MITSUBISHI ELECTRIC

700 series

INVERTER
Plug-in option

FR-A7AX E kit-SC
INSTRUCTION MANUAL

16-bit digital input function

Thank you for choosing this Mitsubishi Inverter plug-in option.
This Instruction Manual gives handling information and precautions for use of this equipment. Incorrect handling might cause an unexpected fault. Before using the equipment, please read this manual carefully to use the equipment to its optimum.
Please forward this manual to the end user.

This section is specifically about safety matters

Do not attempt to install, operate, maintain or inspect this product until you have read through this Instruction Manual and appended documents carefully and can use the equipment correctly. Do not use this product until you have a full knowledge of the equipment, safety information and instructions.
In this Instruction Manual, the safety instruction levels are classified into "WARNING" and "CAUTION".

⚠ WARNING	Incorrect handling may cause hazardous conditions, resulting in death or severe injury.
⚠ CAUTION	Incorrect handling may cause hazardous conditions, resulting in medium or slight injury, or may cause only material damage.

The ⚠ CAUTION level may even lead to a serious consequence according to conditions. Both instruction levels must be followed because these are important to personal safety.

SAFETY INSTRUCTIONS

1. Electric Shock Prevention

⚠ WARNING

- While power is ON or when the inverter is running, do not open the front cover. You may get an electric shock.
- Do not run the inverter with the front cover or wiring cover removed. Otherwise, you may access the exposed high-voltage terminals and charging part and get an electric shock.
- Even if power is OFF, do not remove the front cover except for wiring or periodic inspection. You may accidentally touch the charged inverter circuits and get an electric shock.
- Before wiring or inspection, power must be switched OFF. To confirm that, LED indication of the operation panel must be checked. (It must be OFF.) Any person who is involved in wiring or inspection shall wait for at least 10 minutes after the power supply has been switched OFF and check that there are no residual voltage using a tester or the like. The capacitor is charged with high voltage for some time after power OFF, and it is dangerous.
- Any person who is involved in wiring or inspection of this equipment shall be fully competent to do the work.
- The plug-in option must be installed before wiring. Otherwise, you may get an electric shock or be injured.
- Do not touch the plug-in option or handle the cables with wet hands. Otherwise you may get an electric shock.
- Do not subject the cables to scratches, excessive stress, heavy loads or pinching. Otherwise you may get an electric shock.

2. Injury Prevention

⚠CAUTION

- The voltage applied to each terminal must be the ones specified in the Instruction Manual. Otherwise burst, damage, etc. may occur.
- The cables must be connected to the correct terminals. Otherwise burst, damage, etc. may occur.
- Polarity must be correct. Otherwise burst, damage, etc. may occur.
- While power is ON or for some time after power-OFF, do not touch the inverter as they will be extremely hot. Doing so can cause burns.

3. Additional Instructions

Also the following points must be noted to prevent an accidental failure, injury, electric shock, etc.

1) Transportation and mounting

⚠CAUTION

- Do not install or operate the plug-in option if it is damaged or has parts missing.
- Do not stand or rest heavy objects on the product.
- The mounting orientation must be correct.
- Foreign conductive objects must be prevented from entering the inverter. That includes screws and metal fragments or other flammable substances such as oil.

2) Trial run

⚠CAUTION

- Before starting operation, each parameter must be confirmed and adjusted. A failure to do so may cause some machines to make unexpected motions.

3) Usage

⚠WARNING

- Do not modify the equipment.
- Do not perform parts removal which is not instructed in this manual. Doing so may lead to fault or damage of the inverter.

⚠CAUTION

- When parameter clear or all parameter clear is performed, the required parameters must be set again before starting operations because all parameters return to the initial value.
- For prevention of damage due to static electricity, nearby metal must be touched before touching this product to eliminate static electricity from your body.

4) Maintenance, inspection and parts replacement

⚠CAUTION

- Do not test the equipment with a megger (measure insulation resistance).

5) Disposal

⚠CAUTION

- This inverter plug-in option must be treated as industrial waste.

6) General instruction

Many of the diagrams and drawings in this Instruction Manual show the inverter without a cover or partially open for explanation. Never operate the inverter in this manner. The cover must be reinstalled and the instructions in the inverter manual must be followed when operating the inverter.

— CONTENTS —

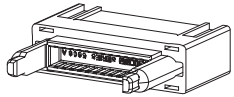
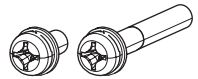
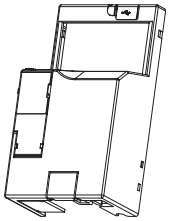
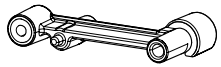
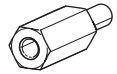
1 PRE-OPERATION INSTRUCTIONS

1.1 Unpacking and Product Confirmation

Take the plug-in option out of the package, check the product name, and confirm that the product is as you ordered and intact.
This product is a plug-in option for the FR-E700-SC series (safety stop function model).

1.1.1 Product confirmation

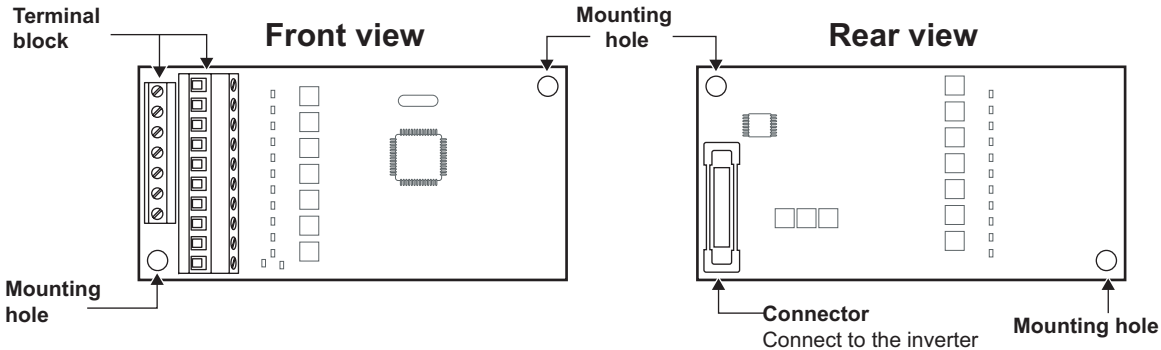
Check the enclosed items.

Plug-in option ..... 1 	Junction connector ..... 1 *(Refer to page 5, 7.)* 	M3 mounting screw (Long) (M3 × 20mm) ..... 1 (Short) (M3 × 6mm)..... 1 *(Refer to page 5, 7.)* 
Front cover for plug-in option..... 1 *(Refer to page 5, 7)* 	Spacer for plug-in option mounting....1 *(Refer to page 5, 7.)* 	Hexagon spacer..... 1 *(Refer to page 5, 7.)* 

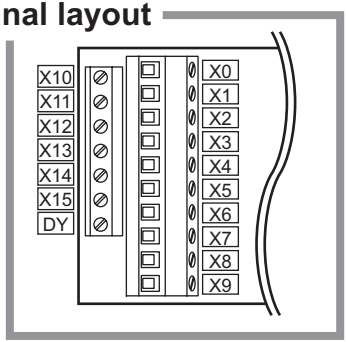
CAUTION

- **Install a provided front cover for plug-in option, in place of the inverter front cover.**

1.2 Parts



Terminal layout



1.3 Specifications

(1) Digital input signal type
BCD code 3-digit or 4-digit
Binary 12-bit or binary 16-bit

(2) Selection of digital input signal
Select from the operation panel or parameter unit.

(3) Input current
5mA(24VDC) for each circuit

(4) Input specifications
Relay contact signal or open collector input

(5) Adjustment function
· Bias and gain

2 INSTALLATION AND WIRING

2.1 Pre-Installation Instructions

Make sure that the input power of the inverter is off.

⚠ CAUTION

⚠ With input power on, do not install or remove the plug-in option. Otherwise, the inverter and plug-in option may be damaged.

⚠ For prevention of damage due to static electricity, touch nearby metal before touching this product to eliminate static electricity from your body.

2.2 Installation Procedure

CAUTION

- **Always perform wiring to the main circuit terminals and control circuit terminals before installing the option. Wiring cannot be performed after installing the option.**
- **When mounting the plug-in option, do not let wires get caught in the plug-in option or the spacer for option mounting. If a wire gets caught, the inverter and the plug-in option may be damaged.**
- **When the inverter cannot recognize that the option is mounted due to improper installation, etc., "E. 1" (option fault) is displayed.**
- **Take care not to drop a mounting screws during mounting and removal.**
- **Pull out the option straight to remove. Otherwise, the connector may be damaged.**

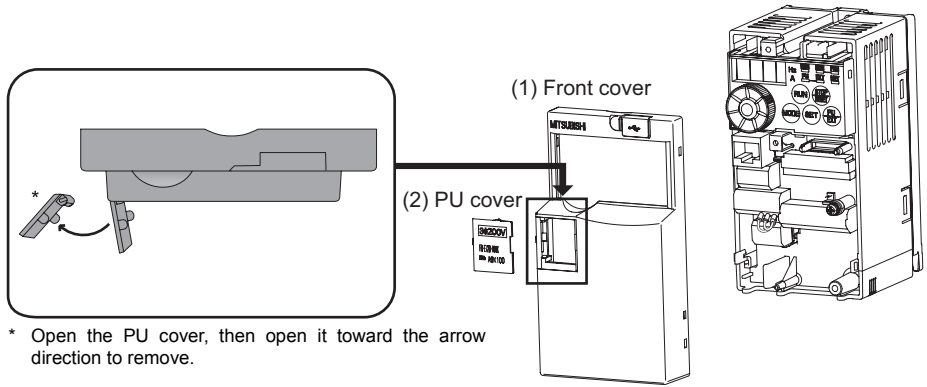
REMARKS

- Bcause the voltage class, model name and serial number (only voltage class is labeled for FR-E720-5.5KSC (FR-E720-240SC), FR-E740-5.5KSC (FR-E740-120SC) or higher) are written on the PU cover, replace the PU cover of the plug-in option with the removed PU cover of the inverter.

● Inverter with one front cover

(1) Remove the front cover from the inverter. (For removing the front cover, refer to the FR-E700 series instruction manual.)

(2) Remove the PU cover from the front cover. Open the PU cover with a driver, etc. and remove it in the direction of arrow as shown below.



* Open the PU cover, then open it toward the arrow direction to remove.

(3) Fit the spacer for plug-in option mounting, the hexagon spacer, and the junction connector into their designated positions shown in the diagram on the next page. Fit the junction connector along the guide of the connector of the inverter and insert it as far as it goes.

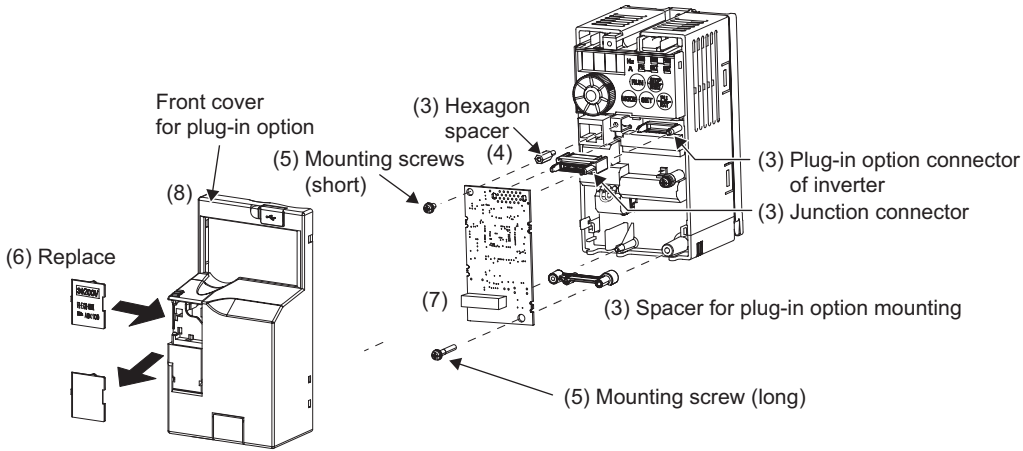
(4) Fit the connector of the plug-in option along the guide of the junction connector and insert it as far as it goes.

(5) Fix the plug-in option securely by using the supplied mounting screw (short) to the upper screw hole and the other supplied mounting screw (long) to the lower screw hole of the plug-in option. If the screw holes do not line up, the connector may not have been plugged properly. Check for loose plugging.
Tightening torque: 0.33 to 0.4N·m

(6) Remove the PU cover provided on the front cover for plug-in option and mount the other PU cover, which was removed in (2).

(7) Loosen the terminal screws and insert the wires into the terminals. After that, fasten the terminal screws to the recommended tightening torque. *(Refer to page 9)*

(8) After wiring of the plug-in option has been completed, mount the front cover for the plug-in option to the inverter.



● Inverter with front covers 1 and 2

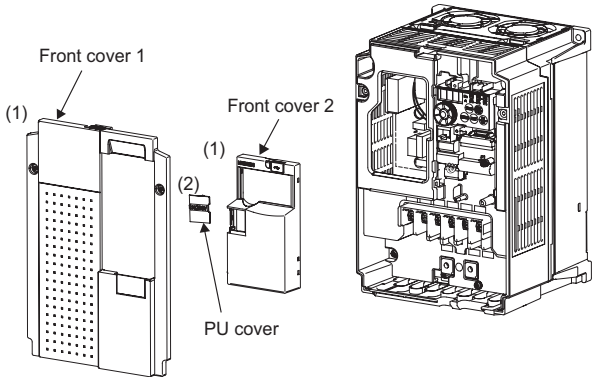
(1) Remove the front cover 1 and 2 from the inverter. (For removing the front cover, refer to the FR-E700 series instruction manual.)

(2) Remove the PU cover from the front cover 2. For removing the PU cover, refer to *page 5*.

(3) Mount the front cover 1 to the inverter.

(4) Fit the spacer for plug-in option mounting, the hexagon spacer, and the junction connector into their designated positions shown in the diagram on the next page. Fit the junction connector along the guide of the connector of the inverter and insert it as far as it goes.

(5) Fit the connector of the plug-in option along the guide of the junction connector and insert it as far as it goes.

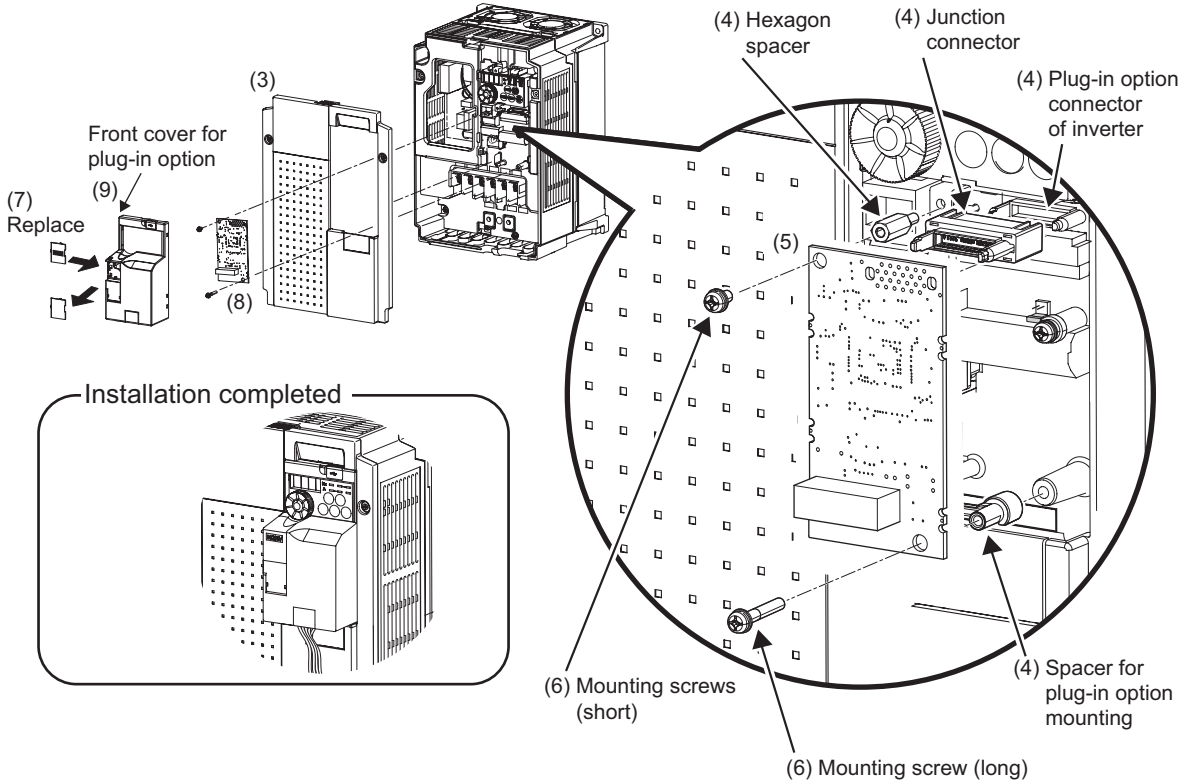


(6) Fix the plug-in option securely by using the supplied mounting screw (short) to the upper screw hole and the other supplied mounting screw (long) to the lower screw hole of the plug-in option. If the screw holes do not line up, the connector may not have been plugged properly. Check for loose plugging.
Tightening torque: 0.33 to 0.4N·m

(7) Remove the PU cover provided on the front cover for plug-in option and mount the other PU cover, which was removed in (2).

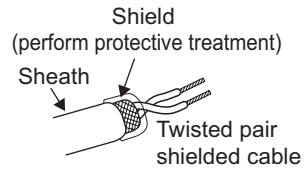
(8) Loosen the terminal screws and insert the wires into the terminals. After that, fasten the terminal screws to the recommended tightening torque. *(Refer to page 9)*

(9) Mount the front cover for plug-in option to the inverter.


(4) Hexagon spacer
(4) Junction connector
(4) Plug-in option connector of inverter
(3)
Front cover for plug-in option
(9)
(7) Replace
(8)
(5)
Installation completed
(6) Mounting screws (short)
(4) Spacer for plug-in option mounting
(6) Mounting screw (long)

2.3 Wiring

(1) Untwist the twisted pair shielded cables after stripping its sheath.
Also, perform protective treatment of the shield to ensure that it will not make contact with the conductive area.



Strip off the sheath about the size as in the right figure. If the length of the sheath peeled is too long, a short circuit may occur among neighboring wires. If the length is too short, wires might come off.
Wire the stripped cable after twisting it to prevent it from becoming loose. (Do not solder it.)

Use a blade type terminal as required.

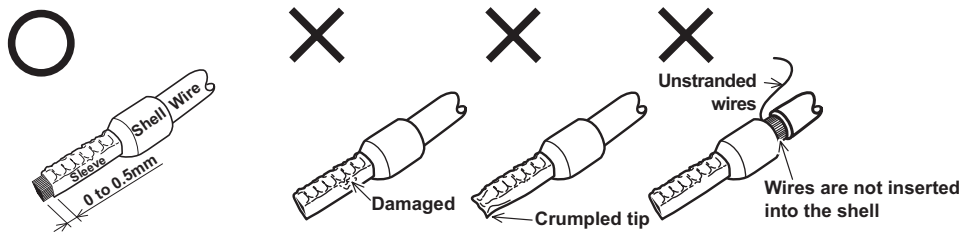
REMARKS

- Information on blade terminals
  Commercially available product examples (as of Jan. 2010)

Terminal Screw Size	Wire Size (mm^2)	Blade Terminal Model		Maker
		With insulation sleeve	Without insulation sleeve	
M2	0.3, 0.5	AI 0,5-6WH	A 0,5-6	Phoenix Contact Co.,Ltd.

Blade terminal crimping tool: CRIMPFOX 6T-F/6 (Phoenix Contact Co., Ltd.)

Insert wires to a blade terminal, and check that the wires come out for about 0 to 0.5 mm from a sleeve. Check the condition of the blade terminal after crimping. Do not use a blade terminal of which the crimping is inappropriate, or the face is damaged.



(2) Loosen the terminal screw and insert the cable into the terminal.

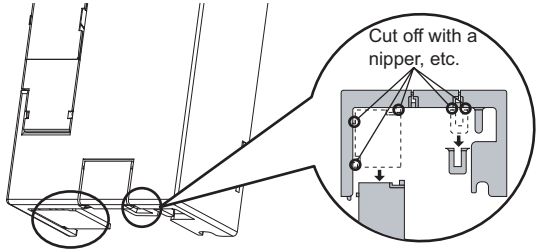
Screw Size	Tightening Torque	Cable Size	Screwdriver
M2	0.22N·m to 0.25N·m	$0.3mm^2$ to $0.75mm^2$	Small ⊖ flat-blade screwdriver (Tip thickness: 0.4mm/tip width: 2.5mm)

CAUTION

- **Undertightening can cause cable disconnection or malfunction. Overtightening can cause a short circuit or malfunction due to damage to the screw or unit.**

POINT

If a hook of the front cover for plug-in option impedes wiring, cut the hooks off and perform wiring.



Cut off hooks at the bottom of the option cover.
(Cut off so that no portion is left.)

REMARKS

- The protective structure (JEM1030) is the open type (IP00).

⚠ CAUTION

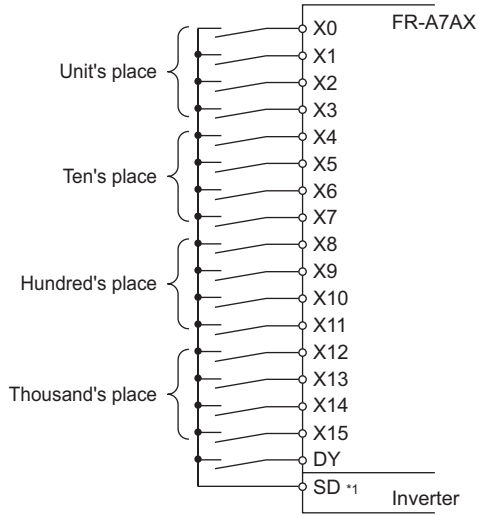
⚠ **When wiring, take care not to subject the cable to stress.**

⚠ **After wiring, wire offcuts must not be left in the inverter. They may cause a fault, failure or malfunction.**

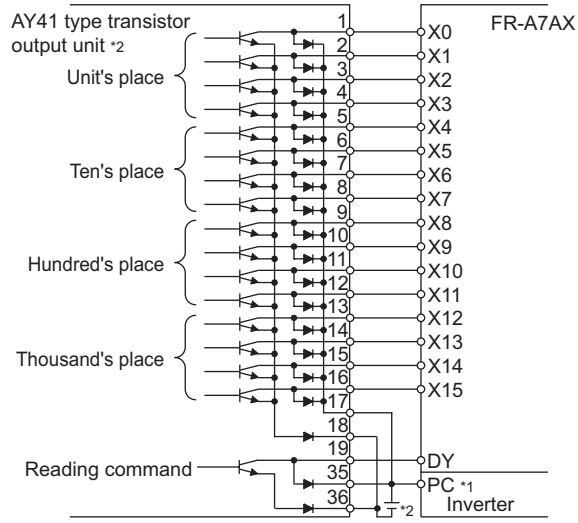
3 CONNECTION DIAGRAM AND TERMINAL

3.1 Connection Diagram

Relay contact signal input (sink logic *3)



Open collector signal input (sink logic *3)



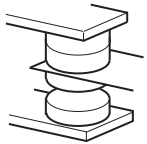
*1 Use terminal SD or PC on the inverter.

*2 AY41 type unit requires 24VDC power.
Example of connection with the output module (AY41 type) of Mitsubishi programmable controller. Refer to the output module manual for details of the output module.

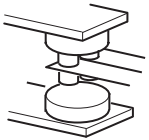
*3 The control logic is the same as that of the inverter.
When the logic of the inverter is changed, the option logic also changes. For details of changing the control logic, refer to the inverter manual.

REMARKS

- As the input signals are at low level, use two parallel micro signal contacts or a twin contact for relay contact inputs to prevent a contact fault.



Micro signal contacts

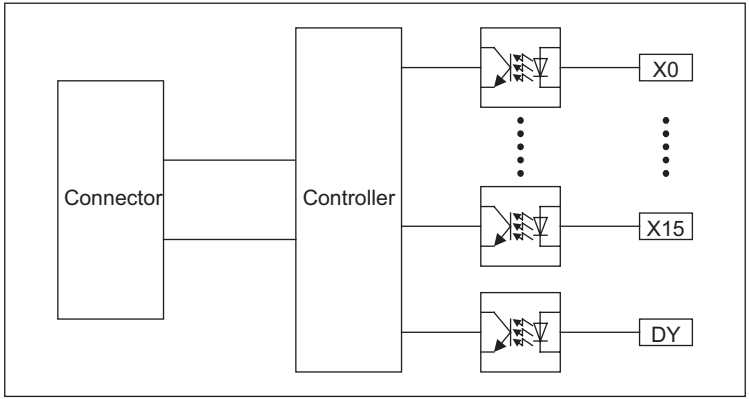


Twin contacts

- A transistor of the following specifications should be selected for the open collector signal:
  Electrical characteristics of the transistor used
  - $I_C \geq 10mA$
  - Leakage current: 100μA maximum
  - $V_{CE} \geq 30V$
  - If $I_C \geq 10mA$, $V_{CE\ (sat)}$ voltage is 3V maximum

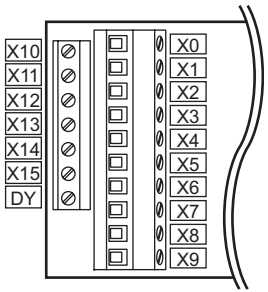
3.2 Internal Block Diagram

The following is the internal block diagram of the FR-A7AX.



3.3 Terminals

● FR-A7AX



Terminal Location	Terminal Symbol	Description
Plug-in option	X0 to X15	Digital signal input terminal (frequency setting signal terminal) Input the digital signal at the relay contact or open collector terminal. *(Refer to page 12.)* For the digital signal input, you can choose either the BCD code input or binary input. BCD code input .... 3-digit (999 maximum) or 4-digit (9999 maximum) Binary input ..... binary 12-bit (X0 to X11, FFFH maximum) or binary 16-bit (X0 to X15, FFFFH maximum)
	DY	Data read timing input signal Use when a digital signal read timing signal is necessary. When *Pr. 305 Read timing operation selection* ="1", data is read only during the DY signal is on. In addition, the X0 to X15 data before signal-off is retained by switching the DY signal off. *(Refer to page 19.)*
Inverter	SD	Common terminal (sink) Common terminal for digital and data read timing signals. Use terminal SD of the inverter.
	PC	External transistor common terminal (sink), common terminal (source) When connecting the transistor output (open collector output) of a programmable controller, etc., connect the external power common (+) to this terminal to prevent a fault occurring due to leakage current. When you have selected the source logic, this terminal is used as a common terminal. Use terminal PC of the inverter.

3.4 Code Input Example

The following explains examples of terminal status and input value at BCD code input and binary input.

Example: when the input value is 6325

BCD Code Input			
Digit	**Terminal name**	**Terminal input status**	**Input value**
1	X0	ON	5
	X1	OFF	
	X2	ON	
	X3	OFF	
10	X4	OFF	2
	X5	ON	
	X6	OFF	
	X7	OFF	
100	X8	ON	3
	X9	ON	
	X10	OFF	
	X11	OFF	
1000	X12	OFF	6
	X13	ON	
	X14	ON	
	X15	OFF	

Example: when the input value is AB65H

Binary Input			
Terminal name	**Terminal input status**	**Input value (hexadecimal)**	**Input value (decimal)**
X0	ON	5	43877
X1	OFF		
X2	ON		
X3	OFF		
X4	OFF	6	
X5	ON		
X6	ON		
X7	OFF		
X8	ON	B	
X9	ON		
X10	OFF		
X11	ON		
X12	OFF	A	
X13	ON		
X14	OFF		
X15	ON		

CAUTION

- **For the BCD code input, the input value of each digit is from 0 to 9. When the value greater than 9 is input, it is invalid and the last value is retained.**

4 PARAMETERS

4.1 Parameter List

The following parameters are used for the plug-in option (FR-A7AX).
The FR-A7AX does not function with the factory setting. When a value other than "9999" is set in *Pr. 304*, digital input is enabled.
Set the following parameters according to applications.

Parameter Number	Name	Setting Range	Minimum Setting Increments	Initial Value	Refer to page
300	BCD input bias	0 to 400Hz	0.01Hz	0Hz	*21*
301	BCD input gain	0 to 400Hz, 9999	0.01Hz	60Hz (50Hz) *1	*21*
302	BIN input bias	0 to 400Hz	0.01Hz	0Hz	*21*
303	BIN input gain	0 to 400Hz, 9999	0.01Hz	60Hz (50Hz) *1	*21*
304	Digital input and analog input compensation enable/disable selection	0, 1, 10, 11, 9999	1	9999	*18*
305	Read timing operation selection	0, 1, 10	1	0	*19*
329 *2	Digital input unit selection	0, 1, 2, 3	1	1	*24*

*1 The initial value of the EC version is 50Hz.
*2 For *Pr. 329*, write is disabled during operation even when "2" is set in *Pr. 77*. When changing the parameter setting, stop the operation. Also parameter clear is invalid.

REMARKS

- Binary input ..... The input data is taken in hexadecimal
  BCD code input ..... The input data is taken in decimal

4.2 Parameter Setting

4.2.1 Selection of input method (Pr. 304)

Parameter Number	Name	Setting Range	Initial Value
304	Digital input and analog input compensation enable/disable selection *	0, 1, 10, 11, 9999	9999

Pr. 304 Setting	BCD Code Input	Binary Input
0	3-digit	—
1	—	12-bit
10	4-digit	—
11	—	16-bit
9999 (initial value)	No function	

* For the FR-E700 series, analog input compensation can not be performed.

REMARKS

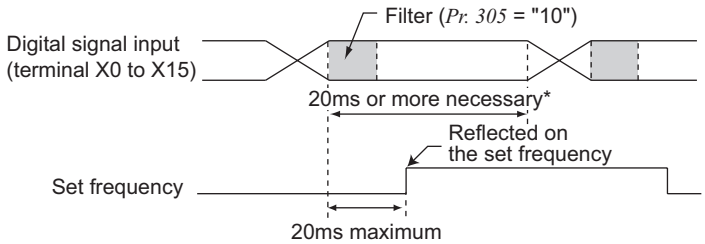
- Signal X12 to X15 become invalid when "0, 1" are set in *Pr. 304*.
- Refer to *page 16* for BCD code/ binary input example.

4.2.2 Read timing operation selection (Pr. 305)

Parameter Number	Name	Setting Range	Initial Value
305	Read timing operation selection	0, 1, 10	0

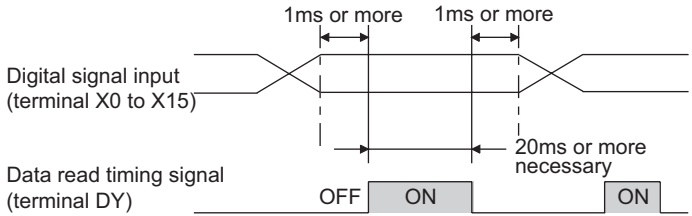
Pr. 305 Setting	Filter	Description
0 (initial value)	Without	The set frequency data entered from the digital signal input terminals (X0 to X15) is always imported independently of whether the DY signal is on or off.
1	Without	The set frequency data entered from the digital signal input terminals (X0 to X15) is imported only when the DY signal is on. The set frequency data is not imported when the DY signal is off. Therefore, even if the input status of the X0-X15 signal changes, the set frequency data before off of the DY signal is valid.
10	With	The set frequency data entered from the digital signal input terminals (X0 to X15) is always imported independently of whether the DY signal is on or off. The time lag when digital signals change can be compensated with a filter.

(1) When "0 or 10" is set in *Pr. 305*



* Hold the digital signal input (X0 to X15) status for 20ms or more. Changing the signal within 20ms may not reflect it on the set frequency.

(2) How to use the DY signal (when "1" is set in *Pr. 305*)



REMARKS

- When *Pr. 305* = "1", each terminal from X0 to X15 is all recognized as off when the inverter is turned on in terminal DY off status.
  For example, when bias is set to 20Hz, turning the power supply on in the DY signal off status and then turning on the start signal will make the frequency command valid, starting the inverter to operate at 20Hz.

4.2.3 Bias and gain adjustment (Pr. 300, Pr. 301, Pr. 302, Pr. 303)

Parameter Number	Name	Setting Range	Initial Value
300	BCD input bias	0 to 400Hz	0Hz
301	BCD input gain	0 to 400Hz, 9999	60Hz (50Hz) *
302	BIN input bias	0 to 400Hz	0Hz
303	BIN input gain	0 to 400Hz, 9999	60Hz (50Hz) *

* The initial value of the EC version is 50Hz.

(1) Bias adjustment

Bias adjustments can be made for the digital input signal.

Set the set frequency at the digital input of 0.

- BCD code input..... Set using *Pr. 300*.
- Binary input..... Set using *Pr. 302*.

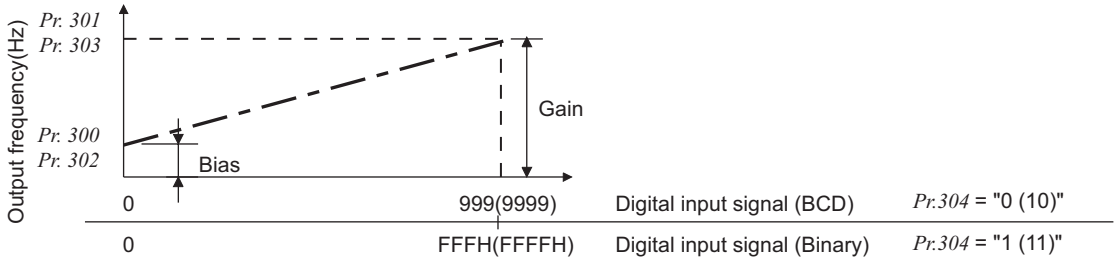
(2) Gain adjustment

The gain may be set in either of the following two ways:

How to set the output frequency when the digital input signal is "999 or 9999" (BCD code input), and "FFFH or FFFFH" (binary input).

- BCD code input .. Set using *Pr. 301*.
- Binary input ..... Set using *Pr. 303*.

The output frequency is factory-set to 60Hz (EC version : 50Hz).

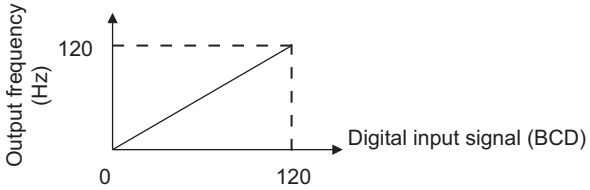


CAUTION

- **The maximum output frequency for operation with the digital input signal is the "gain" value set in *Pr. 301* and *Pr. 303*.**
  To set the maximum output frequency at 60Hz (EC version : 50Hz) or more, change "gain" with the operation panel.

How to set the BCD code or binary value as the output frequency setting

When "9999" is set in *Pr. 301* (BCD code input) or *Pr. 303* (binary input), the digital input value is set as the output frequency.
(For example, to set the output frequency to 120Hz when the BCD code input is "120")



REMARKS

- When this setting method is used, "bias" setting (*Pr. 300* or *Pr. 302*) cannot be made.

4.2.4 Digital input unit selection (Pr. 329)

Parameter Number	Name	Setting Range	Initial Value
329	Digital input unit selection *1	0, 1, 2, 3	1

When "9999" is set in *Pr. 301* or *Pr. 303*, the increments when the digital signal is set as output frequency can be set. *(Refer to page 23)*

Frequency = digital input signal value × *Pr. 329* input increments

Pr. 329 Setting	Input Value Increments	Available Frequencies *			
		12-bit		16-bit	
		BCD code	Binary	BCD code	Binary
0	10	0 to 9990Hz	0 to 40950Hz	0 to 99990Hz	0 to 655350Hz
1 (factory setting)	1	0 to 999Hz	0 to 4095Hz	0 to 9999Hz	0 to 65535Hz
2	0.1	0 to 99.9Hz	0 to 409.5Hz	0 to 999.9Hz	0 to 6553.5Hz
3	0.01	0 to 9.99Hz	0 to 40.95Hz	0 to 99.99Hz	0 to 655.35Hz

* These are not the inverter maximum output frequencies.

REMARKS

- When the values other than "9999" are set in *Pr. 301* or *Pr. 303*, *Pr. 329* is invalid.

<Example>

Pr. 329 = 0 BCD code = 111 → 1110Hz
Binary = 100H (256 in decimal) → 2560Hz
Pr. 329 = 1 BCD code = 111 → 111Hz
Binary = 100H (256 in decimal) → 256Hz
Pr. 329 = 2 BCD code = 111 → 11.1Hz
Binary = 100H (256 in decimal) → 25.6Hz
Pr. 329 = 3 BCD code = 111 → 1.11Hz
Binary = 100H (256 in decimal) → 2.56Hz

4.3 Instructions

(1) Acceleration/deceleration time
When the frequency is set with the digital input signal, the acceleration/deceleration time is the period of time required to reach the *Acceleration/deceleration reference frequency* set in *Pr. 20*. This is the same as when using the analog signal input.

(2) There are the following restrictions on the digital input signal:
When the signal is used to enter a BCD code, 0AH to 0FH entries are ignored during operation and the previous inputs are used to continue operation.
If binary input is changed to BCD code input with 0AH to 0FH input, the set frequency becomes 0Hz.

(3) The priorities of the frequency setting are as follows.
JOG> Stop-on contact (RT, RL) > Multi-speed operation (RH, RM, RL) > PID (X14) > AU (terminal 4) > Digital command by the FR-A7AX > terminal 2*
* When digital input is valid, terminal 2 is invalid.

REVISIONS

*The manual number is given on the bottom left of the back cover.

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