



1. Preface

Thank you for using the MD380 series AC drive and the MD380 series multi-function expansion card from Inovance. The MD38PC1 programmable expansion card is designed for the MD380 series AC drive, integrating the programmable controller (PLC) functions. By installing and programming this card on your AC drive, you can customize control features efficiently. Seamlessly integrated into the logic design of the AC drive, this card streamlines PLC programming for enhanced AC drive control. It outperforms standalone PLC and AC drive setups, offering up to 8K user program space to meet diverse process needs. Before using this product, please read through this user guide.

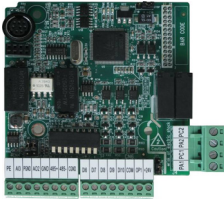


Figure 1.1: MD38PC1 card appearance

2. Installation and Setup

2.1 Installation on the AC Drive

The MD38PC1 card is designed to be embedded in an Inovance AC drive. Before installation, disconnect the power supply to the AC drive and wait for 10 minutes until the power indicator of the AC drive is off. Install the expansion card in accordance with Figure 2.1.

Insert the MD38PC1 card into the AC drive and fasten the screw.

Note: The MD38PC1 expansion card (user-programmable card) must not be installed or removed while powered. To prevent damage to the expansion card components due to static electricity, especially in dry seasons, discharge static electricity by touching a nearby grounded object before touching the control board.

2.2 Hardware Layout

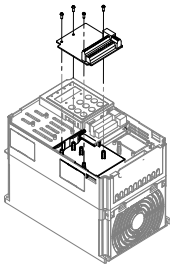


Figure 2.1: MD38PC1 installation

The hardware layout of the MD380PC1 card is shown in Figure 2.2.

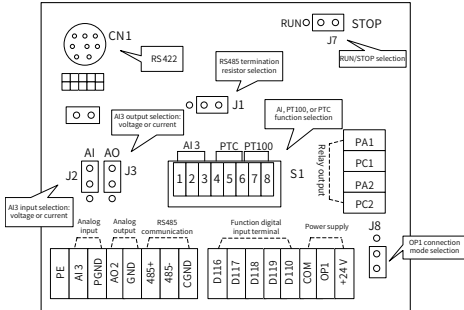


Figure 2.2: Hardware layout of MD38PC1

2.3 Interface Description

2.3.1 Terminal Interfaces

The terminals and their functions are summarized in Table 2.1.

Table 2.1: Terminal interfaces			
Type	Terminal Mark	Terminal Name	Function Description
Power supply	+24V-COM	External +24 V power supply	Provides a +24 V power supply externally. Typically, this is used to power DI/DO terminals and external sensors. Maximum output current: 200 mA
	OP1	Digital input power terminal	OP1 is connected to +24V through jumper J8 at the factory. To use an external power supply, connect OP1 to the external power supply and remove jumper J8.
Analog input	AI3-PGND	Analog input terminal 3	1. Photocoupler isolation input, supporting differential voltage input, current input, and temperature detection resistance input 2. Input voltage: -10 VDC to +10 VDC 3. Input current: -20 mA to +20 mA 4. PTC and PT100 temperature sensors 5. The input mode is set by the DIP switch S1. Only one mode can be enabled at a time.
Functional digital input terminal	DI6-OP1	Digital input 6	1. Photocoupler isolation, compatible with dual-polarity inputs 2. Input impedance: 2.4 kΩ 3. Voltage upon level input: 9 V to 30 V
	DI7-OP1	Digital input 7	
	DI8-OP1	Digital input 8	
	DI9-OP1	Digital input 9	
	DI10-OP1	Digital input 10	
Analog output	AO2-GND	Analog output 2	1. Output voltage: 0 V to 10 V 2. Output current: 0 mV to 20 mV
Relay output	PA1-PC1	Relay 1 Normally-open terminal	Driving capacity of the contact: 250 VAC, 3 A, COSφ = 0.4 30 VDC, 1 A
	PA2-PC2	Relay 2 Normally-open terminal	
RS485 communication	485+/485-	RS485 communication terminal	Modbus RTU communication input and output terminals; isolated input
	GND	RS485 communication ground Isolated power ground	
RS422	CN1	User program download	Interface for user program download (9-pin mini port)

2.3.2 Jumper Interfaces

Jumper No.	Description	Meaning	Settings
J2	AI3 voltage/current input selection	Voltage	
		Current	
J3	AO2 voltage/current output selection	Voltage	
		Current	
J1	RS485 termination resistor selection	Termination resistor	
J7	RUN/STOP selection	RUN	
		STOP	
J8	OP1 connection mode selection	DI terminal active high	
		DI terminal active low	
		DI terminal power by external power supply	
S1	AI/PT100/PTC function selection	AI: 1, 2, and 3 set to ON	
		PTC: 4, 5, and 6 set to ON	
		PT100: 6, 7, and 8 set to ON	

3. Configuration for Communication with the AC Drive

The MD38PC1 user-programmable card is compatible with Inovance H1U/2U series PLCs and uses the AutoShop programming environment for programming. The D elements in the range of D0 to D6999 are available. You can configure fast and slow tables for self-reception and transmission to implement real-time interaction with the AC drive.

In the MD380 series AC drive, parameter groups A7, A9, and U3 are dedicated for the user-programmable card. You can enable or disable the user-programmable card by setting A7-00 to 1 or 0, respectively.

3.1 Internal Communication Methods of the Programmable Module

The development environment for the user-programmable card is AutoShop. When creating a project, select the MDI Card as the PLC type, as shown in Figure 3-1.

Before programming, configure interaction tables based on the actual application to facilitate real-time data exchange between the AC drive and the programmable card. The programmable card acts as the host that initiates read or write operations on AC drive parameters. Interaction tables that trigger read operations include a fast receive table and a slow receive table. Interaction tables that trigger write operations include a fast send table and a slow send table. The tables can be set on the system settings page of the project, as shown in Figure 3-2.

In the configuration, the AC drive parameters represent the AC drive data, while the D element addresses represent the corresponding PLC soft elements. You can control the AC drive by setting values of the D elements.

Fast receive table: The programmable card reads the AC drive (entire table exchanged in less than 10 ms).

Slow receive table: The programmable card reads the AC drive (single frame exchanged in less than 20 ms).

Fast send table: The programmable card writes to the AC drive (entire table exchanged in less than 10 ms).

Slow send table: The programmable card writes to the AC drive (single frame exchanged in less than 20 ms).

During user configuration, simply enter parameter interaction addresses in the AC drive parameter column. (For a send table, enter writable AC drive parameter numbers. For a receive table, enter readable AC drive parameter numbers. See the MD380 guide for more details). For integration of the programmable control card and the AC drive, the interaction tables for MDI Card projects in the AutoShop are pre-configured and cannot be modified by users. However, you can set other parameter numbers (up to 6 for fast tables and up to 27 for slow tables; configured numbers must be consecutive, or the AutoShop will report an error).

To prevent writing of invalid data to the AC drive, default values must be set in the send tables. Specifically, enter the default values of the parameters in the default value column (see the MD380 guide), as shown in Figure 3-3.

Validate the configuration after it is completed. Specifically, download the “system settings” to the programmable card. Power off both the AC drive and the programmable card, and then power them on again for the configuration table to take effect. In the case of a configuration error, the programmable module’s ERR indicator will blink every 2 ms and you can check the D7091 value to locate the error, as shown in Table 3-1. (The D7091 value in other cases is meaningless).

D7091 Value	Table Type	SN
2 to 6	Fast receive table	2 to 6
104 to 130	Slow receive table	4 to 30
201 to 206	Fast send table	1 to 6
304 to 330	Slow send table	4 to 30

Table 3-1: Configuration error indication

After locating the error, correct it and redownload the interaction tables. Then, power off and power on the AC drive and the card. Set D7091 to 0 (you need to manually clear the fault value of D7091) to eliminate the blinking ERR indicator.

3.2 AC Drive Communication Data

With this user-programmable card, you only need to configure the interaction tables to implement data exchange with the AC drive. Specifically, map AC drive parameters to PLC D elements in the specified range for real-time exchange and updates of the parameters and D elements.

The MD380 AC drive provides three function parameter sets: F, A, and U (see the MD380 guide for details). Interaction addresses follow these rules:

High-order 8 bits of the address:

For the F0 to FF groups, the high-order 8 bits of the address are F0 to FF.

For the A0 to AF groups, the high-order 8 bits of the address are A0 to AF.

For the U0 to UF groups, the high-order 8 bits of the address are 70 to 7F.

Low-order 8 bits of the address:

The low-order 8 bits of address are the function parameter index in decimal, which needs to be converted to hexadecimal during address interaction.

For example, function parameter F3-18 corresponds to address F312.

Function parameter U0-07 corresponds to address 7007.

3.2.1 Data Receive Tables

In the receive tables in the programmable card system settings, you can configure all parameters from the F, A, and U groups of the AC drive.

The following table lists some of the parameters as an example.

AC Drive Parameter	Parameter and Programmable Card Interaction Address	Description	Remarks
--------------------	---	-------------	---------

A9-00 to A9-29	A900 to A91D	Function parameter groups dedicated for the PLC	You can write values to this group of parameters through the AC drive panel to change the corresponding D element values in the PLC. This group of parameters provides a means for writing values to PLC soft elements. For example, when the PLC program involves uncertain data such as mechanical parameters that need to be set by the customer, the A9 group can be used, and settings of the A9 group will be used in the PLC program.
U0-07	7007	DI terminal status	MD380 control board DI terminal status 0: Inactive; 1: Active Bit 0: DI1 status Bit 1: DI2 status Bit 2: DI3 status Bit 3: DI4 status Bit 4: DI5 status
U0-09	7009	AI1 voltage	MD380 control board AI1 voltage, in 0.01 V
U0-10	700A	AI2 voltage	MD380 control board AI2 voltage, in 0.01 V
U0-59	703B	Frequency reference	-100.00% to +100.00% +100.00% corresponds to the maximum frequency (F0-10)
U0-60	703C	Operation frequency	-100.00% to +100.00% +100.00% corresponds to the maximum frequency (F0-10)
U0-61	703D	AC drive operation Status	Bit 1 and bit 0: 0 indicates "stopped", 1 indicates "forward running", and 2 indicates "reverse running". Bit 3 and bit 2: 0 indicates constant speed, 1 indicates acceleration, and 2 indicates deceleration.

3.2.2 Data Send Tables

In the send tables in the programmable card system settings, you can configure parameters from the U3 group and modifiable parameters from the F and A groups of the AC drive.

The following table lists some of the parameters as an example.

AC Drive Parameter	Parameter and Programmable Card Interaction Address	Description	Remarks
A7-03	A703	FMP output	The reference range is 0.0% to 100.0%. The PLC program operation value of 1000 corresponds to 100.0%.
A7-04	A704	Analog output	The reference range is 0.0% to 100.0%. The PLC program operation value of 1000 corresponds to 100.0%.
A7-05	A705	Digital output	MD380 digital output terminal control 0: Inactive; 1: Active Bit 0: FMP Bit 1: Relay 1 Bit 2: DO1
A7-06	A706	Frequency reference given by user-programmable card	PLC references of -10000 to +10000 correspond to actual frequency references of -100.00 to +100.00%. (+100.00% corresponds to the maximum frequency)
A7-07	A707	Torque reference given by user-programmable card	PLC references of -2000 to +2000 correspond to actual torque references of -200.0% to +200.0%.
A7-08	A708	Command given by user-programmable card	0: No command 1: Forward running command 2: Reverse running command 3: Forward jog 4: Reverse jog 5: Coast to stop 6: Decelerate to stop 7: Fault reset
A7-09	A709	Fault setting by user-programmable card	0: No fault 80 to 89: Fault code When a value within the range of 80 to 89 is assigned, the AC drive generates a fault corresponding to that value, while other values do not trigger a response.
U3-00 to U3-09	7300 to 7309	PLC-specific monitoring parameter group	Configuring the values in this parameter group enables the U3 group to show the current D element values. This allows you to monitor internal program variables in the PLC through the AC drive panel.

* After changing the configurations of the receive and send tables, download the configurations to the programmable card first. Then, power off and power on the programmable card for the configurations to take effect.

4. Parameter Description

(1) Enabling the programmable card

A7-00	Programmable card function selection	Default	1
	Value range	0: Disable 1: Enable	

When this parameter is set to 1, the MD380 supports the functions of the user-programmable card.

(2) Setting the digital input/output signals of the AC drive and programmable card

A7-01	Output terminal control	Default	0
	Value range	Binary number system 0: AC drive control 1: PLC control Ones: FMP Tens: Relay 1 Hundreds: DO1 Thousands: FMR Ten thousands: AO1	

Set parameter A7-00 to select the AC drive or the programmable card user program as the control source for the AC drive output terminals.

When A7-00 is set to 1 and A7-01 is set to 1, the programmable terminals and the AC drive external terminals can be addressed uniformly, as shown in the following table.

Interface Terminal	Input Terminal Name	PLC Soft Element	Output Terminal Name	PLC Soft Element
AC drive	DI1	X1	FMR	Y2
	DI2	X2	Relay	Y3
	DI3	X3	DO1	Y4
	DI4	X4	/	/
	DI5	X5	/	/
Programmable card	DI6	X6	PA1/PC1	Y0
	DI7	X7	PA2/PC2	Y1
	DI8	X10	/	/
	DI9	X11	/	/
	DI10	X12	/	/

(3) Setting the analog input/output signals of the programmable card

A7-02	Programmable card AI3 and AO2 function selection	Default		0
		AI3		AO2
		0	Voltage input	Voltage output
		1	Voltage input	Current output
		2	Current input	Voltage output
		3	Current input	Current output
		4	PTC input	Voltage output
		5	PTC input	Current output
		6	PT100 input	Voltage output
		7	PT100 input	Current output
	PLC soft element		D7110	D7095

To select AI3 and AO2 signal types, first set DIP switch S1 and jumpers J2 and J3, and then set parameter A7-02 accordingly. This informs the AC drive to process signals accordingly.

For example, to set AI3 to the voltage input type and AO2 to the current output type, you need to set DIP switch S1 and jumpers J2 and J3 as follows:

S1	AI/PT100/PTC function selection	AI	
J2	AI3 voltage/current input selection	Voltage	
J3	AO2 voltage/current output selection	Current	

Then, set A7-02 to 1. Hardware and software settings must align for proper signal reception and transmission.

(4) Setting the FMP signal of the AC drive

A7-03	FMP output	Default	0.0%
	Value range	0.0% to 100.0%	

When the FMP output terminal control source is communication (F5-06 = 12), the actual FMP output state is determined by the value of A7-03. The user-programmable card can control the FMP output by changing the value of A7-03.

(5) Setting the AO1 signal of the AC drive

A7-04	AO1 output	Default	0.0%
	Value range	-10.08104% to +100.0%	

When the AO1 output terminal control source is communication (F5-08 = 12), the actual AO1 output value is determined by A7-04. The user-programmable card can control the AO1 output by changing the value of A7-04.

(6) Setting the digital output signal of the AC drive

A7-05	Digital output	Default	0
	Value range	Binary number system Ones: FMR Tens: Relay 1 Hundreds: DO	

When the digital output terminal FMR, relay 1, and DO control sources are communication (F5-01 = 12, F5-02 = 12, F5-04 = 12), the digital output terminal states are determined by A7-05. The user-programmable card program directly controls the outputs of FMR, relay 1, and DO1 by controlling the values of elements Y2, Y3, and Y4.

(7) Setting the frequency reference of the programmable card

A7-06	Frequency reference by user-programmable card	Default	0.00%
	Value range	-100.00% to +100.00%	

When A7-00 is set to 1 and the frequency source is communication (F0-27 = 900), the frequency reference is determined by A7-06, where 100.00% corresponds to the maximum frequency.

You can control the frequency reference by changing the value of the D element corresponding to A7-06 in the interaction data table in the programmable card's program.

(8) Setting the torque reference of the programmable card

A7-07	Torque reference by user-programmable card	Default	0.0%
	Value range	-200.0% to +200.0%	

In torque control mode, when A7-00 is set to 1 and the torque reference source is communication (A0-01 = 5), the torque reference is determined by the A7-07.

You can control the torque reference by changing the value of the D element corresponding to A7-07 in the interaction data table in the programmable card's program.

(9) Setting the command setting of the programmable card

A7-08	Command given by user-programmable card	Default	0
	Value range	0: No command 1: Forward running command 2: Reverse running command 3: Forward jog 4: Reverse jog 5: Coast to stop 6: Decelerate to stop 7: Fault reset	

When A7-00 is set to 1 and the command source is communication, the control command value is determined by A7-08.

You can control the AC drive by changing the value of the D element corresponding to A7-08 in the interaction data table in the programmable card's program.

(10) Setting the fault setting of the programmable card

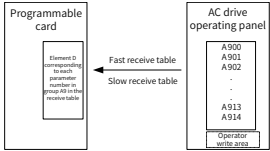
A7-09	Fault setting by user-programmable card	Default	0
	Value range	0: No fault 80 to 89: Fault code	

When A7-00 is set to 1, setting A7-09 to a value in the range of 80 to 89 generates a fault code in the range of Error80 to Err89.

You can create a user-defined AC drive fault code table by changing the value of the D element corresponding to A7-09 in the interaction data table in the programmable card's program.

☞ Use the AC drive panel to set the A9 group of function parameters dedicated for the programmable card, as shown in the following figure.

The U3 group is a dedicated monitoring parameter group for the programmable card. It provides users with a window to observe programmable card data. For data that needs monitoring in the user program, the D elements can be directly passed to the U3 group data for display.

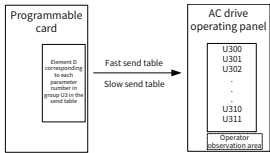


The A9 group is a dedicated function parameter group for the programmable card. It provides users with a window to write programmable card data. For parameter data that

needs to be set in the user program, the A9 group of parameter values can be used to directly change the corresponding D element values through the mapping relations in the interaction tables.

The value range of every parameter in this group is from 0 to 65535.

☞ Use the AC drive panel to observe the U3 group of function parameters dedicated for the programmable card, as shown in the following figure.



5. Examples of Using the User-Programmable Card

To help understand how to use this programmable card effectively, this chapter provides two examples.

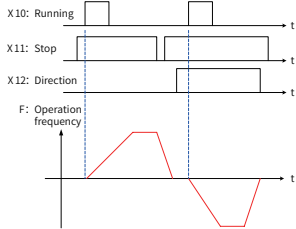
☞ Example 1: Controlling the start/stop of the AC drive using the programmable card

(1) Use the DI input signal status on the programmable card to control the forward/reverse running and stopping of the AC drive.

Terminals DI8 (run signal), DI9 (forward/reverse signal), and DI10 (stop signal) correspond to PLC soft elements X10, X11, and X12, respectively. For specific rules, see the descriptions of parameter A7-01 in Chapter 4.

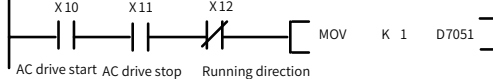
(2) Set the AC drive parameter F002 to 2 (start/stop control by communication), and A7-00 to 1 (enable the programmable card). Configure the parameter read/write interaction table: Map parameter A708 to soft element D7051 in the programmable card.

(3) Process timing diagram

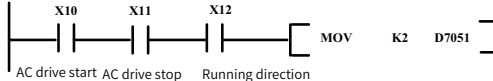


(4) Program code

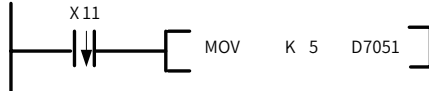
Forward running



Reverse running



Stop



☞ Example 2: Reading AC drive operation status information using the programmable card

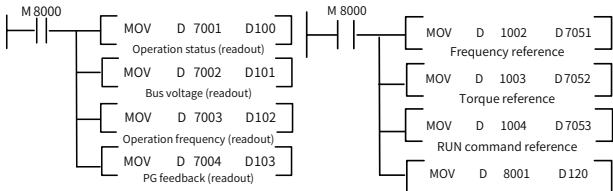
(1) Read the AC drive operation status (U0-61), bus voltage (U0-02), operation frequency (U0-00), and PG feedback frequency (U0-29), and store them in elements D100, D101, D102, and D103, respectively.

The programmable card writes frequency, torque, and operation command to the AC drive.

(2) Set the AC drive parameter F002 to 2 (start/stop control by communication), F003 to 9 (main frequency source selection by communication), and A7-00 to 1 (enable the programmable card).

The interaction addresses of AC drive parameters U0-61, U0-02, U0-00, and U0-29 are 7000, 7003, 7005, and 702D, respectively. For specific mapping rules, see Section 3.2 on AC drive communication data. Configure the interaction table for the programmable card as follows.

(3) Program code



INOVANCE Warranty Agreement

- Inovance provides an 18-month free warranty (subject to information indicated by the barcode on the equipment) to the equipment itself from the date of manufacturing for the failure or damage under normal use conditions.
- Within the warranty period, a maintenance fee will be charged for damage caused by the following reasons:
 - Improper use or repair/modification without prior permission
 - Fire, flood, abnormal voltage, natural disasters, and secondary disasters
 - Hardware damage caused by dropping or transportation after procurement
 - Operations not following the user guide
 - Factors out of the equipment (for example, external device factors)
- If the equipment is faulty or damaged, fill in the Warranty Card correctly and in detail.
- The maintenance fee will be charged according to the latest Maintenance Price List of Inovance.
- The Warranty Card is not re-issuable. Keep the card well and present it to the maintenance personnel during maintenance.
- For service-related issues, contact Inovance's agent or Inovance directly.
- By purchasing this product, you agree to this warranty agreement. Inovance reserves the rights for explanation of this agreement.

INOVANCE Warranty Card

Customer information	Company add.:	
	Company name:	Contact:
	Post code:	Tel.:
Product information	Product model:	
	Barcode (paste the barcode here):	
Agent:		
Fault information	(Maintenance date and description):	
	Maintained by:	

Suzhou Inovance Technology Co., Ltd.

Add.: No. 52, Tian'e Dang Road, Wuzhong District, Suzhou 215104, P.R. China
Tel: (0512) 6637 6666 Fax: (0512) 6285 6720
www.inovance.com