MITSUBISHI ELECTRIC

800 series

INVERTER
Plug-in option
FR-A8AP
INSTRUCTION MANUAL

Orientation control

Encoder feedback control

Vector control

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Thank you for choosing this Mitsubishi 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, always read this Instruction Manual carefully to use this product correctly.
Please forward this Instruction Manual to the end user.

Safety instructions

Do not attempt to install, operate, maintain or inspect the 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.

◆ **Electric Shock Prevention**

⚠ Warning

- While the inverter power is ON, do not open the front cover or the wiring cover. Do not run the inverter with the front cover or the wiring cover removed. Otherwise you may access the exposed high voltage terminals or the charging part of the circuitry and get an electric shock.
- Do not remove the inverter front cover even if the power supply is disconnected. The only exception for this would be when performing wiring and periodic inspection. You may accidentally touch the charged inverter circuits and get an electric shock.
- Before wiring or inspection, LED indication of the inverter unit operation panel must be switched 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 is no residual voltage using a tester or the like. For some time after the power-OFF, a high voltage remains in the smoothing capacitor, 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.

◆ **Injury Prevention**

⚠ Caution

- The voltage applied to each terminal must be the ones 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 or damage may occur.
- While power is ON or for some time after power OFF, do not touch the inverter as it will be extremely hot. Touching these devices may cause a burn.

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

⚠ Caution

Transportation and mounting
- 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 substance such as oil.
- If halogen-based materials (fluorine, chlorine, bromine, iodine, etc.) infiltrate into a Mitsubishi product, the product will be damaged. Halogen-based materials are often included in fumigant, which is used to sterilize or disinfest wooden packages. When packaging, prevent residual fumigant components from being infiltrated into Mitsubishi products, or use an alternative sterilization or disinfection method (heat disinfection, etc.) for packaging. Sterilization of disinfection of wooden package should also be performed before packaging the product.

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

⚠ Warning

Usage
- 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 product.

⚠ Caution

Usage
- When parameter clear or all parameter clear is performed, the required parameters must be set again before starting operations. Because all parameters return to their initial values.
- Static electricity in your body must be discharged before you touch the product.

Maintenance, inspection and parts replacement
- Do not carry out a megger (insulation resistance) test.

Disposal
- The inverter must be treated as industrial waste.

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 Instruction Manual must be followed when operating the inverter.

— CONTENTS —

1PRE-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 dedicated for the FR-A800 series.

◆ Product confirmation

Check the enclosed items.

Plug-in option 1	Mounting screw (M3 × 8 mm) ....2 (Refer to **page 7**.)	Spacer ....2 (Refer to **page 7**.)
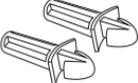
> **NOTE**
> • Connection diagrams in this Instruction Manual appear with the control logic of the input terminals as sink logic, unless otherwise specified. (For the control logic, refer to the Instrucution Manual(Detailed) of the inverter.)

1.2 Component names

Terminal layout

PIN and PO are not used.

Front view

Rear view (g)
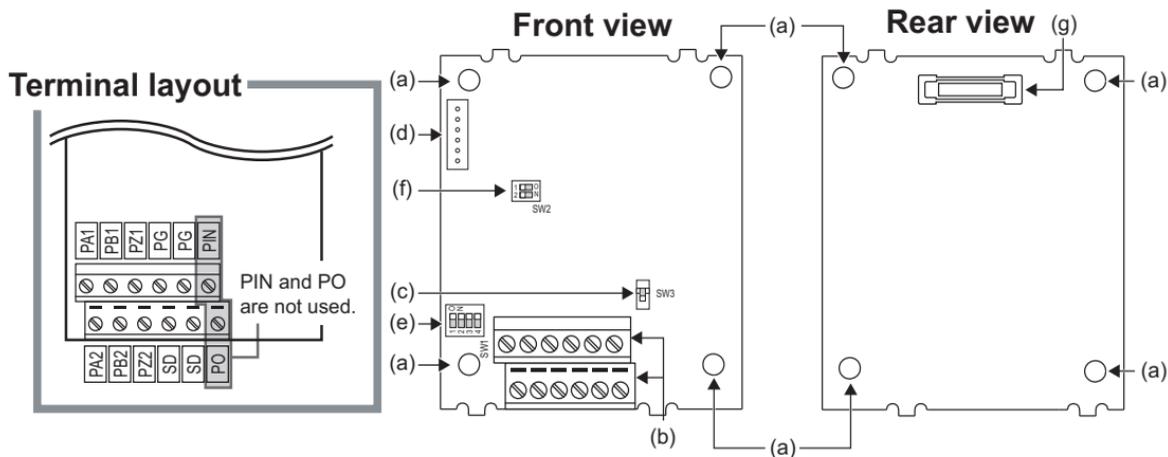
Symbol	Name	Description	Refer to page
a	Mounting hole	Fixes the option to the inverter with screws, or installs spacers.	**7**
b	Terminal block	Connects to the encoder.	**12**
c	Encoder type selection switch (SW3)	Switches the encoder type (differential line driver/ complementary).	**10**
d	CON2 connector	Not used.	—
e	Terminating resistor selection switch (SW1)	Switches ON or OFF the internal terminating resistor.	**10**
f	Switch for manufacturer setting (SW2)	Do not change the initially-set status. (Switches 1 and 2 are OFF.)	—
g	Connector	Connects to the option connector of the inverter.	**7**

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 mount or remove the plug-in option while the input power is ON. Doing so may damage the inverter or plug-in option.
> ● To avoid damage due to static electricity, static electricity in your body must be discharged before you touch the product.

2.2   Installation procedure

(1) Remove the inverter front cover. (Refer to Chapter 2 of the Instruction Manual (Detailed) of the inverter for details on how to remove the front cover.)

(2) For the two mounting holes (as shown in the next page) that will not be tightened with mounting screws, insert spacers.

(3) Fit the connector of the plug-in option along the guide of the connector on the inverter, and insert the plug-in option as far as it goes. (Insert it to the inverter option connector 1 or 2.)

(4) Fit the two locations, the left and right, of the plug-in option securely to the inverter unit by screwing in the supplied mounting screws (tightening torque 0.33 N·m to 0.40 N·m). If the screw holes do not line up, the connector may not be inserted deep enough. Check the connector.
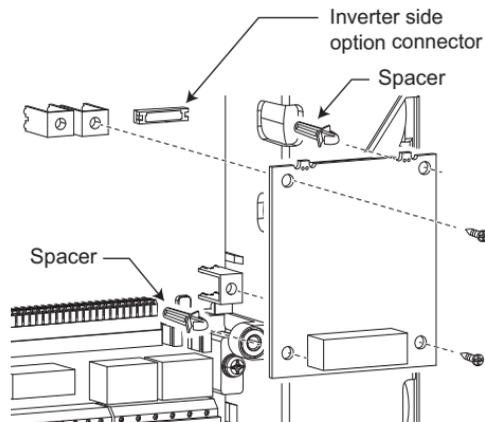
Example of installation to connector 1
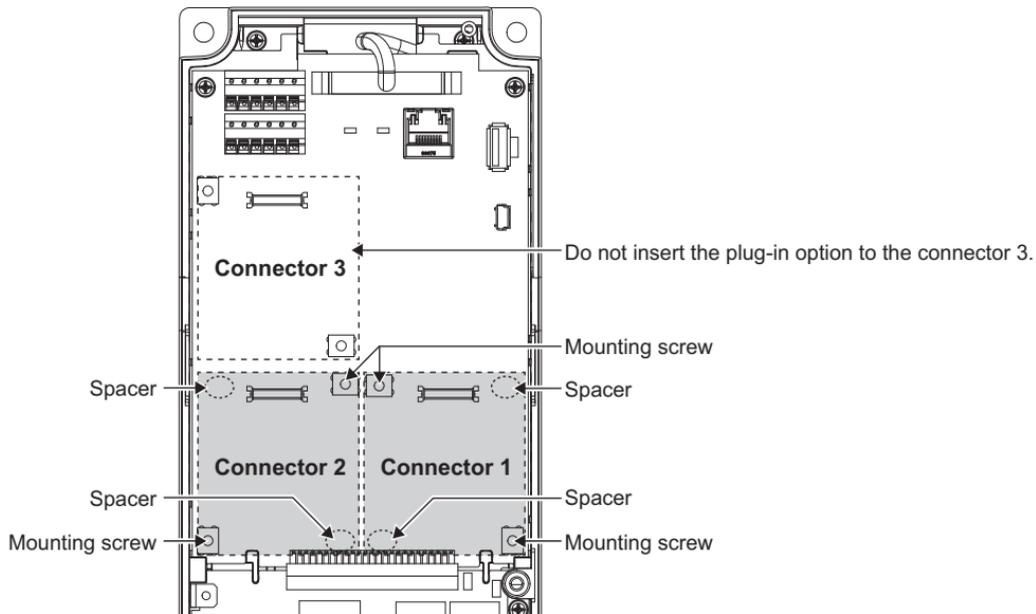
Insertion positions for screws and spacers

- Do not insert the plug-in option to the connector 3.
- Connector 3
- Spacer
- Spacer
- Mounting screw
- Connector 2
- Connector 1
- Spacer
- Spacer
- Mounting screw
- Mounting screw

- Caution must be taken of mounting screws falling off when removing and mounting the plug-in option.
- Only one type of option per inverter may be used. When multiple options are mounted, priority is given to option connectors 1, 2 and 3 on the inverter in this order, and options having a lower priority do not function. (For the positions of the option connectors 1 to 3, refer to **page 8**.)
- When the inverter cannot recognize that the option unit is mounted due to improper installation, etc., the protective function (E.1 to E.3) is displayed. A different indication will appear according to the mounted position (option connector 1 to 3).

| Mounted position	Fault indication
Option connector 1	E. 1
Option connector 2	E. 2
Option connector 3	E. 3

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

2.3   Encoder specification / terminating resistor switch setting

◆ Encoder specification selection switch (SW3)
Select either differential line driver or complementary.
It is initially set to the differential line driver. Switch its position according to output circuit.

Differential line driver
(initial status)
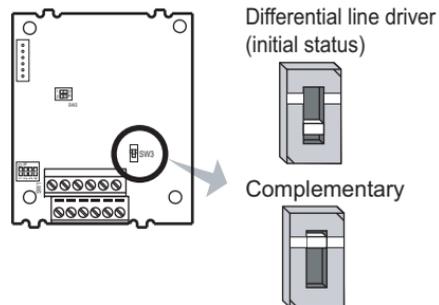
Complementary

#### ◆ Terminating resistor selection switch (SW1)
Select "ON"/"OFF" of the internal terminating resistor. Set the switch to "ON" (initial status) when an encoder output type is differential line driver and set to "OFF" when complementary.
ON : with internal terminating resistor (initial setting status)
OFF : without internal terminating resistor

Internal terminating
resistor-ON
(initial status)
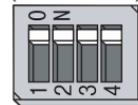
Internal terminating
resistor-OFF
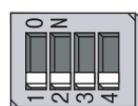
> **NOTE**
> - Set all switches to the same setting ("ON"/ "OFF").
> - If the encoder output type is differential line driver, set the terminating resistor switch to the "OFF" position when sharing the same encoder with other unit (CNC (computerized numerical controller), etc) or a terminating resistor is connected to other unit.

◆ Motor used and switch setting

Motor		Encoder specification selection switch (SW3)	Terminating resistor selection switch (SW1)	Power specifications∗2
Mitsubishi standard motor with encoder Mitsubishi high-efficiency motor with encoder	SF-JR	Differential	ON	5 V
	SF-HR	Differential	ON	5 V
	Others	∗1	∗1	∗1∗3
Mitsubishi constant-torque motor with encoder	SF-JRCA	Differential	ON	5 V
	SF-HRCA	Differential	ON	5 V
	Others	∗1	∗1	∗1∗3
Vector control dedicated motor	SF-V5RU	Complementary	OFF	12 V
Other manufacturer's motor with encoder		∗1	∗1	∗1∗3

∗1   Set according to the motor encoder used.
∗2   Choose a power supply for encoder according to the encoder used (5 V/12 V/15 V/24 V).
∗3   When the encoder output is the differential line driver type, only 5 V can be input.

NOTE

• Switch "SW2" is for manufacturer setting. Do not change the setting.

2

2.4 Wiring

(1) Use twisted pair shield cables ($0.2 \ mm^2$ or larger) to connect the FR-A8AP and position detector.
For the wiring to the terminals PG and SD, use several cables in parallel or use a thick cable, according to the wiring length. To protect the cables from noise, run them away from any source of noise (e.g. the main circuit and power voltage).

| Wiring length	Parallel connection (Cable gauge $0.2 \ mm^2$)	Larger-size cable
Within 10 m	At least two cables in parallel	$0.4 \ mm^2$ or larger
Within 20 m	At least four cables in parallel	$0.75 \ mm^2$ or larger
Within 100 m *1	At least six cables in parallel	$1.25 \ mm^2$ or larger

*1 When differential driver is set and a wiring length is 30 m or more
The wiring length can be extended to 100 m by slightly increasing the 5 V power supply (approx. 5.5 V) and using six or more cables with gauge size of $0.2 \ mm^2$ in parallel or a cable with gauge size of $1.25 \ mm^2$ or more. Note that the voltage applied should be within power supply specifications of encoder.

Example of parallel connection with two cables (with complementary encoder output)

To reduce noise of the encoder cable, earth (ground) the encoder shielded cable to the enclosure (as close as the inverter) with a P clip or U clip made of metal.
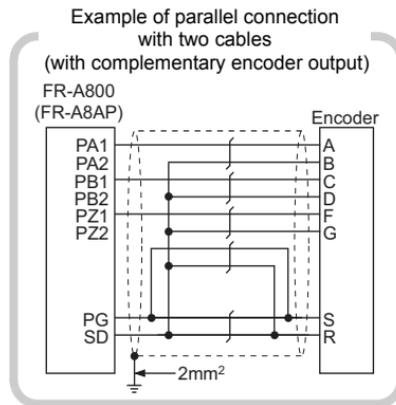
Earthing (grounding) example using a P clip

- Encoder cable
- Shield
- P clip
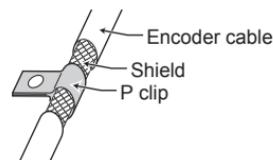
> **NOTE**
> - For details of the optional encoder dedicated cable (FR-JCBL/FR-V7CBL), refer to **page 15**.
> - FR-V7CBL is provided with a P clip for earthing (grounding) shielded cable.

(2) Wire the shielded twisted pair cable after stripping its sheath to make its cables loose.
Also, protect the shielded cable of the shielded twisted pair cable to ensure that it will
not make contact with the conductive area.

Shield
(perform protective treatment)
Sheath

Shielded twisted pair cable

Strip off the sheath for the below length. If the length of the sheath peeled is too long, a
short circuit may occur with 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. In addition,
do not solder it.
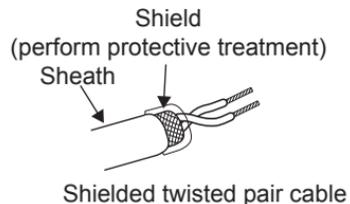
Cable stripping length

5 mm
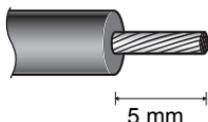
Use a ferrule terminal as necessary.
When using the ferrule terminal, use care so that the twisted wires do not come

Unstranded
wires

Damaged   Crumpled tip   Wires are not inserted
into the sleeve

2
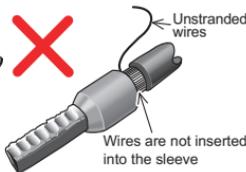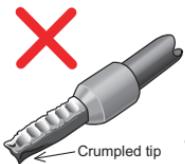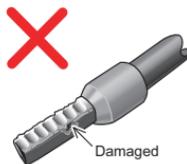
· NOTE

• Ferrule terminals commercially available (as of February 2012. The product may be changed without notice.)

Terminal Screw Size	Wire Size (mm^2)	Ferrule Terminal Model		Manufacturer	Ferrule terminal crimping tool
		with insulation sleeve	without insulation sleeve		
M2	0.3 to 0.5	AI 0,5-6WH	A 0,5-6	Phoenix Contact Co.,Ltd.	CRIMPFOX 6

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

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

NOTE

- Undertightening can cause cable disconnection or malfunction. Overtightening can cause a short circuit or malfunction due to damage to the screw or unit.
- When wiring cables to the inverter's RS-485 terminals while a plug-in option is mounted, take caution not to let the cables touch the circuit board of the option or of the inverter. Otherwise, electromagnetic noises may cause malfunctions.
- When one position detector is shared between FR-A8AP and CNC (computerized numerical controller), its output signal should be connected as shown below. In this case, the wiring length between FR-A8AP and CNC should be as short as possible, within 5 m.
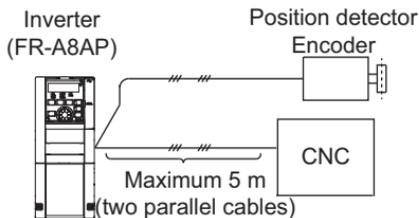

⚠ **CAUTION**

- Do not use empty terminals as junction terminals because they are used in the option unit. If they are used as the junction terminals, the option unit may be damaged.
- After wiring, wire offcuts must not be left in the inverter. They may cause a fault, failure or malfunction.

2.5 Encoder cables dedicated to Mitsubishi motors

Use dedicated encoder cables to connect with Mitsubishi encoder-equipped motors.

FR-JCBL	FR-V7CBL
For SF-JR/HR/JRCA/HRCA (with encoder)	For SF-V5RU and SF-THY

For SF-JR/HR/JRCA/HRCA (with encoder)

F-DPEVSB 12P×0.2mm^2 D/MS3057-12A
Approx. 140 mm
Earth cable
11mm
*1
60mm
L
D/MS3106B20-29S

FR-A800
(FR-A8AP)   Encoder
PA1   C
PA2   R
PB1   A
PB2   N
PZ1   B
PZ2   P

Positioning keyway

PG   H
SD   K

2mm^2

D/MS3106B20-29S
(As viewed from wiring side)

Type	Length L (m)
FR-JCBL5	5
FR-JCBL15	15
FR-JCBL30	30

For SF-V5RU and SF-THY

F-DPEVSB 12P×0.2 mm^2 D/MS3057-12A
Approx. 140 mm
Earth cable
11mm
60mm
L
D/MS3106B20-29S
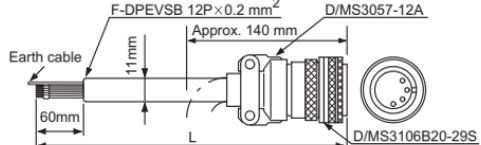
• A P clip for earthing (grounding) a shielded cable is provided.

FR-A800
(FR-A8AP)   Encoder
PA1   A
PA2   B
PB1   C
PB2   D
PZ1   F
PZ2   G

Positioning keyway

PG   S
SD   R

2mm^2

D/MS3106B20-29S
(As viewed from wiring side)

Type	Length L (m)
FR-V7CBL5	5
FR-V7CBL15	15
FR-V7CBL30	30

2

*1   As the terminal block of the FR-A8AP is an insertion type, earth (ground) cables need to be modified. (Refer to)

Motor		SF-JR/HR/JRCA/HRCA (with Encoder)	SF-V5RU, SF-THY
Encoder cable		**FR-JCBL**	**FR-V7CBL**
FR-A8AP terminal	PA1	PA	PA
	PA2	PAR	Keep this open.
	PB1	PB	PB
	PB2	PBR	Keep this open.
	PZ1	PZ	PZ
	PZ2	PZR	Keep this open.
	PG	5E	PG
	SD	AG2	SD

2.6 Terminals

Terminal Symbol	Terminal Name	Description	
PA1	Encoder A-phase signal input terminal	A-phase signal is input from the encoder.	For details of pulse signal, refer to **page 17**.
PA2	Encoder A-phase inverse signal input terminal		
PB1	Encoder B-phase signal input terminal	B-phase signal is input from the encoder.	
PB2	Encoder B-phase inverse signal input terminal		
PZ1	Encoder Z-phase signal input terminal	Z-phase signal is input from the encoder. (Not used for the encoder feedback control.)	
PZ2	Encoder Z-phase inverse signal input terminal		
PG	Encoder power supply (positive side) input terminal	Input power for the encoder power supply. Connect the external power supply (5 V, 12 V, 15 V, 24 V) and the encoder power cable. When the encoder output is the differential line driver type, only 5 V can be input. Make sure the voltage of the external power supply the same as the encoder output voltage. (Check the encoder specification.)	
SD	Encoder power supply ground terminal		

# 3 ENCODER SPECIFICATIONS AND PARAMETER SETTINGS

3.1 Encoder

◆ Position detection (pulse encoder)

Output pulse specifications

Differential line driver
A/$\overline{A}$ signal 1000 P/R to 4096 P/R
B/$\overline{B}$ signal 1000 P/R to 4096 P/R
Z/$\overline{Z}$ signal 1 P/R
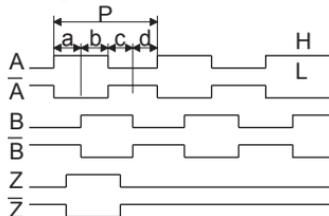
Complementary
A signal 1000 P/R to 4096 P/R
B signal 1000 P/R to 4096 P/R
Z signal 1 P/R
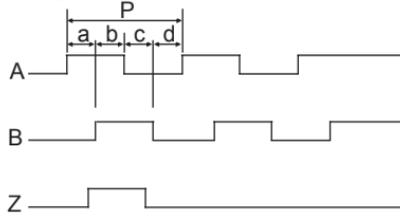
Position detector
Encoder
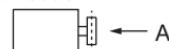
· When rotation is clockwise as viewed from the shaft end (A) of the encoder.
· a, b, c, d should be (1/4 ± 1/8)P

> **NOTE**
>
> • When orientation control, encoder feedback control, vector control are used together, the encoder is shared between these controls.
>   Use an encoder which has a pulse count of 1000 to 4096 ppr (pulse per revolution).
> • The encoder should be coupled with the motor shaft or the spindle oriented with a speed ratio of 1 to 1 without any mechanical looseness.
> • To ensure correct operation, the encoder must be set in the proper rotation direction and the A and B phases connected correctly.

◆ Power supply

Choose a power supply for encoder according to the encoder used (5 V/12 V/15 V/24 V). When the encoder output is the differential line driver type, only 5 V can be input. Make sure the voltage of the external power supply the same as the encoder output voltage. (Check the encoder specification.)

When an encoder is used under orientation control, encoder feedback control, and vector control, the power supply is shared between the inverter and encoder.

• Specifications of the encoders equipped in the motors with encoders and the vector-control dedicated motors

Item	Encoder for SF-JR/HR/JRCA/HRCA	Encoder for SF-V5RU, SF-THY
Resolution	1024 pulses/rev	2048 pulses/rev
Power supply voltage	5 VDC±10%	12 VDC±10%
Current consumption	150 mA	
Output signal form	A, B phases (90° phase shift) Z phase: 1 pulse/rev	
Output circuit	Differential line driver 74LS113 equivalent	Complementary
Output voltage	H level: 2.4 V or more L level: 0.5 V or less	H level: "Power supply for encoder-3 V" or more L level: 3 V or less

NOTE

• When the input power supply voltage to the encoder and its output voltage differ, the protective function (E.ECT) may be activated.

3.2   Parameter setting

3.2.1   Parameter for encoder

Parameter Number	Pr. group	Name	Initial Value	Setting Range	Description	
359	C141	Encoder rotation direction	1	0	Set when using a motor for which forward rotation (encoder) is clockwise (CW) viewed from the shaft CW	Set for the operation at 120 Hz or less.
				100		Set for the operation at a frequency higher than 120 Hz.
				1	Set when using a motor for which forward rotation (encoder) is counterclockwise (CCW) viewed from the shaft CCW	Set for the operation at 120 Hz or less.
				101		Set for the operation at a frequency higher than 120 Hz.
369	C140	Number of encoder pulses	1024	0 to 4096	Set the number of encoder pulses output. Set the number of pulses before it is multiplied by 4.	

3

⋅•◄ **NOTE** ⋅

• If operating at a frequency higher than 120 Hz with **Pr.359** = "0 or 1", the motor rotation will be unstable.

3.2.2   Parameter settings for the motor under vector control

Motor Name		Pr.359 Encoder rotation direction	Pr.369 Number of encoder pulses
Mitsubishi standard motor	SF-JR	1 (Initial value)	1024 (Initial value)
	SF-JR 4P 1.5 kW or less	1 (Initial value)	1024 (Initial value)
	SF-HR	1 (Initial value)	1024 (Initial value)
	Others	*1	*1
Mitsubishi constant-torque motor	SF-JRCA 4P	1 (Initial value)	1024 (Initial value)
	SF-HRCA 4P	1 (Initial value)	1024 (Initial value)
	Others	*1	*1
Mitsubishi vector control dedicated motor	SF-V5RU	1 (Initial value)	2048
	SF-THY	1 (Initial value)	2048
Other manufacturer's standard motor	—	*1	*1
Other manufacturer's constant-torque motor	—	*1	*1

*1   Set this parameter according to the motor (encoder) used.

4 ORIENTATION CONTROL

This function is used with a position detector (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
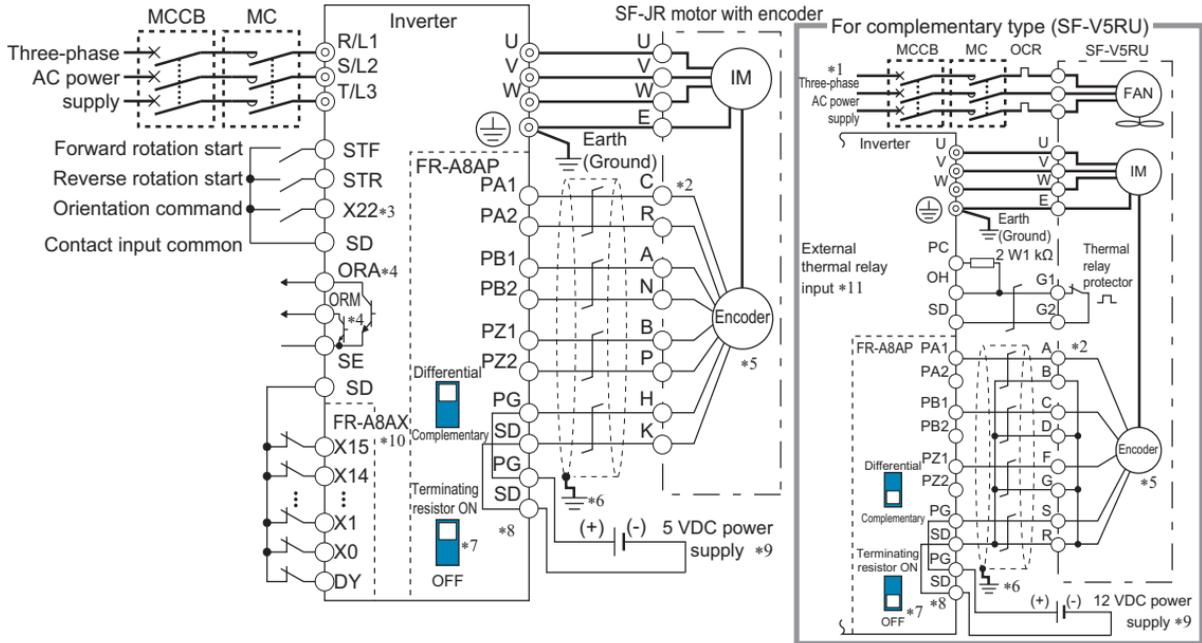
∗1   For the fan of the 7.5 kW or less dedicated motor, the power supply is single phase (200 V/50 Hz, 200 to 230 V/ 60 Hz).

∗2   The pin number differs according to the encoder used.

∗3   Use **Pr. 178 to Pr. 189 (input terminal function selection)** to assign the function to any of terminal.
Refer to the Instruction Manual (Detailed) for details of **Pr. 178 to Pr. 189 (input terminal function selection)**.

∗4   Use **Pr. 190 to Pr. 196 (output terminal function selection)** to assign the function to any of terminal.
Refer to the Instruction Manual (Detailed) for details of **Pr. 190 to Pr. 196 (output terminal function selection)**.

∗5   Connect the encoder so that there is no looseness between the motor and motor shaft. Speed ratio should be 1:1.

∗6   Earth (Ground) the shielded cable of the encoder cable to the enclosure with a P clip, etc. (Refer to **page 12**.)

∗7   For the differential line driver, set the terminating resistor selection switch to on position (initial status) to use. (Refer to **page 10**.)
Note that the terminating resistor switch should be set to off position when sharing the same encoder with other unit (CNC, etc.) and a terminating resistor is connected to other unit. For the complementary, set the switch to off position.

∗8   For terminal compatibility of the FR-JCBL, FR-V7CBL and FR-A8AP, refer to **page 16**.

∗9   A separate power supply of 5 V/12 V/15 V/24 V is necessary according to the encoder power specification. When the encoder output is the differential line driver type, only 5 V can be input.
Make the voltage of the external power supply the same as the encoder output voltage, and connect the external power supply between PG and SD.
When performing encoder feedback control and vector control together, an encoder and power can be shared.

∗10 When a stop position command is input from outside, a plug-in option FR-A8AX is necessary. Refer to the Instruction Manual (Detailed) for details of external stop position command.

∗11 To use a terminal as the terminal OH, assign the OH (external thermal O/L relay input) signal to an input terminal. (Set "7" in any of **Pr.178 to Pr.189**. For details, refer to the Instruction Manual (Detailed) of the inverter.)

4.2　Terminals

◆ Option 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 ORA 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) for details of **Pr.178 to Pr.189 (input terminal function selection)** and **Pr.190 to Pr.196 (output terminal function selection)**.

4

# 4.3   Specifications

Repeated positioning accuracy	±1.5° Depends on the load torque, moment of inertia of the load or orientaion, creep speed, position loop switching position, etc.
Permissible speed	Encoder-mounted shaft speed (6000 r/min with 1024 pulse encoder). The drive shaft and encoder-mounted shaft must be coupled directly or via a belt without any slip. Gear changing shafts cannot be applied.
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 (open collector signal input (complementary) is enabled) Binary signal of maximum 16 bit (when used with the FR-A8AX)
Output signal (open collector output)	Orientation completion signal, orientation fault signal

5 ENCODER FEEDBACK CONTROL

Mount FR-A8AP to an FR-A800 series inverter to perform encoder feedback control 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 speed detector (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
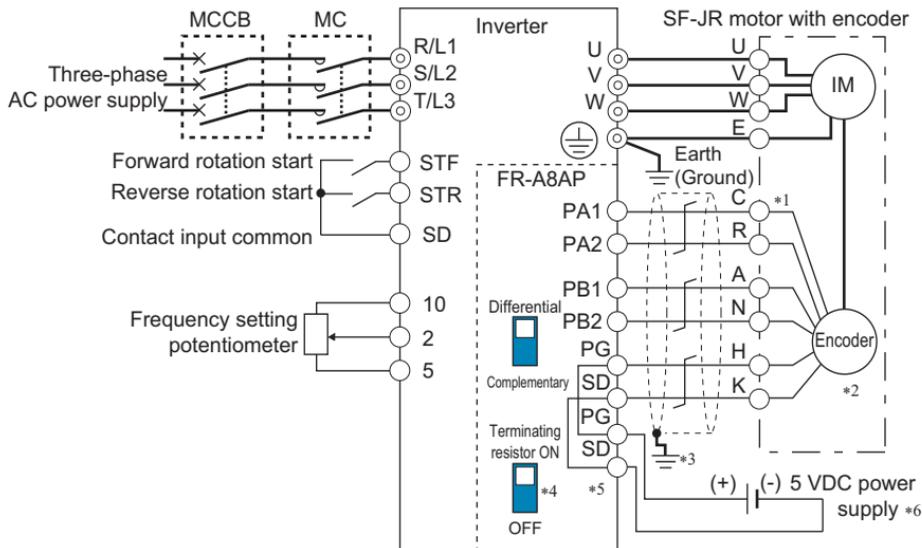
∗1   The pin number differs according to the encoder used.
∗2   Connect the encoder so that there is no looseness between the motor and motor shaft. Speed ratio should be 1:1.
∗3   Earth (Ground) the shielded cable of the encoder cable to the enclosure with a P clip, etc. (Refer to **page 12**.)
∗4   For the differential line driver, set the terminating resistor selection switch to on position (initial status) to use. (Refer to **page 10**) Note that the terminating resistor switch should be set to off position when sharing the same encoder with other unit (CNC, etc) and a terminating resistor is connected to other unit.
      For the complementary, set the switch to off position.
∗5   For terminal compatibility of the FR-JCBL, FR-V7CBL and FR-A8AP, refer to **page 16**.
∗6   A separate power supply of 5 V/12 V/15 V/24 V is necessary according to the encoder power specification. When the encoder output is the differential line driver type, only 5 V can be input.
      Make the voltage of the external power supply the same as the encoder output voltage, and connect the external power supply between PG and SD.
      To perform orientation control together, an encoder and power supply can be shared.

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
Maximum speed	V/F control: 590 Hz, Advanced magnetic flux vector control: 400 Hz (102400 pulse/s or less encoder pulses)

6 VECTOR CONTROL

When FR-A8AP is mounterd on the FR-A800 series, full-scale vector control operation can be performed using a motor with encoder.
Speed control, torque control and position control by vector control can be performed. (Refer to the Instruction Manual (Detailed) for details.)

6.1 Wiring examples

◆ Speed control

Standard motor with encoder (SF-JR), 5 V differential line driver	Vector control dedicated motor (SF-V5RU, SF-THY), 12 V complementary

◆ Torque control
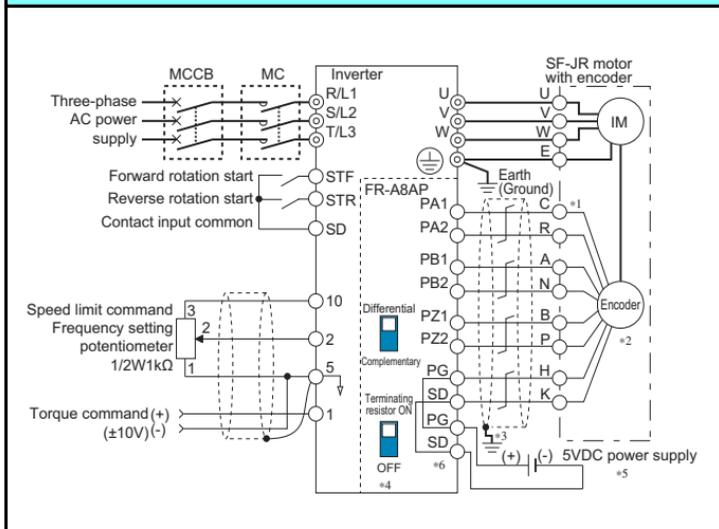
Standard motor with encoder (SF-JR), 5 V differential line driver	Vector control dedicated motor (SF-V5RU, SF-THY), 12 V complementary
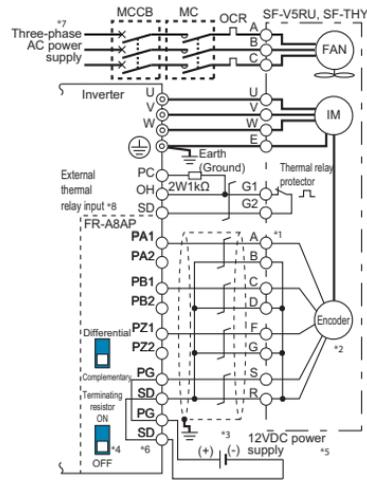
◆ Position control

Vector control dedicated motor (SF-V5RU, SF-THY), 12 V complementary
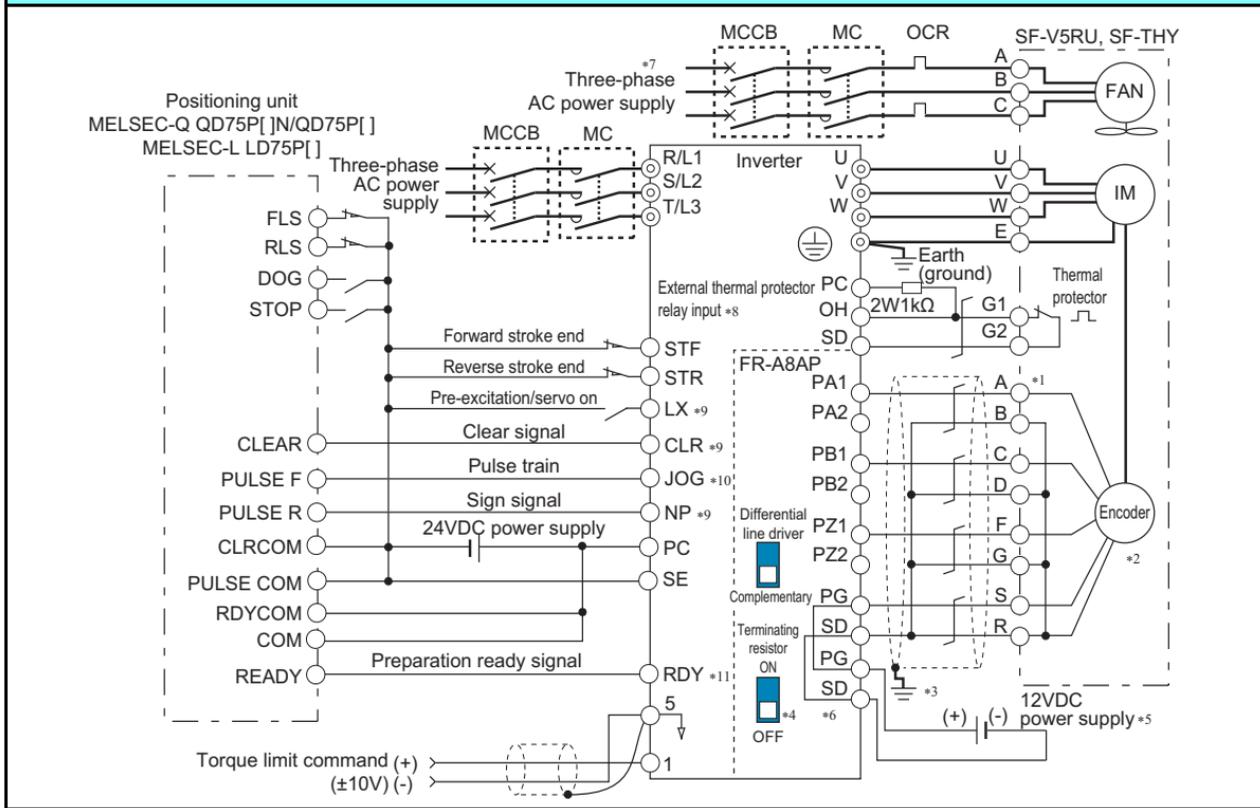
∗1 The pin number differs according to the encoder used.
    Speed, control, torque control, and position control by pulse train input are available with or without the Z-phase being connected.
∗2 Connect the encoder so that there is no looseness between the motor and motor shaft. Speed ratio must be 1:1.
∗3 Earth (ground) the shield of the encoder cable to the enclosure using a tool such as a P-clip. (Refer to **page 12**.)
∗4 For the complementary, set the terminating resistor selection switch to OFF position. (Refer to **page 10**.)
∗5 A separate power supply of 5 V/12 V/15 V/24 V is necessary according to the encoder power specification.
    When the encoder output is the differential line driver type, only 5 V can be input.
    Make the voltage of the external power supply the same as the encoder output voltage, and connect the external power supply across PG and SD.
    When performing orientation control together, an encoder and power supply can be shared.
∗6 For terminal compatibility of the FR-JCBL, FR-V7CBL, and FR-A8AP, refer to **page 16**.
∗7 For the fan of the 7.5 kW or lower dedicated motor, the power supply is single phase. (200 V/50 Hz, 200 to 230 V/60 Hz)
∗8 To use a terminal as the terminal OH, assign the OH (external thermal O/L relay input) signal to an input terminal. (Set "7" in any of **Pr.178 to Pr.189**. For details, refer to the Instruction Manual (Detailed) of the inverter.)
∗9 Assign the function using **Pr.178 to Pr.184, Pr.187 to Pr.189 (input terminal function selection)**.
∗10 When position control is selected, terminal JOG function is invalid and simple position pulse train input terminal becomes valid.
∗11 Assign the function using **Pr.190 to Pr.194 (output terminal function selection)**.

6.2 Specifications

Speed control	Speed control range	1:1500 (both driving/regeneration ∗1)
	Speed variation ratio	±0.01% (100% means 3000 r/min)
	Speed response	130 Hz
	Maximum speed	120 Hz (102400 pulse/s or less encoder pulses)
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	100 kpps (Terminal JOG)
	Positioning feedback pulse	Number of encoder pulses per motor rotation (**Pr.369**) × 4
	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 • Setting of encoder rotation direction

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

REVISIONS

Print Date	*Manual Number	Revision
Aug. 2013	IB(NA)-0600505ENG-A	First edition
Sep. 2014	IB(NA)-0600505ENG-B	Modification •Ferrule terminals commercially available

INVERTER

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