DM5-N Series
High-Performance Low-Voltage Servo System
User Manual

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Shenzhen Megmeet Electrical Co. Ltd. provides professional technical support for our customers. You can contact the local branch office or customer service center, or directly contact the company headquarters.

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Foreword

Thank you for choosing the DM5-N series low-voltage servo system manufactured by Shenzhen Megmeet Electrical Co., Ltd.

DM5-N series servo system, a cost-effective choice for general purposes and the OEM market, is developed on a new hardware platform with cutting-edge control algorithms, and featured with excellent performance, comprehensive functionality, compact structure, convenient installation, simple commissioning, and easy maintenance. The servo system supports the EtherCAT communication protocol, enabling networking of multiple servo systems with a host controller. Additionally, the servo system provides rigidity setting, inertia identification, and vibration suppression, delivering exceptional precision in position, speed and torque control, which are essential for sectors such as mobile robots (AMR, AGV), service robots, specialized robots, logistics warehousing and sorting, medical equipment, measuring instruments, textile processing, electronic manufacturing, new energy industry, inkjet printing, photovoltaic power, lithium batteries, 3C products (computer, communication, consumer electronics), lasers, and machine tools.

DM5-N series servo system operates with DC power supply. With smaller size and lighter weight, it can be easily installed and used together with medium- and low-inertia servo motors, delivering a low mechanical time constant for quick operation. It supports absolute encoders.

This manual provides guidance on installation, wiring, parameter setting, troubleshooting, and related precautions. To ensure proper installation and operation of the DM5-N series servo system, and to maximize its capabilities, please read this user manual thoroughly before installation. This manual shall be kept properly and delivered to the actual users of the product.

Unboxing inspection

When unboxing the product, please make sure to check the followings:

- whether there is any damage to the product;
- Whether the rotating shaft of the servo motor rotates smoothly (motor with brake excepted);
- Whether the servo drive model and the rated values on the nameplate are consistent with your order requirements;
- Whether there is any damage to the cables and wiring, and whether the cables and wiring can work properly.

Our company has implemented strict inspection on the product's manufacturing and packaging. If there is still any error, please contact us or the local distributor.

We are engaged in the continuous improvement of our servo drive products. The relevant manuals provided by us are subject to changes without notice.

Safety precautions

Indicates that failure to comply with the notice can result in death or severe personal injuries.

Indicates that failure to comply with the notice may result in moderate or minor personal injuries or equipment damage.

- Install the product on incombustible materials such as metal. Failure to comply will result in a fire.
- Do not install the product near combustible objects. Failure to comply will result in a fire.
- Do not install the product in places with explosive gases. Failure to comply will result in explosion.
- The wiring work must be done by professional personnel. Otherwise, there will be an electric shock.
- Before wiring, make sure that the power supply input is completely cut off. Otherwise, there is a risk of electric shock.
- Make sure to reliably ground the servo drive. Otherwise, there is a risk of electric shock.
- Properly install the covers of the drive enclosure before powering on. Otherwise, there is a risk of electric shock and explosion.
- When powering on a drive product that has been idle/stored for more than 2 years, employ a voltage regulator to gradually turn up the input voltage to the required level. Otherwise, there is a risk of electric shock or explosion.
- Do not touch any terminals with bare hands when the drive is powered on. Otherwise, there is a risk of electric shock.
- Do not operate the servo drive with wet hands. Otherwise, there is a risk of electric shock.
- Before maintenance, make sure the drive has been powered off for at least 10 minutes, and that the charging indicator is completely off or the bus negative/positive voltage is below 36 V. Failure to comply will result in an electric shock.
- Parts/Components replacement must be carried out by sufficiently qualified personnel. Do not leave any wire residue or foreign metal inside the drive. Failure to comply will result in a fire.
- The bare parts of the terminal lugs in the main circuit must be properly wrapped with insulation tapes. Otherwise, electric shock may occur.

WARNING

- Install the servo drive on the place that can bear the weight. Failure to comply will result in personal injuries or equipment damage.
- Do not install the drive near water pipes or other places capable of water splashing. Otherwise, there is a risk of property damage.
- Do not allow screws, gaskets, metal bars, and the like to fall into the servo drive. Failure to comply may result in a fire or property damage.
- If the servo drive is damaged or lack of components, do not install or run the drive. Failure to comply may result in a fire or personal injuries.
- Do not install the product in places with direct sunlight exposure. Otherwise, there is a risk of property damage.
- Cable lugs must be firmly connected to the terminals of the main circuit. Otherwise, there is a risk of property damage.
- When handling the servo motor, do not drag the machine by pulling the cables or holding the rotating shaft only. Otherwise, there is a risk of machine dropping that may cause personal injuries or property damage.
- Do not impact the shaft with direct striking or pounding as such actions may cause damage to the shaft and the encoder attached to the opposite side of the shaft. Failure to comply may result in property damage.
- Do not store the servo motor in environments with vibration levels exceeding the specified limits, as this may cause equipment damage.

Content

Chapter 1 DM5-N Series Model Selection

1.1 Servo motor and servo drive model

1.1.1 Servo motor model

SPM - B C 8 06 04 M A K - AA 05 - L

Mark	Product series
SPM	SPM series

Mark	Rated voltage (V)	Mark	Rated voltage (V)
A	12	E	60
B	24	F	72
C	36	G	80
D	48	...	

Mark	Rated speed (rpm)	Mark	Rated speed (rpm)
A	1000	E	2000
B	2500	F	4000
C	3000	G	5000
D	1500	...	

Mark	Encoder type	Mark	Encoder type
5	17-bit single-turn absolute optical	8	17-bit multi-turn absolute magnetic
6	23-bit multi-turn absolute optical	...	
7	17-bit single-turn absolute magnetic		

Mark	Frame	Mark	Frame
02	20×20	10	100×100
04	40×40	11	110×110
06	60×60	13	130×130
08	80×80	18	180×180

Mark	Rated power	Mark	Rated power
5A	50	06	600
01	100	07	750
02	200	10	1000
04	400		

Motor design number

Mark	Cable length (m)
03	3*0.1
05	5*0.1
10	10*0.1

Mark	Terminal combination	
	Power terminal	Encoder terminal
AA	UVW and PE are needle-type	Molex 10 pin female
BA	UVW and PE are U-type	Molex 10 pin female
EC	Aviation plug GM-1310/P-4B	Aviation plug GM-1310/P-7
FC	Aviation plug GM-1310/P-6B	Aviation plug GM-1310/P-7
GC	Aviation plug GM-2110/P-4	Aviation plug GM-1310/P-7

Mark	Output shaft	Mark	Output shaft
M	With keyway, without oil seal	C	External spline with oil seal
K	With keyway, with oil seal	D	D-type shaft with oil seal
O	Optical shaft with oil seal		

Mark	With/Without brake
A	Without brake
B	With brake

Mark	Inertia
L	Low inertia
M	Medium inertia
H	High inertia

The standard configuration is 48 V. For other voltage requirements, please contact us.

Fig. 1-1 DM5 servo motor model

Motor power terminal definitions			
No.	Mark	Power terminal	Brake terminal
1	A	UVW and PE are needle-type.	Needle-type
2	B	UVW are needle-type, and PE is U-type.	Needle-type
3	C	UVW and PE are U-type.	Needle-type
4	D	UVW are U-type, and PE is needle-type.	Needle-type
5	E	Aviation plug GM-1310/P-4B	/
6	F	Aviation plug GM-1310/P-6B	/
7	G	Aviation plug GM-2110/P-4	/

Encoder terminal definitions		
No.	Mark	Encoder terminal
1	A	Molex 10-pin female connector (directly connected to the drive)
2	B	Molex 10-pin male connector (indirect connection)
3	C	Aviation plug GM-1310/P-7

Terminal combinations for standard motors					
No.	Mark	Terminal combinations			Suitable motor power
		Power terminal	Encoder terminal	Brake terminal	
1	AA	UVW and PE are needle-type.	Molex 10-pin female connector (directly connected to the drive)	Needle-type	50 W to 600 W
2	BA	UVW and PE are U-type.	Molex 10-pin female connector (directly connected to the drive)	Needle-type	750 W to 1 kW
3	EC	Aviation plug GM-1310/P-4B	Aviation plug GM-1310/P-7	/	50 W to 200 W (motors without brake)
4	FC	Aviation plug GM-1310/P-6B	Aviation plug GM-1310/P-7	/	50 W to 100 W (motors with brake)
5	GC	Aviation plug	Aviation plug	Aviation plug	400 W to 1 kW

Terminal combinations for standard motors					
No.	Mark	Terminal combinations			Suitable motor power
		Power terminal	Encoder terminal	Brake terminal	
		GM-2110/P-4	GM-1310/P-7	GM-1310/P-2	

1.1.2 Servo motor nameplate

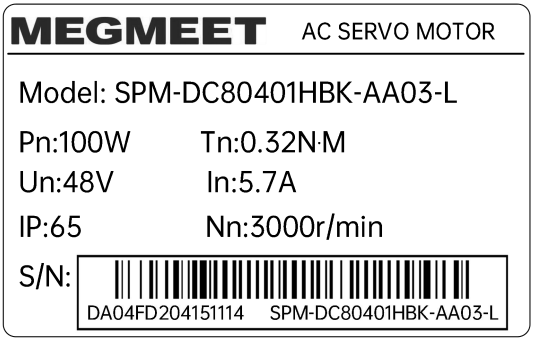


Fig. 1-2 DM5 Servo motor nameplate

1.1.3 Servo drive model

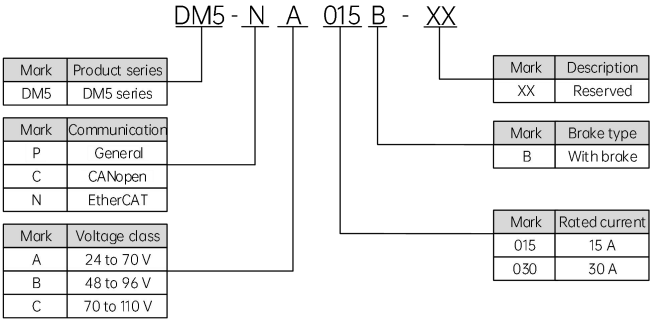


Fig. 1-3 DM5 Servo drive model

1.1.4 Servo drive nameplate

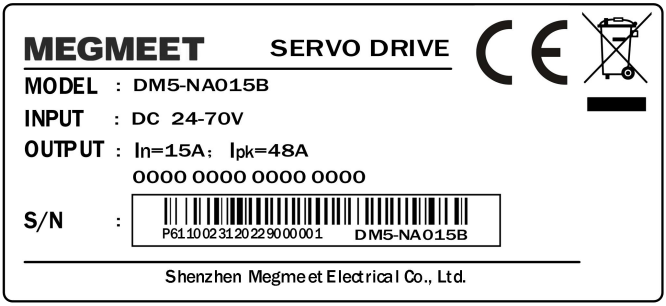


Fig. 1-4 DM5-N servo drive nameplate

1.1.5 Servo drive parts and description

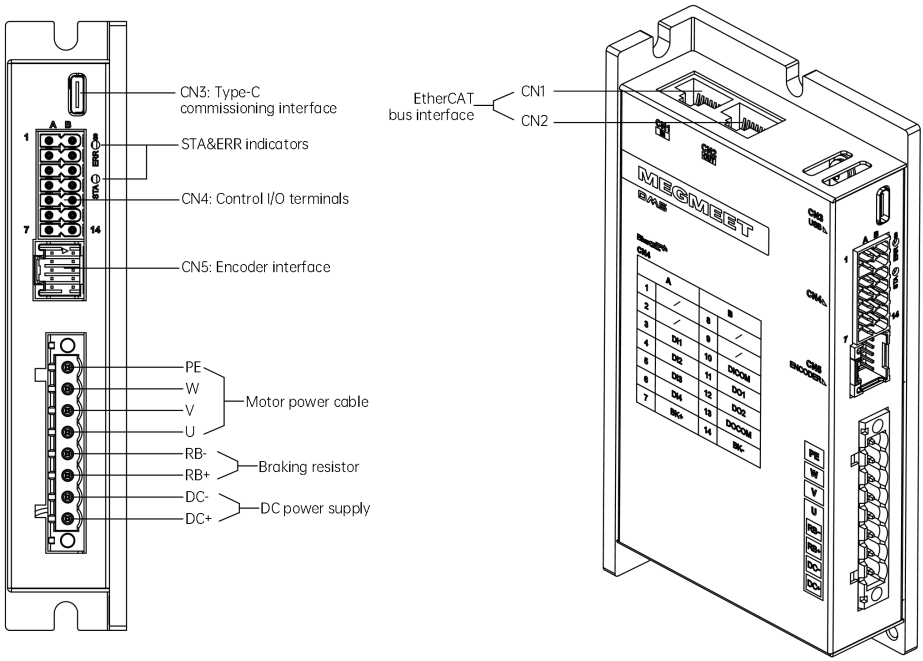


Fig. 1-5 DM5-N servo drive drawing (SIZE A)

Table 1-1 DM5-N servo drive interface description (SIZE A)

No.	Name		Description
1	CN1, CN2: communication interface		Two RJ45 ports for EtherCAT communication
2	CN3: Type-C USB		Connected to a computer's USB port for parameter setting and performance debugging
3	CN4: I/O interface		4 digital inputs, 2 digital outputs, and 1 brake output
4	CN5: encoder interface		Connected to a motor encoder
5	STA&ERR: state and error indicators		Refer to Table 5-1 of this manual for definitions of STA&ERR display.
6	Main circuit terminals	DC+, DC-: main power supply input	Main power supply input, 24 V to 70 V DC
		RB+, RB-: external braking resistor terminals	Used to connect the external braking resistor
		U, V, W: servo motor power terminals	Servo motor UVW power terminals
		PE	Motor's grounding terminal

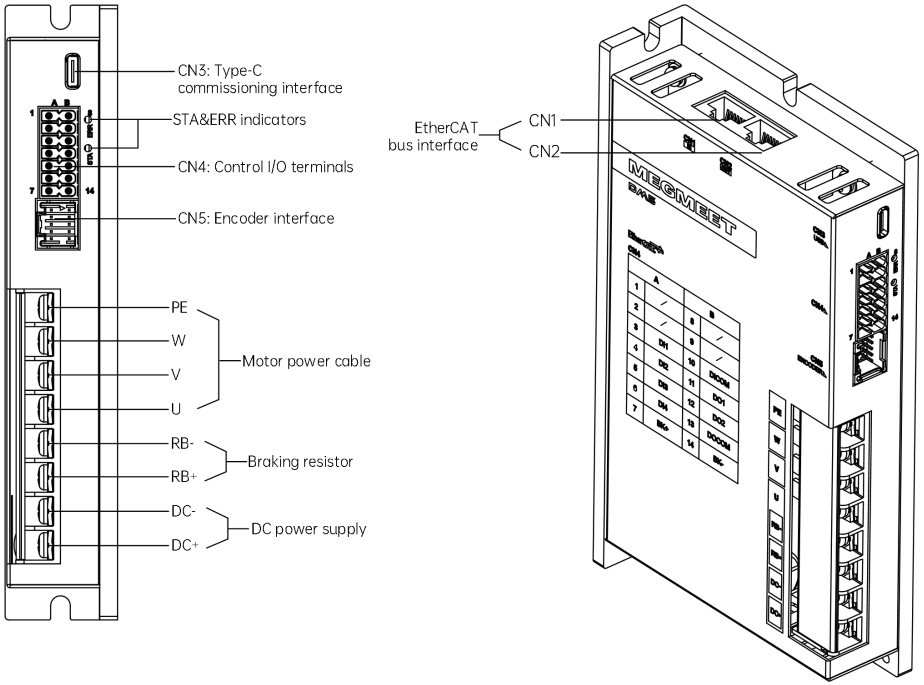


Fig. 1-6 DM5-N servo drive drawing (SIZE B)

Table 1-2 DM5-N servo drive interface Description (SIZE B)

No.	Name		Description
1	CN1, CN2: communication interface		Two RJ45 ports for EtherCAT communication
2	CN3: Type-C USB		Connected to a computer's USB port for parameter setting and performance debugging
3	CN4: I/O interface		4 digital inputs, 2 digital outputs, and 1 brake output
4	CN5: Encoder interface		Connected to a motor encoder
5	STA&ERR: state and error indicators		Refer to Table 5-1 of this manual for definitions of STA&ERR display.
6	Main circuit terminals	DC+, DC-: main power supply input	Main power supply input, 24 V to 70 V DC
		RB+, RB-: external braking resistor terminals	Used to connect the external braking resistor
		U, V, W: servo motor	Servo motor UVW power terminals

No.	Name		Description
		power terminals	
		PE	Motor's grounding terminal

1.2 Servo system configuration

Two methods are provided for the servo system configuration, the applicability of which depends on the types of cable connection, as shown in the following tables.

1.2.1 Direct connection to servo drive

Table 1-3 Servo system configuration 1

Power (W)	Motor model	Encoder type	Connection type	Brake cable	Power cable	Encoder cable	Servo drive
50	SPM-DC8045AM*K-AAXX-L	17-bit multi-turn magnetic encoder	Directly connected to the servo drive	Directly connected to the drive, with no cable required. XX in the model name indicates the outgoing cable length. The standard cable length is 500 mm, with the corresponding XX being 05.			DM5-NA015B
100	SPM-DC80401M*K-AAXX-L						
200	SPM-DC80602M*K-AAXX-L						
400	SPM-DC80604M*K-AAXX-L						
600	SPM-DC80606M*K-BAXX-L						
750	SPM-DC80807M*K-BAXX-L						DM5-NA030B
1000	SPM-DC80810M*K-BAXX-L						

1.2.2 Connected to servo drive through aviation plug

Table 1-4 Servo system configuration 2

Power (W)	Motor model	Encoder type	Connection type	Brake cable	Power cable	Encoder cable	Servo drive
50	SPM-DC8045 AMAK-ECXX-L	17-bit multi-turn magnetic encoder	Indirect connection via the aviation plug	-	SPL-MG11-XX-R2	SPL-E21-XX-R2	DM5-NA015B
	SPM-DC8045 AMBK-FCXX-L			Brake & Power integrated cable	SPL-BMG11-XX-R2	SPL-E21-XX-R2	
100	SPM-DC80401			-	SPL-MG11-	SPL-E21-X	

Power (W)	Motor model	Encoder type	Connection type	Brake cable	Power cable	Encoder cable	Servo drive
	MAK-ECXX-L				XX-R2	X-R2	
	SPM-DC80401 MBK-FCXX-L			Brake & Power integrated cable	SPL-BMG11 -XX-R2	SPL-E21-X X-R2	
200	SPM-DC8060 2MAK-ECXX-L			-	SPL-MG11- XX-R2	SPL-E21-X X-R2	
	SPM-DC8060 2MBK-ECXX-L			SPL-B21-XX-R2	SPL-MG11- XX-R2	SPL-E21-X X-R2	
400	SPM-DC8060 4MAK-GCXX-L			-	SPL-MH21- XX-R2	SPL-E21-X X-R2	
	SPM-DC8060 4MBK-GCXX-L			SPL-B21-XX-R2	SPL-MH21- XX-R2	SPL-E21-X X-R2	
600	SPM-DC8060 6MAK-GCXX-L			-	SPL-MI22- XX-R2	SPL-E21-X X-R2	
	SPM-DC8060 6MBK-GCXX-L			SPL-B21-XX-R2	SPL-MI22- XX-R2	SPL-E21-X X-R2	
750	SPM-DC8080 7MAK-GCXX-L			-	SPL-MJ22- XX-R2	SPL-E21-X X-R2	DM5-N A030B
	SPM-DC8080 7MBK-GCXX-L			SPL-B21-XX-R2	SPL-MJ22- XX-R2	SPL-E21-X X-R2	
1000	SPM-DC80810 MAK-GCXX-L			-	SPL-MJ22- XX-R2	SPL-E21-X X-R2	
	SPM-DC80810 MBK-GCXX-L			SPL-B21-XX-R2	SPL-MJ22- XX-R2	SPL-E21-X X-R2	

1.3 Cable selection

1.3.1 Power cable

SPL - B MH 1 2 - 03 - R2

Mark	Product series
SPL	SPL series

Mark	With/Without brake
Null	Without brake
B	With brake

Mark	Copper wire diameter
MG	Motor power cable cross sectional area 0.75 mm^2
MH	Motor power cable cross sectional area 1.5 mm^2
MI	Motor power cable cross sectional area 2.5 mm^2
MJ	Motor power cable cross sectional area 3.3 mm^2
MK	Motor power cable cross sectional area 4.0 mm^2

Mark	Terminal at motor side (without brake)	Terminal at motor side (with brake)
1	Aviation plug GM-1311/S-4B	Aviation plug GM-1311/S-6B
2	Aviation plug GM-2111/S-4	/

Mark	Allowable times of cable bending
Null	Fixed regular cable
R1	Five million times (flexible cable)
R2	Ten million times (flexible cable)
R3	Twenty million times (flexible cable)
R4	Thirty million times (flexible cable)

Mark	Cable length
03	3 m
05	5 m
10	10 m

Mark	Terminal at drive side
1	UVW and PE are needle-type.
2	UVW and PE are U-type.
3	UVW are needle-type, and PE is U-type.
4	UVW are U-type, and PE is needle-type.

Fig. 1-7 Power cable selection

1.3.2 Encoder cable

SPL - E 2 1 B - 03 - R2

Mark	Product series
SPL	SPL series

Mark	Cable type
E	Encoder cable

Mark	Terminal at motor side
2	Aviation plug GM-1311/S-7

Mark	Terminal at drive side
1	Molex 10-pin male connector

Mark	With/Without battery
Null	Without battery cable, without battery
A	With battery cable, without battery
B	With battery

Mark	Allowable times of cable bending
Null	Fixed regular cable
R1	Five million times (flexible cable)
R2	Ten million times (flexible cable)
R3	Twenty million times (flexible cable)
R4	Thirty million times (flexible cable)

Mark	Cable length
03	3 m
05	5 m
10	10 m

Fig. 1-8 Encoder cable selection

1.3.3 Brake cable

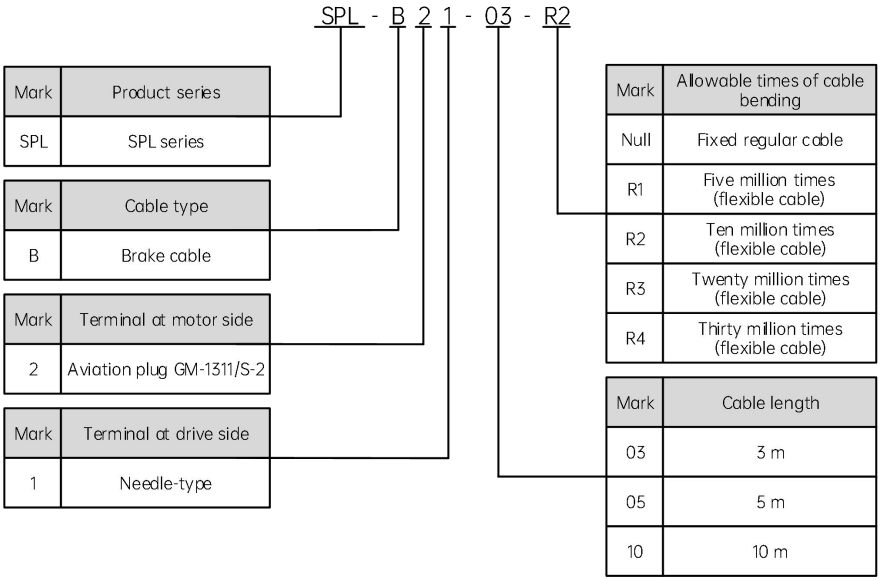


Fig. 1-9 Brake cable selection

1.3.4 Terminal combination allowed by standard cables

The following terminal combination methods are feasible for standard power cables.					
No.	Cable diameter	Terminal mark	Combination		Applicable motor power
			Motor terminal	Drive terminal	
1	18 AWG (approx. 0.8 mm^2)	MG11	Aviation plug GM-1311/S-4B	Needle-type	50 W to 200 W
2	18 AWG + 22 AWG	BMG11	Aviation plug GM-1311/S-6B	Needle-type	50 W to 100 W motor with brake
3	15 AWG (approx. 1.5 mm^2)	MH21	Aviation plug GM-2111/S-4	Needle-type	400 W
4	13 AWG (approx. 2.5 mm^2)	MI22	Aviation plug GM-2111/S-4	U-type	600 W

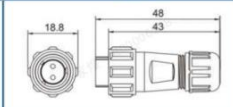
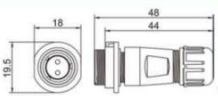
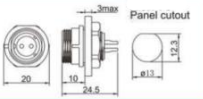
The following terminal combination methods are feasible for standard power cables.					
No.	Cable diameter	Terminal mark	Combination		Applicable motor power
			Motor terminal	Drive terminal	
5	12 AWG (approx. 3.3mm^2)	MJ22	Aviation plug GM-2111/S-4	U-type	750 W to 1 kW

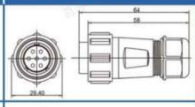
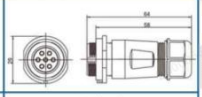
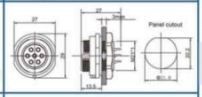
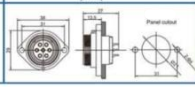
The following terminal combination methods are feasible for standard encoder cables.					
No.	Cable diameter	Terminal mark	Combination		Applicable motor power
			Motor terminal	Drive terminal	
1	26 AWG (approx. 0.128 mm^2)	E21	Aviation plug GM-1311/S-7	Molex 10-pin male connector	50 W to 1 kW

The following terminal combination methods are feasible for standard brake cables.					
No.	Cable diameter	Terminal mark	Combination		Applicable motor power
			Motor terminal	Drive terminal	
1	22 AWG (approx. 0.325mm^2)	B21	Aviation plug GM-1311/S-2	Needle-type	200 W to 1 kW motor with brake

1.3.5 Description of indirect connection motor terminal

The appearance of the indirect connection motor terminal is shown in the table below.

Product image	Dimensions	Number of cores	2	3	4	5	6	7	9
GM 1310/P__GM 1310/S		Front view							
		Rated current	13A	13A	5A	5A	5A	5A	3A
GM 1311/S__GM 1311/P		Contact diameter	⌀1.6*2	⌀1.6*3	1.0*4	1.0*5	⌀1.0*6	⌀1.0*7	⌀0.7*9
		Connection type	Welding/Crimping		Welding	Welding	Welding	Welding	Welding
		Working voltage	250V	200V	200V	180V	125V	125V	125V
GM 1312/S__GM 1312/P		Withstand voltage	1500V	1500V	1500V	1000V	1000V	1000V	1000V
		Contact resistance	2	2	5	5	5	5	10
		Welding wire size	≤2/14	≤2/14	≤0.785/18	≤0.785/18	≤0.785/18	≤0.785/18	≤0.785/18

Product image	Dimensions	Number of cores	2	3	4	5A	5B	5C	7	9	12
GM 2110/P__GM 2110/S		Front view									
		Rated current	30A	30A	30A	30A	5A/30A	15A	15A	5A	5A
GM 2111/S__GM 2111/P		Contact diameter	ø1.5*2	ø1.5*2	ø1.5*3	ø1.5*3	ø1.0*4	ø1.0*5	ø1.0*7	ø1.0*7	ø1.0*9
		Connection type	Welding/Crimping						Welding	Welding	Welding
GM 2112/S__GM 2112/P		Working voltage	5000V	5000V	500V	500V	500V	500V	400V	400V	400V
		Withstand voltage	1500V	1500V	1500V	1500V	1500V	1500V	1200V	1200V	1200V
GM 2113/S__GM 2113/P		Contact resistance	2.5	2.5	2.5	2.5	5	5	5	5	5
		Welding wire size	≤2/14	≤2/14	≤2/14	≤2/14	≤0.785/18	≤0.785/18	≤0.785/18	≤0.785/18	≤0.785/18

1.3.6 Pin definition

1.3.6.1 Power cable pin definition

SPL-MG11-** pin definition (50 W to 200 W motors)			
A end (drive) terminal type: needle-type		B end (motor) terminal type: aviation plug GM-1311/S-4B	
Pin	Signal	Signal	Pin
Needle-type terminal, with cable label	U	U	1
Needle-type terminal, with cable label	V	V	2
Needle-type terminal, with cable label	W	W	3
Needle-type terminal, with cable label	PE	PE	4

SPL-BMG11-** pin definition (50 W to 200 W motors with brake)			
A end (drive) terminal type: needle-type		B end (motor) terminal type: aviation plug GM-1311/S-6B	
Pin	Signal	Signal	Pin
Needle-type terminal, with cable label	U	U	1
Needle-type terminal, with cable label	V	V	2

SPL-BMG11-** pin definition (50 W to 200 W motors with brake)			
A end (drive) terminal type: needle-type		B end (motor) terminal type: aviation plug GM-1311/S-6B	
Pin	Signal	Signal	Pin
Needle-type terminal, with cable label	W	W	3
Needle-type terminal, with cable label	PE	PE	4
Needle-type terminal, with cable label	0V	0V	5
Needle-type terminal, with cable label	24V	24V	6

SPL-MH21-** pin definition (400 W motors)			
A end (drive) terminal type: needle-type		B end (motor) terminal type: aviation plug GM-2111/S-4	
Pin	Signal	Signal	Pin
Needle-type terminal, with cable label	U	U	1
Needle-type terminal, with cable label	V	V	2
Needle-type terminal, with cable label	W	W	3
Needle-type terminal, with cable label	PE	PE	4

SPL-MI22-** pin definition (600 W motors)			
A end (drive) terminal type: U-type		B end (motor) terminal type: aviation plug GM-2111/S-4	
Pin	Signal	Signal	Pin
U-type terminal, with cable label	U	U	1
U-type terminal, with cable label	V	V	2
U-type terminal, with cable label	W	W	3
U-type terminal, with cable label	PE	PE	4

SPL-MJ22-** pin definition (750 W to 1 kW motors)			
A end (drive) terminal type: U-type		B end (motor) terminal type: aviation plug GM-2111/S-4	
Pin	Signal	Signal	Pin
U-type terminal, with cable label	U	U	1
U-type terminal, with cable label	V	V	2
U-type terminal, with cable label	W	W	3
U-type terminal, with cable label	PE	PE	4

1.3.6.2 Encoder cable pin definition

SPL-E21-** pin definition (50 W to 1 kW motors)			
A end (drive) terminal type: Changjiang Connector A2011HA-2x5P		B end (motor) terminal type: aviation plug GM-1311/S-7	
Pin	Signal	Signal	Pin
1	5V	5V	2
2	GND	GND	3
3	SD+	SD+	4
4	SD-	SD-	5
5	Battery not connected to drive	Battery+	6
6	Battery not connected to drive	Battery-	7
7	/	/	/
8	/	/	/
9	PE	PE	1
10	/	/	/

1.3.6.3 Brake cable pin definition

SPL-B21-** pin definition (200 W to 1 kW motors with brake)			
A end (drive) terminal type: needle-type		B end (motor) terminal type: aviation plug GM-1311/S-2	
Pin	Signal	Signal	Pin
Needle-type terminal, with cable label	+24 V	+24V	1
Needle-type terminal, with cable label	0V	0V	2

1.4 Servo motor cable selection

Refer to Table 1-4 "Servo system configuration 2" in Section 1.2.2 of this manual.

Chapter 2 Servo System Specification

2.1 Standard specification of DM5-N servo drives

2.1.1 Electrical specification

Table 2-1 Drive models and electrical specifications

Input voltage range (V DC)	24 to 70 V	
Drive model	DM5-NA015B	DM5-NA030B
Rated output current (A)	15 A (12 A when auxiliary cooling is not added)	30 A (22 A when auxiliary cooling is not added)
Peak output current (A)	48 A	99 A
Control mode	EtherCAT	EtherCAT
Brake power supply	Built-in	
Discharge resistor	External	
Cooling	Natural cooling + Auxiliary cooling via metal enclosure	
Dimensions (mm * mm * mm)	142 x 77 x 29 mm	171 x 100 x 30 mm
Motor power	0.2 kW, 0.4 kW	0.75 kW, 1 kW

2.1.2 General specification

2.1.2.1 Specification list

Table 2-2 General specification of servo drives

General specification		
General	Control mode	MOSFET PWM control, sinusoidal current drive
	Main circuit power supply	DC 24 to 70 V
	Efficiency	⩾95%
	Encoder	Tamagawa absolute encoder, optical/magnetic encoder (single-turn, multi-turn)

I/O	Digital	DI		At least 4 channels of general-purpose input, optocoupler isolation, option between NPN and PNP input; Input voltage between 20 to 30 V, input impedance at 3.9k ohms; Different functions can be assigned to channels via parameter setting; Max. Input frequency at 300 Hz.
		DO		2 channels of general-purpose output, optocoupler isolation, option between NPN and PNP input; Max. working voltage at 30 V, max. current at 50 mA; Different functions can be assigned to channels via parameter setting.
	Pulse	Pulse reference	1. Pulse + Sign 2. A/B orthogonal 3. CW + CCW	Optocoupler isolation; Collector input, input pulse frequency ⩽ 200 Kpps; Supported by model DM5-P; not supported by models DM5-C or DM5-N; compatible with 5 V and 24 V systems.
		High-speed pulse reference		Differential input; Input pulse frequency ⩽ 500 Kpps Supported by model DM5-P; not supported by models DM5-C or DM5-N.
		Pulse feedback		Not available
Communication	485		Two RJ45 ports	Modbus and relevant protocols; supported by model DM5-P
	CAN		Two RJ45 ports	CANopen and relevant protocols; supported by model DM5-C
	EtherCAT		Two RJ45 ports	EtherCAT; supported by model DM5-N
	USB		USB Type-C port	Connected to PC for drive parameter setting, program commissioning, and upgrading
Others	State and error indication		LED	STA: state indicator. ERR: error indicator
	Brake power supply			Built-in 24 V brake power supply in the drive
	Brake output interface			Equipped in the hardware of all models in the series (for models with brake and models without brake)
	Brake interface			Activated upon overvoltage (short circuit protection not supported; short circuit strictly prohibited)

	Braking resistor	External
	4-digit DIP switch (doubled for single-axis and dual-axis models)	Reserved in model DM5-C; not supported by models DM5-P or DM5-N; The first three digits indicate the CAN ID number, and the fourth digit indicates the bus impedance (120 Ω); if the first three digits are not dialed, the host device will set the CAN ID number and save it to EEPROM.

2.1.2.2 Technical specification for servo performance

General	Auto-tuning	The command is sent by the host and executed by the motor; real-time judgement of the load's moment of inertia ratio; automatic rigidity setting;
	Control mode and switchover	1. Position mode; 2. Velocity mode; 3. Torque mode; 4. Position/Velocity mode switchover; 5. Velocity/torque mode switchover; 6. Position/Torque mode switchover; 7. CANopen mode; 8. EtherCAT mode
	Frequency-division pulse	Not available
	Protection	Overvoltage, undervoltage, overcurrent, locked rotor, overspeed, stall, overheat, overload, encoder malfunction, input phase loss, and excessive position deviation (measured by braking resistor)
	Suppression of high-frequency vibration	Four sets of notch filters for the suppression of vibration between 0 and 4000 Hz; one set of speed reference filter for the suppression of vibration between 0 and 1000 Hz
	Suppression of mechanical-end vibration	Suppression of low-frequency mechanical-end vibration between 1 and 100 Hz by two filters
	Homing mode	Multiple modes of homing
	Backlash compensation	Minimize the response delay at the reversal of the mechanical motion direction
	Mechanical analyzer	Frequency analysis of the mechanical system via the host software
	Inertia identification	Offline/Online system inertia identification
	Torque observer	Load torque observation and compensation

	Friction compensation	Used to compensate the loss caused by system friction		
Position control	Control input	Deviation counter clear, command pulse inhibition input (INH), electronic gear switchover, etc.		
	Control output	Positioning completed		
	Pulse input	Pulse mode	1. Pulse + Sign; 2. A/B orthogonal; 3. CW + CCW	
		Input mode	1. Differential input; 2. Open collector	
		Pulse frequency	Differential input: max. 500 Kpps at the high-speed port; pulse width no less than 1 μs; Open collector: max. 200 Kpps; pulse width no less than 2.5 μs;	
		Pulse filter	First order command smoothing filter, or Finite Impulse Response (FIR) filter	
		Electronic gear	4 sets of electronic gear ratio	
	Multi-position command selection	Set the functions of 4 DI to enable the selection among position references 1 to 16.		
Speed control	Performance	Speed change rate	Load change rate	0 to 100% load: < 0.5% (within rated speed)
			Voltage change rate	Rated voltage ± 10%: 0.5% (within rated speed)
			Temperature change rate	25±25℃: < 0.5% (within rated speed)
		Speed control range		1 to 5000
		Speed loop response characteristics		2 kHz
		Soft start time		0 to 6000 ms
	Control input	Internal speed command selection 1, Internal speed command selection 2, Internal speed command selection 3, zero speed clamp, etc.		
	Control output	Speed arrival		

	Internal speed command	Switchover among 8 internal speed references via 3 DI	
	Speed command filter	Speed command first-order lag filter	
Torque control	Performance	Torque control precision	±1%
		Frequency characteristics	3 kHz
	Control input	Zero speed clamp, torque command symbol input, etc.	
	Control output	Speed arrival	
	Speed limit function	Used to set the speed limit via parameter setting	
	Torque command filter	Torque command first-order lag filter	

2.2 Standard specification of DM5-N servo motors

2.2.1 General specification

Table 2-3 General specification of servo motors

General specification	
IP rating	IP67 (excluding the shaft end)
Excitation method	Permanent magnetic
Ambient temperature	0℃ to +40℃
Ambient humidity	Relative humidity: 20% to 80% (non-condensing)
Storage temperature	-20 to +60℃
Storage humidity	20% to 80%RH (frost-free)
Installation method	Flange
Insulation resistance	100MΩ (DC 500 V)
Isolation voltage	AC 1000 V / 3 s / 5 mA
Insulation level	F
Shock resistance	150 m/s²
Vibration resistance	50 m/s²

Vibration level	V15
Altitude	Normal operation below 1000 m; derated use above 1000 m
Installation requirements	The product shall be installed in open places free from corrosive, flammable, and explosive gases/liquids; Please select a motor with oil seal when used in places with metal powder, grinding fluid, oil mist, or cutting operations; Do not use the motor in a closed environment at a high temperature; such environment will greatly shorten the life of the motor.

2.2.2 Servo motor rated specification

Table 2-4 Rated specification of servo motors

Motor model	SPM-DC8 045AM*K -AAXX-L	SPM-DC8 0401M*K-AAXX-L	SPM-DC8 0602M*K-AAXX-L	SPM-DC8 0604M*K-AAXX-L	SPM-DC8 0606M*K-BAXX-L	SPM-DC8 0807M*K-BAXX-L	SPM-DC8 0810M*K-BAXX-L
Voltage (V)	48	48	48	48	48	48	48
Power (W)	50	100	200	400	600	750	1000
Rated speed (rpm)	3000	3000	3000	3000	3000	3000	3000
Max. speed (rpm)	4000	4000	4000	4000	4000	4000	4000
Rated torque (N·m)	0.16	0.32	0.64	1.27	1.91	2.39	3.2
Peak torque (N·m)	0.48	0.96	1.92	3.81	5.73	7.17	9.6
Rated current (A)	3	5.7	6	10	15	19	28
Peak current (A)	9.3	17.7	18.6	31	46.5	59	87
Motor frame number (flange)	40	40	60	60	60	80	80
Moment of inertia ($kg \cdot cm^2$)	0.046 (0.036)	0.072 (0.062)	0.3 (0.29)	0.59 (0.58)	0.84 (0.83)	1.65 (1.5)	1.95 (1.8)
Number of pole pairs (P)	5	5	5	5	5	5	5
Brake voltage (V)	24	24	24	24	24	24	24

Motor model	SPM-DC8 045AM*K -AAXX-L	SPM-DC8 0401M*K-AAXX-L	SPM-DC8 0602M*K-AAXX-L	SPM-DC8 0604M*K-AAXX-L	SPM-DC8 0606M*K-BAXX-L	SPM-DC8 0807M*K-BAXX-L	SPM-DC8 0810M*K-BAXX-L
Brake power (W)	6.9	6.9	7.5	7.5	8.3	11.5	11.5
Brake static torque (N·m)	⩾0.4	⩾0.4	⩾1.5	⩾1.5	⩾2	⩾3.2	⩾3.2

Note:

The moment of inertia data in the above table indicates the value when the motor is without brake.

2.3 Servo drive dimensions

1. SIZE A

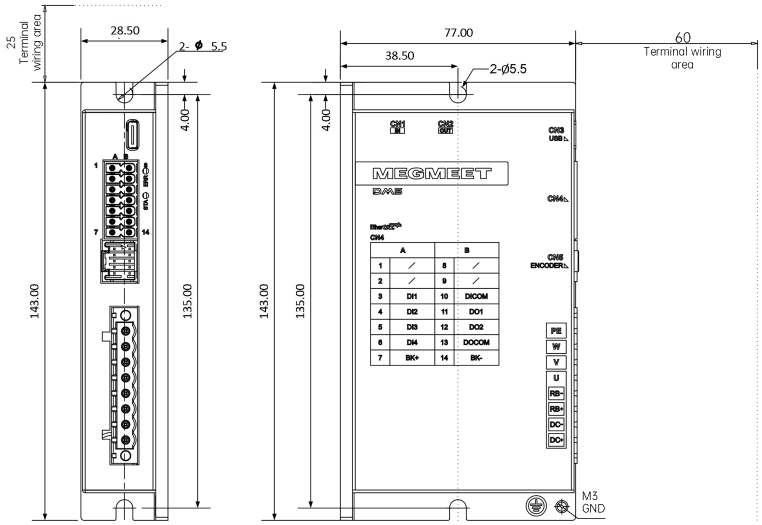


Fig. 2-1 SIZE A servo drive dimensions

2. SIZE B

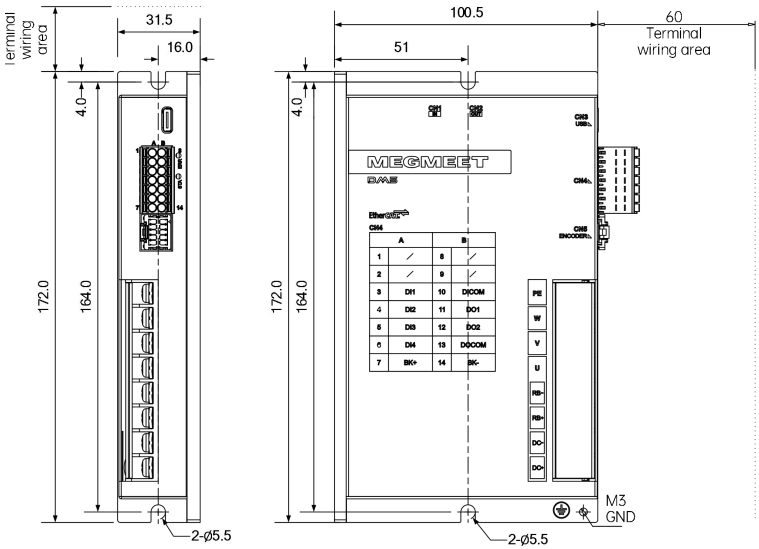


Fig. 2-2 SIZE B servo drive dimensions

2.4 Servo motor dimensions

2.4.1 Frame No. 40 servo motor

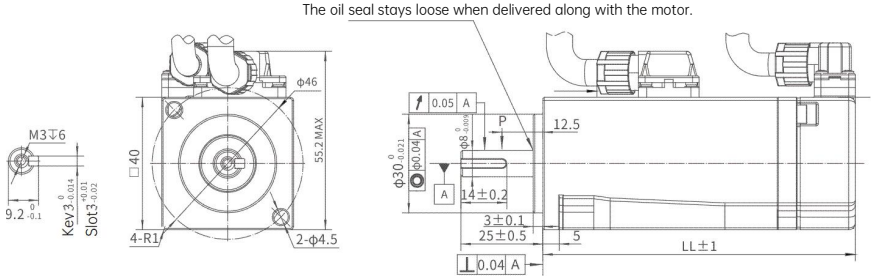


Fig. 2-3 Frame No. 40 servo motor dimensions

Table 2-5 Frame No. 40 servo motor dimensions

Model	Power (W)	Motor length (mm)
SPM-DC8045AM*K-AAXX-L	50	56.7 (84)

Model	Power (W)	Motor length (mm)
SPM-DC80401M*K-AAXX-L	100	67.7 (95)

Note:

Data in parentheses indicates the dimension values when the motor is measured with brake units.

2.4.2 Frame No. 60 servo motor

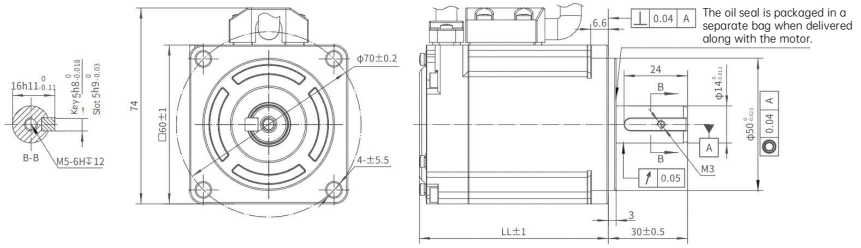


Fig. 2-4 Frame No. 60 servo motor dimensions (without brake)

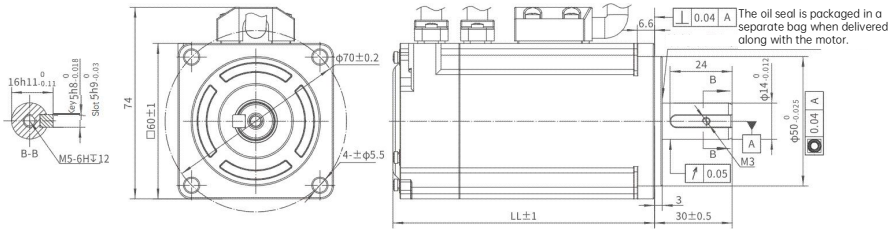


Fig. 2-5 Frame No. 60 servo motor dimensions (with brake)

Table 2-6 Frame No. 60 servo motor dimensions

Model	Power (W)	Motor length (mm)
SPM-DC80602M*K-AAXX-L	200	71.6 (101.9)
SPM-DC80604M*K-AAXX-L	400	88.6 (118.1)
SPM-DC80606M*K-BAXX-L	600	108.6 (138.1)

Note:

Data in parentheses indicates the dimension values when the motor is measured with brake units.

2.4.3 Frame No. 80 servo motor

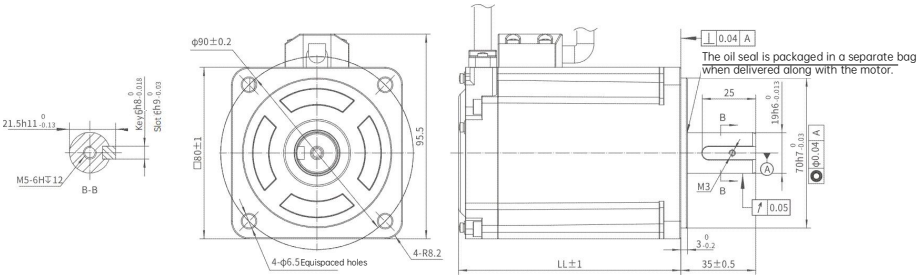


Fig. 2-6 Frame No. 80 servo motor dimensions (without brake)

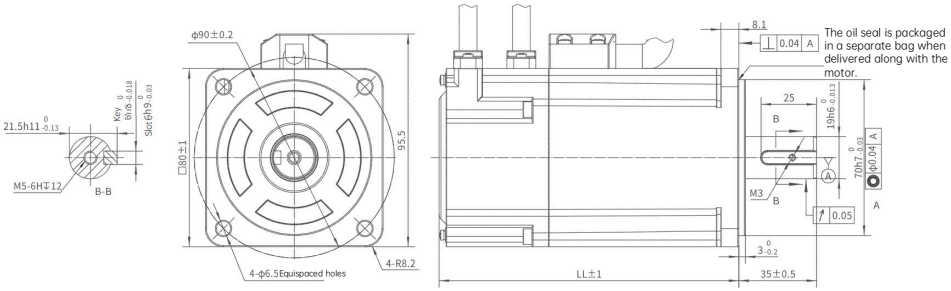


Fig. 2-7 Frame No. 80 servo motor dimensions (with brake)

Table 2-7 Frame No. 80 servo motor dimensions

Model	Power (W)	Motor length (mm)
SPM-DC80807M*K-BAXX-L	750	90.9 (121.9)
SPM-DC80810M*K-BAXX-L	1000	103.9 (134.9)

Note:

Data in parentheses indicates the dimension values when the motor is measured with brake units.

2.5 Servo motor interface definition

Servo motor interface definitions are described as shown in the following table.

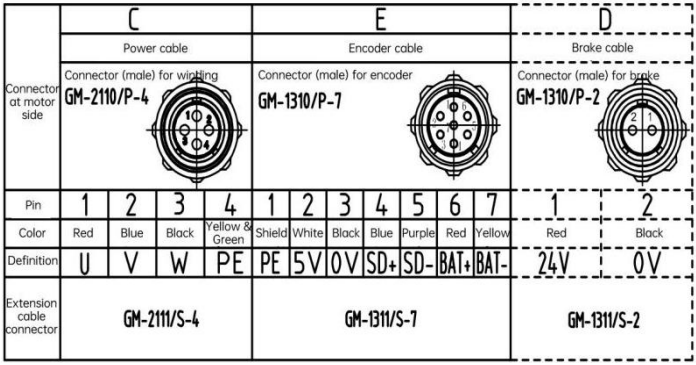
Table 2-8 Interface definition of 50 W and 100 W motor models

Power (W)	Model	Interface definition
50	SPM-DC8045 AMAK-ECXX-L SPM-DC8045 AMBK-FCXX-L	Definition of motor outgoing cable Winding cable: Pin 1 2 3 4; Color Red Blue Black Yellow & Green; Definition U V W PE Winding brake cable: Pin 1 2 3 4 5 6; Color Red Blue Black Yellow & Green Black Red; Definition U V W PE 0V 24V Encoder cable: Pin 1 2 3 4 5 6 7; Color Shield Red Black Blue Yellow Brown White; Definition PE 5V 0V SD+ SD- Bat+ Bat- D Connector (male) for winding GM-1310/P-4B D Connector (male) for winding brake GM-1310/P-6B C Connector (male) for encoder GM-1310/P-7 Extension cable's connector (female) model (purchased separately) GM-1311/S-4B | GM-1311/S-6B | GM-1311/S-7
100	SPM-DC80401 MAK-ECXX-L SPM-DC80401 MBK-FCXX-L	

Table 2-9 Interface definition of 200 W motor models

Power (W)	Model	Interface definition
200	SPM-DC8060 2MAK-ECXX-L SPM-DC8060 2MBK-ECXX-L	Connector at motor side C Power cable: Connector (male) for winding GM-1310/P-4 E Encoder cable: Connector (male) for encoder GM-1310/P-7 D Brake cable: Connector (male) for brake GM-1310/P-2 Pin: C 1 2 3 4; E 1 2 3 4 5 6 7; D 1 2 Color: C Red Blue Black Yellow & Green; E Shield White Black Blue Purple Red Yellow; D Red Black Definition: C U V W PE; E PE 5V 0V SD+ SD- BAT+ BAT-; D 24V 0V Extension cable connector: GM-1311/S-4 | GM-1311/S-7 | GM-1311/S-2

Table 2-10 Interface definition of 400 to 1000 W motor models

Power (W)	Model	Interface definition
400	SPM-DC80604M AK-GCXX-L	
	SPM-DC80604M BK-GCXX-L	
600	SPM-DC80606M AK-GCXX-L	
	SPM-DC80606M BK-GCXX-L	
750	SPM-DC80807M AK-GCXX-L	
	SPM-DC80807M BK-GCXX-L	
1000	SPM-DC80810M AK-GCXX-L	
	SPM-DC80810M BK-GCXX-L	

Chapter 3 Installation

3.1 Servo drive installation

3.1.1 Place for installation

- The product shall be installed inside the cabinet to avoid direct exposure to sunlight, water dripping, and rain.
- Do not install the product in places with dust, metal powder, excessive temperature, or high humidity.
- It is strictly forbidden to install the product in places with corrosive, combustible, or explosive gases.
- The product shall be installed in places without vibration.

3.1.2 Environment requirement

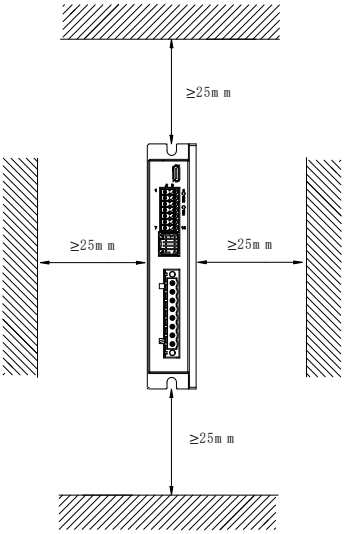
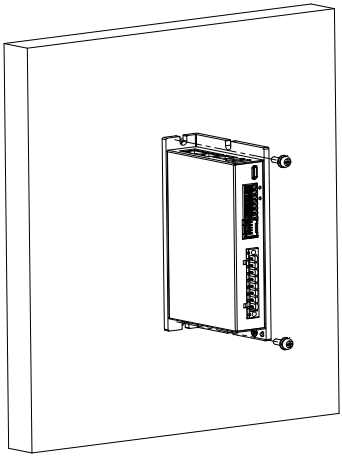
Table 3-1 Environment requirement for DM5-N servo drive installation

Item		Requirement
Operating conditions	Installation place	Vertical installation on stable and firm frame indoors, with at least 5 cm space for air inlet/outlet and at least 2 cm space for the left/right side of the enclosure. Air cooling.
	Ambient temperature	-20 to +40℃ (non-freezing), temperature change rate less than 0.5℃/min; derated use above 40℃ with adequate ventilation; maximum working temperature 55℃ (25% light duty)
	Storage temperature	-40 to +70℃ (non-freezing)
	Humidity	< 90%RH (non-condensing)
	Others	Non-condensing, non-freezing, free from rain, snow, hail, etc., sunlight radiation less than 700 W/m^2, air pressure range between 70 and 106 kPa.
	Salt mist and corrosive gas content	Pollution degree 2
	Dust and solid particle content	Pollution degree 2
	IP rating	IP20

Item		Requirement
	Altitude	Normal use under 1000 m; derated use above 1000 m; derated by 6% for every additional 1000 m
	Vibration resistance	Below 4.9 m/s^2
	Shock resistance	Below 19.6 m/s^2

3.1.3 Servo drive installation precaution

It is recommended to install the drive vertically in an indoor cabinet with good ventilation, and reliably secure it onto the mounting surface through its two fixation holes, as shown in the following figures.

Spacing	Mounting method
Vertical mounting	
	

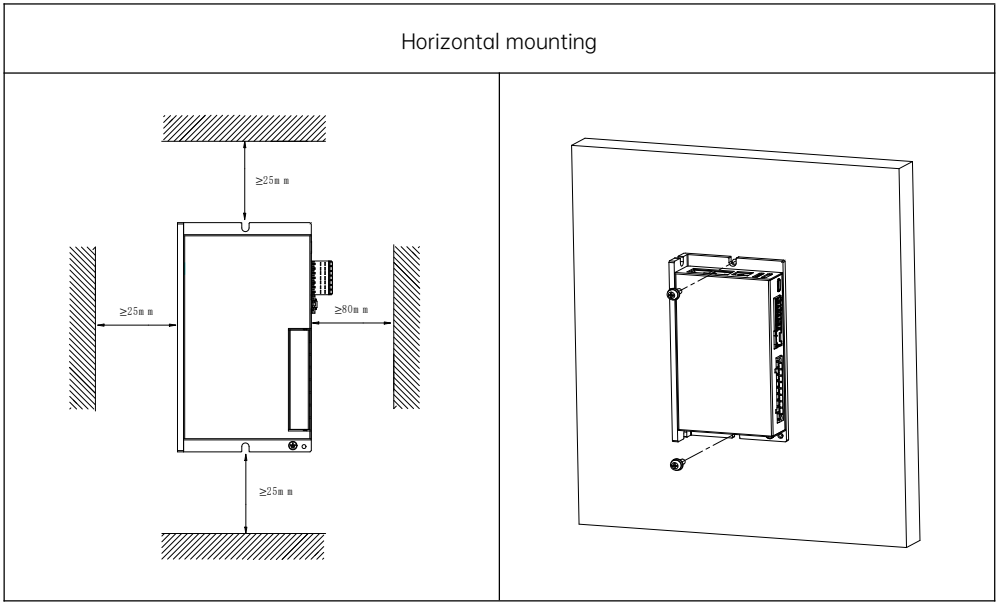


Fig. 3-1 Spacing and mounting method

3.2 System wiring diagram

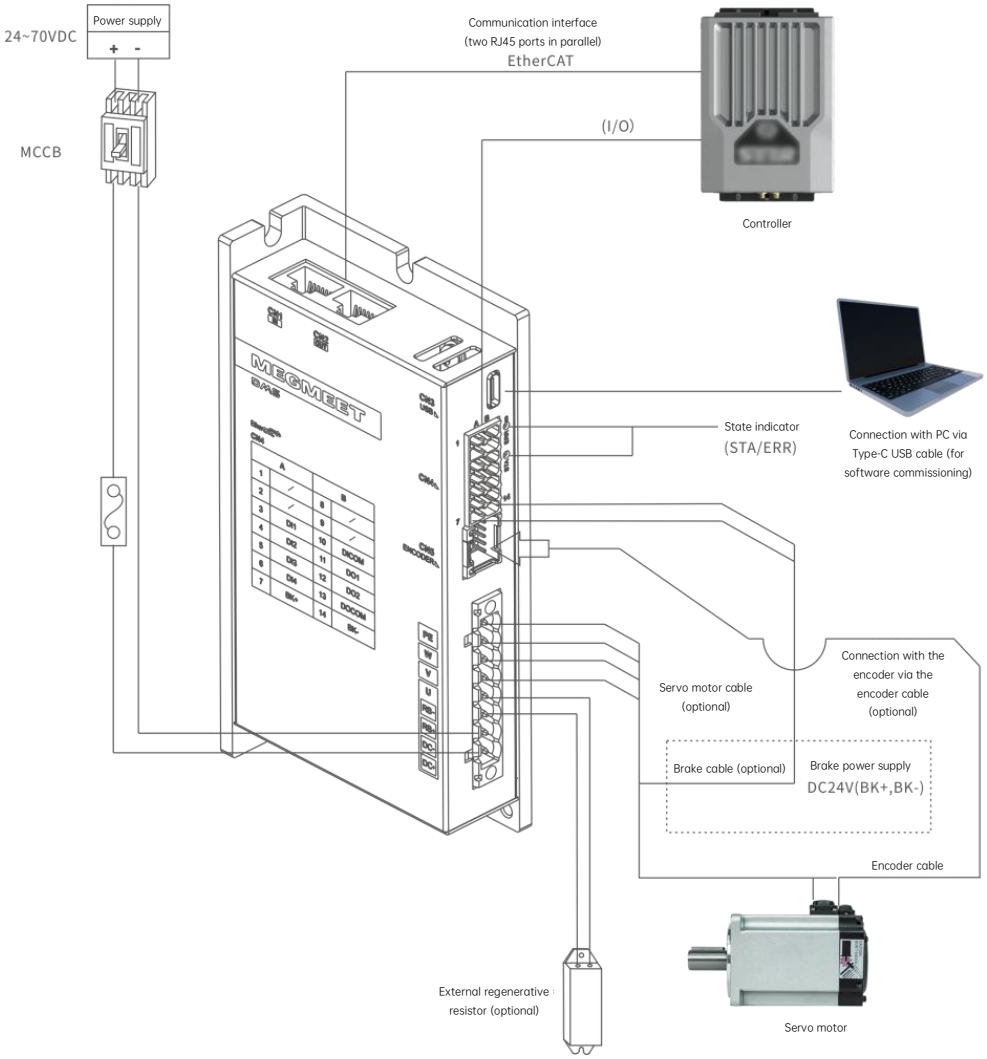


Fig. 3-2 SIZE A model wiring diagram

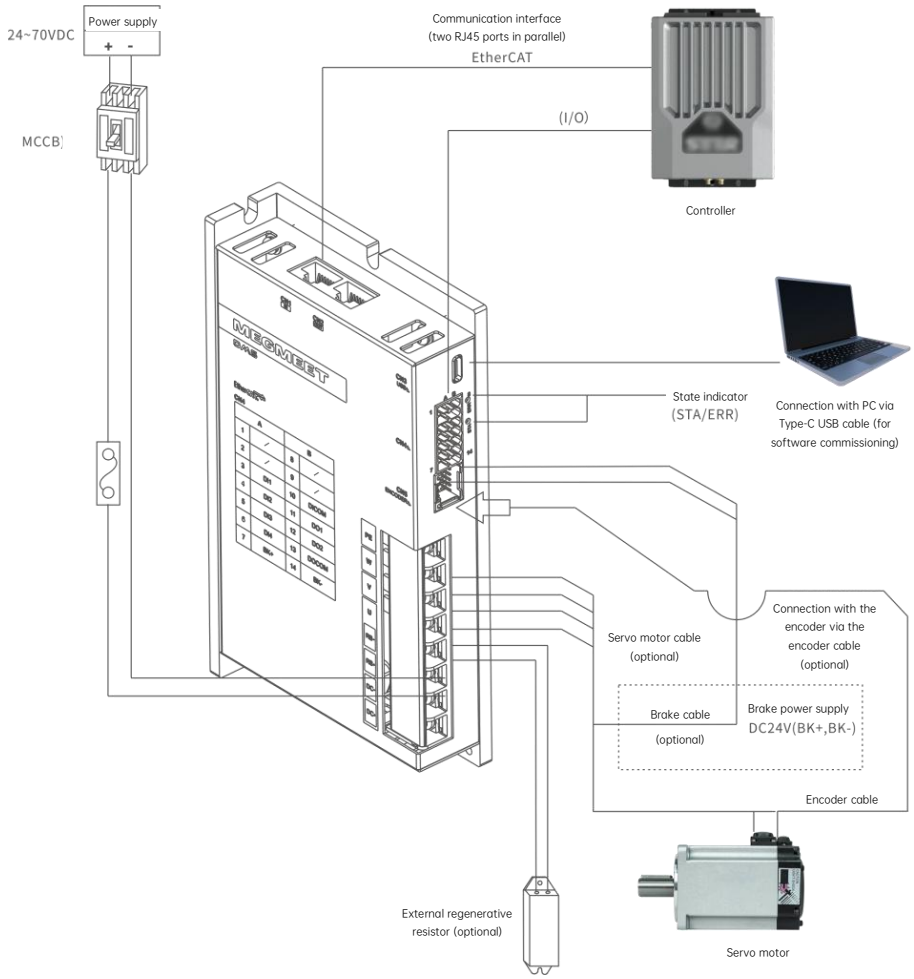


Fig. 3-3 SIZE B model wiring diagram

Precautions during system wiring:

- Make sure that the power supply and wiring of DC+ and DC- are correct. Otherwise, there is a risk of drive damage.
- Make sure that the phases of the output U, V, and W are wired correctly. Otherwise, there is a risk of abnormal motor rotation.
- To protect the drive system and prevent indirect electric shock, use circuit breakers or fuses at the power supply input. The specifications of circuit breakers and fuses are shown in the following table.
- The drive has no built-in ground protection circuit. Please use the leakage circuit breaker with overload and short circuit protection, or the special leakage circuit breaker with ground protection.

- It is strictly prohibited to use the electromagnetic contactor directly in the operation and shutdown of the motor. The motor is a large inductance device, and the instantaneous high voltage generated may puncture the contactor and other components.
- To ensure the reliable operation of the system and reduce interference on the power system, it is recommended to add filters on the input side.

3.3 Circuit breaker and fuse recommendation

Table 3-2 Circuit breaker and fuse recommendation table

Drive model	Circuit breaker	Fuse
DM5-NA015B	AC, 230 V, 63 A	40 A
DM5-NA030B		80 A

3.4 Braking resistor recommendation

The recommended braking resistor specification is shown in the table below.

Table 3-3 Braking resistor recommendation table

Drive model	Minimum braking resistance (Ω)	Braking resistor power (W)	Recommended withstand voltage of the braking resistor (V)
DM5-NA015B	10	100	Above 500 V DC
DM5-NA030B	5	100	

Note:

The external braking resistor shall be installed between RB+ and RB-. The resistance values in the above table are for reference only. Refer to the actual operating conditions for braking resistor selection.

Chapter 4 Servo Drive/Motor Connection

This chapter contains instructions and precautions related to the servo drive wiring.

DANGER

- Before opening the servo drive cover, please wait for at least 10 minutes after the servo drive power supply is reliably cut off.
- High voltage may remain in the servo drive even if the power is turned off. To prevent electric shock, do not touch the power terminal. After the discharge is completed, the charge indicator (STA) light will go out. Please make sure that the STA light is off before further operations (connecting and checking).
- The internal wiring of the servo drive shall be carried out only by trained and qualified professionals authorized to fulfill the task.
- When connecting an emergency stop or safety circuit, carefully check its wiring before and after operation.
- Pay attention to check the voltage level of the servo drive before power on. Otherwise, it may cause casualties and equipment damage.

WARNING

- Before use, carefully verify whether the rated input voltage of the servo drive is consistent with the voltage of the AC power supply.
- The servo drive has passed the withstand voltage test before leaving the factory. Users are forbidden to perform the withstand voltage test again on the servo drive.
- Do not connect the power line to U, V, and W.
- Generally, the ground cable is made of a copper core with a diameter of more than 3.5 mm and a ground resistance of less than 10 ohms.
- To provide overcurrent protection at the input side and facilitate the outage maintenance, the servo drive shall be connected to the power supply through an air switch or a fuse switch.

4.1 Servo drive main circuit connection

4.1.1 Main circuit description

The terminal names and functions of the servo drive main circuit are described in Table 4-1, and the cable specifications are shown in Table 4-2.

Table 4-1 Main circuit terminal names and functions

Name	Mark	Drive model	Function
Main circuit power supply input terminal / DC bus terminal	DC+, DC-	Whole series	External DC power supply (24 to 70 V) input terminal / DC bus terminal
Braking resistor terminal	RB+, RB-	Whole series	When the braking capacity does not meet the requirements, an external braking resistor can be installed between RB+ and RB-. Refer to the recommendations for the external braking resistor specifications.
Servo motor terminal	U, V, W	For connection with the servo motor	
Grounding terminal	PE	For grounding via connection with the grounding terminal of the power supply and the grounding terminal of the motor	

4.1.2 Main circuit cable dimensions

The servo drive main circuit cable dimension recommendations are described in the following table.

Table 4-2 Recommended cable for the main circuit of the DM5 series servo drive

Drive model		Power supply input DC+, DC-	Power output U, V, W	Grounding PE	Braking resistor RB+, RB-
SIZE A	DM5-PA015B	15 AWG (1.6 mm^2)	15 AWG (1.6 mm^2)	15 AWG (1.6 mm^2)	15 AWG (1.6 mm^2)
	DM5-CA015B	15 AWG (1.6 mm^2)	15 AWG (1.6 mm^2)	15 AWG (1.6 mm^2)	15 AWG (1.6 mm^2)
	DM5-NA015B	15 AWG (1.6 mm^2)	15 AWG (1.6 mm^2)	15 AWG (1.6 mm^2)	15 AWG (1.6 mm^2)
SIZE B	DM5-PA030B	12 AWG (3.3 mm^2)	12 AWG (3.3 mm^2)	12 AWG (3.3 mm^2)	12 AWG (3.3 mm^2)
	DM5-CA030B	12 AWG (3.3 mm^2)	12 AWG (3.3 mm^2)	12 AWG (3.3 mm^2)	12 AWG (3.3 mm^2)

Drive model		Power supply input DC+, DC-	Power output U, V, W	Grounding PE	Braking resistor RB+, RB-
	DM5-NA030B	12 AWG (3.3 mm^2)	12 AWG (3.3 mm^2)	12 AWG (3.3 mm^2)	12 AWG (3.3 mm^2)

4.2 Servo motor encoder signal connection (CN5)

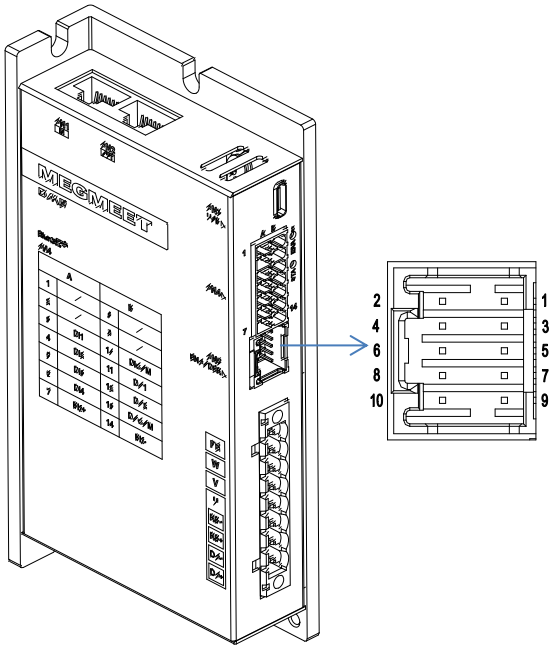


Fig. 4-1 Servo motor encoder signal connection diagram

The motor encoder interface of the DM5-N series servo drive supports the absolute encoder. The signal definition is shown in Table 4-3.

Table 4-3 Encoder terminal definition

Connection terminal: CN5		
Pin	Signal	Description
1	+5 V	Power supply +5 V

Connection terminal: CN5		
Pin	Signal	Description
2	GND	Power supply grounding
3	SD+	Serial data signal
4	SD-	
5	Reserve	—
6		
7		
8		
9	PE	Shield layer
10		

4.3 Control signal interface definition (CN4)

Control signal includes the DI signal and the DO signal. The interface for the pulse input signal and the brake output is CN4 of the drive, as shown in the figure below.

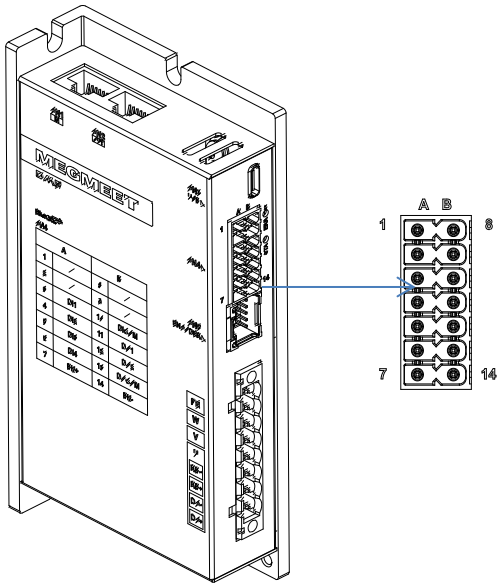


Fig. 4-2 Control signal terminal definition

Control signal definition is shown in the table below.

Table 4-4 Control signal definition

Pin	Signal	Pin	Signal
1	—	8	—
2	—	9	—
3	DI1	10	DICOM
4	DI2	11	DO1
5	DI3	12	DO2
6	DI4	13	DOCOM
7	BK+	14	BK-

4.3.1 DI/DO signal

The DI/DO signal is described as in the table below.

Table 4-5 DI/DO signal

Signal		Default function	Pin	Function description
General	DI1	/SON	3	Servo enable
	DI2	/STOP	4	Emergency stop
	DI4	/ALM-RST	6	Fault reset
	DICOM	DI common terminal	10	DI common terminal
	DO1+	/S-RDY	11	Servo ready
	DO2+	/COIN	12	Positioning finished
	DOCOM	DO common terminal	13	DO common terminal
	BK+	BK	7	Brake output
	BK-		14	

4.3.1.1 DI circuit

The DM5-N series provides four DI terminals that support dry contact input, NPN input, and PNP input. The DI common terminal can be connected to the power supply or the ground.

The following description is based upon DI1. The DI1 to DI4 terminal circuits are the same.

(1) Dry contact mode

The dry contact mode wiring diagram is shown in Fig. 4-3.

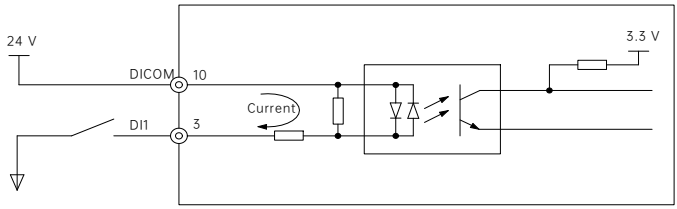


Fig. 4-3 Dry contact mode wiring of the DI terminal

(2) NPN (Sinking) mode

The external controller adopts the NPN common emitter output. The wiring method is shown in Fig. 4-4.

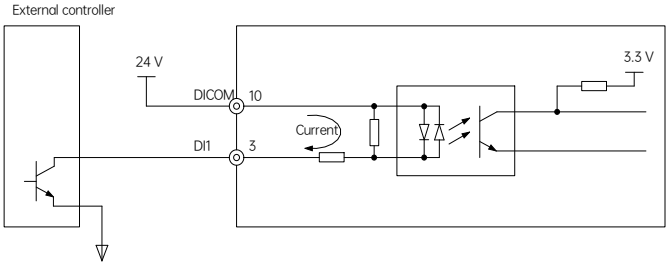


Fig. 4-4 NPN mode wiring of the DI terminal

(3) PNP (Sourcing) mode

The external controller adopts the PNP common emitter output. The wiring method is shown in Fig. 4-5.

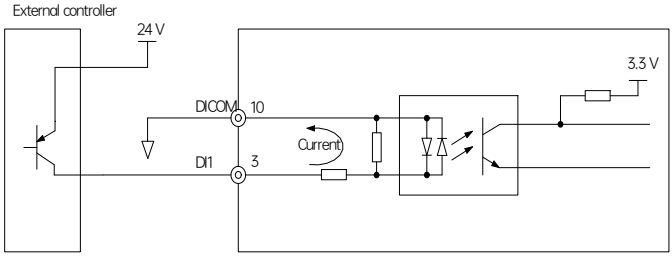


Fig. 4-5 PNP mode wiring of the DI terminal

Note:

It is forbidden for the DI terminals of the same drive to adopt the mixed configuration of NPN and PNP modes.

4.3.1.2 DO circuit

The DO terminal adopts single-ended output, and supports multiple output modes. The following description is based upon DO1. The circuits for terminals DO1 and DO2 are the same.

(1) Relay input from the host device

When the external device adopts the relay input, refer to Fig. 4-6 for the wiring mode.

Warning:

The inductive load (such as relay) shall be anti-parallel with the fly-wheel diode!

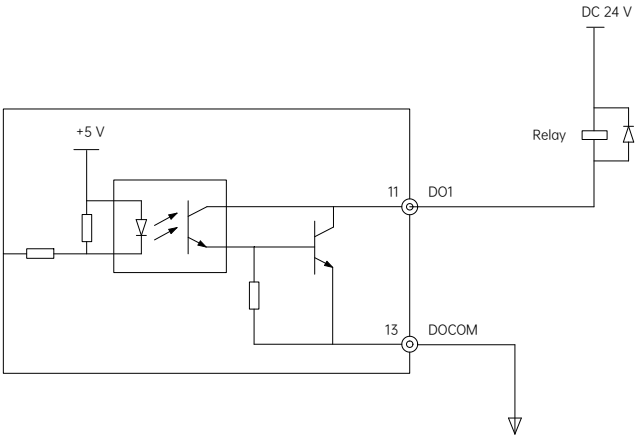


Fig. 4-6 Wiring between the DO terminal and the relay

(2) NPN (Sinking) output

When the controller adopts the sink input, the wiring method is shown in Fig. 4-7.

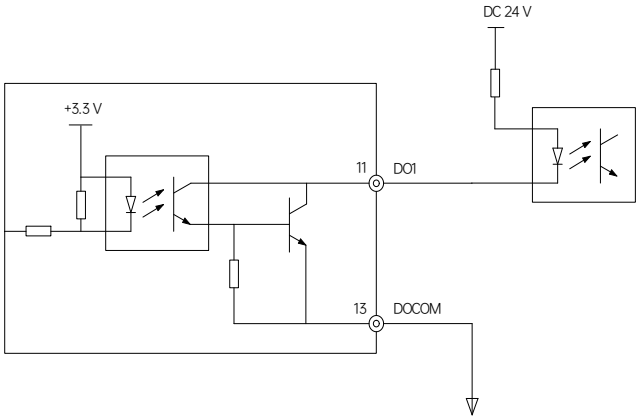


Fig. 4-7 DO terminal sink (NPN) output wiring mode

(3) PNP (Sourcing) output

When the controller adopts the source input, the wiring method is shown in Fig. 4-8

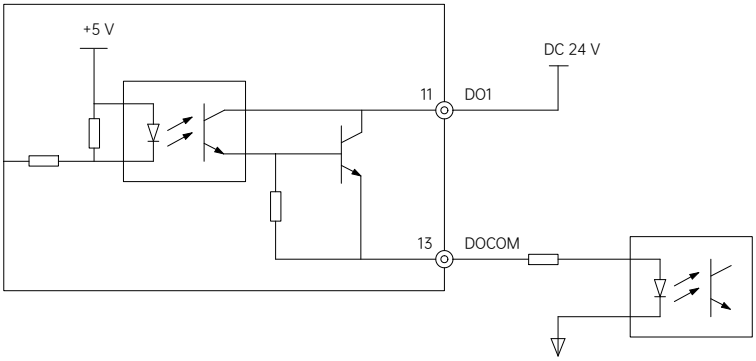


Fig. 4-8 DO terminal source (PNP) output wiring mode

4.4 Communication terminal wiring

The DM5-N series servo adopts EtherCAT communication via terminals CN1 and CN2. The master station is connected to CN1(IN), and the next slave station is connected to CN2(OUT).

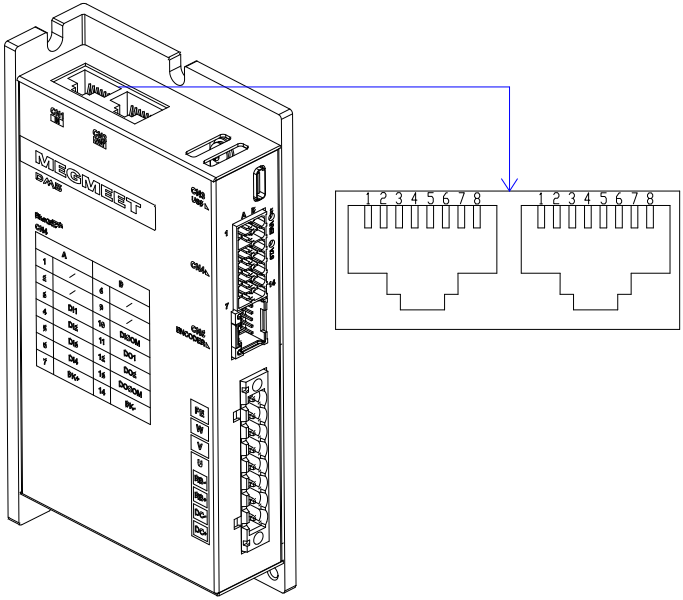


Fig. 4-9 Communication interface

Table 4-6 Communication terminal signal definition table

Pin	Definition	Description
1	TX+	Data transmit +
2	TX-	Data transmit -
3	RX+	Data receive +
6	RX-	Data receive -
Enclosure	PE	Shield
4/5/7/8	Undefined	

Chapter 5 Commissioning

5.1 Inspection before operation

Disconnect the servo motor from its load, and remove the coupling and its related components from the connected shaft of the servo motor. Check whether the servo motor operates normally without load. To prevent potential risks, load the servo motor again only when the no-load operation is determined to be normal.

Before operation, check and make sure:

(1) There is no obvious damage on the exterior of the servo drive;

(2) The wiring terminals have been insulated;

(3) There are no conductive objects, such as screws or metal pieces, or combustible objects inside the servo drive, and there are no conductive objects around the wiring terminals;

(4) The servo drive and the external braking resistor are not placed on combustible objects;

(5) The wiring is completed fully and correctly:

- Power cables, auxiliary power cables, and grounding cables of the servo drive are properly wired;
- All control signal cables are properly and reliably wired;
- Limit switches and protection signals are properly connected;

(6) The servo drive enable switch is in OFF state;

(7) The power circuit is cut off, and the emergency stop circuit is ON;

(8) And that the external voltage reference of the servo drive is correct.

Power on the servo drive when no operation command is sent by the controller.

Check and make sure:

(1) The servo motor works properly without vibration or excessive noise;

(2) All parameters are correctly set. Unexpected actions may occur due to different mechanical characteristics. Please do not set the parameters to extreme values;

(3) And that the STA & ERR indicator works normally.

5.2 Status display

The servo drive provides two LED indicators (see figures in section 1.1.5 in this manual). Refer to the LED display table below to determine the state of the drive.

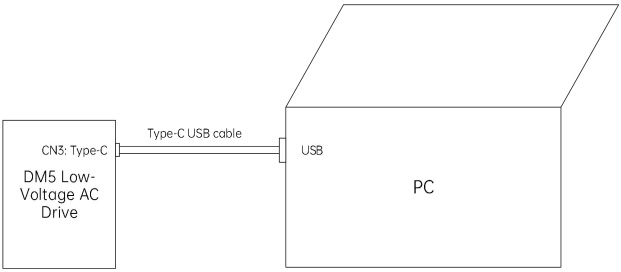
Tabel 5-1 Combination mode of STA & ERR indicators display

LED STA (green)	LED ERR (red)	State
Double flashing	Double flashing	Under-voltage
Steady on	Off	Ready
Flashing	Off	Running
Steady on	Steady on	Alarm
Steady on / Flashing	Flashing	Warning

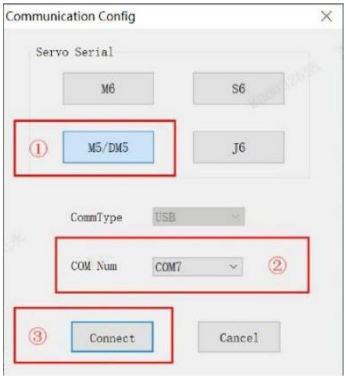
5.3 Host device operation

5.3.1 Connection between PC and drive

1. Connect the servo drive to PC via a Type-C cable



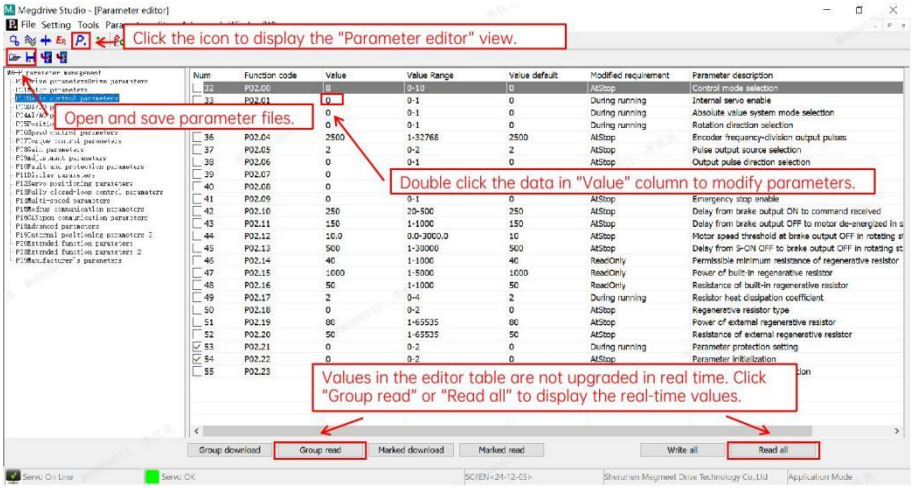
2. Start the software Driver.Soft.exe , select "DM5" in "Servo Serial", select the correct serial port number, and click "Connect" in the "Communication Config" interface.



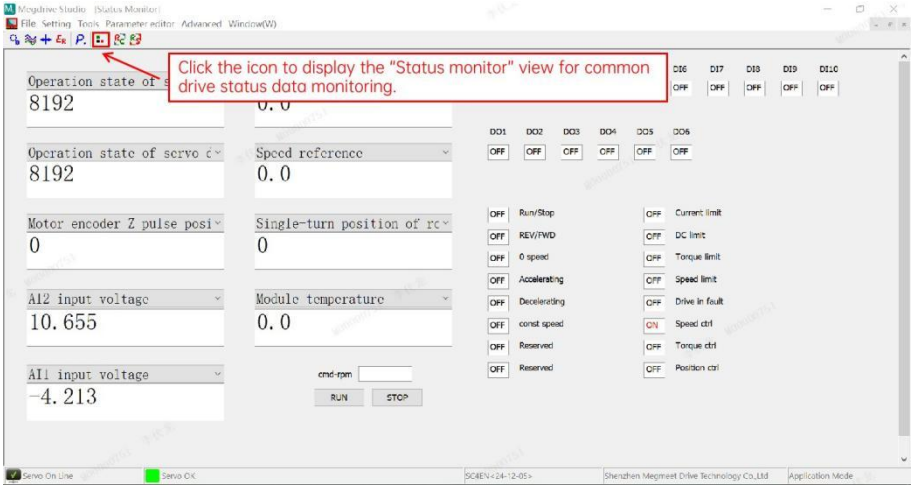
When connected, the left bottom on the interface displays "Servo On Line", as shown below.

5.3.2 Common interfaces of the host device

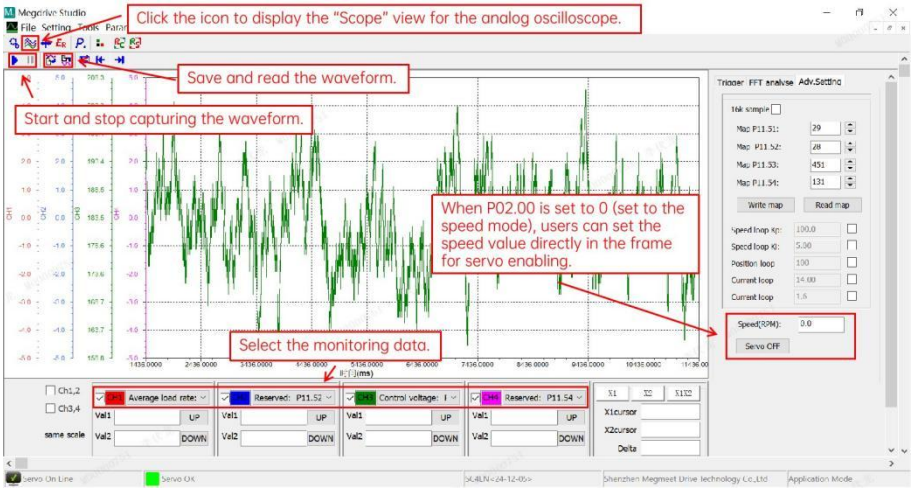
(1) Interface for parameter editor



(2) Interface for status monitor



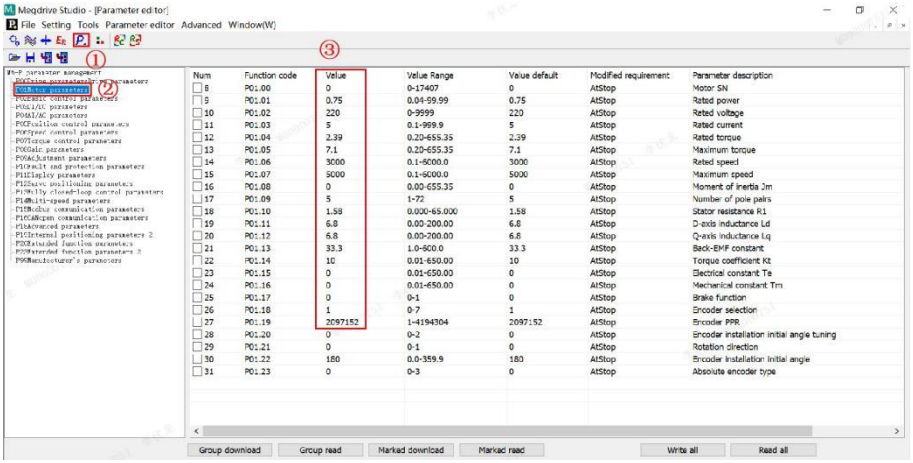
(3) Interface for analog oscilloscope



5.3.3 Motor parameter setting

①It is a normal phenomenon that a fault "E76 Absolute encoder battery disconnection" may be reported when the motor is connected for the first time. The fault will be cleared by clicking the "RESET" button on the interface, as shown in the image below.

②Open the "Parameter editor" interface, and set the values in "P01 Motor parameters" according to the motor specifications.



③Encoder installation initial angle auto-tuning

Set P01.20 to 1. When the STA indicator of the drive status turns from "Running" (green LED flashing) to "Ready" (green LED steady on), the initial angle auto-tuning is completed.

5.3.4 Motor trial run

Method 1: Function code setting via host device in velocity (speed) mode

①Set the control mode to speed control: P02.00 = 0;

②Set the running speed: P06.01 = <running speed>;

③Enable the servo: P02.01 = 1.

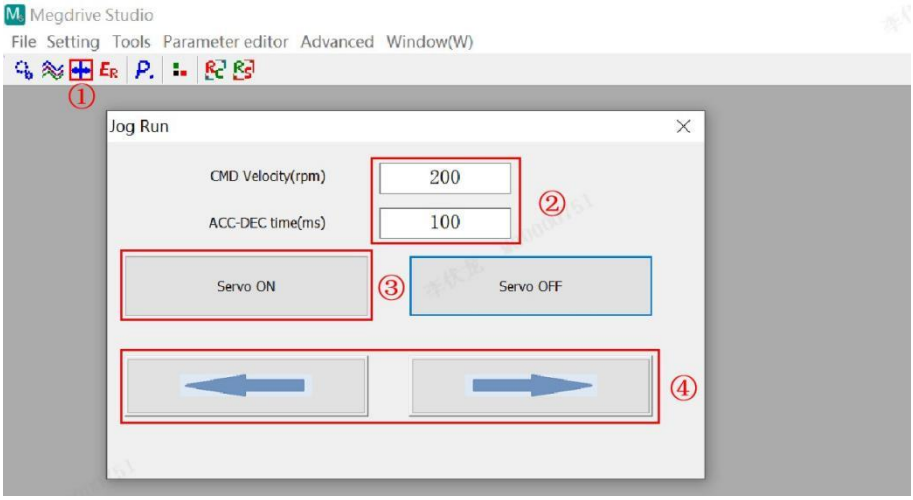
Method 2: Host device jog run in velocity (speed) mode

①Display the "Jog Run" view;

②Set the speed and the acceleration/deceleration time;

③Enable the servo;

④Click "JOG (+)" or "JOG (-)" for forward/reverse rotation, as shown in the image below.

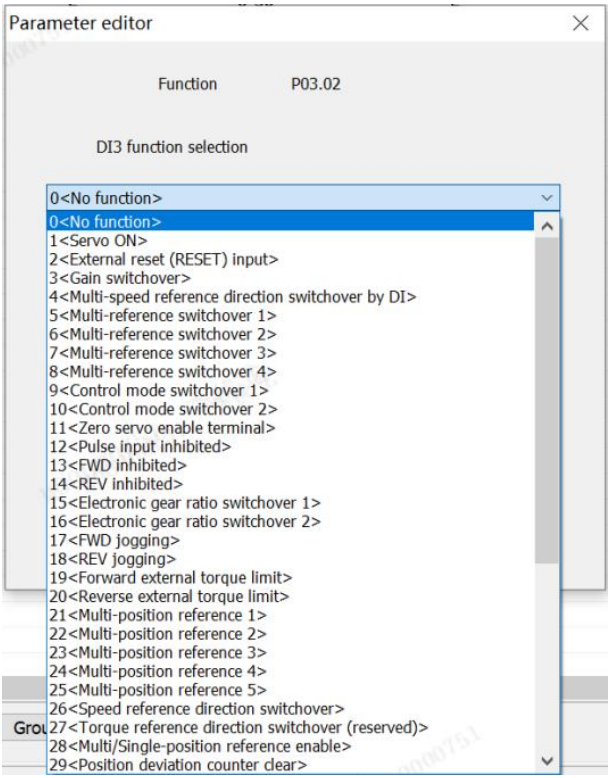


5.4 Commissioning of common parameters

5.4.1 DI terminal function setting

Set the DI1 to DI4 terminal function via function codes P03.00 to P03.03.

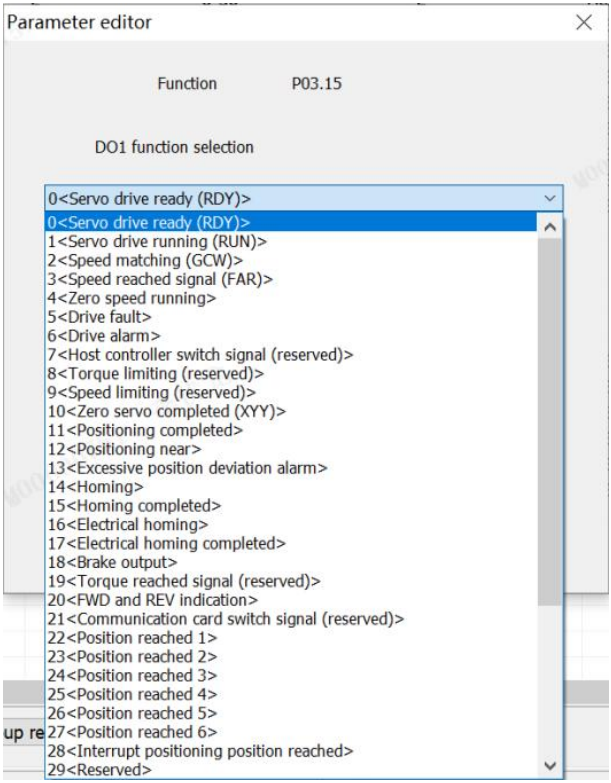
Function code	Value	Value Range	Value default	Modified requirement	Parameter description
P03.00	1	0-50	1	AtStop	DI1 function selection
P03.01	2	0-50	2	AtStop	DI2 function selection
P03.02	5	0-50	5	AtStop	DI3 function selection
P03.03	6	0-50	6	AtStop	DI4 function selection



5.4.2 DO terminal function setting

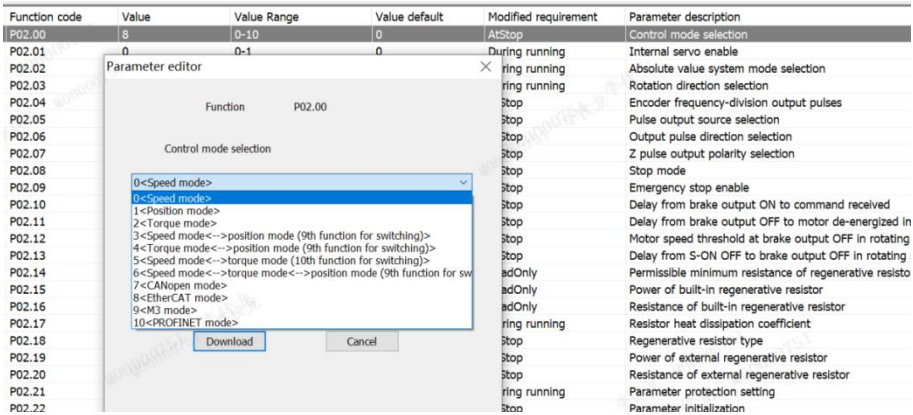
Set the terminal function of DO1 and DO2 via function codes P03.15 and P03.16.

P03.15	0	0-50	0	AtStop	DO1 function selection
P03.16	6	0-50	6	AtStop	DO2 function selection



5.4.3 Control mode setting

Set the control mode via parameter P02.00.



For the details of the control mode parameter settings, refer to the instructions on the running mode and commissioning in Chapter 5 of the servo user manual.

5.4.4 Enable the servo

Method 1: Enable the servo via parameter P02.01

When P02.01 = 1, the servo is enabled

When P02.01 = 0, the servo is disabled.

Method 2: Enable the servo via the DI terminal

The default function of the DI terminal is set to Servo Enable. Enable the servo via input at the valid DI1 terminal.

Method 3: Enable the servo via the control word in the bus mode

Refer to the communication manual.

5.4.5 Gain parameter adjustment

Group P08 contains control parameters related to gain adjustment. To guarantee fast response and stable operation of the system, users can adjust the parameters of the position loop or speed loop according to the actual operating conditions.

Function code	Value	Value Range	Value default	Modified requirement	Parameter description
P08.00	20	0.1-5000.0	20	During running	Speed loop proportional gain 1
P08.01	5	0.00-100.00	5	During running	Speed loop integral time 1
P08.02	100	1-8000	100	During running	Position loop gain 1

5.5 Electronic gear

Using the "electronic gear" function, the amount of workpiece movement corresponding to the unit command pulse can be set to an arbitrary value, which eliminates the need for consideration of the mechanical reduction ratio and the number of encoder pulses in the control of the system.

(1): Setting method of the electronic gear ratio

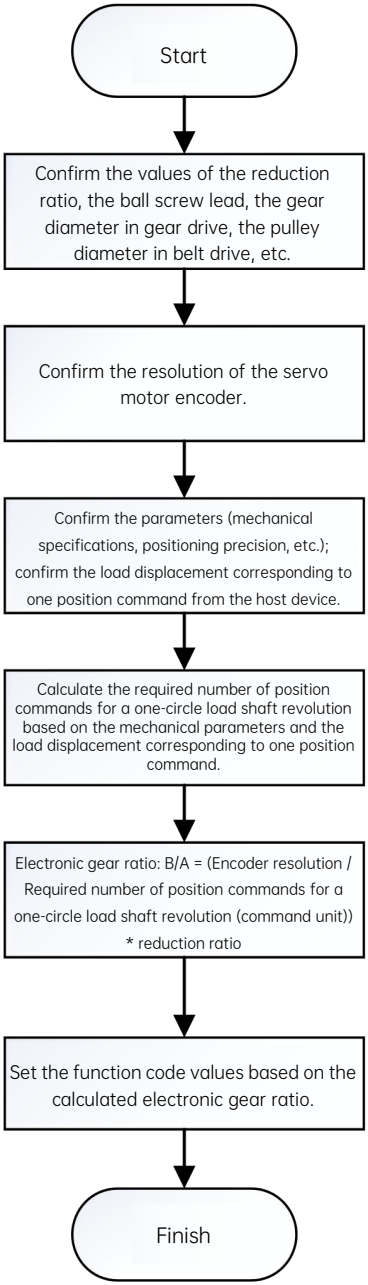


Fig. 5-1 Procedure for the electronic gear ratio setting

The function of the electronic gear ratio parameter is illustrated as below.

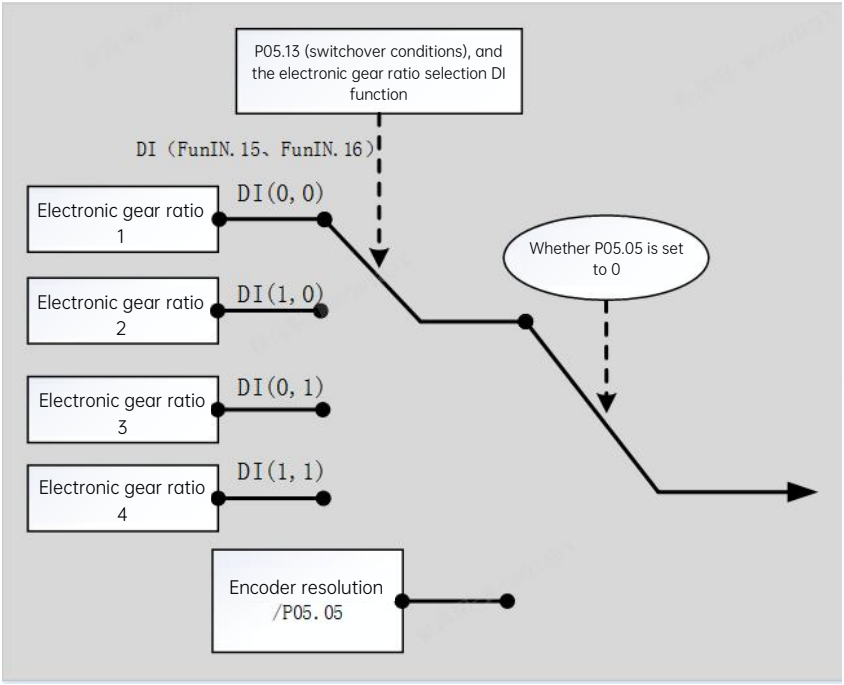


Fig. 5-2 Electronic gear ratio function diagram

When P05.05 is set to a non-zero value, the electronic gear ratio is calculated as $\frac{B}{A} = \frac{\text{Encoder resolution}}{\text{P05.05}}$. The electronic gear ratio 1, electronic gear ratio 2, electronic gear ratio 3, and electronic gear ratio 4 are invalid in such cases.

(2): Related function codes

a. Setting of the electronic gear ratio parameters

Function code	Name	Range	Min. unit	Default	Effective time	Property	Function
P05.05	Number of command pulses per motor revolution	0 to 8388608 P/r	1 P/r	10000	Immediate	At stop	The function code sets the number of position commands required for one circle of motor revolution.
P05.08	Electronic gear numerator	1 to 1073741824	1	8388608	Immediate	At stop	The function code sets the numerator

Function code	Name	Range	Min. unit	Default	Effective time	Property	Function
							for the electronic gear ratio.
P05.09	Electronic gear denominator 1	1 to 1073741824	1	10000	Immediate	At stop	The function code sets the denominator for the electronic gear ratio 1.
P05.10	Electronic gear denominator 2	1 to 1073741824	1	10000	Immediate	At stop	The function code sets the denominator for the electronic gear ratio 2.
P05.11	Electronic gear denominator 3	1 to 1073741824	1	10000	Immediate	At stop	The function code sets the denominator for the electronic gear ratio 3.
P05.12	Electronic gear denominator 4	1 to 1073741824	1	10000	Immediate	At stop	The function code sets the denominator for the electronic gear ratio 4.

Note:

1. The electronic gear ratio shall be set within the range: $0.001<\frac{B}{A}<30000$; otherwise, a fault Er.061 (Electronic gear ratio setting error) may occur.
2. For serial absolute encoders, the encoder resolution is 2^n, the n of which is determined by the encoder bits. The standard configuration for the M5 absolute encoders is 23-bit, which makes the encoder resolution as 2^{23}=8388608.

For incremental encoders, the resolution is calculated by the number of encoder lines * 4. For example, the resolution of a 2500 ppr incremental encoder is 2500*4=10000.

b. Setting of the electronic gear ratio switchover

When P05.05 is set to 0, the electronic gear ratio switchover function is valid. The switchover among the 4 electronic gear ratio selections shall be determined by the actual mechanical condition, and the switchover conditions shall be set as well. At any given moment, there shall be one and only one electronic gear ratio in effect.

The related function code is shown below.

Function code	Name	Range	Min. unit	Default	Effective time	Property	Function
P05.13	Electronic gear ratio switchover conditions	0: Switchover after 3 ms of holding time when the position command is 0; 1: Real-time switchover	1	0	Immediate	At stop	The function code sets the conditions for the electronic gear ratio switchover.

At the same time, set the two DI terminals of the servo drive to function 15 and function 16 (FunIN.15 and FunIN.16), and set the active logic of the terminals. The electronic gear ratio is described as shown in the following table. When no DI terminal is set to FunIN.15 or FunIN.16, FunIN.15 and FunIN.16 are invalid by default.

P05.05	P05.13	DI level for FunIN15	DI level for FunIN16	Electronic gear ratio B/A
0	0 or 1	Invalid	Invalid	P05.08/P05.09
		Valid	Invalid	P05.08/P05.10
		Invalid	Valid	P05.08/P05.11
		Valid	Valid	P05.08/P05.12
1 to 8388608	---			Encoder resolution / P05.05

(3): Calculation method for the electronic gear ratio

When the reduction ratio of the motor shaft and the device at the load side is described as m/n (the load rotates for n circles when the motor rotates for m circles), the setting value of the electronic gear ratio can be calculated by the following equation:

$$\text{Electronic gear ratio } \frac{B}{A} = \frac{\text{Encoder resolution}}{\text{Load displacement for a one-circle revolution (command unit)}} \times \frac{m}{n}$$

a. Confirm the mechanical parameters and the servo motor encoder precision

Confirm the mechanical parameters (reduction ratio, ball screw lead, transmission ratio of the belt drive, etc.); confirm the servo motor encoder precision.

b. Confirm the positioning precision (i.e. pulse equivalent)

The pulse equivalent refers to the minimum displacement unit of the load corresponding to one pulse command signal, i.e. the distance or angle of the load movement per pulse input, which can be 0.001 mm, 0.1°, 0.01 inch, or the like.

For example, when the pulse equivalent is set to 0.001 mm, if the command pulse input is 50000, the load displacement is calculated as (50000*0.001 mm) = 50 mm.

c. Calculate the number of position commands required for one circle of load shaft revolution

Calculate the number of position commands required for one circle of load shaft revolution based on the mechanical parameters and the pulse equivalent.

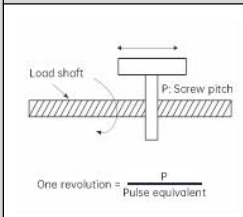
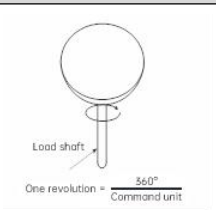
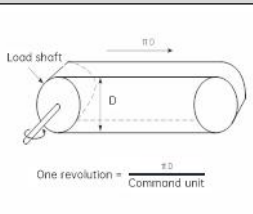
For example, if the ball screw pitch is 5 mm and the pulse equivalent is 0.001 mm, the number of position commands required for one circle of load shaft revolution = 5 mm / 0.001 mm = 5000.

d. Calculate the electronic gear ratio

When the reduction ratio of the motor shaft and the load shaft is described as m/n (the load rotates for n circles when the motor rotates for m circles), the electronic gear ratio is calculated by the following equation:

$$\text{Electronic gear ratio} = \frac{P05.08}{P05.09} = \frac{\text{Encoder resolution}}{\text{Load displacement for a one-circle revolution (command unit)}} \times \frac{m}{n}$$

(4): Example of electronic gear ratio setting

Step	Item	Mechanical part		
		Ball screw	Disc	Belt pulley
				
1	Mechanical structure	Screw lead: 5 mm Reduction ratio: 1/1	Rotation angle per a one-circle revolution: 360° Reduction ratio: 100/1	Pulley diameter: 100 mm (pulley circumference: 314 mm) Reduction ratio: 50/1
2	Encoder resolution	8388608 (23-bit)	8388608 (23-bit)	8388608 (23-bit)
3	Load displacement corresponding to one command unit	0.001 mm	0.01°	0.005 mm
4	Number of position commands required for one circle of load revolution	5 mm / 0.001 mm = 5000	360°/0.01° = 36000	314 mm / 0.005 mm = 62800 mm
5	Electronic gear	$\frac{B}{A}=\frac{8388608}{5000}\times\frac{1}{1}$	$\frac{B}{A}=\frac{8388608}{36000}\times\frac{100}{1}$	$\frac{B}{A}=\frac{8388608}{62800}\times\frac{50}{1}$

	ratio			
6	Function code	P05.08 = 8388608 P05.09 = 5000	P05.08 = 838860800 P05.09 = 36000	P05.08 = 419430400 P05.09 = 62800

5.6 Brake setting

5.6.1 Wiring diagram of the servo motor brake

The DM5-N model brake control directly outputs DC 24 V power supply. The standard wiring of the brake signal BK and the brake power supply is illustrated below.

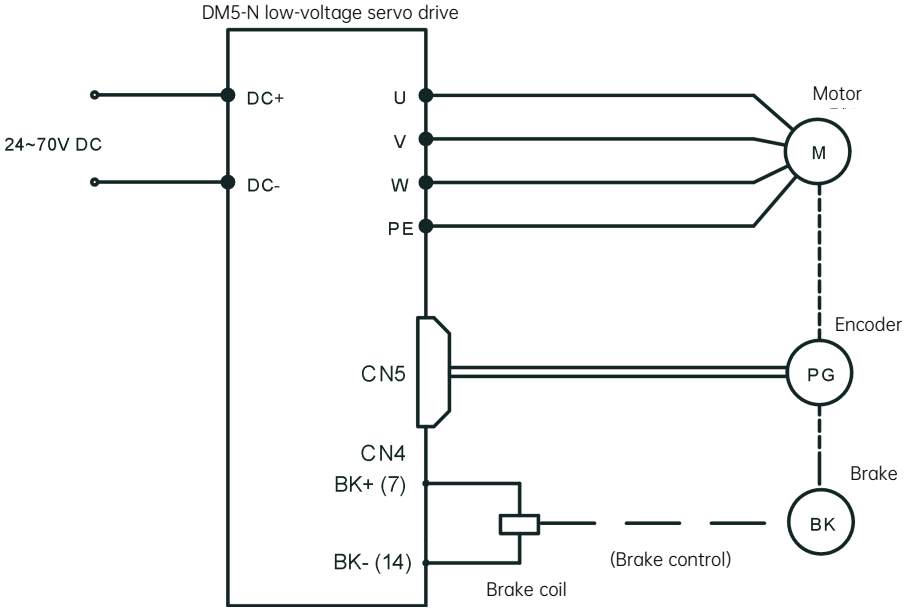


Fig. 5-3 Brake wiring diagram

Note:

It is not recommended for the brake to share its power supply with other electrical units. Such measures are intended to prevent brake malfunctions caused by voltage/current drop resulted from the operation of other electric units.

5.6.2 Time sequence of brake

For servo motors with the brake unit, the connection with the servo drive brake output BK+ and BK- is required.

Based on the present state of the servo drive, the working time sequence of the brake unit offers two modes: "normal state" brake time sequence, and "fault state" brake time sequence of the servo drive.

There are two scenarios for the brake time sequence in normal state: static motor scenario, and rotating motor scenario.

a. Static motor: actual motor rotating speed less than P02.12;

b. Rotating motor: actual motor rotating speed higher than P02.12.

5.6.3 Brake time sequence for static motor

When the servo enable is switched from ON to OFF, if the present rotating speed of the motor is lower than P02.12, the drive will act in static motor time sequence.

Note:

- Do not input speed/position/torque command during the period defined by P02.10 when the brake output is switched from OFF to ON; otherwise, a command loss or operation error may occur.
- When the servo is working with perpendicular shafts, the gravity of the mechanical part in motion or any external force may cause slight movement of the mechanical unit. When the servo motor is in the static state, if the servo enable is switched to OFF, the brake output will be switched to OFF immediately. However, within the time defined by P02.11, the motor will remain powered to prevent the mechanical part movement caused by gravity or external forces.

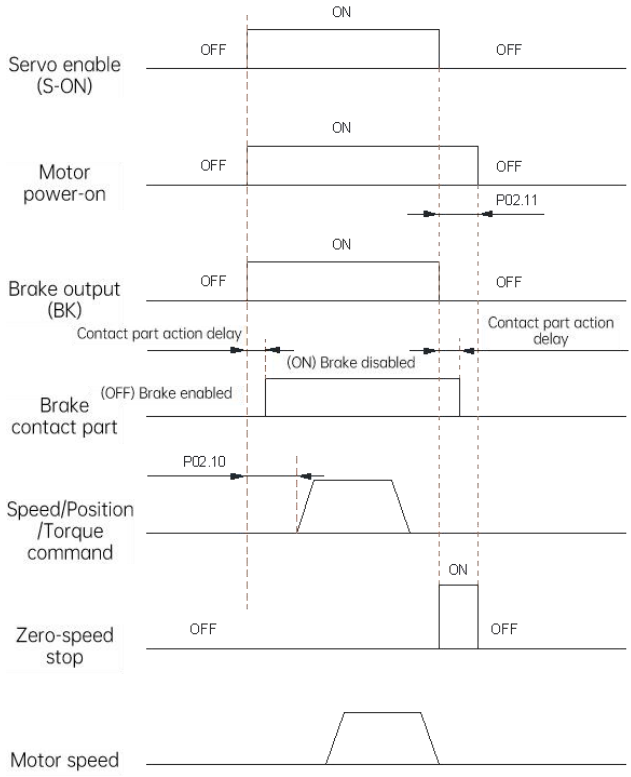


Fig. 5-4 Brake time sequence for static motor

As shown in Figure 5-4, the brake function in static motor state is described below:

a. When the servo enable is ON, the brake output will be switched to ON, and the motor will enter the power-on state;

b. For the delay time of the brake contact part action, refer to the related motor specifications;

c. The time interval from the brake output being switched to ON to the command input shall be greater than the length defined by P02.10;

d. In the static servo motor state (the motor speed is less than the set value of P02.12), when the servo enable is switched to OFF, the brake output will be switched to OFF at the same time; P02.11 enables the setting of delay from the brake output being switched to OFF to the motor's entry into the non-powered state.

Function code	Name	Range	Default	Effective time	Property
P02.10	Delay from the brake output being switched to ON to the command input	20 to 500 ms	250	Immediate	During running

Function code	Name	Range	Default	Effective time	Property
P02.11	Delay from the brake output being switched to OFF to the motor's entry into the non-powered state	1 to 1000 ms	150	Immediate	During running

5.6.4 Brake time sequence for rotating motor

When the servo motor is in the rotating state, pay special attention to the followings:

- Do not input speed/position/torque command during the period defined by P02.10 when the brake output is switched from OFF to ON; otherwise, a command loss or operation error may occur.
- When the servo motor is rotating, if the servo enable is switched to OFF, the motor will enter the zero-speed stop state; however, the brake output will be switched to OFF only when any of the following prerequisites is met:

  a. The time defined by P02.13 is not reached when the motor speed is decreased to P02.12;

  b. The time defined by P02.13 is reached, but the motor speed remains higher than P02.12.
- After the brake output is switched from ON to OFF, the motor will remain powered during the following 40 ms; such measures are intended to prevent the unnecessary movement of the mechanical part caused by gravity or external forces.

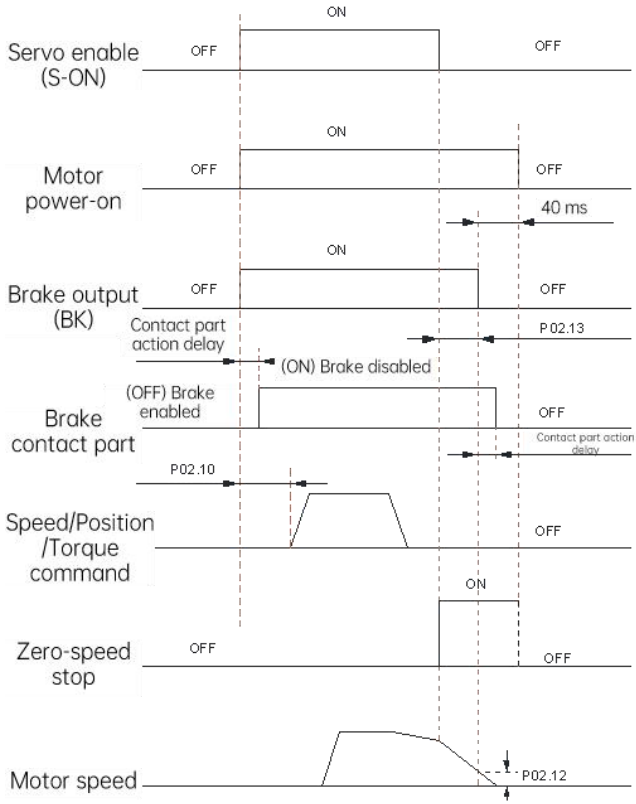


Fig. 5-5 Brake time sequence for rotating motor

As shown in Fig. 5-5, the brake function in rotating motor state is described below:

a. When the servo enable is ON, the brake output will be switched to ON, and the motor will enter the power-on state;

b. For the delay time of the brake contact part action, refer to the related motor specifications;

c. The time interval from the brake output being switched to ON to the command input shall be greater than the length defined by P02.10;

d. In the rotating servo motor state, when the servo enable is OFF, the brake output delay, which starts after the servo enable is switched to OFF, can be set via P02.12 and P02.13; the motor will enter the non-powered state only when the 50 ms delay is reached after the brake output is switched to OFF.

Function code	Name	Range	Default	Effective time	Property
P02.12	Brake command output speed limit value	0 to 3000 rpm	10	Immediate	During running

Function code	Name	Range	Default	Effective time	Property
P02.13	Delay from the servo enable being switched to OFF to the brake output being switched to OFF	1 to 30000 ms	500	Immediate	During running

5.6.5 Brake time sequence in fault state

Once a drive fault occurs, the motor enters the non-powered state immediately, and at the same time, the brake output will be switched from ON to OFF to disable the brake function.

Chapter 6 EtherCAT Communication

6.1 EtherCAT bus overview

EtherCAT is an industrial Ethernet-based fieldbus system that features high performance, low cost, easy use, and flexible topology. It is favorable for applications requiring ultra-high speed I/O network. EtherCAT adopts standard Ethernet physical layer with twisted pair cabling or optical fibers (100Base-TX or 100Base-FX) used as the transmission media.

An EtherCAT system includes the master and the slave. The master requires a common network adapter, and the slave requires a special slave control chip, such as ET1100, ET1200, or FPGA.

EtherCAT offers comprehensive trans-layer data processing abilities throughout the system where I/O layer is included, and it features the following advantages:

- No sub-bus is required for the lower layer;
- No gateway delay;
- Single EtherCAT communication system covering all devices in the network, including:
  - I/O, sensors, actuators, drives, display, etc.
- Transmission rate: 2 x 100 Mbit/s (high-speed Ethernet, full duplex mode)
- Synchronization: synchronization jitter < 1 μs (number of nodes up to 300, and cable length within 120 m between two devices)
- Update time (in typical applications):
  - 256 DI/DOs: 11 μs
  - 1000 DI/DOs distributed within 100 nodes: 30 μs = 0.03 ms
  - 200 AI/AOs (16-bit): 50 μs, sampling rate at 20 kHz
  - 100 servo axes (8 bytes IN + 8 bytes OUT for each): 100 μs = 0.1 ms
  - 12000 DI/DOs: 350 μs

To support more types of devices and extend its application layer, EtherCAT establishes the following application protocols:

- CoE (CAN application protocol over EtherCAT interface)
- SoE (Servo Drive Profile over EtherCAT, compliant with IEC 61800-7-204)
- EoE (Ethernet over EtherCAT)
- FoE (File Access over EtherCAT)

The slave device does not need to offer compatibility with all the above communication protocols; instead, it only needs to support the protocol which is the most applicable.

6.2 DM5-N series drive bus function introduction

DM5-N series servo drive adopts EtherCAT communication (real-time Ethernet communication), and CANopen Drive Profile (CiA 402) on the application layer.

6.2.1 DM5-N series communication specifications

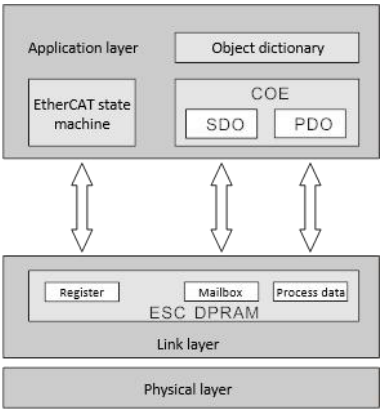
The communication specifications are shown in the table below:

Item		Specification
Communication standard		IEC 61158 Type12, IEC 61800-7 CiA 402 Drive Profile
Physical layer	Transfer protocol	100BASE-TX (IEEE802.3)
	Maximum distance	100 m
	Interface	CN1 (RJ45): EtherCAT Signal IN CN2 (RJ45): EtherCAT Signal OUT
	Cable	Category 5 cable
Application layer	SDO	SDO requests, SDO responses
	PDO	Mutable PDO mapping
	CiA 402 Drive Profile	Profile Position Mode Profile Velocity Mode Profile Torque Mode Homing Mode Cyclic Synchronous Position Mode Cyclic Synchronous Velocity Mode Cyclic Synchronous Torque Mode
Distributed clock		DC mode, DC cycle ⩾ 250 μs

6.2.2 EtherCAT Network reference model

Multiple kinds of application layer protocols are available for EtherCAT communication. The IEC 61800-7 (CiA 402) - CANopen motion control profile is used for DM5-N series servo drives.

The following figure shows the EtherCAT communication structure based on CANopen application layer.



The EtherCAT (CoE) network reference model consists of two parts: the data link layer and the application layer.

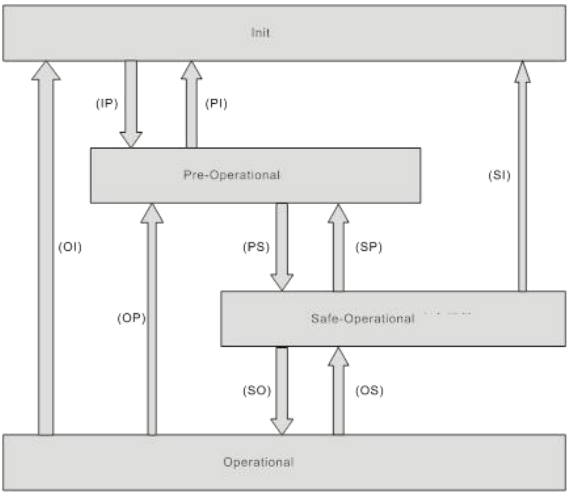
The data link layer is responsible for EtherCAT communication protocol, and the application layer is embedded with the CANopen drive Profile (CiA 402) communication protocol. The application layer object dictionary in the CoE contains communication parameters, application data, and PDO mapping information.

The process data object (PDO) consists of a mappable Object Dictionary. The contents of the PDO data are defined by PDO mapping. While PDO data is read and written periodically and does not need searches in an object dictionary, mailbox communication (SDO) is non-periodic and needs searches in the object dictionary during reading and writing.

6.2.3 EtherCAT network state machine

EtherCAT state machine is used to describe the state and state changes of the slave application.

State change requests are usually initiated by the master station and responded to by the slave station.



The EtherCAT state machine must support the following four states and coordinate the states of the master and slave application programs during initialization and operation.

These four states are:

- Init (I), indicating initialization;
- Pre-Operational (P);
- Safe-Operational (S);
- Operational (O).

Transition from "Init" to "Operational" must be processed in the sequence of "Init → Pre-Operational → Safe-Operational → Operational"; no evasion of state is allowed. Transition from "Operational" to "Init" can be processed with certain states bypassed.

The table below explains the state transition and initialization process.

State & transition	State description & transition process
Init (I)	No communication in the application layer, neither mailbox data or process data; The master can read/write EtherCAT Slave Controller (ESC) register only.
IP	The master configures the slave address; Configure the mailbox channel; Configure the Distributed clock (DC); Check whether the mailbox is successfully initialized; Request for Pre-Operational state.
Pre-Operational (P)	Mailbox data communication in the application layer (SDO) is activated.

State & transition	State description & transition process
PS	The master initializes the process data mapping via mailbox communication; The master configures the Sync Manager (SM) channel for the process data communication; The master configures FMMU (Fieldbus Memory Management Units); The master requests for Safe-Operational state.
Safe-Operational (S)	Process data communication is available, but only the reading of input data is allowed. No output signal is generated. The output is set to the Safe-Operational state. (SDO, TPDO)
SO	The master sends valid output data; The master requests for Operational state.
Operational (O)	Both input and output are valid; Mailbox communication is available. (SDO, TPDO, RPDO)

6.2.4 Process data object (PDO)

EtherCAT PDO consists of Reception PDO (RPDO) and Transmission PDO (TPDO). The slave receives the master command via RPDO, and responds with its state via TPDO.

6.2.4.1 Sync Manager PDO assignment

The process data contains multiple PDO mapping data objects during EtherCAT cyclic data communication. The CoE protocol defines the PDO mapping object list of the Sync Manager using the data objects 1C10h to 1C2Fh. Multiple PDOs can be mapped to different sub-indexes. The DM5-N series servo drive supports assignment of four RPDOs and four TPDOs, as described in the table below.

Index	Sub-index	Description
1C12h	01	Assign 1600h as the RPDO mapping object
1C13h	01	Assign 1A00h as the TPDO mapping object

6.2.4.2 PDO mapping parameter

PDO mapping is used to establish the mapping relation between the object dictionary and the PDO (real-time process data).

In the object dictionary, indexes 1600h to 1603h store RPDO mapping, and indexes 1A00h to 1A03h store TPDO mapping.

The DM5-N series servo drive provides one mutable RPDO1, three fixed RPDO2 to RPDO4, one mutable TPDO1, and three fixed TPDO2 to TPDO4 for use, as listed in the table below.

PDO	Index	Max. number of mapping objects	Max. number of bytes	Default Mapping Object
RPDO1	1600h	10	40	6040h (Control word) ……
RPDO2	1601h	2	6	6040 (Control word) 60FF (Target velocity)
RPDO3	1602h	2	6	6040 (Control word) 607A (Target position)
RPDO4	1603h	2	4	6040 (Control word) 6071 (Target torque)
TPDO1	1A00h	10	40	6041h (Status word) …
TPDO2	1A01h	3	10	6041 (Status word) 6064 (Position actual value) 606C (Velocity actual value)
TPDO3	1A02h	2	6	6041 (Status word) 6064 (Position actual value)
TPDO4	1A03h	3	8	6041 (Status word) 6064 (Position actual value) 6077 (Torque actual value)

6.2.4.3 PDO configuration

PDO mapping parameters contain the objects which are mapped to the process data, including the index, sub-index, and mapping object length. The sub-index 0 indicates the number (n) of mapping

objects in the PDO, and the maximum length of each PDO is 4*n bytes, with each PDO capable of mapping one or multiple objects simultaneously. Sub-indexes 1 to n indicate the mapping content.

The contents of mapping parameters are defined as below:

Bit	31	…	16	15	…	8	7	…	0
Definition	Index			Sub-index			Object length		

The index and sub-index together define the position of an object in the object dictionary. The object length indicates the bit length of the object in hexadecimal, as shown below:

Object Length	Data Length (bit)
08h	8
10h	16
20h	32

Examples:

The mapping parameter value of the 8-bit operating mode 6060-00h is 60600008h;

The mapping parameter value of the 16-bit control word 6040-00h is 60400010h;

The mapping parameter value of the 32-bit interpolated position 60C1-01h is 60C10120h

6.2.4.4 PDO mapping procedure

- Stop PDO assignment function (Write 0 into the sub-index 00h of both 1C12h and 1C13h; PDO assignment disabled);
- Stop PDO mapping function (Set sub-index 00h of both 1600h and 1A00h to 0 to clear the original mapping content);
- Set the content of the PDO mapping object (Based on actual application, the index, sub-index, and length of the mapping object are written respectively into the sub-indexes 1 to 10 of 1600h and 1A00h);
- Set the number of PDO mapping objects (Based on actual application, the sub-index 00h of 1600h and 1A00h is set to 1 to 10);
- Set PDO assignment object (Set the sub-index 1 of 1C12h and 1C13h);
- Enable the PDO assignment function again (Set the sub-index 00h of 1C12h and 1C13h to 1).

6.2.5 Service data object (SDO) for mailbox communication

The EtherCAT mailbox communication SDO is used for acyclic data transmission, such as communication parameter configuration and servo drive parameter configuration.

The CoE service of EtherCAT includes: Emergency message, SDO request, SDO response, Remote TxPDO transmission request, Remote RxPDO transmission request, and SDO message.

The DM5-N series supports SDO request, SDO response, and SDO message.

6.2.6 Distributed Clock

In the Ethernet-based EtherCAT system, the master initializes, configures, starts, and compensate the clock drift of the distributed clock. The distributed clock at the slave end is implemented by the ESC control chip, which provides the interrupt signal and clock information for the slave. The distributed clock also records the input time of the latched input signal.

The distributed clock enables all devices in the EtherCAT system to use the same system time, which facilitates the synchronous task execution of devices. The slave device is able to generate synchronous signals based on the synchronized system time.

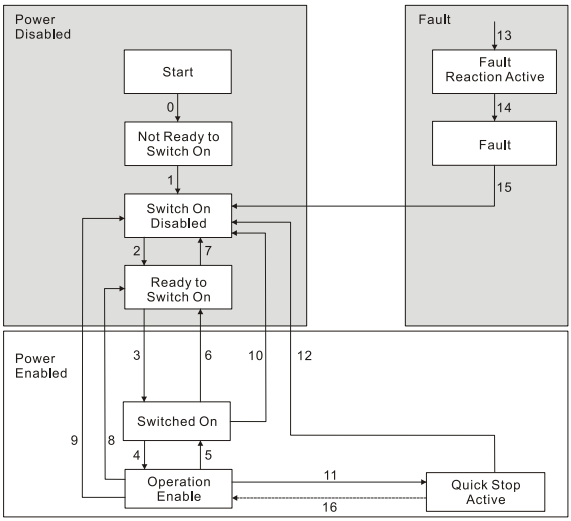
The DM5-N series servo drive supports the distributed clock synchronization function. The synchronization cycle is determined by SYNC0. The synchronization cycle range varies for different operation modes. The typical synchronization cycle includes 250 μs, 500 μs, 1 ms, and 2 ms. The minimum synchronization cycle supported by DM5-N series is 250 μs.

6.3 CiA 402 device control (device profile)

The device control function serves for the implementation of all the operational functions of the drive, including device state machine control and device running mode. The master station controls the drive via the control word and learns the present status of the drive via the status word of the drive.

6.3.1 CoE state machine

The CoE state machine is illustrated in the diagram below:



As shown in the diagram above, the state machine consists of three scenarios, namely Power Disabled, Power Enabled, and Fault.

After power-on, the drive completes initialization, and enters the SWITCH ON DISABLED state. Configuration of the drive operation mode is available at this moment while the power remains disabled.

After the state transition 2, 3, and 4, the system enters the OPERATION ENABLE state. The power is turned on at this moment, and the drive is in control of the motor based on the configured operation mode. Therefore, before the entry of this state, it is required to confirm that the drive parameters are correctly configured and the corresponding values are set to zero.

Switch off the circuit power after the completion of state transition 9.

If the drive reports an alarm, it will enter the Fault state. The drive will enter the Fault state whichever state it is in when an alarm is reported.

The drive states and their definitions are explained in the table below.

State	Definition
Not Ready to Switch On	The drive is in the process of initialization.
Switch On Disabled	The drive initialization is completed; The drive parameters are ready for configuration.
Ready to Switch On	The drive is ready to power on; The drive parameters are ready for configuration.
Switch On	The drive is powered on; The drive parameters are ready for configuration.

State	Definition
Operation Enable	The drive is fault-free; The drive is enabled; The parameter setting of the drive is valid.
Quick Stop Active	The drive stops quickly.
Fault Reaction Active	A fault is detected, and the drive performs the fault stop procedure.
Fault	The fault occurs, and the fault stop procedure finishes; The drive functions are disabled.

The switchover of the drive state is explained in the table below.

State switchover ID	Description
0	Automatic switchover of state upon drive reset
1	Automatic switchover of state upon drive reset
2	Shut Down command received
3	Switch On command received
4	Enable Operation command received
5	Disable Operation command received
6	Shut Down command received
7	Quick Stop and Disable Voltage command received
8	Shut Down command received
9	Disable Voltage command received
10	Quick Stop or Disable Voltage command received
11	Quick Stop command received
12	Quick Stop or Disable Voltage command received
13	Automatic switchover of state upon drive error
14	Automatic switchover of state upon drive error response completion
15	Fault Reset command received
16	Enable Operation command received

6.3.2 Object dictionary

The object dictionary is the most important part of the device specification. It is an ordered set of parameters and variables, containing all parameters of device description and device network state.

It contains sets of objects that can be accessed through a network in an ordered, predefined manner.

The CANopen protocol uses an object dictionary with 16-bit indexes and 8-bit sub-indexes. The structure of the object dictionary is shown in the table below.

Index range	Description
0000h–0FFFh	Data type description object area
1000h–1FFFh	Communication object area: storage of common communication parameters
2000h–5FFFh	Manufacturer-defined object area: storage of manufacturer device parameters, such as drive parameters
6000h–9FFFh	Subprotocol object area: CiA 402 protocol parameters
A000h–FFFFh	Reserved area

6.3.3 Device control word and status word

Index	Data structure	Name	Data type	Accessibility
6040h	VAR	Control word	UINT16	RW
6041h	VAR	Status word	UINT16	RO

6.3.3.1 Control word

The bit definitions of the control word are shown in the table below.

Bit15 to Bit11	Bit10 to Bit9	Bit8	Bit7	Bit6 to Bit4	Bit3	Bit2	Bit1	Bit0
Manufacture specific	Reserved	Halt	Fault reset	Operation mode specific	Enable operation	Quick stop	Enable voltage	Switch on
O	O	O	M	O	M	M	M	M

(In the table above, O is for Optional, and M is for Mandatory.)

The control commands consisting of Bit0, Bit1, Bit2, Bit3, and Bit7 of the control word are used to switch the state machine. The following table describes the defined control commands.

Command	Bit of control word					Transitions
	Fault reset	Enable operation	Quick stop	Enable voltage	Switch on	
Shutdown	0	X	1	1	0	2, 6, 8
Switch on	0	0	1	1	1	3*
Switch on	0	1	1	1	1	3**
Disable voltage	0	X	X	0	X	7, 9, 10, 12
Quick stop	0	X	0	1	X	7, 10, 11
Disable operation	0	0	1	1	1	5
Enable operation	0	1	1	1	1	4, 16
Fault reset		X	X	X	X	15

(In the table above, the bit marked with X can be bypassed.)

Bit4, Bit5, Bit6, and Bit8 of the control word have different definitions in different control modes.

Bit	Operation mode					
	Profile position mode	Profile velocity mode	Homing mode	Interpolated position mode	Cyclic Synchronous position mode	Cyclic Synchronous velocity mode
4	New set-point	reserved	Homing operation start	Enable ip Mode	reserved	reserved
5	Change set immediately	reserved	reserved	reserved	reserved	reserved
6	Abs/Rel	reserved	reserved	reserved	reserved	reserved
8	Halt	Halt	Halt	Halt	Halt	Halt

(For definitions of each bit in the above table, please refer to the running mode description.)

6.3.3.2 Status word

The bit definitions of the status word are shown in the table below.

Bit	Description
0	Ready to switch on

Bit	Description
1	Switched on
2	Operation enabled
3	Fault
4	Voltage enabled
5	Quick stop
6	Switch on disabled
7	Warning
8	Manufacturer specific
9	Remote
10	Target reached
11	Internal limit active
12 to 13	Operation mode specific
14 to 15	Manufacturer specific

Bit0, Bit1, Bit2, Bit3, Bit5, and Bit6 in the status word are used to indicate the state of the drive, as shown in the table below.

Bit value (binary)	State
xxxx xxxx x0xx 0000	Not ready to switch on
xxxx xxxx x1xx 0000	Switch on disabled
xxxx xxxx x01x 0001	Ready to switch on
xxxx xxxx x01x 0011	Switched on
xxxx xxxx x01x 0111	Operation enabled
xxxx xxxx x00x 0111	Quick stop active
xxxx xxxx x0xx 1111	Fault reaction active
xxxx xxxx x0xx 1000	Fault

The status word is described as below:

- The definitions for bits (Bit0 to Bit9) stay the same in different control modes; when the master sends the control word 6040h, the drive will respond with a certain state;
- Bit10, Bit11, Bit12, and Bit13 are related to control modes;

- Bit14 and Bit15 are defined by the manufacturer.

6.3.4 Common conversion factor

User-defined units are usually different from the units applied for the drive-controlled motor. To implement a unified unit system, a set of conversion factors are provided by the CiA 402 device profile to facilitate the conversion between the user-defined units and the motor units.

The default motor units of DM5-N series are as follows:

- Motor displacement unit: p (pulse)
- Motor speed unit: rpm

The units commonly used by users are as follows:

- Load displacement unit: mm
- Load speed unit: mm/s

6.3.4.1 Gear ratio factor (6091h)

The substantial meaning of the conversion factor: the motor displacement (unit: p) corresponding to the load displacement of one user-defined unit.

The gear ratio consists of the numerator 6091-1h and the denominator 6091-2h. The proportional relationship between the load displacement (user-defined unit) and the motor displacement (motor unit) can be established via the gear ratio factor:

$$\text{Gear ratio factor}(6091\text{h}) = \frac{\text{Motor encoder resolution } (6091 - 1\text{h})}{\text{Load shaft resolution } (6091 - 2\text{h})}$$

$$\text{Motor displacement} = \text{Load displacement (user defined)} \times \text{gear ratio factor}$$

$$\text{Load feedback displacement (user defined)} = \frac{\text{Motor feedback displacement}}{\text{Gear ratio factor}}$$

Examples

For ball screw applications:

- Each load feed: 40 mm
- Screw lead: PB = 10 mm/r
- 23-bit motor encoder; resolution: P = 8388608 (p/r)

Based upon the above descriptions, the position factor is calculated as below.

Each load shaft feed:

$$\text{Position factor: Each load shaft feed} = \frac{\text{Load feed}}{\text{Lead}} = \frac{40\ \text{mm}}{10\ \text{mm/r}} = 4\ (\text{r})$$

$$\text{Position factor} = \frac{\text{Each load shaft feed} \times \text{Motor resolution}}{\text{Each load feed}} = \frac{4\ \text{r} \times 8388608\ \text{p/r}}{40} = \frac{8388608}{10}$$

It indicates that the motor displacement reaches to 8388608 pulses when the load displacement is 10 mm.

Therefore, the numerator 6091-1h can be set to 8388608, and the denominator 6091-2h can be set to 10.

6.4 Bus operation mode

DM5-N series supports the following bus operation modes in CoE:

- Profile Position Mode;
- Profile Velocity Mode;
- Profile Torque Mode;
- Homing Mode;
- Cyclic Synchronous Position Mode;
- Cyclic Synchronous Velocity Mode;
- Cyclic Synchronous Torque Mode;

The objects related to the operation modes are listed in the table below. 6060h is used to set the drive operation mode, and 6061h is used to display the present operation mode of the drive.

Index	Data structure	Name	Data type	Accessibility
6060h	VAR	Modes of operation	INT8	RW
6061h	VAR	Modes of operation display	INT8	RO

The values and meanings of the above two objects are explained in the table below.

Value	Description
1	Profile Position Mode
3	Profile Velocity Mode
4	Profile Torque Mode
6	Homing Mode
8	Cyclic Synchronous Position Mode
9	Cyclic Synchronous Velocity Mode

Value	Description
10	Cyclic Synchronous Torque Mode

6.4.1 Profile position mode

This mode is used mainly in applications of point-to-point positioning. In this mode, the master sets the target position (absolute or relative), and the speed/acceleration/deceleration of the position curve. Based on the above settings, the drive generates the target position curve command and performs the complete process of positioning control.

6.4.1.1 Common object

The objects related to this operation mode are listed in the table below.

Index	Data structure	Name	Data type	Accessibility	Mapping type	Unit
603Fh	VAR	Error Code	UINT16	RW	TPDO	-
6040h	VAR	Control word	UINT16	RW	RPDO	-
6041h	VAR	Status word	UINT16	RO	TPDO	-
6060h	VAR	Modes of operation	INT8	RW	RPDO	-
6061h	VAR	Modes of operation display	INT8	RO	TPDO	-
6063h	VAR	Position actual value* (motor unit)	INT32	RO	TPDO	p
6064h	VAR	Position actual value (user-defined unit)	INT32	RO	TPDO	Command unit
6065h	VAR	Following error window	UINT32	RW	RPDO	Command unit
6066h	VAR	Following error window time	UINT16	RW	RPDO	ms
6067h	VAR	Position window	UINT32	RW	RPDO	Command unit
6068h	VAR	Position window time	UINT16	RW	RPDO	ms
607Ah	VAR	Target position	INT32	RW	RPDO	Command unit
607Dh	ARRAY	Software position limit	INT32	RW	RPDO	Command unit
607Eh	VAR	Polarity	UINT8	RW	RPDO	-

Index	Data structure	Name	Data type	Accessibility	Mapping type	Unit
607Fh	VAR	Max. profile velocity	UINT32	RW	RPDO	Command unit / s
6080h	VAR	Max. motor speed	UINT32	RW	RPDO	rpm
6081h	VAR	Profile velocity	UINT32	RW	RPDO	Command unit / s
6083h	VAR	Profile acceleration	UINT32	RW	RPDO	Command unit / s^2
6084h	VAR	Profile deceleration	UINT32	RW	RPDO	Command unit / s^2
6091h	ARRAY	Gear ratio factor	UINT32	RW	RPDO	-
60F4h	VAR	Following error actual value	INT32	RO	TPDO	Command unit

Note:

There are default settings in the drive, including the profile speed, acceleration, deceleration, maximum profile velocity, and gear ratio factor of the position curve, which are set via the function parameters. If the master does not offer new settings of these parameters, the default settings will turn valid. To change the default settings, the drive needs to be powered off and restarted.

6.4.1.2 Control word and status word

The control word in the profile position mode (PP) is explained in the table below.

Bit15 to Bit7	Bit6	Bit5	Bit4	Bit3 to Bit0
*	Abs/Rel	Change set immediately	New set-point	*

Note:

The mark * here and hereinafter indicates that the definition of the corresponding bit are the same with the standard definition.

The bits of the control word in the profile position mode are described in the table below.

Bit	Set value	Function
New set-point	0	No set position
	1	New set position; start positioning
Change set immediately	0	The position is not updated immediately.
	1	The position is updated immediately.
Abs/Rel	0	Absolute position setting
	1	Relative position setting

The status word in the profile position mode (PP) is listed in the table below.

Bit15 to Bit14	Bit13	Bit12	Bit11	Bit10	Bit9 to Bit0
*	Following error	Set-point acknowledge	*	Target reached	*

The bits of the status word in the profile position mode are described in the table below.

Bit	Set value	Function
Target reached	0	Target position not reached
	1	Target position reached
Set-point acknowledge	0	The target position can be updated.
	1	The target position cannot be updated.
Following error	0	No position deviation
	1	There is position deviation.

6.4.1.3 Function description

- Running mode setting: Set 6060h to 1;
- Target position setting: Set the target position in the user-defined unit via 607Ah; if necessary, set the gear ratio factor 6091h;
- Positioning mode setting: Set the positioning mode (including the absolute/relative position setting, the immediate upgrade / non-immediate upgrade setting, etc.) via control word 6040h;
- Positioning speed setting: Set the positioning speed in the user-defined unit via 6081h; if necessary, set the gear ratio factor 6091h, profile acceleration time 6083h, and the profile deceleration time 6084h;
- Positioning enable: Enable the operation of the drive via the object 6040h, and enable the positioning via Bit4;
- Speed limit setting: Select the speed limit channel via 2007.0Ah (P07.09 FWD speed limit channel) and 2007.0Ch (P07.11 REV speed limit channel) in the object dictionary of the function code, where the bus channel is selected by default. The range for the bus speed limit channel is determined by 607Fh maximum profile velocity and 6080h maximum motor speed. Otherwise, set an internal speed limit channel, and the range is determined by 2007.0Bh (P07.10 FWD speed limit) and 2007.0Dh (P07.12 REV speed limit) in the object dictionary of the function code. The speed limit can be decreased to zero based on the decrease time set by P20.19 (2014.14h);

Function code	Name	Range	Max. unit	Default	Effective time	Property	Function
P20.19	Bus speed limit decrease time	0 to 65535	1	0	Immediate	At stop	Set the time of the speed limit decreasing from the max. value to zero (unit: ms)

- Torque limit setting: Select the torque limit channel via 2006.0Dh (P06.12 positive torque limit channel) and 2006.0Eh (P06.13 negative torque limit channel) in the object dictionary of the function code, where the bus channel is selected by default. The range for the bus torque limit channel is determined by the minimum value among 6072h maximum torque, 60E0h positive torque limit, and 60E1h negative torque limit. Otherwise, set an internal torque limit channel, and the range is determined by 2006.0Fh (P06.14 positive torque limit) and 2006.10h (P06.15 negative torque limit) in the object dictionary of the function code;
- Positioning arrival judgement: If the position deviation in the user-defined unit is less than 6067h and the time reaches 6068h, it indicates that the position is arrived; at this point, set bit10 of the status word 6041h to 1;
- Excessive position deviation judgement: If the position deviation in the user-defined unit 60F4h is greater than 6065h, a fault is reported; at this point, bit13 of the status word 6041h is set to 1;
- Polarity 0x607E of command: The command logic of torque, speed, and position shall be set according to the corresponding bit of 0x607E in the object dictionary.

Bit	Name	Set value	Function
Bit5	Torque command polarity	0	Torque command positive logic
		1	Torque command negative logic
Bit6	Speed command polarity	0	Speed command positive logic
		1	Speed command negative logic
Bit7	Position command polarity	0	Position command positive logic
		1	Position command negative logic

6.4.1.4 Basic configuration

The basic configuration of the objects in the profile position mode is described in the table below.

RPDO object	TPDO object	Remark
Control word 6040h	Status word 6041h	Required
Target position 607Ah	Position actual value 6064h	Required
Profile velocity 6081h		Required

RPDO object	TPDO object	Remark
Other objects		Optional; it can be configured as an SDO parameter; otherwise, use the default parameter of the drive.

6.4.2 Profile velocity mode

In this mode, the master sets the target speed, acceleration, and deceleration, and the drive generates the target speed curve command based on the above settings, and performs the complete process of acceleration/deceleration control.

6.4.2.1 Common object

The objects related to this operation mode are listed in the table below.

Index	Data structure	Name	Data type	Accessibility	Mapping type	Unit
603Fh	VAR	Error Code	UINT16	RW	TPDO	-
6040h	VAR	Control word	UINT16	RW	RPDO	-
6041h	VAR	Status word	UINT16	RO	TPDO	-
6060h	VAR	Modes of operation	INT8	RW	RPDO	-
6061h	VAR	Modes of operation display	INT8	RO	TPDO	-
6063h	VAR	Position actual value* (motor unit)	INT32	RO	TPDO	p
6064h	VAR	Position actual value (user-defined unit)	INT32	RO	TPDO	Command unit
6069h	VAR	Velocity sensor actual value	INT32	RO	TPDO	rpm
606Bh	VAR	Velocity demand value	INT32	RO	TPDO	rpm
606Ch	VAR	Velocity actual value	INT32	RO	TPDO	Command unit / s
606Dh	VAR	Velocity window	UINT16	RW	RPDO	rpm
606Eh	VAR	Velocity window time	UINT16	RW	RPDO	ms
606Fh	VAR	Velocity threshold	UINT16	RW	RPDO	rpm
6070h	VAR	Velocity threshold time	UINT16	RW	RPDO	ms
607Eh	VAR	Polarity	UINT8	RW	RPDO	-
607Fh	VAR	Max. profile velocity	UINT32	RW	RPDO	Command unit / s
6080h	VAR	Max. motor speed	UINT32	RW	RPDO	rpm

Index	Data structure	Name	Data type	Accessibility	Mapping type	Unit
6083h	VAR	Profile acceleration	UINT32	RW	RPDO	Command unit / s^2
6084h	VAR	Profile deceleration	UINT32	RW	RPDO	Command unit / s^2
6091h	ARRAY	Gear ratio factor	UINT32	RW	RPDO	-
60FFh	VAR	Target velocity	INT32	RW	RPDO	Command unit / s

Note:

There are default settings in the drive, including the acceleration, deceleration, maximum speed, and gear ratio factor of the speed curve, which are set via the function parameters. If the master does not offer new settings of these parameters, the default settings will turn valid. To change the default settings, the drive needs to be powered off and restarted.

6.4.2.2 Control word and status word

The definition of the control word in the profile velocity mode is the same with the standard definition.

The status word in the profile velocity mode is explained in the table below.

Bit15 to Bit13	Bit12	Bit11	Bit10	Bit9 to Bit0
*	Speed	*	Target reached	*

The bits of the status word in the profile velocity mode are described in the table below.

Bit	Set value	Function
Target reached	0	Target speed not reached
	1	Target speed reached
Speed	0	Speed is not equal to 0.
	1	Speed is equal to 0.

6.4.2.3 Function description

- Control mode setting: Set P02.00 to 8;
- Running mode setting: Set 6060h to 3;
- Target velocity setting: Set the target velocity in the user-defined unit via 60FFh; if necessary, set the gear ratio factor 6091h;
- Acceleration curve setting: If necessary, set the profile acceleration time 6083h, and profile deceleration time 6084h;

- Operation enable: Enable the operation of the drive via the control word 6040h;
- Speed limit setting: Select the speed limit channel via 2007.0Ah (P07.09 FWD speed limit channel) and 2007.0Ch (P07.11 REV speed limit channel) in the object dictionary of the function code, where the bus channel is selected by default. The range for the bus speed limit channel is determined by 607Fh maximum profile velocity and 6080h maximum motor speed. Otherwise, set an internal speed limit channel, and the range is determined by 2007.0Bh (P07.10 FWD speed limit) and 2007.0Dh (P07.12 REV speed limit) in the object dictionary of the function code. The speed limit can be decreased to zero based on the decrease time set by P20.19 (2014.14h);

Function code	Name	Range	Max. unit	Default	Effective time	Property	Function
P20.19	Bus speed limit decrease time	0 to 65535	1	0	Immediate	At stop	Set the time of the speed limit decreasing from the max. value to zero (unit: ms)

- Torque limit setting: Select the torque limit channel via 2006.0Dh (P06.12 positive torque limit channel) and 2006.0Eh (P06.13 negative torque limit channel) in the object dictionary of the function code, where the bus channel is selected by default. The range for the bus torque limit channel is determined by the minimum value among 6072h maximum torque, 60E0h positive torque limit, and 60E1h negative torque limit. Otherwise, set an internal torque limit channel, and the range is determined by 2006.0Fh (P06.14 positive torque limit) and 2006.10h (P06.15 negative torque limit) in the object dictionary of the function code;
- Velocity arrival judgement: If the deviation between 606Ch feedback velocity and 60FFh target velocity is less than 606Dh and the time reaches 606Eh, it indicates that the velocity is arrived; at this point, set bit10 of the status word 6041h to 1;
- Zero-speed operation judgement: if the feedback velocity 606Ch in the user-defined unit is less than 606Fh and the time reaches 6070h, it indicates that zero speed is reached; at this point, set bit12 of the status word 6041h to 1;
- Polarity 0x607E of command: The command logic of torque, speed, and position shall be set according to the corresponding bit of 0x607E in the object dictionary.

Bit	Name	Set value	Function
Bit5	Torque command polarity	0	Torque command positive logic
		1	Torque command negative logic
Bit6	Speed command polarity	0	Speed command positive logic
		1	Speed command negative logic
Bit7	Position command polarity	0	Position command positive logic
		1	Position command negative logic

6.4.2.4 Basic configuration

The basic configuration of the objects in the profile velocity mode is described in the table below.

RPDO object	TPDO object	Remark
Control word 6040h	Status word 6041h	Required
Target velocity 60FFh		Required
	Velocity actual value 606Ch	Optional
Other objects		Optional; it can be configured as an SDO parameter; otherwise, use the default parameter of the drive.

6.4.3 Profile torque mode

The servo drive (slave) controls the torque via the torque command received from the host (master).

6.4.3.1 Common object

The objects related to this operation mode are listed in the table below.

Index	Data structure	Name	Data type	Accessibility	Mapping type	Unit
603Fh	VAR	Error Code	UINT16	RW	TPDO	-
6040h	VAR	Control word	UINT16	RW	RPDO	-
6041h	VAR	Status word	UINT16	RO	TPDO	-
6060h	VAR	Modes of operation	INT8	RW	RPDO	-
6061h	VAR	Modes of operation display	INT8	RO	TPDO	-
6063h	VAR	Position actual value* (motor unit)	INT32	RO	TPDO	Encoder unit
6064h	VAR	Position actual value (user-defined unit)	INT32	RO	TPDO	Command unit
6069h	VAR	Velocity sensor actual value	INT32	RO	TPDO	rpm
606Bh	VAR	Velocity demand value	INT32	RO	TPDO	rpm

Index	Data structure	Name	Data type	Accessibility	Mapping type	Unit
606Ch	VAR	Velocity actual value	INT32	RO	TPDO	Command unit / s
606Dh	VAR	Velocity window	UINT16	RW	RPDO	rpm
606Eh	VAR	Velocity window time	UINT16	RW	RPDO	ms
606Fh	VAR	Velocity threshold	UINT16	RW	RPDO	rpm
6070h	VAR	Velocity threshold time	UINT16	RW	RPDO	ms
6071h	VAR	Target torque	INT16	RW	RPDO	0.1%
6072h	VAR	Max. Torque	UINT16	RW	RPDO	0.1%
6074h	VAR	Torque demand	INT16	RO	TPDO	0.1%
6077h	VAR	Torque actual value	INT16	RO	TPDO	0.1%
607Eh	VAR	Polarity	UINT8	RW	RPDO	-
607Fh	VAR	Max. profile velocity	UINT32	RW	RPDO	Command unit / s
6080h	VAR	Max motor speed	UINT32	RW	RPDO	rpm
6087h	VAR	Torque slope	UINT16	RW	RPDO	0.1%/s
60E0h	VAR	FWD torque limit	UINT16	RW	RPDO	0.1%
60E1h	VAR	REV torque limit	UINT16	RW	RPDO	0.1%

6.4.3.2 Control word and status word

The definition of the control word in the profile torque mode is the same with the standard definition.

The status word in the profile torque mode is explained in the table below。

Bit15 to Bit13	Bit12	Bit11	Bit10	Bit9 to Bit0
*	*	*	Target reached	*

The bits of the status word in the profile torque mode are described in the table below:

Bit	Set value	Function
Target reached	0	Target torque not reached

Bit	Set value	Function
	1	Target torque reached

6.4.3.3 Function description

- Control mode setting: Set P02.00 to 8;
- Running mode setting: Set 6060h to 4;
- Target torque setting: Set the target torque in the user-defined unit via 6071h (unit: 0.1%);
- Speed limit setting: Select the speed limit channel via 2007.0Ah (P07.09 FWD speed limit channel) and 2007.0Ch (P07.11 REV speed limit channel) in the object dictionary of the function code, where the bus channel is selected by default. The range for the bus speed limit channel is determined by 607Fh maximum profile velocity and 6080h maximum motor speed. Otherwise, set an internal speed limit channel, and the range is determined by 2007.0Bh (P07.10 FWD speed limit) and 2007.0Dh (P07.12 REV speed limit) in the object dictionary of the function code. The speed limit can be decreased to zero based on the decrease time set by P20.19 (2014.14h);

Function code	Name	Range	Max. unit	Default	Effective time	Property	Function
P20.19	Bus speed limit decrease time	0 to 65535	1	0	Immediate	At stop	Set the time of the speed limit decreasing from the max. value to zero (unit: ms)

- Torque limit setting: Select the torque limit channel via 2006.0Dh (P06.12 positive torque limit channel) and 2006.0Eh (P06.13 negative torque limit channel) in the object dictionary of the function code, where the bus channel is selected by default. The range for the bus torque limit channel is determined by the minimum value among 6072h maximum torque, 60E0h positive torque limit, and 60E1h negative torque limit. Otherwise, set an internal torque limit channel, and the range is determined by 2006.0Fh (P06.14 positive torque limit) and 2006.10h (P06.15 negative torque limit) in the object dictionary of the function code;
- Operation enable: Enable the operation of the drive via the control word 6040h;
- Polarity 0x607E of command: The command logic of torque, speed, and position shall be set according to the corresponding bit of 0x607E in the object dictionary;

Bit	Name	Set value	Function
BIT5	Torque command polarity	0	Torque command positive logic
		1	Torque command negative logic
BIT6	Speed command polarity	0	Speed command positive logic
		1	Speed command negative logic

Bit	Name	Set value	Function
BIT7	Position command polarity	0	Position command positive logic
		1	Position command negative logic

- Torque arrival: This function determines whether the torque actual value has reached the torque window. If the discrepancy between the torque actual value (6077h) and the torque reference value (2007.0Eh) is greater than the torque arrival effective value (2007.0Fh), bit10 (target reached) of the status word will be set to 1. If the discrepancy between the torque actual value (6077h) and the torque reference value (2007.0Eh) is lower than the torque arrival non-effective value (2007.10h), bit10 (target reached) of the status word will be cleared immediately.

6.4.3.4 Basic configuration

The basic configuration of the objects in the profile torque mode is described in the table below.

RPDO object	TPDO object	Remark
Control word 6040h	Status word 6041h	Required
Target torque 6071h		Required
	Torque actual value 6077h	Optional
Other objects		Optional; it can be configured as an SDO parameter; otherwise, use the default parameter of the drive.

6.4.4 Homing mode

DM5-N series supports the homing mode. In this mode, the drive returns to the designated position based on the settings of homing mode, homing speed, and home offset.

6.4.4.1 Common object

The objects related to this operation mode are listed in the table below.

Index	Data structure	Name	Data type	Accessibility	Mapping type	Unit
6040h	VAR	Control word	UINT16	RW	RPDO	-
6041h	VAR	Status word	UINT16	RO	TPDO	-

Index	Data structure	Name	Data type	Accessibility	Mapping type	Unit
6060h	VAR	Modes of operation	INT8	RW	RPDO	-
6061h	VAR	Modes of operation display	INT8	RO	TPDO	-
6098h	VAR	Homing method	INT8	RW	RPDO	-
607Ch	VAR	Home offset	INT32	RW	RPDO	Command unit
6099h	ARRAY	Homing speeds	UINT32	RW	RPDO	Command unit / s
609Ah	VAR	Homing acceleration	UINT32	RW	RPDO	Command unit / s^2

Object description:

- Homing method (6098h)

  DM5-N series drive supports homing methods of 1 to 35 in CiA 402.

- Home offset (607Ch)

  It indicates the pulses of offset when the home position is found.

- Homing speeds (6099h)

Sub-index	Name	Unit
0	Number of sub-indexes (2)	-
1	High speed homing	rpm
2	Low speed homing	rpm

6.4.4.2 Control word and status word

The control word in the homing mode is explained in the table below.

Bit15 to Bit5	Bit4	Bit3 to Bit0
*	Homing start	*

The bits of the control word in the homing mode are described in the table below.

Bit	Set value	Function
Homing start	0->1	Homing start
	1	Homing in progress
	1->0	End of homing

The status word in the homing mode is explained in the table below.

Bit15 to Bit14	Bit13	Bit12	Bit11	Bit10	Bit9 to Bit0
*	Homing error	Homing attained	*	Target reached	*

The bits of the status word in the homing mode are described in the table below.

Bit	Set value	Function
Target reached	0	Target speed not reached
	1	Target speed reached
Homing attained	0	Unsuccessful homing
	1	Successful homing
Homing error	0	No homing error
	1	Homing error occurred

6.4.4.3 Function description

- Running mode setting:Set 6060h to 6;
- Homing method setting: Set the homing method via object 6098h;
- Home offset setting: Set the value of home offset via object 607Ch;

  When P12.11 = 0, once the home position is found, position actual value 6064h = 607Ch

  When P12.11 = 1, once the home position is found, position actual value 6064h = present position+ home offset 607Ch

  When P12.11 = 2, once the home position is found, continue to perform the home offset position segment; when completed, position actual value 6064h = 0

  When P12.11 = 3, once the home position is found, continue to perform the home offset position segment; when completed, position actual value 6064h = 607Ch

Note:

When P12.11 = 0/1, the drive does not perform the position offset displacement in actual operation.

- Homing speeds setting: Set the running speed of the drive during the homing process via the sub-indexes 01h and 02h of object 6099h;
- Homing enable: Enable the homing function of the drive via control word 6040h.

6.4.4.4 Basic configuration

The basic configuration of the objects in the homing mode is described in the table below.

RPDO object	TPDO object	Remark
Control word 6040h	Status word 6041h	Required
Homing method 6098h		Optional; it can be configured as an SDO parameter.
Home offset 607Ch		Optional; it can be configured as an SDO parameter.
Homing speeds 6099-01h		Optional; it can be configured as an SDO parameter.
Homing speeds 6099-02h		Optional; it can be configured as an SDO parameter.
Other objects		Optional; it can be configured as an SDO parameter.

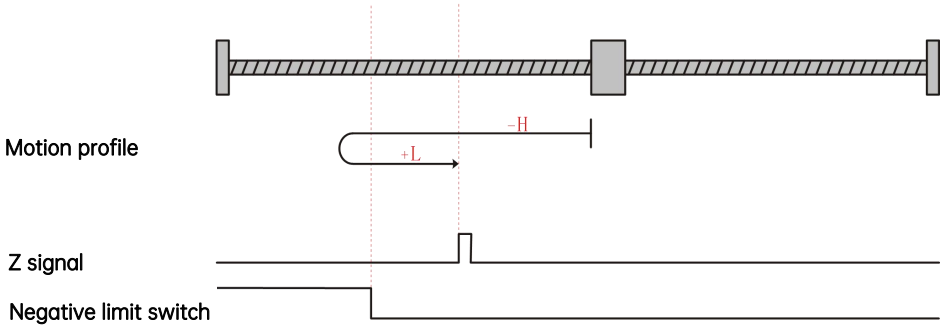
6.4.4.5 Homing mode

To diversify its applicability, DM5-N series servo system supports the homing methods of -4 to 35 in CANopen CiA 402.

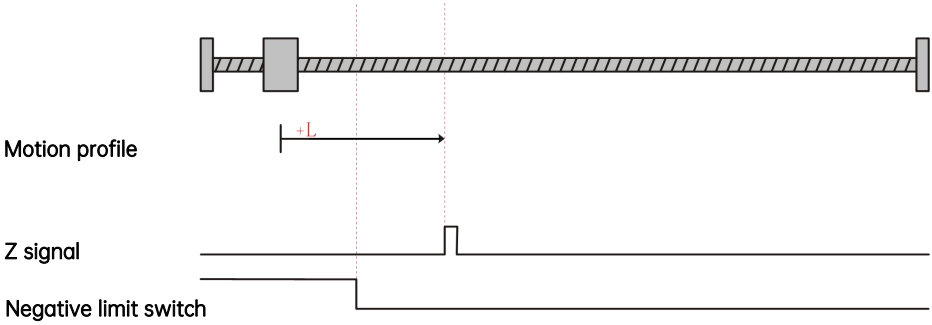
- 0x6098 = 1

Homing in backward direction, negative limit switch as the deceleration point, and motor Z signal as the home position

The present motor position is in the non-effective zone of the negative limit switch. When homing starts, the negative limit switch is at a low level, and homing is processed in the backward direction at a high speed till it reaches the rising edge of the negative limit switch. Then, homing is processed in the forward direction at a low speed till it reaches the falling edge of the negative limit switch. Afterwards, homing continues in the forward direction at a low speed, and stops when the rising edge of the Z signal is reached.



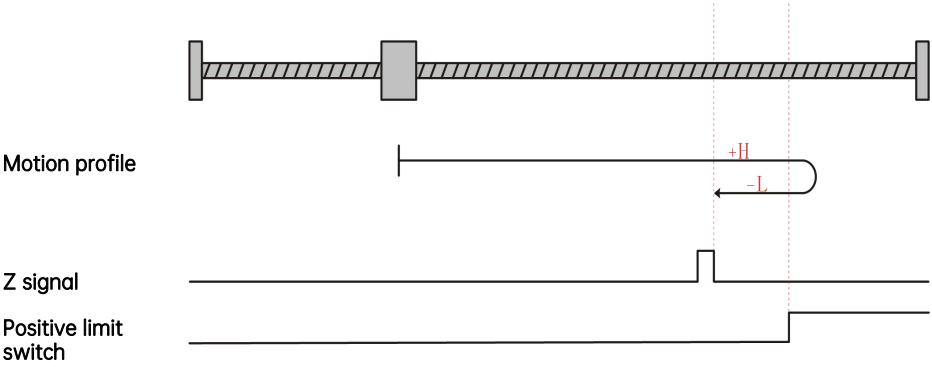
The present motor position is in the effective zone of the negative limit switch. When homing starts, the negative limit switch is at a high level, and homing is process in the forward direction at a low speed till it reaches the falling edge of the negative limit switch. Then, homing continues in the forward direction at a low speed, and stops when the motor reaches the rising edge of the Z signal.



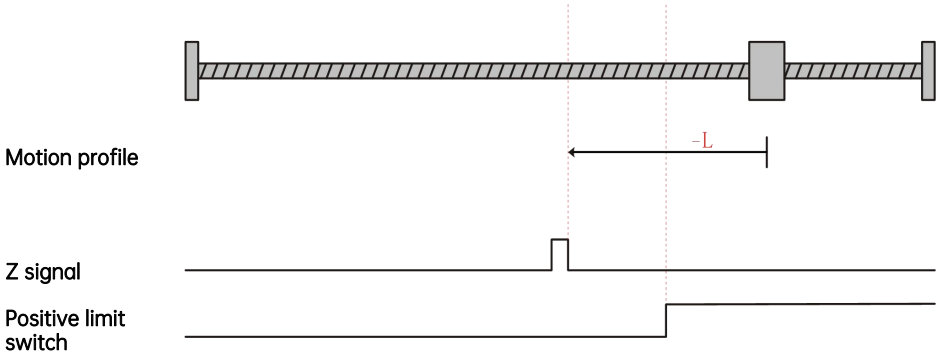
- 0x6098 = 2

Homing in forward direction, positive limit switch as the deceleration point, and motor Z signal as the home position

The present motor position is in the non-effective zone of the positive limit switch. When homing starts, the positive limit switch is at a low level, and homing is processed in the forward direction at a high speed till it reaches the rising edge of the positive limit switch. Then, homing is processed in the backward direction at a low speed till it reaches the falling edge of the positive limit switch. Afterwards, homing continues in the backward direction at a low speed, and stops when the motor reaches the rising edge of the Z signal.



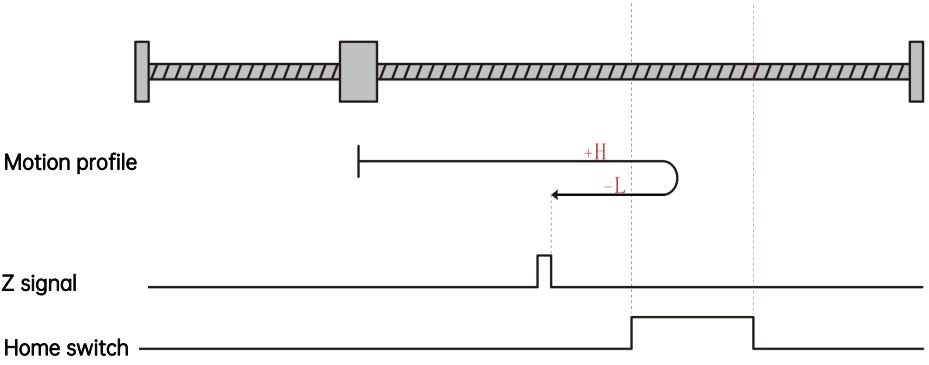
The present motor position is in the effective zone of the positive limit switch. When homing starts, the positive limit switch is at a high level, and homing is processed in the backward direction at a low speed till it reaches the falling edge of the positive limit switch. Then, homing continues in the backward direction at a low speed, and stops when the motor reaches the rising edge of the Z signal.



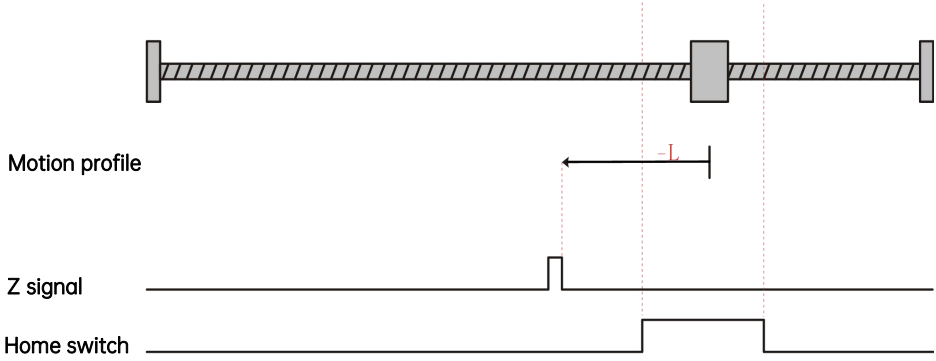
- 0x6098 = 3

Homing in forward direction, home switch as the deceleration point, and motor Z signal as the home position

The present motor position is between the negative limit switch and the home switch. When homing starts, the home switch is at a low level, and homing is processed in the forward direction at a high speed till it reaches the rising edge of the home switch. Then , homing is processed in the backward direction at a low speed till it reaches the falling edge of the home switch. Afterwards, homing continues in the backward direction at a low speed, and stops when the motor reaches the rising edge of the Z signal.



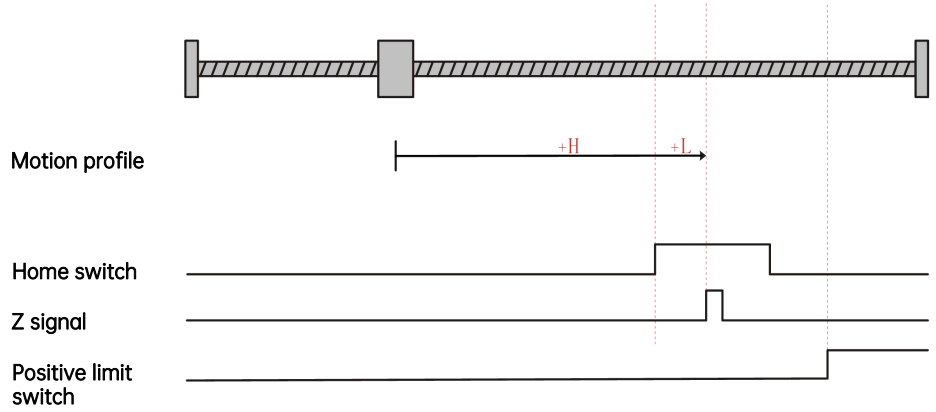
The present motor position is in the effective zone of the home switch. When homing starts, the home switch is at a high level, and homing is processed in the backward direction at a low speed till it reaches the falling edge of the home switch. Then, homing continues in the backward direction at a low speed, and stops when the motor reaches the rising edge of the Z signal.



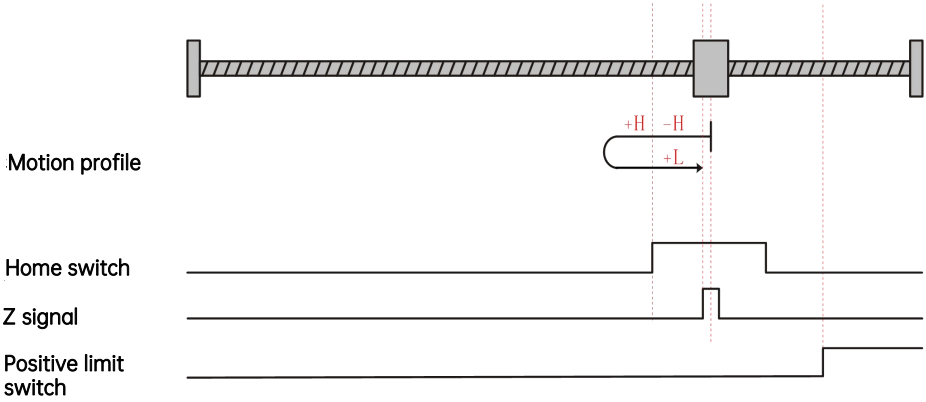
- 0x6098 = 4

Homing in forward direction, home switch as the deceleration point, and the motor Z signal as the home position

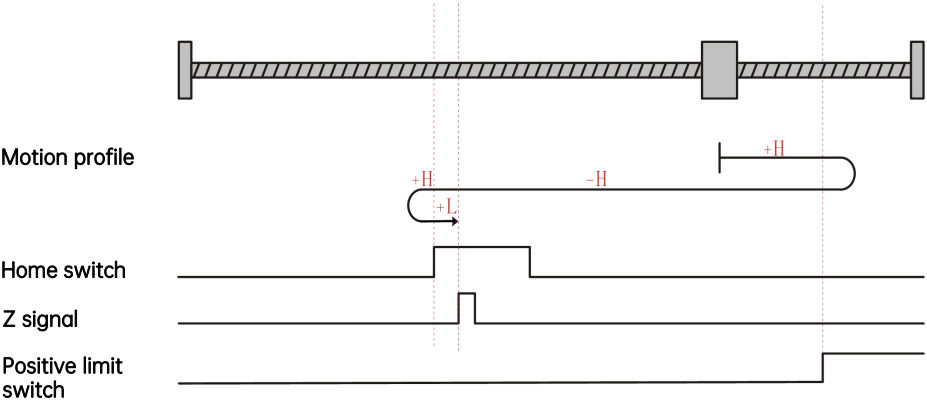
The present motor position is between the negative limit switch and the home switch. When homing starts, the home switch is at a low level, and homing is processed in the forward direction at a high speed till it reaches the rising edge of the home switch. Then, homing continues in the forward direction at a low speed, and stops when the motor reaches the rising edge of the Z signal.



The present motor position is in the effective zone of the home switch. When homing starts, the home switch is at a high level, and homing is processed in the backward direction at a high speed till it reaches the falling edge of the home switch. Then, homing is processed in the forward direction at a high speed till it reaches the rising edge of the home switch. Afterwards, homing continues in the forward direction at a low speed, and stops when the motor reaches the rising edge of the Z signal.



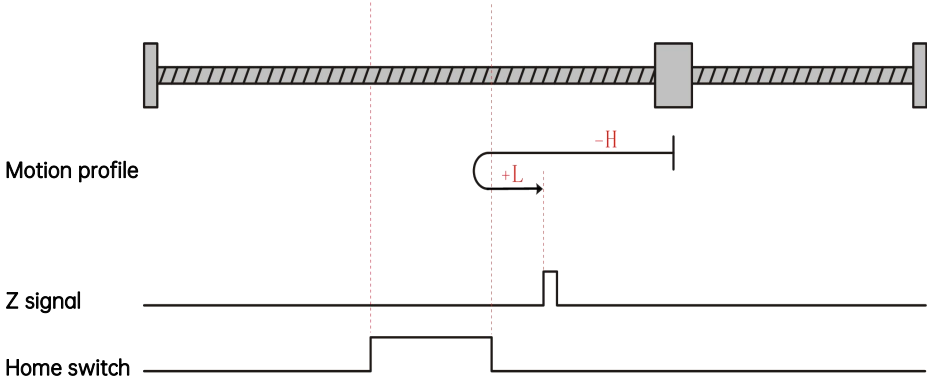
The present motor position is between the home switch and the positive limit switch. When homing starts, the home switch is at a low level, and homing is processed in the forward direction at a high speed till it reaches the rising edge of the positive limit switch. Then, homing is processed in the backward direction at a high speed till it reaches the falling edge of the home switch. Next, homing is processed in the forward direction at a high speed till it reaches the rising edge of the home switch. Afterwards, homing continues in the forward direction at a low speed, and stops when the motor reaches the rising edge of the Z signal.



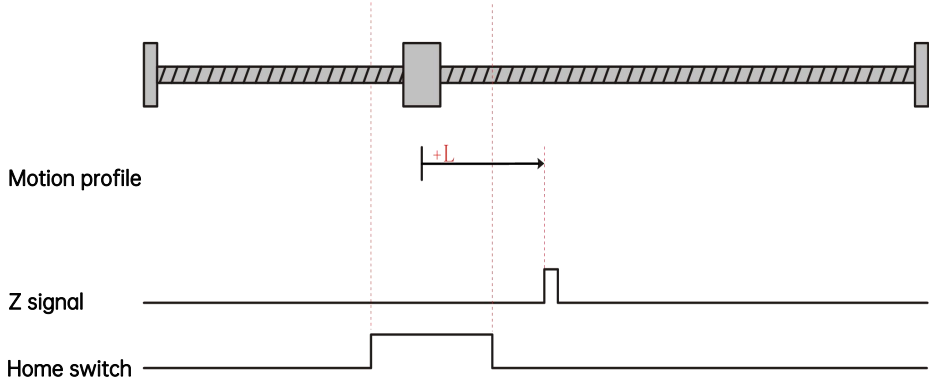
- 0x6098 = 5

Homing in backward direction, home switch as the deceleration point, and the motor Z signal as the home position

The present motor position is between the positive limit switch and the home switch. When homing starts, the home switch is at a low level, and homing is processed in the backward direction at a high speed till it reaches the rising edge of the home switch. Then, homing is processed in the forward direction at a low speed till it reaches the falling edge of the home switch. Afterwards, homing continues in the forward direction at a low speed, and stops when the motor reaches the rising edge of the Z signal.



The present motor position is in the effective zone of the home switch. When homing starts, the home switch is at a high level, and homing is processed in the forward direction at a low speed till it reaches the falling edge of the home switch. Afterwards, homing continues in the forward direction at a low speed, and stops when the motor reaches the rising edge of the Z signal.

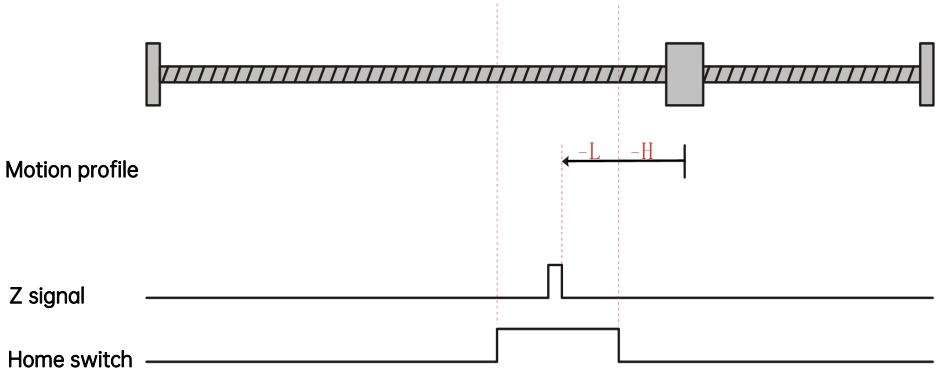


- 0x6098 = 6

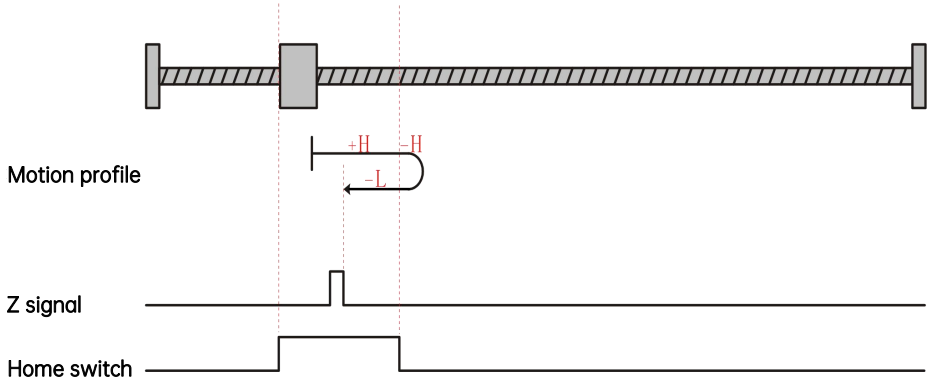
Homing in backward direction, home switch as the deceleration point, and the motor Z signal as the home position

The present motor position is between the positive limit switch and the home switch. When homing starts, the home switch is at a low level, and homing is processed in the backward direction at a high

speed till it reaches the rising edge of the home switch. Then, homing continues in the backward direction at a low speed, and stops when the motor reaches the rising edge of the Z signal.



The present motor position is in the effective zone of the home switch. When homing starts, the home switch is a high level, and homing is processed in the forward direction at a high speed till it reaches the falling edge of the home switch. Then, homing is processed in the backward direction at a high speed till it reaches the rising edge of the home switch. Afterwards, homing continues in the backward direction at a low speed, and stops when the motor reaches the rising edge of the Z signal.

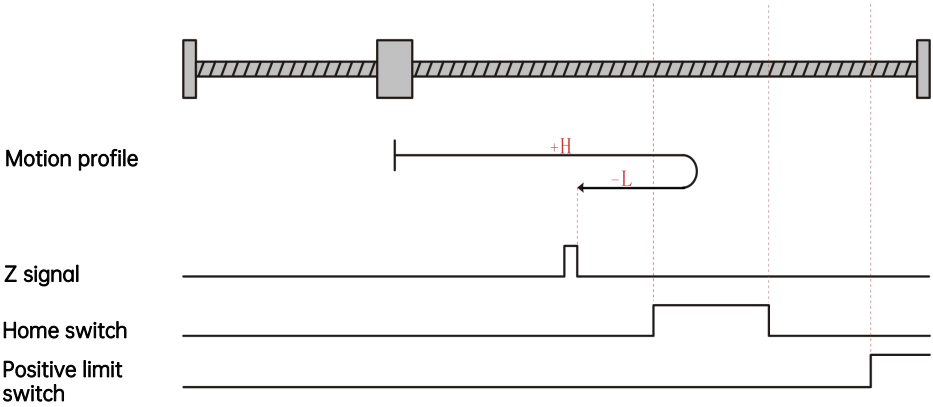


- 0x6098 = 7

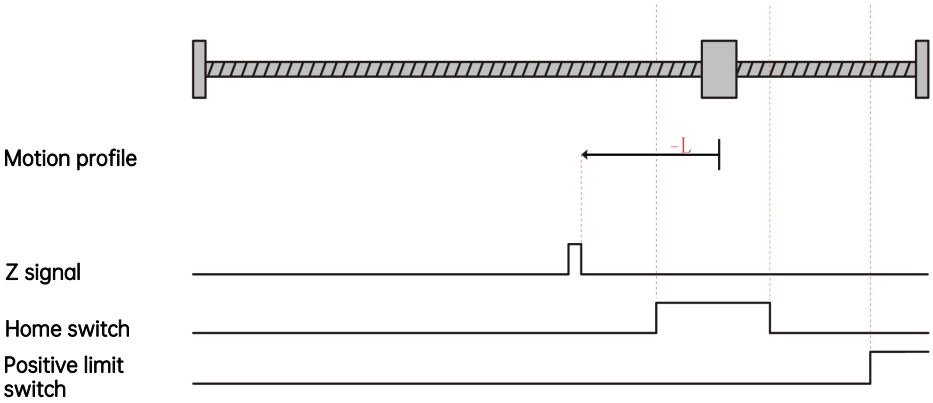
Homing in forward direction, home switch as the deceleration point, and the motor Z signal as the home position

The present motor position is between the negative limit switch and the home switch. When homing starts, the home switch is at a low level, and homing is processed in the forward direction at a high speed till it reaches the rising edge of the home switch. Then, homing is processed in the backward direction at a low speed till it reaches the falling edge of the home switch. Afterwards, homing continues

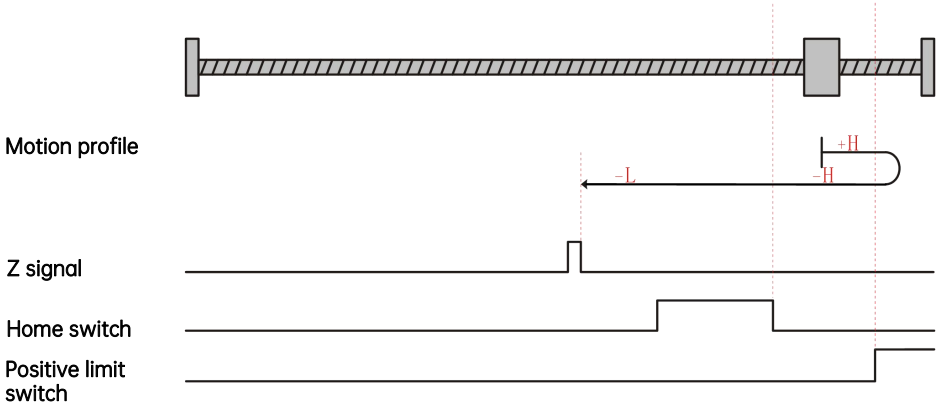
in the backward direction at a low speed, and stops when the motor reaches the rising edge of the Z signal.



The present motor position is in the effective zone of the home switch. When homing starts, the home switch is at a high level, and homing is processed in the backward direction at a low speed till it reaches the falling edge of the home switch. Then, homing continues in the backward direction at a low speed, and stops when the motor reaches the rising edge of the Z signal.



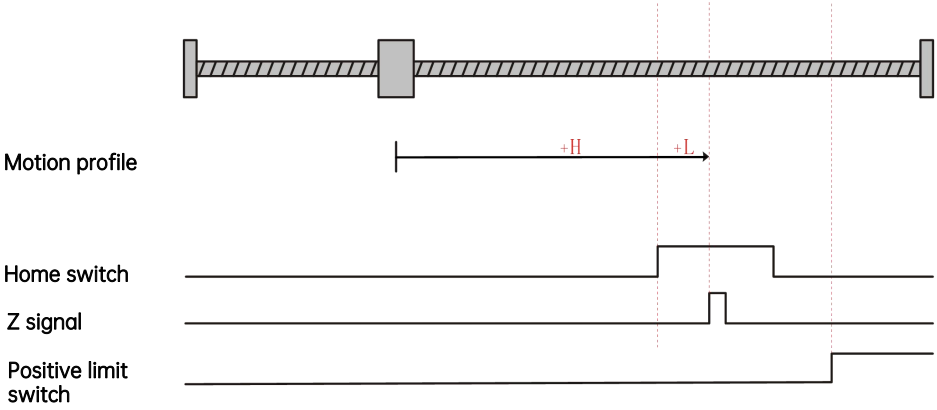
The present motor position is between the positive limit switch and the home switch. When homing starts, the home switch is at a low level, and homing is processed in the forward direction at a high speed till it reaches the rising edge of the positive limit switch. Then, homing is processed in the backward direction at a high speed till it reaches the rising edge of the home switch. Afterwards, homing continues in the backward direction at a low speed, and stops when the motor reaches the rising edge of the Z signal.



- 0x6098 = 8

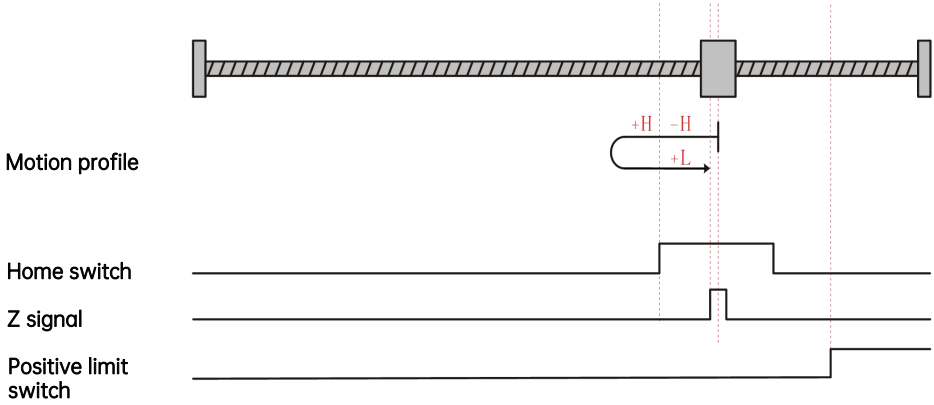
Homing in forward direction, home switch as the deceleration point, and the motor Z signal as the home position

The present motor position is between the negative limit switch and the home switch. When homing starts, the home switch is at a low level, and homing is processed in the forward direction at a high speed till it reaches the rising edge of the home switch. Then, homing continues in the forward direction at a low speed, and stops when the motor reaches the rising edge of the Z signal.

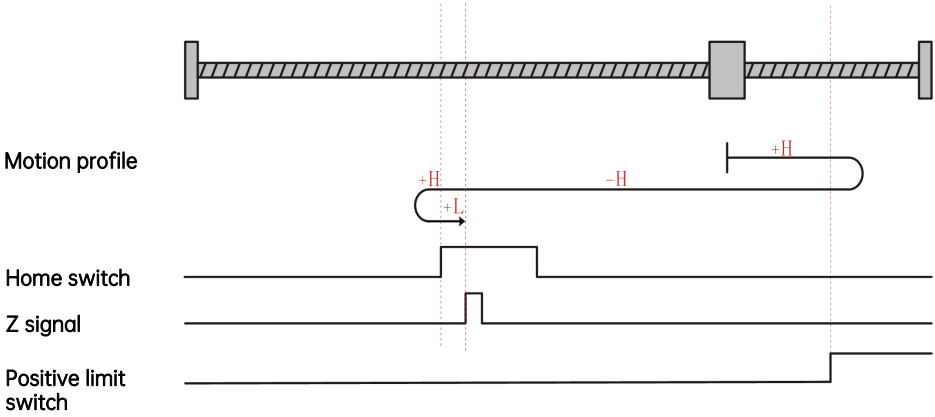


The present motor position is in the effective zone of the home switch. When homing starts, the home switch is at a high level, and homing is processed in the backward direction at a high speed till it reaches

the falling edge of the home switch. Then, homing is processed in the forward direction at a high speed till it reaches the rising edge of the home switch. Afterwards, homing continues in the forward direction at a low speed, and stops when the motor reaches the rising edge of the Z signal.



The present motor position is between the home switch and the positive limit switch. When homing starts, the home switch is at a low level, and homing is processed in the forward direction at a high speed till it reaches the rising edge of the positive limit switch. Then, homing is processed in the backward direction at a high speed till it reaches the falling edge of the home switch. Next, homing is processed in the forward direction at a high speed till it reaches the rising edge of the home switch. Afterwards, homing continues in the forward direction at a low speed, and stops when the motor reaches the rising edge of the Z signal.

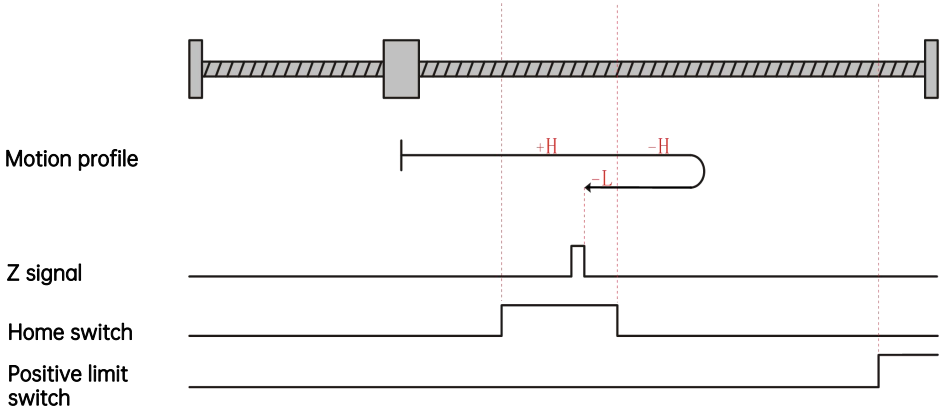


- 0x6098 = 9

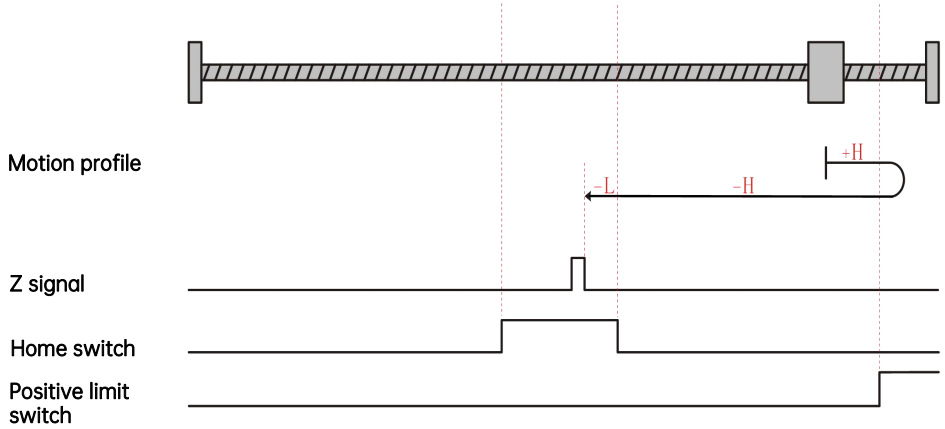
Homing in forward direction, home switch as the deceleration point, and the motor Z signal as the home position

The present motor position is between the negative limit switch and the home switch. When homing starts, the home switch is at a low level, and homing is processed in the forward direction at a high

speed till it reaches the falling edge of the home switch. Then, homing is processed in the backward direction at a high speed till it reaches the rising edge of the home switch. Afterwards, homing continues in the backward direction at a low speed, and stops when the motor reaches the rising edge of the Z signal.

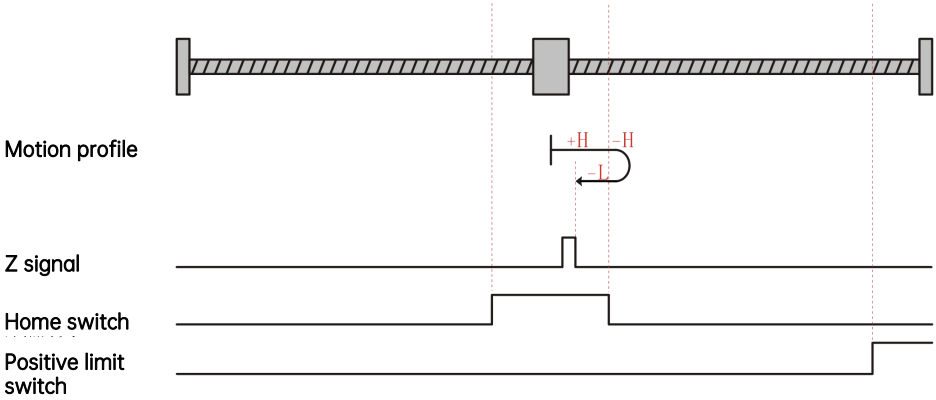


The present motor position is between the positive limit switch and the home switch. When homing starts, the home switch is at a low level, and homing is processed in the forward direction at a high speed till it reaches the rising edge of the positive limit switch. Then, homing is processed in the backward direction at a high speed till it reaches the rising edge of the home switch. Afterwards, homing continues in the backward direction at a low speed, and stops when the motor reaches the rising edge of the Z signal.



The present motor position is in the effective zone of the home switch. When homing starts, the home switch is at a high level, and homing is processed in the forward direction at a a high speed till it reaches the falling edge of the home switch. Then, homing is processed in the backward direction at a high

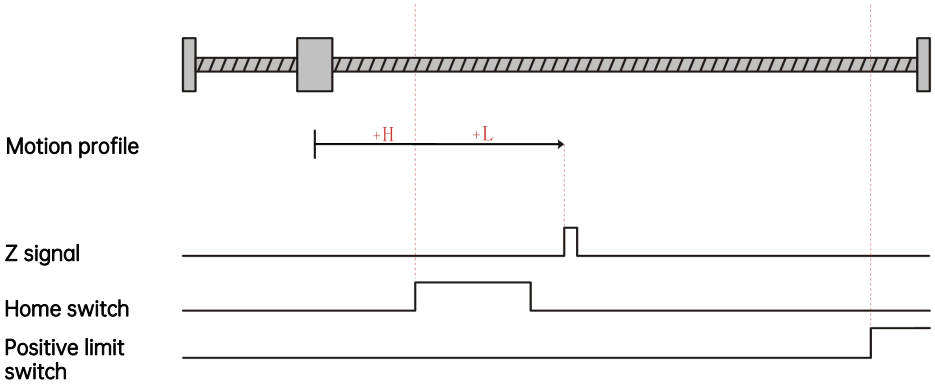
speed till it reaches the rising edge of the home switch. Afterwards, homing continues in the backward direction at a low speed, and stops when the motor reaches the rising edge of the Z signal.



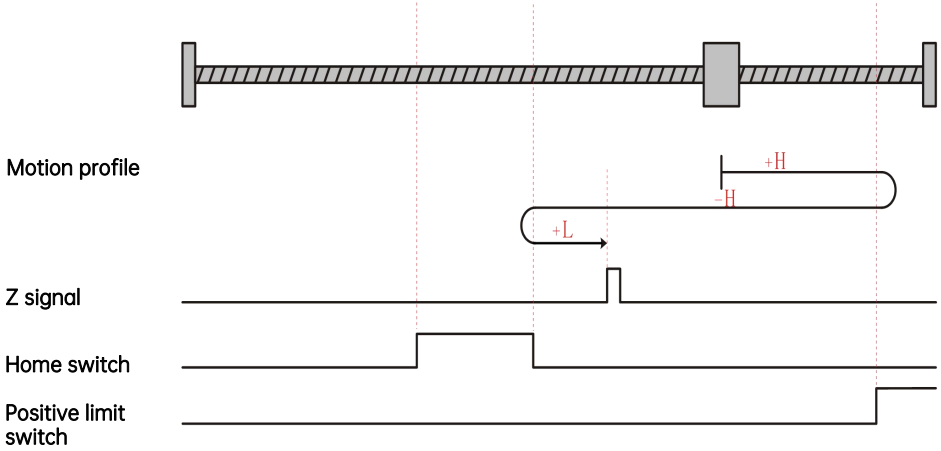
- 0x6098 = 10

Homing in forward direction, home switch as the deceleration point, and the motor Z signal as the home position

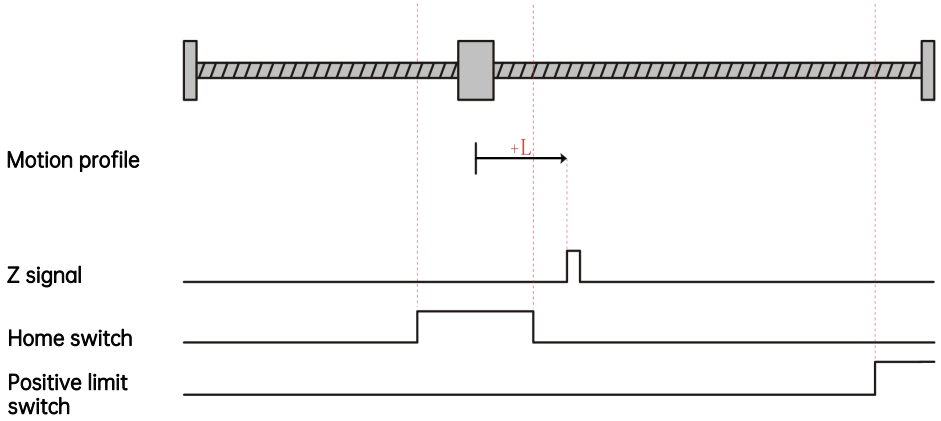
The present motor position is between the negative limit switch and the home switch. When homing starts, the home switch is at a low level, and homing is processed in the forward direction at a high speed till it reaches the rising edge of the home switch. Then, homing continues in the forward direction at a low speed, and stops when the motor reaches the rising edge of the Z signal.



The present motor position is between the positive limit switch and the home switch. When homing starts, the home switch is at low level, and homing is processed in the forward direction at a high speed till it reaches the rising edge of the positive limit switch. Then, homing is processed in the backward direction at a high speed till it reaches the rising edge of the home switch. Afterwards, homing is processed in the forward direction at a low speed, and stops when the motor reaches the rising edge of the Z signal.



The present motor position is in the effective zone of the home switch. When homing starts, the home switch is at a high level, and homing is processed in the forward direction at a low speed. Homing stops when the motor reaches the rising edge of the Z signal.

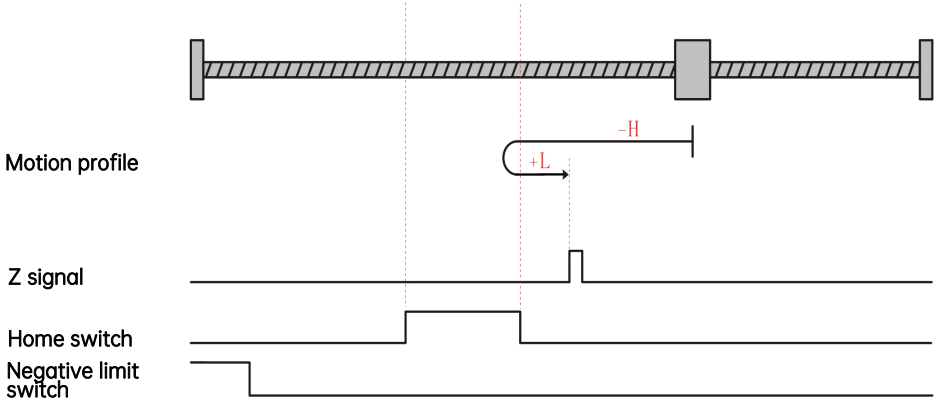


- 0x6098 = 11

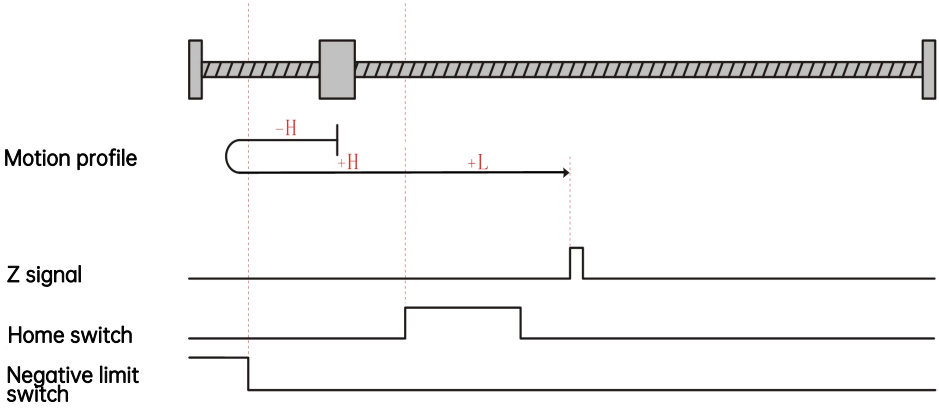
Homing in the backward direction, home switch as the deceleration point, and the motor Z signal as the home position

The present motor position is between the positive limit switch and the home switch. When homing starts, the home switch is at a low level, and homing is processed in the backward direction at a high

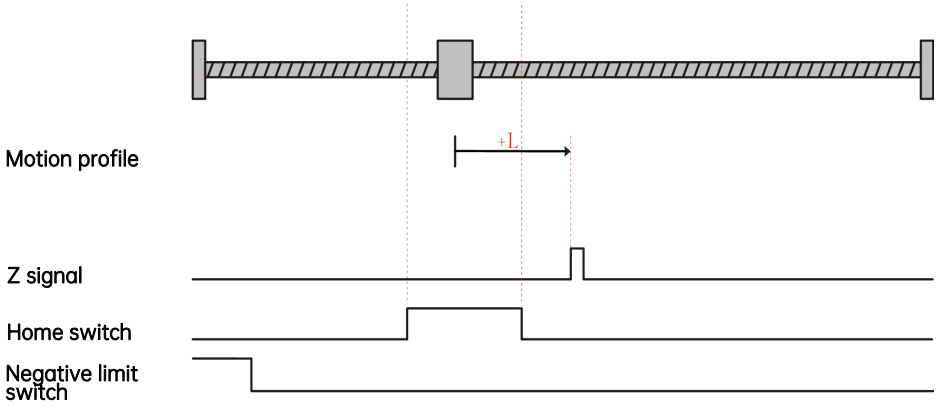
speed till it reaches the rising edge of the home switch. Then, homing is processed in the forward direction at a low speed, and stops when the motor reaches the rising edge of the Z signal.



The present motor position is between the negative limit switch and the home switch. When homing starts, the home switch is at a low level, and homing is processed in the backward direction at a high speed till it reaches the rising edge of the negative limit switch. Then, homing is processed in the forward direction at a high speed till it reaches the rising edge of the home switch. Afterwards, homing continues in the forward direction at a low speed, and stops when the motor reaches the rising edge of the Z signal.



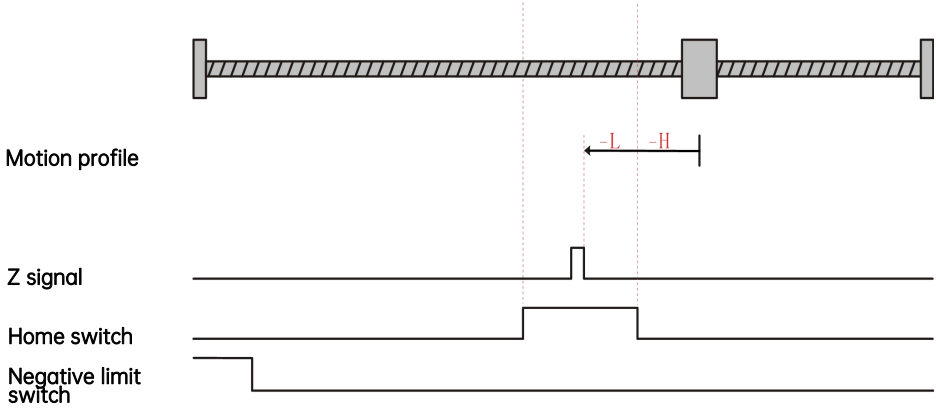
The present motor position is in the effective zone of the home switch. When homing starts, the home switch is at a high level, and homing is processed in the forward direction at a low speed. Homing stops when the motor reaches the rising edge of the Z signal.



- 0x6098 = 12

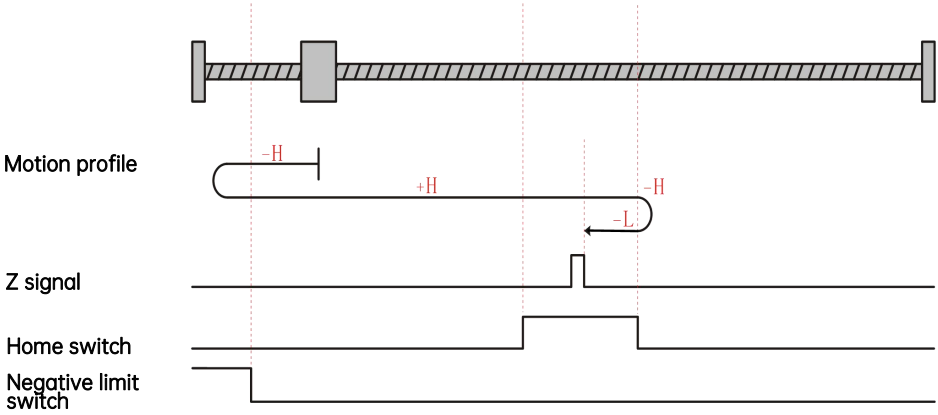
Homing in backward direction, home switch as the deceleration point, and the motor Z signal as the home position

The present motor position is between the positive limit switch and the home switch. When homing starts, the home switch is as a low level, and homing is processed in the backward direction at a high speed till it reaches the rising edge of the home switch. Then, homing continues in the backward direction at a low speed, and stops when the motor reaches the rising edge of the Z signal.

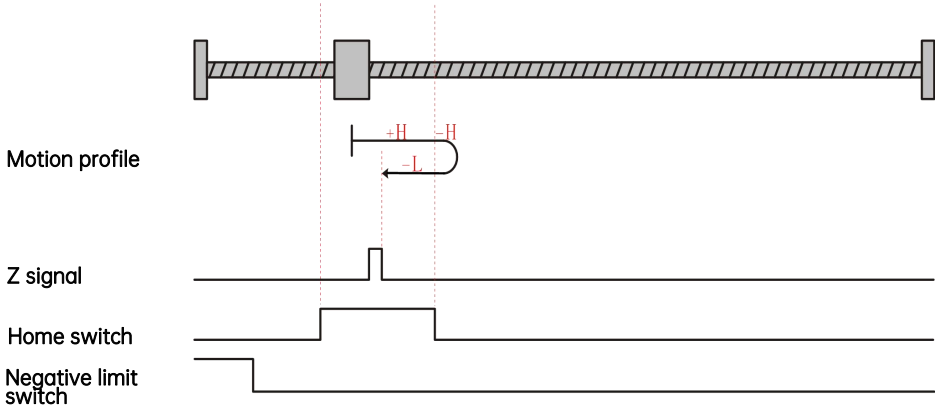


The present motor position is between the negative limit switch and the home switch. When homing starts, the home switch is at a low level, and homing is processed in the backward direction at a high speed till it reaches the rising edge of the negative limit switch. Then, homing is processed in the forward direction at a high speed till it reaches the falling edge of the home switch. Next, homing is processed in the backward direction at a high speed till it reaches the rising edge of the home switch. Afterwards,

homing continues in the backward direction at a low speed, and stops when the motor reaches the rising edge of the Z signal.



The present motor position is in the effective zone of the home switch. When homing starts, the home switch is at a high level, and homing is processed in the forward direction at a high speed till it reaches the falling edge of the home switch. Then, homing is processed in the backward direction at a high speed till it reaches the rising edge of the home switch. Afterwards, homing continues in the backward direction at a low speed, and stops when the motor reaches the rising edge of the Z signal.

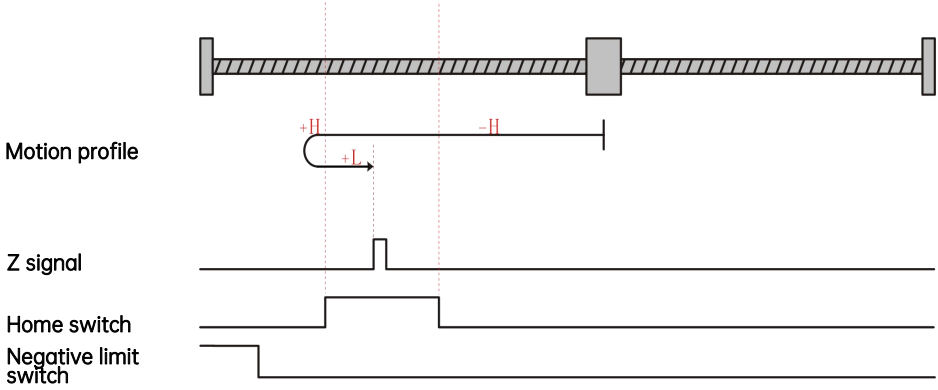


- 0x6098 = 13

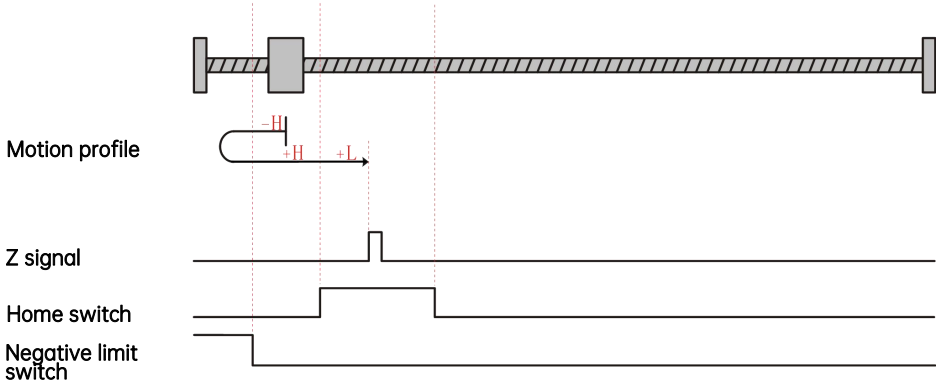
Homing in backward direction, home switch as the deceleration point, and the motor Z signal as the home position

The present motor position is between the positive limit switch and the home switch. When homing starts, the home switch is at a low level, and homing is processed in the backward direction at a high speed till it reaches the falling edge of the home switch. Then, homing is processed in the forward direction at a high speed till it reaches the rising edge of the home switch. Afterwards, homing continues

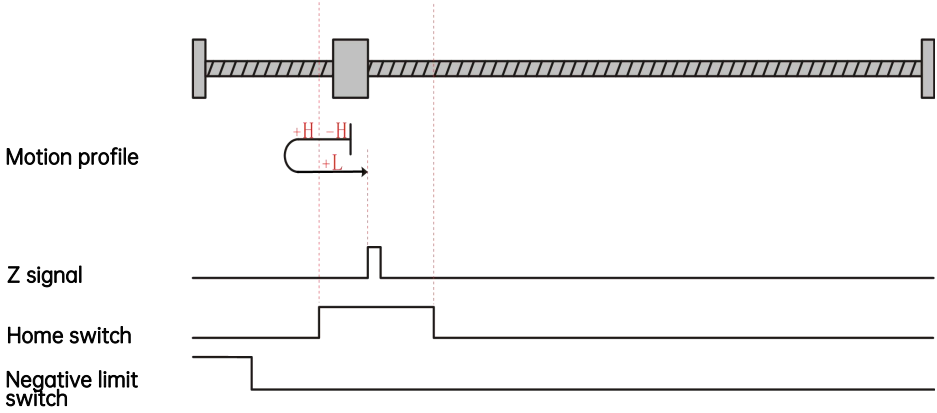
in the forward direction at a low speed, and stops when the motor reaches the rising edge of the Z signal.



The present motor position is between the negative limit switch and the home switch. When homing starts, the home switch is at a low level, and homing is processed in the backward direction at a high speed till it reaches the rising edge of the negative limit switch. Then, homing is processed in the forward direction at a high speed till it reaches the rising edge of the home switch. Afterwards, homing continues in the forward direction at a low speed, and stops when the motor reaches the rising edge of the Z signal.



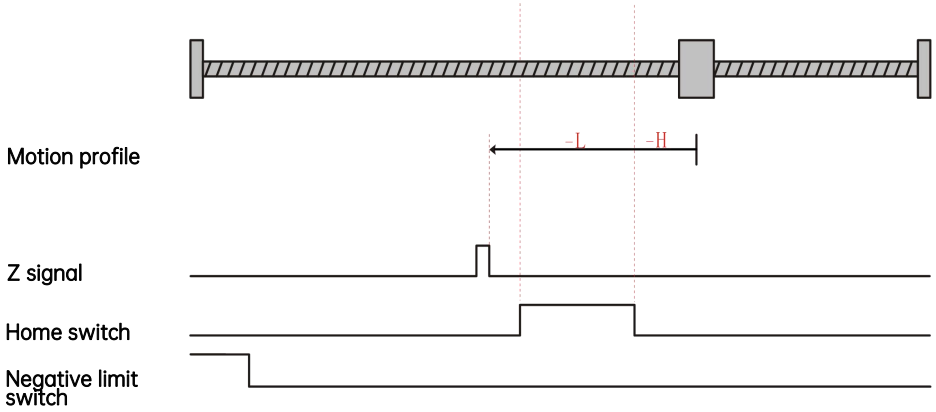
The present motor position is in the effective zone of the home switch. When homing starts, the home switch is at a high level, and homing is processed in the backward direction at a high speed till it reaches the falling edge of the home switch. Then, homing is processed in the forward direction at a high speed till it reaches the rising edge of the home switch. Afterwards, homing continues in the forward direction at a low speed, and stops when the motor reaches the rising edge of the Z signal.



- 0x6098 = 14

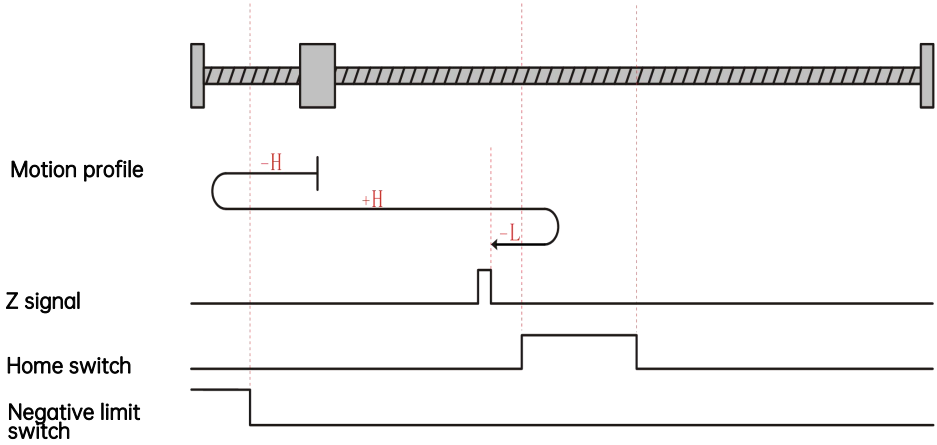
Homing in backward direction, home switch as the deceleration point, and the motor Z signal as the home position

The present motor speed is between the positive limit switch and the home switch. When homing starts, the home switch is at a low level, and homing is processed in the backward direction at a high speed till it reaches the rising edge of the home switch. Then, homing continues in the backward direction at a low speed, and stops when the motor reaches the rising edge of the Z signal.

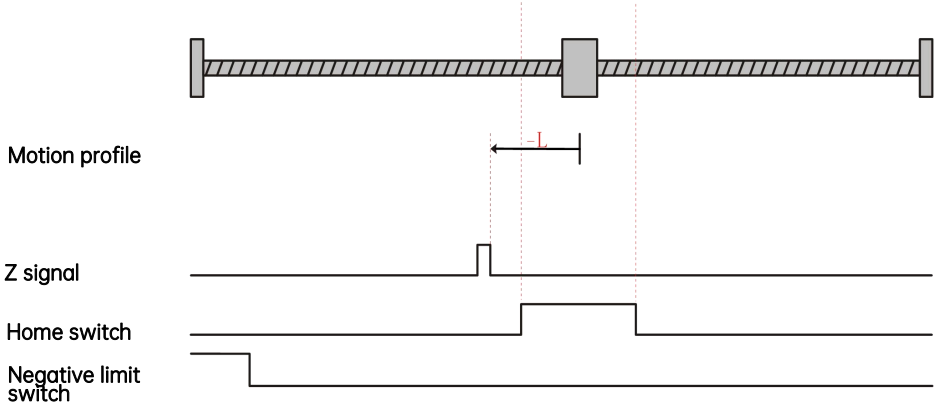


The present motor position is between the negative limit switch and the home switch. When homing starts, the home switch is at a low level, and homing is processed in the backward direction at a high speed till it reaches the rising edge of the negative limit switch. Then, homing is processed in the forward

direction at a high speed till it reaches the rising edge of the home switch. Afterwards, homing is processed in the backward direction at a low speed, and stops when the motor reaches the rising edge of the Z signal.



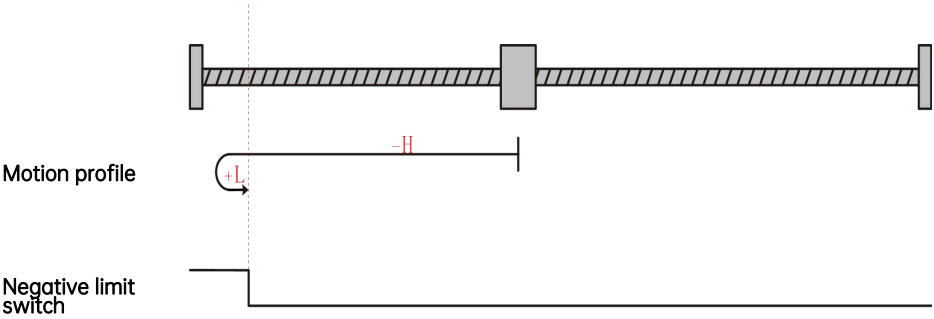
The present motor position is in the effective zone of the home switch. When homing starts, the home switch is at a high level, and homing is processed in the backward direction at a low speed. Homing stops when the motor reaches the rising edge of the Z signal.



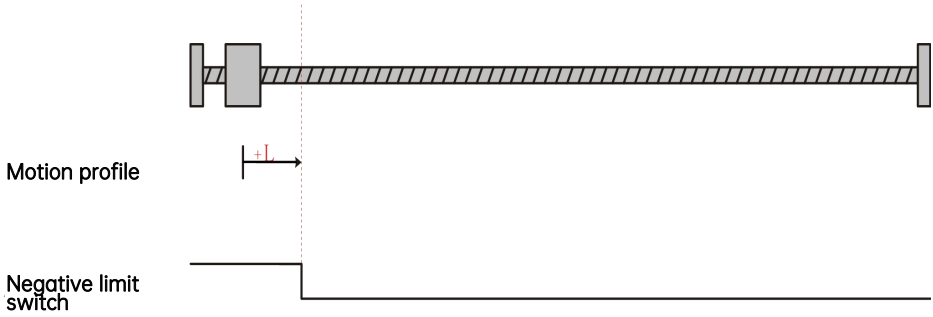
- 0x6098 = 17

Homing in backward direction, and the negative limit switch as both the deceleration point and the home position

The present motor position is in the non-effective zone of the negative limit switch. When homing starts, the negative limit switch is at a low level, and homing is processed in the backward direction at a high speed till it reaches the rising edge of the negative limit switch. Then, homing is processed in the forward direction at a low speed, and stops when the motor reaches the falling edge of the negative limit switch.



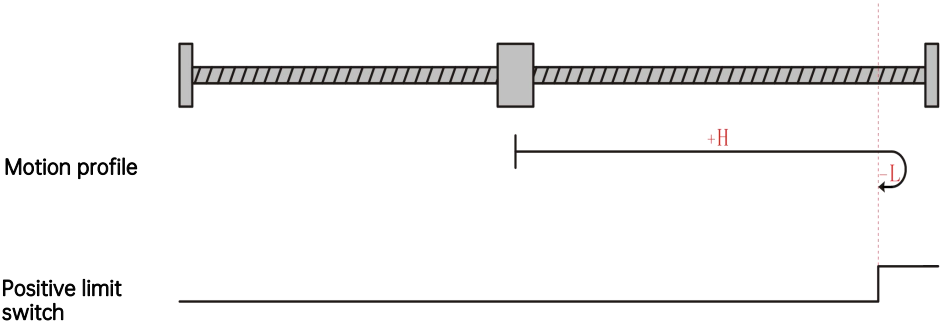
The present motor position is in the effective zone of the negative limit switch. When homing starts, the negative limit switch is at a high level, and homing is processed in the forward direction at a low speed. Homing stops when the motor reaches the falling edge of the negative limit switch.



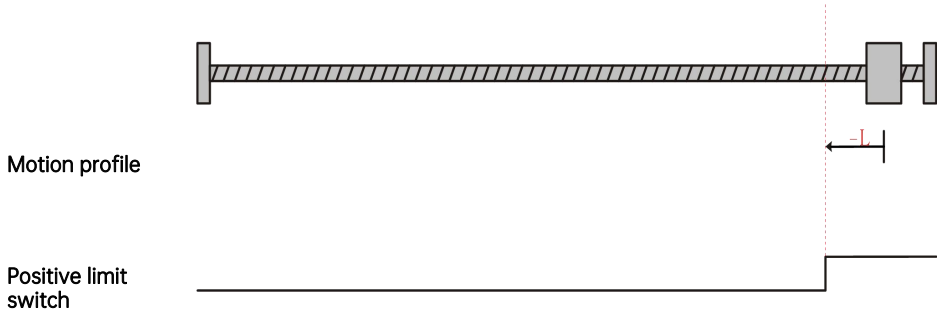
- 0x6098 = 18

Homing in forward direction, and the positive limit switch as both the deceleration point and the home position

The present motor position is in the non-effective zone of the positive limit switch. When homing starts, the positive limit switch is at a low level, and homing is processed in the forward direction at a high speed till it reaches the rising edge of the positive limit switch. Then, homing is processed in the backward direction at a low speed, and stops when the motor reaches the falling edge of the positive limit switch.



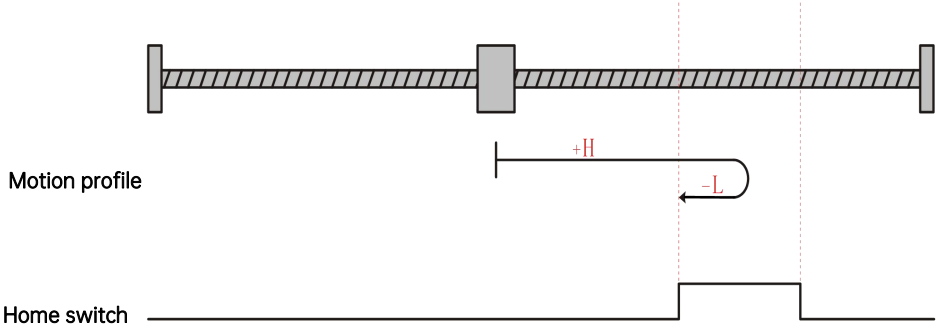
The present motor position is in the effective zone of the positive limit switch. When homing starts, the positive limit switch is at a high level, and homing is processed in the backward direction at a low speed. Homing stops when the motor reaches the falling edge of the positive limit switch.



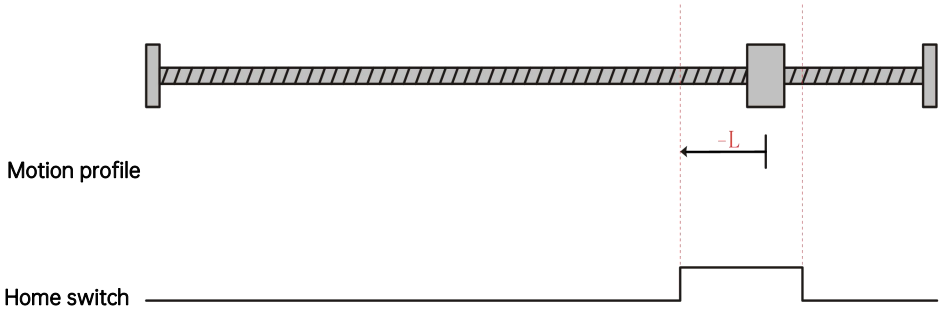
- 0x6098 = 19

Homing in forward direction, and the home switch as both the deceleration point and the home position

The present motor position is in the non-effective zone of the home switch. When homing starts, the home switch is at a low level, and homing is processed in the forward direction at a high speed till it reaches the rising edge of the home switch. Then, homing is processed in the backward direction at a low speed, and stops when the motor reaches the falling edge of the home switch.



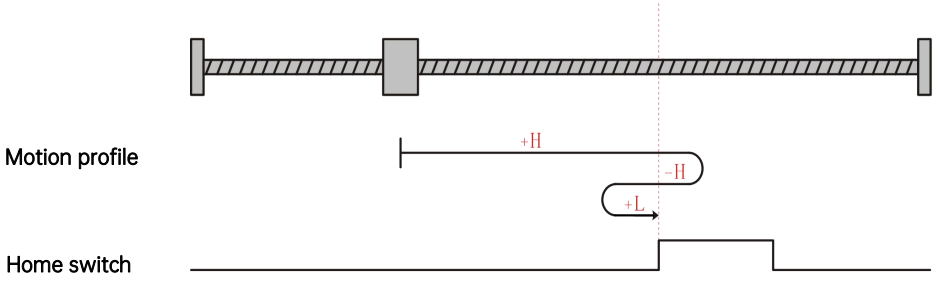
The present motor position is in the effective zone of the home switch. When homing starts, the home switch is at a high level, and homing is processed in the backward direction at a low speed. Homing stops when the motor reaches the falling edge of the home switch.



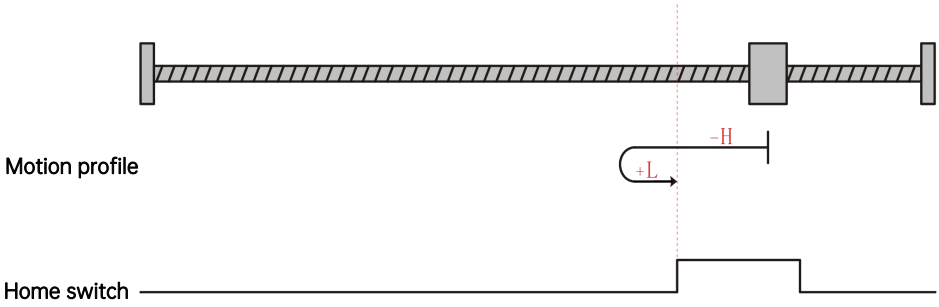
- 0x6098 = 20

Homing in forward direction, and the home switch as both the deceleration point and the home position

The present motor position is between the negative limit switch and the home switch. When homing starts, the home switch is at a low level, and homing is processed in the forward direction at a high speed till it reaches the rising edge of the home switch. Then, homing is processed in the backward direction at a high speed till it reaches the falling edge of the home switch. Afterwards, homing is processed in the forward direction at a low speed, and stops when the motor reaches the rising edge of the home switch.



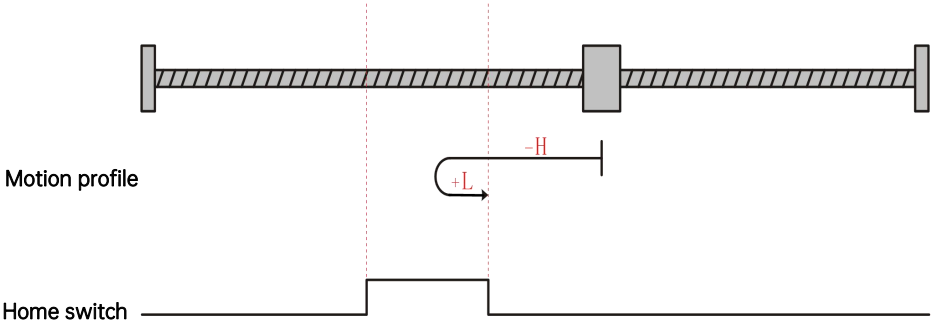
The present motor position is in the effective zone of the home switch. When homing starts, the home switch is at a high level, and homing is processed in the backward direction at a high speed till it reaches the falling edge of the home switch. Then, homing is processed in the forward direction at a low speed, and stops when the motor reaches the rising edge of the home switch.



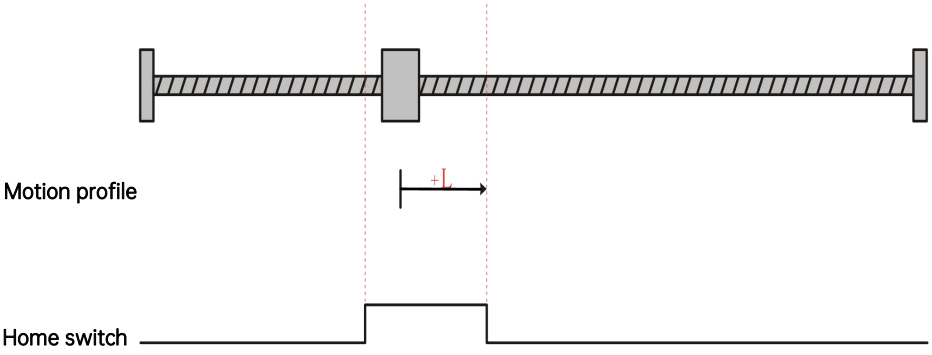
- 0x6098 = 21

Homing in backward direction, and home switch as both the deceleration point and the home position

The present motor position is in the non-effective zone of the home switch. When homing starts, the home switch is at a low level, and homing is processed in the backward direction at a high speed till it reaches the rising edge of the home switch. Then, homing is processed in the forward direction at a low speed, and stops when the motor reaches the falling edge of the home switch.



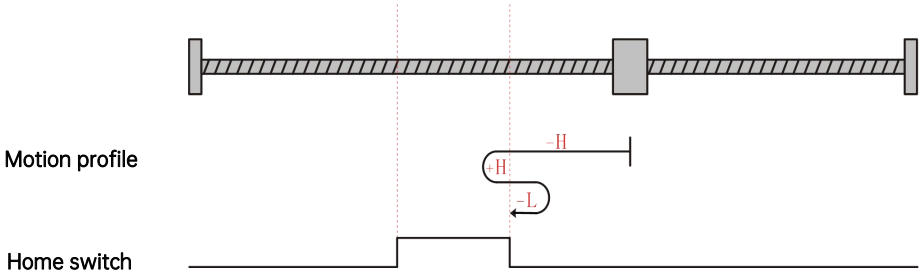
The present motor position is in the effective zone of the home switch. When homing starts, the home switch is at a high level, and homing is processed in the forward direction at a low speed. Homing stops when the motor reaches the falling edge of the home switch.



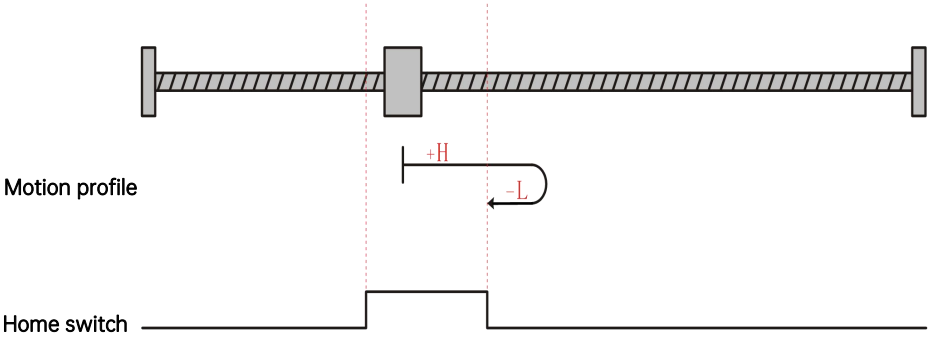
- 0x6098 = 22

Homing in backward direction, and home switch as both the deceleration point and the home position

The present motor position is between the home switch and the positive limit switch. When homing starts, the home switch is at a low level, and homing is processed in the backward direction at a high speed till it reaches the rising edge of the home switch. Then, homing is processed in the forward direction at a high speed till it reaches the falling edge of the home switch. Afterwards, homing is processed in the backward direction at a low speed, and stops when the motor reaches the rising edge of the home switch.



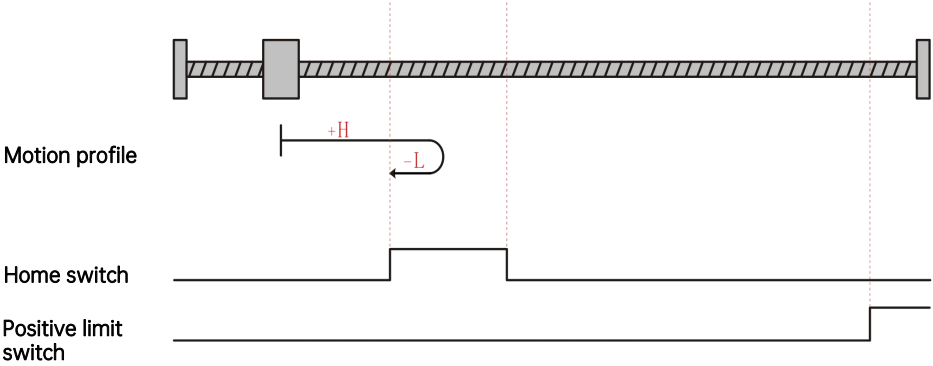
The present motor position is in the effective zone of the home switch. When homing starts, the home switch is at a high level, and homing is processed in the forward direction at a high speed till it reaches the falling edge of the home switch. Then, homing is processed in the backward direction at a low speed, and stops when the motor reaches the rising edge of the home switch.



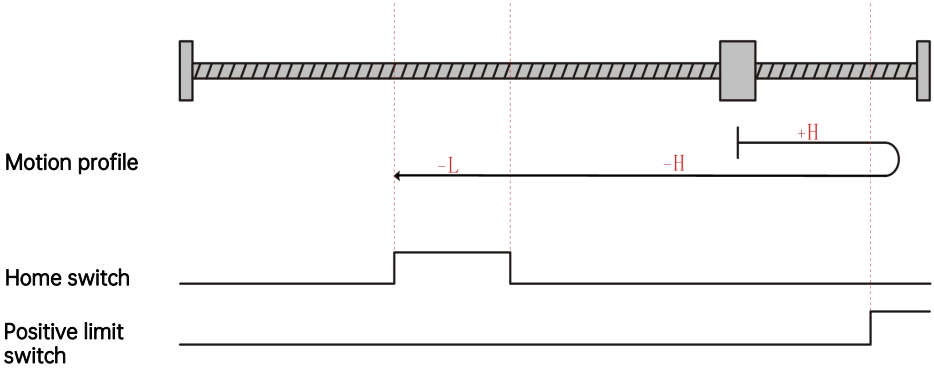
- 0x6098 = 23

Homing in forward direction, and home switch as both the deceleration point and the home position

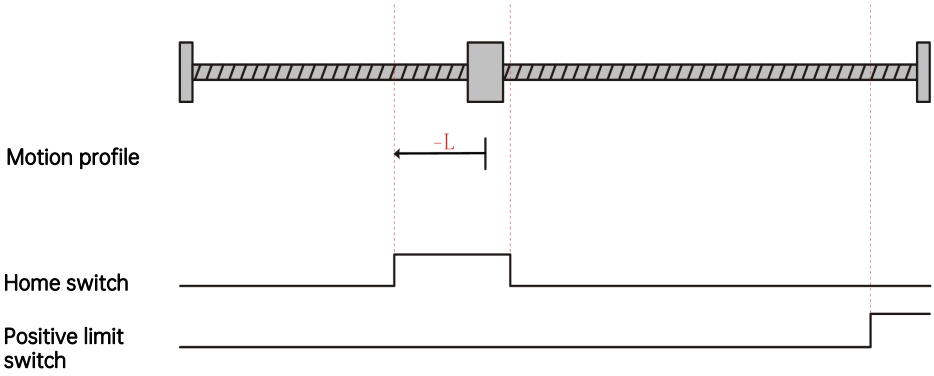
The present motor position is between the negative limit switch and the home switch. When homing starts, the home switch is at a low level, and homing is processed in the forward direction at a high speed till it reaches the rising edge of the home switch. Then, homing is processed in the backward direction at a low speed, and stops when the motor reaches the falling edge of the home switch.



The present motor position is between the positive limit switch and the home switch. When homing starts, the home switch is at a low level, and homing is processed in the forward direction at a high speed till it reaches the rising edge of the positive limit switch. Then, homing is processed in the backward direction at a high speed till it reaches the rising edge of the home switch. Afterwards, homing continues in the backward direction at a low speed, and stops when the motor reaches the falling edge of the home switch.



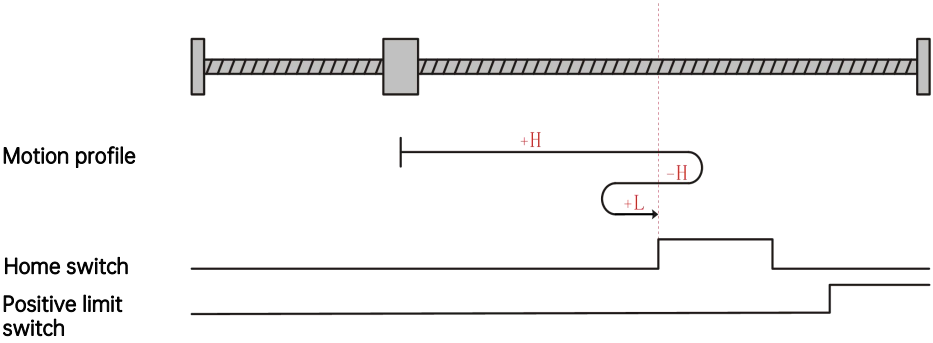
The present motor position is in the effective zone of the home switch. When homing starts, the home switch is at a high level, and homing is processed in the backward direction at a low speed. Homing stops when the motor reaches the falling edge of the home switch.



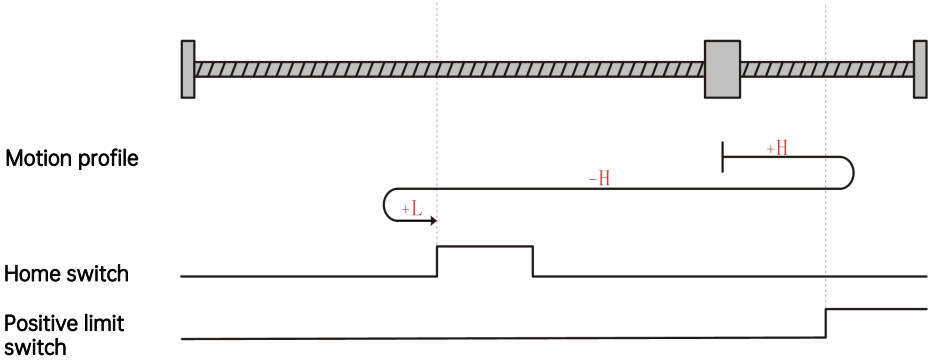
- 0x6098 = 24

Homing in forward direction, and home switch as both the deceleration point and the home switch

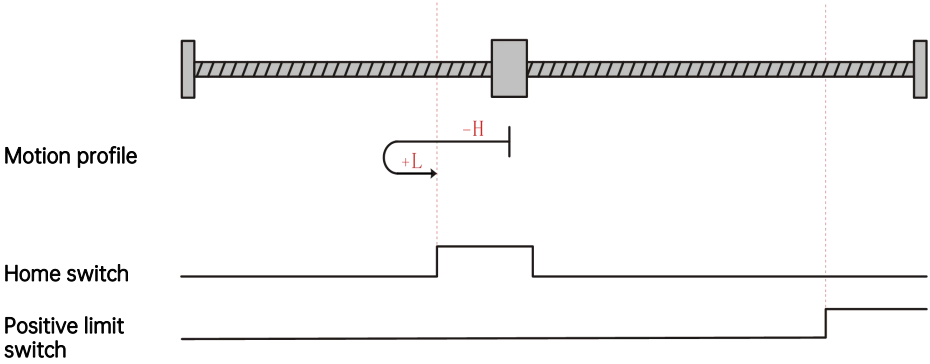
The present motor position is between the negative limit switch and the home switch. When homing starts, the home switch is at a low level, and homing is processed in the forward direction at a high speed till it reaches the rising edge of the home switch. Then, homing is processed in the backward direction at a high speed till it reaches the falling edge of the home switch. Afterwards, homing is processed in the forward direction at a low speed, and stops when the motor reaches the rising edge of the home switch.



The present motor position is between the home switch and the positive limit switch. When homing starts, the home switch is at a low level, and homing is processed in the forward direction at a high speed till it reaches the rising edge of the positive limit switch. Then, homing is processed in the backward direction at a high speed till it reaches the falling edge of the home switch. Afterwards, homing is processed in the forward direction at a low speed, and stops when the motor reaches the rising edge of the home switch.



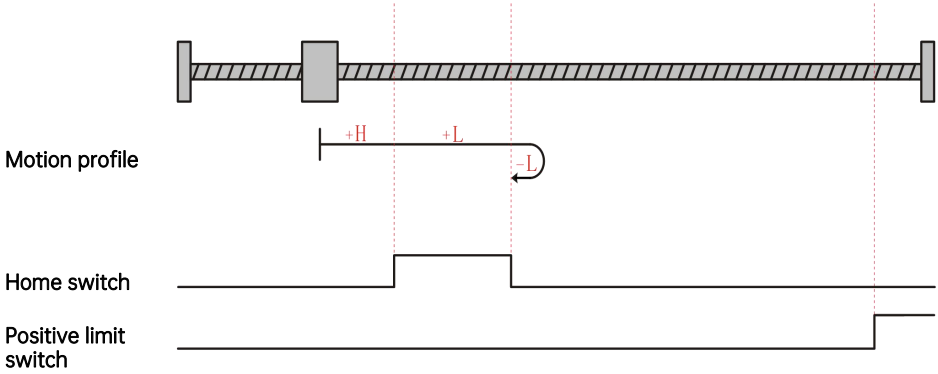
The present motor position is in the effective zone of the home switch. When homing starts, the home switch is at a high level, and homing is processed in the backward direction at a high speed till it reaches the falling edge of the home switch. Then, homing is processed in the forward direction at a low speed, and stops when the motor reaches the rising edge of the home switch.



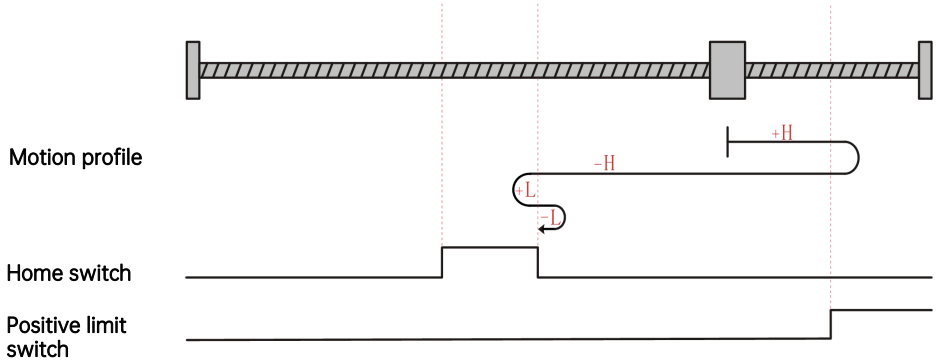
- 0x6098 = 25

Homing in forward direction, and home switch as both the deceleration point and the home position

The present motor position is between the negative limit switch and the home switch. When homing starts, the home switch is at a low level, and homing is processed in the forward direction at a high speed till it reaches the rising edge of the home switch. Then, homing continues in the forward direction at a low speed till it reaches the falling edge of the home switch. Afterwards, homing is processed in the backward direction at a low speed, and stops when the motor reaches the rising edge of the home switch.

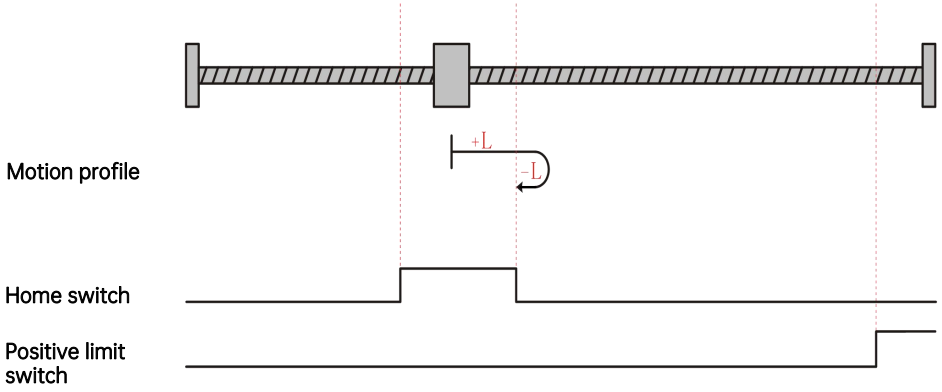


The present motor position is between the positive limit switch and the home switch. When homing starts, the home switch is at a low level, and homing is processed in the forward direction at a high speed till it reaches the rising edge of the positive limit switch. Then, homing is processed in the backward direction at a high speed till it reaches the rising edge of the home switch. Next, homing is processed in the forward direction at a low speed till it reaches the falling edge of the home switch. Afterwards, homing is processed in the backward direction at a low speed, and stops when the motor reaches the rising edge of the home switch.



The present motor position is in the effective zone of the home switch. When homing starts, the home switch is at a high level, and homing is processed in the forward direction at a low speed till it reaches

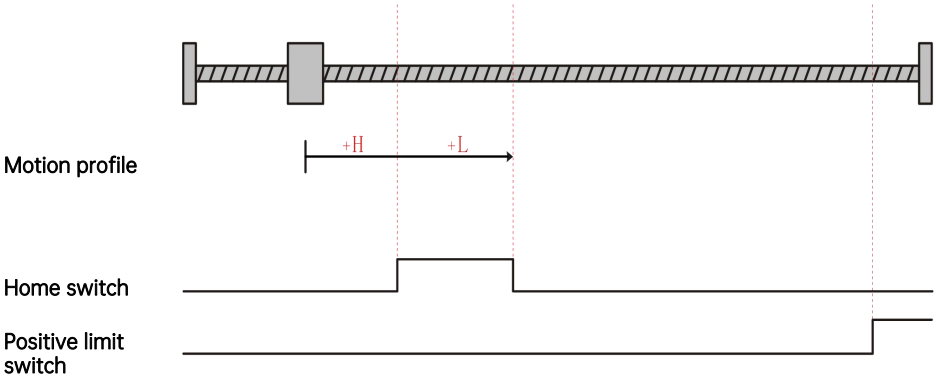
the falling edge of the home switch. Then, homing is processed in the backward direction at a low speed, and stops when the motor reaches the rising edge of the home switch.



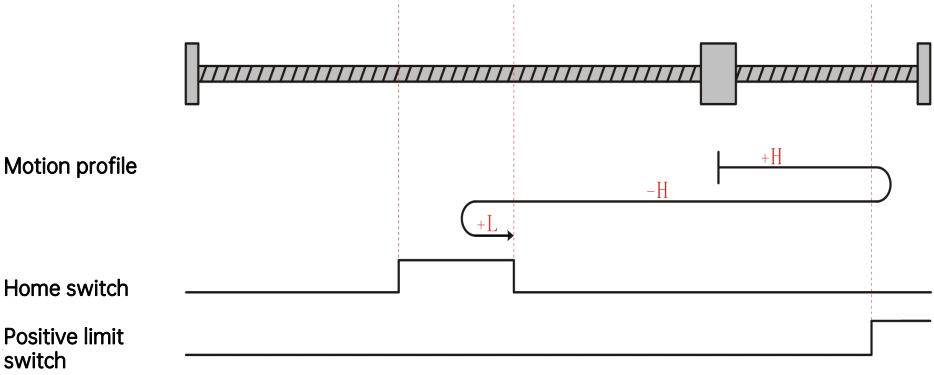
- 0x6098 = 26

Homing in forward direction, and home switch as both the deceleration point and the home position

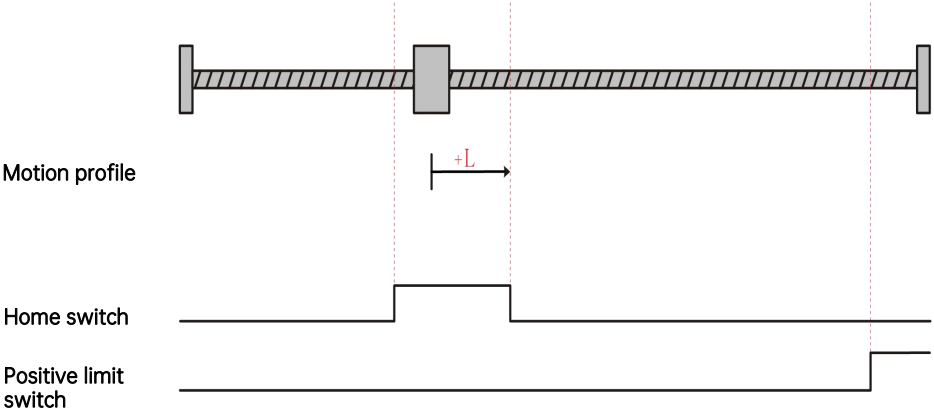
The present motor position is between the negative limit switch and the home switch. When homing starts, the home switch is at a low level, and homing is processed in the forward direction at a high speed till it reaches the rising edge of the home switch. Then, homing continues in the forward direction at a low speed, and stops when the motor reaches the falling edge of the home switch.



The present motor position is between the positive limit switch and the home switch. When homing starts, the home switch is at a low level, and homing is processed in the forward direction at a high speed till it reaches the rising edge of the positive limit switch. Then, homing is processed in the backward direction at a high speed till it reaches the rising edge of the home switch. Afterwards, homing is processed in the forward direction at a low speed, and stops when the motor reaches the falling edge of the home switch.



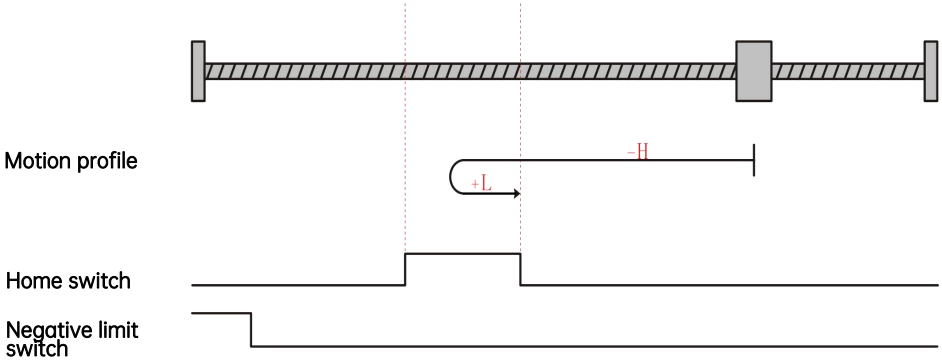
The present motor position is in the effective zone of the home switch. When homing starts, the home switch is at a high level, and homing is processed in the forward direction at a low speed. Homing stops when the motor reaches the falling edge of the home switch.



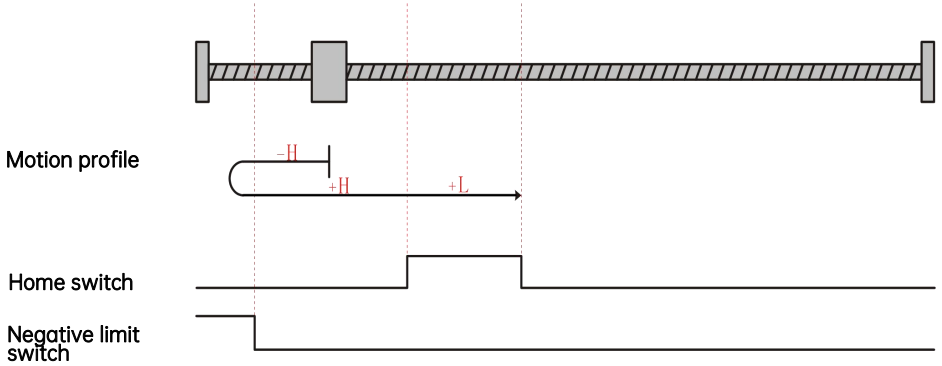
- 0x6098 = 27

Homing in backward direction, and home switch as both the deceleration point and the home position

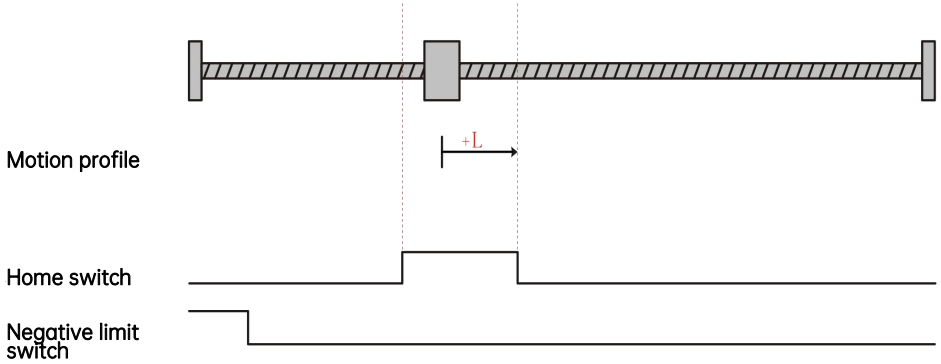
The present motor position is between the positive limit switch and the home switch. When homing starts, the home switch is at a low level, and homing is processed in the backward direction at a high speed till it reaches the rising edge of the home switch. Then, homing is processed in the forward direction at a low speed, and stops when the motor reaches the falling edge of the home switch.



The present motor position is between the negative limit switch and the home switch. When homing starts, the home switch is at a low level, and homing is processed int the backward direction at a high speed till it reaches the rising edge of the negative limit switch. Then, homing is processed in the forward direction at a high speed till it reaches the rising edge of the home switch. Afterwards, homing continues in the forward direction at a low speed, and stops when the motor reaches the falling edge of the home switch.



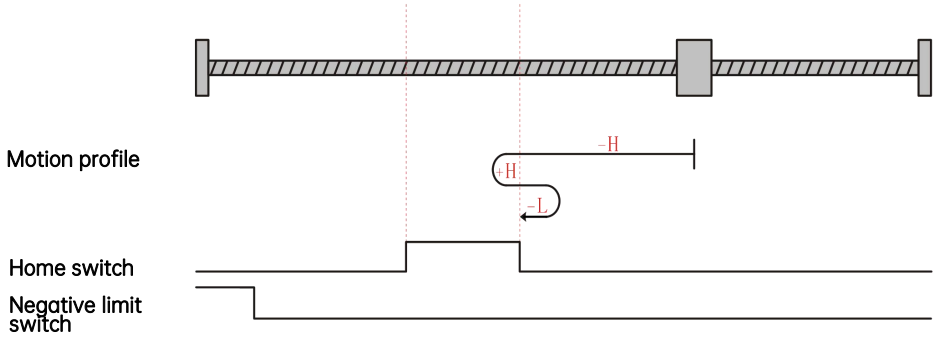
The present motor position is in the effective zone of the home switch. When homing starts, the home switch is at a high level, and homing is processed in the forward direction at a low speed. Homing stops when the motor reaches the falling edge of the home switch.



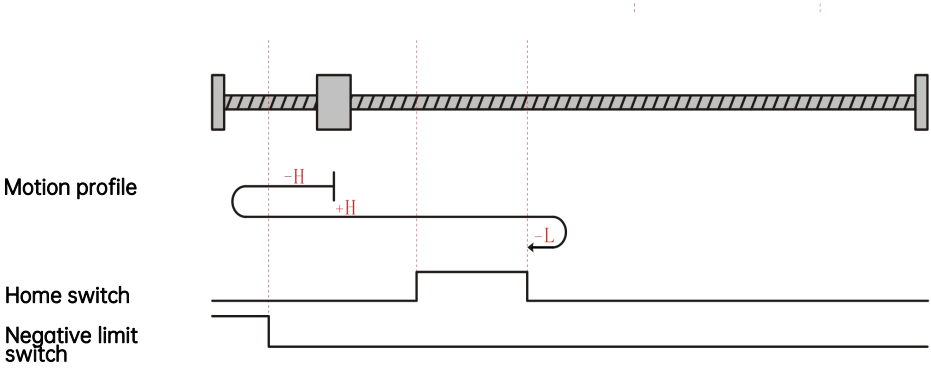
- 0x6098 = 28

Homing in backward direction, and home switch as both the deceleration point and the home position

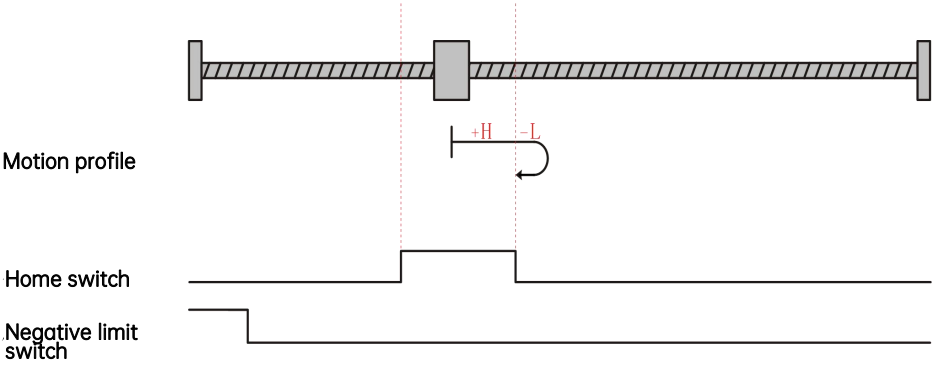
The present motor position is between the home switch and the positive limit switch. When homing starts, the home switch is processed in the backward direction at a high speed till it reaches the rising edge of the home switch. Then, homing is processed in the forward direction at a high speed till it reaches the falling edge of the home switch. Afterwards, homing is processed in the backward direction at a low speed, and stops when the motor reaches the rising edge of the home switch.



The present motor position is between the negative limit switch and the home switch. When homing starts, the home switch is at a low level, and homing is processed in the backward direction at a high speed till it reaches the negative limit switch. Then, homing is processed in the forward direction at a high speed till it reaches the falling edge of the home switch. Afterwards, homing is processed in the backward direction at a low speed, and stops when the motor reaches the rising edge of the home switch.



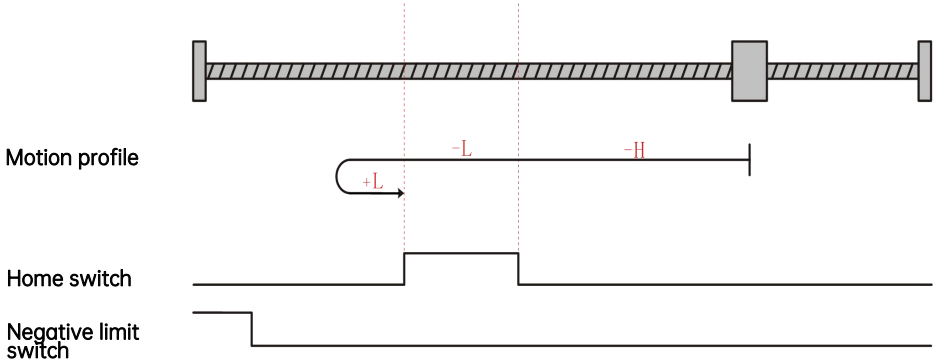
The present motor position is in the effective zone of the home switch. When homing starts, the home switch is at a high level, and homing is processed in the forward direction at a high speed till it reaches the falling edge of the home switch. Then, homing is processed in the backward direction at a low speed, and stops when the motor reaches the rising edge of the home switch.



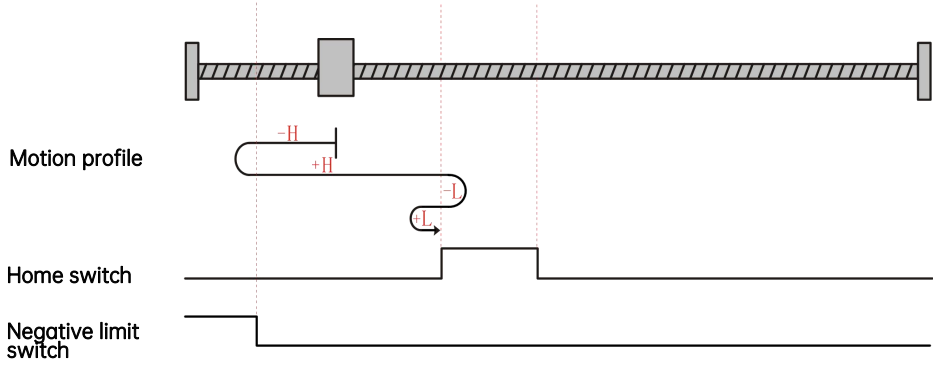
- 0x6098 = 29

Homing in backward direction, and home switch as both the deceleration point and the home position

The present motor position is between the positive limit switch and the home switch. When homing starts, the home switch is at a low level, and homing is processed in the backward direction at a high speed till it reaches the rising edge of the home switch. Then, homing continues in the backward direction at a low speed till it reaches the falling edge of the home switch. Afterwards, homing is processed in the forward direction at a low speed, and stops when the motor reaches the rising edge of the home switch.

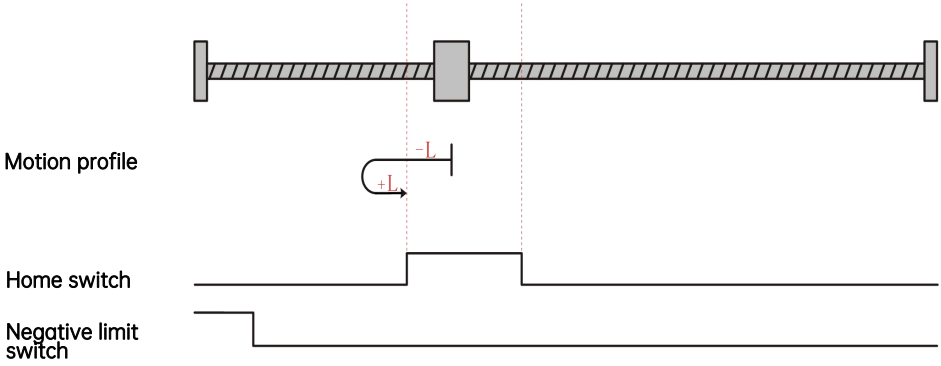


The present motor position is between the negative limit switch and the home switch. When homing starts, the home switch is at a low level, and homing is processed in the backward direction at a high speed till it reaches the rising edge of the negative limit switch. Then, homing is processed in the forward direction at a high speed till it reaches the rising edge of the home switch. Next, homing is processed in the backward direction at a low speed till it reaches the falling edge of the home switch. Afterwards, homing is processed in the forward direction at a low speed, and stops when the motor reaches the rising edge of the home switch.



The present motor position is in the effective zone of the home switch. When homing starts, the home switch is at a high level, and homing is processed in the backward direction at a low speed till it reaches the falling edge of the home switch. Then, homing is processed in the forward direction at a low speed,

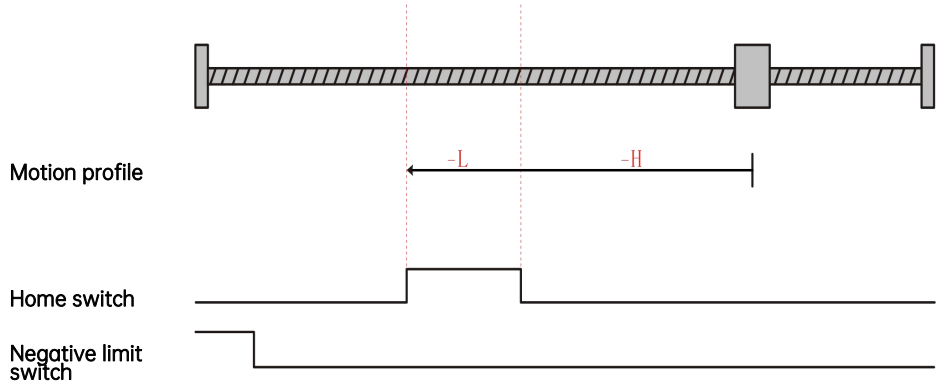
and stops when the motor reaches the rising edge of the home switch.



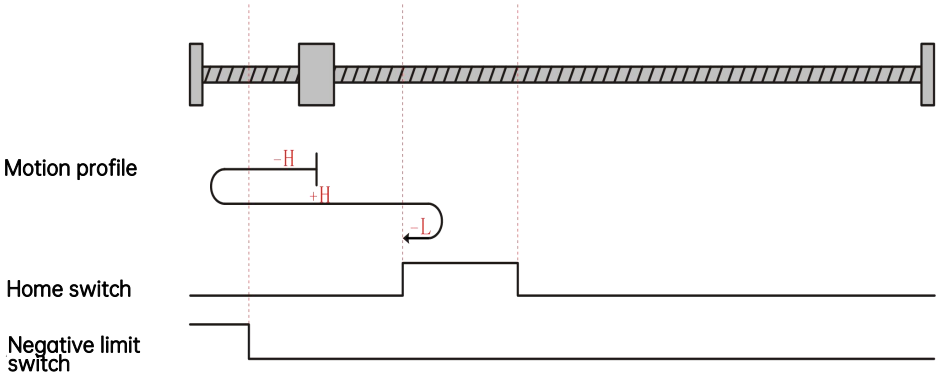
- 0x6098 = 30

Homing in backward direction, and home switch as both the deceleration point and the home position

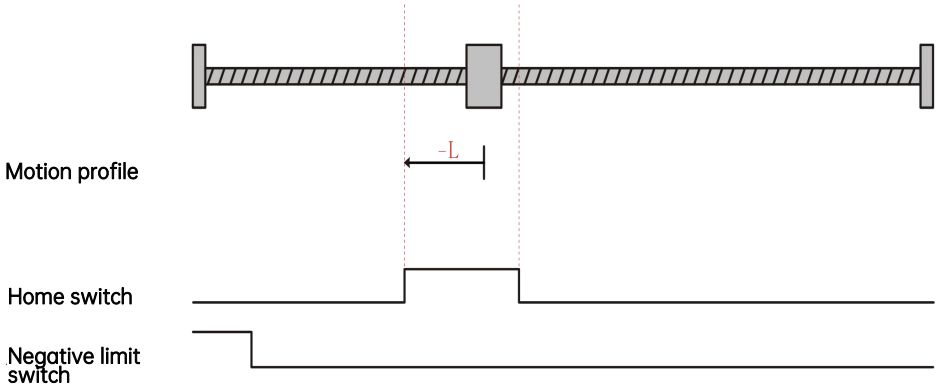
The present motor position is between the positive limit switch and the home position. When homing starts, the home switch is at a low level, and homing is processed in the backward direction at a high speed till it reaches the rising edge of the home switch. Then, homing continues in the backward direction at a low speed, and stops when the motor reaches the falling edge of the home switch.



The present motor position is between the negative limit switch and the home switch. When homing starts, the home switch is at a low level, and homing is processed in the backward direction at a high speed till it reaches the rising edge of the negative limit switch. Then, homing is processed in the forward direction at a high speed till it reaches the rising edge of the home switch. Afterwards, homing is processed in the backward direction at a low speed, and stops when the motor reaches the falling edge of the home switch.



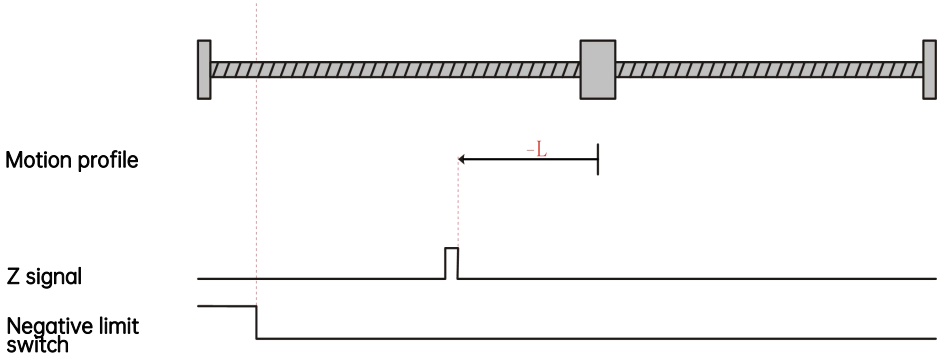
The present motor position is in the effective zone of the home switch. When homing starts, the home switch is at a high level, and homing is processed in the backward direction at a low speed. Homing stops when the motor reaches the falling edge of the home switch.



- 0x6098 = 33

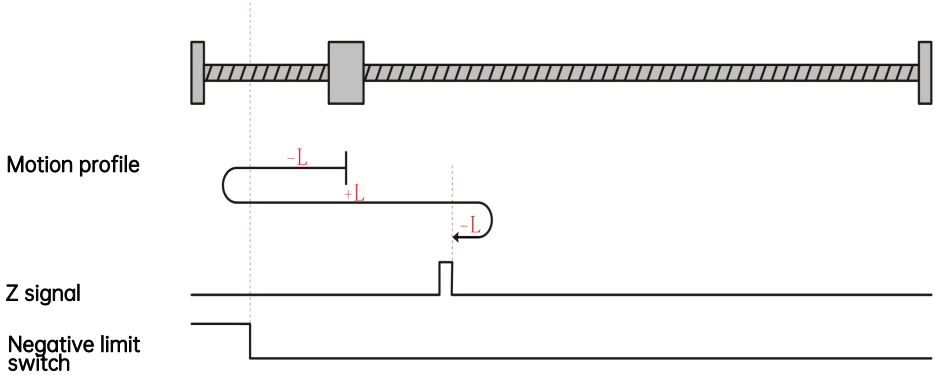
Homing in backward direction, and the motor Z signal as both the deceleration point and the home position

When there is at least one Z signal between the present motor position and the negative limit switch, homing will be processed in the backward direction at a low speed, and stop when the motor reaches the rising edge of the Z signal.



When the present motor position is at the Z signal, homing enable will be activated, the present position will be recorded as the home position, and homing will stop immediately.

When there is no Z signal between the present motor position and the negative limit switch, homing will be processed in the backward direction at a low speed before it reaches the rising edge of the negative limit switch. Then, homing will be processed in the forward direction at a low speed till it reaches the falling edge of the Z signal. Afterwards, homing will be processed in the backward direction at a low speed, and stop when the motor reaches the Z signal.

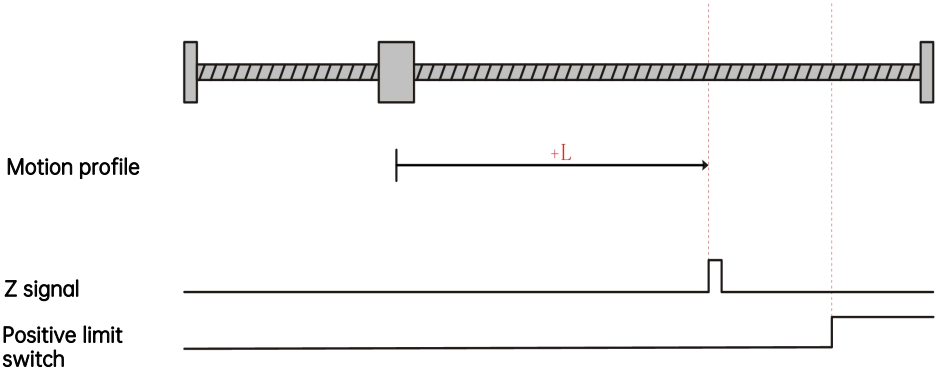


- 0x6098 = 34

Homing in forward signal, and the motor Z signal as both the deceleration point and the home position

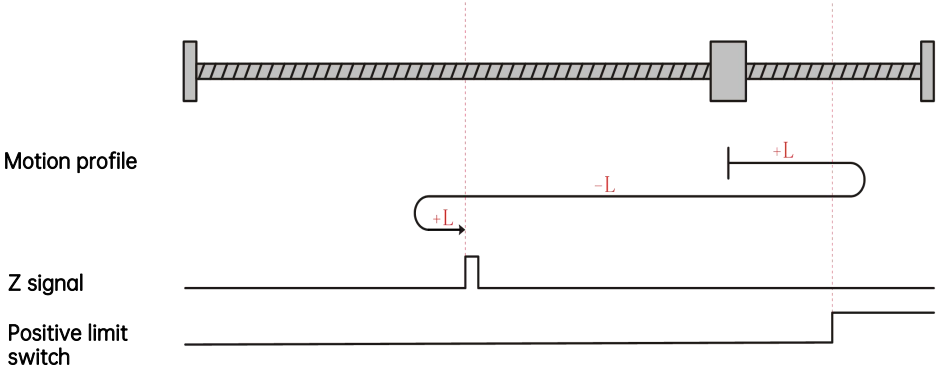
When there is at least one Z signal between the present motor position and the positive limit switch, homing will be processed in the forward direction at a low speed, and stop when the motor reaches the

rising edge of the Z signal.



When the present motor position is at the Z signal, homing enable will be activated, the present position will be recorded as the home position, and homing will stop immediately.

When there is no Z signal between the present motor position and the positive limit switch, homing will be processed in the forward direction at a low speed before it reaches the rising edge of the positive limit switch. Then, homing will be processed in the backward direction at a low speed before it reaches the falling edge of the Z signal. Afterwards, homing will be processed in the forward direction at a low speed, and stop when the motor reaches the Z signal.



- 0x6098 = 35

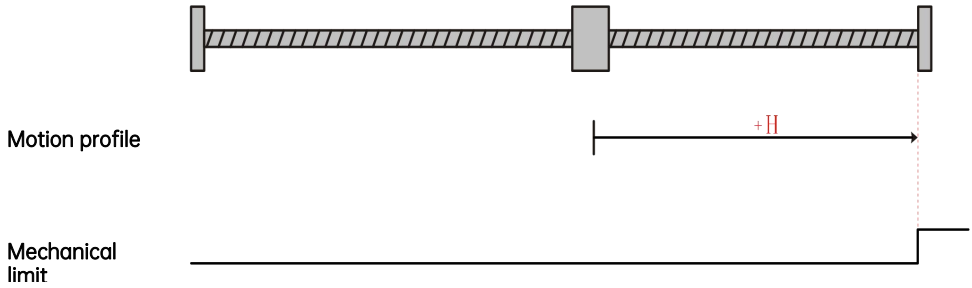
The present position will be determined as the home position.

- 0x6098 = -1

Homing in forward direction, and the mechanical limit position as both the deceleration point and the home position

Homing is processed in the forward direction at a high speed. When it reaches the mechanical limit position, if the output torque reaches 2017.15h (P23.20 homing torque limit) and the hold time reaches 2017.16h (P23.21 homing torque arrival time), homing stops.

Function code	Name	Range	Max. unit	Default	Effective time	Property	Function
P23.20	Homing torque limit	0 to 400.0%	0.1%	30.0%	Immediate	At stop	Judgement of mechanical limit arrival: the output torque reaches the homing torque limit value (P23.20) and the hold time of such state reaches a certain amount (P23.21), then the mechanical limit is determined as reached.
P23.21	Homing torque arrival time	0 to 65535 ms	1 ms	1	Immediate	At stop	

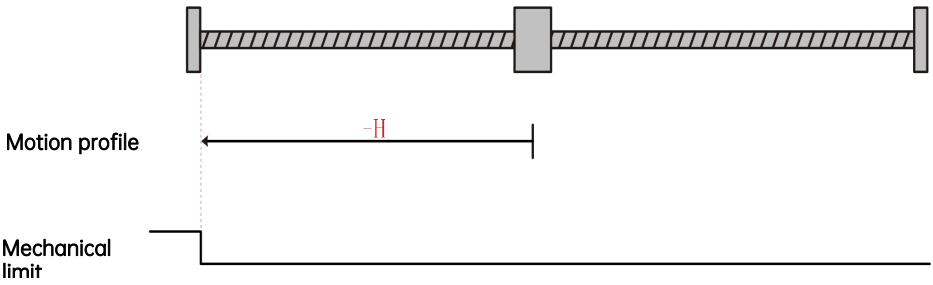


- 0x6098 = -2

Homing in backward direction, and the mechanical limit position as both the deceleration point and the home position

Homing is processed in the backward direction at a high speed. When it reaches the mechanical limit position, if the torque reaches 2017.15h (P23.20 homing torque limit) and the hold time reaches 2017.16h (P23.21 homing torque arrival time), homing stops.

Function code	Name	Range	Max. unit	Default	Effective time	Property	Function
P23.20	Homing torque limit	0 to 400.0%	0.1%	30.0%	Immediate	At stop	Judgement of mechanical limit arrival: the output torque reaches the homing torque limit value (P23.20) and the hold time of such state reaches a certain amount (P23.21), then the mechanical limit is determined as reached.
P23.21	Homing torque arrival time	0 to 65535 ms	1 ms	1	Immediate	At stop	

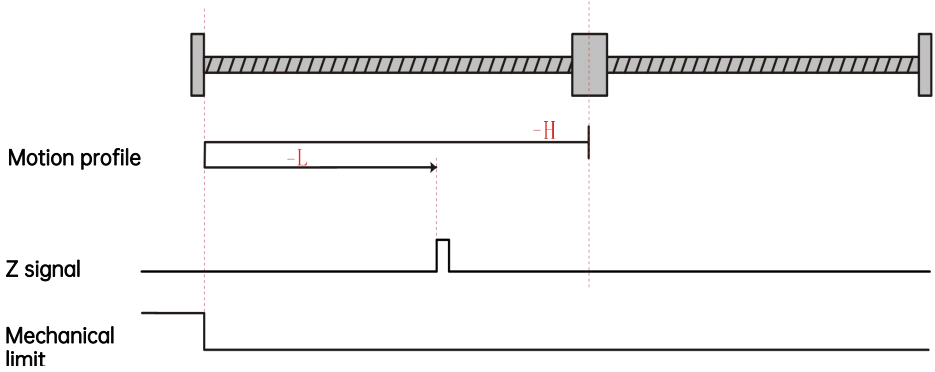


- 0x6098 = -3

Homing in backward direction, mechanical limit position as the deceleration point, and the motor Z signal as the home position

Homing is processed in the backward direction at a high speed. When it reaches the mechanical limit position, if the torque reaches 2017.15h (P23.20 homing torque limit) and the hold time reaches 2017.16h (P23.21 homing torque arrival time), homing is reversed to the forward direction at a low speed and stops when the motor reaches the Z signal.

Function code	Name	Range	Max. unit	Default	Effective time	Property	Function
P23.20	Homing torque limit	0 to 400.0%	0.1%	30.0%	Immediate	At stop	Judgement of mechanical limit arrival: the output torque reaches the homing torque limit value (P23.20) and the hold time of such state reaches a certain amount (P23.21), then the mechanical limit is determined as reached.
P23.21	Homing torque arrival time	0 to 65535 ms	1 ms	1	Immediate	At stop	

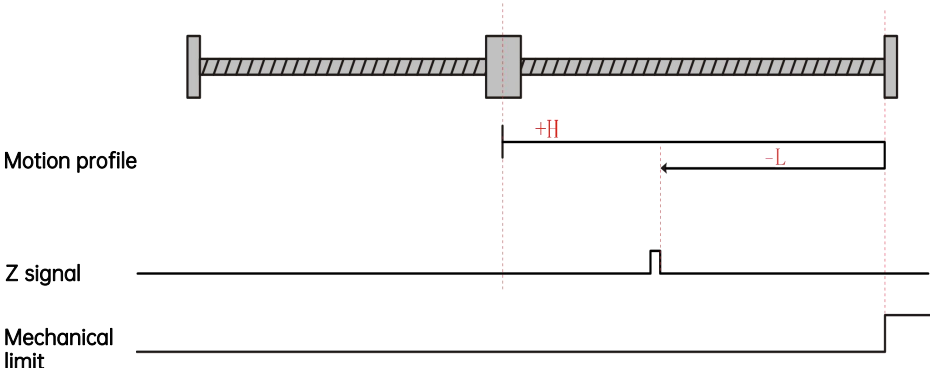


- 0x6098 = -4

Homing in forward direction, mechanical limit position as the deceleration point, and the motor Z signal as the home position

Homing is processed in the forward direction at a high speed. When it reaches the mechanical limit position, if the torque reaches 2017.15h (P23.20 homing torque limit) and the hold time reaches 2017.16h (P23.21 homing torque arrival time), homing is reversed to the backward direction at a low speed, and stops when the motor reaches the Z signal.

Function code	Name	Range	Max. unit	Default	Effective time	Property	Function
P23.20	Homing torque limit	0 to 400.0%	0.1%	30.0%	Immediate	At stop	Judgement of mechanical limit arrival: the output torque reaches the homing torque limit value (P23.20) and the hold time of such state reaches a certain amount (P23.21), then the mechanical limit is determined as reached.
P23.21	Homing torque arrival time	0 to 65535 ms	1 ms	1	Immediate	At stop	



6.4.5 Cyclic synchronous position mode

The principle of the cyclic synchronous position mode is similar to that of the interpolated position mode. In this mode, the master station performs the planning of the position command, and sends the planned target position to the slave station drive in a periodic synchronous manner. In this mode, the target position object is 607Ah.

The cyclic synchronous position mode supports the absolute position command only, and DM5-N series supports linear interpolation only.

6.4.5.1 Common object

The objects related to this operation mode are listed in the table below.

Index	Data structure	Name	Data type	Accessibility	Mapping type	Unit
6040h	VAR	Control word	UINT16	RW	RPDO	-
6041h	VAR	Status word	UINT16	RO	TPDO	-
6060h	VAR	Modes of operation	INT8	RW	RPDO	-
6061h	VAR	Modes of operation display	INT8	RO	TPDO	-
6063h	VAR	Position actual value* (motor unit)	INT32	RO	TPDO	p
6064h	VAR	Position actual value (user-defined unit)	INT32	RO	TPDO	Command unit
6065h	VAR	Following error window	UINT32	RW	RPDO	Command unit
6066h	VAR	Following error window time	UINT16	RW	RPDO	ms
6067h	VAR	Position window	UINT32	RW	RPDO	Command unit
6068h	VAR	Position window time	UINT16	RW	RPDO	ms
607Ah	VAR	Target position	INT32	RW	RPDO	Command unit
607Dh	ARRAY	Software position limit	INT32	RW	RPDO	Command unit
607Eh	VAR	Polarity	UINT8	RW	RPDO	-
6091h	ARRAY	Gear ratio factor	UINT32	RW	RPDO	-
60F4h	VAR	Following error actual value	INT32	RO	TPDO	Command unit
2014.0bh	VAR	Data interpolation cycle	UINT16	RW	RPDO	us

Note:

Data interpolation cycle P20.10 (2014.0bh) is implemented only in the situation where the synchronization cycle is not consistent with the data cycle. Under the circumstances, the data interpolation cycle is used as the data cycle, and the unit is μs.

6.4.5.2 Control word and status word

The definition of the control word in the cyclic synchronous position mode is the same with the standard definition.

The status word in the cyclic synchronous position mode is explained in the table below.

Bit15 to Bit14	Bit13	Bit12	Bit11	Bit10	Bit9 to Bit0
*	Following error	Target position ignored	*	Target reached	*

The bits of the status word in the cyclic synchronous position mode are described in the table below.

Bit	Set value	Function
Target reached	0	Target position not reached
	1	Target position reached
Target position ignored	0	Position command not followed
	1	Position command followed
Following error	0	No position deviation
	1	There is position deviation.

6.4.5.3 Function description

- Running mode setting: Set 6060h to 8;
- Target position setting: Set the target position in the user-defined unit via 607Ah; if necessary, set the gear ratio factor 6091h;
- Operation enable: Enable the operation of the drive via the control word 6040h;
- Speed limit setting: Select the speed limit channel via 2007.0Ah (P07.09 FWD speed limit channel) and 2007.0Ch (P07.11 REV speed limit channel) in the object dictionary of the function code, where the bus channel is selected by default. The range for the bus speed limit channel is determined by 607Fh maximum profile velocity and 6080h maximum motor speed. Otherwise, set an internal speed limit channel, and the range is determined by 2007.0Bh (P07.10 FWD speed limit) and 2007.0Dh (P07.12 REV speed limit) in the object dictionary of the function code. The speed limit can be decreased to zero based on the decrease time set by P20.19 (2014.14h);

Function code	Name	Range	Max. unit	Default	Effective time	Property	Function
P20.19	Bus speed limit decrease time	0 to 65535	1	0	Immediate	At stop	Set the time of the speed limit decreasing from the max. value to zero (unit: ms)

- Torque limit setting: Select the torque limit channel via 2006.0Dh (P06.12 positive torque limit channel) and 2006.0Eh (P06.13 negative torque limit channel) in the object dictionary of the function code, where the bus channel is selected by default. The range for the bus torque limit channel is determined by the minimum value among 6072h maximum torque, 60E0h positive torque limit, and 60E1h

negative torque limit. Otherwise, set an internal torque limit channel, and the range is determined by 2006.0Fh (P06.14 positive torque limit) and 2006.10h (P06.15 negative torque limit) in the object dictionary of the function code;

- Excessive position deviation judgement: If the position deviation in the user-defined unit 60F4h is greater than 6065h, a fault is reported; at this point, bit13 of the status word 6041h is set to 1;
- When the synchronization cycle is not consistent with the data cycle, it is required to set the data interpolation cycle 2014.0bh;
- Polarity 0x607E of command: The command logic of torque, speed, and position shall be set according to the corresponding bit of 0x607E in the object dictionary.

Bit	Name	Set value	Function
BIT5	Torque command polarity	0	Torque command positive logic
		1	Torque command negative logic
BIT6	Speed command polarity	0	Speed command positive logic
		1	Speed command negative logic
BIT7	Position command polarity	0	Position command positive logic
		1	Position command negative logic

6.4.5.4 Basic configuration

The basic configuration of the objects in the cyclic synchronous position mode is described in the table below.

RPDO object	TPDO object	Remark
Control word 6040h	Status word 6041h	Required
Target position 607Ah	Position actual value 6064h	Required
Other objects		Optional; it can be configured as an SDO parameter.

6.4.6 Cyclic synchronous velocity mode

In this mode, the master sends the calculated target velocity to the slave drive in a cyclic synchronous manner. The slave drive implements the target velocity sent by the master. The interpolation cycle is the same with the synchronous signal cycle.

6.4.6.1 Common object

The objects related to this operation mode are listed in the table below.

Index	Data structure	Name	Data type	Accessibility	Mapping type	Unit
603Fh	VAR	Error Code	UINT16	RW	TPDO	-
6040h	VAR	Control word	UINT16	RW	RPDO	-
6041h	VAR	Status word	UINT16	RO	TPDO	-
6060h	VAR	Modes of operation	INT8	RW	RPDO	-
6061h	VAR	Modes of operation display	INT8	RO	TPDO	-
606Ch	VAR	Velocity actual value	INT32	RO	TPDO	Command unit / s
606Dh	VAR	Velocity window	UINT16	RW	RPDO	rpm
606Eh	VAR	Velocity window time	UINT16	RW	RPDO	ms
607Eh	VAR	Polarity	UINT8	RW	RPDO	-
6091h	ARRAY	Gear ratio factor	UINT32	RW	RPDO	-
60FFh	VAR	Target velocity	INT32	RW	RPDO	Command unit / s

6.4.6.2 Control word and status word

The definition of the control word in the cyclic synchronous velocity (CSV) mode is the same with the standard definition.

The status word in the cyclic synchronous velocity mode is explained in the table below.

Bit15 to Bit13	Bit12	Bit11	Bit10	Bit9 to Bit0
*	Target velocity ignored	*	Target reached	*

The bits of the status word in the cyclic synchronous velocity mode are described in the table below.

Bit	Set value	Function
Target reached	0	Target speed not reached
	1	Target speed reached
Target velocity ignored	0	Velocity command not followed
	1	Velocity command followed

6.4.6.3 Function description

- Running mode setting: Set 6060h to 9;
- Target velocity setting: Set the target velocity in the user-defined unit via 60FFh; if necessary, set the gear ratio factor 6091h;
- Operation enable: Enable the operation of the drive via the control word 6040h;
- Speed limit setting: Select the speed limit channel via 2007.0Ah (P07.09 FWD speed limit channel) and 2007.0Ch (P07.11 REV speed limit channel) in the object dictionary of the function code, where the bus channel is selected by default. The range for the bus speed limit channel is determined by 607Fh maximum profile velocity and 6080h maximum motor speed. Otherwise, set an internal speed limit channel, and the range is determined by 2007.0Bh (P07.10 FWD speed limit) and 2007.0Dh (P07.12 REV speed limit) in the object dictionary of the function code. The speed limit can be decreased to zero based on the decrease time set by P20.19 (2014.14h);

Function code	Name	Range	Max. unit	Default	Effective time	Property	Function
P20.19	Bus speed limit decrease time	0 to 65535	1	0	Immediate	At stop	Set the time of the speed limit decreasing from the max. value to zero (unit: ms)

- Torque limit setting: Select the torque limit channel via 2006.0Dh (P06.12 positive torque limit channel) and 2006.0Eh (P06.13 negative torque limit channel) in the object dictionary of the function code, where the bus channel is selected by default. The range for the bus torque limit channel is determined by the minimum value among 6072h maximum torque, 60E0h positive torque limit, and 60E1h negative torque limit. Otherwise, set an internal torque limit channel, and the range is determined by 2006.0Fh (P06.14 positive torque limit) and 2006.10h (P06.15 negative torque limit) in the object dictionary of the function code;
- Polarity 0x607E of command: The command logic of torque, speed, and position shall be set according to the corresponding bit of 0x607E in the object dictionary.

Bit	Name	Set value	Function
Bit5	Torque command polarity	0	Torque command positive logic
		1	Torque command negative logic
Bit6	Speed command polarity	0	Speed command positive logic
		1	Speed command negative logic
Bit7	Position command polarity	0	Position command positive logic
		1	Position command negative logic

6.4.6.4 Basic configuration

The basic configuration of the objects in the cyclic synchronous velocity mode is described in the table below.

RPDO object	TPDO object	Remark
Control word 6040h	Status word 6041h	Required
Target position 60FFh		Required
	Velocity actual value 606Ch	Optional
Other objects		Optional; it can be configured as an SDO parameter.

6.4.7 Cyclic synchronous torque mode

In this mode, the master sends the calculated target torque to the slave drive in a cyclic synchronous manner. The slave drive implements the target torque sent by the master. The interpolation cycle is consistent with the synchronous signal cycle.

6.4.7.1 Common object

The objects related to this operation mode are listed in the table below.

Index	Data structure	Name	Data type	Accessibility	Mapping type	Unit
603Fh	VAR	Error Code	UINT16	RW	TPDO	-
6040h	VAR	Control word	UINT16	RW	RPDO	-
6041h	VAR	Status word	UINT16	RO	TPDO	-
6060h	VAR	Modes of operation	INT8	RW	RPDO	-
6061h	VAR	Modes of operation display	INT8	RO	TPDO	-
6063h	VAR	Position actual value* (motor unit)	INT32	RO	TPDO	Encoder unit
6064h	VAR	Position actual value (user-defined unit)	INT32	RO	TPDO	Command unit
606Ch	VAR	Velocity actual value	INT32	RO	TPDO	Command unit / s

Index	Data structure	Name	Data type	Accessibility	Mapping type	Unit
606Dh	VAR	Velocity window	UINT16	RW	RPDO	rpm
6071h	VAR	Target torque	INT16	RW	RPDO	0.1%
6072h	VAR	Max. Torque	UINT16	RW	RPDO	0.1%
6074h	VAR	Torque demand	INT16	RO	TPDO	0.1%
6077h	VAR	Torque actual value	INT16	RO	TPDO	0.1%
607Eh	VAR	Polarity	UINT8	RW	RPDO	-
607Fh	VAR	Max. profile velocity	UINT32	RW	RPDO	Command unit / s
6080h	VAR	Max. motor speed	UINT32	RW	RPDO	rpm
60E0h	VAR	FWD torque limit	UINT16	RW	RPDO	0.1%
60E1h	VAR	REV torque limit	UINT16	RW	RPDO	0.1%

6.4.7.2 Control word and status word

The definition of the control word in the cyclic synchronous torque mode is the same with the standard definition.

The status word in the cyclic synchronous torque mode is explained in the table below.

Bit15 to Bit13	Bit12	Bit11	Bit10	Bit9 to Bit0
*	Target torque ignored	*	Target reached	*

The bits of the status word in the cyclic synchronous torque mode are described in the table below.

Bit	Set value	Function
Target reached	0	Target torque not reached
	1	Target torque reached
Target torque ignored	0	Torque command not followed
	1	Torque command followed

6.4.7.3 Function description

- Control mode setting: Set P02.00 to 8;
- Running mode setting: Set 6060h to 10;
- Target torque setting: Set the target torque in the user-defined unit via 6071h (unit: 0.1%);
- Speed limit setting: Select the speed limit channel via 2007.0Ah (P07.09 FWD speed limit channel) and 2007.0Ch (P07.11 REV speed limit channel) in the object dictionary of the function code, where the bus channel is selected by default. The range for the bus speed limit channel is determined by 607Fh maximum profile velocity and 6080h maximum motor speed. Otherwise, set an internal speed limit channel, and the range is determined by 2007.0Bh (P07.10 FWD speed limit) and 2007.0Dh (P07.12 REV speed limit) in the object dictionary of the function code. The speed limit can be decreased to zero based on the decrease time set by P20.19 (2014.14h);

Function code	Name	Range	Max. unit	Default	Effective time	Property	Function
P20.19	Bus speed limit decrease time	0 to 65535	1	0	Immediate	At stop	Set the time of the speed limit decreasing from the max. value to zero (unit: ms)

- Torque limit setting: Select the torque limit channel via 2006.0Dh (P06.12 positive torque limit channel) and 2006.0Eh (P06.13 negative torque limit channel) in the object dictionary of the function code, where the bus channel is selected by default. The range for the bus torque limit channel is determined by the minimum value among 6072h maximum torque, 60E0h positive torque limit, and 60E1h negative torque limit. Otherwise, set an internal torque limit channel, and the range is determined by 2006.0Fh (P06.14 positive torque limit) and 2006.10h (P06.15 negative torque limit) in the object dictionary of the function code;
- Operation enable: Enable the operation of the drive via the control word 6040h;
- Polarity 0x607E of command: The command logic of torque, speed, and position shall be set according to the corresponding bit of 0x607E in the object dictionary;

Bit	Name	Set value	Function
BIT5	Torque command polarity	0	Torque command positive logic
		1	Torque command negative logic
BIT6	Speed command polarity	0	Speed command positive logic
		1	Speed command negative logic
BIT7	Position command polarity	0	Position command positive logic
		1	Position command negative logic

- Torque arrival: This function determines whether the torque actual value has reached the torque window. If the discrepancy between the torque actual value (6077h) and the torque reference value (2007.0Eh) is greater than the torque arrival effective value (2007.0Fh), bit10 (target reached) of the status word will be set to 1. If the discrepancy between the torque actual value (6077h) and the torque reference value (2007.0Eh) is lower than the torque arrival non-effective value (2007.10h), bit10 (target reached) of the status word will be cleared immediately.
- Target torque ramp: This function defines the acceleration/deceleration time of the target torque. When the controller cannot plan the ramp for the target torque (6071h), the system can plan the acceleration/deceleration for the servo internal torque via the setting of P20.20 (2014.15h), and the unit is 0.01% / 1 ms. If only the deceleration ramp from the target torque to zero is required, set P20.18 (2014.13h) to plan the servo internal torque deceleration. If P20.18 and P20.20 are both set, P20.18 will be valid when the target torque is decreased to zero, and P20.20 will be valid under other circumstances. If the controller offers planning of the torque ramp, neither P20.18 nor P20.20 can be set.

Function code	Name	Range	Max. unit	Default	Effective time	Property	Function
P20.18	Bus torque command full deceleration ramp	0 to 65535	1	0	Immediate	At stop	Set the ramp of the torque decreasing to zero (unit: 0.01% / 1 ms)
P20.20	Bus torque command acceleration/ deceleration ramp	0 to 65535	1	0	Immediate	At stop	Set the ramp of the torque acceleration/ deceleration (unit: 0.01% / 1 ms); it can be valid with P20.18 at the same time.

6.4.7.4 Basic configuration

The basic configuration of the objects in the cyclic synchronous torque mode is described in the table below.

RPDO object	TPDO object	Remark
Control word 6040h	Status word 6041h	Required
Target torque 6071h		Required
	Torque actual value 6077h	Optional
Other objects		Optional; it can be configured as an SDO parameter; otherwise, use the default parameter of the drive.

6.5 Servo drive stop

Stop mode: coast to stop; decelerate to stop.

When the drive is in the running state, if the control word receives a Shutdown command, the drive will stop in the mode defined by 605Bh.

When the drive is in the running state, if the control word receives a Disable operation command, the drive will stop in the mode defined by 605Ch.

When the drive is in the running state, if the control word receives a Quick stop command, the drive will stop in the mode defined by 605Ah.

When the emergency stop DI (FunIN.34) is applied, the drive will stop in the mode defined by 605Ah.

Object dictionary	Name	Data type	Accessibility	Mapping type	Unit	Function
605Ah	Quick stop option code	INT16	RW	RPDO	-	0 - Coast to stop 1 - 6084h / 609Ah (HM) / 6087h (PT/CST) 2 - 6085h /6087h (PT/CST) 5 - 6084h / 609Ah (HM) / 6087h (PT/CST), drive position lock 6 - 6085h /6087h (PT/CST), drive position lock **Remark:** The torque mode does not support position lock.
605Dh	Halt option code	INT16	RW	RPDO	-	1 - 6084h / 609Ah (HM) / 6087h (PT/CST) 2 - 6085h / 6087h (PT/CST)
605Bh	Shutdown option code	INT16	RW	RPDO	-	0 - Coast to stop 1 - 6084h / 609Ah (HM) / 6087h (PT/CST)
605Ch	Disable operation option code	INT16	RW	RPDO	-	0 - Coast to stop 1 - 6084h / 609Ah (HM) / 6087h (PT/CST)
6084h	Profile deceleration	UINT32	RW	RPDO	Command unit / s^2	

Object dictionary	Name	Data type	Accessibility	Mapping type	Unit	Function
6085h	Quick stop deceleration	UINT32	RW	RPDO	Command unit / s^2	
6087h	Torque slope	UINT16	RW	RPDO	0.1%/s	
609Ah	Homing acceleration	UINT32	RW	RPDO	Command unit /s^2	

6.6 Servo drive application

6.6.1 Touch probe function

DM5 series servo drives adopt two channels of touch probes, capable of simultaneously recording the position information of the positive and negative values of the touch probe signals.

If the DI terminal is used as the touch probe trigger signal terminal, select terminal function 49 (Touch probe 1) or terminal function 50 (Touch probe 2) for P03.XX.

Z signal can be used as the touch probe trigger signal.

Object dictionary	Name	Data type	Accessibility	Mapping type	Unit
60B8h	Touch probe function	INT16	RW	RPDO	-
60B9h	Touch probe status	UINT16	RO	TPDO	-
60BAh	Touch probe Pos1 pos value	INT32	RO	TPDO	Command unit
60BBh	Touch probe Pos1 neg value	INT32	RO	TPDO	Command unit
60BCh	Touch probe Pos2 pos value	INT32	RO	TPDO	Command unit
60BDh	Touch probe Pos2 neg value	INT32	RO	TPDO	Command unit

Object dictionary	Bit	Function
60B8h Touch probe function	0	0 - Disable touch probe 1 1 - Enable touch probe 1
	1	0 - Touch probe 1 single latch 1 - Touch probe 1 consecutive latch

	2	0 - Trigger touch probe 1 by DI terminal 1 - Trigger touch probe 1 by Z signal
	3	Reserved
	4	0 - Touch probe Pos1 pos value not latch 1 - Touch probe Pos1 pos value latch
	5	0 - Touch probe Pos1 neg value not latch 1 - Touch probe Pos1 neg value latch
	6 to 7	Reserved
	8	0 - Disable touch probe 2 1 - Enable touch probe 2
	9	0 - Touch probe 2 single latch 1 - Touch probe 2 consecutive latch
	10	0 - Trigger touch probe 2 by DI terminal 1 - Trigger touch probe 2 by Z signal
	11	Reserved
	12	0 - Touch probe Pos2 pos value not latch 1 - Touch probe Pos2 pos value latch
	13	0 - Touch probe Pos2 neg value not latch 1 - Touch probe Pos2 neg value latch
	14 to 15	Reserved
Object dictionary	Bit	Function
60B9h Touch probe status	0	0 - Touch probe 1 not enabled 1 - Touch probe 1 enabled
	1	0 - Touch probe Pos1 pos value latch not implemented 1 - Touch probe Pos1 pos value latch implemented
	2	0 - Touch probe Pos1 neg value latch not implemented 1 - Touch probe Pos1 neg value latch implemented
	3 to 7	Reserved
	8	0 - Touch probe 2 not enabled 1 - Touch probe 2 enabled

	9	0 - Touch probe Pos2 pos value latch not implemented 1 - Touch probe Pos2 pos value latch implemented
	10	0 - Touch probe Pos2 neg value latch not implemented 1 - Touch probe Pos2 neg value latch implemented
	11 to 15	Reserved

6.6.2 I/O terminal 60FDh/60FEh

The DM5 series servo drive supports 60FDh, which is used to set the input state of each drive terminal.

Object dictionary	Bit	Function
60FDh Digital inputs	0	1 - Negative limit valid 0 - Negative limit invalid
	1	1 - Positive limit valid 0 - Positive limit invalid
	2	1 - Home signal valid 0 - Home signal invalid
	3 to 15	Reserved
	16	1 - DI1 input valid 0 - DI1 input invalid
	17	1 - DI2 input valid 0 - DI2 input invalid
	18	1 - DI3 input valid 0 - DI3 input invalid
	19	1 - DI4 input valid 0 - DI4 input invalid
	20 to 23	Reserved
	24	1 - STO input valid 0 - STO input invalid
	25	1 - Z signal valid 0 - Z signal invalid

Object dictionary	Bit	Function
	26	1 - Touch probe 1 valid 0 - Touch probe 1 invalid
	27	1 - Touch probe 2 valid 0 - Touch probe 2 invalid
	28 to 31	Reserved

The DM5 series servo drive supports 60FEh, which is used for the EtherCAT bus to control the forced output of the DO signal.

Before the drive enters the OP state, DO terminal does not output.

When the drive is in the OP state, DO terminal controls the digital output via the corresponding bits of 60FESUB1 after enabled via 60FESUB2.

When the drive exits the OP state (i.e. cutoff), the drive will perform digital output as set by P03.22.

Object dictionary	Bit	Function
60FEh Sub1 (DO forced output control)	0 to 15	Reserved
	16	1 - DO1 Switch on 0 - DO1 Switch off
	17	1 - DO2 Switch on 0 - DO2 Switch off
	18 to 31	Reserved
60FEh Sub2 (DO forced output enable)	0 to 15	Reserved
	16	1 - Enable DO1 output 0 - Disable DO1 output
	17	1 - Enable DO2 output 0 - Disable DO2 output
	18 to 31	Reserved
P03.22	0	0 - DO1 state hold (hold the state as before cutoff) 1 - Disable DO1 output
	1	0 - DO2 state hold (hold the state as before cutoff) 1 - Disable DO2 output
	2 to 15	Reserved

6.6.3 Slave address distribution function

When the slave address is distributed automatically by the master, P20.09 (2014.0Ah) displays the addresses distributed by the master. When it is required to set the address by the slave, P20.08 (2014.09h) sets the slave address number.

6.6.4 User-defined unit selection

6.6.4.1 User-defined unit for position

The user can set P05.05 (2005.06h) number of command pulses per motor revolution, and match the setting with controller target position. The default value is 8388608 P/r. The electronic gear ratio 6091h can be set at the same time.

6.6.4.2 User-defined unit for velocity

The user can select the user-defined unit of velocity via the setting of P20.15 (2014.10h). The default user-defined unit for bus velocity is command unit / s.

6.6.4.3 User-defined unit for torque

The user can select the user-defined unit of torque via the setting of P20.14 (2014.0Fh). The default user-defined unit for bus torque is 0.1% of the rated torque P01.04 (2001.05h).

Chapter 7 Drive Parameter Object

7.1 DM5-N series drive parameter

The object indexes of the DM5-N drive parameters are shown in the table below.

Parameter group	Index	Sub-index	Remark
P00	2000h	01h to the number of parameters in the group	Index of the drive parameter = (2000h + Group number); Sub-index of the drive parameter = (The offset of the parameter within this group + 1) Examples: The 1st parameter P00.00 of group P00: Index = 2000h, sub-index = 01h; The 11th parameter P12.10 of group P12: Index = 200Ch, sub-index = 0Bh.
P01	2001h	01h to the number of parameters in the group	
…			

The parameters related to the drive are listed below.

Function code	Sub -index	Name	Range	Min. unit	Default	Effective time	Property
Index 2000h (P00): Drive parameters							
P00.00	01h	Series number	0 to FFFF	1	Manufacturer setting	-	At display
P00.01	02h	DSP software version number	0.00 to 99.99	0.01	Manufacturer setting	-	At display
P00.02	03h	Customized version number	0 to 9999	1	Manufacturer setting	-	At display
P00.03	04h						
P00.04	05h	Servo drive voltage class	0: 220 V AC 1: 380 V AC 2: 24 to 70 V DC 3: 48 to 96 V DC 4: 70 to 110 V DC	1	Manufacturer setting	-	At display

Function code	Sub -index	Name	Range	Min. unit	Default	Effective time	Property
P00.05	06h	Servo drive rated current	0 to 999.9 A	0.1 A	Manufacturer setting	-	At display
P00.06	07h	Servo drive maximum current	0 to 999.9 A	0.1 A	Manufacturer setting	-	At display
Index 2001h (P01): Motor parameters							
P01.00	01h	Motor number	0: Motor parameter can be set 0x0001 to 0xFFFF: Motor parameter is set automatically based on motor number	1	0	Immediate	At stop
P01.01	02h	Rated power	0.04 to 99.99 kW	0.01 kW	Depend on model	Power-on again	At stop
P01.02	03h	Rated voltage	0 to Servo drive rated voltage	1 V	0	Power-on again	At stop
P01.03	04h	Rated current	0.1 to 999.9 A	0.1 A	Depend on model	Power-on again	At stop
P01.04	05h	Rated torque	0.1 to 655.35 Nm	0.01 Nm	Depend on model	Power-on again	At stop
P01.05	06h	Maximum torque	0.1 to 655.35 Nm	0.01 Nm	Depend on model	Power-on again	At stop
P01.06	07h	Rated rotating speed	0.1 to 6000.0 rpm	0.1 rpm	Depend on model	Power-on again	At stop
P01.07	08h	Maximum rotating speed	0.1 to 6000.0 rpm	0.1 rpm	Depend on model	Power-on again	At stop
P01.08	09h	Rotor inertia Jm	0.01 to 655.35 kg*cm^2	0.01 kg*cm^2	Depend on model	Power-on again	At stop
P01.09	0Ah	Number of pole pairs	2 to 72 pole pairs	1 pole pair	Depend on model	Power-on again	At stop
P01.10	0Bh	Stator Resistance R1	0.000 to 65.000 Ω	0.001 Ω	Depend on model	Power-on again	At stop
P01.11	0Ch	Direct axis inductance Ld	0.00 to 200.00 mH	0.01 mH	Depend on	Power-on	At stop

Function code	Sub -index	Name	Range	Min. unit	Default	Effective time	Property
					model	again	
P01.12	0Dh	Q-axis Inductance Lq	0.00 to 200.00 mH	0.01 mH	Depend on model	Power-on again	At stop
P01.13	0Eh	Back-EMF constant	1 to 600.0 V/krpm	0.1 V/krpm	Depend on model	Power-on again	At stop
P01.14	0Fh	Torque coefficient Kt	0.001 to 65.000 N·M/A	0.01 N·M/A	Depend on model	Power-on again	At stop
P01.15	10h	Electrical constant Te	0.01 to 650.00 ms	0.01 ms	Depend on model	Power-on again	At stop
P01.16	11h	Mechanical constant Tm	0.01 to 650.00 ms	0.01 ms	Depend on model	Power-on again	At stop
P01.17	12h	Brake function	0: Without brake 1: With brake	1	Depend on model	Immediate	At stop
P01.18	13h	Encoder selection	1: Tamagawa serial intelligent 23-bit absolute encoder 5: Reagle Sensing 17-bit absolute encoder Others: Reserved	1	1	Immediate	At stop
P01.19	14h	Number of encoder lines	1 to 4194304	1	2097152	Immediate	At stop
P01.20	15h	Initial angle tuning during encoder installation	0: No action 1: Action (static motor)	1	0	Immediate	At stop
P01.21	16h	Rotation direction	0: A ahead of B 1: B ahead of A	1	0	Immediate	At stop
P01.22	17h	Initial angle of encoder installation	0.0 to 359.9°	0.1°	180.0	Immediate	At stop
P01.23	18h	Absolute encoder mode	0: Absolute position multi-turn mode 1: Absolute position single-turn mode 2: Incremental position	1	0	Immediate	At stop

Function code	Sub -index	Name	Range	Min. unit	Default	Effective time	Property
			mode Others: Reserved				
Index 2002h (P02): Basic control parameters							
P02.00	01h	Control mode selection	0: Speed mode 1: Position mode 2: Torque mode 3: Speed mode ←→ position mode (switchover via function 9) 4: Torque mode ←→ position mode (switchover via function 9) 5: Speed mode ←→ torque mode (switchover via function 9) 6: Speed mode ←→ torque mode ←→ position mode(torque switchover via function 9; position switchover via function 10; no switchover when function 9 and 10 are both valid or invalid, and the system stays in speed mode under the circumstances) 8: EtherCAT mode	1	8	Immediate	At stop
P02.01	02h	Internal servo enable	0 to 1	1	0	Immediate	During running
P02.02	03h	Absolute system mode selection	0: Absolute position linear mode 1: Absolute position rotation mode	1	0	Immediate	At stop

Function code	Sub -index	Name	Range	Min. unit	Default	Effective time	Property
P02.03	04h	Rotation direction selection	0: CCW direction as the forward direction (A ahead of B) 1: CW direction as the forward direction (reverse mode; A after B)	1	0	Immediate	During running
P02.04	05h	Reserved					
P02.05	06h	Reserved					
P02.06	07h	Reserved					
P02.07	08h	Z pulse output polarity selection	0: Positive output (Z pulse at a high level) 1: Negative output (Z pulse at a low level)	1	0	Immediate	During running
P02.08	09h	Stop mode	0: Decelerate to stop 1: Coast to stop	1	0	Immediate	During running
P02.09	0Ah	Emergency stop enable	0: No operation; remain in the present running state 1: Enable the emergency stop; stop based on the set stop mode (P02.08); report an alarm AI.038	1	0	Immediate	During running
P02.10	0Bh	Delay from the brake output being switched to ON to the command input	20 to 500 ms	1 ms	250	Immediate	During running
P02.11	0Ch	Delay from the brake output being switched to OFF to the motor's entry into the non-powered state	1 to 1000 ms	1 ms	150	Immediate	During running
P02.12	0Dh	Brake command output speed limit value	0 to 3000.0 rpm	1 rpm	10.0	Immediate	During running
P02.13	0Eh	Delay from the servo	1 to 30000 ms	1 ms	500	Immediate	During

Function code	Sub -index	Name	Range	Min. unit	Default	Effective time	Property
		enable being switched to OFF to the brake output being switched to OFF					running
P02.14	0Fh	Energy consumption resistor derating factor	0.5 to 1.0	0.1	0.8	Immediate	At display
P02.15	10h	Built-in energy consumption resistor power	-	1	Depend on model	-	At display
P02.16	11h	Built-in energy consumption resistor resistance	-	1	Depend on model	-	At display
P02.17	12h	Resistor heat dissipation coefficient	0: 0% 1: 25% 2: 50% 3: 75% 4: 100%	1	2	Immediate	During running
P02.18	13h	Energy consumption resistor selection	0: Use built-in energy consumption resistor 1: Use external energy consumption resistor 2: Energy consumption resistor not used	1	0	Immediate	At stop
P02.19	14h	External energy consumption resistor power	1 to 65535 W	1 W	Depend on model	Immediate	At stop
P02.20	15h	External energy consumption resistor resistance	1 to 65535 Ω	1 Ω	Depend on model	Immediate	At stop
P02.21	16h	Parameter protection setting	0: Modification available for all data; 1: Modification prohibited except for this function code and P06.01; 2: Modification prohibited	1	0	Immediate	During running

Function code	Sub -index	Name	Range	Min. unit	Default	Effective time	Property
			except for this function code;				
P02.22	17h	Parameter initialization	0: State of parameter modification 1: Clear fault memory information 2: Restore to default value 3. Clear motor number	1	0	Immediate	At stop
P02.23	18h	LED display parameter selection	0: Switch to display P11.00 1: Switch to display P11.01 2: Switch to display P11.02 3: Switch to display P11.03 4: Switch to display P11.04 5: Switch to display P11.05 …	1	0	Immediate	During running
P02.24	19h	Valid mode selection of DI enable terminal	0: Valid via level 1: Valid via transition edge	1	1	Immediate	During running
Index 2003h (P03): Digital input/output terminal parameters							
P03.00	01h	DI1 terminal function selection	0: No function 1: Servo enable 2: External reset (RESET) input 3: Gain switchover 4: Multi-speed DI switchover of running direction 5: Multi-segment running reference switchover 1 6: Multi-segment running reference switchover 2 7: Multi-segment running reference switchover 3 8: Multi-segment running	1	1	Immediate	At stop
P03.01	02h	DI2 terminal function selection		1	2	Immediate	At stop
P03.02	03h	DI3 terminal function selection		1	3	Immediate	At stop
P03.03	04h	DI4 terminal function selection		1	35	Immediate	At stop

Function code	Sub -index	Name	Range	Min. unit	Default	Effective time	Property
			reference switchover 4 9: Control mode switchover 1 10: Control mode switchover 2 11: Zero servo enable terminal 12: Pulse input prohibit 13: FWD rotation prohibit 14: REV rotation prohibit 15: Electronic gear ratio switchover 1 16: Electronic gear ratio switchover 2 17: FWD jog 18: REV jog 19: External torque limit during FWD rotation 20: External torque limit during REV rotation 21: Multi-segment position reference 1 23: Multi-segment position reference 2 23: Multi-segment position reference 3 24: Multi-segment position reference 4 25: Multi-segment position reference 5 26: Speed command direction switchover 27: Torque command direction switchover 28: Multi-segment /				

Function code	Sub -index	Name	Range	Min. unit	Default	Effective time	Property
			Signal-point position command enable 29: Position deviation counter clear 30: Interrupt positioning state release 31: Interrupt positioning prohibit 32: Home switch 33: Homing enable 34: Emergency stop 35: Positive limit switch 36: Negative limit switch 37: Main/Auxiliary speed reference switchover 38: External fault input 39 to 48: Reserved 49: Touch probe 1 50: Touch probe 2				
P03.04 to P03.11	05h to 0Ch	Reserved					
P03.12	0Dh	DI terminal filter time	1 to 500 ms	1 ms	10	Immediate	During running
P03.13	0Eh	State of enabled input terminal	Binary setting 0: Normal logic, positive logic active 1: logical negation, negative logic active Bit0 to Bit3: DI1 to DI4	1	000	Immediate	During running
P03.14	0Fh	Virtual input terminal setting	Binary setting 0: Disabled 1: Enabled Bit0 to Bit3: DI1 to DI4	1	000	Immediate	During running

Function code	Sub -index	Name	Range	Min. unit	Default	Effective time	Property
P03.15	10h	DO1 function selection	0: Servo drive ready (RDY)	1	0	Immediate	At stop
P03.16	11h	DO2 function selection	1: Servo drive running signal (RUN) 2: Consistent speed 3: Speed arrival signal 4: Zero-speed operation 5: Drive fault 6: Drive alarm 7: Host device switch signal 8: Torque limit 9: Speed limit 10: Zero servo completed 11: Positioning completed 12: Position proximity 13: Alarm of position exceeding tolerance 14: Homing 15: Homing completed 16: Electrical homing 17: Electrical homing completed 18: Brake output (brake output signal) 19: Torque arrival signal 20: FWD/REV indication terminal 21: Reserved 22: Position arrival 1 23: Position arrival 2 24: Position arrival 3 25: Position arrival 4 26: Position arrival 5 27: Interrupt positioning	1	5	Immediate	At stop

Function code	Sub -index	Name	Range	Min. unit	Default	Effective time	Property
			completed 28: ECAT DO forced output 29: Reserved 30: Reserved				
P03.17 to P03.22	12h to 17h	Reserved					
P03.23	18h	State setting of enabled output terminal	Binary setting 0: Positive logic active 1: Negative logic active Bit0 to Bit1: DO1 to DO2	1	00	Immediate	During running
Index 2005h (P05): Position control parameters							
P05.00	01h	Position reference mode	0: Pulse reference 1: Single-point position reference 2: Multi-segment position reference	1	0	Immediate	At stop
P05.01 to P05.04	02h to 05h	Reserved					
P05.05	06h	Number of command pulses per motor revolution	0 to 8388608 P/r	1 P/r	8388608	Immediate	At stop
P05.06	07h	Position Command first-order low-pass filter time	0.0 to 2000.0 ms	0.1 ms	0	Immediate	During running
P05.07	08h	Position command movement average filter time	0.0 to 12.8 ms	0.1 ms	0	Immediate	During running
P05.08	09h	Electronic gear numerator	1 to 1073741824	1	8388608	Immediate	At stop
P05.09	0Ah	Electronic gear denominator 1	1 to 1073741824	1	10000	Immediate	At stop
P05.10	0Bh	Electronic gear	1 to 1073741824	1	10000	Immediate	At stop

Function code	Sub -index	Name	Range	Min. unit	Default	Effective time	Property
		denominator 2					
P05.11	0Ch	Electronic gear denominator 3	1 to 1073741824	1	10000	Immediate	At stop
P05.12	0Dh	Electronic gear denominator 4	1 to 1073741824	1	10000	Immediate	At stop
P05.13	0Eh	Electronic gear ratio switchover conditions	0: Switchover after 3 ms of holding time when the position command is 0; 1: Real-time switchover	1	0	Immediate	At stop
P05.14	0Fh	Position deviation clear method selection	0: Clear position deviation when servo enable is OFF or when servo is stopped; 1: Clear position deviation when servo enable is OFF or a fault/alarm occurs; 2: Clear position deviation when servo enable is OFF or the external position deviation clear DI is valid.	1	00	Immediate	At stop
P05.15	10h	Position deviation clear DI signal type	0: Pulse mode 1: Level mode	0	0	Immediate	At stop
P05.16	11h	Speed feedforward control selection	0: No speed feedforward; 1: Internal speed feedforward (take the speed information corresponding to the position command in the encoder unit as the source of the speed feedforward signal); 2 to 3: Reserved.	1	1	Immediate	At stop
P05.17	12h	Position controller output limit	0 to Maximum speed	0.1 rpm	6000.0	Immediate	During running

Function code	Sub -index	Name	Range	Min. unit	Default	Effective time	Property
P05.18	13h	Output conditions for positioning completion	0: The absolute value of position deviation is smaller than the amplitude of positioning completion; 1: The absolute value of position deviation is smaller than the amplitude of positioning completion, and the command after the position command filtering is zero; 2: The absolute value of position deviation is smaller than the amplitude of positioning completion, and the position command is zero.	1	0	Immediate	At stop
P05.19	14h	Positioning completion range	0 to 10000	1 command unit	100	Immediate	During running
P05.20	15h	Position proximity signal width	1 to 32767	1 command unit	100	Immediate	During running
P05.21	16h	Position error detection range	0 to 1073741824	1 encoder unit	23860929	Immediate	During running
P05.22	17h	Alarm of position exceeding tolerance	0: Enable 1: Disable	1	0	Immediate	During running
P05.23	18h	Servo shutdown mode	0: Switch to speed control and stop according to servo shutdown time; 1: Switch to speed control and decelerate to stop	1	1	Immediate	During running

Function code	Sub -index	Name	Range	Min. unit	Default	Effective time	Property
P05.24	19h	Servo shutdown time	0 to 3000 ms When PL (CCWL) or NL (CWL) occurs, decelerate to stop according to the shutdown time	1	100	Immediate	During running
P05.25	1Ah	Mechanical gear ratio numerator in the absolute position rotation mode	1 to 65535	1	1	Immediate	At stop
P05.26	1Bh	Mechanical gear ratio denominator in the absolute position rotation mode	1 to 65535	1	1	Immediate	At stop
P05.27	1Ch	Position offset in the absolute position linear mode (lower 32 bits)	0 to 4294967295	1 encoder unit	0	Immediate	At stop
P05.28	1Dh	Position offset in the absolute position linear mode (higher 32 bits)	0 to 4294967295	1 encoder unit	0	Immediate	At stop
P05.29	1Eh	Number of pulses per load revolution in the absolute position rotation mode (lower 32 bits)	0 to 4294967295	1 encoder unit	0	Immediate	At stop
P05.30	1Fh	Number of pulses per load revolution in the absolute position rotation mode (higher 32 bits)	0 to 127	1 encoder unit	0	Immediate	At stop
P05.31	20h	Soft limit function setting	0: Disable soft limit 1: Enable software limit immediately upon power-on 2: Enable soft limit after homing	1	0	Immediate	At stop

Function code	Sub -index	Name	Range	Min. unit	Default	Effective time	Property
P05.32	21h	Software limit maximum point	-2147483647 to 2147483647	1 command unit	2147483647	Immediate	At stop
P05.33	22h	Software limit minimum point	-2147483647 to 2147483647	1 command unit	-2147483648	Immediate	At stop
Index 2006h (P06): Speed control parameters							
P06.00	01h	Main reference source selection	0: Digital reference (P06.01) 1 to 4: Reserved	1	0	Immediate	At stop
P06.01	02h	Main reference speed setting	-6000.0 to 6000.0 rpm	0.1 rpm	0.0	Immediate	During running
P06.02	03h	Auxiliary speed source selection	0: No auxiliary reference 1: Digital reference 2 to 4: Reserved	1	0	Immediate	At stop
P06.03	04h	Auxiliary reference speed setting	-6000.0 to 6000.0 rpm	0.1 rpm	0	Immediate	During running
P06.04	05h	Main/Auxiliary reference calculation	0: Main + Auxiliary 1: Main - Auxiliary 2: Main/Auxiliary reference switchover via terminal 3: MAX (main/auxiliary reference) 4: MIN (main/auxiliary reference)	1	0	Immediate	During running
P06.05	06h	Jog speed	0.0 to 6000.0 rpm	0.1 rpm	100.0	Immediate	At stop
P06.06	07h	Jog operation					
P06.07	08h	Speed command acceleration time 1	0 to 65535 ms	1 ms	1000	Immediate	During running
P06.08	09h	Speed command deceleration time 1	0 to 65535 ms	1 ms	1000	Immediate	During running
P06.09	0Ah	Maximum speed	0.0 to 6000.0 rpm	0.1 rpm	6000.0	Immediate	During

Function code	Sub -index	Name	Range	Min. unit	Default	Effective time	Property
		threshold					running
P06.10	0Bh	Forward speed threshold	0.0 to 6000.0 rpm	0.1 rpm	6000.0	Immediate	During running
P06.11	0Ch	Reverse speed threshold	0.0 to 6000.0 rpm	0.1 rpm	6000.0	Immediate	During running
P06.12	0Dh	Positive torque limit channel	0: Internal positive torque limit value 1: Bus positive torque limit value 2: MIN (internal positive torque limit, bus positive torque limit) 3: External positive torque limit value	1	1	Immediate	At stop
P06.13	0Eh	Negative torque limit channel	0: Internal negative torque limit value 1: Bus negative torque limit value 2: MIN (internal negative torque limit, bus negative torque limit) 3: External negative torque limit value	1	1	Immediate	At stop
P06.14	0Fh	Internal positive torque limit value	0.0% to +400.0%	0.1%	Depend on model	Immediate	During running
P06.15	10h	Internal negative torque limit value	0.0% to +400.0%	0.1%	Depend on model	Immediate	During running
P06.16	11h	External positive torque limit value	0.0% to +400.0%	0.1%	100.0	Immediate	During running
P06.17	12h	External negative torque limit value	0.0% to +400.0%	0.1%	100.0	Immediate	During running
P06.18	13h	Torque feedforward Control selection	0: No torque feedforward 1: Internal torque	1	1	Immediate	At stop

Function code	Sub -index	Name	Range	Min. unit	Default	Effective time	Property
			feedforward (take the speed command as the torque feedforward signal source. In the position control mode, the speed command comes from the output of the position controller)				
P06.19	14h	Zero clamp function	0: Disabled 1: Always enabled 2: Enabled under conditions (enabled via terminal)	1	0	Immediate	At stop
P06.20	15h	Zero clamp gain	0 to 6.000	0.001	1.000	Immediate	During running
P06.21	16h	Zero clamp starting speed	0.0 to 1000.0 rpm	0.1 rpm	2.0	Immediate	During running
P06.22	17h	Speed arrival detection width	0.0 to 6000.0 rpm	0.1 rpm	1000.0	Immediate	During running
P06.23	18h	Zero speed threshold	0.0 to 200.0 rpm	0.1%	20.0	Immediate	During running
P06.24	19h	Speed consistency threshold	0.0 to 100.0 rpm	0.1 rpm	10.0	Immediate	During running
Index 2007h (P07): Torque control parameters							
P07.00	01h	Torque reference selection	0: Digital reference 1 to 3: Reserved	1	0	Immediate	At stop
P07.01	02h	Positive direction selection of torque	0: FWD drive as positive 1: REV drive as positive	1	0	Immediate	At stop
P07.02	03h	Speed/Torque switchover mode selection	0: Direct switchover 1: Switch over the torque switchover point	1	0	Immediate	At stop
P07.03	04h	Torque digital reference	-400.0% to +400.0%	0.1%	0.0	Immediate	During running

Function code	Sub -index	Name	Range	Min. unit	Default	Effective time	Property
P07.04	05h	Torque reference acceleration / deceleration time	0 to 65535 ms	1 ms	0	Immediate	At stop
P07.05	06h	Torque command filter time constant	0 to 30.0 ms	0.1 ms	1.0	Immediate	At stop
P07.06	07h	Second torque command filter time constant	0 to 30.0 ms	0.1 ms	1.0	Immediate	At stop
P07.07	08h	Speed/Torque switchover point	0.0% to 400.0% of initial torque	0.1%	100.0	Immediate	At stop
P07.08	09h	Speed/Torque switchover delay	0 to 1000 ms	1 ms	0	Immediate	At stop
P07.09	0Ah	FWD speed limit channel	0: FWD speed limit value 1: Bus speed limit value 2: MIN (FWD speed limit, bus speed limit)	1	1	Immediate	At stop
P07.10	0Bh	FWD speed limit value	0.0% to 100.0%	0.1%	100.0	Immediate	During running
P07.11	0Ch	REV speed limit channel	0: REV speed limit value 1: Bus speed limit value 2: MIN (REV speed limit, bus speed limit)	1	1	Immediate	At stop
P07.12	0Dh	REV speed limit value	0.0% to 100.0%	0.1%	100.0	Immediate	During running
P07.13	0Eh	Torque arrival reference value	0.0 to 400.0%	0.1%	0.0	Immediate	During running
P07.14	0Fh	Torque arrival effective value	0.0 to 400.0%	0.1%	20.0	Immediate	During running
P07.15	10h	Torque arrival non-effective value	0.0 to 400.0%	0.1%	10.0	Immediate	During running
Index 2008h (P08): Gain parameters							
P08.00	01h	Speed loop proportional	0.1 to 5000.0 Hz	0.1 Hz	20.0	Immediate	During

Function code	Sub -index	Name	Range	Min. unit	Default	Effective time	Property
		gain 1					running
P08.01	02h	Speed loop integral time 1	0.00 to 100.00 ms	0.01 ms	5.00	Immediate	During running
P08.02	03h	Position loop gain 1	1 to 8000 rad/s	1 rad/s	100	Immediate	During running
P08.03	04h	Speed regulator output filter time 1	0 to 32.0 ms	0.1 ms	0.8	Immediate	During running
P08.04	05h	Speed loop proportional gain 2	0.1 to 5000.0 Hz	0.1 Hz	20.0	Immediate	During running
P08.05	06h	Speed loop integral time 2	0.00 to 100.00 ms	0.01 ms	1.00	Immediate	During running
P08.06	07h	Position loop gain 2	1 to 8000 rad/s	1 rad/s	100	Immediate	During running
P08.07	08h	Speed regulator output filter time 2	0 to 32.0 ms	0.1 ms	0.8	Immediate	During running
P08.08	09h	Gain selection mode	0: Gain 1 is fixed; P/PI switchover via external DI 1:Gain switchover based on condition selection of P08.09	1	0	Immediate	During running
P08.09	0Ah	Gain switchover condition selection	0: No switchover of gain 1 1: Switchover via external DI terminal 2: Torque command 3: Speed command 4: Feedback speed 5: Speed command change rate 6: Position deviation 7: Speed command high/low speed threshold 8: Position command	1	0	Immediate	During running

Function code	Sub -index	Name	Range	Min. unit	Default	Effective time	Property
			received 9: Positioning not completed 10: Position command received + actual speed				
P08.10	0Bh	Gain switchover delay	0 to 1000 ms	1 ms	5	Immediate	During running
P08.11	0Ch	Gain switchover level	0 to 20000	Switch on condition	50	Immediate	During running
P08.12	0Dh	Gain switchover hysteresis	0 to 20000	Switch on condition	30	Immediate	During running
P08.13	0Eh	Position gain switchover time	0 to 1000 ms	1 ms	5	Immediate	During running
P08.14	0Fh	Speed feedforward filter time	0.00 to 64.00 ms	0.01 ms	0.5	Immediate	During running
P08.15	10h	Speed feedforward gain	0.0 to 100.0%	0.01%	0.0	Immediate	During running
P08.16	11h	Torque feedforward filter time	0.00 to 64.00 ms	0.01	0.5	Immediate	During running
P08.17	12h	Torque feedforward gain	0.0 to 200.0%	0.1%	0.0	Immediate	During running
P08.18	13h	Encoder filter time	0.0 to 40.0 ms	0.1 ms	1.0	Immediate	During running
P08.19	14h	PDFF (pseudo-differential feedforward) control coefficient (reserved in non-torque control mode)	0.0 to 100.0%	0.1%	100.0	Immediate	During running
Index 2009h (P09): Adjustment parameters							
P09.00	01h	Offline inertia identification function		0.01	0.00	Immediate	At stop
P09.01	02h	Inertia identification	200 to 2000 rpm	1 rpm	800	Immediate	At stop

Function code	Sub -index	Name	Range	Min. unit	Default	Effective time	Property
		maximum speed					
P09.02	03h	Inertia identification acceleration time	10 to 1000 ms	1 ms	100	Immediate	At stop
P09.03	04h	Motor revolutions for inertia identification	0.00 to 2.00 r	0.01 r	0.00	Immediate	At stop
P09.04	05h	Waiting time after single inertia identification	50 to 10000	1 ms	800	Immediate	At stop
P09.05	06h	Online inertia identification mode	0: Disabled 1: Enabled; change slowly 2: Enabled; change at normal speed 3: Enabled; change quickly	1	0	Immediate	At stop
P09.06	07h	Gain adjustment mode	0: Parameter auto-tuning is invalid; manual tuning is applied; 1: Parameter auto-tuning mode; automatically adjust the gain parameters using the rigidity table; 2: Positioning mode; automatically adjust the gain parameters using the rigidity table.	1	0	Immediate	At stop
P09.07	08h	Rigidity level	0 to 41	1	14	Immediate	At stop
P09.08	09h	Adaptive notch filter mode	0: The parameters of the 3rd and 4th notch filters are not updated; 1: The adaptive results of the 3rd notch filter parameters are updated; 2: The parameter adaptive results of the 3rd and 4th notch filters are updated;	1	0	Immediate	At stop

Function code	Sub -index	Name	Range	Min. unit	Default	Effective time	Property
			3: Automatically detect the mechanical resonance frequency, but do not set the relevant parameters of the notch filter; 4: Restore the parameters of the 4 notch filters to default values.				
P09.09	0Ah	Setting of sensitivity for automatic vibration suppression	1 to 100	1	1	Immediate	At stop
P09.10	0Bh	Notch filter 1 frequency	0 to 4000 Hz	1 Hz	0	Immediate	At stop
P09.11	0Ch	Notch filter 1 width	10 to 1000 Hz	1 Hz	100	Immediate	At stop
P09.12	0Dh	Notch filter 2 frequency	0 to 4000 Hz	1 Hz	0	Immediate	At stop
P09.13	0Eh	Notch filter 2 width	10 to 1000 Hz	1 Hz	100	Immediate	At stop
P09.14	0Fh	Notch filter 3 frequency	0 to 4000 Hz	1 Hz	0	Immediate	At stop
P09.15	10h	Notch filter 3 width	10 to 1000 Hz	1 Hz	100	Immediate	At stop
P09.16	11h	Notch filter 4 frequency	0 to 4000 Hz	1 Hz	0	Immediate	At stop
P09.17	12h	Notch filter 4 width	10 to 1000 Hz	1 Hz	100	Immediate	At stop
P09.18	13h	Speed loop low-pass filter time-constant	0 to 65536 μs	1 μs	0	Immediate	At stop
P09.19	14h	Speed reference notch filter frequency	0 to 1000 Hz	1 Hz	0	Immediate	At stop
P09.20	15h	Speed reference notch filter width	10 to 500 Hz	1 Hz	100	Immediate	At stop
P09.21	16h	Reserved					
P09.22	17h	Resonance frequency identification result	0 to 4000 Hz	1 Hz	-	Immediate	At stop
P09.23	18h	Disturbance torque compensation gain	0.0% to 100.0%	0.1%	0	Immediate	At stop
P09.24	19h	Disturbance observer	0.00 to 25.00 ms	0.01 ms	0	Immediate	At stop

Function code	Sub -index	Name	Range	Min. unit	Default	Effective time	Property
		filter time					
P09.25	1Ah	Low-frequency resonance suppression mode selection	0: Manually set vibration suppression parameters 1: Automatically set vibration suppression parameters	1	0	Immediate	During running
P09.26	1Bh	Low-frequency resonance frequency	0.0 to 100.0 Hz	0.1 Hz	0.0	Immediate	During running
P09.27	1Ch	Low-frequency resonance frequency filter setting	0 to 20	1	0	Immediate	During running
P09.28	1Dh	Low-frequency resonance position deviation judgment threshold	0 to 100 P	1 P	10	Immediate	At stop
P09.29	1Eh	Torque command offset (vertical axis mode)	-300.00% to 300.00%	0.01%	0.00	Immediate	During running
P09.30	1Fh	Gravity compensation	-100.0% to 100.0%	0.1%	0.0	Immediate	At stop
P09.31	20h	Positive friction compensation	0.0% to 100.0%	0.1%	0.0	Immediate	At stop
P09.32	21h	Negative friction compensation	0.0% to 100.0%	0.1%	0.0	Immediate	At stop
P09.33	22h	Friction compensation speed threshold	0.1 to 30.0 rpm	0.1 rpm	0.0	Immediate	At stop
P09.34	23h	Friction compensation speed selection	0: Speed command 1: Speed feedback	1	0	Immediate	At stop
P09.35 to P09.37		Reserved					
P09.38	27h	Load's moment of inertia ratio	0.00 to 120.00	0.01	1.00	Immediate	At stop
Index 200Ah (P10): Fault and protection parameters							
P10.00	01h	Action selection upon	0: Activate protection upon	1	0	Immediate	During

Function code	Sub -index	Name	Range	Min. unit	Default	Effective time	Property
		phase loss	input and output phase loss 1: No protection upon input phase loss 2: No protection upon output phase loss 3: No protection upon input/output phase loss				running
P10.01	02h	Action selection upon communication timeout	0: Activate protection and coast to stop 1: Report an alarm and keep running	1	0	Immediate	During running
P10.02	03h	Action selection upon temperature sampling disconnection	0: Activate protection and coast to stop 1: Report an alarm and keep running	1	0	Immediate	During running
P10.03	04h	Reserved					
P10.04	05h	Over-travel stop mode selection	0: Activate protection and coast to stop 1: Report an alarm, decelerate to zero, and hold the state of position lock	1	0	Immediate	During running
P10.05	06h	Output disconnection action selection	0: No action 1: Activate protection	1	0	Immediate	During running
P10.06	07h	Motor overload protection action selection	0: Activate protection and coast to stop 1: Report an alarm and keep running	1	1	Immediate	At stop
P10.07	08h	Motor overload protection gain	20.0% to 300.0%	0.1%	100.0	Immediate	During running
P10.08	09h	Drive fan action selection	0: Control via temperature (activate the fan when module temperature >	1	0	Immediate	At stop

Function code	Sub -index	Name	Range	Min. unit	Default	Effective time	Property
			35°; stop the fan when module temperature < 30°) 1: Keep the fan working 2: Control based on the drive state (activate the fan when the drive is enabled; when the drive is stopped, activate the fan when module temperature > 35°, and stop the fan when module temperature < 30°) 3: No action				
P10.09	0Ah	Locked rotor over-temperature protection enable	0: Shield the detection for locked rotor over-temperature protection 1: Enable the detection for locked rotor over-temperature protection	1	1	Immediate	At stop
P10.10	0Bh	Locked rotor over-temperature protection time window	10 to 800 ms	1 ms	200	Immediate	At stop
P10.11	0Ch	Action selection for encoder multi-turn overflow fault	0: Not shield 1: Shield	1	1	Immediate	At stop
P10.12	0Dh	Overspeed fault threshold	0.0 to 10000.0 rpm	0.1 rpm	6000.0	Immediate	At stop
P10.13	0Eh	Maximum position pulse frequency	100 to 8000 kHz	1 kHz	8000	Immediate	At stop
P10.14	0Fh	Action selection for absolute encoder battery	0: Set the battery undervoltage as a fault; each time the drive is	1	0	Immediate	At stop

Function code	Sub -index	Name	Range	Min. unit	Default	Effective time	Property
		undervoltage fault	powered on or reset, detect the battery voltage and report an alarm if an undervoltage occurs; detection is disabled during other periods of operation; 1: Set the battery undervoltage as an alarm; report an alarm when the battery voltage is lower than 3 V; battery voltage detection is always enabled.				
P10.15	10h	Reserved					
P10.16	11h	Reserved					
P10.17	12h	Reserved					
P10.18	13h	Type of the last fault	0: No record of abnormalities 1: Overcurrent 2: Main circuit overvoltage 3: Reserved 4: Motor locked rotor 5: Reserved 6: Phase loss on the input side 7: Phase loss on the output side 8: Heatsink overheat 9: Braking resistor overload 10: Power module protection 11: Servo drive overload 12: Motor overload	1	0	-	At display

Function code	Sub -index	Name	Range	Min. unit	Default	Effective time	Property
			13: EEPROM read/write error 14: Reserved 15: Reserved 16: Abnormal current detection circuit 17: Reserved 18: Poor auto-tuning 19: Encoder fault 20: Undervoltage during main circuit operation 21: Reserved 22: Parameter setting error 23: Reserved 24: Reserved 25: Inverter module sampling disconnection protection 26: Reserved 27: Overspeed (the actual speed of the servo motor exceeds the overspeed fault threshold) 28 to 30: Reserved 31: Encoder multi-turn count overflow 32: Excessively large position deviation 33: Abnormal pulse input 34: Reserved 35: Reserved 36: Connection interruption in bus communication 37: Homing timeout				

Function code	Sub -index	Name	Range	Min. unit	Default	Effective time	Property
			38: Reserved 39: Forward over-travel alarm 40: Reverse over-travel alarm 41: Reserved 42: Reserved 43: External fault 44: Reserved 45: Reserved 46: Short circuit to ground at power-on 47: Reserved 48: Internal logic error 1 49: Internal logic error 2 50: EtherCAT initialization error 51: EtherCAT parameter mapping error 52: EtherCAT distributed clock / interpolation cycle incorrect 53: Reserved 54: Synchronization signal loss 55 to 60: Reserved 61: Abnormal electronic gear ratio 62: Interrupt positioning alarm 63 to 65: Reserved 66: Homing logic error 70 to 71: Reserved 72: Software does not				

Function code	Sub -index	Name	Range	Min. unit	Default	Effective time	Property
			match control board 73: Bootstrapping timeout 74: STO fault 75: Absolute encoder battery undervoltage alarm 76: Absolute encoder battery disconnection fault 77: Actual encoder type inconsistent with the result read by P01.00 78: No parameter stored in EEPROM of the absolute encoder 79: Absolute encoder EEPROM parameter writing error 80: Reserved 81: Encoder homing error 84: Absolute encoder EEPROM parameter reading error 85: Drive output disconnection				
P10.19	14h	Type of the second last fault	Same as P10.18	1	0	-	At display
P10.20	15h	Type of the first fault	Same as P10.18	1	0	-	At display
P10.21	16h	The bus voltage at the last fault	0 to 999 V	1 V	0	-	At display
P10.22	17h	V-phase current at the last fault	-1000.0 to 1000.0 A	0.1 A	0.0	-	At display
P10.23	18h	W-phase current at the	-1000.0 to 1000.0 A	0.1 A	0.0	-	At

Function code	Sub -index	Name	Range	Min. unit	Default	Effective time	Property
		last fault					display
P10.24	19h	D-axis current reference value at the last fault	-1000.0 to 1000.0 A	0.1 A	0.0	-	At display
P10.25	1Ah	Q-axis current reference value at the last fault	-1000.0 to 1000.0 A	0.1 A	0.0	-	At display
P10.26	1Bh	D-axis current feedback value at the last fault	-1000.0 to 1000.0 A	0.1 A	0.0	-	At display
P10.27	1Ch	Q-axis current feedback value at the last fault	-1000.0 to 1000.0 A	0.1 A	0.0	-	At display
P10.28	1Dh	Speed at the last fault	-6000.0 to 6000.0 rpm	0.1 rpm	0.0	-	At display
P10.29	1Eh	Encoder position feedback at the last fault (PUU unit)	-2147483648 to 2147483647	1	0	-	At display
P10.30	1Fh	DI state at the last fault	Bit0 to Bit3: DI1 to DI4	1	0	-	At display
P10.31	20h	DO state at the last fault	Bit0 to Bit1: DO1 to DO2	1	0	-	At display
P10.32	21h	Drive state at the last fault	0 to FFFFH (same as P11.11)	1	0	-	At display
P10.33	22h	Temperature at the last fault	-40.0 to 150.0℃	0.1℃	0.0	-	At display
P10.34	23h	Bus voltage at the second fault	0 to 999 V	1 V	0	-	At display
P10.35	24h	V-phase current at the second fault	-1000.0 to 1000.0 A	0.1 A	0.0	-	At display
P10.36	25h	W-phase current at the second fault	-1000.0 to 1000.0 A	0.1 A	0.0	-	At display
P10.37	26h	D-axis current reference value at the second fault	-1000.0 to 1000.0 A	0.1 A	0.0	-	At display
P10.38	27h	Q-axis current reference	-1000.0 to 1000.0 A	0.1 A	0.0	-	At

Function code	Sub -index	Name	Range	Min. unit	Default	Effective time	Property
		value at the second fault					display
P10.39	28h	D-axis current feedback value at the second fault	-1000.0 to 1000.0 A	0.1 A	0.0	-	At display
P10.40	29h	Q-axis current feedback value at the second fault	-1000.0 to 1000.0 A	0.1 A	0.0	-	At display
P10.41	2Ah	Speed at the second fault	-6000.0 to 6000.0 rpm	0.1 rpm	0.0	-	At display
P10.42	2Bh	Encoder position feedback at the second fault (PUU unit)	-2147483648 to 2147483647	1	0	-	At display
P10.43	2Ch	DI state at the second fault	Bit0 to Bit3: DI1 to DI4	1	0	-	At display
P10.44	2Dh	DO state at the second fault	Bit0 to Bit1: DO1 to DO2	1	0	-	At display
P10.45	2Eh	Drive state at the second fault 态	0 to FFFFH (same as P11.11)	1	0	-	At display
P10.46	2Fh	Temperature at the second fault	-40.0 to 150.0℃	0.1℃	0.0	-	At display
P10.47	30h	Bus voltage at the first fault	0 to 999 V	1 V	0	-	At display
P10.48	31h	V-phase current at the first fault	-1000.0 to 1000.0 A	0.1 A	0.0	-	At display
P10.49	32h	W-phase current at the first fault	-1000.0 to 1000.0 A	0.1 A	0.0	-	At display
P10.50	33h	D-axis current reference value at the first fault	-1000.0 to 1000.0 A	0.1 A	0.0	-	At display
P10.51	34h	Q-axis current reference value at the first fault	-1000.0 to 1000.0 A	0.1 A	0.0	-	At display
P10.52	35h	D-axis current feedback value at the first fault	-1000.0 to 1000.0 A	0.1 A	0.0	-	At display
P10.53	36h	Q-axis current feedback	-1000.0 to 1000.0 A	0.1 A	0.0	-	At

Function code	Sub -index	Name	Range	Min. unit	Default	Effective time	Property
		value at the first fault					display
P10.54	37h	Speed at the first fault	-6000.0 to 6000.0 rpm	0.1 rpm	0.0	-	At display
P10.55	38h	Encoder position feedback at the first fault (PUU unit)	-2147483648 to 2147483647	1	0	-	At display
P10.56	39h	DI state at the first fault	Bit0 to Bit3: DI1 to DI4	1	0	-	At display
P10.57	3Ah	DO state at the first fault	Bit0 to Bit1: DO1 to DO2	1	0	-	At display
P10.58	3Bh	Drive state at the first fault	0 to FFFFH (same as P11.11)	1	0	-	At display
P10.59	3Ch	Temperature at the first fault	-40.0 to 150.0℃	0.1℃	0.0	-	At display
Index 200Bh (P11): Display parameters							
P11.00	01h	Speed command	-6000.0 to 6000.0 rpm	0.1 rpm		-	At display
P11.01	02h	Actual motor speed	-6000.0 to 6000.0 rpm	0.1 rpm		-	At display
P11.02	03h	Output voltage	0 to 480 V	1 V		-	At display
P11.03	04h	Output current	0.0 to 4Ie A	0.1 A		-	At display
P11.04	05h	Q-axis current	-400.0 to +400.0% Ie	0.1%		-	At display
P11.05	06h	D-axis current	-400.0 to +400.0% Ie	0.1%		-	At display
P11.06	07h	Output torque	-400.0 to +400.0%	0.1%		-	At display
P11.07	08h	Reserved					
P11.08	09h	Average load rate	0.0 to 400.0% Te	0.1%		-	At

Function code	Sub -index	Name	Range	Min. unit	Default	Effective time	Property
							display
P11.09	0Ah	Main circuit bus voltage	0 to 800 V	1 V		-	At display
P11.10	0Bh	Control circuit bus voltage	0 to 800 V	1 V		-	At display
P11.11	0Ch	Servo drive operation status	0 to FFFFH bit0: RUN/STOP bit1: REV/FWD bit2: Running at zero speed bit3: Accelerating bit4: Decelerating bit5: Running at a constant speed bit6: Reserved bit7: Reserved bit8: In overcurrent limit bit9: In DC overvoltage limit bit10: In torque limit bit11: In speed limit bit12: Servo drive fault bit13: Speed control bit14: Torque control bit15: Position control	1		-	At display
P11.12	0Dh	DI terminal status	0 to 1FH 0: Disconnect 1: Connect The high-speed pulse reference will not be refreshed synchronously.	1		-	At display
P11.13	0Eh	DO terminal status	0 to 7H 0: Disconnect 1: Connect	1		-	At display

Function code	Sub -index	Name	Range	Min. unit	Default	Effective time	Property
			The high-speed pulse output will not be refreshed synchronously.				
P11.14 to P11.17	0Fh to 12h	Reserved					
P11.18	13h	Motor encoder counter value	0 to 4 times motor encoder lines -1	1		-	At display
P11.19	14h	Reserved					
P11.20	15h	Number of input pulses	-2147483648 to 2147483647			-	At display
P11.21	16h	Location of the position reference point Lower 32 bits (encoder unit)	-2147483648 to 2147483647	1		-	At display
P11.22	17h	Position reference	-2147483648 to 2147483647	1		-	At display
P11.23	18h	Position feedback	-2147483648 to 2147483647	1		-	At display
P11.24	19h	Position deviation pulse	-2147483648 to 2147483647	1		-	At display
P11.25	1Ah	Location of the position reference point Lower 32 bits (PUU unit)	-2147483648 to 2147483647	1		-	At display
P11.26	1Bh	Position reference (PUU unit)	-2147483648 to 2147483647	1		-	At display
P11.27	1Ch	Position reference (PUU unit)	-2147483648 to 2147483647	1		-	At display
P11.28	1Dh	Position deviation pulse (PUU unit)	-2147483648 to 2147483647	1		-	At display
P11.29	1Eh	Accumulated time of power-on	0 to maximum 65535 hours	1 hour		-	At display
P11.30	1Fh	Accumulated time of	0 to maximum 65535 hours	1 hour		-	At

Function code	Sub -index	Name	Range	Min. unit	Default	Effective time	Property
		operation					display
P11.31	20h	Module temperature	-40.0℃ to 150.0℃	0.1℃		-	At display
P11.32	21h	Encoder single-turn position	0 to 8388608	1		-	At display
P11.33	22h	Absolute encoder revolutions	0 to 65535 r	1 r		-	At display
P11.34	23h	Load's moment of inertia ratio	0.00 to 120.00	0.01		-	At display
P11.35	24h	Absolute position PUU value	Present absolute position of the machine (command unit) = Absolute mechanical position / Mechanical gear ratio -2147483648 to 2147483647	Command unit		-	At display
P11.36	25h	Absolute mechanical position (lower 32 bits)	Absolute mechanical position refers to the position at the motor end which is converted from the load position in absolute position linear mode or absolute position rotation mode (encoder unit). Absolute mechanical position = Absolute encoder position - Home offset	Encoder unit		-	At display
P11.37	26h	Absolute mechanical position (higher 32 bits)		Encoder unit		-	At display
P11.38	27h	Absolute position of the absolute encoder (lower 32 bits)	Absolute position of the absolute encoder refers to the feedback absolute position of the absolute encoder. Encoder unit	Encoder unit		-	At display
P11.39	28h	Absolute position of the absolute encoder (higher 32 bits)		Encoder unit		-	At display

Function code	Sub -index	Name	Range	Min. unit	Default	Effective time	Property
P11.40	29h	Single-turn position of the rotating load (lower 32 bits)	Single-turn position of the rotating load refers to the position at the motor end which is converted from the single-turn position of the rotating load in the absolute position rotation mode. Encoder unit	Encoder unit		-	At display
P11.41	2Ah	Single-turn position of the rotating load (higher 32 bits)		Encoder unit		-	At display
P11.42	2Bh	Single-turn position of the rotating load	It refers to the position during the single turn of the rotating load in the absolute position rotation mode. Command unit	Command unit		-	At display
P11.43	2Ch	Mechanical angle (number of pulses from home position)		Encoder unit		-	At display
P11.44	2Dh	Electrical angle	0.00 to 360.00°	0.01°		-	At display
P11.45	2Eh	Encoder multi-turn overflow value	-2147483648 to 2147483647	1		-	At display
P11.46	2Fh	High 32 bits of the position reference point location (PUU unit)	-2147483648 to 2147483647	1		-	At display
P11.47	30h	Reserved					
P11.48	31h	High 32 bits of the position reference point location (encoder unit)	-2147483648 to 2147483647	1		-	At display
P11.49 to P11.54	32h to 37h	Reserved					
Index 200Ch (P12): Servo positioning parameters							
P12.00	01h	Homing enable control	: Disable homing 1: Enable homing by the HomingStart signal input via DI 2: Enable electrical homing	1	0	Immediate	During running

Function code	Sub -index	Name	Range	Min. unit	Default	Effective time	Property
			by the HomingStart signal input via DI 3: Immediately activate homing upon power-on 4: Immediately activate homing 5: Activate electrical homing 6: Take the present position as the home position				
P12.01	02h	Homing method	0: Homing in forward direction, and home switch as both the deceleration point and the home position; 1: Homing in backward direction, and home switch as both the deceleration point and the home position; 2: Homing in forward direction, and the motor Z pulse as both the deceleration point and the home position; 3: Homing in backward direction, and the motor Z pulse as both the deceleration point and the home position; 4: Homing in forward direction, home switch as the deceleration point, and the motor Z pulse as the home position; 5: Homing in backward direction, home switch as	1	9	Immediate	At stop

Function code	Sub -index	Name	Range	Min. unit	Default	Effective time	Property
			the deceleration point, and the motor Z pulse as the home position; 6: Homing in forward direction, and the positive limit switch as both the deceleration point and the home position; 7: Homing in backward direction, and the negative limit switch as both the deceleration point and the home position; 8: Homing in forward direction, the positive limit switch as the deceleration point, and the motor Z pulse as the home position; 9: Homing in backward direction, the negative limit switch as the deceleration point, and the motor Z pulse as the home position; 100+X: CiA 402 homing method X				
P12.02	03h	Mode of the homing terminal command	0: Level mode 1: Pulse mode	1	0	Immediate	At stop
P12.03	04h	Reserved					
P12.04	05h	Positioning acceleration/ deceleration curve selection	0: T-shaped curve 1: S-shaped curve	1	0	Immediate	At stop
P12.05	06h	Speed of high-speed	0.0 to 1000.0 rpm	0.1 rpm	100.0	Immediate	At stop

Function code	Sub -index	Name	Range	Min. unit	Default	Effective time	Property
		home position search					
P12.06	07h	Speed of low-speed home position search	0.0 to 1000.0 rpm	0.1 rpm	10.0	Immediate	At stop
P12.07	08h	Home offset	-1073741824 to 1073741824	1	0	Immediate	At stop
P12.08	09h	Acceleration/ Deceleration time of home position search	0 to 65535 ms	1	200	Immediate	At stop
P12.09	0Ah	Time limit for home position search	0 to 65535 ms	1	60000	Immediate	At stop
P12.10	0Bh	Positioning mode selection	0: Relative position 1: Absolute position	1	0	Immediate	At stop
P12.11	0Ch	Home offset mode	0: When home is located, position feedback 6064h = 607Ch 1: When home is located, position feedback 6064h = present position + incremental displacement 607Ch 2: When the home position is located, continue to perform the home offset position segment; once completed, position actual value 6064h = 0 3: When the home position is located, continue to perform the home offset position segment; once completed, position actual value 6064h = 607Ch	1	0	Immediate	At stop
P12.12	0Dh	Positioning time sequence selection	0: No response to new positioning signal received during	1	0	Immediate	At stop

Function code	Sub -index	Name	Range	Min. unit	Default	Effective time	Property
			positioning 1: Positioning according to new positioning signal received during positioning				
P12.85	56h	Mechanical position offset	-2147483648 to 2147483647			-	At display
Index 2011h (P17): EtherCAT communication parameters							
P17.00	01h	EtherCAT software version number	0.00 to 99.99	0.01		-	At display
P17.01	02h	EtherCAT bus subprotocol	101: COE 102: SOE(Reserved) Others: Reserved	1	-	-	At display
P17.02	03h	EtherCAT bus state	1: INIT 2: PRE-OPERATIONAL 3: SAFE-OPERATIONAL 4: OPERATIONAL	1	-	-	At display
P17.03	04h	Bus working mode	Drive operating mode in COE bus control 1: Profile Position Mode 3: Profile Velocity Mode 4: Profile Torque Mode 6: Homing Mode 8: Cyclic Synchronous Position Mode 9: Cyclic Synchronous Velocity Mode 10: Cyclic Synchronous Torque Mode	1	-	-	At display
P17.04	05h	0x6040 control word	0 to 65535	1	-	-	At display
P17.05	06h	0x6060 control mode	0 to 65535	1	-	-	At

Function code	Sub -index	Name	Range	Min. unit	Default	Effective time	Property
							display
P17.06	07h	0x607A position reference	-2147483648 to 2147483647	1	-	-	At display
P17.07	08h	0x60FF speed reference	-2147483648 to 2147483647	1	-	-	At display
P17.08	09h	0x6071 torque reference	-32768 ~ 32767	1	-	-	At display
P17.09	0Ah	0x60E0 positive torque limit	0 to 65535	1	-	-	At display
P17.10	0Bh	0x60E1 negative torque limit	0 to 65535	1	-	-	At display
P17.11	0Ch	0x6072 maximum torque	0 to 65535	1	-	-	At display
P17.12	0Dh	0x607F speed limit	0 to 4294967295	1	-	-	At display
P17.13	0Eh	0x6080 speed limit	0 to 4294967295	1	-	-	At display
P17.14	0Fh	0x6098 homing mode	0 to 65535	1	-	-	At display
P17.15	10h	0x607E polarity	0 to 65535	1	-	-	At display
P17.16	11h	0x6081 profile velocity	0 to 4294967295	1	-	-	At display
P17.17	12h	0x6041control word	0 to 65535	1	-	-	At display
P17.18	13h	0x6061 control mode	0 to 65535	1	-	-	At display
P17.19	14h	0x6064 position feedback	-2147483648 to 2147483647	1	-	-	At display
P17.20	15h	0x606C speed feedback	-2147483648 to 2147483647	1	-	-	At display

Function code	Sub -index	Name	Range	Min. unit	Default	Effective time	Property
P17.21	16h	0x6077 torque feedback	-32768 to 32767	1	-	-	At display
P17.22	17h	Reserved		1	-	-	At display
P17.23	18h	Reserved		1	-	-	At display
P17.24	19h	Options for storing the function code parameters written via EtherCAT communication into EEPROM	0: Not store function code parameters 1: Store the data written via EtherCAT bus into the drive EEPROM	1	0	Immediate	At stop
P17.25	1Ah	EtherCAT communication disconnection detection time	0.0 to 1000.0 s (No disconnection detection when the parameter is set to 0)	0.1 s	0.1	再次通电	At stop
P17.26	1Bh	EtherCAT bus parameter initialization	0: No action 1: Restore to default value 2: Save parameter	1	0	Immediate	At stop
Index 2012h (P18): Advanced parameters							
P18.00	01h	User password					
P18.01	02h	Drive operation mode	1: VC 2: IF (P02.00 is invalid for this setting; rotating speed reference is P06.01) 3: VF (same as above)	1	1	Immediate	At stop
P18.02	03h	Current loop gain	0.01 to 500.00	0.01	10.00	Immediate	At stop
P18.03	04h	Current loop integral	0.5 to 100.0 ms	0.1 ms	10.0	Immediate	At stop
P18.04 to P18.15	05h to 10h	Advanced parameters					
P18.16 to	11h to	Reserved					

Function code	Sub -index	Name	Range	Min. unit	Default	Effective time	Property
P18.28	1Dh						
Index 2014h (P20): Bus application parameters							
P20.00	01h	Synchronization coefficient	0 to 65535	1	0	Power-on again	At stop
P20.01	02h	Synchronization coefficient upper limit	0 to 65535	1	-	-	At display
P20.02 to P20.07	03h to 08h	Reserved					
P20.08	09h	Slave station axis address	0 to 65535	1	0	Power-on again	At stop
P20.09	0Ah	Master station configuration address	0 to 65535	1	-	-	At display
P20.10	0Bh	Data interpolation cycle	0 to 65535	1	0	Power-on again	At stop
P20.11	0Ch	Zero-speed torque limit	0 to 65535	1	0	Immediate	At stop
P20.12	0Dh	Reserved					
P20.13	0Eh	Er.076 fault reset selection	0: Fault 76 reset unavailable via bus 1: Fault 76 reset available via bus	1	0	Immediate	At stop
P20.14	0Fh	Torque user-defined unit	0: 0.1% 1: 0.01 NM	1	0	Immediate	At stop
P20.15	10h	Speed user-defined unit	0: Command unit / s 1: rpm	1	0	Immediate	At stop
P20.16	11h	Command interpolation selection	0: Interpolation enable 1: Interpolation disable	1	0	Immediate	At stop
P20.17	12h	Bus torque command filter	0 to 65535	1	0	Immediate	At stop
P20.18	13h	Bus torque command full deceleration ramp	0 to 65535	1	0	Immediate	At stop

Function code	Sub -index	Name	Range	Min. unit	Default	Effective time	Property
P20.19	14h	Bus speed limit decrease time	0 to 65535	1	0	Immediate	At stop
P20.20	15h	Bus torque command acceleration/ deceleration ramp	0 to 65535	1	0	Immediate	At stop
P20.21 to P20.29	16h to 1Eh	Reserved					
Index 2017h (P23): Special function parameters							
P23.00 to P23.05	01h to 06h	Reserved					
P23.06	07h	Output torque filter time coefficient	0 to 100.0 ms	0.1 ms	0.0	Immediate	At stop
P23.07	08h	Power-off storage selection of encoder multi-turn overflow value	0: Store the value at power-off 1: Not store the value at power-off	1	0	Immediate	At stop
P23.08 to P23.10	09h to 0Bh	Reserved					
P23.11	0Ch	Accumulated number of absolute encoder position errors	0 to 65535	1	0	-	At display
P23.12	0Dh	Range of the number of pulses for homing completion	0: 100 pulses Others: Number set via parameters	1	0	Immediate	At stop
P23.13 to P23.39	0Eh to 28h	Reserved					

7.2 CiA 402 object dictionary list

Index	Data structure	Name	Data type	Accessibility	Mapping type	Unit
603Fh	VAR	Error Code	UINT16	RW	TPDO	-
6040h	VAR	Control word	UINT16	RW	RPDO	-
6041h	VAR	Status word	UINT16	RO	TPDO	-
605Ah	VAR	Quick stop option code	INT16	RW	RPDO	-
605Bh	VAR	Shutdown option code	INT16	RW	RPDO	-
605Ch	VAR	Disable operation option code	INT16	RW	RPDO	-
605DH	VAR	Halt option code	INT16	RW	RPDO	-
6060h	VAR	Modes of operation	INT8	RW	RPDO	-
6061h	VAR	Modes of operation display	INT8	RO	TPDO	-
6063h	VAR	Position actual value* (motor unit)	INT32	RO	TPDO	p
6064h	VAR	Position actual value (user-defined unit)	INT32	RO	TPDO	Command unit
6065h	VAR	Following error window	UINT32	RW	RPDO	Command unit
6066h	VAR	Following error window time	UINT16	RW	RPDO	ms
6067h	VAR	Position window	UINT32	RW	RPDO	Command unit
6068h	VAR	Position window time	UINT16	RW	RPDO	ms
6069h	VAR	Velocity sensor actual value	INT32	RO	TPDO	rpm
606Bh	VAR	Velocity demand value	INT32	RO	TPDO	rpm
606Ch	VAR	Velocity actual value	INT32	RO	TPDO	Command unit / s
606Dh	VAR	Velocity window	UINT16	RW	RPDO	rpm
606Eh	VAR	Velocity window time	UINT16	RW	RPDO	ms
606Fh	VAR	Velocity threshold	UINT16	RW	RPDO	rpm

Index	Data structure	Name	Data type	Accessibility	Mapping type	Unit
6070h	VAR	Velocity threshold time	UINT16	RW	RPDO	ms
6071h	VAR	Target torque	INT16	RW	RPDO	0.1%
6072h	VAR	Max. Torque	UINT16	RW	RPDO	0.1%
6074h	VAR	Torque demand	INT16	RO	TPDO	0.1%
6077h	VAR	Torque actual value	INT16	RO	TPDO	0.1%
607Ah	VAR	Target position	INT32	RW	RPDO	Command unit
607Ch	VAR	Home offset	INT32	RW	RPDO	Command unit
607Dh	ARRAY	Software position limit	INT32	RW	RPDO	Command unit
607Eh	VAR	Polarity	UINT8	RW	RPDO	-
607Fh	VAR	Max. profile velocity	UINT32	RW	RPDO	Command unit / s
6080h	VAR	Max. motor speed	UINT32	RW	RPDO	rpm
6081h	VAR	Profile velocity	UINT32	RW	RPDO	Command unit / s
6083h	VAR	Profile acceleration	UINT32	RW	RPDO	Command unit / s^2
6084h	VAR	Profile deceleration	UINT32	RW	RPDO	Command unit / s^2
6085h	VAR	Quick stop deceleration	UINT32	RW	RPDO	Command unit / s^2
6087h	VAR	Torque slope	UINT16	RW	RPDO	0.1%/s
6091h	ARRAY	Gear ratio factor	UINT32	RW	RPDO	-
6098h	VAR	Homing method	INT8	RW	RPDO	-
6099h	ARRAY	Homing speeds	UINT32	RW	RPDO	
609Ah	VAR	Homing acceleration	UINT32	RW	RPDO	
60B8h	VAR	Touch probe function	INT16	RW	RPDO	-

Index	Data structure	Name	Data type	Accessibility	Mapping type	Unit
60B9h	VAR	Touch probe status	UINT16	RO	TPDO	-
60BAh	VAR	Touch probe Pos1 pos value	INT32	RO	TPDO	Command unit
60BBh	VAR	Touch probe Pos1 neg value	INT32	RO	TPDO	Command unit
60BCh	VAR	Touch probe Pos2 pos value	INT32	RO	TPDO	Command unit
60BDh	VAR	Touch probe Pos2 neg value	INT32	RO	TPDO	Command unit
60E0h	VAR	FWD torque Limit	UINT16	RW	RPDO	0.1%
60E1h	VAR	REV torque Limit	UINT16	RW	RPDO	0.1%
60F4h	VAR	Following error actual value	INT32	RO	TPDO	Command unit
60FDh	VAR	Digital inputs	UINT32	RO	TPDO	-
60FEh	ARRAY	Digital outputs	UINT32	RW	RPDO	-
60FFh	VAR	Target velocity	INT32	RW	RPDO	Command unit / s

Chapter 8 Fault Diagnosis and Removal

The drive has two protection levels: Fault and Alarm. When the drive fault or alarm occurs, the high byte of 0x603f is 0xff, and the low byte is the drive fault code or alarm code. For details, see P10.18. Please refer to bit7 of 0x6041 to determine whether it is a fault or alarm. When bit7 = 1, it indicates an alarm; otherwise, it is a fault.

603Fh	VAR	Error Code	UINT16	RW	TPDO	-

All possible fault types, fault causes, and solutions for DM5-N series are summarized as shown in Table 8-1.

Tabel 8-1 Fault record table

Fault code	Fault type	Cause	Confirmation method	Solution
Er.001	Drive overcurrent	The motor cables are in poor contact	Check whether the cable connector is loose.	Reliably fasten the cable connector.
		The motor cables are grounded.	Check the insulation resistance between the UVW and the grounding cable of the motor.	Replace the motor if the insulation is poor.
		Short circuit occurs among the motor UVW phases.	Check whether the motor UVW interphase short circuit occurs.	Connect the motor cables correctly.
		The motor is burned out and damaged.	Check whether the resistances between the motor cables are balanced.	Replace the motor if the resistances are unbalanced.
		The gain setting is improper and the motor oscillates.	Check whether the motor oscillates or generates abnormal noise, or check the running graphs.	Re-adjust the gain.
		The encoder is incorrectly wired, its cables are aged and corroded, or the connection becomes loose.	Check whether the encoder wiring is correct, whether the cables are aged, and whether the connection is reliable.	Re-weld or fasten the encoder cables.

Fault code	Fault type	Cause	Confirmation method	Solution
Er.002	Drive main circuit overvoltage	The main circuit input voltage exceeds the specified range.	Measure the input power line voltage range.	Adjust the input power voltage according to the specifications.
		The braking resistor fails.	Measure the resistance between RB+ and RB-.	If the resistor is open, replace the external braking resistor.
		The resistance of the external braking resistor does not match (the resistance is too large, resulting in the insufficiency of the energy absorption during braking.)	Confirm the resistance of the braking resistor.	Select braking resistors with proper resistance according to the operation conditions and the load.
		The motor is in the full acceleration/deceleration state.	Check the deceleration ramp time during running, and monitor the bus voltage P11.09.	Increase the acceleration/deceleration time within the allowed range.
Er.004	Motor locked rotor occurs.	Output UVW phase loss or incorrect phase sequence occurs.	Perform noload motor trial running, and check the motor wiring.	Re-wire correctly, and replace the cables.
		UVW output disconnection occurs.	Check the UVW wiring.	Re-wire correctly, and replace the cables.
		The locked rotor is caused by mechanical factors.	Check the running command and the motor speed.	Check and remove the mechanical factors that cause the locked rotor.
Er.007	Output side phase loss	Phase loss occurs in output UVW.	Check the output wiring, the motor, and the cables.	Replace the wiring cables.
Er.008	Drive overheat	Ambient temperature is excessively high.	Check the cooling conditions around the drive.	Improve the servo drive cooling conditions, and reduce the ambient temperature.

Fault code	Fault type	Cause	Confirmation method	Solution
		Overload operation for excessive times	Check whether any overload fault is reported in the fault record.	To reset, wait for 60 s after overload occurs; increase the capacity of the drive and motor; increase the acceleration/deceleration time; reduce the load.
		The fan is damaged.	Check whether the fan is running during drive operation.	Replace the fan.
Er.009	Braking resistor overload	The external braking resistor is in poor wiring, its connection is loose, or the cables are disconnected.	Check whether the braking resistor is reliably wired.	Re-wire the external braking resistor according to the correct wiring diagram.
		The jumper wire across the power terminals RB+ and RB- is disconnected when the internal braking resistor is used.	Check whether the jumper wire across the power terminals is reliably connected.	Correctly and reliably connect the jumper wire.
		Insufficient capacity of the servo drive or the braking resistor	Calculate the maximum braking energy.	Increase the braking resistor capacity; increase the servo drive capacity; increase the acceleration/deceleration time.
		The load's moment of inertia allowed by the moment of inertia ratio is excessively large.	Check the value of the load's moment of inertia.	Increase the capacity of the drive, motor, and the resistor.
Er.010	Power module protection	Interphase short circuit or short circuit to ground occurs in the output three phases.	Check the insulation of the cable and the output motor.	Replace the cable or the motor.
		Instantaneous overcurrent of the drive	See overcurrent solutions.	See overcurrent solutions.
		The auxiliary power supply is damaged; the drive voltage is insufficient.	Seek technical assistance.	Seek technical assistance.
		Inverter shoot-through	Seek technical assistance.	Seek technical assistance.

Fault code	Fault type	Cause	Confirmation method	Solution
		Abnormal control board	Seek technical assistance.	Seek technical assistance.
		Brake pipe is damaged.	Seek technical assistance.	Seek technical assistance.
Er.011 Er.012	Er.011: Servo drive overload Er.012: Motor overload	Incorrect wiring of the motor and the encoder	Check whether the wiring is correct according to the correct wiring diagram.	Re-wire according to the correct wiring diagram; replace the cables.
		The load is excessively heavy, and the motor keeps outputting effective torque higher than the rated value for a long time.	Check the overload characteristics and the running commands of the motor or drive.	Increase the capacity of the drive and motor; reduce the load; increase the acceleration/deceleration time.
		The acceleration/deceleration is excessively frequent, or the load inertia is excessively large.	Check the inertia ratio and the start-stop cycle.	Increase the acceleration/deceleration time.
		The gain adjustment is improper; there is excessive rigidity; the motor vibrates; the sound is abnormal.	Check whether the motor vibrates and whether the sound is abnormal during motor running.	Re-adjust the gain.
		The servo drive or motor model is set incorrectly.	Check the setting of the motor model.	Correctly set the motor model.
		Overload during running resulted from locked rotor which is caused by mechanical factors	Check the running commands and the motor speed via the commissioning platform or the panel display.	Remove the mechanical factors causing the locked rotor.
		Note: To clear the fault or power on again, wait for 60 s after the occurrence of the overload fault.		
Er.013	EEPROM read/write fault	Parameter read/write error	Check whether an instantaneous power failure occurs during parameter writing.	Restore to the default setting (P02.22=2), and reset the parameter.

Fault code	Fault type	Cause	Confirmation method	Solution
		The number of times of parameter writing within a certain amount of time exceeds the maximum.	Check whether the host device frequently modifies the parameters.	Change the parameter writing method and write again.
Er.014	Abnormal communication of serial port	Improper setting of communication parameters	Check the function code settings.	Correctly set the baud rate and the communication data format.
		The communication wiring is incorrect, or the cable is unreliably connected or disconnected.	Check whether the communication wiring is correct and whether the connection is reliable.	Wire the communication cables again, or replace the communication cables.
		Improper setting of fault parameters.	Check whether the setting of P15.02 is excessively short.	Correctly set P15.02.
		The host device does not work.	Check the signal of the host system.	Check whether the host device is working.
Er.016	The current detection circuit is abnormal.	The cable connection or the plug-in unit of the control board is loose.	Check whether the cable connection or the plug-in unit of the control board is loose.	Check the wiring, and re-wire.
Er.018	Poor auto-tuning	The motor parameter setting is incorrect.	Check the parameters on the motor nameplate.	Correctly set the motor parameters.
		Reverse rotating auto-tuning is performed when reverse running is prohibited.	Check whether the reverse running prohibit function is enabled.	Disable the reverse running prohibit function.
		Incorrect wiring of motor	Check the motor wiring.	Make sure the power line UVW is properly connected, and the sequence is correct.
Er.019	Encoder fault	Encoder type error	Check the setting of the encoder type.	Correctly set the encoder type parameter.
		Encoder disconnection	Check the encoder cables.	Replace the encoder cables.

Fault code	Fault type	Cause	Confirmation method	Solution
Er.020	Undervoltage during main circuit operation	Voltage drop of the power grid	Measure the voltage and check whether the voltage of the input grid power is abnormal.	Improve the input of grid power.
		Overload or mismatching between the motor and the drive	Check the load and whether the drive and motor match.	Select the appropriate drive and motor.
Er.022	Incorrect setting of control mode parameters	Parameter auto-tuning in the non-VC control mode	Check the setting of the control mode parameters.	Make sure the control mode parameters are correctly set.
Er.025	Inverter module temperature sampling disconnection protection	The temperature sampling circuit is abnormal.		Seek technical assistance.
		The temperature sensor or signal cable is abnormal.		Seek technical assistance.
Er.027	Servo motor overspeed	The initial angle of the encoder is incorrect.	Check the initial angle of the encoder P01.22.	Perform the encoder angle auto-tuning again.
		The actual speed of the servo motor exceeds the overspeed threshold.	Check whether the overspeed threshold is set appropriately. (The overspeed threshold is set via P10.12; when P10.12 is set to 0, the overspeed threshold is 1.2 times of the motor maximum speed; when P10.12 is set to a non-0 value, the overspeed threshold is the minimum between P10.12 and the value of 1.2 times of the motor maximum speed)	Correctly set the overspeed threshold.
		Incorrect UVW phase sequence of the motor wiring	Check the wiring of the servo motor.	Make sure the motor wiring is correct.
		The input reference value exceeds the overspeed range.	Check the input reference.	Decrease the value of the reference, or adjust the gain.

Fault code	Fault type	Cause	Confirmation method	Solution
		The motor speed overshoots.	Check the waveform of the motor speed.	Decrease the regulator gain; adjust the servo gain, or adjust the operating conditions.
		Servo drive fault	Check whether the fault is reported again when the system is powered off and powered on again.	Replace the servo drive.
Er.031	Encoder multi-turn count overflow	The multi-turn count exceeds 65535.	Check whether the value of P11.33 exceeds the maximum number of encoder turns.	Operate the motor in the speed mode to make the multi-turn count avoid the overflow judgement value 65535; shield the multi-turn overflow fault.
Er.032	Excessive position deviation	The position deviation exceeds the setting value of P05.21.	Check whether the position deviation detection range P05.21 is excessively small, or whether the position gain P08.02 is excessively small.	Increase the position loop gain P08.02.
Er.033	Abnormal pulse input	The pulse frequency exceeds the setting value of P10.13.	Check whether the maximum position pulse frequency P10.13 is excessively small.	Reset P10.13 according to the maximum position pulse frequency needed for normal mechanical running. If the output pulse frequency of the host device exceeds 4 MHz, it is necessary to reduce the output pulse frequency of the host device.
Er.036	EtherCAT bus communication connection is interrupted.	Communication disconnection between controller and servo exceeds the time defined by P17.25.	Check the connection between controller and servo.	Connect the cables again, or set appropriate disconnection detection time P17.25 according to the communication cycle.

Fault code	Fault type	Cause	Confirmation method	Solution
Er.037	Homing timeout	After homing is enabled, the home position is not located within the time set by P12.09.	Check the settings of the homing mode and the homing timeout detection time P12.09.	Properly set the homing timeout detection time according to the homing motion profile.
Er.039	Positive over-travel	The motor exceeds the positive limit switch during running when P10.04 is set to the value of 0.	Check whether the mechanical device comes in contact with the limit switch.	Reverse the motor running to detach the device from the limit switch.
Er.040	Negative over-travel	The motor exceeds the negative limit switch during running when P10.04 is set to the value of 0.	Check whether the mechanical device comes in contact with the limit switch.	Reverse the motor running to detach the device from the limit switch.
Er.043	External fault	Action of the external fault terminal	Check whether the fault terminal is triggered by mistake.	Check the external wiring.
Er.046	Short circuit to ground upon power-on	The power output cables (UVW) of the drive are short circuited to ground.	Disconnect the UVW cables on the motor side, and check whether the power cables are short circuited to ground.	Re-wire, or replace the cables.
		The motor is short circuited to ground.	Disconnect the UVW cables on the motor side, and check whether the motor internal power cables are short circuited to the motor grounding wire.	Replace the motor.
Er.047 Er.048 Er.049	Internal logic error	...	...	Seek technical assistance.
Er.050	ASIC initialization error	Abnormal ASIC communication	Restart the drive.	Restart the drive; if the fault can not be reset, replace the drive.

Fault code	Fault type	Cause	Confirmation method	Solution
Er.052	Interpolation cycle error	The interpolation cycle set by P20.10 is invalid.	Check the synchronization cycle of the master and the interpolation cycle.	When the master synchronization cycle is consistent with the interpolation cycle, set P20.10 to 0; when inconsistent, P20.10 is the same as the interpolation cycle of the master.
Er.053	The position reference command of the controller is excessively large.	The position reference command of the controller is excessively large.	Check the position reference command of the controller.	Reduce the deviation of the position reference command of the controller.
Er.054	Synchronization signal loss	No synchronization signal is detected after the entry into OP state.	Check the DC configuration of the controller.	Seek technical assistance.
Er.061	Electronic gear ratio setting error	Electronic gear ratio setting error	Check whether the electronic gear ratio parameter is set appropriately.	Correctly set the electronic gear ratio parameter.
Er.062	Interrupt positioning alarm	...	...	Seek technical assistance.
Er.065	ASIC EEPROM is not burned.	ASIC EEPROM is not burned by the controller.	The controller burns the EEPROM according to the description file.	If the fault can not be reset, the controller needs to burn the EEPROM according to the description file.
Er.066	Homing logic error	The homing parameters are set improperly, or homing command is executed during positioning.	Check whether the homing parameters, including the home position search acceleration/deceleration time and the homing method, are set correctly.	Properly set the homing parameters according to the actual homing method, or perform homing after the completion of positioning.
Er.073	Bootstrapping failure	When enabling the drive, the motor speed is excessively high (exceeding 100 rpm).	Check whether the motor is rotating before enabling the drive.	Enable the drive when the motor is static or its speed is lower than 100 rpm.

Fault code	Fault type	Cause	Confirmation method	Solution
Er.074	State of Safe Torque Off	Abnormal STO input signal	Check the status of the STO input signal.	Configure the STO terminal input correctly.
Er.075	Absolute encoder battery undervoltage alarm	...	...	Seek technical assistance.
Er.076	Absolute encoder battery disconnection	The absolute encoder battery is disconnected, or the battery voltage is lower than 2.75 V during drive power failure.	Check whether the encoder battery is disconnected during drive power failure; check whether the battery voltage is excessively low.	If Er.076 is reported after the drive is powered on for the first time, press the reset button to clear the fault. If the fault remains after several times of resetting, replace the encoder cable or battery.
Er.077	Incorrect setting of encoder type	The actual encoder type is inconsistent with that read by P01.00.	Check whether the required encoder type of P01.00 is consistent with the actual encoder type.	Confirm the motor model, and modify the value of P01.00 if necessary.
Er.078	No parameter stored in the absolute encoder EEPROM	There is no parameter in the absolute encoder EEPROM when P01.00 is reading EEPROM.	Check whether any parameter has been written into the absolute encoder EEPROM.	Seek technical assistance.
Er.079	Absolute encoder EEPROM parameter write error	Error occurs when writing parameters into the absolute encoder EEPROM.	Check whether parameters can be written after power-off and power-on again.	Check the encoder type; replace the encoder or the motor if necessary.
Er.081	Encoder homing error	...	...	Seek technical assistance.
Er.084	Absolute encoder EEPROM parameter read error	...	...	Seek technical assistance.

Fault code	Fault type	Cause	Confirmation method	Solution
Er.085	Drive output disconnection	The drive UVW output cables are disconnected; the connection of the output terminal is unreliably.	Check whether the connection of the output cables and the output terminal is reliable.	Make sure the connection of the output cables are safe and reliable.

Possible alarm types, causes, and solutions of the DM5-N series are summarized as shown in table 8-2.

Tabel 8-2 Alarm code table

Alarm code	Alarm type	Cause	Confirmation method	Solution
AL.012	Motor overload	Incorrect wiring of motor or encoder	Check the wiring according to the correct wiring diagram.	Properly re-wire according to the correct wiring diagram; replace the cables.
		The motor outputs effective torque exceeding the rated value for an extended period, which is resulted from excessive overload.	Check the overload characteristics and the running commands of the motor or drive.	Increase the capacity of the drive and the motor; reduce the load; increase the acceleration/deceleration time.
		Acceleration/Deceleration is excessively frequent, or the load inertia is excessively large.	Check the inertia ratio and the start/stop cycle.	Increase the acceleration/deceleration time.
		The gain adjustment is inappropriate; there is excessive rigidity; the motor vibrates and generates abnormal sound.	Check whether the motor vibrates and generates abnormal sound during running.	Re-adjust the gain.
		Incorrect setting of the drive/motor model	Check the setting of the motor model.	Correctly set the motor model.
		Overload during running resulted from locked rotor which is caused by mechanical factors	Check the running commands and the motor speed via the commissioning platform or the panel display.	Remove the mechanical factors causing the locked rotor.

Alarm code	Alarm type	Cause	Confirmation method	Solution
AL.014	Abnormal connection of the serial port	Inappropriate settings of communication parameters	Check the function code settings.	Correctly set the baud rate and the communication data format.
		The communication wiring is incorrect, or the cable is unreliably connected or disconnected.	Check whether the communication wiring is correct and whether the connection is reliable.	Wire the communication cables again, or replace the communication cables.
		Improper setting of alarm parameters.	Check whether the setting of P15.02 is excessively short.	Correctly set P15.02.
		The host device does not work.	Check the signal of the host system.	Check whether the host device is working.
AL.025	Temperature sampling disconnection protection	The temperature sampling circuit is abnormal.		Seek technical assistance.
		The temperature sensor or signal cable is abnormal.		Seek technical assistance.
AL.038	DI emergency brake alarm	Action by emergency brake terminal	Set P02.09 to 1 to enable the emergency brake. An alarm will be reported upon any action by the emergency brake terminal when the drive is in the running state.	Set the reference according to normal logic.
AL.039	Positive over-travel alarm	The drive position exceeds the positive limit switch when P10.04 is set to 1.	Check whether the DI terminal is set to function 35 in group P03. Check the DI terminal logic validity of the bit corresponding to the input signal monitoring P11.12.	Check the running mode. Under the premise of safety, make the terminal logic of the positive limit switch invalid by implementing a reverse command or rotating the motor.

Alarm code	Alarm type	Cause	Confirmation method	Solution
AL.040	Negative over-travel alarm	The drive position exceeds the negative limit switch when P10.04 is set to 1.	Check whether the DI terminal is set to function 36 in group P03. Check the DI terminal logic validity of the bit corresponding to the input signal monitoring P11.12.	Check the running mode. Under the premise of safety, make the terminal logic of the negative limit switch invalid by implementing a reverse command or rotating the motor.
AL.062	Interrupt positioning alarm	The interrupt positioning is enabled during zero-speed running.	Check the servo running state.	Perform the interrupt positioning in non-zero speed state.
AL.075	Absolute encoder battery undervoltage	The absolute encoder battery voltage is lower than 3.1 V when the drive is powered on.	When operation is enabled, an alarm of LOW is reported. When not enabled, AL.075 is reported; measure the battery voltage and check whether it is lower than 3.1 V.	Replace the encoder cable or battery.

Appendix I Warranty and Service

Megmeet rigorously adheres to the ISO 9001:2015 standard in manufacturing motor drive products. If any irregularities occur with our products, please contact the product supplier or the headquarters directly. Megmeet is committed to delivering comprehensive technical support services to all our clients.

1. Warranty period

The warranty period for the product is 18 months from the date of purchase, but not exceeding 24 months after the manufacturing date recorded on the nameplate.

2. Warranty scope

During the warranty period, any abnormalities arising from the responsibility of our company can be repaired or replaced free of charge by our company. However, a certain amount of repair charges may apply even within the warranty period under the following circumstances:

(1) Damage caused by fire, flood, severe lightning strikes, or similar reasons;

(2) Man-made damage caused by users' unauthorized modifications;

(3) Damage due to dropping or transportation after purchase;

(4) Damage caused by usage beyond the standard specifications or requirements;

(5) Damage resulting from operation/use not in accordance with the user manual.

3. After-sales service

(1) If there are special requirements for the installation and commissioning of the drive product, or if the product's performance or functionality is not satisfactory, please contact the product distributor or Megmeet.

(2) In case of any abnormalities, please seek assistance by contacting the product supplier or Megmeet.

(3) During the warranty period, any abnormalities caused by manufacturing and design defects will be repaired free of charge by our company.

(4) Beyond the warranty period, repairs will be conducted at the customer's request and charged by our company.

(5) Service fees are calculated based on actual costs. Any agreements in place will take precedence.

Shenzhen Megmeet Electrical Co., Ltd.

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Website: www.megmeet.com

Parameter Recording Table

Shenzhen Megmeet Electrical Co., Ltd.

DM5-N Series Servo Drive Warranty Bill

Customer company:	
Detailed address:	
Zip code:	Contact:
Tel:	Fax:
Machine model:	
Power:	Machine No.:
Contract No.:	Purchase date:
Service unit:	
Contact:	Tel:
Maintenance person:	Tel:
Maintenance date:	

Comment on service:

☐ **Excellent** ☐ **Good** ☐ **Fair** ☐ **Unsatisfactory**

Other comment:

User's signature: Date:

Customer Service Center follow-up record:

☐ **Follow-up phone call** ☐ **Follow-up letter**

Other:

Signature of the technical support engineer: Date:

Note:

This bill becomes invalid if the user can not be visited.

Shenzhen Megmeet Electrical Co., Ltd.

DM5-N Series Servo Drive Warranty Bill

Customer company:	
Detailed address:	
Zip code:	Contact:
Tel:	Fax:
Machine model:	
Power:	Machine No.:
Contract No.:	Purchase date:
Service unit:	
Contact:	Tel:
Maintenance person:	Tel:
Maintenance date:	

Comment on service:

☐ **Excellent** ☐ **Good** ☐ **Fair** ☐ **Unsatisfactory**

Other comment:

User's signature: Date:

Customer Service Center follow-up record:

☐ **Follow-up phone call** ☐ **Follow-up letter**

Other:

Signature of the technical support engineer: Date:

Note:

This bill becomes invalid if the user can not be visited.