



DS5C series servo driver

Fast manual

Version 1

Wuxi Xinje Electric Co., Ltd

Data No. SC502 20181025 1.0

This manual is suitable for below users

- Servo system installation
- Installation and wiring
- Test run and servo debug
- Maintenance and inspection

Responsibility statement

- the contents of the manual though have been carefully checked, but mistakes is unavoidably, we can't guarantee completely consistent
- we will check the contents of the manual, and carry on the correction in future versions, welcome to put forward valuable opinion
- The contents described in the manual, if there are any changes, please understand we will not prior notice

Contact us

If you have any questions about the use of this product, please contact the agent or xinje company.

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Related manual

- Please contact us for the DS5C series user manual.

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►► Confirmation when receive the products

After the arrival of the product, please confirm the integrity of the product in the following aspects.

Items	Comments
Are the delivered products the ones that were ordered?	Check the model numbers marked on the nameplates of the servomotor and servo drive.
The panel displays flashing “code”	Please set motor code in P0-33 (the motor code please refer to motor label)
Does the servomotor shaft rotate smoothly?	The servomotor shaft is normal if it can be turned smoothly by hand. Servomotors with brakes, however, cannot be turned manually.
Is there any damage?	Check the overall appearance, and check for damage or scratches that may have occurred during shipping.
Are there any loose screws?	Check screws for looseness using a screwdriver.
Is the motor code the same with the code in drive?	Check the motor code marked on the nameplates of the servomotor and the parameter P0-33 on the servo drive.

If there is anything wrong with the items listed above, please contact the agent or xinje company.

►► Safety caution

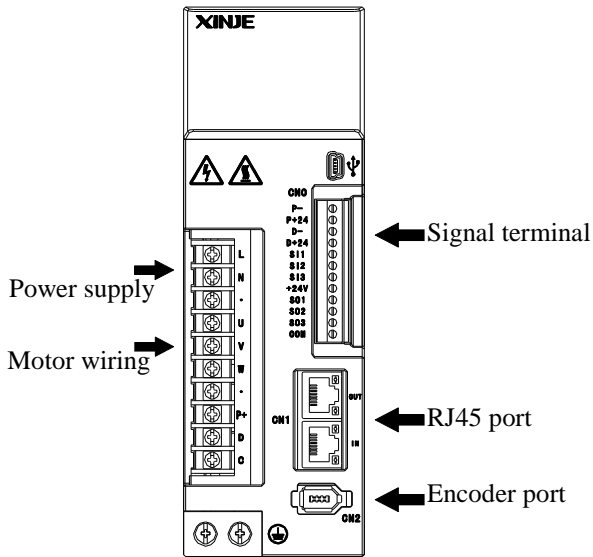
- Confirmation when receive products
 - ✓ DO NOT install any driver which is damaged, lack of accessories or not the same with the model ordered.
- Installation
 - ✓ Cut off external power supply before installation.
- Wiring
 - ✓ Cut off external power supply before wiring.
 - ✓ Connect AC power supply to the corresponding terminals.

-
- ✓ Do not connect a three-phase power supply to the U, V, or W output terminals.
 - ✓ Use 2mm² wire to grounding the ground terminals.
 - ✓ For wiring please make sure that the encoder lines, power lines in loose state, not tight, so as to avoid cable damage.
 - Product running and maintenance
 - Do not remove the panel cover while the power is ON.
 - Do not touch terminals for 10 minutes after the power has been turned OFF.
 - Do not connect with any motor when trial operation.
 - Before starting operation with a machine connected, change the settings to match the parameters of the machine.
 - Do not attempt to change wiring while the power is ON.
 - Do not touch the heat sinks during operation.

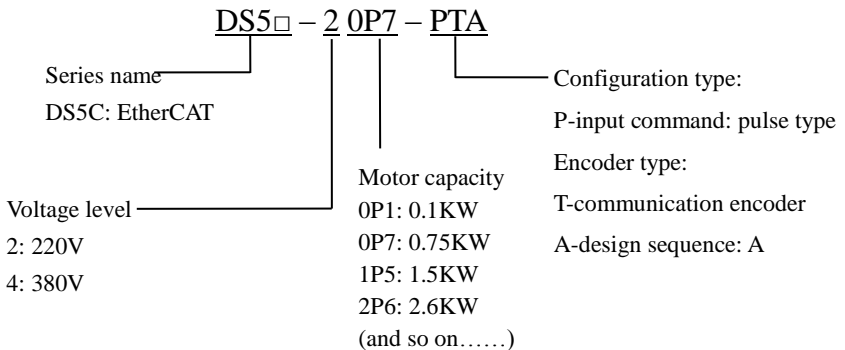
1.Servo system model

1-1.Servo driver

1-1-1.Part description



1-1-2. Model name

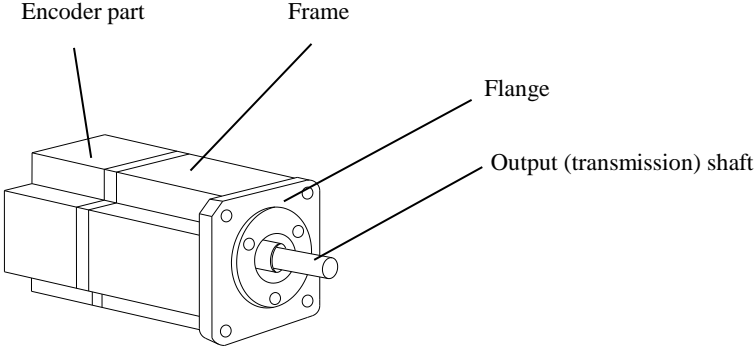


1-1-3. Performance

Servo unit		DS5C series 220V
Suitable encoder		Standard: 17bit/ 23bit encoder
Input power supply		DS5C-2□P□-PTA: single phase AC200~240V, 50/60Hz 【below 1.5KW(except 1.5KW) can use single phase AC200~240V 50/60Hz; 1.5KW and up please use single phase or 3-phase AC200~240V 50/60Hz. (for single phase power supply, please connect L1, L3, otherwise it will affect the power-off memory)】
Control method		3-phase full wave rectifier IPM PWM control sine current driving mode
Using condition	Using temperature	0~+50 °C
	Storage temperature	-20~+85 °C
	Humidity	Below 90% RH (no condensation)
	Resistance to vibration and impact strength	4.9m/s ² / 19.6m/s ²
Structure		Base installation

1-2.Servo motor

1-2-1.Part description



1-2-2. Model name

MS5S - 80 ST E - C S 02430 B Z - 2 0P7 - S01

Name	inertia
MS5S	Low inertia
MS5G	Middle inertia
MS5H	High inertia

Name	Base no.
60	60 base
80	80 base

Name	Product name
ST	Sine driven motor

Name	Oil seal
-	-
E	with oil seal

Name	Encoder type
C	Magnetic
T	Optical

Name	Encoder precision
S	Single rotate 17 bits
M	Multi-rotate 17 bits
U	Single rotate 23 bits
L	Multi-rotate 23 bits

Name	Rated torque (N m)	Rated speed (rpm)
00630	0.637	3000
01330	1.3	3000
02430	2.39	3000

Name	Design no.
S01	standard

Name	Rated power (KW)
0P2	0.2
0P4	0.4
0P7	0.75

Name	Voltage level
2	220V
4	380V

Name	Power-off brake
-	-
Z	with

Name	Shaft
A	No key
B	With key

1-3. Cable type

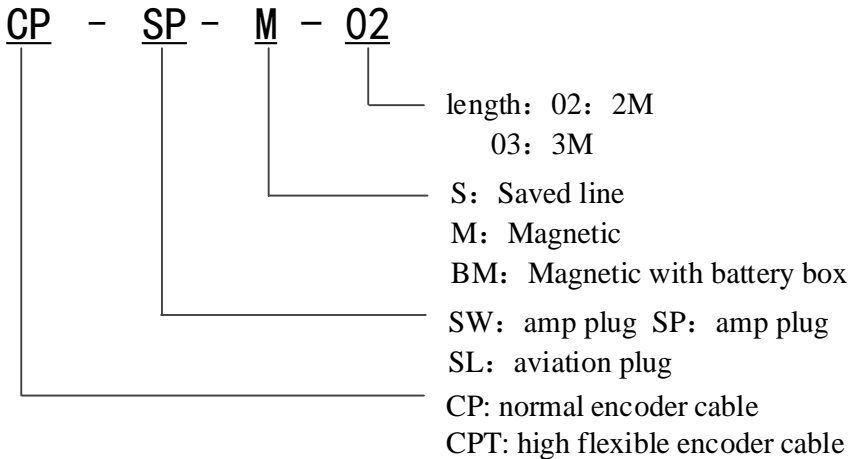
1-3-1. Cable configuration

Servo drive model	Encoder cable	Motor cable	Brake cable
DS5C-20P2-PTA			
DS5C-20P2-PTA	CP-SP-M--length	CM-P07-M-length	CB-P03-length
DS5C-20P4-PTA	CPT-SW-M-length	CM-W07-M-length	CMBT-W07-M-length
DS5C-20P7-PTA			

- P is suitable for the motor with the suffix S01, W is applicable to motor with the suffix S02.
- CB series brake cable is suitable for the motor with the suffix S01, CMB series brake cable is suitable for the motor with the suffix S02.

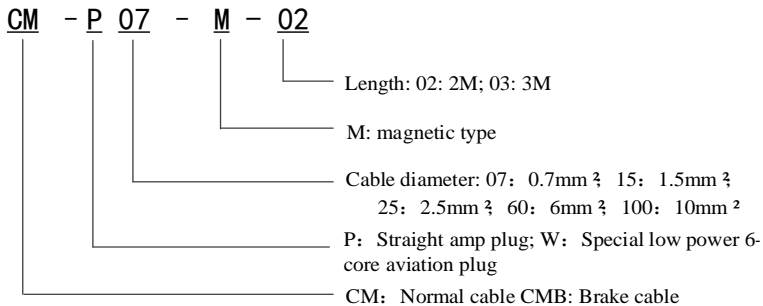
1-3-2. Model name

■ Encoder cable model

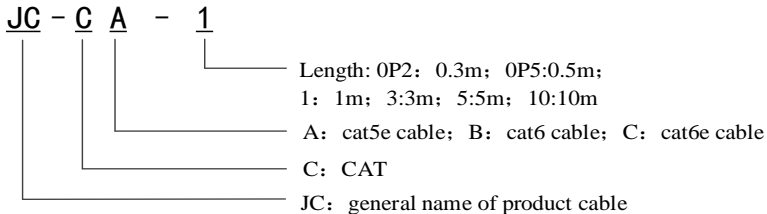


- SW: SC-06 plug-in connector is suitable for the motor with the suffix S02.
- SP: SC-06 plug-in connector is suitable for the motor with the suffix S01.

■ Power supply cable model



■ EtherCAT cable model



1-4.Other accessories

1-4-1.Regenerative resistor

When the servo motor operates in generator mode, power is returned to the servo drive side. This is called regenerative power. The regenerative power is absorbed by charging the smoothing capacitor, but when the capacitor's charging limit is exceeded, the regenerative power needs to be reduced by the regenerative resistor.

The servomotor is driven in regeneration (generator) mode in the following conditions:

- From decelerating to stop for acceleration/deceleration operation.
- Move down on the vertical axis.
- The external load drives the motor running

Servo driver model	Regenerative resistor connection terminals
DS5C-2□P□-PTA	for internal regenerative resistor: short P+ and D, disconnect P+ and C, P0-24=0. for external regenerative resistor: connect resistor between P+ and C, disconnect P+ and D, P0-24=1, P0-25=power value, P0-26=resistor value.

The below table is external regenerative resistor specifications for each motor.

Servo drive	Min resistor (cannot smaller than this value)	External regenerative resistor (recommend value)	External regenerative resistor (recommend power)
DS5C-20P2-PTA	$\geq 50\Omega$	50 Ω —100 Ω	$\geq 200W$
DS5C-20P4-PTA	$\geq 40\Omega$	40 Ω —100 Ω	$\geq 500W$
DS5C-20P7-PTA	$\geq 40\Omega$	40 Ω —100 Ω	$\geq 500W$

Note:

1. The temperature will be very high when the regenerative resistor is discharging, please using heat-resistant non-flammable wire. Don't touch the regenerative resistor when wiring.
2. When you choose the regenerative resistor, please make the resistor value close to the min value of recommend value. The resistor power is decided by the actual condition specially the heat.

2.Product installation

2-1.Servo drive installation

2-1-1.Installation location

- Please install in the cabinet without sunshine and rain
- Please get away from corrosive and flammable gases
- please do not install in high temperature, humidity, dust, metal dust environment

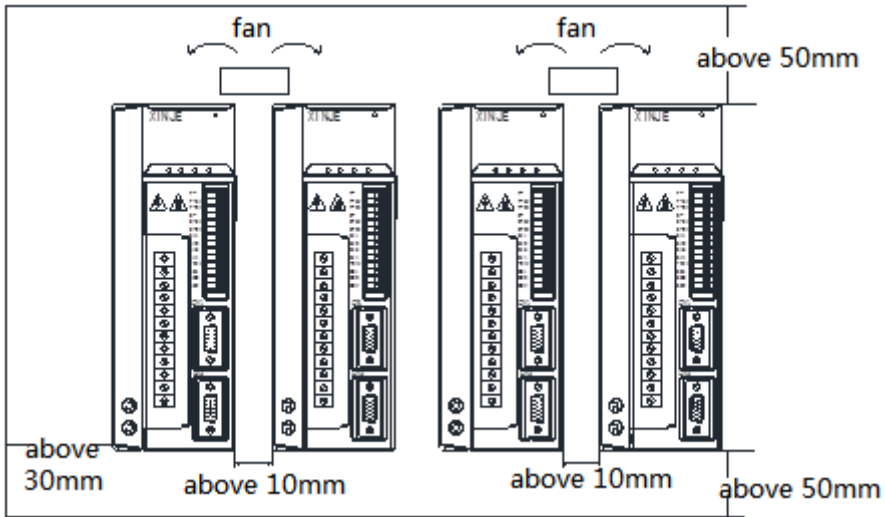
-
- No vibration location

2-1-2.Environment conditions

Item	Description
Using temperature	0°C~40°C (not freeze)
Using humidity	-20%~90%RH (no condensation)
Storage temperature	-20°C~60°C
Storage humidity	-20%~90%RH (no condensation)
Protection level	IP65

2-1-3.Installation standard

Be sure to comply with the installation standard in the control panel shown below, which is applicable for installing multiple servo drives side-by-side in the control panel (hereinafter called "side-by-side installation" for short).



- Servo drive direction

When installing, make the front of the servo drive (the actual installation surface of the operator) facing the operator and make it vertical to the wall. For the drive with regenerated resistance at the bottom, please pay attention to the heat dissipation of the mounting surface to avoid overheating of the drive and causing fire.

- Cooling

As shown in the figure above, allow sufficient space around each servo drive for cooling by cooling fans or natural convection.

- Side by side installation

When install servo drives side by side as shown in the figure above, make at least 10mm between and at least 50mm above and below each servo drive. Install cooling fans above the servo drives to avoid excessive temperature rise and to maintain even temperature inside the control panel.

- The conditions in the control cabinet

- Ambient Temperature: 0~50 °C
- Humidity: 90%RH or less
- Vibration: 4.9m/s²
- Condensation and Freezing: None
- Ambient Temperature for Long-term Reliability: 50 °C maximum

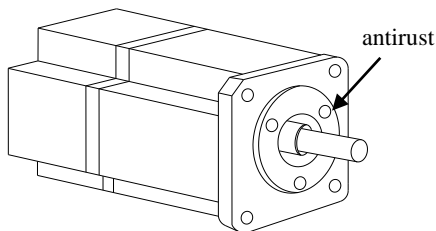
2-2.Servo motor installation

MS series servo motors can be installed either horizontally or vertically. The service life of the servo motor can be shortened or unexpected problems might occur if it is installed incorrectly or in an inappropriate location. Follow these installation instructions carefully.



Caution

1. The end of the motor shaft is coated with antirust. Before installing, carefully remove all of the paint using a cloth moistened with paint thinner.
2. Avoid getting thinner on other parts of the servo motor.



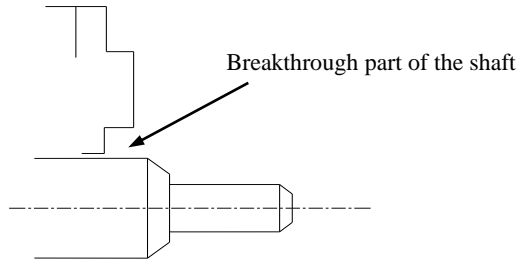
2-2-1. Installation environment

- Free of corrosive or explosive gases
- Please choose oil seal motor in the environment with grinding fluid, oil mist, iron powder, cutting, ect
- Away from the heating source such as stove

- please do not use the motor in a closed environment. Closed environment will lead to motor temperature, shorten service life

2-2-2. Environment conditions

When used in places with water or oil, the protective effect can be achieved through the treatment of the motor. However, when sealing the shaft through part, please specify the motor with an oil seal. Please install the connector downward.

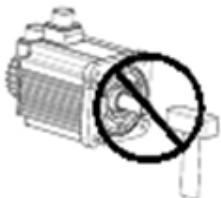


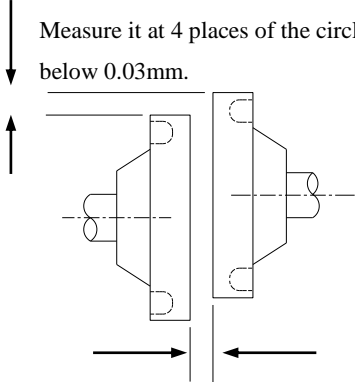
MS series servo motors are for indoor use, please use in the following installation conditions:

Item	Description
Using temperature	0°C~40°C (not freeze)
Using humidity	-20%~90%RH (no condensation)
Storage temperature	-20°C~60°C
Storage humidity	-20%~90%RH (no condensation)
Protection level	IP65

2-2-3. Installation notes

Item	Description
Rust proofing	◆ Please clean the "anti-rust agent" at the extension end of the shaft of the servo motor before installation, and then do the relevant anti-rust treatment.

Encoder notes	<ul style="list-style-type: none">◆ The installation process is not allowed to impact the shaft extension, otherwise the internal encoder will be broken. 
	<ul style="list-style-type: none">◆ When a pulley is mounted on a servo motor shaft with a keyway, screw holes are used at the end of the shaft. To install the pulley, first insert the double-headed nail into the screw hole of the shaft, use the washer on the surface of the coupling end and gradually lock the nut into the pulley.◆ For the servo motor shaft with a keyway, the shaft end screw hole is used for installation. For a shaft without a keyway, a frictional coupling or similar method is used.◆ When removing the pulley, a pulley stripper is used to prevent the bearing from being strongly impacted by the load.◆ To ensure safety, a protective cover or similar device, such as a pulley mounted on a shaft, is installed in the rotating area.

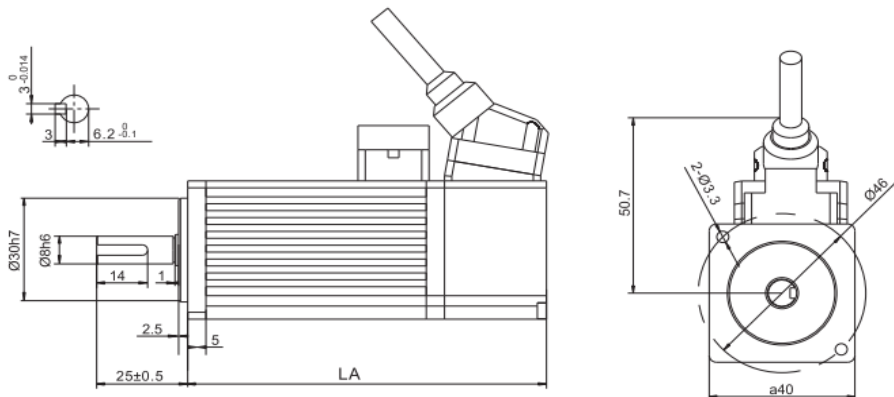
<p>Concentricity</p>	<p>◆ When installing the servo motor, make it meet the centering precision requirements as shown below. If the centering is not sufficient, vibration may occur, and sometimes the bearing and encoder may be damaged. When installing the shaft coupler, please do not directly impact the motor shaft, otherwise it will damage the encoder installed on the load reverse side of shaft end.</p> <p>↓ Measure it at 4 places of the circle, the difference should be below 0.03mm.</p>  <p>Measure it at 4 places of the circle, the difference should be below 0.03mm.</p>
<p>Installation direction</p>	<p>◆ The servo motor can be mounted horizontally or vertically</p>
<p>Oil and water solution</p>	<p>When using in places with drops of water, please use it on the basis of confirming the protection level of the servo motor. Specify a servo motor with an oil seal when there is an oil droplet that drips to the through part of the shaft.</p> <p>Using condition of motor with oil seal:</p> <p>When using, please make sure the oil level is lower than the lip of the oil seal.</p> <p>Please use the motor in a condition where the oil seal keeps the spray</p>

	<p>level in good condition.</p> <p>When installing the servo motor vertically up, please pay attention not to grease the lip of the oil seal.</p>
The stress state of the cable	<p>Do not "bend" the wire or apply "tension" to it. Especially, the core wire of the signal wire is 0.2mm or 0.3mm, very thin.</p>
connector	<ul style="list-style-type: none"> ◆ When the connector is connected, please make sure there is no garbage or metal sheet or other foreign matter in the connector. ◆ When connecting the coupling to the servo motor, it is important to connect the coupling from the side of the main circuit cable of the servo motor first, and the ground wire of the main cable must be connected reliably. If one side of the encoder cable is connected first, the encoder maybe error due to potential difference between PE. ◆ Please make sure that the pins are aligned correctly when engaged. ◆ The fraud connector is made of resin. Do not impact the connector to avoid damage. ◆ When handling operations while the cable remains connected, be sure to hold the servo motor body. If you only hold the cable for handling, you may damage the connector or break the cable. ◆ If a curved cable is used, full attention shall be paid to the distribution of the cables and no stress shall be applied to the connector part. If stress is applied to the connector part, the connector may be damaged.

2-3.Servo motor dimension

■ 40 series motor dimension

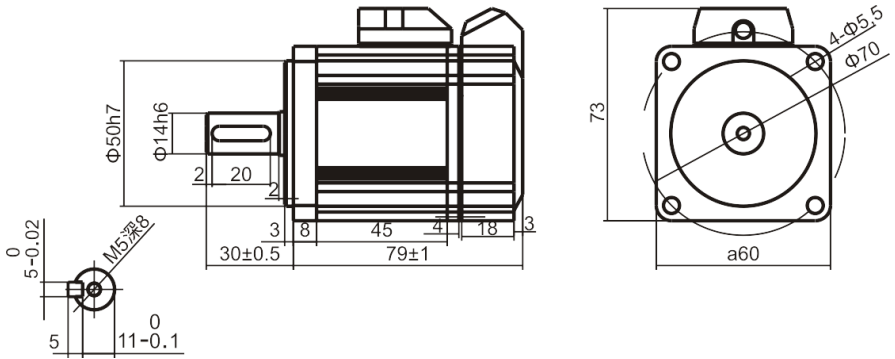
Unit: mm



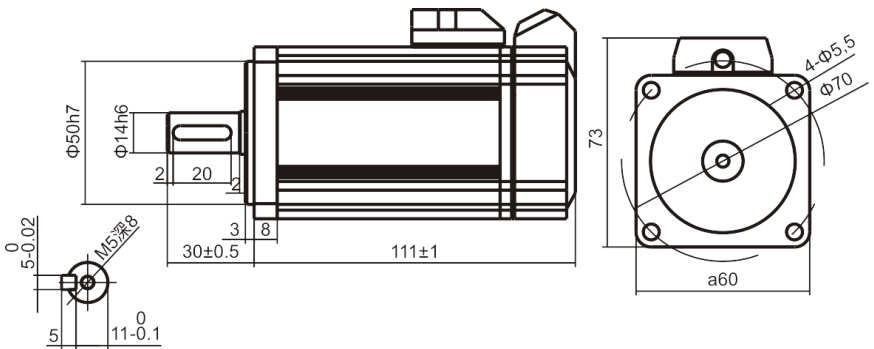
Motor model	Body length		Inertia level
	Normal	With brake	Low inertia
MS5S-40ST-CS0030□□-20P1-S01/S02	99 ± 1.5	129.5 ± 1	Low inertia

■ 60 series motor dimension

Unit: mm



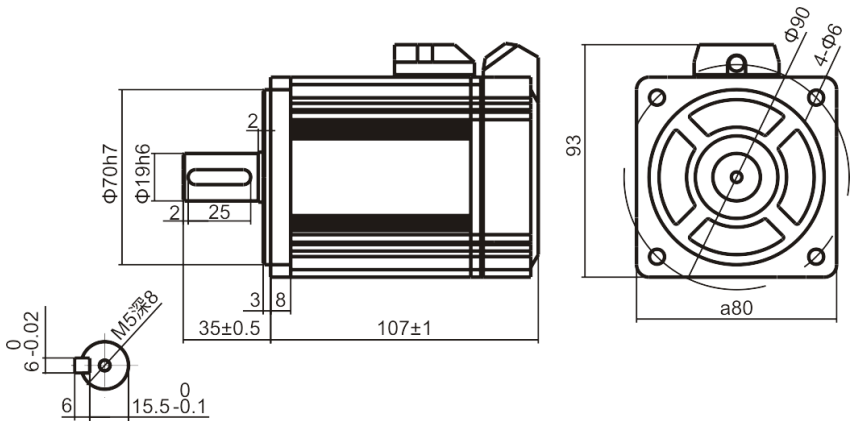
Motor model	Body length		Inertia level
	Normal	With brake	
MS5S-60ST-CS00630□□-20P2-SO1/SO2	79±1	114±1	Small inertia
MS5S-60ST-CS01330□□-20P4-SO1/SO2	99±1	134±1	



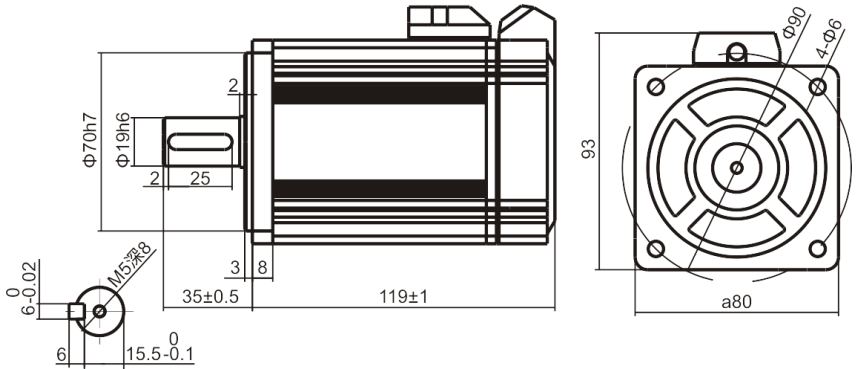
Motor model	Body length		Inertia level
	Normal	With brake	Large inertia
MS5H-60ST-CS01330□□-20P4-SO1/SO2	111±1	146±1	
MS5H-60ST-CS00630□□-20P2-SO1/SO2	91±1	126±1	

■ 80 series motor dimension

Unit: mm



Motor model	Body length		Inertia level
	Normal	With brake	Small inertia
MS5S-80ST-CS02430□□-20P7-SO1/SO2	107±1	144±1	
MS5S-80ST-CS03230□□-21P0-SO1/SO2	128±1	165±1	

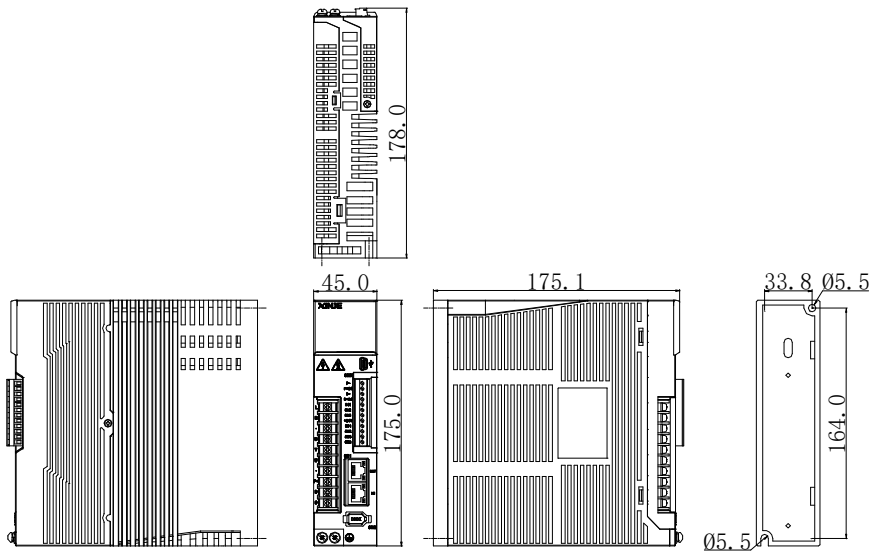


Motor model	Body length		Inertia level
	Normal	With brake	Large inertia
MS5H-80ST-CS02430□□-20P7-SO1/S02	119 ± 1	156 ± 1	
MS5H-80ST-CS03230□□-21P0-SO1/S02	140 ± 1	177 ± 1	

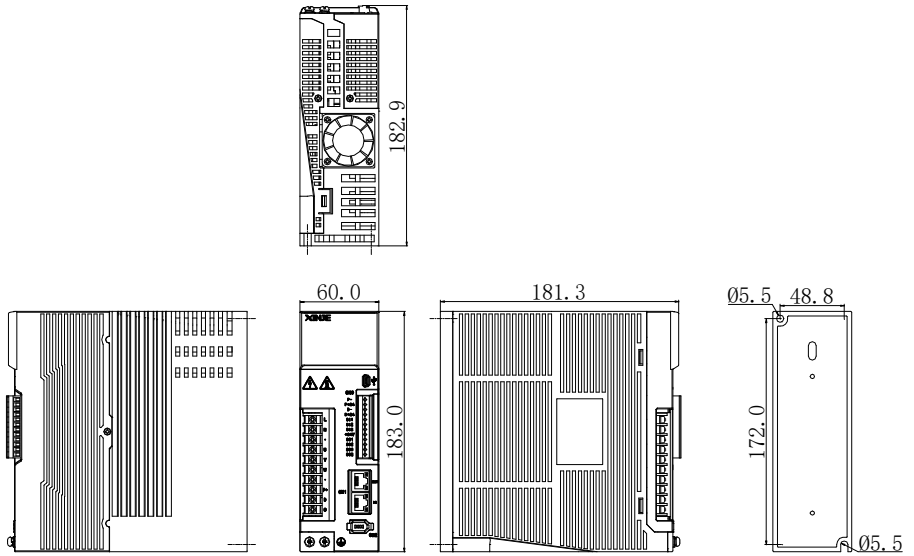
2-4.Servo drive dimension

Unit: mm

■ DS5C-20P1/2/4-PTA



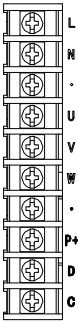
■ DS5C-20P7-PTA



3.Servo drive and motor wiring

3-1. Main circuit terminals

■ DS5C-20P1/2/4/7-PTA



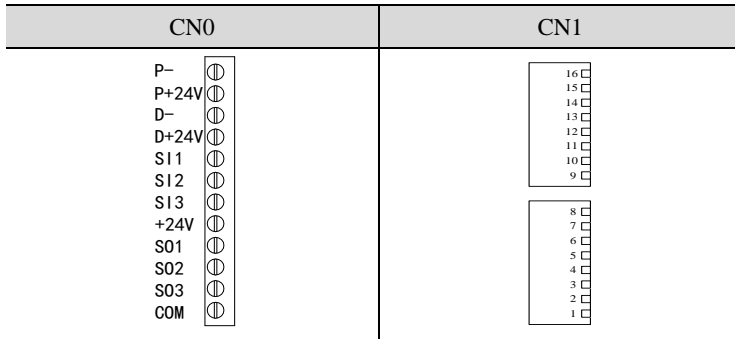
Terminal	Function	Explanation
L/N	Power supply input of main circuit	Single phase AC200~240V, 50/60Hz
•	Vacant terminal	-
U, V, W	Motor terminals	Connect the motor (Note: the ground line is on the cooling fin, please check it before power on!)
P+, D, C	Internal regenerative resistor	Short P+ and D, disconnect P+ and C, set P0-24=0
	External regenerative resistor	Connect regenerative resistor between P+ and C, disconnect P+ and D, set P0-24=1, P0-25= power value, P0-26= resistor value

■ Wiring terminals of servo motor

Signal	40, 60, 80 series motor
PE	4-yellow green
U	1-brown
V	3-black
W	2-blue

3-2. Control terminals

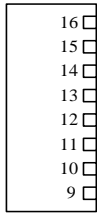
The serial numbers of the following connectors are in the order of viewing the welding side.



■ CN0 terminals

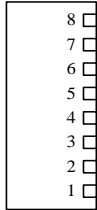
No.	Name	Explanation	No.	Name	Explanation
1	P-	Pulse input PUL-	7	SI3	Input 3
2	P+24V	Open collector input	8	+24V	Input +24V
3	D-	Direction input DIR-	19	SO1	Output 1
4	D+24V	Open collector input	10	SO2	Output 2
5	SI1	Input 1	11	SO3	Output 3
6	SI2	Input 2	12	COM	Ground of output

■ CN1 terminals



Outlet

No.	Name	No.	Name
1	TAX A+	9	TAX B+
2	TAX A-	10	TAX B-
3	RX A+	11	RX B+
4	-	12	-
5	-	13	-
6	RX A-	14	RX B-
7	-	15	-
8	-	16	-



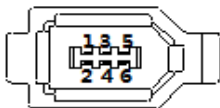
Inlet

Note:

The servo bus function needs to be equipped with the bus module, which is inserted into the driver CN1 port for the purpose of extending the bus function. Please note that the transfer module should not be hot-pluggable. It is recommended to use the profibus standard cable to achieve the best communication reliability.

■ CN2 terminals

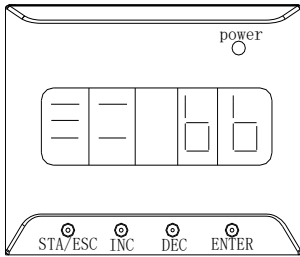
CN2 connector terminal arrangement (facing the weld):



No.	Definition
1	5V
2	GND
5	A
6	B

4. Operation before using servo system

4-1. Operate panel

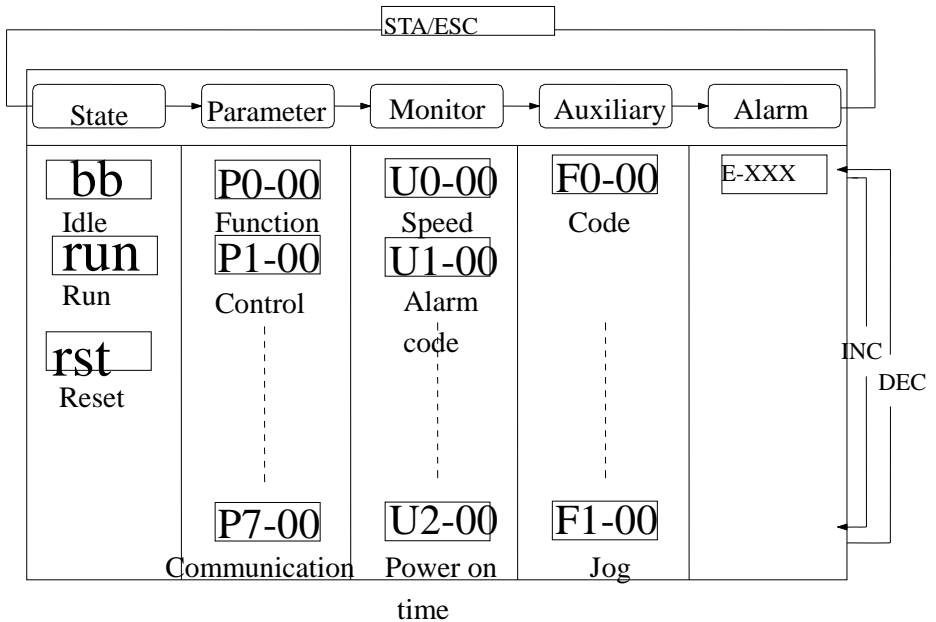


Button	Function
STA/ESC	Press: Status switch, status return
INC	Press: Increase the value; Press and hold: Increase the value continuously
DEC	Press: Decrease the value; Press and hold: Decrease the value continuously
ENTER	Press: Shift the editing digit; Press and hold: Enter a status, Enter

The operate panel can display the status, set parameter and run the command by switching the basic mode.

The running status, auxiliary function, parameter setting, and monitoring are the basic modes. The modes switch as the below diagram by pressing STATUS/ESC.

Status: bb indicates that the servo system is idle; Run indicates that the servo system is running, and RST indicates that the servo needs to be powered on again.



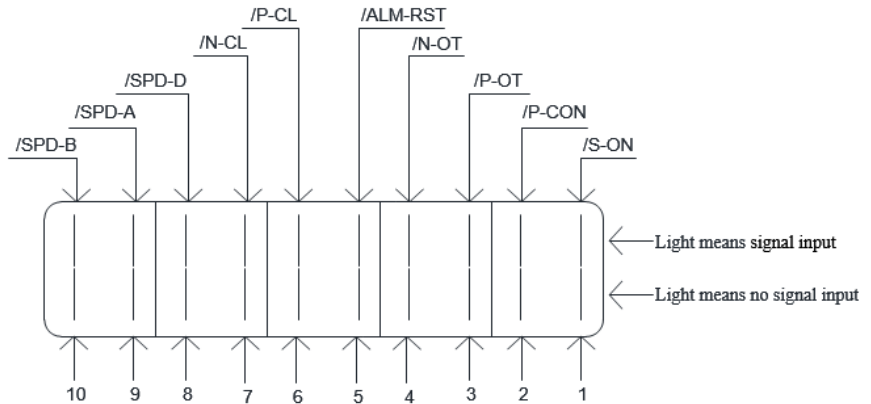
- Monitor Function UX—XX: The first X means group No., the last two X means the member No. in the group.
- Auxiliary Function FX—XX: The first X means group No., the last two X means the member No. in the group.
- Parameter Setting PX—XX: The first X means group No., the last two X means the member No. in the group.
- Alarm E—XXX: XXX means the alarm code.

4-1-1.Group P parameters

Refer to the appendix.

4-1-2.Group U parameters

U0-21 input signal status

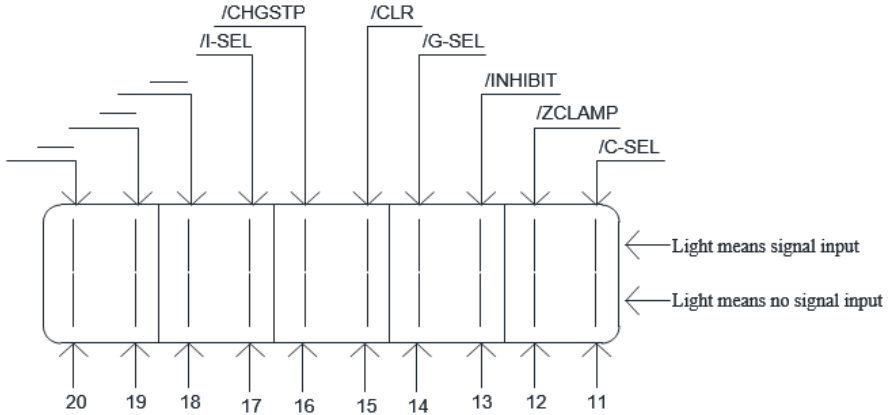


U0-21 input signal 1 distribution

Segment code	Explanation	Segment code	Explanation
1	/S-ON servo enable signal	2	/P-CON proportion action command
3	/P-OT forward run prohibited	4	/N-OT reverse run prohibited
5	/ALM-RST alarm reset	6	/P-CL forward side external torque limit
7	/N-CL reverse side external torque limit	8	/SPD-D internal set speed selection
9	/SPD-A internal set speed selection	10	/SPD-B internal set speed selection

Note: read the status through communication, the binary value from right to left are related to /S-ON, /P-CON. 0 means no input, 1 means has input. For example: 0x0001 means /S-ON has input, 0x0201 means /S-ON and /SPD-B has input.

U0-22 input signal status



U0-22 input signal 2 distribution

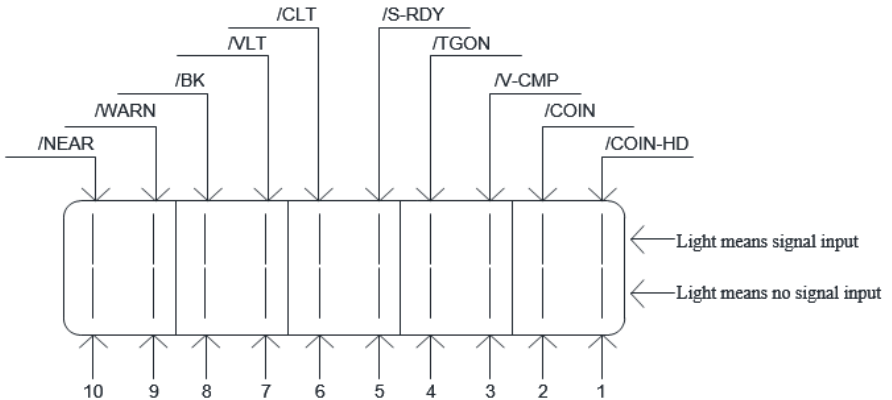
Segment code	Explanation	Segment code	Explanation
11	/C-SEL control mode	12	/ZCLAMP zero clamp
13	/INHIBIT command pulse prohibited	14	/G-SEL gain switch
15	/CLR pulse clear	16	/CHGSTP change step
17	/I-SEL inertia switch	18	—
19	—	20	—

Note: read the status through communication, the binary value from right to left are related to /C-SEL, /ZCLAMP. 0 means no input, 1 means has input. For example:

0x0001 means /C-SEL has input, 0x0041 means /C-SEL and /I-SEL has input.

Note: “—” is reserved bit, it is always 0.

U0-23 output signal status

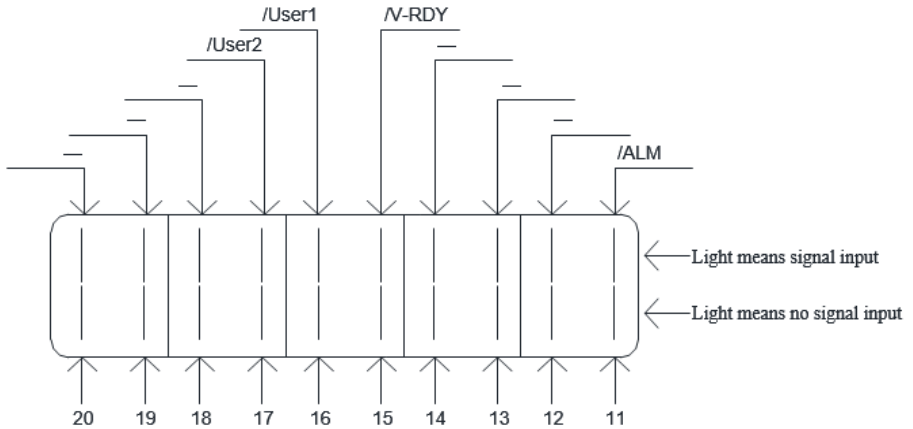


U0-23 output signal 1 distribution

Segment code	Explanation	Segment code	Explanation
1	Positioning complete maintain (/COIN_HD)	2	Positioning end (/COIN)
3	Same speed detection (/V-CMP)	4	Rotate detection (/TGON)
5	Ready (/S-RDY)	6	Torque limit (/CLT)
7	Speed limit detection (/VLT)	8	Brake lock (/BK)
9	Warn (/WARN)	10	Output near (/NEAR)

Note: read the status through communication, the binary value from right to left are related to /COIN_HD, /COIN. 0 means no output, 1 means has output. For example: 0x0001 means /COIN_HD has output, 0x0201 means /COIN_HD and /NEAR has output.

U0-24 output signal status



U0-24 output signal 2 distribution

Segment code	Explanation	Segment code	Explanation
11	Alarm (/ALM)	12	—
13	—	14	—
15	Speed reach (/V-RDY)	16	Self-defined output 1
17	Self-defined output 2	18	—
19	—	20	—

Note: read the status through communication, the binary value from right to left are related to /ALM, “-“. 0 means no output, 1 means has output. For example: 0x0001 means /ALM has output, 0x0041 means /ALM and self-defined output 2 has output.

Note: “—“ is reserved bit, it is always 0.

4-1-3. FX-XX auxiliary function

■ F0-XX

Function No.	Description
F0-00	Clean the alarm
F0-01	Back to out of factory settings
F0-02	Clean the offset

1. Clean the alarm (F0-00)

Set F0-00=1 to reset the alarm. When the alarm occurred, please find out the alarm reasons then clean the alarm.

2. Back to out of factory settings (F0-01)

Please power off the servo drive before the operation.

Set F0-01=1, then press ENTER. No need to re-power the servo drive.

3. Clean the offset (F0-02)

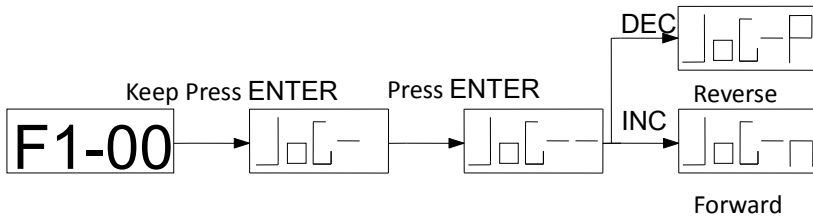
Set F0-02=1 to clean the offset.

■ F1-XX

Function code	Explanation
F1-00	Jog run
F1-01	Test run
F1-02	Current sampling zero calibration
F1-05	Panel enable
F1-06	Absolute encoder clear number of turns

1. Jog run (F1-00)

Make sure that the motor shaft is not connected to the machine before jogging!



When the servo is in jog run mode, gain and other parameters will join the process. Please adjust the parameters according to the jog run status.

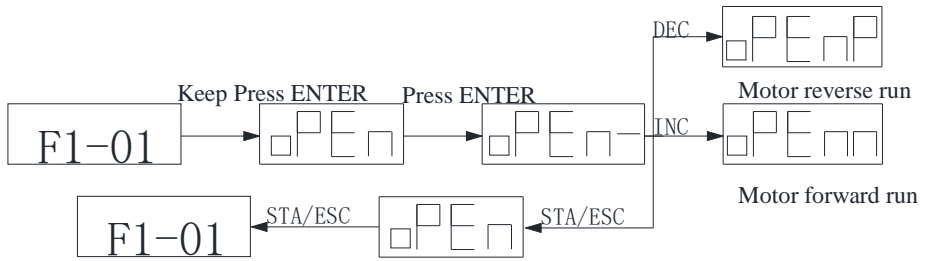
P3-18	JOG speed					
	Unit	Default	Setting range	Suitable mode	Change	Effective
	1Rpm	100	0~1000	JOG	Servo OFF	Immediately

2. Test run (F1-01)

Make sure that the motor shaft is not connected to the machine before test run!

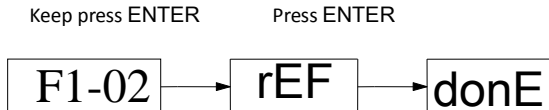
When servo drive is connected with non-original encoder line or power line, test run must be run first to ensure that the encoder line or power line is connected correctly.

Test run can detect the connection of power line and encoder feedback. Please operate the servo as the following steps. If the motor shaft jitter or servo alarm, please cut off the power at once then check the wiring.



3. Current sampling zero calibration (F1-02)

After the servo drive updated to latest software version, or the motor does not revolve smoothly for long time, the current offset auto-adjustment is recommended.



Press STATUS/ESC to exit, need to power on again.

4. Panel enable

Parameter	Signal name	Setting	Meaning	Modify	Effective
P0-03	Enable mode	0	Not enable	Servo OFF	At once
		1 (default)	I/O enable /S-ON		
		2	Software enable (F1-05 or communication)		
		3	Fieldbus enable (support motion fieldbus model)		

Set P0-03 to 2

F1-05 = 0: cancel the enable, back to bb state.

F1-05 = 1: forced enable, servo is in RUN state.

Note: forced enable will be ineffective after power on again.

5. Absolute encoder clear number of turns



First power off the servo drive, then clear the absolute encoder number of turns. The operation is shown as below:

Set F1-06 to 1 through the operate panel or write 1 to address 0x2106 through Modbus-RTU (be effective in servo bb state, write 0 to 0x2106 after clearing) can clear the number of turns.

4-2. Panel key operation

Take P3-09 as an example:

Steps	Operate panel	Key	Operations
1		STA/ESC INC DEC ENTER ⊙ ⊙ ⊙ ⊙	No need any operation
2		STA/ESC INC DEC ENTER ⊙ ⊙ ⊙ ⊙	Press STA/ESC to enter parameter settings
3		STA/ESC INC DEC ENTER ⊙ ⊙ ⊙ ⊙	Press INC once will increase 1, increase the parameter to 3, it will show P3-00
4		STA/ESC INC DEC ENTER ⊙ ⊙ ⊙ ⊙	Press ENTER, the last 0 will flash
5		STA/ESC INC DEC ENTER ⊙ ⊙ ⊙ ⊙	Press INC to increase to 9
6		STA/ESC INC DEC ENTER ⊙ ⊙ ⊙ ⊙	Keep press ENTER, enter P3-09 to change the value.

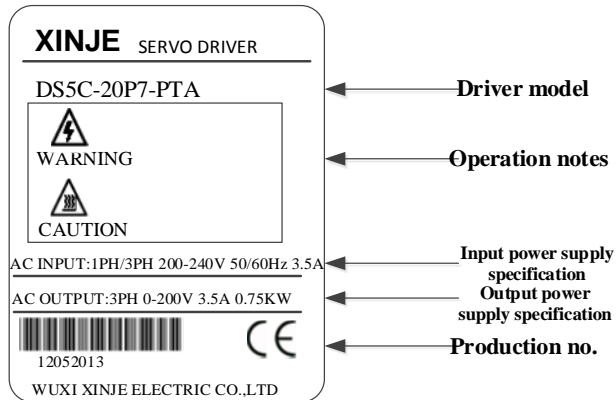
7		STA/ESC INC DEC ENTER 	Press INC, DEC, ENTER to increase decrease or shift, keep press ENTER to confirm after changing.
8	Operation end		

4-3. Change motor code

- (1) One servo drive can match several servo motors with same power level. Before using the servo system, please make sure the motor code on the servo motor label is the same to P0-33.
- (2) If the motor code setting is error, it will show E-310, please clear the alarm through F0-00, then set the correct code.



Driver label



5. Gain adjustment

The new generation DS5 series servo has rigidity self-adaption, auto-tuning and manual adjustment modes, without complicated parameter adjustment process, which greatly saves the gain adjustment time.

Self-adaption function: self-adaption function means that no matter the type of machinery and the fluctuation of load, it can get stable response through automatic adjustment.

Auto-tuning function: when running automatically within the setting scope (the reciprocating movement of the forward and reverse) or receive superior equipment operating instructions, the servo can automatical adjust according to the mechanical characteristics.

Manual adjustment function: setting the speed loop, position loop, model loop gain, vibration frequency and other parameters manually in the auto-setting mode to achieve quick response.

5-1. Self-adaption

In the case of low responsiveness requirements, this function can be used quickly by setting the gear ratio and enabling functional parameters, saves the servo adjustment time.

The self-adaption default parameter is defined as the small inertia mode, in which the load inertia does not change within 20 times; P2-03.3 setting to 1 means switch to large inertia mode, which is most suitable for 50-80 times load inertia operation (above take 60/80 flange motor as the example).

In order to ensure safety, the self-adaption operation should be carried out when the enable function can be shut down and servo can be stop urgently at any time.

5-1-1. Self-adaption mode selection switch parameter

Inertia mode selection switch	Self-adaption default parameters	Parameter notes
P2-03.3=0 Small inertia mode	P2-05=400	Adaptive small inertia mode speed loop gain
	P2-11=100	Adaptive small inertia mode position loop gain
	P2-10=500	Adaptive small inertia mode speed loop integral
	P2-07=0	Adaptive small inertia mode inertia ratio
	P2-08=60	Adaptive small inertia mode speed observer gain
	P2-12=30	Adaptive small inertia mode stable max inertia ratio
	P2-19=50	Adaptive small inertia mode control bandwidth
P2-03.3=1 Large inertia mode	P6-05=200	Adaptive large inertia mode speed loop gain
	P2-11=100	Adaptive large inertia mode position loop gain
	P2-10=500	Adaptive large inertia mode speed loop integral
	P6-07=50	Adaptive large inertia mode inertia ratio
	P6-08=40	Adaptive large inertia mode speed

		observer gain
	P6-12=50	Adaptive large inertia mode stable max inertia ratio
	P2-19=70	Adaptive large inertia mode control bandwidth

Note:

- (1) P2-19 default value is different for different power drive.
- (2) P2-05 default value is 200 for the drive above 1.5kw.

Parameter	Default value	Range	Effect
P2-05/P6-05	400/200	200~400	Reduction can improve the inertia capability, but it will reduce the responsiveness, which has a greater impact on the responsiveness.
P2-07/P6-07	0/50	0~200	Increase can greatly improve the inertia capacity, and will not affect the responsiveness, too large is prone to oscillation.
P2-08/P6-08	60/40	30~60	Reducing P2-08 and increasing P2-12 can greatly improve the inertia capability, but it will reduce the responsiveness, which has a great impact on responsiveness.
P2-12/P6-12	30/50	30~60	
P2-10	500	200~larger	Adjust according to need, generally increase
P2-11	100	50~200	Adjust according to need
P2-19	50~70	40~80	Increasing will increase the inertia capacity slightly, and it has little effect on the

			responsiveness, as an auxiliary parameter.
--	--	--	--

5-1-2. Recommended inertia ratio under default parameters

Motor flange	Recommended load inertia ratio in small inertia mode	Recommended load inertia ratio in large inertia mode
40	Below 20 times	60 times ~ 80 times
60	Below 20 times	60 times ~ 80 times
80	Below 20 times	60 times ~ 80 times
130	Below 10 times	15 times ~ 20 times
180	Below 5 times	10 times ~ 20 times

If the load inertia is over the recommended value in the table, please change the related parameters of gain. The method is shown as below:

If the inertia is 20 times to 30 times

Increase P2-07 appropriately, decrease P2-05 if necessary. You can also refer to the following super-large inertia debugging methods.

Super-large debugging experience (50-100 times inertia):

Increase P2-12 (40~50 is recommended), reduce P2-08 (40~50 is recommended), reduce P2-05(100~300 is recommended), increase P2-07(10~50 is recommended). Please flexible adjust according to load inertia.

Application example:

(1) 30-times inertia load gain parameters

When it is default value, please set P2-08=50 P2-12=40 P2-07=50

(2) 80-times inertia load gain parameters

When it is default value, please set P2-08=40 P2-12=50 P2-07=50 P2-05=200

5-2.Auto-tuning

Auto-tuning parameter setting is based on the current institution, the parameters after auto-tuning is not applicable to empty shaft and other types of load, the auto-tuning is divided into no instruction auto-tuning and auto-tuning with instruction, it needs the servo PC software to adjust, detailed usage please refer to PC software manual.

5-2-1. No instruction auto-tuning

The no-instruction auto-tuning: set the motion range through PC software, then the servo drive will output command to make the motor move forth and back in the travel range, and adjust automatically according to the mechanical properties.

No instruction auto-tuning process:

1. set the left and right travel limit through software jog running
2. assum the load inertia (set by manual or assum automatically)
3. auto-tuning (auto-tune according to the setting travel in step 1)

5-2-2. Auto-tuning with instruction

Auto-tuning with instruction: automatical adjust according to the upper device command(pulse).

Auto-tuning with instruction process:

1. set the left and right travel limit through software jog running
2. assum the load inertia (set by manual or assum automatically)
3. auto-tuning (auto-tune according to the upper device pulse command)

Note: when auto-tuning, the positioning complete width P5-00 should change as the motor pulses per rotate. Too large or small value will cause the auto-tuning result failure. The default value of P5-00 is 11 when motor is 10000 pulses per rotate.

5-3.Manual adjustment

Manual adjustment needs to set load inertia first, then turn off the self-adaption function to use. Servo firmware version 3640 and later supports this function.

5-3-1.Manual adjustment steps

1. Set the load inertia ratio P0-07 (Estimation of inertia by upper computer or known load inertia).
2. Change P2-01.0 to 0, turn off self-adaption function.

After the above two steps, the manual adjustment takes effect. The rigidity level is adjusted by P0-04 (rigidity level parameter). The rigidity gain is divided into 31 levels, and each level corresponds to a set of parameters.

Parameter	Name
P1-00	Speed loop gain
P1-01	Integral time constant of speed loop
P1-02	Position loop gain
P2-49	Model loop gain
P2-35	Torque command filter time constant

Notes for debugging:

- (1) Rigidity level generally increases or decreases in the default value. If the rigidity level is not suitable in actual operation, it can be modified by P0-04. The larger the value, the greater the gain and the stronger the rigidity.
- (2) Under the current rigidity level, if the requirements are not met, the above five parameters can still be fine-tuned.
- (3) If vibration occurs, it is necessary to detect resonance frequency by mechanical characteristic analysis and to configure notch parameters to suppress vibration.

5-3-2.Manual adjustment parameter and function

Parameter	Name	Explanation
P0-07	Load inertia ratio	The ratio of load and rotor inertia, the value can be deduced by the upper device inertia recognition
P1-00	Speed loop gain	In the absence of noise and vibration, increasing this parameter can speed up the positioning time and bring better speed stability and follow-up. In the case of noise and vibration, reduce the setting value of this parameter
P1-01	Speed loop integral	In the absence of noise and vibration, reducing the value can strengthen the integral function and speed up the positioning time. If this value is too high, it will cause the speed loop deviation return to zero become slowly
P1-02	Position loop gain	In the absence of noise and vibration, increasing this parameter can speed up the positioning time
P2-01.0	Auto-tuning switch	0- auto-tuning 1- self-adaption
P2-35	Torque filter time constant	increase this value can reduce the noise, but the velocity fluctuation will become larger and vibration will easily occur. If this value is reduced, the noise will increase, but the velocity fluctuation will decrease. The greater the load inertia, the greater the value
P2-49	Model loop gain	When the value is increased, the rigidity level will be improved and the position curve following features will be improved, but it is easy to overshoot. decreasing this value can reduce the overshoot, but the position curve becomes less traceable

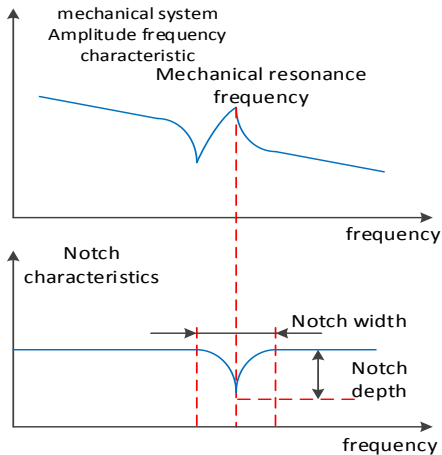
5-4.Vibration suppression

When the excitation frequency of the mechanical system is close to the natural frequency of a certain order of the system, the system amplitude increases significantly, which will cause vibration and noise.

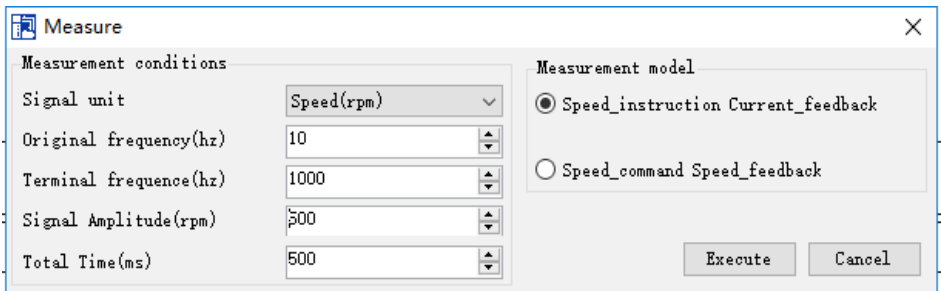
Generally, the screw equipment with small load inertia can achieve better results by auto-tuning directly with the upper computer. When the inertia identified by other equipment in the process of inertia identification is small, it can also use the upper computer to auto-tune directly without manual adjustment. The current version needs to be re-energized after modifying the P2 parameters in the process of manual adjustment. In addition, after each parameter re-adjustment, it should first run at low speed to observe whether there is vibration. However, vibration or overshoot may occur during the adjustment process. Please perform manual adjustment when the enablement can be stopped or servo can be turned off at any time.

Band trap:

Notch filter can suppress mechanical resonance by reducing the gain at a specific frequency. After the notch filter is set correctly, the vibration can be effectively suppressed and the servo gain can be continuously increased. The principle of notch filter is as follows:



- (1) Open the Xinje servo software, click mechanical properties
- (2) Click measure, it will show below window



- (3) click execute, wait for data reading to complete
- (4) click amplitude and phase, set the filter width according to the waveform sharpness
- (5) click display in the pointer window, set vibration frequency peak

The filter width

1

Pointer

Display

Amplitude-Frequency

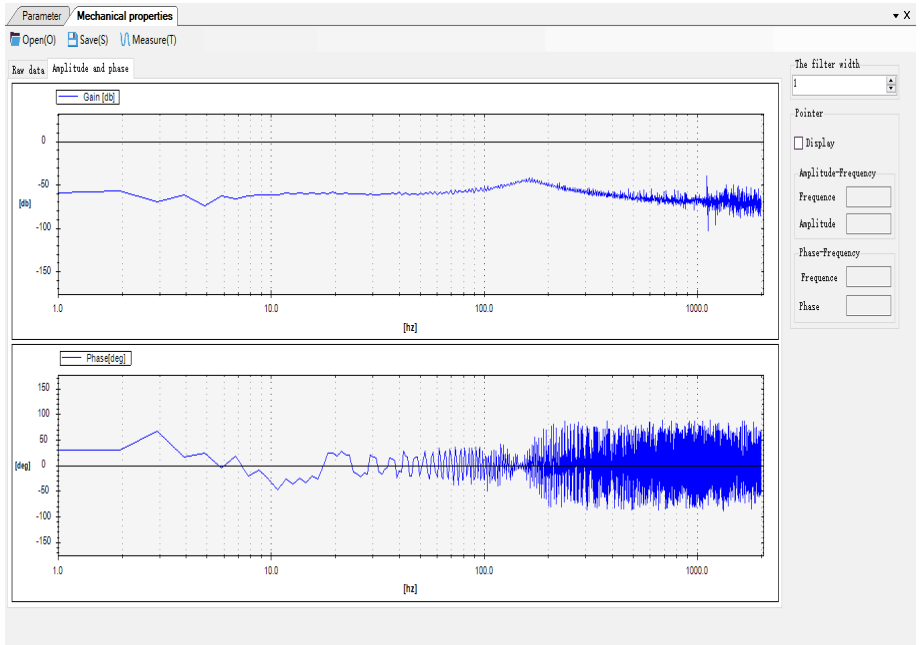
Frequency

Amplitude

Phase-Frequency

Frequency

Phase



- (6) open vibration suppression switch, set the vibration frequency
- (7) if there is still vibration after setting notch frequency, please adjust P2-35.

Refer to below table for detailed parameters:

Parameter	Name	Explanation
P2-00.0	Disturbance observer switch	0: Close 1: Open
P2-41	Disturbance observer gain	Default 91, Generally changed to 85
P2-69.0	First notch switch	0: Close 1: Open
P2-69.1	Second notch switch	0: Close 1: Open
P2-69.3	Fourth notch switch	0: Close 1: Open
P2-71	First notch frequency	Setting according to the result of characteristic analysis
P2-74	Second notch frequency	Setting according to the result of characteristic analysis
P2-77	Fourth notch frequency	Setting according to the result of characteristic analysis

6.EtherCAT communication specification

Physical layer	100BASE-TX
Communication interface	RJ45 × 2 (CN1)
Network architecture	Tandem connection
transmission speed	2 x 100 Mbps (full duplex)
Data frame length	Maximum 1484 bytes
SyncManager	SM0: Mailbox output SM1: Mailbox input SM2: Periodic data output SM3: Periodic data input

FMMU(Bus Memory Management Unit)	FMMU0: Periodic Data Output Zone FMMU1: Periodic Data Output Zone FMMU2: Mailbox status zone
Application Layer Protocol	CoE: CANopen over EtherCAT
Synchronization mode	DC Synchronization mode (SYNC0)
Communication object	SDO: Aperiodic data objects PDO: Periodic Data Objects
LED light(the indicator lamp is located on the RJ45 port)	EtherCAT ERR(ER) × 1 EtherCAT Link / Activity(L / A) × 2 EtherCAT RUN(RN) × 1
Application Layer Specification	IEC61800-7 CiA402 Drive Profile
Support CIA402 operating mode	Homing Mode(HM) Cycle Synchronized Position Mode(CSP) Cycle Synchronized Velocity Mode(CSV) Cycle Synchronized Torque Mode(CST)

7.Canopen operation mode

7-1.Homing Mode

7-1-1.Summary

Users can use this mode to let the driver search for the origin position, set the way to return to the origin, the speed and acceleration of the regression.

7-1-2.Operation steps

1. **【Mode of operations:6060h】** set to homing mode)(0x06).
2. set **【Homing method:6098h】** , the range is 1 to 35. (support method 1, 2, 3, 4, 5, 6, 33, 34, 35, 37)
3. set **【Homing speeds:6099h Sub-1】** , define the speed when searching for origin switches (unit: command unit/s)
4. set **【Homing speeds:6099h Sub-2】** , define the speed of finding origin (unit: command unit/s)
5. set**【Homing acceleration:609Ah】**, define the regression acceleration speed (unit: command unit/s²)
6. set **【Controlword:6040h】** to (0x06 > 0x07 > 0x0F) , enable the driver and make the motor work.
7. set **【Controlword:6040h】** to (0x0F > 0x1F) , find the (Home Switch) and regression.
8. read **【Statusword:6041h】** to get the driver status.

7-1-3.Related object table

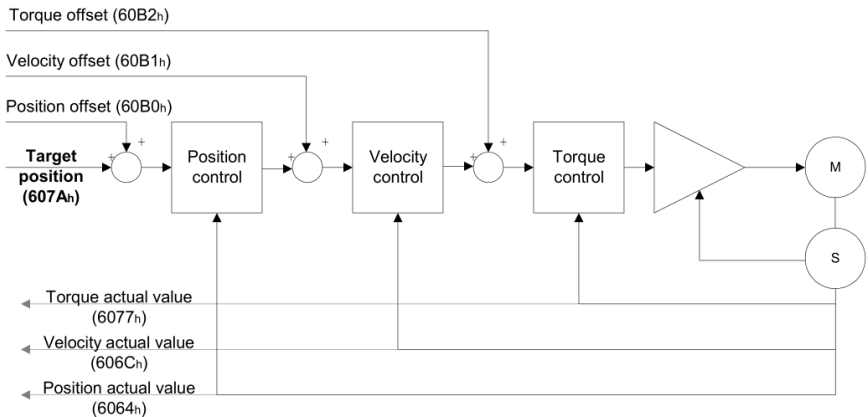
Index	Name	Units	Access
6040h	Controlword	-	RW
6041h	Statusword	-	RO
6060h	Modes of operation	-	RW
6061h	Modes of operation display	-	RO
6098h	Homing method	-	RW
6099h	Homing speed	Command unit/s	RW
609A	Homing acceleration	Command unit /s ²	RW

7-2.Cyclic Synchronous Position Mode

7-2-1.Summary

The host computer plans the path in CSP mode and sends the PDO in a specified period. When transmitting each PDO, the data of target position and control word will be transmitted to the driver at the same time.

7-2-2.CSP mode



7-2-3.Operation steps

1. set **【Mode of operations:6060h】** to cyclic synchronous position mode)(0x08).
2. set **【Interpolation time period:60C2h】** , settings must be the same as SYNC0 cycles.
 - 60C2h Sub-1 can set the Interpolation time units, the range is 1ms~20ms;
 - 60C2h Sub-2 can set the Interpolation time index, the value fixed at -3 indicates that Interpolation time unit is 10^{-3} seconds.
3. Drive PDO Rx:
 - Use 607Ah to set Target Pos Cmd (32-bit).

- Use 6040h Sub-0 to set control word.

7-2-4.Related object table

Index	Name	Units	Access
6040h	Control word	-	RW
6072h	Max torque	0.1%	RW
607Ah	Target Position	Command unit	RW
607Dh	Soft Position Limit	-	RW
	Number of entries	-	RW
607Bh	Position range limit	-	RW
	HighestSub-Index numbers	-	RW
60C5h	Max acceleration	Command unit /s ²	RW
60C6h	Max deceleration	Command unit /s ²	RW
60F2h	Positioning option code	-	RW

Detection classes related to CSP control mode

Index	Name	Units	Test result
6041h	Statusword	-	RO
6062h	Position demand value (command position)	Command unit	RO
6063h	Position actual internal value	pulse	RO
6064h	Position actual value		RO
6065h	Following error window	Command unit	RW
6066h	Following error timeout	1ms	RW
606Ch	Velocity actual value	Command	RO

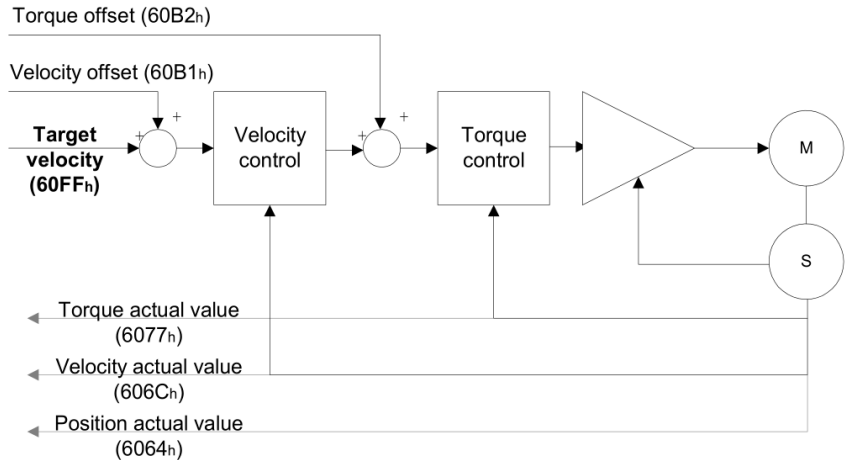
		unit /s	
6076h	Motor rated torque	mN m	RO
6077h	Torque actual value	0.1%	RO
60F4h	Following error actual value	Command unit	RO
60FAh	Control effort (Represents the output of internal instruction speed, position loop output)	Command unit	RO
60FCh	Position deamnd internal value (represents internal command position)	Command unit	RO

7-3.Cyclic Synchronous Velocity Mode

7-3-1.Summary

The host computer plans the speed in CSV mode and sends the PDO according to the specified period. When transmitting each PDO, the data of target velocity and control word will be transmitted to the driver at the same time.

7-3-2.The function of CSV mode



7-3-3.Operation steps

1. set **【Mode of operations:6060h】** to **Cyclic Synchronous Velocity Mode** (0x09) .
2. set **【Interpolation time period:60C2h】**, the settings should be same to the period of SYNC0.
 - 60C2h Sub-1 can set Interpolation time units, the range is 1ms~20ms.
 - 60C2h Sub-2 can set Interpolation time index, the value fixed at -3 indicates that Interpolation time unit is 10^{-3} seconds.
3. Drive PDO Rx:
 - Use 60FFh to set Target Velocity Cmd (32-bit)
 - Use 6040h Sub-0 to set the controlword

7-3-4.Related object table

Index	Name	Units	Access
6040h	Control word	-	RW
6072h	Max torque	0.1%	RW
60B1h	Velocity offset	Command unit/s	RW
60FFh	Target velocity	Command unit/s	RW

Detection classes related to csv control mode

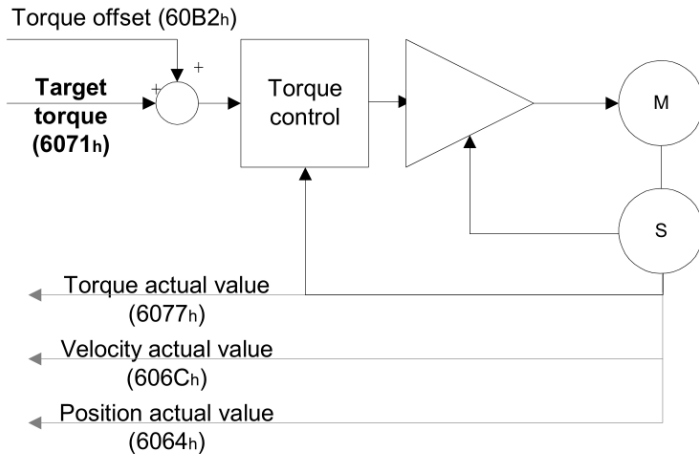
Index	Name	Units	Access
6041h	Statusword	-	RO
6063h	Position actual internal value	Pulse	RO
6064h	Position actual value	Command unit	RO
606Bh	Velocity demand value	Command unit /s	RO
606Ch	Velocity actual value	Command unit /s	RO
6074h	Torque demand value (command torque)	0.1%	RO
6076h	Motor rated torque	mN m	RO
6077h	Torque actual value	0.1%	RO

7-4.Cyclic Synchronous Torque Mode

7-4-1.Summary

The upper computer plans the torque in the CST mode. In this mode, the host computer transmits the target torque and control word data to the driver at the same time when transmitting each PDO.

7-4-2.The function of CST mode



7-4-3.Operation steps

1. set **【Mode of operations:6060h】** to Cyclic Synchronous Velocity Mode (0x09)
2. set **【Interpolation time period:60C2h】**, the settings should be same to the period of SYNC0
 - 60C2h Sub-1 can set the Interpolation time units, the range is 1ms~20ms.
 - 60C2h Sub-2 can set the Interpolation time index, the value fixed at -3 indicates that Interpolation time unit is 10^{-3} seconds.
3. Drive PDO Rx:
 - Use 6071h to set the Target Torque Cmd (16-bit)
 - Use 6040h Sub-0 to set the control word.

7-4-4.Related object table

Index	Name	Units	Access
6040h	Control word	-	RW
6071h	Target Torque	0.1%	RW
6072h	Max Torque	0.1%	RW
60B2h	Torque offset	0.1%	RW

Detection classes related to cst control mode

Index	Name	Units	Access
6041h	Status word	-	RO
6063h	Position actual internal value	Pulse	RO
6064h	Position actual value	Command unit	RO
606Ch	Velocity actual value	Command unit/s	RO
6074h	Torque demand	0.1%	RO
6075h	Motor rated current	mA	RO
6076h	Motor rated torque	mN m	RO
6077h	Torque actual value	0.1%	RO
6078h	Current actual value	0.1%	RO
6079h	DC link circuit voltage	mV	RO

8.Mode common function

8-1.Touch Probe Function

8-1-1.Summary

The probe function can be triggered by the SI terminal of CN0 or encoder, and the feedback position can be fixed to the rising or falling edge by the P-(SI5)/D-(SI6) input terminal of CN0. The fixed position time can be less than 5 s. This function can be used for high-speed measurement or packaging applications.

8-1-2.Operation steps

P5-62 corresponds to probe 1, P5-63 corresponds to probe 2 (must be allocated on SI5/SI6).

【Touch probe function: 60B8h】disable the probe in 60B8h, set the input terminal in P5-62/P5-63, then enable the object word 60B8h.

When reading the probe value, the corresponding probe value object (60BAh-60BDh) needs to be added to TxPDO.

8-1-3.Related object table

Index	Name	Units	Access
60B8h	Touch probe function	-	RW
60B9h	Touch probe status	-	RO
60BAh	Touch probe pos1 pos value	Command unit	RO
60BBh	Touch probe pos1 neg value	Command unit	RO
60BCh	Touch probe pos2 pos value	Command unit	RO
60BDh	Touch probe pos2 neg value	Command unit	RO

Users can get the current settings of probe function from object 60B8h. For the same probe, do not set the rising edge and the falling edge at the same time. Below is the bit description of

60B8h.

bit	value	note	
0	0	switch off Touch probe 1	stop/execute Touch probe1
	1	enable Touch probe 1	
1	0	Trigger first event	Touch probe1 mode selection
	1	Continuous	
2	0	Trigger with Touch probe1 input	Touch probe1 triggering selection (external input/Z phase)
	1	Trigger with zero impulse signal of position encoder	
3	0	Reserved	Not used
4	0	switch off sampling at positive edge of touch probe1	Touch probe1 rising edge selection
	1	enable sampling at positive edge of touch probe1	
5	0	switch off sampling at negative edge of touch probe1	Touch probe1 falling edge selection
	1	enable sampling at negative edge of touch probe1	
6-7	0	reserved	Retention parameters
8	0	switch off Touch probe 2	Stop/execute Touch probe2
	1	enable Touch probe 2	
9	0	Trigger first event	Touch probe2 mode selection (single/continuous)
	1	Continuous	
10	0	Trigger with Touch probe2 input	Touch probe2 triggering selection (external input/Z phase)
	1	Trigger with zero impulse signal of position encoder	

11	0	Reserved	Not used
12	0	switch off sampling at positive edge of touch probe2	Touch probe2 rising edge selection
	1	enable sampling at positive edge of touch probe2	
13	0	switch off sampling at negative edge of touch probe2	Touch probe2 falling edge selection
	1	enable sampling at negative edge of touch probe2	
14-15	0	reserved	Retention parameters

The user can get the current status of the probe from the object 60B9h. Below is description of the corresponding bits for 60B9h.

bit	value	note	
0	0	Touch probe1 is switch off	Probe 1 action stop
	1	Touch probe1 is enabled	Probe 1 action
1	0	Touch probe1 no positive edge value stored	Rising edge probe 1 incomplete state
	1	Touch probe1 positive edge value stored	Rising edge probe 1 completion state
2	0	Touch probe1 no negative edge value stored	Falling edge probe 1 incomplete state
	1	Touch probe1 negative edge value stored	Falling edge probe 1 completion state
3-5	-	reserved	Not used
6-7	-	Not supported	Not used
8	0	Touch probe2 is switch off	Probe 2 action stop
	1	Touch probe2 is enabled	Probe 2 action

9	0	Touch probe2 no positive edge value stored	Rising edge probe 2 incomplete state
	1	Touch probe2 positive edge value stored	Rising edge probe 2 completion state
10		Touch probe2 no negative edge value stored	Falling edge probe 2 incomplete state
		Touch probe2negative edge value stored	Falling edge probe 2 completion state
11-13	-	Reserved	Not used
14-15	-	Not supported	Not used

8-2.Position information

8-2-1.Electronic gear function

Index	Sub-Index	Name	Units	Access
608Fh	-	Position encoder resolution	-	RO
	00h	Highest Sub-Index supported	-	RO
	01h	Encoder increments	Pulse	RO
	02h	Motor revolutions	r (motor)	RO
6091h	-	Gear ratio	-	RW
	00h	Number of entries	-	RW
	01h	Motor revolutions	r (motor)	RW
	02h	Shaft revolutions	R (shaft)	RW
6092h	-	Feed constant	-	RW
	00h	Highest Sub-Index supported	-	RO
	01h	Feed	Command unit	RW
	02h	Shaft revolutions	R (shaft)	RW

【Gear ratio:6091h】

$$\text{Electronic gear ratio} = \frac{\text{Motor revolutions (6091h-01h)}}{\text{Shaft revolutions (6091h-02h)}}$$

【Position encoder resolution: 608Fh】

$$\text{Motor resolution} = \frac{\text{Encoder increments (608Fh-01h)}}{\text{Motor revolutions (608Fh-02h)}}$$

【Feed constant:6092h】

$$\text{Encoder frequency division ratio} = \frac{\text{Feed(6092h-01h)}}{\text{Shaft revolutions (6092h-02h)}}$$

The default value of motor resolution and encoder frequency division ratio is 1.

8-2-2. Initialization of absolute encoder

When absolute encoder is used in position control mode and multi-loop mode, it no needs to return to the origin.

8-2-3.Position range limit

If the value of [target position: 607A] exceeds [position range limit: 607B], perform wrap-around operation, do not change the factory value of 607B at - 01h and - 02h.

Index	Sub-Index	Name	Units	Access
607Ah	-	Position encoder resolution	-	RW
	00h	Highest Sub-Index supported	-	RW
607Bh	-	Position range limit	-	RW
	00h	Highest Sub-Index supported	-	RW
	01h	Min position range limit	Command unit	RW
	02h	Max position range limit	Command unit	RW

8-3. Interpolation time period

【Interpolation time period: 60C2h】 is set automatically according to the communication cycle, please do not change.

Communication period	60C2h-01h	60C2h-02h
250us	25	-5
500us	5	-4
1ms	1	-3
2ms	2	-3
4ms	4	-3

Index	Sub-Index	Name	Units	Access
60C2h	-	Interpolation time period	-	-
	00h	Highest Sub-Index supported	-	RO
	01h	Interpolation time period value	-	RW
	02h	Interpolation time index	-	RW

9. Parameter list

9-1. CoE object word

9-1-1. Communication Profile zone

Index		Name	Data type	Access
1000h	VAR	device type	UNSIGNED32	RO
1001h	VAR	error register	UNSIGNED8	RO
1600h~03h	RECORD	Receive PDO mapping	UNSIGNED32	RW
1A00h~03h	RECORD	Transmit PDO mapping	UNSIGNED32	RW

9-1-2.Driver Profile zone

Index		Name	Data type	Access
603Fh	VAR	Error Code	UNSIGNED16	RO
6040h	VAR	Controlword	UNSIGNED16	RW
6041h	VAR	Statusword	UNSIGNED16	RO
605Bh	VAR	Shutdown option code	INTEGER16	RW
605Eh	VAR	Fault reaction option code	INTEGER16	RW
6060h	VAR	Modes of operation	INTEGER8	RW
6061h	VAR	Modes of operation display	INTEGER8	RO
6062h	VAR	Position demand value [PUU]	INTEGER32	RO
6063h	VAR	Position actual value [increment]	INTEGER32	RO
6064h	VAR	Position actual value	INTEGER32	RO
6065h	VAR	Following error window	UNSIGNED32	RW
6067h	VAR	Position windows	UNSIGNED32	RW
6068h	VAR	Position window time	UNSIGNED16	RW
606Bh	VAR	Velocity demand value	INTEGER32	RO
606Ch	VAR	Velocity actual value	INTEGER32	RO
606Dh	VAR	Velocity window	UNSIGNED16	RW
606Eh	VAR	Velocity window time	UNSIGNED16	RW
606Fh	VAR	Velocity threshold	UNSIGNED16	RW
6071h	VAR	Target torque	INTEGER16	RW
6072h	VAR	Max torque	UNSIGNED16	RW

6074h	VAR	Torque demand value	INTEGER16	RO
6075h	VAR	Motor rated current	UNSIGNED32	RO
6076h	VAR	Motor rated torque	UNSIGNED32	RO
6077h	VAR	Torque actual value	UNSIGNED16	RO
6078h	VAR	Current actual value	INTEGER16	RO
607Ah	VAR	Target position	INTEGER32	RW
607Ch	VAR	Home Offset	INTEGER32	RW
607Dh	ARRAY	Software position limit	INTEGER32	RW
607Eh	VAR	Polarity	UNSIGNED8	RW
607Fh	VAR	Max profile velocity	UNSIGNED32	RW
6080h	VAR	Max motor speed	UNSIGNED32	RW
6081h	VAR	Profile velocity	UNSIGNED32	RW
6083h	VAR	Profile acceleration	UNSIGNED32	RW
6084h	VAR	Profile deceleration	UNSIGNED32	RW
6085h	VAR	Quick stop deceleration	UNSIGNED32	RW
6086h	VAR	Motion profile type	INTEGER16	RW
6087h	VAR	Torque slope	UNSIGNED32	RW
6093h	ARRAY	Position factor	UNSIGNED32	RW
6098h	VAR	Homing method	INTEGER8	RW
6099h	ARRAY	Homing speeds	UNSIGNED32	RW
609Ah	VAR	Homing acceleration	UNSIGNED32	RW
60B0h	VAR	Position offset	INTEGER32	RW
60B1h	VAR	Velocity offset	INTEGER32	RW
60B2h	VAR	Torque offset	INTEGER16	RW
60B8h	VAR	Touch probe function	UNSIGNED16	RW
60B9h	VAR	Touch probe status	UNSIGNED16	RO
60BAh	VAR	Touch probe pos1 pos	INTEGER32	RO

		value		
60BBh	VAR	Touch probe pos1 neg value	INTEGER32	RO
60BCh	VAR	Touch probe pos2 pos value	INTEGER32	RO
60BDh	VAR	Touch probe pos2 neg value	INTEGER32	RO
60C0h	VAR	Interpolation sub mode select	INTEGER16	RW
60C1h	ARRAY	Interpolation data record	UNSIGNED16/32	RW
60C2h	RECORD	Interpolation time period	SIGNED8	RW
60C5h	VAR	Max acceleration	UNSIGNED32	RW
60C6h	VAR	Max deceleration	UNSIGNED32	RW
60F2h	VAR	Positioning option code	UNSIGNED16	RW
60F4h	VAR	Following error actual value	INTEGER32	RO
60FCh	VAR	Position demand value	INTEGER32	RO
60FDh	VAR	Digital inputs	UNSIGNED32	RO
60FFh	VAR	Target velocity	INTEGER32	RW
6502h	VAR	Supported drive modes	UNSIGNED32	RO
Xinje custom area				
2000h~281Ah	VAR	Parameter Mapping	INTEGER16/32	RW

9-2.Driver parameters

9-2-1.Group P parameters

Modification and Effective Time:

○ Represents Servo OFF Modification, effective immediately;

√ means that it may be changed at any time and shall take effect immediately.

● represents need to re-energize to take effect after the change;

Adding “n.” before the parameter means the value is hex.

Parameter: PX-XX= n.xx xx _____

PX-XX.H ← | ↘ PX-XX.L

P0: Function selection parameter

P0-	Function	Unit	Default	Range	Effective	Suitable mode
00	Driver type 0: Common type 1: EtherCat type	-	1	0~1	○	All
01	Control mode 1 6: Origin Regression Model (HM) 8: Cyclic Synchronized Position Control Mode (CSP) 9: Cyclic Synchronization Speed Control Mode (CSV) 10: Cyclic Synchronized Torque Control Mode (CST)	-	8	1~10	○	All
02	Control Mode 2 (Description same as above)	-	8	1~10	○	All
03	Enabling mode: 0: Not enabled	-	3	0~3	○	All

	1:IO/SON Input Signal 2: Software enabled (panel/Modbus) panel F1-05 writes 1; Modbus writes 1 to 0x2105 register. Write 0 to cancel enablement 3: Bus Enablation					
04	Rigidity level	-	4	1-31	●	All
05	Selection of rotation direction	-	0	0~1	●	All
09	Forward direction of input pulse command	-	0	0~1	○	6、7
10 xxx □	0: CW/CCW 1: AB 2: P+D	-	2	0~2	○	6、7
10 x1x □	0: Falling edge is valid 1: Rising edge is valid	-	0	0~1	○	6、7
11	Set the low position of pulses per cycle ×1	-	0	0~999 9	√	6
12	Set the high position of pulses per cycle ×10000	-	1	0~655 35	√	6
13	Numerator of electronic gear	-	1	1~655 35	√	6
14	Denominator of electronic gear	-	1	1~655 35	√	6
15	Pulse Frequency Corresponding to Rated Speed in Speed Mode	*100 Hz	1000	0~100 00	○	7
16	Speed Instruction Pulse Filtering Time	0.01 ms	100	0~100 00	○	7
23	Pulse Deviation Limit	*256	1000	0~655	√	6

		com mand unit		35		
24	Discharge resistance type 0: built in 1: external	-	0	0~1	○	All
25	Discharge Resistance power	W	Related to driver power	0~655 35	√	All
26	Discharge Resistance value	Ω		0~655 35	√	All
27	Servo OFF Stop Mode 0: Inertial operation stops and remains in inertial operation state after stopping. 2: The deceleration operation stops, and the inertia operation state is maintained after the stop.	-	0	0、 2	○	All
28	Servo Overrun Stop Mode 0: deceleration stop, after stop, overrun direction moment is 0, receive instructions. 1: Inertia stops, after stopping, overrun direction moment is 0, receiving instructions. 2: The deceleration stops, after stopping, the overrun direction does not receive instructions. 3: Alarm (E-260)	-	0	0~3	○	All
29	Servo Alarm Stop Mode 0: Inertial operation stops and remains in inertial operation state	-	0	0、 2	○	All

	after stopping. 2: The deceleration operation stops, and the inertia operation state is maintained after the stop.					
30	Stopping overtime time	0.1ms	2000	0~65535	○	All
33	Motor code	-		0~65535	●	All
69	Fan power on 0: Turn on the fan with temperature greater than 45 degrees and turn off the fan with temperature less than 42 degrees (hysteresis 3 degrees Celsius) 1: Turn on the fan after enabling, turn off the fan when enabling.		1	0/1	○	All
74	Blocking alarm time	1ms	0	0-65535	○	
75	Blocking alarm speed	1rpm	50	5~9999	○	All
92	Low position of electronic gear numerator	-	1	1~9999	√	6
93	High position of electronic gear numerator*10000	-	1	1~65535	√	6
94	Low position of electronic gear denominator	-	1	1~9999	√	6
95	High position of electronic gear denominator*10000	-	1	1~65535	√	6

P1

P1-	Name	Unit	Default	Range	Effective	Suitable mode
00	The gain of speed loop (fit for auto-tuning mode)	1Hz	200	10~20000	√	All
01	speed loop integral time(fit for auto-tuning mode)	0.1ms	3300	15~51200	√	All
02	The gain of position loop (fit for auto-tuning mode)	1/s	200	10~20000	√	All
03	Speed feedback filter time (fit for auto-tuning mode)	1/s	50	0~65535	√	All
22	First-order filtering time of speed instruction	0	-	0~1	○	3.4.7
23	Speed Instruction Smoothing Filtering Time	0	0.1ms	0~65535	○	3.4.7
24	First-order filtering time of position instruction	0	-	0~1	○	3.4.7
25	Position Instruction Smoothing Filtering Time	0	0.1ms	0~65535	○	6.10

P2

P2-	Name	Unit	Default value	Range	Effective	Suitable mode
00.0	Disturbance observer switch	-	0	0000-000f	●	All
01.1	auto-tuning mode selector switch 0: auto-tuning, 1: self-adaptive		1	0/1	●	All

00.2	Dead zone compensation switch	-	0	0000-000f	●	All
03.3	Self-adaptive mode switch	-	0	0/1	●	All
05	Speed loop gain in adaptive mode	-	400	1~65535	●	All
07	Load inertia ratio in adaptive mode	-	0	0~10000	●	All
08	Speed observer gain	-	60	1~10000	●	All
12	Stable max inertia ratio in adaptive mode		30	1~10000	●	All
19	Adaptive control band width	-	50	1~100	●	All
35	Torque filter time	0.01ms	100	0~65535	√	All
41	Disturbance observer gain	-	100	10~1000	√	All
49	Model loop gain	0.1ms	100	10~20000	√	All
69.0	First trapped wave switch (auto-tuning mode)	-	0	0~1	√	All
69.1	Second trapped wave switch (auto-tuning mode)	-	0	0~1	√	All
69.3	Fourth trapped wave switch (auto-tuning mode)	-	0	0~1	√	All
71	First trapped wave frequency (auto-tuning mode)	Hz	5000	50~5000	√	All
74	Second trapped wave frequency (auto-tuning mode)	Hz	5000	50~5000	√	All
77	Fourth trapped wave frequency (auto-tuning mode)	Hz	5000	50~5000	√	All

P3: speed control

P3-XX	Name	Unit	Default value	Range	Effective	Suitable mode
00	V-REF Function Allocation 0:V-REF is input as speed instruction. 1:V-REF will be used as the input reference value of the external speed limit. The actual speed limit depends on the external analog speed limit. 2: Speed Feedforward	—	0	0~2	○	1、2、4、6
03	Speed instruction input dead zone voltage	0.001v	0	0~500	√	4
05	Preset speed 1	rpm	0	-9999~+9999	√	3
06	Preset speed 2	rpm	0	-9999~+9999	√	3
07	Preset speed 3	rpm	0	-9999~+9999	√	3
09	Acceleration time	ms	0	0~65535	○	3、4
10	Deceleration time	ms	0	0~65535	○	3、4
11	Reserved	—	—	—	—	—
12	Zero speed clamp mode 0: ZCLAMP input signal is ON, forced speed	—	0	0~2	○	3、4、7

<p>command is 0. When the speed below P3-13, switch to position mode and the servo locked in this position</p> <p>1: ZCLAMP input signal is ON, forced set speed command to 0</p> <p>2: ZCLAMP input signal is ON, speed below P3-13 switch to position mode and the servo locked in this position</p> <p>Note: after entering zero clamp mode, setting speed is higher than P3-13, motor still cannot work, it needs the ZCLAMP input signal to be OFF to exit zero clamp mode, then the motor can work again.</p> <p>3: ZCLAMP input signal is ON, and the setting speed is below P3-13, switch to position control mode, and servo locked in this position. At this time, when the setting speed is</p>					
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	higher than P3-13, motor work again.					
13	Zero speed clamp speed	rpm	10	0~300	○	3、4
14	Forward max speed command limit	rpm	Related to motor	30~10000	○	All
15	Reverse max speed command limit	rpm	Related to motor	30~10000	○	All
16	Internal forward speed limit in torque control mode	rpm	Related to motor	30~10000	√	1、2
17	Internal reverse speed limit in torque control mode	rpm	Related to motor	30~10000	√	1、2
18	Jog speed	rpm	100	0~1000	○	All
19	Forward warning speed	rpm	Related to motor	0~10000	○	All
20	Reverse warning speed	rpm	Related to motor	0~10000	○	All
21	Forward alarm speed	rpm	Related to motor	0~10000	○	All
22	Reverse alarm speed	rpm	Related to motor	0~10000	○	All
23	T-REF Function Allocation 0: Input as Torque Instruction 1: Compared with	—	0	0~2	○	All

	P3-28/P3-29, the minimum value is valid, as a necessary condition for limiting input of external torque. 2: Torque Feedforward					
28	Internal forward torque limit	%	300	0~300	√	All
29	Internal reverse torque limit	%	300	0~300	√	All
30	External forward torque limit	%	300	0~300	√	2、3、4、6、7
31	External reverse torque limit	%	300	0~300	√	2、3、4、6、7
32	Brake torque	1%	100	0~300	√	All
33	Preset torque	%	0	-300~300	√	1
37	Gravity compensation	0.1% rated current	0	-3000~3000	√	All
38	Gravity compensation coefficient	1% coefficient	100	0~100	√	All
Note: compensation rated current percentage = $(P0-37/1000)*(P3-38/100)$						

P4: internal position parameter (not open for customers now)

P4-	Name	Unit	Default value	Range	Effective	Suitable mode
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0 .xxx□	Pass Z phase signal times after leaving the limit switch	-	2	1~F	○	5、6
0. xx□x	Find origin function 0: OFF 1: ON	-	0	0~1	○	5、6
01	Hit proximity switch speed	1rpm	600	0~50000	○	5、6
02	Leaving proximity switch speed	1rpm	100	0~50000	○	5、6
03	Internal position mode	-	n.0000		○	5
04	Effective segment number		1	1-35	○	5
10	First segment pulse (low byte)	1 pulse	0	-9999~99 99	○	5
11	First segment pulse (high byte)	10000 pulses	0	-32767~3 2767	○	5
12	First segment speed	0.1rpm	0	0~10000	○	5
13	First segment acceleration time	1ms	0	0~65535	○	5
14	First segment deceleration time	1ms	0	0~65535	○	5
15	Reserved	-	-	-	-	5
16	Adjustment time	1ms	0	0~65535	○	5
P4-17~P4-23 are internal position segment 2 parameters, the following total 35 segments.						
Note: (1) setting pulse number = pulse numbers (high byte)×10000+pulse number(low byte) (2) total 35 segments. Segment 1~12 parameters can be set through operate panel, segment 13~35 can write in parameters through communication (RS232 or RS485).						

P5: signal setting

P5-	Name	Unit	Def ault	Range	Effec tive	Suita ble mode
00	Positioning finished width /COIN	Comman d unit	7	0~65535	○	6
01	Positioning finished checking mode 0: offset absolute value below P5-00, output COIN signal 1: offset below P5-00 after command finished, output COIN signal 2: command finished, motor speed below P5-03 and offset absolute value below P5-00, output COIN signal 3: command finished, offset absolute value below P5-00, output COIN signal. If COIN keeps the time P5-02, output COIN-HOLD signal.	-	0	0~3	○	6
02	Positioning finished hold time	ms	0	0~65535	○	6
03	Rotation checking speed	rpm	50	0~10000	○	All
04	Same speed checking speed	rpm	50	0~10000	○	3、4、 7
05	Reach checking speed	rpm	100 0	0~10000	○	3、4、 7
06	Positioning near output width	Comman d unit	50	0~65535	○	6
07	Servo OFF delay time	ms	0	0~65535	○	All

08	Brake command output speed	rpm	30	0~10000	○	All
09	Brake command waiting time	ms	500	0~65535	○	All
10	User-defined output 1 trigger condition	-	0	0~FFFF	○	All
11	Set a value that compares with the trigger condition of custom output 1	Related to the trigger condition	0	-9999~9999	○	All
12	0: P5-10 \geq P5-11, output SOx 1: P5-10<P5-11, output SOx 2: P5-10 absolute value \geq P5-11, output SOx 3: P5-10 absolute value <P5-11, output SOx	-	0	0~3	○	All
13	custom output 1 hysteresis	Related to the trigger condition	0	0~65535	○	All
14	Custom output 2 trigger condition	-	0	0~FFFF	○	All
15	Set a value that compares with the trigger condition of custom output 2	Related to the trigger condition	0	-9999~9999	○	All
16	0: P5-14 \geq P5-15, output SOx 1: P5-14 \leq P5-15, SOx output 2: P5-14 absolute value \geq P5-15, output SOx 3: P5-14 absolute value <P5-15, output SOx	-	0	0~3	○	All

17	custom output 2 hysteresis	Related to the trigger condition	0	0~65535	○	All
18	IO filter time	ms	0	0~10000	○	All
19	Z phase signal pulse width	ms	2	2~20	√	All
20	/S-ON servo signal 0000: signal is always invalid 0001: input positive signal from SI1 0002: input positive signal from SI2 0003: input positive signal from SI3 0004: input positive signal from SI4 0010: signal is always valid 0011: input negative signal from SI1 0012: input negative signal from SI2 0013: input negative signal from SI3 0014: input negative signal from SI4	—	000 1	※1	√	All
21	/P-CON proportion action command Ditto	—	0	※1	√	All
22	/P-OT forward drive ban ditto	—	000 3	※1	√	All
23	/N-OT reverse drive ban ditto	—	000 4	※1	√	All
24	/ALM-RST alarm clean ditto	—	000 2	※1	√	All
25	/P-CL forward side external torque limit ditto	—	0	※1	√	All

26	/N-CL reverse side external torque limit ditto	—	0	※1	√	All
27	/SPD-D internal speed direction choice ditto	—	0	※1	√	1、2、3、4
28	/SPD-A internal setting speed choice ditto	—	000 0	※1	√	3、6
29	/SPD-B internal setting speed choice ditto	—	0	※1	√	3、6
30	/C-SEL control mode choice ditto	—	0	※1	√	All
31	/ZCLAMP zero clamp ditto	—	0	※1	√	3、4、7
32	/INHIBIT command pulse ban ditto		0	※1	√	6
33	/G-SEL gain switching ditto	—	0	※1	√	All
34	/CLR pulse offset clean ditto	—	0	※1	√	6
37	/COIN_HD positioning finished hold 0000: not output to the terminal 0001: output positive signal from SO1 0002: output positive signal from SO2 0003: output positive signal from SO3		0	※2	√	6

	0011: output negative signal from SO1 0012: output negative signal from SO2 0013: output negative signal from SO3					
38	/COIN positioning finished ditto	—	000 1	※2	√	6
39	/V-CMP same speed checking ditto	—	0	※2	√	3、4、 7
40	/TGON rotation checking ditto	—	0	※2	√	All
41	/S-RDY ready ditto	—	000 0	※2	√	All
42	/CLT torque limit ditto	—	0	※2	√	3、4、 6、7
43	/VLT speed limit checking ditto	—	0	※2	√	1、2、 6
44	/BK brake lock Ditto	—	0	※2	√	All
45	/WARN warning ditto	—	0	※2	√	All
46	/NEAR near ditto	—	0	※2	√	6
47	/ALM alarm ditto	—	000 2	※2	√	All
48	/Z phase encoder signal	—	0	※2	√	All
51	/V-RDY speed arrived	—	0	※2	√	3、4、

						7
52	/Custom Output 1 Output Port Settings	—	0	※2	○	All
53	/Custom Output 2 Output Port Settings	—	0	※2	○	All
57	PREFA segment 1 internal position	—	0	※1	√	5
58	PREFB segment 2 internal position	—	0	※1	√	5
59	PREFC segment 3 internal position	—	0	※1	√	5
62	Probe function 1	—	0	0005	○	
63	Probe function 2	—	0	0006	○	

P6: signal parameters (some parameters are reserved)

P6-	Name	Unit	Default value	Range	Effective	Suitable mode
05	Speed loop gain in adaptive large inertia mode	-	200	1-65535	●	All
07	Load inertia ratio in adaptive large inertia mode	-	50	0-10000	●	All
08	Position loop gain in adaptive large inertia mode	-	40	1-10000	●	All
12	Stable max inertia ratio in adaptive large inertia mode	-	50	1-10000	●	All

P7: communication parameters (not support RS485 communication)

P7-	Name		Unit	Default value	Range		Effective	Suitable mode
00	RS485 station no.		-	1	1~255		○	All
01	RS485 parameter	n.xx□□	Baud rate	06	00~10 00: 300 01: 600 02: 1200 03: 2400 04: 4800 05: 9600 06: 19200 07: 38400 08: 57600 09: 115200	0A: 192000 0B: 256000 0C: 288000 0D: 384000 0E: 512000 0F: 576000 10: 768000 11: 1M 12: 2M 13: 3M 14: 4M 15: 5M 16: 6M	○	All
		n.x□□□	Stop bit	2	0: 2 bits 2: 1 bit		○	All
		n.□xxx	Parity bit	2	0~2 0: no parity 1: odd parity 2: even parity		○	All
		Note: data bit cannot be selected, it is 8-bit.						
02	RS485 communication protocol		—	1	1: Modbus Rtu 2: Xnet		○	All
03	Xnet synchronous		1ms	9	1~500		○	All

	sampling time					
04	Xnet slave station data	—	15	1~500	○	All
05	Xnet slave station numbers	—	10	1~256	○	All
06	Communication overtime retry times	time	10	1~500	○	All
07	Fieldbus command update period	1us	3000	1~65535	○	All
10	RS232 station no.	—	1	1~255	○	All
11	RS232 parameter	—	2206	Parameter same to P7-01	○	All
20	Back to zero direction (fieldbus)	—	1	-9999~9999	○	All
	Note: the positive and negative value means the direction of back to zero, positive value means finding origin in forward direction, negative value means find origin in reverse direction, absolute value means finding Z phase numbers when backing to zero.					
21	Filter time after backing to zero(fieldbus)	0.25ms	400	1~65535	○	All
	Note: after find the zero position, back to position mode and there is no position offset, the back to zero process is completed after keeping the time of this parameter, then send back to zero complete flag to PLC.					

Table 1 Input signal allocation

input terminal	Servo model	Setting range
P5-20~P5-36	DS5C series	n.0000~n.0003
P5-57~P5-59		n.0010~n.0013

Table 2 Output Signal Allocation

output terminal	Servo model	Setting range
P5-37~P5-53	DS5C series	n.0000~n.0003 n.0010~n.0013

9-2-2.Group F parameters

Code	Explanation
F0-00	Clean the alarm
F0-01	Back to out of factory settings
F0-02	Clean the position offset
F1-00	Jog run
F1-01	Test run
F1-02	Current sampling zero calibration
F1-05	Panel enable
F1-06	Absolute encoder clear the rotate numbers

9-2-3.Group U parameters

U0-XX:

Number	Contents	Unit
U0-00	Actual speed of motor	Rpm
U0-01	Input speed command	Rpm
U0-02	Torque command	% rated

U0-03	Mechanical angle		1 °
U0-04	Electric angle		1 °
U0-05	Bus voltage		V
U0-06	IPM temperature		0.1°C
U0-07	Torque feedback		% rated
U0-08	Pulse offset value	(0000~9999) *1	Command pulse
U0-09		(0000~9999) *10000	
U0-10	Encoder feedback value	0000~9999	encoder pulse
U0-12	Pulse value of input command	(0000~9999) *1	Command pulse
U0-13		(0000~9999) *10000	
U0-14	Position feedback	(0000~9999) *1	Command pulse
U0-15		(0000~9999) *10000	
U0-16	Encoder position (Accumulated)	(0000~9999) *1	Encoder pulse
U0-17		(0000~9999) *10000	
U0-18	torque current		0.01A
U0-19	Analog input V-REF value		0.001V
U0-20	Analog input T-REF value		0.001V
U0-21	Input signal status 1		
U0-22	Input signal status 2		
U0-23	Output signal status 1		
U0-24	Output signal status 2		
U0-25	Input pulse frequency	(0000~9999) *1	Hz
U0-26		(0000~9999) *10000	
U0-41	Instantaneous output power		1W
U0-42	Average output power		1W
U0-43	Instantaneous thermal power		1W

U0-44	Average thermal power	1W
U0-49	Position feedforward	1 command unit
U0-50	Speed feedforward	rpm
U0-51	Torque feedforward	% rated
U0-52	Instantaneous bus capacitor power	1W
U0-53	Average bus capacitor power	1W
U0-55	Instantaneous regenerative braking discharge power	1W
U0-56	Average regenerative braking discharge power	1W
U0-57	Absolute encoder present position feedback	Read the address 0x1039 value(dword) through modbus-rtu, which is present encoder position with positive or negative pulses.
U0-58		

U1-XX:

Number	Contents	Unit
U1-00	Current alarm code	
U1-01	Current warning code	
U1-02	U phase current when alarming	0.01A
U1-03	V phase current when alarming	0.01A
U1-04	Bus voltage when alarming	V
U1-05	IGBT temperature when alarming	0.1°C
U1-06	Torque current when alarming	0.1A
U1-07	Excitation current when alarming	A
U1-08	Position offset when alarming	Command pulse

U1-09	Speed value when alarming	rpm
U1-10	The alarm occurred time second (low 16 bits), count from the first time power on	s
U1-11	The alarm occurred time second (high 16 bits), count from the first time power on	s
U1-12	Run error times, count from power on this time	
U1-13	Warning times, count from power on this time	
U1-14	History alarm times	
U1-15	History warning times	
U1-16	The second time alarm code recently	
U1-17	The third time alarm code recently	
U1-18	The fourth time alarm code recently	
U1-19	The fifth time alarm code recently	
U1-20	The sixth time alarm code recently	
U1-21	The second time warning code recently	
U1-22	The third time warning code recently	
U1-23	The fourth time warning code recently	
U1-24	The fifth time warning code recently	
U1-25	The sixth time warning code recently	

U2-XX:

Number	Contents	Unit
U2-00	Power on times	
U2-01	Series	
U2-02	Model (low 16-bit)	
U2-03	Model (high 16-bit)	
U2-04	Out of factory: year	

U2-05	Out of factory date: year		
U2-06	Out of factory date: month		
U2-07	Out of factory date: day		
U2-08	Firmware version		
U2-09	Total run time (from the first time power on)		Hour
U2-10	Total run time (from the first time power on)		Minute
U2-11	Total run time (from the first time power on)		Second
U2-12	This time run time (from this time power on)		Hour
U2-13	This time run time (from this time power on)		Minute
U2-14	This time run time (from this time power on)		Second
U2-15	Average output power (count from the first time enable)		1W
U2-16	Average heating power (count from the first time enable)		1W
U2-17	Average bus capacitor filter power(from the first time power on)		1W
U2-18	Motor accumulative	(0000~9999) *1	circle
U2-19	circles	(0000~9999) *10000	circle
U2-20	Device serial number: low 16 bits		
U2-21	Device serial number: high 16 bits		
U2-22	Firmware generation date: year		
U2-23	Firmware generation date: month/day		
U2-24	Firmware generation time: hour/minute		

Appendix

Appendix 1 motor specification table

Voltage level	220V			
Motor model MS	5S-40ST-	5S-60ST	5H-60ST	5S-60ST-
	CS00330	CS00630	CS00630	CS01330
	-20P1-S01/S02	-20P2-S01/S02	-20P2-S01/S02	20P4-S01/S02
Motor code (no brake/with brake)	5022/5822	5003/5803	5803/58C3	5004/5804
Encoder bit numbers	17	17	17	17
Polar logarithm	4	5	5	5
Rated speed [rpm]	3000	3000	3000	3000
Max speed [rpm]	6000	6500	6500	6500
Rated torque [Nm]	0.32	0.64	0.64	1.27
Max torque [Nm]	0.96	1.92	1.92	4.45
Overload multiples	3	3.5	3.5	3.5
Rated current [mA]	950	1900	1900	2800
Max current [mA]	2850	6650	6650	9800
Phase resistor [mΩ]	5780	2410	2410	1705
Phase inductance [mH]	5675	5150	5150	2910
Rotor inertia [10 ⁻⁷ kg.m ²]	44	137	137	258
Back EMF constant [V/krpm]	34	35	35	42

Rated output power [W]	100	200	200	400
Protection level	IP65			
Motor insulation level	Class F (155°C)			
Ambient temperature	-15°C~+40°C			
Ambient humidity	Relative humidity < 90% (no condensation)			

Voltage level	220V		
Motor model MS	5H-60ST	5S-80ST	5H-80ST
	CS01330	CS02430	CS02430
	-20P4-S01/S02	-20P7-S01/S02	-20P7-S01/S02
Motor code (no brake/with brake)	50C4/58C4	5011/5811	50D1/58D1
Encoder bit numbers	17	17	17
Polar logarithm	5	5	5
Rated speed [rpm]	3000	3000	3000
Max speed [rpm]	6500	5200	5200
Rated torque [Nm]	1.27	2.39	2.39
Max torque [Nm]	4.45	7.17	7.17
Overload multiples	3.5	3	3
Rated current [mA]	2800	4000	4000
Max current [mA]	9800	12000	12000
Phase resistor [mΩ]	1665	990	990

Phase inductance [mH]	2810	3300	3300
Rotor inertia [10 ⁻⁷ kg.m ²]	648	902	1650
Back EMF constant [V/krpm]	42	54	54
Rated output power [W]	400	750	750
Protection level	IP65		
Motor insulation level	Class F (155°C)		
Ambient temperature	-15°C~+40°C		
Ambient humidity	Relative humidity < 90% (no condensation)		

Appendix 2. List of Servo Drive and Motor Matching

Motor model	Motor code	Adapter driver	Voltage level
MS5S-80ST-CS02430-20P7-S01/S02	5011	DS5C-20P7-PTA	Single-phase 220V
MS5S-80ST-CS02430BZ-20P7-S01/S02	5811	DS5C-20P7-PTA	Single-phase 220V
MS5H-80ST-CS02430B-20P7-S01/S02	50D1	DS5C-20P7-PTA	Single-phase 220V
MS5H-80ST-CS02430B-20P7-S01/S02	58D1	DS5C-20P7-PTA	Single-phase 220V
MS5S-60ST-CS01330B-20P4-S01/S02	5004	DS5C-20P4-PTA	Single-phase 220V
MS5S-60ST-CS01330BZ-20P4-S01/S02	5804	DS5C-20P4-PTA	Single-phase 220V
MS5H-60ST-CS01330B-20P4-S01/S02	50C4	DS5C-20P4-PTA	Single-phase 220V
MS5H-60ST-CS01330BZ-20P4-S01/S02	58C4	DS5C-20P4-PTA	Single-phase 220V

MS5S-60ST-C00630B-20P2-S01/S02	5003	DS5C-20P2-PTA	Single-phase 220V
MS5S-60ST-C00630BZ-20P2-S01/S02	5803	DS5C-20P2-PTA	Single-phase 220V
MS5H-60ST-C00630B-20P2-S01/S02	50C3	DS5C-20P2-PTA	Single-phase 220V
MS5H-60ST-C00630BZ-20P2-S01/S02	58C3	DS5C-20P2-PTA	Single-phase 220V
MS5S-40ST-CS00330B-20P1-S01/S02	5022	DS5C-20P1-PTA	Single-phase 220V
MS5S-40ST-CS00330BZ-20P1-S01/S02	5822	DS5C-20P1-PTA	Single-phase 220V

Note: The motor is divided into large inertia, small inertia and brake motor, and the motor codes are different from each other.

For example: 5003:200W small inertia motor

50C3:200W Large Inertia Motor

5083:200W brake motor

Appendix 3. Alarm list

		Code	Contents	Reason	Solution
01	0	E-010	Hardware version not match	The hardware version is error	Contact us
	2	E-012	System loading error	The program damaged	Contact us
	3	E-013	FPGA loading error	1. program damaged 2. hardware damaged	Contact us
	4	E-014	FPGA visiting error	1. program damaged 2. hardware damaged 3. external interference is too serious	Contact us
	5	E-015	Program running error	Program damaged	Contact us
	6	E-016	CPU running error	Hardware damaged	Contact us
	7	E-017	CPU running overtime	Program damaged	Contact us
	8	E-018	FPGA running overtime	Program damaged	Contact us
	9	E-019	System password error	Program damaged	Contact us
	02	0	Parameter loading error	Parameter self-checking cannot pass	Re-power the servo to restore default setting or contact us
1		Parameter	The setting	Check the parameters	Parameter out of

		out of range	value out of range	and set again	range
	2	Parameter conflict	TREF or VREF function setting conflict	1. P0-01=4, P3-00=1 will alarm	Parameter conflict
	3	Sampling channel setting error	User-defined output trigger channel or data monitor channel setting error	Check the setting parameter	Sampling channel setting error
	4	Parameter lost	Power supply voltage too low	1.for single phase 220V, connect L1, L3 2. set the parameter again	Parameter lost
	5	Erase flash error	Parameter store error when power off	Contact us	Erase flash error
	6	Initialize flash error	Flash chip power supply not stable	Contact us	Initialize flash error
02	8	E-028	Data Reading Failure in Communication	1. Poor cable contact or disconnection 2. Abnormal data communication between driver and motor	1. Check communication wiring 2. Re-energize and power off
03	0	Bus overvoltage	1. power grid voltage too high	1. check the grid fluctuation	Bus overvoltage (220V: $U_{0-05} \geq$

		e (220V: U0-05 \geq 390 alarm, 380V: U0-05 \geq 780V alarm)	2. not connect regenerative resistor 3. regenerative damaged or resistor too large	2. connect regenerative resistor 3. check if the regenerative resistor matched power	390 alarm, 380V: U0-05 \geq 780V alarm)
04	0	Bus undervoltage(220V: U0-05 \leq 140. 380V: U0-05 \leq 300)	1. Power grid voltage too low 2. instant power off	1. check the grid fluctuation 2. use constant voltage source	Bus undervoltage(220V: U0-05 \leq 140. 380V: U0-05 \leq 300)
	1	Drive power off	Drive power cut off	Check the power supply	Drive power off
	3	Bus voltage charging failure	Hardware damage	Please note if there is relay ON/OFF sound when drive power on	Bus voltage charging failure
06	0	E-060	Module temperature too high	1. long time running with large load 2. environment temperature too high 3. fan has error	1. consider change the motor capacity(monitor U0-02, motor present torque)

					<p>decrease the load</p> <p>2. good ventilation, decrease environment temperature</p> <p>3. check if the fan works when servo enabled, module temperature</p> <p>U0-06\geq45°C, fan will work.</p>
	1	E-061	Motor temperature too high	<p>1. long time running with large load</p> <p>2. environment temperature too high</p>	<p>1. decrease the load</p> <p>2. good ventilation</p>
	2	E-062	Drive too cold	<p>1. Environment temperature is too low</p> <p>2. drive temperature collection chip</p>	The environment must up to 0°C
07	0	E-070	Overcurrent	<p>1.Driver U/V/W Output Short Circuit</p> <p>2. Motor failure</p> <p>3. The load part is blocked.</p>	<p>1. Replace the damaged motor and check the UVW connection of the motor.</p> <p>2. It is suggested that the motor be</p>

					operated on an empty shaft to eliminate the load problem.
08	0	E-080	Over speed	<ul style="list-style-type: none"> 1. motor speed too fast 2. motor UVW connection error 3. parameters error 	<ul style="list-style-type: none"> 1. check if there is external force make the motor over speed 2. check UVW wiring 3. actual speed larger than P3-21/P3-22 will alarm
09	2	E-092	Analog Tref Zero-Calibration Overrun	Analog zero calibration operation error	Please not add analog value when calibrating
	3	E-093	Analog Vref Zero-Calibration Overrun	Analog zero calibration operation error	Please not add analog value when calibrating
10	0	E-100	Position offset too large	The difference between setting position and actual position is over the limit	<ul style="list-style-type: none"> 1. check whether the motor stall, decrease the position setting speed 2. increase the offset pulse limit P0-23
11	0	E-110	Motor UVW	1、external short	1. check motor

			short circuit	circuit when self-checking 2、 load blocked	UVW wiring 2. change drive 3. change motor 4. suggest to run without load, to troubleshoot load problem
12	0	E-120	Current sensor error	Current sensor damaged or external interference too large	Check the ground wiring or contact us
	1	E-121	U phase current sampling zero calibration value error	Current sensor damaged or external interference too large	Check the ground wiring or contact us
	2	E-122	V phase current sampling zero calibration value error	Current sensor damaged or external interference too large	Check the ground wiring or contact us
13	0	E-130	AB or UVW phase of motor orthogonal encoder break	AB or UVW phase break during self-inspection	1. check encoder cable wiring, use multi-meter to measure the connection 2. change motor
14	2	E-142	Z-phase of motor encoder break	Z-phase break during self-inspection	Disconnect the power supply of the driver to check whether the line is connected

					properly. Re-energize after eliminating errors
15	0	E-150	Motor U/V/W phase break	UVW phase break during self-inspection	Check power line U/V/W connection is normal
16	0	E-160	Motor output power overload	Motor output power over the rated power	1. Change larger power motor 2. Check the motor shaft wiring
	1	E-161	The heating power overload	Motor overheating	1、P0-33 confirm motor code 2. check the motor shaft connection 3. change larger power motor
	4	E-164	The bus capacitor overload	Power supply not stable, motor load too large, cause the bus capacitor charge frequently	1. use 3 phase 220V power supply for 220V drive 2. change larger power motor
	5	E-165	Prevent from blocking alarm	When the blocking time reached P0-74 (S) and motor speed lower than(1rpm), current	1. monitor U0-02 motor torque, check if P3-28, P3-29

				motor output torque larger than P3-28, P3-29, it will alarm	torque setting is suitable 2. check external mechanical structure and installation
	6	E-166	Motor temperature too high	11KW and 15KW large power motor encoder cover is installed thermistor, will alarm when the temperature is higher than 85 °	1. check if the machine has blocked. 2. if the motor is running over speed at high torque
17	0	E-170	Motor undervoltage when running	Bus voltage too low when running	1. check the power grid voltage fluctuation 2. wait the bus voltage stable, then repower on
20	0	E-200	Regenerative resistor overload	Regenerative resistor discharging power over the rated	Change larger power regenerative resistor
	1	E-201	Regenerative resistor discharge too long time	Regenerative resistor connection error or value too large	Change small value resistor and check the wiring
22	0	E-220	Absolute	Encoder not connect or	Cut off drive

			encoder communication error	contactor not good	power, check encoder wiring, use multi-meter test the connection
				received encoder data error, and error time over encoder error time register P0-56 value	Not put the encoder wire together with the strong power supply cable, install filter at servo drive power supply input side, install magnet ring around encoder wire, far away from large noise equipment
2	E-222	Absolute encoder battery voltage low (version 3.4 can shield this alarm)	1. The battery voltage is lower than 3.2V 2. new motor alarm when power on	1. Please change new battery when the servo power is on, the battery is no.5 3.6V 2. if disconnect encoder cable with motor, the motor current position will	

					lose and servo will alarm, set F0-00=1 to clear this alarm
	3	E-223	Absolute encoder data visit alarm	Encoder problem, or power supply is not stable	Unplugging the encoder cable without battery will alarm
	4	E-224	Absolute encoder overspeed	Large change of encoder data	Unplugging the encoder cable without battery will alarm
22	8	E-228	Absolute encoder counting value overflow	Motor run at same direction for long time , the encoder value too large	1. set F1-06=1 clear the encoder rotate numbers 2. set P0-79=1 can shield this alarm
26	0	E-260	Over range alarm	detected the over range signal and the over range mode is alarm	If it no need to alarm after over range, user can change the over range signal mode
	1	E-261	Over range signal connection error	1. motor run forward and encounter the reverse over range signal 2. motor run reverse	Check the over range connection and over range terminal distribution

				and encounter the forward over range signal	
	2	E-262	Control stop over time	<ol style="list-style-type: none"> 1. inertia too big 2. stop overtime too short 3. brake torque too small 	<ol style="list-style-type: none"> 1. decrease the inertia or use motor with brake 2. increase stop overtime P0-30 3. increase brake torque P3-32
28	0	E-280	Excessive Vibration Intensity	Strong vibration of motor	Reduce the gain of servo position loop or speed loop and check whether the motor shaft connection is firm.
30	0	E-300	Loss of synchronization with Motion Bus	Motion Bus Communication Abnormality	Check Motion Bus Connection
31	0	E-310	Motor code error	Motor code error	Set the correct motor code in P0-33
	1	E-311	Motor code lost	Motor code not set	Set motor code in P0-33

Appendix 4. Modbus address list

■ Parameter address

Parameter	Modbus address		Parameter	Modbus address	
	Hex	Decimal		Hex	Decimal
P0-00	0x0000	0	P0-17	0x0011	17
P0-01	0x0001	1	P0-18	0x0012	18
P0-02	0x0002	2	P0-19	0x0013	19
P0-03	0x0003	3	P0-20	0x0014	20
P0-04	0x0004	4	P0-21	0x0015	21
P0-05	0x0005	5	P0-22	0x0016	22
P0-06	0x0006	6	P0-23	0x0017	23
P0-07	0x0007	7	P0-24	0x0018	24
P0-08	0x0008	8	P0-25	0x0019	25
P0-09	0x0009	9	P0-26	0x001A	26
P0-10	0x000A	10	P0-27	0x001B	27
P0-11	0x000B	11	P0-28	0x001C	28
P0-12	0x000C	12	P0-29	0x001D	29
P0-13	0x000D	13	P0-30	0x001E	30
P0-14	0x000E	14	P0-31	0x001F	31
P0-15	0x000F	15	P0-32	0x0020	32
P0-16	0x0010	16	P0-33	0x0021	33

Parameter	Modbus address		Parameter	Modbus address	
	Hex	Decimal		Hex	Decimal
P1-00	0x0100	256	P1-15	0x010F	271
P1-01	0x0101	257	P1-16	0x0110	272

P1-02	0x0102	258	P1-17	0x0111	273
P1-03	0x0103	259	P1-18	0x0112	274
P1-04	0x0104	260	P1-19	0x0113	275
P1-05	0x0105	261	P1-20	0x0114	276
P1-06	0x0106	262	P1-21	0x0115	277
P1-07	0x0107	263	P1-22	0x0116	278
P1-08	0x0108	264	P1-23	0x0117	279
P1-09	0x0109	265	P1-24	0x0118	280
P1-10	0x010A	266	P1-25	0x0119	281
P1-11	0x010B	267	P1-26	0x011A	282
P1-12	0x010C	268	P1-27	0x011B	283
P1-13	0x010D	269	P1-28	0x011C	284
P1-14	0x010E	270			

Parameter	Modbus address		Parameter	Modbus address	
	Hex	Decimal		Hex	Decimal
P2-00	0x0200	512	P2-15	0x20F	527
P2-01	0x0201	513	P2-16	0x210	528

Parameter	Modbus address		Parameter	Modbus address	
	Hex	Decimal		Hex	Decimal
P3-00	0x0300	768	P3-19	0x0313	787
P3-01	0x0301	769	P3-20	0x0314	788
P3-02	0x0302	770	P3-21	0x0315	789
P3-03	0x0303	771	P3-22	0x0316	790
P3-04	0x0304	772	P3-23	0x0317	791
P3-05	0x0305	773	P3-24	0x0318	792

P3-06	0x0306	774	P3-25	0x0319	793
P3-07	0x0307	775	P3-26	0x031A	794
P3-08	0x0308	776	P3-27	0x031B	795
P3-09	0x0309	777	P3-28	0x031C	796
P3-10	0x030A	778	P3-29	0x031D	797
P3-11	0x030B	779	P3-30	0x031E	798
P3-12	0x030C	780	P3-31	0x031F	799
P3-13	0x030D	781	P3-32	0x0320	800
P3-14	0x030E	782	P3-33	0x0321	801
P3-15	0x030F	783	P3-34	0x0322	802
P3-16	0x0310	784	P3-35	0x0323	803
P3-17	0x0311	785	P3-36	0x0324	804
P3-18	0x0312	786			

Parameter	Modbus address		Parameter	Modbus address	
	Hex	Decimal		Hex	Decimal
P4-00	0x0400	1024	P4-15	0x040F	1039
P4-01	0x0401	1025	P4-16	0x0410	1040

Parameter	Modbus address		Parameter	Modbus address	
	Hex	Decimal		Hex	Decimal
P5-00	0x0500	1280	P5-27	0x051B	1307
P5-01	0x0501	1281	P5-28	0x051C	1308
P5-02	0x0502	1282	P5-29	0x051D	1309
P5-03	0x0503	1283	P5-30	0x051E	1310
P5-04	0x0504	1284	P5-31	0x051F	1311
P5-05	0x0505	1285	P5-32	0x0520	1312

P5-06	0x0506	1286	P5-33	0x0521	1313
P5-07	0x0507	1287	P5-34	0x0522	1314
P5-08	0x0508	1288	P5-35	0x0523	1315
P5-09	0x0509	1289	P5-36	0x0524	1316
P5-10	0x050A	1290	P5-37	0x0525	1317
P5-11	0x050B	1291	P5-38	0x0526	1318
P5-12	0x050C	1292	P5-39	0x0527	1319
P5-13	0x050D	1293	P5-40	0x0528	1320
P5-14	0x050E	1294	P5-41	0x0529	1321
P5-15	0x050F	1295	P5-42	0x052A	1322
P5-16	0x0510	1296	P5-43	0x052B	1323
P5-17	0x0511	1297	P5-44	0x052C	1324
P5-18	0x0512	1298	P5-45	0x052D	1325
P5-19	0x0513	1299	P5-46	0x052E	1326
P5-20	0x0514	1300	P5-47	0x052F	1327
P5-21	0x0515	1301	P5-48	0x0530	1328
P5-22	0x0516	1302	P5-49	0x0531	1329
P5-23	0x0517	1303	P5-50	0x0532	1330
P5-24	0x0518	1304	P5-51	0x0533	1331
P5-25	0x0519	1305	P5-52	0x0534	1332
P5-26	0x051A	1306	P5-53	0x0535	1333

Parameter	Modbus address		Parameter	Modbus address	
	Hex	Decimal		Hex	Decimal
P6-00	0x0600	1536	P6-10	0x060A	1546
P6-01	0x0601	1537	P6-11	0x060B	1547

Parameter	Modbus address		Parameter	Modbus address	
	Hex	Decimal		Hex	Decimal
P7-00	0x0700	1792	P7-10	0x070A	1802
P7-01	0x0701	1793			

■ Monitor status group U

Parameter	Modbus address		Parameter	Modbus address	
	Hex	Decimal		Hex	Decimal
U0-00	0x1000	4096	U0-28	0x101C	4124
U0-01	0x1001	4097	U0-29	0x101D	4125
U0-02	0x1002	4098	U0-30	0x101E	4126
U0-03	0x1003	4099	U0-31	0x101F	4127
U0-04	0x1004	4100	U0-32	0x1020	4128
U0-05	0x1005	4101	U0-33	0x1021	4129
U0-06	0x1006	4102	U0-34	0x1022	4130
U0-07	0x1007	4103	U0-35	0x1023	4131
U0-08	0x1008	4104	U0-36	0x1024	4132
U0-09	0x1009	4105	U0-37	0x1025	4133
U0-10	0x100A	4106	U0-38	0x1026	4134
U0-11	0x100B	4107	U0-39	0x1027	4135
U0-12	0x100C	4108	U0-40	0x1028	4136
U0-13	0x100D	4109	U0-41	0x1029	4137
U0-14	0x100E	4110	U0-42	0x102A	4138
U0-15	0x100F	4111	U0-43	0x102B	4139
U0-16	0x1010	4112	U0-44	0x102C	4140
U0-17	0x1011	4113	U0-45	0x102D	4141
U0-18	0x1012	4114	U0-46	0x102E	4142
U0-19	0x1013	4115	U0-47	0x102F	4143

U0-20	0x1014	4116	U0-48	0x1030	4144
U0-21	0x1015	4117	U0-49	0x1031	4145
U0-22	0x1016	4118	U0-50	0x1032	4146
U0-23	0x1017	4119	U0-51	0x1033	4147
U0-24	0x1018	4120	U0-52	0x1034	4148
U0-25	0x1019	4121	U0-53	0x1035	4149
U0-26	0x101A	4122	U0-57	0x1039	4153
U0-27	0x101B	4123	U0-58	0x103A	4154

Parameter	Modbus address		Parameter	Modbus address	
	Hex	Decimal		Hex	Decimal
U1-00	0x1100	4352	U2-00	0x1200	4608
U1-01	0x1101	4353	U2-01	0x1201	4609
U1-02	0x1102	4354	U2-02	0x1202	4610
U1-03	0x1103	4355	U2-03	0x1203	4611
U1-04	0x1104	4356	U2-04	0x1204	4612
U1-05	0x1105	4357	U2-05	0x1205	4613
U1-06	0x1106	4358	U2-06	0x1206	4614
U1-07	0x1107	4359	U2-07	0x1207	4615
U1-08	0x1108	4360	U2-08	0x1208	4616
U1-09	0x1109	4361	U2-09	0x1209	4617
U1-10	0x110A	4362	U2-10	0x120A	4618
U1-11	0x110B	4363	U2-11	0x120B	4619
U1-12	0x110C	4364	U2-12	0x120C	4620
U1-13	0x110D	4365	U2-13	0x120D	4621
U1-14	0x110E	4366	U2-14	0x120E	4622
U1-15	0x110F	4367	U2-15	0x120F	4623

U1-16	0x1110	4368	U2-16	0x1210	4624
U1-17	0x1111	4369	U2-17	0x1211	4625
U1-18	0x1112	4370	U2-18	0x1212	4626
U1-19	0x1113	4371	U2-19	0x1213	4627
U1-20	0x1114	4372	U2-20	0x1214	4628
U1-21	0x1115	4373			
U1-22	0x1116	4374			
U1-23	0x1117	4375			
U1-24	0x1118	4376			
U1-25	0x1119	4377			

Parameter	Modbus address		Parameter	Modbus address	
	Hex	Decimal		Hex	Decimal
F0-00	0x2000	8192	F1-00	0x2100	8448
F0-01	0x2001	8193	F1-01	0x2101	8449
F0-02	0x2002	8194	F1-02	0x2102	8450
F2-09	0x2209	8713	F1-03	0x2103	8451
			F1-04	0x2104	8452
			F1-05	0x2105	8453
			F1-06	0x2106	8454

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