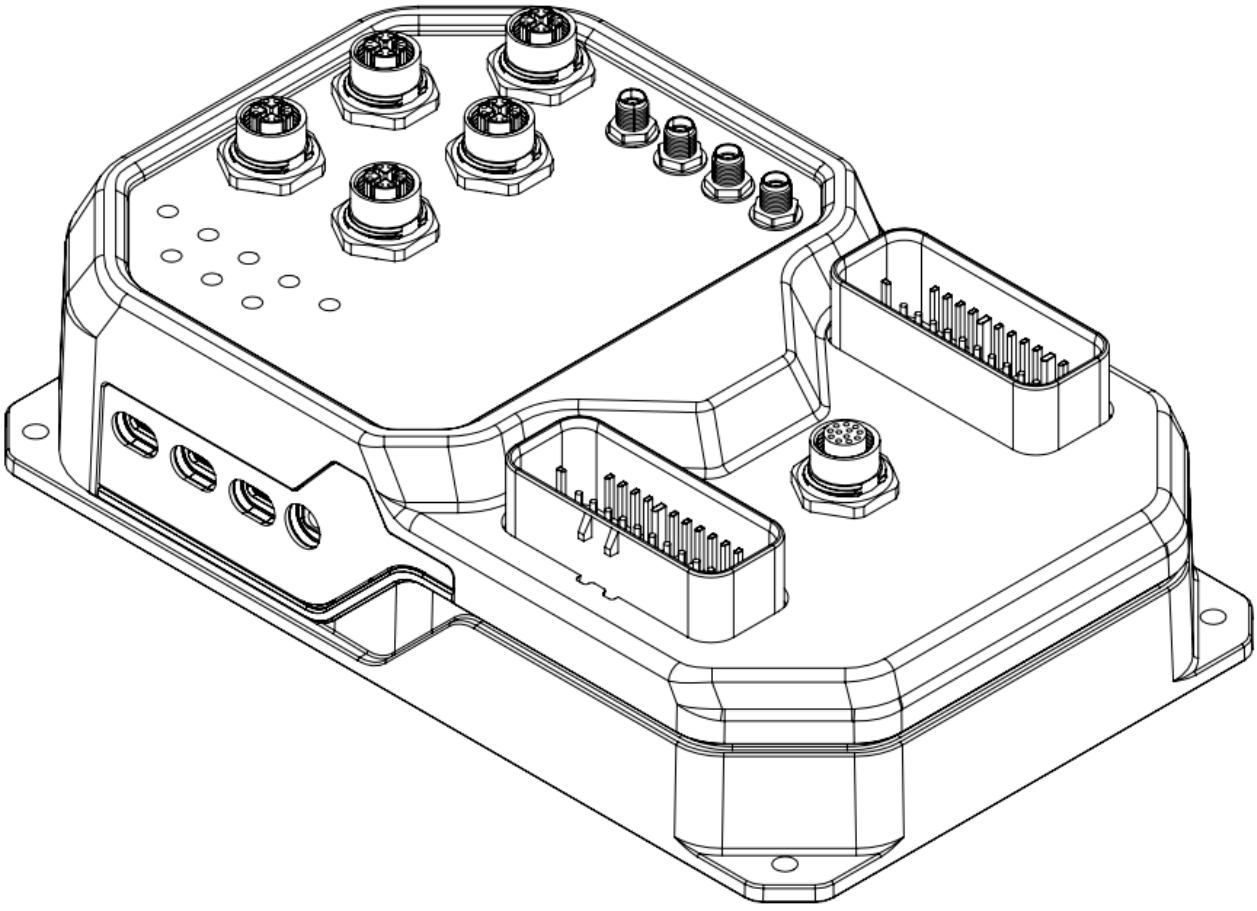
SRC-3000FS（Forklift)



Revision History

Version	Date of Issue	Description
V1.0	2023.05	First edition
V1.1	2023.10	Updated seer logo, encoder interface definition, and ETL certification

For more information

Please visit https://www.seer-group.com/

Thank you for your purchase.

Only qualified personnel who have received corresponding training and qualified are allowed to operate this product.

It is recommended to refer to the ISO 3691-4 when using this product to manufacture mobile robots.

The use and maintenance of mobile robots manufactured with this product must comply with *Industrial Trucks - Safety Rules for the Application, Operation and Maintenance (GB/T 36507-2018)*.

Disclaimer

We have checked the content of this document. But there is no guarantee that the description is completely consistent with the product. We will always inspect the content of the description and make necessary corrections in the subsequent editing.

Technical data is always subject to change without notice.

Tips

- Before using the product, please read the product manual carefully.
- The controller can be disassembled only by the authorized maintenance personnel.
- Before use, please fix the controller on a stable surface.
- Keep the controller dry and avoid overheating of the components in the chassis. Please fix the controller on a bottom plate with good heat conduction.
- Before connecting the controller to the power supply, please confirm that the power supply voltage and the connection method of the power supply terminal meet the requirements.
- Please put the power cord in a place where it will not be stepped on, and do not stack any objects on the power cord.
- Before connecting or removing any equipment, please make sure that all power cords have been removed in advance.
- Please pay attention to all the precautions and warnings mentioned in the manual.
- If there is an abnormal situation during the use of the equipment, please consult a professional.
- Do not place or store this device in an environment where the ambient temperature is higher than 70°C; otherwise, it will cause irreversible damage to the device.
- This document cannot substitute the technical agreement. If the content in this document conflicts with the technical agreement, please refer to the technical agreement or contract.
- The right of final interpretation to this document is reserved by Shanghai Seer Intelligent Technology Corporation.

Content

1 Introduction

1.1 Product Introduction

This product is a functional safety controller designed for mobile robots (AGV, AMR and automatic forklifts,etc.), with a safety integrity level of SIL2, which can be used to build mobile robots that comply with *ISO 3691-4 standards*, and provides core features such as map construction,navigation, model editing. The controller adapts to a variety of mainstream laser radars, and provides a wealth of I/O, CAN, RS485, Ethernet and other interfaces for connecting various sensors and driver devices. This product integrates the core components of mobile robots, and with powerful client software, it can help users quickly complete the manufacturing and application of safe mobile robots.

Trademark

Some of the names below and possibly other names without the registered trademark symbol ® are registered trademarks of Shanghai Seer Intelligent Technology Corporation:

SEER and SRC

Certification

According to the CE certification, the product complies with below Standards:

IEC-61508;
ISO-13849-1;
IEC-62061;
EN 61010-1:2010;
CE-EMC (IEC 61326-1)
UL 61010-1
CSA C22.2#61010-1-12
UL 61010-2-201
CSA C22.2#61010-2-201
47CFR Part 15(2020)
ANSI C63.4(2014)

1.2 Overview of Functions

Functional safety	IEC 61508 SIL2 / IEC 62601 SIL2; ISO 13849-1 Cat.3 PLd
Power ON mode	Provide an one-key system power ON/OFF interface
Digital input	Provide 24 isolated digital input interfaces
Digital Output	Provide 12 controllable digital output interfaces
Power Output	Provide 4 controllable power output interfaces
Power supply monitoring	Monitor the system power supply voltage and battery power status
Battery management	For batteries with output switches, provide corresponding battery switch management ports
Emergency stop forwarding	Provides the function of forwarding one emergency stop input to two emergency stop outputs
Communication bus	Provide RS485, CAN, USB and other communication bus interfaces
Posture sensing	Accommodate six-axis IMU sensor, which can accurately sense the posture of the controller
Temperature and humidity environment	Accommodate temperature and humidity sensors to effectively sense the environment inside the controller
Network interface	Integrate 5-port Gigabit network switch and 2.4/5GHz dual-band Wifi (industrial grade)

1.3 Product Dimensions and Environment

Overall dimensions: 225mm*136mm*65.6mm
Product weight: 1.8kg
Working temperature: -30°C to 55°C
Working humidity: 10-90% RH, non-condensing
Storage temperature: -40°C to 70°C
Protection level: IP52 (IP65 Custom casing required)

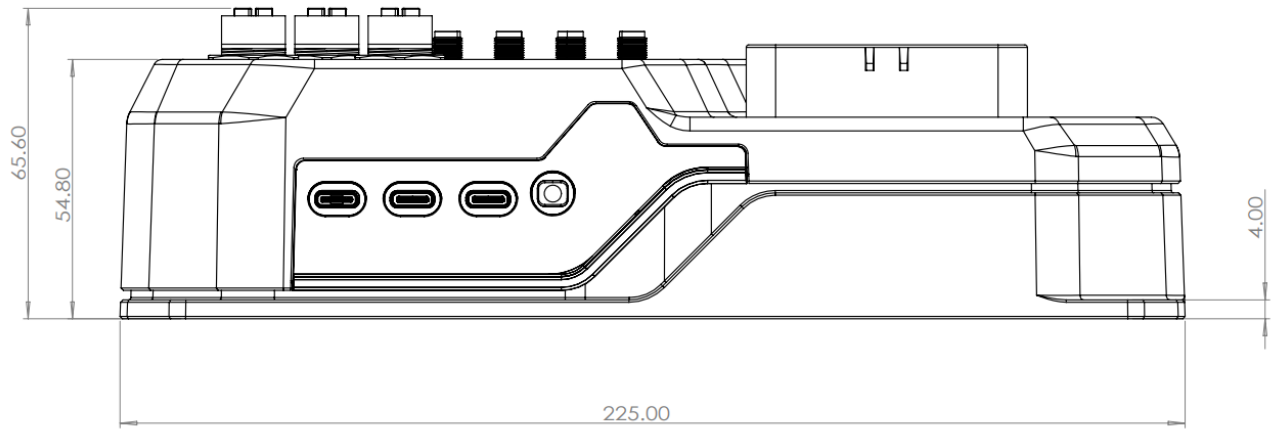
1.4 Requirements for External Power Supply

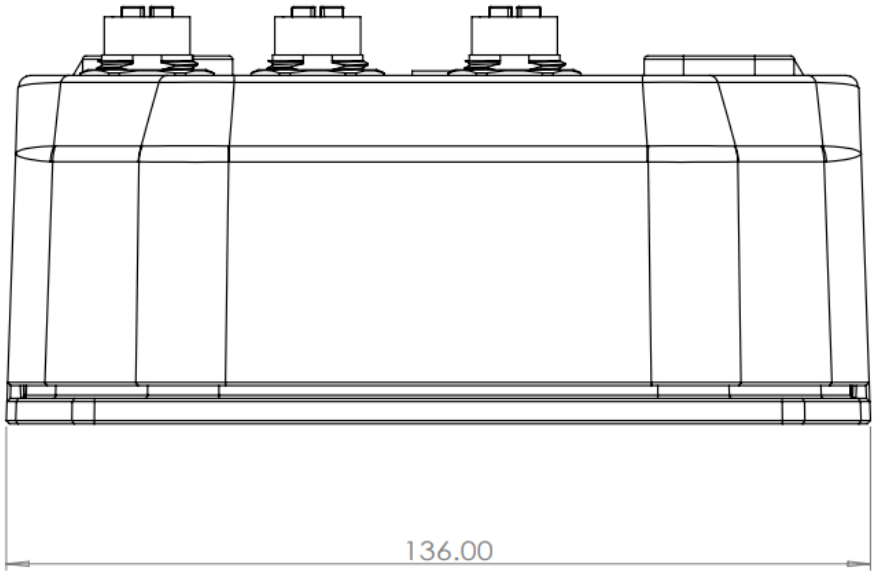
Voltage	22-55V
Ripple and noise	150mVpp
Total power	18W (excluding Power DO load)

2 Dimensions and Installation

2.1 Appearance and Dimension Drawing

The dimension drawing is as follows: (unit: mm)



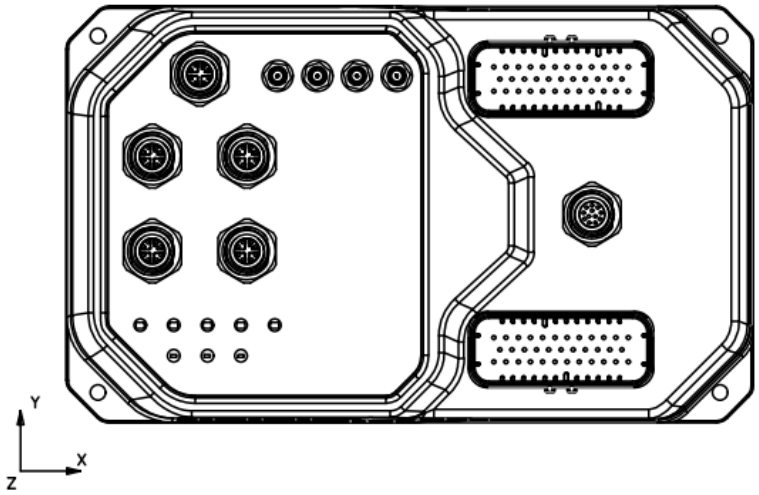


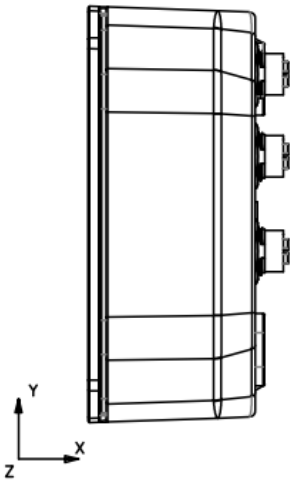
2.2 Installation Precautions

2.2.1 Installation Direction

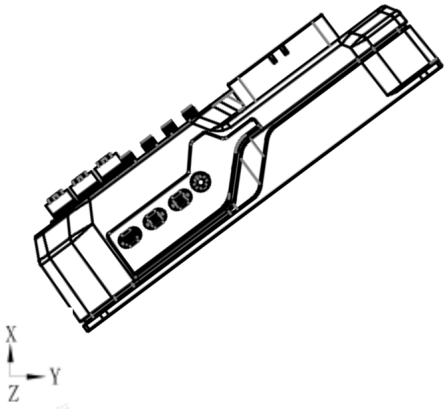
The mounting surface of the fixed bottom plate of the controller must be perpendicular to any direction of the space coordinates system.

Allowable placement direction (where X, Y & Z are the directions of the space coordinates system):

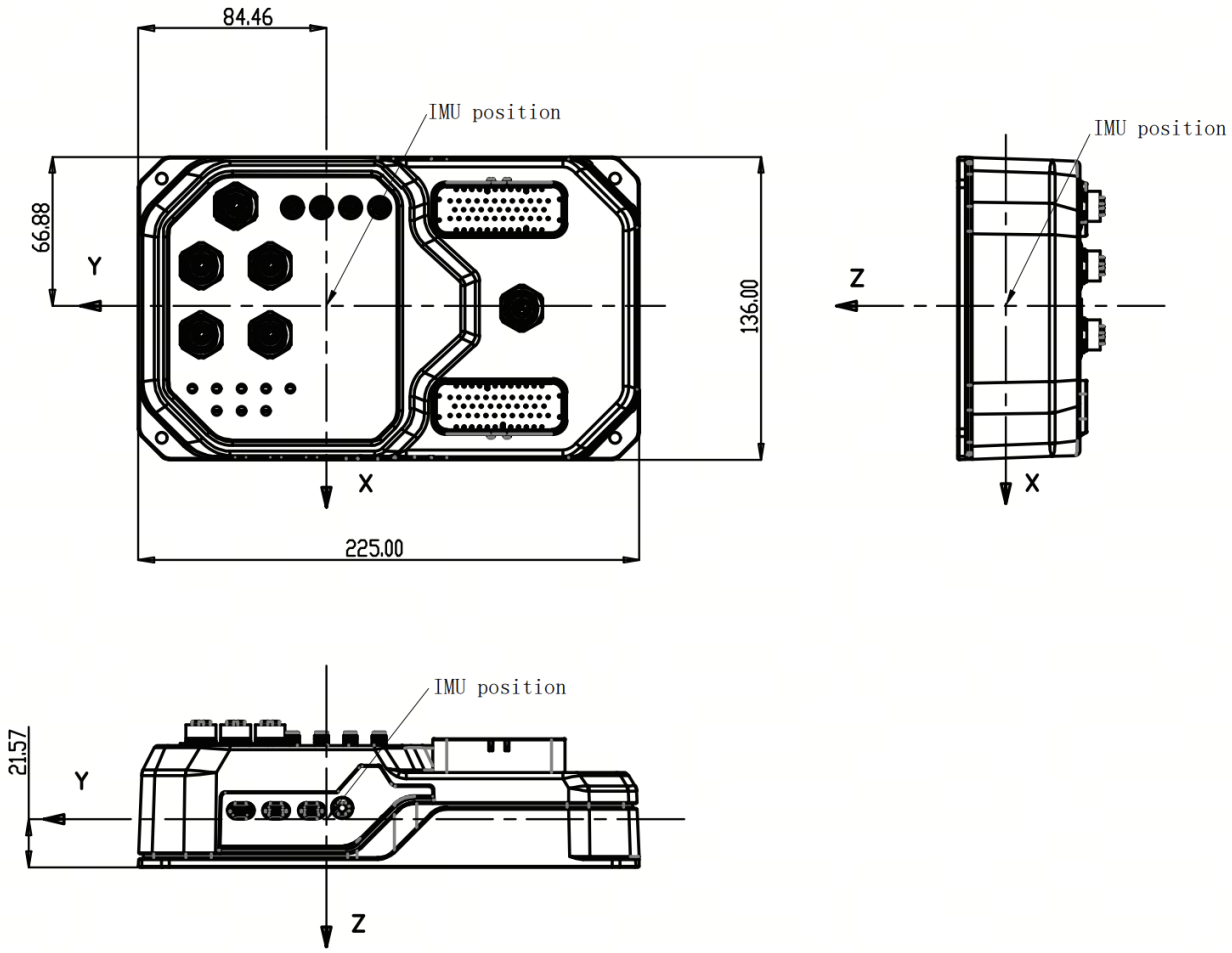




Wrong placement direction (where X, Y & Z are the directions of the space coordinates system):

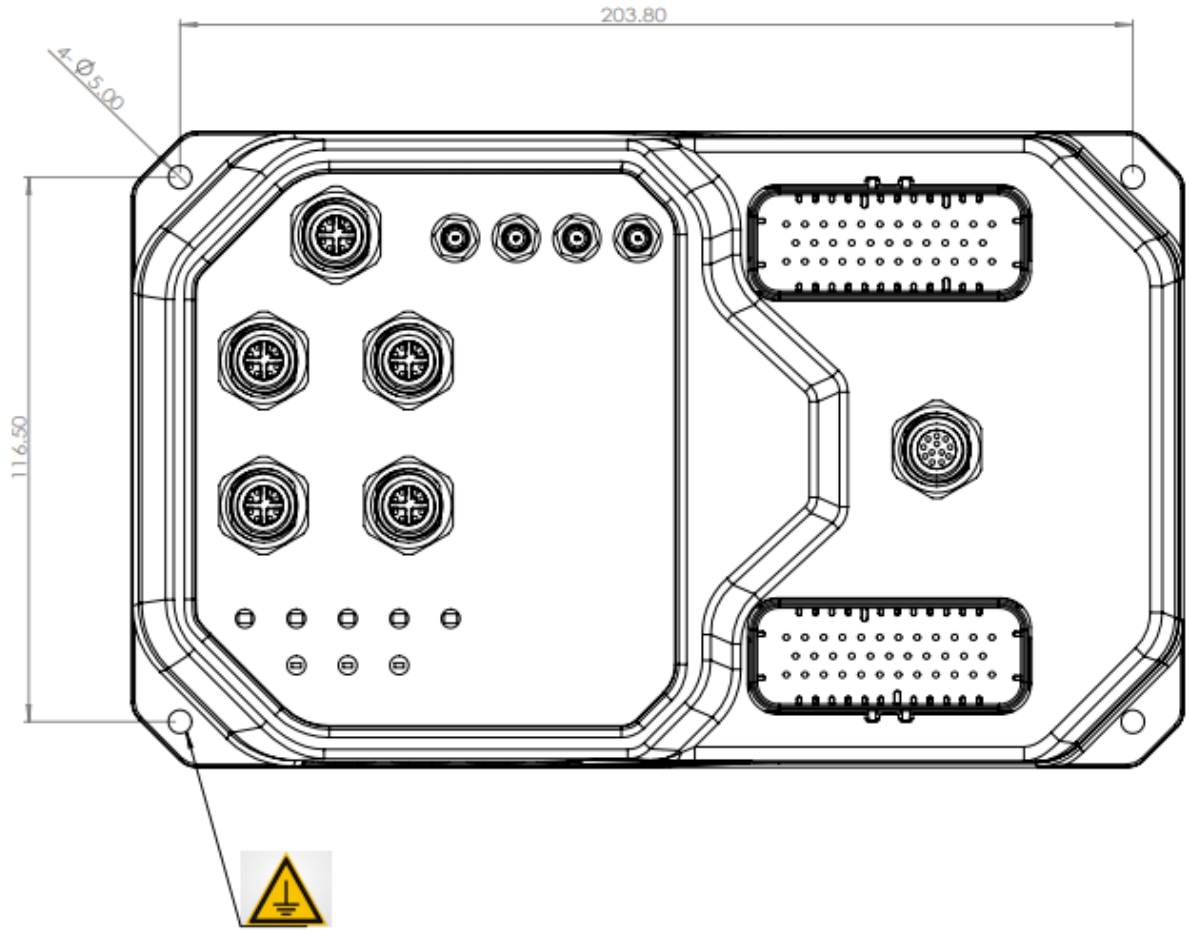


2.2.2 Coordinate Direction of Gyroscope



2.2.3 Mounting Holes

Unit: mm

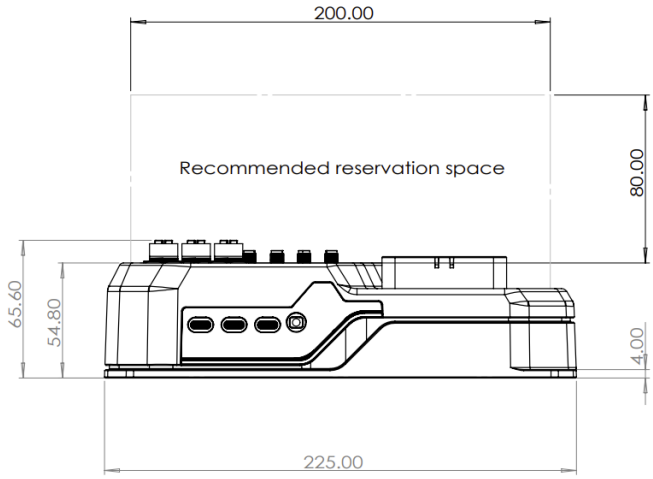


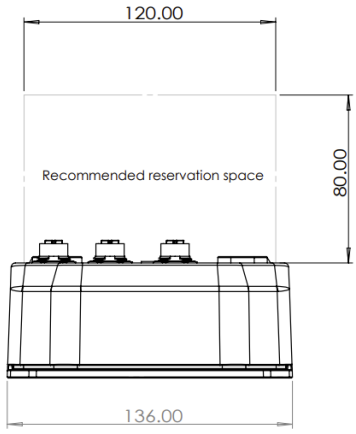
1. The red box indicates the position & dimension of the controller mounting hole.
2. The blue box indicates the size of the controller mounting screw (M4 locking screw is recommended).

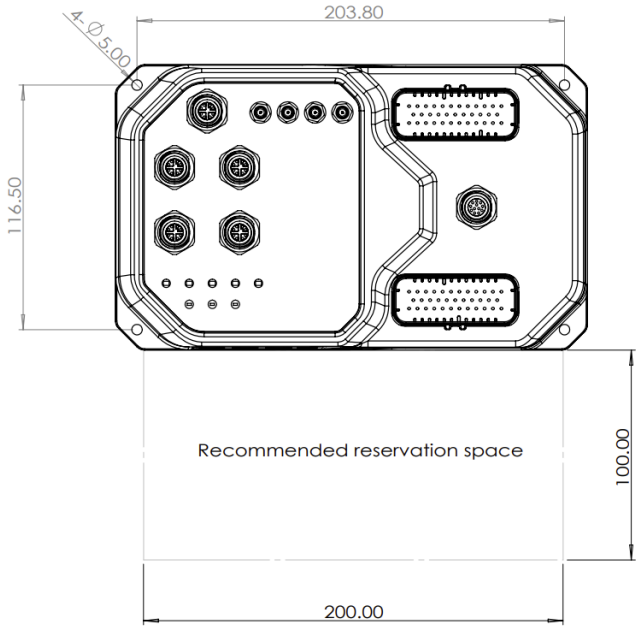
Notes:

1. It is recommended that the controller installation plane has certain thermal conductivity and heat dissipation capacity, which is beneficial to the overall heat dissipation of the controller and ensures its operating performance
2. There is a grounding hole on the right side of the controller, which connects the controller shell with the robot body through a round terminal.

2.2.4 Reserved Space for Wiring







3 Interfaces and General Functions

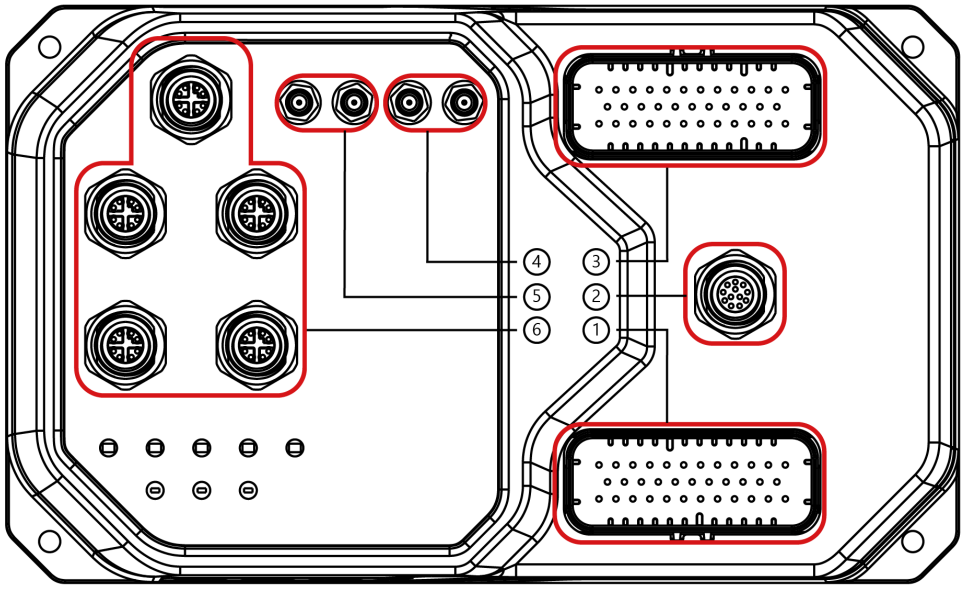
The following table is an overview and quantity of the external interfaces for the controller:

Category	Description
Controller model	SRC-3000FS
Communication Interface	
Isolated CAN	1
Optional isolated RS485 and CAN interfaces (software for option, battery communication interface)	1
Optional isolated RS485 and CAN interfaces (software for option)	1
Non-isolated RS485 interface	2
Type-C USB2.0	1
Type-C USB3.0	2
Safety encoder	2
Control Interface	
Power DO (the maximum output current of a single channel is 1A, DO_0-3)	4
Ordinary DO (the maximum current of a single channel is 400mA, DO_4-15)	12
OSSD output (multiplexed with DO, 2 consecutive DOs can be configured as a group of OSSD)	6
DI	16 PNPs+8 PNP/NPNs for option
Pulse output	2
Power ON/OFF button	1
Network Interface	
Wired network interface (Gigabit)	5
Wireless network interface 2.4/5GHz dual-band Wifi (industrial grade)	2T2R
Battery Interface	
Battery switch (multiplexed with **power ON/OFF** button)	1
Audio/Video Interface	
Multimedia audio output	1
Indicator Lamps	
WIFI indicator lamp	1
LTE indicator lamp	1
Working status indicator lamp	1

3.1 Interface Definition

3.1.1 Definition of Controller Top Interface

The interface layout is as follows:



Interface Description:

No.	Description
1	Connector A, J1, black
2	M12 external thread safety encoder interface, 12PIN
3	Connector B, J2, blue
4	Wifi antenna*2 (industrial grade), when the controller needs to be connected to a wireless local network, the two antennas must be connected at the same time (extended cables can be used), and the antennas shall not be surrounded by metallic shells.
5	Antenna interface for LTE/5G module(optional)
6	M12 X-Code Gigabit Ethernet interface*5

Detailed interface definition:

J1 (black):

[12]Pulse Out A(test pulse)	[23]Pulse Out B(test pulse)	[35]Passive Out N2(Dry contact)
[11]DI_18	[22]DI_19	[34]Passive Out P2(Dry contact)
[10]DI_16	[21]DI_17	[33]Passive Out N1(Dry contact)
[9]OSSD7A in/DI_14	[20]OSSD7B in/DI_15	[32]Passive Out P1(Dry contact)
[8]OSSD6A in/DI_12	[19]OSSD6B in/DI_13	[31]DI_23
[7]OSSD5A in/DI_10	[18]OSSD5B in/DI_11	[30]DI_22
[6]OSSD4A in/DI_08	[17]OSSD4B in/DI_09	[29]DI_21
[5]OSSD3A in/DI_06	[16]OSSD3B in/DI_07	[28]DI_20
[4]OSSD2A in/DI_04	[15]OSSD2B in/DI_05	[27]Power Supply2-
[3]OSSD1A in/DI_02	[14]OSSD1B in/DI_03	[26]Power Supply1-
[2]DI_00 (emergency stop input)	[13]DI_01 (emergency stop input)	[25]Power Supply2+
[1]DI_COM		[24]Power Supply1+

Note:DI_COM must be connected, The DI with same background color is the associated group.

J2 (blue):

[12]Power Supply5-	[23]DO_01（Power）	[35]DO_00（Power）
[11]Power Supply4-	[22]DO_03（Power）	[34]DO_02（Power）
[10]Power Supply3-	[21]Safe_DO1B/DO_05	[33]Safe_DO1A/DO_04
[9]CAN_L1	[20]Safe_DO2B/DO_07	[32]Safe_DO2A/DO_06
[8]CAN_H1	[19]Safe_DO3B/DO_09	[31]Safe_DO3A/DO_08
[7]GND_CAN1	[18]Safe_DO4B/DO_11	[30]Safe_DO4A/DO_10
[6]CAN_L2_RS485_3B	[17]Safe_DO5B/DO_13	[29]Safe_DO5A/DO_12
[5]CAN_H2_RS485_3A	[16]Safe_DO6B/DO_15	[28]Safe_DO6A/DO_14
[4]GND_CAN2	[15]RS485_A1(/dev/ttyUart2)	[27]RS485_A2(/dev/ttyUart3)
[3]RS485.4B_CANL3(/dev/ttyUart0)	[14]RS485_B1(/dev/ttyUart2)	[26]RS485_B2(/dev/ttyUart3)
[2]RS485.4A_CANH3(/dev/ttyUart0)	[13]BAT_SWITCH_O	[25]KEY_BOOT
[1]GND_BAT_COM		[24]BAT_SWITCH_N

Note: The signals with same background color are the associated group.

Encoder interface definition:

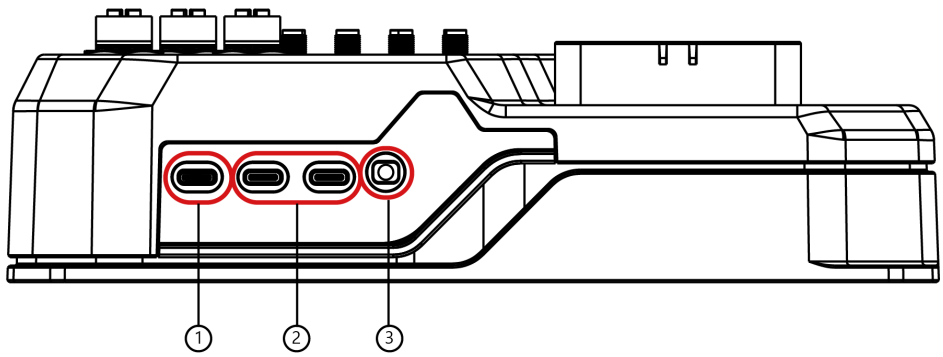
No.	Definition	No.	Definition
1	ENCODER1_POWER_5V	2	ENCODER1_COSB_N
3	ENCODER1_COSB_P	4	ENCODER1_SINA_N
5	ENCODER1_SINA_P	6	ENCODER2_COSB_N
7	ENCODER2_COSB_P	8	ENCODER2_SINA_N
9	ENCODER2_SINA_P	10	ENCODER2_POWER_5V
11	GND	12	GND

Note:

1. Do not bend or damage the internal pins of the connector.
2. Do not touch the connector pins with your hands.
3. Please use a blind plug to seal the female end of the wiring harness without any pins to ensure good waterproofness of the controller.
4. Please use the connector sockets and pins provided in the package, and fabricate the wiring harness according to the connector and connection line definition documents, and use it with the controller. Please ask for the connection line definition documents from us.

3.1.2 Side Interface Definition

Interface picture:

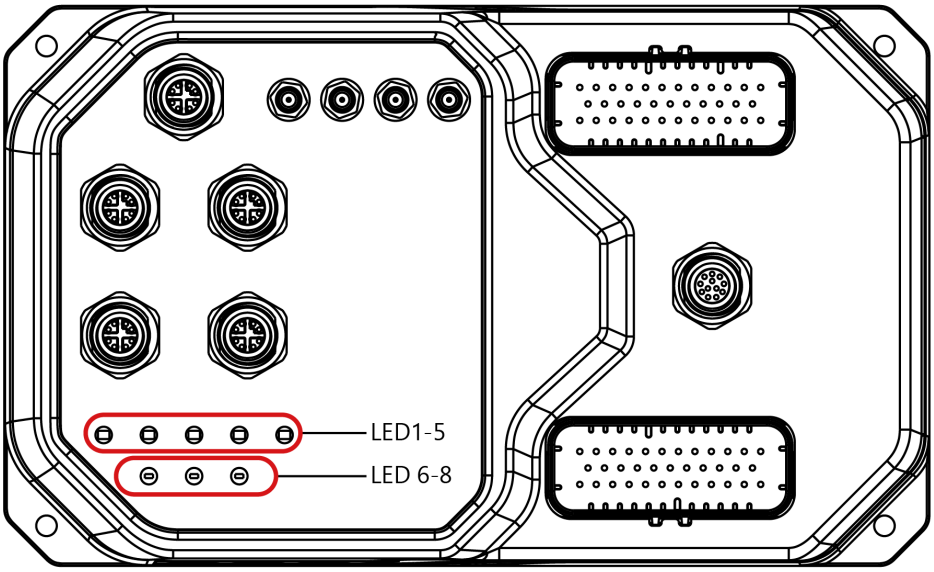


Detailed interface definition:

No.	Interface Definition
1	Type-C USB2.0*1
2	Type-C USB3.0*2
3	Multimedia audio output

3.1.3 Definition of indicator

Indicator picture:



Detailed indicator definition (Link LED 1-5):

Ethernet interface	Link LED 1-5
No Link	Off
10M Link-no activity	Orange on
10M Link-activity	Orange blinking
100M Link-no activity	Red on
100M Link-activity	Red blinking
1000M Link-no activity	Green on
1000M Link-activity	Green blinking

Detailed indicator definition (Link LED 6-8):

Definition	LED 6-8
WLAN connection indicator	Link LED 6
LET connection indicator	Link LED 7
Working status indicator of system	Link LED 8

3.2 Function Description of Interfaces

3.2.1 Power Interface

- The power supply voltage of SRC-3000FS controller is 24V or 48V, and the voltage range is 22-55V. But the external DCDC power supply or battery can be used for power supply. The ripple requirement is ⩽150mVpp, and the minimum working current of the system is 1A@24V (excluding the power supply requirement of DO).
- The power input terminal has protection functions such as over-voltage, under-voltage, over-current and short-circuit protection etc. Exceeding the limited working range will affect the normal operation of the controller.
- According to the requirements of the external DO output current, a DCDC power supply with a suitable loading capacity can be selected.
- **Do not share a DCDC power supply with any electrical equipment or equipment with high power consumption.**
- Please connect the power supply correctly according to the J1 line sequence definition in 3.1.1. It should be noted that the positive and negative poles shall not be reversed.

3.2.2 Power ON/OFF Interface

- SRC-3000FS series controller provides a interface for power ON/OFF button.
- Power ON/OFF button connection: Select one self-reset button with one N.C(normally closed) contact, one N.O(normally open) contact and 24VDC indicator lamp, where the N.C contact is connected respectively to "KEY_BOOT" and ground, one N.O battery switch contact is connected respectively to the "BAT_SWITCH_N" and "BAT_SWITCH_O" on the controller, the 24VDC indicator is connected respectively to a DO and ground. **Do not use switches with common contacts between N.C and N.O contacts. Do not use the switches with self-locking function.**
- Power ON: Press on the power ON/OFF button until the start indicator lamp lights up, then release the power ON/OFF button to complete the start process. power OFF: In order to avoid spurious triggering power off in some scenarios, it is necessary to press on the power ON/OFF button of the controller, which means pressing on the power ON/OFF button for 2s and then release it until the stop indicator lamp goes out to complete the stop process; if pressing on the button for over 10s, the machine will be forced to power off;

- When the battery has a switch and the controller needs to control the on and off of the battery, the battery switch should be connected to the battery switch interface of the controller;
- Please use the power ON/OFF function after connecting correctly according to the J2 line sequence definition in 3.1.1.

3.2.3 Battery Switch and Charging Signal Interface

- SRC-3000FS series controller provides a battery switch interface, “BAT_SWITCH_N” and “BAT_SWITCH_O”. These signals are multiplexed with the power ON/OFF button and connected to the switch control interface on the battery.
- The controller provides one manual charging switch signals which is multiplexed with DI signal. When the robot is not charging, the charging signal will be suspended; when the robot is connected to manual charger, the corresponding charging switch signal will be triggered, and the controller will receive the charging signal.
- Please use the battery switch and charging interface functions after connecting correctly according to the J1 and J2 line sequence definitions in 3.1.1.

3.2.4 External network Interface

- The controller provides five X-Code Gigabit Ethernet interfaces to communicate with lasers, panels or other actuators.
- When connecting an external AP or other devices such as Moxa WiFi client, it must be configured as Router mode (different network segments between WAN and LAN), and Bridge mode is not allowed, otherwise the network conflict will be caused.
- 4 antenna connectors are provided, where two are built-in WLAN module external antenna interfaces, and two are built-in LTE/5G module external antenna interfaces. The connector is a standard SMA interface, and the controller has an external thread and inner hole, which requires an antenna or feeder with an internal screw and an inner pin.
- The controller that fully supports 5G will not support built-in wifi, and all 4 antennas will be used by the 5G module.

3.2.5 Communication Interface

- SRC-3000FS series controller provides one isolated standard CAN interface, two non-isolated standard RS485 interfaces, one isolated CAN/RS485 switchable communication interface, one isolated CAN/RS485 switchable communication interface, one USB2.0 Type-C interface and two USB3.0 Type-C interfaces.

- To adapt to different devices, the 120Ohm terminal resistors of some interfaces can be configured through software. See the table below for details. The CAN interface is generally used to connect to the motor driver, and the RS485 interface is generally used to connect to ambient lights, QR code cameras, etc.

Interface	Quantity	Terminal Resistor
Isolated CAN	1	Software for option
Optional isolated RS485 and CAN interfaces (software for option, battery communication interface)	1	Fixed terminal resistor
Optional isolated RS485 and CAN interfaces (software for option)	1	Software for option
Non-isolated RS485 interface	2	Fixed terminal resistor

- This controller respectively provides one switchable CAN/RS485 channel and one switchable CAN/RS485 channel, which can be switched by software, and each group of signals are mutually exclusive and cannot be used simultaneously. The SRC-3000FS communicates with the battery through the switchable CAN/RS485 channel, and the switchable CAN/RS485 channel is often connected to an encoder (such as a pull-wire encoder of a forklift).

- The ground of the isolated communication interface of the controller must be connected to the communication ground of the actuator; otherwise, the device cannot work.

- When twisted pairs are prepared, the following requirements shall be met:

  - The twisting rate of the twisted pairs is 33-50twist/m. In each “strand” of the wire harness, the twisted pair is required to be twisted by 360 degrees, which can also be understood as the twisted pair of each wire by 180 degrees.

  - For the convenience of connecting with the connector, the connection part allows cables shorter than 25mm without twisting pair.

  - No power line is allowed to run through between the high and low twisted pairs.

- Please use the communication function after connecting correctly according to the J2 line sequence definition in 3.1.1.

3.2.6 DO Interface

- The SRC-3000FS series controller provides 16 source-based DO interfaces to provide stable 24V power supply for external devices. Four of them (DO_00-DO_03) are large-current Power DO outputs, and the current-limiting protection value of single channel is 1A. In general, the turn signal, large-current contactor and laser power supply will be connected to these four channels. The current0limiting protection value of the remaining 12 DO outputs is 400mA.
- DO can control the corresponding DO switch state through software according to actual usage.
- The total output current of all DOs depends on the external DC-DC stabilized voltage supply (DCDC) of the controller or the output current capacity of the battery. The total power consumption shall not exceed 96W (24V/4A).
- To use the safety function of the controller, please refer to chapter 3.3. After DO is configured as a safety function, it will not be controlled by Roboshop and other upper software.
- When DO is connected to an inductive load, such as relays, contactors, solenoid valves, etc., a freewheeling diode must be added to both ends of its coil to eliminate the interference of the back electromotive force generated when the inductive load is disconnected on the system circuit. For details of the freewheeling diode connection, please refer to Appendix 2 FAQ on the Use of SRC-3000FS.
- Please use the DO function after connecting correctly according to the J2 line sequence definition in 3.1.1. Please note that the positive and negative poles of the actuator shall not be reversed.

3.2.7 DI Interface

- SRC-3000FS series controller provides 24 DI interfaces.
- DI only supports the input voltage of 24V level logic.
- DI supports source-based and leakage-based input, which is determined by whether the COM terminal is connected to 0V or 24V. When connected to 0V, DI only supports source-based input; when connected to 24V, DI supports leakage-based input. This function is limited to DI16-23.
- When the controller input pin is pulled high, the controller will receive high-level logic (do not directly connect to the power supply) to pull the DI port low or get it grounded, and the controller will receive low-level logic. The suspension defaults to low-level logic.
- When the external input source of the controller is a mechanical switch, a reed sensor, or a two-wire sensor, please do not directly connect the sensor or switch signal line to the controller. Please connect

a 470-2kΩ 1/2W 5% resistor in series with the signal line of the sensor before connecting it to the controller.

- To use the safety function of the controller, please refer to section 3.3. After DI is configured as a safety function, it cannot be used as a normal DI.
- Please use the DI function after connecting correctly according to the J1 line sequence definition in 3.1.1.

3.2.8 Power Supply Interface for External Driver

- Since SRC-3000FS series controller does not provide built-in driver power supply interface similar to SRC-2000, it needs to control external relay expansion through DO.

3.3 Safety Function

3.3.1 Safety information

- Basic safety instructions: Improper installation or use will result in failure to achieve the required safety level.
- Be sure to follow the instructions, especially the inspection instructions in this guide (e.g. involving use, assembly, installation or integration into the machine control system). Only qualified safety personnel are allowed to carry out the deployment, assembly, connection, debugging and maintenance.
- The inspection must be carried out by qualified safety personnel or specially certified and authorized personnel, and recorded in a way that can be traced by a third party at any time.
- The actual safety level depends on the external wiring, the implementation mode of wiring, parameter setting, the selection of control switch and its arrangement on the machine.

3.3.2 List of Safety Peripherals

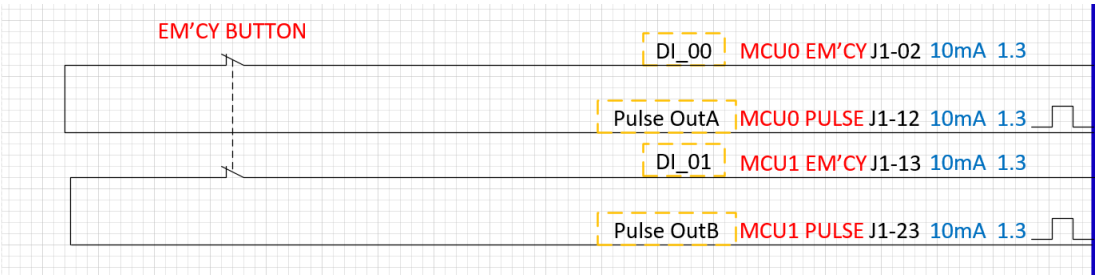
The current list of safety peripherals supported by SRC-3000FS is as follows:

Category	Model	Brand
Safety emergency stop switch	Double-blade normally closed logic	IDEC, Schneider
Safety laser	nanoScan3 Core I/O	SICK
	nanoScan3 Pro I/O	
Safety encoder	DFS60S	SICK

Safety proximity switch	IN30 IME2S	SICK
safety relay	SICK OSSD1 RELY SICK OSSD2 RELY SICK OSSD3 RELY	SICK

3.3.3 Safety Emergency Stop Function Interface

- The emergency stop button input function of the SRC-3000FS series controller is integrated in the DI interface. The emergency stop output is divided into dry contact output and wet contact output, where the wet contact is multiplexed with DO. The specific DO selection is realized through software configuration.
- Connection method for emergency stop switch: Select a group of dual-channel emergency stop buttons, with two pairs of normally closed contacts, the first pair is connected to "Pulse Out A" and "DI_00", and the second pair is connected to "Pulse Out B" and "DI_01". Such connection cannot be changed.
- The emergency stop output of the controller supports both dry contact and wet contact access methods. It is generally used as the driver's emergency stop signal to connect to the driver's STO interface or emergency stop DI interface. The dry contact is closed under normal conditions, and it is disconnected under emergency stop conditions. The dry contact has 120mA current-limiting protection. The output voltage of the wet contact is 24V and the maximum current is 400mA. Under normal conditions, it is high level, and under emergency stop conditions, it is low level.
- If the emergency stop button is pressed gently, the dry contact will be disconnected through the hardware circuit, where the response time is less than 2ms; the wet contact can also be controlled by software to trigger the driver's emergency stop, where the response time is less than 5ms.
- When any emergency stop event is triggered, the emergency stop signal will be output by opening the dry contact or turning the wet contact to low level.
- Please use the emergency stop function after connecting correctly according to the J1 and J2 line sequence definition in 3.1.1.
- The wiring diagram of emergency stop is as shown in the figure below:



3.3.4 Safety DO Interface

- The 12 DO interfaces (DO_04-DO_15) provided by the SRC-3000FS series controller can be used in pairs of combined safety DO for laser switching zone, wet contact of safety emergency stop output or driving safety relay. The 6 combination sequences are shown in the table below, and any one or several groups can be configured through software.

No.	DO Definitions		Remarks
1	Safe_DO1A/DO_04	Safe_DO1B/DO_05	Preferentially used for wet contact of emergency stop output
2	Safe_DO2A/DO_06	Safe_DO2B/DO_07	Preferentially used for laser switching zone
3	Safe_DO3A/DO_08	Safe_DO3B/DO_09	Preferentially used for laser switching zone
4	Safe_DO4A/DO_10	Safe_DO4B/DO_11	Preferentially used for laser switching zone
5	Safe_DO5A/DO_12	Safe_DO5B/DO_13	Preferentially used for laser switching zone
6	Safe_DO6A/DO_14	Safe_DO6B/DO_15	Preferentially used to drive safety relay

- When driving the safety laser switching zone, each group of safety DOs can be configured as mutually inverse logic outputs; when driving safety relays, they can be configured with the same logic output, and each group of DO can add test pulses.
- If the corresponding pair of DOs is not combined into a safety DO, it can be used as a normal DO alone to drive non-safety functional equipment, as shown in 3.2.6.

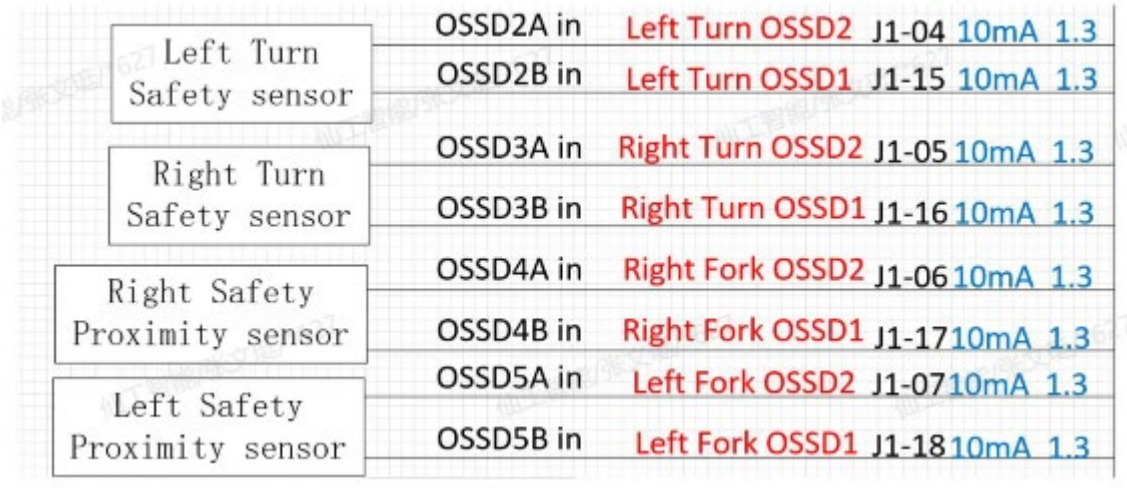
3.3.5 Safety DI Interface

- The 24 DI interfaces (DI_00-DI_23) provided by the SRC-3000FS series controller can be combined in pairs of safety DIs for detecting internal test pulse signals and external OSSD signals. Priority is given to the 7 combination sequences (from 2~8). As shown in the table below, any one or several groups can be configured through software.

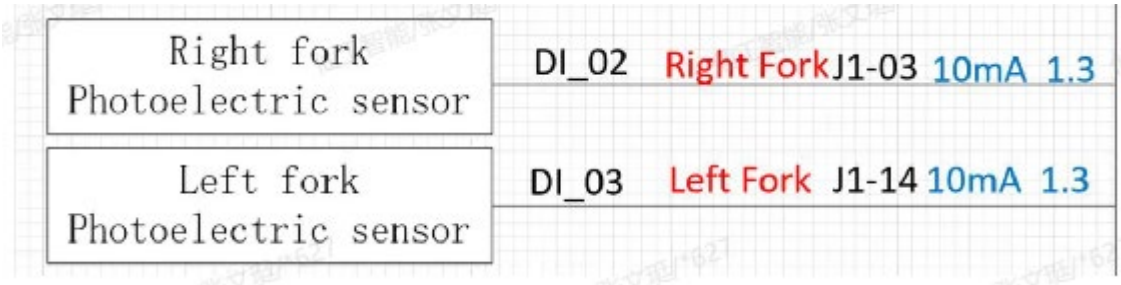
1	D1_00	DI_01	It must be used for safety emergency stop button input
2	OSSD1A in/DI_02	OSSD1B in/DI_03	It can be used as OSSD signal detection
3	OSSD2A in/DI_04	OSSD2B in/DI_05	It can be used as OSSD signal detection
4	OSSD3A in/DI_06	OSSD3B in/DI_07	It can be used as OSSD signal detection
5	OSSD4A in/DI_08	OSSD4B in/DI_09	It can be used as OSSD signal detection

6	OSSD5A in/DI_10	OSSD5B in/DI_11	It can be used as OSSD signal detection
7	OSSD6A in/DI_12	OSSD6B in/DI_13	It can be used as OSSD signal detection
8	OSSD7A in/DI_14	OSSD7B in/DI_15	It can be used as OSSD signal detection
9	DI_16	DI_17	It can be used as normal DI
10	DI_18	DI_19	It can be used as normal DI
11	DI_20	DI_21	It can be used as normal DI
12	DI_22	DI_23	It can be used as normal DI

- DI_00/DI_01 is used for emergency stop button input, as shown in 3.3.3.
- An example of safe DI wiring is shown in the figure below:



- If the corresponding pair of DI is not combined into a safety DI, it can be used as a normal DI for connecting non-safety functional sensors, as shown in 3.2.7.
- An example of normal DI wiring is shown in the figure below:



3.3.6 Encoder Interface

- The controller uses a dedicated M12 A-Code 12P female socket as the interface between the controller and the motor encoder. For interface definition, see 3.1.1.

Pin	Signal	Description
1	5V	5V voltage output
2	ENCODER1_COSB_N	Encoder 1, cosine, negative polarity
3	ENCODER1_COSB_P	Encoder 1, cosine, positive polarity
4	ENCODER1_SINA_N	Encoder 1, sine, negative polarity
5	ENCODER1_SINA_P	Encoder 1, sine, positive polarity
6	ENCODER2_COSB_N	Encoder 2, cosine, negative polarity
7	ENCODER2_COSB_P	Encoder 2, cosine, positive polarity
8	ENCODER2_SINA_N	Encoder 2, sine, negative polarity
9	ENCODER2_SINA_P	Encoder 2, sine, positive polarity
10	5V	5V voltage output
11	GND	Ground
12	GND	Ground
Shield	nc	Shielded layer

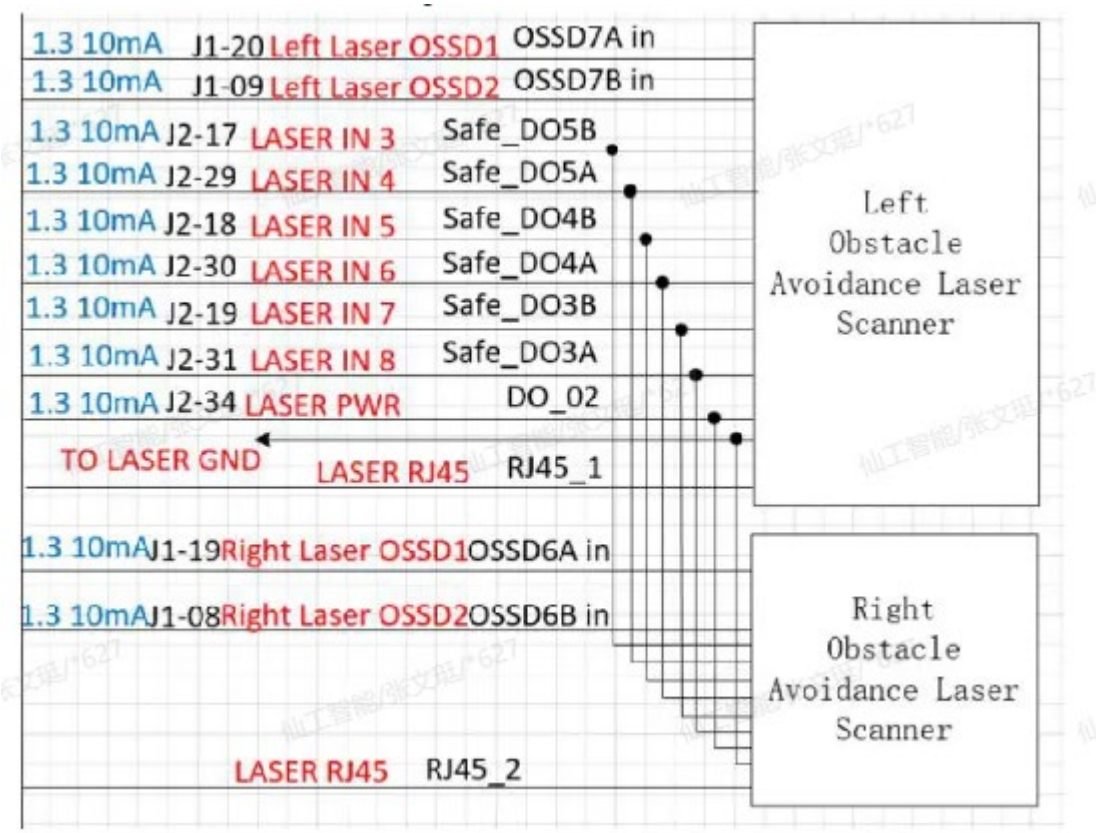
- The controller supports sin/cos encoder.
- Through software configuration, the encoder interface can monitor AMR driving speed. These values are used to determine the switch logic of the laser zone.

3.3.7 Safety Laser Interface

- The safety laser is a safety laser sensor that meets safety standards. The safety laser interface is not a separate hardware interface but a composite interface based on existing hardware and software function definitions. It contains the following functional interfaces:

Interfaces	Functions	Controller Interfaces
Laser switching zone output	Switch to different shapes of laser detection templates according to AMR speed or turn	Safety DO
Laser protection zone input	When the laser detects an obstacle in the protection zone, the OSSD output of the laser will change from high level to low level, and the AMR will immediately stop moving	Safety DI
Laser alarm zone input	When the laser detects an obstacle in the alarm zone, the ordinary DO output of the laser will change from high level to low level, and the AMR will decelerate	Ordinary DI
Laser EDM signal input	When the laser detects its own trouble, the ordinary DO output of the laser will change from high level to low level, and the AMR will immediately stop moving	Ordinary DI

- An example of safety laser wiring is shown in the figure below:



3.3.8 Safety Proximity Switch

- The safety proximity switch is used to detect whether the moving stroke of the mechanism is in place. It can be used for the collision detection of the forklift tooth tip, and it can also be used to detect the left and right turns of the forklift steering wheel. The safety DI of the controller is needed to detect the OSSD signal of the safety proximity switch.

3.3.9 Safety maintainance

The safety functions shall be checked regularly by qualified safety personnel

- Inspect the equipment within the required time window according to applicable domestic regulations. This ensures that changes on the machine or tampering on the protective equipment are found after the first commissioning.
- Each safety function must be checked for a fixed period of time. The effectiveness of safety functions must be checked by authorized qualified personnel.
- If the machine or safety function is changed or the safety controller has been modified or repaired, please recheck the corresponding equipment.
- Perform periodic inspections to keep the controller in optimal operation.
- Check that the installation conditions and the wiring of the controller are still correct.
- Regularly verify that the safety function meets the application requirements and all applicable regulations & standards (such as regular inspection) to ensure the reliability of safety functions.

3.3.10 Safety-related Technical Parameters

Safety-related Technical Parameters	
Safety Integrity Level	SIL2（IEC 61508）
Category	Cat.3 (ISO 13849-1)
Performance Level	PLd (ISO 13849-1)
PFH	1.38*10-7
TM（continuous operating time）	5 years

4 Precautions

Please be sure to follow the requirements below; otherwise, it will affect safety or cause damage to the controller:

1. For safety, please be sure to use a battery with short-circuit protection; if you are not sure about that, please add an air switch at the battery output;
2. In order to improve the safety of the controller, there is an M3 threaded hole on the right side of the aluminum plate of the controller, which must be connected to the robot body with a 2.5m^2 yellow-green wire, and the robot body must be grounded through a well-conducted grounding chain or grounding brush. The ground wire in the robot body must not be bridged.
3. Please insulate all exposed terminals (bare wires on the switch).
4. If there is no pin position on the female connector of the wire harness, please use a blind plug to seal it; otherwise, it will affect the waterproofness of the controller.
5. For CAN bus, the controller connects several drivers of the AGV in a daisy chain. The controller is at the near end of the daisy chain, and the 120ohm terminal resistor option needs to be selected in Roboshop. The driver at the far end of the daisy chain also needs to be connected to the 120ohm terminal resistor. The CAN cable should be of a uniformly twisted pair. If there is a shielding layer, please ground the shielding layer at a single point, and connect the CAN ground of the driver to the CAN_GND of the corresponding channel of the controller; otherwise, the controller cannot communicate with the actuator.
6. It is prohibited to enter the controller system to install other software programs; otherwise, it will cause unpredictable errors.
7. It is prohibited to modify the IP address of the controller or other internal settings; otherwise, it will cause serious communication errors.
8. It is prohibited to plug and unplug the J1 and J2 ports when the power supply is on. Pay special attention to the situation that the battery is not controlled by the controller. Make sure to plug and unplug the J1 and J2 ports after the battery is turned off. Otherwise, the controller may be damaged.
9. Before inserting the J1 and J2 connectors into the controller, please inspect whether the pins of the female end of the wiring harness are bent. If so, please replace the wiring harness; otherwise, it will damage the connector terminals on the controller side, and even cause a fire due to short circuit.
10. When the J1 and J2 cables are inserted into the corresponding ports, there will be a snapping sound. If you do not hear it, please inspect whether the rubber seals in the J1 and J2 cable connectors are turned over or curled. If so, please straighten it out, and then insert into the corresponding port.

11. To stop the device, please press the stop button, but do not turn off the battery directly; otherwise, it is easy to cause the hardware or software of the controller to malfunction.
12. If the battery is improperly replaced, it may explode. Please be sure to use the battery that is of same type or equivalent type and is recommended by the manufacturer.
13. The used batteries and used controllers shall be disposed of by the product purchaser in accordance with relevant national laws and regulations.

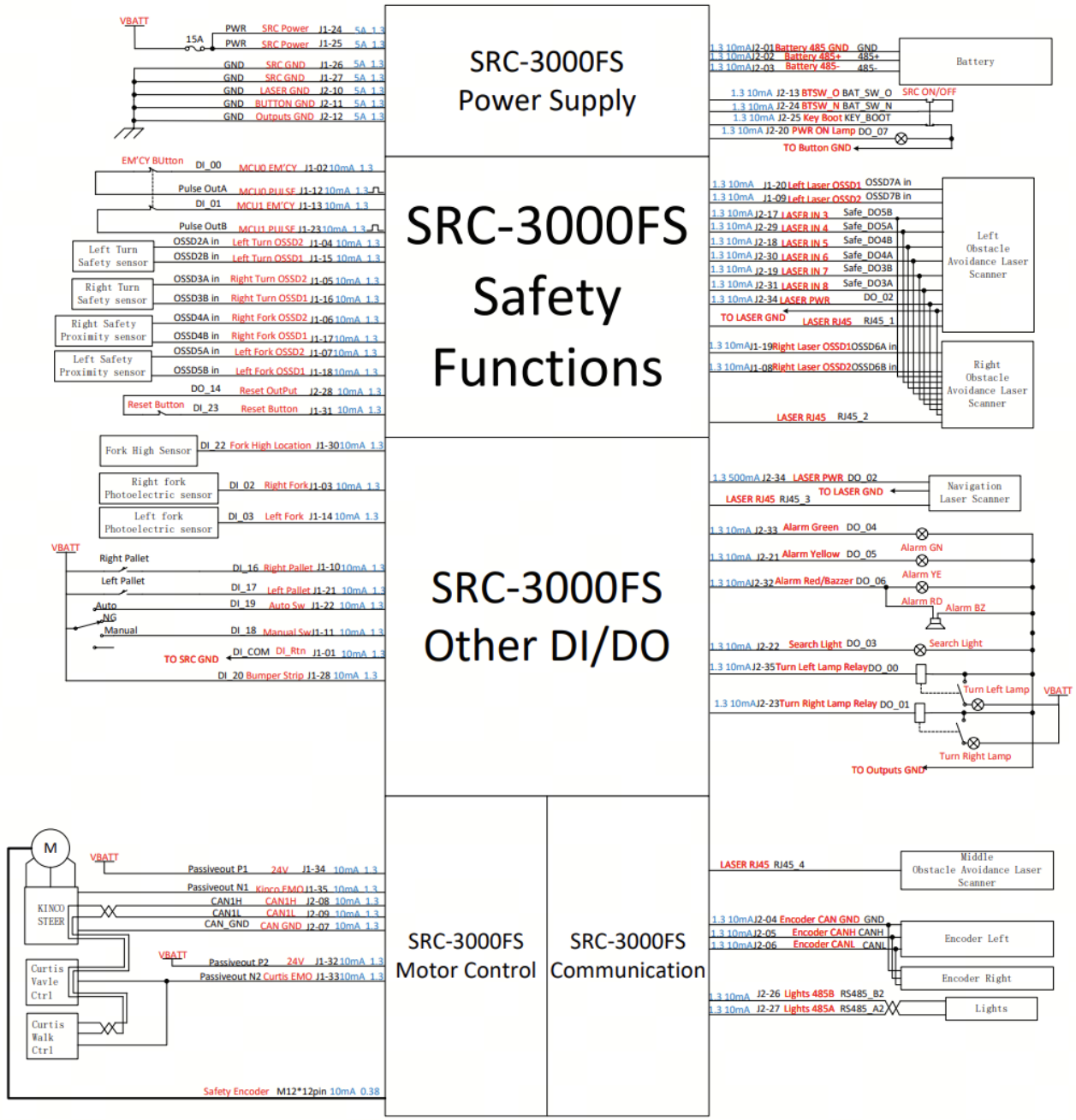
It is recommended to perform the first power-on test in the following steps:

1. Inspect whether the positive and negative poles of the vehicle are short-circuited;
2. Inspect whether the vehicle and the shell screws are open-circuited;
3. Inspect whether the positive and negative poles of the terminal block are reversed;
4. Inspect whether the DO and the ground are short-circuited;
5. Inspect whether the resistance between the controller shell and the ground is less than 1ohm;
6. Inspect whether the positive pole of the DCDC input terminal is shorted to the negative pole;
7. Inspect whether the positive pole of the DCDC output terminal is shorted to the negative pole;
8. Inspect whether the positive pole of the motor power supply is short-circuited to the ground;
9. Inspect whether the positive and negative poles of the motor power supply are reversed;
10. Inspect whether the positive pole of the laser power supply is shorted to the ground;
11. Inspect whether the positive and negative poles of the laser power supply are reversed;
12. Before powering on for the first time, disconnect the laser power supply and the power supply of the motor driver;
13. If there is no abnormality when the power is on, turn on the power supply of the motor driver after stopping the device;
14. If there is no abnormality when the power is on, turn on the laser power supply after stopping the device;
15. Start the commissioning test.

Appendix 1 Typical Electrical Schematic Diagram

If different motors and drivers are used, the wiring may be slightly different; therefore, the following figure is for reference only

The schematic diagram of the forklift is as follows:



Appendix 2 FAQ for SRC-3000FS

1. How to connect the power ON/OFF button?

The button must be without self-locking; C1 and C2 are not connected. The number below is the line sequence of the J2 interface.

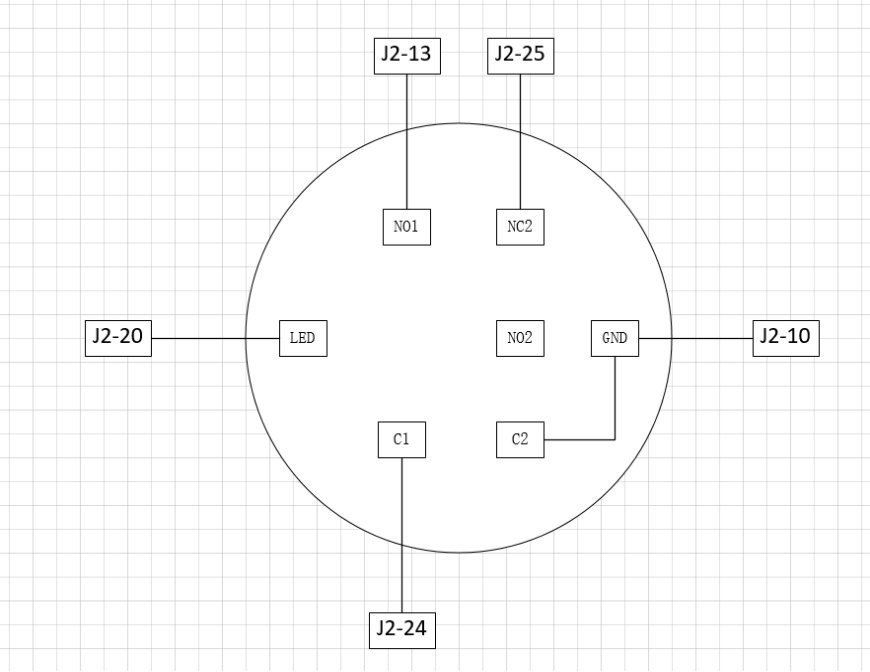
NC: Normal Close

NO: Normal Open

C: Common Port

LED: Indicator Lamp

GND: Ground



2. What will happen if you press on the power ON/OFF button?

In the power off state: Press on the key to start the device and maintain the power on state;

In the power on state: Press on the key to power off the system;

When the power ON/OFF button cable is disconnected, the system will start abnormally if the battery supplies power again since the disconnection of power ON/OFF button cable is equivalent to the effect of pressing on the power ON/OFF button.

3. What should we do if the controller crashes?

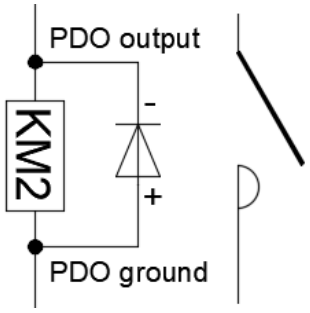
Press on the power ON/OFF button for more than 10s, and then release it; the controller will be forced stop.

4. How will the delayed battery output affect the start after the battery switch is turned on?

If the battery switch of the controller is used to control the external power supply and disconnect the external power supply from the battery, and the power output has a delay after the battery switch is turned on, you need to press on the power button for a longer time than the battery delay output time.

5. How to connect inductive loads such as relays and contactors etc. to PDO?

Inductive loads such as relays and contactors etc. must be connected with a freewheeling diode to eliminate the interference of the back electromotive force generated when the inductive load is disconnected on the system circuit. The cathode of the freewheeling diode is connected to the PDO output, and the anode is connected to the PDO ground.



If the freewheeling diode is not added, the possible interference hazards are as follows:

- The laser communication is disturbed, and the controller may alarm about laser connection failure.
- The controller Linux system crashes. 192.168.192.5 network port cannot communicate, Roboshop cannot be connected.

When connecting the contactor, please judge the internal resistance and the tripping current of the contactor coil, and do not exceed the output current of the PDO (1A).

Recommended diode model:SR3100

Maximum Ratings and Electrical Characteristics @T_A=25°C unless otherwise specified

Single Phase, half wave, 60Hz, resistive or inductive load.
For capacitive load, derate current by 20%.

Characteristic	Symbol	SR320	SR330	SR340	SR350	SR360	SR380	SR3100	SR3150	SR3200	Unit
Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage	V_{RRM} V_{RWM} V_R	20	30	40	50	60	80	100	150	200	V
RMS Reverse Voltage	$V_{R(RMS)}$	14	21	28	35	42	56	70	105	140	V
Average Rectified Output Current @T_L = 95°C (Note 1)	I_O	3.0									A
Non-Repetitive Peak Forward Surge Current 8.3ms Single half sine-wave superimposed on rated load (JEDEC Method)	I_{FSM}	80									A
Forward Voltage @I_F = 3.0A	V_{FM}	0.5			0.75		0.85		0.92		V
Peak Reverse Current @T_A = 25°C At Rated DC Blocking Voltage @T_A = 100°C	I_{RM}	0.5 20							0.02 10		mA
Typical Junction Capacitance (Note 2)	C_j	250									pF
Typical Thermal Resistance (Note 1)	$R_{\theta JA}$	20									°C/W

6. *How to activate after battery over-discharge or short-circuit protection?*

The following content is only for batteries that have been verified by us to support reactivation.

After the battery is over-discharged, it will enter the over-discharge protection state. At this time, even if the battery switch is turned on, the battery will not output. In this case, the battery can be reactivated in the forced charging mode of the charger; after the battery output is accidentally short-circuited, the battery will enter the short-circuit protection state. After the external short-circuit state is cancelled, the battery should activate the forced charging mode of the charger to resume normal output.

If the forced charging activation is invalid, the battery must be returned to the factory for repair.

7. *It is found that DI will not be triggered during operation*

Inspect whether the DI COM port is properly connected.

In addition, if the DI COM port is not connected, it may cause a problem of triggering one DI on one circuit but displaying multiple DIs triggered on the software.

8. *CAN port TX/RX or RS485 port A/B are connected correctly, but they cannot communicate with each other?*

The CAN port and RS485 port are isolated in design, and the *COM-GND* interface must be used to ensure that the interface is grounded.

In addition, if the baud rate settings are wrong, the ports can’ t communicate correctly.

Appendix 3 Terms and Definitions

Terms	Definitions
SRC	Seer Intelligent Robotics Controller
AGV	Automated Guided Vehicle
AMR	Auto Mobile Robot
TE	TE Connectivity
DI	Digital input
DO	Digital output
Passive Out	Passive output
Pulse Out	Pulse output
Connector	Connector
DCDC	DC-DC stabilized voltage supply
PS+(-)	Power supply + (-)
RJ45	Eight-core Ethernet twisted pair socket
RS232	Asynchronous transmission standard interface
RS485	Differential asynchronous transmission standard interface
CAN	Controller area network
Roboshop	Seer Intelligent Robot Client Software

For more information, please visit SEER’s official website: https://www.seer-group.com

For API-related information, please visit the SEER’s smart documentation website: https://docs.seer-group.com