



**XS** series PLC

User manual 【Motion control】

Wuxi Xinje Electric Co., Ltd

Data No. PS03 20211125EN 1.0

## Basic description

- ◆ Thank you for purchasing Xinje XS series programmable controller.
- ◆ This manual mainly introduces the application of Codesys programming.
- ◆ Before using the product, please read this manual carefully and operate on the premise of fully understanding the contents of the manual.
- ◆ Please refer to the relevant manuals for the programming mode and hardware specifications of XS products.
- ◆ 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 is any unknown place, please consult the technical support personnel of the company.
- ◆ 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 safety by yourself. The failure of this product may lead to the machine failure
- ◆ In case of failure or loss, please set up backup and safety functions by yourself.

## 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.

For the hardware related and software application of XS series PLC, please refer to the following manual.

- ◆ XS series programmable controller user manual [hardware]
- ◆ XS series programmable controller user manual [software]

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November 2021

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# 1. EtherCAT overview

## 1-1. EtherCAT overview

EtherCAT is the abbreviation of Ethernet for control automation technology. It is the open network communication between master station and slave station for real-time Ethernet developed by Beckhoff automation GmbH, which is managed by ETG (EtherCAT Technology Group).

## 1-2. System composition

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

The number of nodes that the slave station can connect depends on the processing or communication cycle of the master station, the number of transmitted bytes, etc.

## 1-3. Communication specification

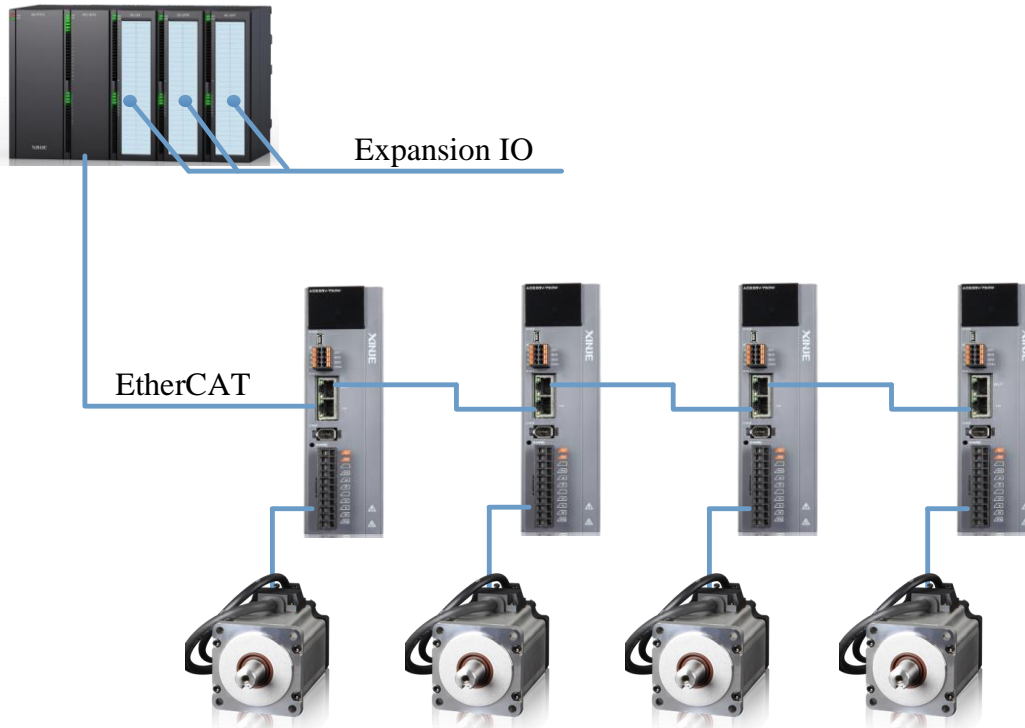
Item	Specification																				
Physical layer	100BASE-TX (IEEE802.3)																				
Baud rate	100[Mbps] (full duplex)																				
Topology	Line																				
Cable	JC-CA twisted pair (shielded twisted pair)																				
Cable length	The maximum length between nodes is 50m																				
Port	2 Port (RJ45)																				
EtherCAT Indicators (LED)	[Run] RUN Indicator [L/A IN] Port0 Link/Activity Indicator (Green) [L/A OUT] Port1 Link/Activity Indicator (Green)																				
Station Alias (ID)	Range: 0~65535. Address: 2700h																				
Explicit Device ID	Not support																				
Mailbox protocol	COE (CANopen Over EtherCAT)																				
SyncManager	4																				
FMMU	3																				
Modes of operation	<table border="1"> <thead> <tr> <th></th> <th colspan="2">Modes of operation</th> </tr> </thead> <tbody> <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> </tbody> </table>		Modes of operation		position	csp	Cyclic synchronous position mode	PP	Profile position mode	hm	Homing mode	speed	csv	Cyclic synchronous velocity mode	pv	Profile velocity mode	torque	cst	Cyclic synchronous torque mode	tq	Torque profile mode
	Modes of operation																				
position	csp	Cyclic synchronous position mode																			
	PP	Profile position mode																			
	hm	Homing mode																			
speed	csv	Cyclic synchronous velocity mode																			
	pv	Profile velocity mode																			
torque	cst	Cyclic synchronous torque mode																			
	tq	Torque profile mode																			
Touch Probe	2 channels																				
Synchronization mode	DC (SYNCO Event synchronization) SM (SM Event synchronization)																				
Cyclic time (DC Communication cycle)	500, 1000, 2000, 4000[μs]																				

Item	Specification
Communication object	SDO[service data object], PDO[process data object]
Single station PDO maximum allocation	TxPDO: 4 [pcs]      RxPDO: 4 [pcs]
Single station PDO max bytes	TxPDO: 24[byte]      RxPDO: 24[byte]
Mailbox communication space in PreOP mode	1ms
Email	SDO request and SDO information

## 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, DS5C series servo is equipped with EtherCAT communication network port, the consumption of cables and bridges is greatly reduced, and the workload of connection design and joint calibration is greatly reduced, which is convenient to save installation costs.

It is recommended to use linear connection method for EtherCAT bus wiring. XS series wiring mode is shown in the figure below:



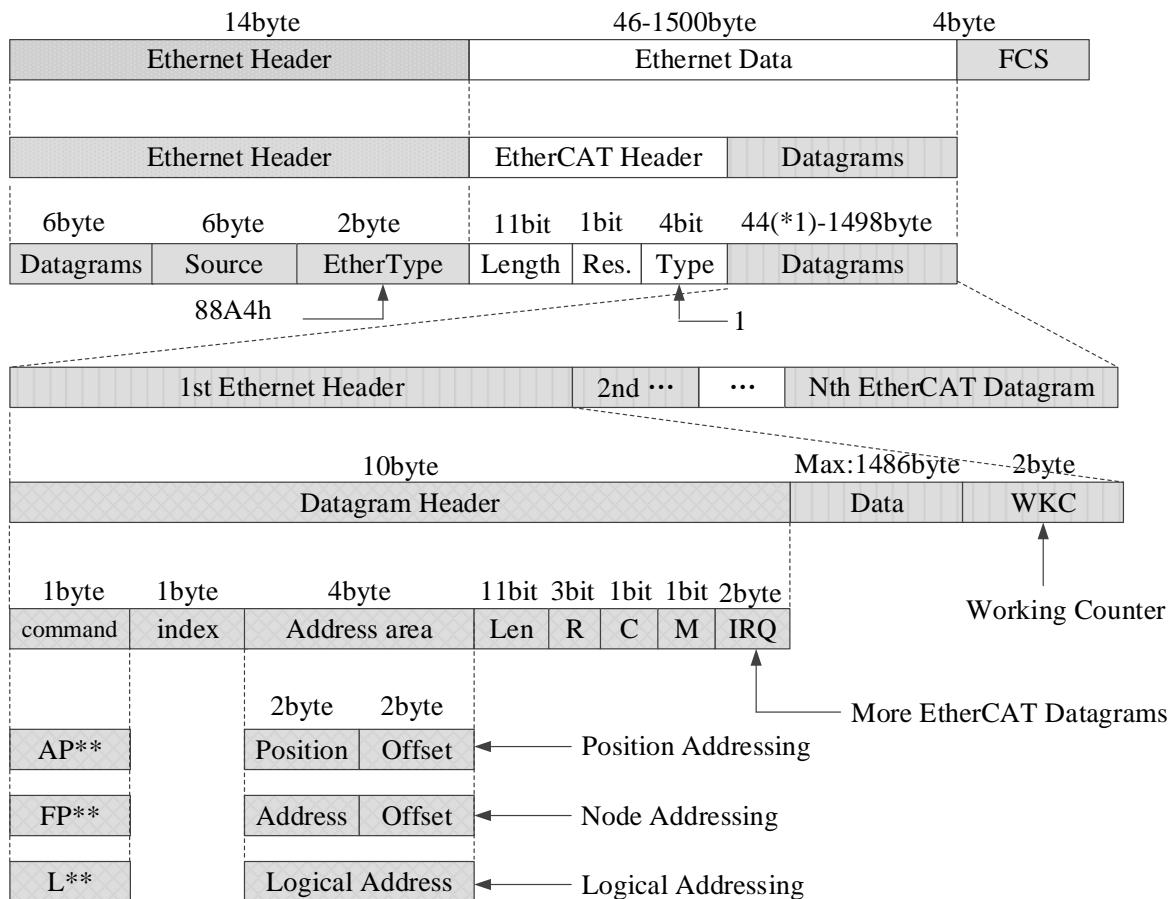
The whole bus network is linear structure, in which XS3 series controller is the master station and Xinje DS5C1 series servo station is the slave station. XS3 series PLC has upper and lower network ports. The upper network port is Ethernet/IP, which is used to connect Codesys upper computer. The lower network port is EtherCAT connection port, which is used to connect Xinje DS5C1 series servo to realize EtherCAT communication. The two communication network ports of Xinje DS5C1 series servo driver shall follow the principle of "bottom in and top out".

## 2. EtherCAT specification

### 2-1. EtherCAT frame structure

EtherCAT is an industrial communication protocol that can be controlled in real time based on Ethernet. It only expands the IEEE 802.3 Ethernet specification without any change to the basic structure, so it can transfer the data in the standard Ethernet frame.

#### EtherNet/EtherCAT frame structure



Note: when Ethernet frame is shorter than 64 bytes, add 1~32 bytes.

(Ethernet Header + Ethernet Data + FCS)

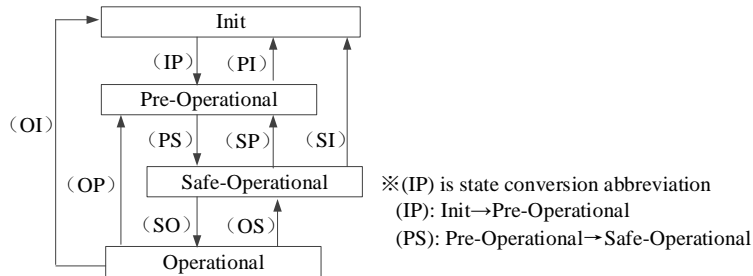
Because the EtherType of the Ethernet Header is [88A4h], the subsequent Ethernet data is processed as an EtherCAT frame. "EtherCAT frame" is defined and analyzed by a certain protocol. As long as the master station and slave station abide by this protocol, data communication can be realized. Commonly used protocols include CANopen Over EtherCAT (CoE), Sercos Over EtherCAT (SoE), etc.

## 2-2. ESM

EtherCAT State machine (ESM) is responsible for coordinating the state relationship between master and slave applications during initialization and operation.

The state change request is executed by the master station. The master station puts forward a control request to the application layer service, which generates an application layer control event in the slave station. After the state change request succeeds or fails, the slave station responds to the application layer control service through the local application layer state write service. If the state change fails, the slave station maintains the state and sets an error flag.

The following figure shows the state transition diagram of ESM:



Init: Initialization status

Pre-Operational: pre-operation status

Safe-Operational: safe operation status

Operational: operation status

Slave station status	Actions in each state	Communication action		
		SDO (mailbox) send & receive	PDO Send	PDO Receive
Init	Communication is initialized, SDO and PDO cannot receive and send messages	-	-	-
Pre-Operational (PreOP)	Only SDO can send and receive	Yes	-	-
Safe-Operational (SafeOP)	Only SDO can send and receive, PDO can send	Yes	Yes	-
Operational (OP)	SDO and PDO both can send and receive	Yes	Yes	Yes

Note: the access from the master station to the ESC register is independent of the above table and can be used at any time.

PDO (process data object) is used to transmit periodic communication data.

SDO (service data object) is used to transmit aperiodic communication data.

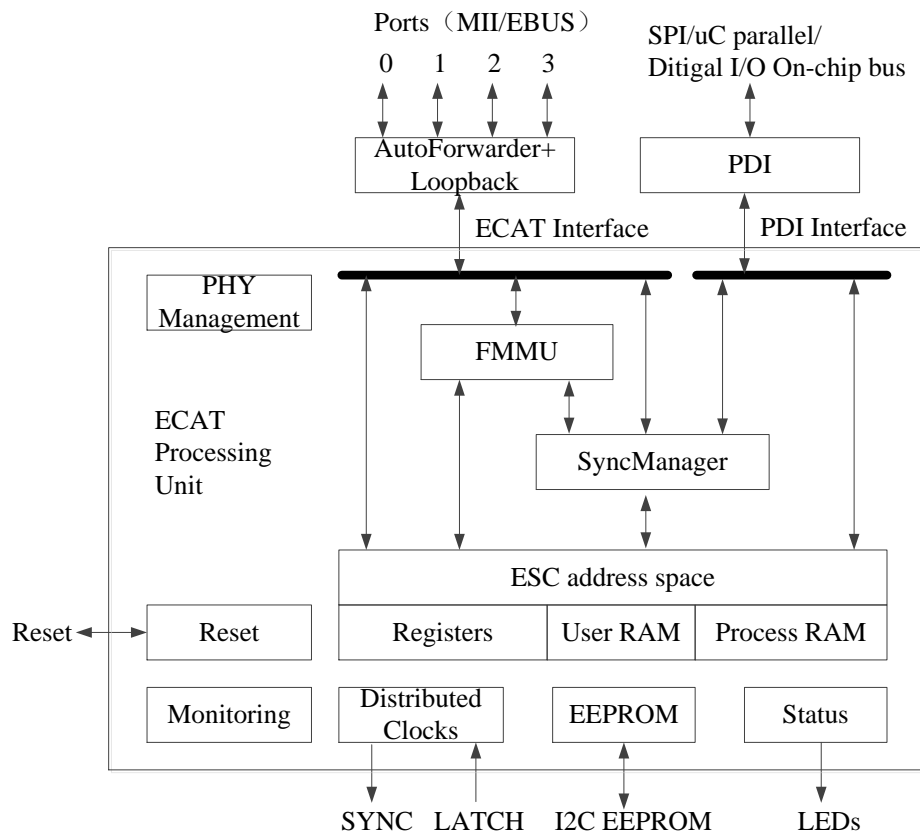
Instruction or interface operation during ESM state switching may cause abnormal communication and error reporting.



## 2-3. ESC

### 2-3-1. Principle overview

ESC refers to the EtherCAT slave controller. The communication process is completely handled by ESC, which has four data transceiver ports, and each port has a Tx and Rx. Each port can send and receive Ethernet data frames, and the data flow direction in ESC is fixed: port 0 -> port 3 -> port 1 -> port 2 -> port 0. If ESC detects that a port has no external PHY, it will automatically close the port and automatically forward to the next port through internal loopback.



### 2-3-2. Address space

DS5C1 series holds 8kbyte physical address space.

The initial 4kbyte (0000H ~ 0FFFH) is used as register space, and the other 4kbyte (1000H ~ 1FFFH) is process data PDO used as RAM field. Please refer to the data table of IP (ET1810/ET1811/ET1812) for details of registers.

ESC register byte address	Length (Byte)	Explanation	Initial value*1
ESC Information (slave station controller information)			
0000h	1	type	04h
0001h	1	Revision	02h
0002h~0003h	2	Build	0040h
0004h	1	FMMUs supported	03h
0005h	1	SyncManagers supported	04h
0006h	1	RAM Size	08h
0007h	1	Port Descriptor	0Fh

ESC register byte address	Length (Byte)	Explanation	Initial value*1
0008h~0009h	2	ESC Features supported	0184h
Station Address			
0010h~0011h	2	Configured Station Address	-
0012h~0013h	2	Configured Station Alias	-
...			
Data Link Layer			
...			
0100h~0103h	4	ESC DL Control	-
...			
0110h~0111h	2	ESC DL Status	-
Application Layer			
0120h~0121h	2	AL Control	-
0130h~0131h	2	AL Status	-
0134h~0135h	2	AL Status Code	-
...			
PDI			
0140h	1	PDI Control	08h
0141h	1	ESC Configuration	0Ch
0150h	1	PDI Configuration	-
0151h	1	SYNC/LATCH PDI Configuration	66h
0152h~153h	2	Extend PDI Configuration	-
...			
Watchdogs			
0400h~0401h	2	Watchdog Divider	-
0410h~0411h	2	Watchdog Time PDI	-
0420h~0421h	2	Watchdog Time Process Data	-
0440h~0441h	2	Watchdog Status Process Data	-
0442h	1	Watchdog Counter Process Data	-
0443h	1	Watchdog Counter PDI	-
...			
FMMU			
0600h~062Fh	3x16	FMMUs [2:0]	-
+0h~3h	4	Logical Start Address	-
+4h~5h	2	Length	-
+6h	1	Logical Start bit	-
+7h	1	Logical Stop bit	-
+8h~9h	2	Physical Start Address	-
+Ah	1	Physical Start bit	-
+Bh	1	Type	-

ESC register byte address	Length (Byte)	Explanation	Initial value*1
+Ch	1	Activate	-
+Dh~Fh	3	Reserved	-
...			
Distributed Clocks (DC) -SYNC Out Unit			
0981h	1	Activation	-
...			
0984h	1	Activation Status	-
098Eh	1	SYNCO Status	-
...			
0990h~0993h	4	Start Time Cyclic Operation/Next SYNCO Pulse	-
...			
09A0h~09A3h	4	SYNCO Cycle Time	-
...			

## 2-4. SII area

After the driver power is on, Configured Station Alias auto-read as the ESC and write in ESC register in the ESC configuration area (EEPROM word address 0000h~0007h). When the changed value of SII EEPROM is reflected in the ESC register, the power supply needs to be started again. In addition, the initial value of the IP core (ET1810/ET1811/ET1812) is set. Please refer to IP core (ET1810/ET1811/ET1812) data list for details.

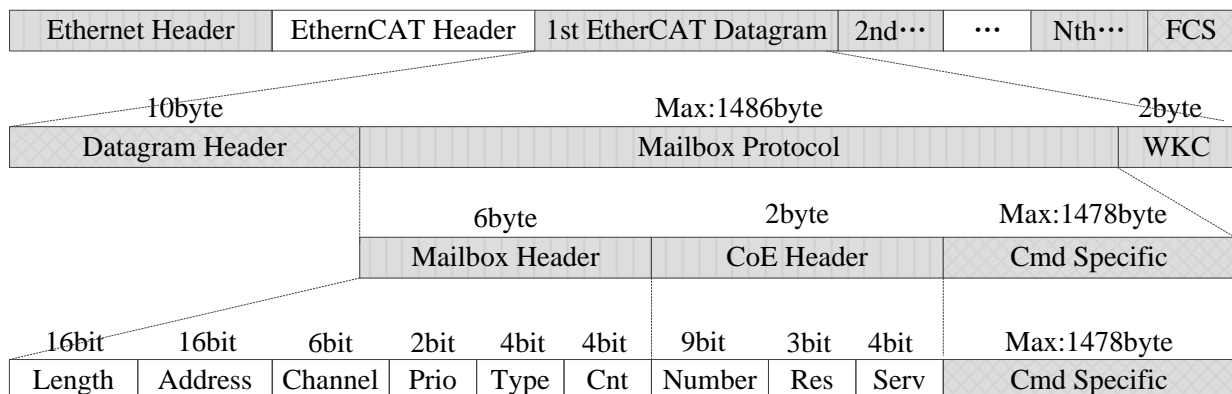
## 2-5. SDO

DS5C1 series supports SDO (service data object). The data exchange of SDO uses mailbox communication, so the data refresh time of SDO becomes unstable.

The master station side reads and writes data in the records in the object dictionary, and can set the object and monitor various states of the slave station. The response to the read-write action to the SDO takes time. For objects refreshed with PDO, do not refresh with SDO, but overwrite with the value of PDO.

### 2-5-1. Mailbox frame structure

The frame structure of mailbox/SDO is as follows. Please refer to ETG specification (ETG1000-5 and ETG1000-6) for details.



Frame	Data area	Data type	Function
MailBox Header	Length	WORD	Mailbox data length
	Address	WORD	Address of source station
	Channel	Unsigned6	(Reserved)
	Priority	Unsigned2	Priority
	Type	Unsigned4	Mailbox type 00h: error 01h: (reserved) 02h: EoE (not corresponding) 03h: CoE 04h: FoE (not corresponding) 05h: SoE (not corresponding) 06h-0Eh: (reserved) 0Fh: VoE (not corresponding)
	Cnt	Unsigned3	Mailbox counter
	Reserved	Unsigned1	(Reserved)
CoE Header	Number	Unsigned9	Reserved
	Reserved	Unsigned3	Reserved
	Service	Unsigned4	Information type
Cmd specific	Size Indicator	Unsigned1	Data Set Size use license
	Transfer Type	Unsigned1	Normal transfer/Expedited transfer
	Data Set Size	Unsigned2	Specified data size
	Complete Access	Unsigned1	Selection of object access method (not corresponding)
	Command Specfier	Unsigned3	Upload/download Selection of requirements / responses, etc
	Index	WORD	Object Index
	Subindex	BYTE	Object Subindex
			Object data or Abort message

### 2-5-2. Mailbox timeout

The servo driver performs the following timeout settings in mailbox communication.

Timeout of mailbox request: 100ms

The master station sends a request to the slave station (driver). If the WKC of the transmission data of the request frame is updated, the slave station is considered to receive the request normally. Retry repeatedly until the WKC is updated. However, if the WKC is not updated until this set time, the master station side times out.

Mailbox response timeout: 10s

The master station receives the response from the request of the slave station (driver). If this WKC is updated, it is considered to be a normal response. Until this set time, if the response that WKC is updated cannot be received, the master station side times out.

The maximum time required for the response of the slave station (driver) to complete.

### 2-5-3. Alarm information

#### (1) Error code

Error code returns the same value as 603Fh (Error code).

0000h~FEFFh are defined according to IEC61800-7-201.

FF00h~FFFFh are defined by the manufacturer, as shown below.

Index	Subindex	Name	Range	Data type	Accessibility	PDO	Op-mode
603Fh	00h	Error code	0-65535	U16	ro	TxPDO	All
		<p>The alarm of servo driver now (only the main number).            When the alarm does not occur, 0000H is displayed.            When the alarm occurs, the alarm is displayed.            FF**h            Alarm main number (00h~FFh)            For example: FF03h ... 03h=3d E-030 (overvoltage protection) occurs            FF55h ...55h=85d E-850 (TxPDO configuration error protection), E-851(RxPDO configuration error protection). Any one of them occurs as an exception, E-817 (SyncManager2/3 setting error), it will display A000h.</p>					

#### (2) Error register

Error register returns same value as 1001h (Error register).

Index	Subindex	Name	Range	Data type	Accessibility	PDO	Op-mode															
1001h	00h	Error register	0-65535	U16	ro	TxPDO	All															
		<p>Displays the type (status) of the alarm that is happening to the servo driver.            When the alarm does not occur, 0000H is displayed.            Do not display warnings.</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 10%;">Bit</th> <th style="width: 90%;">Content</th> </tr> </thead> <tbody> <tr> <td>0</td> <td rowspan="4" style="text-align: center; vertical-align: middle;">Not support</td> </tr> <tr> <td>1</td> </tr> <tr> <td>2</td> </tr> <tr> <td>3</td> </tr> <tr> <td>4</td> <td>The alarm defined by AL status code occurs *1</td> </tr> <tr> <td>5</td> <td style="text-align: center;">Not support</td> </tr> <tr> <td>6</td> <td style="text-align: center;">Reserved</td> </tr> <tr> <td>7</td> <td>The alarm undefined by AL status code occurs *2</td> </tr> </tbody> </table> <p>*1: The alarm defined by AL status code refers to EtherCAT communication related error E-800~7, E-810~7, E-850~7.            *2: The alarm undefined by AL status code refers to EtherCAT communication related error E-880~7 and error other than EtherCAT communication association.</p>						Bit	Content	0	Not support	1	2	3	4	The alarm defined by AL status code occurs *1	5	Not support	6	Reserved	7	The alarm undefined by AL status code occurs *2
Bit	Content																					
0	Not support																					
1																						
2																						
3																						
4	The alarm defined by AL status code occurs *1																					
5	Not support																					
6	Reserved																					
7	The alarm undefined by AL status code occurs *2																					

## 2-6. PDO

DS5C1 series supports PDO (process data object).

EtherCAT based real-time data transfer is performed through data exchange of PDO (process data object).

PDO includes RxPDO transferred from master station to slave station and TxPDO transferred from slave station to master station.

	Send side	Receive side
RxPDO	Master station	Slave station
TxPDO	Slave station	Master station

### 2-6-1. PDO mapping object

PDO mapping refers to the mapping from the object dictionary to the application object of PDO.

DS5C series PDO mapping tables can use mapping objects of 1600h ~ 1603h for RxPDO and 1A00h ~ 1A03h for TxPDO.

The maximum number of application objects that a mapping object can map is as follows:

RxPDO: 24 [byte], TxPDO: 24 [byte]

The following shows the setting example of PDO mapping.

< Setting example >

Assign the application object 6040h, 6060h, 607Ah, 60B8h to the mapping object 1600h (Receive PDO mapping 1: RxPDO\_1).

Index	Subindex	Object contents	
1600h	00h	04h	
	01h	6040 00 10 h	
	02h	6060 00 08 h	
	03h	607A 00 20 h	
	04h	60B8 00 10 h	
	05h	0000 00 00 h	
	...		
	18h	0000 00 00 h	
6040h	00h	Controlword	U16
6060h	00h	Mode of operation	I8
607Ah	00h	Target Position	I32
60B8h	00h	Touch probe function	U16

### 2-6-2. PDO Allocation object

For PDO data exchange, tables for PDO mapping must be assigned to syncmanager. The relationship between the table used for PDO mapping and syncmanager is described to the PDO allocation object. DS5C series, as PDO allocation objects, can use 1C12h for RxPDO (syncmanager2) and 1C13h for TxPDO (syncmanager3).

The maximum number of application objects that a mapping object can map is as follows:

RxPDO: 4 [Table] (1600h~1603h).

RxPDO: 4 [Table] (1A00h~1A03h).

Usually, one mapping object is enough, so the default one does not need to be changed.

---

Example of setting PDO allocation object:

Allocation of mapping object 1600h to allocation object 1C12h (sync Manager Channel 2).

Index	Subindex	Object contents
1C12h	00h	01h
	01h	1600h
	02h	0000h
	03h	0000h
	04h	0000h

Allocation of mapping object 1600h to allocation object 1C13h (sync Manager Channel 3).

Index	Subindex	Object contents
1C13h	00h	01h
	01h	1A00h
	02h	0000h
	03h	0000h
	04h	0000h

## 2-7. Communication synchronization mode

The DS5C series can select the following synchronization modes.

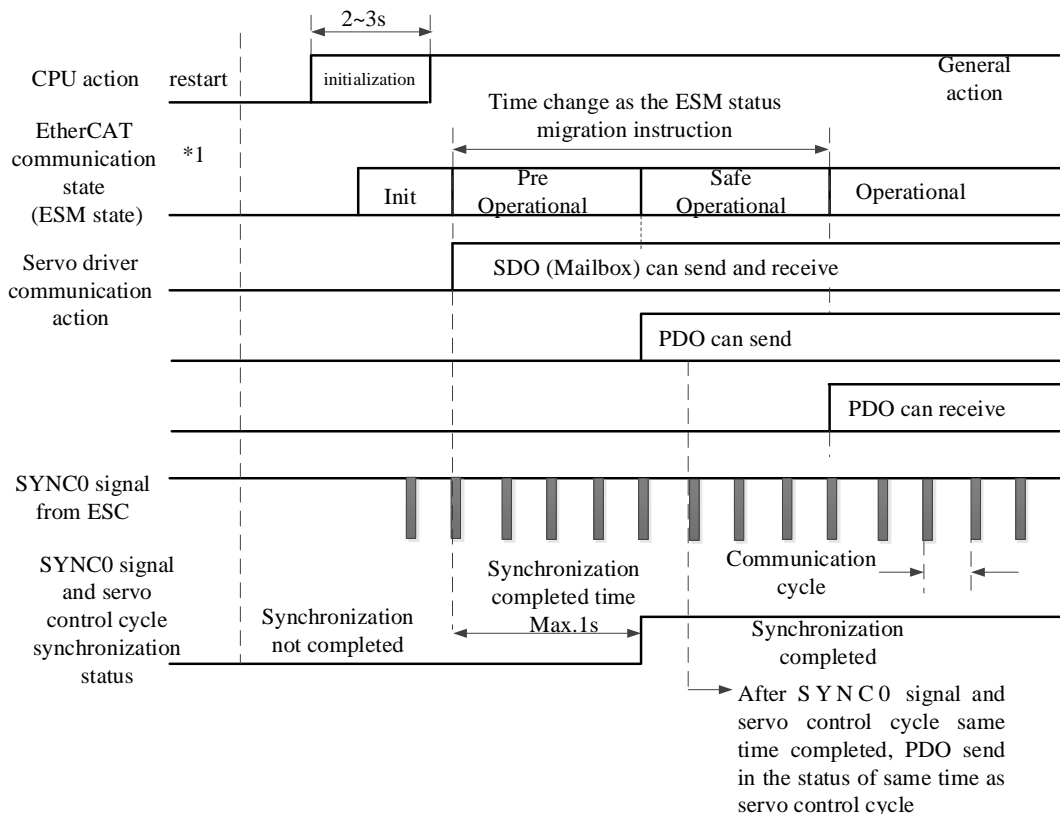
synchronization modes	content	Synchronization method	Feature
DC	SYNC0 event synchronization	Synchronize the time information of other slave stations based on the time of axis 1	High-precision Compensation processing is required at the master station side
SM2	SM2 event synchronization	Synchronize according to RxPDO receiving time	No transmission delay compensation, poor accuracy It is necessary to maintain the transfer time on the controller side (special hardware, etc.)

### 2-7-1. DC (SYNC0 event synchronization)

DS5C series have 64 bits DC (Distributed Clock).

The synchronization of EtherCAT communication is based on this DC. According to the DC slave station, the synchronization is realized by sharing the same reference clock (system time). The local cycle of the slave station starts with the SYNC0 event. Since the slave processing (servo processing) starts from the sync0 event cycle, it is always synchronized with the SYNC0 event.

The master station needs transmission delay compensation (offset compensation) and regular deviation compensation during communication initialization. The following figure shows the synchronization completion process from the control power input to the sync0 event and slave station processing (servo processing).





## 2-7-2. SM2 (SM2 event synchronization)

The local cycle of the slave station starts with the SM2 event.

Since the processing of the slave station starts from the SM2 event cycle, it is always synchronized with the SM2 event.

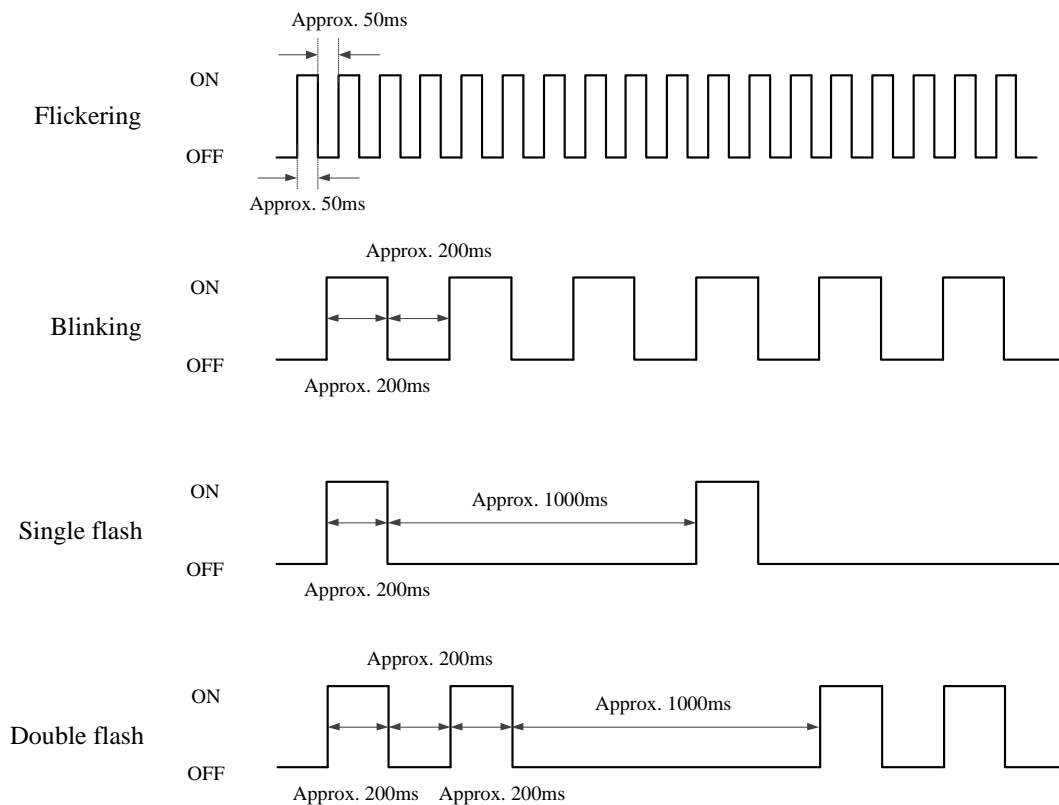
Since the SM2 event occurs when the receiving of PDO is completed, it must be ensured that the upper (Master) side sends messages regularly. If the fluctuation (deviation) of the sending time is too large, the synchronization cannot be completed, or an alarm occurs.

If the above problem occurs, please use DC (sync0 event synchronization).

## 2-8. LED light

DS5C has three EtherCAT Indicators (LED).

As the LED display status, on and off have the following four modes.



### 2-8-1. RUN Indicator

RUN Indicator represents ESM (EtherCAT State Machine) status.

The light on status is green.

LED status	Content
OFF	ESM: INIT status
Blinking	ESM: Pre-Operational status
Single flash	ESM: Safe-Operational status
ON	ESM: Operational status

Note: this light is on the PCB inside the servo and cannot be observed outside the servo.

---

## 2-8-2. L/A IN/OUT

The L/A IN/OUT Indicator indicates the link status and action status of the physical layer of each port.

The light on status is green.

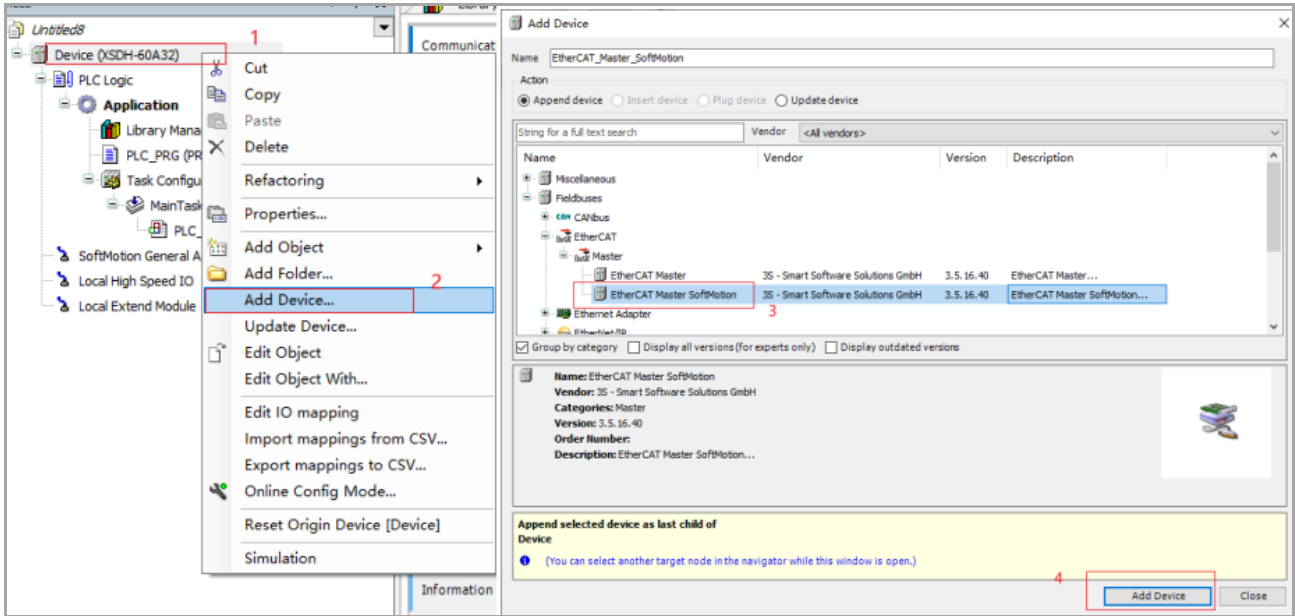
LED status	Content
OFF	LINK not established
Flickering	LINK established, with send and receive
ON	LINK established, without send and receive

# 3. EtherCAT parameter configuration

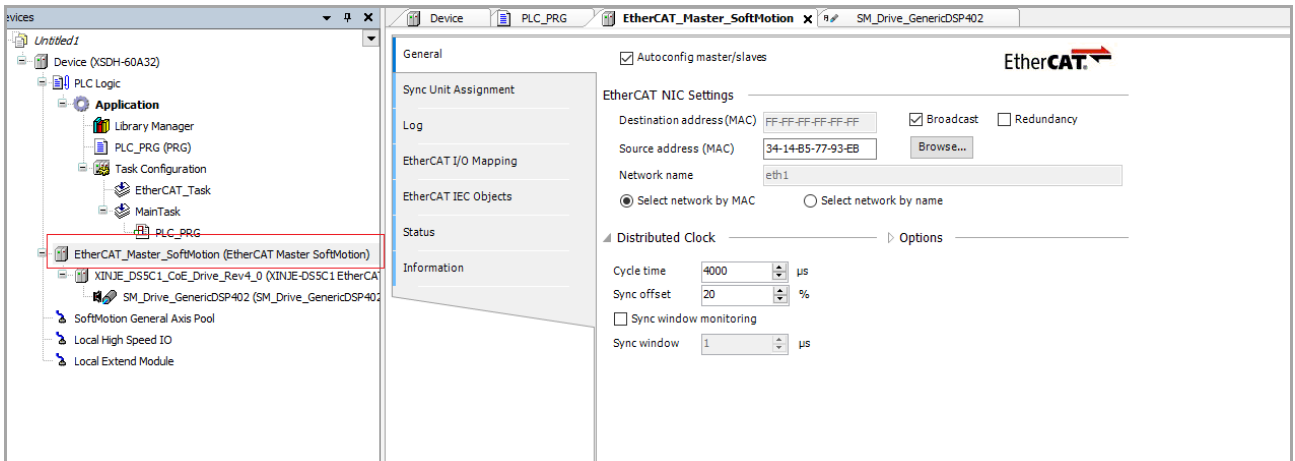
## 3-1. Master station configuration

### 3-1-1. Add master station

Right click [Device], click [Add Device], select [Ethercat Master SoftMotion], then click [Add Device].



### 3-1-2. General



#### (1) EtherCAT NIC Settings

##### **Destination address (MAC):**

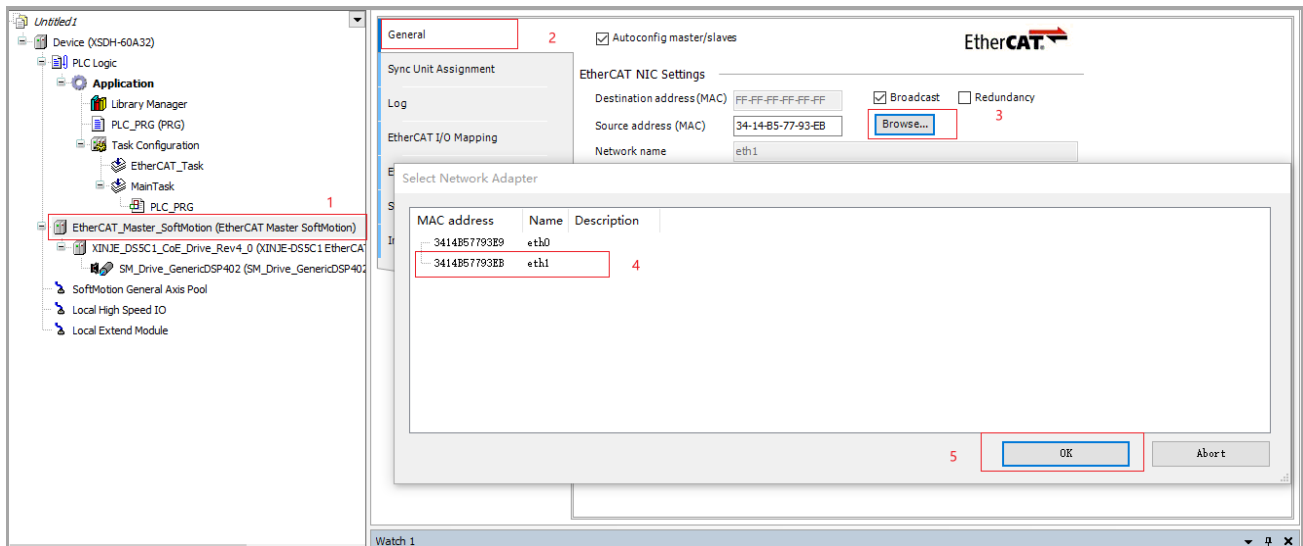
to receive the target address of EtherCAT message, if the [broadcast] option is activated, the target address does not need to be entered, and the system will automatically search the target address through broadcast.

##### **Redundancy:**

when this option is enabled, the EtherCAT redundancy mode is officially enabled, which supports the ring topology.

##### **Source address (MAC):**

MAC address of PLC network interface. You can select [select network by Mac] or [select network by name]. The user can select the [Browse] to select the source address to be set.



## (2) Distributed Clock

### Cycle time:

If the distributed clock function is activated, the master station will send corresponding data messages to the slave station according to the cycle time. Therefore, data exchange can achieve accurate synchronization. This function is particularly important when synchronous action is required in the distributed process (for example, several servo axes perform simultaneous linkage tasks). The master clock with signal jitter less than 1 microsecond can be provided within the network.

### Sync offset:

Generally, when the PLC task starts 20%, the synchronization message starts to affect the slave station, which means that the PLC task cycle can have 80% delay, and no data will be lost within this delay.

### Sync window monitoring:

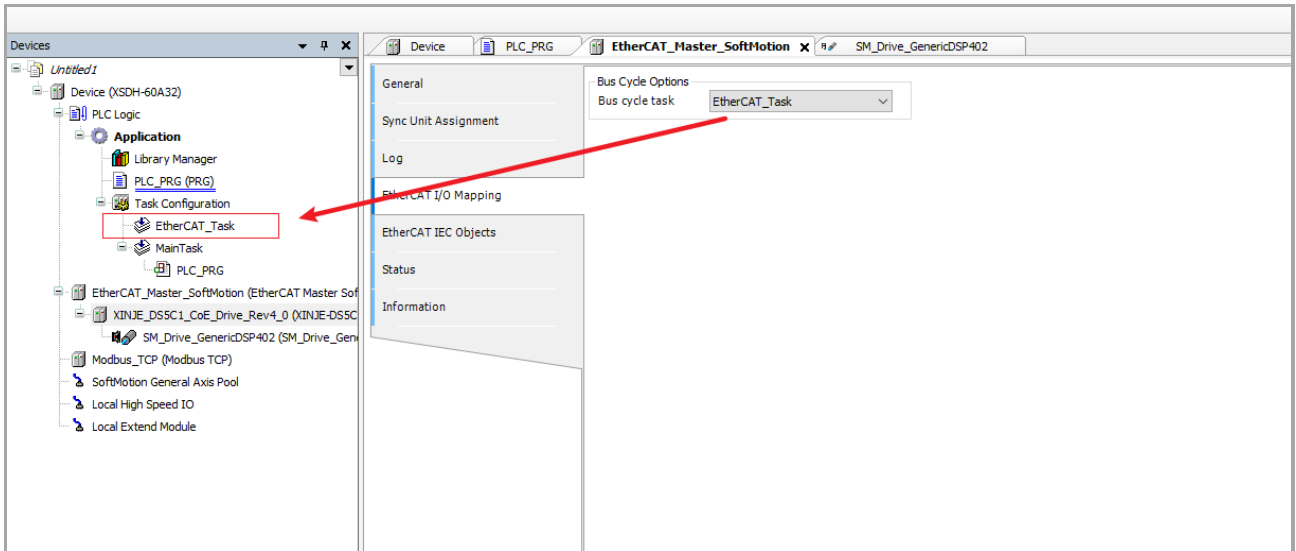
If this option is on, you can monitor the synchronization status of the slave station.

### Sync window:

Time used to monitor the synchronization window. If all slaves are within the synchronization window time, the variable xSyncInWindow (IoDrvEtherCAT) will be set to TRUE, otherwise it will be FALSE.

## 3-1-3. EtherCAT I/O mapping

When the EtherCAT master station is established, EtherCAT\_Task will be established automatically, set the bus cycle task in the EtherCAT I/O mapping. The default is EtherCAT\_Task.

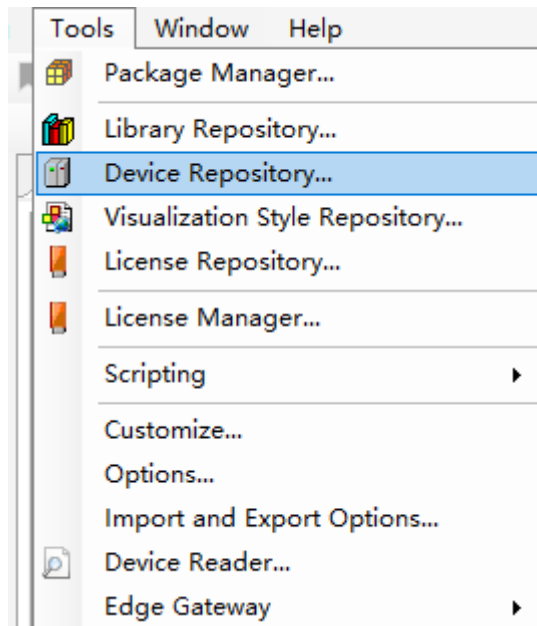


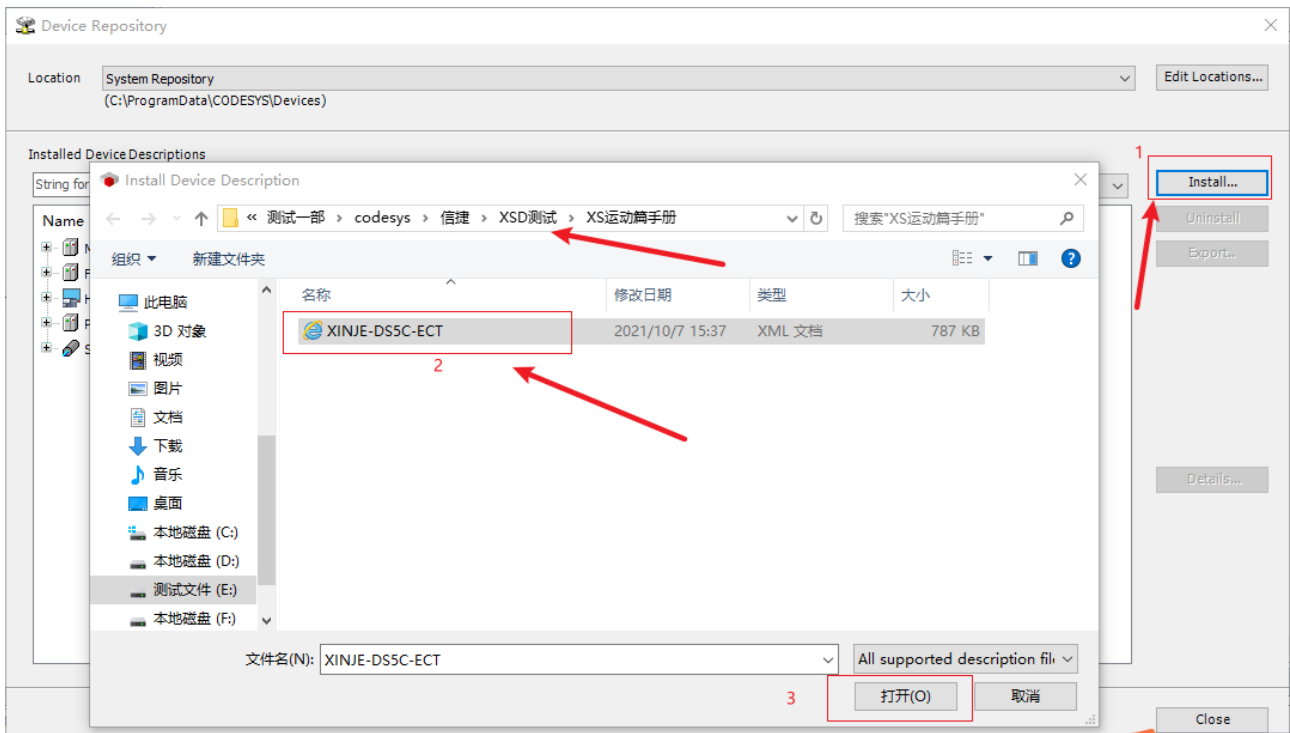
## 3-2. Slave station configuration

### 3-2-1. Add slave station

#### (1) Add xml file

Click Tools--Device Repository, then click Install, select the XML file, click open.

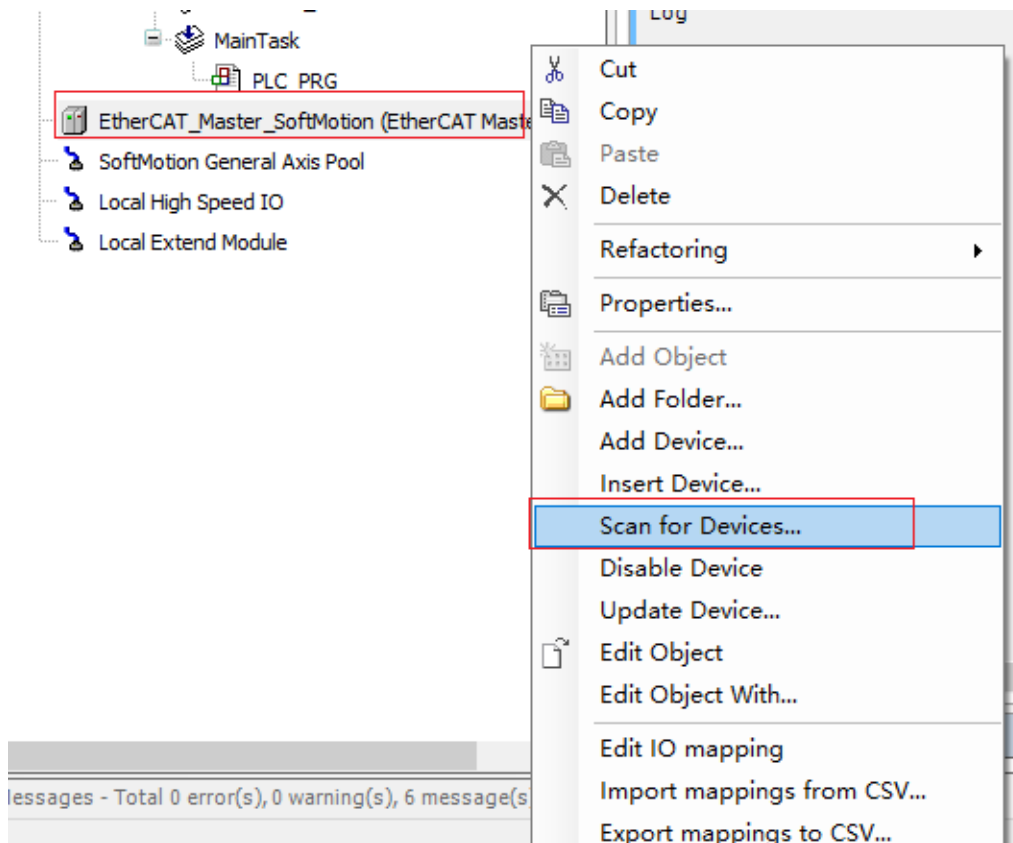




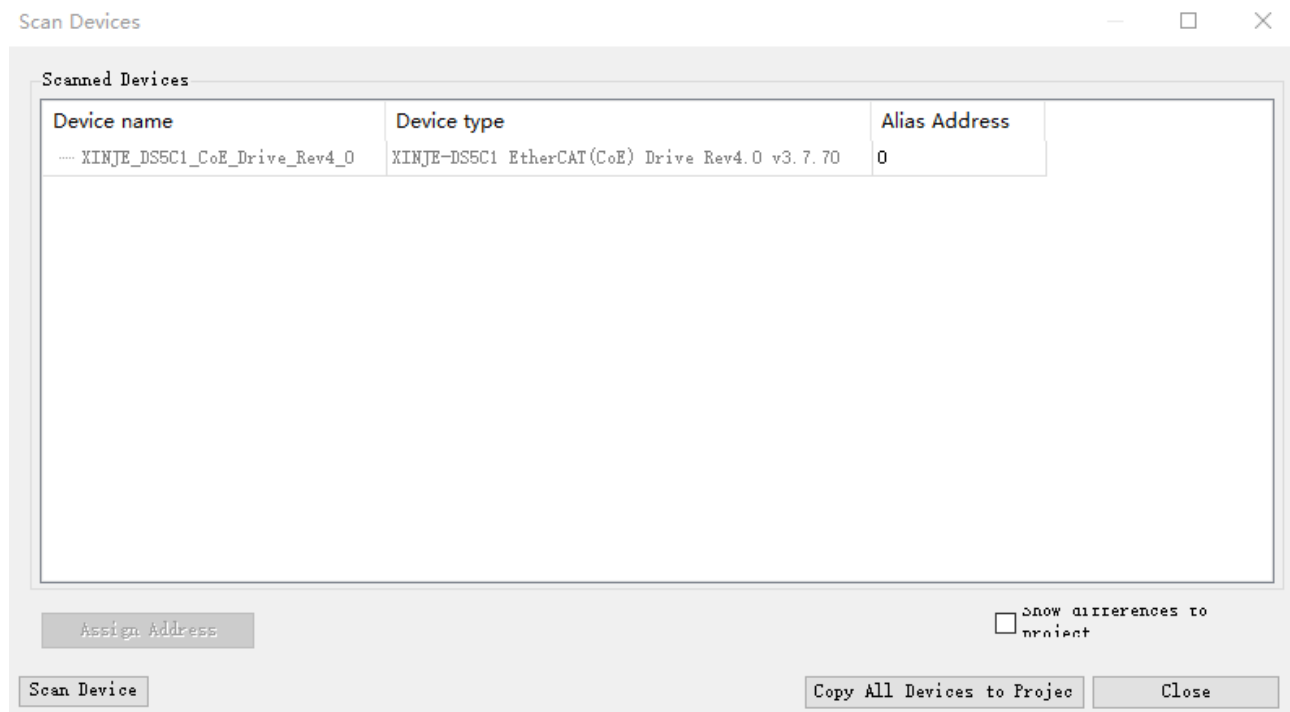
## (2) Scan th slave station

In the project bar [Device], right click [EtherCAT\_Master\_SoftMotion], click [Scan For Devices] to scan the EtherCAT slave station.

Or right click [EtherCAT\_Master\_SoftMotion], click [Insert Devices], to add the device by manual.

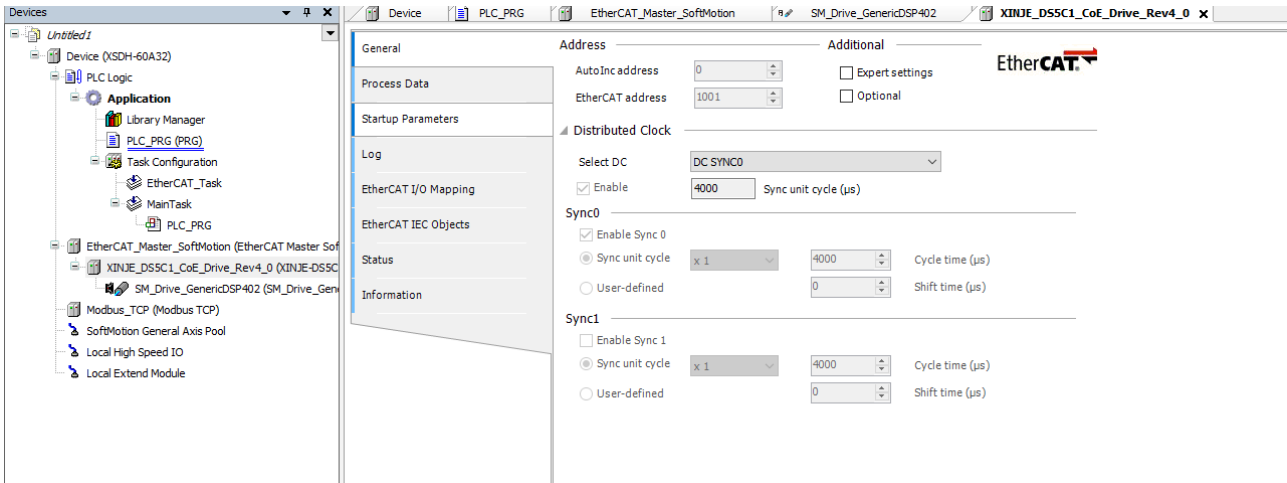


In this example, one DS5C1 series servo is connected, the scanning result is shown as below. Click [Copy All to Project], add all scanned slave stations to the project.



**Note:** Before using the [scan devices] function, it must be ensured that the EtherCAT device description file of the slave station has been installed in the Codesys of the commissioning PC, otherwise this function cannot be used.

### 3-2-2. General



#### (1) Address

##### **AutoInc address:**

Determined by the location of the slave station in the network. This address is only used during startup. The master station needs to assign an EtherCAT address to the slave station. When the first message for this purpose passes through the slave station, each passing slave station adds its own automatic increment address by 1.

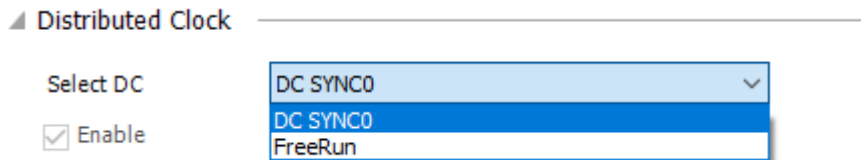
##### **EtherCAT address:**

The final address of the slave station, which is allocated by the master station during startup.

#### (2) Distributed Clock

##### **Select DC:**

The drop-down menu provides all settings about the distributed clock provided by the device description file. You can select DC SYNC0 (synchronous mode) or Freerun (asynchronous mode).



#### (3) Sync 0/1

##### **Enable Sync 0/1:**

If this option is selected, use [sync0/1] synchronous unit. A synchronization unit describes a set of synchronously exchanged process data.

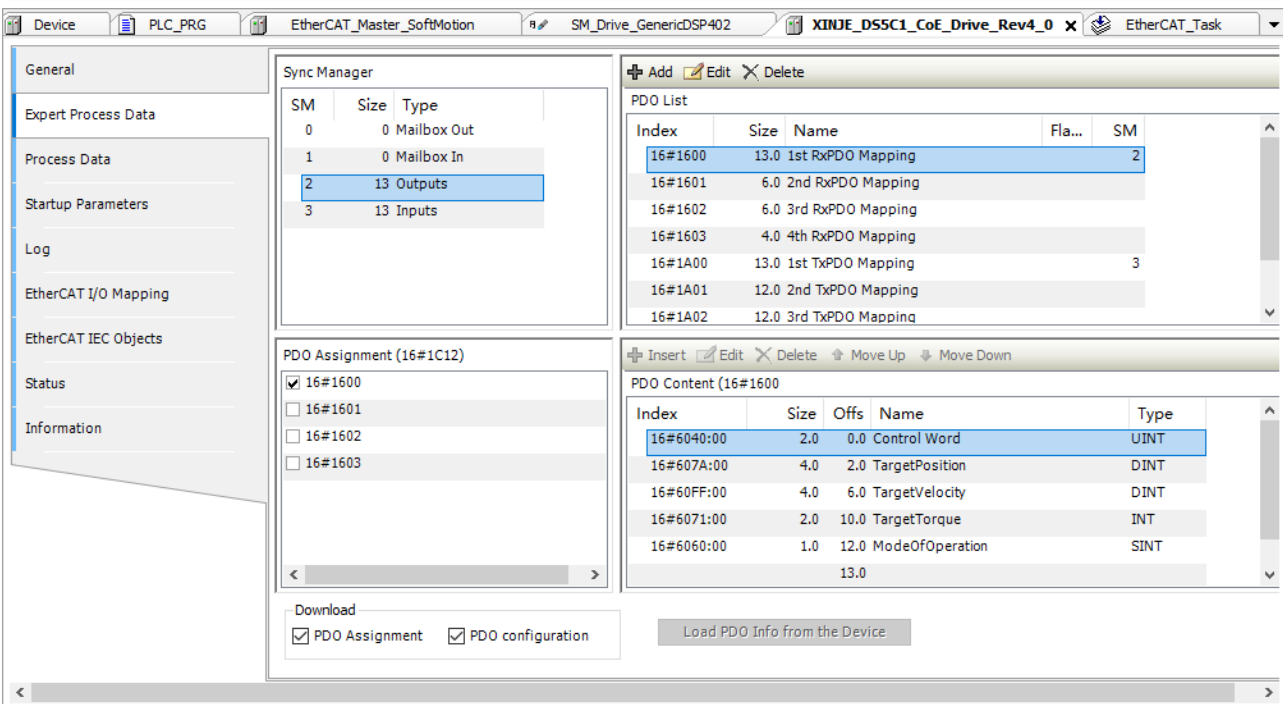
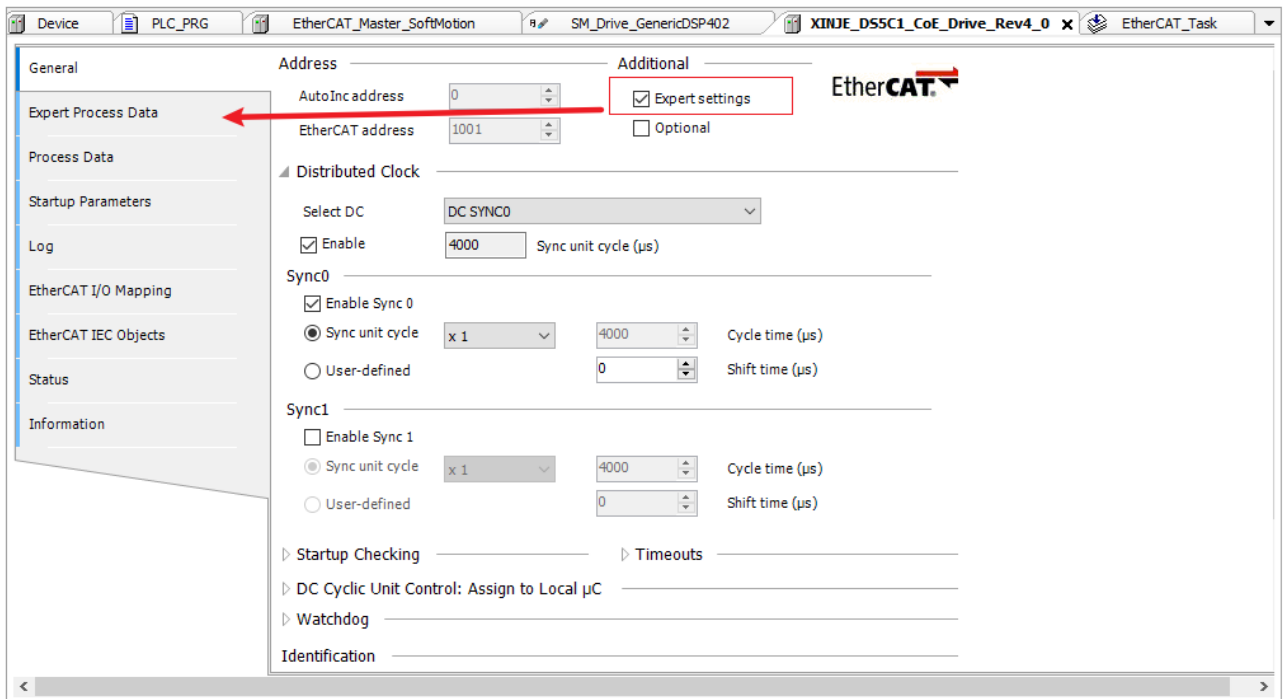
##### **Sync unit cycle:**

The time of the master station cycle multiplied by the selected coefficient will be used as the synchronization cycle time of the slave station. The cycle time (us) column displays the currently set cycle time.



### 3-2-3. Expert process data

Select [expert settings] in the general interface, it will show [expert process data] configuration interface.



#### (1) Sync manager

Used for mailbox data (SDO) interaction. SM2 and SM3 are used for the interaction of PDO data (their type input and output are relative to the master station).

#### Note:

- ① PDO (Process Data Object): used to transmit periodic communication data.
- ② SDO (Service Data Object): used to transmit aperiodic communication data.

## (2) PDO assignment

The larger the PDO data, the longer the transmission time, and it may not be completed within the synchronization unit cycle. Therefore, the stability of data transmission cannot be guaranteed when there are many slave stations and each slave station has a large PDO data.

## (3) PDO list

Some predefined PDO mappings in the servo XML. RxPDO represents the PDO transmitted from the master station to the slave station, which can use 1600h~1603h. TxPDO represents the PDO transmitted from the slave station to the master station, which can use 1A00h~1A03h.

## (4) PDO content

Specify the PDO object to be mapped from the object dictionary, and the object performs periodic data exchange through PDO.

### 3-2-4. Process data

Displays the slave input and output process data described in the device description file.

The screenshot displays a software configuration window with a sidebar on the left and two main panels. The sidebar includes categories: General, Process Data (selected), Startup Parameters, Log, EtherCAT I/O Mapping, EtherCAT IEC Objects, Status, and Information. The 'Process Data' panel is active, showing two sub-panels: 'Select the Outputs' and 'Select the Inputs'.

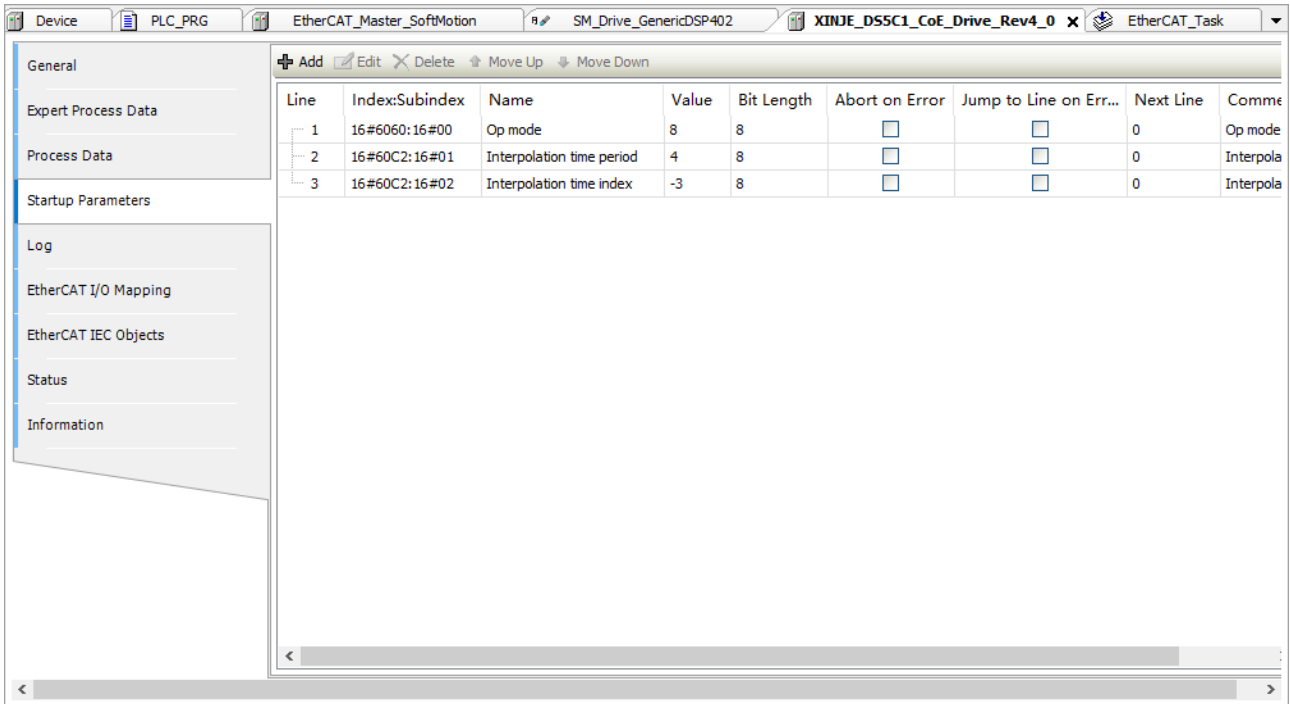
**Select the Outputs**

Name	Type	Index
<input checked="" type="checkbox"/> <b>16#1600 1st RxPDO Mapping</b>		
Control Word	UINT	16#6040:00
TargetPosition	DINT	16#607A:00
TargetVelocity	DINT	16#60FF:00
TargetTorque	INT	16#6071:00
ModeOfOperation	SINT	16#6060:00
<input type="checkbox"/> <b>16#1601 2nd RxPDO Mapping</b>		
Control Word	UINT	16#6040:00
TargetPosition	DINT	16#607A:00
<input type="checkbox"/> <b>16#1602 3rd RxPDO Mapping</b>		
Control Word	UINT	16#6040:00
TargetVelocity	DINT	16#60FF:00
<input type="checkbox"/> <b>16#1603 4th RxPDO Mapping</b>		
Control Word	UINT	16#6040:00
TargetTorque	INT	16#6071:00

**Select the Inputs**

Name	Type	Index
<input checked="" type="checkbox"/> <b>16#1A00 1st TxPDO Mapping</b>		
Status Word	UINT	16#6041:00
ActualPosition	DINT	16#6064:00
Velocity actual value	DINT	16#606C:00
ActualTorque	INT	16#6077:00
ModeOfOperationDisplay	SINT	16#6061:00
<input type="checkbox"/> <b>16#1A01 2nd TxPDO Mapping</b>		
Status Word	UINT	16#6041:00
ActualPosition	DINT	16#6064:00
Velocity actual value	DINT	16#606C:00
ActualTorque	INT	16#6077:00
<input type="checkbox"/> <b>16#1A02 3rd TxPDO Mapping</b>		
Status Word	UINT	16#6041:00
ActualPosition	DINT	16#6064:00
Velocity actual value	DINT	16#606C:00
ActualTorque	INT	16#6077:00
<input type="checkbox"/> <b>16#1A03 4th TxPDO Mapping</b>		
Status Word	UINT	16#6041:00
ActualPosition	DINT	16#6064:00
Velocity actual value	DINT	16#606C:00
ActualTorque	INT	16#6077:00

### 3-2-5. Startup parameters



There are three default configurations in the startup parameters, of which 6060h is the slave operation mode, and the default value is 8 (CSP mode). 60C2-1 and 60C2-2 are synchronization unit cycles, 60C2-1 is the value of synchronization unit cycles, and 60C2-2 is the unit of synchronization unit cycles.

Start parameters and their execution sequence can be configured through add, edit, delete, move up and move down.

**Note:**

The execution sequence is from top to bottom. Different values can be written for the same parameter, indicating that the parameters are assigned values from top to bottom.

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

[Error - > Jump] and [Next line] to specify that when an error occurs, jump to the specified line to continue configuration.

### 3-2-6. EtherCAT I/O mapping

The screenshot shows the 'EtherCAT I/O Mapping' window for a device named 'XINDE\_DS5C1\_CoE\_Drive\_Rev4\_0'. The interface includes a left-hand navigation menu with options like 'General', 'Expert Process Data', 'Process Data', 'Startup Parameters', 'Log', 'EtherCAT I/O Mapping', 'EtherCAT IEC Objects', 'Status', and 'Information'. The main area displays a table with the following columns: Variable, Mapping, Channel, Address, Type, Unit, and Description. Below the table are controls for 'Reset Mapping', 'Always update variables', and a status indicator 'Enabled 2 (always in bus cycle task)'. A legend at the bottom indicates that a yellow star icon means 'Create new variable' and a blue star icon means 'Map to existing variable'.

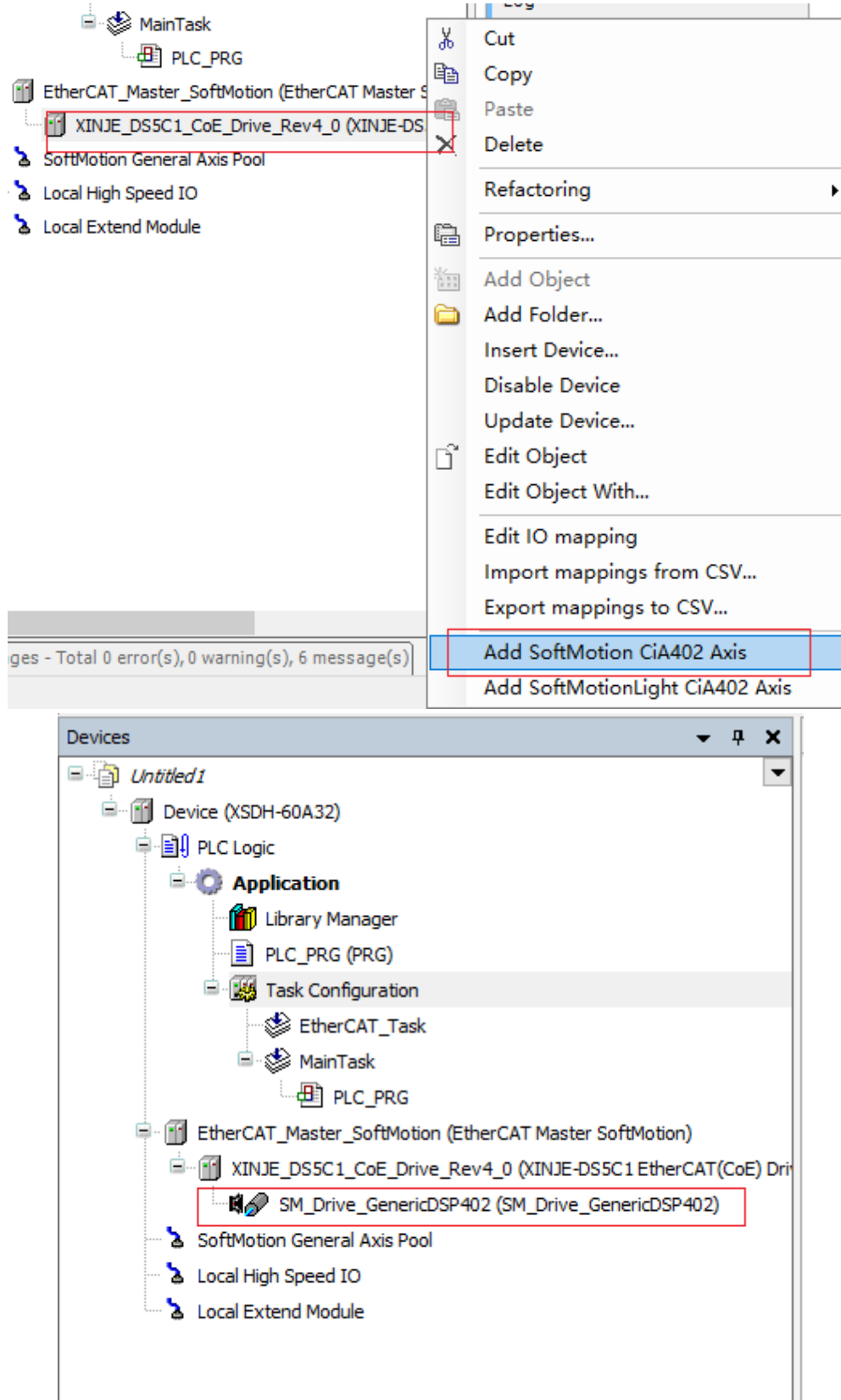
Variable	Mapping	Channel	Address	Type	Unit	Description
Control Word			%QW0	UINT		Control Word
TargetPosition			%QD1	DINT		TargetPosition
TargetVelocity			%QD2	DINT		TargetVelocity
TargetTorque			%QW6	INT		TargetTorque
ModeOfOperation			%QB14	SINT		ModeOfOperation
Status Word			%IW0	UINT		Status Word
ActualPosition			%ID1	DINT		ActualPosition
Velocity actual value			%ID2	DINT		Velocity actual value
ActualTorque			%IW6	INT		ActualTorque
ModeOfOperationDisplay			%IB14	SINT		ModeOfOperationDisplay

You can view EtherCAT I/O mapping relationships, function descriptions, actual addresses, and types of mapping variables.

### 3-3. Axis configuration

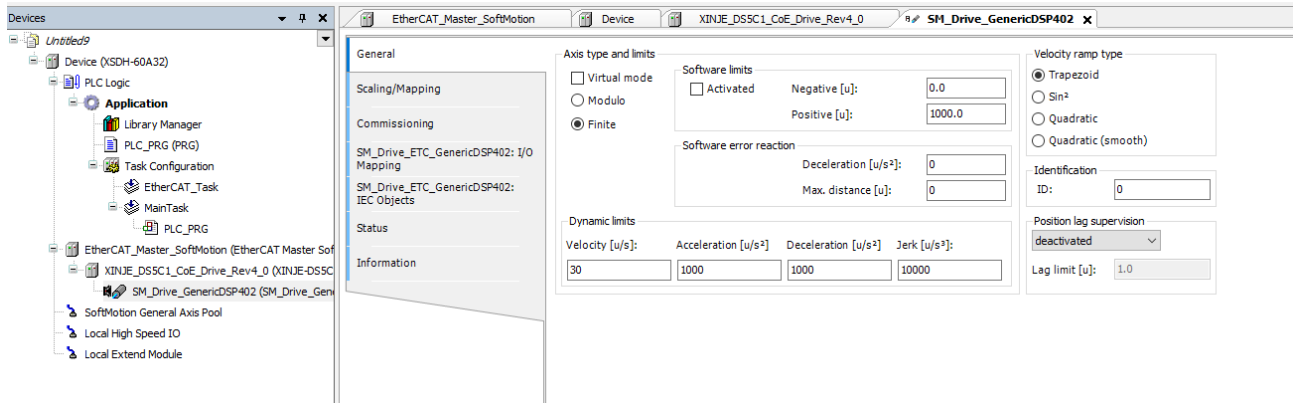
#### 3-3-1. Add axis

After adding the slave station device, right click the slave station device [XINJE\_DS5C1\_CoE\_Drive\_Rev4\_0], click [Add SoftMotion CiA 402 Axis].



**Note:** If there are multiple slaves, you need to manually add axes for each slave station.

### 3-3-2. SoftMotion drive: general



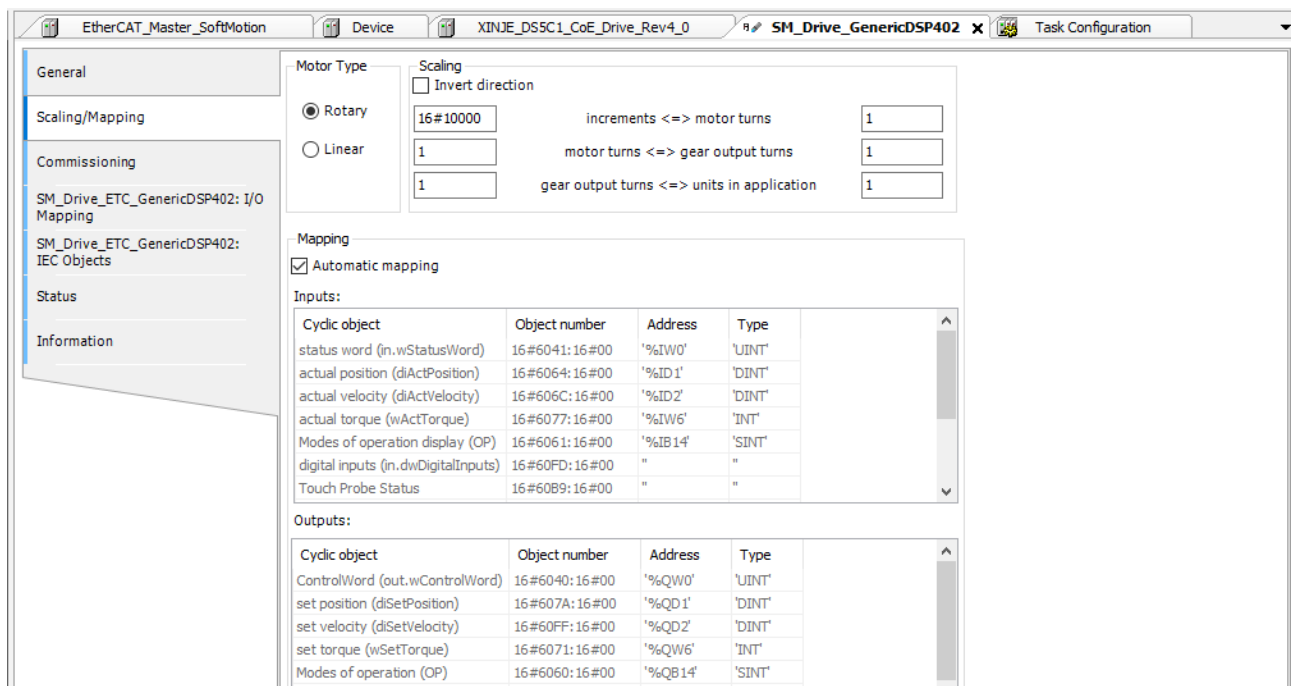
#### Axis type:

In order to accurately control the motion position, the controller must accurately calculate the position of the servo motor. According to the operating characteristics and stroke characteristics of the application system, select [axis type and limit] so that the controller can calculate the feedback information of the encoder of the reading motor to obtain the accurate position and avoid the error caused by the accumulated overflow of the encoder pulse number.

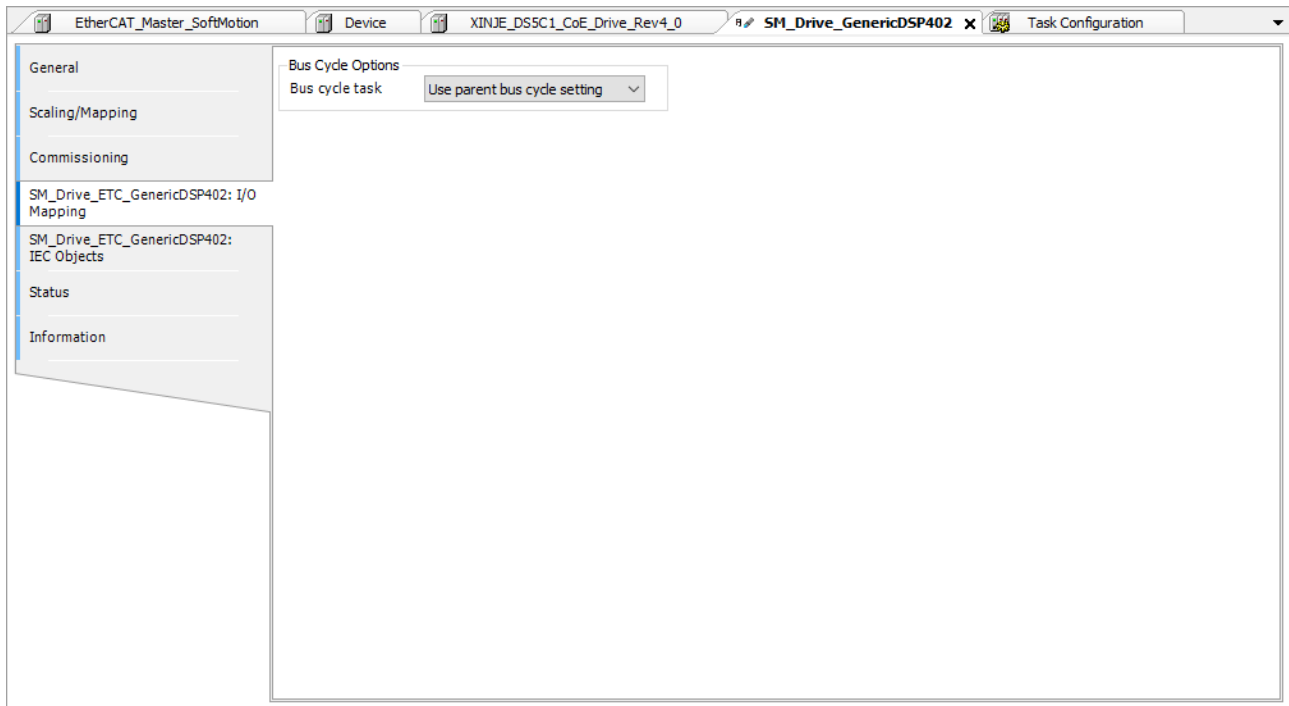
If the actual servo motor is not connected, select [virtual mode]. For the reciprocating mechanism of screw type, its stroke is limited. We often need to know its absolute position within the range of screw stroke. At this time, it is better to choose [linear mode]. For the rotating shaft of one-way operation type, if the linear mode is adopted, the position count overflow is likely to occur, resulting in position calculation errors. It is better to select [periodic mode].

### 3-3-3. SoftMotion drive: scaling/mapping

The encoder parameters (such as resolution) of the motor and the mechanical reduction ratio of the application system may be different, and they also need to be set according to the actual situation during programming.



### 3-3-4. SM\_Drive\_ETC\_GenericDSP402: I/O mapping



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## 4. EtherCAT control project

### 4-1. Motion project control

In a project, the instructions used in the program need the support from the file library. Each POU, if not called in a task, will not be executed. The user can choose to directly configure a task for execution, or select another POU that is already in the task to call the POU that is the configured task. If the program executed in the POU needs to interact with external IO or bus, the corresponding high-speed IO module or EtherCAT bus and slave station equipment shall be configured in the program.

### 4-2. Multiple POU usage

When writing application programs, program functions with different execution cycles should be written in different POU and configured to tasks with different priorities and cycle times, so as to facilitate the viewing and optimization of subsequent programs.

- ◆ Allocate CPU resources reasonably and allocate cycles according to the cycle time required by each function
- ◆ The program structure is clear, and each function is clearly distinguished. Compared with stacking all programs together, multiple POU usages can distinguish functions through different names, which are reflected in the project bar, and the logical structure of the program is clear at a glance
- ◆ It is convenient for debugging. During debugging, it is very convenient to shield some functions that need to be shielded
- ◆ It can directly quote POU between different projects, and directly copy POU from project 1 to project 2
- ◆ After the program is clearly planned, it can be sent to several people for programming to improve the efficiency of programming
- ◆ Different programming languages can be used in different POU. As long as the interface is clear, there is no unified requirement for programming languages in POU.

### 4-3. Call mode of motion function

In a project, in order to allocate CPU resources more reasonably, programs with different cycles will be placed in different POU and tasks during programming.

The motion function requires the task with the highest priority, while the logic function generally does not require the task configuration with that high priority. Therefore, in practical projects, these two blocks are usually placed in two different POU and tasks. So, how can we control the execution of a motion function in the logic function even if the motion function is separated from the logic function? Generally, some input variables and output variables are defined in the motion function for calling by other functions. For example, in the logic POU, if the motion function needs to be called, the control data is written to the input variables of the motion POU. The motion POU puts the motion state into the output variable and gives it to the logic POU to judge the motion state and the execution of program logic.



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## 5. Motion instructions

### 5-1. Single axis function

#### 5-1-1. Single axis instruction list

Instruction	Function
MC_Power	Enable the axis
MC_Reset	Reset the axis faults
MC_Stop	Stop the controller motion
MC_Halt	Pause the execution of function blocks in progress
MC_Home	Homing
MC_Jog	Jog operation
MC_MoveAbsolute	Single axis absolute position control
MC_MoveAdditive	Acceleration moves an additional distance at a given speed
MC_MoveRelative	Moves the axis one relative position from the position of the current axis
MC_MoveSuperImposed	On the basis of the previous motion, superimpose the speed and acceleration to run an additional distance
MC_MoveVelocity	The axis runs continuously at a specified speed
MC_PositionProfile	Plan and execute the motion as the time-position
MC_VelocityProfile	Plan and execute the motion as the time-speed
MC_AccelerationProfile	Plan and execute the motion as the time-acceleration
MC_ReadActualPosition	Read the current position of the current relevant axis
MC_ReadActualTorque	Read the current torque of the current relevant axis
MC_ReadActualVlocity	Read the current speed of the current relevant axis
MC_ReadAxisError	Obtain the error code
MC_ReadBoolParameter	Get the parameter value according to the parameter serial number
MC_ReadParameter	Get the parameter value according to the parameter ID
SMC_ReadSetPosition	Read the setting position of the current axis
SMC_ReadFBError	Read historical error information of function block
MC_WriteBoolParameter	Modify the parameter value of a specific boolean variable specified by the user
MC_WriteParameter	Modify user specified special parameters
SMC_ClearFBError	Clear historical error messages for function blocks
SMC_ErrorString	Read the error description information corresponding to the error code

## 5-1-2. Single axis instructions

### 5-1-2-1. Axis enable [MC\_Power]

#### (1) Instruction overview

It is used to enable the specified axis to enter or exit the runnable state. It is also called axis enable.

Instruction	Name	Graphic representation	ST representation
MC_Power	Axis enable		<pre>MC_Power(   Axis:= ,   Enable:= ,   bRegulatorOn:= ,   bDriveStart:= ,   Status=&gt; ,   bRegulatorRealState=&gt; ,   bDriveStartRealState=&gt; ,   Busy=&gt; ,   Error=&gt; ,   ErrorID=&gt; );</pre>

#### (2) Related variables

VAR_IN_OUT	Name	Data type	Effective range	Initial value	Description
Axis	Axis	AXIS_REF_SM3	-	-	Specified axis
VAR_INPUT	Name	Data type	Effective range	Initial value	Description
Enable	Valid	BOOL	TRUE/FALSE	FALSE	Must be set to TRUE to enable processing of function blocks
bRegulatorOn	Enable	BOOL	TRUE/FALSE	FALSE	Must be set to TRUE to activate the enable status of the function block
bDriveStart	Drive startup	BOOL	TRUE/FALSE	FALSE	Must be set to TRUE to turn off the emergency stop processing of the function block
VAR_OUTPUT	Name	Data type	Effective range	Initial value	Description
Status	Operable	BOOL	TRUE/FALSE	FALSE	Axis ready is TRUE
bRegulatorRealState	Enable effective	BOOL	TRUE/FALSE	FALSE	Active state of axis enable
bDriveStartRealState	Drive available	BOOL	TRUE/FALSE	FALSE	Drive not interrupted by quick stop mechanism is TRUE
Busy	In execution	BOOL	TRUE/FALSE	FALSE	Processing of function block did not complete is TRUE
Error	Error	BOOL	TRUE/FALSE	FALSE	Error occurs is TRUE
ErrorID	Error code	SMC_ERROR	-	0	The value is 0 under normal conditions, and the error code is output under abnormal conditions

5-1-2-2. Axis reset [MC\_Reset]

(1) Instruction overview

Used to reset (clear) axis errors.

Instruction	Name	Graphic representation	ST representation
MC_Reset	Axis reset		<pre>MC_Reset(   Axis:= ,   Execute:= ,   Done=&gt; ,   Busy=&gt; ,   Error=&gt; ,   ErrorID=&gt; );</pre>

(2) Related variables

VAR_IN_OUT	Name	Data type	Efficient range	Initial value	Description
Axis	Axis	AXIS_REF_SM3	-	-	Specified axis
VAR_INPUT	Name	Data type	Efficient range	Initial value	Description
Execute	Valid	BOOL	TRUE/FALSE	FALSE	The rising edge of the input value will start the execution of the function block
VAR_OUTPUT	Name	Data type	Efficient range	Initial value	Description
Done	Completed	BOOL	TRUE/FALSE	FALSE	Reset executed is TRUE
Busy	In execution	BOOL	TRUE/FALSE	FALSE	The function block execution has not ended is TRUE
Error	Error	BOOL	TRUE/FALSE	FALSE	Function block execution error
ErrorID	Error code	SMC_ERROR	-	0	Error identification

### 5-1-2-3. Stop motion [MC\_Stop]

#### (1) Instruction overview

Make the axis deceleration stop

Instruction	Name	Graphic representation	ST representation
MC_Stop	Forced stop		<pre> MC_Stop( Axis:= , Execute:= , Deceleration:= , Jerk:= , Done=&gt; , Busy=&gt; , Error=&gt; , ErrorID=&gt; ); </pre>

#### (2) Related variables

VAR_IN_OUT	Name	Data type	Efficient range	Initial value	Description
Axis	Axis	AXIS_REF_SM3	-	-	Specified axis
VAR_INPUT	Name	Data type	Efficient range	Initial value	Description
Execute	Valid	BOOL	TRUE/FALSE	FALSE	Rising edge triggers command movement
Deceleration	Deceleration speed	LREAL	Positive number	0	Specified deceleration speed, the unit is [command unit/s <sup>2</sup> ]
Jerk	Jerk	LREAL	Positive number	0	Specified jerk, the unit is [command unit/s <sup>3</sup> ]
VAR_OUTPUT	Name	Data type	Efficient range	Initial value	Description
Done	Completed	BOOL	TRUE/FALSE	FALSE	Execution completed is TRUE
Busy	In execution	BOOL	TRUE/FALSE	FALSE	After receiving the command is TRUE
Error	Error	BOOL	TRUE/FALSE	FALSE	Function block execution error
ErrorID	Error code	SMC_ERROR	-	0	Error identification

### 5-1-2-4. Pause the motion [MC\_Halt]

#### (1) Instruction overview

Decelerates to stop the motion being performed by the axis, and the stop motion can resume the uncompleted part of the execution.

Instruction	Name	Graphic representation	ST representation
MC_Halt	Pause the motion		<pre> MC_Halt(   Axis:= ,   Execute:= ,   Deceleration:= ,   Jerk:= ,   Done=&gt; ,   Busy=&gt; ,   CommandAborted=&gt; ,   Error=&gt; ,   ErrorID=&gt; ); </pre>

#### (2) Related variables

VAR_IN_OUT	Name	Data type	Efficient range	Initial value	Description
Axis	Axis	AXIS_REF_SM3	-	-	Specified axis
VAR_INPUT	Name	Data type	Efficient range	Initial value	Description
Execute	Valid	BOOL	TRUE/FALSE	FALSE	Execute at the rising edge
Deceleration	Deceleration speed	LREAL	Positive value	0	Specified deceleration speed. The unit is [command unit/s <sup>2</sup> ]
Jerk	Jerk	LREAL	Positive value	0	Specified jerk. The unit is [command unit/s <sup>3</sup> ]
VAR_OUTPUT	Name	Data type	Efficient range	Initial value	Description
Done	Completed	BOOL	TRUE/FALSE	FALSE	Becomes TRUE when execution is complete
Busy	In execution	BOOL	TRUE/FALSE	FALSE	TRUE when the function block execution has not ended
CommandAborted	Instruction interrupted	BOOL	TRUE/FALSE	FALSE	TRUE if the command has been terminated by another command
Error	Error	BOOL	TRUE/FALSE	FALSE	Function block execution error
ErrorID	Error code	SMC_ERROR	-	0	Error identification

### 5-1-2-5. Axis homing [MC\_Home]

#### (1) Instruction overview

This command executes the homing action of the motor. The specific homing process is determined by the homing mode designed by the bus driver.

Instruction	Name	Graphic representation	ST representation
MC_Home	Axis homing		<pre> MC_Home(   Axis:= ,   Execute:= ,   Position:= ,   Done=&gt; ,   Busy=&gt; ,   CommandAborted=&gt; ,   Error=&gt; ,   ErrorID=&gt; ); </pre>

#### (2) Related variables

VAR_IN_OUT	Name	Data type	Efficient range	Initial value	Description
Axis	Axis	AXIS_REF_SM3	-	-	Specified axis
VAR_INPUT	Name	Data type	Efficient range	Initial value	Description
Execute	Valid	BOOL	TRUE/FALSE	FALSE	Execute at the rising edge
Position	Axis reached position	LREAL	Data range	0	Axis homing position
VAR_OUTPUT	Name	Data type	Efficient range	Initial value	Description
Done	Completed	BOOL	TRUE/FALSE	FALSE	Becomes TRUE when execution is complete
Busy	In execution	BOOL	TRUE/FALSE	FALSE	TRUE when the function block execution has not ended
CommandAborted	Instruction interrupted	BOOL	TRUE/FALSE	FALSE	TRUE if the command has been terminated by another command
Error	Error	BOOL	TRUE/FALSE	FALSE	Function block execution error
ErrorID	Error code	SMC_ERROR	-	0	Error identification

#### (3) Function description

This function block is homing operation, Position is the homing position of the axis.

This function block operation status is Standstill, instruction running status is homing, other status cannot run.

The instruction starts at the rising edge of Execute.

Before homing operation, it is necessary to configure bus homing parameters, such as homing mode, speed, acceleration, etc. Please refer to the manual of the driver used for which parameters need to be configured for bus drive homing. For example, DS5C1 series servo driver user manual – chapter 6.5 HM mode.

For general bus drive homing, the data of index and subindex shall be set as shown in the following table.

Index	Subindex	Explanation
0x6098	00h	Homing mode
0x6099	01h	The speed from homing start to find the home point, the value is high to decrease the homing time
0x6099	02h	The speed from finding the zero point to homing completed, the value is low to improve the precision
0x609A	00h	Homing acceleration speed

### 5-1-2-6. Jog operation [MC\_Jog]

#### (1) Instruction overview

This command is used to manually control the movement of the axis in the specified direction.

Instruction	Name	Graphic representation	ST representation
MC_Jog	Jog operation		<pre> MC_Jog( Axis:= , JogForward:= , JogBackward:= , Velocity:= , Acceleration:= , Deceleration:= , Jerk:= , Busy=&gt; , CommandAborted=&gt; , Error=&gt; , ErrorId=&gt; ); </pre>

#### (2) Related variables

VAR_IN_OUT	Name	Data type	Efficient range	Initial value	Description
Axis	Axis	AXIS_REF_SM3	-	-	Specified axis
VAR_INPUT	Name	Data type	Efficient range	Initial value	Description
JogForward	Jog forward	BOOL	TRUE/FALSE	FALSE	If JogForward is TRUE, the axis moves forward as the given parameters (Velocity, Acceleration, Deceleration, Jerk). If JogBackward is TRUE, axis does not move
JogBackward	Jog reverse	BOOL	TRUE/FALSE	FALSE	If JogBackward is TRUE, the axis moves reverse as the given parameters (Velocity, Acceleration, Deceleration, Jerk). If JogForward is TRUE, axis does not move
Velocity	Target speed	LREAL	0, positive value	0	max speed [u/s]
Acceleration	Target acceleration	LREAL	positive value	0	Acceleration speed [u/s <sup>2</sup> ]
Deceleration	Target	LREAL	positive value	0	Deceleration speed [u/s <sup>2</sup> ]

VAR_IN_OUT	Name	Data type	Efficient range	Initial value	Description
	deceleration				
Jerk	Target jerk speed	LREAL	positive value	0	Jerk speed [u/s <sup>3</sup> ]
VAR_OUTPUT	Name	Data type	Efficient range	Initial value	Description
Busy	In execution	BOOL	TRUE/FALSE	FALSE	TRUE when the function block execution has not ended
CommandAborted	Instruction interrupted	BOOL	TRUE/FALSE	FALSE	TRUE if the command has been terminated by another command
Error	Error	BOOL	TRUE/FALSE	FALSE	Function block execution error
ErrorID	Error code	SMC_ERROR	-	0	Error identification

### 5-1-2-7. Absolute position [MC\_MoveAbsolute]

#### (1) Instruction overview

This command is used to move the control axis to the specified absolute position according to the set parameters.

Instruction	Name	Graphic representation	ST representation
MC_MoveAbsolute	Absolute position		<pre> MC_MoveAbsolute(   Axis:= ,   Execute:= ,   Position:= ,   Velocity:= ,   Acceleration:= ,   Deceleration:= ,   Jerk:= ,   Direction:= ,   BufferMode:= ,   Done=&gt; ,   Busy=&gt; ,   Active=&gt; ,   CommandAborted=&gt; ,   Error=&gt; ,   ErrorID=&gt; ); </pre>

#### (2) Related variables

VAR_IN_OUT	Name	Data type	Efficient range	Initial value	Description
Axis	Axis	AXIS_REF_SM3	-	-	Specified axis
VAR_INPUT	Name	Data type	Efficient range	Initial value	Description
Execute	Valid	BOOL	TRUE/FALSE	FALSE	Start at rising edge
Position	Position	LREAL	Data range	0	Target position of motion
Velocity	Target speed	LREAL	0, positive value	0	Max speed [u/s]
Acceleration	Target	LREAL	positive value	0	Acceleration speed [u/s <sup>2</sup> ]



VAR_IN_OUT	Name	Data type	Efficient range	Initial value	Description
	acceleration				
Deceleration	Target deceleration	LREAL	positive value	0	Deceleration speed [u/s <sup>2</sup> ]
Jerk	Target jerk speed	LREAL	positive value	0	Jerk speed [u/s <sup>3</sup> ]
Direction	Direction	MC_DIRECTION	3: fastest 2: current 1: Positive 0: shortest -1: Negative	0	Fastest: automatically select the fastest direction to move Current: move in current direction Positive: move forward Shortest: select the direction according to the shortest path Negative: move reverse
BufferMode	Buffer mode	MC_BUFFER_MODE	-	0	if function block is Busy, then only allow BufferMode=Aborting
VAR_OUTPUT	Name	Data type	Efficient range	Initial value	Description
Done	Completed	BOOL	TRUE/FALSE	FALSE	TRUE after execution
Busy	In execution	BOOL	TRUE/FALSE	FALSE	TRUE when the function block execution has not ended
Active	In control	BOOL	TRUE/FALSE	FALSE	Change to TRUE in control
CommandAborted	Instruction interrupted	BOOL	TRUE/FALSE	FALSE	TRUE if the command has been terminated by another command
Error	Error	BOOL	TRUE/FALSE	FALSE	Function block execution error
ErrorID	Error code	SMC_ERROR	-	0	Error identification

### 5-1-2-8. Position superposition [MC\_MoveAdditive]

#### (1) Instruction overview

The axis superimposes the data specified by Distance on the original command position, which is used for the online superposition position of the motion axis control process.

Instruction	Name	Graphic representation	ST representation
MC_MoveAdditive	Position superposition		<pre> MC_MoveAdditive(   Axis:= ,   Execute:= ,   Distance:= ,   Velocity:= ,   Acceleration:= ,   Deceleration:= ,   Jerk:= ,   Done=&gt; ,   Busy=&gt; ,   CommandAborted=&gt; ,   Error=&gt; ,   ErrorID=&gt; ); </pre>

(2) Related variables

VAR_IN_OUT	Name	Data type	Efficient range	Initial value	Description
Axis	Axis	AXIS_REF_SM3	-	-	Specified axis
VAR_INPUT	Name	Data type	Efficient range	Initial value	Description
Execute	Valid	BOOL	TRUE/FALSE	FALSE	Start at rising edge
Distance	Position	LREAL	Data range	0	This data is superposition position data
Velocity	Target speed	LREAL	0, positive value	0	Max speed [u/s]
Acceleration	Target acceleration	LREAL	positive value	0	Acceleration speed [u/s <sup>2</sup> ]
Deceleration	Target deceleration	LREAL	positive value	0	Deceleration speed [u/s <sup>2</sup> ]
Jerk	Target jerk speed	LREAL	positive value	0	Jerk speed [u/s <sup>3</sup> ]
VAR_OUTPUT	Name	Data type	Efficient range	Initial value	Description
Done	Completed	BOOL	TRUE/FALSE	FALSE	TRUE after execution
Busy	In execution	BOOL	TRUE/FALSE	FALSE	TRUE when the function block execution has not ended
CommandAborted	Instruction interrupted	BOOL	TRUE/FALSE	FALSE	TRUE if the command has been terminated by another command
Error	Error	BOOL	TRUE/FALSE	FALSE	Function block execution error
ErrorID	Error code	SMC_ERROR	-	0	Error identification

5-1-2-9. Relative position [MC\_MoveRelative]

(1) Instruction overview

The axis operates in a relative position specified by Distance.

Instruction	Name	Graphic representation	ST representation
MC_MoveRelative	Relative position		<pre> MC_MoveRelative (   Axis:= ,   Execute:= ,   Distance:= ,   Velocity:= ,   Acceleration:= ,   Deceleration:= ,   Jerk:= ,   BufferMode:= ,   Done=&gt; ,   Busy=&gt; ,   Active=&gt; ,   CommandAborted=&gt; ,   Error=&gt; ,   ErrorID=&gt; ); </pre>

## (2) Related variables

VAR_IN_OUT	Name	Data type	Efficient range	Initial value	Description
Axis	Axis	AXIS_REF_SM3	-	-	Specified axis
VAR_INPUT	Name	Data type	Efficient range	Initial value	Description
Execute	Valid	BOOL	TRUE/FALSE	FALSE	Start at the rising edge
Distance	Position	LREAL	Data range	0	Relative distance from the target to the current position
Velocity	Target speed	LREAL	0, positive value	0	Max speed [u/s]
Acceleration	Target acceleration	LREAL	positive value	0	Acceleration speed [u/s <sup>2</sup> ]
Deceleration	Target deceleration	LREAL	positive value	0	Deceleration speed [u/s <sup>2</sup> ]
Jerk	Target jerk speed	LREAL	positive value	0	Jerk speed [u/s <sup>3</sup> ]
BufferMode	Buffer mode	MC_BUFFER_MODE	-	0	if function block is Busy, then only allow BufferMode=Aborting
VAR_OUTPUT	Name	Data type	Efficient range	Initial value	Description
Done	Completed	BOOL	TRUE/FALSE	FALSE	TRUE after execution
Busy	In execution	BOOL	TRUE/FALSE	FALSE	TRUE when the function block execution has not ended
Active	In control	BOOL	TRUE/FALSE	FALSE	Becomes TRUE in control
CommandAborted	Instruction interrupted	BOOL	TRUE/FALSE	FALSE	TRUE if the command has been terminated by another command
Error	Error	BOOL	TRUE/FALSE	FALSE	Function block execution error
ErrorID	Error code	SMC_ERROR	-	0	Error identification

5-1-2-10. Superimpose relative motion command [MC\_MoveSuperImposed]

(1) Instruction overview

Based on the original command speed and position, the axis superimposes the data of speed and position on the running command.

Instruction	Name	Graphic representation	ST representation
MC_MoveSuperImposed	Superimpose relative motion command		<pre> MC_MoveSuperImposed(   Axis:= ,   Execute:= ,   Abort:= ,   Distance:= ,   VelocityDiff:= ,   Acceleration:= ,   Deceleration:= ,   Jerk:= ,   Done=&gt; ,   Busy=&gt; ,   CommandAborted=&gt; ,   Error=&gt; ,   ErrorID=&gt; );         </pre>

(2) Related variables

VAR_IN_OUT	Name	Data type	Efficient range	Initial value	Description
Axis	Axis	AXIS_REF_SM3	-	-	Specified axis
VAR_INPUT	Name	Data type	Efficient range	Initial value	Description
Execute	Valid	BOOL	TRUE/FALSE	FALSE	Start at the rising edge
Abort	Abort	BOOL	TRUE/FALSE	FALSE	Aborts the motion in progress and resets all outputs
Distance	Position	LREAL	Data range	0	This is superimposition data
VelocityDiff	Stacking velocity	LREAL	0, positive value	0	Maximum speed of superimposed motion [u/s]
Acceleration	Target acceleration	LREAL	positive value	0	Acceleration speed [u/s <sup>2</sup> ]
Deceleration	Target deceleration	LREAL	positive value	0	Deceleration speed [u/s <sup>2</sup> ]
Jerk	Target jerk speed	LREAL	positive value	0	Jerk speed [u/s <sup>3</sup> ]
VAR_OUTPUT	Name	Data type	Efficient range	Initial value	Description
Done	Completed	BOOL	TRUE/FALSE	FALSE	TRUE after execution
Busy	In execution	BOOL	TRUE/FALSE	FALSE	TRUE when the function block execution has not ended
CommandAborted	Instruction interrupted	BOOL	TRUE/FALSE	FALSE	TRUE if the command has been terminated by another command
Error	Error	BOOL	TRUE/FALSE	FALSE	Function block execution error

VAR_IN_OUT	Name	Data type	Efficient range	Initial value	Description
ErrorID	Error code	SMC_ERROR	-	0	Error identification

### 5-1-2-11. Speed control [MC\_MoveVelocity]

#### (1) Instruction overview

The function block moves infinitely at a specified speed.

Instruction	Name	Graphic representation	ST representation
MC_MoveVelocity	Speed control		<pre> MC_MoveVelocity( Axis:= , Execute:= , Velocity:= , Acceleration:= , Deceleration:= , Jerk:= , Direction:= , BufferMode:= , InVelocity=&gt; , Busy=&gt; , Active=&gt; , CommandAborted=&gt; , Error=&gt; , ErrorID=&gt; ); </pre>

#### (2) Related variables

VAR_IN_OUT	Name	Data type	Efficient range	Initial value	Description
Axis	Axis	AXIS_REF_SM3	-	-	Specified axis
VAR_INPUT	Name	Data type	Efficient range	Initial value	Description
Execute	Valid	BOOL	TRUE/FALSE	FALSE	Start running at the rising edge
Velocity	Speed	LREAL	0, positive value	0	Speed [u/s]
Acceleration	Target acceleration	LREAL	0, positive value	0	Acceleration speed [u/s <sup>2</sup> ]
Deceleration	Target deceleration	LREAL	0, positive value	0	Deceleration speed [u/s <sup>2</sup> ]
Jerk	Target jerk speed	LREAL	0, positive value	0	Jerk speed [u/s <sup>3</sup> ]
Direction	Direction	MC_DIRECTION	3: fastest 2: current 1: Positive 0: shortest -1: Negative	0	Fastest: automatically select the fastest direction to move Current: move in current direction Positive: move forward Shortest: select the direction according to the shortest path

VAR_IN_OUT	Name	Data type	Efficient range	Initial value	Description
					Negative: move reverse
BufferMode	Buffer mode	MC_BUFFER_MODE	-	0	If the function block is Busy, then only allow BufferMode=Aborting
VAR_OUTPUT	Name	Data type	Efficient range	Initial value	Description
InVelocity	Reach setting speed flag	BOOL	TRUE/FALSE	FALSE	The setting speed reached is TRUE
Busy	In execution	BOOL	TRUE/FALSE	FALSE	TRUE when the function block execution has not ended
Active	In control	BOOL	TRUE/FALSE	FALSE	Becomes TRUE in control
Command Aborted	Instruction interrupted	BOOL	TRUE/FALSE	FALSE	TRUE if the command has been terminated by another command
Error	Error	BOOL	TRUE/FALSE	FALSE	Function block execution error
ErrorID	Error code	SMC_ERROR	-	0	Error identification

#### 5-1-2-12. Position profile [MC\_PositionProfile]

##### (1) Instruction overview

The user can plan the "time-position" data table by himself, and the controller will complete the movement according to the planned data.

Instruction	Name	Graphic representation	ST representation
MC_PositionProfile	Position profile		<pre> MC_PositionProfile(   Axis:= ,   TimePosition:= ,   Execute:= ,   ArraySize:= ,   PositionScale:= ,   Offset:= ,   Done=&gt; ,   Busy=&gt; ,   CommandAborted=&gt; ,   Error=&gt; ,   ErrorID=&gt; ); </pre>

##### (2) Related variables

VAR_IN_OUT	Name	Data type	Efficient range	Initial value	Description
Axis	Axis	AXIS_REF_SM3	-	-	Specified axis
TimePosition	Data table	MC_TP_REF	-	-	Time-position data table planned by the user
VAR_INPUT	Name	Data type	Efficient range	Initial value	Description
Execute	Valid	BOOL	TRUE/FALSE	FALSE	Start at the rising edge
ArraySize	Dynamic	INT	Positive value	0	Number of arrays used in the running

VAR_IN_OUT	Name	Data type	Efficient range	Initial value	Description
	array				profile
PositionScale	General factor	LREAL	Data range	1	Overall position scale factor
Offset	Offset	LREAL	Data range	0	Position offset
VAR_OUTPUT	Name	Data type	Efficient range	Initial value	Description
Done	Completed	BOOL	TRUE/FALSE	FALSE	TRUE after execution completed
Busy	In execution	BOOL	TRUE/FALSE	FALSE	TRUE when the function block execution has not ended
CommandAborted	Instruction interrupted	BOOL	TRUE/FALSE	FALSE	TRUE if the command has been terminated by another command
Error	Error	BOOL	TRUE/FALSE	FALSE	Function block execution error
ErrorID	Error code	SMC_ERROR	-	0	Error identification

5-1-2-13. Speed profile [MC\_VelocityProfile]

(1) Instruction overview

Like MC\_PositionProfile, MC\_VelocityProfile plans the motion through defining the “time-speed” data.

Instruction	Name	Graphic representation	ST representation
MC_VelocityProfile	Speed profile		<pre> MC_VelocityProfile(   Axis:= ,   TimeVelocity:= ,   Execute:= ,   ArraySize:= ,   VelocityScale:= ,   Offset:= ,   Done=&gt; ,   Busy=&gt; ,   CommandAborted=&gt; ,   Error=&gt; ,   ErrorID=&gt; ); </pre>

(2) Related variables

VAR_IN_OUT	Name	Data type	Efficient range	Initial value	Description
Axis	Axis	AXIS_REF_SM3	-	-	Specified axis
TimePosition	Data table	MC_TP_REF	-	-	Time-speed data table planned by the user
VAR_INPUT	Name	Data type	Efficient range	Initial value	Description
Execute	Valid	BOOL	TRUE/FALSE	FALSE	Start at the rising edge
ArraySize	Dynamic array	INT	Positive value	0	Number of arrays used in the running profile
VelocityScale	General factor	LREAL	Data range	1	Overall speed scale factor
Offset	Offset	LREAL	Data range	0	Speed offset
VAR_OUTPUT	Name	Data type	Efficient range	Initial value	Description
Done	Completed	BOOL	TRUE/FALSE	FALSE	TRUE after execution completed
Busy	In execution	BOOL	TRUE/FALSE	FALSE	TRUE when the function block execution has not ended
CommandAborted	Instruction interrupted	BOOL	TRUE/FALSE	FALSE	TRUE if the command has been terminated by another command
Error	Error	BOOL	TRUE/FALSE	FALSE	Function block execution error
ErrorID	Error code	SMC_ERROR	-	0	Error identification



5-1-2-14. Acceleration speed profile [MC\_AccelerationProfile]

(1) Instruction overview

Like MC\_PositionProfile, MC\_AccelerationProfile plans the motion through defining “time-acceleration” data.

Instruction	Name	Graphic representation	ST representation
MC_AccelerationProfile	Acceleration profile		<pre>MC_AccelerationProfile( Axis:= , TimeAcceleration:= , Execute:= , ArraySize:= , AccelerationScale:= , Offset:= , Done=&gt; , Error=&gt; , ErrorID=&gt; );</pre>

(2) Related variables

VAR_IN_OUT	Name	Data type	Efficient range	Initial value	Description
Axis	Axis	AXIS_REF_SM3	-	-	Specified axis
TimePosition	Data table	MC_TP_REF	-	-	Time-acceleration data table planned by the user
VAR_INPUT	Name	Data type	Efficient range	Initial value	Description
Execute	Valid	BOOL	TRUE/FALSE	FALSE	Start at the rising edge
ArraySize	Dynamic array	INT	Positive value	0	Number of arrays used in the running profile
AccelerationScale	General factor	LREAL	Data range	1	Acceleration or deceleration scale factor
Offset	Offset	LREAL	Data range	0	Acceleration offset
VAR_OUTPUT	Name	Data type	Efficient range	Initial value	Description
Done	Completed	BOOL	TRUE/FALSE	FALSE	TRUE after execution completed
Busy	In execution	BOOL	TRUE/FALSE	FALSE	TRUE when the function block execution has not ended
CommandAborted	Instruction interrupted	BOOL	TRUE/FALSE	FALSE	TRUE if the command has been terminated by another command
Error	Error	BOOL	TRUE/FALSE	FALSE	Function block execution error
ErrorID	Error code	SMC_ERROR	-	0	Error identification

5-1-2-15. Actual position read [MC\_ReadActualPosition]

(1) Instruction overview

Read the axis current actual position.

Instruction	Name	Graphic representation	ST representation
MC_ReadActualPosition	Read actual position		<pre>MC_ReadActualPosition(   Axis:= ,   Enable:= ,   Valid=&gt; ,   Busy=&gt; ,   Error=&gt; ,   ErrorID=&gt; ,   Position=&gt; );</pre>

(2) Related variables

VAR_IN_OUT	Name	Data type	Efficient range	Initial value	Description
Axis	Axis	AXIS_REF_SM3	-	-	Specified axis
VAR_INPUT	Name	Data type	Efficient range	Initial value	Description
Enable	Valid	BOOL	TRUE/FALSE	FALSE	When TRUE, read the servo current position
VAR_OUTPUT	Name	Data type	Efficient range	Initial value	Description
Valid	Obtain the flag	BOOL	TRUE/FALSE	FALSE	If the output is valid, then is TRUE
Busy	In execution	BOOL	TRUE/FALSE	FALSE	TRUE when the function block execution has not ended
Error	Error	BOOL	TRUE/FALSE	FALSE	Function block execution error
ErrorID	Error code	SMC_ERROR	-	0	Error identification
Position	Obtained axis position	LREAL	Data range	0	Axis position data read by command

5-1-2-16. Read the current torque [MC\_ReadActualTorque]

(1) Instruction overview

Read the axis actual torque.

Instruction	Name	Graphic representation	ST representation
MC_ReadActualTorque	Read the current actual torque		<pre>MC_ReadActualTorque( Axis:= , Enable:= , Valid=&gt; , Busy=&gt; , Error=&gt; , ErrorID=&gt; , Torque=&gt; );</pre>

(2) Related variables

VAR_IN_OUT	Name	Data type	Efficient range	Initial value	Description
Axis	Axis	AXIS_REF_SM3	-	-	Specified axis
VAR_INPUT	Name	Data type	Efficient range	Initial value	Description
Enable	Valid	BOOL	TRUE/FALSE	FALSE	Must set to TRUE to activate the processing of the function block
VAR_OUTPUT	Name	Data type	Efficient range	Initial value	Description
Valid	Obtain the flag	BOOL	TRUE/FALSE	FALSE	If the output is valid, then is TRUE
Busy	In execution	BOOL	TRUE/FALSE	FALSE	TRUE when the function block execution has not ended
Error	Error	BOOL	TRUE/FALSE	FALSE	Function block execution error
ErrorID	Error code	SMC_ERROR	-	0	Error identification
Torque	Obtained current torque	LREAL	Data range	0	Current torque data read by command

5-1-2-17. Read the current speed [MC\_ReadActualVelocity]

(1) Instruction overview

Read the axis actual speed.

Instruction	Name	Graphic representation	ST representation
MC_ReadActualVelocity	Read the current speed		<pre>MC_ReadActualVelocity( Axis:= , Enable:= , Valid=&gt; , Busy=&gt; , Error=&gt; , ErrorID=&gt; , Velocity=&gt; );</pre>

(2) Related variables

VAR_IN_OUT	Name	Data type	Efficient range	Initial value	Description
Axis	Axis	AXIS_REF_SM3	-	-	Specified axis
VAR_INPUT	Name	Data type	Efficient range	Initial value	Description
Enable	Valid	BOOL	TRUE/FALSE	FALSE	Must set to TRUE to activate the processing of the function block
VAR_OUTPUT	Name	Data type	Efficient range	Initial value	Description
Valid	Obtain the flag	BOOL	TRUE/FALSE	FALSE	If the output is valid, then is TRUE
Busy	In execution	BOOL	TRUE/FALSE	FALSE	TRUE when the function block execution has not ended
Error	Error	BOOL	TRUE/FALSE	FALSE	Function block execution error
ErrorID	Error code	SMC_ERROR	-	0	Error identification
Velocity	Obtained current speed	LREAL	Data range	0	Current speed data read by the command

5-1-2-18. Read axis error status [MC\_ReadAxisError]

(1) Instruction overview

Read the axis error.

Instruction	Name	Graphic representation	ST representation
MC_ReadActualVelocity	Read the axis error status		<pre>MC_ReadAxisError(   Axis:= ,   Enable:= ,   Valid=&gt; ,   Busy=&gt; ,   Error=&gt; ,   ErrorID=&gt; ,   AxisError=&gt; ,   AxisErrorID=&gt; ,   SWEndSwitchActive=&gt; );</pre>

(2) Related variables

VAR_IN_OUT	Name	Data type	Efficient range	Initial value	Description
Axis	Axis	AXIS_REF_SM3	-	-	Specified axis
VAR_INPUT	Name	Data type	Efficient range	Initial value	Description
Enable	Valid	BOOL	TRUE /FALSE	FALSE	Must set to TRUE to activate the processing of the function block
VAR_OUTPUT	Name	Data type	Efficient range	Initial value	Description
Valid	Obtain the flag	BOOL	TRUE/FALSE	FALSE	If the output is valid, then is TRUE
Busy	In execution	BOOL	TRUE/FALSE	FALSE	TRUE when the function block execution has not ended
Error	Error	BOOL	TRUE/FALSE	FALSE	Function block execution error
ErrorID	Error code	SMC_ERROR	-	0	Error identification
AxisError	Axis error flag	BOOL	TRUE/FALSE	FALSE	Axis error flag
AxisErrorID	Axis error code	DWORD	Positive value, 0	0	Read axis error code
SWEndSwitchActive	Soft limit	BOOL	TRUE/FALSE	FALSE	TRUE if the soft limit is exceeded

5-1-2-19. Read axis bit parameter [MC\_ReadBoolParameter]

(1) Instruction overview

Read the value of the specified BOOL variable.

Instruction	Name	Graphic representation	ST representation
MC_ReadBoolParameter	Read axis bit parameter		<pre> MC_ReadBoolParameter(   Axis:= ,   Enable:= ,   ParameterNumber:= ,   Valid=&gt; ,   Busy=&gt; ,   Error=&gt; ,   ErrorID=&gt; ,   Value=&gt; ); </pre>

(2) Related variables

VAR_IN_OUT	Name	Data type	Efficient range	Initial value	Description
Axis	Axis	AXIS_REF_SM3	-	-	Specified axis
VAR_INPUT	Name	Data type	Efficient range	Initial value	Description
Enable	Valid	BOOL	TRUE/FALSE	FALSE	Must set to TRUE to activate the processing of the function block
ParameterNumber	Axis parameter number	DINT	Positive value, 0	0	Parameter number
VAR_OUTPUT	Name	Data type	Efficient range	Initial value	Description
Valid	Obtain the flag	BOOL	TRUE/FALSE	FALSE	If the output is valid, then is TRUE
Busy	In execution	BOOL	TRUE/FALSE	FALSE	TRUE when the function block execution has not ended
Error	Error	BOOL	TRUE/FALSE	FALSE	Function block execution error
ErrorID	Error code	SMC_ERROR	-	0	Error identification
Value	Parameter value	BOOL	TRUE/FALSE	FALSE	Read the parameter value

5-1-2-20. Read the axis parameter [MC\_ReadParameter]

(1) Instruction overview

Read the specified parameter.

Instruction	Name	Graphic representation	ST representation
MC_ReadParameter	Read the axis parameter		<pre> MC_ReadParameter(   Axis:= ,   Enable:= ,   ParameterNumber:= ,   Valid=&gt; ,   Busy=&gt; ,   Error=&gt; ,   ErrorID=&gt; ,   Value=&gt; ); </pre>

(2) Related variables

VAR_IN_OUT	Name	Data type	Efficient range	Initial value	Description
Axis	Axis	AXIS_REF_SM3	-	-	Specified axis
VAR_INPUT	Name	Data type	Efficient range	Initial value	Description
Enable	Valid	BOOL	TRUE/FALSE	FALSE	Must set to TRUE to activate the processing of the function block
ParameterNumber	Axis parameter number	DINT	Positive value, 0	0	Parameter number
VAR_OUTPUT	Name	Data type	Efficient range	Initial value	Description
Valid	Obtain the flag	BOOL	TRUE/FALSE	FALSE	If the output is valid, then is TRUE
Busy	In execution	BOOL	TRUE/FALSE	FALSE	TRUE when the function block execution has not ended
Error	Error	BOOL	TRUE/FALSE	FALSE	Function block execution error
ErrorID	Error code	SMC_ERROR	-	0	Error identification
Value	Parameter value	LREAL	Data range	0	Read the parameter value

5-1-2-21. Read axis command position [SMC\_ReadSetPosition]

(1) Instruction overview

Read the driver current setting position.

Instruction	Name	Graphic representation	ST representation
SMC_ReadSetPosition	Read axis command position		<pre>SMC_ReadSetPosition(   Axis:= ,   Enable:= ,   Valid=&gt; ,   Busy=&gt; ,   Error=&gt; ,   ErrorID=&gt; ,   Position=&gt; );</pre>

(2) Related variables

VAR_IN_OUT	Name	Data type	Efficient range	Initial value	Description
Axis	Axis	AXIS_REF_SM3	-	-	Specified axis
VAR_INPUT	Name	Data type	Efficient range	Initial value	Description
Enable	Valid	BOOL	TRUE/FALSE	FALSE	Must set to TRUE to activate the processing of the function block
VAR_OUTPUT	Name	Data type	Efficient range	Initial value	Description
Valid	Obtain the flag	BOOL	TRUE/FALSE	FALSE	If the output is valid, then is TRUE
Busy	In execution	BOOL	TRUE/FALSE	FALSE	TRUE when the function block execution has not ended
Error	Error	BOOL	TRUE/FALSE	FALSE	Function block execution error
ErrorID	Error code	SMC_ERROR	-	0	Error identification
Position	Position	LREAL	Data range	0	Setting position



5-1-2-22. Read function block error [SMC\_ReadFBError]

(1) Instruction overview

Read the axis function block error information.

Instruction	Name	Graphic representation	ST representation
SMC_ReadFBError	Read function block error		<pre>SMC_ReadFBError(   Axis:= ,   bEnable:= ,   bValid=&gt; ,   bBusy=&gt; ,   bFBError=&gt; ,   nFBErrorID=&gt; ,   pbyErrorInstance=&gt; ,   strErrorInstance=&gt; ,   tTimeStamp=&gt; );</pre>

(2) Related variables

VAR_IN_OUT	Name	Data type	Efficient range	Initial value	Description
Axis	Axis	AXIS_REF_SM3	-	-	Specified axis
VAR_INPUT	Name	Data type	Efficient range	Initial value	Description
bEnable	Valid	BOOL	TRUE/FALSE	FALSE	Must set to TRUE to activate the processing of the function block
VAR_OUTPUT	Name	Data type	Efficient range	Initial value	Description
bValid	Obtain the flag	BOOL	TRUE/FALSE	FALSE	If the output is valid, then is TRUE
bBusy	In execution	BOOL	TRUE/FALSE	FALSE	TRUE when the function block execution has not ended
bFBError	Error	BOOL	TRUE/FALSE	FALSE	Function block execution error
nFBErrorID	Error code	SMC_ERROR	-	0	Error identification
pbyErrorInstance	Error pointer	POINTER TO BYTE	-	-	Pointer to the function block with error
strErrorInstance	Error pointer	STRING	-	-	-
tTimeStamp	Time stamp	TIME	-	0	Time stamp when the error occurred

5-1-2-23. Set the axis bit parameter [MC\_WriteBoolParameter]

(1) Instruction overview

Write in BOOL parameter value.

Instruction	Name	Graphic representation	ST representation
MC_WriteBoolParameter	Set the axis bit parameter		<pre> MC_WriteBoolParameter( Axis:= , Execute:= , ParameterNumber:= , Value:= , Done=&gt; , Busy=&gt; , Error=&gt; , ErrorID=&gt; ); </pre>

(2) Related variables

VAR_IN_OUT	Name	Data type	Efficient range	Initial value	Description
Axis	Axis	AXIS_REF_SM3	-	-	Specified axis
VAR_INPUT	Name	Data type	Efficient range	Initial value	Description
Execute	Valid	BOOL	TRUE/FALSE	FALSE	The rising edge of the input value will start the execution of the function block
ParameterNumber	Parameter number	DINT	Positive value, 0	0	Parameter ID
Value	Parameter value	BOOL	TRUE/FALSE	FALSE	-
VAR_OUTPUT	Name	Data type	Efficient range	Initial value	Description
Done	Completed	BOOL	TRUE/FALSE	FALSE	TRUE if the parameter value has been successfully written
Busy	In execution	BOOL	TRUE/FALSE	FALSE	TRUE when the function block execution has not ended
Error	Error	BOOL	TRUE/FALSE	FALSE	Function block execution error
ErrorID	Error code	SMC_ERROR	-	0	Error identification

5-1-2-24. Set axis parameter [MC\_WriteParameter]

(1) Instruction overview

Write in specified parameter value.

Instruction	Name	Graphic representation	ST representation
MC_WriteParameter	Set the axis parameter		<pre>MC_WriteParameter(   Axis:= ,   Execute:= ,   ParameterNumber:= ,   Value:= ,   Done=&gt; ,   Busy=&gt; ,   Error=&gt; ,   ErrorID=&gt; );</pre>

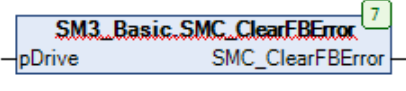
(2) Related variables

VAR_IN_OUT	Name	Data type	Efficient range	Initial value	Description
Axis	Axis	AXIS_REF_SM3	-	-	Specified axis
VAR_INPUT	Name	Data type	Efficient range	Initial value	Description
Execute	Valid	BOOL	TRUE/FALSE	FALSE	The rising edge of the input value will start the execution of the function block
ParameterNumber	Parameter number	DINT	Positive value, 0	0	Parameter ID
Value	Parameter value	LREAL	Data range	-	Write the value to be set
VAR_OUTPUT	Name	Data type	Efficient range	Initial value	Description
Done	Completed	BOOL	TRUE/FALSE	FALSE	TRUE if the parameter value has been successfully written
Busy	In execution	BOOL	TRUE/FALSE	FALSE	TRUE when the function block execution has not ended
Error	Error	BOOL	TRUE/FALSE	FALSE	Function block execution error
ErrorID	Error code	SMC_ERROR	-	0	Error identification

5-1-2-25. Clear the error [SMC\_ClearFBError]

(1) Instruction overview

Clear the historical error message of the function block.

Instruction	Name	Graphic representation	ST representation
SMC_ClearFBError	Clear the error		<pre>SMC_ClearFBError(pDrive:= )</pre>

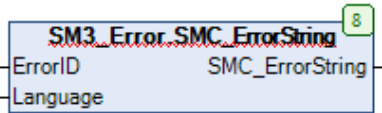
(2) Related variables

VAR_INPUT	Name	Data type	Efficient range	Initial value	Description
pDrive	Axis pointer	POINTR TO AXIS_REF_SM3	-	-	Map to axis
VAR_OUTPUT	Name	Data type	Efficient range	Initial value	Description
SMC_ClearFBError	Valid	BOOL	TRUE/FALSE	FALSE	TRUE if the error is cleared

5-1-2-26. Read error information [SMC\_ErrorString]

(1) Instruction overview

Read the error description information corresponding to the error code.

Instruction	Name	Graphic representation	ST representation
SM3_Error.SMC_ErrorString	Read the error information		<pre>SMC_ErrorString( ErrorID:= , Language:= )</pre>

(2) Related variables

VAR_INPUT	Name	Data type	Efficient range	Initial value	Description
ErrorID	Error code	SMC_ERROR	-	-	Error identification
Language	Language	-	-	-	Required language
VAR_OUTPUT	Name	Data type	Efficient range	Initial value	Description
SMC_ErrorString	Error	STRING (100)	-	-	Error description information

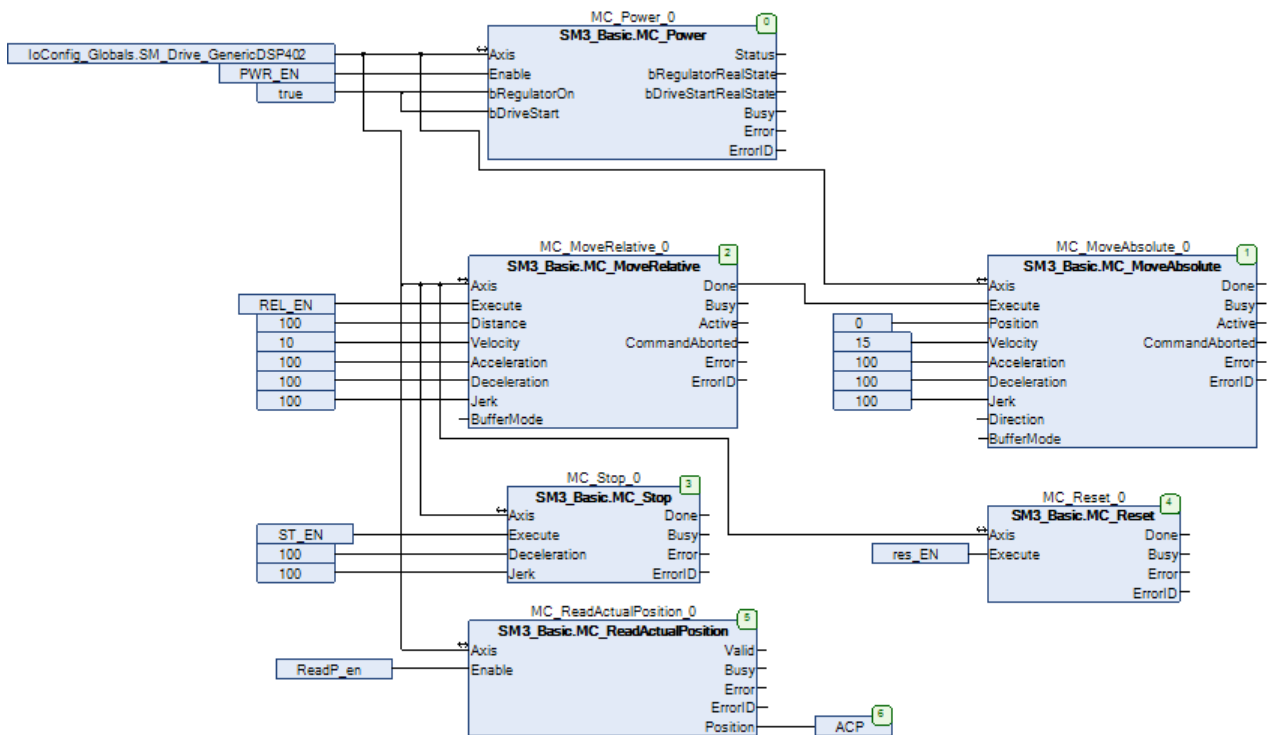
### 5-1-3. Single axis function application

Example 1: realize that axis 0 moves in two sections to reach the designated position 0 Pluse, the first section runs at a speed of 10 pluse/s and an acceleration of 100 pluse/s<sup>2</sup> for relative motion, and then runs 100 pluse relative to the starting position. After reaching the relative position of the target, it runs absolute motion at a speed of 15 pluse/s and an acceleration of 100 pluse/s<sup>2</sup> for absolute motion, and moves to the target position as 0 pluse. During the movement, the real-time position can be read, and the movement can be stopped. If an error is reported, the axis can also be reset.

```

PROGRAM POU
VAR
    //define the function block
    MC_Power_0: SM3_Basic.MC_Power;
    MC_MoveRelative_0: SM3_Basic.MC_MoveRelative;
    MC_MoveAbsolute_0: SM3_Basic.MC_MoveAbsolute;
    MC_Stop_0: SM3_Basic.MC_Stop;
    MC_Reset_0: SM3_Basic.MC_Reset;
    MC_ReadActualPosition_0: SM3_Basic.MC_ReadActualPosition;
    PWR_EN: BOOL;// Enable
    ST_EN: BOOL;// Stop
    res_EN: BOOL;// Reset
    ReadP_en: BOOL;// Real time position read
    ACP: LREAL;// Read position
END_VAR

```



## 5-2. Axis group function

### 5-2-1. Axis group instruction list

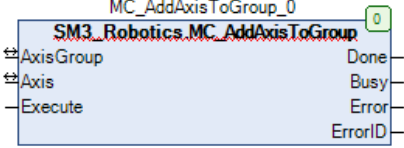
Instruction	Function
MC_AddAxisToGroup	Add the axis to the axis group
MC_RemoveAxisFromGroup	Remove one axis in the axis group
MC_UngroupAllAxes	Delete all the axes in the axis group
MC_GroupEnable	Enable the axis group
MC_GroupDisable	Disable the axis group
MC_GroupReset	Reset the axis group
MC_GroupSetPosition	Set the axis group position
MC_SetCoordinateTransform	Transform the coordinate
MC_SetDynCoordTransform	Connect two axis groups
MC_GroupContinue	Axis group continue
MC_GroupHalt	Axis group stop
MC_GroupInterrupt	Axis group interrupt
MC_GroupStop	Axis group stop
MC_GroupSetOverride	Change speed, acceleration, or active and controlled actions
MC_SetKinTransform	Motion coordinate system conversion
MC_MoveCircularAbsolute	Circular move to absolute position
MC_MoveCircularRelative	Circular move to relative position
MC_MoveDirectAbsolute	Move to absolute position
MC_MoveDirectRelative	Move to relative position
MC_MoveLinearAbsolute	Linear move to absolute position
MC_MoveLinearRelative	Linear move to relative position
MC_GroupReadActualPosition	Read actual position
MC_GroupReadActualVelocity	Read actual speed
MC_GroupReadConfiguration	Read parameter
MC_GroupReadError	Read error
MC_GroupReadStatus	Read status
SMC_StartupAxisGroup	Startup the axis group
SMC_GroupPower	Power the axis group
SMC_GroupInterruptAt	Break assignment
SMC_GroupEnableResumeAfterError	Restore movement after axis error
SMC_GroupJog	Axis group jog operation
SMC_GroupWait	Axis group wait

## 5-2-2. Axis group instruction introduction

### 5-2-2-1. Add axis to axis group [MC\_AddAxisToGroup]

#### (1) Instruction overview

Add the axis to the axis group in command mode.

Instruction	Name	Graphic representation	ST representation
MC_AddAxisToGroup	Add axis to axis group		<pre>MC AddAxisToGroup(   AxisGroup:= ,   Axis:= ,   Execute:= ,   Done=&gt; ,   Busy=&gt; ,   Error=&gt; ,   ErrorID=&gt; );</pre>

#### (2) Related variables

VAR_IN_OUT	Name	Data type	Efficient range	Initial value	Description
AxisGroup	Axis group	AXIS_GROUP_REF_SM3	-	-	Specified axis group
Axis	Axis	AXIS_REF_SM3	-	-	Specified axis
VAR_INPUT	Name	Data type	Efficient range	Initial value	Description
Execute	Valid	BOOL	TRUE/FALSE	FALSE	The rising edge of the input value will start the execution of the function block
VAR_OUTPUT	Name	Data type	Efficient range	Initial value	Description
Done	Completed	BOOL	TRUE/FALSE	FALSE	TRUE when instruction execution is complete
Busy	In execution	BOOL	TRUE/FALSE	FALSE	TRUE when the function block execution has not ended
Error	Error	BOOL	TRUE/FALSE	FALSE	Function block execution error
ErrorID	Error code	SMC_ERROR	-	0	Error identification

5-2-2-2. Remove axis from the axis group [MC\_RemoveAxisFromGroup]

(1) Instruction overview

Remove axis from the axis group.

Instruction	Name	Graphic representation	ST representation
MC_RemoveAxisFromGroup	Remove axis from the axis group		<pre>MC_RemoveAxisFromGroup( AxisGroup:= , Axis:= , Execute:= , Done=&gt; , Busy=&gt; , Error=&gt; , ErrorID=&gt; );</pre>

(2) Related variables

VAR_IN_OUT	Name	Data type	Efficient range	Initial value	Description
AxisGroup	Axis group	AXIS_GROUP_REF_SM3	-	-	Specified axis group
Axis	Axis	AXIS_REF_SM3	-	-	Specified axis
VAR_INPUT	Name	Data type	Efficient range	Initial value	Description
Execute	Valid	BOOL	TRUE/FALSE	FALSE	The rising edge of the input value will start the execution of the function block
VAR_OUTPUT	Name	Data type	Efficient range	Initial value	Description
Done	Completed	BOOL	TRUE/FALSE	FALSE	TRUE when instruction execution is complete
Busy	In execution	BOOL	TRUE/FALSE	FALSE	TRUE when the function block execution has not ended
Error	Error	BOOL	TRUE/FALSE	FALSE	Function block execution error
ErrorID	Error code	SMC_ERROR	-	0	Error identification



### 5-2-2-3. Release axis group [MC\_UngroupAllAxes]

#### (1) Instruction overview

Remove all the axes contained in an axis group and release the axis group.

Instruction	Name	Graphic representation	ST representation
MC_UngroupAllAxes	Release the axis group		<pre>MC_UngroupAllAxes( AxisGroup:= , Execute:= , Done=&gt; , Busy=&gt; , Error=&gt; , ErrorID=&gt; );</pre>

#### (2) Related variables

VAR_IN_OUT	Name	Data type	Efficient range	Initial value	Description
AxisGroup	Axis group	AXIS_GROUP_REF_SM3	-	-	Specified axis group
VAR_INPUT	Name	Data type	Efficient range	Initial value	Description
Execute	Valid	BOOL	TRUE/FALSE	FALSE	The rising edge of the input value will start the execution of the function block
VAR_OUTPUT	Name	Data type	Efficient range	Initial value	Description
Done	Completed	BOOL	TRUE/FALSE	FALSE	TRUE when instruction execution is complete
Busy	In execution	BOOL	TRUE/FALSE	FALSE	TRUE when the function block execution has not ended
Error	Error	BOOL	TRUE/FALSE	FALSE	Function block execution error
ErrorID	Error code	SMC_ERROR	-	0	Error identification

#### 5-2-2-4. Enable the axis group [MC\_GroupEnable]

##### (1) Instruction overview

Enable the axis group.

Instruction	Name	Graphic representation	ST representation
MC_GroupEnable	Enable the axis group		<pre>MC_GroupEnable( AxisGroup:= , Execute:= , CompatibilityOptions:= , Done=&gt; , Busy=&gt; , Error=&gt; , ErrorID=&gt; );</pre>

##### (2) Related variables

VAR_IN_OUT	Name	Data type	Efficient range	Initial value	Description
AxisGroup	Aix group	AXIS_GROUP_REF_SM3	-	-	Specified axis group
VAR_INPUT	Name	Data type	Efficient range	Initial value	Description
Execute	Valid	BOOL	TRUE/FALSE	FALSE	The rising edge of the input value will start the execution of the function block
CompatibilityOptions	Compatibility options	SMC_AXIS_GROUP_COMPATIBILITY_OPTIONS	-	-	Parameters that exist for compatibility with previous versions
VAR_OUTPUT	Name	Data type	Efficient range	Initial value	Description
Done	Completed	BOOL	TRUE/FALSE	FALSE	TRUE when instruction execution is complete
Busy	In execution	BOOL	TRUE/FALSE	FALSE	TRUE when the function block execution has not ended
Error	Error	BOOL	TRUE/FALSE	FALSE	Function block execution error
ErrorID	Error code	SMC_ERROR	-	0	Error identification

### 5-2-2-5. Disable the axis group [MC\_GroupDisable]

#### (1) Instruction overview

The axis group is switched to the disable state, and the motion control of the axis group is not allowed in this state.

Instruction	Name	Graphic representation	ST representation
MC_GroupEnable	Disable the axis group		<pre>MC_GroupDisable( AxisGroup:= , Execute:= , Done=&gt; , Busy=&gt; , Error=&gt; , ErrorID=&gt; );</pre>

#### (2) Related variables

VAR_IN_OUT	Name	Data type	Efficient range	Initial value	Description
AxisGroup	Axis group	AXIS_GROUP_RE F_SM3	-	-	Specified axis group
VAR_INPUT	Name	Data type	Efficient range	Initial value	Description
Execute	Valid	BOOL	TRUE/FALSE	FALSE	The rising edge of the input value will start the execution of the function block
VAR_OUTPUT	Name	Data type	Efficient range	Initial value	Description
Done	Completed	BOOL	TRUE/FALSE	FALSE	TRUE when instruction execution is complete
Busy	In execution	BOOL	TRUE/FALSE	FALSE	TRUE when the function block execution has not ended
Error	Error	BOOL	TRUE/FALSE	FALSE	Function block execution error
ErrorID	Error code	SMC_ERROR	-	0	Error identification

5-2-2-6. Reset the axis group [MC\_GroupReset]

(1) Instruction overview

Remove the abnormal state of the axis group and the axis.

Instruction	Name	Graphic representation	ST representation
MC_GroupReset	Reset the axis group		<pre>MC_GroupReset( AxisGroup:= , Execute:= , Done=&gt; , Busy=&gt; , Error=&gt; , ErrorID=&gt; );</pre>

(2) Related variables

VAR_IN_OUT	Name	Data type	Efficient range	Initial value	Description
AxisGroup	Axis group	AXIS_GROUP_REF_SM3	-	-	Specified axis group
VAR_INPUT	Name	Data type	Efficient range	Initial value	Description
Execute	Valid	BOOL	TRUE/FALSE	FALSE	The rising edge of the input value will start the execution of the function block
VAR_OUTPUT	Name	Data type	Efficient range	Initial value	Description
Done	Completed	BOOL	TRUE/FALSE	FALSE	TRUE when instruction execution is complete
Busy	In execution	BOOL	TRUE/FALSE	FALSE	TRUE when the function block execution has not ended
Error	Error	BOOL	TRUE/FALSE	FALSE	Function block execution error
ErrorID	Error code	SMC_ERROR	-	0	Error identification

5-2-2-7. Set axis group instruction position [MC\_GroupSetPosition]

(1) Instruction overview

Set the command position of each axis in the axis group.

Instruction	Name	Graphic representation	ST representation
MC_GroupSetPosition	Set axis group instruction position		<pre>MC_GroupSetPosition(   AxisGroup:= ,   Execute:= ,   Position:= ,   Relative:= ,   CoordSystem:= ,   Done=&gt; ,   Busy=&gt; ,   Error=&gt; ,   ErrorID=&gt; );</pre>

(2) Related variables

VAR_IN_OUT	Name	Data type	Efficient range	Initial value	Description
AxisGroup	Axis group	AXIS_GROUP_REF_SM3	-	-	Specified axis group
VAR_INPUT	Name	Data type	Efficient range	Initial value	Description
Execute	Valid	BOOL	TRUE/FALSE	FALSE	The rising edge of the input value will start the execution of the function block
Position	Position	SMC_POS_REF	Data range	0	Axis target position
Relative	Position mode	BOOL	TRUE/FALSE	FALSE	Relative position mode =True, absolute position mode =False(default)
CoordSystem	Apply coordinate system	SMC_COORD_SYSTEM	-	-	Apply coordinate system
VAR_OUTPUT	Name	Data type	Efficient range	Initial value	Description
Done	Completed	BOOL	TRUE/FALSE	FALSE	TRUE when instruction execution is complete
Busy	In execution	BOOL	TRUE/FALSE	FALSE	TRUE when the function block execution has not ended
Error	Error	BOOL	TRUE/FALSE	FALSE	Function block execution error
ErrorID	Error code	SMC_ERROR	-	0	Error identification

5-2-2-8. Coordinate system conversion [MC\_SetCoordinateTransform]

(1) Instruction overview

It is used to convert the command coordinates of different reference coordinate systems.

Instruction	Name	Graphic representation	ST representation
MC_SetCoordinateTransform	Coordinate system conversion		<pre>MC_SetCoordinateTransform(   AxisGroup:= ,   Execute:= ,   CoordTransform:= ,   CoordSystem:= ,   Done=&gt; ,   Busy=&gt; ,   Error=&gt; ,   ErrorID=&gt; );</pre>

(2) Related variables

VAR_IN_OUT	Name	Data type	Efficient range	Initial value	Description
AxisGroup	Axis group	AXIS_GROUP_REF_SM3	-	-	Specified axis group
VAR_INPUT	Name	Data type	Efficient range	Initial value	Description
Execute	Valid	BOOL	TRUE/FALSE	FALSE	The rising edge of the input value will start the execution of the function block
CoordTransform	Transform coordinate system	MC_COORD_REF	-	-	Coordinate transformation, i.e. product coordinate system (PCS_1 or PCS_2) or machine coordinate system (MCS) expressed in world coordinate system (WCS)
CoordSystem	Apply coordinate system	SMC_COORD_SYSTEM	-	-	Target coordinate system, allowing conversion of PCS_1, PCS_2, and MCS
VAR_OUTPUT	Name	Data type	Efficient range	Initial value	Description
Done	Completed	BOOL	TRUE/FALSE	FALSE	TRUE when instruction execution is complete
Busy	In execution	BOOL	TRUE/FALSE	FALSE	TRUE when the function block execution has not ended
Error	Error	BOOL	TRUE/FALSE	FALSE	Function block execution error
ErrorID	Error code	SMC_ERROR	-	0	Error identification

5-2-2-9. Dynamic coordinate system conversion [MC\_SetDynCoordTransform]

(1) Instruction overview

When the specified coordinate system moves relative to WCS, call this instruction to realize coordinate system conversion.

Instruction	Name	Graphic representation	ST representation
MC_SetDynCoordTransform	Dynamic coordinate system conversion		<pre>MC_SetDynCoordTransform(   AxisGroup:= ,   MasterAxisGroup:= ,   Execute:= ,   CoordTransform:= ,   CoordSystem:= ,   Done=&gt; ,   Busy=&gt; ,   InUse=&gt; ,   Error=&gt; ,   ErrorID=&gt; );</pre>

(2) Related variables

VAR_IN_OUT	Name	Data type	Efficient range	Initial value	Description
AxisGroup	Axis group	AXIS_GROUP_REF_SM3	-	-	Specified axis group
MasterAxisGroup	Master axis group	AXIS_GROUP_REF_SM3	-	-	Specified master axis group
VAR_INPUT	Name	Data type	Efficient range	Initial value	Description
Execute	Valid	BOOL	TRUE/FALSE	FALSE	The rising edge of the input value will start the execution of the function block
CoordTransform	Coordinate system to be converted	MC_COORD_REF	-	-	Tool coordinate system of master axis group relative to the PCS coordinate and direction
CoordSystem	Coordinate system	SMC_COORD_SYSTEM	-	-	PCS coordinate system to be converted (PCS_1 or PCS_2)
VAR_OUTPUT	Name	Data type	Efficient range	Initial value	Description
Done	Completed	BOOL	TRUE/FALSE	FALSE	TRUE when instruction execution is complete
Busy	In execution	BOOL	TRUE/FALSE	FALSE	TRUE when the function block execution has not ended
InUse	Reference system	BOOL	-	-	Indicates the dynamic coordinate system that the axis group still needs to reference
Error	Error	BOOL	TRUE/FALSE	FALSE	Function block execution error
ErrorID	Error code	SMC_ERROR	-	0	Error identification

5-2-2-10. Axis group continue to run [MC\_GroupContinue]

(1) Instruction overview

Release the interrupt status of the axis group and continue to execute the uncompleted command.

Instruction	Name	Graphic representation	ST representation
MC_GroupContinue	Axis group continue to run		<pre>MC_GroupContinue (   AxisGroup:= ,   continueData:= ,   Execute:= ,   Done=&gt; ,   CommandAborted=&gt; ,   Busy=&gt; ,   Error=&gt; ,   ErrorID=&gt; );</pre>

(2) Related variables

VAR_IN_OUT	Name	Data type	Efficient range	Initial value	Description
AxisGroup	Axis group	AXIS_GROUP_REF_SM3	-	-	Specified axis group
continueData	Continue motion data	SMC_AXIS_GROUP_CONTINUE_DATA	-	-	Axis group position when motion is interrupted
VAR_INPUT	Name	Data type	Efficient range	Initial value	Description
Execute	Valid	BOOL	TRUE/FALSE	FALSE	Execute the current command
VAR_OUTPUT	Name	Data type	Efficient range	Initial value	Description
Done	Completed	BOOL	TRUE/FALSE	FALSE	TRUE when instruction execution is complete
CommandAborted	Instruction interrupted	BOOL	TRUE/FALSE	FALSE	Module execution interrupted is TRUE
Busy	In execution	BOOL	TRUE/FALSE	FALSE	TRUE when the function block execution has not ended
Error	Error	BOOL	TRUE/FALSE	FALSE	Function block execution error
ErrorID	Error code	SMC_ERROR	-	0	Error identification



5-2-2-11. Axis group pause [MC\_GroupHalt]

(1) Instruction overview

Pause the current axis group motion.

Instruction	Name	Graphic representation	ST representation
MC_GroupHalt	Axis group pause		<pre> MC_GroupHalt( AxisGroup:= , Execute:= , Deceleration:= , Jerk:= , AccFactor:= , JerkFactor:= , Done=&gt; , Busy=&gt; , Active=&gt; , CommandAborted=&gt; , CommandAccepted=&gt; , Error=&gt; , ErrorID=&gt; , MovementId=&gt; ); </pre>

(2) Related variables

VAR_IN_OUT	Name	Data type	Efficient range	Initial value	Description
AxisGroup	Axis group	AXIS_GROUP_REF_SM3	-	-	Specified axis group
VAR_INPUT	Name	Data type	Efficient range	Initial value	Description
Execute	Valid	BOOL	TRUE/FALSE	FALSE	Execute current instruction
Deceleration	Deceleration speed	LREAL	Positive value	0	Maximum combined deceleration speed [command unit/s <sup>2</sup> ]
Jerk	Jerk speed	LREAL	Positive value	0	Max combined jerk speed [command unit/s <sup>3</sup> ]
AccFactor	Acceleration factor	LREAL	0-1	1	Acceleration factor, the maximum speed of each axis multiplied by this acceleration factor, and the value is between [0, 1]
JerkFactor	Jerk factor	LREAL	0-1	1	Jerk factor: the maximum speed of each axis is multiplied by this jerk factor, and the value is between [0, 1]
VAR_OUTPUT	Name	Data type	Efficient range	Initial value	Description
Done	Completed	BOOL	TRUE/FALSE	FALSE	TRUE when instruction execution is complete
Busy	In execution	BOOL	TRUE/FALSE	FALSE	TRUE when the function block execution has not ended
Active	In control	BOOL	TRUE/FALSE	FALSE	Becomes TRUE in control
CommandAborted	Instruction	BOOL	TRUE/FALSE	FALSE	Module execution interrupted is

	interrupted				TRUE
CommandAccepted	Motion accepted	BOOL	TRUE/FALSE	FALSE	TRUE when the module successfully calls the axis group
Error	Error	BOOL	TRUE/FALSE	FALSE	Function block execution error
ErrorID	Error code	SMC_ERROR	-	0	Error identification
MovementId	Motion flag	SMC_Movement_Id	TRUE/FALSE	FALSE	TRUE when the motion is executing or completed

### 5-2-2-12. Axis group interrupt [MC\_GroupInterrupt]

#### (1) Instruction overview

Interrupt the current moving axis group, continue to run the unexecuted command through MC\_GroupContinue.

Instruction	Name	Graphic representation	ST representation
MC_GroupInterrupt	Axis group interrupt		<pre> MC_GroupInterrupt(   AxisGroup:= ,   continueData:= ,   Execute:= ,   Done=&gt; ,   Busy=&gt; ,   CommandAborted=&gt; ,   Error=&gt; ,   ErrorID=&gt; ,   mvtIdInterruptPosition=&gt; ); </pre>

#### (2) Related variables

VAR_IN_OUT	Name	Data type	Efficient range	Initial value	Description
AxisGroup	Axis group	AXIS_GROUP_REF_SM3	-	-	Specified axis group
continueData	Continue moving data	SMC_AXIS_GROUP_CONTINUE_DATA	-	-	Motion information when axis group motion is interrupted
VAR_INPUT	Name	Data type	Efficient range	Initial value	Description
Execute	Valid	BOOL	TRUE/FALSE	FALSE	Execute current instruction
VAR_OUTPUT	Name	Data type	Efficient range	Initial value	Description
Done	Completed	BOOL	TRUE/FALSE	FALSE	TRUE when instruction execution is completed
CommandAborted	Instruction interrupted	BOOL	TRUE/FALSE	FALSE	Module execution interrupted is TRUE
Busy	In execution	BOOL	TRUE/FALSE	FALSE	TRUE when the function block execution has not ended
Error	Error	BOOL	TRUE/FALSE	FALSE	Function block execution error
ErrorID	Error code	SMC_ERROR	-	0	Error identification
mvtIdInterruptPosition	Interrupt position ID	SMC_Movement_Id	-	-	Movement ID corresponding to the interrupt location

5-2-2-13. Axis group stop [MC\_GroupStop]

(1) Instruction overview

Stop the axis group motion.

Instruction	Name	Graphic representation	ST representation
MC_GroupStop	Axis group stop		<pre> MC_GroupStop(   AxisGroup:= ,   Execute:= ,   Deceleration:= ,   Jerk:= ,   AccFactor:= ,   JerkFactor:= ,   Done=&gt; ,   Busy=&gt; ,   Active=&gt; ,   CommandAborted=&gt; ,   CommandAccepted=&gt; ,   Error=&gt; ,   ErrorID=&gt; ,   MovementId=&gt; ); </pre>

(2) Related variables

VAR_IN_OUT	Name	Data type	Efficient range	Initial value	Description
AxisGroup	Axis group	AXIS_GROUP_REF_SM3	-	-	Specified axis group
VAR_INPUT	Name	Data type	Efficient range	Initial value	Description
Execute	Valid	BOOL	TRUE/FALSE	FALSE	Execute current instruction
Deceleration	Deceleration speed	LREAL	Positive value	0	Maximum combined deceleration [command unit/s <sup>2</sup> ]
Jerk	Jerk speed	LREAL	Positive value	0	Max combined jerk speed [command unit/s <sup>3</sup> ]
AccFactor	Acceleration factor	LREAL	0-1	1	Acceleration factor, the maximum speed of each axis is multiplied by this acceleration factor, and the value is between [0, 1]
JerkFactor	Jerk factor	LREAL	0-1	1	Jerk factor, the maximum speed of each axis is multiplied by this acceleration factor, and the value is between [0, 1]
VAR_OUTPUT	Name	Data type	Efficient range	Initial value	Description
Done	Completed	BOOL	TRUE/FALSE	FALSE	TRUE when instruction execution is completed
Busy	In execution	BOOL	TRUE/FALSE	FALSE	TRUE when the function block execution has not ended
Active	In control	BOOL	TRUE/FALSE	FALSE	TRUE in control
CommandAborted	Instruction	BOOL	TRUE/FALSE	FALSE	Module execution interrupted is

	interrupted				TRUE
CommandAccepted	Motion accepted	BOOL	TRUE/FALSE	FALSE	TRUE when the module successfully calls the axis group
Error	Error	BOOL	TRUE/FALSE	FALSE	Function block execution error
ErrorID	Error code	SMC_ERROR	-	0	Error identification
MovementId	Motion flag	SMC_Movement_Id	TRUE/FALSE	FALSE	TRUE when the motion is executing or completed

#### 5-2-2-14. Axis group overshoot [MC\_GroupSetOverride]

##### (1) Instruction overview

When the axis group is in the moving state, change the movement speed of the axis group.

Instruction	Name	Graphic representation	ST representation
MC_GroupSetOverride	Set axis group overshoot		<pre> MC_GroupSetOverride(   AxisGroup:= ,   Enable:= ,   VelFactor:= ,   AccFactor:= ,   JerkFactor:= ,   PathVelFactor:= ,   PathAccFactor:= ,   PathJerkFactor:= ,   Enabled=&gt; ,   Busy=&gt; ,   Error=&gt; ,   ErrorID=&gt; ); </pre>

##### (2) Related variables

VAR_IN_OUT	Name	Data type	Efficient range	Initial value	Description
AxisGroup	Axis group	AXIS_GROUP_REF_SM3	-	-	Specified axis group
VAR_INPUT	Name	Data type	Efficient range	Initial value	Description
Execute	Valid	BOOL	TRUE/FALSE	FALSE	Execute current instruction
VelFactor	Speed factor	LREAL	0-1	1	Speed factor, the maximum speed of each axis multiplied by this speed factor, and the value is between [0, 1]
AccFactor	Acceleration factor	LREAL	0-1	1	Acceleration factor, the maximum speed of each axis multiplied by this acceleration factor, and the value is between [0, 1]
JerkFactor	Jerk factor	LREAL	0-1	1	Jerk factor: the maximum speed of each axis is multiplied by this jerk factor, and the value is between [0, 1]
PathVelFactor	Combined speed factor	LREAL	0-1	1	Combined velocity factor, the maximum combined velocity of the whole axis group motion track multiplied by this

					velocity factor, and the value is between [0, 1]
PathAccFactor	Combined acceleration factor	LREAL	0-1	1	Combined acceleration factor, the maximum combined acceleration of the whole axis group motion track multiplied by this combined acceleration factor, and the value is between [0, 1]
PathJerkFactor	Combined jerk factor	LREAL	0-1	1	Combined jerk factor, the maximum combined jerk of the whole axis group motion track multiplied by this combined jerk factor, and the value is between [0, 1]
VAR_OUTPUT	Name	Data type	Efficient range	Initial value	Description
Enabled	Setting completed	BOOL	TRUE/FALSE	FALSE	Overshoot factor setting completed is TRUE
Busy	In execution	BOOL	TRUE/FALSE	FALSE	TRUE when the function block execution has not ended
Error	Error	BOOL	TRUE/FALSE	FALSE	Function block execution error
ErrorID	Error code	SMC_ERROR	-	0	Error identification

#### 5-2-2-15. Kinematic coordinate transformation [MC\_SetKinTransform]

##### (1) Instruction overview

Set the kinematic conversion of axis group, from ACS coordinate system to MCS coordinate system.

Instruction	Name	Graphic representation	ST representation
MC_SetKinTransform	Kinematic coordinate transformation		<pre>MC_SetKinTransform(   AxisGroup:= ,   Execute:= ,   KinTransform:= ,   Done=&gt; ,   Busy=&gt; ,   Error=&gt; ,   ErrorID=&gt; );</pre>

##### (2) Related variables

VAR_IN_OUT	Name	Data type	Efficient range	Initial value	Description
AxisGroup	Axis group	AXIS_GROUP_REF_SM3	-	-	Specified axis group
VAR_INPUT	Name	Data type	Efficient range	Initial value	Description
Execute	Valid	BOOL	TRUE/FALSE	FALSE	The rising edge of the input value will start the execution of the function block
KinTransform	Kinematic transformation	TRAFO.MC_KIN_REF_SM3	-	-	Kinematic transformation

VAR_OUTPUT	Name	Data type	Efficient range	Initial value	Description
Done	Completed	BOOL	TRUE/FALSE	FALSE	TRUE when instruction execution is completed
Busy	In execution	BOOL	TRUE/FALSE	FALSE	TRUE when the function block execution has not ended
Error	Error	BOOL	TRUE/FALSE	FALSE	Function block execution error
ErrorID	Error code	SMC_ERROR	-	0	Error identification

### 5-2-2-16. Absolute circular interpolation [MC\_MoveCircularAbsolute]

#### (1) Instruction overview

The axis group performs the arc interpolation movement in the absolute position mode.

Instruction	Name	Graphic representation	ST representation
MC_MoveCircularAbsolute	Absolute circular interpolation		<pre> MC_MoveCircularAbsolute(   AxisGroup:= ,   Execute:= ,   CircMode:= ,   AuxPoint:= ,   EndPoint:= ,   PathChoice:= ,   Velocity:= ,   Acceleration:= ,   Deceleration:= ,   Jerk:= ,   CoordSystem:= ,   BufferMode:= ,   TransitionMode:= ,   TransitionParameter:= ,   OrientationMode:= ,   VelFactor:= ,   AccFactor:= ,   JerkFactor:= ,   Done=&gt; ,   Busy=&gt; ,   Active=&gt; ,   CommandAborted=&gt; ,   CommandAccepted=&gt; ,   Error=&gt; ,   ErrorID=&gt; ,   MovementId=&gt; ); </pre>

#### (2) Related variables

VAR_IN_OUT	Name	Data type	Efficient range	Initial value	Description
AxisGroup	Axis group	AXIS_GROUP_REF_SM3	-	-	Specified axis group
VAR_INPUT	Name	Data type	Efficient range	Initial value	Description
Execute	Valid	BOOL	TRUE/FALSE	FALSE	Execute current instruction

CircMode	Arc mode	SMC_CIRC_MODE	Border/Center/ Radius	-	Specify the method of arc interpolation: Border: three-point arc Center: Center arc Radius: radius arc
AuxPoint	Auxiliary point	SMC_POS_REF	-	-	Specify an auxiliary point in the coordinate system. Refer to CircMode
EndPoint	End point	SMC_POS_REF	-	-	Specify the end position in the coordinate system
PathChoice	Direction	MC_CIRC_PATHCHOICE	CLOCKWISE/ COUNTER_CLOCKWISE	-	Motion direction: CLOCKWISE: clockwise COUNTER_CLOCKWISE: counterclockwise
Velocity	Speed	LREAL	0, positive value	0	Maximum combined speed [command unit/s]
Deceleration	Deceleration speed	LREAL	positive value	0	Max combined deceleration speed [command unit/s <sup>2</sup> ]
Jerk	Jerk speed	LREAL	positive value	0	Max combined jerk speed [command unit/s <sup>3</sup> ]
VAR_INPUT	Name	Data type	Efficient range	Initial value	Description
CoordSystem	Reference coordinate system	SMC_COORD_SYSTEM	SMC_COORD_SYSTEM	-	Reference coordinate system
BufferMode	Buffer mode	MC_BUFFER_MODE	-	0	Specifies the action when multiple motion commands are started.
TransitionMode	Corner transition mode	MC_TRANSITION_MODE	TMNone/ TMStartVelocity/ TMCornerDistance	-	TMNone: no mixing TMStartVelocity: mix based on speed TMCornerDistance: mix based on distance
TransitionParameter	Corner transition parameters	array [0..(SMC_RCNS T.MAX_TRANS _PARAMS - 1)] OF LREAL	0, positive value	0	Corner transition parameters
OrientationMode	Interpolation positioning mode	SMC_ORIENTATION_MODE	GreatCircle/ Axis	-	GreatCircle: Move from the start position to the target position along the shortest path. In this mode, even if the start position and the end position are within the specified area, the realized path may leave the area Axis: The positioning axis moves within the specified area from the start position to the end position. Not all kinematic transformations support this mode

VelFactor	Speed factor	LREAL	0-1	1	Speed factor, the maximum speed of each axis multiplied by this speed factor, and the value is between [0, 1]
AccFactor	Acceleration factor	LREAL	0-1	1	Acceleration factor, the maximum speed of each axis multiplied by this acceleration factor, and the value is between [0, 1]
JerkFactor	Jerk factor	LREAL	0-1	1	Jerk factor, the maximum speed of each axis multiplied by this jerk factor, and the value is between [0, 1]
VAR_OUTPUT	Name	Data type	Efficient range	Initial value	Description
Done	Completed	BOOL	TRUE/FALSE	FALSE	TRUE when instruction execution is completed
Busy	In execution	BOOL	TRUE/FALSE	FALSE	TRUE when the function block execution has not ended
Active	In control	BOOL	TRUE/FALSE	FALSE	Becomes TRUE in control
CommandAborted	Instruction interrupted	BOOL	TRUE/FALSE	FALSE	Module execution interrupted is TRUE
CommandAccepted	Motion accepted	BOOL	TRUE/FALSE	FALSE	TRUE when the module successfully calls the axis group
Error	Error	BOOL	TRUE/FALSE	FALSE	Function block execution error
ErrorID	Error code	SMC_ERROR	-	0	Error identification
MovementId	Motion flag	SMC_Movement_Id	TRUE/FALSE	FALSE	Valid when CommandAccepted or Done is TRUE



5-2-2-17. Relative circular interpolation [MC\_MoveCircularRelative]

(1) Instruction overview

The axis group perform arc interpolation movement in relative position mode.

Instruction	Name	Graphic representation	ST representation
MC_MoveCircularRelative	Relative circular interpolation		<pre> MC_MoveCircularRelative( AxisGroup:= , Execute:= , CircMode:= , AuxPoint:= , EndPoint:= , PathChoice:= , Velocity:= , Acceleration:= , Deceleration:= , Jerk:= , CoordSystem:= , BufferMode:= , TransitionMode:= , TransitionParameter:= , OrientationMode:= , VelFactor:= , AccFactor:= , JerkFactor:= , Done=&gt; , Busy=&gt; , Active=&gt; , CommandAborted=&gt; , CommandAccepted=&gt; , Error=&gt; , ErrorID=&gt; , MovementId=&gt; ); </pre>

(2) Related variables

VAR_IN_OUT	Name	Data type	Efficient range	Initial value	Description
AxisGroup	Axis group	AXIS_GROUP_REF_SMC3	-	-	Specified axis group
VAR_INPUT	Name	Data type	Efficient range	Initial value	Description
Execute	Valid	BOOL	TRUE/FALSE	FALSE	Execute the current command
CircMode	Arc mode	SMC_CIRC_MODE	Border/Center/Radius	-	Specify the method of arc interpolation: Border: three-point arc Center: Center arc Radius: radius arc
AuxPoint	Auxiliary point	SMC_POS_REF	-	-	Specify an auxiliary point in the coordinate system. Refer to CircMode
EndPoint	End point	SMC_POS_REF	-	-	Specify the end position in the coordinate system
PathChoice	Direction	MC_CIRC_PATHCHOICE	CLOCKWISE/COUNTER_CLOCKWISE	-	Motion direction: CLOCKWISE: clockwise COUNTER_CLOCKWISE: counterclockwise

Velocity	Speed	LREAL	0, positive value	0	Max combined speed [command unit/s]
Deceleration	Deceleration speed	LREAL	positive value	0	Max combined deceleration speed [command unit/s <sup>2</sup> ]
Jerk	Jerk speed	LREAL	positive value	0	Max combined jerk speed [command unit/s <sup>3</sup> ]
CoordSystem	Reference coordinate system	SMC_COORD_SYSTEM	SMC_COORD_SYSTEM	-	Reference coordinate system
VAR_INPUT	Name	Data type	Efficient range	Initial value	Description
BufferMode	Buffer mode	MC_BUFFER_MODE	-	0	Specifies the action when multiple motion commands are started
TransitionMode	Corner transition mode	MC_TRANSITION_MODE	TMNone/ TMStartVelocity/ TMCornerDistance	-	TMNone: no mixing TMStartVelocity: mix based on speed TMCornerDistance: mix based on distance
TransitionParameter	Corner transition parameters	Array [0..(SMC_RCNS_T.MAX_TRANS_PARAMS - 1)] OF LREAL	0, positive value	0	Corner transition parameters
OrientationMode	Interpolation positioning mode	SMC_ORIENTATION_MODE	GreatCircle/ Axis	-	GreatCircle: Move from the start position to the target position along the shortest path. In this mode, even if the start position and the end position are within the specified area, the realized path may leave the area Axis: The positioning axis moves within the specified area from the start position to the end position. Not all kinematic transformations support this mode
VelFactor	Speed factor	LREAL	0-1	1	Speed factor, the maximum speed of each axis multiplied by this speed factor, and the value is between [0, 1]
AccFactor	Acceleration factor	LREAL	0-1	1	Acceleration factor, the maximum speed of each axis multiplied by this acceleration factor, and the value is between [0, 1]
JerkFactor	Jerk factor	LREAL	0-1	1	Jerk factor, the maximum speed of each axis multiplied by this jerk factor, and the value is between [0, 1]
VAR_OUTPUT	Name	Data type	Efficient range	Initial value	Description

Done	Completed	BOOL	TRUE/FALSE	FALSE	TRUE when instruction execution is completed
Busy	In execution	BOOL	TRUE/FALSE	FALSE	TRUE when the function block execution has not ended
Active	In control	BOOL	TRUE/FALSE	FALSE	Becomes TRUE in control
CommandAborted	Instruction interrupted	BOOL	TRUE/FALSE	FALSE	Module execution interrupted is TRUE
CommandAccepted	Motion accepted	BOOL	TRUE/FALSE	FALSE	TRUE when the module successfully calls the axis group
Error	Error	BOOL	TRUE/FALSE	FALSE	Function block execution error
ErrorID	Error code	SMC_ERROR	-	0	Error identification
MovementId	Motion flag	SMC_Movement_Id	TRUE/FALSE	FALSE	Valid when CommandAccepted or Done is TRUE

### 5-2-2-18. Absolute position fast positioning [MC\_MoveDirectAbsolute]

#### (1) Instruction overview

All axes in the control axis group run to the end of absolute position at the specified speed.

Instruction	Name	Graphic representation	ST representation
MC_MoveDirectAbsolute	Absolute position fast positioning		<pre> MC_MoveDirectAbsolute(   AxisGroup:= ,   Execute:= ,   Position:= ,   MovementType:= ,   CoordSystem:= ,   BufferMode:= ,   TransitionMode:= ,   TransitionParameter:= ,   VelFactor:= ,   AccFactor:= ,   JerkFactor:= ,   Done=&gt; ,   Busy=&gt; ,   Active=&gt; ,   CommandAborted=&gt; ,   CommandAccepted=&gt; ,   Error=&gt; ,   ErrorID=&gt; ,   MovementId=&gt; ); </pre>

#### (2) Related variables

VAR_IN_OUT	Name	Data type	Efficient range	Initial value	Description
AxisGroup	Axis group	AXIS_GROUP_REF_SM3	-	-	Specified axis group
VAR_INPUT	Name	Data type	Efficient range	Initial value	Description
Execute	Valid	BOOL	TRUE/FALSE	FALSE	Execute the current command
Position	Position	SMC_POS_REF	-	-	Absolute target position in the specified reference coordinate system
MovementType	PTP motion	SMC_PTP_MOVEMEN	-	-	Fast (0): PTP motion mode with time

	mode	T_TYPE			priority Path_Invariant: PTP motion with fixed path
CoordSystem	Reference coordinate system	SMC_COORD_SYSTEM	SMC_COORD_SYSTEM		Reference coordinate system
BufferMode	Buffer mode	MC_BUFFER_MODE	-	0	Specifies the action when multiple motion commands are started
TransitionMode	Corner transition mode	MC_TRANSITION_MODE	TMNone/ TMStartVelocity/TMCornerDistance	-	TMNone: no mixing TMStartVelocity: mix based on speed TMCornerDistance: mix based on distance
TransitionParameter	Corner transition parameters	Array [0..(SMC_RCNST.MAX_TRANS_PARAMS - 1)] OF LREAL	0, positive value	0	Corner transition parameters
VelFactor	Speed factor	LREAL	0-1	1	Speed factor, the maximum speed of each axis multiplied by this speed factor, and the value is between [0, 1]
VAR_INPUT	Name	Data type	Efficient range	Initial value	Description
AccFactor	Acceleration factor	LREAL	0-1	1	Acceleration factor, the maximum speed of each axis multiplied by this acceleration factor, and the value is between [0, 1]
JerkFactor	Jerk factor	LREAL	0-1	1	Jerk factor, the maximum speed of each axis multiplied by this jerk factor, and the value is between [0, 1]
VAR_OUTPUT	Name	Data type	Efficient range	Initial value	Description
Done	Completed	BOOL	TRUE/FALSE	FALSE	TRUE when instruction execution is completed
Busy	In execution	BOOL	TRUE/FALSE	FALSE	TRUE when the function block execution has not ended
Active	In control	BOOL	TRUE/FALSE	FALSE	Becomes TRUE in control
CommandAborted	Instruction interrupted	BOOL	TRUE/FALSE	FALSE	Module execution interrupted is TRUE
CommandAccepted	Motion accepted	BOOL	TRUE/FALSE	FALSE	TRUE when the module successfully calls the axis group
Error	Error	BOOL	TRUE/FALSE	FALSE	Function block execution error
ErrorID	Error code	SMC_ERROR	-	0	Error identification
MovementId	Motion flag	SMC_Movement_Id	TRUE/FALSE	FALSE	TRUE when the motion is executing or completed

5-2-2-19. Relative position fast positioning [MC\_MoveDirectRelative]

(1) Instruction overview

All axes in the control axis group run to the end of the relative position at the specified speed.

Instruction	Name	Graphic representation	ST representation
MC_MoveDirectRelative	Relative position fast positioning		<pre>MC_MoveDirectRelative(   AxisGroup:= ,   Execute:= ,   Distance:= ,   MovementType:= ,   CoordSystem:= ,   BufferMode:= ,   TransitionMode:= ,   TransitionParameter:= ,   VelFactor:= ,   AccFactor:= ,   JerkFactor:= ,   Done=&gt; ,   Busy=&gt; ,   Active=&gt; ,   CommandAborted=&gt; ,   CommandAccepted=&gt; ,   Error=&gt; ,   ErrorID=&gt; ,   MovementID=&gt; );</pre>

(2) Related variables

VAR_IN_OUT	Name	Data type	Efficient range	Initial value	Description
AxisGroup	Axis group	AXIS_GROUP_REF_SM3	-	-	Specified axis group
VAR_INPUT	Name	Data type	Efficient range	Initial value	Description
Execute	Valid	BOOL	TRUE/FALSE	FALSE	Execute the current command
Distance	Relative position	SMC_POS_REF	-	-	Relative target position in the specified reference coordinate system
MovementType	PTP motion mode	SMC_PTP_MOVEMENT_TYPE	-	-	Fast (0): PTP motion mode with time priority Path_Invariant: PTP motion with fixed path
CoordSystem	Reference coordinate system	SMC_COORD_SYSTEM	SMC_COORD_SYSTEM		Reference coordinate system
BufferMode	Buffer mode	MC_BUFFER_MODE	-	0	Specifies the action when multiple motion commands are started
TransitionMode	Corner transition mode	MC_TRANSITION_MODE	TMNone/TMStartVelocity/TMCornerDistance		TMNone: no mixing TMStartVelocity: mix based on speed TMCornerDistance: mix based on distance
Transition Parameter	Corner transition parameters	Array [0..(SMC_RCNST.MAX_TRANS_PARAMETERS)]	0, positive value	0	Corner transition parameters

VAR_INPUT	Name	Data type	Efficient range	Initial value	Description
VelFactor	Speed factor	LREAL	0-1	1	Speed factor, the maximum speed of each axis multiplied by this speed factor, and the value is between [0, 1]
AccFactor	Acceleration speed factor	LREAL	0-1	1	Acceleration factor, the maximum speed of each axis multiplied by this acceleration factor, and the value is between [0, 1]
JerkFactor	Jerk speed factor	LREAL	0-1	1	Jerk factor, the maximum speed of each axis multiplied by this jerk factor, and the value is between [0, 1]
VAR_OUTPUT	Name	Data type	Efficient range	Initial value	Description
Done	Completed	BOOL	TRUE/FALSE	FALSE	TRUE when instruction execution is completed
Busy	In execution	BOOL	TRUE/FALSE	FALSE	TRUE when the function block execution has not ended
Active	In control	BOOL	TRUE/FALSE	FALSE	Becomes TRUE in control
Command Aborted	Instruction interrupted	BOOL	TRUE/FALSE	FALSE	Module execution interrupted is TRUE
Command Accepted	Motion accepted	BOOL	TRUE/FALSE	FALSE	TRUE when the module successfully calls the axis group
Error	Error	BOOL	TRUE/FALSE	FALSE	Function block execution error
ErrorID	Error code	SMC_ERROR	-	0	Error identification
MovementId	Motion flag	SMC_Movement_Id	TRUE/FALSE	FALSE	TRUE when the motion is executing or completed

5-2-2-20. Absolute position linear interpolation [MC\_MoveLinearAbsolute]

(1) Instruction overview

Linear interpolation motion in the absolute position mode of the axis group in the specified coordinate system.

Instruction	Name	Graphic representation	ST representation
MC_MoveLinearAbsolute	Absolute position linear interpolation		<pre> MC_MoveLinearAbsolute(   AxisGroup:= ,   Execute:= ,   Position:= ,   Velocity:= ,   Acceleration:= ,   Deceleration:= ,   Jerk:= ,   CoordSystem:= ,   BufferMode:= ,   TransitionMode:= ,   TransitionParameter:= ,   OrientationMode:= ,   VelFactor:= ,   AccFactor:= ,   JerkFactor:= ,   Done=&gt; ,   Busy=&gt; ,   Active=&gt; ,   CommandAborted=&gt; ,   CommandAccepted=&gt; ,   Error=&gt; ,   ErrorID=&gt; ,   MovementId=&gt; );         </pre>

(2) Related variables

VAR_IN_OUT	Name	Data type	Efficient range	Initial value	Description
AxisGroup	Axis group	AXIS_GROUP_REF_SM3	-	-	Specified axis group
VAR_INPUT	Name	Data type	Efficient range	Initial value	Description
Execute	Valid	BOOL	TRUE /FALSE	FALSE	Execute the current command
Position	Position	SMC_POS_REF	-	-	Absolute target position in the specified reference coordinate system
Velocity	Speed	LREAL	0, positive value	0	Max combined speed [command unit/s]
Acceleration	Acceleration	LREAL	positive value	0	Max combined acceleration speed [command unit/s <sup>2</sup> ]
Deceleration	Deceleration	LREAL	positive value	0	Max combined deceleration speed [command unit/s <sup>2</sup> ]
Jerk	Jerk speed	LREAL	positive value	0	Max combined jerk speed [command unit/s <sup>3</sup> ]
CoordSystem	Reference coordinate system	SMC_COORD_SYSTEM	SMC_COORD_SYSTEM	-	Reference coordinate system
BufferMode	Buffer mode	MC_BUFFER_MODE	-	0	Specifies the action when multiple motion commands are started
TransitionMode	Corner transition	MC_TRANSITION_MODE	TMNone/TMStartVelocity/TMC	-	TMNone: no mixing TMStartVelocity: mix based on speed

	mode		ornerDistance		TMCornerDistance: mix based on distance
TransitionParameter	Corner transition parameter	Array [0..(SMC_RCNS T.MAX_TRANS_PARAMS - 1)] OF LREAL	0, positive value	0	Corner transition parameter
VAR_INPUT	Name	Data type	Efficient range	Initial value	Description
OrientationMode	Interpolation positioning mode	SMC_ORIENTA TION_MODE	GreatCircle/ Axis	-	GreatCircle: Move from the start position to the target position along the shortest path. In this mode, even if the start position and the end position are within the specified area, the realized path may leave the area Axis: The positioning axis moves within the specified area from the start position to the end position. Not all kinematic transformations support this mode
VelFactor	Speed factor	LREAL	0-1	1	Speed factor, the maximum speed of each axis multiplied by this speed factor, and the value is between [0, 1]
AccFactor	Acceleration factor	LREAL	0-1	1	Acceleration factor, the maximum speed of each axis multiplied by this acceleration factor, and the value is between [0, 1]
JerkFactor	Jerk factor	LREAL	0-1	1	Jerk factor: the maximum speed of each axis is multiplied by this jerk factor, and the value is between [0, 1]
VAR_OUTPUT	Name	Data type	Efficient range	Initial value	Description
Done	Completed	BOOL	TRUE/FALSE	FALSE	TRUE when instruction execution is completed
Busy	In execution	BOOL	TRUE/FALSE	FALSE	TRUE when the function block execution has not ended
Active	In control	BOOL	TRUE/FALSE	FALSE	Becomes TRUE in control
CommandAborted	Command interrupted	BOOL	TRUE/FALSE	FALSE	Module execution interrupted is true
CommandAccepted	Motion accepted	BOOL	TRUE/FALSE	FALSE	TRUE when the module successfully calls the axis group
Error	Error	BOOL	TRUE/FALSE	FALSE	Function block execution error
ErrorID	Error code	SMC_ERROR	-	0	Error identification
MovementId	Motion flag	SMC_Movement_Id	TRUE/FALSE	FALSE	TRUE when the motion is executing or completed



5-2-2-21. Relative position linear interpolation [MC\_MoveLinearRelative]

(1) Instruction overview

Linear interpolation movement in the relative position mode of the axis group in the specified coordinate system.

Instruction	Name	Graphic representation	ST representation
MC_MoveLinearRelative	Relative position linear interpolation		<pre> MC_MoveLinearRelative(   AxisGroup:= ,   Execute:= ,   Distance:= ,   Velocity:= ,   Acceleration:= ,   Deceleration:= ,   Jerk:= ,   CoordSystem:= ,   BufferMode:= ,   TransitionMode:= ,   TransitionParameter:= ,   OrientationMode:= ,   VelFactor:= ,   AccFactor:= ,   JerkFactor:= ,   Done=&gt; ,   Busy=&gt; ,   Active=&gt; ,   CommandAborted=&gt; ,   CommandAccepted=&gt; ,   Error=&gt; ,   ErrorID=&gt; ,   MovementId=&gt; );         </pre>

(2) Related variables

VAR_IN_OUT	Name	Data type	Efficient range	Initial value	Description
AxisGroup	Axis group	AXIS_GROUP_REF_SM3	-	-	Specified axis group
VAR_INPUT	Name	Data type	Efficient range	Initial value	Description
Execute	Valid	BOOL	TRUE/FALSE	FALSE	Execute the current command
Distance	Relative position	SMC_POS_REF	-	-	Relative target position in the specified reference coordinate system
Velocity	Speed	LREAL	0, positive value	0	Max combined speed [command unit/s]
Acceleration	Acceleration speed	LREAL	positive value	0	Max combined acceleration speed [command unit/s <sup>2</sup> ]
Deceleration	Deceleration speed	LREAL	positive value	0	Max combined deceleration speed [command unit/s <sup>2</sup> ]
Jerk	Jerk speed	LREAL	positive value	0	Max combined jerk speed [command unit/s <sup>3</sup> ]
CoordSystem	Reference coordinate system	SMC_COORD_SYSTEM	SMC_COORD_SYSTEM	-	Reference coordinate system
BufferMode	Buffer mode	MC_BUFFER_MODE	-	0	Specifies the action when multiple motion commands are started

VAR_IN_OUT	Name	Data type	Efficient range	Initial value	Description
TransitionMode	Corner transition mode	MC_TRANSITION_MODE	TMNone/TMS StartVelocity/T MCornerDistance	-	TMNone: no mixing TMStartVelocity: mix based on speed TMCornerDistance: mix based on distance

VAR_INPUT	Name	Data type	Efficient range	Initial value	Description
TransitionParameter	Corner transition parameter	Array [0..(SMC_RCNST.M AX_TRANS_P MS - 1)] OF LREAL	0, positive value	0	Corner transition parameter
OrientationMode	Interpolation positioning mode	SMC_ORIENTATIO N_MODE	GreatCircle /Axis	-	GreatCircle: Move from the start position to the target position along the shortest path. In this mode, even if the start position and the end position are within the specified area, the realized path may leave the area Axis: The positioning axis moves within the specified area from the start position to the end position. Not all kinematic transformations support this mode
VelFactor	Speed factor	LREAL	0-1	1	Speed factor, the maximum speed of each axis multiplied by this speed factor, and the value is between [0, 1]
AccFactor	Acceleration factor	LREAL	0-1	1	Acceleration factor, the maximum speed of each axis multiplied by this acceleration factor, and the value is between [0, 1]
JerkFactor	Jerk factor	LREAL	0-1	1	Jerk factor: the maximum speed of each axis is multiplied by this jerk factor, and the value is between [0, 1]
VAR_OUTPUT	Name	Data type	Efficient range	Initial value	Description
Done	Completed	BOOL	TRUE/FALSE	FALSE	TRUE when instruction execution is completed
Busy	In execution	BOOL	TRUE/FALSE	FALSE	TRUE when the function block execution has not ended
Active	In control	BOOL	TRUE/FALSE	FALSE	Becomes TRUE in control
CommandAborted	Command interrupted	BOOL	TRUE/FALSE	FALSE	Module execution interrupted is true
CommandAccepted	Motion	BOOL	TRUE/FALSE	FALSE	TRUE when the module successfully

	accepted				calls the axis group
Error	Error	BOOL	TRUE/FALSE	FALSE	Function block execution error
ErrorID	Error code	SMC_ERROR	-	0	Error identification
MovementId	Motion flag	SMC_Movement_Id	TRUE/FALSE	FALSE	TRUE when the motion is executing or completed

### 5-2-2-22. Read axis group feedback position [MC\_GroupReadActualPosition]

#### (1) Instruction overview

Read the feedback position of the axis group in the specified coordinate system.

Instruction	Name	Graphic representation	ST representation
MC_GroupReadActualPosition	Read axis group feedback position		<pre>MC_GroupReadActualPosition(   AxisGroup:= ,   Enable:= ,   CoordSystem:= ,   Valid=&gt; ,   Busy=&gt; ,   Error=&gt; ,   ErrorID=&gt; ,   Position=&gt; ,   KinematicConfig=&gt; );</pre>

#### (2) Related variables

VAR_IN_OUT	Name	Data type	Efficient range	Initial value	Description
AxisGroup	Axis group	AXIS_GROUP_REF_SM3	-	-	Specified axis group
VAR_INPUT	Name	Data type	Efficient range	Initial value	Description
Enable	Valid	BOOL	TRUE/FALSE	FALSE	Must be set to TRUE to enable processing of function blocks
CoordSystem	Apply coordinate system	SMC_COORD_SYSTEM	-	-	Apply coordinate system
VAR_OUTPUT	Name	Data type	Efficient range	Initial value	Description
Valid	Obtain the flag	BOOL	TRUE/FALSE	FALSE	If the output value is valid, it is TRUE
Busy	In execution	BOOL	TRUE/FALSE	FALSE	TRUE when the function block execution has not ended
Error	Error	BOOL	TRUE/FALSE	FALSE	Function block execution error
ErrorID	Error code	SMC_ERROR	-	0	Error identification
Position	Position	SMC_POS_REF	-	-	Axis group actual position
KinematicConfig	Motion configuration	TRAFO.CONFIGDATA	-	-	Kinematic configuration of the current position. Set only when the coordinate system is

VAR_IN_OUT	Name	Data type	Efficient range	Initial value	Description
					a Cartesian coordinate system (i.e. not set in case of ACS)

### 5-2-2-23. Read axis group feedback speed [MC\_GroupReadActualVelocity]

#### (1) Instruction overview

Read the feedback speed of the axis group in the specified coordinate system.

Instruction	Name	Graphic representation	ST representation
MC_GroupReadActualVelocity	Read axis group feedback speed		<pre>MC_GroupReadActualVelocity(   AxisGroup:= ,   Enable:= ,   CoordSystem:= ,   Valid=&gt; ,   Busy=&gt; ,   ErrorID=&gt; ,   Error=&gt; ,   Velocity=&gt; );</pre>

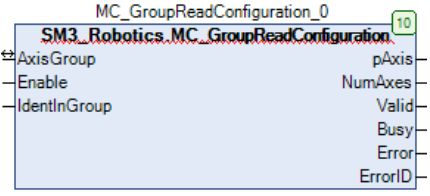
#### (2) Related variables

VAR_IN_OUT	Name	Data type	Efficient range	Initial value	Description
AxisGroup	Axis group	AXIS_GROUP_REF_SM3	-	-	Specified axis group
VAR_INPUT	Name	Data type	Efficient range	Initial value	Description
Enable	Valid	BOOL	TRUE/FALSE	FALSE	Must be set to TRUE to enable processing of function blocks
CoordSystem	Apply coordinate system	SMC_COORD_SYSTEM	-	-	Apply coordinate system
VAR_OUTPUT	Name	Data type	Efficient range	Initial value	Description
Valid	Obtain the flag	BOOL	TRUE/FALSE	FALSE	If the output value is valid, it is TRUE
Busy	In execution	BOOL	TRUE/FALSE	FALSE	TRUE when the function block execution has not ended
Error	Error	BOOL	TRUE/FALSE	FALSE	Function block execution error
ErrorID	Error code	SMC_ERROR	-	0	Error identification
Velocity	Speed	SMC_POS_REF	-	-	Current feedback speed of the axis group. If the Cartesian coordinate system is selected, Velocity.c contains Cartesian velocities: (X, Y, Z) are velocity vectors, (A, B, C) are angular velocities around the X, Y, Z axes respectively

5-2-2-24. Read axis group configuration parameters [MC\_GroupReadConfiguration]

(1) Instruction overview

Read the configuration parameters such as axes and quantity contained in the axis group.

Instruction	Name	Graphic representation	ST representation
MC_GroupReadConfiguration	Read axis group configuration parameters		<pre>MC_GroupReadConfiguration(   AxisGroup:= ,   Enable:= ,   IdentInGroup:= ,   pAxis=&gt; ,   NumAxes=&gt; ,   Valid=&gt; ,   Busy=&gt; ,   Error=&gt; ,   ErrorID=&gt; );</pre>

(2) Related variables

VAR_IN_OUT	Name	Data type	Efficient range	Initial value	Description
AxisGroup	Axis group	AXIS_GROUP_REF_SM3	-	-	Specified axis group
VAR_INPUT	Name	Data type	Efficient range	Initial value	Description
Enable	Valid	BOOL	TRUE/FALSE	FALSE	Must be set to TRUE to enable processing of function blocks
IdentInGroup	Axis no.	IDENT_IN_GROUP_REF_SM3	0, positive value	0	Corresponding axis no. in the input axis group
VAR_OUTPUT	Name	Data type	Efficient range	Initial value	Description
pAxis	Reference axis	POINTER TO AXIS_REF_SM3	-	-	Selected reference axis
NumAxes	Axis number	UDINT	0, positive value	0	Axis numbers in the axis group
Valid	Obtain the flag	BOOL	TRUE/FALSE	FALSE	If the output value is valid, it is TRUE
Busy	In execution	BOOL	TRUE/FALSE	FALSE	TRUE when the function block execution has not ended
Error	Error	BOOL	TRUE/FALSE	FALSE	Function block execution error
ErrorID	Error code	SMC_ERROR	-	0	Error identification

5-2-2-25. Read axis group error [MC\_GroupReadError]

(1) Instruction overview

Get the error information of the axis group.

Instruction	Name	Graphic representation	ST representation
MC_GroupReadError	Read axis group error		<pre>MC_GroupReadError(   AxisGroup:= ,   Enable:= ,   Valid=&gt; ,   Busy=&gt; ,   Error=&gt; ,   ErrorID=&gt; ,   GroupErrorID=&gt; );</pre>

(2) Related variables

VAR_IN_OUT	Name	Data type	Efficient range	Initial value	Description
AxisGroup	Axis group	AXIS_GROUP_REF_SM3	-	-	Specified axis group
VAR_INPUT	Name	Data type	Efficient range	Initial value	Description
Enable	Valid	BOOL	TRUE/FALSE	FALSE	Must be set to TRUE to enable processing of function blocks
VAR_OUTPUT	Name	Data type	Efficient range	Initial value	Description
Valid	Obtain the flag	BOOL	TRUE/FALSE	FALSE	If the output value is valid, it is TRUE
Busy	In execution	BOOL	TRUE/FALSE	FALSE	TRUE when the function block execution has not ended
Error	Error	BOOL	TRUE/FALSE	FALSE	Function block execution error
ErrorID	Error code	SMC_ERROR	-	0	Single axis error code indication
GroupErrorID	Error code	SMC_ERROR	-	0	Axis group error code indication

5-2-2-26. Read the axis group current motion status [MC\_GroupReadStatus]

(1) Instruction overview

Obtain the current motion state of the axis group.

Instruction	Name	Graphic representation	ST representation
MC_GroupReadStatus	Read the axis group current motion status		<pre>MC_GroupReadStatus( AxisGroup:= , Enable:= , Valid=&gt; , Busy=&gt; , Error=&gt; , ErrorID=&gt; , GroupMoving=&gt; , GroupHoming=&gt; , GroupErrorStop=&gt; , GroupStandby=&gt; , GroupStopping=&gt; , GroupDisabled=&gt; , TrackingDynamicCS=&gt; , InSync=&gt; , ActiveMovementId=&gt; , LastAcceptedMovementId=&gt; );</pre>

(2) Related variables

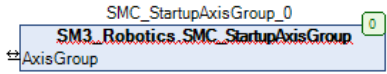
VAR_IN_OUT	Name	Data type	Efficient range	Initial value	Description
AxisGroup	Axis group	AXIS_GROUP_REF _SM3	-	-	Specified axis group
VAR_INPUT	Name	Data type	Efficient range	Initial value	Description
Enable	Valid	BOOL	TRUE/FALSE	FALSE	Must be set to TRUE to enable processing of function blocks
VAR_OUTPUT	Name	Data type	Efficient range	Initial value	Description
Valid	Obtain the flag	BOOL	TRUE/FALSE	FALSE	If the output value is valid, it is TRUE
Busy	In execution	BOOL	TRUE/FALSE	FALSE	TRUE when the function block execution has not ended
Error	Error	BOOL	TRUE/FALSE	FALSE	Function block execution error
ErrorID	Error code	SMC_ERROR	-	0	Single axis error code indication
GroupErrorID	Error code	SMC_ERROR	-	0	Axis group error code indication
GroupMoving	Moving	BOOL	TRUE/FALSE	FALSE	Axis group in motion is TRUE
GroupHoming	Homing	BOOL	TRUE/FALSE	FALSE	Axis group homing is TRUE
GroupErrorStop	Error stop	BOOL	TRUE/FALSE	FALSE	Axis group report error and stop is TRUE
GroupStandby	Ready to move	BOOL	TRUE/FALSE	FALSE	Axis group standby is TRUE
GroupStopping	Stop	BOOL	TRUE/FALSE	FALSE	Axis group stop is TRUE
GroupDisabled	Disable axis group	BOOL	TRUE/FALSE	FALSE	Axis group invalid status is TRUE
TrackingDynamicCS	Current	BOOL	TRUE/FALSE	FALSE	True if the dynamic coordinate

	dynamic coordinate system				system is currently used
InSync	On path or already in place	BOOL	TRUE/FALSE	FALSE	In continuous interpolation motion, it is true when the acquired position belongs to the specified path. True when the current position is equal to the target position in ordinary point position and interpolation motion
ActiveMovementId	Motion segment no.	SMC_Movement_Id	0, positive value	-	Identifier of the active move. ID is 0 indicates no active movement
VAR_OUTPUT	Name	Data type	Efficient range	Initial value	Description
LastAcceptedMovementId	Motion segment no.	SMC_Movement_Id	0, positive value	0	Identifier of the last accepted motion. ID is 0 indicates that no action has been accepted

#### 5-2-2-27. Startup the axis group [SMC\_StartupAxisGroup]

##### (1) Instruction overview

Used for testing and commissioning the axis group.

Instruction	Name	Graphic representation	ST representation
SMC_StartupAxisGroup	Startup the axis group		<pre>SMC_StartupAxisGroup(AxisGroup:= );</pre>

##### (2) Related variables

VAR_IN_OUT	Name	Data type	Efficient range	Initial value	Description
AxisGroup	Axis group	AXIS_GROUP_REF_SM3	-	-	Specified axis group



5-2-2-28. Axis group enable [SMC\_GroupPower]

(1) Instruction overview

Enable all the axes in the axis group, equivalent to calling MC\_Power for all axes in the axis group.

Instruction	Name	Graphic representation	ST representation
SMC_GroupPower	Enable axis group		<pre>SMC_GroupPower(   AxisGroup:= ,   Enable:= ,   bRegulatorOn:= ,   bDriveStart:= ,   Status=&gt; ,   Busy=&gt; ,   Error=&gt; ,   ErrorID=&gt; );</pre>

(2) Related variables

VAR_IN_OUT	Name	Data type	Efficient range	Initial value	Description
AxisGroup	Axis group	AXIS_GROUP_REF_SM3	-	-	Specified axis group
VAR_INPUT	Name	Data type	Efficient range	Initial value	Description
Enable	Valid	BOOL	TRUE/FALSE	FALSE	Input TRUE to make the module operate
bRegulatorOn	Enable	BOOL	TRUE/FALSE	FALSE	Set to TRUE to make the axis group enable
bDriveStart	Drive start	BOOL	TRUE/FALSE	FALSE	Must be set to TRUE to turn off emergency stop processing for the function block
VAR_OUTPUT	Name	Data type	Efficient range	Initial value	Description
Status	Operable	BOOL	TRUE/FALSE	FALSE	TRUE if the axis group is ready
Valid	Obtain the flag	BOOL	TRUE/FALSE	FALSE	If the output value is valid, it is TRUE
Busy	In execution	BOOL	TRUE/FALSE	FALSE	TRUE when the function block execution has not ended
Error	Error	BOOL	TRUE/FALSE	FALSE	Function block execution error
ErrorID	Error code	SMC_ERROR	-	0	Error code

5-2-2-29. Interrupt the axis group [SMC\_GroupInterruptAt]

(1) Instruction overview

Interrupts the currently moving axis group.

Instruction	Name	Graphic representation	ST representation
SMC_GroupInterruptAt	Interrupt the axis group		<pre>SMC_GroupInterruptAt ( AxisGroup:= , continueData:= , Execute:= , Position:= , Done=&gt; , Busy=&gt; , Interrupting=&gt; , CommandAborted=&gt; , Error=&gt; , ErrorID=&gt; , mvtIdInterruptPosition=&gt; );</pre>

(2) Related variables

VAR_IN_OUT	Name	Data type	Efficient range	Initial value	Description
AxisGroup	Axis group	AXIS_GROUP_REF_SM3	-	-	Specified axis group
continueData	Continue motion data	SMC_AXIS_GROUP_CONTINUE_DATA	-	-	Motion information when axis group motion is interrupted
VAR_INPUT	Name	Data type	Efficient range	Initial value	Description
Execute	Valid	BOOL	TRUE/FALSE	FALSE	Execute current instruction
Position	Position	SMC_GroupInterruptPosition	-	-	Where the ongoing movement will be interrupted
VAR_OUTPUT	Name	Data type	Efficient range	Initial value	Description
Done	Completed	BOOL	TRUE/FALSE	FALSE	TRUE when instruction execution is completed
Busy	In execution	BOOL	TRUE/FALSE	FALSE	TRUE when the function block execution has not ended
Interrupting	Interrupting	BOOL	TRUE/FALSE	FALSE	Signal indicates that the function block is currently being interrupted
CommandAborted	Instruction interrupted	BOOL	TRUE/FALSE	FALSE	Module execution interrupted is TRUE
Error	Error	BOOL	TRUE/FALSE	FALSE	Function block execution error
ErrorID	Error code	SMC_ERROR	-	0	Error code
mvtIdInterruptPosition	Interrupt position ID	-	-	-	MovementID corresponding to the interrupt location

5-2-2-30. Restart after error reset [SMC\_GroupEnableResumeAfterError]

(1) Instruction overview

Restore the status of the axis group interrupted due to an error.

Instruction	Name	Graphic representation	ST representation
SMC_GroupEnableResumeAfterError	Restart after error reset		<pre>SMC_GroupEnableResumeAfterError( AxisGroup:= , continueData:= , Enable:= , Busy=&gt; , Active=&gt; );</pre>

(2) Related variables

VAR_IN_OUT	Name	Data type	Efficient range	Initial value	Description
AxisGroup	Axis group	AXIS_GROUP_REF_SM3	-	-	Specified axis group
continueData	Continue moving data	SMC_AXIS_GROUP_CONTINUE_DATA	-	-	Axis group position when motion is interrupted
VAR_INPUT	Name	Data type	Efficient range	Initial value	Description
Enable	Valid	BOOL	TRUE/FALSE	FALSE	Enable command function
VAR_OUTPUT	Name	Data type	Efficient range	Initial value	Description
Busy	In execution	BOOL	TRUE/FALSE	FALSE	TRUE when the function block execution has not ended
Active	Calling	BOOL	TRUE/FALSE	FALSE	Writing the continous data

5-2-2-31. Axis group jogging [SMC\_GroupJog]

(1) Instruction overview

Control the jog motion of the axis group in the specified coordinate system.

Instruction	Name	Graphic representation	ST representation
SMC_GroupJog	Axis group jogging		<pre> SMC_GroupJog(   AxisGroup:= ,   Execute:= ,   CoordSystem:= ,   CoordSystemPCS:= ,   VelFactor:= ,   AccFactor:= ,   JerkFactor:= ,   AxisX:= ,   AxisY:= ,   AxisZ:= ,   AxisA:= ,   AxisB:= ,   AxisC:= ,   ABC_as_ACS:= ,   Busy=&gt; ,   InitialPositionReached=&gt; ,   CommandAborted=&gt; ,   Error=&gt; ,   ErrorID=&gt; ); </pre>

(2) Related variables

VAR_IN_OUT	Name	Data type	Efficient range	Initial value	Description
AxisGroup	Axis group	AXIS_GROUP_REF_SM3	-	-	Specified axis group
VAR_INPUT	Name	Data type	Efficient range	Initial value	Description
Execute	Valid	BOOL	TRUE/FALSE	FALSE	Execute current instruction
CoordSystem	Reference coordinate system	SMC_COORD_SYSTEM	-	-	Reference coordinate system
CoordSystemPCS	PCS coordinate system	SMC_COORD_SYSTEM	-	-	The internal coordinate system for jogging is PCS, use SMC_SetDynCoordTransformEx to change when required
VelFactor	Speed factor	LREAL	0-1	1	Speed factor, the maximum speed of each axis multiplied by this speed factor, and the value is between [0, 1]
AccFactor	Acceleration factor	LREAL	0-1	1	Acceleration factor, the maximum speed of each axis multiplied by this acceleration factor, and the value is between [0, 1]
JerkFactor	Jerk factor	LREAL	0-1	1	Jerk factor, the maximum speed of each axis multiplied by this jerk factor, and the value is between [0, 1]
AxisX	Axis X	IAxisRef	-	0	The X axis in the coordinate system, set to 0 if it is not used
AxisY	Axis Y	IAxisRef	-	0	The Y axis in the coordinate system, set to 0

					if it is not used
AxisZ	Axis Z	IAxisRef	-	0	The Z axis in the coordinate system, set to 0 if it is not used
AxisA	Axis A	IAxisRef	-	0	Control the A coordinate (rotation around the Z axis) or the first tool axis. Set to 0 if not applicable

VAR_INPUT	Name	Data type	Efficient range	Initial value	Description
AxisB	Axis B	IAxisRef	-	0	Control the B coordinate (rotation around the Y axis) or the second tool axis. Set to 0 if not applicable
AxisC	Axis C	IAxisRef	-	0	Control the C coordinate (rotation around the Z axis) or the third tool axis. Set to 0 if not applicable
ABC_as_ACS	Start coordinate conversion	BOOL	TRUE/FALSE	FALSE	If TRUE, the positions of AxisA, AxisB and AxisC will be interpreted as the target position of the tool kinematic axis, otherwise as the ZYZ representation of the direction. If CoordSystem is set to ACS, it will be ignored. If TRUE, the kinematic transformation of the axis group must be Kin_Coupled type and support SMC_ORIENTATION_MODE. Axis
VAR_OUTPUT	Name	Data type	Efficient range	Initial value	Description
Busy	In execution	BOOL	TRUE/FALSE	FALSE	TRUE when the function block execution has not ended
InitialPosition Reached	Received position	BOOL	TRUE/FALSE	FALSE	-
CommandAborted	Command interrupted	BOOL	TRUE/FALSE	FALSE	Module execution interrupted is TRUE
Error	Error	BOOL	TRUE/FALSE	FALSE	Function block execution error
ErrorID	Error code	SMC_ERROR	-	0	Error code

5-2-2-32. Axis group wait [SMC\_GroupWait]

(1) Instruction overview

Set the delay waiting of the axis group.

Instruction	Name	Graphic representation	ST representation
SMC_GroupJog	Axis group waiting		<pre> SMC_GroupWait(   AxisGroup:= ,   Execute:= ,   WaitTime:= ,   Done=&gt; ,   Busy=&gt; ,   Active=&gt; ,   CommandAborted=&gt; ,   CommandAccepted=&gt; ,   Error=&gt; ,   ErrorID=&gt; ,   MovementId=&gt; ); </pre>

(2) Related variables

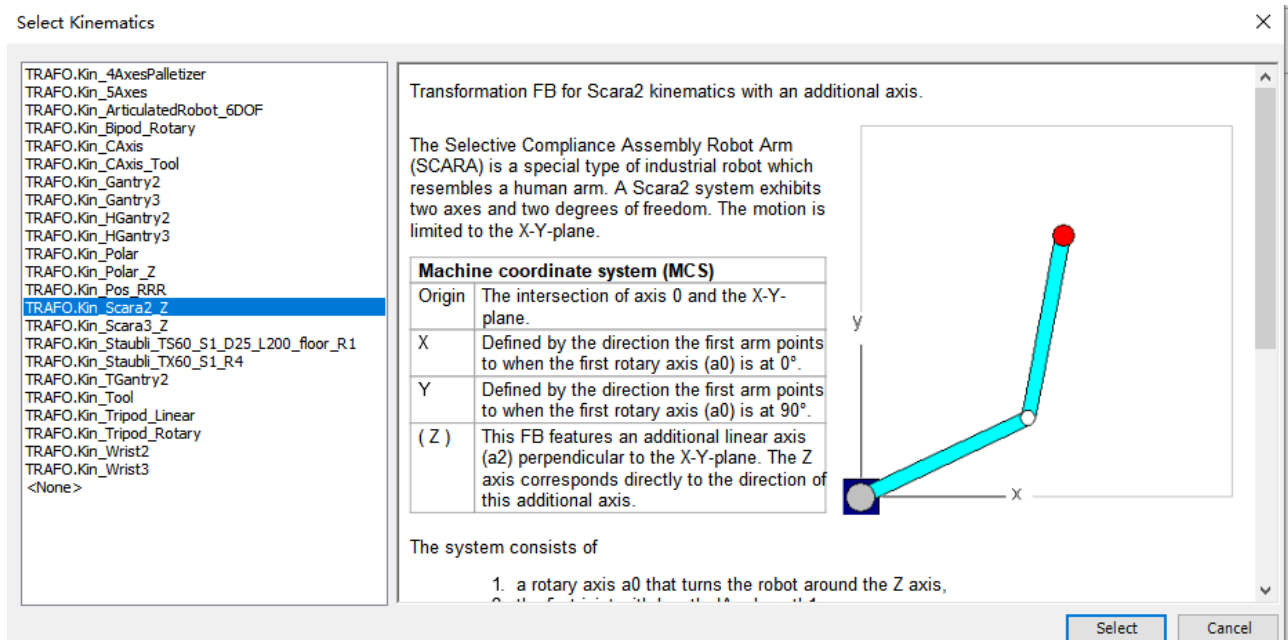
VAR_IN_OUT	Name	Data type	Efficient range	Initial value	Description
AxisGroup	Axis group	AXIS_GROUP_REF_SM3	-	-	Specified axis group
VAR_INPUT	Name	Data type	Efficient range	Initial value	Description
Execute	Valid	BOOL	TRUE/FALSE	FALSE	Execute the current command
WaitTime	Wait time	LREAL	0, positive value	0	Time to wait on the path, in seconds
VAR_OUTPUT	Name	Data type	Efficient range	Initial value	Description
Done	Completed	BOOL	TRUE/FALSE	FALSE	TRUE when instruction execution is completed
Busy	In execution	BOOL	TRUE/FALSE	FALSE	TRUE when the function block execution has not ended
Active	In control	BOOL	TRUE/FALSE	FALSE	Becomes TRUE in control
CommandAborted	Instruction interrupted	BOOL	TRUE/FALSE	FALSE	Module execution interrupted is TRUE
CommandAccepted	Motion accepted	BOOL	TRUE/FALSE	FALSE	TRUE when the module successfully calls the axis group
Error	Error	BOOL	TRUE/FALSE	FALSE	Function block execution error
ErrorID	Error code	SMC_ERROR	-	0	Error identification
MovementId	Motion flag	SMC_Movement_Id	TRUE/FALSE	FALSE	True when the motion is executing or completed

### 5-2-3. Axis group function application

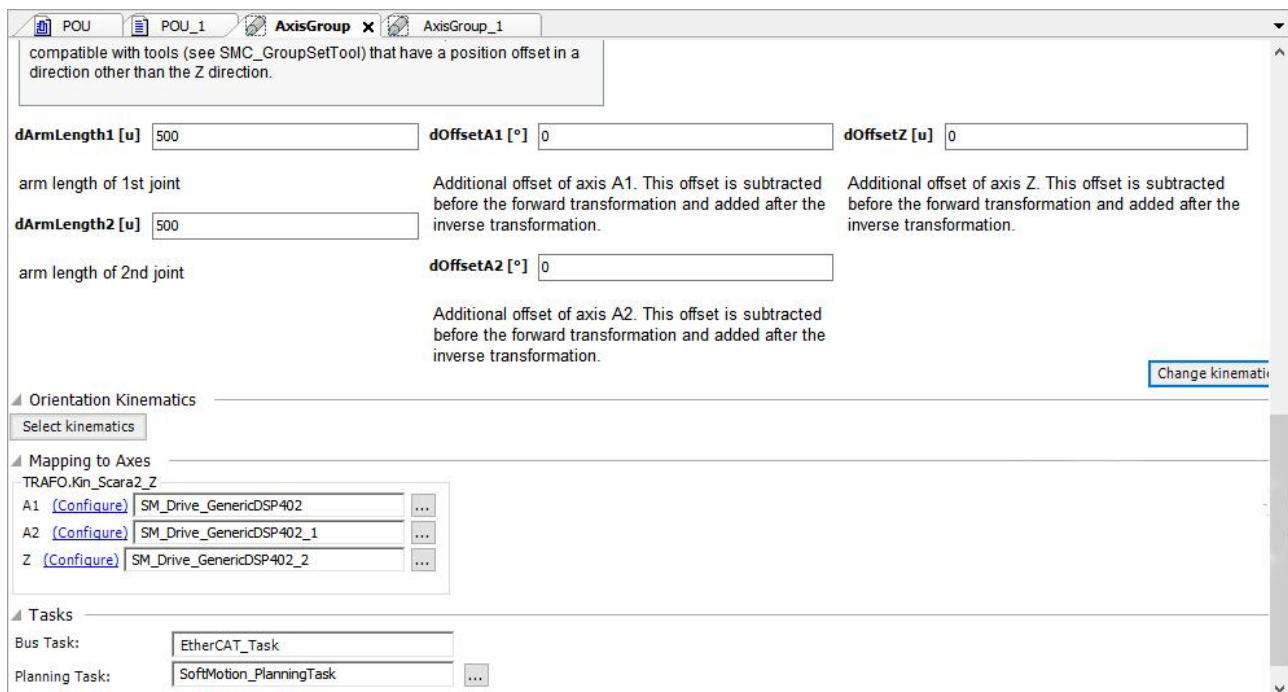
**Example:** This example introduces the motion control of a SCARA system that implements two nodes.

Program operation:

- (1) click [Application] in the project bar, select [add object]—[AxisGroup], and name as AxisGroup and open it. Select the SCARA kinematics model through the kinematics model interface.



- (2) Configure kinematic parameters: the length of the big and small arms is set to 500, and the angle offset is all zero. Axis parameter configuration, mapping axis position.

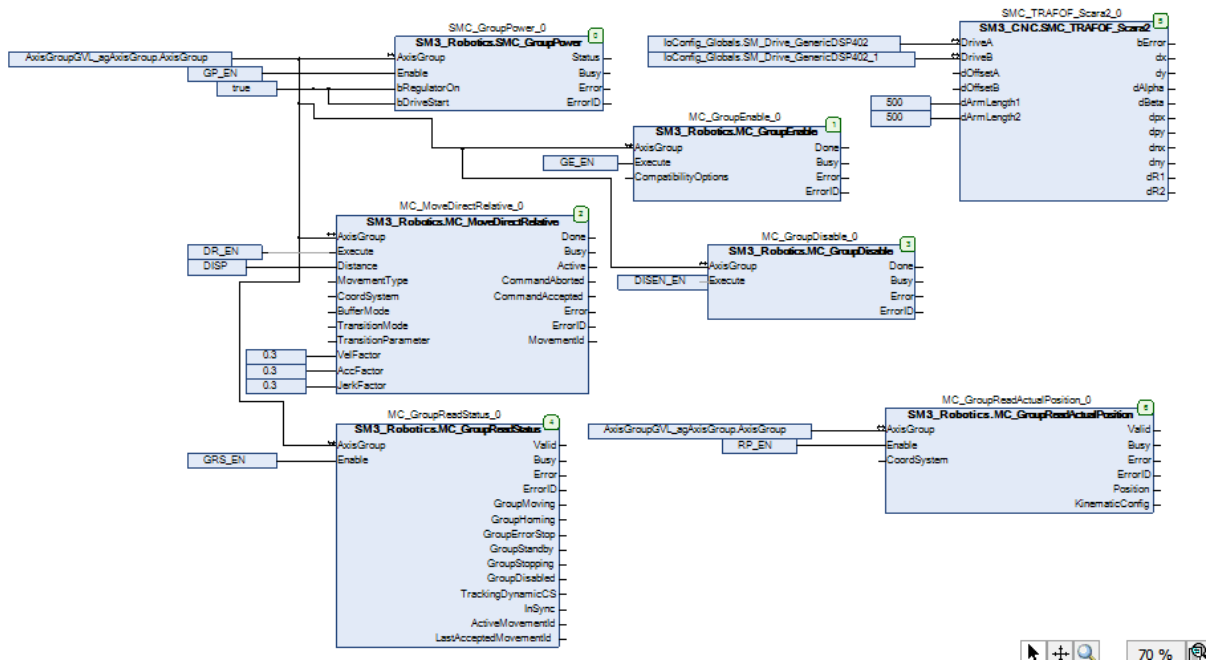


- (3) According to the motion trajectory, compile the kinematics instructions and configure the motion parameters.

```

PROGRAM POU
VAR
    SMC_GroupPower_0: SM3_Robotics.SMC_GroupPower;
    GP_EN: BOOL;//servo enable
    GE_EN: BOOL;// axis group start
    MC_MoveDirectRelative_0: SM3_Robotics.MC_MoveDirectRelative;
    DR_EN: BOOL;// move to relative position
    DISP: SM3_Robotics.SMC_POS_REF;// set relative position
    DIST: SM3_Robotics.SMC_POS_REF;
    MC_GroupEnable_0: SM3_Robotics.MC_GroupEnable;
    MC_GroupReadStatus_0: SM3_Robotics.MC_GroupReadStatus;
    GRS_EN: BOOL;//read axis group status
    Kin_HGantry2_0: TRAFO.Kin_HGantry2;
    SMC_TRAFOF_Gantry2_0: SM3_CNC.SMC_TRAFOF_Gantry2;
    SMC_TRAFOF_Scara2_0: SM3_CNC.SMC_TRAFOF_Scara2;
    MC_GroupReadActualPosition_0: SM3_Robotics.MC_GroupReadActualPosition;
    RP_EN: BOOL;// read real-time position
    MC_GroupDisable_0: SM3_Robotics.MC_GroupDisable;
    DISEN_EN: BOOL;// disable the axis group
END VAR

```





## 5-3. CAM function

### 5-3-1. CAM instruction list

Instruction	Function
MC_CamTableSelect	Connect the selected CAM table to the actual CAM table
MC_CamIn	CAM binding
MC_CamOut	CAM unbinding
MC_GearIn	Set the master-slave axis gear ratio and start the electronic gear
MC_GearInPos	Set the master-slave axis synchronization distance and gear ratio and start the electronic gear
MC_GearOut	Disconnect the master-slave axis electronic gear
MC_Phasing	Phase offset
SMC_CAMBounds	Master axis coupling slave axis
SMC_CAMBounds_Pos	Slave axis coupling master axis
SMC_CamEditor	Show CAM table in visualization
SMC_CamRegister	Read tappet information only
SMC_GetCamSlaveSetPosition	Obtain CAM table slave axis position
SMC_GetTappetValue	Evaluating output tappet
SMC_ReadCAM	Read CAM table
SMC_WriteCAM	Write CAM table

## 5-3-2. CAM instructions

### 5-3-2-1. CAM table assignment [MC\_CamTableSelect]

#### (1) Instruction overview

Select the CAM table to be executed, it should be used together with MC\_CamIn.

Instruction	Name	Graphic representation	ST representation
MC_CamTableSelect	Cam table assignment		<pre>MC_CamTableSelect(   Master:= ,   Slave:= ,   CamTable:= ,   Execute:= ,   Periodic:= ,   MasterAbsolute:= ,   SlaveAbsolute:= ,   Done=&gt; ,   Busy=&gt; ,   Error=&gt; ,   ErrorID=&gt; ,   CamTableID=&gt; );</pre>

#### (2) Related variables

VAR_IN_OUT	Name	Data type	Efficient range	Initial value	Description
Master	Master axis	AXIS_REF	-	-	Map to master axis
Slave	Slave axis	AXIS_REF	-	-	Map to slave axis
CamTable	CAM table	MC_CAM_REF	-	-	Map to cam table description
VAR_INPUT	Name	Data type	Efficient range	Initial value	Description
Execute	Valid	BOOL	TRUE/FALSE	FALSE	Rising edge signal, execute current command
Periodic	Repeat mode	BOOL	TRUE/FALSE	FALSE	TRUE: execute the specified cam table periodically and repeatedly FALSE: execute cam table only once
MasterAbsolute	Master axis absolute mode	BOOL	TRUE/FALSE	FALSE	TRUE: absolute coordinates FALSE: relative coordinates
SlaveAbsolute	Slave axis absolute mode	BOOL	TRUE/FALSE	FALSE	TRUE: absolute coordinates FALSE: relative coordinates
VAR_OUTPUT	Name	Data type	Efficient range	Initial value	Description
Done	Completed	BOOL	TRUE/FALSE	FALSE	TRUE when instruction execution is completed
Busy	In execution	BOOL	TRUE/FALSE	FALSE	TRUE when the function block execution has not ended
Error	Error	BOOL	TRUE/FALSE	FALSE	Function block execution error
ErrorID	Error code	SMC_ERROR	-	0	Error identification

CamTableID	Valid CAMID	MC_CAM_ID	-	-	Select valid Cam_ID, used together with CamTableID in MC_CamIn
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### 5-3-2-2. CAM binding [MC\_CamIn]

#### (1) Instruction overview

The master-slave axis is bound, and the engagement mode of the slave axis and the related speed can be set.

Instruction	Name	Graphic representation	ST representation
MC_CamIn	CAM action start		<pre> MC_CamIn (   Master:= ,   Slave:= ,   Execute:= ,   MasterOffset:= ,   SlaveOffset:= ,   MasterScaling:= ,   SlaveScaling:= ,   StartMode:= ,   CamTableID:= ,   VelocityDiff:= ,   Acceleration:= ,   Deceleration:= ,   Jerk:= ,   TappetHysteresis:= ,   InSync=&gt; ,   Busy=&gt; ,   CommandAborted=&gt; ,   Error=&gt; ,   ErrorID=&gt; ,   EndOfProfile=&gt; ,   Tappets=&gt; ); </pre>

#### (2) Related variables

VAR_IN_OUT	Name	Data type	Efficient range	Initial value	Description
Master	Master axis	AXIS_REF	-	-	Map to master axis
Slave	Slave axis	AXIS_REF	-	-	Map to slave axis
VAR_INPUT	Name	Data type	Efficient range	Initial value	Description
Execute	Valid	BOOL	TRUE/FALSE	FALSE	Execute the current command at the rising edge of the signal
MasterOffset	Master axis offset	LREAL	-	0	Offset on the master table
SlaveOffset	Slave axis offset	LREAL	-	0	Offset on the slave table
MasterScaling	Master axis scale	LREAL	-	1	Master configuration file scale factor
SlaveScaling	Slave axis scale	LREAL	-	1	Slave configuration file scale factor
StartMode	Slave axis engagement mode	MC_StartMode	0-4	absolute	0: absolute (absolute position) 1: relative (relative position) 2: ramp_in (Ramp cut in) 3: ramp_in_pos (positive ramp cut in) 4: ramp_in_neg (negative ramp cut in)

CamTableID	Cam table	MC_CAM_ID	-	-	Define the use of cam table, used together with MC_Cam TableSelect output point CamTableID
VelocityDiff	Speed	LREAL	Negative value, 0, positive value	0	Maximum speed of superimposed motion [u/s]
Acceleration	Target acceleration	LREAL	Negative value, 0, positive value	0	Acceleration speed [u/s <sup>2</sup> ]
Deceleration	Target deceleration	LREAL	Negative value, 0, positive value	0	Deceleration speed [u/s <sup>2</sup> ]
Jerk	Target jerk speed	LREAL	Negative value, 0, positive value	0	Jerk speed [u/s <sup>3</sup> ]
TappetHysteresis	Lag size of tappet	LREAL	-	-	Lag size of tappet

VAR_OUTPUT	Name	Data type	Efficient range	Initial value	Description
InSync	Cam valid	BOOL	TRUE/FALSE	FALSE	TRUE indicates that the slave axis is synchronized with the master axis according to the cam table
Busy	In execution	BOOL	TRUE/FALSE	FALSE	TRUE when the function block execution has not ended
CommandAborted	Command interrupted	BOOL	TRUE/FALSE	FALSE	Module execution interrupted is TRUE
Error	Error	BOOL	TRUE/FALSE	FALSE	Function block execution error
ErrorID	Error code	SMC_ERROR	-	0	Error identification
EndOfProfile	Curve completed	BOOL	TRUE/FALSE	FALSE	Pulse output: cycle end of cam profile
Tappets	Tappet table	SMC_TappetData	-	-	For tappet signal processed by SMC_GetTappetValue

### 5-3-2-3. Cam unbinding [MC\_CamOut]

#### (1) Instruction overview

Release the cam coupling relationship between the specified slave axis and its corresponding master axis.

Instruction	Name	Graphic representation	ST representation
MC_CamOut	Release cam action		<pre>MC_CamOut (   Slave:= ,   Execute:= ,   Done=&gt; ,   Busy=&gt; ,   Error=&gt; ,   ErrorID=&gt; );</pre>

#### (2) Related variables

VAR_IN_OUT	Name	Data type	Efficient range	Initial value	Description
Slave	Slave axis	AXIS_REF	-	-	Map to the axis
VAR_INPUT	Name	Data type	Efficient range	Initial value	Description
Execute	Valid	BOOL	TRUE/FALSE	FALSE	Execute the current command at the rising edge of the signal
VAR_OUTPUT	Name	Data type	Efficient range	Initial value	Description
Done	Completed	BOOL	TRUE/FALSE	FALSE	TRUE when instruction execution is completed
Busy	In execution	BOOL	TRUE/FALSE	FALSE	TRUE when the function block execution has not ended
Error	Error	BOOL	TRUE/FALSE	FALSE	Function block execution error
ErrorID	Error code	SMC_ERROR	-	0	Error identification

### 5-3-2-4. CAM action start [MC\_GearIn]

#### (1) Instruction overview

Set the master-slave axis gear ratio and start the electronic gear.

Instruction	Name	Graphic representation	ST representation
MC_GearIn	Cam action start		<pre> MC_GearIn(   Master:= ,   Slave:= ,   Execute:= ,   RatioNumerator:= ,   RatioDenominator:= ,   Acceleration:= ,   Deceleration:= ,   Jerk:= ,   BufferMode:= ,   InGear=&gt; ,   Busy=&gt; ,   Active=&gt; ,   CommandAborted=&gt; ,   Error=&gt; ,   ErrorID=&gt; ); </pre>

#### (2) Related variables

VAR_IN_OUT	Name	Data type	Efficient range	Initial value	Description
Master	Master axis	AXIS_REF	-	-	Map to master axis
Slave	Slave axis	AXIS_REF	-	-	Map to slave axis
VAR_INPUT	Name	Data type	Efficient range	Initial value	Description
Execute	Valid	BOOL	TRUE/FALSE	FALSE	Execute the current command at the rising edge of the signal
RatioNumerator	Numerator of gear ratio	DINT	Positive value	1	Offset on the master table
RatioDenominator	Denominator of gear ratio	UDINT	Positive value	1	Offset on the slave table
Acceleration	Target acceleration	LREAL	Positive value	0	Acceleration speed [u/s <sup>2</sup> ]
Deceleration	Target deceleration	LREAL	Positive value	0	Deceleration speed [u/s <sup>2</sup> ]
Jerk	Target Jerk speed	LREAL	Positive value	0	Jerk speed [u/s <sup>3</sup> ]
BufferMode	Buffer mode	MC_BUFFER_MODE	-	-	-
VAR_OUTPUT	Name	Data type	Efficient range	Initial value	Description
InGear	Gear ratio reached	BOOL	TRUE/FALSE	FALSE	The slave moves at the given master speed ratio, and the target speed reached by the slave axis is TRUE

VAR_IN_OUT	Name	Data type	Efficient range	Initial value	Description
Busy	In execution	BOOL	TRUE/FALSE	FALSE	TRUE when the function block execution has not ended
Active	In control	BOOL	TRUE/FALSE	FALSE	Becomes TRUE in control
CommandAborted	Command interrupted	BOOL	TRUE/FALSE	FALSE	Module execution interrupted is TRUE
Error	Error	BOOL	TRUE/FALSE	FALSE	Function block execution error
ErrorID	Error code	SMC_ERROR	-	0	Error identification

### 5-3-2-5. Position assignment gear action [MC\_GearInPos]

#### (1) Instruction overview

Set the electronic gear ratio between the main axis and the slave axis to perform the electronic gear action.

Specify the master axis position to start synchronization, the slave axis position, and the synchronization distance of the master axis, to complete the action of cutting in the electronic gear.

Instruction	Name	Graphic representation	ST representation
MC_GearInPos	Position assignment gear action		<pre> MC_GearInPos(   Master:= ,   Slave:= ,   Execute:= ,   RatioNumerator:= ,   RatioDenominator:= ,   MasterSyncPosition:= ,   SlaveSyncPosition:= ,   MasterStartDistance:= ,   BufferMode:= ,   AvoidReversal:= ,   StartSync=&gt; ,   InSync=&gt; ,   Busy=&gt; ,   Active=&gt; ,   CommandAborted=&gt; ,   Error=&gt; ,   ErrorID=&gt; ); </pre>

#### (2) Related variables

VAR_IN_OUT	Name	Data type	Efficient range	Initial value	Description
Master	Master axis	AXIS_REF	-	-	Map to master axis
Slave	Slave axis	AXIS_REF	-	-	Map to slave axis
VAR_INPUT	Name	Data type	Efficient range	Initial value	Description
Execute	Valid	BOOL	TRUE/FALSE	FALSE	Execute the current command at the rising edge of the signal
RatioNumerator	Numerator of gear ratio	DINT	Positive value	1	Offset on the master table

RatioDenominator	Denominator of gear ratio	UDINT	Positive value	1	Offset on the slave table
MasterSyncPosition	Main axis synchronization position	LREAL	Negative, 0, positive	0	Main position of axis synchronous operation
SlaveSyncPosition	Slave axis synchronization position	LREAL	Negative, 0, positive	0	Slave position of axis synchronous operation
MasterStartDistance	Perform synchronous master axis position	LREAL	Negative, 0, positive	0	Main distance of gears in the program (start the slave axis to enter synchronization)
BufferMode	Buffer mode	MC_BUFFER_MODE	-	-	-
AvoidReversal	Reverse inhibit	BOOL	TRUE/FALSE	FALSE	Set to FALSE, reversed when the physical position of the slave axis is advanced. Set to TRUE if the reverse operation of the slave axis is physically impossible or dangerous. Applicable only under modal axis. If reversal cannot be avoided, the axis will stop for the error.
<b>VAR_OUTPUT</b>	<b>Name</b>	<b>Data type</b>	<b>Efficient range</b>	<b>Initial value</b>	<b>Description</b>
StartSync	Start synchronization	BOOL	TRUE/FALSE	FALSE	TRUE if the electronic gear starts processing
InSync	Arrival synchronization	BOOL	TRUE/FALSE	FALSE	Electronic gear command completed

<b>VAR_OUTPUT</b>	<b>Name</b>	<b>Data type</b>	<b>Efficient range</b>	<b>Initial value</b>	<b>Description</b>
Busy	In execution	BOOL	TRUE/FALSE	FALSE	TRUE when the function block execution has not ended
Active	In control	BOOL	TRUE/FALSE	FALSE	Becomes TRUE in control
CommandAborted	Command interrupted	BOOL	TRUE/FALSE	FALSE	Module execution interrupted is TRUE
Error	Error	BOOL	TRUE/FALSE	FALSE	Function block execution error
ErrorID	Error code	SMC_ERROR	-	0	Error identification



### 5-2-3-6. Release gear action [MC\_GearOut]

#### (1) Instruction overview

Disconnect the slave axis from the electronic gear coupling of the master axis.

Instruction	Name	Graphic representation	ST representation
MC_GearOut	Release gear action		<pre> MC_GearOut(   Slave:= ,   Execute:= ,   Done=&gt; ,   Busy=&gt; ,   Error=&gt; ,   ErrorID=&gt; ); </pre>

#### (2) Related variables

VAR_IN_OUT	Name	Data type	Efficient range	Initial value	Description
Slave	Slave axis	AXIS_REF	-	-	Map to the axis
VAR_INPUT	Name	Data type	Efficient range	Initial value	Description
Execute	Valid	BOOL	TRUE/FALSE	FALSE	Execute the current command at the rising edge of the signal
VAR_OUTPUT	Name	Data type	Efficient range	Initial value	Description
Done	Completed	BOOL	TRUE/FALSE	FALSE	TRUE if the electronic gear coupling between the slave axis and the master axis is disconnected
Busy	In execution	BOOL	TRUE/FALSE	FALSE	TRUE when the function block execution has not ended
Error	Error	BOOL	TRUE/FALSE	FALSE	Function block execution error
ErrorID	Error code	SMC_ERROR	-	0	Error identification

### 5-2-3-7. Master-slave axis phase offset [MC\_Phasing]

#### (1) Instruction overview

Specify the phase offset between the master and slave axis.

Instruction	Name	Graphic representation	ST representation
MC_Phasing	Master-slave axis phase offset		<pre> MC_Phasing(   Master:= ,   Slave:= ,   Execute:= ,   PhaseShift:= ,   Velocity:= ,   Acceleration:= ,   Deceleration:= ,   Jerk:= ,   Done=&gt; ,   Busy=&gt; ,   CommandAborted=&gt; ,   Error=&gt; ,   ErrorID=&gt; ); </pre>

#### (2) Related variables

VAR_IN_OUT	Name	Data type	Efficient range	Initial value	Description
Master	Master axis	AXIS_REF	-	-	Map to master axis
Slave	Slave axis	AXIS_REF	-	-	Map to slave axis
VAR_INPUT	Name	Data type	Efficient range	Initial value	Description
Execute	Valid	BOOL	TRUE/FALSE	FALSE	Execute the current command at the rising edge of the signal
PhaseShift	Phase compensation	LREAL	Negative, 0, positive	0	Specify the master axis phase compensation
Velocity	Speed	LREAL	0, positive	0	Maximum speed value when performing phase offset [command unit/s]
Acceleration	Acceleration	LREAL	0, positive	0	Maximum acceleration speed value when performing phase offset [command unit/s <sup>2</sup> ]
Deceleration	Deceleration	LREAL	0, positive	0	Maximum deceleration speed value when performing phase offset [command unit /s <sup>2</sup> ]
Jerk	Jerk speed	LREAL	0, positive	0	Maximum jerk speed value when performing phase offset [command unit /s <sup>3</sup> ]
VAR_OUTPUT	Name	Data type	Efficient range	Initial value	Description
Done	Completed	BOOL	TRUE/FALSE	FALSE	TRUE if the electronic gear coupling between the slave axis and the master axis is disconnected
Busy	In execution	BOOL	TRUE/FALSE	FALSE	TRUE when the function block execution has not ended
CommandAborted	Command interrupted	BOOL	TRUE/FALSE	FALSE	Module execution interrupted is TRUE

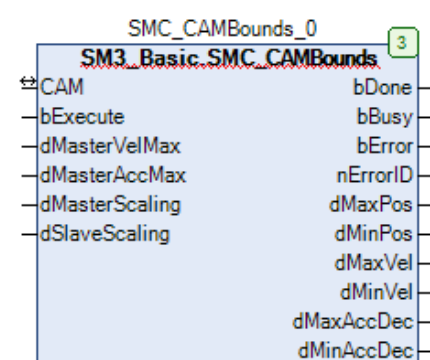
Error	Error	BOOL	TRUE/FALSE	FALSE	Function block execution error
ErrorID	Error code	SMC_ERROR	-	0	Error identification

### 5-2-3-8. CAM range [SMC\_CAMBounds]

#### (1) Instruction overview

When the slave axis is coupled with the master axis cam, the maximum position, speed and acceleration of the slave axis can be calculated through this function block.

The master axis moves under the input maximum speed and acceleration/deceleration limit. This command can check whether the curve is correct when designing the cam table, provided that the maximum acceleration and deceleration, speed, etc. of the master axis are known.

Instruction	Name	Graphic representation	ST representation
SMC_CAMBounds	Cam range		<pre> SMC_CAMBounds( CAM:= , bExecute:= , dMasterVelMax:= , dMasterAccMax:= , dMasterScaling:= , dSlaveScaling:= , bDone=&gt; , bBusy=&gt; , bError=&gt; , nErrorID=&gt; , dMaxPos=&gt; , dMinPos=&gt; , dMaxVel=&gt; , dMinVel=&gt; , dMaxAccDec=&gt; , dMinAccDec=&gt; ); </pre>

#### (2) Related variables

VAR_IN_OUT	Name	Data type	Efficient range	Initial value	Description
Cam	Cam	MC_CAM_REF	-	-	Map to the cam
VAR_INPUT	Name	Data type	Efficient range	Initial value	Description
bExecute	Valid	BOOL	TRUE/FALSE	FALSE	Execute the current command at the rising edge of the signal
dMasterVelMax	Max speed	LREAL	-	1	Maximum master axis speed in absolute mode
dMasterAccMax	Max acceleration speed	LREAL	-	0	Maximum master axis acceleration in absolute mode
dMasterScaling	Scale factor	LREAL	-	1	Master axis CAM application scale factor
dSlaveScaling	Scale factor	LREAL	-	1	Slave axis CAM application scale factor
VAR_OUTPUT	Name	Data type	Efficient range	Initial value	Description
bDone	Completed	BOOL	TRUE/FALSE	FALSE	TRUE if the electronic gear coupling

VAR_IN_OUT	Name	Data type	Efficient range	Initial value	Description
					between the slave axis and the master axis is disconnected
bBusy	In execution	BOOL	TRUE/FALSE	FALSE	TRUE when the function block execution has not ended
bError	Error	BOOL	TRUE/FALSE	FALSE	Function block execution error
nErrorID	Error code	SMC_ERROR	-	0	Error identification
dMaxPos	Max position	LREAL	-	0	Calculate the maximum position of the slave axis according to the cam table
dMinPos	Min position	LREAL	-	0	Calculate the minimum position of the slave axis according to the cam table
dMaxVel	Max speed	LREAL	-	0	Calculate the maximum speed of the slave axis
dMinVel	Min speed	LREAL	-	0	Calculate the minimum speed of the slave axis
dMaxAccDec	Max acceleration	LREAL	-	0	Calculate the maximum acceleration of the slave axis
dMinAccDec	Min acceleration	LREAL	-	0	Calculate the minimum acceleration of the slave axis

### 5-2-3-9. CAM position range [SMC\_CAMBounds\_Pos]

#### (1) Instruction overview

When the slave axis is coupled with the master axis cam, the maximum position and minimum position of the slave axis can be calculated through this function block. Compared with SMC\_CAMBounds, this function block has no calculation of maximum acceleration, and other functions are the same.

Instruction	Name	Graphic representation	ST representation
SMC_CAMBounds_Pos	CAM position range		<pre> SMC_CAMBounds_Pos(   CAM:= ,   bExecute:= ,   dMasterVelMax:= ,   dMasterAccMax:= ,   dMasterScaling:= ,   dSlaveScaling:= ,   bDone=&gt; ,   bBusy=&gt; ,   bError=&gt; ,   nErrorID=&gt; ,   dMaxPos=&gt; ,   dMinPos=&gt; ); </pre>

#### (2) Related variables

VAR_IN_OUT	Name	Data type	Efficient range	Initial value	Description
Cam	Cam	MC_CAM_REF	-	-	Map to the cam
VAR_INPUT	Name	Data type	Efficient range	Initial	Description

				value	
bExecute	Valid	BOOL	TRUE/FALSE	FALSE	Execute the current command at the rising edge of the signal
dMasterVelMax	Max speed	LREAL	-	1	Maximum master axis speed in absolute mode
dMasterAccMax	Max acceleration	LREAL	-	0	Maximum master axis acceleration speed in absolute mode
dMasterScaling	Scale factor	LREAL	-	1	Scale factor in master axis cam application
dSlaveScaling	Scale factor	LREAL	-	1	Scale factor in slave axis cam application
<b>VAR_OUTPUT</b>	<b>Name</b>	<b>Data type</b>	<b>Efficient range</b>	<b>Initial value</b>	<b>Description</b>
bDone	Completed	BOOL	TRUE/FALSE	FALSE	TRUE if the electronic gear coupling between the slave axis and the master axis is disconnected
bBusy	In execution	BOOL	TRUE/FALSE	FALSE	TRUE when the function block execution has not ended
bError	Error	BOOL	TRUE/FALSE	FALSE	Function block execution error
nErrorID	Error code	SMC_ERROR	-	0	Error identification
dMaxPos	Max position	LREAL	-	0	Calculate the maximum position of the slave axis according to the cam table
dMinPos	Min position	LREAL	-	0	Calculate the minimum position of the slave axis according to the cam table

5-3-2-10. Show cam table in visualization [SMC\_CamEditor]

(1) Instruction overview

This function block is used to display the cam table in the visualization. This function block does not work without TargetVisu or WebVisu.

Instruction	Name	Graphic representation	ST representation
SMC_CamEditor	Show cam table in visualization		<pre> SMC_CamEditor(   bEnable:= ,   bCAMchanged=&gt; ,   bError=&gt; ,   nErrorID=&gt; ,   cam:= ); </pre>

(2) Related variables

VAR_IN_OUT	Name	Data type	Efficient range	Initial value	Description
Cam	Cam	MC_CAM_REF	-	-	Map to the cam
VAR_INPUT	Name	Data type	Efficient range	Initial value	Description
bEnable	Valid	BOOL	TRUE/FALSE	FALSE	Modify cam table when TRUE
VAR_OUTPUT	Name	Data type	Efficient range	Initial value	Description
bCAMchanged	Completed	BOOL	TRUE/FALSE	FALSE	The cam in the visualization has changed. Then is TRUE
bError	Error	BOOL	TRUE/FALSE	FALSE	Function block execution error
nErrorID	Error code	SMC_ERROR	-	0	Error identification

5-3-2-11. CAM tappet control [SMC\_CamRegister]

(1) Instruction overview

Realize cam tappet control (cam switch). During cam editing, master-slave axis curve no need to be edited. Tappet control can be realized through this function block by configuring tappet table.

Instruction	Name	Graphic representation	ST representation
SMC_CamRegister	Cam tappet control		<pre> SMC_CamRegister(   Master:= ,   CamTable:= ,   bTappet:= ,   Enable:= ,   MasterOffset:= ,   MasterScaling:= ,   TappetHysteresis:= ,   DeadTimeCompensation:= ,   Busy=&gt; ,   Error=&gt; ,   ErrorID=&gt; ,   EndOfProfile=&gt; ); </pre>

(2) Related variables

VAR_IN_OUT	Name	Data type	Efficient range	Initial value	Description
Master	Master axis	AXIS_REF	-	-	Map to the master axis
CamTable	Cam table	MC_CAM_REF	-	-	Map to an electronic cam which is an instance of electronic cam
bTappet	Tappet output	ARRAY [1..MAX_NUM _TAPPETS]OF BOOL	-	-	Tappet point output
VAR_INPUT	Name	Data type	Efficient range	Initial value	Description
Enable	Execution	BOOL	TRUE/FALSE	FALSE	Execute the current command is TRUE
MasterOffset	Master axis offset	LREAL	-	0	Offset on the master table
MasterScaling	Master axis scale	LREAL	-	1	Scale factor of master configuration file
TappetHysteresis	Lag size of tappet	LREAL	-	-	Lag size of tappet
DeadTimeCompensation	Dead time compensation	LREAL	-	0	Dead time compensation in seconds. The expected master axis position will be calculated by linear extrapolation
VAR_OUTPUT	Name	Data type	Efficient range	Initial value	Description
Busy	In execution	BOOL	TRUE/FALSE	FALSE	TRUE when the function block execution has not ended
Error	Error	BOOL	TRUE/FALSE	FALSE	Function block execution error
ErrorID	Error code	SMC_ERROR	-	0	Error identification

VAR_IN_OUT	Name	Data type	Efficient range	Initial value	Description
EndOfProfile	Curve period completed	BOOL	TRUE/FALSE	FALSE	TRUE if the master axis position is greater than or equal to the set cycle

### 5-3-2-12. Obtain cam slave axis position [SMC\_GetCamSlaveSetPosition]

#### (1) Instruction overview

Read the position, speed, acceleration of the cam table slave axis.

Instruction	Name	Graphic representation	ST representation
SMC_GetCamSlaveSetPosition	Obtain cam slave axis position		<pre>SMC_GetCamSlaveSetPosition( Master:= , Slave:= , Enable:= , MasterOffset:= , SlaveOffset:= , MasterScaling:= , SlaveScaling:= , CamTableID:= , fStartPosition=&gt; , fStartVelocity=&gt; , fStartAcceleration=&gt; , Busy=&gt; , Error=&gt; , ErrorID=&gt; );</pre>

#### (2) Related variables

VAR_IN_OUT	Name	Data type	Efficient range	Initial value	Description
Master	Master axis	AXIS_REF	-	-	Map to the master axis
Slave	Slave axis	AXIS_REF	-	-	Map to the slave axis
VAR_INPUT	Name	Data type	Efficient range	Initial value	Description
Execute	Valid	BOOL	TRUE/FALSE	FALSE	Execute the current command at the rising edge of the signal
MasterOffset	Master axis offset	LREAL	-	0	offset on the master table
SlaveOffset	Slave axis offset	LREAL	-	0	offset on the slave table
MasterScaling	Master axis scale	LREAL	-	1	Scale factor of the master configuration file
SlaveScaling	Slave axis scale	LREAL	-	1	Scale factor of the slave configuration file
CamTableID	Cam table	MC_CAM_ID	-	-	Define the use of cam table, use together with the output point CamTableI of MC_CamTable Select
VAR_OUTPUT	Name	Data type	Efficient range	Initial value	Description
fStartPosition	Slave axis	LREAL	-	0	Slave axis position obtained from cam



VAR_IN_OUT	Name	Data type	Efficient range	Initial value	Description
	position				table and current master axis information
fStartVelocity	Slave axis speed	LREAL	-	0	Slave axis speed obtained from cam table and current master axis information
fStartAcceleration	Slave axis acceleration	LREAL	-	0	Slave axis acceleration obtained from cam table and current master axis information
Busy	In execution	BOOL	TRUE/FALSE	FALSE	TRUE when the function block execution has not ended
Error	Error	BOOL	TRUE/FALSE	FALSE	Function block execution error
ErrorID	Error code	SMC_ERROR	-	0	Error identification

### 5-3-2-13. Obtain tappet output value [SMC\_GetTappetValue]

#### (1) Instruction overview

Read the current tappet status, need to use together with MC\_CamIn.

Instruction	Name	Graphic representation	ST representation
SMC_GetTappetValue	Obtain tappet output value		<pre>SMC_GetTappetValue( Tappets:= , iID:= , bInitValue:= , bSetInitValueAtReset:= , bTappet=&gt; );</pre>

#### (2) Related variables

VAR_IN_OUT	Name	Data type	Efficient range	Initial value	Description
Tappet	Tappet	SMC_Tappet Data	-	-	Map to a tappet
VAR_INPUT	Name	Data type	Efficient range	Initial value	Description
iID	Tappet group ID	INT	Positive, 0	0	Tappet group ID
bInitValue	Initial value	BOOL	TRUE/FALSE	FALSE	Initial value of tappet to be assigned at the first calling
bSetInitValueAtReset	Tappet reset	BOOL	TRUE/FALSE	FALSE	If TRUE, the output value of the tappet will be set to the initial value when the CamIn function block is restarted. If FALSE, the tappet value will be maintained when the CamIn function block is restarted
VAR_OUTPUT	Name	Data type	Efficient range	Initial value	Description
bTappet	Tappet value	BOOL	TRUE/FALSE	FALSE	Tappet value

5-3-2-14. Read the cam table [SMC\_ReadCAM]

(1) Instruction overview

Instruction	Name	Graphic representation	ST representation
SMC_ReadCAM	Read the cam table		<pre>SMC_ReadCAM(   bExecute:= ,   sFileName:= ,   bDone=&gt; ,   bBusy=&gt; ,   bError=&gt; ,   ErrorID=&gt; ,   CAM=&gt; );</pre>

(2) Related variables

VAR_INPUT	Name	Data type	Efficient range	Initial value	Description
bExecute	Execution	BOOL	TRUE/FALSE	FALSE	Execute the function block at the rising edge
sFileName	File name	STRING(255)	-	-	The name of the file that contains the cam description that defines the ASCII format
VAR_OUTPUT	Name	Data type	Efficient range	Initial value	Description
bDone	Completed	BOOL	TRUE/FALSE	FALSE	TRUE when the Cam is read
bBusy	In execution	BOOL	TRUE/FALSE	FALSE	TRUE when the function block execution has not ended
bError	Error	BOOL	TRUE/FALSE	FALSE	Function block execution error
nErrorID	Error code	SMC_ERROR	-	0	Error identification
CAM	-	MC_CAM_REF	STRUCT(nElements := 0, nTappets := 0)	-	-

5-3-2-15. Change the cam table [SMC\_WriteCAM]

(1) Instruction overview

Used to store the cam table created in the cam editor to a file at run time.

Instruction	Name	Graphic representation	ST representation
SMC_WriteCAM	Change the cam table		<pre> SMC_WriteCAM( CAM:= , bExecute:= , sFileName:= , bDone=&gt; , bBusy=&gt; , bError=&gt; , ErrorID=&gt; ); </pre>

(2) Related variables

VAR_IN_OUT	Name	Data type	Efficient range	Initial value	Description
CAM	Cam	MC_CAM_REF	-	-	Map to the cam
VAR_INPUT	Name	Data type	Efficient range	Initial value	Description
bExecute	Execution	BOOL	TRUE/FALSE	FALSE	Execute the function block at the rising edge
sFileName	File name	STRING(255)			The name of the file that contains the cam description that defines the ASCII format
VAR_OUTPUT	Name	Data type	Efficient range	Initial value	Description
bDone	Completed	BOOL	TRUE/FALSE	FALSE	TRUE if cam write to file is complete
bBusy	In execution	BOOL	TRUE/FALSE	FALSE	TRUE when the function block execution has not ended
bError	Error	BOOL	TRUE/FALSE	FALSE	Function block execution error
nErrorID	Error code	SMC_ERROR	-	0	Error identification

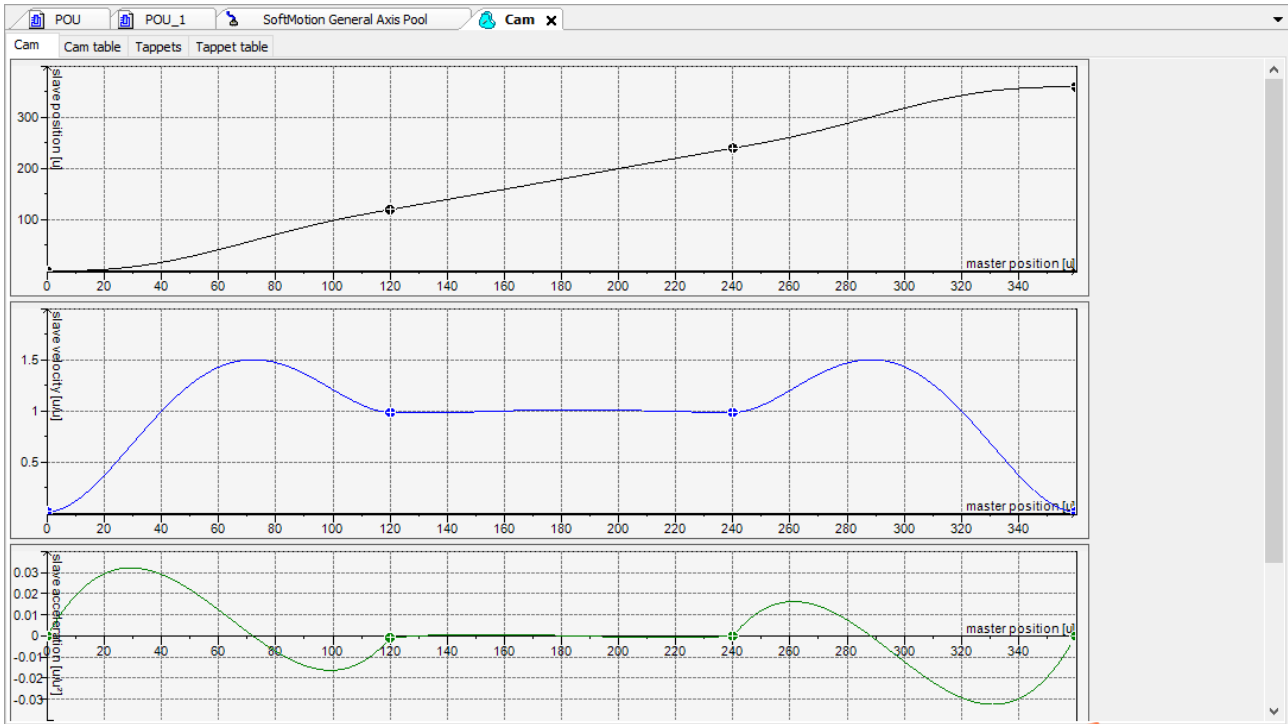
### 5-3-3. CAM function application

#### Example 1:

The electronic cam is used to realize the master axis running speed mode. The speed is 15 pulse/s, the acceleration is 100 pulse/s<sup>2</sup>, and the direction is positive. The slave station operates according to cam table.

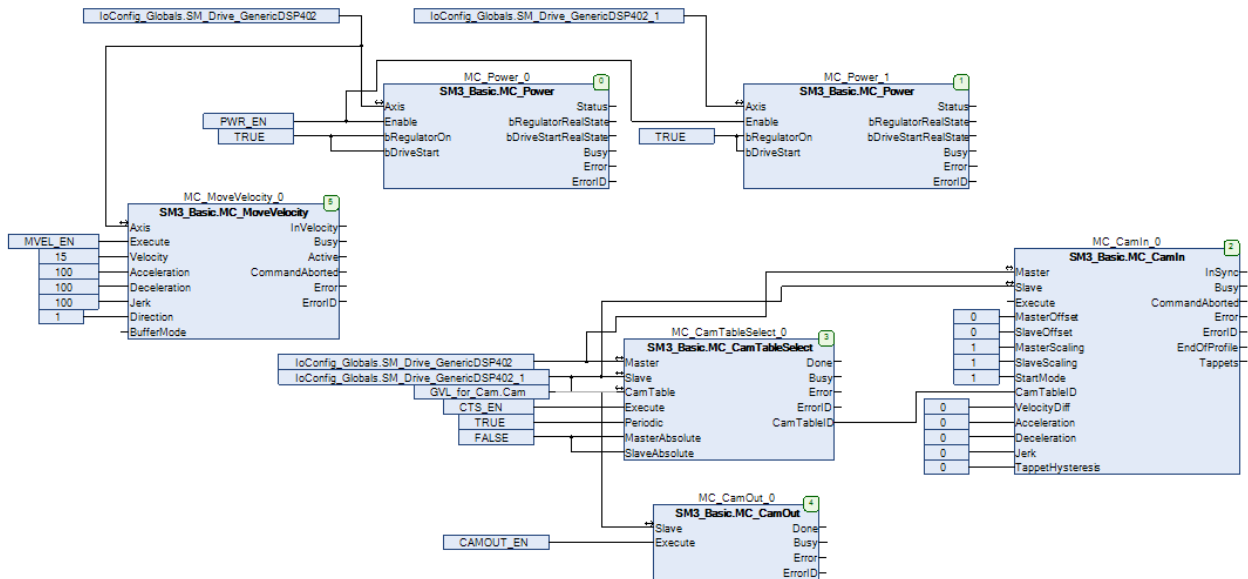
Program operation:

- (1) right click [application] in the project bar, select the [add object]—[cam table], name as Cam and open.  
Add the cam parameters as the following diagram.



- (2) Add enable module MC\_Power in the main program POU\_1, master axis speed module MC\_MoveVelocity, calling cam module MC\_CamTableSelect, configure cam module MC\_CamIn, unbinding cam module MC\_CamOut.

```
PROGRAM POU_1
VAR
    MC_Power_0: SM3_Basic.MC_Power;
    PWR_EN: BOOL; //master slave enable
    MC_Power_1: SM3_Basic.MC_Power;
    MC_CamIn_0: SM3_Basic.MC_CamIn;
    MC_CamTableSelect_0: SM3_Basic.MC_CamTableSelect;
    CTS_EN: BOOL; // cam table loading
    MC_CamOut_0: SM3_Basic.MC_CamOut;
    CAMOUT_EN: BOOL; // cam unbinding
    MC_MoveVelocity_0: SM3_Basic.MC_MoveVelocity;
    MVEL_EN: BOOL; // master axis speed mode
END_VAR
```



Note:

If the slave axis is in motion during the execution of Camout, the slave axis will continue to run at the original speed after the command is executed. It can stop through MC\_Stop, MC\_Halt command.

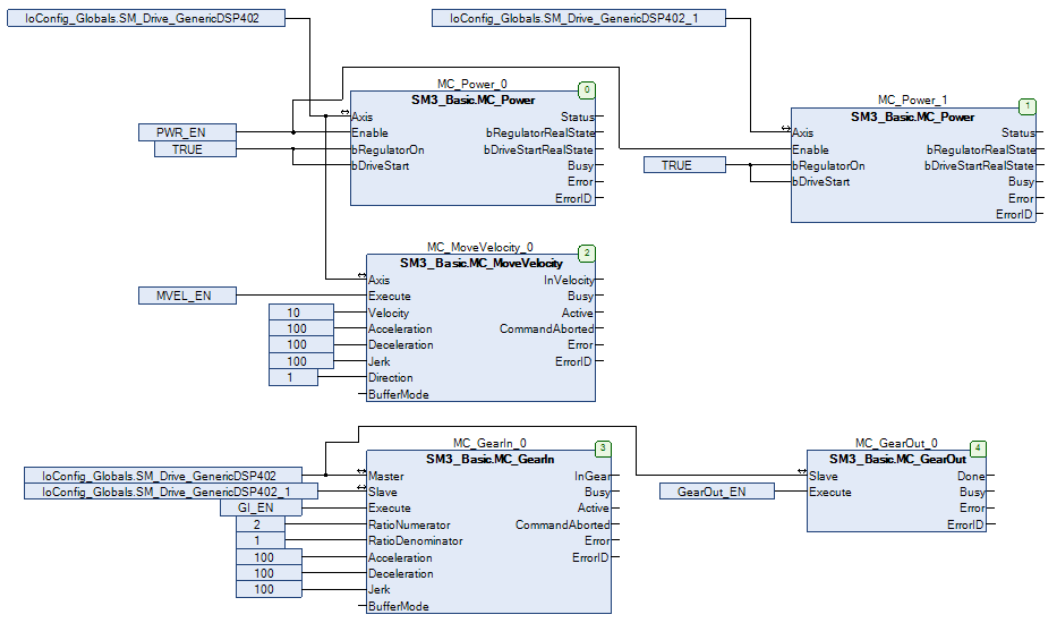
### Example 2:

The master axis running speed mode is realized by using the electronic gear. The speed is 15 pulse/s, the acceleration is 100 pulse/s<sup>2</sup>, and the direction is positive. The slave station moves according to the electronic gear ratio of 2. Then the speed of the slave station is 30 pulse/s.

```

PROGRAM POU_2
VAR
  MC_Power_0: SM3_Basic.MC_Power;
  MC_Power_1: SM3_Basic.MC_Power;
  PWR_EN: BOOL; // enable
  MC_GearIn_0: SM3_Basic.MC_GearIn;
  MC_GearOut_0: SM3_Basic.MC_GearOut;
  MC_MoveVelocity_0: SM3_Basic.MC_MoveVelocity;
  MVEL_EN: BOOL; // speed mode
  GearOut_EN: BOOL; // disconnect electronic gear
  GI_EN: BOOL; // bind the electronic gear
  SMC_GroupPower_0: SM3_Robotics.SMC_GroupPower;
END_VAR

```



## 6. Q&A

When running or debugging PLC, users may encounter some difficult problems due to lack of experience. This part mainly aims at the problems that users are most likely to encounter, and puts forward solutions for users' reference.

Q1: When the user newly installs the Codesys software and opens it for compilation, there will be many reasons for error reporting.

A1: Generally, it is caused by the missing library. Double click the library manager - click download missing Libraries... And wait for the missing library to be downloaded.

Q2: Why the gateway displays red dots?

A2:

The gateway service may be shut down by an unknown force. You can open the service "Codesys gateway V3" in task management or restart the computer.

Q3: Reasons for warning prompt after adding multiple EtherCAT slave stations?

A3:

Because the servo station number is repeated, it will not affect the use. If you want to clear the warning and double blue underline, scan the servo again, and then modify the repeated station number.

Q4: The reason why the communication will be cut off once the EtherCAT axis is running?

A4:

The EtherCAT related POU must be placed under the EtherCAT task. It has a position synchronization cycle.

Q5: How to cancel password login?

A5:

(1) Click [chang communicaton Policy] in [device] of scanning device interface, change to [Optional User Management] for the [New Policy] in the [Device User Management].

(2) Select [Device], right click and select [Reset Origin Device[Device]].

After this operation, it no needs password when login.

If user needs password when login, please click [chang communicaton Policy] in [device], change to [Enforced User Management] for the [New Policy] in the [Device User Management].

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