MITSUBISHI ELECTRIC

800 series

INVERTER

Plug-in option

FR-A8APA

INSTRUCTION MANUAL

SinCos encoder interface

Orientation control

Encoder feedback control

Vector control

Thank you for choosing this Mitsubishi Electric inverter plug-in option.
This Instruction Manual provides handling information and precautions for use of this product. Incorrect handling might cause an unexpected fault. Before using this product, read all relevant instruction manuals carefully to ensure proper use.
Please forward this Instruction Manual to the end user.

Safety instructions

Do not attempt to install, operate, maintain or inspect this product until you have read this Instruction Manual and appended documents carefully. Do not use this product until you have a full knowledge of this product mechanism, 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.**

Note that even the ⚠CAUTION level may lead to a serious consequence depending on conditions. Be sure to follow the instructions of both levels as they are critical to personnel safety.

◆ **Electric shock prevention**

⚠WARNING

- Do not remove the front cover or the wiring cover of the inverter while the inverter power is ON. Do not operate the inverter with any cover or wiring cover removed, as accidental contact with exposed high-voltage terminals and internal components may occur, resulting in an electrical shock.
- Even if power is OFF, do not remove the front cover of the inverter except for wiring or periodic inspection as the inside of the inverter is charged. Otherwise you may get an electric shock.
- Before wiring or inspection, check that the display of the inverter operation panel is OFF. Any person who is involved in wiring or inspection shall wait for 10 minutes or longer after power 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 product shall be fully competent to do the work.
- This product must be installed before wiring. Otherwise you may get an electric shock or be injured.
- Do not subject the cables to scratches, excessive stress, heavy loads or pinching. Doing so may cause an electric shock.
- Do not touch the this product or handle the cables with wet hands. Doing so may cause an electric shock.

◆ **Injury prevention**

⚠CAUTION

- The voltage applied to each terminal must be as specified in the Instruction Manual. Otherwise a burst, damage, etc. may occur.
- The cables must be connected to the correct terminals. Otherwise a burst, damage, etc. may occur.
- The polarity (+ and -) must be correct. Otherwise a burst, damage, etc. may occur.
- While power is ON or for some time after power OFF, do not touch the inverter as it will be extremely hot. Doing so may cause a burn.

◆ **Additional instructions**

The following instructions must be also followed. If this product is handled incorrectly, it may cause unexpected fault, an injury, or an electric shock.

⚠ CAUTION

Transportation and installation

- Do not stand or place heavy objects on this product.
- The installing orientation of this product must be correct.
- Do not install or operate this product if it is damaged or has parts missing.
- Foreign conductive objects must be prevented from entering the inverter. That includes screws and metal fragments or other flammable substance such as oil.
- If halogen-based materials (fluorine, chlorine, bromine, iodine, etc.), included in fumigants to sterilize or disinfect wooden packages, infiltrate into this product, the product may be damaged. Prevent residual fumigant components from being infiltrated into the product when packaging, or use an alternative sterilization or disinfection method (heat disinfection, etc.). Note that sterilization or disinfection of wooden package should also be performed before packing the product.

Test operation

- Before starting operation, confirm or adjust the parameter settings. Failure to do so may cause some machines to make unexpected motions.

⚠ WARNING

Usage

- Do not modify this product.
- Do not remove any part which is not instructed to be removed in the Instruction Manuals. Doing so may lead to a failure or damage of this product.

⚠ CAUTION

Usage

- As all parameters return to their initial values after Parameter clear or All parameter clear is performed, the needed parameters for operation of the inverter and this product must be set again before the operation is started.
- To avoid damage to this product due to static electricity, static electricity in your body must be discharged before you touch this product.

Maintenance, inspection and parts replacement

- Do not carry out a megger (insulation resistance) test.

Disposal

- This product must be treated as industrial waste.

General instruction

- For clarity purpose, illustrations in this Instruction Manual may be drawn with covers or safety guards removed. Ensure all covers and safety guards are properly installed prior to starting operation.

─ CONTENTS ─

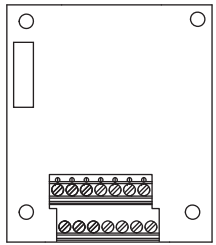
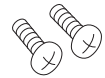
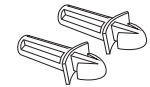
1 PRE-OPERATION INSTRUCTIONS

1.1 Unpacking and product confirmation

Take the product 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 made for the FR-A800 series inverter.

1.1.1 Product confirmation

Check the enclosed items.

Plug-in option .....1 	Mounting screw (M3 × 8 mm) ..... 2 (Refer to page 9) 	Spacer .....2 (Refer to page 9) 

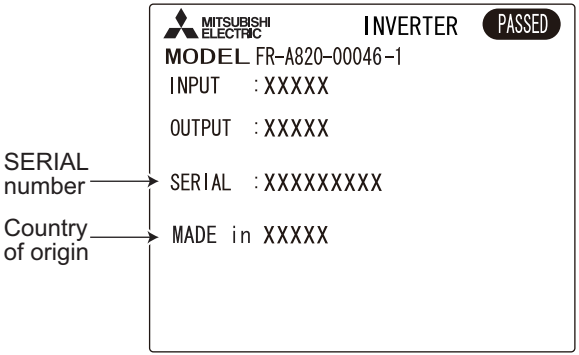
NOTE

- Connection diagrams in this Instruction Manual appear with the control logic of the input terminals as sink logic, unless otherwise specified. (For the control logic, refer to the Instruction Manual of the inverter.)

1.1.2 SERIAL number check

The FR-A8APA can be used with the models of inverters listed below which have the following SERIAL number. Check the SERIAL number indicated on the inverter rating plate or package.

Rating plate example



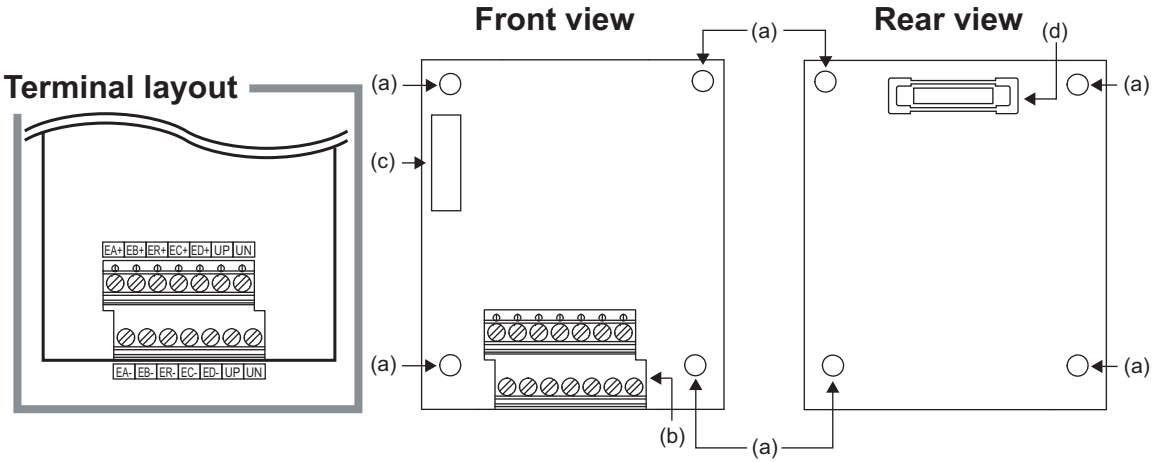
□ ○ ○ ○○○○○○
Symbol Year Month Control number
SERIAL

The SERIAL consists of one symbol, two characters indicating the production year and month, and six characters indicating the control number.
The last digit of the production year is indicated as the Year, and the Month is indicated by 1 to 9, X (October), Y (November), or Z (December).

FR-A800 series

Model	Country of origin indication	SERIAL number
FR-A820-00046(0.4K) to 04750(90K) FR-A840-00023(0.4K) to 06830(280K) FR-A842-07700(315K) to 12120(500K) FR-A846-00023(0.4K) to 03610(132K)	MADE in Japan	□83○○○○○○ or later
	MADE in China	□84○○○○○○ or later

1.2 Component names



Symbol	Name	Description	Refer to page
a	Mounting hole	Used to fix this product to the inverter by inserting a mounting screw or a spacer.	9
b	Terminal block	Used to connect the terminals of this product and an encoder.	14
c	CON2 connector	Pulse output connector.	—
d	Board mounted option connector	Used to connect this product to the option connector on the inverter.	9

2 INSTALLATION AND WIRING

2.1 Pre-installation instructions

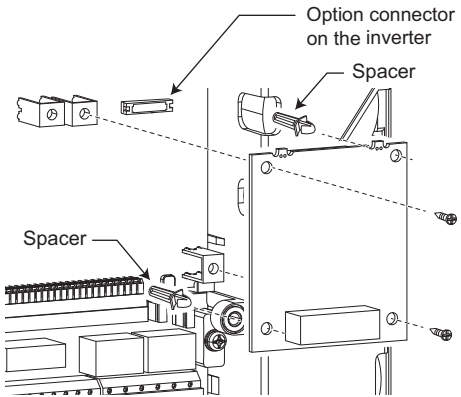
Check that the inverter's input power and the control circuit power are both OFF.

⚠ CAUTION

- **Do not install or remove this product while the inverter power is ON. Doing so may damage the inverter or this product.**
- **To avoid damage due to static electricity, static electricity in your body must be discharged before you touch this product.**

2.2 Installation procedure

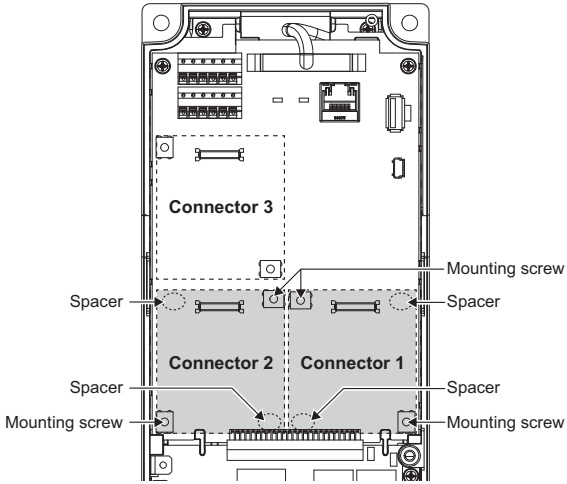
(1) Remove the inverter front cover. (Refer to Chapter 2 of the Instruction Manual (Detailed) of the inverter for instructions for removing the front cover.)
(2) Insert two spacers into the mounting holes that will not be filled with mounting screws (see the diagrams on the next page to identify the holes).
(3) Fit the board mounted option connector on this product to the guide of the option connector on the inverter, and insert the option as far as it goes.
(4) Fasten this product to the inverter using the two mounting screws through the holes on either side (tightening torque: 0.33 to 0.40 N·m). If the screw holes do not line up, the connector may not be inserted deep enough. Check the connector.



Example of installation to connector 1

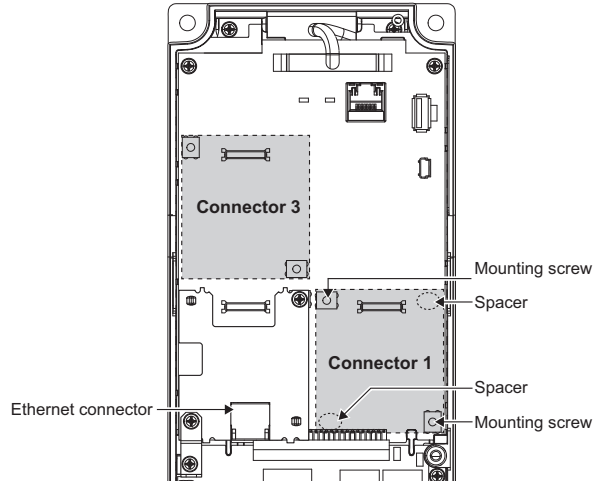
- Insertion positions for screws and spacers

FR-A800



Attach the option to connector 1 or 2.
(Do not attach the plug-in option to connector 3.)

FR-A800-E



Attach the option to connector 1 or 3.

NOTE

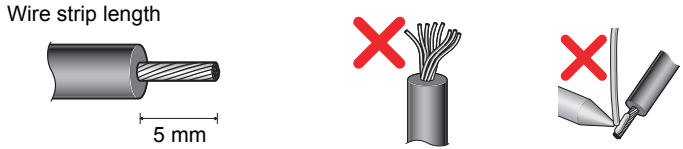
- When installing/removing the plug-in option, hold the sides of the option. Do not press on the parts on the option circuit board. Stress applied to the parts by pressing, etc. may cause a failure.
- Be careful not to drop mounting screws during the installation or removal of the plug-in option.
- The priorities of vector control compatible plug-in options are defined as follows: FR-A8AL > FR-A8APS > FR-A8APA > FR-A8APR > FR-A8AP. The vector control compatible plug-in options with lower priority do not function.
- Only one option attached to the option connector with high priority can function at once if more than one option of the same name are installed together on an inverter. Priority is given to option connectors in descending order (1 to 3), and options having a lower priority do not function.
- When the inverter cannot recognize the option unit due to improper installation, etc., or when a fault occurs in the option or encoder, the protective function (E.1 to E.3 or E.OP1 to E.OP3) is activated and the inverter cannot be operated. The indication shown (when a fault occurs) depends on the connector used (option connector 1 to 3).

Mounted position	Fault indication	
Option connector 1		
Option connector 2		
Option connector 3		

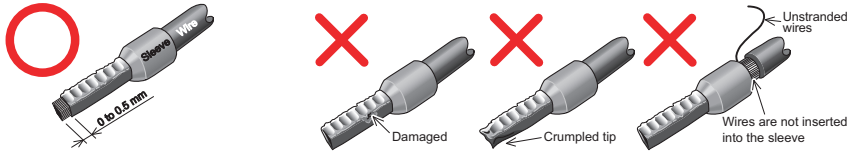
- When removing the plug-in option, remove the two screws on either side, and then pull it straight out. Pressure applied to the option connectors and to the option board may break the option.

2.3 Wiring

(1) Strip the signal wires as shown below. If too much of the wire is stripped, a short circuit may occur with neighboring wires.
If not enough of the wire is stripped, wires may become loose and fall out.
Twist the stripped end of wires to prevent them from fraying. Do not solder it.



Use appropriate crimp terminals (ferrules, blade terminals, etc.) for these terminal blocks as necessary.
When using the crimp terminal, make sure that the stranded wire do not come out of the terminal.



NOTE

- Crimp terminals commercially available (as of January 2017. The product may be changed without notice.)

Terminal screw size	Wire size (mm^2)	Ferrule part No.		Manufacturer	Crimping tool model No.
		With insulation sleeve	Without insulation sleeve		
M2	0.3	AI 0,34-6TQ	A 0,34-7	Phoenix Contact Co., Ltd.	CRIMPFOX 6
	0.5	AI 0,5-6WH	A 0,5-6		

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

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

NOTE

- Under-tightening may cause cable disconnection or malfunction. Over-tightening may cause a short circuit or malfunction due to damage to the screw or unit.
- When wiring the RS-485 terminals on the inverter with the plug-in options installed, be careful not to let RS-485 cables touch the option circuit boards and the inverter circuit board. This is to prevent a malfunction due to electromagnetic noises.

⚠ CAUTION

- **After wiring, do not leave wire offcuts in the inverter. Doing so may cause a fault, failure, or malfunction.**

2.4 Terminals

Terminal symbol	Terminal name	Description
UP	Encoder power supply (Up)	For the power supply (5 V) for the encoder
UN	Encoder earth (ground) (0V)	
EA+	Incremental sine signal: phase A (A+)	For the incremental sine signal output from the sinusoidal encoder
EA-	Incremental sine signal: phase A (A-)	
EB+	Incremental cosine signal: phase B (B+)	For the incremental cosine signal output from the sinusoidal encoder. The cosine signal has a phase difference of 90 degrees with respect to the sine signal (phase A).
EB-	Incremental cosine signal: phase B (B-)	
ER+	Home position signal: phase R (R+)	For the home position signal output from the sinusoidal encoder
ER-	Home position signal: phase R (R-)	
EC+	Magnetic pole position detection sine signal: phase C (C+)	For the sine signal taken from the Z1 track of the sinusoidal encoder (one period per revolution)
EC-	Magnetic pole position detection sine signal: phase C (C-)	
ED+	Magnetic pole position detection cosine signal: phase D (D+)	For the cosine signal taken from the Z1 track of the sinusoidal encoder (one period per revolution)
ED-	Magnetic pole position detection cosine signal: phase D (D-)	

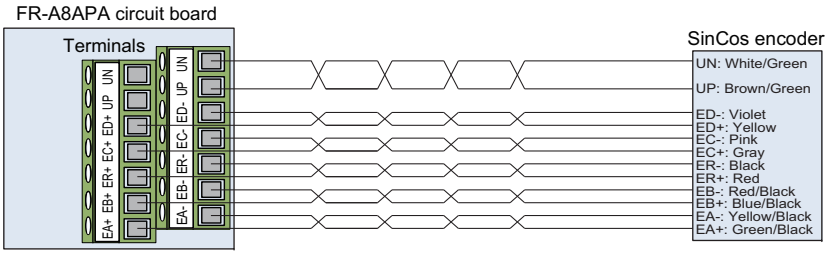
2.5 Encoder

◆ Required encoder specifications

Interface	Sinusoidal voltage signal (1 Vpp)
Signal type	Incremental signal (sine/cosine) Home position signal Magnetic pole position detection signal (sine/cosine signal taken from the Z1 track, one period per revolution)
Signal period	2048
Permissible speed	Rotation speed of the SinCos encoder interface encoder-mounted shaft: 5800 r/min The drive shaft and encoder-mounted shaft must be coupled directly or via a belt (with the speed ratio of 1:1) without any mechanical looseness or slip. Gear changing shafts cannot be applied.

The following table shows the supported encoder and cables.
(as of January 2018. The product may be changed without notice.)

Applicable encoder	ERN 1387
Recommended cable	Cables compatible with the encoder above (manufactured by HEIDENHAIN)
Maximum wiring length	100 m
Manufacturer	HEIDENHAIN



◆ Parameter for detector

Setting item	Parameters for FR-A8APA
Encoder rotation direction	**Pr.359**
Number of detector pulses (Signal period)	**Pr.369**
Encoder signal loss detection enable/disable selection	**Pr.376**

◆ Maximum setting speed of the inverter

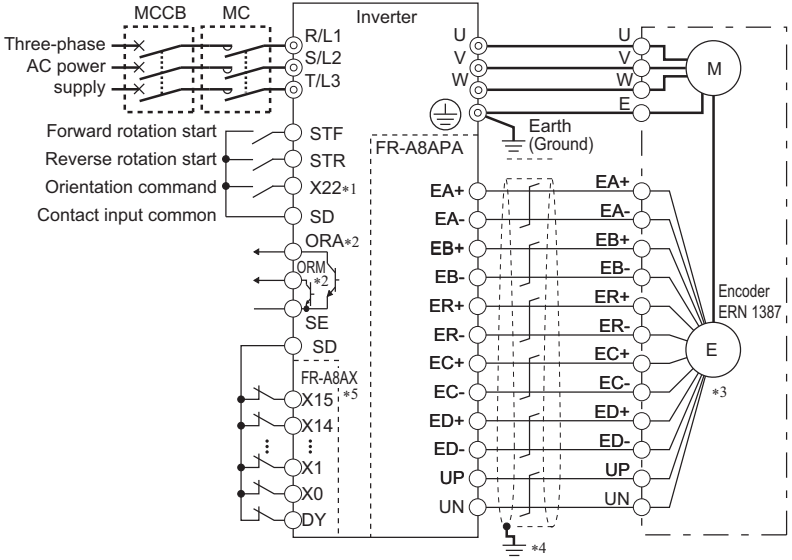
When the FR-A8APA is installed, operate the inverter so that the encoder pulse frequency is kept at 100 kHz or lower. If a speed higher than the maximum speed is set, the speed is clamped at the maximum speed.

NOTE

- While the motor stops, signal loss may not be detected depending on the motor shaft position. Before starting the operation, check the wiring.
- The availability of the functions differ according to the specifications of the inverter. Refer to the Instruction Manual of the Inverter.
- When the motor rotation in the low-speed range (60 r/min or lower) is unstable, check if the encoder cables are properly connected.

This function is used with an encoder installed to the spindle of a machine tool, etc. to allow a rotary shaft to be stopped at the specified position (oriented).
For the details of the parameters used for orientation control, refer to the Instruction Manual (Detailed) of the inverter.

4.1 Wiring example



*1 Use **Pr.178 to Pr.189 (input terminal function selection)** to assign the function to any of terminal.
Refer to the Instruction Manual (Detailed) of the inverter for details of **Pr.178 to Pr.189 (input terminal function selection)**.

*2 Use **Pr.190 to Pr.196 (output terminal function selection)** to assign the function to any of terminal.
Refer to the Instruction Manual (Detailed) of the inverter for details of **Pr.190 to Pr.196 (output terminal function selection)**.

*3 Connect the encoder so that there is no looseness between the motor and motor shaft. Speed ratio should be 1:1.

*4 Earth (ground) the shield of the encoder cable to the enclosure using a tool such as a P-clip.

*5 When a stop position command is input from outside, a plug-in option FR-A8AX is necessary. Refer to the Instruction Manual (Detailed) of the inverter for details of external stop position command.

4.2 Terminals

◆ FR-A8AX terminal

Terminal symbol	Terminal name	Description
X0 to X15	Digital signal input terminal	Input the digital signal at the relay contact or open collector terminal. Using **Pr.360**, speed or position command is selected as the command signal entered.
DY	Data read timing input signal terminal	Used when a digital signal read timing signal is necessary. Data is read only during the DY signal is on. By switching the DY signal off, the X0 to X15 data before signal-off is retained.

◆ Inverter terminal

Terminal (signal)		Terminal (signal) name	Application explanation
Input	X22	Orientation command	Used to enter an orientation signal for orientation. For the terminal used for X22 signal input, set "22" in any of **Pr.178 to Pr.189** to assign the function. *1
Output	ORA	Orientation complete	Switched LOW if the orientation has stopped within the in-position zone while the start and X22 signals are input. For the terminal used for the ORA signal output, assign the function by setting "27 (positive logic) or 127 (negative logic)" in any of **Pr.190 to Pr.196**. *1
	ORM	Orientation fault	Switched LOW if the orientation has not completed within the in-position zone while the start and X22 signals are input. For the terminal used for the ORM signal output, assign the function by setting "28 (positive logic) or 128 (negative logic)" in any of **Pr.190 to Pr.196**. *1

*1 Refer to the Instruction Manual (Detailed) of the inverter for details of **Pr.178 to Pr.189 (input terminal function selection)** and **Pr.190 to Pr.196 (output terminal function selection)**.

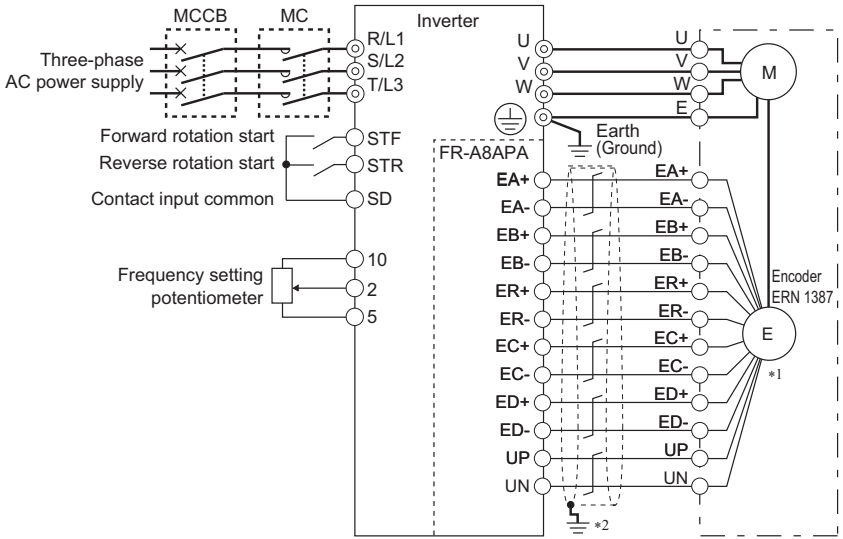
4.3 Specifications

Repeated positioning accuracy	±1.5° Depends on the load torque, moment of inertia of the load or orientation, creep speed, position loop switching position, etc.
Functions	Orientation, creep speed setting, stop position command selection, DC injection brake start position setting, creep speed and position loop switch position setting, position shift, orientation in-position, position pulse monitor, etc.
Holding force after positioning	Under V/F control, Advanced magnetic flux vector control...without servo lock function Under vector control...with servo lock function
Input signal (contact input)	Orientation command, forward and reverse rotation commands, stop position command Binary signal of maximum 16 bits (when used with the FR-A8AX)
Output signal (open collector output)	Orientation completion signal, orientation fault signal

5 ENCODER FEEDBACK CONTROL V/F Magnetic flux

When the FR-A8APA is installed on the FR-A800 series inverter, encoder feedback control can be performed under V/F control or Advanced magnetic flux vector control.
This controls the inverter output frequency so that the motor speed is constant to the load variation by detecting the motor speed with the encoder to feed back to the inverter.
For the details of the parameters used for encoder feedback control, refer to the Instruction Manual (Detailed) of the inverter.

5.1 Wiring examples



*1 Connect the encoder so that there is no looseness between the motor and motor shaft. Speed ratio should be 1:1.
*2 Earth (ground) the shield of the encoder cable to the enclosure using a tool such as a P-clip.

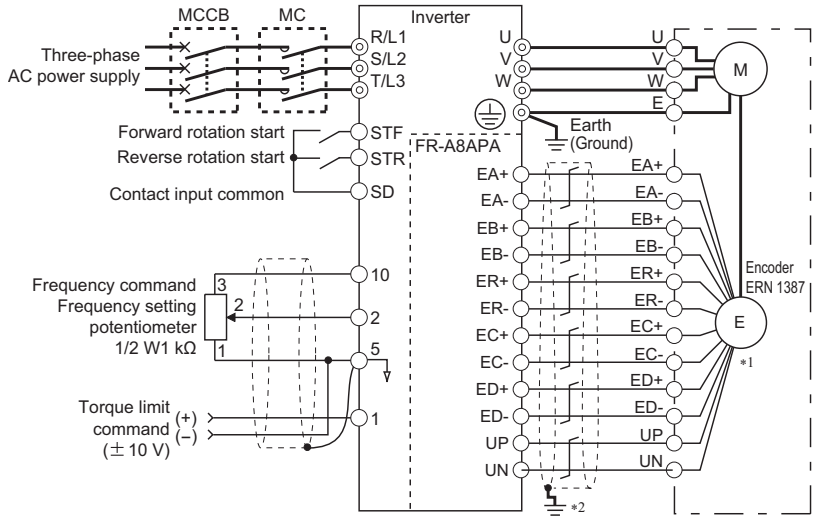
5.2 Specifications

Speed variation ratio	±0.1% (100% means 3600 r/min)
Function	• Setting of speed feedback range • Setting of feedback gain • Setting of encoder rotation direction

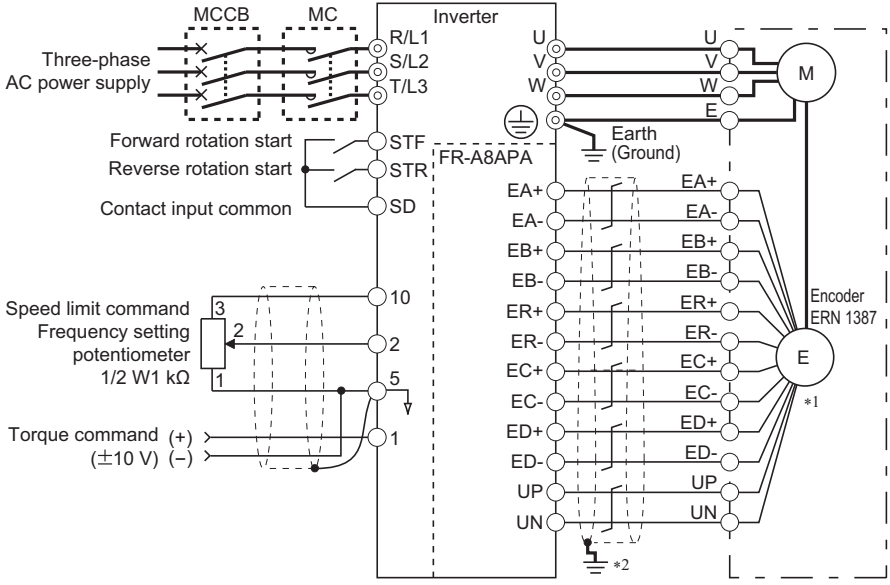
When the FR-A8APA is installed on the FR-A800 series inverter, full-scale vector control operation can be performed using a motor with encoder. (For the details of vector control, refer to the Instruction Manual (Detailed) of the inverter.)
Speed control, torque control, and position control are enabled under vector control for the induction motor.
Speed control and position control are enabled under vector control for the PM motor.

6.1 Wiring examples

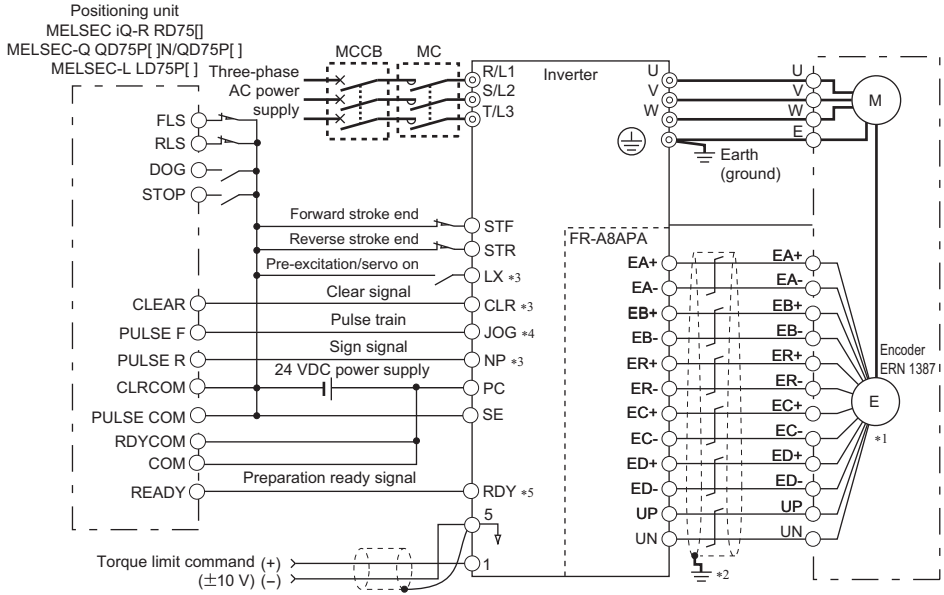
◆ Speed control



◆ Torque control (With induction motor only)



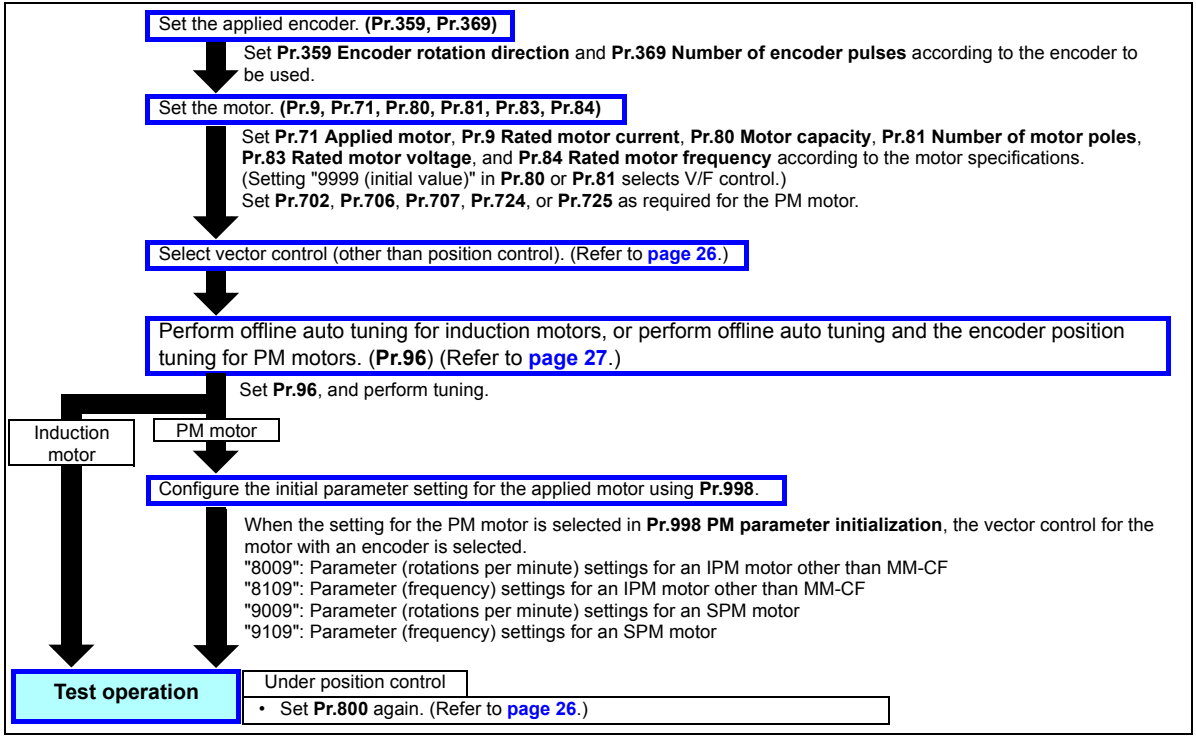
◆ Position control



*1 Connect the encoder so that there is no looseness between the motor and motor shaft. Speed ratio must be 1:1.
*2 Earth (ground) the shield of the encoder cable to the enclosure using a tool such as a P-clip.
*3 Assign the function using **Pr.178 to Pr.184, Pr.187 to Pr.189 (input terminal function selection)**.
*4 When position control is selected, terminal JOG function is invalid and simple position pulse train input terminal becomes valid.
*5 Assign the function using **Pr.190 to Pr.194 (output terminal function selection)**.

6.2 Setting procedure of vector control for motor with encoder

Follow the following procedure to change the setting for the vector control for the motor with an encoder.



NOTE

- For PM motors, after performing offline auto tuning and encoder position tuning, first perform PM parameter initialization. If parameter initialization is performed after setting other parameters, some of those parameters will be initialized too. (For the parameters to be initialized, refer to the Instruction Manual (Detailed) of the inverter.)

6.3 Vector control for PM motor with encoder

- With the FR-A8APA, PM motors with an encoder can be driven under vector control. (For the setting of vector control for an induction motor, refer to the Instruction Manual (Detailed) of the inverter.)

<table>
<tr><th>Pr.80 (Pr.453), Pr.81 (Pr.454)</th><th>Pr.71 (Pr.450)</th><th>Pr.800 setting *1</th><th>Pr.451 setting *1</th><th>Control method</th><th>Control mode</th><th>Remarks</th></tr>
<tr><td rowspan="7">Other than 9999</td><td rowspan="7">IPM/SPM motor (other than MM-CF)</td><td colspan="2">0, 100*2</td><td rowspan="4">Vector control*4</td><td>Speed control</td><td>—</td></tr>
<tr><td colspan="2">3, 103</td><td>Position control</td><td>—</td></tr>
<tr><td colspan="2">4, 104*3</td><td>Speed control/position control switchover</td><td>MC signal: ON Position control
MC signal: OFF Speed control</td></tr>
<tr><td colspan="2">6, 106</td><td>Torque control by variable-current limiter control</td><td>—</td></tr>
<tr><td>9, 109</td><td>—</td><td colspan="3">PM sensorless vector control test operation</td></tr>
<tr><td>20 (initial value), 110*5</td><td>20, 110*5</td><td>PM sensorless vector control</td><td>Speed control</td><td>—</td></tr>
<tr><td>—</td><td>9999 (initial value)</td><td colspan="3">The setting value of Pr.800 is used for the second motor.
(PM sensorless vector control (speed control) when Pr.800="9 or 109")</td></tr>
<tr><td>9999*6</td><td>—</td><td colspan="2">—</td><td colspan="3">—</td></tr>
</table>

*1 The setting values of 100 and above are used when the fast-response operation is selected.
*2 The operation for the setting of "0 or 100" is performed when "1, 2, 101, or 102" is set.
*3 The operation for the setting of "4 or 104" is performed when "5 or 105" is set.
*4 Speed control under PM sensorless vector control when the FR-A8APA is not installed.
*5 The operation for the setting of "20 or 110" is performed when "10 to 14, or 111 to 114" is set.
*6 When a PM motor is used, set **Pr.80** and **Pr.81** according to the motor. Setting "9999" disrupts proper operation.

6.4 Offline auto tuning Vector

- Offline auto tuning enables the optimal operation of a motor with encoder.

Pr.	Name	Initial value	Setting range	Description	
				PM motor	Induction motor
96 C110	Auto tuning setting/status	0	0	Offline auto tuning disabled.	
			1	Offline auto tuning enabled (without the motor rotating).	
			11	Offline auto tuning enabled only for motor constant R1 (without the motor rotating).	
			101	Encoder position tuning and offline auto tuning enabled (with the motor rotating slightly).	Offline auto tuning enabled (with the motor rotating).
463 C210	Second motor auto tuning setting/status	0	0, 1, 11, 101	Setting of offline auto tuning for the second motor (refer to **Pr.96** for the setting description.)	

POINT

- Refer to the Instruction Manual (Detailed) of the inverter to perform offline auto tuning.
- This section explains the specific information of the motor with an encoder.

◆ Parameters to be overwritten with the tuning result data after tuning of PM motor

Pr.	Name	Tuning according to Pr.96 (Pr.463) setting			Description
		101	1	11	
90 (458)	Motor constant (R1)	○	○	○	Resistance per phase
92 (460)	Motor constant (L1)/d-axis inductance (Ld)	○	○	—	d-axis inductance
93 (461)	Motor constant (L2)/q-axis inductance (Lq)	○	○	—	q-axis inductance
711 (739)	Motor Ld decay ratio	○	○	—	d-axis inductance decay ratio
712 (740)	Motor Lq decay ratio	○	○	—	q-axis inductance decay ratio
859 (860)	Torque current/Rated PM motor current	○	○	—	
96 (463)	Auto tuning setting/status	○	○	○	
373	Encoder position tuning setting/status	○	—	—	Encoder position tuning performing status
1105	Encoder magnetic pole position offset	○	—	—	Turning data of encoder position tuning

○: Tuned, —: Not tuned

NOTE

- If the offline auto tuning is started before the encoder position tuning for a PM motor is finished (**Pr.1105** = "9999"), the protective function (E.MP) is activated.

6.5 Encoder position tuning Vector

- Encoder position tuning is required when a PM motor with an encoder is driven. The measured offset value between the motor home magnetic pole position and the encoder home position is stored. Only encoder position tuning can be performed when offline auto tuning is not required, such as when the parameters for motor constant are set manually, or when offline auto tuning is already performed.

Pr.	Name	Initial value	Setting range	Description
373 C142	Encoder position tuning setting/status	0	0	Encoder position tuning disabled.
			1	Encoder position tuning enabled.
1105 C143	Encoder magnetic pole position offset	9999	0 to 4095	Encoder position tuning data set.
			9999	No encoder position tuning data.

◆ Before performing encoder position tuning

- Check that the FR-A8APA, a motor, and an encoder are properly connected.
- Check that a motor (single, stop status) is connected. (Check that the motor is not rotated by an external force during tuning.)
- Check that the mechanical brake is released.
- Check that the vector control (speed control) for the PM motor with an encoder is selected (refer to page 26).

NOTE

- Encoder position tuning is required when a PM motor is used. (It is disabled when an induction motor is used.)
- When auto tuning is performed while **Pr.96** = "101", offline auto tuning and encoder position tuning can be performed at the same time (refer to page 27).

◆ Setting

- To perform tuning, set **Pr.373** = "1".

◆ Performing tuning

POINT

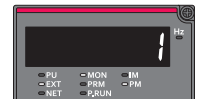
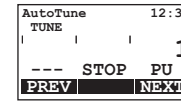
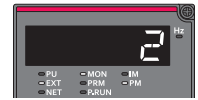
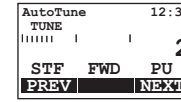
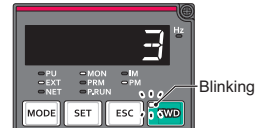
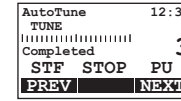
- Before tuning, check the monitor display of the PU if the inverter is in the state ready for tuning. If the start command is turned ON though the inverter is not ready, the motor can start running.

- In the PU operation mode, press FWD / REV on the operation panel.
  In the external operation mode, turn ON the start command (STF signal or STR signal). Tuning will start.

NOTE

- The motor shaft rotates up to 2 times during tuning.

- The displays/indicator on the operation panel (FR-DU08), the parameter unit (FR-PU07), and the LCD operation panel (FR-LU08) will change as shown below while tuning when **Pr.373** = "1".

Status	Parameter unit (FR-PU07) display	Operation panel (FR-DU08) display/indicator	LCD operation panel (FR-LU08) display
Setting	READ:List TUNE 1 --- STOP PU		
During tuning	TUNE 2 STF FWD PU		
Normal completion	TUNE 3 COMPLETION STF STOP PU		

- When encoder position tuning ends, press STOP RESET on the operation panel during PU operation. In the external operation mode, turn OFF the start signal (STF signal or STR signal).
  This operation resets encoder position tuning, and the PU's monitor display returns to the normal indication. (Without this operation, next operation cannot be started.)

NOTE

- The encoder position tuning data is stored in **Pr.1105** until encoder position tuning is performed again. However, performing all parameter clear resets the tuning data.

- If encoder position tuning has ended in error (see the table below), tuning data has not been set. Perform an inverter reset and restart tuning.

Pr.373 setting	Error cause	Corrective actions
8	Forced end	Set **Pr.373** = "1" and try tuning again.
9	Inverter protective function operation	Identify and remove the cause of the protective function activation, and make the setting again.
93	The motor or the encoder is not connected.	Check the wiring of the motor and the encoder, the brake opening, and make the setting again.

- When tuning is ended forcibly by pressing STOP RESET or turning OFF the start signal (STF or STR) during tuning, tuning does not end properly. (The tuning data have not been set.)
  Perform an inverter reset and restart tuning.
- When the protective function (Encoder phase fault (E.EP)) is activated during tuning, check the wiring of the motor and the encoder, **Pr.359** setting, and then perform tuning again.
- When tuning ends properly, the counter value of the offset between the motor home magnetic pole position and the encoder home position is written in **Pr.1105**.

6.6 Specifications

Speed control	Speed control range	1:1500 (both driving/regeneration *1)
	Speed variation ratio	±0.01% (100% means 3000 r/min)
	Speed response	20 Hz (40 Hz during fast-response operation)
Torque control	Torque control range	1:50
	Absolute torque accuracy	±10% *2
	Repeated torque accuracy	±5% *2
Position control	Repeated positioning accuracy	±1.5° (at motor shaft end)
	Maximum input pulse frequency	100k pulses/s (Terminal JOG)
	Positioning feedback pulse	Different depending on the encoder resolution
	Electronic gear setting	1/50 to 20
	In-position width	0 to 32767 pulses
	Error excess	0 to 400k pulses
Function		• Setting of speed feedback range • Setting of feedback gain

*1 A regeneration unit (option) is necessary for regeneration.
*2 With online auto tuning (adaptive magnetic flux observer), dedicated motor, rated load

Restricted Use of Hazardous Substances in Electronic and Electrical Products

The mark of restricted use of hazardous substances in electronic and electrical products is applied to the product as follows based on the “Management Methods for the Restriction of the Use of Hazardous Substances in Electrical and Electronic Products” of the People's Republic of China.

电器电子产品有害物质限制使用标识要求

环境保护使用期限标识

本产品中所含有的有害物质的名称、含量、含有部件如下表所示。

• 产品中所含有害物质的名称及含量

部件名称*2	有害物质*1					
	铅(Pb)	汞(Hg)	镉(Cd)	六价铬(Cr(VI))	多溴联苯(PBB)	多溴二苯醚(PBDE)
电路板组件 （包括印刷电路板及其构成的零部件，如电阻、电容、集成电路、连接器等）、电子部件	×	○	×	○	○	○
金属壳体、金属部件	×	○	○	○	○	○
树脂壳体、树脂部件	○	○	○	○	○	○
螺丝、电线	○	○	○	○	○	○

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MEMO

REVISIONS

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

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HEAD OFFICE: TOKYO BUILDING 2-7-3, MARUNOUCHI, CHIYODA-KU, TOKYO 100-8310, JAPAN

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