

MD38PGMD Multi-function Encoder Expansion Card User Guide



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Data code 19012128 C00

Preface

Introduction

This guide describes the specifications, dimensions, installation, and wiring of the MD38PGMD expansion card.

Revision History

Date	Version	Description
July 2022	C00	• Added "1.2 Applicable AC Drives"; added dimensions in section 1.3 • Adjusted the structure of the guide • Corrected minor errors
November 2020	B04	...
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x, 20xx	A00	First release

Access to the Guide

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Table of Contents

Preface 1

General Safety Precautions..... 3

1 Product Information 9

 1.1 Introduction 9

 1.2 Applicable AC Drives 10

 1.3 Outline Dimensions 10

 1.4 Interface Layout and Description 11

2 Installation and Wiring 16

 2.1 Installation..... 16

 2.2 Wiring 16

 2.2.1 Wiring Instructions 16

 2.2.2 Encoder Cable Length and Cable Gauge Relationship..... 22

 2.2.3 EMC Considerations in Wiring 22

General Safety Precautions

Safety Disclaimer

1. This chapter presents essential safety instructions for proper use of the equipment. Before operating the equipment, read through the user guide and comprehend all the safety precautions. Failure to comply with the safety precautions may result in equipment damage, severe physical injuries, or even death.
2. "CAUTION", "WARNING", and "DANGER" items in the guide only indicate some of the instructions that need to be followed; they just supplement the safety instructions.
3. Use this product in an environment that complies with the design specifications. Malfunctions or component damage caused by improper use is not covered by warranty.
4. Inovance shall take no responsibility for any physical injury or property damage caused by noncompliance with this user guide or improper use of the equipment.

Safety Categories and Definitions



indicates that failure to comply with the notice will result in severe physical injuries or even death.



indicates that failure to comply with the notice may result in severe physical injuries or even death.



indicates that failure to comply with the notice may result in minor or moderate physical injuries or equipment damage.

General Safety Precautions

- Some drawings in this guide show the equipment without covers or protective guards to display more details. Remember to install the covers and protective guards before using the equipment and operate it in accordance with the instructions.
- Drawings in the user guide are for illustration only and may be different from the equipment you purchased.

Unpacking



- Do not install the product if you find damage, rust, or signs of use on it or its accessories upon unpacking.
- Do not install the product if you find water seepage or any components being missing or damaged upon unpacking.
- Do not install the product if the packing list does not match the product you received.

 CAUTION

- Before unpacking, check the package for any damage, water seepage, dampness, or deformation.
- Unpack the product layer by layer. Do not strike the package violently.
- Check the surfaces of the equipment and accessories for any damage, rust, and scratches.
- Check the equipment, accessories, and materials in the package against the packing list.

Storage and Transportation

 WARNING

- Large-scale or heavy equipment must be transported by qualified professionals using specialized hoisting equipment. Failure to comply may result in physical injuries or equipment damage.
- Before hoisting the equipment, ensure the equipment components such as the front cover and terminal blocks are secured firmly with screws. Loosely-connected components may fall off and result in physical injuries or equipment damage.
- Never stand or stay below the equipment when the equipment is being hoisted.
- When hoisting the equipment with a steel rope, ensure the equipment is hoisted at a constant speed without suffering from vibration or shock. Do not turn the equipment over or let the equipment stay hanging in the air. Failure to comply may result in physical injuries or equipment damage.

 CAUTION

- Handle the equipment with care and mind your steps. Failure to comply may result in physical injuries or equipment damage.
- When carrying the equipment with bare hands, hold the equipment casing firmly with care to prevent parts from falling. Failure to comply may result in physical injuries.
- Store and transport the equipment based on the storage and transportation requirements. Failure to comply will result in equipment damage.
- Avoid storage and transportation in environments with water splash, rain, direct sunlight, strong electric field, strong magnetic field, and strong vibration.
- Avoid storage for more than three months. Long-term storage requires stricter protection and necessary inspections.
- Pack the product properly before transportation by vehicle. Use an enclosed box for long-distance transportation.
- Never transport the product with devices or materials that may damage or negatively impact the product.

Installation

 DANGER

- Installation must be carried out by technicians who have received relevant training on electrical equipment and have sufficient electrical expertise. Non-professionals are not allowed to operate the equipment.

 WARNING

- Read through the user guide and safety precautions before installation.
- Do not install the product in places with strong electric or magnetic fields.
- Before installation, check that the mechanical strength of the installation site can bear the weight of the equipment. Failure to comply will result in mechanical hazards.
- Do not wear loose clothes or accessories during installation. Failure to comply may result in an electric shock.
- When installing the equipment in a closed environment (such as a cabinet or casing), use a cooling device (such as a fan or air conditioner) to cool the environment down to the required temperature. Failure to comply may result in equipment over-temperature or fire.
- Do not modify the product.
- Do not fiddle with the bolts used to fix parts and components or the bolts marked in red.
- When the equipment is installed in a cabinet or final assembly, a fireproof enclosure providing both electrical and mechanical protections must be provided. The IP rating must meet IEC standards and local laws and regulations.
- If any equipment with strong electromagnetic interference, such as a transformer, is needed, install a shielding device to prevent malfunction of this product.
- Install the equipment on metal or other incombustible objects. Keep the equipment away from combustible objects. Failure to comply will result in fire.

 CAUTION

- Cover the top of the equipment with a piece of cloth or paper during installation. This is to prevent unwanted objects such as metal chippings, oil, and water from falling into the equipment and causing faults. After installation, remove the cloth or paper on the top of the equipment to prevent over-temperature caused by poor ventilation due to blocked ventilation holes.
- Resonance may occur when a machine supposed to run at a constant speed is running at variable speeds. In this case, install the vibration-proof rubber under the motor frame or use the vibration suppression function to reduce resonance.

Wiring

 DANGER

- Never allow non-skilled personnel to carry out installation, wiring, maintenance, inspection, or part replacement.
- Before wiring, cut off all the power supplies of the equipment. Wait for at least the time designated on the equipment warning label before further operations because residual voltage still exists after power-off. After waiting for the designated time, measure the DC voltage in the main circuit to ensure the DC voltage is within the safe voltage range. Failure to comply will result in an electric shock.
- Do not perform wiring, remove the equipment cover, or touch the circuit board while power is on. Failure to comply will result in an electric shock.
- Ensure that the equipment is well grounded. Failure to comply will result in an electric shock.

 WARNING

- Do not connect the input power supply to the output end of the equipment. Failure to comply may result in equipment damage or even fire.
- When connecting a drive to the motor, check that the phase sequences of the drive and motor terminals are consistent to prevent reverse motor rotation.
- Use cables with required diameter and shield. Properly ground one end of the shield if a shielded cable is used.
- Fix the terminal screws with the tightening torque specified in the user guide. Improper tightening torque may overheat or damage the connecting part, resulting in fire.
- After wiring is done, check that all cables are connected properly and no screws, washers, or exposed cables are left inside the equipment. Failure to comply may result in an electric shock or equipment damage.

 CAUTION

- During wiring, follow the proper electrostatic discharge (ESD) procedures and wear an anti-static wrist strap. Failure to comply will result in damage to the equipment or internal circuits of the product.
- Use shielded twisted pairs for the control circuit. Connect the shield to the grounding terminal of the equipment for grounding purpose. Failure to comply will result in equipment malfunction.

Power-on

 DANGER

- Before power-on, check that the equipment is installed properly with reliable wiring and the motor can be restarted.
- Check that the power supply meets equipment requirements before power-on to prevent equipment damage or fire.
- After power-on, do not open the cabinet door or protective cover of the equipment, touch any terminal, or disassemble any unit or component of the equipment. Failure to comply will result in an electric shock.

 WARNING

- Perform a trial run after wiring and parameter setting to ensure the equipment operates safely. Failure to comply may result in physical injuries or equipment damage.
- Before power-on, check that the rated voltage of the equipment is consistent with that of the power supply. Failure to comply may result in fire.
- Before power-on, check that no one is near the equipment, motor, or machine. Failure to comply may result in physical injuries or even death.

Operation

 DANGER

- The equipment must be operated only by professionals. Failure to comply will result in physical injuries or even death.
- Do not touch any connecting terminals or disassemble any unit or component of the equipment during operation. Failure to comply will result in an electric shock.

 WARNING

- Do not touch the equipment casing, fan, or resistor to check the temperature. Failure to comply may result in burns.
- Prevent metal or other objects from falling into the equipment during operation. Failure to comply may result in fire or equipment damage.

Maintenance
 DANGER

- Never allow non-skilled personnel to carry out installation, wiring, maintenance, inspection, or part replacement.
- Do not maintain the equipment while power is on. Failure to comply will result in an electric shock.
- Before maintenance, cut off all the power supplies of the equipment and wait for at least the time designated on the equipment warning label.
- In case of a permanent magnet motor, do not touch the motor terminals immediately after power-off because the motor terminals will generate induced voltage during rotation even after the equipment power supply is off. Failure to comply will result in an electric shock.

 WARNING

- Carry out daily and periodic inspection and maintenance on the equipment according to maintenance requirements and retain a maintenance record.

Repair
 DANGER

- Never allow non-skilled personnel to carry out installation, wiring, maintenance, inspection, or part replacement.
- Do not repair the equipment while power is on. Failure to comply will result in an electric shock.
- Before inspection and repair, cut off all the power supplies of the equipment and wait for at least the time designated on the equipment warning label.

 WARNING

- Submit the repair request according to the warranty agreement.
- When the fuse is blown or the circuit breaker or earth leakage current breaker (ELCB) trips, wait for at least the time designated on the equipment warning label before power-on or further operations. Failure to comply may result in equipment damage, physical injuries, or even death.
- When the equipment is faulty or damaged, the troubleshooting and repair work must be performed by professionals that follow the repair instructions, with repair records kept properly.
- Replace quick-wear parts of the product according to the replacement instructions.
- Do not use damaged equipment. Failure to comply may result in further equipment damage, physical injuries, or even death.
- After equipment replacement, check the wiring and set parameters again.

Disposal	
	WARNING • Dispose of retired equipment in accordance with local regulations and standards. Failure to comply may result in property damage, physical injuries, or even death. • Recycle retired equipment in accordance with waste disposal standards of the industry to avoid environmental pollution.

Safety Label

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

Safety Label	Description
	• Read through the safety instructions and user guide before operating the equipment. Failure to comply may result in equipment damage, physical injuries, or even death. • Do not touch the terminals or remove the cover while power is on or within 10 min after power-off. Failure to comply will result in an electric shock.

1 Product Information

1.1 Introduction

The MD38PGMD card is a multi-function PG card optimized and improved based on the MD38PG1, MD38PG5, and MD38PG6D cards. It supports differential input, collector input, and push-pull input. It also supports differential output and collector output. Therefore, it is compatible with various interfaces of common encoders and A/B phase inputs from host controllers. The MD38PGM version with the complex programmable logic device (CPLD) features multiple frequency-division outputs (divided by 0 to 63), adaptive filtering, automatic interlock, and encoder disconnection detection.

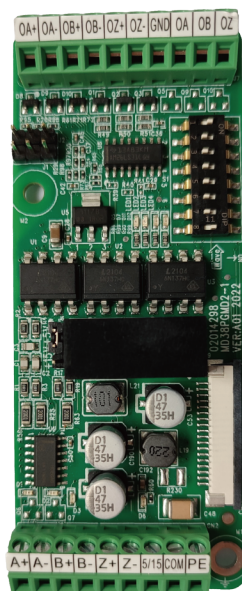


Figure 1-1 MD38PGMD card appearance

1.2 Applicable AC Drives

Expansion Card	Applicable AC Drive
MD38PGMD	MD480
	MD500
	MD500-PLUS
	MD510
	MD520
	CS700
	CS710

1.3 Outline Dimensions

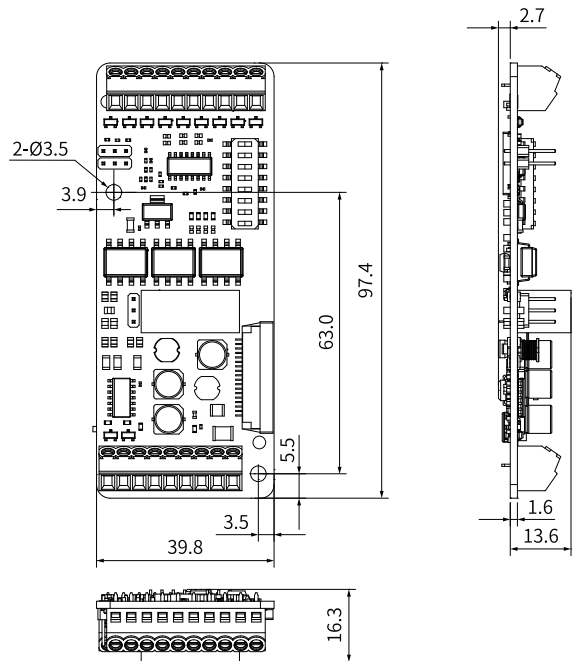


Figure 1-2 MD38PGMD card dimensions (unit: mm)

1.4 Interface Layout and Description

Interface layout

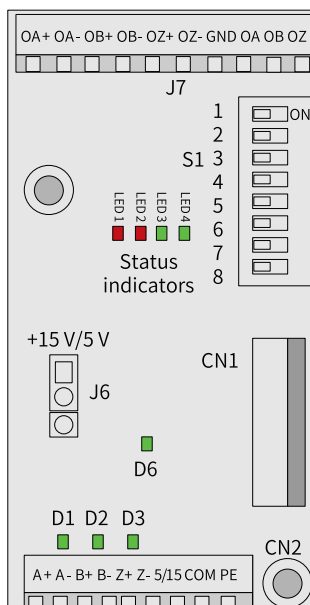


Figure 1-3 MD38PGMD expansion card interface layout

Name	Description	Remarks
CN1	PG card signal interface with AC drive control board	-
CN2	Encoder signal input terminal, supporting differential and collector input modes	See "Pin assignment of the CN2 encoder signal input terminal".
S1	DIP switch for frequency-division coefficient and filter function selection	Available on MD38PGMD only
J6	Jumper for encoder power supply selection: 5 V or 15 V output	5 V by default at delivery
J7	Frequency-division output terminal, supporting differential and collector frequency-division output	-
LED1/LED2/LED3/LED4	Status indicators	See the following table. Available on MD38PGMD only

Name	Description	Remarks
D6	Power indicator	-
D1/D2/D3	Encoder input signal indicators, blinking or steady ON when there is signal input to the encoder	D1 for A+/A–, D2 for B+/B–, and D3 for Z+/Z–

Interfaces

Table 1–1 Pin assignment of the CN2 encoder signal input terminal

Pin Number	Terminal Name	Description
1	A+	Encoder output A signal (positive)
2	A–	Encoder output A signal (negative)
3	B+	Encoder output B signal (positive)
4	B–	Encoder output B signal (negative)
5	Z+	Encoder output Z signal (positive)
6	Z–	Encoder output Z signal (negative)
7	5 V/15 V	5 V/15 V encoder power supply
8	COM	Encoder power ground
9	PE	Shield connection terminal

Table 1–2 Pin assignment of the J7 frequency-division output signal terminal

Pin Number	Terminal Name	Description
1	OA+	Differential frequency-division output A signal (positive)
2	OA–	Differential frequency-division output A signal (negative)
3	OB+	Differential frequency-division output B signal (positive)
4	OB–	Differential frequency-division output B signal (negative)
5	OZ+	Differential frequency-division output Z signal (positive)
6	OZ–	Differential frequency-division output Z signal (negative)
7	GND	Frequency-division output reference ground
8	OA	Collector frequency-division output A signal

Pin Number	Terminal Name	Description
9	OB	Collector frequency-division output B signal
10	OZ	Collector frequency-division output Z signal

DIP switch S1

The DIP switch S1 has two main functions: setting a frequency-division coefficient and selecting a filtering function. A pin set to "ON" indicates the value of "1", while a pin set to "OFF" indicates the value of "0".

Frequency-Division Coefficient	DIP Switch								Filtering Function
	Pins for Frequency-Division Coefficient Settings						Pins for Filtering Function Selection		
	1	2	3	4	5	6	7	8	
No output	0	0	0	0	0	0	0	0	Non-adaptive filtering
Frequency divided-by-1 output	1	0	0	0	0	0			
Frequency divided-by-2 output	0	1	0	0	0	0	1	0	Adaptive filtering
Frequency divided-by-3 output	1	1	0	0	0	0			
-	-	-	-	-	-	-	0	1	Fixed inter lock
-	-	-	-	-	-	-			

Frequency-Division Coefficient	DIP Switch								Filtering Function
	Pins for Frequency-Division Coefficient Settings						Pins for Filtering Function Selection		
	1	2	3	4	5	6	7	8	
-	-	-	-	-	-	-			
Frequency divided-by-63 output	1	1	1	1	1	1	1	1	Automatic interlock

Filtering functions include:

- Non-adaptive filtering: The PG card filter coefficient is fixed and small. This mode is suitable for applications with little to no interference or high-speed requirements.
- Adaptive filtering: The PG card filter coefficient is automatically adjusted. This mode provides strong antijamming ability, which is especially obvious for encoder feedback speeds below 100 kHz. It is suitable for applications with significant interference. This is the default mode at delivery.
- Fixed interlock: This mode builds upon the adaptive filtering mode by adding edge jitter elimination for encoder feedback signals. It is suitable for applications where encoder feedback signals exhibit edge jitter.
- Automatic interlock: This mode automatically toggles between adaptive filtering and fixed interlock to adapt to zero-speed and non-zero-speed operating conditions. This prevents the fixed interlock function from mistakenly eliminating useful signals as edge jitter during zero-speed operation.

Status indicators

No.	Type	Indicator Status	Function Description
LE D1	Indicator for encoder input signal quality (red)	OFF	The encoder input signal is normal. The speed is stable or there is no interference.
		Steady ON	The encoder input signal is slightly unstable, which occurs when the motor accelerates/decelerates or the encoder input signal is slightly interfered with.
		Blinking slow [Note]	The encoder input signal is moderately unstable, which occurs when the motor accelerates/decelerates or the encoder input signal is moderately interfered with.
		Blinking fast	The encoder input signal is highly unstable, which occurs when the motor accelerates/decelerates quickly or the encoder input signal is severely interfered with.
LE D2	Indicator for PG card signal processing quality (red)	OFF	The PG card input signal is normal. The speed is stable or there is no interference.
		Steady ON	The PG card signal is slightly unstable, which occurs when the motor accelerates/decelerates or interference in the encoder input signal is not completely filtered out (less than 10 interference pulses are not filtered out per unit time).
		Blinking slow	The PG card signal is moderately unstable, which occurs when the motor accelerates/decelerates or interference in the encoder input signal is not completely filtered out (less than 30 interference pulses are not filtered out per unit time).
		Blinking fast	The PG card signal is highly unstable, which occurs when the motor accelerates/decelerates or interference in the encoder input signal is not completely filtered out (more than 30 interference pulses are not filtered out per unit time).
LE D3	Interlock state indicator (green)	ON	Interlock is enabled.
		OFF	Interlock is disabled.
LE D4	System state indicator (green)	Steady ON	The system is working properly.
		Blinking	The encoder cable is disconnected.

Note

Frequency of slow blinking: 2 Hz; frequency of fast blinking: 10 Hz

2 Installation and Wiring

2.1 Installation

The MD38PGMD card is designed to be embedded in the MD series AC drive. Before installation, cut off the power supply of the AC drive and wait for about 10 minutes until the charging indicator of the AC drive becomes off. Then, insert the MD38PGMD card into the AC drive and fasten the screws to protect the signal socket between boards from being damaged by the pulling force of the external signal cable. See *"Figure 2-1 " on page 16* for installation.

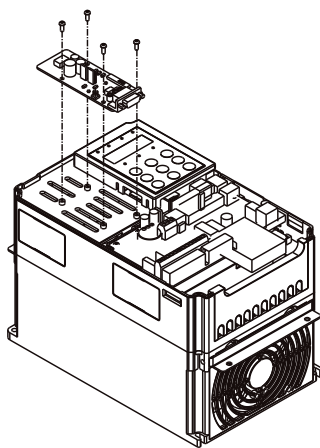


Figure 2-1 MD38PGMD card installation

2.2 Wiring

2.2.1 Wiring Instructions

Differential encoder input wiring

The steps of wiring a differential encoder to the MD38PGMD expansion card are as follows:

1. Connect the output signals of the encoder to the A+/A-, B+/B-, Z+/Z-, 5 V/15 V, and COM input terminals of the PG card.
2. Set the encoder power supply mode to 5 V (short-circuit jumper J6 to the +5 V terminal, which is the factory default).
3. Connect the shield of the encoder cable to the PE terminal of the PG card.

4. Select a filtering function based on the application. (Set through pins 7 and 8 of the DIP switch. For details, see "Pins for Filtering Function Selection" in "[DIP switch S1](#)" on page 13.)

The 18-pin flat cables (one short and one long) in "[Figure 2-2](#)" on page 17 are supplied by the manufacturer. The order codes are 15041056 (short flat cable) and 15041067 (long flat cable).

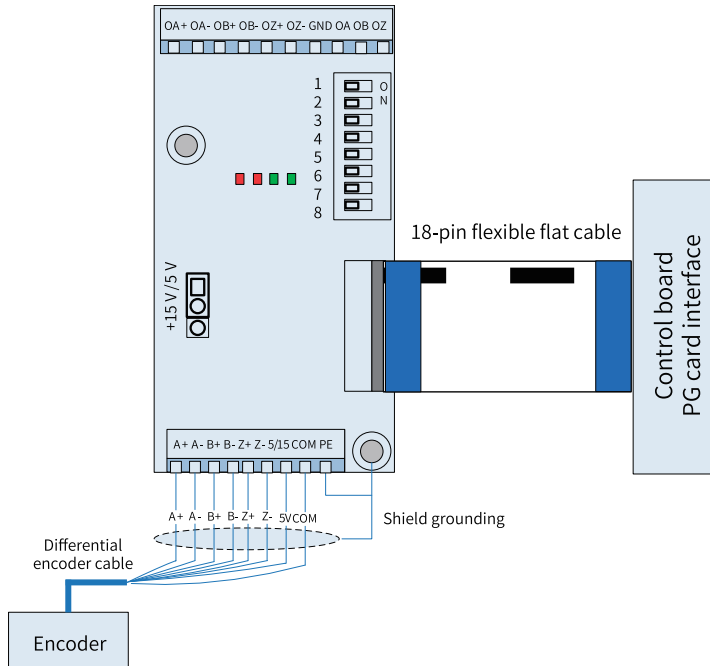


Figure 2-2 Differential encoder input wiring

Note

- The PG card offers two power supply modes: 5 V and 15 V (selected through jumper J6). Before powering on the PG card, it is essential to verify that the jumper settings enable the 5 V output. Incorrect settings may lead to excessive voltage damaging the encoder.
- For differential encoders, it is highly recommended to use shielded twisted pair cables. Wire the cables in strict accordance with the differential pairs (this also applies to differential frequency-division output).

Collector input wiring

The steps of collector input wiring for the MD38PGMD expansion card are as follows:

1. Connect the output A/B/Z phases of the encoder to the A–/B–/Z– input terminals of the PG card, respectively. Connect the encoder's power supply cable to the 5 V/15 V and COM terminals of the PG card.
2. Change the PG card's encoder power supply mode to 15 V (short-circuit jumper J6 to the +15 V terminal).
3. Connect the shield of the encoder cable to the PE terminal of the PG card.
4. Select a filtering function based on the application. (Set through pins 7 and 8 of the DIP switch. For details, see "Pins for Filtering Function Selection" in ["DIP switch S1" on page 13.](#))

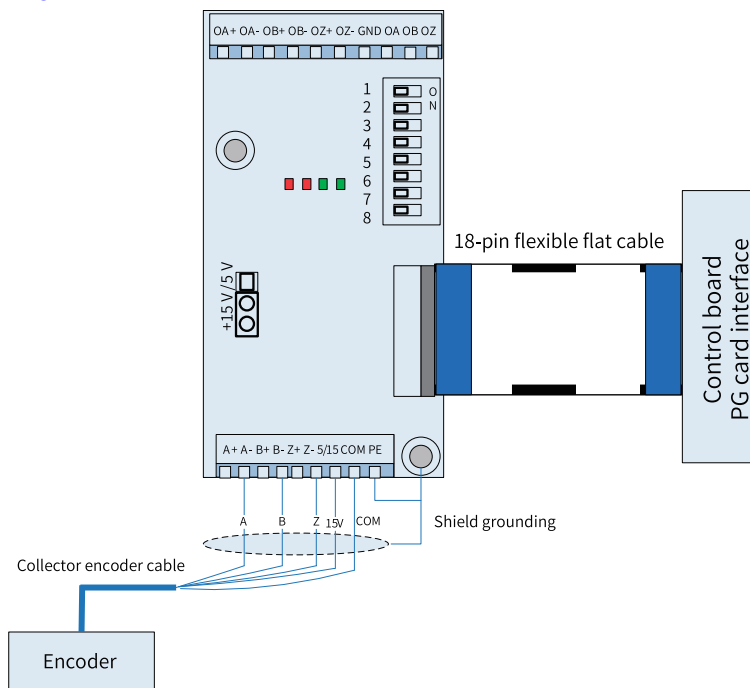


Figure 2-3 Collector input wiring

Note

Collectors can result in slow signal rising edges due to their electrical characteristics, resulting in a limited signal transmission distance, typically within 50 m. Therefore, for applications where the cable length exceeds 50 m, it is advisable not to use collector encoders. Instead, it is recommended to use push-pull or differential encoders.

Push-pull input wiring

The steps of push-pull input wiring for the MD38PGMD expansion card are as follows:

1. For a push-pull encoder with differential output, connect the output A–/B–/Z– phases of the encoder to the A–/B–/Z– input terminals of the PG card, while leave the output A+/B+/Z+ phases of the encoder unconnected. For a push-pull encoder with single-end signal output, connect the signal A/B/Z phases of the encoder to the A–/B–/Z– input terminals of the PG card, while connect the encoder's power supply cable to the 5 V/15 V and COM terminals of the PG card.
2. Select the PG card's encoder power supply mode based on the encoder's power supply voltage (5 V or 15 V, selected through jumper J6).
3. Connect the shield of the encoder cable to the PE terminal of the PG card.
4. Select a filtering function based on the application. (Set through pins 7 and 8 of the DIP switch. For details, see "Pins for Filtering Function Selection" in "[DIP switch S1](#)" [on page 13.](#))

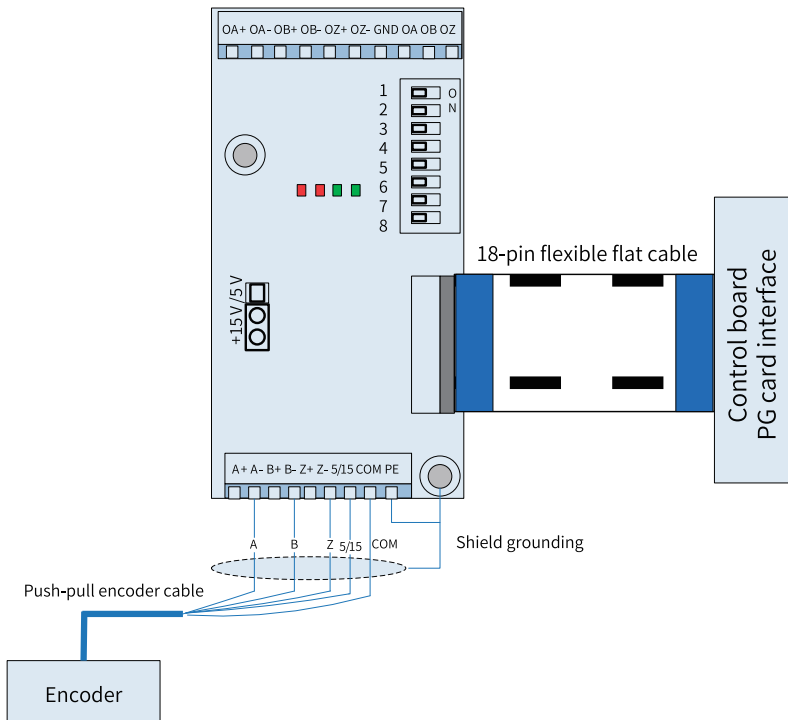


Figure 2-4 Push-pull input wiring

Note

For a push-pull encoder with differential output, do not connect the A+/B+/Z+ signals of the push-pull output to the A+/B+/Z+ terminals on the PG card. In this case, the A+/B+/Z+ terminals on the PG must be left unconnected. Failure to comply will damage the PG card.

Differential frequency-division output wiring

The steps of differential frequency-division output wiring for the MD38PGMD expansion card are as follows:

1. Connect the frequency-division output cable to the OA+/OA-, OB+/OB-, and OZ+ /OZ- frequency-division output terminals of the PG card. It is recommended to connect the reference ground GND of the frequency-division output.
2. Set a frequency dividing coefficient. (Set through pins 1 to 6 of the DIP switch. For details, see "Pins for Frequency-Division Coefficient Settings" in ["DIP switch S1" on page 13.](#))
3. Connect the shield of the frequency-division output cable to the PE terminal of the frequency-division signal receiving device.

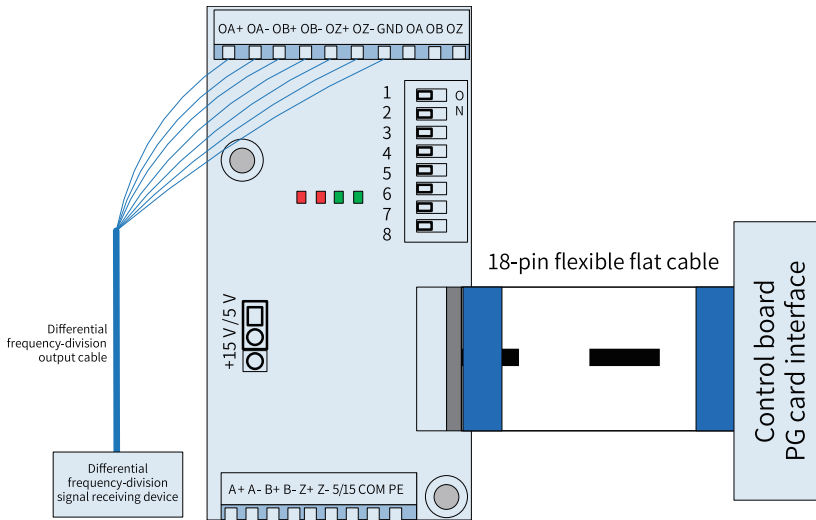


Figure 2-5 Differential frequency-division output wiring

Collector frequency-division output wiring

The steps of collector frequency-division output wiring for the MD38PGMD expansion card are as follows:

1. Connect the frequency-division output cable to the OA/OB/OZ/GND frequency-division output terminals of the PG card.
2. Set a frequency dividing coefficient. (Set through pins 1 to 6 of the DIP switch. For details, see "Pins for Frequency-Division Coefficient Settings" in ["DIP switch S1" on page 13.](#))
3. Connect the shield of the frequency-division output cable to the PE terminal of the frequency-division signal receiving device.

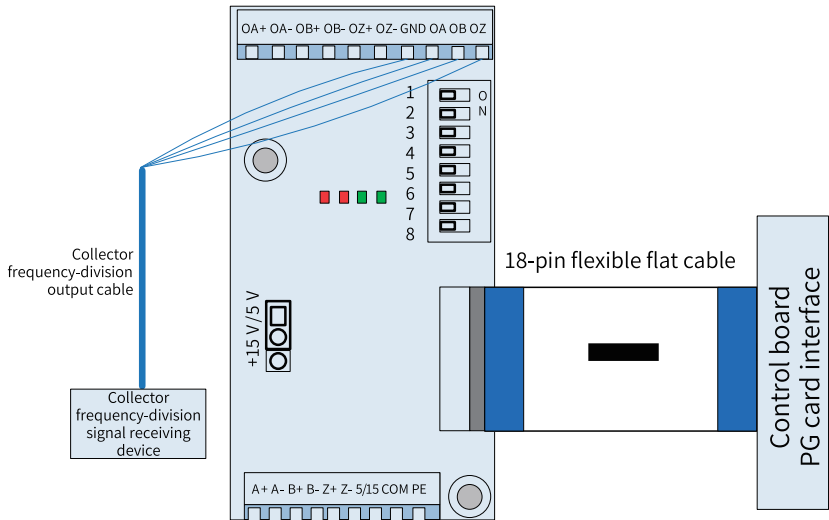


Figure 2-6 Collector frequency-division output wiring

Pulse+direction input

Connect the pulse signal to the phase-A terminal and the direction signal to the phase-B terminal.

- For differential input, connect the pulse signal to the A+/A- terminals and the direction signal to the B+/B- terminals. Change the PG card's encoder power supply mode to +5 V (short-circuit jumper J6 to the +5 V terminal, which is the factory default).
- For collector input, connect the pulse signal to the A- terminal, the direction signal to the B- terminal, and the reference ground to the COM terminal. Change the PG card's encoder power supply mode to 15 V (short-circuit jumper J6 to the +15 V terminal).

Note

- The PG card offers two power supply modes: 5 V and 15 V (selected through jumper J6). Before powering on the PG card, it is essential to verify that the PGM power supply jumper is set correctly. Incorrect settings may lead to excessive voltage damaging the encoder.
- The filtering mode must be set to "non-adaptive filtering" or "adaptive filtering" through DIP switch S1. Selecting the "fixed interlock" or "automatic interlock" mode can cause abnormal feedback signals from the encoder, causing the AC drive to malfunction.

2.2.2 Encoder Cable Length and Cable Gauge Relationship

A long encoder cable means high cable resistance, resulting in a greater voltage drop on the encoder power supply and encoder signal. In long-distance applications, inappropriate cable gauge will cause the encoder and PG card to malfunction due to signal attenuation caused by cable resistance.

See the following table for the relationship between the encoder cable length and cable gauge. Select the appropriate cable gauge based on the actual cable length on-site. (Cable gauge is a standard that distinguishes wire diameters. This guide uses the AWG standard.)

Cable Length (m)	Cable Gauge (AWG)
10	≤ 26
20	
30	≤ 24
40	
50	≤ 22
60	
70	≤ 21
80	
90	≤ 20
100	

2.2.3 EMC Considerations in Wiring

- During on-site installation and commissioning, route signal cables (such as encoder cables) and power cables in different cable troughs. Never bundle an encoder cable with a power cable. Failure to comply may result in encoder interference.
- Connect the motor enclosure to the PE terminal of the AC drive. Ensure that the grounding wire of the motor enclosure is well overlapped. Failure to comply will result in poor grounding performance.
- Use shielded twisted pair cables. For differential encoders, wire the cables based on differential pairs and connect the shield to the PE terminal of the AC drive.
- In some large equipment applications, the AC drive is far away from the motor and the motor cable is long (> 10 m). The cable inductance weakens the grounding effect. In this case, the encoder shield needs not to be connected to the PE terminal of AC drive.
- You can determine whether the encoder input is interfered with based on the status indicator LED1 on the PG card. For details, see "[Status indicators](#)" on [page 15](#).



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