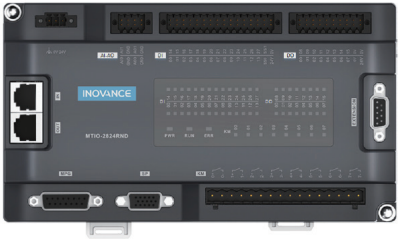
INOVANCE

MTIO-2824RND

Multi-functional Remote I/O Module User Guide



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Preface

Overview

MTIO-2824RND is a multi-functional remote I/O extension module developed and manufactured by Inovance. Using the EtherCAT bus, this product supports up to 24 digital outputs (including 8 relay outputs and 16 common digital outputs), 28 digital inputs, 2 analog inputs, 2 analog outputs, handwheel input terminal (including 9 digital inputs and 1 pair of phase A/B differential quadrature pulse inputs), and servo pulse control terminal.

This user guide describes the specifications, characteristics, and usage of this product. Please read this user guide carefully before using to ensure safety. You can obtain the latest version of this user guide from Inovance's website (www.inovance.com).

Intended Audience

This user guide is intended for the users (including electrical engineers, software engineers, and system engineers) of computer numerical control (CNC) machine tools such as the engraving and milling machine and spring machine.

First Use

Read this document carefully before you use the product for the first time. For any doubts about functionality and performance, consult Inovance's technical support personnel.

Standards Compliance

The product complies with the following directives and standards:

Directive	Name	Standards Compliance	Mark
LVD	2014/35/EU	EN 61010-1:2010 EN 61010-2-201:2013	CE
EMC	2014/30/EU	EN 61131-2:2007 EN 55011:2016+A1:2017 IEC 61000-6-2:2016	

The product complies with the LVD and EMC and is labeled with the CE mark.

LVD: 2014/35/EU; EMC: 2014/30/EU

A machine or device equipped with the product must also be labeled with the CE mark.

The customer who finally assembles the machine equipped with the product is responsible for attaching the CE mark to the machine. The customer finally confirms whether the machine complies with the uniform European standards.

Change History

Date	Issue	Description
November 2019	A00	Released the first issue.

Safety Instructions

Safety Precautions

1) Before installing, operating, and maintaining this equipment, read the safety instructions and precautions thoroughly, and comply with them during operations.
2) To ensure personal safety and equipment security, follow the signs on the equipment and all the safety instructions in this user guide.
3) "CAUTION", "WARNING", and "DANGER" items in the user guide do not indicate all safety precautions that need to be followed; instead, they just supplement the safety precautions.
4) Use this equipment according to the designated environment requirements. Damage caused by improper usage is not covered by warranty.
5) Inovance shall take no responsibility for any personal injuries or property damage caused by improper usage.

Safety Levels and Definitions

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

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

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

Keep this user guide well so that it can be read when necessary and forward this user guide to the end user.

Control System Design

DANGER

- Design a safety circuit to ensure that the control system operates safely upon power or controller failure.
- Do not apply this product to machines that may cause personal injuries or death, equipment damage, or system shutdown.

CAUTION

- When an output unit such as a relay or transistor of the controller is damaged, its output cannot be controlled in the ON or OFF state. To ensure proper operating of the equipment, design an external protection circuit and a safety mechanism for the output signals related to critical incidents.
- The controller is designed for indoor electrical environments complying with the Class II overcurrent rating. Install a lightning protection device for the power system to prevent lightning overvoltage on the power input terminal, signal input terminal, or control output terminal of the controller and avoid equipment damage.

Installation

DANGER

- Equipment installation must be performed only by professional maintenance personnel who have been trained on necessary electrical knowledge.
- The controller adopts the microcomputer design. Keep the controller clean and prevent metal scraps, conductors, water, and corrosive gases or liquids from entering it. Any noncompliance may result in a fire, a malfunction, or a misoperation. Cut off all external power supplies of the system before you install or remove a module. Any noncompliance may result in an electric shock, a malfunction, or a misoperation.
- Do not install this product on a flammable object or in an environment with overhigh temperature. Any noncompliance may result in a fire, a malfunction, or damage.

WARNING

- Ensure that the ventilation plane of the controller is unblocked after installation. Any noncompliance may result in poor heat dissipation, a fire, a malfunction, or a misoperation.
- During installation, connect the modules to corresponding connectors reliably and secure the hooks. Improper installation of a module may result in a misoperation, a malfunction, or falling off.

Wiring

DANGER

- Equipment wiring must be performed only by professional maintenance personnel who have been trained on necessary electrical knowledge.
- Before assembly, ensure that the controller and peripherals (such as the machine tool) are properly grounded for lightning and leakage protection.
- Cut off all external power supplies of the system before wiring. Any noncompliance may result in an electric shock, a malfunction, or a misoperation.
- The rated voltage of the power system for the controller must comply with the specifications. If the voltage is unstable, install a voltage regulator to ensure proper operating of the controller.
- Take insulation measures for cable terminals to avoid a decrease in the insulation distance after cables are connected to the terminals. Any noncompliance may result in an electric shock or equipment damage.

WARNING

- The specifications and installation methods for external wiring of the equipment must comply with local power distribution regulations. A cable with a sufficient diameter must be used for reliable grounding. For details, see the wiring descriptions in the user guide.
- Verify the connector type before you connect a cable. Connection to a wrong connector or a wiring mistake may result in a malfunction of a module or external equipment.
- Tighten the bolt on the terminal block within the specified torque range. Any noncompliance may result in a short circuit, a fire, or a misoperation.
- Do not bundle the control and communication cables with the main circuit or power cable; instead, keep them at least 100 mm apart. Any noncompliance may result in noise and a misoperation.
- Use a shielded cable for input or output of high-frequency signals in application scenarios with serious interference, to improve the interference immunity of the system.

Maintenance

DANGER

- Equipment maintenance must be performed only by professional maintenance personnel who have been trained on necessary electrical knowledge.
- Before first power-on, cut off the loads of all external equipment to avoid internal testing with the PLC and a danger to persons nearby because the motor may immediately start upon power input.

WARNING

- As a precision instrument, the controller must be installed or removed only by maintenance personnel of the manufacturer or electrical control personnel of related machinery factories. Familiarize yourself with the user guide to ensure safety during operations such as running or stopping the equipment, modification during operating, or forcible output.
- Disconnect the power cable from the socket before you clean the equipment with a wet cloth. Do not clean the equipment with liquids or detergent sprays.
- If the equipment is unused for a long time, disconnect the power cable from the socket to avoid equipment damage caused by excessive voltage fluctuation.

Disposal

WARNING

- The computer is configured with a real-time clock circuit powered by batteries. Improper installation of the batteries may result in explosion. Therefore, use the same or a similar type of batteries recommended by the manufacturer for replacement.
- Dispose of retired batteries by following the instructions of the manufacturer. According to the IEC 704-1:1982, the sound pressure in the place where an operator is located must be less than or equal to 70 dB(A).
- Disclaimer: The safety instructions comply with the IEC 704-1. Inovance assumes no legal liability for the accuracy of the content.

CAUTION

- Dispose of retired equipment as industrial waste and dispose of retired batteries by following local directives.

Safety Signs

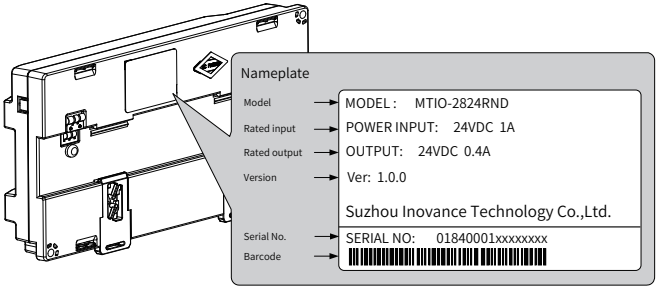
For safe equipment operation and maintenance, comply with safety signs on the equipment, and do not damage or remove the safety labels. The following table describes the safety signs.

Safety Sign	Description
	◆ Read the user guide before installation and operation. Failure to comply will result in an electric shock. ◆ Do not remove the cover at power-on or within 10 minutes after power-off. ◆ Before maintenance, inspection, and wiring, cut off input and output power, and wait at least 10 minutes until the power indicator is off.

1 Product Information

■ Nameplate information

The nameplate is on the back of the product. The MTIO-2824RND module is used as an example.



MT IO – 2824 RN D

Code	Product Family
MT	Machine tool

Code	Module Type
IO	I/O extension module

Code	Number of I/O Channels
Four digits	Inputs (two digits) + Outputs (two digits)

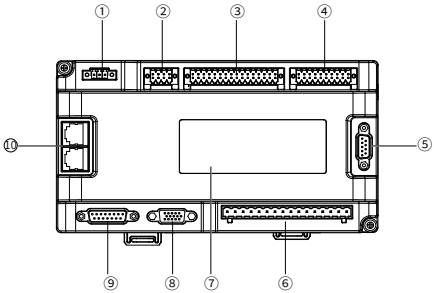
Code	Power Supply Type
D	24 VDC power supply
A	110–220 VAC power supply

Code	Output Type
R	Relay output
RN	Relay + transistor output (sink)
TP	Transistor output (source)
TN	Transistor output (sink)

■ Terminal type

Model	Port Silkscreen	Description
MTIO-2824RND	DI	28 digital inputs
	DO	16 digital outputs
	KM	8 relay outputs
	AI-AO	2 analog inputs + 2 analog outputs
	EtherCAT	EtherCAT input and output
	SP	1 pulse spindle control
	MPG	1 handwheel signal input
	EXTENSION	Extension port (reserved)

■ Terminal function



No.	Terminal Name	Function
1	Power terminal	Mark / Description: ⏚ Connected to PE, case ground; 0V 0 V power ground; +24V +24 V power supply
2	Analog input/ output terminal	The terminal is marked as AI-AO. For its definition, see "3 Wiring" on page 15.
3	Digital input terminal	The terminal is marked as DI. For its definition, see "3 Wiring" on page 15.
4	Digital output terminal	The terminal is marked as DO. For its definition, see "3 Wiring" on page 15.
5	Extension port	The port is marked as EXTENSION. It is reserved.

<table>
<tr><th>No.</th><th>Terminal Name</th><th>Function</th></tr>
<tr><td>6</td><td>Relay output terminal</td><td>The terminal is marked as KM. It is used as the user control relay output (RO) terminal.</td></tr>
<tr><td>7</td><td>Indicators</td><td>
<table>
<tr><th>Indicator</th><th>Color</th><th>Definition</th></tr>
<tr><td>PWR</td><td>Yellow</td><td>Power indicator</td></tr>
<tr><td>RUN</td><td>Green</td><td>Normal running indicator</td></tr>
<tr><td>ERR</td><td>Red</td><td>Faulty indicator</td></tr>
</table>
</td></tr>
<tr><td>8</td><td>Spindle terminal - SP</td><td>
<table>
<tr><th>No.</th><th>Name</th><th>Direction</th><th>Description</th></tr>
<tr><td>1</td><td>Sign+</td><td>Output</td><td>Spindle pulse output Sign+</td></tr>
<tr><td>2</td><td>Sign-</td><td>Output</td><td>Spindle pulse output Sign-</td></tr>
<tr><td>3</td><td>Pulse+</td><td>Output</td><td>Spindle pulse output Pulse+</td></tr>
<tr><td>4</td><td>Pulse-</td><td>Output</td><td>Spindle pulse output Pulse-</td></tr>
<tr><td>5</td><td>GND</td><td>Digital ground</td><td>Digital signal ground</td></tr>
<tr><td>6</td><td>PA-</td><td>Input</td><td>Encoder input PA-</td></tr>
<tr><td>7</td><td>PB+</td><td>Input</td><td>Encoder input PB+</td></tr>
<tr><td>8</td><td>PB-</td><td>Input</td><td>Encoder input PB-</td></tr>
<tr><td>9</td><td>PZ+</td><td>Input</td><td>Encoder input PZ+</td></tr>
<tr><td>10</td><td>PZ-</td><td>Input</td><td>Encoder input PZ-</td></tr>
<tr><td>11</td><td>PA+</td><td>Input</td><td>Encoder input PA+</td></tr>
<tr><td>12</td><td>COM</td><td>Input</td><td>Common terminal COM</td></tr>
<tr><td>13</td><td>DI</td><td>Input</td><td>Servo alarm input Alarm</td></tr>
<tr><td>14</td><td>DO0</td><td>Output</td><td>Servo enabling output En</td></tr>
<tr><td>15</td><td>DO1</td><td>Output</td><td>Servo reset output Reset</td></tr>
</table>
</td></tr>
</table>

<table>
<tr><th>No.</th><th>Terminal Name</th><th>Function</th></tr>
<tr><td>9</td><td>Handwheel terminal - MPG</td><td>
<table>
<tr><th>No.</th><th>Name</th><th>Type</th><th>Description</th></tr>
<tr><td>1</td><td>5V</td><td>Power</td><td>Handwheel power supply 5 V</td></tr>
<tr><td>2</td><td>HA+</td><td>Signal input</td><td>Handwheel quadrature differential input phase A+</td></tr>
<tr><td>3</td><td>HA-</td><td>Signal input</td><td>Handwheel quadrature differential input phase A-</td></tr>
<tr><td>4</td><td>HB+</td><td>Signal input</td><td>Handwheel quadrature differential input phase B+</td></tr>
<tr><td>5</td><td>HB-</td><td>Signal input</td><td>Handwheel quadrature differential input phase B-</td></tr>
<tr><td>6</td><td>HX1</td><td>Signal input</td><td>x1 in frequency</td></tr>
<tr><td>7</td><td>HX10</td><td>Signal input</td><td>x10 increase in frequency</td></tr>
<tr><td>8</td><td>HX100</td><td>Signal input</td><td>x100 increase in frequency</td></tr>
<tr><td>9</td><td>GND</td><td>Signal input</td><td>GND terminal</td></tr>
<tr><td>10</td><td>HSX</td><td>Signal input</td><td>Axis X selected</td></tr>
<tr><td>11</td><td>HSY</td><td>Signal input</td><td>Axis Y selected</td></tr>
<tr><td>12</td><td>HSZ</td><td>Signal input</td><td>Axis Z selected</td></tr>
<tr><td>13</td><td>HSU</td><td>Signal input</td><td>Axis U selected</td></tr>
<tr><td>14</td><td>HSV</td><td>Signal input</td><td>Axis V selected</td></tr>
<tr><td>15</td><td>HSW</td><td>Signal input</td><td>Axis W selected</td></tr>
</table>
</td></tr>
<tr><td>10</td><td>EtherCAT communication port</td><td>Two RJ45 network ports, 100 Mbps
IN - EtherCAT communication input port
OUT - EtherCAT communication output port</td></tr>
</table>

■ Product specifications

1) Basic specifications

Item	Specification
Weight	0.4 kg
Ambient temperature	0°C to 55°C
Ambient humidity	90%RH below (non-condensing)
Storage temperature	-20°C to +55°C (non-freezing)
Storage humidity	90%RH below (non-condensing)
Altitude	2000 m
Vibration	4.9 m/s^2 below
Impact	19.6 m/s^2 below

Item	Specification
Pollution degree	PD2
Safety level	IEC61131-2
IP rating	IP20

2) Technical specifications

Item	Specification
Power terminal	+24 VDC power supply (20.4 VDC to 28.8 VDC) (-15% to +20%)
Communication port	A pair of EtherCAT slave station ports
Digital input channel	28 common digital inputs
Digital output channel	16 common digital outputs
Relay output	8 relay digital outputs
Analog input channel	Two -10 V to +10 V inputs or sampling channels, with delay less than 1 ms
Analog output channel	Two -10 V to +10 V outputs or sampling channels, with delay less than 1 ms
Pulse output mode	Three modes, including direction+pulse, quadrature pulse, and CW/CCW pulse Maximum output frequency: 4 MHz
Encoder input	One group of incremental ABZ inputs Maximum input frequency: 4 MHz
Handwheel input	One incremental AB input Maximum input frequency: 2.5 kHz
Extension port	One port reserved
Minimum bus cycle	500 μs
Alarm information display	ERR indicator on: faulty ERR indicator off: normal

■ Specifications of digital input and output channels

Item		Specifications
Power	24 V power supply	Maximum load current: 0.4 A (Use the external 24 V power supply if higher current is required.)

Item		Specifications
Input	Input channel	28
	Input connection method	Crimping wiring terminal
	Input type	Digital, NPN or PNP input selected using the common terminal
	ON voltage range	18–30 VDC
	OFF voltage range	0–5 VDC
	Input current (typical 24 V)	About 5 mA
	Maximum input voltage	30 VDC
	Maximum input frequency	1 kHz
	Input impedance	> 5.6 kΩ
	Isolation mode	Optoelectronic isolation
Output	Output channels	16
	Output connection method	Crimping wiring terminal
	Output type	NPN type
	Output voltage range (DC)	15–29 V
	Maximum output impedance	< 1 Ω
	Maximum load current of single channel	0.2 A
	Maximum leakage current at OFF	< 10 μA
	Maximum output frequency	0.15 kHz
	Output maintained	When the system is stopped or abnormal, the output signal remains or a fixed value is output.
	Isolation mode	Optoelectronic isolation

■ Specifications of the RO terminal

Item	Specifications
Output channels	8
Output connection method	Crimping wiring terminal
Output type	Relay output
Output maintained	When the system is stopped or abnormal, the output signal remains or a fixed value is output.

Item	Specifications
Maximum switching voltage	277 VAC/30 VDC
Maximum switching current	5 A
Isolation mode	Electromagnetic isolation

■ Specifications of analog input and output channels

1) Basic specifications

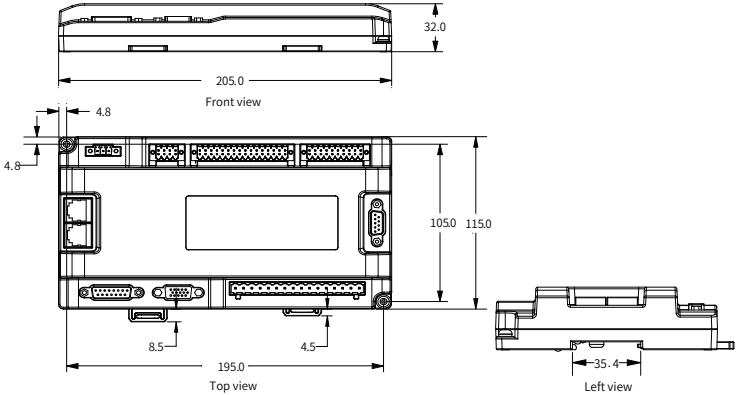
Item		Specifications
Input	Channel type	Analog voltage input
	Voltage input impedance	＞10 kΩ
	Voltage input range	–10 V to +10 V
	Resolution	12 bits
	Sampling time	Configurable. All channel sampling can be completed within 1 ms.
	Accuracy (ambient temperature: 0 to 55 ℃)	Full range ± 1%
Output	Channel type	Analog voltage output
	Voltage output load	1–10 kΩ
	Output voltage range	–10 V to +10 V
	Output maintained	When the system is stopped or abnormal, the output signal remains or a fixed value is output.
	Short circuit alarm	When AO short circuit occurs, the alarm indicator ERR is steady on.
	Stability time	200 μs
	Resolution	12 bits
	Voltage switching time	250 μs
	Accuracy (ambient temperature: 0 to 55 ℃)	Full range ± 1%

2) Relationship between input and output

Mode	Rated Range	Rated Digital Value	Voltage Limit
Analog voltage input	–10 V to +10 V	-20000 to +20000	±12 V
Analog voltage output	–10 V to +10 V	-20000 to +20000	±12 V

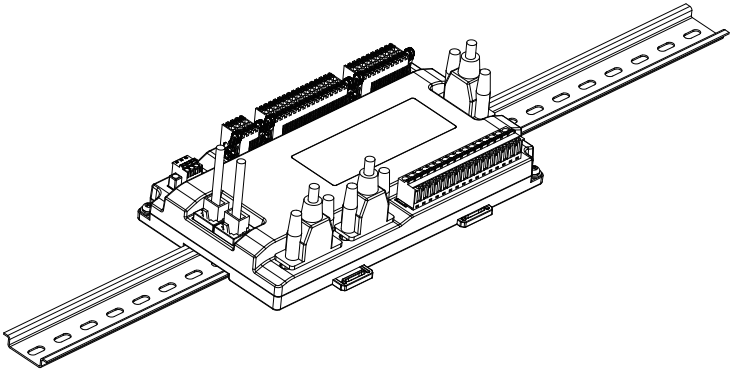
2 Installation

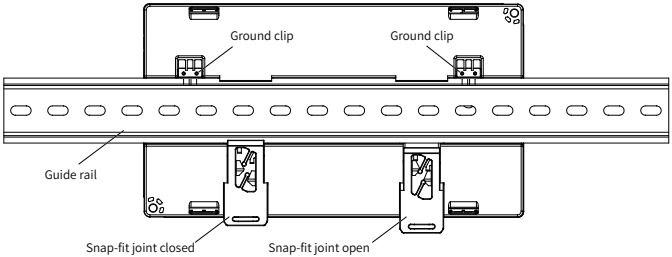
■ Installation Dimensions



■ Installation

The module can be installed on the guide rail. The electrical connection between the module and guide rail can be realized using a ground clip routed out from the module.



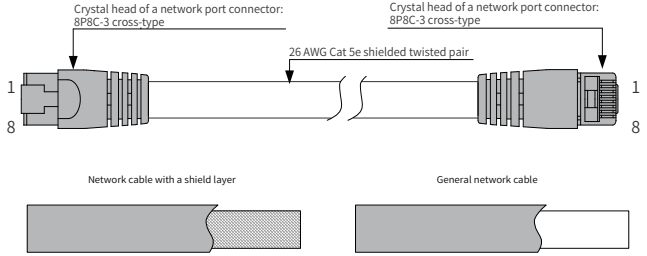


3 Wiring

3.1 Network Cable

■ Manufacturing requirement

Use a Cat 5e shielded twisted pair, an injection molding cable with an iron shell.



■ Length requirement

The FastEthernet technology proves that a cable connected between devices must be less than or equal to 100 m in the EtherCAT bus architecture, to avoid signal attenuation and ensure proper communication.

■ Technical Requirements

In the EtherCAT bus architecture, the following network cables with shield layers are recommended for network data transmission.

Item	Specifications
Cable type	Flexible cross cable, S-FTP, Cat 5e
Standards compliance	EIA/TIA568A, EN50173, ISO/IEC11801, EIA/TI Abulletin TSB, and EIA/TIA SB40-A&TSB36
Cross section of conductor	AWG26
Conductor type	Twisted pair
Wire pair	4

3.2 Definition of Input and Output Terminals

■ Definition of digital input (DI) terminals

If the common terminal (SS0 of DI0 to DI13 or SS1 of DI14 to DI27) of the module is connected to the COM terminal, the corresponding DI is source input and active at high level.

If the common terminal (SS0 of DI0 to DI13 or SS1 of DI14 to DI27) of the module is connected to the +24 V terminal, the corresponding DI is sink input and active at low level.

No.	Name	Direction	Function	No.	Name	Direction	Function
1	DI0	Input	Bit 0 of digital input	2	DI14	Input	Bit 14 of digital input
3	DI1	Input	Bit 1 of digital input	4	DI15	Input	Bit 15 of digital input
5	DI2	Input	Bit 2 of digital input	6	DI16	Input	Bit 16 of digital input
7	DI3	Input	Bit 3 of digital input	8	DI17	Input	Bit 17 of digital input
9	DI4	Input	Bit 4 of digital input	10	DI18	Input	Bit 18 of digital input
11	DI5	Input	Bit 5 of digital input	12	DI19	Input	Bit 19 of digital input
13	DI6	Input	Bit 6 of digital input	14	DI20	Input	Bit 20 of digital input
15	DI7	Input	Bit 7 of digital input	16	DI21	Input	Bit 21 of digital input
17	DI8	Input	Bit 8 of digital input	18	DI22	Input	Bit 22 of digital input
19	DI9	Input	Bit 9 of digital input	20	DI23	Input	Bit 23 of digital input
21	DI10	Input	Bit 10 of digital input	22	DI24	Input	Bit 24 of digital input
23	DI11	Input	Bit 11 of digital input	24	DI25	Input	Bit 25 of digital input
25	DI12	Input	Bit 12 of digital input	26	DI26	Input	Bit 26 of digital input
27	DI13	Input	Bit 13 of digital input	28	DI27	Input	Bit 27 of digital input
29	SS0		Common terminal of DI0 to DI13	30	SS1		Common terminal of DI14 to DI27
31	+24V		+24 V power supply	32	0V		COM terminal for digital input

■ Definition of digital output (DO) terminals

The DO terminal is sink output and active at low level.

No.	Name	Direction	Function	No.	Name	Direction	Function
1	DO0	Output	Bit 0 of digital output	2	DO8	Output	Bit 8 of digital output
3	DO1	Output	Bit 1 of digital output	4	DO9	Output	Bit 9 of digital output
5	DO2	Output	Bit 2 of digital output	6	DO10	Output	Bit 10 of digital output
7	DO3	Output	Bit 3 of digital output	8	DO11	Output	Bit 11 of digital output
9	DO4	Output	Bit 4 of digital output	10	DO12	Output	Bit 12 of digital output
11	DO5	Output	Bit 5 of digital output	12	DO13	Output	Bit 13 of digital output
13	DO6	Output	Bit 6 of digital output	14	DO14	Output	Bit 14 of digital output
15	DO7	Output	Bit 7 of digital output	16	DO15	Output	Bit 15 of digital output
17	0V		COM terminal for digital output	18	0V		COM terminal for digital output
19	+24V		+24 V power supply	20	0V		COM terminal for digital output

■ Definition of relay output (RO) terminals

No.	Name	Direction	Function	No.	Name	Direction	Function
16	ROUT0+	Output	Bit 0 of user control relay output	8	ROUT4+	Output	Bit 4 of user control relay output
15	ROUT0-	Output		7	ROUT4-	Output	
14	ROUT1+	Output	Bit 1 of user control relay output	6	ROUT5+	Output	Bit 5 of user control relay output
13	ROUT1-	Output		5	ROUT5-	Output	
12	ROUT2+	Output	Bit 2 of user control relay output	4	ROUT6+	Output	Bit 6 of user control relay output
11	ROUT2-	Output		3	ROUT6-	Output	
10	ROUT3+	Output	Bit 3 of user control relay output	2	ROUT7+	Output	Bit 7 of user control relay output
9	ROUT3-	Output		1	ROUT7-	Output	

■ Definition of analog input/output (AI/AO) terminals

No.	Name	Direction	Description
1	AI0	Input	Bit 0 of user linear voltage input -10 V to +10 V
2	AI1	Input	Bit 1 of user linear voltage input -10 V to +10 V
3	GND	Analog ground	Analog ground

No.	Name	Direction	Description
4	GND	Analog ground	Analog ground
5	AO0	Output	Bit 0 of user linear voltage output -10 V to +10 V
6	AO1	Output	Bit 1 of user linear voltage output -10 V to +10 V
7	GND	Analog ground	Analog ground
8	GND	Analog ground	Analog ground

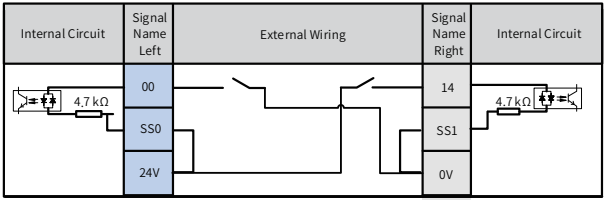
3.3 External Wiring

■ Wiring of DI terminals

As shown in the following figure, SS0 on the left is connected to 24 V. It is sink input and active at low level. (SS0 on the left can be connected to 0 V, too. In this case, it is source input and active at high level.)

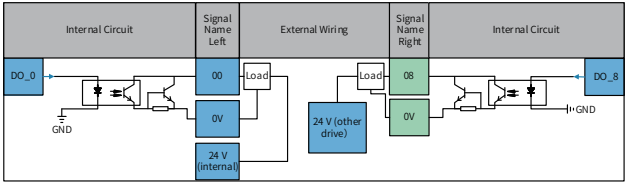
As shown in the following figure, SS1 on the right is connected to 0 V. It is source input and active at high level. (SS1 on the right can be connected to 24 V, too. In this case, it is sink input and active at low level.)

SS0 and SS1 can be connected to 0 V or 24 V at the same time. You can wire them as required.



■ Wiring of DO terminals

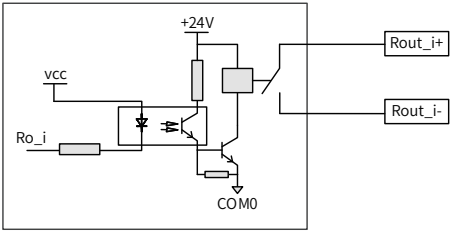
The following figure shows the wiring of DO terminals. The load can be powered by the internal 24 V power supply of the I/O module (maximum output current 0.5 A) or the external 24 V power supply. When the external power supply is used, the COM terminal must be connected to the power ground terminal of the load.



■ Wiring of RO terminals

The letter **i** in the following figure can be any one of terminals 0 to 7. You can connect or disconnect any terminal according to on-site requirements.

MTIO-2824RND



1) Electric shock protection when using inductive load

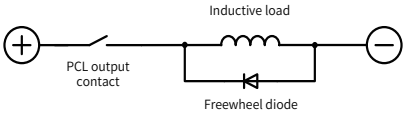
Since no internal protection circuit for relays is designed, when the inductive load is applied, large back EMF will be produced between contacts and arc discharge is also caused when the inductive load stops. This may result in contact failure or contact sag, shortening the contact lifetime. Therefore, it is recommended to use the products with built-in relay protection circuit. For the products without built-in relay protection circuit, an external electric shock protection circuit can be used to reduce noises and prolong the lifetime of product.

Relay DC circuit: Connect a freewheel diode in parallel with the load. The freewheel diode must satisfy:

① The reverse voltage is 5 to 10 times of load voltage.

② The forward current is larger than load current.

The following figure shows the DC circuit electric shock protection when using inductive load.



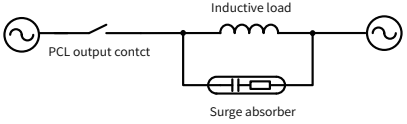
Relay AC circuit: Connect a surge absorber (or a surge suppressor, a spark suppressor and other CR composite components) in parallel with the load. The surge absorber must satisfy:

① The rated voltage is applicable to all kinds of outputs.

② The electrostatic capacity is about 0.1 μF.

③ The resistance is about 100 Ω to 200 Ω.

The following figure shows the AC circuit electric shock protection when using inductive load

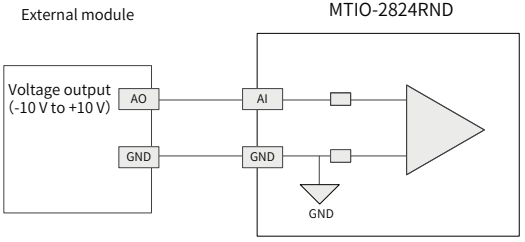


2) Electric shock protection when using capacitive load

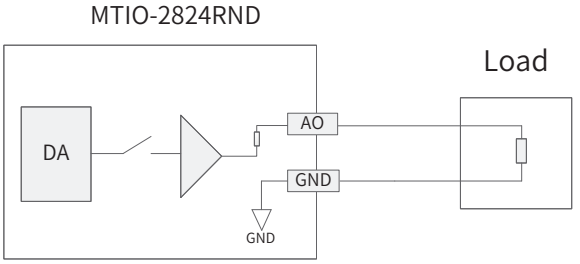
When the capacitive load is applied, the impulse current, which is 20 to 40 times of the normal current, can occur in the case of electric shock. Therefore, the impulse current should not exceed the current generated when using maximum resistive load.

When using electronic circuit load such as AC drives, capacitive loads can also exist due to capacitors and others.

■ Wiring of AI terminals

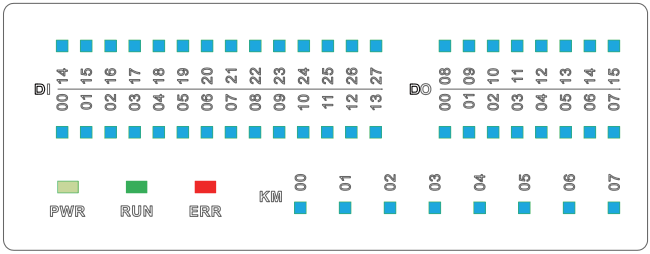


■ Wiring of AO terminals



4 Introduction to Panel Indicators

The panel indicators include three module status indicators (PWR, RUN, and ERR) and I/O status indicators. The number of I/O status indicators is determined by the I/O terminals used. When an I/O terminal is valid, its corresponding indicator is on.



■ Indicator description

Name	Basic Function	Status Description	
PWR Yellow	Power indicator	On/Off	Off: powered off On: powered on

Name	Basic Function	Status Description	
RUN Green	Module status indicator that indicates the status of the EtherCAT communication state machine	Off	EtherCAT communication state machine in the INIT state
		Blinking	EtherCAT communication state machine in the Pre-Operational state
		Single flash	EtherCAT communication state machine in the Safe-Operational state
		On	EtherCAT communication state machine in the Operational state
ERR Red	Module status indicator that indicates the faulty status of EtherCAT communication, internal communication, and AO	Off	EtherCAT communication state machine in the Normal state
		Blinking	EtherCAT communication synchronization loss
		Single flash	EtherCAT communication state machine Eeprom error
		Double flash	EtherCAT communication state machine configuration error
		Triple flash	Internal communication error
		Steady ON	AO short circuit
DI Blue	Module digital input status indicator	Off	No voltage input on the input terminal
		On	Voltage input on the input terminal
DO Blue	Module digital output status indicator	Off	Output terminal not conducted with the common terminal
		On	Output terminal conducted with the common terminal
KM Blue	Module relay output status indicator	Off	Relay output not conducted
		On	Relay output conducted