SYNTEC

1KWX4 driver control hardware operating instructions

Servo Products

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SYNTEC

Servo Drive Operation Manual

2. Preface

Thank you for your continued support of our products. Our servo team is forever committed to the research and development of new products; we hope that our products and services can bring each user the best possible experience.

The SYNTEC high-performance servo drive series consists of our company's latest servo drive models. Each product is manufactured using high quality materials and has been through rigorous testing. In addition, our drives adopt precise vector control, guaranteeing high accuracy, high stability and high efficiency.

This Operation Manual includes the drive's hardware specifications, installation instructions, as well as wiring and signal descriptions, providing each user with detailed guidance. To achieve the best performance of our products and to maintain the safety of both personnel and equipment, please read this manual carefully before use and keep it in a safe place for future reference. If any doubts arise, please do not hesitate to contact our office--we will be happy to help!

3. Applicable models

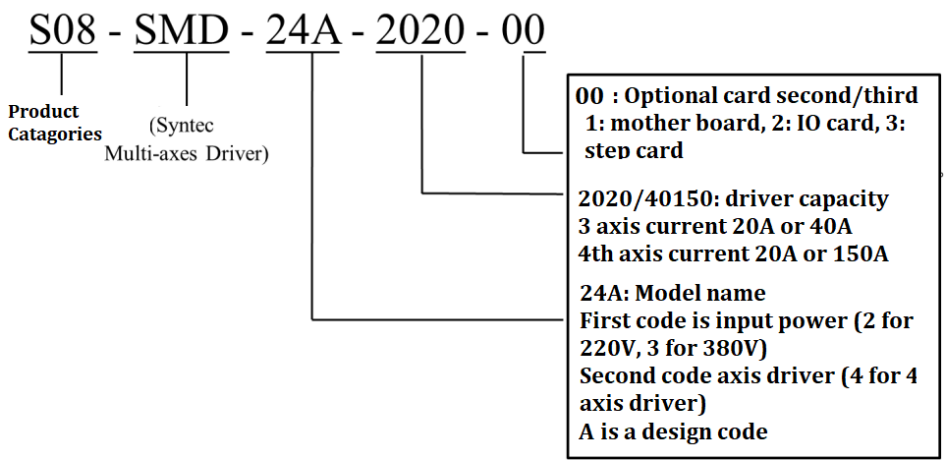
This single-axis operation manual is suitable for the new generation 1kWx4 drive integrated machine.

4. Hardware specification

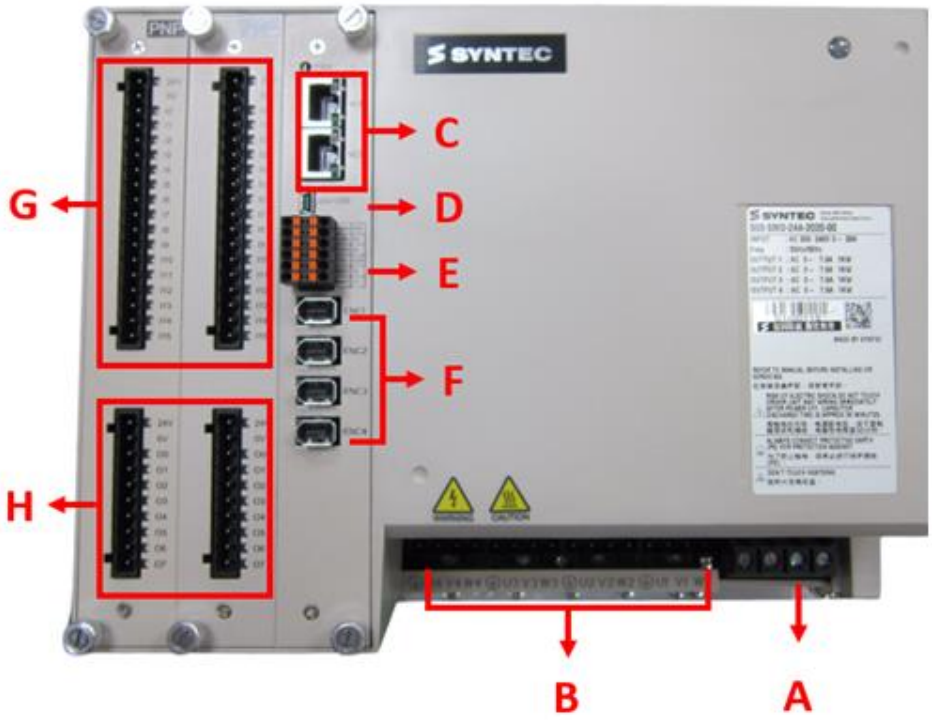
4.1. Description

Each drive undergoes strict quality inspection and anti-collision packaging before leaving the factory. Please check for impact damage upon receiving the product. Users should also compare the serial numbers on the outer box and on the product itself. If there is any discrepancy, please contact us immediately.

Model Description



4.2. Appearance introduction

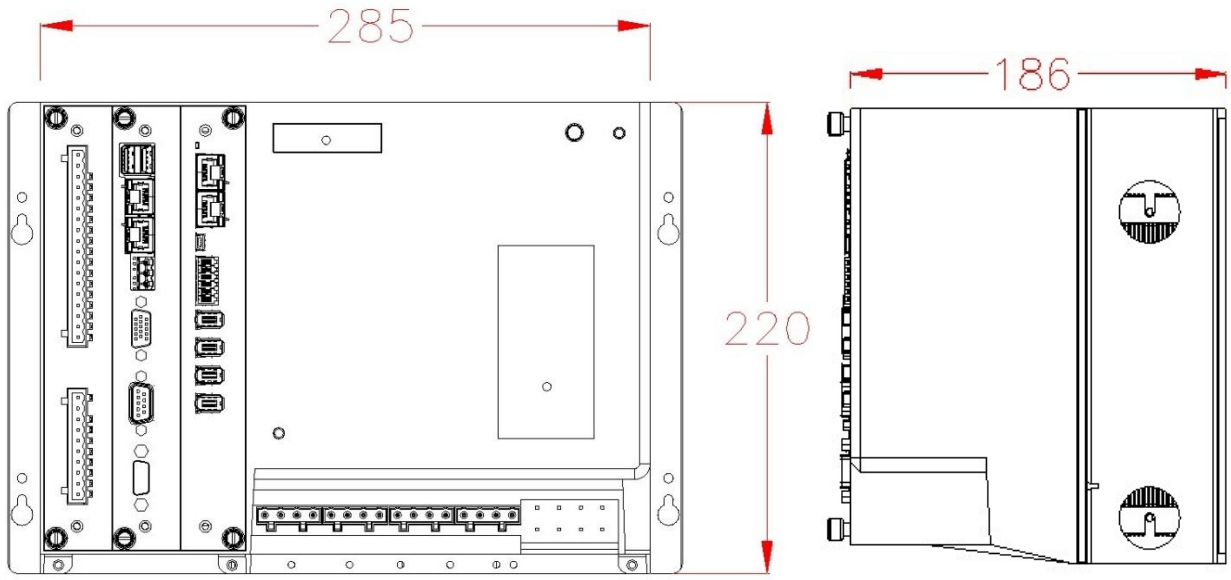


S08-SMD-24A-2020-22

Item	Module	Description
A	External Power	Connects to 220 V 3-phase AC (RST)
B	Motor Power Supply	Connects to the motor to supply motor power (UVW) Fours groups total: Axis1~Axis4 from right to left
C	MIII Serial Communication Port	Connects to host controller (MIII signal) Connects to serial drive (MIII signal)
D	Mini USB Port	Connects to PC
E	I/O Signal Port	Connects to I/O equipment (emergency stop, warning light…etc.)
F	Encoder Feedback	Port 1~Port 4 from top to bottom; connects to Axis1~Axis4 motor encoders
G	I Bit Signal Port	Connects to I equipment (ex. emergency stop)
H	O Bit Signal Port	Connects to O equipment (ex. warning light)

4.3. Dimensions

S08-SMD-24A-2020-22



Drive specification

Syntec Drive		**SMD-22B-2020-00**
Power	**Rated Voltage**	3-phase 200~230V 50/60Hz
	Voltage Error Bound	-15 ~ +10%
	Frequency Error Bound	±5%
Output	**Rated Current**	7.6A
	Over-current	150% 60s, 200% 1s
Control Method		3-phase full wave rectification, SVPWM一 VVVF control
Regenerator		Internal; external available For external, refer to the Regenerator Selection section
Encoder		Supported interfaces：Tamagawa, SYNNET, NIKON, FeeDAT Extended encoder modules： Supports Tamagawa, SYNNET,

		NIKON, ABZ, Serial, SSI, BiSS (Does NOT support UVW wire-saving encoders) (For more about extended encoder modules, refer to Servo 10PX1/10PX3 Extended Module Operation Manual)
PC Interface		USB
Controller Serial Communication		Mechatrolink III
I/O Signal	**Digital Input**	4 ports, function alterable
	Digital Output	2 ports, function alterable
	STO	Dual-channel Safety Torque Off switch (2I 1O)
Cooling Method		Fan cooling
Environment	**Temperature**	0℃ ~ 55℃(If the surrounding temperature exceeds 45℃, implement forced air circulation), storage: -20～65℃ (non-freezing)
	Humidity	Maximum 90% RH (non-condensing), storage: under 90%RH (non-condensing)
	Location	Indoors (avoid direct sunlight); keep away from oil, dust, and corrosive or flammable gases
	Altitude	Below 1000 m until sea level
	Vibration	Maximum 5.9 m/s^2
Weight		7 kg

5. Handling and installation

5.1. Transport

The entire body of the drive must be held during transportation. To avoid the risk of falling, do NOT hold the drive by its upper cover or by any individual part.

5.2. Installation Environment Conditions and Precautions

Installation Environment Conditions

- Locations without high heat generating devices.
- Locations without floating dust or metal particles.
- Locations without corrosive or flammable gasses and liquids.
- Locations without water, steam, dust, or oily dust.
- Locations without electromagnetic noise interference.
- A sturdy, vibration-free location.
- Suitable ambient temperature is 0 ° C ~ 55 ° C; if the ambient temperature is above 45 ° C, please put the drive in a well-ventilated place or in an air-conditioned room.

Installation Precautions

- Install the drive in the direction specified by the instructions; incorrect positioning may lead to servo failure.
- When installing the drive, do not block its ventilation holes and do not place it upside down, otherwise the drive may malfunction.
- Do not use on or near flammable materials.
- Make sure that each fastening point is tight when fixing the drive in place.
- Install on a surface that can withstand the weight.

Operation Precautions

- For long-term operation, it is recommended to maintain an ambient temperature below 45 °C to ensure product reliability.
- If the product is installed in an electrical cabinet, the size and ventilation of the cabinet must prevent any internal electronic devices from overheating. Also pay attention to whether the machine's vibrations will affect other electronics in the cabinet.
- To enhance cooling circulation, maintain sufficient space between all sides and surrounding objects of the drive and the baffles (walls); also take care not to block the ventilation holes, otherwise the drive may malfunction.

Other Precautions

- The cable between the drive and the motor should not be stretched too tightly.
- Do not place heavy objects on top of the drive.

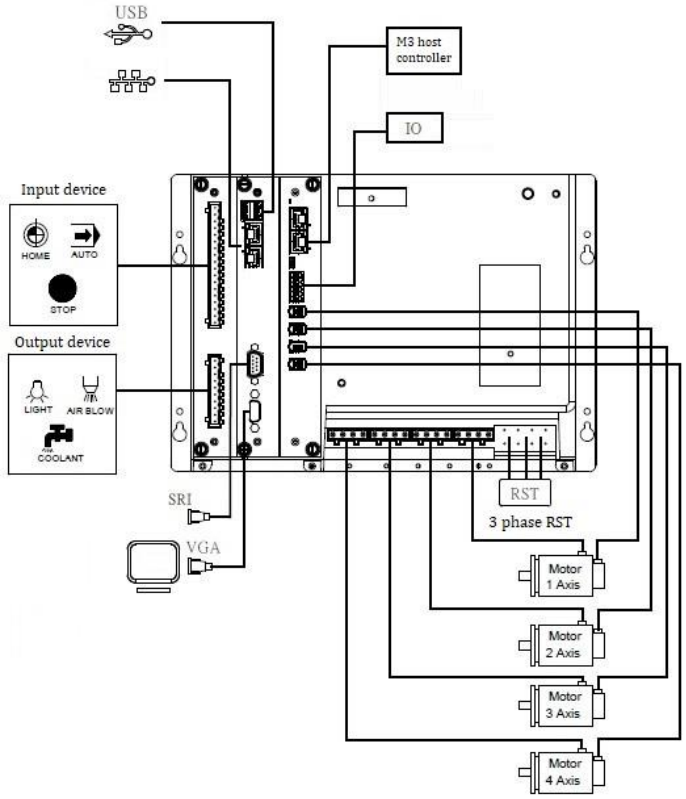
- Keep the drive clear from conductive objects such as metal and screws or combustibles such as oil.
- If the cable connecting the motor and the drive is longer than 20 meters, please thicken the U, V, W and encoder cables.
- Do not drop or impact the drive.
- Do not force the drive to operate if it is damaged.

6. Wiring and signal

6.1. Peripheral device wiring diagram

S08-SCD-80 series

※Recommended encoder wiring: 22AWG×2C+24AWG×2P
※Recommended RST wiring: 10AWG or 5.3mm^2
※Recommended UVW wiring: 14AWG or 2.0mm^2



Installation Precautions:

- Before powering on, check if the U, V, W, and G terminals are correctly wired to the motor. An incorrect UVW sequence may lead to rotation in the reverse direction or even motor malfunction; at that point, Encoder Testing and Magnetic Pole Offset Detection must be re-performed. An incorrect G wiring may cause damage to the motor or the drive.

- It is recommended to provide the power supply of the controller through any two terminals of the RST.
- When wiring the host controller, select either general servo signal or serial servo signal-- not both.

Wiring Instructions

- **Power supply:**
  1. Input power from R, S, T, L1, L2
  2. L1 and L2 are optional
- **Encoder Terminals:**
  1. Single-axis Axial Type (SVD) has one set of encoder feedback (6PIN) and Spindle Type (SPD) has two sets of encoder feedback (6PIN); each set of encoder terminals has a 5V power output (up to 150mA).
  2. Supports encoder interface of Tamagawa, SYNTEC, and NIKON.
  3. Supports expansion modules that connect other encoder interfaces (refer to Servo 10PX1/10PX3 Expansion Module Guide).
  4. Battery voltage checking for absolute encoders.
- **Host Controller Serial Communication:**
  1. Mechatrolink-II Serial 10Mbps
  2. Mechatrolink-III Serial 100Mbp
  3. EtherCAT Serial 100Mbps (Currently unsupported)
- **General IO Signal:**
  1. 2 DI ports
  2. 1 DO port
  3. Absolute Battery Voltage Input
  4. Note
     NC: Empty port
     I port: Input a voltage of 24V relative to COM
     port: O0+ and O0- are internally conductive
- **STO I/O:**

2 Safety inputs (STO-A, STO-B)
1 Safety feedback (STO-FB)

- **USB Communication:**

Connects to PC to set the servo's internal parameters and monitor the operation status.

- **LED :**

Operation Status and Power indicator.

6.2. Drive connector and terminal description

Name	Terminal	Description
Main Loop Power Input Terminal	R, S, T	Connects to 3-phase AC
Motor Power Input Terminal	U, V, W	Connects to motor
Serial Communication Interface	M3A, M3B	Connects to host controller
USB Port	mini USB	Connects to PC's USB port
Encoder Feedback (Axis1)	ENC1	Connects to motor encoder
Encoder Feedback (Axis2)	ENC2	Connects to motor encoder
Encoder Feedback (Axis3)	ENC3	Connects to motor encoder
Encoder Feedback (Axis4)	ENC4	Connects to motor encoder
Ground Terminal		Connects to ground

Wiring Precautions:

Keep the six power lines R, S, T and U, V, W away from other signal lines, at least a 30 cm distance if possible.

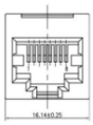
When the power is cut off, the drive's internal capacitor still contains a large amount of charge-- do NOT touch the six power lines R, S, T, and U, V, W. Please wait until the charging light goes out.

When lengthening the encoder cable, apply twisted pair cabling to the encoder cable and the grounding signal cable. Do not exceed a length of 20 m (65.62 in or 14 ft); if it is absolutely necessary to do so, please use a signal line with twice the wire diameter in order to minimize signal attenuation.

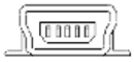
Please wire according to relevant regulations. Select the wire diameter according to motor wattage, as follows:

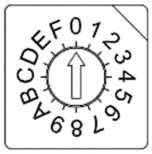
Type	Wattage	Wire Diameter
Axial	100W~850W	20AWG
	850W~7.5kW	16AWG
Spindle	7.5kW and below	12AWG
	11kW and above	10AWG

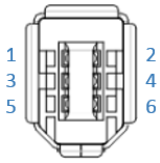
6.3. Interface pin definition

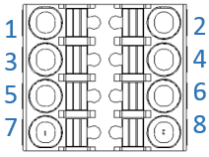
M3 Serial Servo /EtherCAT Serial		
		
Pin	**Name**	**Description Description**
1	TX+	Differential Signal (+)
2	TX-	Differential signal (-)
3	RX+	Differential Signal (+)
4	NC	--
5	NC	--
6	RX-	Differential signal (-)
7	NC	--
8	NC	--

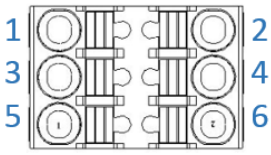
M2 serial servo M2 Serial		
		
1	--	--
2	D-	Differential signal (-)
3	D+	Differential Signal (+)
4	--	--

Mini USB communication Mini USB Port		
		
1	5V	5V power supply
2	DM	USB differential signal (-)
3	DP	USB Differential Signal (+)
4	GND	Power Reference GND
5	GND	Power Reference GND

Station Number							
							
0	N/A	**4**	Station No. 4	**8**	Station No. 8	**C**	Station No. 12
1	Station No. 1	**5**	Station No. 5	**9**	Station No. 9	**D**	Station No. 13
2	Station No. 2	**6**	Station No. 6	**A**	Station No. 10	**E**	Station No. 14
3	Station No. 3	**7**	Station No. 7	**B**	Station No. 11	**F**	Station No. 15

Encoder Feedback			
			
1	5V	**2**	GND
3	BAT+	**4**	BAT-
5	D+	**6**	D-

IO interface signal IO Signal Port			
			
1	C01	**2**	O0 +
3	I0	**4**	O0-
5	I1	**6**	BAT+
7	NC	**8**	BAT-

STO signal STO Signal Port			
			
1	STO-A	**2**	STO-B
3	STO-COM	**4**	STO-COM
5	STO-FB +	**6**	STO-FB

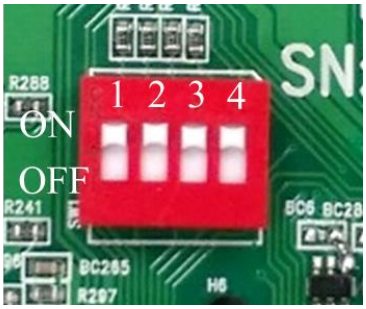
6.4. Multiple four-in-one series description

The drives of the Multi-axis Servo Drive series has a multi-drive serial function, activated by using an M3 cable to connect the M3B port of one drive to the M3A port of a second drive. The user can then control this function using the panel DIP switch and controller parameters, as follows:

DIP Switch Guide

The physical diagram of the dip switch on the pre-level version is shown below.

The panel DIP switch is pictured below:



The DIP switch has four PINs, where each PIN has the two states ON and OFF. The switch can therefore represent 16 distinct station numbers, as shown in the table below. Be especially aware of the relationship between station numbers and controller parameters.

PIN 1	PIN 2	PIN 3	PIN 4	Station No.
ON	ON	ON	ON	1
OFF	ON	ON	ON	2
ON	OFF	ON	ON	3
OFF	OFF	ON	ON	4
ON	ON	OFF	ON	5
OFF	ON	OFF	ON	6
ON	OFF	OFF	ON	7
OFF	OFF	OFF	ON	8
ON	ON	ON	OFF	9

PIN 1	PIN 2	PIN 3	PIN 4	Station No.
OFF	ON	ON	OFF	10
ON	OFF	ON	OFF	11
OFF	OFF	ON	OFF	12
ON	ON	OFF	OFF	13
OFF	ON	OFF	OFF	14
ON	OFF	OFF	OFF	15
OFF	OFF	OFF	OFF	16

Controller Axis Number Encryption Principles

The user should adjust controller parameters Pr21~24 and Pr3261~3262 according to the DIP switch station number. Encryption principles are explained below.

The controller's corresponding axis number should be set in the form MMnn: MM denotes the main station number, or the DIP switch's corresponding station number, which can be obtained from the table in the last section above or from Pn-031 of the tuning software; nn denotes the substation number, which has a range of 0~6, where 0~3 represent Axis1~Axis4, 4 represents laser function, and 5~6 represent IO expansion cards 1~2, respectively.

If the station number is 1, set controller parameters as follows:

Parameter	Value	Description
Pr21	1000	Motion control port number corresponding to axis
Pr22	1001	Motion control port number corresponding to axis
Pr23	1002	Motion control port number corresponding to axis
Pr24	1003	Motion control port number corresponding to axis

Pr3261	1005	Drive station number corresponding to M3 IO 1st station
Pr3262	1006	Drive station number corresponding to M3 IO 2nd station

If the station number is 2, Pr21 is changed to 2000, Pr22 is changed to 2001, and other Pr23, Pr24 and other parameters are deduced by analogy; if the station number is 10, Pr21 needs to be changed to 10000, and Pr22 needs to be changed to 10001. Other parameters such as Pr23 and Pr24 are the same; if the number is 11, the Pr21 needs to be changed to 11000, the Pr22 to 11001, and the other Pr23, Pr24 and so on.
It should be noted that the controller must provide M3 serial communication to use the serial function, so Pr9 must be set to 103, and consider the compatibility of future automatic detection. The digital settings of parameters Pr3261 and Pr3262 should be arranged from small to large. .

If the station number is 2, set Pr21 as 2000, Pr22 as 2001, and so on; if the station number is 10, set Pr21 as 10000, Pr22 as 10001, and so on; if the station number is 11, set Pr21 as 11000, Pr22 as 110001, and so on.

Note that this serial function is available only if the controller is using M3 serial communication, therefore Pr9 should be set as 103. In addition, considering the function's future compatibility with auto detection, the user should set the values of Pr3261~Pr3262 in order of least to greatest.

6.5. Regeneration resistor selection

6.5.1. Overview of Regenerative Resistor Selection

Internal regenerative resistors are recommended. If special needs arise, compute values according to the following table (see *Detailed Selection Guide of Regeneration Resistors*):

Drive Model No.	Internal Regenerator	
	Capacitance (W)	Resistance (Ω)
S08-SCD-80 series	200W	20 Ω

Note:

The Recommended Regeneration Resistance Table is designed for general machining situations. If these values do no meet the actual application conditions, users can refer to the Detailed Selection Guide for Regenerative Resistors and select a regenerator of higher power.

Recommended resistance = operating voltage / maximum brake current, and it is the minimum regenerative resistance of the drive. If no suitable resistance value is found, users must select a regenerator of hig

There are three types of regenerative resistors commonly used in CNC machining: wirewound resistors, ripple resistors, and aluminum-housed resistors; users can select the type according to their needs. The following chart compares the three types of brake resistors:

Resistor Type	Wirewound	Ripple	Alumium-Housed
Characteristics			
Heat Dissipation	Poor	Average	Excellent
Operating Power Range	Large (30~20000W)	Large (30~20000W)	Small (40~2000W)
Operating Resistance Range	2~1000Ω	2~1000Ω	0.1~10KΩ
Cost	Low	Average	High
Dimensions Length X Width X Height (Unit: mm)	Large (362 x 70 x 138)	Large (362 x 70 x 138)	Small (335 x 76 x 44)

6.5.2. Detailed Selection Guide for Regeneration Resistors

Motors generally do positive work while operating, but they may do negative work when the output torque direction is opposite of the rotation direction. For instance, the motor may output torque to resist the inertia during braking, or it may experience an external torque load while in torque mode...etc. During those times, the external force is doing positive work through the motor and transferring that energy to the drive; that is, the motor acts as a generator. When this happens, the regenerative resistor must quickly dissipate the energy in order to prevent flooding the DC terminal voltage.

Suppose the external torque load is TL and the unit is a percentage of the rated torque (%). The speed at that instance in time is Wr (rpm). The regenerative resistance power must be greater than the External Torque Power = TL x Rated Torque x (Wr x 2π/60).

For example, if the external torque is 50% of rated torque, the speed is 2000 (rpm), and the motor rated torque is 2 (Nm), then the external torque produces a power of 0.5 * 2 * 2000 * 2π / 60 ≈ 210 W. To be safe, that number is usually multiplied by a safety factor of around 2 ~ 3, therefore the user needs to select a regenerative resistor of more than 420W.

Free of External Torque Load

Assuming that the motor moves back and forth, the energy generated by the inertial force during braking will be poured back into the drive. At this time, the capacitor of the DC bus terminal of the drive is the first buffer to absorb and reuse the energy. However, the absorption of energy by the capacitor causes the DC bus voltage to rise, so when the voltage rises to a certain level, the second buffered regenerative resistor is turned on to convert the energy into heat and discharge it.

The calculation method of the regenerative energy generated by the spindle motor of the drive during braking is provided below, and the user can calculate the required resistance according to different occasions.

E0 in the table below is the regenerative energy required to dissipate from the rated speed to the standstill when the motor is load-free, E0 =J*ωr2/182, where J is the rotor inertia (kg-m2) and ωr is the rated speed of the motor (Rpm). And Ec is the energy that the DC bus capacitor can absorb, Ec = C*(Vb,max2-Vb2)/2, where C is the capacitance value of the DC bus terminal. Vb,max is the maximum voltage that the DC bus can withstand, the 220V drive can withstand 400 V, and the 380V drive can withstand 800 V. The Vb value is the rated voltage of the DC bus, and the value is 2 times the root of the input supply voltage.

Considering the actual application, assume that the load inertia ratio is N times the motor inertia. If the speed is braked from the rated M times to zero speed, the regenerative resistor must consume E0(N+1)*M2-Ec Joule. If the motor reciprocating cycle (Time of accelerating, being steady, to decelerating) is T sec, then the regenerative resistor power W = 1.2[E0*(N+1)*M2-Ec]/T, 1.2 is the safety factor.

In addition, according to the application of the spindle cover, the allowable frequency index is provided for the user to select. The allowable frequency is defined as the continuous acceleration and deceleration of the motor. In the case where the regenerative resistor and the motor are not overheated, the maximum number of round trips per minute is equal to 60 seconds divided by the round trip period T, i.e. 60/T. For example, when the milling machine is performing drilling and tapping, the spindle will frequently perform acceleration and deceleration (single drilling involves two acceleration and deceleration actions). If it is desired that the regenerative

resistor is not prone to overheating and smoke, the number of drilling per minute must be limited to less than half of the allowable frequency.