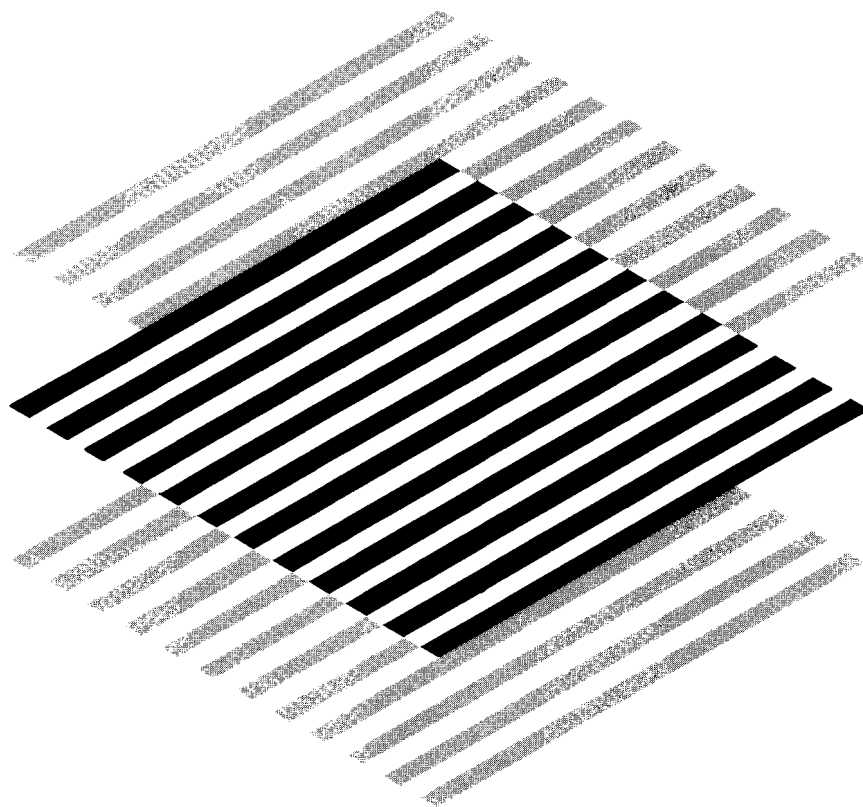


mitsubishi
TRANSISTORIZED
INVERTER

FREQROL-Z

PI CONTROL UNIT

TYPE FR-ZPI
Instruction Manual



Thank you for choosing the option unit for the Mitsubishi FREQROL-Z200 series transistorized frequency inverter.

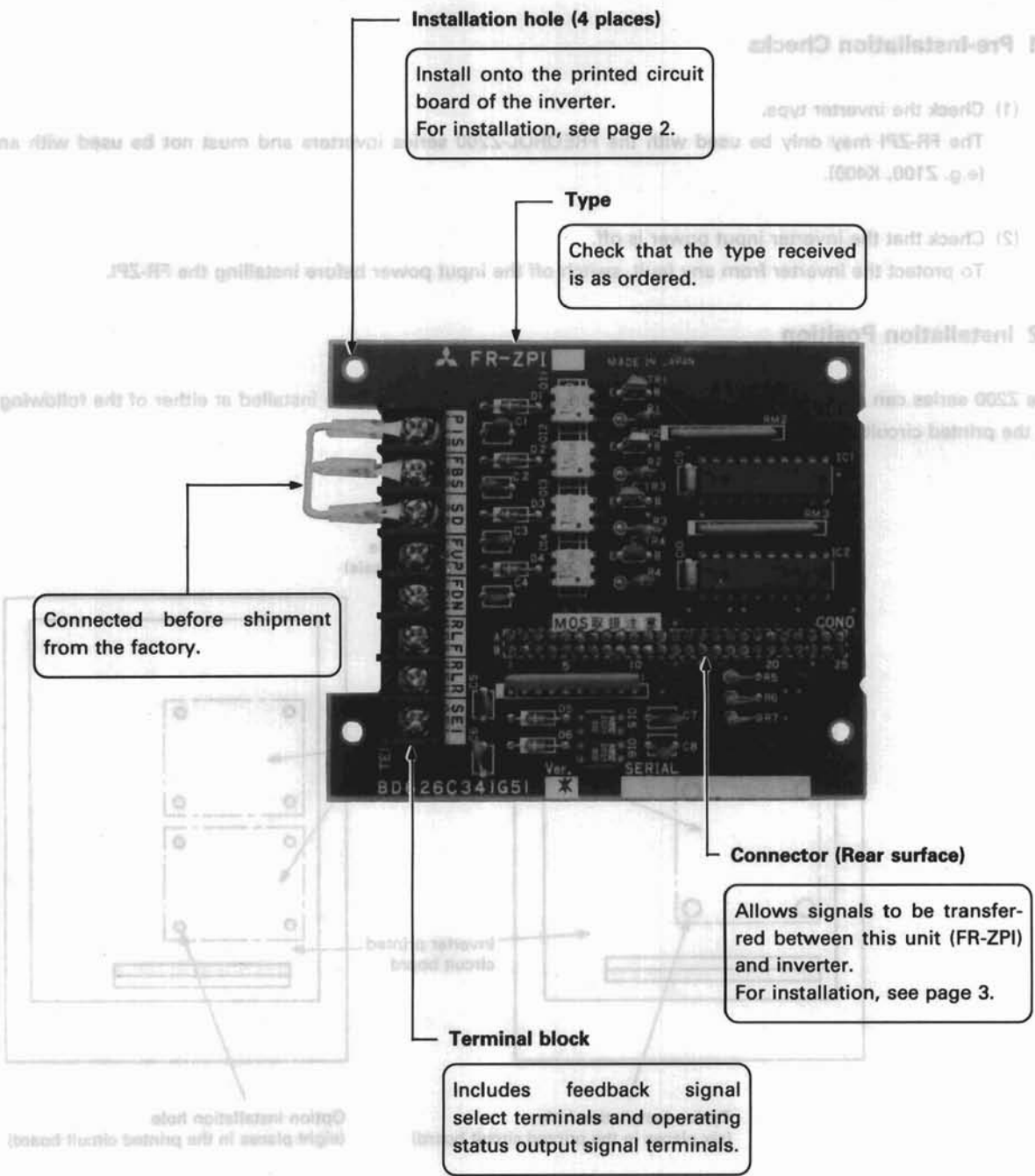
Please read this manual carefully to use the equipment to its optimum.

The FR-ZPI PI control unit is designed for PI control when the inverter is used for process control, e.g. flow or pressure control.

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1. STRUCTURE



Accessories: Check that eight installation pins are supplied with the FR-ZPI.
 8 - Installation pins

2. INSTALLATION

Remove the inverter cover and install the FR-ZPI option unit in the following procedure:

2.1 Pre-Installation Checks

- (1) Check the inverter type.

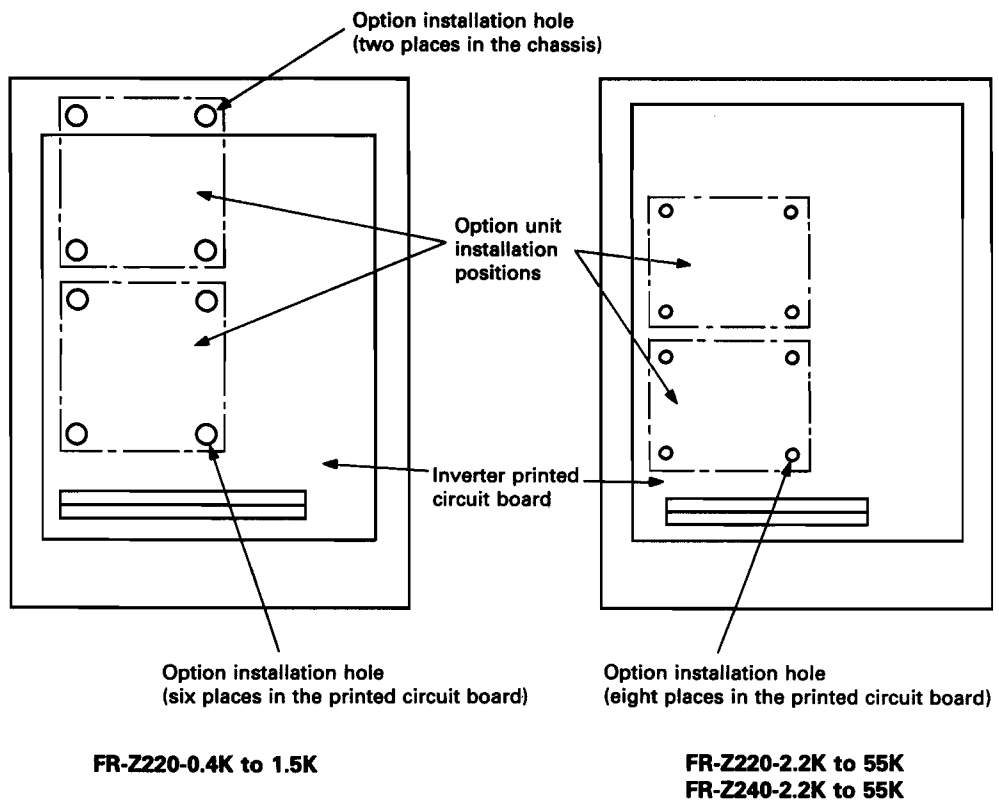
The FR-ZPI may only be used with the FREQROL-Z200 series inverters and must not be used with any other series (e.g. Z100, K400).

- (2) Check that the inverter input power is off.

To protect the inverter from any fault, switch off the input power before installing the FR-ZPI.

2.2 Installation Position

The Z200 series can accommodate up to two option units. The FR-ZPI may be installed at either of the following two positions on the printed circuit board:

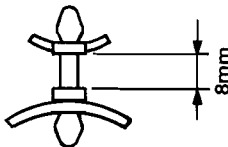
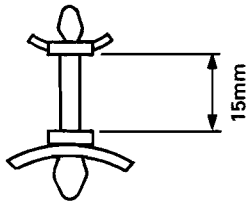


2.3 Installation Procedure

(1) Insert the supplied installation pins into the four installation holes in the inverter printed circuit board.

● **Selecting the installation pin size**

Two pin types (long and short) are supplied with the FR-ZPI. Determine the size in accordance with the inverter model (type) used.

Inverter Model	Other Models	FR-Z220-2.2K to 11K FR-Z240-2.2K to 7.5K
Installation pin size	Short (4 pieces) 	Long (4 pieces) 

● **Direction of pin installation**

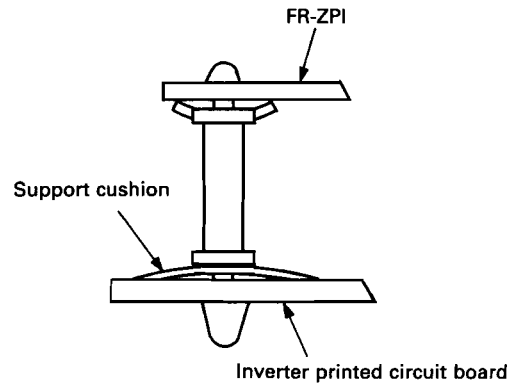
Insert the longer support cushion end of the installation pin into the installation hole in the inverter printed circuit board.

(2) Securely fit the FR-ZPI into the installation pins.

The FR-ZPI connector is then fitted into the connector pins on the inverter printed circuit board.

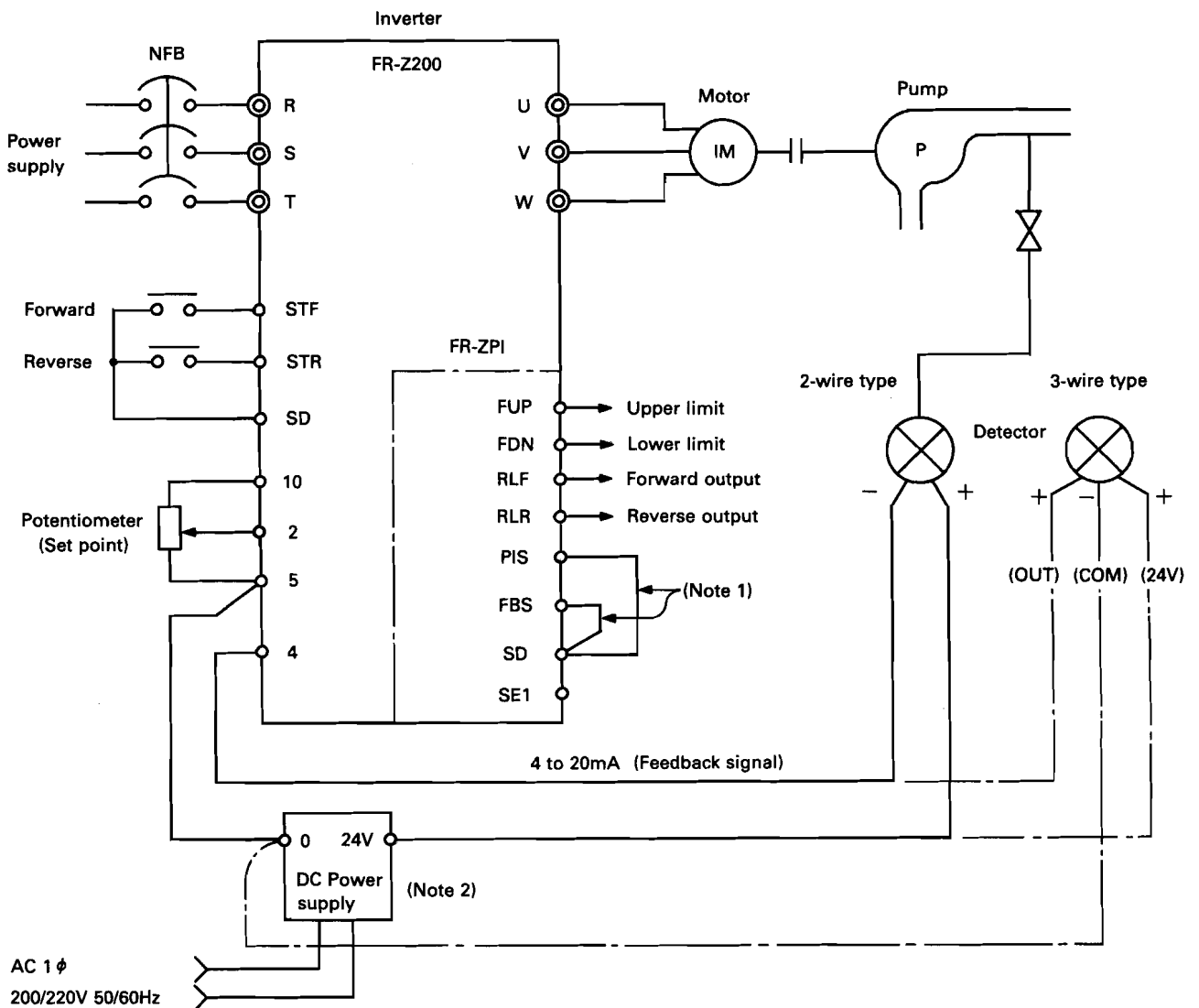
Check points

- Check that the FR-ZPI connector has been fitted into the inverter connector at the correct position.
- Check that the connectors have been fitted without any clearance between them.



3. WIRING

3.1 Wiring Example



Note: 1. The terminals have been connected by jumpers before shipment.

Disconnect terminals PIS and SD to stop PI operation.

Disconnect terminals FBS and SD to calculate deviation using the external calculation circuit and input its signal to the inverter. The deviation signal must be input to terminal 1K (0 to $\pm 10V$) or 1E (0 to $\pm 5V$).

2. The power supply must be selected in accordance with the power specifications of the detector used.

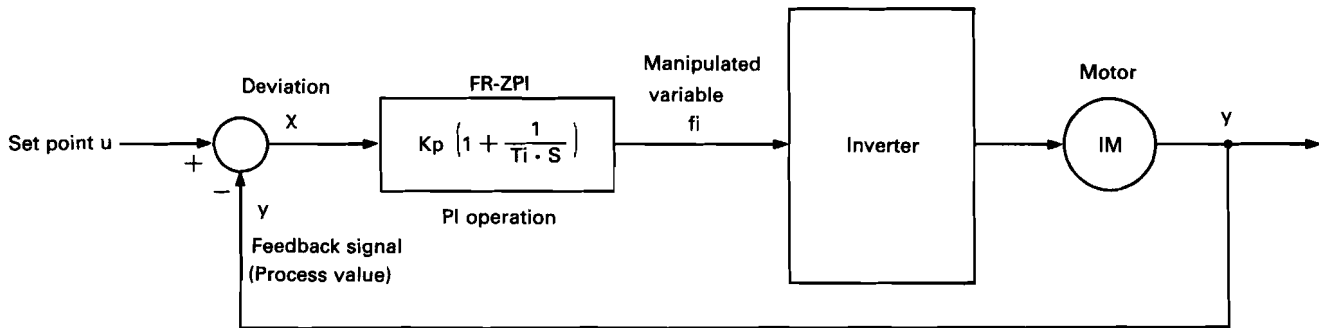
3.2 Terminals

Symbol	Terminal	Description
PIS	PI control select input terminal	Connect with SD to enable PI operation.
FBS	Feedback signal select terminal	Connect with SD to input a 4-20mA signal from the detector as a process value signal.
SD	Input signal common terminal	Common terminal for PIS and FBS. Common to SD of the inverter.
FUP	Upper limit output terminal	Gives output if the process value exceeds the upper limit set value. Open collector output.
FDN	Lower limit output terminal	Gives output if the process value falls below the lower limit set value. Open collector output.
RLF	Forward output terminal	Gives output if the inverter start signal is the forward (STF) command. Open collector output.
RLR	Reverse output terminal	Gives output if the inverter start signal is the reverse (STR) command. Open collector output.
SE1	Output signal common terminal	Common terminal for FUP, FDN, RLF and RLR. Isolated from the inverter terminal SE.

Note: Allowable load of open collector output: 24V DC, 0.1A

4. OPERATION

4.1 System Configuration



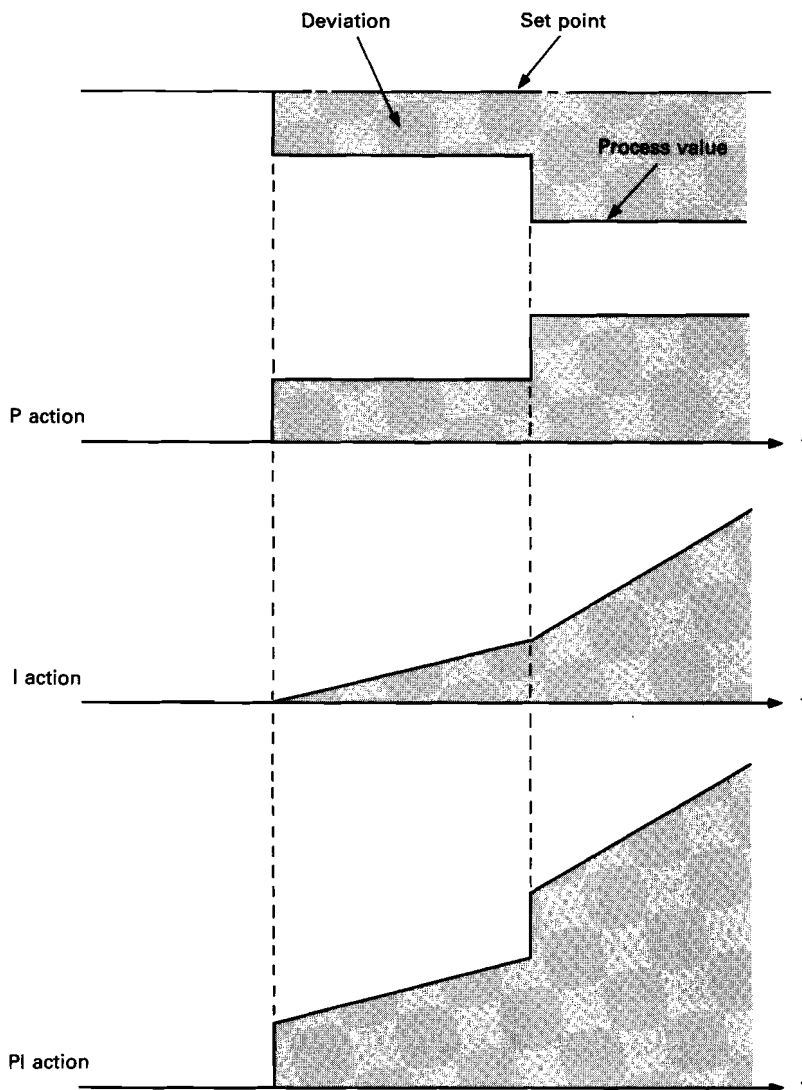
K_p : Proportional constant T_i : Integral time S : Operator

4.2 General Operation

(1) PI action

A combination of proportional control action (P) and integral control action (I) for providing a manipulated variable in response to deviation and changes with time.

[Operation example for stepped changes of the process value]

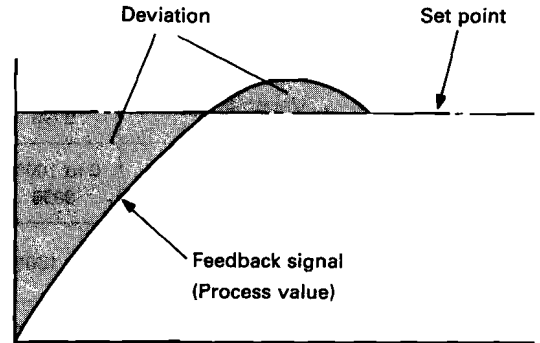
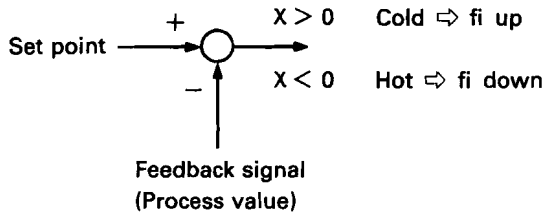


Note: The PI action is the addition of the P and I actions.

(2) Reverse action

Increases the manipulated value if deviation X (set value $-$ process value) is positive and decreases the manipulated value if deviation is negative.

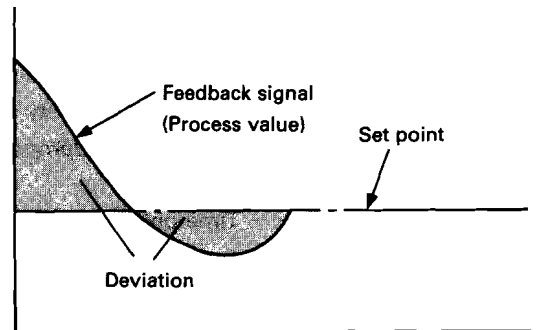
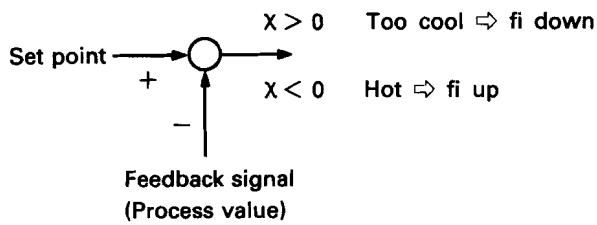
[Heating]



(3) Forward action

Increases the manipulated value if deviation X (set value $-$ process value) is negative and decreases the manipulated value if deviation is positive.

[Cooling]



4.3 Functions

The following functions available for PI control are only valid when the PI control unit is on the inverter and cannot be set without installing the PI control unit. Set the functions from the parameter unit (FR-PU01).

Parameter List

Function No.	Description	Range	Minimum Input Increment	Factory Setting	Remarks
60	Upper limit	0 to 100% 9999	1%	9999	FUP is output if the feedback value exceeds the upper limit value setting.
61	Lower limit	0 to 100% 9999	1%	9999	FDN is output if the feedback value falls below the lower limit value setting.
62	PI control set value for PU, data link operation	0 to 100%	0.01%	0%	Only valid for PU or data link operation.
69*	Proportional band	1 to 1000% 9999	1%	100%	Set to 9999 to use integral control only.
70*	Integral time	0.1 to 3600 9999	0.1 seconds	1 second	Set to 9999 to use proportional control only.
71	PI action selection	0, 1	—	0	0: PI reverse action 1: PI forward action

**Note: Function numbers 69 and 70 may be changed during operation.*

Proportional band If the proportional band is narrow (parameter setting is small), the manipulated value varies greatly with a slight change of the process value. Hence, as the proportional band narrows, the response sensitivity (i.e. gain) improves but the stability deteriorates, e.g. hunting occurs.

$$\text{Gain } K_p = 1/\text{proportional band}$$

Integral time Time only required for the integral (I) action to obtain the same manipulated value as that for the proportional (P) action. As the integral time decreases, the set value is reached earlier but hunting occurs more easily.

5. PRE-OPERATION SETTING

5.1 Terminals

- (1) Before starting the PI action, ensure that the FR-ZPI terminals PIS and SD are connected. The PI action cannot be performed without connecting these terminals.
- (2) Specify the set point using the inverter terminal 2, digital input unit (FR-ZDA), or parameter unit (Pr. 6), and input the feedback signal to the inverter terminal 4, after checking that the FR-ZPI terminals FBS and SD are connected.

Specifying the Set Point

Item	Description
Inverter terminal 2	Define 0V as 0% and 5V as 100%.
Digital input unit (FR-ZDA)	Set 9999 in Pr 51 (BCD input) or Pr 53 (BIN input) from the parameter unit, then enter the required value (0 to 100%) to the FR-ZDA. e.g. When setting 50%, specify 50 for BCD, 32H for BIN.

The feedback signal of 4mA correspond to 0% and 20mA to 100%.

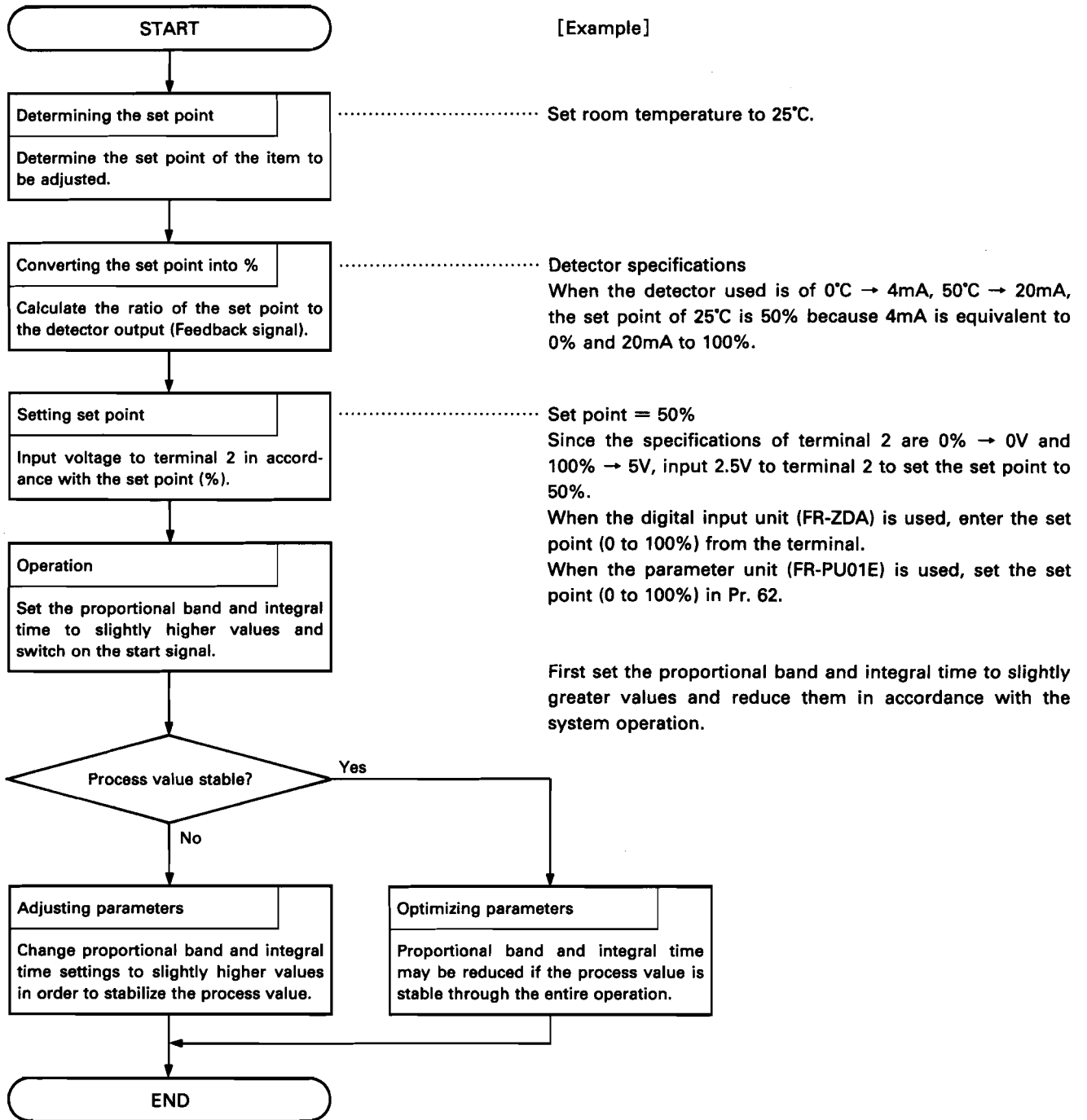
- (3) Disconnect terminals FBS and SD to calculate deviation using the external calculation circuit and input its signal to the inverter. The deviation signal must be input to terminal 1K (0 to $\pm 10V$) or 1E (0 to $\pm 5V$).
- (4) Test operation must be performed after disconnecting the FR-ZPI terminals PIS and SD to allow normal inverter operation.

5.2 Functions (See page 8 for function types.)

- (1) Alarm can be output if the feedback signal (process value) comes out of the setting range. Set the upper limit value in Pr. 60 and the lower limit value in Pr. 61. The feedback signal of 4mA corresponds to 0% and 20mA to 100%.
- (2) Set the proportional band (Pr. 69) and/or integral time (Pr. 70) according to the application.
Set 9999 in Pr. 69 to use the integral (I) action only and 9999 in Pr. 70 to use the proportional (P) action only.
- (3) Set the negative or positive action in Pr. 71 (PI action selection) in accordance with the controlled system,

e.g. Negative action (Pr. 71 = 0) For heating, pressure control, etc.
 Positive action (Pr. 71 = 1) For cooling, etc.
- (4) If the manipulated variable is 0%, the frequency set in C-2 (Bias for frequency reference voltage signal) is output. If the manipulated variable is 100%, the frequency set in C-3 (Gain for frequency reference voltage signal) is output.

5.3 Adjustment Example



6. INSTRUCTIONS

- (1) The FR-ZPI is designed for use in the FR-Z200 series inverters. It cannot be used with the other series of inverters.
- (2) The FR-ZPI must not be used outside the inverter.
- (3) The FR-ZPI cannot be used with the orientation control unit (FR-ZOR), PLG feedback unit (FR-ZPG) or data link unit (FR-ZDL) at the same time.

7. SPECIFICATIONS

(1) PI setting ranges

Proportional band (P): 1 to 1000%

Integral time (I): 0.1 to 3600 seconds

(2) Input signals

(a) Set point, feedback signal (process value) and deviation

Input Specifications		Input Terminal, Input Method	Input Signal
Feedback signal of 4 to 20mA	Set point	Inverter terminal 2	0 to 5V, 0 to 10V
		Inverter terminal 1K (or 1E)	0 to 10V (0 to 5V)
		Digital input unit (FR-ZDA)	BCD or binary
		Parameter unit (FR-PU01E)	Digital signal
	Feedback signal	Inverter terminal 4	4 to 20mA
Direct input of deviation	Deviation	1K or (1E)*	0 to $\pm 10V$ (or 0 to $\pm 5V$)

* : If a deviation value has been calculated outside the inverter, enter that value into 1K ($\pm 10V$) or 1E ($\pm 5V$), with the FR-ZPI terminals FBS and SD disconnected.

(b) Select signals (Contact input)

- PI action selection
- Feedback input signal (4 to 20mA) selection

(3) Output signals (Open collector output)

- Upper limit
- Lower limit
- Rotation direction (forward, reverse)

(4) Functions (from parameter unit)

- Upper limit value
- Lower limit value
- Proportional band
- Integral time
- Positive/negative action selection

(5) Detector power supply

Use the appropriate power supply in accordance with the detector's power specifications. The detector power cannot be supplied by the inverter and PI control unit.



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