F&eIT Series

Input Module for Pt100 Thermo-sensor
PTI-4(FIT)GY
User's Manual

CONTEC CO.,LTD.

Check Your Package

Thank you for purchasing the CONTEC product.

The product consists of the items listed below.

Check, with the following list, that your package is complete. If you discover damaged or missing items, contact your retailer.
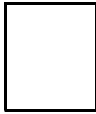
Product Configuration List

    - Module[PTI-4(FIT)GY] …1

    - First Step Guide …1

    - CD-ROM [F&eIT Series Setup Disk] *1 …1

    - Interface connector plug(mounted on the module) …2

    *1 The CD-ROM contains various software and User's Manual (this manual)

Module   First step guide   CD-ROM [F&eIT Series Setup Disk]

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Table of Contents

1. Before Using the Product

This chapter provides information you should know before using the product.

About the Module

This product is a module to collect temperature data from a platinum resistance temperature detector of Pt100 or JPt100. The product is used in combination with the I/O controller module <CPU-CAxx(FIT)GY> (*1) or microcontroller unit <CPU-SBxx(FIT)GY> (*1) in the F&eIT Series.

Please read this manual carefully to create application programs and configure the system, such as setting the switches and connecting it to external devices.

*1   The "x" in a model code represents a single digit (or no digit) indicating different products.
     (The same convention applies below).

Features

- Four channel temperature measurement by one module
  (Up to six units of the PTI-4(FIT)GY can be connected to the I/O controller module and microcontroller unit in the F&eIT Series.)
- IEC/JIS standard compliant RTD is usable
  Allowing connection of the platinum resistance temperature detector using Three-wire or Four-wire.
- Capable of Temperature data averaging by time or count
- Disconnction detection
  Resistance temperature detector or conductor disconnction can be detected per channel.
- Error compensation by offset/gain settings
  Error compensation can be made by setting offset and gain values on each channel.
- Digital filter against noise from the (50/60 Hz) commercial power supply (only at a conversion speed of 150 ms)
- Measurement precision kept highly stable with respect to variation in ambient temperature
- Like other F&eIT series products, the module has a 35mm DIN rail mounting mechanism as standard. A connection to a controller module can be effected on a lateral, stack basis in a unique configuration, which permits a simple, smart system configuration without the need for a backplane board.

Function

Temperature measurement function

The module can input temperature data from the platinum resistance temperature detector connected. As the output from the resistance temperature detector is nonlinear with respect to temperature changes, the module linearizes the input.

The module can use a Three-wire or Four-wire of platinum resistance temperature detector.

Conversion disable function

This function disables temperature measurement of channels not in use. Use the function to disable conversion of the channels to be unused.

Disconnction detection function

This function detects the platinum resistance temperature detector connected to each channel or the disconnction of its conductors.

Averaging function

This function averages input temperature data by Time averaging processing or Count averaging processing.

Alarm output function

This function outputs a flag to the alarm output register upon detection of a temperature falling outside the set temperature range.

Offset/Gain settings function

This function compensates temperature change values according to the platinum resistance temperature detector used and the wiring environment.

Functions and control method by controller connected

The PTI-4(FIT)GY can be connected to the following F&eIT series controllers.

Corresponding controller

Micro Controller Unit	: CPU-SBxx(FIT)GY
I/O Controller Module	: CPU-CAxx(FIT)GY
Monitoring & Control Server Unit	: SVR-MMF2(FIT)

Check each controller to which the module can be connected as well as the method of controlling the module when connected to that controller.

Connections to controllers

O: Permitted
x: Not permitted

	CPU-SBxx(FIT)GY	CPU-CAxx(FIT)GY	SVR-MMF2(FIT)	SVR-MMF(FIT)GY
PTI-4(FIT)GY	O	O	O	×
Device ID setting range	0 - 7	0 - 7	0 - 7	0 - 7

Control method by controller connected

	CPU-SBxx(FIT)GY	CPU-CAxx(FIT)GY	SVR-MMF2(FIT)	SVR-MMF(FIT)GY	CPU-CA10(USB)GY
Control using the I/O address map	O				
Control using the memory address map		O			
Control via the Windows driver * — FIT Protocol		O			
Control via the Windows driver * — API-SBP(W32)	O				
Control via the Windows driver * — API-CAP(W32)		O			
Control via the Windows driver * — API-USBP(WDM)					O
Control over the web			O		

* API-SBP(W32) can be downloaded from CONTEC's web site. The other drivers are bundled with each controller.

Control using the I/O address map -- Connecting to the CPU-SBxx(FIT)GY
When connected to the CPU-SBxx(FIT)GY, the PTI-4(FIT)GY can receive I/O instructions directly from the controller module. For details, see Chapter 4 "Using the I/O Address Map".

Control using the memory address map – Connecting to the CPU-CAxx(FIT)GY
When connected to the CPU-CAxx(FIT)GY, the PTI-4(FIT)GY can be accessed from the host computer over the network. The PTI-4(FIT)GY is assigned with its device ID in the memory managed by the controller module. The application running on the host computer controls the module by reading/writing the memory managed by the controller module. For details, see Chapter 5 "Using the Memory Address Map".

Control via the Windows driver
API-SBP(W32) is a Win32 API type of driver library available to control the module without having to pay special attention to the hardware. For the functions and settings available when using the Windows driver, refer to the API-SBP(W32) online help.

Control over the web – Connecting to the SVR-MMF2(FIT)
You can monitor collected data and manage the log over the web. You can use your familiar browser to easily make various settings. For details, refer to the reference manual for the SVR-MMF2(FIT).

Customer Support

CONTEC provides the following support services for you to use CONTEC products more efficiently and comfortably.

Web Site

Japanese	http://www.contec.co.jp/
English	http://www.contec.com/
Chinese	http://www.contec.com.cn/

Latest product information

CONTEC provides up-to-date information on products.
CONTEC also provides product manuals and various technical documents in the PDF.

Free download

You can download updated driver software and differential files as well as sample programs available in several languages.

Note! For product information

Contact your retailer if you have any technical question about a CONTEC product or need its price, delivery time, or estimate information.

Limited One-Year Warranty

CONTEC products are warranted by CONTEC CO., LTD. to be free from defects in material and workmanship for up to one year from the date of purchase by the original purchaser.
Repair will be free of charge only when this device is returned freight prepaid with a copy of the original invoice and a Return Merchandise Authorization to the distributor or the CONTEC group office, from which it was purchased.
This warranty is not applicable for scratches or normal wear, but only for the electronic circuitry and original products. The warranty is not applicable if the device has been tampered with or damaged through abuse, mistreatment, neglect, or unreasonable use, or if the original invoice is not included, in which case repairs will be considered beyond the warranty policy.

How to Obtain Service

For replacement or repair, return the device freight prepaid, with a copy of the original invoice. Please obtain a Return Merchandise Authorization number (RMA) from the CONTEC group office where you purchased before returning any product.

* No product will be accepted by CONTEC group without the RMA number.

Liability

The obligation of the warrantor is solely to repair or replace the product. In no event will the warrantor be liable for any incidental or consequential damages due to such defect or consequences that arise from inexperienced usage, misuse, or malfunction of this device.

Safety Precautions

Understand the following definitions and precautions to use the product safely.

Safety Information

This document provides safety information using the following symbols to prevent accidents resulting in injury or death and the destruction of equipment and resources. Understand the meanings of these labels to operate the equipment safely.

⚠ DANGER	DANGER indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury.
⚠ WARNING	WARNING indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.
⚠ CAUTION	CAUTION indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury or in property damage.

Handling Precautions

⚠ CAUTION

- Do not modify the module. CONTEC will bear no responsibility for any problems, etc., resulting from modifying this module.

- Do not plug or unplug the interface connector inadvertently. Do not apply spray or grease to contacts, or altered contact resistance results in degraded performance.

- Do not use or store the equipment in a hot or cold place, or in a place that is subject to severe temperature changes. (Operating temperature range: 0 - 50°C)

- Do not use or store the equipment in a place subject to direct sunlight or near a heating device, such as a stove.

- Do not use or store the equipment in a dusty or humid place.
  (Operating humidity range: 10 - 90%RH, No condensation)

- As this product contains precision electronic components, do not use or store in environments subject to shock or vibration.

- Do not use or store the product near equipment generating a strong magnetic field or radio waves.

- If you notice any strange odor or overheating, please unplug the power cord immediately.

- In the event of an abnormal condition or malfunction, please consult the dealer from whom the equipment was purchased.

- To avoid electric shock, please do not touch the system with a wet hand.

- Do not open the module casing. CONTEC will disclaim any responsibility for equipment whose casing has been opened.

- To prevent damage, please do not subject the module to impact or bend it.

- To prevent contact malfunction, please do not touch the metallic pins on the external module connector.

- The module contains switches that need to be properly set. Before using the module, please check its switch settings.

- To avoid malfunction, please do not change the module switch settings in an unauthorized manner.

- Do not operate the device module when the power for the Controller Module is on.
  To avoid malfunction, please be sure to turn off the power for the Controller Module.

FCC PART 15 Class A Notice

NOTE

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in commercial environment.
This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference at his own expense.

WARNING TO USER

Change or modifications not expressly approved the manufacturer can void the user's authority to operate this equipment.

Environment

Use this product in the following environment. If used in an unauthorized environment, the module may overheat, malfunction, or cause a failure.

Operating temperature

0 - 50°C

Operating humidity

10 - 90%RH (No condensation)

Corrosive gases

None

Floating dust particles

Not to be excessive

Inspection

Inspect the product periodically as follows to use it safely.

*The ventilation slits are not covered, and neither dust nor alien substance is attached to the ventilation slits
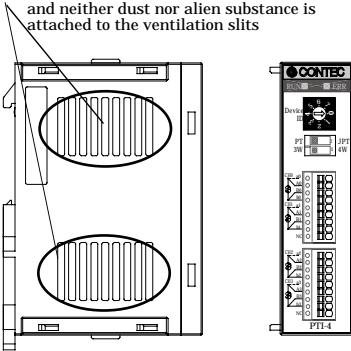
Storage

When storing this product, keep it in its original packing form.

(1) Put the module in the storage bag.

(2) Wrap it in the packing material, then put it in the box.

(3) Store the package at room temperature at a place free from direct sunlight, moisture, shock, vibration, magnetism, and static electricity.

Disposal

When disposing of the product, follow the disposal procedures stipulated under the relevant laws and municipal ordinances.

2. Module Nomenclature and Settings

Nomenclature of Module Components

Figure 2.1. shows the names of module components.

In the figure, the indicated switch settings represent factory settings.
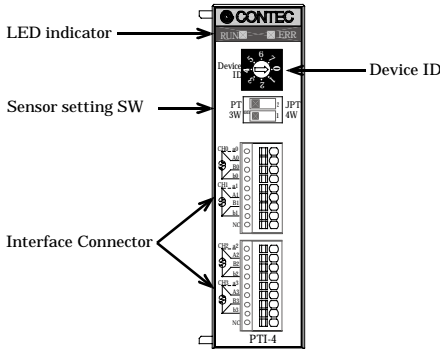
Figure 2.1. Names of module components

Setting a Device ID

The controller module distinguishes and keeps track of the modules that are connected to it by assigning device IDs to them. Each module, therefore, should be assigned a unique ID.

A Device ID can be assigned in a 0 - 7 range, so that a maximum of eight modules can be distinguished.

The factory setting for the Device ID is [0].

Setup Method

A device ID can be set by turning the rotary switch on the device face.

To set a device ID, turn the switch knob.
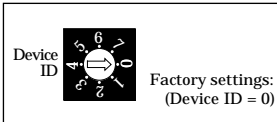
Figure 2.2. Setting a Device ID

LED Indicator

Table 2.1. LED indicator

Name	Color	LED indicator
RUN	Green	Comes on upon completion of startup after the power is turned on.
ERR	Red	Comes on upon disconnction detection or alarm output.

Sensor setting SW

The settings of the sensor setting switches can be read by software.

Use the channel-1 and channel-2 switches to select the wiring method and the type of platinum resistance temperature detector to be used, respectively.

Table 2.2. Settings of Sensor Setting Switches

SW setting	Wiring method	Platinum resistance temperature detector
PT 3W [switch] JPT 4W	Three-wire type	Pt100 *1
PT 3W [switch] JPT 4W		JPt100
PT 3W [switch] JPT 4W	Four-wire type	Pt100
PT 3W [switch] JPT 4W		JPt100

*1 Factory setting

3. Connecting to an External Device

Interface Connector

How to Connect an Interface Connector

When connecting the Module to an external device, use the attached connector plug. When wiring the Module, strip off approximately 7 - 8 mm of the covering for the cable, and insert the bare wire by pressing the orange button on the connector plug. Releasing the orange button after the wire is inserted fixes the cable. Applicable wire size is AWG 28 - 20.

Press this section to insert the wire material.

7 - 8mm

- Applicable plug:
    Front-operable spring gauge type
    FK- MC0,5/9-ST-2,5 plug
    (made by Phoenix Contact Corp.)
    Applicable wire: AWG 28 - 20
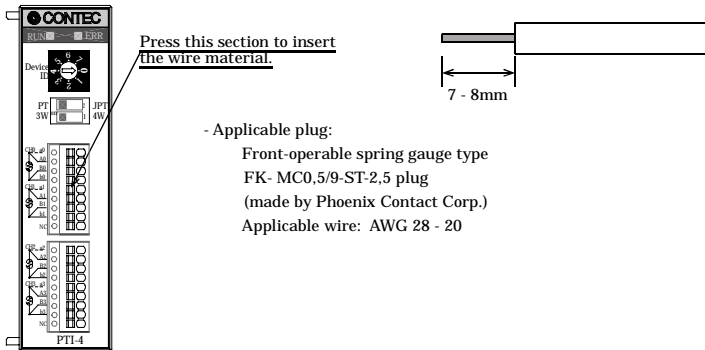
Figure 3.1. Connecting an Interface Connector and Connectors That Can Be Used

⚠ CAUTION

- Leave the NC pin unconnected.

- Removing the connector plug by grasping the cable can break the wire.

Connecting a Platinum Resistance Temperature Detector

To connect a platinum resistance temperature detector, use the interface connector on the face of the module. Set the sensor setting switches according to the type of the platinum resistance temperature detector and its wiring method.

Notes on wiring
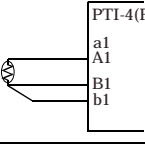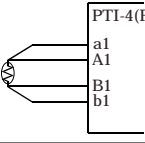
- When wiring the resistance temperature detector, set the three or four conductors to the same length (equal resistance).

- Set the wire resistance to 10Ω or less per conductor.

- Before adjustment using offset and gain settings, install the module and sensors in the actual environment in which to use the module.

- Leave the NC pin unconnected.

To keep measurement precision, external wiring that is protected from noise is required.
Please observe the following precautions for external wiring:

- For wiring the external AC circuit and sensor, use separate cables to prevent the sensor input from being affected by surges in AC and its electromagnetic field.

- Wire the module apart from any power line or high-voltage line. Do not bundle them together.

- When using a shielded cable, connect it to the ground terminal of the control panel on which this product is installed; do not connect it to the N.C. pin of this module.
  Note, however, that external of the control panel grounding may be better depending on noise states.

*1 Factory setting

Figure 3.2. Switch Settings and Wiring Methods

4. Using the I/O Address Map

Starting I/O Address

When connected to a CPU-SBxx(FIT)GY, the PTI-4(FIT)GY can directly receive I/O commands from the controller module. Depending on how the Device ID is set, the I/O addresses indicated below will be used exclusively by the PTI-4(FIT)GY.

Because the address bus on which the I/O address space is specified is not fully decoded in continued 16 bits, four starting I/O addresses exist in each Device ID.

If the Device ID is set to 0h, one of the four addresses (0800h, 0840h, 0880h, or 08C0h) will be used as a starting I/O address.

Table 4.1. List of starting I/O addresses

DeviceID	Occupied I/O address
0	0800h - 082Fh
1	1800h - 182Fh
2	2800h - 282Fh
3	3800h - 382Fh
4	4800h - 482Fh
5	5800h - 582Fh
6	6800h - 682Fh
7	7800h - 782Fh

For detailed specifications on the I/O space that is managed by the controller module, see the controller module manual.

List of I/O Address Maps

Starting I/O address	D7	D6	D5	D4	D3	D2	D1	D0
+0 (00h) Input	**Products Category** (Input Only)				**Rivision Data** (Input Only)			
	0	0	1	0	Rivision Data 3	Rivision Data 2	Rivision Data 1	Rivision Data 0
+1 (01h)	**Products ID Number**							
	0	0	0	0	0	1	0	0
+2 (02h)	**Conversion setting**							
	Reserved	Reserved	Average processing1	Average processing0	Average processing1	Average processing0	Calibration selection	Operation mode
+3 (03h)	**Disconnction detection flag** (Input Only)							
	Reserved	Reserved	Reserved	Reserved	CH3	CH2	CH1	CH0
+4 (04h) +5 (05h) +6 (06h) +7 (07h) +8 (08h)	DO NOT USE							
+9 (09h)	**SW setting information** (Input Only)							
	Reserved	Reserved	Reserved	Reserved	Reserved	PT/JPT 1	PT/JPT 0	3 wires/ 4 wires
+10 (0Ah)	**Average processing time / average processing count setting**							
	Data7	Data6	Data5	Data4	Data3	Data2	Data1	Data0
+11 (0Bh)	**Alarm output enable**							
	Reserved	Reserved	Reserved	Reserved	CH3	CH2	CH1	CH0
+12 (0Ch)	**Current value of alarm output flag** (Input Only)							
	CH3 upper	CH2 upper	CH1 upper	CH0 upper	CH3 lower	CH2 lower	CH1 lower	CH0 lower
+13 (0Dh)	**Current value of alarm output flag / latch** (Input Only)							
	CH3 upper	CH2 upper	CH1 upper	CH0 upper	CH3 lower	CH2 lower	CH1 lower	CH0 lower
+14 (0Eh)	**Conversion disable setting**							
	Reserved	Reserved	Reserved	Reserved	CH3	CH2	CH1	CH0

Figure 4.1. I/O address map list *< 1 / 3 >*   **< Continued >**

	Channel selection							
+15 (0Fh)	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Data1	Data0
	CHx temperature data 1/3 (Input Only)							
+16 (10h)	DATA7	DATA6	DATA5	DATA4	DATA3	DATA2	DATA1	DATA0
	CHx temperature data 2/3 (Input Only)							
+17 (11h)	DATA15	DATA14	DATA13	DATA12	DATA11	DATA10	DATA9	DATA8
	CHx temperature data 3/3 (Input Only)							
+18 (12h)	Over	Sign bit	DATA21	DATA20	DATA19	DATA18	DATA17	DATA16
	CHx offset setting value 1/3							
+19 (13h)	DATA7	DATA6	DATA5	DATA4	DATA3	DATA2	DATA1	DATA0
	CHx offset setting value 2/3							
+20 (14h)	DATA15	DATA14	DATA13	DATA12	DATA11	DATA10	DATA9	DATA8
	CHx offset setting value 3/3							
+21 (15h)	Sign bit	DATA22	DATA21	DATA20	DATA19	DATA18	DATA17	DATA16
	CHx Gain Settings value 1/3							
+22 (16h)	DATA7	DATA6	DATA5	DATA4	DATA3	DATA2	DATA1	DATA0
	CHx Gain Settings value 2/3							
+23 (17h)	DATA15	DATA14	DATA13	DATA12	DATA11	DATA10	DATA9	DATA8
	CHx Gain Settings value 3/3							
+24 (18h)	Sign bit	DATA22	DATA21	DATA20	DATA19	DATA18	DATA17	DATA16
+25 (19h) +31 (1Fh)	Reserved							

Figure 4.1. I/O address map list < 2 / 3 >   < Continued >

	DATA7 / DATA15 / Sign bit							
	CHx alarm output upper / upper limit 1/3							
+32 (20h)	DATA7	DATA6	DATA5	DATA4	DATA3	DATA2	DATA1	DATA0
	CHx alarm output upper / upper limit 2/3							
+33 (21h)	DATA15	DATA14	DATA13	DATA12	DATA11	DATA10	DATA9	DATA8
	CHx alarm output upper / upper limit 3/3							
+34 (22h)	Sign bit	DATA22	DATA21	DATA20	DATA19	DATA18	DATA17	DATA16
	CHx alarm output upper / lower limit 1/3							
+35 (23h)	DATA7	DATA6	DATA5	DATA4	DATA3	DATA2	DATA1	DATA0
	CHx alarm output upper / lower limit 2/3							
+36 (24h)	DATA15	DATA14	DATA13	DATA12	DATA11	DATA10	DATA9	DATA8
	CHx alarm output upper / lower limit 3/3							
+37 (25h)	Sign bit	DATA22	DATA21	DATA20	DATA19	DATA18	DATA17	DATA16
	CHx alarm output lower / upper limit 1/3							
+38 (26h)	DATA7	DATA6	DATA5	DATA4	DATA3	DATA2	DATA1	DATA0
	CHx alarm output lower / upper limit 2/3							
+39 (27h)	DATA15	DATA14	DATA13	DATA12	DATA11	DATA10	DATA9	DATA8
	CHx alarm output lower / upper limit 3/3							
+40 (28h)	Sign bit	DATA22	DATA21	DATA20	DATA19	DATA18	DATA17	DATA16
	CHx alarm output lower / lower limit 1/3							
+41 (29h)	DATA7	DATA6	DATA5	DATA4	DATA3	DATA2	DATA1	DATA0
	CHx alarm output lower / lower limit 2/3							
+42 (2Ah)	DATA15	DATA14	DATA13	DATA12	DATA11	DATA10	DATA9	DATA8
	CHx alarm output lower / lower limit 3/3							
+43 (2Bh)	Sign bit	DATA22	DATA21	DATA20	DATA19	DATA18	DATA17	DATA16

Figure 4.1. I/O address map list < 3 / 3 >

I/O Address Map Detailed Information

Product information

These information is common to all modules in F&eIT series.

	D7	D6	D5	D4	D3	D2	D1	D0
	Product Category				Rivision Data			
+0 (00h)	0	0	1	0	Revision Data3	Revision Data2	Revision Data1	Revision Data0
	Product ID Number							
+1 (01h)	0	0	0	0	0	1	0	0

Figure 4.2. Product information

- Revision Data [D3 - D0]:

    This is product update information, subject to change without notice, that is managed by CONTEC.

- Product Category [D7 - D4]:

    This is a module function classification code. For the PTI-4(FIT)GY, the code is "2h".

Table 4.2. Product Category

Code	Function
0	Extension BUS
1	Digital input-output
2	Analog input-output
3	Counter
4	Surial communication
5	GPIB
6-F	Reserved

- Products ID Number [D7 - D0]:

    This is the product ID within the same product category. For the PTI-4(FIT)GY, the product ID is "2h".

Following are examples of the initialization that is performed.

Microsoft C   Microsoft QBASIC

ProductID = inp(ADR+1);   ProductID = INP(ADR+1)

* ADR indicates the starting I/O address set with the rotary switch on the module.

Basic function

Conversion setting

Set basic operation states.

	D7	D6	D5	D4	D3	D2	D1	D0
Input	Conversion setting							
+2 (02h)	Reserved	Reserved	Average processing1	Average processing0	Conversion speed1	Conversion speed0	Calibration selection	Operation mode

Figure 4.3. Conversion setting

D0: Operation mode

Set this bit to read the direct resistance value of the resistance temperature detector. Setting the bit to 1 selects the resistance mode. Setting the bit to 0 causes the module to run in the temperature mode. The bit is set to 0 when a reset occurs.

In the temperature mode, a temperature (Unit : °C) <u>multiplied by 100</u> is output to the +10h [CHx temperature data] register.

In the resistance mode, a resistance (Unit : Ω) <u>multiplied by 1000</u> is output to the +10h [CHx temperature data] register.

Example: When a resistor of 125.01Ω is connected, 30D5h, a binary equivalent of 12501 obtained by multiplying the resistance by 100 is written to the temperature data register.

D1: Calibration selection

Set this bit to 1 to use specified compensation values (offset/gain). The bit is set to 0 when a reset occurs.

D2 - D3: Conversion speed selecting

These bits can be set to the time required for reading temperature from each channel in three levels. 2h represents 5 ms per channel for reading at the highest speed, followed by lower speeds of 40 ms and 150 ms. During operation at 150 ms, a 80-dB digital filter works in the 50/60 Hz band, thereby reducing the effect of noise from commercial power supplies. Note that it is not necessary to switch between 50 and 60 Hz. The bit is set to 0 when a reset occurs.

Conversion speed selection setting	Updating rate per 1 channel
00h	150ms
01h	40ms
02h	5ms

When the module is not averaging inputs while using all of the four channels, their update intervals is equal to "[conversion speed setting] x 4". If you use the conversion disable register to disable channels unused, the update interval is equal to "[conversion speed setting] x [the number of channels in use]".

D4 - D5: Average processing selecting

Set these bits to use the averaging function. You can choose from two types of averaging: averaging by time and averaging by count.

The registers are used in combination with the +0Ah "averaging time/count setting" register. When the averaging function is used, the CHx temperature data registers from +13h to +15h store the temperature averaged by time or sampling count according to the "averaging time/count setting".

The bit is set to 0 when a reset occurs.

Setting value	Average processing method
00h	No averaging
01h	Average count
02h	Average time

Disconnction detection flag (Input Only)

	D7	D6	D5	D4	D3	D2	D1	D0
	Disconnction detection flag (Input Only)							
+3 (03h)	Reserved	Reserved	Reserved	Reserved	CH3	CH2	CH1	CH0

Figure 4.4. Disconnction detection flag

D0 - D3: CH0 - CH3

When a resistance temperature detector or the disconnction of its conductor is detected, 1 is output to the bit corresponding to the relevant channel. When disconnction is detected, the ERR LED on the module comes on.

It takes about "[conversion cycle] x 5 ms" until the detection of continuity is reset after a sensor is connected and wired with that disconnction detected. This flag is not latched.

 Example: When disconnction is detected in channel 1, CH1(D1) is set to 1.

Disconnction is not detected in channels for which conversion has been disabled with the +0Eh "conversion disable setting" register.

To prevent unnecessary detection of disconnction, it is advisable to disable the channels not in use.

SW setting information (Input Only)

This register is the status register for the sensor setting switches on the module.

	D7	D6	D5	D4	D3	D2	D1	D0
	SW setting information (Input Only)							
+9 (09h)	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	PT/JPT	3 wires/4 wires

Figure 4.5. SW setting information

D0: 3 wires / 4 wires

This bit is the status bit for sensor setting switch 1 that selects the wiring method of the resistance temperature detector to be used. Setting the switch to ON selects "three wires" and sets the status bit to 1. The status bit set to 0 indicates "Four-wire".

D1: PT / JPT

This bit is the status bit for sensor setting switch 2 that selects the type of the resistance temperature detector to be used. Setting the switch to ON selects " Pt100" and sets the status bit to 1. The status bit set to 0 indicates " JPt100".

Average processing time / average processing count setting

	D7	D6	D5	D4	D3	D2	D1	D0
	Average processing time / average processing count setting							
+10 (0Ah)	Data7	Data6	Data5	Data4	Data3	Data2	Data1	Data0

Figure 4.6. Average processing time / average processing count setting

This setting stores the averaging count/time setting according to the setting of the +2h [conversion setting] register.

When time-based averaging has been set, the value obtained by averaging the values sampled for a period of [this register's setting x 100] ms is output to the +10h [CHx temperature data] register.

When count-based averaging has been set, the value obtained by averaging the values sampled [this register's setting x 8] times per channel is output to the +10h [CHx temperature data] register.

For time-based averaging, do not set a value equal to or less than twice the update rate set by the [conversion speed selection] register. Setting a value equal to or less than the update rate prevents temperature data from being updated.

Conversion disable setting

	D7	D6	D5	D4	D3	D2	D1	D0
	Conversion disable setting							
+14 (0Eh)	Reserved	Reserved	Reserved	Reserved	CH3	CH2	CH1	CH0

Figure 4.7. Conversion disable setting

This register disables the conversion (use) of channels with no resistance temperature detector connected. Disable the conversion of channels with no resistance temperature detector connected.

Example: Setting the register to 0Ch disables the conversion of channels 2 and 3.

Channel selection

	D7	D6	D5	D4	D3	D2	D1	D0
	Channel selection							
+15 (0Fh)	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Data1	Data0

Figure 4.8. Channel selection

The [CHx temperature data], [CHx offset], [CHx gain], and CHx alarm output setting registers from +10h on store data on the channels selected by this channel selection register. Before accessing the +10h register and following ones, for example, to read temperature data, use this register to select the target channels. The bit is set to 0 when a reset occurs.

Setting value	Selecting channel
00h	Channel0
01h	Channel1
02h	Channel2
03h	Channel3

CHx temperature data (Input Only)

	D7	D6	D5	D4	D3	D2	D1	D0
	CHx temperature data 1/3 (Input Only)							
+16 (10h)	DATA7	DATA6	DATA5	DATA4	DATA3	DATA2	DATA1	DATA0
	CHx temperature data 2/3 (Input Only)							
+17 (11h)	DATA15	DATA14	DATA13	DATA12	DATA11	DATA10	DATA9	DATA8
	CHx temperature data 3/3 (Input Only)							
+18 (12h)	Over	Sign bit	DATA21	DATA20	DATA19	DATA18	DATA17	DATA16

Figure 4.9. CHx temperature data

The [CHx temperature data] register is three bytes long. This register contains data on the channels specified by the [channel selection] register.

When the operation mode set by the [conversion setting] register is temperature mode:

The absolute value obtained by multiplying a temperature (Unit : °C) by 100 is output to the DATA0 to DATA21 bits. The sign bit contains 0 to represent a plus sign or 1 to represent a minus sign. The Over bit is set to 1 when the temperature falls outside the measurable range (-200 - 850°C centigrade for Pt100; -200 - 510°C centigrade for JPt100).

Example: When a temperature of -60°C centigrade is input, 60 is multiplied by 100 into 6000, the result is converted to a binary value of 1770h, and the minus sign bit is applied to that value to set 401770h in this register.

Example: When a temperature of 300°C centigrade is input, the register holds 007530h, a binary equivalent of 30000 obtained by multiplying 300 by 100.

When the operation mode set by the [conversion setting] register is resistance mode:

The value obtained by multiplying the resistance (Unit : Ω) by 1000 is output. The Over bit is set to 1 when the resistance falls outside the measurable range (15 - 1000Ω).

Example: When a value of 300Ω is input, the register holds 0493E0h, a binary equivalent of 300000 obtained by multiplying 300 by 1000.

Alarm output function

If detecting the temperature different from the setting range, you can output to the alarm output register. The module can be programmed to take action only when the alarm output register changes without reading temperatures regularly. Alarm output can be set for each channel.

The alarm output range can be set with four levels: upper / upper limit, upper / lower limit, lower / upper limit, and lower / lower limit.

The alarm output flag is set to 1 when the temperature exceeds the upper / upper limit or goes below the lower / lower limit.

The alarm output flag is set to 0 when the temperature goes below the upper / lower limit or exceeds the upper / lower limit.
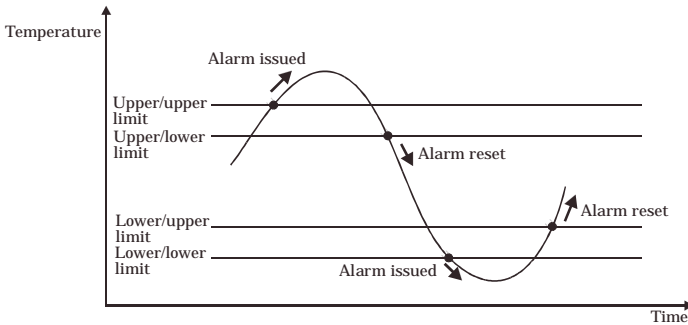
Figure 4.10.   Alarm output range

Alarm output enable

Set this register to use the alarm output function.

	D7	D6	D5	D4	D3	D2	D1	D0
	Alarm output enable
+11 (0Bh)	Reserved	Reserved	Reserved	Reserved	CH3	CH2	CH1	CH0

Figure 4.11.   Alarm output enable

D0 - D3: CH0 - CH3

This register enables or disables the alarm output function. Setting the bit for each channel in the register to 1 enables the alarm output function for that channel. Before enabling the alarm output function, set the threshold values for alarm output at +20h and later.

Example: To enable the alarm output function for channel 2, set the CH2 (D2) bit to 1.

Current value of alarm output flag (Input Only)

	D7	D6	D5	D4	D3	D2	D1	D0
	Current value of alarm output flag (Input Only)							
+12 (0Ch)	CH3 upper	CH2 upper	CH1 upper	CH0 upper	CH3 lower	CH2 lower	CH1 lower	CH0 lower

Figure 4.12.   Current value of alarm output flag

When the alarm output function for a given channel is enabled in the [alarm output enable] register, the corresponding alarm output flag is set to 1 the moment the input exceeds the upper / upper value or goes below the lower / lower value, which are specified at +20h and later and is set to 0 the moment the input goes below the upper / lower value or exceeds the upper / lower value.

D0 - D3: CH0 - CH3 lower
   These bits indicate that the lower-limit alarm has been output for channel x (x substituted for 0 - 3).
D4 - D7: CH0 - CH3 upper
   These bits indicate that the upper-limit alarm has been output for channel x (x substituted for 0 - 3).

Current value of alarm output flag / latch (Input Only)

	D7	D6	D5	D4	D3	D2	D1	D0
	Current value of alarm output flag / latch (Input Only)							
+13 (0Dh)	CH3 upper	CH2 upper	CH1 upper	CH0 upper	CH3 lower	CH2 lower	CH1 lower	CH0 lower

Figure 4.13.   Current value of alarm output flag / latch

When the alarm output function for a given channel is enabled in the [alarm output enable] register, the corresponding alarm output flag is set to 1 the moment the input exceeds the upper / upper value or goes below the lower / lower value, which are specified at +20h and later. Once set to 1, the flag maintains 1 until this register is read. When the register is read, all the bits therein are cleared to 0 upon completion of the next acquisition of temperature data.

D0 - D3: CH0 - CH3 lower
   These bits indicate that the lower-limit alarm was output at least once for channel x (x substituted for 0 - 3).
D4 - D7: CH0 - CH3 upper
   These bits indicate that the upper-limit alarm was output at least once for channel x (x substituted for 0 - 3).

CHx alarm output upper / upper limit, upper / lower limit, lower / upper limit and lower / lower limit

	D7	D6	D5	D4	D3	D2	D1	D0
	CHx alarm output * / * limit 1/3							
XXh	DATA7	DATA6	DATA5	DATA4	DATA3	DATA2	DATA1	DATA0
	CHx alarm output * / * limit 2/3							
(XX+1)h	DATA15	DATA14	DATA13	DATA12	DATA11	DATA10	DATA9	DATA8
	CHx alarm output * / * limit 3/3							
(XX+2)h	Sign bit	DATA22	DATA21	DATA20	DATA19	DATA18	DATA17	DATA16

Figure 4.14.   CHx alarm output upper / upper limit, upper / lower limit, lower / upper limit and lower / lower limit

This register is three bytes long and inputs / outputs data on the channels specified by the [channel selection] register.

The absolute value obtained by multiplying a temperature (Unit : °C) by 100 is set to the DATA0 - DATA22 bits. The sign bit contains 0 to represent a plus sign or 1 to represent a minus sign. Set each temperature to within the measurable range (-200 - 850°C centigrade for Pt100; -200 - 510°C centigrade for JPt100).

   Example: When a temperature of -60°C centigrade is set, 60 is multiplied by 100 into 6000, the result
                  is converted to a binary value of 1770h, and the minus sign bit is applied to that value to set
                  801770h in this register.
   Example: When a temperature of 300°C centigrade is set, the register holds 007530h, a binary
                  equivalent of 30000 obtained by multiplying 300 by 100.

Offset / Gain settings function

The offset and gain values can be set for each channel to correct errors. This function can be used for correcting temperature conversion according to the actual measurement environment.

Setting the [calibration selection] bit in the [conversion setting] register to 1 enables the offset/gain setting function. Once values are written to the [offset/gain setting value] register, the values are stored automatically in FLASH ROM in the module and remain stored even when a power failure or shutdown occurs. As the [calibration selection] bit is not saved, however, it must be set again when the power is turned back on.

When the power is turned back on, the offset/gain setting values are read automatically from FLASH ROM.

⚠ CAUTION
FLASH ROM can be written to up to 100000 times. Do not program the module such that offset/gain values are written every time.
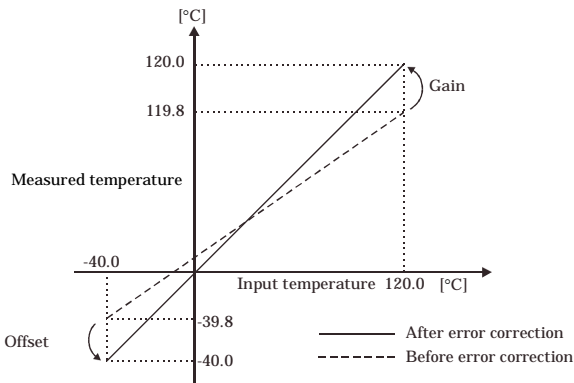
Figure 4.15.   Error Compensation Based on Offset/Gain Settings

To set offset and gain values, follow the procedure below to obtain the values at the minimum and maximum temperatures in the measured temperature range. If it is difficult to input a temperature as the ideal input to this product, connect a precision resistor equivalent to that temperature to the end of the conductor (the far side from the module) for error compensation purposes. Follow the procedure below in that case as well:

1. Enable the calibration function.
    Make sure that the [operation mode] bit in the [conversion setting] register is 0.
    Set the [calibration selection] bit in the +02h [conversion setting] register to 1.
2. Calculate the offset value and write it to the [offset setting value] register.
    Input the minimum temperature in the measured temperature range or its resistance equivalent to obtain the offset value from the following equation. Write the obtained value to the [offset setting value] register according to "CHx Offset and Gain Settings".
    Offset setting value = { (Measured temperature conversion value)-(Temperature input value)}
                    x 100   [Unit : °C]
    Example1:   Figure 4.15. {(-39.8)-(-40.0)} x 100 = 20
    Example2:   Temperature input is 5°C, conversion value is 4.7°C
            {(4.7)-(5.0)} x 100 = -30

3. Calculate the gain value and write it to the [gain setting value] register.

   After writing the offset value, input the maximum temperature in the measured temperature range or its resistance equivalent to obtain the gain setting value from the following equation: Write the obtained value to the [gain setting value] register according to "CHx Offset and Gain Settings".
   Gain setting value = {(Measured temperature conversion value) - (Temperature input value)}

   $$x\ 100 \qquad\qquad\qquad\qquad\qquad \text{[Unit : °C]}$$

   Example1:   Figure 4.15. {(119.8)-(120.0)} x 100 = -20.0

   Example2:   Temperature input is 30°C, conversion value is 32°C

   {(32.0)-(30.0)} x 100 = 200

Conversion setting

	D7	D6	D5	D4	D3	D2	D1	D0
Input	Conversion setting							
+2 (02h)	Reserved	Reserved	Average processing1	Average processing0	Conversion speed1	Conversion speed0	Calibration selection	Operation mode

Figure 4.16.   Conversion setting

D1: Calibration selection
   Set this bit to 1 to use the offset/gain setting function. The bit is set to 0 when a reset occurs. Set the offset/gain values before setting this bit to 1.

CHx Offset and Gain Settings

	D7	D6	D5	D4	D3	D2	D1	D0
XXh	CHx * setting value 1/3							
	DATA7	DATA6	DATA5	DATA4	DATA3	DATA2	DATA1	DATA0
(XX+1)h	CHx * setting value 2/3							
	DATA15	DATA14	DATA13	DATA12	DATA11	DATA10	DATA9	DATA8
(XX+2)h	CHx * setting value 3/3							
	Sign bit	DATA22	DATA21	DATA20	DATA19	DATA18	DATA17	DATA16

Figure 4.17.   CHx Offset and Gain Settings

This register is three bytes long and inputs / outputs data on the channels specified by the [channel selection] register.
The absolute value obtained by multiplying a temperature (Unit : °C) by 100 is set to the DATA0 - DATA22 bits. The sign bit contains 0 to represent a plus sign or 1 to represent a minus sign.

   Example1:   When a temperature of -60°C centigrade is set, 60 is multiplied by 100 into 6000, the result is converted to a binary value of 1770h, and the minus sign bit is applied to that value to set 801770h in this register.

   Example1:   When a temperature of 300°C centigrade is set, the register holds 007530h, a binary equivalent of 30000 obtained by multiplying 300 by 100.

Examples

Software Mode

Flowchart

Following is a description of an example where the PTI-4(FIT)GY is installed at device ID: 0.

Address : Output 0Ch to a base I/O address of +0Eh disables conversion of channels 2 and 3.

Address : Output channel value to a base I/O address+0Fh and input a base I/O address+10h, 11h and 12h gains temperature value and disables conversion of channel 2 and 3.
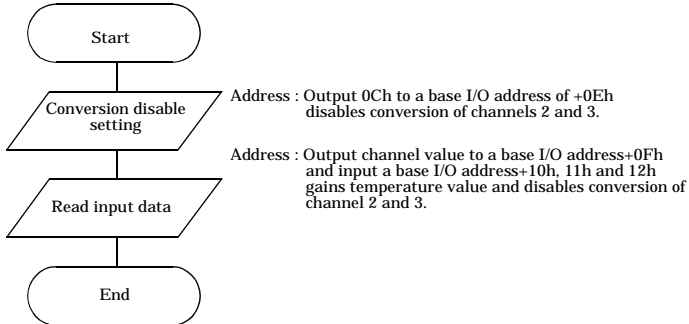
Figure 4.18.   Flow chart of software mode

Sample program

```
/* ======================================================================
    Sample program 1

    DEVICE ID:       0
    Channel:         Input 4ch/
====================================================================== */
#include  <stdio.h>
#include  <conio.h>


/* ----- Constant ----------------------------------------------------- */
#define   ADR   0x0800            /* I/O address */


/* ----- Prototype ---------------------------------------------------- */
void  main( void );


/* ----- Main --------------------------------------------------------- */
void  main( void )
{
    long              inData;
    float             inData1;
    unsigned char     convSet=0x0C;
    unsigned char     ch;
```

```
outp( ADR+0x0E, convSet );

for( ch = 0; ch < 4; ch++ ){
    outp( ADR+0x0F, ch );
    inData  =(unsigned long)inp( ADR+0x10 );
    inData |=(unsigned long)inp( ADR+0x11 ) << 8;
    inData |=(unsigned long)inp( ADR+0x12 ) << 16;

    /* over check */
    if( inData & 0x00800000 ){
        over = 1;
        inData -= 0x00800000;
    }else{
        over = 0;
    }

    /* sign check */
    if( inData & 0x00400000 ){
        inData = ~(inData - 0x00400000) + 1;
    }

    inData1 = (float)inData / 100;
    printf("Input Data Ch%u  %.2f\n", ch, inData1 );
}
}
```

5. Using the Memory Address Map

When connected to a CPU-CA10xx(FIT), the PTI-4(FIT)GY can be accessed by a host computer through a network. In addition, the Module can be allocated to the memory controlled by the Controller Module according to a given Device ID. Applications running on the host computer control the I/O modules by reading/writing the memory that is controlled by the Controller Module.

For detailed specifications on the memory controlled by the Controller Module, see the Controller Module manual.

Following is an explanation of the memory areas necessary for the use of this I/O module: the "module area", the "module information area", and the "basic data area".

Module settings area

This area controls the settings and how the module is started.

The module becomes available when the necessary settings are written into this area and the module activation option is set in the [module startup register].

Module information area

The current module settings are stored in this area.

When the Module is started, the contents of the Module Settings Area are copied to the Module Information Area. By reading this area, you can verify the current module settings.

Basic I/O data area

Basic I/O data is read and written in this area.

Module Settings Area

A module settings area, which is a 128-byte (80h) area beginning with address 301000h and corresponding to a given Device ID, is where the settings for the given device are read and written.

The starting address can be determined according to the following expression:

Starting address = 301000h + 80h x (Device ID)

Table 5.1.   Module setting area *< 1 / 3 >*

Address (h)	Area	Item	Size	Access type	Initial value (h)	Initial settings
Starting address+00	Module-specific information	Module type (category)	1	R	02	PTI-4(FIT)GY
Starting address+01		Module type (serial No.)	1	R	04	
Starting address+02		System-reserved (revision No.)	1	R	None	
Starting address+03		Supported functions	1	R	03	Basic I/O
Starting address+04		Number of basic input channels	1	R	04	4 channels
Starting address+05		Basic input data size	1	R	04	4 bytes
Starting address+06		Number of basic output channels	1	R	04	4 channels
Starting address+07		Basic output data size	1	R	04	4 bytes
Starting address+08		Input channel settings address	1	R	20	20h
Starting address+09		Input channel settings data size	1	R	18	24 bytes
Starting address+0A		Output channel settings address	1	R	00	
Starting address+0B		Output channel settings data size	1	R	00	
Starting address+0C - Starting address +0F		Reserved	4	R	None	
Starting address+10	Common to modules	Module startup register	1	R/W	00	Stopping
Starting address+11		Error status	1	R	00	
Starting address+12		SW setting (wiring method)	1	R	00	Reflecting SW settings
Starting address+13		SW setting (Resistance temperature detector)	1	R	00	Reflecting SW settings
Starting address+14		operation mode	1	R/W	00	Temperature value
Starting address+15		Convesion speed setting	1	R/W	00	150ms
Starting address+16		Average processing setting	1	R/W	00	Unused
Starting address+17		Average processing value	1	R/W	00	
Starting address+18		Calibration selection	1	R/W	00	Default factory setting
Starting address+19 - Starting address+1F		Reserved	7	R	None	

Table 5.1.   Module setting area < 2 / 3 >

Address (h)	Area	Item		Size	Access type	Initial value (h)	Initial settings
Starting address+20		CH0	Conversion disable	1	R/W	00	Conversion
Starting address+21			Alarm output setting	1	R/W	00	OFF
Starting address+22 - Starting address+24			Alarm output upper / upper limit	3	R/W	000000	
Starting address+25 - Starting address+27			Alarm output upper / lower limit	3	R/W	000000	
Starting address+28 - Starting address+2A			Alarm output lower / upper limit	3	R/W	000000	
Starting address+2B - Starting address+2D			Alarm output lower / lower limit	3	R/W	000000	
Starting address+2E - Starting address+30			Offset value	3	R/W	000000	
Starting address+31 - Starting address+33			Gain value	3	R/W	000000	
Starting address+34 - Starting address+37			Reserved	4	R	None	
Starting address+38		CH1	Conversion disable	1	R/W	00	Conversion
Starting address+39			Alarm output setting	1	R/W	00	OFF
Starting address+3A - Starting address+3C			Alarm output upper / upper limit	3	R/W	000000	
Starting address+3D - Starting address+3F			Alarm output upper / lower limit	3	R/W	000000	
Starting address+40 - Starting address+42	Channel settings		Alarm output lower / upper limit	3	R/W	000000	
Starting address+43 - Starting address+45			Alarm output lower / lower limit	3	R/W	000000	
Starting address+46 - Starting address+48			Offset value	3	R/W	000000	
Starting address+49 - Starting address+4B			Gain value	3	R/W	000000	
Starting address+4C - Starting address+4F			Reserved	4	R	None	
Starting address+50		CH2	Conversion disable	1	R/W	00	Conversion
Starting address+51			Alarm output setting	1	R/W	00	OFF
Starting address+52 - Starting address+54			Alarm output upper / upper limit	3	R/W	000000	
Starting address+55 - Starting address+57			Alarm output upper / lower limit	3	R/W	000000	
Starting address+58 - Starting address+5A			Alarm output lower / upper limit	3	R/W	000000	
Starting address+5B - Starting address+5D			Alarm output lower / lower limit	3	R/W	000000	
Starting address+5E - Starting address+60			Offset value	3	R/W	000000	
Starting address+61 - Starting address+63			Gain value	3	R/W	000000	
Starting address+64 - Starting address+67			Reserved	4	R	None	

Table 5.1.   Module setting area *< 3 / 3 >*

Address (h)	Area	Item		Size	Access type	Initial value (h)	Initial settings
Starting address+68	Channel settings	CH3	Conversion disable	1	R/W	00	Conversion
Starting address+69			Alarm output setting	1	R/W	00	OFF
Starting address+6A - Starting address+6C			Alarm output upper / upper limit	3	R/W	000000	
Starting address+6D - Starting address+6F			Alarm output upper / lower limit	3	R/W	000000	
Starting address+70 - Starting address+72			Alarm output lower / upper limit	3	R/W	000000	
Starting address+73 - Starting address+75			Alarm output lower / lower limit	3	R/W	000000	
Starting address+76 - Starting address+78			Offset value	3	R/W	000000	
Starting address+79 - Starting address+7B			Gain value	3	R/W	000000	
Starting address+7C - Starting address+7F			Reserved	4	R	None	

Module-specific information

- Module type (category)
  The PTI-4(FIT)GY belongs to the analog module (02h) category.

- Module type (serial No.)
  The PTI-4(FIT)GY is an analog module with a serial No. 4 (04h).

- Supported functions
  The PTI-4(FIT)GY supports the basic I/O function (03h).

  The basic input data takes temperature value.

  Basic output data is used to clear the status flag.

- Number of basic input channels
  The number of basic input channels for the PTI-4(FIT)GY is 4 (04h).

  Four temperature channels are provided.

- Basic input data size
  The basic input data size for the PTI-4(FIT)GY is 4 (04h) bytes.

  The temperature value and status flag use three bytes and one byte, respectively.

- Number of basic output channels

  The PTI-4(FIT)GY takes basic output data 4 (04h).

  Be used to clear the status flag.

- Basic output data size

  The basic output data size for the PTI-4(FIT)GY is 4 (04h) bytes.

- Input channel settings address

  The address of the area storing the settings of individual input channels is indicated as the offset address in the module setting area.

  The PTI-4(FIT)GY stores input channel settings from 20h on.

- Input channel settings data size

  This item indicates the data size of the area storing the settings of individual input channels.

  The data size of the input channel settings area for the PTI-4(FIT)GY is 24 bytes (18h).

- Output channel settings address

  The PTI-4(FIT)GY does not have channel-specific settings. This field is provided for compatibility with other device modules.

- Output channel settings data size

  The PTI-4(FIT)GY does not have channel-specific settings. This field is provided for compatibility with other device modules.

Items Common to Modules

- Module startup register

    Setting the module startup (01h) register activate the module to start conversion of selected channels.

    > 00h : Module stop (Conversion terminated)
    > 01h : Module startup (Conversion in progress)

- Error status

    The error status bits, which are not reflected in the module settings area, always remain [00h].

    The error status on a module is stored in the module information area.

- SW setting (Wiring method)

    This item reflects the settings of the sensor setting switches on the module, which select the wiring method of the resistance temperature detector to be used.

    > 00h : Four-wire type
    > 01h : Three-wire type

- SW setting (Resistance temperature detector)

    This item reflects the settings of the sensor setting switches on the module, which select the type of the resistance temperature detector to be used.

    > 00h : JPt100
    > 01h : Pt100

- Operation mode

    Resistance can be read directly without being converted to temperature.

    > 00h : Temperature value (Factory setting)
    > 01h : Registance

Temperature mode outputs a temperature (Unit : °C) multiplied by 100.
Resistance mode outputs a resistance (Unit : Ω) multiplied by 1000.

- Conversion speed setting

    Select the conversion speed of the AD converter.
    During operation at 150 ms, a 80-dB digital filter works in the 50/60 Hz band, thereby reducing the effect of noise from commercial power supplies.

Conversion speed setting value	Updating rate per 1 channel
0 (00h)*1	150ms
1 (01h)	40ms
2 (02h)	5ms
3 (03h)	1.5ms

    *1 Factory setting

    When the module is not averaging inputs while using all of the four channels, their update intervals is equal to "[conversion speed setting] x 4." If any channel is not used, set the corresponding [conversion disable] item in the channel settings area to "01h" to disable the conversion of the channel, and the update interval is equal to "[conversion speed setting] x [the number of channels in use]".

- Average processing setting

Set this item to average temperature data by time or sampling count.

Setting value	Function
0 (00h)*1	No averaging
1 (01h)	Average count
2 (02h)	Average time

*1 Factory setting

- Average processing value

Set a value for the count or time set for averaging. Set 00h if the averaging function is not used.

Average count   : Setting value x 8 times

Average time   : Setting value x 100ms

For time-based averaging, do not set a value equal to or less than twice the update rate set by [conversion speed selection]. Setting a value equal to or less than the update rate prevents temperature data from being updated.

- Calibration setting

Set "01h" to use user-specified calibration values.

00h : Default factory setting (Factory setting)
01h : Use user-specified calibration values

Chanel setting

- Conversion disable

  This item controls conversion of a given channel. Setting the data for a channel to "01h" disables the conversion of that channel, saving the update interval for the channel.

      00h : Conversion (Factory setting)
      01h : Conversion disable

- Alarm output setting

  This item selects whether to output an alarm depending on the temperature data value. Setting the data for a given channel to "01h" sets alarm information in the basic input data status flag.

      00h : Alarm OFF (Factory setting)
      01h : Alarm ON

- Alarm output upper / upper limit

  Set the upper / upper limit when the alarm output setting for a given channel is "01h". When the temperature data value exceeds this setting, the "alarm upper (no latch)" alarm information bit in the basic input data status flag is set to "1".

- Alarm output upper / lower limit

  Set the upper / lower limit when the alarm output setting for a given channel is "01h". When the temperature data value goes below this setting, the "alarm upper (no latch)" alarm information bit in the basic input data status flag is set to "0".

- Alarm output lower / upper limit

  Set the lower / upper limit when the alarm output setting for a given channel is "01h". When the temperature data value exceeds this setting, the "alarm lower (no latch)" alarm information bit in the basic input data status flag is set to "0".

- Alarm output lower / lower limit

  Set the lower / lower limit when the alarm output setting for a given channel is "01h". When the temperature data value goes below this setting, the "alarm lower (no latch)" alarm information bit in the basic input data status flag is set to "1".

- Offset value

  Set the offset value for each channel when the calibration selection setting is "01h".

- Gain value

  Set the gain value for each channel when the calibration selection setting is "01h".

Module Information Area

The module information area is a 128-byte (80h) area beginning with address 300000h and corresponding to a given Device ID. It is the area to read the setting.

The starting address can be determined according to the following expression:

Starting address = 300000h + 80h x (Device ID)

Table 5.2. Module information area _< 1 / 2 >_

Address (h)	Area	Item	Size	Access type	Initial value (h)
Starting address+00	Module-specific information	Module type (category)	1	R	02
Starting address+01		Module type (serial No.)	1	R	04
Starting address+02		System-reserved (revision No.)	1	R	None
Starting address+03		Supported functions	1	R	03
Starting address+04		Number of basic input channels	1	R	04
Starting address+05		Basic input data size	1	R	04
Starting address+06		Number of basic output channels	1	R	04
Starting address+07		Basic output data size	1	R	04
Starting address+08		Input channel settings address	1	R	20
Starting address+09		Input channel settings data size	1	R	18
Starting address+0A		Output channel settings address	1	R	00
Starting address+0B		Output channel settings data size	1	R	00
Starting address+0C - starting address+0F		Reserved	4	R	None
Starting address+10	Common to modules	Module startup register	1	R	00
Starting address+11		Error status	1	R	00
Starting address+12		SW setting (wiring method)	1	R	00
Starting address+13		SW setting (Resistance temperature detector)	1	R	00
Starting address+14		operation mode	1	R	00
Starting address+15		Conversion speed setting	1	R	00
Starting address+16		Average processing setting	1	R	00
Starting address+17		Average processing value	1	R	00
Starting address+18		Calibration setting	1	R	00
Starting address+19 - starting address +1F		Reserved	7	R	None

Table 5.2. Module information area *< 2 / 2 >*

Address (h)	Area		Item	Size	Access type	Initial value (h)
Starting address+20	Channel settings	CH0	Conversion disable	1	R	00
Starting address+21			Alarm output setting	1	R	00
Starting address+22 - Starting address+24			Alarm output upper / upper limit	3	R	000000
Starting address+25 - Starting address+27			Alarm output upper / lower limit	3	R	000000
Starting address+28 - Starting address+2A			Alarm output lower / upper limit	3	R	000000
Starting address+2B - Starting address+2D			Alarm output lower / lower limit	3	R	000000
Starting address+2E - Starting address+37			Reserved	10	R	None
Starting address+38		CH1	Conversion disable	1	R	00
Starting address+39			Alarm output setting	1	R	00
Starting address+3A - Starting address+3C			Alarm output upper / upper limit	3	R	000000
Starting address+3D - Starting address+3F			Alarm output upper / lower limit	3	R	000000
Starting address+40 - Starting address+42			Alarm output lower / upper limit	3	R	000000
Starting address+43 - Starting address+45			Alarm output lower / lower limit	3	R	000000
Starting address+46 - Starting address+4F			Reserved	10	R	None
Starting address+50		CH2	Conversion disable	1	R	00
Starting address+51			Alarm output setting	1	R	00
Starting address+52 - Starting address+54			Alarm output upper / upper limit	3	R	000000
Starting address+55 - Starting address+57			Alarm output upper / lower limit	3	R	000000
Starting address+58 - Starting address+5A			Alarm output lower / upper limit	3	R	000000
Starting address+5B - Starting address+5D			Alarm output lower / lower limit	3	R	000000
Starting address+5E - Starting address+67			Reserved	10	R	None
Starting address+68		CH3	Conversion disable	1	R	00
Starting address+69			Alarm output setting	1	R	00
Starting address+6A - Starting address+6C			Alarm output upper / upper limit	3	R	000000
Starting address+6D - Starting address+6F			Alarm output upper / lower limit	3	R	000000
Starting address+70 - Starting address+72			Alarm output lower / upper limit	3	R	000000
Starting address+73 - Starting address+75			Alarm output lower / lower limit	3	R	000000
Starting address+76 - Starting address+7F			Reserved	10	R	None

When the module is started, the contents of the module setting area are stored in the module information area, with the exception of the [Module Startup Register] and the [Error Status].

- Module startup register
    This register holds the module operating status.
        00h : Module shutdown (Conversion processing terminated)
        01h : Module operating (Conversion progressing in operation)

- Error status
    This register stores the error status of the module.
    The error status register is reset when the module is restarted.
        00h : Normal status

Basic I/O Data Area

The basic input data area, which is a 128-byte (80h) area beginning with address 304000h, corresponds to a given Device ID.

The starting address can be determined according to the following expression:

Starting address = 304000h + 80h x (Device ID)

Table 5.3.   Basic input data area

Address (h)	Area	Item	Size	Access type
Starting address+00	CH0	Temperature data	3	R
Starting address+03		Status flag	1	R
Starting address+04	CH1	Temperature data	3	R
Starting address+07		Status flag	1	R
Starting address+08	CH2	Temperature data	3	R
Starting address+0B		Status flag	1	R
Starting address+0C	CH3	Temperature data	3	R
Starting address+0F		Status flag	1	R
Starting address+10 - starting address +7F	Reserved		112	R

Temperature data

Temperature data is stored in the little endian format.

	D7	D6	D5	D4	D3	D2	D1	D0
+0h	C7	C6	C5	C4	C3	C2	C1	C0
+1h	C15	C14	C13	C12	C11	C10	C9	C8
+2h	Over bit	Sign bit	C21	C20	C19	C18	C17	C16

Figure 5.1. Temperature data input value

- Over bit

    This bit is set to "1" when the temperature data input falls outside the range from -200 to 850°C centigrade for Pt100 or from -200 to 510°C centigrade for JPt100. Either of 850, 510, and -200°C centigrade is set as data depending on the Pt100 or JPt100 setting.

- Sign bit

    Unsigned integers can be obtained as channel data. The sign of obtained data depends on the sign bit setting.

    0 : Plus
    1 : Minus

Status flag

	D7	D6	D5	D4	D3	D2	D1	D0
+3h	-	-	-	Disconnction	Alarm / upper	Alarm / lower	Alarm / upper (Latch)	Alarm / lower (Latch)

Figure 5.2. Status flag

- Alarm upper / lower (latch)
    The bit is set to "1" when input data exceeds the upper upper limit for alarm output or goes below the lower lower limit even once with the alarm output set to "01h". The bit maintains the value until the alarm is cleared.
    > 0 : Input data neither over the upper upper limit for alarm output nor under the lower lower limit
    > 1 : Input data either over the upper upper limit for alarm output or under the lower lower limit
- Alarm upper / lower
    The bit is set to "1" when the current input data exceeds the upper / upper limit for alarm output or goes below the lower / lower limit with the alarm output set to "01h". The bit does not maintain the value, only indicating whether the current data falls within the range between the upper and lower limits for alarm output.
    > 0 : Current input data within the range between upper / lower limit for alarm output and upper lower limit
    > 1 : Current input data outside the range between upper / upper limit for alarm output and lower / lower limit
- Disconnction
    A disconnction in each channel is detected. If disconnction is detected, the conversion data existing before the detection is held as input data.
    > 0 : Continuity
    > 1 : Disconnction

⚠ CAUTION

Disconnction is not detected when the "conversion disable" setting in the channel settings area is [01h].

The basic output data area, which is a 128-byte (80h) area beginning with address 305000h, corresponds to a given Device ID.
The starting address can be determined according to the following expression:
Starting address = 305000h + 80h x (Device ID)

Table 5.4. Basic output data area

Address (h)	Area	Item	Size	Access type
Starting address+00	CH0	Reserved	3	R
Starting address+03		Status flag	1	R/W
Starting address+04	CH1	Reserved	3	R
Starting address+07		Status flag	1	R/W
Starting address+08	CH2	Reserved	3	R
Starting address+0B		Status flag	1	R/W
Starting address+0C	CH3	Reserved	3	R
Starting address+0F		Status flag	1	R/W
Starting address+10 - starting address+7F	Reserved		112	R

Status flag

	D7	D6	D5	D4	D3	D2	D1	D0
+3h	-	-	-	-	-	-	Alarm upper (latch)	Alarm lower (latch)

Figure 5.3. Status flag

- Alarm upper / lower (latch clear)

  Setting the bit clears alarm latch data set in the basic input data area. The bit is set to 0 upon completion of latch clearing.

  > 1 : Alarm upper / lower limit latch data clear
  > 0 : No processing

Examples

Flowchart

Following is a description of an example where the PTI-4(FIT)GY is installed at device ID: 0

Start

Open processing

Open seccess? No

Yes

Is the module type analog? No — Address : Reading the address 301000h identifies the category. Analog module is "02h".

Yes

Set the module startup in the module startup register. — Address : Starting the module enables it to obtain input data from channels selected for conversion.

Acquiring the input data — Address : Input data from CH0 can be obtained by reading 4 bytes from 304000h. By reading each set of 4 bytes that follow, input data from succeeding channels to CH3 can be obtained.

Displays the input data

Checking the error status — Address : Reading the address 3000011h identifies the error status.

Close processing

End

Figure 5.4. Flowchart

Sample program

```
/*=========================================================================
   F&eIT I/F Sample Program

      DEVICE ID:   0
      Channel:     0 to 3ch
========================================================================= */
#include  <windows.h>
#include  <stdio.h>
#include  <stdlib.h>
#include  <conio.h>
#include  "Fit.h"

/* Address(common) */
#define   FIT_IO                    (0x00300000)
#define   FIT_IO_DEVICE_INFOR       (0x0000)
#define   FIT_IO_DEVICE_CONFIG      (0x1000)
#define   FIT_IO_INPUT              (0x4000)
#define   FIT_IO_OUTPUT             (0x5000)

#define   FIT_IO_DEVICE_SIZE        (0x0080)

#define   FIT_PRODUCT_CATEGORY      (0x00)

#define   FIT_MODULE_START          (0x10)
#define   FIT_ERROR_STATUS          (0x11)

/* Information(Common) */
#define   FIT_PRODUCT_DIGITAL       (0x01)
#define   FIT_PRODUCT_ANALOG        (0x02)
#define   FIT_PRODUCT_COUNTER       (0x03)

#define   FIT_MODULE_START_OFF      (0x00)
#define FIT_MODULE_START_ON         (0x01)

/* Sample */
#define   FIT_SAMPLE_IP_ADDRESS     "192.168.132.211"
#define   FIT_SAMPLE_PORT           (0x5007)
#define   FIT_SAMPLE_DEVICE_ID      (0)

int main(void)
{
    DWORD  dwIpAddress;
    DWORD  dwVaBase;
    DWORD  dwVaOffset;
    WORD   hHandle;
    WORD   wStatus;
    BYTE   byCategory;
    BYTE   byRange;
    BYTE   byModuleStart;
    BYTE   byData[0x80];
    BYTE   byChCount;
    BYTE   byErrorStatus;

    /* Open   */
    dwIpAddress = FIT_IpChenge((BYTE *)FIT_SAMPLE_IP_ADDRESS);
    hHandle = FIT_Open((BYTE *)&dwIpAddress, FIT_SAMPLE_PORT, NULL);
    if (hHandle == 0) {
        printf("Error! FIT_Open = %04X(H)\n", hHandle);
        return 1;
    }
```

```
    /* Offset Address  */
    dwVaOffset = FIT_IO_DEVICE_SIZE * FIT_SAMPLE_DEVICE_ID;

    /* Read 'Category' */
    dwVaBase = FIT_IO + FIT_IO_DEVICE_CONFIG;
    wStatus = FIT_Read(hHandle, dwVaBase + dwVaOffset + FIT_PRODUCT_CATEGORY,
                1, &byCategory);
    if (wStatus != 0) {
        printf("Error! FIT_Read = %04X(H)\n", wStatus);
        FIT_Close(hHandle);
        return 1;
    }
    if (byCategory != FIT_PRODUCT_ANALOG) {
        printf("Error! Category = %02X(H)\n", byCategory);
        FIT_Close(hHandle);
        return 1;
    }

    /* Write 'Module Start'  */
    byModuleStart = FIT_MODULE_START_ON;
    wStatus = FIT_Write(hHandle, dwVaBase + dwVaOffset + FIT_MODULE_START,
                1, &byModuleStart);
    if (wStatus != 0) {
        printf("Error! FIT_Write = %04X(H)\n", wStatus);
    }

    /* Read 'Data'  */
    dwVaBase = FIT_IO + FIT_IO_INPUT;
    wStatus = FIT_Read(hHandle, dwVaBase + dwVaOffset, 4 * 4, (BYTE *)&byData[0]);
    if (wStatus != 0) {
        printf("Error! FIT_Read = %04X(H)\n", wStatus);
    }

    for (byChCount = 0; byChCount < 4; byChCount++) {
        printf("Input Data CH%d Flag:%02X Data:%02X%02X%02X\n", byChCount,
            byData[byChCount*4+3], byData[byChCount*4+2], byData[byChCount*4+1],
            byData[byChCount*4]);
    }

    /* Read 'Error Status'*/
    dwVaBase = FIT_IO + FIT_IO_DEVICE_INFOR;
    wStatus = FIT_Read(hHandle, dwVaBase + dwVaOffset + FIT_ERROR_STATUS,
                1, &byErrorStatus);
    if (wStatus != 0) {
        printf("Error! FIT_Read = %04X(H)\n", wStatus);
    }
    if (byErrorStatus != 0x00) {
        printf("Error! Error Status = %02X(H)\n", byErrorStatus);
    }

    /* Close */
    FIT_Close(hHandle);

    return 0;
}
```
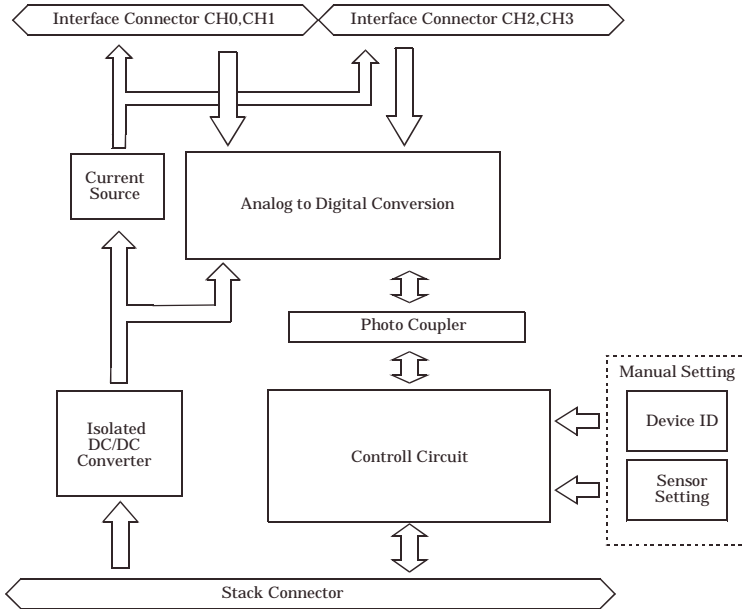
6. System Reference

Block Diagram

Figure 6.1. Circuit block diagram

Specifications

Table 6.1. Specifications

Item		Specifications
Number of channel		4 channels
Platinum resistance temperature detectors acceptable		Pt100(JIS C1604-1997, IEC 751 1983), JPt100(JIS C1604-1989)
Wiring method		Three-wire or Four-wire
Measurable temperature range		Pt100 : -200 - 850°C JPt100 : -200 - 510°C
Precision	Operating temperature 0 - 50°C	±0.3°C *1
	Operating temperature 15 - 35°C	±0.15°C *1
Resolution		0.01°C
Conversion speed		Select from 150ms / 40ms / 5ms per one channel
Output current for temperature detection		1mA
Isolation method		Between platinum resistance temperature detector input and power supply : Opto-coupler isolation Between platinum resistance temperature detector input channels : unisolation
Flash ROM writing count		100000 times (Max.)
Applicable wire		AWG28 - 20
Applicable plug		FK- MC0,5/9-ST-2,5 plug (made by Phoenix Contact Corp.)
Internal current consumption		5VDC(±5%) 500mA(Max.) *2
External dimensions (mm)		25.2(W) x 64.7(D) x 94.0(H) (exclusive of protrusions)
Weight (module itself)		100g
Module connection method		Stack connection by means of a connection mechanism that is provided in the system as a standard item
Module installation method		One-touch connection to 35mm DIN rails (standard connection mechanism provided in the system)

*1 Assuming a conversion speed of 150 ms

*2 The stack connector allowable current is 3.0 A (max.). Up to six units of the PTI-4(FIT)GY can be connected
   to one controller.

Table 6.2. Installation Environment Requirements

Parameter		Requirement description
Operating temperature		0 - 50°C
Storage temperature		-10 - 60°C
Operating humidity		10 - 90%RH (No condensation)
Floating dust particles		Not to be excessive
Corrosive gases		None
Noise immunity	Line noise *1	AC line/2kV, Signal line/1kV (IEC1000-4-4Level 3, EN61000-4-4Level 3)
	Static electricity resistance	Contact discharge/4kV (IEC1000-4-2Level 2, EN61000-4-2Level 2) Atmospheric discharge/8kV (IEC1000-4-2Level 3, EN61000-4-2Level 3)
Vibration resistance	Sweep resistance	10 - 57Hz/semi-amplitude 0.15mm, 57 - 150Hz/2.0G 80minutes each in X, Y, and Z directions (JIS C0040-compliant, IEC68-2-6-compliant)
Impact resistance		15G half-sine shock for 11ms in X, Y, and Z directions (JIS C0041-compliant, IEC68-2-27-compliant)

*1 When using a POW-AD22GY

⚠ CAUTION

When connecting one of the modules to a controller module, the internal power consumption should be taken into account. If the total current exceeds the capacity of the power supply unit, the integrity of the operation cannot be guaranteed. For further details, please see the Controller Module manual.
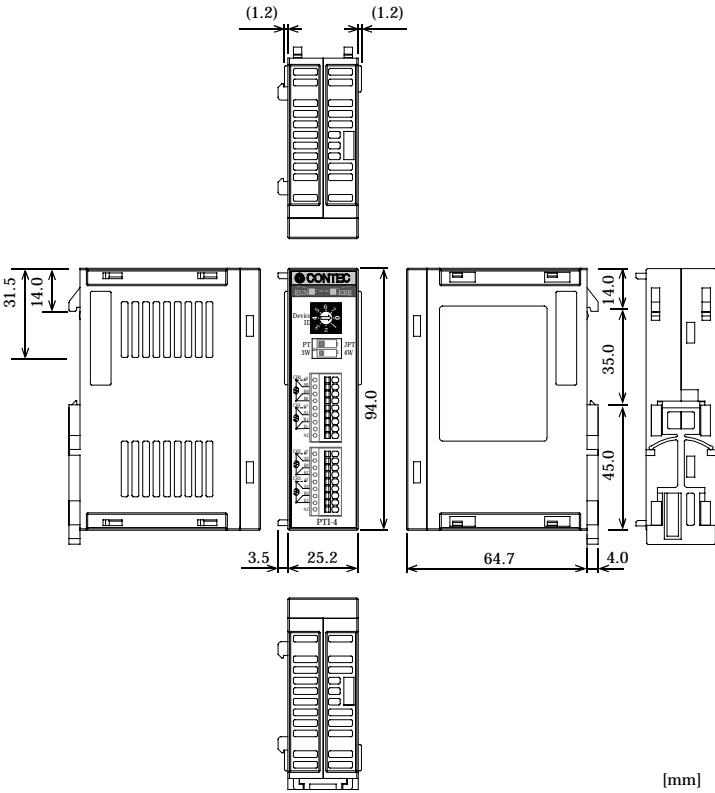
External Dimensions

[mm]

Figure 6.2. External dimensions

Appendix

Reference Resistances of Resistance Temperature Detectors

Table 6.3. New JIS / IEC type (Pt100)

JIS C1604-1997, IEC 751 1983   Unit : Ω

-200	-100	-0	Temp [°C]	Temp [°C]	0	100	200	300	400	500	600	700	800
18.52	60.26	100.00	-0	0	100.00	138.51	175.86	212.05	247.09	280.98	313.71	345.28	375.70
	56.19	96.09	-10	10	103.90	142.29	179.53	215.61	250.53	284.30	316.92	348.38	378.68
	52.11	92.16	-20	20	107.79	146.07	183.19	219.15	253.96	287.62	320.12	351.46	381.65
	48.00	88.22	-30	30	111.67	149.83	186.84	222.68	257.38	290.92	323.30	354.53	384.60
	43.88	84.27	-40	40	115.54	153.58	190.47	226.21	260.78	294.21	326.48	357.59	387.55
	39.72	80.31	-50	50	119.40	157.33	194.10	229.72	264.18	297.49	329.64	360.64	390.48
	35.54	76.33	-60	60	123.24	161.05	197.71	233.21	267.56	300.75	332.79	363.67	
	31.34	72.33	-70	70	127.08	164.77	201.31	236.70	270.93	304.01	335.93	366.70	
	27.10	68.33	-80	80	130.90	168.48	204.90	240.18	274.29	307.25	339.06	369.71	
	22.83	64.30	-90	90	134.71	172.17	208.48	243.64	277.64	310.49	342.18	372.71	

Table 6.4. Old JIS type (JPt100)

JIS C1604-1989   Unit : Ω

-200	-100	-0	Temp [°C]	Temp [°C]	0	100	200	300	400	500
17.14	59.57	100.00	-0	0	100.00	139.16	177.13	213.93	249.56	284.02
	55.44	96.02	-10	10	103.97	143.01	180.86	217.54	253.06	287.40
	51.29	92.02	-20	20	107.93	146.85	184.58	221.15	256.55	
	47.11	88.01	-30	30	111.88	150.67	188.29	224.74	260.02	
	42.91	83.99	-40	40	115.81	154.49	191.99	228.32	263.49	
	38.68	79.96	-50	50	119.73	158.29	195.67	231.89	266.94	
	34.42	75.91	-60	60	123.64	162.08	199.35	235.45	270.38	
	30.12	71.85	-70	70	127.54	165.86	203.01	238.99	273.80	
	25.80	67.77	-80	80	131.42	169.63	206.66	242.53	277.22	
	21.46	63.68	-90	90	135.30	173.38	210.30	246.05	280.63	

Q&A

Q The ERR LED remains on immediately after the power is turned on. What's wrong?

A The ERR LED interlocks with the disconnction detection and alarm output functions. If any channel has no sensor connected or an incorrect Three-wire or Four-wire setting, the module detects disconnction and turns on the ERR LED. If any channel is not used, use the [conversion disable] register to disable conversion of the channel.

Q The ERR LED (red) comes on for a few seconds when the power is turned on. Any problem?

A No problem. When all the channels have sensors connected, the ERR LED goes out upon completion of startup.

Q Is it possible to switch between Pt100 and JPt100 by software?

A No, it isn't. When connecting a sensor, use the switch on the module to set the sensor.

Q Measured temperatures are definitely abnormal. What's wrong?

A Check the following points. Check that the Pt100 or JPt100 has been set up correctly, if any wiring is wrong, if any resistance temperature detector connected has been disconnected, whether unused channels have been conversion-disabled, and if the environment has been changed after setting offset and gain values.

Q Measured temperatures are obviously different in value. What can I do?

A There is no drastic solution because differences in measured values depend on extraneous noise, wiring states, and so on. A software workaround is to set the conversion speed to 150 ms and, if any channel is not used, check that the channel has been conversion-disabled. If measured values are still too different, try to use shielded cables, connect the shield to the ground terminal of, e.g., a control panel, change the connection of the shield, reroute the conductor to the sensor according to Chapter 3 "Notes on Wiring," minimize the conductor length, etc.

Q I have used a product from another manufacturer, which requires range switching for measuring a wide range of temperatures. Does this product require range switching as well?

A The analog circuitry in this product contains a high-resolution 24-bit $\Delta\Sigma$ AD converter, allowing measurement in the entire temperature range at the rated resolution without range switching.

Q I want offset/gain calibration. Would you recommend some instruments?

A We recommend the use of a standard resistor or precision resistor such as the one manufactured by FLUKE CORPORATION. Some electronic calibrators generate resistance equivalently using, for example, a switched capacitor, preventing accurate calibration depending on the switching time.

PTI-4(FIT)GY

User's Manual

CONTEC CO., LTD.   November 2006 Edition

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