



SYNTEC
TECHNOLOGY CO.,LTD.

Hardware Manual of SMD-30/30/30/30-XS

匯出日期: 2023-05-10

修改日期: 2022-03-30

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Version	Date	Content Change	Author	Editor	Status
V1.2	2018/08/01	Organized common content into Source files; included corresponding files into the manual Added content translations	☐ Annabel Chang		

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Servo Drive Operation Manual

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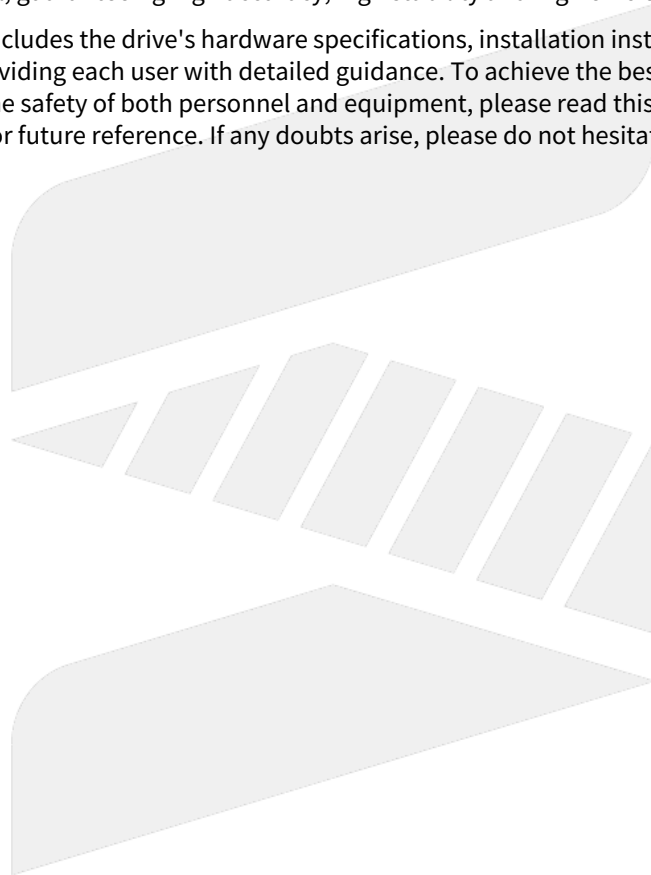


1 **Preface**

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!



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2 **Application**

This manual is applicable to SMD-30/30/30/30-XS



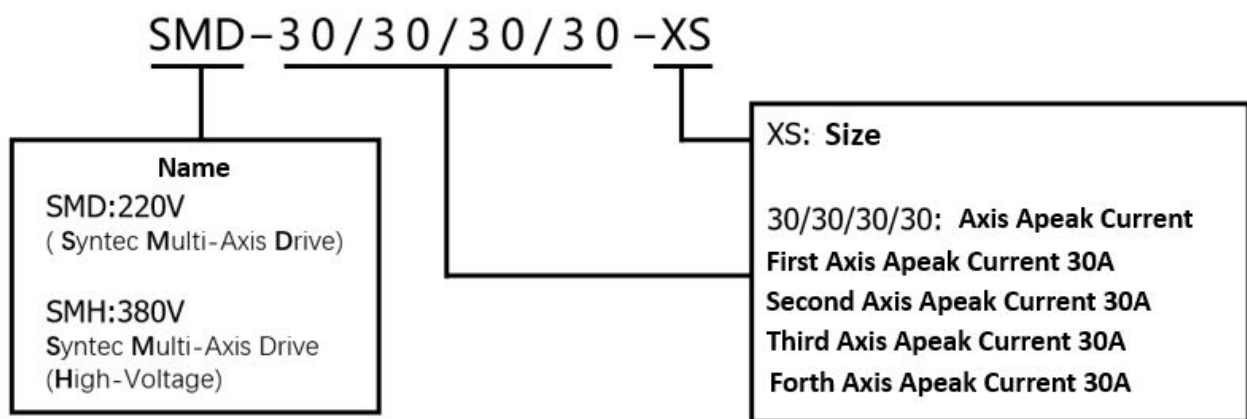
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3 Hardware Specification

3.1 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.

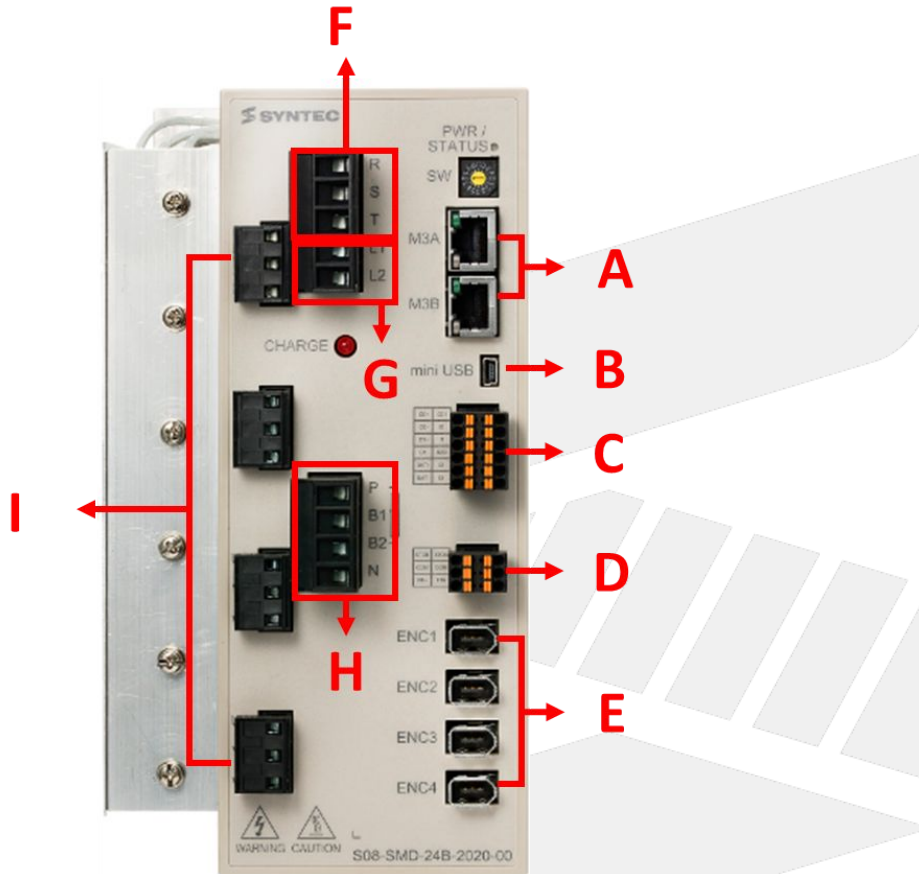
Model Description



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3.2 Appearance

SMD-30/30/30/30-XS



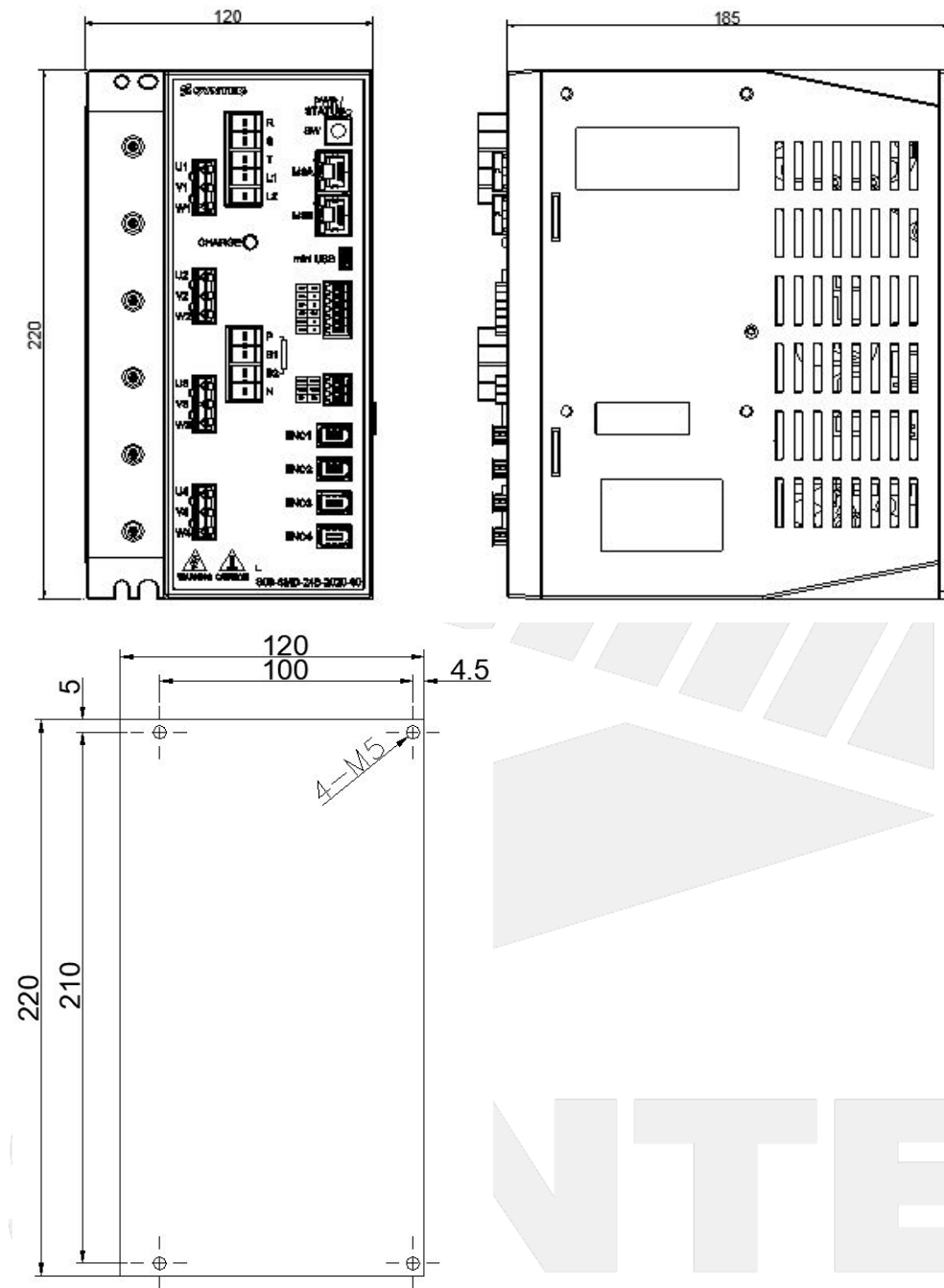
Item	Module	Description
Drive Function		
A	MIII Serial Communication Port	Connects to host controller (MIII signal) Connects to serial drive (MIII signal)
B	Mini USB Port	Connects to PC
C	I/O Signal Port External Battery Port	Connects to I/O equipment (emergency stop, warning light...etc.) Connects to absolute encoder battery

Item	Module	Description
D	STO Signal Port	STO port, 2 groups of safety input, 1 group of safety feedback
E	Encoder Feedback	Port 1~Port 4 from top to bottom All four ports connect to motor encoders
F	External Power	Connects to 220 V 3-phase AC (RST)
G	Control Power	If safety regulations apply, control power can be independently supplied by L1 and L2, connected to single-phase AC 220V and with input voltage corresponding to RST.
H	Regenerative Resistor	Select one of the two following ways to wire: 1. Connect external regenerator to P and B2 2. Short-circuit B1 and B2 for internal brakes
I	Motor Power Supply	Connects to the motor to supply motor power (UVW)

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3.3 Dimension

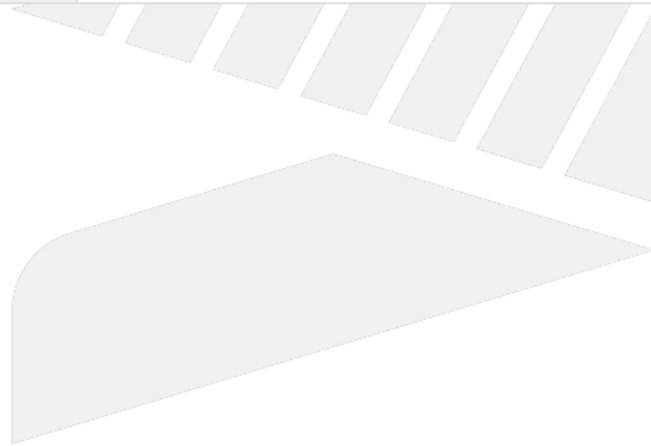
SMD-30/30/30/30-XS



3.4 Specification

Syntec Drive		SMD-30/30/30/30-XS
Power	Rated Voltage	3-phase 200~230V 50/60Hz
	Voltage Error Bound	-15 ~ +10%
	Frequency Error Bound	±5%
Output	Rated Current	7.6 A
	Over-current	150% 60s、200% 1s
Control Method		3-phase full wave rectification, SVPWM—VWF control
Regenerator		Internal; external also 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

Cooling Method		Fan cooling
Environment	Temperature	0°C ~ 55°C(If the surrounding temperature exceeds 45°C, implement forced air circulation), storage: -20 ~ 65°C (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		4.5 kg



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4 Transportation and Installation

4.1 Transportation

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.

4.2 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.



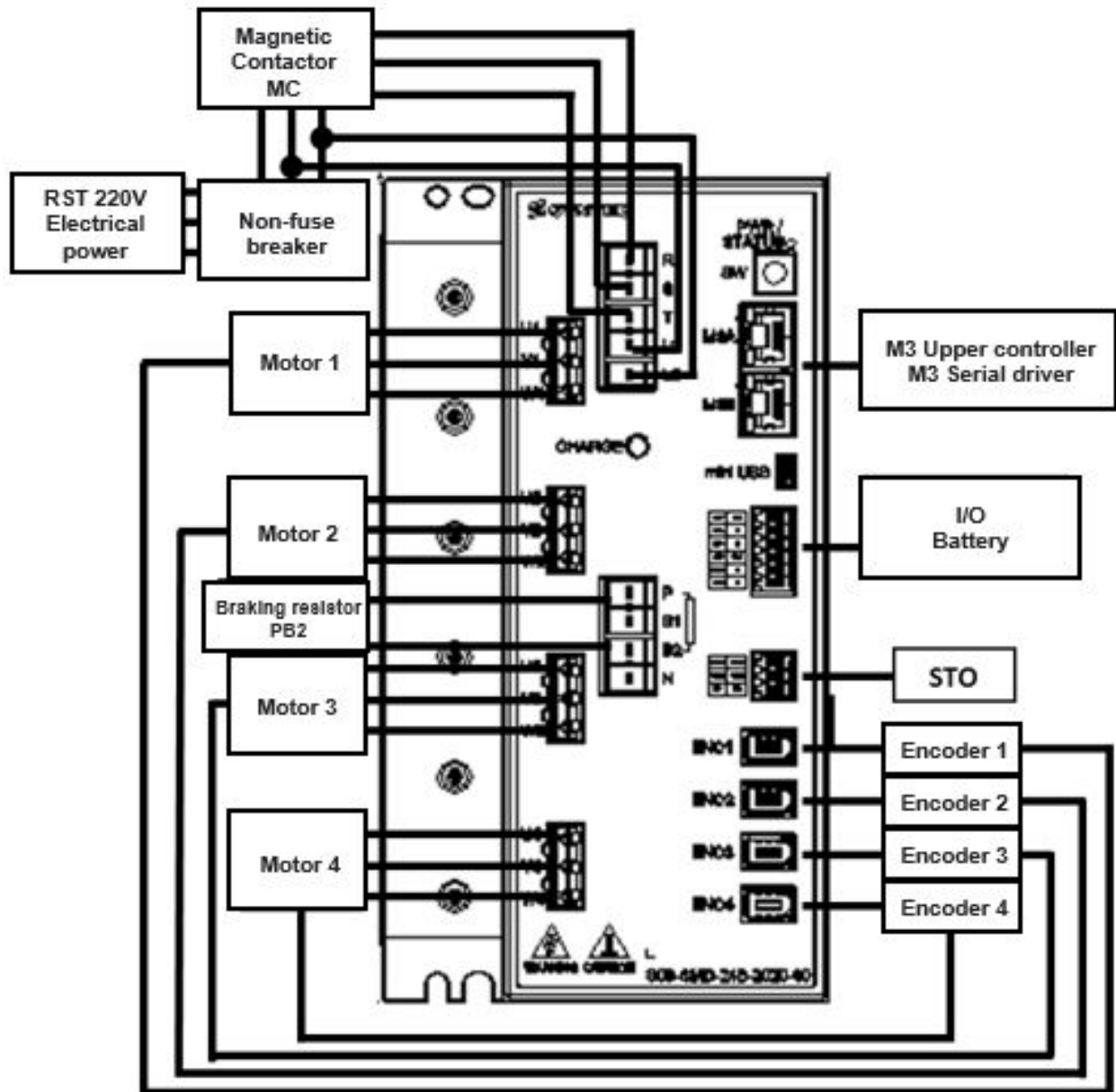
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5 Wiring and Signal

5.1 Wiring Diagram

SMD-30/30/30/30-XS

※Recommended encoder wiring: 22AWG×2C+24AWG×2P, 90% coverage



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 100Mbps
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
 - O port: O0+ and O0- are internally conductive

STO I/O:

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

USB Communication:

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

LED :

1. Operation Status and Power indicator.

5.2 Connector and Terminal Definition

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
Ground Terminal		Connects to ground
USB Port	USB	Connects to PC's USB port
Serial Communication Interface	M3A, M3B	Use M3 wire to connect M3A and host controller M3B can connect to the next OpenDrive M3A in series
Encoder Feedback (Axis1)	CN1	Connects to Axis1 motor encoder
Encoder Feedback (Axis2)	CN2	Connects to Axis2 motor encoder
Encoder Feedback (Axis3)	CN3	Connects to Axis3 motor encoder
Encoder Feedback (Axis4)	CN4	Connects to Axis4 motor encoder

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

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

5.3 Regenerator Selection

5.3.1 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)
SMD-30/30/30/30-XS	200	20

Note:

1. The Recommended Regeneration Resistance Table is designed for general machining situations. If these values do not meet the actual application conditions, users can refer to the Detailed Selection Guide for Regenerative Resistors and select a regenerator of higher power.
2. 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 higher power.

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	Aluminum-Housed
Characteristics			

Resistor Type	Wirewound	Ripple	Aluminum-Housed
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)

5.3.2

Detailed Selection Guide for Regeneration Resistors

Motors do Negative Work under External Torque Load

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 T_L and the unit is a percentage of the rated torque (%). The speed at that instance in time is ω_r (rpm). The regenerative resistance power must be greater than the External Torque Power = $T_L \times \text{Rated Torque} \times (\omega_r \times 2\pi/60)$.

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 $0.5 \times 2 \times 2000 \times 2\pi / 60 \approx 210 \text{ W}$. 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.

E_0 in the table below is the regenerative energy required to dissipate from the rated speed to the standstill when the motor is load-free, $E_0 = J \cdot \omega_r^2 / 182$, where J is the rotor inertia ($\text{kg} \cdot \text{m}^2$) and ω_r is the rated speed of the motor

(Rpm). And E_c is the energy that the DC bus capacitor can absorb, $E_c = C \cdot (V_{b,max}^2 - V_b^2) / 2$, where C is the capacitance value of the DC bus terminal. $V_{b,max}$ 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 V_b 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 $E_0(N+1) \cdot M^2 - E_c$ Joule. If the motor reciprocating cycle (Time of accelerating, being steady, to decelerating) is T sec, then the regenerative resistor power $W = 1.2[E_0(N+1) \cdot M^2 - E_c] / T$, 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.

Axial Motor

Drive Model No.	Axial Motor Model No.	Rotor Inertia J (10^{-4} kg-m^2)	Rated Speed (rpm)	Load-free Rated Speed to Zero Speed Regenerative Energy $E_0(J)$	Capacitor Absorbed Energy $E_c(J)$
SMD-30/30/30/30-XS	S08-AM03-50-E12-□-M□	0.043	3000	0.21	62.57
	S08-AM06-50-E12-□-M□	0.19	3000	0.94	62.57
	S08-AM1-50-E12-□-M□	0.44	3000	2.18	62.57
	S08-AM06-50-E12-□-Z□	0.16	3000	0.79	62.57

6 Document Revision Table (SMD-30/30/30/30-XS)

Version	Date	Content Change	Author	Editor	Status
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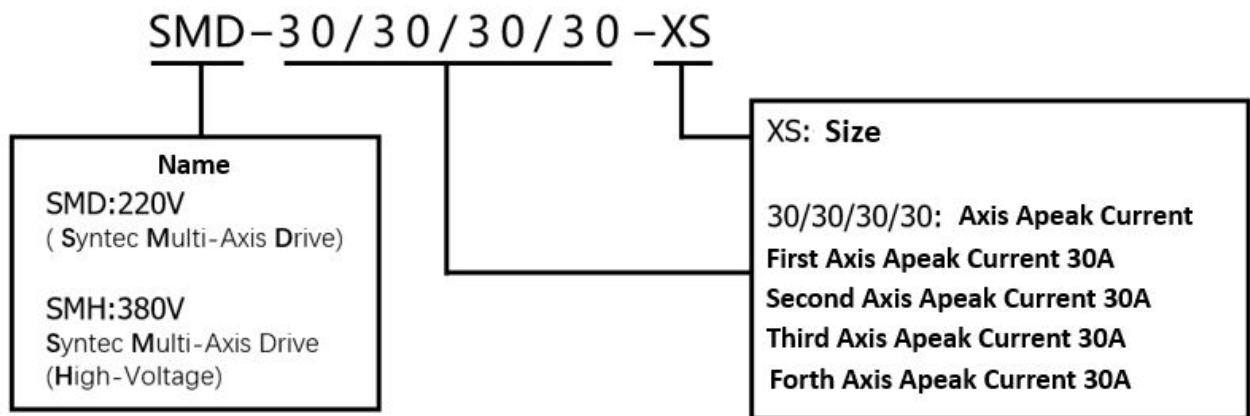
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7 Hardware Specification (SMD-30/30/30/30-XS)

7.1 Description

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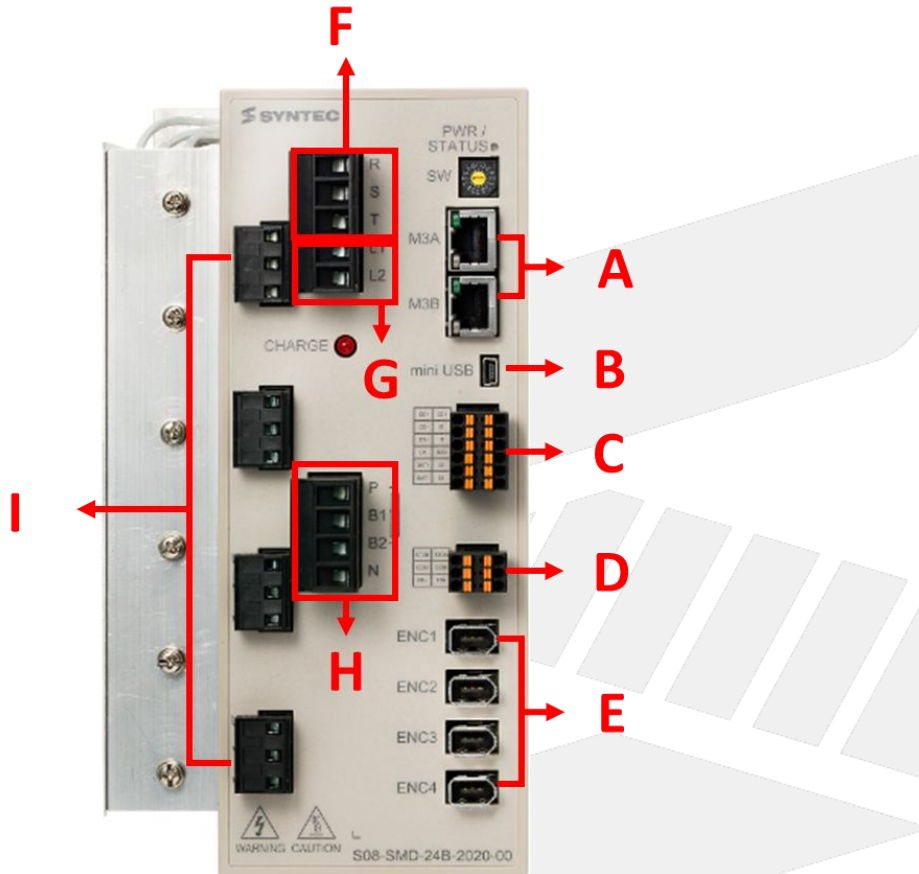
Model Description



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7.2 Appearance

SMD-30/30/30/30-XS



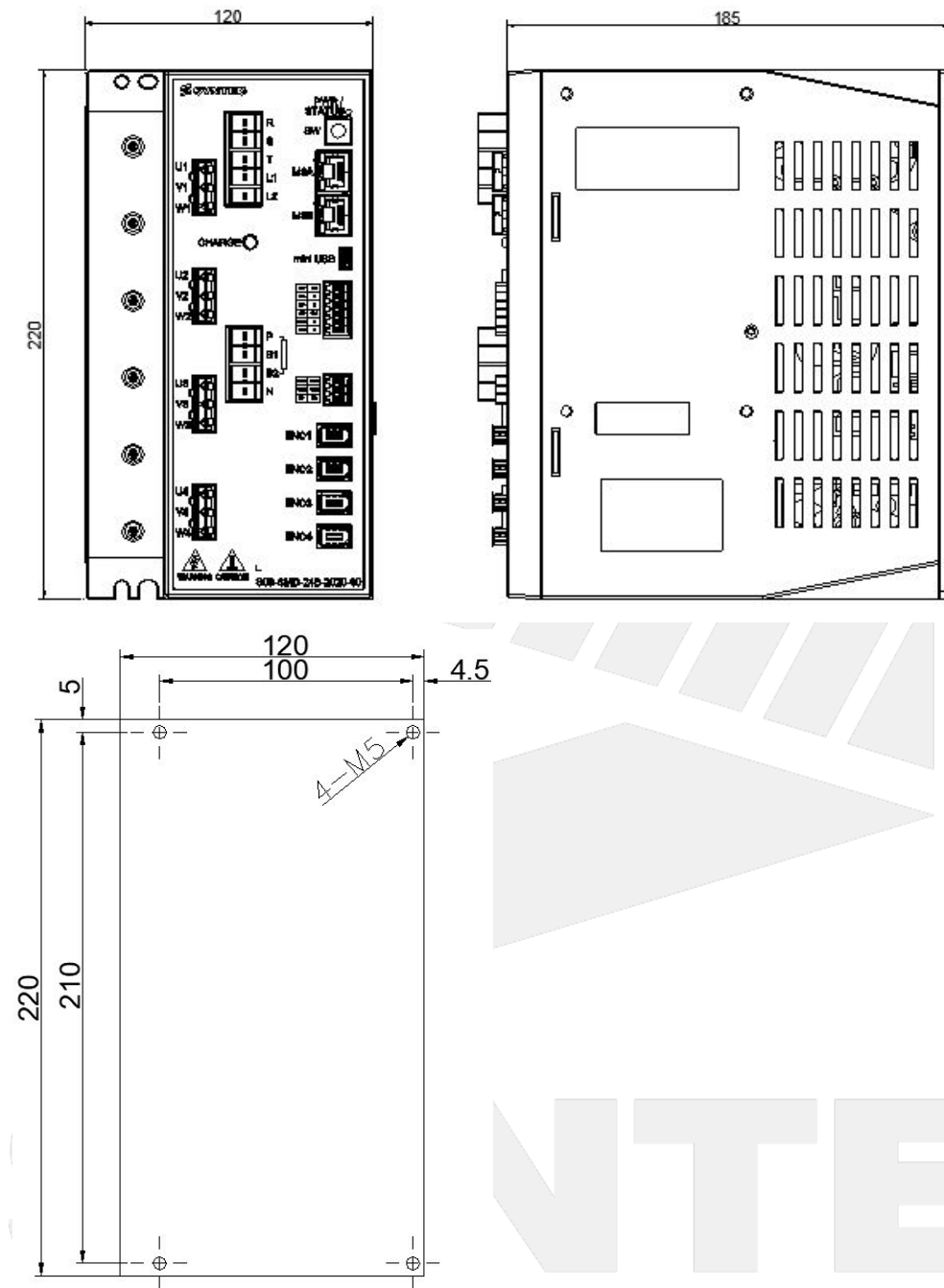
Item	Module	Description
Drive Function		
A	MIII Serial Communication Port	Connects to host controller (MIII signal) Connects to serial drive (MIII signal)
B	Mini USB Port	Connects to PC
C	I/O Signal Port External Battery Port	Connects to I/O equipment (emergency stop, warning light...etc.) Connects to absolute encoder battery

Item	Module	Description
D	STO Signal Port	STO port, 2 groups of safety input, 1 group of safety feedback
E	Encoder Feedback	Port 1~Port 4 from top to bottom All four ports connect to motor encoders
F	External Power	Connects to 220 V 3-phase AC (RST)
G	Control Power	If safety regulations apply, control power can be independently supplied by L1 and L2, connected to single-phase AC 220V and with input voltage corresponding to RST.
H	Regenerative Resistor	Select one of the two following ways to wire: 1. Connect external regenerator to P and B2 2. Short-circuit B1 and B2 for internal brakes
I	Motor Power Supply	Connects to the motor to supply motor power (UVW)

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7.3 Dimension

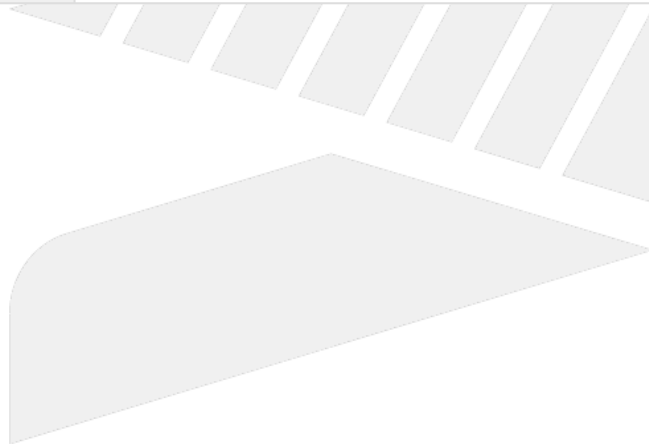
SMD-30/30/30/30-XS



7.4 Specification

Syntec Drive		SMD-30/30/30/30-XS
Power	Rated Voltage	3-phase 200~230V 50/60Hz
	Voltage Error Bound	-15 ~ +10%
	Frequency Error Bound	±5%
Output	Rated Current	7.6 A
	Over-current	150% 60s、200% 1s
Control Method		3-phase full wave rectification, SVPWM—VWF control
Regenerator		Internal; external also 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)
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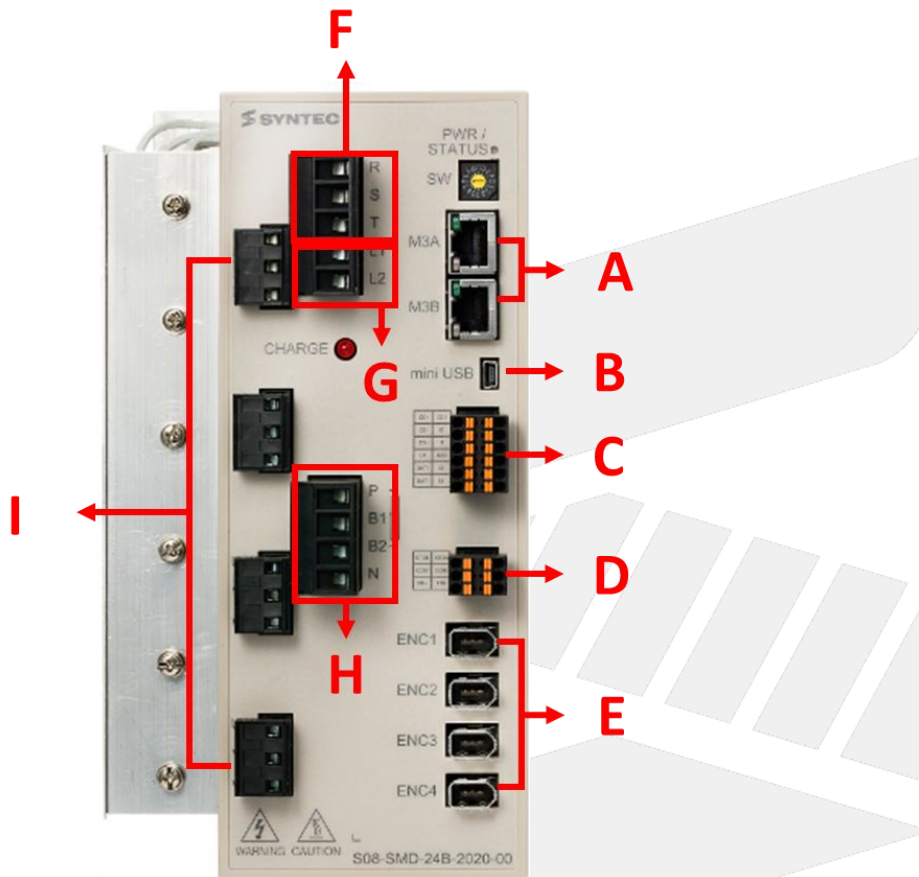
Cooling Method		Fan cooling
Environment	Temperature	0°C ~ 55°C(If the surrounding temperature exceeds 45°C, implement forced air circulation), storage: -20 ~ 65°C (non-freezing)
	Humidity	Maximum 90% RH (non-condensing); storage: under 90%RH (non-condensing)
	Location	Indoors (avoid direct sunlight); 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		4.5 kg



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SMD-30/30/30/30-XS



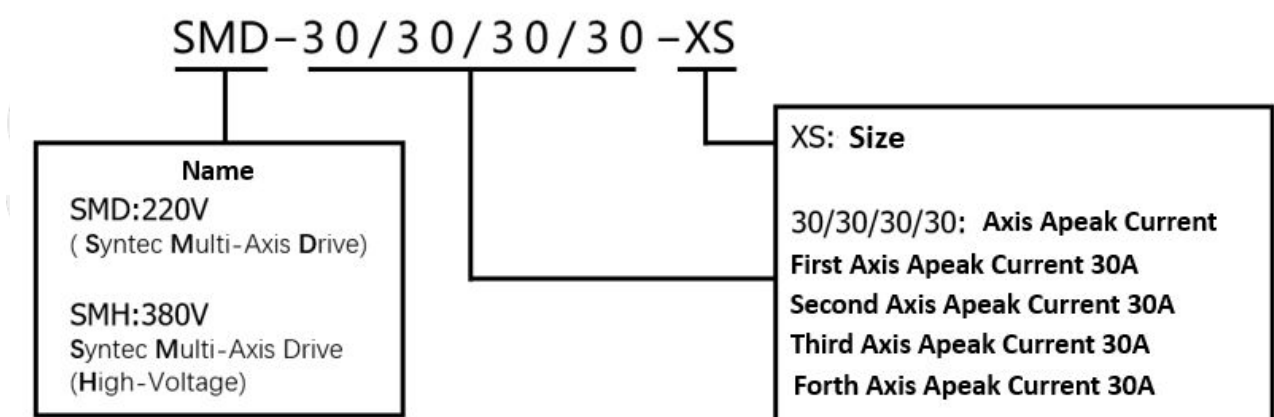
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8 HomePage(SMD-30/30/30/30-XS)

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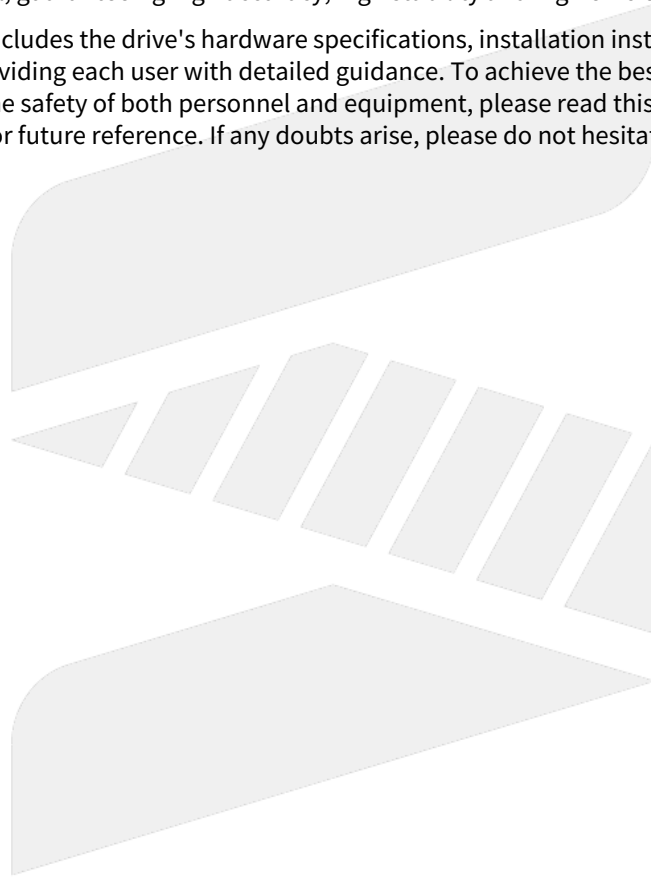


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- Do not drop or impact the drive.
- Do not force the drive to operate if it is damaged.



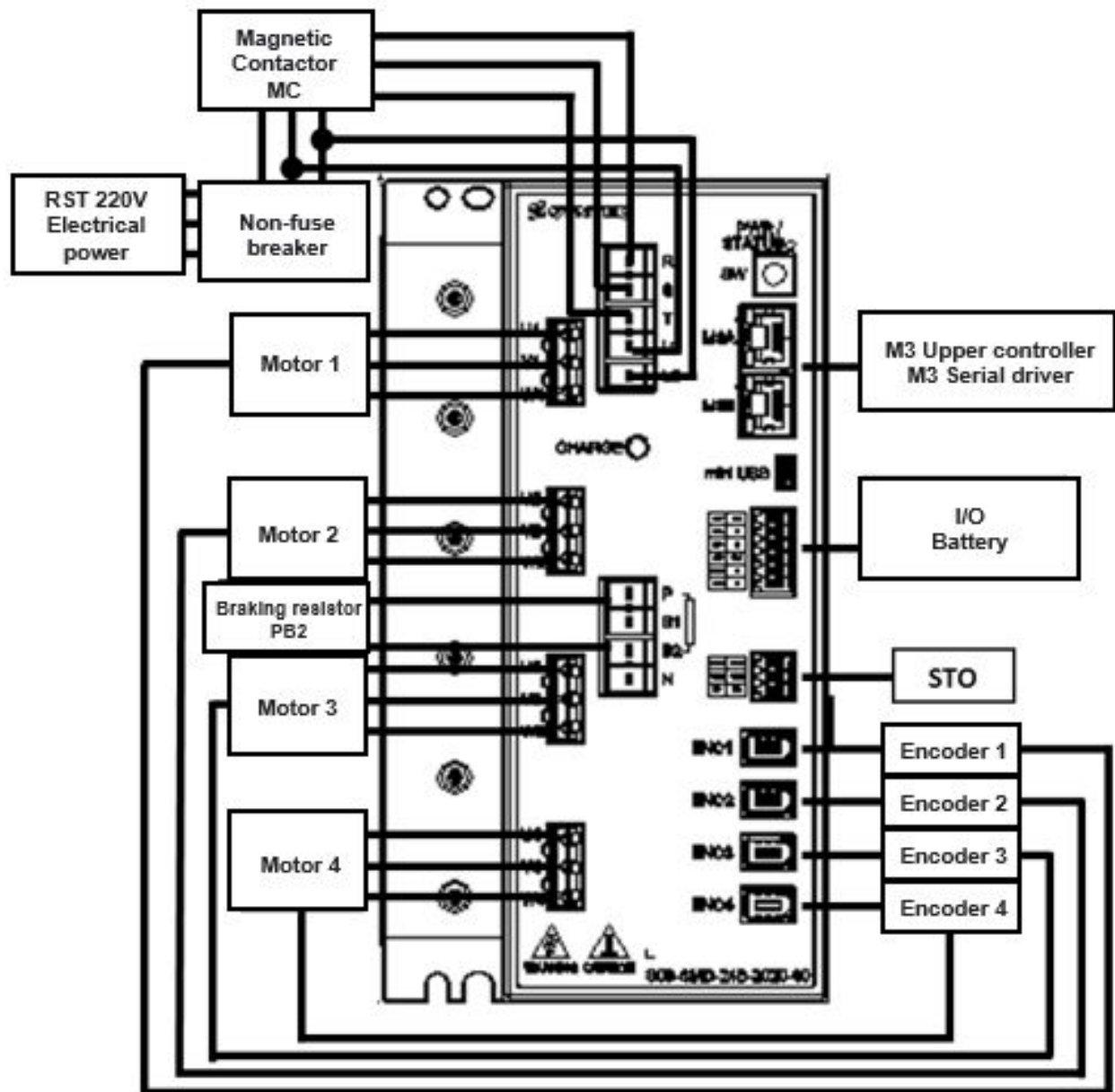
SYNTEC

11 Wiring and Signal (SMD-30/30/30/30-XS)

11.1 Wiring Diagram

SMD-30/30/30/30-XS

※Recommended encoder wiring: 22AWG×2C+24AWG×2P, 90% coverage



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 100Mbps
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
 - O port: O0+ and O0- are internally conductive

STO I/O:

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

USB Communication:

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

LED :

1. Operation Status and Power indicator.

11.2 Connector and Terminal Definition

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
Ground Terminal		Connects to ground
USB Port	USB	Connects to PC's USB port
Serial Communication Interface	M3A, M3B	Use M3 wire to connect M3A and host controller M3B can connect to the next OpenDrive M3A in series
Encoder Feedback (Axis1)	CN1	Connects to Axis1 motor encoder
Encoder Feedback (Axis2)	CN2	Connects to Axis2 motor encoder
Encoder Feedback (Axis3)	CN3	Connects to Axis3 motor encoder
Encoder Feedback (Axis4)	CN4	Connects to Axis4 motor encoder

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

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

11.3 Regenerator Selection

11.3.1 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)
SMD-30/30/30/30-XS	200	20

Note:

1. The Recommended Regeneration Resistance Table is designed for general machining situations. If these values do not meet the actual application conditions, users can refer to the Detailed Selection Guide for Regenerative Resistors and select a regenerator of higher power.
2. 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 higher power.

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	Aluminum-Housed
Characteristics			

Resistor Type	Wirewound	Ripple	Aluminum-Housed
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)

11.3.2

Detailed Selection Guide for Regeneration Resistors

Motors do Negative Work under External Torque Load

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 T_L and the unit is a percentage of the rated torque (%). The speed at that instance in time is ω_r (rpm). The regenerative resistance power must be greater than the External Torque Power = $T_L \times \text{Rated Torque} \times (\omega_r \times 2\pi/60)$.

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 $0.5 \times 2 \times 2000 \times 2\pi / 60 \approx 210$ 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.

E_0 in the table below is the regenerative energy required to dissipate from the rated speed to the standstill when the motor is load-free, $E_0 = J \cdot \omega_r^2 / 182$, where J is the rotor inertia ($\text{kg} \cdot \text{m}^2$) and ω_r is the rated speed of the motor

(Rpm). And E_c is the energy that the DC bus capacitor can absorb, $E_c = C \cdot (V_{b,max}^2 - V_b^2) / 2$, where C is the capacitance value of the DC bus terminal. $V_{b,max}$ 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 V_b 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 $E_0(N+1) \cdot M^2 - E_c$ Joule. If the motor reciprocating cycle (Time of accelerating, being steady, to decelerating) is T sec, then the regenerative resistor power $W = 1.2[E_0(N+1) \cdot M^2 - E_c] / T$, 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.

Axial Motor

Drive Model No.	Axial Motor Model No.	Rotor Inertia J (10^{-4} kg-m ²)	Rated Speed (rpm)	Load-free Rated Speed to Zero Speed Regenerative Energy E_0 (J)	Capacitor Absorbed Energy E_c (J)
SMD-30/30/30/30-XS	S08-AM03-50-E12-□-M□	0.043	3000	0.21	62.57
	S08-AM06-50-E12-□-M□	0.19	3000	0.94	62.57
	S08-AM1-50-E12-□-M□	0.44	3000	2.18	62.57
	S08-AM06-50-E12-□-Z□	0.16	3000	0.79	62.57

11.4 Connector and Terminal Definition (SMD-30/30/30/30-XS)

Name	Terminal	Description
Main Loop Power Input Terminal	R, S, T	Connects to 3-phase AC

Name	Terminal	Description
Motor Power Input Terminal	U, V, W	Connects to motor
Ground Terminal		Connects to ground
USB Port	USB	Connects to PC's USB port
Serial Communication Interface	M3A, M3B	Use M3 wire to connect M3A and host controller M3B can connect to the next OpenDrive M3A in series
Encoder Feedback (Axis1)	CN1	Connects to Axis1 motor encoder
Encoder Feedback (Axis2)	CN2	Connects to Axis2 motor encoder
Encoder Feedback (Axis3)	CN3	Connects to Axis3 motor encoder
Encoder Feedback (Axis4)	CN4	Connects to Axis4 motor encoder

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.

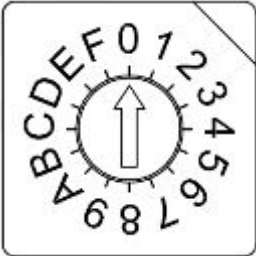
When the power is cut off, the drive's internal capacitor still contains a large amount of charge-- do NOT touch the six power lines R, S, T, and U, V, W. Please wait until the charging light goes out.

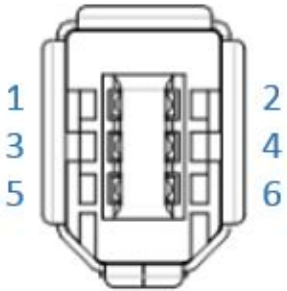
When lengthening the encoder cable, apply twisted pair cabling to the encoder cable and the grounding signal cable. Do not exceed a length of 20 m (65.62 in or 14 ft); if it is absolutely necessary to do so, please use a signal line with twice the wire diameter in order to minimize signal attenuation.

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

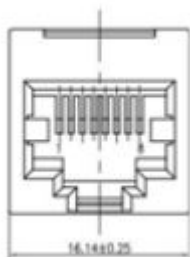
Type	Wattage	Wire Diameter
Axial	100W~850W	20AWG
	850W~7.5kW	16AWG
Spindle	7.5kW and below	12AWG
	11kW and above	10AWG

11.5 Connector Pin Define (SMD-30/30/30/30-XS)

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

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

M3 Serial / EtherCAT Serial



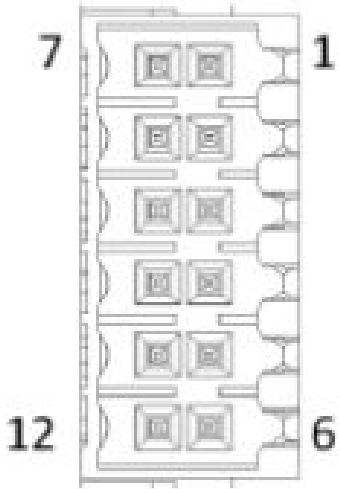
Pin	Name	Description
1	TX+	Differential Signal (+)
2	TX-	Differential Signal (-)
3	RX+	Differential Signal (+)
4	NC	--
5	NC	--
6	RX-	Differential Signal (-)
7	NC	--
8	NC	--

Mini USB Port

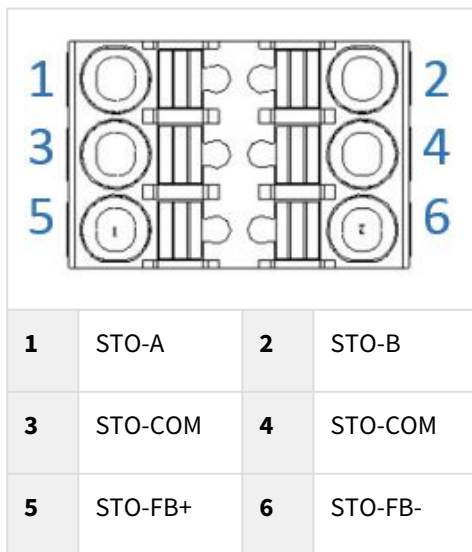


Pin	Name	Description
1	5V	5V Power

2	DM	USB Differential Signal (-)
3	DP	USB Differential Signal (+)
4	GND	Power Reference GND
5	GND	Power Reference GND

IO Signal Port			
			
1	SDI COM01	2	SDI0
3	SDI1	4	SDI COM23
5	SDI2	6	SDI3
7	SDO 0+	8	SDO 0-
9	SDO 1+	10	SDO 1-
11	BAT+	12	BAT-

STO Signal Port



11.6 Regenerator Selection (SMD-30/30/30/30-XS)

11.6.1 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)
SMD-30/30/30/30-XS	200	20

Note:

1. The Recommended Regeneration Resistance Table is designed for general machining situations. If these values do not meet the actual application conditions, users can refer to the Detailed Selection Guide for Regenerative Resistors and select a regenerator of higher power.
2. 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 higher power.

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Resistor Type	Wirewound	Ripple	Aluminum-Housed
Characteristics			
Heat Dissipation	Poor	Average	Excellent
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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)

11.6.2

Detailed Selection Guide for Regeneration Resistors

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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.

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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 $0.5 \times 2 \times 2000 \times 2\pi / 60 \approx 210$ 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.

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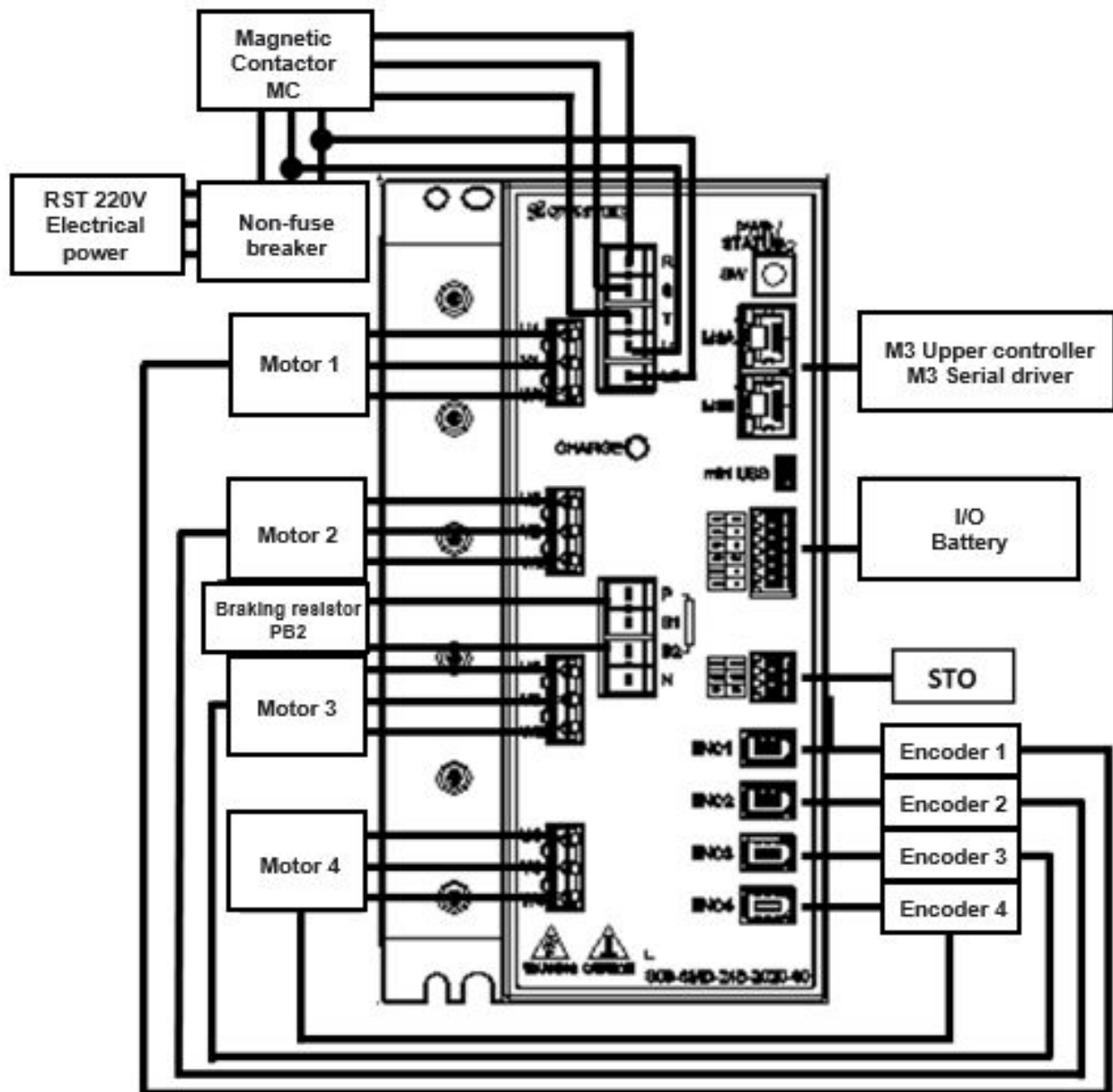
Axial Motor

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	S08-AM06-50-E12-□-Z□	0.16	3000	0.79	62.57

11.7 Wiring Diagram (SMD-30/30/30/30-XS)

SMD-30/30/30/30-XS

※Recommended encoder wiring: 22AWG×2C+24AWG×2P, 90% coverage



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.

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4. Battery voltage checking for absolute encoders.

Host Controller Serial Communication:

1. Mechatrolink-II Serial 10Mbps
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3. EtherCAT Serial 100Mbps (Currently unsupported)

General IO Signal:

1. 2 DI ports
2. 1 DO port
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4. Note
 - NC: Empty port
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STO I/O:

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

USB Communication:

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

LED :

1. Operation Status and Power indicator.