituent axis of the axis group cannot be encoder axis
5051	X axis max soft limit	Check whether the X-axis of the axis group is at the max soft limit
5052	Y axis max soft limit	Check whether the Y-axis of the axis group is at the max soft limit
5053	Z axis max soft limit	Check whether the Z-axis of the axis group is at the max soft limit
5054	X axis min soft limit	Check whether the X-axis of the axis group is at the min soft limit
5055	Y axis min soft limit	Check whether the Y-axis of the axis group is at the min soft limit
5056	Z axis min soft limit	Check whether the Z-axis of the axis group is at the min soft limit
5057	The radius vector is not	Check whether the command parameter setting is reasonable

Code	Explanation	Solution
	perpendicular to the selected plane	
5058	Wheelbase input value is 0, illegal	Check whether the command parameter setting is reasonable
5059	Axial displacement is 0, illegal	Check whether the command parameter setting is reasonable
5060	Function reload	Check whether the command parameter setting is reasonable
5061	The current state does not allow starting in interrupt mode	Check whether the command parameter setting is reasonable
5062	The start or end point is not on the ellipse	Check whether the command parameter setting is reasonable
5063	The starting position is different	Check whether the command parameter setting is reasonable
5064	Rotary cutting does not support this motion model	Check whether the configuration parameters are reasonable
5065	Pathsel buffer has data, not supported	Pathsel buffer has data, not supported
5066	MPLS execution is illegal. Other instructions are currently running	MPLS execution is illegal. Other instructions are currently running
5067	The command does not support this motion model	Check whether the configuration parameters are reasonable
5068	Currently in pause or continuing motion	Currently in pause or continuing motion
5069	Special curvature extremum	
5070	Invalid long and short axes	Check if the parameter settings for the long and short axes of the ellipse are reasonable
5071	Invalid plane, path direction, position type	Check if the elliptical parameter settings are reasonable
5072	The position is inconsistent with the plane	Check if the elliptical parameter settings are reasonable
5073	Bessel input not completed in pathsel, insert other types of curves	Check if the Pathsel Bessel input is reasonable
5074	Point distance is 0	Check if the command parameter settings are reasonable
5075	Bessel's control point sequence number is incorrect	Check if the command parameter settings are reasonable
5076	Bessel invalid order, no longer between 2-4	Check if the command parameter settings are reasonable
5077	Elliptical velocity planning speed failed	Check if the command parameter settings are reasonable
5078	Emergency stop triggered	Axis group emergency stop opening
5079	Instruction conflict, execution not allowed	Check if instructions are allowed to be executed
5080	The specified plane is incorrect	Check if the command parameter settings are reasonable
5081	The number of pathov fixed point signals exceeds the limit	Check if the command parameter settings are reasonable

Code	Explanation	Solution
5082	Pathmov fixed-point signal mapping type error	Check if the command parameter settings are reasonable
5083	Pathmov fixed point condition less than 0	Check if the command parameter settings are reasonable
5084	Pathmov fixed-point detection type error	Check if the command parameter settings are reasonable
5085	Pathsel_ Illegal input of 2 parameters	Check if the command parameter settings are reasonable
5086	Communication not established	Check if ETHERCAT configuration is activated
5087	Probe overload, other instructions are using the probe	Check if the probe is overloaded
5088	This axis does not support probe commands	Check if the shaft type supports probes
5089	Illegal probe parameters	Check if the command parameter settings are reasonable
5090	Probe window invalid	Check if the command parameter settings are reasonable
5091	Axis type does not support probe configuration mismatch	Check if the command parameter settings are reasonable
5092	Probe missing object word	Check if the probe object word setting is reasonable
5093	Pathmov fixed-point input for two consecutive lines	Check if the command parameter settings are reasonable
5094	Reset not allowed during emergency stop	Emergency stop triggered, reset invalid
5095	Pause to continue pairing for use	Pause to continue pairing for use
5096	Resetting is not allowed in configuration errors	Error deceleration stopping, reset invalid
5097	Command invalid, axis in axis position filtering	The axis is in axis position filtering, and the command trigger is invalid
6000	Duplicate index for constituent axes of the axis group	Check whether the SFD48001+300*N~SFD48003+300*N has duplicate axis number
6001	constituent axes index of the axis group exceeds the number of single axis	Check whether the SFD48001+300*N~SFD48003+300*N exceeds the axis number SFD810
6002	Single axis has error	Single axis in the axis group has error
6003	Single axis is not enabled	Single axis in the axis group is not enabled
6004	Linear speed overspeed alarm	Check whether the linear speed is abnormal. If there is no abnormality, increase the linear speed alarm value appropriately
6005	Acceleration over limit	Not support at the moment
6006	Deceleration over limit	Not support at the moment
6007	Abnormal number of constituent axes	The number of single axes configured for the axis group does not match the model
6008	The hardware channels in the axis group are inconsistent	Confirm whether the SFD8001+300*N of constitute axis is consistent
6009	Counting mode abnormal	Only linear counting is supported. Confirm whether SFD8020+300*N is correct

Code	Explanation	Solution
6010	The constitute axis is not CSP mode	Confirm whether the value of IO mapping 6060h is 8. If not, modify it through A_MODE command
6011	Invalid kinematics type	Confirm whether SFD48000+300*N setting is normal
6012	Axis group given position step	Check whether the position parameters of the command are reasonable
6013	The constitute axis is conflict	The constituent axis cannot be the constituent axis of another enabled axis group
6015	Servo disconnected	Check whether the servo connection is normal and whether the slave ESM state machine is in OP state
6016	Soft limit setting is abnormal	Check whether the maximum value of soft limit of axis group is greater than the minimum value
6017	Illegal soft limit stop mode	Check whether the SFD48145+300*N setting is correct
6018	Forward motion overtaking tail pointer	Check whether the position parameter of the command is reasonable
6019	Reverse motion overtaking tail pointer	Check whether the position parameter of the command is reasonable
6020	Illegal header and footer pointer, header pointer is greater than or equal to footer pointer	Check whether the position parameter of the command is reasonable
6021	Illegal starting segment during data retrieval	Check whether the position parameter of the command is reasonable
6022	Illegal termination segment during data retrieval	Check whether the position parameter of the command is reasonable
6023	MPLS_ Illegal semaphore index value	Check whether the position parameter of the command is reasonable
6024	MPLS type error	Check whether the position parameter of the command is reasonable
6025	MPLS illegal bit operation	Check whether the position parameter of the command is reasonable
6026	MPLS illegal wait operation	Check whether the position parameter of the command is reasonable
6027	Invalid acceleration and deceleration parameters	Check whether the position parameter of the command is reasonable
6028	Invalid acceleration/deceleration percentage parameter	Check whether the position parameter of the command is reasonable
6029	Invalid soft limit configuration	Check whether the position parameter of the command is reasonable
6030	Invalid emergency stop mode	Check whether the parameter setting is reasonable
6031	Command configuration is not numeric	Check whether the parameter setting is reasonable
6032	Axis group error stopping	The axis group is in an error stop state, and the command trigger is invalid
6033	The axes within the axis group are not allowed to enable closed-loop operation	Axis group composition: Axis not allowed to open closed loop
6101	Three points of an arc are collinear	The start point, auxiliary point and end point of the G_CIRCLE command cannot be on the same straight line
6102	Matrix irreversibility	Arc input point position abnormality
6103	The calculated radius is	The values from start point to center, auxiliary point to center, and end

Code	Explanation	Solution
	inconsistent	point to center are inconsistent
6104	The distance between two points is too short	The distance between any two points of starting point, auxiliary point and ending point cannot be less than 0.00001
6105	The rotational axis speed exceeds the single axis limit, if in the singular region, the polar coordinates (0,0)	Check the configuration of polar coordinate parameters
6106	The position of the movement axis in polar coordinates cannot be less than 0	Check the configuration of polar coordinate parameters
7001	Illegal input	The instruction parameter cannot be less than 0
7002	The given distance is too short to accelerate to the specified speed	Unreasonable input parameters
7003	The given distance is too short to decelerate to the specified speed	Unreasonable input parameters
7004	Illegal input	The instruction parameter cannot be less than 0
7006	Illegal input	The instruction parameter cannot be less than 0
7100	Cannot decelerate to 0. The original acceleration and deceleration model cannot decelerate to zero through the current model	Check whether the configuration is reasonable
7101	Unknown G code type	Check whether the input G code is reasonable
7102	Unknown acceleration/deceleration type	Check whether the acceleration and deceleration settings are reasonable
7103	Illegal input	Check the axis configuration and axis group configuration parameters
7104	The given distance is too short to accelerate to the specified speed	Unreasonable input parameters
7105	The given distance is too short to decelerate to the specified speed	Unreasonable input parameters
7116	Radius close to 0	Unreasonable input parameters
7117	The starting point, center and end point are collinear	The starting point, center and end point are collinear
7118	The start point, center point and end point coincide	The start point, center point and end point coincide
7119	After correcting the center of the circle, the error value is greater than the allowable value	After correcting the center of the circle, the error value is greater than the allowable value
7120	The included angle of starting point, circle center and ending point is 0	Check whether the command end point and circle center parameters are reasonable
7121	Connecting point distance	Start to end greater than diameter

Code	Explanation	Solution
	greater than diameter	
7122	The vector between the start point and the end point is not perpendicular to the normal vector	The vector between the start point and the end point is not perpendicular to the normal vector
9090	The interpolation buffer is empty	PATHSEL untimely data distribution
9114	Timeout waiting for data from upper computer	Check whether the termination line is missing or whether the parameter type is reasonable

Appendix 2. EtherCAT communication related servo driver alarm

Appendix 2-1. Alarm list

Alarm code	Explanation	Reason	Solution
E-800	Incorrect ESM requires fault protection	Accept the requires cannot tranform from the current status: Init→Safeop Init→OP PreOP→OP ESM status after alarm: when the current status is Init, PreOP, it stops in current status, and transforms to SafeOP when OP. ESC register AL Status Code: 0011h	Confirm the state transformation of the upper device. Set ON SM2013+20*(N-1) or set servo parameter F0-00=1 to clear the alarm.
801	Undefined ESM requires fault protection	Accept status transform requires except the followings: 1：Request Init State 2：Request Pre-Operational State 3：Request Bootstrap State 4：Reauest Safe-operational State 8：Request Operational State ESM status after alarm: when the current status is Init, PreOP, SafeOP, it stops in current status, and transforms to SafeOP when OP. ESC register AL Status Code: 0012h	Confirm the state transformation of the upper device. Set ON SM2013+20*(N-1) or set servo parameter F0-00=1 to clear the alarm.
802	Leading status requires fault protection	Accept the following status transforming requires: 3：Request Bootstrap State ESM status after alarm: Init ESC register AL Status Code: 0013h	Confirm the state transformation of the upper device. Set ON SM2013+20*(N-1) or set servo parameter F0-00=1 to clear the alarm.
803	PLL not finish fault protection	After 1s of synchronization, the phase combination (PLL locking) of communication and servo still cannot be completed. ESM status after alarm: PreOP ESC register AL Status Code: 002Dh	Confirm the setting of DC, and whether transmission delay compensation and deviation compensation are correct. Set ON SM2013+20*(N-1) or set servo parameter F0-00=1 to clear the alarm.
804	PDO watchdog fault protection	For PDO communication (SafeOP or OP status), bit 10 that setting time 0220 (AL Event Request) through ESC register address 0400 (Watchdog Divider) and 0420 (Watchdog Time Process Data) is not ON. ESM status after alarm: Safe OP ESC register AL Status Code: 001Bh	Confirm whether the transmission time of PDO from the upper device is fixed (whether it is interrupted); Confirm that the PDO watchdog detection delay value is too large; Confirm whether there is any problem in the wiring of EtherCAT communication cable and whether there is serious noise on the cable. Set ON SM2013+20*(N-1) or set servo parameter F0-00=1 to clear

			the alarm.
806	PLL fault protection	ESM state is the case that the phase (PLL lock) of communication and servo does not match in SafeOP or OP state. ESM status after alarm: SafeOP ESC register AL Status Code: 0032h	Confirm the setting of DC, and confirm whether transmission delay compensation and deviation compensation are correct. The alarm can be cleared through cutting off the control power or set servo parameter F0-00 = 1.
807	Synchronization signal fault protection	After the completion of synchronization, according to SYNC0 or IRQ, interrupt processing occurs above the setting threshold. ESM status after alarm: SafeOP ESC register AL Status Code: 002Ch	Confirm the setting of DC, and confirm whether transmission delay compensation and deviation compensation are correct. The alarm can be cleared through cutting off the control power or set servo parameter F0-00 = 1.
810	Synchronization period setting error protection	Cannot support the setting period: Synchronization period should be 500us, 1ms, 2ms, 4ms. ESM status after alarm: PreOP ESC register AL Status Code: 0035h	Set correct synchronization period. Set ON SM2013+20*(N-1) or set servo parameter F0-00=1 to clear the alarm.
811	Mailbox setting fault protection	Bad SM0 / 1 setting for mailbox: The receiving and sending area of the mailbox overlaps, overlaps with SM2/3, and the address of the receiving and sending area is odd; The mailbox start address is out of the range of SyncManager0: 1000h~10FFh, SyncManager1: 1200h~12FFh. SyncManager0/1 length (ESC register: 0802h, 0803h/080Ah, 080Bh) setting error: SyncManager0: out of the range of 32~256byte SyncManager1: out of the range of 40~256byte SyncManager0/1 Control Register (ESC register: 0804h/080Ch) setting error conditions: Not set 100110b to 0804h: bit5-0 Not set 100110b to 080Ch: bit5-0 ESM status after alarm: Init ESC register AL Status Code: 0016h	Set SyncManager as ESI file. Set ON SM2013+20*(N-1) or set servo parameter F0-00=1 to clear the alarm.
814	PDO watchdog setting fault protection	PDO watchdog setting error. PDO watchdog trigger is valid (syncmanager: bit6 of register 0804h is 1), the setting value of PDO watchdog detection timeout value (register 0400h, 0402h) does not meet the condition of "communication cycle * 2" ESM status after alarm: PreOP ESC register AL Status Code: 001Fh	Set the watchdog detection timeout value correctly. Set ON SM2013+20*(N-1) or set servo parameter F0-00=1 to clear the alarm.
815	DC setting error protection	The setting of DC is wrong. Bit2-0 of ESC register 0981h (activation) is set to a value other than the following. bit2-0=000b；bit2-0=011b	Confirm the DC setting. Set ON SM2013+20*(N-1) or set servo parameter F0-00=1 to clear the alarm.

		ESM status after alarm: PreOP ESC register AL Status Code: 0030h	
816	SM event mode setting error protection	Unsupported SM time mode is set. 1C32 / 1C33-01 sets values other than 00, 01 and 02. Bit2-0 = 000b of ESC register 0981 and only SM2 of 1C32h-01h and 1C33h-01h are set. ESM status after alarm: PreOP ESC register AL Status Code: 0028h	Confirm that the settings of 1C32h-01h and 1C33h-01h are the same and the values are in 00h, 01h and 02h. Set ON SM2013+20*(N-1) or set servo parameter F0-00=1 to clear the alarm.
817	SyncManager 2/3 setting error protection	SM2/3 is set to error value. The physical address of SM2/3 is set incorrectly (ESC register: 0810h / 0818h): the receiving and sending areas overlap, coincide with SM2/3, the starting address is odd, and the completion address of the starting address is outside the range SM2/3 length setting (ESC register: 0812h/081A) is different from RxPDO, TxPDO. The control register (ESC register: 0814h/081ch) of SM2/3 is not set correctly. Not set 100110b to bit5-0. ESM status after alarm: PreOP ESC register AL Status Code: 001Dh/001Eh	Set correct value of SyncManager2/3 as ESI file. Set ON SM2013+20*(N-1) or set servo parameter F0-00=1 to clear the alarm.
850	TxPDO distribution error protection	Data size of TxPDO mapping exceeds 24 bytes. ESM status after alarm: PreOP ESC register AL Status Code: 0024h	Confirm that the data size of TxPDO mapping is set within 24 bytes. Set ON SM2013+20*(N-1) or set servo parameter F0-00=1 to clear the alarm.
851	RxPDO distribution error protection	Data size of RxPDO mapping exceeds 24 bytes. ESM status after alarm: PreOP ESC register AL Status Code: 0025h	Confirm that the data size of RxPDO mapping is set within 24 bytes. Set ON SM2013+20*(N-1) or set servo parameter F0-00=1 to clear the alarm.
881	Control mode setting error protection	When the set value of 6060h is 0 and the set value of 6061h is 0, the PDS status will be converted to "operation enabled". 6060h is set to not corresponding control mode. In full closed-loop control, 6060h is not set to position control mode. ESM status after alarm: stop in the current ESM status ESC register AL Status Code: 0000h	Confirm the setting value of 6060h. Set ON SM2013+20*(N-1) or set servo parameter F0-00=1 to clear the alarm.
882	ESM requires in operation error protection	When PDS status is "Operation enabled" or "Quick stop active", other ESM status conversion commands are received. ESM status after alarm: based on the requirement of state transformation from upper device. ESC register AL Status Code: 0000h	Confirm the state transformation requirements from the upper device. Set ON SM2013+20*(N-1) or set servo parameter F0-00=1 to clear the alarm.
883	abnormal action	When the input signal EXT1 / EXT2 is not allocated, select the external trigger condition	Set ON SM2013+20*(N-1) or set servo parameter F0-00=1 to clear

	protection	through Touch probe function; The calculation result of electronic gear ratio is 1/1000 to 1000 times; The calculation process of electronic gear ratio, when the denominator or numerator is not signed and more than 64-bit; The final calculation result of electronic gear ratio, when the denominator or numerator is not signed and more than 32-bit; ESM status after alarm: stop in current ESM status ESC register AL Status Code: 0000h	the alarm.

Appendix 2-2. Read alarm

0000h ~ FEFFh is defined according to IEC61800-7-201.
FF00h~FFFFh can be defined uniquely by users, as shown below.
The lower 8-bit of the defined value (FF00h ~ FFFFh) is shown in the following table as the main code of the alarm number of servo abnormality (alarm). (The secondary code of the alarm number is not read.)
In addition, the main code of the alarm number is represented by a hexadecimal number.

Index	Sub-Index	Name/Description	Range	DateType	Access	PDO	Op-mode
603Fh	00h	Error code	0-65535	U16	ro	TxPDO	All
		Now the alarm of servo driver (only the main number). When the alarm does not occur, it displays 0000h. When the alarm occurs, the alarm is displayed. FF**h Alarm main code (00h~FFh) For example: FF03h … 03h=3d E-030 (overvoltage protection) occured FF55h … 55h=85d E-850 (TxPDO setting abnormal protection), E-851 (RxPDO setting abnormal protection) Any one of them occurs As an exception, when E-817 (SyncManager2/3 setting abnormal), it will show A000h.					

Appendix 2-3. Clear the alarm

Reset method of protection function associated with EtherCAT that can be cleared in case of abnormal (alarm)

The following methods ① ② ③ can be used for abnormal (alarm) clearing no matter which method.

In addition, for protection functions other than EtherCAT association, please refer to the basic function specifications of technical manual.

Method ①: bit4 (Error Ind ACK) of AL control is set to "1".
After that, bit7 of 6040h (control word) is cleared by setting 0 → 1 (sending Fault result command).
After the alarm is cleared, the PDS status is converted from Fault to Switch on disabled.
Method ②: carry out abnormal (alarm) clearing by servo driver (panel F0-00, upper computer software).
After the alarm is cleared, the PDS status is transferred from Fault to Switch on disabled.
Method ③: the external alarm clear input (A-CLR) of servo driver changes from OFF state to ON state.
After the alarm is cleared, the PDS status is migrated from Fault to Switch on disabled.

Appendix 3. Register and coil distribution

Type	Type	Space	Starting address	End address
Single axis	M	50	20000	23200
	D	200	20000	32800
	SFD	300	8000	27200
Axis group	M	100	28000	29000
	D	300	46000	49000
	SFD	300	48000	51000

Appendix 4. Servo driver group U parameters

U0-XX

Code	Contents		Unit
U0-00	servo motor speed		Rpm
U0-01	Input speed instruction		Rpm
U0-02	Torque instruction		% rated
U0-03	Mechanical angle		1°
U0-04	Electric angle		1°
U0-05	Bus voltage		V
U0-06	IPM temperature		0.1 ℃
U0-07	Torque feedback		% rated
U0-08	pulse offset	(0000～9999)*1	Instruction pulse
U0-09		(0000～9999)*10000	
U0-10	Encoder feedback	(0000～9999)*1	Encoder pulse
U0-12	input instruction pulse numbers	(0000～9999)*1	Instruction pulse
U0-13		(0000～9999)*10000	
U0-14	position feedback	(0000～9999)*1	Instruction pulse
U0-15		(0000～9999)*10000	
U0-16	encoder accumulated position	(0000～9999)*1	Encoder pulse
U0-17		(0000～9999)*10000	
U0-18	Torque current		0.01A
U0-19	Analog input V-REF value		0.001V
U0-20	Analog input T-REF value		0.001V
U0-21	Input signal status 1		
U0-22	Input signal status 2		
U0-23	output signal status 1		
U0-24	ouput signal status 2		
U0-25	Input pulse frequency	(0000～9999)*1	1Hz
U0-26		(0000～9999)*10000	
U0-41	Instantaneous output power		1W
U0-42	Average output power		1W
U0-43	Instantaneous thermal power		1W
U0-44	average thermal power		1W
U0-49	position feedforward		1 command unit
U0-50	speed feedforward		rpm
U0-51	torque feedforward		% rated
U0-52	Instantaneous Bus Capacitor Power		1W
U0-53	Average Bus Capacitor Power		1W
U0-55	Discharge power of instantaneous regenerative braking		1W

U0-56	Average regenerative brake discharge power	1W
U0-57 U0-58	Absolute encoder present position feedback low 32-bit	Encoder Position
U0-59 U0-60	Absolute encoder present position feedback high 32-bit	Encoder Position
U0-89	Position instruction end flag	
U0-91	Absolute number of motor turns for multiple turns	

U1-XX

Code	Contents	Unit
U1-00	present alarm code	
U1-01	present warning code	
U1-02	U phase current when alarming	0.01A
U1-03	V phase current when alarming	0.01A
U1-04	bus voltage when alarming	V
U1-05	IGBT temperature when alarming	0.1 ℃
U1-06	torque current when alarming	0.1A
U1-07	excitation current when alarming	A
U1-08	position offset when alarming	Instruction pulse
U1-09	speed when alarming	rpm
U1-10	Seconds(low 16-bit) when alarming, cumulated seconds from the first time power-on	s
U1-11	Seconds(high 16-bit) when alarming, cumulated seconds from the first time power-on	s
U1-12	this time running error numbers, counting after power on this time	
U1-13	this time operation warning numbers, counting after power on this time	
U1-14	historical alarm amounts	
U1-15	historical warning amounts	
U1-16	Recent 2nd alarm code	
U1-17	Recent 3rd alarm code	
U1-18	Recent 4th alarm code	
U1-19	Recent 5th alarm code	
U1-20	Recent 6th alarm code	
U1-21	Recent 2nd warning code	
U1-22	Recent 3rd warning code	
U1-23	Recent 4th warning code	
U1-24	Recent 5th warning code	
U1-25	Recent 6th warning code	

U2-XX

Code	Contents	Unit
U2-00	Power on times	
U2-01	series	
U2-02	Model (low 16-bit)	
U2-03	Model (high 16-bit)	

U2-04	out of factory date: year	
U2-05	out of factory date: month	
U2-06	out of factory date: day	
U2-07	Firmware version	
U2-08	Hardware version	
U2-09	Total running time (from the first time power on)	hour
U2-10	Total running time (from the first time power on)	minute
U2-11	Total running time (from the first time power on)	second
U2-12	This time running time (from this time power on)	hour
U2-13	This time running time (from this time power on)	minute
U2-14	This time running time (from this time power on)	second
U2-15	Average output power (from the first time enabled, average power in the process of enabling)	1W
U2-16	Average thermal power (from the first time enabled, average power in the process of enabling)	1W
U2-17	Average bus capacitor filter power (from the first time power on, average power in the process of power on)	1W
U2-18	Accumulated number of motor turns (0000～9999)*1	lap
U2-19	Accumulated number of motor turns (0000～9999)*10000	lap
U2-20	Device serial no.: low 16-bit	
U2-21	Device serial no.: high 16-bit	
U2-22	Firmware generation date: year	
U2-23	Firmware generation date: month/day	
U2-24	Firmware generation date: hour/minute	

U3-XX

Code	Contents	Unit
U3-00	Motor code (including thermal power parameters) read automatically by driver	-
U3-01	Motor version	-
U3-02	Encoder version	-
U3-70	Automatically read the motor code of the encoder in the motor parameters (only related to the motor code)	-

Appendix 5. Phraseology

Abbreviation	Full name	Description
EtherCAT	Ethernet for Control Automation Technology	Using Ethernet for communication functions in automation control technology
COE	CANopen Over EtherCAT	CAN application protocol based on EtherCAT
FMMU	Fieldbus Memory Management Unit	Fieldbus Memory Management Unit
SM	Sync Manager	Synchronization Manager
pp	Profile position	Internal position control mode
pv	Profile velocity	Internal speed control mode
tq	Torque profile	Internal torque control mode
csp	Cyclic synchronous position mode	Cyclic position control mode
hm	Homing mode	Origin reset position control mode
csv	Cyclic synchronous velocity mode	Cyclic speed control mode
cst	Cyclic synchronous torque mode	Cyclic torque control mode
DC	Distributed Clock	Distributed clock
SDO	Service Data Object	Service data object, used to transmit non periodic communication data
PDO	Process Data Object	Process data object, used to transmit periodic communication data
TxPDO	-	PDO transmitted from the slave station to the master station
RxPDO	-	PDO transmitted from master station to slave station
ESM	EtherCAT State Machine	EtherCAT state machine
ESC	EtherCAT Salve Controller	Slave controller
PHY	Physical layer device that converts data from the Ethernet controller to electric or optical signals.	Physical layer devices that convert data from Ethernet controllers into electrical or optical signals.
PDI	Process Data Interface or Physical Device Interface	Process Data Interface
EEPROM	Electrically Erasable Programmable Read Only Memory	Programmable Read Only Memory, a non-volatile memory used to store ESC configurations and device descriptions. Connect to ESI interface
ESI	EtherCAT Slave Information, stored in ESI EEPROM(formerly known as SII)	EtherCAT slave level information, stored in ESI EEPROM (formerly known as SII)

Appendix 6. List of object dictionaries

Appendix 6-1. COE communication area (0x1000-0x1FFF)

Index	Subindex	Name	Unit	Data arange	Data type	Flag	PDO
1000h	00h	device type	-	0-429496795	U32	RO	N0
1001h	00h	error register	-	0-65535	U16	RO	N0
1008h	00h	Device name	-	-	-	RO	N0
1009h	00h	Hardware version	-	-	-	RO	N0
100Ah	00h	software version	-	-	-	RO	N0
1018h	00h	Identity	-	-	-	RO	-
	01h	vendor ID	-	0-255	U8	RO	N0
	02h	product code	-	0-429496795	U32	RO	N0
	03h	Revision	-	0-429496795	U32	RO	N0
	04h	Serial number	-	0-429496795	U32	RO	N0
1600h	00h	1st RxPDO mapping	-	0-24	U8	RW	N0
	01h	SubIndex 001	-	0-4294967295	U32	RW	N0
	02h	SubIndex 002	-	0-4294967295	U32	RW	N0
	03h	SubIndex 003	-	0-4294967295	U32	RW	N0
	...	...	-	0-4294967295	U32	RW	N0
	18h	SubIndex 024	-	0-4294967295	U32	RW	N0
1601h	00h	2nd RxPDO mapping	-	0-24	U8	RW	N0
	01h	SubIndex 001	-	0-4294967295	U32	RW	N0
	02h	SubIndex 002	-	0-4294967295	U32	RW	N0
	03h	SubIndex 003	-	0-4294967295	U32	RW	N0
	...	...	-	0-4294967295	U32	RW	N0
	18h	SubIndex 024	-	0-4294967295	U32	RW	N0
1602h	00h	3rd RxPDO mapping	-	0-24	U8	RW	N0
	01h	SubIndex 001	-	0-4294967295	U32	RW	N0
	02h	SubIndex 002	-	0-4294967295	U32	RW	N0
	03h	SubIndex 003	-	0-4294967295	U32	RW	N0
	...	...	-	0-4294967295	U32	RW	N0
	18h	SubIndex 024	-	0-4294967295	U32	RW	N0
1603h	00h	4th RxPDO mapping	-	0-24	U8	RW	N0
	01h	SubIndex 001	-	0-4294967295	U32	RW	N0
	02h	SubIndex 002	-	0-4294967295	U32	RW	N0
	03h	SubIndex 003	-	0-4294967295	U32	RW	N0
	...	...	-	0-4294967295	U32	RW	N0
	18h	SubIndex 024	-	0-4294967295	U32	RW	N0
1A00h	00h	1st TxPDO mapping	-	0-24	U8	RW	N0
	01h	SubIndex 001	-	0-4294967295	U32	RW	N0
	02h	SubIndex 002	-	0-4294967295	U32	RW	N0
	03h	SubIndex 003	-	0-4294967295	U32	RW	N0
	...	...	-	0-4294967295	U32	RW	N0
	18h	SubIndex 024	-	0-4294967295	U32	RW	N0
1A01h	00h	2nd TxPDO mapping	-	0-24	U8	RW	N0
	01h	SubIndex 001	-	0-4294967295	U32	RW	N0
	02h	SubIndex 002	-	0-4294967295	U32	RW	N0
	03h	SubIndex 003	-	0-4294967295	U32	RW	N0
	...	...	-	0-4294967295	U32	RW	N0
	18h	SubIndex 024	-	0-4294967295	U32	RW	N0
1A02h	00h	3rd TxPDO mapping	-	0-24	U8	RW	N0
	01h	SubIndex 001	-	0-4294967295	U32	RW	N0

	02h	SubIndex 002	-	0-4294967295	U32	RW	N0
	03h	SubIndex 003	-	0-4294967295	U32	RW	N0
	...	...	-	0-4294967295	U32	RW	N0
	18h	SubIndex 024	-	0-4294967295	U32	RW	N0
1A03h	00h	4th TxPDO mapping	-	0-24	U8	RW	N0
	01h	SubIndex 001	-	0-4294967295	U32	RW	N0
	02h	SubIndex 002	-	0-4294967295	U32	RW	N0
	03h	SubIndex 003	-	0-4294967295	U32	RW	N0
	...	...	-	0-4294967295	U32	RW	N0
	18h	SubIndex 024	-	0-4294967295	U32	RW	N0
1C00h	00h	Sync mangager communication type	-	0-255	U8	RO	N0
	01h	SubIndex 001	-	0-4	U8	RO	N0
	02h	SubIndex 002	-	0-4	U8	RO	N0
	03h	SubIndex 003	-	0-4	U8	RO	N0
	04h	SubIndex 004	-	0-4	U8	RO	N0
1C12h	00h	RxPDO assign	-	0-4	U8	RW	N0
	01h	SubIndex 001	-	1600h-1603h	U16	RW	N0
	02h	SubIndex 002	-	1600h-1603h	U16	RW	N0
	03h	SubIndex 003	-	1600h-1603h	U16	RW	N0
	04h	SubIndex 004	-	1600h-1603h	U16	RW	N0
1C13h	00h	TxPDO assign	-	0-4	U8	RW	N0
	01h	SubIndex 001	-	1A00h-1A03h	U16	RW	N0
	02h	SubIndex 002	-	1A00h-1A03h	U16	RW	N0
	03h	SubIndex 003	-	1A00h-1A03h	U16	RW	N0
	04h	SubIndex 004	-	1A00h-1A03h	U16	RW	N0
1C32h	00h	SM output parameter	-	0-20h	U8	RO	N0
	01h	Synchronization Type	-	0-65535	U16	RW	N0
	02h	Cycle Time	ns	0-4294967295	U32	RW	N0
	03h	SubIndex 003	ns	0-4294967295	U32	RW	N0
	04h	Synchronization Type supported	-	0-65535	U16	RO	N0
	05h	Minimum Cycle Time	ns	0-4294967295	U32	RO	N0
	06h	Calc and Cope Time	ns	0-4294967295	U32	RO	N0
	08h	Get Cycle Time	ns	0-65535	U16	RO	N0
	09h	Delay Time	ns	0-4294967295	U32	RO	N0
	0Ah	Sync0 Cycle Time	-	0-4294967295	U32	RO	N0
	0Bh	SM -Event Missed	-	0-65535	U16	RO	N0
	0Ch	Cycle Time Too Small	-	0-65535	U16	RO	N0
	0Dh	Shift Time Too Short	-	0-65535	U16	RO	N0
	0Eh	SubIndex 0014	-	0-65535	U16	RW	N0
	20h	Sync Error	-	0-1	BOOL	RO	N0
1C33h	00h	SM input parameter	-	0-20h	U8	RO	N0
	01h	Synchronization Type	-	0-65535	U16	RW	N0
	02h	Cycle Time	ns	0-4294967295	U32	RW	N0
	03h	SubIndex 003	ns	0-4294967295	U32	RW	N0
	04h	Synchronization Type supported	-	0-65535	U16	RO	N0
	05h	Minimum Cycle Time	ns	0-4294967295	U32	RO	N0
	06h	Calc and Cope Time	ns	0-4294967295	U32	RO	N0
	08h	Get Cycle Time	ns	0-65535	U16	RO	N0
	09h	Delay Time	ns	0-4294967295	U32	RO	N0
	0Ah	Sync0 Cycle Time	-	0-4294967295	U32	RO	N0
	0Bh	SM -Event Missed	-	0-65535	U16	RO	N0
	0Ch	Cycle Time Too Small	-	0-65535	U16	RO	N0
	0Dh	Shift Time Too Short	-	0-65535	U16	RO	N0

	0Eh	SubIndex 0014	-	0-65535	U16	RW	N0
	20h	Sync Error	-	0-1	BOOL	RO	N0

Appendix 6-2. Servo parameter area

Index	Subindex	Name
2000h	00h	P0-00
2001h	00h	P0-01
2002h	00h	P0-02
2003h	00h	P0-03
...	...	...
205Fh	00h	P0-95
2100h	00h	P1-00
2101h	00h	P1-01
2102h	00h	P1-02
2103h	00h	P1-03
...	...	...
214Ah	00h	P1-74
2200h	00h	P2-00
2201h	00h	P2-01
2202h	00h	P2-02
2203h	00h	P2-03
...	...	...
2263h	00h	P2-99
2300h	00h	P3-00
2301h	00h	P3-01
2302h	00h	P3-02
2303h	00h	P3-03
...	...	...
232Eh	00h	P3-46

Index	Subindex	Name
2500h	00h	P5-00
2501h	00h	P5-01
2502h	00h	P5-02
2503h	00h	P5-03
...	...	...
2547h	00h	P5-71
2700h	00h	P7-00
2701h	00h	P7-01
2702h	00h	P7-02
2703h	00h	P7-03
...	...	...
2715h	00h	P7-21
2800h	00h	P8-00
2801h	00h	P8-01
2802h	00h	P8-02
2803h	00h	P8-03
...	...	...
281Ah	00h	P8-26

Appendix 6-3. Servo driver Profile area (0x6000~0x6FFF)

Index	Subindex	Name	Unit	Data range	Data type	Flag	PDO
6007h	00h	Abort connection option code		0-3	I16	RW	NO
603Fh	00h	Error Code		0 - 65535	U16	RO	TxPDO
6040h	00h	Controlword		0 - 65535	U16	RW	RxPDO
6041h	00h	Statusword		0 - 65535	U16	RO	TxPDO
605Ah	00h	Quickstop option code	-	0 - 7	I16	RW	NO
605Bh	00h	Shutdown option code	-	0 - 1	I16	RW	NO
605Ch	00h	Disable operation option code	-	0 – 1	I16	RW	NO
605Dh	00h	Halt option code	-	1 – 3	I16	RW	NO
605Eh	00h	Fault reaction option code	-	0 – 2	I16	RW	NO
6060h	00h	Modes of operation		--128-127	I8	RW	RxPDO
6061h	00h	Modes of operation display		--128-127	I8	RO	TxPDO
6062h	00h	Position demand value [PUU]	Command unit	-2147483648 – 2147483647	I32	RO	TxPDO

6063h	00h	Position actual internal value	pulse	-2147483648 – 2147483647	I32	RO	TxPDO
6064h	00h	Position actual value	Command unit	-2147483648 – 2147483647	I32	RO	TxPDO
6065h	00h	Following error window	Command unit	0 – 4294967295	U32	RW	RxPDO
6066h	00h	Following error time out	1ms	0 – 65535	U16	RW	RxPDO
6067h	00h	Position windows	Command unit	0 – 4294967295	U32	RW	RxPDO
6068h	00h	Position window time	1ms	0 – 65535	U16	RW	RxPDO
6069h	00h	Velocity sensor actual value			I32	RO	TxPDO
606Ah	00h	Sensor selection code				RW	
606Bh	00h	Velocity demand value	Command unit /s	-2147483648 – 2147483647	I32	RO	TxPDO
606Ch	00h	Velocity actual value	Command unit /s	-2147483648 – 2147483647	I32	RO	TxPDO
606Dh	00h	Velocity window	Command unit	0 – 4294967295	U32	RW	RxPDO
606Eh	00h	Velocity window time	1ms	0 – 65535	U16	RW	RxPDO
606Fh	00h	Velocity threshold	Command unit	0 – 4294967295	U32	RW	RxPDO
6070h	00h	Velocity threshold time	1ms	0 – 65535	U16	RW	RxPDO
6071h	00h	Target torque	0.10%	-32768 – 32767	I16	RW	RxPDO
6072h	00h	Max torque	0.10%	0 – 65535	U16	RW	RxPDO
6073h	00h	Max current	0.10%	0 - 65535	U16	RO	NO
6074h	00h	Torque demand value	0.10%	-32768 – 32767	I16	RO	TxPDO
6075h	00h	Motor rated current	1mA	0 – 4294967295	U32	RO	TxPDO
6076h	00h	Motor rated torque	Mn·m	0 – 4294967295	U32	RO	TxPDO
6077h	00h	Torque actual value	0.10%	-32768 – 32767	I16	RO	TxPDO
6078h	00h	Current actual value	0.10%	-32768 – 32767	I16	RO	TxPDO
6079h	00h	DC link circuit voltage				RO	
607Ah	00h	Target position	Command unit	-2147483648 – 2147483647 E208	I32	RW	RxPDO
607Bh	-	Position range limit	-	-	-	-	-
	00h	Number of entries	-	2	U8	RO	NO
	01h	SubIndex 001	Command unit	-2147483648 – 2147483647	I32	RW	RxPDO
	02h	SubIndex 002	Command unit	-2147483648 – 2147483647	I32	RW	RxPDO
607Ch		Home Offset	Command unit	-2147483648 – 2147483647	I32	RW	RxPDO
607Dh	-	Software position limit	-	-	-	-	-
	00h	Number of entries	-	2	U8	RO	NO
	01h	SubIndex 001	Command unit	-2147483648 – 2147483647	I32	RW	RxPDO
	02h	SubIndex 002	Command unit	-2147483648 – 2147483647	I32	RW	RxPDO
607Eh	00h	Polarity	-	0 – 255	U8	RW	NO
607Fh	00h	Max profile velocity	Command unit /s	0 – 4294967295	U32	RW	RxPDO
6080h	00h	Max motor speed	r/min	0 – 4294967295	U32	RW	RxPDO

6081h	00h	Profile velocity	Command unit /s	0 – 4294967295	U32	RW	RxPDO
6082h	00h	End velocity	Command unit /s	0 – 4294967295	U32	RW	RxPDO
6083h	00h	Profile acceleration	Command unit /s²	0 – 4294967295	U32	RW	RxPDO
6084h	00h	Profile deceleration	Command unit / s²	0 – 4294967295	U32	RW	RxPDO
6085h	00h	Quick stop deceleration	Command unit / s²	0 – 4294967295	U32	RW	RxPDO
6086h	00h	Motion profile type	-	-32768 – 32767	I16	RW	RxPDO
6087h	00h	Torque slope	0.1%/S	0 – 4294967295	U32	RW	RxPDO
6088h	00h	Torque profile type	-	-65535	I16	RW	RxPDO
608Fh	-	Position encoder resolution	-	-	-	-	-
	00h	Number of entries	-	2	U8	RO	NO
	01h	SubIndex 001	pulse	1 – 4294967295	U32	RO	NO
	02h	SubIndex 002	r (motor)	1 – 4294967295	U32	RO	NO
6091h	-	Gear ratio	-	-	-	-	-
	00h	Number of entries	-	2	U8	RO	NO
	01h	SubIndex 001	r (motor)	1 – 4294967295	U32	RW	NO
	02h	SubIndex 002	r (shaft)	1 – 4294967295	U32	RW	NO
6092h	-	Feed constant	-	-	-	-	-
	00h	Number of entries	-	2	U8	RO	NO
	01h	SubIndex 001	Command unit	1 – 4294967295	U32	RW	NO
	02h	SubIndex 002	r (shaft)	1 – 4294967295	U32	RW	NO
6093h	00h	Position factor	No supported				
6098h	00h	Homing method	-	-128 – 127	I8	RW	RxPDO
6099h	-	Homing speeds	-	-	-	-	-
	00h	Number of entries	-	2	U8	RO	NO
	01h	SubIndex 001	Command unit /s	0 – 4294967295	U32	RW	RxPDO
	02h	SubIndex 002	Command unit/s	0 – 4294967295	U32	RW	RxPDO
609Ah	00h	Homing acceleration	-	0 – 4294967295	U32	RW	RxPDO
60A3h	-	Profile jerk use	These two parameter versions are not supported, extended backup				
60A4h	00h	Profile jerk					
	01h	SubIndex 001					
	02h	SubIndex 002					
60B0h	00h	Position offset	These three parameters are used for the 3-loop control of the drive. As the servo underlying algorithm does not support feedforward control, these three parameters are temporarily not needed. Modifying them does not affect the effect.				
60B1h	00h	Velocity offset					
60B2h	00h	Torque offset					
60B8h	00h	Touch probe function	-	0 - 65535	U16	RW	RxPDO
60B9h	00h	Touch probe status	-	0 - 65535	U16	RO	TxPDO
60BAh	00h	Touch probe pos1 pos value	Command unit	-2147483648 – 2147483647	I32	RO	TxPDO
60BBh	00h	Touch probe pos1 neg value	Command unit	-2147483648 – 2147483647	I32	RO	TxPDO
60BCh	00h	Touch probe pos2 pos value	Command unit	-2147483648 – 2147483647	I32	RO	TxPDO
60BDh	00h	Touch probe pos2 neg value	Command unit	-2147483648 – 2147483647	I32	RO	TxPDO

60C0h		Interpolation sub mode select	No supported				
60C1h	-	Interpolation data record					
	00h	Number of entries					
	01h	SubIndex 001					
	02h	SubIndex 002					
60C2h	-	Interpolation time period	-	-	-	-	-
	00h	Number of entries	-	2	U8	RO	TxPDO
	01h	SubIndex 001	-	0– 4294967295	U32	RW	TxPDO
	02h	SubIndex 002	-	0– 4294967295	U32	RW	TxPDO
60C5h		Max acceleration	Command unit /s²	0 – 4294967295	U32	RW	RxPDO
60C6h		Max deceleration	Command unit/s²	0 – 4294967295	U32	RW	RxPDO
60E0h	00h	Positive torque limited	No supported				
60E1h	00h	Negtive torque limited	No supported				
60E3h	-	Supported homing method	-	-	-	-	TxPDO
	00h	Number of entries	-	1 - 254	U8	RO	TxPDO
	01h	1st supported homing method	-	0 - 32767	U16	RO	TxPDO
	..	..	..	..	..	..	..
	20h	32nd supported homing method	-	0 - 32767	U16	RO	TxPDO
60F2h	00h	Positioning option code					
60F4h	00h	Following error actual value	Command unit	-2147483648 – 2147483647	I32	RO	TxPDO
60FA	00h	Following error actual value	Command unit/s	-2147483648 – 2147483647	I32	RO	TxPDO
60FCh	00h	Position demand value	pulse	-2147483648 – 2147483647	I32	RO	TxPDO
60FDh	00h	Digital inputs	-	0~4294967295	U32	RO	TxPDO
60FEh	00h	Number of entries	-	2	U8	RO	NO
	01h	Physical outputs	-	0~4294967295	U32	RW	RxPDO
	02h	Bit mask	-	0~4294967295	U32	RW	RxPDO
	00h	Target velocity	Command unit/s	0~4294967295	U32	RW	RxPDO
60FFh	00h	Supported drive modes		0~4294967295	U32	RO	TxPDO
6502h							

Note:

(1) The object dictionary default value of 607Bh (Position range limited) and 607Dh (softward position limited): Min range limited: -2147483648; Max range limited: 2147483647.
This parameter modification does not work.

(2) 6086h (Motion profile type)
0: step type 1: slope type
This parameter is only fit for HM mode. In PP, PV mode, trajectory planning is directly used for slope type.
In CSP and CSV mode, it is unnecessary to use this parameter, and the trajectory planning is completed in the master station.

(3) 6088h (Torque profile type)
0: step type 1: slope type
In TQ mode, the slope type is used for torque planning directl, this parameter does not work.

Appendix 7. Key points for attention

(1) Do not activate the parameters when the servo is enabled. If you want to activate the parameters, please activate them in the servo disabled state, otherwise the correct execution of the action cannot be guaranteed;

(2) If it is necessary to power down and power on the driver or the host, please power off and power on both, otherwise the correct execution of the action cannot be guaranteed.

(3) In CSP, CSV and CST modes, do not manually modify the value of 6040h (control word) during motor operation.

(4) Regarding the usage of SM1940 and SM1943:

◆ SM1940: defaults to OFF; After being set to ON, it is equivalent to clicking the activation button on the upper computer, which prohibits constant communication. The PLC has an automatic activation function when powered on, and SM1940 activation is not allowed when the PLC is powered on.

◆ SM1943: defaults to OFF; After setting it to ON, the disconnection self recovery function is enabled. If a disconnection occurs, EtherCAT communication is disconnected. When the master station detects that the number of topology structures in the slave station has recovered to the same level as before, an activation operation will be triggered. After this function is enabled, SM1940 will be blocked.

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