MITSUBISHI ELECTRIC

VECTOR INVERTER

-INSTRUCTION MANUAL-

HIGH RESOLUTION ANALOG INPUT / EXTRA CONTACT INPUT / THERMISTOR INTERFACE

FR-V5AX

Thank you for choosing the Mitsubishi vector inverter option unit.
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**	**Assumes that incorrect handling may cause hazardous conditions, resulting in death or severe injury.**
⚠ **CAUTION**	**Assumes that incorrect handling may cause hazardous conditions, resulting in medium or slight injury, or may cause physical damage only.**

Note that the CAUTION level may lead to a serious consequence according to conditions. Please follow the instructions of both levels because they are important to personnel 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 removed. Otherwise, you may access the exposed high-voltage terminals and charging part and get an electric shock.**
- **If power is off, do not remove the front cover except for wiring or periodic inspection. You may access the charged inverter circuits and get an electric shock.**
- **Before starting wiring or inspection, switch power off, wait for more than 10 minutes, and check for no residual voltage with a tester or the like.**

⚠ WARNING

- Any person who is involved in the wiring or inspection of this equipment should be fully competent to do the work.
- Always install the option unit before wiring. Otherwise, you may get an electric shock or be injured.
- Handle this option unit with dry hands to prevent 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

- Apply only the voltage specified in the instruction manual to each terminal to prevent burst, damage, etc.
- Ensure that the cables are connected to the correct terminals. Otherwise, burst, damage, etc. may occur.
- Always make sure that polarity is correct to prevent burst, damage, etc.
- While power is on or for some time after power-off, do not touch the inverter as it is hot and you may get burnt.

3. Additional instructions

Also note the following points to prevent an accidental failure, injury, electric shock, etc.:

(1) Transportation and mounting

⚠ CAUTION

- Do not install or operate the option unit if it is damaged or has parts missing.
- Do not stand or rest heavy objects on the product.
- Check that the mounting orientation is correct.
- Prevent screws, metal fragments or other conductive bodies or oil or other flammable substance from entering the inverter.

(2) Test operation and adjustment

⚠ CAUTION

- Before starting operation, confirm and adjust the parameters. A failure to do so may cause some machines to make unexpected motions.

(3) Usage

⚠ WARNING
● Do not modify the equipment.

⚠ CAUTION
● When parameter clear or all parameter clear is performed, each parameter returns to the factory setting. Re-set the required parameters before starting operation. ● For prevention of damage due to static electricity, touch nearby metal before touching this product to eliminate static electricity from your body.

(4) Maintenance, inspection and parts replacement

⚠ CAUTION
● Do not test the equipment with a megger (measure insulation resistance).

(5) Disposal

⚠ CAUTION
● Treat as industrial waste.

(6) General instruction

All illustrations given in this manual may have been drawn with covers or safety guards removed to provide in-depth description. Before starting operation of the product, always return the covers and guards into original positions as specified and operate the equipment in accordance with the manual.

CONTENTS

1.PRE-OPERATION INSTRUCTIONS

1.1 Unpacking and Product Confirmation

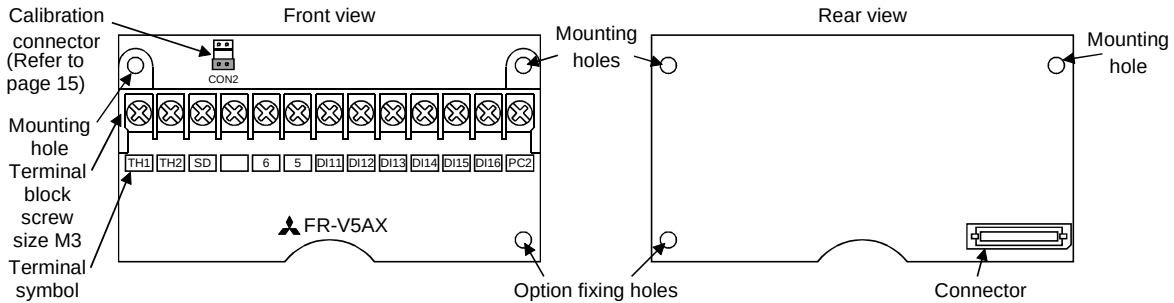
Take the option unit out of the package, check the unit name, and confirm that the product is as you ordered and intact.
This product is an option unit designed for exclusive use in the Mitsubishi FR-V500 series vector inverter. Functions available differ, before using it, always make the following checks.

1.2 Packing Confirmation

Make sure that the package includes the following

- Instruction manual.....1
- Mounting screws M3 × 10 2

1.3 Structure



2.INSTALLATION

2.1 Pre-Installation Instructions

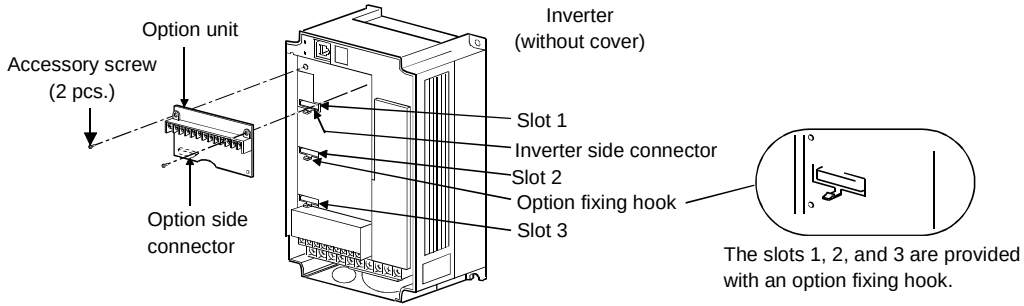
Make sure that the input power of the inverter is off.

⚠ CAUTION
⚠ **With input power on, do not install or remove the option unit. Otherwise, the inverter and option unit may be damaged.**

2.2 Installation Procedure

(1) Securely insert the connector of the option unit far into the connector of the inverter. At this time, fit the option fixing holes snugly.
Also be sure to fit the unit into the option fixing hook.

(2) Securely fix the option unit to the inverter on both sides with the accessory mounting screws. If the screw holes do not match, the connector may not have been plugged snugly. Check for loose plugging.



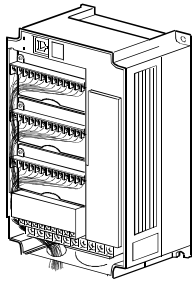
CAUTION

1. **Only one type of option per inverter may be used. When two or more options are mounted, priority is in order of slots 1, 2 and 3, the options having lower priority are inoperative.**
2. **When the inverter cannot recognize that the option is mounted, it displays the option error. The errors shown differ according to the mounting slots 1, 2, 3.**

Mounting Position	Error Display
Slot 1	E.OP1
Slot 2	E.OP2
Slot 3	E.OP3

2.3 Wiring

Route the wires so that they do not take up a large space in the control circuit terminal block of the option unit. During wiring, do not leave wire off-cuts in the inverter. They may cause a fault, failure or malfunction. Use the space on the left side of the Control circuit terminal unit to route the wires.



Cable routing

REMARKS

The wires with large gaze may not be connected to the terminal block. When connected in parallel, all wires may not fit in the wiring space due to the increased number of wires. In such cases, perform wiring by using a junction terminal block.

⚠ CAUTION

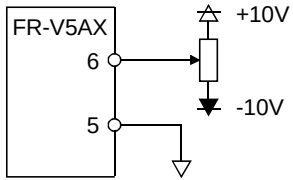
⚠ **Do not use empty terminals as junction terminals because they are used in the option unit. If they are used as the junction terminals, the option unit may be damaged.**

⚠ **When installing the inverter front cover, the cables to the inverter's control circuit terminals and option terminals should be routed properly in the wiring space to prevent them from being caught between the inverter and its cover.**

3.HIGH RESOLUTION ANALOG INPUT

Speed command, torque command, speed retriction value and torque restriction value (same level for driving and regenerative modes) can be set using 0 to ±10VDC analog voltage.

3.1 Connection example



3.2 Explanation of terminals

The high resolution analog input function uses the following terminals.

Terminal symbol	Terminal name	Rated current, etc.	Description
6	High resolution input terminal	Max. permissible voltage 20VDC	0 to ±10VDC input, high resolution (16-bit) analog voltage input terminal. Select the terminal function using Pr. 406 " high resolution analog input selection".
5	Analog common terminal	—	Common terminal for the No. 6 terminal.

3.3 Related parameters

Set the high resolution analog input.
When Pr. 406 = "9999" (factory setting), "high resolution analog input selection" does not function.

Parameter number	Name	Setting range	Minimum setting increments	Factory setting
406	High resolution analog input selection	0, 2 to 5, 9999	1	9999
926	No.6 terminal bias (speed)	0 to 10V, 0 to 3600r/min	0.1r/min	0V, 0r/min
927	No.6 terminal gain (speed)	0 to 10V, 0 to 3600r/min	1r/min	10V, 1500r/min
928	No.6 terminal bias (torque)	0 to 10V, 0 to 400%	0.1%	0V, 0%
929	No.6 terminal gain (torque))	0 to 10V, 0 to 400%	0.1%	10V, 150%

REMAKS

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

The Pr. 406 "high resolution analog input selection" setting and control modes are combined as indicated in the following table.

Pr. 406 setting	No. 6 terminal function for speed control	No. 6 terminal function for torque control	No. 6 terminal function for position control	Bias/gain setting	Remarks
0	Speed command	Speed limit	No function	Pr. 926, Pr. 927	Terminal 2 is made invalid and its functions are replaced by terminal 6. When Pr.868=0, terminal 1 acts as auxiliary.
2	Regenerative mode torque limit	No function	Regenerative mode torque limit	Pr. 928, Pr. 929	When Pr.868=2, terminal 1 is made invalid and its functions are replaced by terminal 6.

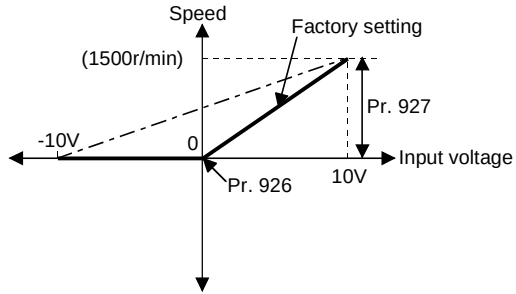
Pr. 406 setting	No. 6 terminal function for speed control	No. 6 terminal function for torque control	No. 6 terminal function for position control	Bias/gain setting	Remarks
3	No function	Torque command	No function	Pr. 928, Pr. 929	During torque control, terminal 3 is made invalid and its functions are replaced by terminal 6.
4	Torque limit	Torque command	Torque limit	Pr. 928, Pr. 929	During speed control and position control with Pr.801=1 and torque control, terminal 3 is made invalid and its functions are replaced by terminal 6. Torque restriction level :Driving/regenration are the same level:
5	No function (*)	Driving side speed limit	No function	Pr. 926, Pr. 927	When Pr.868=5, terminal 1 is made invalid and its functions are replaced by terminal 6.
9999 (factory setting)	No function	No function	No function		

REMAKS

1. *:When performing driving side speed restriction, set "2" in Pr.807 "speed restriction selection".
   The speed restriction value becomes Pr.1"maximum setting" when the driving side speed restriction is exercised.
2. The minimum resolution of the speed is 0.1r/min.
3. The setting of Pr. 822 "speed setting filter 1", Pr. 832 "speed setting filter 2", Pr. 826 "torque setting filter" or Pr. 836 "torque setting filter 2" is valid for the No. 6 terminal input.
   For parameter details, refer to the Inverter Instruction Manual (detailed).
4. For details of terminals 1, 2, and 3, refer to inverter instruction manual (detailed).

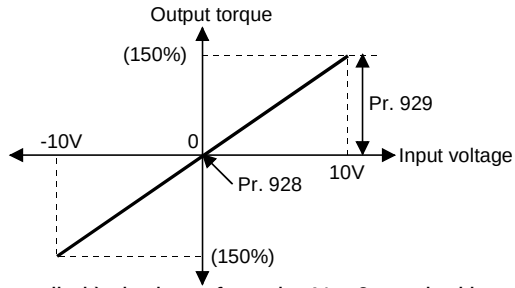
3.4 Calibration

(1) When Pr. 406 = 0 or 5 (speed setting), calibration is made as shown below.



* When Pr. 406 = 5 (speed limit setting for torque control), the input from the No. 6 terminal is valid for the driving mode only. It is invalid for the regenerative mode.

(2) When Pr. 406 = 2, 3 or 4 (torque command), calibration is made as shown below.



* When Pr. 406 = 2 (torque limit), the input from the No. 6 terminal is valid for the regenerative mode only.

3.5 Noise reduction techniques

Use the following techniques if an analog signal is compounded with noise, resulting in instable operation.

(1) Techniques for wiring

1) Separate the power and signal cables as far as possible.

2) Use a twisted pair shield cable as the signal cable.
Handle the shield cable in any of the following ways.

- Connect it to the No. 5 terminal of the FR-V5AX.
- Connect it to the common terminal on the analog command device side.
- Connect it to both the No. 5 terminal of the FR-V5AX and the common terminal on the analog command device side.
- Connect it to neither the No. 5 terminal of the FR-V5AX nor the common terminal on the analog command device side. (Keep the shield cable suspended.)

(2) Techniques on the inverter side

Decrease the setting of Pr. 72 "PWM frequency selection". (Motor-produced sound increases but inverter-generated noise reduces.)
Increase the settings of the speed (torque) setting filters, Pr. 822, Pr. 832 (Pr. 826, Pr. 836).

CAUTION

Changing the speed (torque) setting filter value affects the response level of the inverter to a command. Therefore, adjust it while simultaneously looking at the machine motion.

(3) Others

Install the FR-BLF line noise filter (FR-BSF01 for 3.7K or less).
Reinforce or separate earthing.

3.6 Specifications

Resolution	0.003% at 0 to ±10V input (16 bits)
Input resistance	14kΩ
Max. input voltage	20V

4.EXTRA CONTACT INPUT FUNCTION

4.1 Overview

Six terminal input points can be added by assigning functions to the DI11 to DI16 input terminals using Pr. 400 to Pr. 405 (input terminal function selection). At this time, since five more points can be chosen with Pr. 180 to Pr. 183 and Pr. 187 "input terminal assignment" of the inverter, a total of 11 input terminals are available. The signal from the 6 bit data (binary) input terminal can be used as external position command during position control.

4.2 Explanation of terminals

This extra contact input function uses the following terminals.

<table>
<tr><th>Terminal symbol</th><th>Terminal name</th><th>Description</th></tr>
<tr><td>PC2</td><td>External transistor common</td><td>When connecting the transistor output (open collector output) of a programmable controller (PC) or like, connecting the external power supply common for transistor output to this terminal prevents a malfunction caused by a sneak current.</td></tr>
<tr><td>DI11
DI12
DI13
DI14
DI15
DI16</td><td>Multi-function input terminal</td><td>•Set function assignment in Pr. 400 to Pr. 405 (input terminal function selection).
•Input the binary 6 bit signal during position control.
<table>
<tr><td>bit</td><td>b5</td><td>b4</td><td>b3</td><td>b2</td><td>b1</td><td>b0</td></tr>
<tr><td>terminal</td><td>DI16</td><td>DI15</td><td>DI14</td><td>DI13</td><td>DI12</td><td>DI11</td></tr>
</table></td></tr>
<tr><td>SD</td><td>Contact input common</td><td>Contact input common terminal. Do not connect this terminal with the other common terminal. Do not earth (ground) this terminal.</td></tr>
</table>

4.3 Related Parameters

The functions of the DI11 to DI16 input terminals can be assigned using Pr. 400 to Pr. 405 (input terminal function selection).

Parameter number	Name	Factory setting	Setting range	Minimum setting increments
400	DI11 terminal function selection	9999	0 to 99, 9999	1
401	DI12 terminal function selection	9999	0 to 99, 9999	1
402	DI13 terminal function selection	9999	0 to 99, 9999	1
403	DI14 terminal function selection	9999	0 to 99, 9999	1
404	DI15 terminal function selection	9999	0 to 99, 9999	1
405	DI16 terminal function selection	9999	0 to 99, 9999	1

REMAKS

For Pr.400 to Pr.406, write is disabled during operation even when “2” is set in Pr.77. When changing the parameter setting, stop the operation.

4.4 Setting

The Pr.400 to Pr.405 "input terminal function selection" settings are the same as Pr.180 to Pr.183 and Pr.187 "input terminal function selection". Note that the X10 signal can not be assigned to the FR-V5AX.
When using the X10 signal, assign it to the input terminals DI1 to DI4 of the inverter.
Refer to the instruction manual of the inverter for parameter details.

4.5 Specifications

- Input signal types
  Select a signal from among the low-speed operation command, mid-speed operation command, high-speed operation command, remote setting, second function selection, jog operation selection, 15-speed selection, third function selection, FR-HC connection (instantaneous power failure detection), PU operation external interlock, external DC braking start, PID control enable terminal, brake opening completion signal, PU operation-external operation switch-over, S-pattern acceleration/deceleration C switching terminal, orientation command, pre-excitation/servo on, output stop, start self-holding selection, control mode changing, torque limit selection, torque bias selection 1, torque bias selection 2 and P control selection (P/PI control switching).
- Input signal selection ..... Use Pr. 400 to Pr. 405 to make selection.
- Input terminal selection ..... Open collector output or no-voltage contact signal

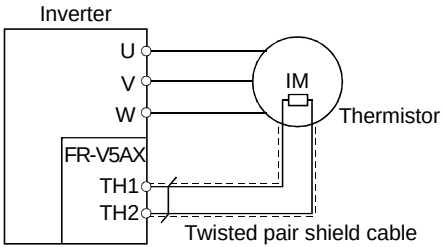
5.THERMISTOR INTERFACE

When the vector inverter motor with a thermistor (SF-V5R) is used, the motor temperature detected by the thermistor in the motor can be fed back to the inverter to reduce the fluctuation of generated torque caused by temperature change.
The rauge or motor temperature that can be detected is between -50°C to 200°C (-58°F to 392°F).

CAUTION

To detect temperatures at the FR-V5AX, always use the SF-V5R vector inverter motor provided with thermistor.

5.1 Connection example



Change jumpers of the thermistor calibration connecter to use the themistor. (Refer to page 15)

5.2 Explanation of terminals

This extra contact input function uses the following terminals.

Terminal symbol	Terminal name	Description
TH1	Thermistor input 1	A motor side thermistor output signal is input.
TH2	Thermistor input 2	

5.3 Parameter setting

The following parameters are provided for use of the thermistor interface.

Parameter	Name	Factory setting	Setting range	Minimum input increments	Remarks
407	Motor temperature detection filter	9999	0 to 100s, 9999	1s	9999: No function
925	Motor temperature detection calibration	100%	0 to 200%	0.1%	

5.4 Motor thermal relay alarm

(1) When Pr. 407 = "0 to 100"

Normally, set 30s in Pr. 407. If the response level to a motor temperature is low, make adjustment to decrease the setting.

- Detection of a 145°C (293°F) or higher motor temperature continuously for 10s results in a motor thermal relay alarm (E.THM), shutting off the output.
- Detection of a -30°C (-22°F) or lower motor temperature during operation results in a motor thermal relay alarm (E.THM), shutting off the output.
  During a stop, a motor thermal relay alarm (E.THM) does not occur.
- The OH terminal (thermal relay protector input) is invalid.

(2) When Pr. 407 = "9999"

A motor thermal relay alarm (E.THM) is not detected by the FR-V5AX.

CAUTION

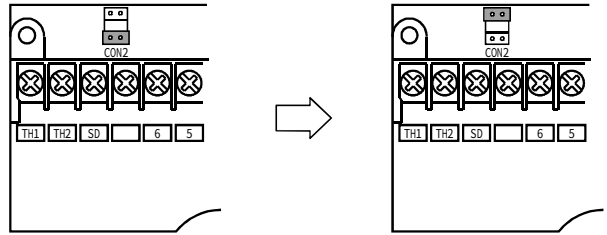
The vector inverter motor with thermistor does not have a thermal relay protector. When using this type of motor, always set a value other than "9999" in Pr. 407 "motor temperature detection filter". If the setting remains "9999", motor protection cannot be provided.

5.5 Calibration

Calibrate the inverter and FR-V5AX (thermistor interface). Always calibrate them at the time of installation.

(1) Calibration method

1) Remove the jumper from the lower pin of CON2 and insert it into the upper pin to choose the thermistor calibration status.



2) Read Pr. 925 and set a compensation value.
(For the setting method of the compensation value, refer to page 16.)

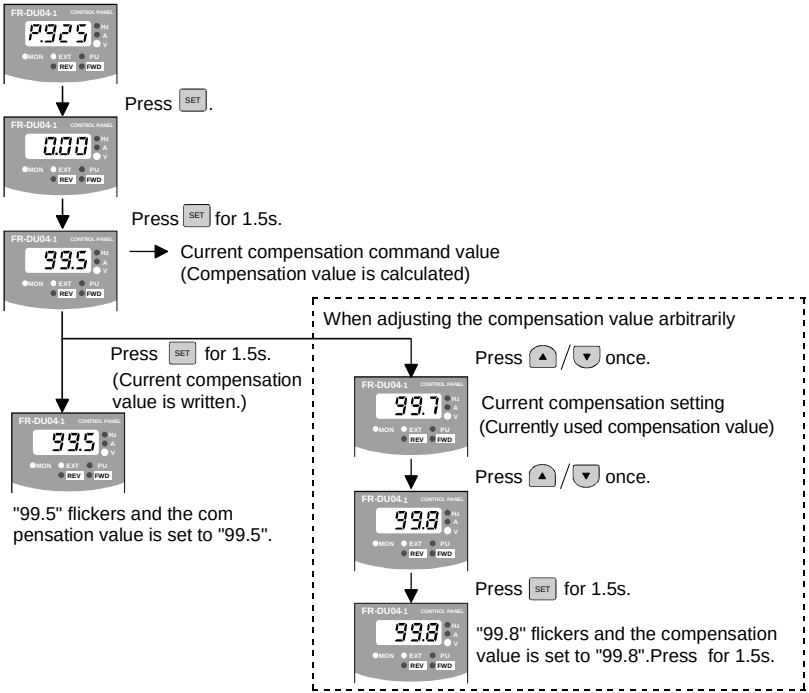
3) After completion of compensation, return the jumper to the lower pin.

REMAKS

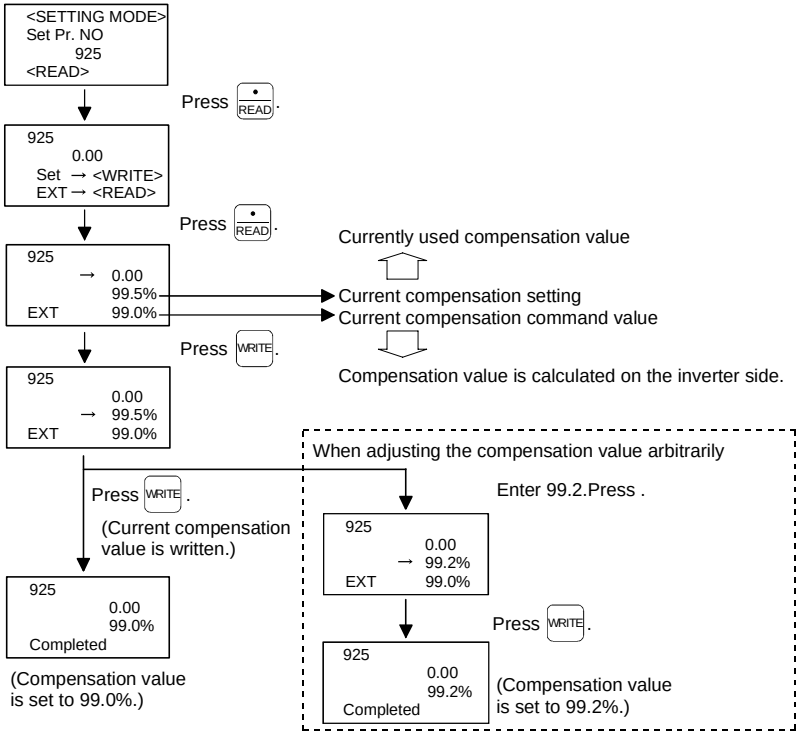
If you start the motor in the thermistor calibration status (with the jumper of CON2 inserted in the upper pin), a motor thermal relay alarm (E.THM) will occur in 10 seconds and the inverter output is shut off.
Likewise, if you start the motor without the thermistor interface being connected, a motor thermal relay alarm (E.THM) will occur in 10 seconds and the inverter output is shut off.

(2) Operation procedure for compensation value setting

•For FR-DU04-1



•For FR-PU04V


<SETTING MODE>
Set Pr. NO
925
<READ>
Press READ.
925
0.00
Set → <WRITE>
EXT → <READ>
Press READ.
925
→ 0.00
99.5%
EXT 99.0%
Currently used compensation value
Current compensation setting
Current compensation command value
Compensation value is calculated on the inverter side.
Press WRITE.
925
0.00
→ 99.5%
EXT 99.0%
When adjusting the compensation value arbitrarily
Press WRITE.
(Current compensation value is written.)
925
0.00
99.0%
Completed
(Compensation value is set to 99.0%.)
Enter 99.2.Press .
925
0.00
→ 99.2%
EXT 99.0%
Press WRITE.
925
0.00
99.2%
Completed
(Compensation value is set to 99.2%.)

REVISIONS

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

Print Date	*Manual Number	Revision
Oct., 2001	IB(NA)-0600083-A	First edition