MITSUBISHI ELECTRIC

700 series

INVERTER
Plug-in option
FR-A7AZ
INSTRUCTION MANUAL

Bipolar analog output function

High resolution analog input function

Motor thermistor interface

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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.
- Static electricity in your body must be discharged before you touch the product. Otherwise the product may be damaged.

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 Inverter model

The inverter models 55K and 75K stated in this Instruction Manual differ according to -NA, -EC, -CH(T) versions. Refer to the following correspondence table for each inverter type. (Refer to *the Instruction Manual of each inverter* for the inverter type.)

For example, "for the 75K or higher" indicates "for the FR-A740-01440-NA or higher" in the case of FR-A740 of NA version.

		NA	EC	CH
A700	FR-A720-55K	FR-A720-02150-NA	—	—
	FR-A720-75K	FR-A720-02880-NA	—	—
	FR-A740-55K	FR-A740-01100-NA	FR-A740-01800-EC	FR-A740-55K-CHT
	FR-A740-75K	FR-A740-01440-NA	FR-A740-02160-EC	FR-A740-75K-CHT

1.2   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-A700/A701 series.

Refer to *page 4* for details of compatible inverters.

1.2.1 Product confirmation

Check the enclosed items.

Plug-in option 1	Mounting screw (M3 × 6mm) .... 2 *(Refer to page 8.)*	Hex-head screw for option mounting (5.5mm) .... 1 *(Refer to page 8.)*
		5.5mm

1.2.2 Parts

Front view

Rear view

Terminal block

Mounting hole

Mounting hole

Mounting hole

FR-A7AZ

Switch for manufacturer setting (SW3)
Do not change from initially-set status
(1, 2: OFF).

Switch for manufacturer setting (SW1)
Do not change from initially-set status
(1, 2: ON).

Switch for thermistor calibration (SW2)
Change the setting when calibrating the
thermistor. *(Refer to page 34.)*

Connector
Connect to the inverter
option connector.
(Refer to page 8.)

Mounting hole

Terminal layout

*1	5			6	*2
*2	TST			TST	
*1	5			DA1	
*1	5			5	*1
*1	5			5	*1
	TH2			TH1	

* 1 All terminal 5 are connected internally.
* 2 TST are not used. Keep these open.
Accidental connection will damage the
option.

1

3

1.3   Compatible inverters

This product can be used with the FR-A700 series inverters assembled in and after July 2006 and the FR-A701 series.

Check the SERIAL number indicated on the inverter rating plate or package.

Refer to *the Inverter Manual* for the location of the rating plate.

Rating plate example

☐	6	7	○○○○○○
Symbol	Year	Month	Control number

SERIAL (Serial No.)

The SERIAL consists of one symbol, two characters indicating production year and month, and six characters indicating 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.)

(1) Japanese specification/NA specification

Type	SERIAL (the first three digits)
FR-A720-0.4K to 90K, FR-A740-0.4K to 500K	☐67〇〇〇〇〇〇〇 or later
FR-A720-00030 to 03460-NA, FR-A740-00015 to 09620-NA	

(2) CHT specification

Type	SERIAL	Type	SERIAL
FR-A740-0.4K/0.75K-CHT	M67〇〇〇〇〇〇〇 or later	FR-A740-185K to 250K-CHT	F67〇〇〇〇〇〇〇 or later
FR-A740-1.5K to 3.7K-CHT	N67〇〇〇〇〇〇〇 or later	FR-A740-280K-CHT	G67〇〇〇〇〇〇〇 or later
FR-A740-5.5K/7.5K-CHT	M67〇〇〇〇〇〇〇 or later	FR-A740-315K-CHT	F67〇〇〇〇〇〇〇 or later
FR-A740-11K to 22K-CHT	N67〇〇〇〇〇〇〇 or later	FR-A740-355K-CHT	D67〇〇〇〇〇〇〇 or later
FR-A740-30K to 55K-CHT	K67〇〇〇〇〇〇〇 or later	FR-A740-400K/450K-CHT	F67〇〇〇〇〇〇〇 or later
FR-A740-75K to 160K-CHT	G67〇〇〇〇〇〇〇 or later	FR-A740-500K-CHT	G67〇〇〇〇〇〇〇 or later

1

(3) EC specification

Type	SERIAL (the first three digits)
FR-A740-00023 to 00620-EC	E67 or later
FR-A740-00770 to 12120-EC*	D67 or later

* For the FR-A740-00770 to 12120-EC
  Check the SERIAL indicated on the serial number sticker shown below.

Serial number sticker example
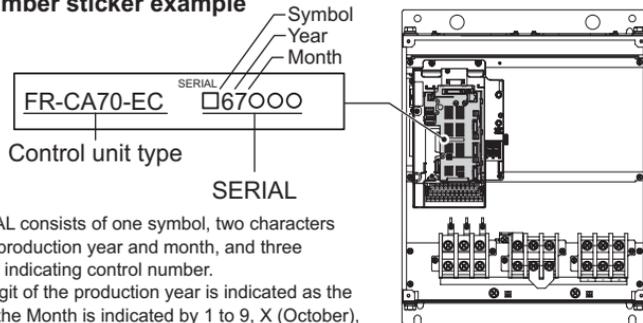

```
                          Symbol
                        ┌ Year
                        ├ Month
                   SERIAL
FR-CA70-EC       □67○○○
───────────
Control unit type
                       │
                   SERIAL
```

The SERIAL consists of one symbol, two characters indicating production year and month, and three characters indicating 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.)

• To check the SERIAL, the front cover must be removed.
  For the removal of the front cover, refer to *the Inverter Manual*.

# 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.**

⚠ **Static electricity in your body must be discharged before you touch the product. Otherwise the product may be damaged.**

2.2　Installation procedure
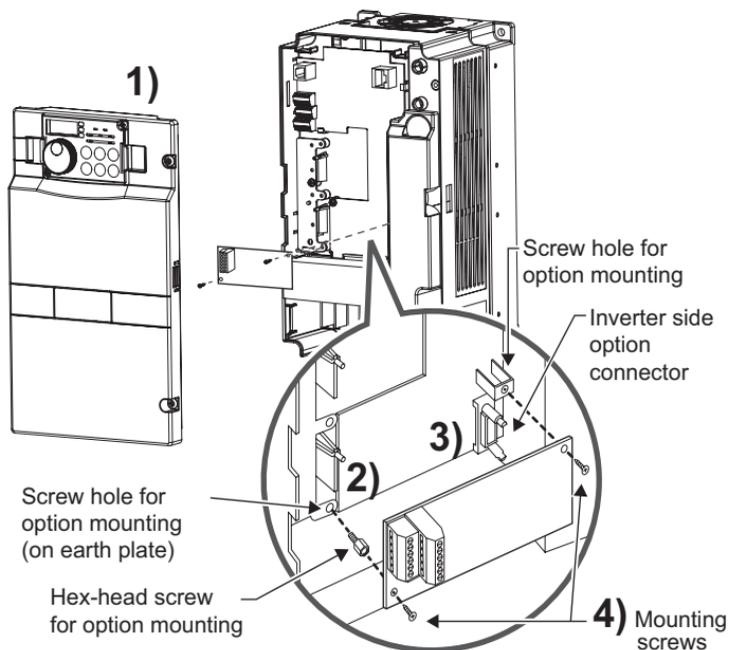
1) Remove the inverter front cover.

2) Mount the hex-head screw for option mounting into the inverter screw hole (on earth plate). (Size 5.5mm, tightening torque 0.56N·m to 0.75N·m)

3) Securely fit the connector of the plug-in option to the inverter connector along the guides.

4) Securely fix the both right and left sides of the plug-in option to the inverter with the accessory mounting screws. (Tightening torque 0.33N·m to 0.40N·m) If the screw holes do not line-up, the connector may not have been plugged securely. Check for loose plugging.

REMARKS

· After removing two screws on the right and left places, remove the plug-in option.
(When the plug-in option is mounted in the connector 3, it is easier to remove the plug-in option after removing a control circuit terminal block.)

——— **CAUTION** ———

- **Only one type of option per inverter may be used. When two or more options are mounted, priority is in order of inverter option connectors 1, 2 and 3, the options having lower priority are inoperative.**
- **When the inverter cannot recognize that the option is mounted due to improper installation, etc., " $E.\ \ 1$ to $E.\ \ 3$ " (option alarm) are displayed. The errors shown differ according to the mounting positions (connectors 1, 2, 3).**

Mounting Position	Error Display
Connector 1	$E.\ \ 1$
Connector 2	$E.\ \ 2$
Connector 3	$E.\ \ 3$

- **Take care not to drop a hex-head screw for option mounting or mounting screw during mounting and removal.**
- **Pull out the option straight to remove. Otherwise, the connector may be damaged.**

2

2.3 Wiring

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

Shield
(perform protective treatment)

Sheath

Shielded twisted
pair cable
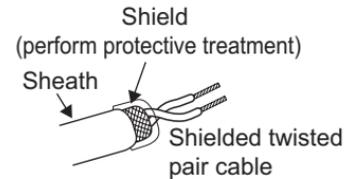
Strip off the sheath for the below length. If the length of the sheath peeled is too long, a short circuit
may occur with neighboring wires. If the length is too short, wires might come off.
Wire the stripped cable after twisting it to prevent it from becoming loose. In addition, do not solder it

Cable stripping length

5mm
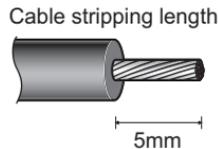
Use a blade terminal as necessary.

REMARKS

• Information on blade terminals
  Commercially available product examples (as of January 2010)

Terminal Screw Size	Cable Size (mm²)	Blade Terminal Model		Manufacturer
		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 the 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
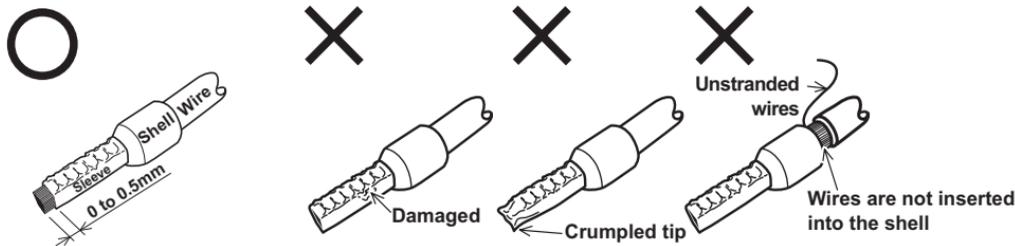
═══ **CAUTION** ═══
The wiring length should be 30m maximum.

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

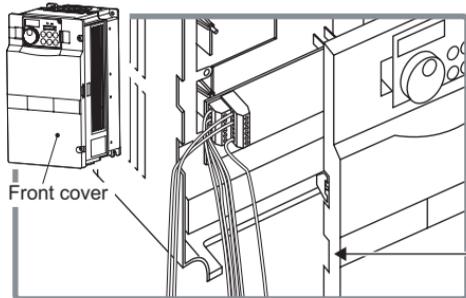| Screw Size	Tightening Torque	Cable Size	Screwdriver
M2	0.22N·m to 0.25N·m	0.3mm² to 0.75mm²	Small ⊖ flat-blade screwdriver (Tip thickness: 0.4mm/tip width: 2.5mm)

=== **CAUTION** ===

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

(3) For wiring of the **inverter which has one front cover**, route cables between the control circuit terminal block and front cover. If cables cannot be routed between the control circuit terminal block and front cover due to the increased number of cables, remove a hook of the front cover and use a space become available.
For wiring of **the inverter which has front covers 1 and 2**, use the space on the left side of the control circuit terminal block.

Cut off with a nipper, etc.

Cut off a hook on the inverter front cover side surface. (Cut off so that no portion is left.)

Front cover

Inverter which has one front cover

Front cover 1
Front cover 2

Control circuit terminal block

Inverter which has front covers 1 and 2
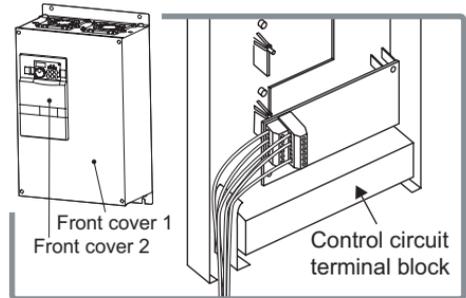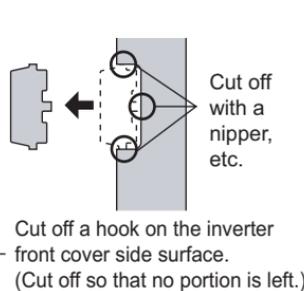
2

REMARKS

When the hook of the inverter front cover is cut off for wiring, the protective structure (JEM1030) changes to open type (IP00).

⚠ **CAUTION**

⚠ **When performing wiring using the space between the inverter front cover and control circuit terminal block, take caution 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.**

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3 PARAMETER LIST

Use the following parameters with the FR-A7AZ.
Set these as required.

Parameter Number	Name	Setting Range	Minimum Increments	Initial Value	Refer to Page
406 *1	High resolution analog input selection	0, 2 to 6, 9999	1	9999	*21*
407 *1	Motor temperature detection filter	0 to 100s, 9999	1s	9999	*30*
408 *1	Motor thermistor selection	0, 1	1	0	*30*
750 *1	Motor temperature detection level	0 to 200°C	1°C	75°C	*37*
751 *1	Reference motor temperature	1 to 200°C	1°C	150°C	*38*
838 *1	DA1 terminal function selection	1 to 3, 5 to 14, 17, 18, 21, 24, 32 to 34, 36, 46, 50, 52, 53	1	2	*16*
839 *1	DA1 output filter	0 to 5s	0.001s	0.05s	*16*
846	Torque bias balance compensation	0 to 10V, 9999	0.1V	9999	*21*
847	Fall-time torque bias terminal 1 bias	0 to 400%, 9999	1%	9999	*21*
848	Fall-time torque bias terminal 1 gain	0 to 400%, 9999	1%	9999	*21*
857 *1	DA1-0V adjustment	900 to 1100%	1%	1000%	*16*
C0 (900) *2	FM(CA) terminal calibration	–	–	–	*16*
C29 (925) *1, 2	Motor temperature detection calibration (analog input)	0 to 200%	0.1%	100%	*30*
C30 (926) *2	Terminal 6 bias frequency (speed)	0 to 400Hz	0.01Hz	0Hz	*21*

Parameter Number	Name	Setting Range	Minimum Increments	Initial Value	Refer to Page
C31 (926) *2	Terminal 6 bias (speed)	0 to 300%	0.1%	0%	*21*
C32 (927) *2	Terminal 6 gain frequency (speed)	0 to 400Hz	0.01Hz	60Hz (50Hz) *3	*21*
C33 (927) *2	Terminal 6 gain (speed)	0 to 300%	0.1%	100%	*21*
C34 (928) *2	Terminal 6 bias command (torque)	0 to 400%	0.1%	0%	*21*
C35 (928) *2	Terminal 6 bias (torque)	0 to 300%	0.1%	0%	*21*
C36 (929) *2	Terminal 6 gain command (torque)	0 to 400%	0.1%	150%	*21*
C37 (929) *2	Terminal 6 gain (torque)	0 to 300%	0.1%	100%	*21*

*1   They can be set only when used with the FR-A7AZ.

*2   The parameter number in parentheses is the one for use with the parameter unit (FR-PU07/FR-PU04).

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

3

4 BIPOLAR ANALOG OUTPUT

Bipolar analog output is available with FR-A7AZ.
Outputting 0 to ±10VDC enables output frequency, output voltage, etc. to be monitored with a DC voltage meter.

4.1 Connection diagram
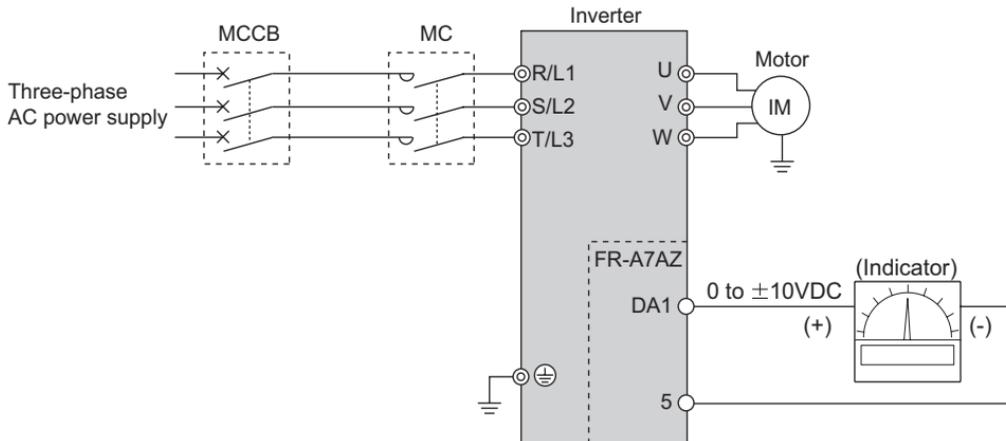
4.2   Terminals
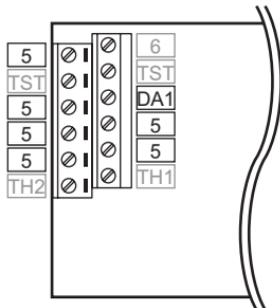
Terminal Symbol	Terminal Name	Description
DA1	Bipolar analog output terminal	Connect a DC indicator (±10VDC).
5	Common terminal	Common terminal of the DA1

4.3   Bipolar analog outputting parameter

4.3.1   Parameter list

The following parameters are used for outputting bipolar analog.

Parameter Number	Name	Setting Range	Minimum Increments	Initial Value
838 *1	DA1 terminal function selection	1 to 3, 5 to 14, 17, 18, 21, 24, 32 to 34, 36, 46, 50, 52, 53	1	2
839 *1	DA1 output filter	0 to 5s	0.001s	0.05s
857 *1	DA1-0V adjustment	900% to 1100%	1%	1000%
C0 (900) *2	FM(CA) terminal calibration	—	—	—

*1   They can be set only when used with the FR-A7AZ.

*2   The parameter number in parentheses is the one for use with the parameter unit (FR-PU07/FR-PU04).

4

4.3.2 Calibration of the indicator (Pr. 838, Pr. 857, C0)

Refer to the following flow chart to calibrate the indicator.

Start	
Connect the indicator across terminals DA1 and terminal 5.	At this time, check that the polarity is correct. Terminal DA1 is plus.
Use *Pr. 857* to make calibration of indicator at 0 voltage.	If the indicator needle does not point to 0 when voltage output is 0, adjust the setting value of *Pr. 857 DA1 0V adjustment* in between 900% and 1100%.
Set "21" (reference voltage output) in *Pr. 838*.	Setting "21" in *Pr. 838* outputs 10VDC to deflect the indicator needle.
Run the inverter	If the inverter is at a stop, (press the $\boxed{\text{FWD}}$ or $\boxed{\text{REV}}$) to start the inverter. (Motor needs not be connected.)
Use *C0 (Pr. 900)* to make adjustment, then set.	Turn $\bigcirc$ to adjust the indicator needle to deflect to full-scale, then press $\boxed{\text{SET}}$ to set.
End	

Use *Pr. 838* to set the types of the signals to be monitored. *(Refer to page 19.)*

=== CAUTION ===

- **If calibration is performed without setting "21" (reference voltage output) in *Pr. 838*, terminal FM of the inverter is calibrated.**
- **When FR-A7AZ is remounted on other inverter, use *Pr. 857* and *C0 (Pr. 900)* of the inverter with the option to calibrate again.**
- **When FR-A7AZ and FR-A7AY are used together with "1 or 11" set in *Pr. 309 Analog output signal voltage/current switchover* and "21" set in *Pr. 310 Analog meter voltage output selection*, *C0 (Pr. 900)* calibrates terminal AM0 of the FR-A7AY. (*Pr. 309* and *Pr. 310* are parameters for FR-A7AY. Refer to** *the Instruction Manual of the FR-A7AY* **for details of *Pr. 309* and *Pr. 310*.)**

4.3.3 Monitor item list

- Set the monitor to be output to the terminal DA1 (bipolar analog output (0 to ±10VDC voltage output)) in *Pr. 838 DA1 terminal function selection*.
- Refer to the following table and set the monitor to be displayed. Refer to *the Inverter Manual* for details of monitors.

Pr. 838 Setting	Types of Monitor	Increments	Terminal DA1 Full Scale Value
1 *1	Output frequency	0.01Hz	*Pr. 55*
2	Output current	0.01A/0.1A *2	*Pr. 56*
3	Output voltage	0.1V	400V/800V
5	Frequency setting value	0.01Hz	*Pr. 55*
6 *1	Running speed	1(r/min)	The value converted with the *Pr. 37* value from *Pr. 55*.
7 *3	Motor torque	0.1%	*Pr. 866*
8	Converter output voltage	0.1V	400V/800V
9	Regenerative brake duty	0.1%	*Pr. 70*
10	Electronic thermal relay function load factor	0.1%	100%
11	Output current peak value	0.01A/0.1A *2	*Pr. 56*
12	Converter output voltage peak value	0.1V	400V/800V
13	Input power	0.01kW/0.1kW *2	Rated inverter power × 2
14	Output power	0.01kW/0.1kW *2	Rated inverter power × 2
17 *3	Load meter	0.1%	*Pr. 866*
18	Motor excitation current	0.01A/0.1A *2	*Pr. 56*
21	Reference voltage output	–	–
24	Motor load factor	0.1%	200%

Pr. 838 Setting	Types of Monitor	Increments	Terminal DA1 Full Scale Value
32 *3	Torque command	0.1%	*Pr. 866*
33 *3	Torque current command	0.1%	*Pr. 866*
34 *4	Motor output	0.01kW/0.1kW *2	Rated motor capacity
36 *4, 5	Torque monitor (driving/regenerative polarity switching)	–	*Pr. 866*
46	Motor temperature	1°C	200°C
50	Power saving effect	Variable according to parameters	Inverter capacity
52	PID set point	0.1%	100%
53	PID process value	0.1%	100%

*1 Positive (plus) output during forward rotation and negative (minus) output during reverse rotation.
*2 Differ according to capacities. (55K or lower/75K or higher) The inverter models 55K and 75K differ according to -NA and -EC versions. *(Refer to page 1.)*
*3 Positive voltage is output during forward driving/reverse regeneration and negative voltage is output during reverse driving/forward regeneration.
*4 Positive voltage is output during forward driving/reverse driving and negative voltage is output during forward regeneration/reverse regeneration.
*5 Torque monitor cannot be assigned to the terminal FM(CA)/AM of the inverter.

4

4.3.4 Terminal DA1 response level adjustment (Pr. 839)

· The response level of the output voltage of the terminal DA1 can be adjusted between 0 and 5s with *Pr. 839*.

· Increasing the setting stabilizes the terminal DA1 output more but reduces the response level.

REMARKS

· Response time of the terminal DA1 is a total of the set value in *Pr.839 DA1 output filter* and a variable (up to 5ms).
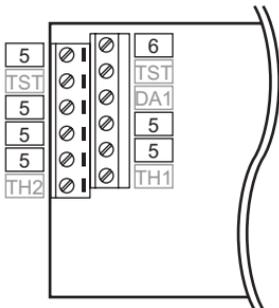
5 HIGH RESOLUTION ANALOG INPUT

High resolution analog input is available with FR-A7AZ.

Inputting 0 to ±10VDC voltage enables speed command, torque limit command, torque command, torque bias, and stall prevention operation level input.

5.1 Connection diagram
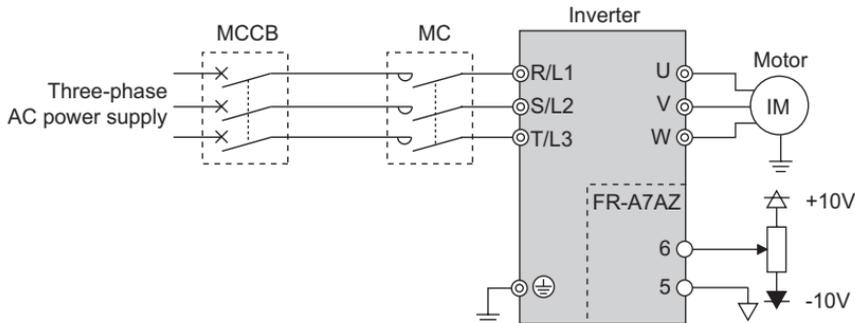
5.2 Terminals

Terminal Symbol	Terminal Name	Description
6	High resolution input terminal	Terminal for 0 to ±10VDC high resolution (16 bits) analog voltage input. Use *Pr. 406 High resolution analog input selection* to select terminal function. Maximum permissible voltage: ±20VDC
5	Common terminal	Common terminal of terminal 6

5.3 High resolution analog input parameter

5.3.1 Parameter list

Use the following parameters for high resolution analog input.

Parameter Number	Name	Setting Range	Minimum Increments	Initial Value
406 [*1], [*2]	High resolution analog input selection	0, 2 to 6, 9999	1	9999
846	Torque bias balance compensation	0 to 10V, 9999	0.1V	9999
847	Fall-time torque bias terminal 1 bias	0 to 400%, 9999	1%	9999
848	Fall-time torque bias terminal 1 gain	0 to 400%, 9999	1%	9999
C30 (926) [*1], [*3]	Terminal 6 bias frequency (speed)	0 to 400Hz	0.01Hz	0Hz
C31 (926) [*1], [*3]	Terminal 6 bias (speed)	0 to 300%	0.1%	0%
C32 (927) [*1], [*3]	Terminal 6 gain frequency (speed)	0 to 400Hz	0.01Hz	60Hz (50Hz) [*4]
C33 (927) [*1], [*3]	Terminal 6 gain (speed)	0 to 300%	0.1%	100%
C34 (928) [*1], [*3]	Terminal 6 bias command (torque)	0 to 400%	0.1%	0%
C35 (928) [*1], [*3]	Terminal 6 bias (torque)	0 to 300%	0.1%	0%
C36 (929) [*1], [*3]	Terminal 6 gain command (torque)	0 to 400%	0.1%	150%
C37 (929) [*1], [*3]	Terminal 6 gain (torque)	0 to 300%	0.1%	100%

*1 They can be set only when used with the FR-A7AZ.

*2 For *Pr. 406* , write is disabled during operation even when "2" is set in *Pr. 77*. When changing the parameter setting, stop the operation.

*3 The parameter number in parentheses is the one for use with the parameter unit (FR-PU07/FR-PU04).

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

5.3.2 Selection of terminal 6 function (Pr. 406)

(1) Terminal 6 function list

Functions of terminal 6 change according to the *Pr. 406* setting and control method.

When a function is assigned to the terminal 6 while the same function is assigned to the terminal 1, 2, or 4, the input to the terminal 1, 2 or 4 becomes invalid.

Pr. 406 Setting	V/F Control/ Advanced Magnetic Flux Vector Control	Real Sensorless Vector Control/ Vector Control		Vector Control	Remarks
		Speed control	Torque control	Position control	
0	Speed command	Speed command	Speed limit	—	Speed command and speed limit are not available with terminal 2.
2	—	Regenerative torque limit (*Pr. 810* = 1)	—	Regenerative torque limit (*Pr. 810* = 1)	Regenerative torque limit is not available with terminal 1.
3	—	—	Torque command (*Pr. 804* = 0)	—	Torque command is not available with terminal 1.
4	Stall prevention operation level input	Torque limit (*Pr. 810* = 1)	Torque command (*Pr. 804* = 0)	Torque limit (*Pr. 810* = 1)	Stall prevention operation level input and torque limit are not available with terminal 1 or 4. Torque command is not available with terminal 1.
5	—	—	Forward/reverse rotation speed limit (*Pr. 807* = 2)	—	Forward/reverse rotation speed limit is not available with terminal 1.
6	—	Torque bias (*Pr. 840* = 1, 2, 3)	—	—	Torque bias is not available with terminal 1.
9999 (initial value)	—	—	—	—	Terminal 6 is invalid.

5

(2) Filter of terminal 6 input

When giving the speed command or limiting the speed from terminal 6 input, settings of *Pr. 822 Speed setting filter 1* and *Pr. 832 Speed setting filter 2* are valid.

When giving the torque command or limiting the torque from terminal 6 input, settings of *Pr. 826 Torque setting filter 1* and *Pr. 836 Torque setting filter 2* are valid.

Refer to *the Inverter Manual* for details of *Pr. 822 Speed setting filter 1, Pr. 832 Speed setting filter 2, Pr. 826 Torque setting filter 1, and Pr. 836 Torque setting filter 2*.

(3) Calibration and adjustment of terminal 6

When "0" is set in *Pr.406,* terminal 6 is used for speed command and speed limit inputs, and terminal 2 becomes invalid for those inputs.

Pr. 242 Terminal 1 added compensation amount (terminal 2) becomes valid for terminal 6 and compensation of terminal 6 input is made by terminal 1 input.

Pr. 849 Analog input offset adjustment becomes valid for terminal 6 and terminal 6 input is provided with offset.

Refer to *the Inverter Manual* for details of *Pr. 242 Terminal 1 added compensation amount (terminal 2)* and *Pr. 849 Analog input offset adjustment*.

(4) Torque bias of terminal 6

When "6" is set in *Pr. 406 High resolution analog input selection*, terminal 6 is used for torque bias input.

Pr. 846 Torque bias balance compensation, Pr. 847 Fall-time torque bias terminal 1 bias, Pr. 848 Fall-time torque bias terminal 1 gain become valid for terminal 6.

## 5.3.3 Calibration of terminal 6 (Pr. 148, Pr. 149, Pr. 846 to Pr. 848, C30 to C37)

(1) Terminal 6 calibration parameter

Use the following parameters for calibration of terminal 6 according to the *Pr. 406* setting.

Pr. 406 Setting	Terminal 6 Function	Calibration Parameters		Related Parameters
		Bias setting	Gain setting	
0	Speed command/ speed limit	*C30 (Pr. 926) Terminal 6 bias frequency (speed)* *C31 (Pr. 926) Terminal 6 bias (speed)*	*C32 (Pr. 927) Terminal 6 gain frequency (speed)* *C33 (Pr. 927) Terminal 6 gain (speed)*	*Pr. 822, Pr. 832* *Pr. 242, Pr. 849*
2	Regenerative torque limit	*C34 (Pr. 928) Terminal 6 bias command (torque)* *C35 (Pr. 928) Terminal 6 bias (torque)*	*C36 (Pr. 929) Terminal 6 gain command (torque)* *C37 (Pr. 929) Terminal 6 gain (torque)*	*Pr. 826, Pr. 836*
3	Torque command	*C34 (Pr. 928) Terminal 6 bias command (torque)* *C35 (Pr. 928) Terminal 6 bias (torque)*	*C36 (Pr. 929) Terminal 6 gain command (torque)* *C37 (Pr. 929) Terminal 6 gain (torque)*	*Pr. 826, Pr. 836*
4	Torque limit/ torque command	*C34 (Pr. 928) Terminal 6 bias command (torque)* *C35 (Pr. 928) Terminal 6 bias (torque)*	*C36 (Pr. 929) Terminal 6 gain command (torque)* *C37 (Pr. 929) Terminal 6 gain (torque)*	*Pr. 826, Pr. 836*
	Stall prevention operation level	*Pr. 148 Stall prevention level at 0V input*	*Pr. 149 Stall prevention level at 10V input*	
5	Forward rotation reverse rotation speed limit	*C30 (Pr. 926) Terminal 6 bias frequency (speed)* *C31 (Pr. 926) Terminal 6 bias (speed)*	*C32 (Pr. 927) Terminal 6 gain frequency (speed)* *C33 (Pr. 927) Terminal 6 gain (speed)*	*Pr. 822, Pr. 832*
6	Torque bias	*C34 (Pr. 928) Terminal 6 bias command (torque)* *C35 (Pr. 928) Terminal 6 bias (torque)* *Pr. 846 Torque bias balance compensation* *Pr. 847 Fall-time torque bias terminal 1 bias*	*C36 (Pr. 929) Terminal 6 gain command (torque)* *C37 (Pr. 929) Terminal 6 gain (torque)* *Pr. 846 Torque bias balance compensation* *Pr. 848 Fall-time torque bias terminal 1 gain*	
9999 (initial value)	—	—	—	

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**(2) Calibration of speed command/speed limit (***Pr. 406* = "0, 5"**)**

When *Pr. 406* = "0, 5", terminal 6 acts as speed command or speed limit input and *C30 to C33* are used for calibration parameter.
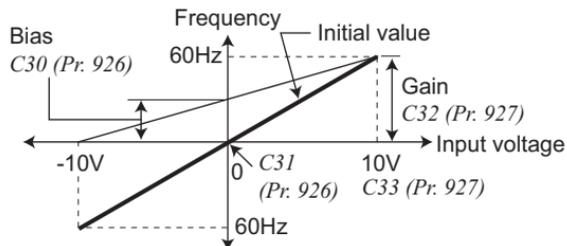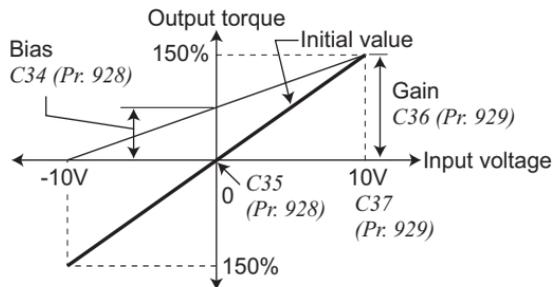

(3) Calibration of torque command/torque limit (*Pr. 406* = "2, 3, 4"**)**

When *Pr. 406* = "2, 3, 4" under Real sensorless vector control or vector control, terminal 6 acts as torque command or torque limit input and *C34 to C 37* are used for calibration parameters.
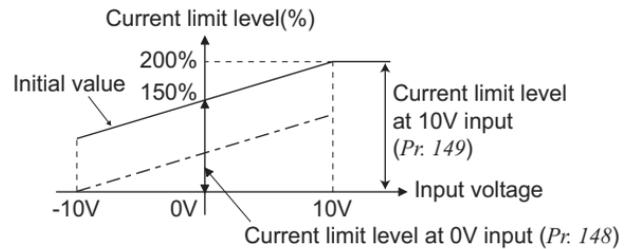
<Torque limit, regenerative torque limit>　　　　**<Torque command>**
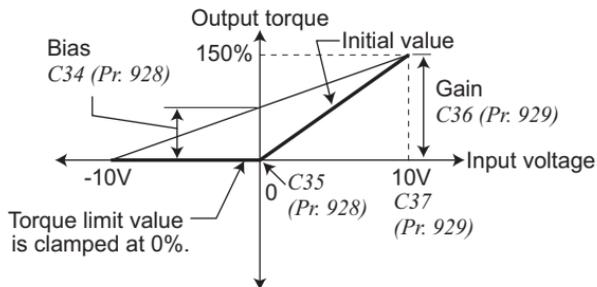
(4) Calibration of stall prevention operation level (*Pr. 406* **= "4")**
When *Pr. 406* = "4" under V/F control and Advanced magnetic flux vector control, terminal 6 acts as stall prevention operation level and *Pr. 148* and *Pr. 149* are used for calibration parameter.
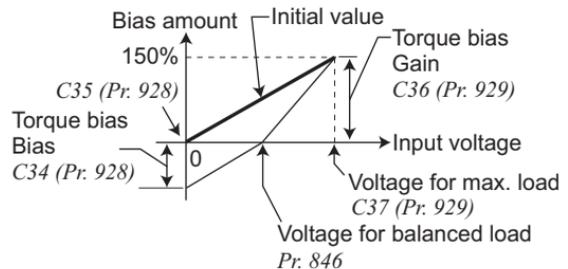

Current limit level(%)

Initial value

200%
150%

Current limit level at 10V input (*Pr. 149*)

-10V   0V   10V   → Input voltage

Current limit level at 0V input (*Pr. 148*)

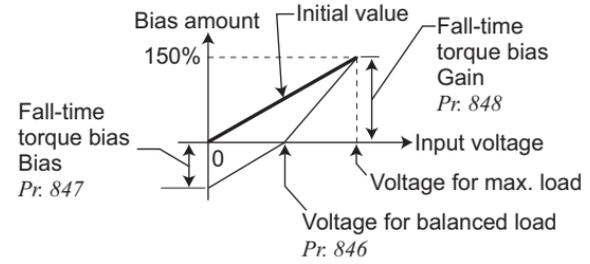**(5) Calibration of torque bias input (***Pr. 406* **= "6")**
When *Pr. 406* = "6", terminal 6 acts as torque bias input and *Pr. 846 to Pr. 848, C34 to C37* are used for calibration parameter.

Pr. 840 = "1" (at driving when the motor is in forward rotation)

<When the motor runs in forward rotation direction>

Bias amount ┌Initial value
150%

Torque bias Gain
C36 (Pr. 929)

Torque bias Bias
C34 (Pr. 928)

0 → Input voltage

Voltage for max. load
C37 (Pr. 929)

Voltage for balanced load
Pr. 846

<When the motor runs in reverse rotation direction>

Bias amount ┌Initial value
150%

Fall-time torque bias Gain
Pr. 848

Fall-time torque bias Bias
Pr. 847

0 → Input voltage

Voltage for max. load

Voltage for balanced load
Pr. 846

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Pr. 840 = "2" (at regeneration when the motor is in forward rotation)

<When the motor runs in forward rotation direction>

Bias amount
Torque bias
Bias
C34 (Pr. 928)
Voltage for balanced load
Pr. 846
Voltage for max. load
C37 (Pr. 929)
Input voltage
C35 (Pr. 928)
Torque bias
Gain
C36 (Pr. 929)
150%
Initial value
0

<When the motor runs in reverse rotation direction>

Bias amount
Fall-time
torque bias
Bias
Pr. 847
Voltage for balanced load
Pr. 846
Voltage for max. load
Input voltage
Fall-time
torque bias
Gain
Pr. 848
150%
Initial value
0
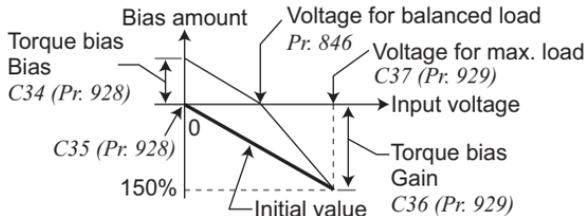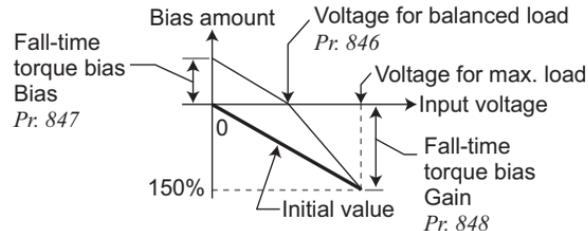
5.4　Noise reduction techniques

When operation is unstable due to Electro-Magnetic Interference (EMI), take measures referring to below.

(1)　Measures at wiring

· Separate the power cable as far away as possible from the signal cable.
· Use a shielded twisted pair cable for a signal cable.
　Take one of appropriate measures below for the shielded cable.

· Connect to terminal 5 of the FR-A7AZ.
· Connect to the common terminal of an analog command device.
· Connect to both terminal 5 of the FR-A7AZ and common terminal of the analog command device.
· Leave both terminal 5 of the FR-A7AZ and common terminal of the analog command device open. (leave the shielded cable suspended)

---

(2) Measures of inverter
· If a large value is set in *Pr. 72 PWM frequency selection*, decrease the *Pr. 72* setting. (Noise from the motor increases.)
· Increase the setting of speed (torque) setting filter *Pr. 822, Pr. 832 (Pr. 826, Pr. 836)* .

===== CAUTION =====

As changing the speed (torque) setting filter will affect the response level of the inverter to the command, adjust the setting by looking at the machine movement.

(3) Measures of option
· Install the line noise filter FR-BLF (FR-BSF01 for the 3.7K or lower).

REMARKS

· Refer to *the Inverter Manual* for details of measures for EMI.

5.5 Specifications

Frequency setting resolution ..... 0.01Hz/0 to 60Hz (-10 to +10V)
(0.015Hz/0 to 60Hz when option is not mounted)
Torque setting resolution .... 0.024%/0 to 100% (-10 to +10V)
(0.1%/0 to 100% when option is not mounted)
Input resistance 10kΩ
Maximum input voltage .... ±20VDC

5

6 MOTOR THERMISTOR INTERFACE

A vector-controlled motor with thermistor (SF-V5RU☐☐☐☐☐T/A) detects the motor temperature with the motor-side thermistor and sends the detected temperature to the inverter as a feedback. This operation reduces fluctuation of the generated torque due to temperature changes. The detected motor temperature can be output as an output signal (Y55 signal) or be displayed on the monitor.

(The motor temperature detection signal (Y55) and the motor temperature monitor output are available in the FR-A700 series inverters manufactured in December 2010 or later. For how to find the SERIAL number, *refer to page 4*.)
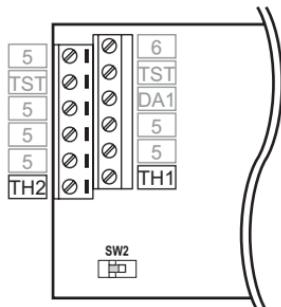
Torque accuracy is ±3%.

6.1 Connection diagram
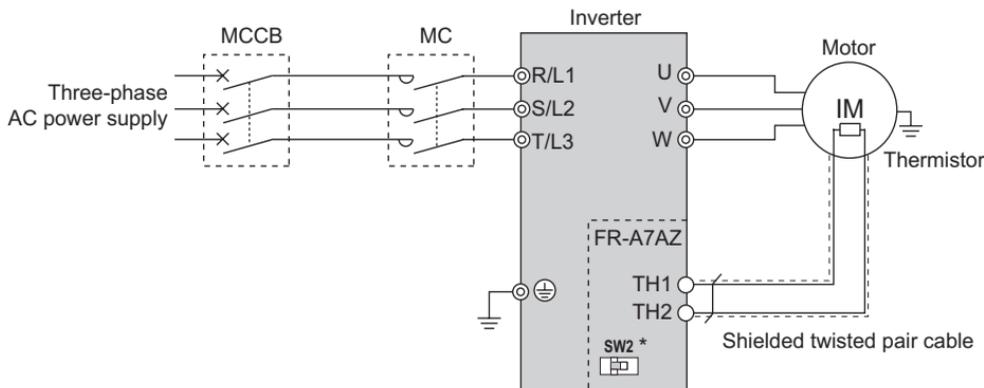
* When calibrating the thermistor, change the thermistor calibration status switch. *(Refer to page 34.)*

=== CAUTION ===

· **To detect temperature with FR-A7AZ, be sure to use the SF-V5RU☐☐☐☐☐T/A, a dedicated motor with thermistor.**

6.2 Terminals

Terminal Symbol	Terminal Name	Description
TH1	Thermistor input 1	Input the motor side thermistor output signal.
TH2	Thermistor input 2	
SW2	Thermistor calibration status switch	When calibrating at installation, change the switch to place the inverter in calibration status.

6.3 Motor thermistor parameter

6.3.1 Parameter list

Parameters below are used for motor thermistor interface.
Following parameters are available only when used with FR-A7AZ.

Parameter Number	Name	Setting Range	Minimum Increments	Initial Value
407	Motor temperature detection filter	0 to 100s, 9999	1	9999
408	Motor thermistor selection	0, 1	1	0
750	Motor temperature detection level	0 to 200°C	1°C	75°C
751	Reference motor temperature	1 to 200°C	1°C	150°C
C29 (925) *	Motor temperature detection calibration (analog input)	0 to 200%	0.1%	100%

* The parameter number in parentheses is the one for use with the parameter unit (FR-PU07/FR-PU04).

6

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6.3.2 Thermistor setting

When using the thermistor interface, set *Pr. 408 Motor thermistor selection* according to the motor type.
Its initial value is "0" (SF-V5RU□□□□□T). Set this parameter according to the motor.

Parameter	Name	Initial Value	Minimum Setting Increments	Setting Range	Description
408	Motor thermistor selection	0	1	0	SF-V5RU□□□□□T
				1	SF-V5RU□□□□□A

6.3.3 Activating the motor thermistor

Set *Pr.407* ≠ "9999" to activate the motor thermistor. Activation of the motor thermistor enables thermal protection of the motor and slip compensation.

· Normally set about "30s" in *Pr.407*.
· When the response is slow to the motor temperature, set a smaller value.

(1) Thermal protection of the motor

· When the motor temperature remains at 145°C or higher for 10s, motor overload trip (E.THM) activates to shut off the inverter output.
· When the motor temperature goes to -30°C or lower during operation, motor overload trip (E.THM) activates to shut off the inverter output. Motor overload trip (E.THM) does not occur during a stop.

=== CAUTION ===

· **When operation is performed with the thermal protection function valid without a thermistor or in the calibration status, protection function activates to shut off the inverter output.**
· **Since a dedicated motor with thermistor has no thermal protector, always set a value other than "9999" in *Pr.407 Motor temperature detection filter* to make the thermal protection function valid.**
  When the setting remains "9999", motor protection is not activated. (Electronic thermal O/L relays operate following the current value set in *Pr.9 Electronic thermal O/L relay*.)

(2) Slip compensation (R2 compensation)

Slip compensation (R2 compensation) is available during vector control.
Slip frequencies are compensated according to temperatures detected by the thermistor.

REMARKS

· Setting *Pr.407* ≠ "9999" disables the magnetic flux observer setting (*Pr.95* = "2").

6.3.4 Thermistor calibration (C29)

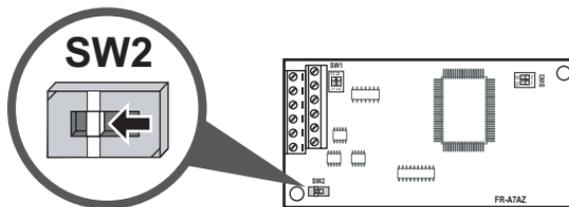Perform calibration of the inverter and FR-A7AZ (thermistor interface) at installation, before starting the motor.

========= **CAUTION** =========
· **Calibration must be performed at installation.**

(1) Calibration method

1) Set the thermistor calibration status switch (SW2) to the line to place the FR-A7AZ in the calibration status.
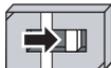

2) Read *C29 (Pr. 925)* and set the compensation value.
  · Compensation using the operation panel (FR-DU07) ☞ *refer to page 35*
  · Compensation using the parameter unit (FR-PU07) ☞ *refer to page 36*

3) After compensation, reset the thermistor calibration status switch (SW2) to the original position.

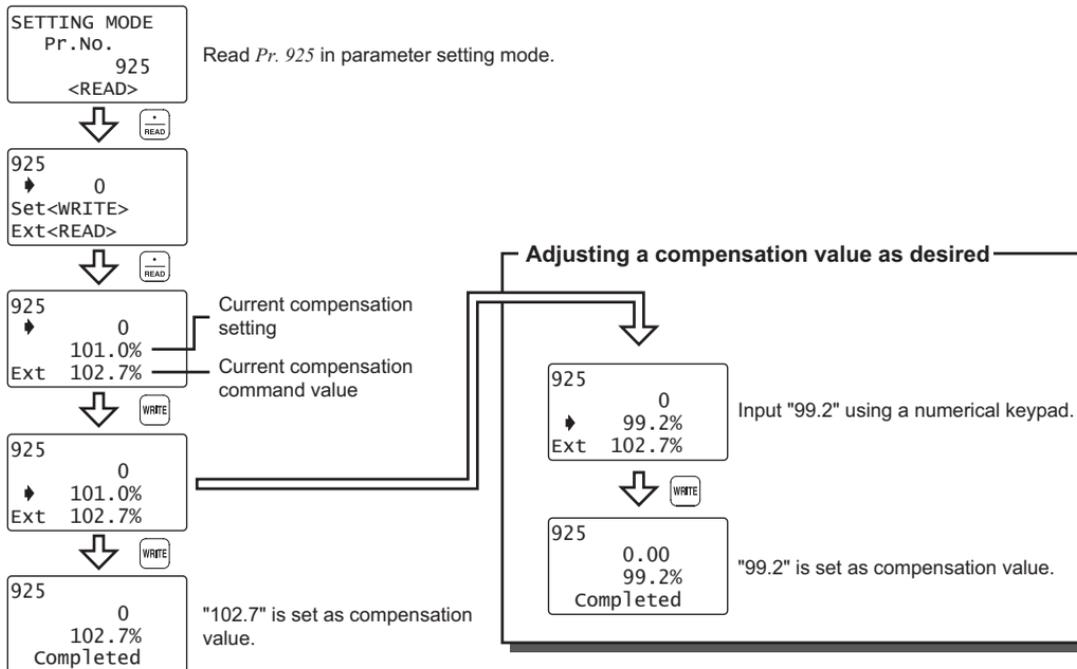========= **CAUTION** =========
· **Always return the SW2 to the original position after calibration. Starting the motor in the calibration status results in motor overload trip (E.THM), shutting off the inverter output.**

(2) Operation example of compensation value setting

1) Calibration using the operation panel (FR-DU07)

Display	Description
C 29	Select C29 in parameter setting mode.
⬇ (SET)	
102.7	Present compensation command value is displayed.
⬇ (SET)	
102.7 / **C 29**	"102.7" and "C29" are alternately displayed, then "102.7" is set as compensation value.

Adjusting a compensation value as desired

Turn ◯.

100.2 — The present setting at the instant of turning ◯ is displayed.

⬇ Turn ◯.

99.8

⬇ (SET)

99.8 — "99.8" flickers and "99.8" is set as compensation value.

2) Calibration using the parameter unit (FR-PU07)

```
SETTING MODE
  Pr.No.
        925
   <READ>
```
Read *Pr. 925* in parameter setting mode.

⬇ [·/READ]

```
925
♦     0
Set<WRITE>
Ext<READ>
```

⬇ [·/READ]

```
925
♦     0
    101.0%
Ext 102.7%
```
Current compensation setting
Current compensation command value

⬇ [WRITE]

```
925
      0
♦  101.0%
Ext 102.7%
```

⬇ [WRITE]

```
925
      0
    102.7%
  Completed
```
"102.7" is set as compensation value.

Adjusting a compensation value as desired

⬇

```
925
      0
♦    99.2%
Ext 102.7%
```
Input "99.2" using a numerical keypad.

⬇ [WRITE]

```
925
    0.00
    99.2%
  Completed
```
"99.2" is set as compensation value.

6.3.5 Motor temperature detection signal

When motor temperature exceeds the detection level, motor temperature detection signal (Y55) is output.
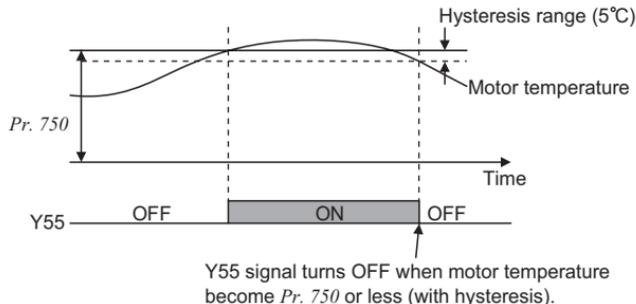(Set *Pr. 407 Motor temperature detection filter* ≠ "9999")

Set "55 (positive logic)" or "155 (negative logic)" in the following parameters to output the motor temperature detection signal (Y55) when motor temperature exceeds the detection level.

· *Pr.190 to Pr.196 Output terminal function selection* (Refer to *the Instruction Manual of the inverter* for details.)
· *Pr.313 to Pr.319 DO0 to DO6 output function selections* (Refer to *the Instruction Manual of FR-A7AY* for details.)
· *Pr.320 to Pr.322 RA1 to RA3 output function selections* (Refer to *the Instruction Manual of FR-A7AR* for details.)

Use the following parameter to adjust the temperature to output the motor temperature detection signal (Y55).

Parameter Number	Name	Initial Value	Minimum setting increments	Setting Range
750 *	Motor temperature detection level	75°C	1°C	0 to 200°C

* Read/write is enabled when using FR-A7AZ.

Y55 signal turns OFF when motor temperature become *Pr. 750* or less (with hysteresis).

REMARKS

· The motor temperature detection signal is not available when *Pr. 407* = "9999".

6.3.6 Motor temperature monitor output

Motor temperature monitoring is available from PU, DU, terminal AM, terminal FM/CA*, RS-485 communication, and output options. (Set *Pr. 407 Motor temperature detection filter* ≠ "9999")
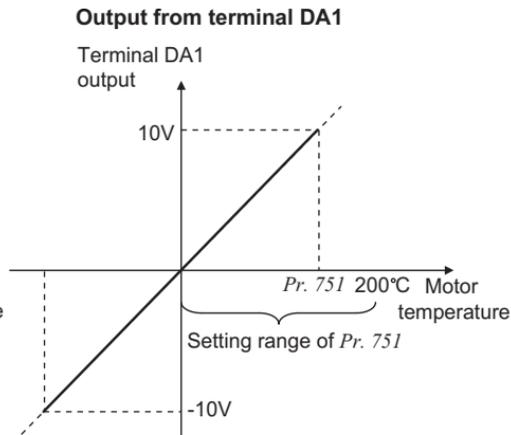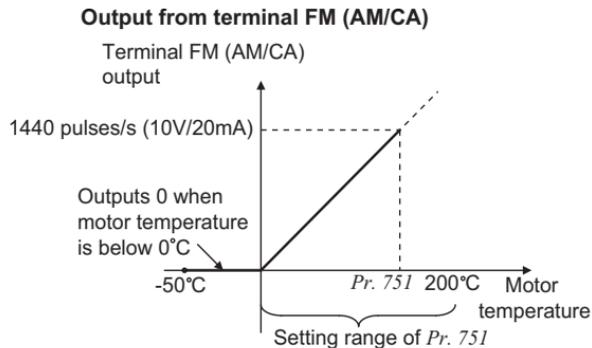Set "46" in the following parameters to monitor motor temperature from the assigned terminal or from PU/DU.

* Terminals provided differ according to the inverter.

· *Pr.52 DU/PU main display data selection, Pr.54 FM/CA terminal function selection, Pr.158 AM terminal function selection* (Refer to *the Instruction Manual of the inverter* for details.)
· *Pr.306 Analog output signal selection, Pr.310 Analog meter voltage output selection* (Refer to *the Instruction Manual of FR-A7AY* for details.)
· *Pr.838 DA1 terminal function selection* (Refer to *page 17*.)

Set the following parameter to adjust the motor temperature on the full scale.

Parameter Number	Name	Initial Value	Minimum setting increments	Setting Range
751 *	Reference motor temperature	150°C	1°C	1 to 200°C

* Read/write is enabled when using FR-A7AZ.

Output from terminal FM (AM/CA)

Terminal FM (AM/CA) output

1440 pulses/s (10V/20mA)

Outputs 0 when motor temperature is below 0°C

-50°C

Pr. 751 200°C Motor temperature

Setting range of *Pr. 751*

Output from terminal DA1

Terminal DA1 output

10V

Pr. 751 200°C Motor temperature

Setting range of *Pr. 751*

-10V

REMARKS

· Motor temperature monitor outputs present motor temperature even when the inverter is stopped, running or at a fault.
· When *Pr. 407* = "9999", motor temperature monitor is not activated and the output remains 0.

REVISIONS

Print Date	*Manual Number	Revision
Jul. 2006	IB(NA)-0600288ENG-A	First edition
Dec. 2011	IB(NA)-0600288ENG-B	Addition · Compatibility with the FR-A701 series inverters · Motor temperature detection signal · Motor temperature monitor · Screw tightening torque of the plug-in option

INVERTER

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