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# MD520I01 I/O Expansion Card User Guide

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# Preface

## ■ Introduction

The MD520IO1 card is an I/O expansion card applies to AC drives. The card supports three DI circuits, one AO circuit, one RO circuit, and one isolated RS-485 circuit.

This guide describes the technical specifications, dimensions, installation, wiring, and troubleshooting of the MD520IO1 expansion card.

## ■ Revision history

Date	Version	Description
April 2023	A00	First release

## ■ Document acquisition

This guide is not delivered along with the product. You can download the PDF version by the following way:

Log in to Inovance's website ([www.inovance.com](http://www.inovance.com)), choose Support > Download, search by keyword, and then download the PDF file.

## ■ Warranty

If your product becomes defective under normal use conditions, we will offer guaranteed repair services within the warranty period. You will be charged for any repair work after the warranty period expires.

The warranty does not cover any damage caused by:

- The user does not perform operations in compliance with the user manual of the product.
- The product is damaged due to fire, flood, and abnormal voltage.
- The user uses the product for abnormal functions.
- The user uses the product outside the specified specification range.
- The product is damaged by force majeure, such as natural disasters, earthquakes, or lightning strikes.

The maintenance fee is charged according to the latest Price List of Inovance. If otherwise agreed upon, the agreed terms and conditions shall prevail.

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# 1 Product Information

## 1.1 Introduction

The MD520IO1 card is an I/O expansion card applied to the AC drive. The card supports three DI circuits, one AO circuit, one RO circuit, and one isolated RS-485 circuit.



Figure 1-1 MD520IO1 card appearance

The following table describes differences among the MD520IO1 card, MD38IO1 card, MD38IO2 card, and MD38IO3 card.

Type	MD520IO1	MD38IO1	MD38IO2	MD38IO3
External power supply	Not supported	External power supply: +24V-COM Digital input power supply: OP1	External power supply: +24V-COM Digital input power supply: OP2	Not supported
AI	Not supported	AI3-PGND <ul style="list-style-type: none"> <li>● Optocoupler isolation input, differential voltage input, temperature detection resistor input</li> <li>● Input voltage range: -10 VDC to +10 VDC</li> <li>● PT100 and PT1000 temperature sensors</li> <li>● The input mode is determined by DIP switch S1. Only one function is available at a time.</li> </ul>	Not supported	Not supported

Type	MD520IO1	MD38IO1	MD38IO2	MD38IO3
DI	<p>Three channels: DI6 to DI8</p> <p>Refer to DI technical specifications.</p>	<p>Five channels: DI6 to DI10</p> <p>Optocoupler isolation, compatible with bipolarity input</p> <p>Input impedance: 2.4 k<math>\Omega</math></p> <p>Voltage at level input: 9 V to 30 V</p>	<p>Three channels: DI6 to DI8</p> <p>Optocoupler isolation, compatible with bipolarity input</p> <p>Input impedance: 3.3 k<math>\Omega</math> for DI6 and DI7 and 2.4 k<math>\Omega</math> for DI8</p> <p>Voltage range upon level input: 9 V to 30 V</p> <p>DI6, DI7 and DI8: Common input terminals with the input frequency less than 100 Hz</p>	<p>Three channels: DI6 to DI8</p> <p>Optocoupler isolation, compatible with bipolarity input, maximum input frequency of 100 Hz</p> <p>Input impedance: 3.4 k<math>\Omega</math></p> <p>Voltage range upon level input: 9 V to 24 V</p>
AO	<p>AO2</p> <p>Refer to AO2 technical specifications.</p>	<p>AO2-GND</p> <p>Output voltage: 0 V to 10 V</p> <p>Output current: 0 mA to 20 mA</p> <p>Impedance for output current: 0 <math>\Omega</math> to 500 <math>\Omega</math></p>	Not supported	Not supported
DO	Not supported	<p>DO2-CME</p> <p>Optocoupler isolation, bipolarity open collector output</p> <p>Output voltage range: 0 V to 24 V</p> <p>Output current range: 0 mA to 50 mA</p>	Not supported	Not supported

Type	MD520IO1	MD38IO1	MD38IO2	MD38IO3
Relay output	NO terminal 1: PA-PC	NC terminal: PA-PB NO terminal: PA-PC Contact driving capacity: 250 VAC, 3 A, COS $\phi$ = 0.4; 30 VDC, 1 A	Not supported	NO terminal: PA-PC Contact drive capability: 250 VAC, 5 A; 30 VDC, 5 A
RS-485 communi- cation	Supported	Supported	Not supported	Supported
CAN communi- cation	Not supported	Supported	Not supported	Not supported

## 1.2 Applicable AC Drive

Expansion Card Model	Applicable AC Drive
MD520IO1	MD290
	MD480 (for T2 models and above)
	MD480-PLUS
	MD500
	MD500E
	MD480-PLUS
	MD510
	MD520

### Note

Except the AO2 of the MD520IO1 card, the MD480-PLUS series and MD500-PLUS series AC drives support other terminal functions of the MD520IO1 card.

## 1.3 Technical Specifications

For details on the layout of the interfaces on the MD520IO1 card, see “[Figure 1-3](#)” on [page 10](#).

### ■ Technical specifications of the power supply terminal J1

The power supply terminal J1 is located on the back of the expansion card and supplies power only to the card.

Name	Ground	Technical Specification
+5V	GND	<ul style="list-style-type: none"><li>● Standard voltage: +5 V</li><li>● Voltage fluctuation range: <math>\pm 5\%</math></li><li>● Maximum input current: 0.8 A</li></ul>
+15V	GND	<ul style="list-style-type: none"><li>● Standard voltage: +15 V</li><li>● Voltage fluctuation range: <math>\pm 10\%</math></li><li>● Maximum input current: 0.09 A</li></ul>
-15V	GND	<ul style="list-style-type: none"><li>● Standard voltage: -15 V</li><li>● Voltage fluctuation range: <math>\pm 10\%</math></li><li>● Maximum input current: 0.09 A</li></ul>
+24V	COM	<ul style="list-style-type: none"><li>● Standard voltage: +24V</li><li>● Voltage fluctuation range: <math>\pm 10\%</math></li><li>● Maximum input current: 0.47 A</li></ul>

### ■ Technical specifications of the DI

Signal Name	Technical Specification	Remarks
DI6	Isolated sink/source programmable DI; input frequency: < 100 Hz; operating voltage range: 9 V to 30 V; invalid voltage: < 5 V; valid voltage: > 15 V; input impedance: 3.61 k $\Omega$	Optocoupler isolation
DI7		
DI8		

## ■ Technical specifications of the AO

Signal Name	Technical Specification
AO2	<ul style="list-style-type: none"> <li>● Voltage range: 0 V to 10 V</li> <li>● Maximum output current: 0 mA to 20 mA</li> <li>● Resolution: 12-bit</li> <li>● Accuracy (25°C): <math>\pm 2\%</math></li> <li>● Cut-off frequency: 115.5 Hz</li> <li>● Isolation: Not required</li> <li>● Type of protection: Clamp diode</li> <li>● In the voltage mode, the maximum output load current is 2 mA and the load impedance is larger than 5 k<math>\Omega</math>. In the current mode, the load impedance is lower than 500 <math>\Omega</math>.</li> </ul>

## ■ Technical specifications of the RS-485 communication terminal

Signal Name	Technical Specification
485+	<ul style="list-style-type: none"> <li>● RS-485 communication</li> </ul>
485-	<ul style="list-style-type: none"> <li>● Maximum rate supported by hardware: 250 Kbps. The actual maximum rate is subject to the software.</li> <li>● Transmission distance: The maximum transmission distance of the baud rate 9.6 Kbps is 1 km. The higher the rate, the shorter the transmission distance.</li> </ul>

## ■ Technical specifications of the relay terminal

Signal Name	Terminal Name	Technical Specification
PA	Normally open (NO) terminal	Contact capacity: 250 VAC/5 A, 30 VDC/5A
PC		

## ■ Safety requirements

Electrical Clearance/Creepage Distance (unit: mm)

Isolation Circuit	Insulation Type <sup>1</sup>	isolation Component	Electrical Clearance	Creepage Distance
From the high-voltage pin to the low-voltage pin of the relay	RI	Relay (K1)	6.3	6.3

## Note

- <sup>1</sup>FI: Functional insulation; BI: Basic insulation; SI: Supplementary insulation; RI: Reinforced insulation
- If the functional insulation requirements are not met, you must communicate with Inovance in advance.
- Board slotting requirements:  $\geq 1.0$  mm (error must be considered). Determine if slotting is required based on actual situations.
- The margin is not taken into account to the above clearance/distance. If there is sufficient space, add the margin of 0.3 mm to 0.5 mm to the listed clearance/distance.

## 1.4 Outline Dimensions

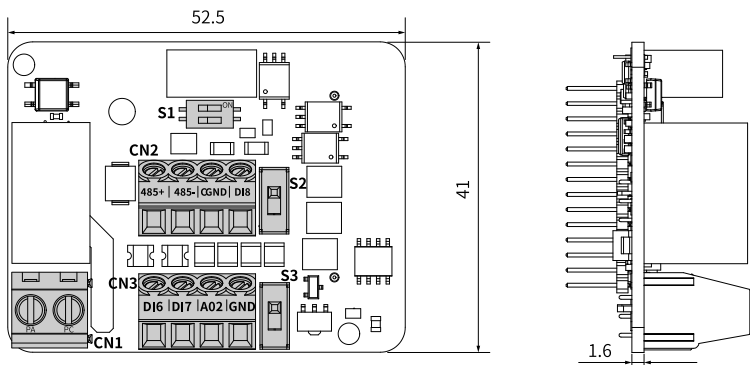


Figure 1-2 Outline dimensions of the MD520IO1 card (unit: mm)

## 1.5 Terminal Descriptions

### Terminal layout

The following figure shows the layout of the MD520IO1 card terminal.

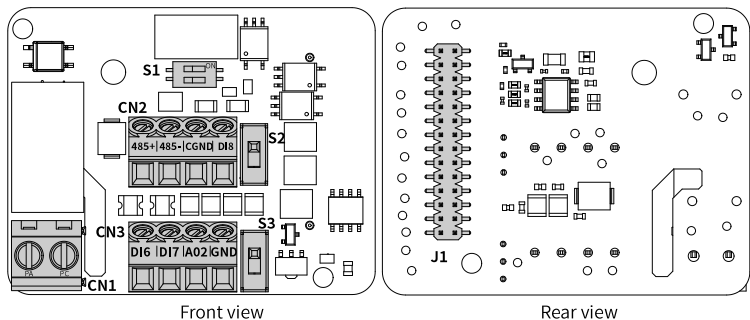


Figure 1-3 MD520IO1 card terminal layout

## ■ Terminal descriptions

Symbol		Name	Function
CN1	PA-PC	NO terminal	Contact driving capacity: 250 VAC/5 A, 30 VDC/5A
CN2	485+	RS-485 communication signal (positive)	Modbus protocol supported, isolation input
	485-	RS-485 communication signal (negative)	
	CGND	RS-485 communication signal ground	
	DI8	One digital input	<ul style="list-style-type: none"> <li>• Optocouper isolation, bipolar input compatible, maximum input frequency of 100 Hz; external or internal power supply selected by S2</li> <li>• Input impedance: 3.61 k<math>\Omega</math></li> <li>• Voltage range upon level input: 9 V to 30 V</li> </ul>
CN3	DI6, DI7	Two digital inputs	<ul style="list-style-type: none"> <li>• Optocouper isolation, bipolar input compatible, maximum input frequency of 100 Hz; external or internal power supply selected by S2</li> <li>• Input impedance: 3.61 k<math>\Omega</math></li> <li>• Voltage range upon level input: 9 V to 30 V</li> </ul>
	AO2	One analog output	Voltage or current output selected by S3 <ul style="list-style-type: none"> <li>• Output voltage: 0 V to 10 V</li> <li>• Output current: 0 mA to 20 mA</li> <li>• Impedance for output current: 0 <math>\Omega</math> to 500 <math>\Omega</math></li> </ul>
	GND	+5V, $\pm$ 15V power supply and signal reference ground	-

Symbol		Name	Function
S1	Selection of RS-485 termination resistor	Two-position DIP switch	<ul style="list-style-type: none"> <li>● Toggle positions 1 and 2 to ON: Termination resistor connected</li> <li>● Toggle positions 1 and 2 to OFF: Termination resistor disconnected</li> <li>● The default setting is OFF, and toggling S1 to the left indicates OFF.</li> </ul>
S2	DI source/sink wiring selection	Slide switch	<ul style="list-style-type: none"> <li>● If the DI uses the sink wiring method, connect OP to 24V and slide the switch to OFF.</li> <li>● If the DI uses the source wiring method, connect OP to COM and slide the switch to ON.</li> </ul>
S3	AO2 output type	Slide switch	Voltage type: 0 V to 10 V DIP switch: OFF (The default setting is OFF, and toggling S1 upward indicates OFF.)
			Current type: 0 mA to 20 mA DIP switch: ON

## 2 Installation and Wiring

### 2.1 Installation

The MD520IO1 card is installed in the MD520 series AC drive. Before installation, power off the AC drive, and wait for about 10 minutes until the charging indicator on the AC drive becomes OFF. After inserting the MD520IO1 card into the drive, fix corresponding screws to prevent the signal socket from being damaged by external signal cables. *"Figure 2-1 " on page 13* shows the installation position of the MD520IO1 card.

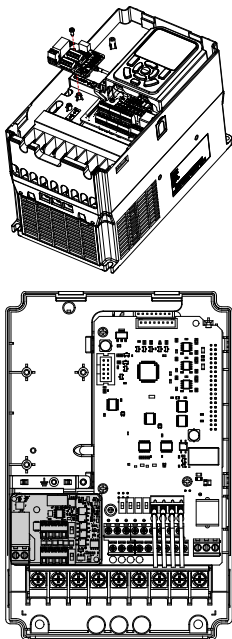


Figure 2-1 MD520IO1 card installation

## 2.2 Wiring

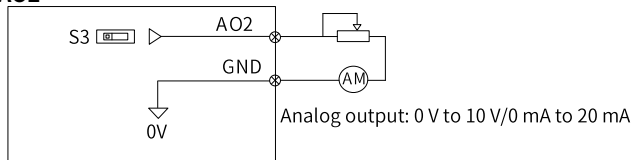
### 2.2.1 Wiring Instructions

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#### Note

- By default, S2 is toggled to OFF and the internal 24 V power supply is connected. When S2 is toggled to ON and OP and COM are connected, an external power supply is required. For details, see "[DI](#)" on page 16.
  - By default, S3 is in the voltage mode.
- 

#### ■ AO2



AO2: By default, the OFF state of the S3 DIP switch indicates the voltage mode with the output voltage ranging from 0 V to 10 V. The ON state of the S3 DIP switch indicates the current mode with the output current ranging from 0 mA to 20 mA.

The AO2 can be assigned with different functions, as shown in the table below. For more information, see *MD520 Series General Purpose AC Drive Function Guide*. The preceding figure shows the wiring for the AO2 to connect to the meter (AM).

Definition	Value
AO2 function selection	0: Operating frequency 1: Set frequency 2: Output current 3: Output torque (absolute value) 4: Output power 5: Output voltage 6: Pulse input 7: AI1 8: AI2 9: AI3 10: Length 11: Count value 12: Communication 13: Motor speed 14: Output current 15: Bus voltage 16: Output torque (actual value) Other value: F connector

## ■ RS-485 communication terminal

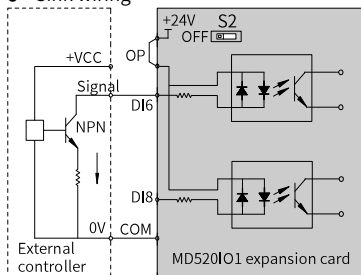
Use a three-conductor shielded cable for the RS-485 bus. The AC drive comes with three cables for connection to the RS485+, RS485–, and CGND terminals. The two cables to connect to the RS485+ and RS485– terminals are twisted pair cables. The third cable is connected to the RS-485 reference ground CGND. The shield is connected to the equipment ground. Connect a 120 Ω termination resistor at each end of the bus to prevent RS-485 signal reflection. Toggle positions 1 and 2 of the S1 DIP switch on the expansion card to ON to connect the termination resistor to the drive. The following table describes the pins of the communication cable between the drive and PLC.

Table 2-1 Pins of the communication cable between the drive and PLC

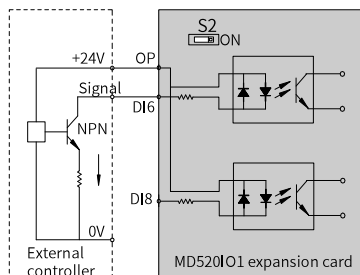
AC Drive			PLC		
Communication Type	Signal Name	Function	Communication Type	Signal Name	Function
RS-485	RS485+	RS-485 signal (positive)	RS-485	RS485+	RS-485 signal (positive)
	RS485-	RS-485 signal (negative)		RS485-	RS-485 signal (negative)
	CGND	Signal reference ground		CGND	Signal reference ground
-	PE (shield layer)	Enclosure	-	PE (shield layer)	Enclosure

## DI

### ● Sink wiring



Sink wiring method when the internal 24 V power supply of the drive is used



Sink wiring method when the external 24 V power supply is used

Figure 2-2 Sink wiring

Using the internal 24 V power supply of the drive is the most commonly used wiring method. By default, S2 is toggle to OFF. In this case, OP of the drive is connected to the internal 24 V power supply, and COM of the drive is connected to 0V of the external controller.

When using the external 24 V power supply, toggle S2 to ON. Then connect +24V of the external power supply to OP of the drive and connect 0V of the external power supply to the corresponding DI through the contact of the controller.

## Note

In the mode, the DIs of different AC drives cannot be connected in parallel. Otherwise, the DI may malfunction. If DIs of different AC drives must be connected in parallel, connect the anode of a diode to the DI in series and make the diode satisfy the requirement:  $I_F > 40 \text{ mA}$  and  $V_R > 40 \text{ V}$ , as shown in "Figure 2-3" on page 17.

The MD520 series AC drive is as an example, as shown in "Figure 2-3" on page 17.

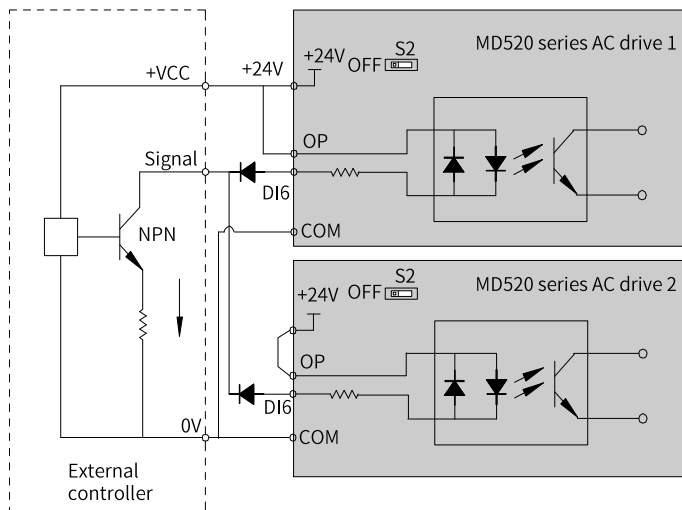
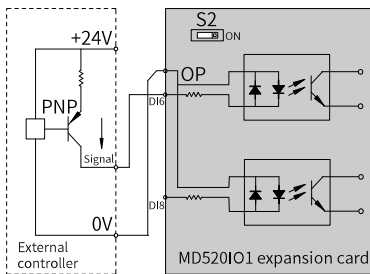


Figure 2-3 Parallel connection for DIs of different AC drives in sink wiring mode

- Source wiring



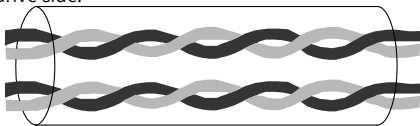
Source wiring method when the external 24 V power supply is used

Figure 2-4 Source wiring

When using the source wiring method, an external 24 V power supply is required. Toggle S2 to ON and connect 0V of the external controller to OP of the drive, as shown in “[Figure 2-4](#)” on [page 18](#).

## 2.2.2 EMC Routing Instructions

- During field installation and commissioning, the I/O signal includes the analog output signal, the digital input signal, and the relay output signal. Route the control circuit cables and the main circuit cables (R/S/T cables or U/V/W cables), other power cables, or electrical powers through different routes with a distance of at least 30 cm. Failure to comply will result in disturbed I/O signals.
- Connect the motor casing to the ground terminal (PE terminal) of the AC drive, and connect the ground cable of the motor casing properly. Otherwise, grounding performance will be degraded.
- It is recommended to use shielded signal cables to prevent the I/O signal circuit from being disturbed by peripheral interference. Connect both ends of the shield to the device in 360 degrees with the shield bracket. Use different shielded cables for different analog signal cables and use shielded twisted pair cables for digital signal cables. Connect the drain wire of the analog terminal shield to the PE terminal on the drive side.



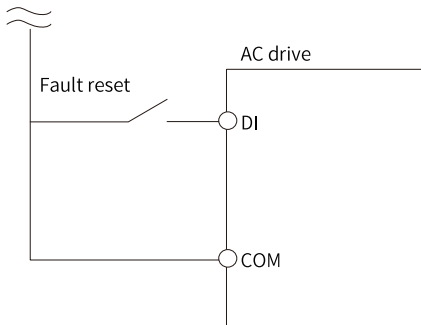
- Weak analog voltage signals are susceptible to external interference. Therefore, a shielded cable is typically required, and the wiring distance should be as short as possible (within 20 m). In applications where severe interference exists and impacts certain analog signals, install a filter capacitor or ferrite core at the analog signal source.

### 3 Troubleshooting

This section exemplifies the MD520 series AC drive as an example to describe troubleshooting of the MD520IO1 card.

- Fault reset method

1. Assign the fault reset function to the DI by setting any of F4-00 to F4-09 to 9.



- Common faults and solutions

Fault Description	Possible Cause	Solution
The DI is disabled.	Parameters are set incorrectly.	Check and reset the parameters in group F4.
	External signals are wrong.	Re-connect the external signal cable.
	The jumper between OP and +24V becomes loose.	Secure the jumper between OP and +24V.
	The control board is faulty.	Contact the agent or Inovance.

- Fault code

Fault Code	Fault Name	Possible Cause	Solution
E015.1	External input fault	An external fault signal is input through the multi-functional DI (NO).	Eliminate external faults, and ensure that restart (F8-18) is allowed under the mechanical condition to restart the device.
E015.2		An external fault signal is input through the multi-functional DI (NC).	Eliminate external faults, and ensure that restart (F8-18) is allowed under the mechanical condition to restart the device.
E027.1 E027.2	User-defined fault	The signal of a user-defined fault is input through the multi-functional DI.	Eliminate external faults, and ensure that restart (F8-18) is allowed under the mechanical condition to restart the device.
E160.1	Modbus communication fault	Modbus communication timeout	Check and ensure that the RS-485 communication cable is connected properly.
			Check whether the settings of Fd-04 and the PLC communication cycle are proper.