User's Manual

FA-M3V VITESSE™

Temperature Monitoring Module

IM 34M06H63-02E

Applicable Modules:

Model Code	Model Name
F3CX04-0H	Temperature Monitoring Module

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Applicable Product

- **Range-free Controller FA-M3**

  - Model : F3CX04-0H
  - Name : Temperature Monitoring Module

The document number for this manual is given below.

Refer to the document number in all communications, including when purchasing additional copies of this manual.

- Document No.: IM 34M06H63-02E

Precautions

■ About This Manual

- This Manual should be passed on to the end user.
- This manual is an essential part of the product; keep it in a safe place for future reference.
- This product is designed to be used by a person with specialized knowledge.
- Before using the product, read this manual thoroughly to have a clear understanding of the product.
- This manual explains the functions of this product, but there is no guarantee that they will suit the particular purpose of the user.
- Under absolutely no circumstances may the contents of this manual be transcribed or copied, in part or in whole, without permission.
- The contents of this manual are subject to change without prior notice.
- Every effort has been made to ensure accuracy in the preparation of this manual. However, should any errors or omissions come to the attention of the user, please contact the nearest Yokogawa Electric representative or sales office.

■ Safety Symbols

- **”Handle with care.”** This symbol on the product indicates that the operator must follow the instructions laid out in this user's manual to avoid the risk of personnel injuries, fatalities, or damage to the instrument.

- **Protective Conductor Terminal**

  This terminal is to prevent electric shock. Before using the instrument, connect to the Protective earth (Comply with the regulation of each country.), and route the line through the shortest path possible.

- **Functional Earth Terminal**

  This terminal is for stable operation. Before using the instrument, be sure to ground this terminal.

- **Alternating current.** Indicates alternating current.

- **Direct current.** Indicates direct current.

The following symbols are used only in the user's manual.

WARNING

- Draws attention to information essential to prevent electrical shock or other dangers that may result in injury or the loss of life.

CAUTION

- Draws attention to information essential to prevent hardware damage, software damage or system failure.

NOTE

- Draws attention to information essential to the understanding of operation and functions.

■ Safety Precautions when Using/Maintaining the Product

- For the protection and safe use of the product and the system controlled by it, be sure to follow the instructions and precautions on safety stated in this manual whenever handling the product. Take special note that if you handle the product in a manner other than prescribed in these instructions, the protection feature of the product may be damaged or impaired. In such cases, Yokogawa cannot guarantee the quality, performance, function and safety of the product.
- When installing protection and/or safety circuits such as lightning protection devices and equipment for the product and control system as well as designing or installing separate protection and/or safety circuits for fool-proof design and fail-safe design of processes and lines using the product and the system controlled by it, the user should implement it using devices and equipment, additional to this product.
- If component parts or consumable are to be replaced, be sure to use parts specified by the company.
- This product is not designed or manufactured to be used in critical applications which directly affect or threaten human lives and safety — such as nuclear power equipment, devices using radioactivity, railway facilities, aviation equipment, shipboard equipment, aviation facilities or medical equipment. If so used, it is the user’s responsibility to include in the system additional equipment and devices that ensure personnel safety.
- Do not attempt to modify the product.
- To avoid electrical shock, turn off the power before wiring.
- This product is classified as Class A for use in industrial environments. If used in a residential environment, it may cause electromagnetic interference (EMI).

  In such situations, it is the user's responsibility to adopt the necessary measures against EMI.

■ Exemption from Responsibility

- Yokogawa Electric Corporation (hereinafter simply referred to as Yokogawa Electric) makes no warranties regarding the product except those stated in the WARRANTY that is provided separately.
- Yokogawa Electric assumes no liability to any party for any loss or damage, direct or indirect, caused by the use or any unpredictable defect of the product.

■ Software Supplied by the Company

- Yokogawa Electric makes no other warranties expressed or implied except as provided in its warranty clause for software supplied by the company.
- Use the software with one computer only. You must purchase another copy of the software for use with each additional computer.
- Copying the software for any purposes other than backup is strictly prohibited.
- Store the original media that contain the software in a safe place.
- Reverse engineering, such as decompiling of the software, is strictly prohibited.
- Under absolutely no circumstances may the software supplied by Yokogawa Electric be transferred, exchanged, or sublet or leased, in part or as a whole, for use by any third party without prior permission by Yokogawa Electric.

■ General Requirements for Using the FA-M3 / e-RT3 Controller

● Set the product in a location that fulfills the following requirements:

- INDOOR USE ONLY
- This product is an open equipment. The product must be installed in a metallic panel enclosure with an impact rating IK08 or more.
- Where the product will not be exposed to direct sunlight, and where the operating surrounding air temperature is from 0°C to 55°C (32°F to 131°F).

  There are modules that must be used in an environment where the operating surrounding air temperature is in a range smaller than 0°C to 55°C (32°F to 131°F). Refer to “Hardware Manual” (IM 34M06C11-01E) or the applicable user's manual. In case of attaching such a module, the entire system's operating surrounding air temperature is limited to the module's individual operating surrounding air temperature.
- Where the relative humidity is from 10 to 90%.

  In places where there is a chance of condensation, use a space heater or the like to constantly keep the product warm and prevent condensation.
- For use in Pollution Degree 2 Environment.
- Where there are no corrosive or flammable gases.
- Where the product will not be exposed to mechanical vibration or shock that exceed specifications.
- Where there is no chance the product may be exposed to radioactivity.

● Use the correct types of wire for external wiring:

- USE COPPER CONDUCTORS ONLY.
- Use conductors with temperature rating above 75°C.

● Securely tighten screws:

- Securely tighten module mounting screws and terminal screws to avoid problems such as faulty operation.
- Tighten terminal block screws with the correct tightening torque as given in this manual. Refer to the “Hardware Manual” (IM 34M06C11-01E) or the applicable user's manual for the appropriate tightening torque.

● Securely lock connecting cables:

- Securely lock the connectors of cables, and check them thoroughly before turning on the power.

● Interlock with emergency-stop circuitry using external relays:

- Equipment incorporating the FA-M3 / e-RT3 controller must be furnished with emergency-stop circuitry that uses external relays. This circuitry should be set up to interlock correctly with controller status (stop/run).

● Ground for low impedance:

- For safety reasons, connect the [FG] grounding terminal to a protective earth (Comply with the regulation of each country.). For compliance to CE Marking, use braided or other wires that can ensure low impedance even at high frequencies for grounding.

- **Configure and route cables with noise control considerations:**
  - Perform installation and wiring that segregates system parts that may likely become noise sources and system parts that are susceptible to noise. Segregation can be achieved by measures such as segregating by distance, installing a filter or segregating the grounding system.

- **Configure for CE Marking Conformance:**
  - For compliance to CE Marking, perform installation and cable routing according to the description on compliance to CE Marking in the “Hardware Manual” (IM 34M06C11-01E).
  - The list of CE conforming models is available in Appendix A2. of “Hardware Manual”.

- **Keep spare parts on hand:**
  - We recommend that you stock up on maintenance parts, including spare modules, in advance.
  - Preventive maintenance (replacement of the module) is required for using the module beyond 10 years.

- **Discharge static electricity before touching the system:**
  - Because static charge can accumulate in dry conditions, first touch grounded metal to discharge any static electricity before touching the system.

- **Wipe off dirt with a soft cloth:**
  - Gently wipe off dirt on the product's surfaces with a soft cloth.
  - If you soak the cloth in water or a neutral detergent, tightly wring it out before wiping the product. Letting water enter the module interior can cause malfunctions.
  - Do not use volatile solvents such as benzine or paint thinner or chemicals for cleaning, as they may cause deformity, discoloration, or malfunctioning.

- **Avoid storing the FA-M3 /e-RT3 controller in places with high temperature or humidity:**
  - Since the CPU module has a built-in battery, avoid storage in places with high temperature or humidity.
  - Since the service life of the battery is drastically reduced by exposure to high temperatures, take special care (storage surrounding air temperature should be from -20°C to 75°C).
  - There is a built-in lithium battery in a Sequence CPU module which serves as backup power supply for programs, device information and configuration information.

    The service life of this battery is more than 10 years in standby mode at room temperature. Take note that the service life of the battery may be shortened when installed or stored at locations of extreme low or high temperatures. Therefore, we recommend that modules with built-in batteries be stored at room temperature.

- **Always turn off the power before installing or removing modules:**
  - Failing to turn off the power supply when installing or removing modules, may result in damage.

- **Do not touch components in the module:**
  - In some modules you can remove the right-side cover and install ROM packs or change switch settings. While doing this, do not touch any components on the printed-circuit board, otherwise components may be damaged and modules may fail to work.

- **Do not use unused terminals:**
  - Do not connect wires to unused terminals on a terminal block or in a connector. Doing so may adversely affect the functions of the module.
- **Use the following power source:**
  - Use only F3PU□□-□□ as the power supply module.
  - If using this product as a UL-approved product, for the external power supply, use a limited voltage / current circuit power source or a Class 2 power source.
  - If using this product as a CE-complied product, for the external power supply, use a SELV and limited-energy circuit separated by reinforced insulation or double insulation from hazardous voltage.
- **Refer to the user's manual before connecting wires:**
  - Refer to the “Hardware Manual” (IM 34M06C11-01E) or the applicable user’s manual for the external wiring drawing.
  - Refer to “A3.6.5 Connecting Output Devices” in the “Hardware Manual” before connecting the wiring for the output signal.
  - Refer to “A3.5.4 Grounding Procedure” in the “Hardware Manual” for attaching the grounding wiring.
- **Authorized Representative in the EEA:**
  - The Authorized Representative for this product in the EEA is:

    Yokogawa Europe B. V.

    Euroweg 2, 3825 HD Amersfoort, The Netherlands
- **In relation to UKCA marking, the importer for this product into Great Britain market via the YOKOGAWA sales channel is:**
  - **Yokogawa United Kingdom Limited**, Stuart Road Manor Park Runcorn, WA7 1TR, United Kingdom.

■ General Requirements for Using the FA-M3 Slave Units (TAH Series)

● Connect YHLS cable to SHIELD terminal:

- Connect the DRAIN line of the YHLS cable to the SHIELD terminal of the YHLS master module securely. Failing to do so may affect the performance of the YHLS system.

● Do not touch components in the unit:

- Do not remove the back cover of the unit. Doing so may cause a failure.

■ Waste Electrical and Electronic Equipment (WEEE)

Waste Electrical and Electronic Equipment (WEEE)

(Only valid in the EEA for EU WEEE Directive and in the UK for UK WEEE Regulation)

This product complies with the WEEE marking requirement.

This marking indicates that you must not discard this electrical/electronic product in domestic household waste.

When disposing of products in the EEA and UK, contact your local Yokogawa office in the EEA and/or UK respectively.

■ How to dispose the batteries

(Only valid in the EEA for EU Battery Directive/Regulation and in the UK for UK Battery Regulation)

Batteries are included in some modules of this product.

This marking indicates they shall be sorted out and collected as ordained in the EU battery Directive/Regulation and UK battery Regulation.

The procedure is different when the user can remove or cannot remove.

①Batteries the user can remove

The battery of F3RP6☐, F3RP7☐ and F3NP5☐ can be removed by yourself.
When you remove the battery from F3RP6☐, F3RP7☐ and F3NP5☐ dispose it, discard them in accordance with domestic law concerning disposal. See the User's Manual of F3RP6☐, F3RP7☐ and F3NP5☐ for the removal procedure.

If you don't remove the battery from this product, please see ②.

②Batteries the user cannot remove

Dispose the battery together with this product.
When you dispose this product in the EEA and UK, contact your local Yokogawa office in the EEA and/or UK respectively.
Do not dispose them as domestic household waste.

Battery category: Lithium battery

Introduction

■ Overview of the Manual

This instruction manual describes the specifications, functions and use of the Temperature Monitoring Module. The information is especially useful when you are performing pre-operation engineering.

■ ToolBox for Temperature Monitoring Modules

A dedicated ToolBox software is provided for this module. With this software, you can easily set up various parameters of the module and monitoring by following screen instructions. For details, see the “ToolBox for Temperature Control and Monitoring Modules User’s Manual” (IM 34M06Q31-02E).

CAUTION

This module supports ToolBox for Temperature Control and Monitoring Modules R7.03 and later. However, some functions are limited in R7.03, so please see Section A2.2, “Operating Environment.”

R7.04 and later will no longer have any functional restrictions in R7.03.

■ Notation

References to chapters and sections are denoted by the chapter or section number, followed by the chapter or section title enclosed within double-quotation marks.

Relay names and register names are shown with Initial caps.

States or setting values are enclosed within double quotation marks, or displayed with initial caps.

■ Other User’s Manuals

Read the following manuals, as required.

- **For information on the specifications, configuration*, installation, wiring, trial operation, maintenance and inspection of the e-RT3, as well as information on the system-wide limitation of module installation, refer to:**

  - Hardware Manual (IM 34M06C11-01E).

*: For information on the specifications of products other than the power supply module, base module, I/O module, cable and terminal block unit, refer to their respective user’s manuals.

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Temperature Monitoring Module

PART-A Function Overview

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PART-A provides an overview of the module functions.

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A1. Overview

The temperature monitoring module (hereafter called “the module”) is an input module to be mounted on the FA-M3 base module. Figure A1.1 shows a schematic diagram of a system containing the module.

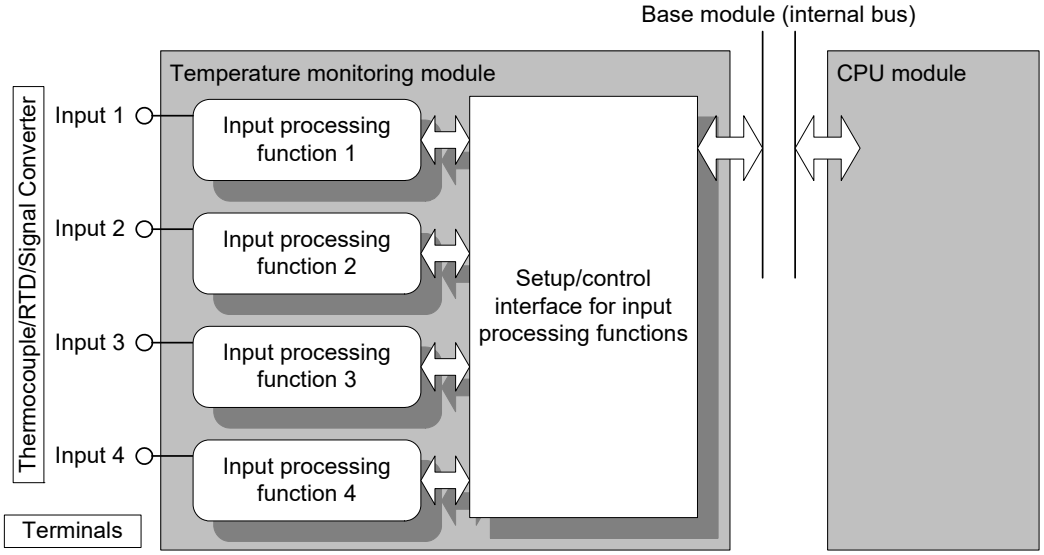
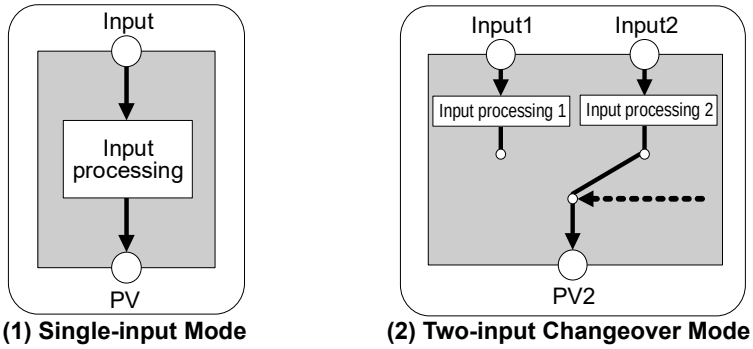


Figure A1.1 Schematic Diagram Showing the Relationship between Sensors, Temperature Monitoring Module and CPU Module

The module is provided with four input processing functions and one input processing function setup and operation interface to handle up to four inputs. Common and individual settings allow the module to support a wide variety of applications.

Two monitoring modes are available: Single-input and Two-input Changeover. In Single-input mode (default), individual input processing functions operate independently. In Two-input changeover mode, two input processing functions operate as a pair.



(1) Single-input Mode **(2) Two-input Changeover Mode**

Figure A1.2 Monitoring Modes

Monitoring mode selection, instrument ranges, alarm parameters and other preset data can be stored in the module to simplify operation setup at each system startup.

■ Features

- **High accuracy, high resolution, high speed**

  The input sampling period may be selected from 10ms, 100ms, or 200ms. The input conversion accuracy is ±0.1% of full scale, and the input resolution is 0.1°C (using 5-digit representation). Low-resolution operation (using 4-digit representation) is also available.

- **Universal input**

  The input type may be set to thermocouple, RTD, or DC voltage for each channel.

A2. Specifications

A2.1 Model and Suffix Codes

Table A2.1 shows the model name and suffix code of the module.

Table A2.1 Model and Suffix Codes

Model	Suffix Code	Style Code	Option Code	Description
F3CX04	-0H	—	—	4 channels Universal input Single-slot size

A2.2 Operating Environment

■ CPU Modules

There is no restriction on the type of CPU modules that can be used with this module.

However, this module cannot be accessed by Byte size. If using the RTOS-CPU module, use Word size access.

■ FA-M3 ToolBox for Temperature Control and Monitoring Modules

This module supports R7.03 and later of the FA-M3 ToolBox for Temperature Control and Monitoring Modules. However, R7.03 has the following functional restrictions.

- Input sampling periods of 10 ms and 100 ms for 4 channels cannot be selected.
- The upper and lower limits of the RTD input range cannot be set to a value that exceeds the default value.

R7.04 and later will no longer have any functional restrictions in R7.03.

A2.3 General Specifications

Table A2.2 lists the general specifications of the F3CX04-0H temperature monitoring module.

Table A2.2 General Specifications

Item		Specification
Number of channels		4 channels
Isolation	Between input terminals and internal circuit	Isolation (capacitive/inductive couplling devices) (tested for 1500 V AC voltage withstanding for 1 minute)
	Between input terminals	
Alarm types		4 types of alarm: input upper limit alarm, input lower limit alarm (with or without waiting for each of the above 2 alarms)
Number of alarm outputs (input relays)		4 points per channel (Only alarms 1 and 2 have input relays)
Alarm delay timer		Yes
Warm-up time		30 minutes min.
Max. allowable ambient temperature change rate*1		10°C/h max.
Mounting position		Horizontal or inverted orientation not allowed
External connection		40-pin spring terminal block*2
External dimensions*3		28.9 (W) x 100 (H) x 104.2 (D) mm
Current consumption		200 mA at 5 V DC
Weight		160 g
Surrounding air temperature range		Operating : 0 to 55°C
		Storage :-20 to 75°C
Surrounding humidity range		Operating : 10 to 90% RH (non-condensing)
		Storage : 10 to 90% RH (non-condensing)
Surrounding atmosphere		Must be free of corrosive gases, flammable gases or heavy dust.

*1: The stated accuracy for the reference junction for thermocouple input deteriorates if the ambient temperature change exceeds this rate.
*2: When wiring to this module, be sure to use the terminal block provided. The 40-pin spring terminal block (Part No.: T9113PL) for this module can be purchased separately as a spare part.
*3: External dimensions excluding protrusions (for details, see the External Dimensions drawing).

A2.4 Input Specifications

Table A2.3 lists the input specifications of the F3CX04-0H temperature monitoring module.

Table A2.3 Input Specifications

Item			Specification
Input sampling period*1			10 ms, 100 ms, 200 ms
Input types and ranges			See Table A2.4, “Instrument Range and Accuracy”. Individual inputs separately configurable by software or collectively by hardware Thermocouple input : 15 ranges RTD input : 9 ranges DC voltage input : 6 ranges
Burnout detection			Thermocouples or RTDs are checked for burnout. Up-scale, down-scale, or none may be selected.
	Detection current	Thermocouple	100 nA max.
		RTD	100 nA max.
Input insulation resistance			1 MΩ min.
Allowable signal source resistance		Thermocouple or DC mV input	250 Ω max.
		DC voltage input	2 kΩ max.
Allowable wiring resistance		RTD	10 Ω max. per wire (three wires must have the same resistance)
Measuring current		RTD	Approx. 250 μA
Reference junction compensation		Thermocouple*2	± 2.0°C (0 to 55°C)
Allowable input voltage range			-20 to 20 V DC
Noise reduction*3*4*5		Common mode	120 dB (50/60 Hz) min.
		Normal mode	40 dB (50/60 Hz) min.
Effect of ambient temperature			± 0.01%/°C or ± 1μV/°C, whichever is greater

*1: You can select an input sampling period of 10 ms for 4 channels, 100 ms for 2 channels, 100 ms for 4 channels, or 200 ms for 4 channels.
*2: This value assumes that all input terminals are correctly wired (that is, using ferrule, wire diameters and connections are correct).
*3: This value assumes that the power supply frequency is correctly selected.
*4: This module continues to operate at a input accuracy of ±0.5% max. of F.S. during the radiated electromagnetic field test.
*5: This is the value when an input sampling period of 100ms or 200ms is selected. If 10ms is selected, 50/60 Hz noise canceling is not be enabled.

Table A2.4 Instrument Range and Accuracy (for high resolution operation) 1/2

Input Category	Input Type[*1]	Instrument Range[*2]	Input Type Selector Switch[*3] SW1-3	SW1-4	SW5	Software Setting	Accuracy[*4]	Resolution[*2]
Software setting (factory setting)			OFF	OFF	0	Instrument ranges may be specified by software using one of the following codes.		
Thermocouple	K[*5]	-200.0 to 1370.0°C	OFF	OFF	1	1 ($01)	± 0.5°C[*5]	0.1°C[*5]
		-200.0 to 1000.0°C			2	2 ($02)		
		-200.0 to 500.0°C			3	3 ($03)	± 0.5°C[*6]	0.1°C[*6]
	J	-200.0 to 1200.0°C			4	4 ($04)	± 0.5°C[*7]	0.1°C[*7]
		-200.0 to 500.0°C			5	5 ($05)	± 0.5°C[*8]	0.1°C[*8]
	T	-270.0 to 400.0°C			6	6 ($06)	± 0.5°C[*9]	0.1°C[*9]
	B[*10]	0.0 to 1600.0°C			7	7 ($07)	± 1.0°C[*10]	0.1°C[*10]
	S[*11]	0.0 to 1600.0°C			8	8 ($08)	± 1.0°C[*11]	0.1°C[*11]
	R[*11]	0.0 to 1600.0°C			9	9 ($09)	± 1.0°C[*11]	0.1°C[*11]
	N	-200.0 to 1300.0°C			A	10 ($0A)	± 0.6°C[*12]	0.1°C[*12]
	E	-270.0 to 1000.0°C			B	11 ($0B)	± 0.5°C[*13]	0.1°C[*13]
	L	-200.0 to 900.0°C			C	12 ($0C)	± 0.6°C	0.1°C
	U	-200.0 to 400.0°C			D	13 ($0D)	± 0.6°C	0.1°C
	W[*14]	0.0 to 1600.0°C			E	14 ($0E)	± 0.8°C[14]	0.1°C[14]
	Platinel 2	0.0 to 1390.0°C			F	15 ($0F)	± 0.6°C	0.1°C
RTD	JPt100	-200.0 to 500.0°C	OFF	ON	0	16 ($10)	± 0.4°C	0.1°C
		-200.0 to 200.0°C			1	17 ($11)		
		0.0 to 300.0°C			2	18 ($12)	± 0.3°C	0.1°C
		0.00 to 150.00°C			3	19 ($13)	± 0.20°C	0.03°C
	Pt100	-200.0 to 850.0°C			4	20 ($14)	± 0.4°C	0.1°C
		-200.0 to 500.0°C			5	21 ($15)	± 0.4°C	0.1°C
		-200.0 to 200.0°C			6	22 ($16)		
		0.0 to 300.0°C			7	23 ($17)	± 0.3°C	0.1°C
		0.00 to 150.00°C			8	24 ($18)	± 0.20°C	0.03°C
DC voltage	DC mV input[*15]	0 to 10.00 mV DC	—[*16]	ON	9	25 ($19)	± 0.1% of instrument range ± 1 digit[*15]	
		0 to 100.0 mV DC			A	26 ($1A)		
	DC V input[*15]	0.000 to 1.000 V DC			B	27 ($1B)		
		0.000 to 5.000 V DC			D	29 ($1D)		
		1.000 to 5.000 V DC			E	30 ($1E)		
		0.00 to 10.00 V DC			F	31 ($1F)		

*1: Applicable standard is JIS/IEC/DIN (ITS-90) for thermocouples and RTD.

*2: For thermocouples K, B, S, R, W, and for RTD in the 0.00 to 150.00°C range, the input ranges may be set wider than their instrument range (see the notes below). However, if the difference between the upper and lower limit settings exceeds 1600°C, the resolution will be twice the stated value. Furthermore, the actual range for an acceptable input is the input range ±5%.

*3: When you turn on the power after changing the hardware switch settings, data stored in the Non-volatile memory is initialized to follow the switch settings.

*4: This accuracy applies if the ambient temperature is 25 ± 5°C and the input value is within the instrument range. If the input type is thermocouple and reference junction compensation is used, you should also take into consideration the accuracy of the reference junction compensation. If the input sampling period of 10 ms is selected, the accuracy will be twice the stated value.

*5: For K-type thermocouples, the input range may be set from -270.0 to 1370.0°C beyond its instrument range. The accuracy and resolution depend on measured temperatures as follows:
-270.0 to -200.0°C: Neither accuracy or resolution is guaranteed.
-200.0 to 0.0°C: ±1.0°C accuracy, 0.2°C resolution

*6: For K-type thermocouples, the accuracy and resolution depend on measured temperatures as follows:
-200.0 to -180.0°C: ±0.9°C accuracy, 0.2°C resolution
-180.0 to -100.0°C: ±0.6°C accuracy, 0.1°C resolution

*7: For J-type thermocouples, the accuracy and resolution depend on measured temperatures as follows:
-200.0 to -100.0°C: ±1.0°C accuracy, 0.2°C resolution

*8: For J-type thermocouples, the accuracy and resolution depend on measured temperatures as follows:
-200.0 to -150.0°C: ±0.6°C accuracy, 0.1°C resolution

*9: For T-type thermocouples, the accuracy and resolution depend on measured temperatures as follows:
-270.0 to -200.0°C: ±3.5°C accuracy, 0.5°C resolution
-200.0 to -100.0°C: ±1.0°C accuracy, 0.1°C resolution

*10: For B-type thermocouples, the input range may be set from 0.0 to 1800.0°C beyond its instrument range. The accuracy and resolution depend on measured temperatures as follows:
0.0 to 300.0°C: Neither accuracy nor resolution is guaranteed.
300.0 to 900.0°C: ±2.5°C accuracy, 0.3°C resolution

*11: For S-type and R-type thermocouples, the input range may be set from 0.0 to 1700.0°C beyond its instrument range. The accuracy and resolution depend on measured temperatures as follows:
0.0 to 200.0°C: ±1.5°C accuracy, 0.2°C resolution

*12: For N-type thermocouples, the accuracy and resolution depend on measured temperatures as follows:
-200.0 to 0.0°C: ±1.3°C accuracy, 0.3°C resolution

*13: For E-type thermocouples, the accuracy and resolution depend on measured temperatures as follows:
-270.0 to -200.0°C: ±6.5°C accuracy, 2.0°C resolution
-200.0 to -100.0°C: ±1.0°C accuracy, 0.2°C resolution

*14: For W-type thermocouples, the input range may be set from 0.0 to 2300.0°C beyond its instrument range. The accuracy and resolution depend on measured temperatures as follows:
0.0 to 100.0°C: ±1.0°C accuracy, 0.2°C resolution

*15: Resolution is determined by the upper and lower limits for the input range, as well as the upper and lower scaling limits. It is represented by one digit.

*16: "–" means that the value is ignored.

Table A2.4 Instrument Range and Accuracy (for low resolution operation) 2/2

Input Category	Input Type[*1]	Instrument Range	Input Type Selector Switch[*3] SW1-3	SW1-4	SW5	Software Setting	Accuracy[*4]	Resolution[*2]
Software setting			ON	OFF	0	Instrument ranges may be specified by software using one of the following codes.		
Thermocouple	K[*5]	-200 to1370°C	ON	OFF	1	33 ($21)	± 2°C[*5]	1°C[*5]
		-200 to1000°C			2	34 ($22)		
		-200 to500°C			3	35 ($23)	± 2°C	1°C
	J	-200 to 1200°C			4	36 ($24)		
		-200 to 500°C			5	37 ($25)		
	T	-270 to 400°C			6	38 ($26)	± 2°C[*6]	1°C
	B[*7]	0 to 1600°C			7	39 ($27)	± 2°C[*7]	1°C[*7]
	S[*8]	0 to 1600°C			8	40 ($28)	± 2°C	1°C
	R[*9]	0 to 1600°C			9	41 ($29)		
	N	-200 to 1300°C			A	42 ($2A)	± 2°C[*9]	1°C
	E	-270 to 1000°C			B	43 ($2B)	± 2°C[*10]	1°C[*10]
	L	-200 to 900°C			C	44 ($2C)	± 2°C	1°C
	U	-200 to 400°C			D	45 ($2D)		
	W[*11]	0 to 1600°C			E	46 ($2E)		
	Platinel 2	0 to 1390°C			F	47 ($2F)		
RTD	JPt100	-200 to 500°C	ON	ON	0	48 ($30)	± 2°C	1°C
		-200 to 200°C			1	49 ($31)		
		0 to 300°C			2	50 ($32)		
		0.0 to 150.0°C			3	51 ($33)	± 0.3°C	0.1°C
	Pt100	-200 to 850°C			4	52 ($34)	± 2°C	1°C
		-200 to 500°C			5	53 ($35)		
		-200 to 200°C			6	54 ($36)		
		0 to 300°C			7	55 ($37)		
		0.0 to 150.0°C			8	56 ($38)	± 0.3°C	0.1°C

*1: Applicable standard is JIS/IEC/DIN (ITS-90) for thermocouples and RTD.
*2: For thermocouples K, B, S, R, W, and for RTD in the 0.0 to 150.0°C range, the input ranges may be set wider than their instrument range (see the notes below). Furthermore, the actual range for an acceptable input is the input range ±5%.
*3: When you turn on the power after changing the hardware switch settings, data stored in the Non-volatile memory is initialized to follow the switch settings.
*4: This accuracy applies if the ambient temperature is 25 ± 5°C and the input value is within the instrument range. If the input type is thermocouple and reference junction compensation is used, you should also take into consideration the accuracy of the reference junction compensation.
*5: For K-type thermocouples, the upper and lower input range limits may be set from -270 to 1370°C. The accuracy and resolution depend on measured temperatures as follows:
-270 to -200°C: Neither accuracy nor resolution is guaranteed.
*6: For T-type thermocouples, the accuracy and resolution depend on measured temperatures as follows:
-270 to -200°C: ±4°C accuracy, 1°C resolution
*7: For B-type thermocouples, the upper and lower input range limits may be set from 0 to 1800°C. The accuracy and resolution depend on measured temperatures as follows:
0 to 300°C: Neither accuracy nor resolution is guaranteed.
300 to 900°C: ±3°C accuracy, 1°C resolution
*8: For S-type and R-type thermocouples, the upper and lower input range limits may be set from 0 to 1700°C.
*9: For N-type thermocouples, the accuracy and resolution depend on measured temperatures as follows:
-200 to 0°C: ±3°C accuracy, 1°C resolution
*10: For E-type thermocouples, the detailed accuracy and resolution are as follows:
-270 to -200°C: ±8°C accuracy, 2°C resolution
-200 to 1000°C: ±2°C accuracy, 1°C resolution
*11: For W-type thermocouples, the upper and lower input range limits may be set from 0 to 2300°C.

A2.5 Backup Function

The F3CX04-0H temperature monitoring module stores input type, input range and many other parameters internally each time the corresponding registers are updated, unless the backup function is disabled.

Take note, however, that there is a maximum limit to the number of write operations allowed for the backup function.

Table A2.5 Backup Function

	Description
Stored parameters	Monitoring parameters, input parameters, and operation parameters. For details, refer to the register list.
Rewrite count limit	10 million times (100,000 times before REV:01:00)
Disable backup function	This parameter disables the backup function. It may be used, if required, to avoid reaching the maximum limit for write operations.

CAUTION

The Non-volatile memory can be rewritten up to 10 million times (100,000 times before REV:01:00). In situations where the CPU module frequently overwrites the I/O data registers earmarked to be stored by the backup function, the maximum limit for write operations may be reached. To prevent this, turn on the Disable Backup Function parameter. Once the write limit is reached, data backup is no longer allowed and the system enters hardware failure mode. Furthermore, parameter data may be reset at system startup to the default values given in Section B2, "Types of Relays and Registers."

Note

For details on the I/O data registers that are stored by the backup function and their data position numbers, see Section B2, "Types of Relays and Registers."

A2.6 Function Specifications

Table A2.6 shows the function specifications of the F3CX04-0H temperature monitoring module.

Table A2.6 Function List

Category	Functions		Description
Monitoring	Input sampling period		Sets the input sampling period.
	Monitoring mode selection		Specifies monitoring mode for each of 2 channels.
	Monitoring mode	Single input mode	Basic function for independent operation.
		Two input changeover	Switches between two measured inputs (e.g. using a register or measured value range) and handles them as one measured input (using a pair of 2 channels).
		Disabled	Channels specified as 'disabled' are not used.
Input processing	Input type selection		Sets input type using switches (for all channels) or software (for individual channels).
	Power supply frequency specification		Specifies the power supply frequency. An appropriate setting value will reduce common mode noise.
	Input range setting		Sets input ranges.
	PV range setting		Sets PV range for two-input changeover mode.
	Burnout selection		Selectable from Up Scale, Down Scale, or OFF (no burnout detection) for thermocouple or RTD input open-circuit detection. *1
	Reference junction compensation		Sets thermocouple reference junction compensation to either On or Fixed Value.
	Input operation functions	Broken-line biasing	Specifies any temperature and its bias value. A compensation value based on the linear interpolation of the specified bias values is automatically added to a measured input. This function is particularly useful for a deteriorated sensor, for which input compensation is desirable.
		Fixed biasing	Specifies a fixed bias value to be automatically added to measured input values. This function is useful when a measured input suffers a fixed deviation due to a known physical problem with a sensor, or when fine adjustment of measured input is desirable for better consistency with values indicated by other equipment, even though data deviation is within tolerance.
		Input filtering	Filtering can be used to remove high frequency noise from measured inputs such as flow rate and pressure.
		Square root extraction	Performs square root extraction on measured inputs. This function is useful for converting differential pressure signals (of orifice, nozzle, or other types of restriction flowmeter) to flow rate signals.
	Two-input changeover		Sets the two-input changeover mode to perform changeover based on temperature range, preset temperature value, or register value.
Alarm	Alarm	Alarm setup	Sets four alarms for each channel.
		Waiting	Suppresses alarm during the startup period after powering on until the operation stabilizes.
		Delay timer	Reports an alarm only if an alarm condition persists for a minimum duration.
Backup function (Storing of preset values)			Holds parameters in non-volatile memory. It can be rewritten 10 million times (100,000 times before REV:01:00).

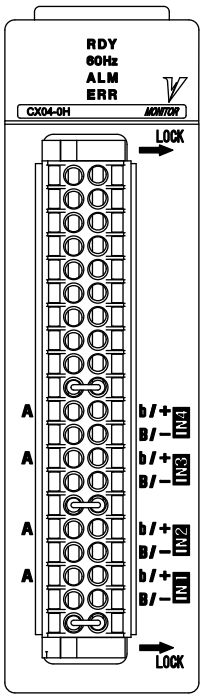
*1: When burnout selection is set to OFF, the measured input value at the time of burnout (open circuit) is unpredictable and may approach either the upper limit or the lower limit. Furthermore, the burnout relay is not set. However, +OVER or -OVER detection is performed.

CAUTION

If the Sequence CPU module experiences an error, this module continues operation regardless of the severity level of the Sequence CPU module.

A2.7 Components and Functions

F3CX04-0H



Status Indicators

RDY (green)

Lit when the internal circuit is functioning normally.
Turns off when an error occurs in the module.

60 Hz (green)

Indicates the frequency of the commercial power supply,
Off: 50Hz;
On: 60 Hz.

ALM (orange)

Lit when an alarm occurs in any channel.

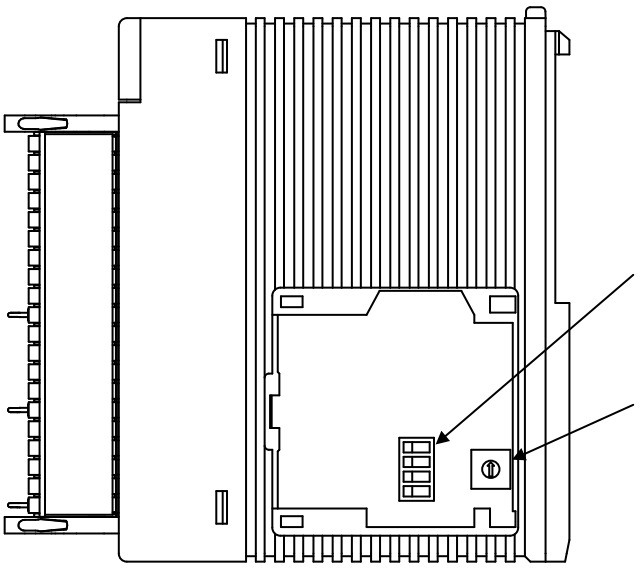
ERR (red)

Lit or flashes when a hardware failure is detected or an error is detected in stored data.
Lit when an error is detected in RAM, ROM, system data, calibration values, ADC, RJC or Non-volatile memory.
Flashes when a parameter error or burnout is detected.

I/O terminal block

40-pin spring terminal block.

Figure A2.1 F3CX04-0H Front View



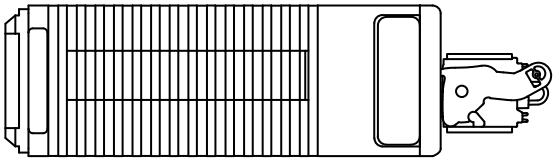
Note: This is the right side view of the module with its cover removed.

Figure A2.2 Right Side View Showing Input Type and Power Frequency Selector Switches

CAUTION

Do not turn on switch SW1-1. Otherwise, this module will not function properly.

A2.8 External Dimensions



Unit : mm

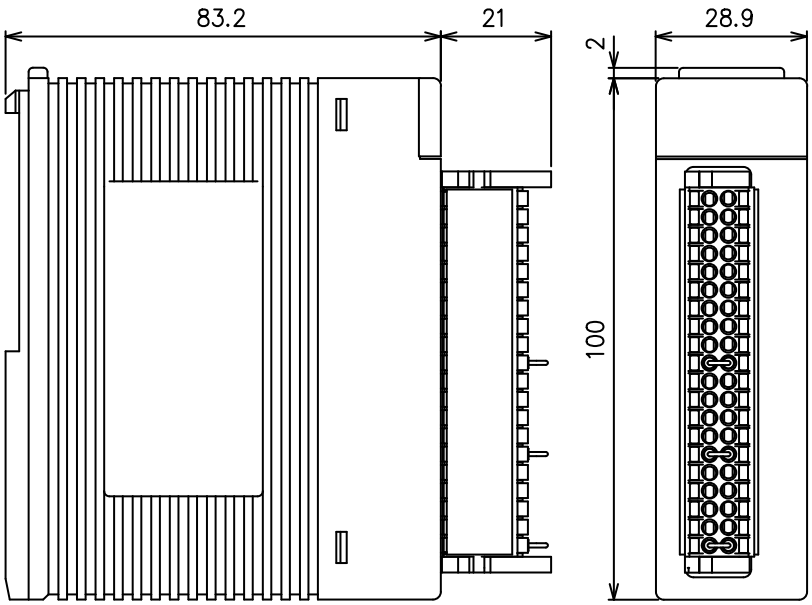


Figure A2.3 External Dimensions

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A3. Startup Procedure

Install the module into your system and perform the following startup procedure.

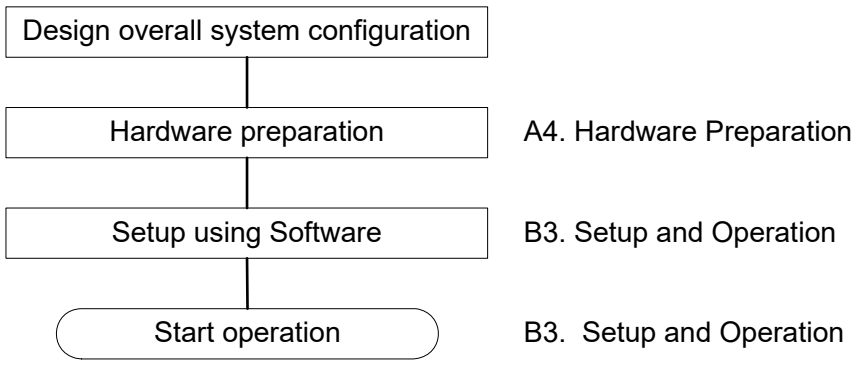

Figure A3.1 Startup Procedure

Before you use the module, you must first design the overall system configuration, set the switches, install the module on the base module, and perform required wiring and other hardware preparation. Following that, you will set the monitoring modes and input ranges using software. The software here refers to the FA-M3 Programming Tool WideField3, the BASIC Programming Tool M3 or the ToolBox for Temperature Control and Monitoring modules. Essential components of the system are the power supply module, the base module, the CPU module, software and a personal computer for running the software. For details on the required environment for executing the software, including specifications for the personal computer and compatible CPU modules, see the relevant software manuals.

After software setup, perform trial runs to tune parameters for optimal performance. Now, you are ready for actual operation.

Sections A4, "Hardware Preparation" and B3, "Setup and Operation" describe these procedures in detail. For details on how to access the module using software to perform setup and for more information on relays and registers, see Section B1, "Accessing the Module," and B2, "Types of Relays and Registers," respectively.

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A4. Hardware Preparation

To use the temperature monitoring module, you must set the operation switches and perform wiring connections. In this chapter, we describe the details of hardware preparation.
Figure A4.1 shows the workflow for hardware preparation. For details on each operation, refer to the sections indicated in the column on the right.

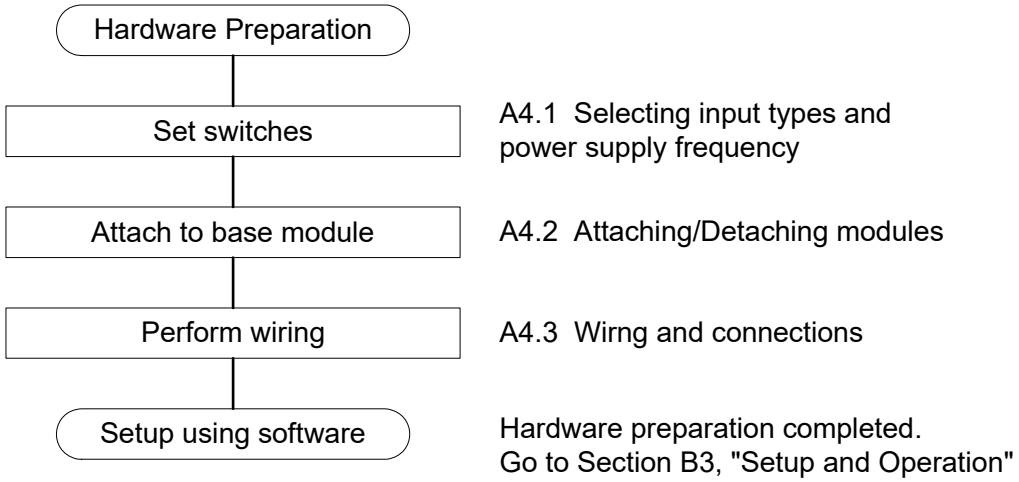
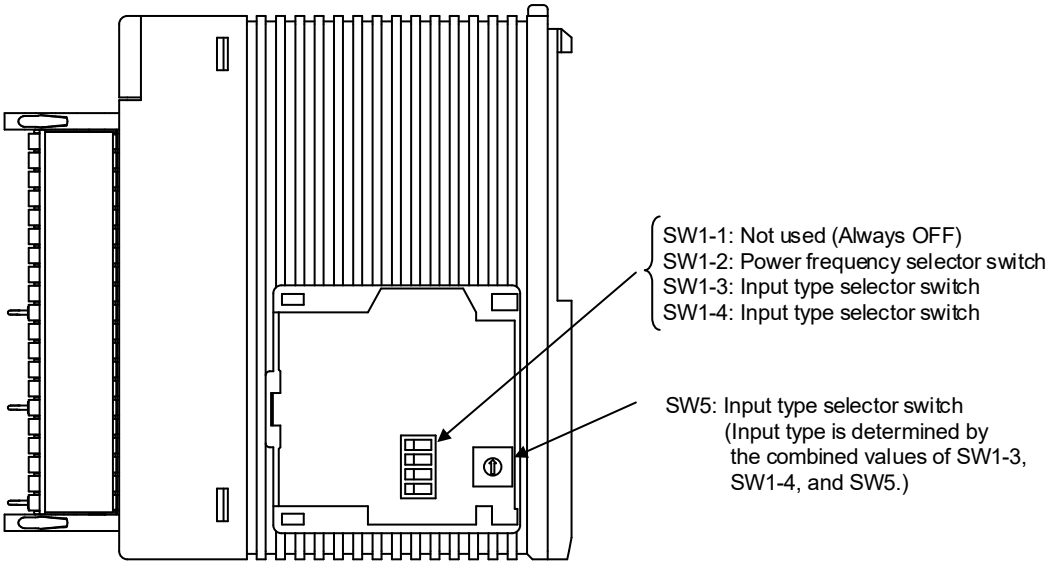


Figure A4.1 Workflow for Hardware Preparation

A4.1 Selecting Input Types and Power Frequency

This section describes how to select appropriate input types for given temperature ranges and how to select a suitable power frequency for a given power supply environment.

Figure A4.2 shows the hardware switches for selecting input types and power frequency.



Note: This is the right side view of the module with its cover removed.

Figure A4.2 Input Types and Power Frequency Selector Switches

Use switches SW1-3, SW1-4 and SW5 to perform input setup. SW1-4 and SW5 together specifies an input type, which apply to all channels, while SW1-3 specifies a resolution. For the various switch combinations and their corresponding input type and resolution values, see Table 4.1, “Input Type Selection”.

Use SW1-2 to select a power frequency corresponding to the AC power used in the equipment. For the mapping between SW1-2 and frequency, see Table 4.2, “Power Frequency Settings”. Selecting an appropriate power frequency will reduce the influence of common mode noise.

You can also set input types and power frequency using data registers. To do so, set the input type selector switches to “set by software”, that is, “SW5=0; SW1-4=OFF”. This will mean that the power frequency will also have to be set using data registers. The factory switch setting is “set by software.”

For details on input type selection and power frequency selection, see Section C2.1, “Input Type Selections” and Section C2.2, “Power Frequency Selection ” respectively.

CAUTION

- Always turn off the power before performing switch setup.
- Do not turn on switch SW1-1. Otherwise, this module will not function properly.

Note

If an input sampling period of 10 ms is selected, the common mode noise reduction function is not be enabled regardless of the setting of the power frequency selector switch.

Table A4.1 Input Type Selection

Input Type		Instrument Range	Input Type Selector Switch*2			Software Setting	Input Range*1				
							Default			Allowable Range	
			SW5	SW1-4	SW1-3	IN*3	RL	RH	DEC.P	RL	RH
Software setting *4			0	OFF	X						
Thermocouple	K	-200.0 to 1370.0°C	1	OFF	OFF	1 ($01)	-2000	13700	1	-2700	13700
					ON	33 ($21)	-200	1370	0	-270	1370
		-200.0 to 1000.0°C	2		OFF	2 ($02)	-2000	10000	1	-2700	13700
					ON	34 ($22)	-200	1000	0	-270	1370
		-200.0 to 500.0°C	3		OFF	3 ($03)	-2000	5000	1	-2000	5000
					ON	35 ($23)	-200	500	0	-200	500
	J	-200.0 to 1200.0°C	4		OFF	4 ($04)	-2000	12000	1	-2000	12000
					ON	36 ($24)	-200	1200	0	-200	1200
		-200.0 to 500.0°C	5		OFF	5 ($05)	-2000	5000	1	-2000	5000
					ON	37 ($25)	-200	500	0	-200	500
	T	-270.0 to 400.0°C	6		OFF	6 ($06)	-2700	4000	1	-2700	4000
					ON	38 ($26)	-270	400	0	-270	400
	B	0.0 to 1600.0°C	7		OFF	7 ($07)	0	16000	1	0	18000
					ON	39 ($27)	0	1600	0	0	1800
	S	0.0 to 1600.0°C	8		OFF	8 ($08)	0	16000	1	0	17000
					ON	40 ($28)	0	1600	0	0	1700
	R	0.0 to 1600.0°C	9		OFF	9 ($09)	0	16000	1	0	17000
					ON	41 ($29)	0	1600	0	0	1700
	N	-200.0 to 1300.0°C	A		OFF	10 ($0A)	-2000	13000	1	-2000	13000
					ON	42 ($2A)	-200	1300	0	-200	1300
	E	-270.0 to 1000.0 °C	B		OFF	11 ($0B)	-2700	10000	1	-2700	10000
					ON	43 ($2B)	-270	1000	0	-270	1000
	L	-200.0 to 900.0°C	C		OFF	12 ($0C)	-2000	9000	1	-2000	9000
					ON	44 ($2C)	-200	900	0	-200	900
	U	-200.0 to 400.0°C	D		OFF	13 ($0D)	-2000	4000	1	-2000	4000
					ON	45 ($2D)	-200	400	0	-200	400
	W	0.0 to 1600.0°C	E		OFF	14 ($0E)	0	16000	1	0	23000
					ON	46 ($2E)	0	1600	0	0	2300
	Platinel 2	0.0 to 1390.0°C	F		OFF	15 ($0F)	0	13900	1	0	13900
					ON	47 ($2F)	0	1390	0	0	1390
RTD	JPt100	-200.0 to 500.0°C	0	ON	OFF	16 ($10)	-2000	5000	1	-2000	5000
					ON	48 ($30)	-200	500	0	-200	500
		-200.0 to 200.0°C	1		OFF	17 ($11)	-2000	2000	1	-2000	2000
					ON	49 ($31)	-200	200	0	-200	200
		0.0 to 300.0°C	2		OFF	18 ($12)	0	3000	1	0	3000
					ON	50 ($32)	0	300	0	0	300
		0.00 to 150.00°C	3		OFF	19 ($13)	0	15000	2	-10000	20000
					ON	51 ($33)	0	1500	1	-1000	2000
	Pt100	-200.0 to 850.0°C	4		OFF	20 ($14)	-2000	8500	1	-2000	8500
					ON	52 ($34)	-200	850	0	-200	850
		-200.0 to 500.0°C	5		OFF	21 ($15)	-2000	5000	1	-2000	5000
					ON	53 ($35)	-200	500	0	-200	500
		-200.0 to 200.0°C	6		OFF	22 ($16)	-2000	2000	1	-2000	2000
					ON	54 ($36)	-200	200	0	-200	200
		0.0 to 300.0°C	7		OFF	23 ($17)	0	3000	1	0	3000
					ON	55 ($37)	0	300	0	0	300
		0.00 to 150.00°C	8		OFF	24 ($18)	0	15000	2	-10000	20000
					ON	56 ($38)	0	1500	1	-1000	2000
DC voltage	0-10mV	0.00 to 10.00 mV	9	ON	X	25 ($19)	0	1000	2	0	1000
	0-100mV	0.0 to 100.0 mV	A			26 ($1A)	0	1000	1	0	1000
	0-1V	0.000 to 1.000 V	B			27 ($1B)	0	1000	3	0	1000
	0-5V	0.000 to 5.000 V	D			29 ($1D)	0	5000	3	0	5000
	1-5V	1.000 to 5.000 V	E			30 ($1E)	1000	5000	3	1000	5000
	0-10V	0.00 to 10.00 V	F			31 ($1F)	0	1000	2	0	1000

*1: For thermocouples K, B, S, R, W, and for RTD in the 0.00 to 150.00 °C range, the upper and lower limits of the input range can be set to a value that exceeds the initial value.

*2: When you change the switch settings and then power on the module, all stored data is initialized according to the hardware switch settings. An 'X' symbol in the SW1-3 column indicates that the switch setting is ignored.

*3: "Software Setting" refers to values specified for input type selection (IN). Any value not listed here is ignored.

*4: These are factory settings. When 'set by software' is selected, the initial value of input type selection (IN) is "1: Thermocouple K".

Table A4.2 Power Frequency Selection

Power Frequency Selection	Power Frequency Selector Switch (SW1-2)	Software Setting*1	Remarks
		FREQ	
50 Hz	OFF	0	Factory setting
60 Hz	ON	1	

*1: "Software Setting" refers to values specified for FREQ. Any value not listed here is ignored. To enable software setting, set the input type selector switches to "set by software", that is, "SW5=0; SW1-4=OFF". If software setting is enabled, the initial power supply frequency setting follows SW1-2. This may be subsequently overridden using the "software setting".

A4.2 Attaching/Detaching Modules

After setting hardware switches, attach the module to the base unit. This section describes the procedure for attaching/detaching the module and the necessary precautions.

■ Attaching Modules

Figure A4.3 shows how to attach this module to the base module. First hook the anchor slot at the bottom of the module to be attached onto the anchor pin on the bottom of the base module. Push the top of this module towards the base module until the anchor/release button clicks into place.

CAUTION

Always switch off the power before attaching or detaching a module.

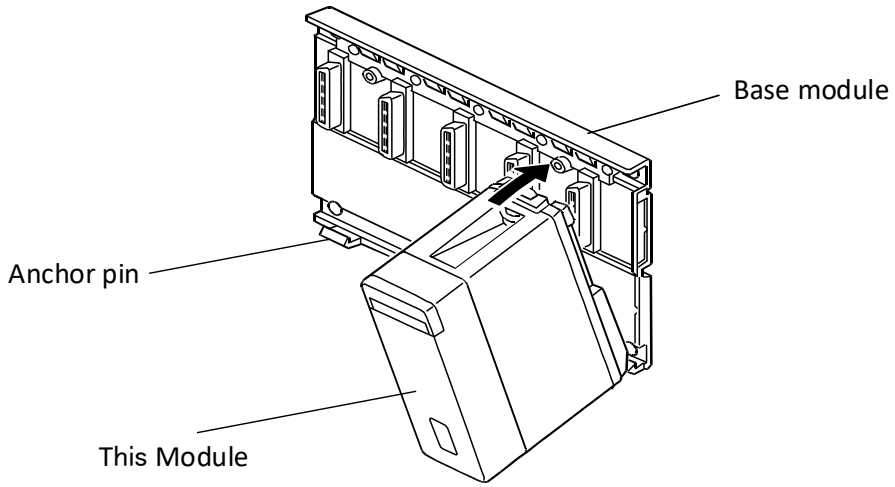


Figure A4.3 Attaching Modules

CAUTION

DO NOT bend the connector on the rear of the module by force during the above operation. If the module is pushed with improper force, the connector may bend causing an error.

■ Detaching Modules

To remove this module from the base module, reverse the above operation. Press the anchor/release button on the top of this module to unlock it and tilt the module away from the base module. Then lift the module off the anchor pin at the base.

■ Attaching Modules in Intense Vibration Environments

If the module is used in intense vibration environments, fasten the module with a screw. Use screws of type listed in the table below. Insert these screws into the screw holes on top of the module and tighten them with a Phillips screwdriver.

Screw Required
M4-size Binder screw 12 to 15 mm long (or 14 to 15 mm if fitted with a washer)

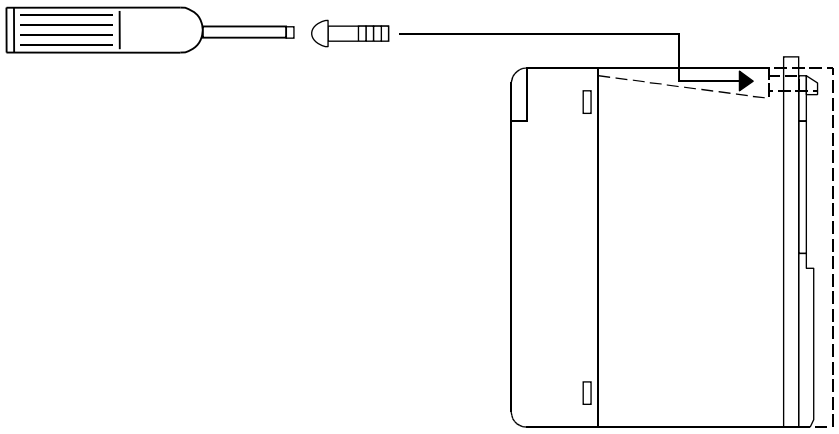


Figure A4.4 Tightening the Module

A4.3 Wiring

After attaching the module to the base module, connect the input signals to the module. This section describes wiring precautions. Actual wiring can be performed before or after program creation, at your convenience.

A4.3.1 Wiring Precautions

To wire the module, see Section A4.3.3, “Terminal Wiring Diagram” and observe the following precautions.

(1) For thermocouple input, use the specified compensating wire.

(2) For resistance temperature detector input, use a lead wire with low resistance (10 Ω/wire max.) with the three wires having identical resistance.

(3) To protect the input circuitry against noise, observe the following precautions.

(a) The wiring for the input circuit must be kept as far away as possible from the power supply or grounding circuitry.

(b) Twisting the input wire at short equal intervals may effectively protect against electromagnetic-induced noise.

(c) Using a shielded wire may effectively protect against static-induced noise. Strip off the outer shield to expose the wire, and ground it with an FG clamp. (two-point grounding should be avoided.)

(d) Attach a ferrite core to the wire near the exit of the panel enclosure to reduce the effect of noise if the input wiring leads outside the panel enclosure.

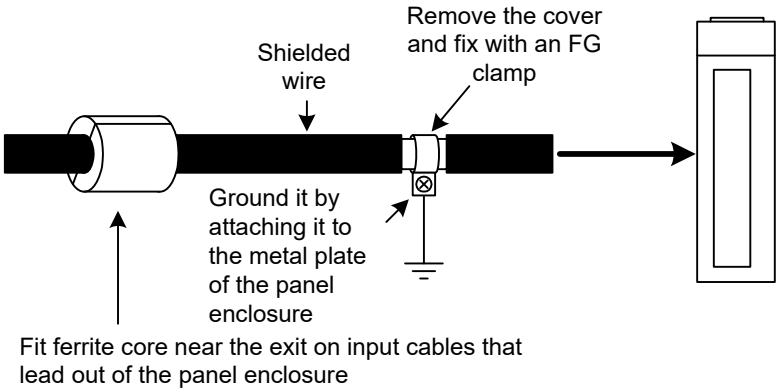


Figure A4.5 Wiring Precautions

Table A4.3 FG Clamps and Ferrite Core Recommended by Yokogawa

FG clamp	Kitagawa Kogyo Industries Co., Ltd.	FGC Series
Ferrite core	Kitagawa Kogyo Industries Co., Ltd.	RFC Series
	TDK Corporation	ZCAT Series
	Tokin Corporation	ESD-SR Series

(4) We recommend using ferrule with insulating sleeve to connect a signal wire to a terminal.

Table A4.4 Cable and Crimp-style Terminal

Cable Type	Shielded twist-pair wire
Cable temperature rating	75°C min.
Cable connection method	Using ferrule

	Manufacturer	**Model**	**Compatible Wire**
Crimp-style terminals and compatible wires	Phoenix Contact	AI 0,34-8 TQ	AWG22 (0.34 mm^2)
		AI 0,5-10 WH	AWG20 (0.52 mm^2)
		AI 0,75-10 GY	AWG18 (0.75 mm^2)
		AI 1-10 RD	AWG18 (1.00 mm^2)

CAUTION

For crimping, use the crimping tools specified by the crimping terminal manufacturer.

CAUTION

When wiring to this module, be sure to use the terminal block provided. Otherwise, this module will not function properly.

The 40-pin spring terminal block (Part No.: T9113PL) for this module can be purchased separately as a spare part.

A4.3.2 Wiring to the Terminal Block, and Attaching/Detaching

The following describes wiring input/output signals to this module, and attaching and detaching the terminal block from the module.

■ Connecting/removing wires

1.How to Connect a Wire
Insert a stranded wire with ferrule into a wire insertion opening as far as the wire goes.

2.How to Remove a Wire
Remove the wire while keeping the release button pressed by using a flat-blade screwdriver.

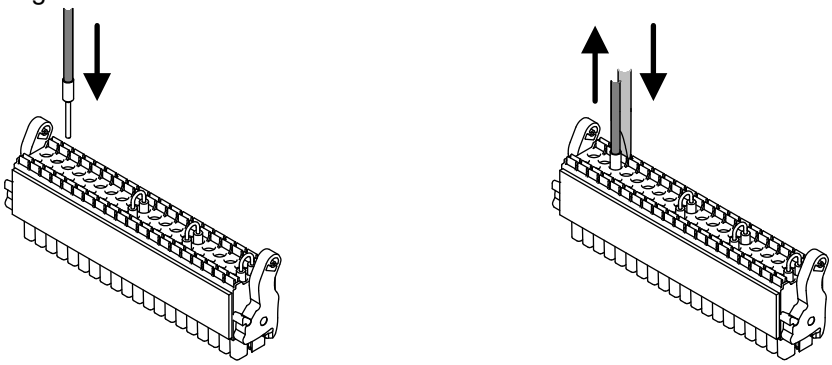


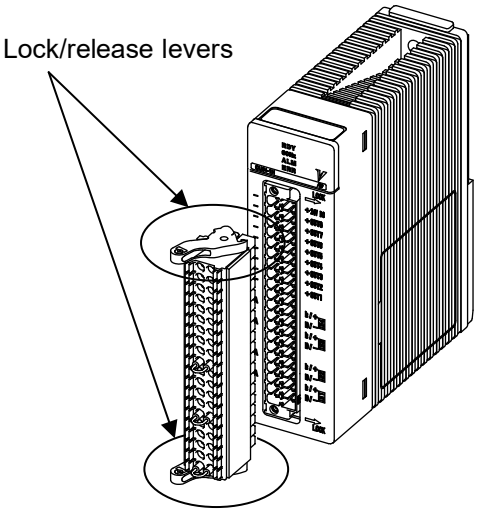
Figure A4.6 Connecting and removing wires

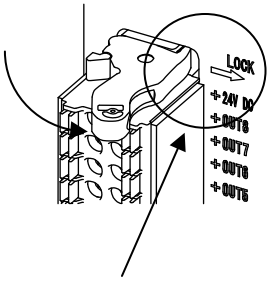
CAUTION

When wiring to this module, be sure to use the terminal block provided. Otherwise, this module will not function normally.

The 40-pin spring terminal block (Part No.: T9113PL) for this module can be purchased separately as a spare part.

■ Attaching/detaching the terminal block





When you attach the terminal block to the connector on the module, make sure that the lock/release levers are securely locked into the module.
If the levers are not completely locked, push the terminal block in as far as it goes until the levers are fully locked.

Figure A4.7 Precautions for attaching and detaching the terminal block

CAUTION

When attaching the terminal block to the connector on the module, move the lock/release levers on the terminal block to release. Otherwise, damage may result.

CAUTION

When detaching the terminal block from the connector on the module, be sure to use the lock/release levers. Detaching the terminal block by force could damage the module and terminal block. Also be sure to use both lock/release levers at the same time.

A4.3.3 Terminal Wiring Diagram

■ External Connection Diagram

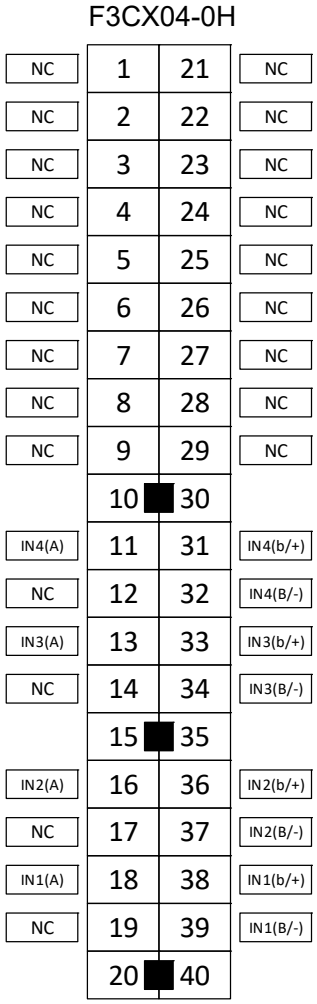


Figure A4.8 Terminal Wiring Diagram

The wiring diagram of the module when viewed from the front.

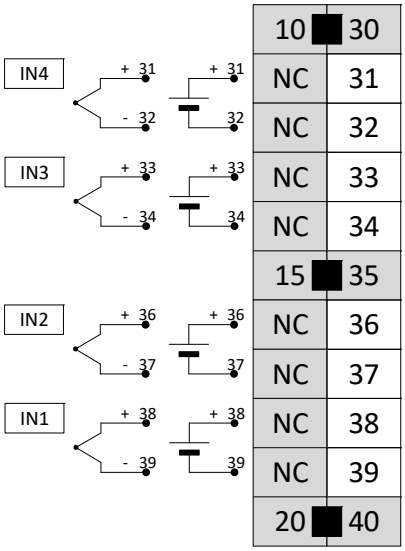
CAUTION

A reference junction compensation element (RJC) is installed between terminals 10-30, 15-35, and 20-40. Do not remove the element, and do not touch it with your fingers. Doing so can introduce error into the reference junction compensation.

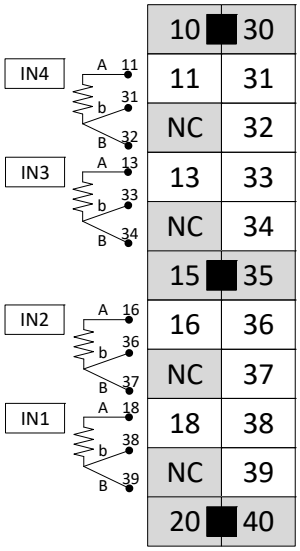
CAUTION

Connect no wires to terminals marked "NC" in the terminal assignment or wiring diagrams. Otherwise, the module will not function normally.

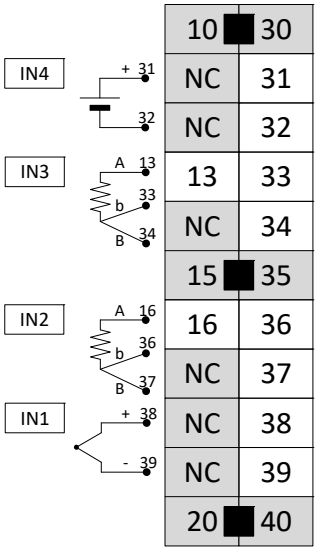
■ Input Terminal Wiring Examples



a) For thermocouple and DC voltage input



b) For RTD input



c) With IN1 as the thermocouple input, IN2-3 as the RTD input, and IN4 as the DC voltage input

Figure A4.9 Input terminal wiring examples

Temperature Monitoring Module

PART-B Parameter Description

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PART-B describes the parameters of the module.

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B1. Accessing the Module

The relays and registers of this module can be accessed from a sequence CPU or BASIC CPU. This chapter explains the precautions when reading from or writing to the module from a CPU. For details on the relays and registers provided with this module, see Chapter B2, “Types of Relays and Registers”.

Content	See
Accessing from a CPU	B1.1 Accessing Using Sequence Instructions
Accessing from a BASIC CPU	B1.2 Accessing Using BASIC
Precautions when reading and writing to the module	B1.3 Writing and Reading after Powering on

B1.1 Accessing Using Sequence Instructions

Accesses to this module from a sequence CPU can be classified into three types, namely, reading from data registers, writing to data registers and reading from input relays.

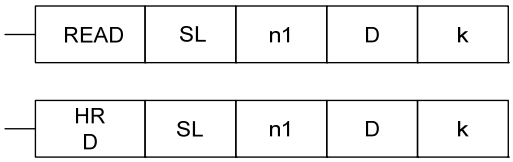
■ Reading Registers (READ / HRD)

Use the Special Module Read instruction or Special Module High Speed Read instruction for reading registers. Reading is performed in 16-bit units.

Table B1.1 Reading Registers

Function No.	Instruction	Mnemonic	Symbol	Is Input condition Required?		Condition for Execution	Step count	Processing unit	Carry
				Yes	No				
81	Special module read	READ	READ	•	—		5	16 bits	—
81P		↑READ	READ				6		
83	Special module high speed read	HRD	HRD	•	—		5	16 bits	—
83P		↑HRD	HRD				6		

● Description of Symbols



SL : Slot Number
n1 : First Data Position Number for Reading
D : First Device Number for Writing Read Data
k : Transfer Data Count

Slot Number: a 3-digit integer (leading '0's may be omitted)

X XX
- XX → Physical slot position (1 to 16) where teh module is installed
- X → Slot number
  main unit : 0
  subunit : 1 to 7

First Data Position Number for Reading : Data position number from which to start reading
First Device Number for Writing Read Data : For available devices, (see "Sequence CPU Modules - Instructions" manual.)
Transfer Data Count : Number of data to read

■ Writing to Registers (WRITE / HWR)

Use the Special Module Write instruction or Special Module High Speed Write instruction for writing to registers. These instructions write the value stored in the specified data device number into the specified area. Writing is performed in 16-bit units.

Table B1.2 Writing to Registers

Function No.	Instruction	Mnemonic	Symbol	Is Input condition Required? Yes	Is Input condition Required? No	Condition for Execution	Step count	Processing unit	Carry
82	Special module write	WRITE	WRITE	•	—		5	16 bits	—
82P		↑ WRITE	WRITE				6		
84	Special module high speed write	HWR	HWR	•	—		5	16 bits	—
84P		↑ HWR	HWR				6		

● Description of Symbols

WRITE	S	SL	n2	k

HWR	S	SL	n2	k

S : First Device Number for Write Data
SL : Slot Number
n2 : First Data Position Number for Writing
k : Transfer Data Count

First Device Number for Write Data : First device number containing write data. For available devices, see "Sequence CPU Instruction Manual - Instructions".

Slot Number : a 3-digit integer (leading '0's may be omitted)

X XX
- XX → Physical slot position (1 to 16) where the module is installed
- X → Slot number
  main unit : 0
  subunit : 1 to 7

First Data Position Number for Writing : Data position number from which to start writing

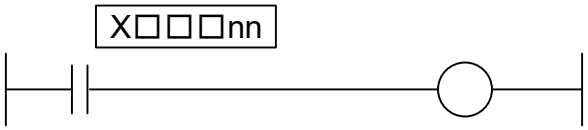
Transfer Data Count : Number of write data

Note

You must observe some precautions when writing to the module. For details, see Section B1.3, “Reading and Writing After Powering On”.

■ Reading Input Relays

Use the LD and other basic instructions to read from a relay in bit units.



□□□ denotes the slot number where the module is installed.

Figure B1.1 Reading Relays

B1.2 Accessing Using BASIC

Table 1.3 lists the BASIC statements that can be used to access this module from a BASIC CPU.

Table B1.3 Available BASIC Statements

Function	Syntax	Description
Declare of use of module	Example: ASSIGN CX04=SL SL : Slot number	Defines the mapping between module and slot number. Always execute this statement before accessing this module. Execute this statement in the main program.
Read data from registers	Example: ENTER SL, n NOFORMAT; I or ENTER SL NOFORMAT; I(*) SL : Slot number n : Data position number I : Name of input variable for storing read data	Reads data position number n of the module installed in slot SL and stores it in input variable I. If the data position number is omitted, reads data sequentially starting from register 1 into input array variable I(*).
Write data to registers	Example: OUTPUT SL, n NOFORMAT;I or OUTPUT SL NOFORMAT;I(*) SL : Slot number n : Data position number I : Output variable name storing data to be written	Writes output variable I to data position number n of the module installed in slot SL. If the data position number is omitted, writes output array variable I(*) sequentially to registers, starting at data position number 1.
Read input relays	Example: STATUS SL,101; P SL : Slot number P : Name of variable for storing read data	Reads input relays X□□□01 to X□□□16 of the module installed in slot number SL and stores the data in variable P.
Interrupt detection	Example: ON INT SL,n GOTO {Label, etc.} ON INT SL,n GOSUB {Label, etc.} ON INT SL,n CALL {Subprogram} SL : Slot number n : Terminal number	The module generates an interrupt when it detects an OFF→ON transition of input relay for terminal number n of the module installed in slot number SL. Refer to the list of relays to find out which relays support interrupts.

Note

Using a BASIC statement not listed in Table B1.3 may produce unexpected results.

Note

You must observe some precautions when writing to the module. For details, see Section B1.3, “Reading and Writing After Powering On”.

B1.3 Writing and Reading After Powering On

Do not read and write to output data registers before module startup completes. This can be ensured by checking that the MDLRDY relay is set.

Table B1.4 Relays Related to Writing and Reading after Powering On

Input Relay Number X□□□nn*1	Symbol	Description	Data Values
X16	MDLRDY	Module startup has completed	0: During startup, 1: Startup completed

*1: □□□ denotes the slot number where the module is installed.

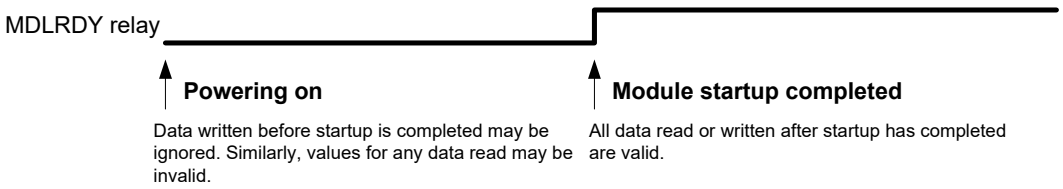


Figure B1.2 Checking for Module Startup Completion after Powering On

After powering on, it takes up to approximately 2 seconds for the module startup to complete (startup initialization). Any data written during this period may be ignored. For instance, if a write instruction to the special relay M35, “On for 1 Scan after Startup” is used in a sequence program to start a program after powering on, the written data may be ignored.

Note

If data is written before the MDLRDY relay turns on, such data may be overwritten during module initialization. If the write destination is a stored parameter, the data may be overwritten by the stored data; if the write destination is a non-stored parameter, the data may be overwritten by the default value.

Similarly, if data is read before the MDLRDY relay is set, the data read may be invalid.

B2. Types of Relays and Registers

This module provides input relays and input/output data registers for accessing the module from a CPU module. This chapter describes these relays and registers.

B2.1 Types of Relays

This module has 3 input relays for each channel and 3 system-wide input relays, but no output relay. Table B2.1 (1/2) lists the channel-specific input relays. Table B2.1 (2/2) lists the system-wide input relays. For details on each relay, refer to the text section indicated in the “See Also” column.

Table B2.1 List of Input Relays (1/2)

Input Relay Number X□□□nn*1				Symbol	Description	Data Range	Interrupt	See Also
CH1	CH2	CH3	CH4					
X01	X09	X17	X25	ALM1.R	Alarm 1	0: Normal; 1: Alarm 1	✓	C3.
X02	X10	X18	X26	ALM2.R	Alarm 2	0: Normal; 1: Alarm 2	✓	
X07	X15	X23	X31	FUNC.ERR	Burnout or error detected *2	0: Normal; 1: Error detected	✓	C2.5 C5.

*1: □□□ denotes the slot number where the module is installed.
*2: Denotes that self-diagnostics has detected a burnout, A/D converter error or other errors, which prohibits normal operation.

Table B2.1 List of Input Relays (2/2)

Input Relay Number X□□□nn*1	Symbol	Description	Data Range	Interrupt	See Also
X08	CMDRDY	Command processing completed	0: Processing in progress; 1: Processing completed	✓	B2.3
X16	MDLRDY	Module startup completed	0: Startup in progress; 1: Startup completed	✓	B1.3
X24	SETUP.R	Setup mode	0: Normal operation mode 1: Setup mode	✓	B2.3

*1: □□□ denotes the slot number where the module is installed.

Note

A “✓” mark in the “Interrupt” column denotes that the module allows an interrupt to be sent to the CPU module when the input relay changes from 0 to 1. This allows a program on the CPU module to easily detect, say, an alarm. For details on interrupt handling, read the instruction manual for the software used.

Note

Input relays are refreshed at input sampling periodic intervals (10ms, 100ms, or 200ms), defined by the Input Sampling Period parameter.

Note

An interrupt that is sent to the CPU module immediately after module startup may be ignored if the CPU module is not ready to receive interrupts. Hence, to check the status of the module immediately after startup, always refer to the state of the individual relays.

B2.2 Types of Registers

This module is provided with input/output relays for configuring module operation and reading operation status. Registers for configuration include basic setup elements, as well as supplementary setup elements for supporting various modes of operation. Set these registers appropriately to suit the intended usage. In addition to registers for reading the status of individual channels, other registers are provided to store process data for all channels, arranged sequentially within a data area. Table B2.2 lists the categories of I/O data registers provided, along with a short description for each category. Table B2.3 and subsequent tables lists the I/O data registers by category.

Table B2.2 Structural Overview of I/O Data Registers

Category			Description	See Also
Common	Common process data		These are representative process-related data for all channels. It consolidates, in one data area, process-related data that are most commonly monitored for all channels, such as process value, operating status and error status.	B2.2.1
	Setup control parameters		Use these parameters to enable various settings, required when monitoring parameters or input parameters are updated. For details on the procedure, see Section B2.3, “How to Enable Settings.”	B2.2.2 B2.3
	Function control parameters		Use these parameters to configure the operation of module functions on a module-wide basis.	B2.2.3
	Monitoring parameters		Use these parameters to set up the basic operation of the module, such as Input Sampling Period and Monitoring mode, on a module-wide basis	B2.2.5 B3.1
Channel 1 to 4	Process data		These are process-related data for each channel. They include input process value, operating status, error status, etc., which cane be used for monitoring the operation of the module.	B2.2.6
	Operation control parameters		Use these parameters to control the operation of individual channels, such as whether to perform reference junction compensation. They	B2.2.7
	Input parameters	Input type settings	Use these parameters to select input type for individual channels. These parameters are the most basic setup elements for a channel.	B2.2.8
		Input range settings	Use these parameters to set up the input of individual channels, as required, such as changing the input range, or selecting an appropriate burnout operation.	B3.2
		PV range settings	These parameters are only valid in Two-input Changeover mode, and are used for defining the PV range in Two-input Changeover control. By default, the PV range follows the input range of the even channel.	
	Operation parameters	Two-input change-over functions settings	Use these parameters to perform setup when using Two-input Changeover mode. They can be used for setting the changeover mode and changeover temperature.	B2.2.9
		Input functions settings	Use these parameters to configure processing of input values of individual channels, as required. They can be used for setting input correction, square root extraction and input filtering of the input, as required.	
		Alarm function settings	Use these parameters to set up the operation of the alarm functions for individual channel as required. They can be used to set the alarm type, hysteresis, ON delay timer, as required.	
		SP parameter	Use these parameters to set alarm preset values of individual channels. Up to 4 sets of parameters can be set.	

Note

Monitoring parameters and input parameters must be enabled before any written content can take effect. For details on how to enable such parameters, see Section B2.3, “How to Enable Settings.”

■ Common Precautions for Registers

CAUTION

The Non-volatile memory can be rewritten up to 10 million times (100,000 times before REV:01:00). In situations where the CPU module frequently overwrites the I/O data registers earmarked to be stored by the backup function, the maximum limit for write operations may be reached. To prevent this, turn on the Disable Backup Function parameter. Once the write limit is reached, data backup is no longer allowed and the system enters hardware failure mode. Furthermore, parameter data may be reset at system startup to the default values given in Section B2, "Types of Relays and Registers."

Note

Only registers listed in Table B2.3 and subsequent tables are valid data registers provided with this module. Any number missing from the “Data Position Number” column in these tables is omitted intentionally. When a value written to a valid data register exceeds the valid data range, as indicated in the “Data Range” column in these tables, the written value is ignored and the original value is restored. An out-of-range value written to a monitoring parameter or input parameter, however, remains and is returned as read data until an instruction is executed to enable the parameter, at which time, the out-of-range value will be restored to the original value. At the same time, an error status is returned.

Any data written to a read-only (R/O) data register is ignored, in so far as it has no effect on module operation. However, if the register is read immediately after the write operation (for example, within the same scan of the sequence program), the written value may be returned.

Any data written to an undefined register or a register that is considered invalid for a module type or monitoring mode is ignored, in so far as it has no effect on module operation. If the register is read after the write operation, however, the written value or a register-specific value may be returned. The register-specific value may or may not be a fixed value.

Note

The “Attribute” column in a table indicates whether a register can be read and written. “RO” indicates a read-only register, whilst “RW” indicates a register that can be read, as well as written.

Parameters with "Stored" marked with "-" are not backed up. At power-on or reset start, the value shown in "Default value" is entered.

Parameters with "Stored" marked with "✓" will be backed up to the non-volatile memory but will not be written to the non-volatile memory when the backup function is stopped. The "Default value" of the parameter is the value set at the time of shipment from the factory or at the time of initialization. If the parameter is rewritten while the backup function is enabled, it will be written to the non-volatile memory. At power-on or reset start, the parameter is the value stored in the non-volatile memory.

When the setting of the input type selector switch or the operation parameter is changed, the corresponding and related parameters enter the value shown in "Default value".

B2.2.1 Common Process Data

These are representative process-related data for all channels. It consolidates in a single data area process-related data such as process value, operating status and error status.

Table B2.3 Common Process Data

	Data Position Number	Symbol	Description	Unit	Data Range	Default Value	Attribute	Stored	See Also
Process Value	1	PV.1	Process value	Industrial unit	-5.0 to 105.0% of (PRL to PRH)	—	RO	—	C2.
	2	PV.2				—	RO	—	
	3	PV.3				—	RO	—	
	4	PV.4				—	RO	—	
Operating Status	41	RUN.STUS.1	Operating status	None	Each bit is on or off depending on the status of the operating status. For details, see text section under “See Also”	—	RO	—	B2.2.6
	42	RUN.STUS.2				—	RO	—	
	43	RUN.STUS.3				—	RO	—	
	44	RUN.STUS.4				—	RO	—	
Error Status	51	ERR.STUS.1	Error status	None	Each bit is on or off depending on the error status. For details, see text section under “See Also”.	—	RO	—	C5.
	52	ERR.STUS.2				—	RO	—	
	53	ERR.STUS.3				—	RO	—	
	54	ERR.STUS.4				—	RO	—	

B2.2.2 Setup Control Parameters

Use these parameters to enable various settings, required when monitoring parameters and input parameters are updated. For details on the procedure, see Section B2.3, “How to Enable Settings”.

Table B2.4 Setup Control Parameters

Data Position Number	Symbol	Description	Unit	Data Range	Default Value	Attribute	Stored	See Also
71	SETUP	Setup	None	0: Disable setup instruction operand; 1: Enable setup instruction operand	0	RW	—	B2.3
72	OPE	Setup instruction operand	None	1, 2, 4, 8or 16. For details, see Table B2.5.	0	RW	—	
73	STUS	Setup instruction response	None	0: No error; or data position number of error register	0	RO	—	

Table B2.5 Setup Instruction Operand Values (data position number: 72)

Preset Value	Description	Explanation
1	Initialize all parameters	Reverts all parameters to their factory settings. *1
2	Enable monitoring parameters	Enables the monitoring parameters, which are the most basic setup elements. The module initializes input parameters and operation parameters based on the monitoring parameter values.
4	Enable input type settings	Enables the Input Type Selection parameter. The module initializes input range settings, PV range settings and Operation parameters based on the input type selection parameter value.
8	Enable input range settings	Enables the input range settings. The module initializes PV range settings and operation parameters based on these settings.
16	Enable PV range settings	Enables the PV range settings, which are required only in Two-input Changeover mode. The module initializes operation parameters based on these settings.

*1: Input type and power supply frequency selection defined by the hardware switches have precedence over software settings.

Note

Writing to the Setup Instruction Operand (OPE) register a preset value that is not listed in Table B2.5, “Setup Instruction Operand Values (data position number: 72),” has no effect on module operation. When the setup operation completes, the Setup Instruction Operand (OPE) register resets to “0”.

Note

For details on the procedure for enabling settings, see Section B2.3, “How to Enable Settings”.

B2.2.3 Function Control Parameters

Use these parameters to define the operation of module functions on a module-wide basis.

Table B2.6 Function Control Parameters

Data Position Number	Symbol	Description	Unit	Data Range	Default Value	Attribute	Stored	See Also
75	NBKUP	Disable backup function	None	0: Enable backup 1: Disable backup	0	RW	—	C4.

B2.2.4 Non-volatile memory Write Counter

The Non-volatile memory Write Counter counts the number of write-to-Non-volatile memory executions. Once the value of the Non-volatile memory Write counter reaches its maximum limit, subsequent write-to-Non-volatile memory executions are no longer counted, although they can still be executed until the Non-volatile memory actually fails.

Table B2.7 Backup Operation Parameter

Data Position Number	Symbol	Description	Unit	Data Range	Default Value	Attribute	Stored	See Also
77 and 78 (long word)	EEP.CNTR	Non-volatile memory Write Counter	Times	1 to 10,000,000	—	RO	—	—

CAUTION

The Non-volatile memory can be rewritten up to 10 million times (100,000 times before REV:01:00). In situations where the CPU module frequently overwrites the I/O data registers earmarked to be stored by the backup function, the maximum limit for write operations may be reached. To prevent this, turn on the Disable Backup Function parameter. Once the write limit is reached, data backup is no longer allowed and the system enters hardware failure mode. Furthermore, parameter data may be reset at system startup to the default values given in Section B2, "Types of Relays and Registers."

Note

The Non-volatile memory write counter counts the number of write-to-Non-volatile memory executions, but not the number of write executions to individual data position numbers.

B2.2.5 Monitoring Parameters

Use these parameters to set up the basic operation of the module, such as Input Sampling Period and Monitoring Mode, on a module-wide basis.

Table B2.8 Monitoring Parameters

Data Position Number	Symbol	Description	Unit	Data Range	Default Value	Attribute	Stored	See Also
81	FREQ	Power supply frequency selection *1	None	0: 50Hz, 1: 60Hz	0	RW	✓	C2.2
82	SMP	Input Sampling period*2	None	0: 100ms (Up to 2 channels) 1: 200ms 2: 100ms 3: 10ms	1	RW	✓	B3.1.2
83	MD12	Monitoring mode	None	0: Single-input mode ×2 1: Two-input changeover mode 3: Single-input mode (Odd channel disabled) 4: Both channels disabled	0	RW	✓	C1.
84	MD34				0	RW	✓	
90	REV	Firmware revision	None	—	—	RO	—	—

*1: The power frequency is set by default to the value set with the power frequency selector switch SW1-2. It can also be selected with SW1-2. For details on how to do so, see Section A4.1, “Selecting Input Types and Power Supply Frequency”. If the power supply frequency is set using the hardware switch selector, the setting cannot be changed by software.

*2: The number of channels that can be used depends on settings. For "0: 100ms," up to 2 channels. For Other settings, you can use up to 4 channels.

Note

Monitoring parameters must be enabled before any written content can take effect. For details on how to enable these parameters, see Section B2.3, “How to Enable Settings.”

Note

Changing a monitoring parameter initializes other related parameters. Always set monitoring parameters before setting input parameters and operation parameters.

Note

You must observe some precautions when writing to the module. For details, see Section B1.3, “Writing and Reading after Powering on.”

B2.2.6 Process Data

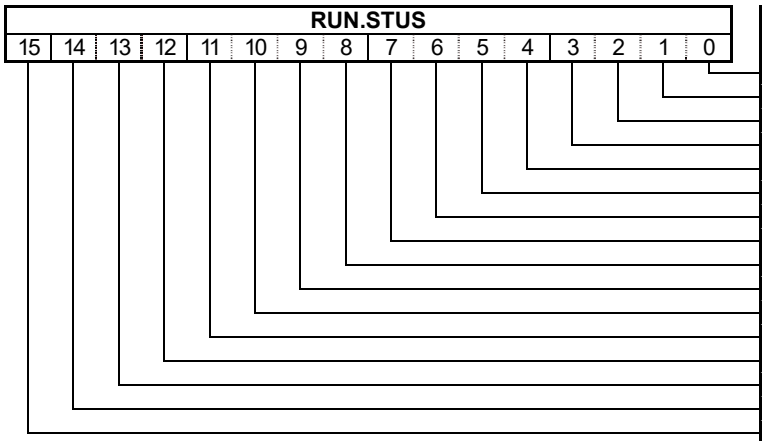
These are process-related data, such as input process value, process value and operating status, which can be used for monitoring the operation of the module.

Table B2.9 Process Data

Data Position Number				Symbol	Description	Unit	Data Range	Default Value	Attribute	Stored	See Also
CH1	CH2	CH3	CH4								
101	301	501	701	PVIN	Input process value	Industrial unit	-5% to 105% of (SL to SH)	—	RO	—	C2.
102	302	502	702	PV	Process value	Industrial unit	-5% to 105% of (PRL to PRH)	—	RO	—	
107	307	507	707	CSPNO	Current SP number	None	1 to 4	—	RO	—	C3.
108	308	508	708	RUN.STUS	Operating status	None	See Table B2.10	—	RO	—	C5.
109	309	509	709	ALM.STUS	Alarm status	None	See Table B2.11	—	RO	—	C3.
110	310	510	710	ERR.STUS	Error status	None	See Table B2.12	—	RO	—	C5.

■ Operating Status

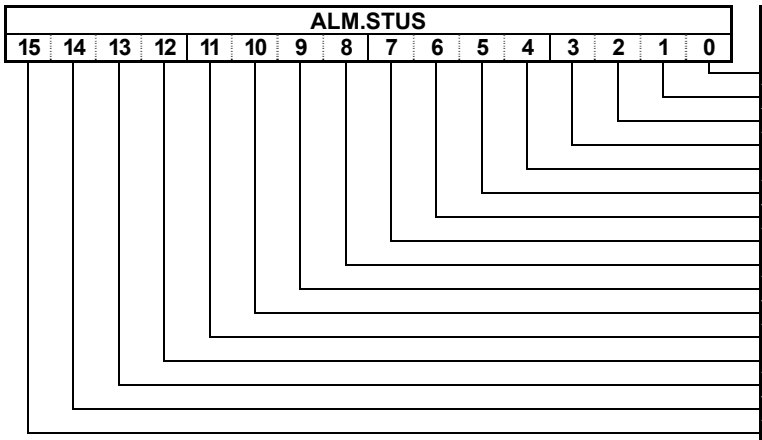
Table B2.10 Operating Status



Bit position	Symbol	Description
0	—	
1	—	
2	—	
3	—	
4	EXPV/PV	0: normal; 1: external
5	—	
6	—	
7	—	
8	B.OUT	PVIN burnout
9	+OVER	PVIN +OVER
10	-OVER	PVIN –OVER
11	B.OUT	PV burnout
12	+OVER	PV +OVER
13	-OVER	PV –OVER
14	—	
15	FUNC.ER	Error detected

■ Alarm Status

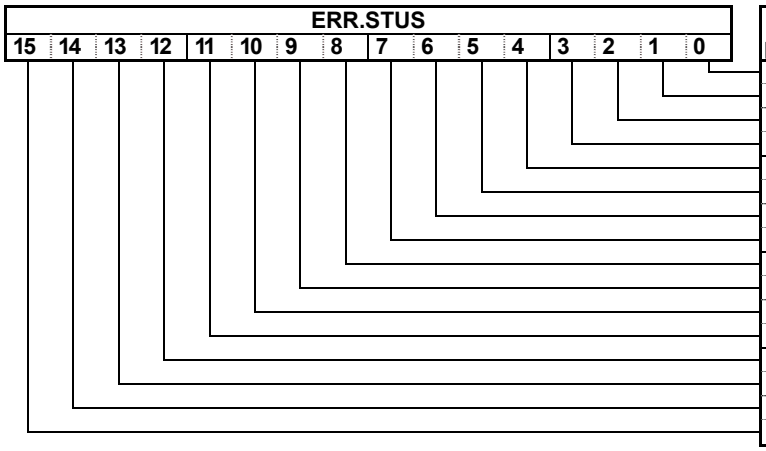
Table B2.11 Alarm Status



Bit position	Symbol	Description
0	ALM1	Alarm 1 generated
1	ALM2	Alarm 2 generated
2	ALM3	Alarm 3 generated
3	ALM4	Alarm 4 generated
4	ALMW1	Alarm 1 waiting
5	ALMW2	Alarm 2 waiting
6	ALMW3	Alarm 3 waiting
7	ALMW4	Alarm 4 waiting
8	—	
9	—	
10	—	
11	—	
12	—	
13	—	
14	—	
15	—	

■ Error Status

Table B2.12 Error Status



Bit position	Description
0	—
1	System data error
2	Calibration value error
3	Monitoring/input parameter error
4	Operation parameter error
5	AD converter error
6	RJC error
7	Non-volatile memory error
8	Memory error
9	—
10	—
11	—
12	—
13	—
14	—
15	—

B2.2.7 Operation Control Parameters

Use these parameters to control the operation of individual channels.

Table B2.13 Operation Control Parameters

Data Position Number				Symbol	Description	Unit	Data Range	Default Value	Attribute	Stored	See Also
CH1	CH2	CH3	CH4								
	323		723	INSEL	Input selection	None	0: Input 1 1: Input 2	0	RW	—	C2.11
125	325	525	725	EXPV/ PV	External input/normal input selection	None	0: Normal input 1: External input	0	RW	—	C2.12
128	328	528	728	SPNO	SP number selection	None	1 to 4	1	RW	—	C3.
131	331	531	731	EXPV	External input	Industrial unit	From 95.0% of SL to 105.0% of SH	SL	RW	—	C2.12
132	332	532	732	EXRJC	Reference junction temperature (Valid only when reference junction compensation is disabled)	Industrial unit	-100 to 700 (-10.0°C to 70.0°C	0	RW	—	C2.6

Note

All operation parameters revert to their default values after powering on. Hence, always set their values again after powering on.

Note

You must observe some precautions when writing to the module. For details, see Section B1.3, “Writing and Reading after Powering on.”

B2.2.8 Input Parameters

Input parameters are classified into categories: required setup parameters that must be checked and set, as well as optional setup parameters that can be set as required. All input parameters apply to individual channels.

The only required setup parameter is the Input Type Selection. It is the most basic channel setup element.

Optional setup parameters include settings for changing the input range and defining a burnout condition, as well as parameters that applies only to Two-input Changeover mode.

■ Input Type Settings

Use these parameters to select input type for individual channels.

These parameters are the most basic setup elements for a channel.

Table B2.14 Input Parameters (1/3)

Data Position Number				Symbol	Description	Unit	Data Range	Default Value	Attribute	Stored	See Also
CH1	CH2	CH3	CH4								
142	342	542	742	IN	Input type selection *1	None	1 to 31, 33 to 56 For details, see Table A4.1, “Input Type Selection.”		RW	✓	C2.1

*1: To select input type by software, you must set the input type selector switches to “set by software”, that is, “SW5=0; SW1-4=OFF”.

■ Input Range Settings

Use these parameters to set up the input of individual channels, as required, such as changing the input range or selecting an appropriate burnout operation.

Table B2.14 Input Parameters (2/3)

Data Position Number				Symbol	Description	Unit	Data Range		Default Value	Attribute	Stored	See Also
CH1	CH2	CH3	CH4									
143	343	543	743	RH	Input range upper limit	Industrial unit	See Table A4.1, “Input Type Selection”.			RW	✓	C2.3
144	344	544	744	RL	Input range lower limit					RW	✓	
145	345	545	745	DEC.P	Decimal point position	None				RO	✓	
146	346	546	746	SH	Scaling upper limit	None	-30000 to 30000; 0 < SH - SL ≤ 30000. Changeable only for DC voltage input with a maximum resolution of 14 bits (16383).	Other than DC voltage input	RH	RW	✓	C2.3
								DC voltage input	1000			
147	347	547	747	SL	Scaling lower limit			Other than DC voltage input	RL	RW	✓	
								DC voltage input	0			
148	348	548	748	SDP	Scaling decimal point position	None	0 to 4 Changeable only for DC voltage input	Other than DC voltage input	DEC.P	RW	✓	
								DC voltage input	1			
149	349	549	749	RJC	Reference junction compensation	None	0: Fixed value 1: ON		1	RW	✓	C2.6
150	350	550	750	BSL	Burnout selection	None	0: OFF 1: Up Scale 2: Down Scale (Valid for Thermocouple input and RTD input)		1	RW	✓	C2.5

■ PV Range Settings

These parameters are only valid in Two-input Changeover mode, and are used for defining the input range in Two-input Changeover mode. By default, the PV range follows the input range of the even channel.

Table B2.14 Input Parameters (3/3)

Data Position Number				Symbol	Description	Unit	Data Range	Default Value	Attribute	Stored	See Also
CH1	CH2	CH3	CH4								
	351		751	PRH	PV range upper limit	Industrial unit	0 < PRH - PRL ≤ 30000. Changeable only for even channels in two-input changeover mode with a maximum resolution of 14 bits (16383).	SH	RW	✓	C2.4
	352		752	PRL	PV range lower limit			SL	RW	✓	
	353		753	PDP	PV range decimal point position	None	0 to 4 Changeable only for even channels in two-input changeover mode	SDP	RW	✓	

Note

Input parameters must be enabled before any written content can take effect. For details on how to enable such parameters, see Section B2.3, “How to Enable Settings.”

Note

Changing an input parameter initializes operation parameters. Therefore, always set input parameters before setting operation parameters.

Note

You must observe some precautions when writing to the module. For details, see Section B1.3, “Writing and Reading after Powering on.”

B2.2.9 Operation Parameters

Operation parameters are option parameters used for selecting and configuring various module function options. They are classified into two-input changeover function settings, input function settings and alarm function settings, and can be set, as required.

Unlike monitoring parameters and input parameters, operation parameters do not need to be manually enabled after writing. The module checks the content of I/O data registers at periodic intervals defined by the Input Sampling Period parameter and if it finds that a value has been updated, it performs a range check. If the range check is successful, it automatically enables the new value. If the new value is out of range, it ignores the new value and restores the original register value.

Note

Changing a monitoring parameter or input parameter initializes operation parameters. Therefore, always set the monitoring parameters and input parameters before setting operation parameters.

Note

You must observe some precautions when writing to the module. For details, see Section B1.3, “Writing and Reading after Powering on.”

■ Two-input Changeover Function Settings

Use these parameters to perform setup when using Two-input Changover mode, as required.

They can be used for setting the changeover mode and changeover temperature.

Table B2.15 Two-input Changeover Function Settings

Data Position Number				Symbol	Description	Unit	Data Range	Default Value	Attribute	Stored	See Also
CH1	CH2	CH3	CH4								
	361		761	SELMD	Two-input changeover mode	None	0: Automatic changeover using temperature range 1: Automatic changeover using upper limit 2: Manual changeover using input selection	0	RW	✓	C2.11
	362		762	SELH	Two-input changeover upper limit	Industrial unit	PRL to PRH if SELL < SELH. If SELL ≥ SELH, changeover occurs with respect to SELH.	PRL+1	RW	✓	
	363		763	SELL	Two-input changeover lower limit			PRL	RW	✓	

■ Input Function Settings

Use these parameters to configure processing of input values of individual channels, as required. They can be used for setting input correction, square root extraction and input filtering of the input.

Table B2.16 Input Function Settings

Data Position Number				Symbol	Description	Unit	Data Range	Default Value	Attribute	Stored	See Also
CH1	CH2	CH3	CH4								
170	370	570	770	AVG	Moving average input filter	None	0 to 1: OFF 2 to 20 times (moving average times)	0	RW	✓	C2.10
171	371	571	771	BS	Input correction (biasing)	Industrial unit	-(SH - SL) to (SH - SL)	0	RW	✓	C2.8
172	372	572	772	FL	First-order lag Input filter	Seconds	0: OFF 1 to 120 seconds	0	RW	✓	C2.10
173	373	573	773	X1	Broken-line input 1	Industrial unit	-5.0% to 105.0% of (SH – SL)	SL	RW	✓	C2.7
174	374	574	774	Y1	Broken-line bias 1	Industrial unit	-(SH-SL) to (SH-SL)	0	RW	✓	
175	375	575	775	X2	Broken-line input 2	Industrial unit	-5.0% to 105.0% of (SH – SL)	SL	RW	✓	
176	376	576	776	Y2	Broken-line bias 2	Industrial unit	-(SH-SL) to (SH-SL)	0	RW	✓	
177	377	577	777	X3	Broken-line input 3	Industrial unit	-5.0% to 105.0% of (SH – SL)	SL	RW	✓	
178	378	578	778	Y3	Broken-line bias 3	Industrial unit	-(SH-SL) to (SH-SL)	0	RW	✓	
179	379	579	779	SR	Square root extraction	None	0: OFF (no square root extraction) 1: ON (square root extraction)	0	RW	✓	C2.9
180	380	580	780	LC	Low cut	Industrial unit	0.0-5.0% of (SH-SL)	1.0% of (SH-SL)	RW	✓	

■ Alarm Function Settings

Use these parameters to set up the operation (alarm type, hysteresis and ON delay time) of the alarm functions for individual channels, as required.

Table B2.17 Alarm Function Settings

Data Position Number				Symbol	Description	Unit	Data Range	Default Value	Attribute	Stored	See Also
CH1	CH2	CH3	CH4								
281	481	681	881	AL1	Alarm 1 type	None	0: OFF 1: Upper limit 2: Lower limit 11: Upper limit with waiting 12: Lower limit with waiting	1	RW	✓	C3.
282	482	682	882	AL2	Alarm 2 type			2	RW	✓	
283	483	683	883	AL3	Alarm 3 type			1	RW	✓	
284	484	684	884	AL4	Alarm 4 type			2	RW	✓	
285	485	685	885	HY1	Alarm 1 hysteresis	Industrial unit	0 to (PRH-PRL)	(PRH-PRL) ×0.5%	RW	✓	C3.
286	486	686	886	HY2	Alarm 2 hysteresis				RW	✓	
287	487	687	887	HY3	Alarm 3 hysteresis				RW	✓	
288	488	688	888	HY4	Alarm 4 hysteresis				RW	✓	
289	489	689	889	DLY1	Alarm 1 ON delay time	Seconds	0 to 999	0	RW	✓	C3.3
290	490	690	890	DLY2	Alarm 2 ON delay time				RW	✓	
291	491	691	891	DLY3	Alarm 3 ON delay time				RW	✓	
292	492	692	892	DLY4	Alarm 4 ON delay time				RW	✓	

■ SP Parameters

Use these parameters to set alarm preset values of individual channels, as required. Up to 4 sets of parameters can be set.

Table B2.18 SP Parameters

Data Position Number				Symbol	Description	Unit	Data Range	Default Value	Attribute	Stored	See Also
CH1	CH2	CH3	CH4								
202	402	602	802	1.A1	Alarm 1 preset value	Industrial unit	-30000 to 30000	PRH	RW	✓	C3.
203	403	603	803	1.A2	Alarm 2 preset value			PRL	RW	✓	
204	404	604	804	1.A3	Alarm 3 preset value			PRH	RW	✓	
205	405	605	805	1.A4	Alarm 4 preset value			PRL	RW	✓	
222	422	622	822	2.A1	Alarm 1 preset value	Industrial unit	-30000 to 30000	PRH	RW	✓	C3.
223	423	623	823	2.A2	Alarm 2 preset value			PRL	RW	✓	
224	424	624	824	2.A3	Alarm 3 preset value			PRH	RW	✓	
225	425	625	825	2.A4	Alarm 4 preset value			PRL	RW	✓	
242	442	642	842	3.A1	Alarm 1 preset value	Industrial unit	-30000 to 30000	PRH	RW	✓	C3.
243	443	643	843	3.A2	Alarm 2 preset value			PRL	RW	✓	
244	444	644	844	3.A3	Alarm 3 preset value			PRH	RW	✓	
245	445	645	845	3.A4	Alarm 4 preset value			PRL	RW	✓	
262	462	662	862	4.A1	Alarm 1 preset value	Industrial unit	-30000 to 30000	PRH	RW	✓	C3.
263	463	663	863	4.A2	Alarm 2 preset value			PRL	RW	✓	
264	464	664	864	4.A3	Alarm 3 preset value			PRH	RW	✓	
265	465	665	865	4.A4	Alarm 4 preset value			PRL	RW	✓	

B2.3 How to Enable Settings

Parameters described in Section B2.2.5, “Monitoring Parameters” and Section B2.2.8, “Input Parameters” must be enabled to take effect. This section describes how to enable various settings and check for successful completion.

Table B2.19 lists the input relays and Table B2.20 lists the I/O data registers that are used for enabling monitoring parameters and input parameters.

Table B2.19 Relays for Enabling Settings

Input Relay Number X□□□nn *1	Symbol	Description	Data Range	Interrupt
X08	CMDRDY	Command processing completed	0: Processing, 1: Processing completed	✓
X16	MDLRDY	Module startup completed	0: Processing, 1: Processing completed	✓
X24	SETUP.R	Setup mode	0: Normal state, 1: Setup mode	✓

*1: □□□ denotes the slot number where the module is installed.

Table B2.20 Data Registers for Enabling Settings

Data Position Number	Symbol	Description	Data Range	Default Value	Attribute
71	SETUP	Setup	0: Disable setup instruction operand 1: Enable setup instruction operand	0	RW
72	OPE	Setup Instruction Operand	1, 2, 4, 8, 16: See Table B2.21 for details.	0	RW
73	STUS	Setup Instruction Response	0: No error; Data position number of error register	0	RO

Table B2.21 Setup Instruction Operand (OPE) Values

Preset Value	Description	Explanation
1	Initialize all parameters	Reverts all parameters to their factory settings. *1
2	Enable monitoring parameters	Enables the monitoring parameters, which are the most basic setup elements. The module initializes input parameters and operation parameters based on the monitoring parameter values.
4	Enable input type settings	Enables the Input Type Selection parameter. The module initializes input range settings, PV range settings and Operation parameters based on the input type selection parameter value.
8	Enable input range settings	Enables the input range settings. The module initializes PV range settings and operation parameters based on these settings.
16	Enable PV range settings	Enables the PV range settings, which are required only in Two-input Changeover mode. The module initializes operation parameters based on these settings.

*1: Input type and power supply frequency selection defined by the hardware switches have precedence over software settings.

Note

Writing to the Setup Instruction Operand (OPE) register a preset value that is not listed in Table B2.21, “Setup Instruction Operand Values,” has no effect on module operation. When the setup operation completes, the Setup Instruction Operand (OPE) register resets to “0”.

Note

The Setup Instruction Operand (OPE) register functions only when the module is in Setup mode. Accessing the OPE register before transiting to Setup mode generates an error, and returns an error value of –32767 in the Setup Instruction Response register.

Note

Always finishing enabling all required settings, always set SETUP to “0: Disable setup instruction operand”. With SETUP set to “1: Enable setup instruction operand”, no I/O refreshing or control computation can be executed.

■ State Transition

The operating states of the module can be classified into 3 categories. For details on how to confirm a transition to a new state, and the content of registers and relays in each state, see Table B2.22, “Content of Registers and Relays in Each Operating State”.

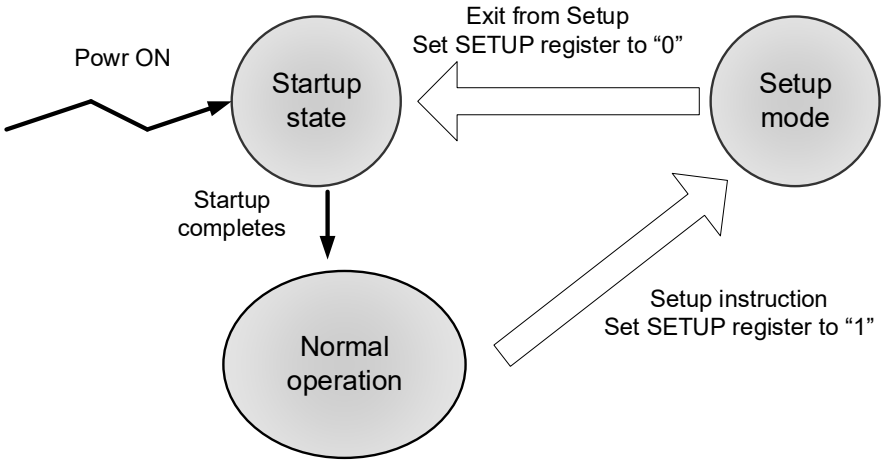


Table B2.1 Operating State Transition Diagram

● Powering on

When power is turned on, the module enters startup state.

● Startup completes (transition from Startup state to normal operation)

When startup completes, the module enters Normal Operation state. The MDLRDY automatically turns on, to notify that the module has entered Normal Operation state.

● Setup instruction (Transition from normal operation to Setup mode)

Writing a value of “1” to the Setup register initiates a transition to Setup mode. When the transition completes, the Setup.R relay turns on to indicate that the module has entered Setup mode.

● Exit from Setup (Transition from Setup mode to Startup state)

Writing a value of “0” to the Setup register initiates an exit from Setup mode. When the exit completes, the Setup.R relay resets, and the module transits to Startup state. The MDLRDY relay resets to indicate that the module is in Startup state.

Table B2.22 Content of Registers and Relays in Each Operating State

	MDLRDY Relay	SETUP.R Relay	Read Operation	Write Operation	Process Data	Operation Control Parameters
Startup State	0	0	×	×	Undefined	Undefined
Normal Operation	1	0	✓	✓	Normal vales	Normal values
Setup Mode	1	1	✓	✓	Default values	Default values

× : Data is invalid in this state.
✓: Data is valid in this state.

■ Procedure

Figure B2.2 illustrates the procedure for enabling monitoring parameter and input parameter values. Two I/O data registers, namely, SETUP and OPE, are used to enable settings, whilst three relays (SETUP.R, CMDRDY, MDLRDY) and one input data register (STUS) are used to check for successful execution.

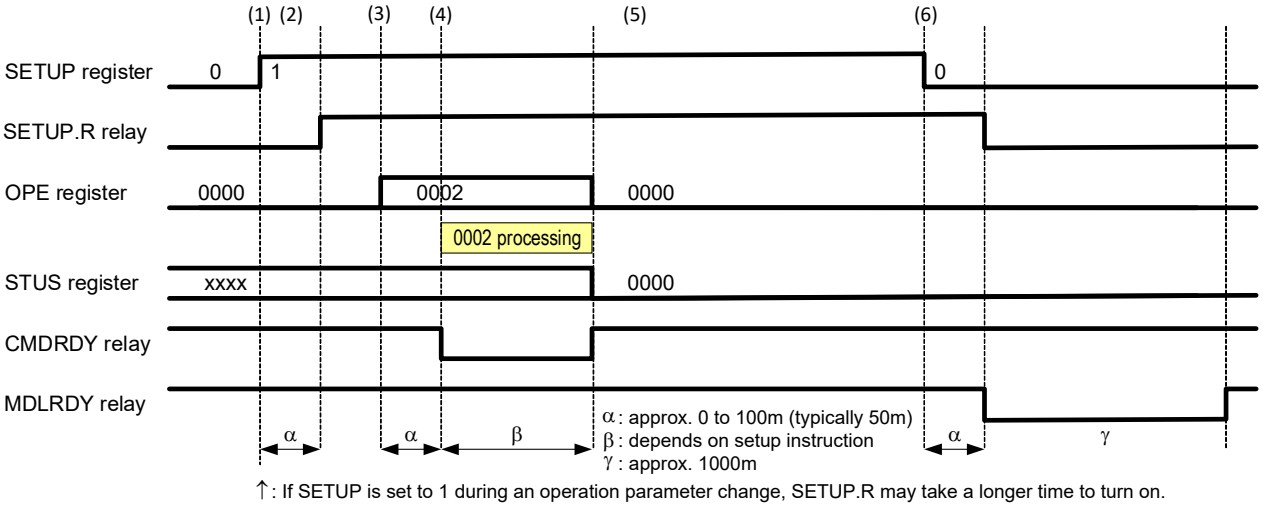


Figure B2.2 Procedure for Enabling Monitoring Parameters and Input Parameters

(1) Write a value of “1” to the SETUP register to transit to Setup Mode and enable access to the OPE register. To confirm that the module is now in Setup mode, check that the SETUP.R relay has turned on. In Setup mode, the module suspends refreshing of data registers.

(2) Write the new parameter value.

(3) Write to the OPE register an appropriate preset value to initiate the process for enabling the new parameter value.

(4) The module resets the CMDRDY relay as the setup process begins. It then resets the OPE register to “0”, initializes the relevant parameter, writes the exit status to the STUS register, and turns on the CMDRDY relay upon setup completion. Therefore, to confirm setup completion, check that CMDRDY has turned on.

(5) Read the STUS register to determine if setup is successful. During setup, the module performs range checks on all registers within the activated range, in ascending order of their data position numbers. If it finds an out-of-range register value, it restores the original register value and returns the data position number of the register in the Setup Instruction Response register. Note that only the first error register number is returned, although the range check is performed over all registers within the activated range. You can return to step 2 to enable other settings.

(6) Finally, write a value of “0” to the SETUP register to exit from Setup mode. The module initializes the operation parameters according to the new settings. Precautions for initialization are the same as those for module startup. For details, see Section B1.3, “Writing and Reading After Powering On”.

Note

The STUS register is a read-only register, which is updated after execution of each setup instruction. When executing a sequence of setup instructions, check the STUS register after each execution to determine if setup is successful.

Note

If a sequence program has a long execution cycle, a rise in the CMDRDY relay may fail to be detected. In such situations, confirm completion of setup by checking that the OPE register is reset to “0”.

Note

Always confirm that transition to Setup mode has been completed before writing to the OPE register. If data is written to the OPE register before transition has completed, the setup process will not start.

Note

Always write the new parameter before executing the corresponding setup instruction to enable the parameter value. Otherwise, the written value will be ignored.

Note

In Figure B2.2, α is the value when the input sampling period is set to 100ms or 200ms. If it is set to 10ms, it is about 0 to 20ms (typ.10ms).

B2.4 Initializing All Settings

To initialize all settings, use the procedure described in B2.3, “How to Enable Settings,” with the Setup Instruction Operand (OPE) register set to Initialize All Settings.

B3. Setup and Operation

The module is provided with multiple built-in monitoring functions to support various forms of operations.
Before using the module, you must select an operating mode, and configure the various monitoring functions. This chapter describes the basic workflow from setup to operation.
For details on individual functions, see PART-C, "Function Description".
For details on module access, use Chapter B1, "Accessing the Module."

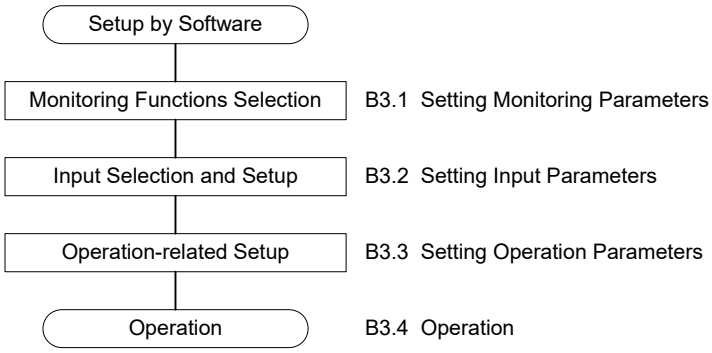


Figure B3.1 Procedure from Setup to Operation

Figure B3.1 shows the procedure flow from setup to operation. Updating a parameter may inadvertently affect (initialize) other parameters, and thus it is important that you perform setup, following the sequence described above. Section 3.1, "Setting Module Parameters" describes how to configure channels and perform other module-wide setup to match a specific usage. Section B3.2, "Setting Input Parameters" describes how to set up basic input-related elements, such as input type selection and input range for individual channels. Section B3.3, "Setting Operation Parameters" describes the operation-related parameters. Lastly, Section B3.4, "Operation" describes operation-related procedures.

B3.1 Setting Monitoring Parameters

Monitoring parameters are used for performing module-wide setup to suit the operating environment and mode of use. They define the most basic operations of the module.

The setup elements are described in Section B3.1.1, “Power Supply Frequency Selection”, Section B3.1.2, “Input Sampling Period” and Section B3.1.3, “Monitoring Mode”. You should set these parameters to match the operating and usage environment. Monitoring parameters must be enabled before any written content can take effect. For details on how to enable such parameters, see Section B2.3, “How to Enable Settings.”

Note

Changing a monitoring parameter initializes other related parameters. Always set monitoring parameters before setting input parameters and operation parameters.

B3.1.1 Power Frequency Selection

Use this parameter to select a power frequency that matches the power supply environment.

Table B3.1 Power Frequency Selection

Data Position Number				Symbol	Description	Unit	Data Range	Default Value	Attribute	Stored	See Also
CH1	CH2	CH3	CH4								
81				FREQ	Power frequency selection *1	None	0: 50Hz 1: 60Hz	0	RW*1	✓	C2.2

*1: The power frequency can also be selected using a hardware switch selector. For details on how to do so, see Section A4.1, “Selecting Input Types and Power Frequency”. If the power frequency is set using the hardware switch selector, the setting cannot be changed by software.

Selecting an appropriate power frequency reduces interference of common mode noise from the power supply on input signals.

Note

If an input sampling period of 10ms is selected, the common mode noise reduction function is not be enabled regardless of the setting of the power frequency selector switch.

B3.1.2 Input Sampling Period

This parameter sets the input sampling period. Beware that a short sampling period restricts the number of available channels.

Table B3.2 Input Sampling Period

Data Position Number				Symbol	Description	Unit	Data Range	Default Value	Attribute	Stored	See Also
CH1	CH2	CH3	CH4								
82				SMP	Input Sampling period*1	None	0: 100ms (Up to 2 channels) 1: 200ms 2: 100ms 3: 10ms	1	RW	✓	–

*1: The number of channels that can be used depends on settings. For "0: 100ms," up to 2 channels. For Other settings, you can use up to 4 channels.

Table B3.3 Mapping between Input Sampling Period and Usable Channels

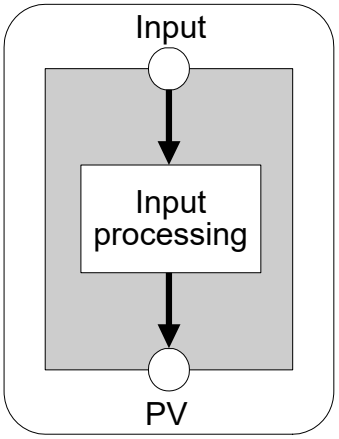
Input Sampling Period	Preset Value	Usable Channels*1				Remarks
		1	2	3	4	
100ms	0	✓	✓	–	–	
200ms	1	✓	✓	✓	✓	Default Value
100ms	2	✓	✓	✓	✓	
10ms	3	✓	✓	✓	✓	

*1 "✓" : usable; "– ": not usable.

B3.1.3 Monitoring Mode

The monitoring mode parameter configures how channels are combined. The module supports Single-input mode and Two-input Changeover mode. In Two-input Changeover mode, two channels are combined and used as one.

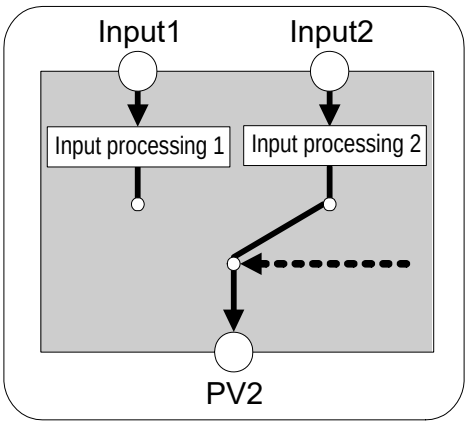
■ Single-input Mode



This is the standard mode of use.

In Single-input mode, each input operates independently, and is configured separately. Descriptions in Section B3.2, “Setting Input Parameters” and Section B3.4, “Operation” assumes the use of Single-input mode.

■ Two-input Changeover Mode



Two-input changeover mode uses two channels of monitoring functions to monitor a single process value, by switching between two inputs.

In this mode, setup and operation acts on a pair of channels (channels 1 and 2, or channels 3 and 4). Only parameters of even (2, 4) channels are used for controlling.

Descriptions in Section B3.2, “Setting Input Parameters” and Section B3.4, “Operation” assumes the use of Single-input mode. For details on setup and operation unique to Two-input Changeover mode, see Section C1.2, “Two-input Changeover Mode.”

The monitoring mode is set for a pair of channels. Register MD12 corresponds to channels 1 and 2, whilst MD34 corresponds to Channels 3 and 4. Table B3.5 shows the relationship between monitoring mode preset values and channels.

Table B3.4 Monitoring Mode

Data Position Number				Symbol	Description	Unit	Data Range	Default Value	Attribute	Stored	See Also
CH1	CH2	CH3	CH4								
83				MD12	Monitoring mode	None	0 to 4: See Table B3.5 for details.	0	RW	✓	C1.
		84		MD34				0	RW	✓	

Table B3.5 Monitoring Mode and Channels

Symbol	Description	Relationship between Monitoring Mode Preset Value and Channel		
			Odd Channel (1 or 3)	Even Channel (2 or 4)
MD12 MD34	Monitoring mode	0: Single input	Single input	Single input
		1: Two-input changeover	Low temperature input*1	High temperature input
		3: Odd channel disabled	Not used	Single input
		4: Both channels disabled	Not used	Not used

*1: Only inputs are used.

Note

The monitoring mode is a monitoring parameter. Changing a monitoring parameter reverts all parameters of the module to their default values.

However, switching between Disabled and Single-input monitoring modes, that is, between monitoring modes “0”, “3” and “4” will not initialize the parameters.

B3.1.4 Sample Program for Setting Monitoring Parameters

This section shows a sample program for setting monitoring parameters. The program sets the input sampling period to 100ms. For details on how to enable settings, see Section B2.3, “How to Enable Settings.”

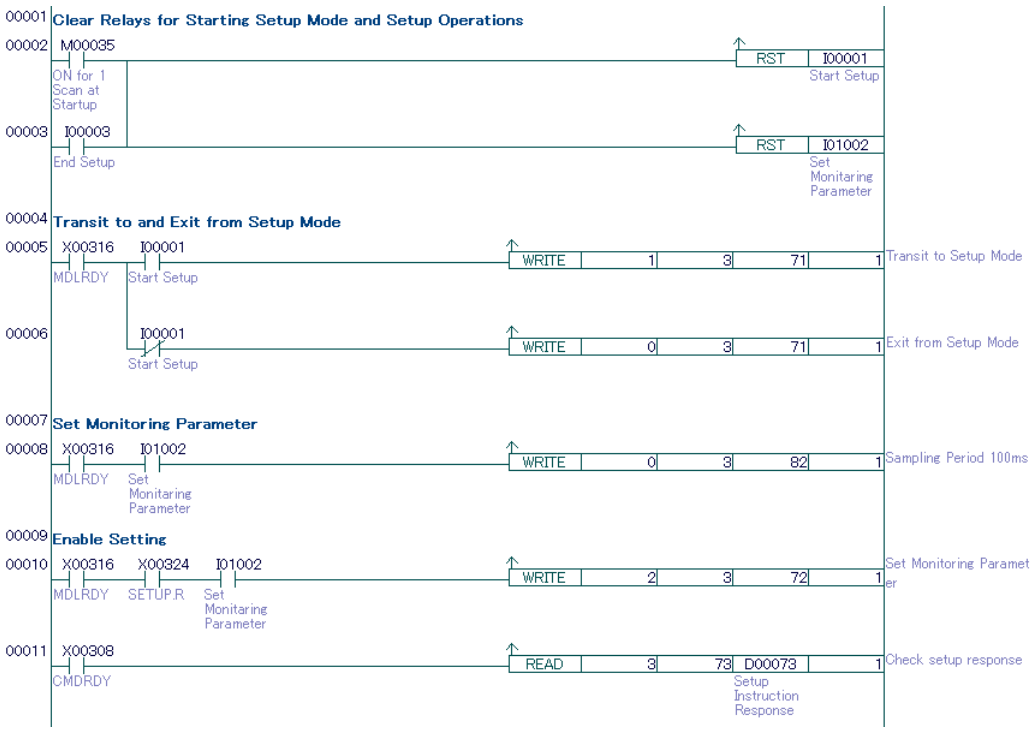


Figure B3.2 Sample Program for Setting Monitoring Parameters

B3.2 Setting Input Parameters

Input parameters are classified into two categories: required input parameters that must be checked and set, as well as optional input parameters that can be set as required. All input parameters apply to individual channels.

The only required input parameter is described in Section 3.2.1, “Input Type Selection”.

Optional setup parameters are used for changing the input range, for selecting burnout detection, as well as for setting the upper and lower limits of the PV range when using Two-input Changeover mode.

For details on functions selectable by optional setup parameters, see Chapter C2, “Input-related Functions”.

Input parameters must be enabled before any written content can take effect. For details on how to enable such parameters, see Section B2.3, “How to Enable Settings.”

Note

Changing an input parameter initializes operation parameters and other related input parameters. Therefore, always set input parameters before setting operation parameters.

B3.2.1 Input Type Selection

These parameters specify the input type of individual channels. Select a preset value that matches the temperature range and voltage range of the sensor to be used.

Table B3.6 Input Type Selection

Data Position Number				Symbol	Description	Unit	Data Range	Default Value	Attribute	Stored	See Also
CH1	CH2	CH3	CH4								
142	342	542	742	IN	Input type selection *1	None	1 to 31, 33 to 56 For details, see Table A4.1, "Input Type Selection."	Depends on switch setting	RW	✓	C2.1

*1: You can also select input types using hardware switches as described in Section A4.1, "Selecting Input Types and Power Frequency." If a selection is made using a hardware switch, the setting cannot be changed by software.

B3.2.2 Sample Program for Setting Input Parameters

This section shows a sample program for setting input parameters. The program sets the input type for channels 1 and 2. For details on how to enable settings, see Section B2.3, “How to Enable Settings.”

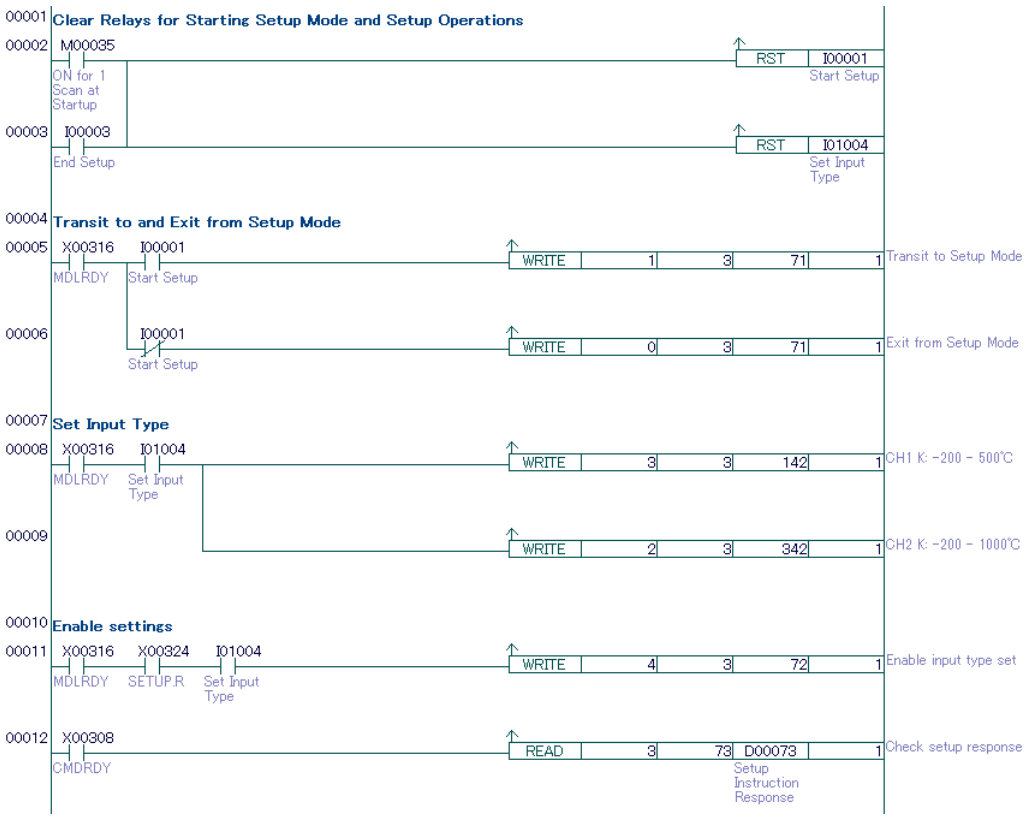


Figure B3.3 Sample Program for Setting Input Parameters

B3.3 Setting Operation Parameters

Operation parameters are option parameters used for selecting and configuring various module function options. They are classified into two-input changeover function settings, input function settings and alarm function settings, and can be set, as required. For details, see Chapter C2, “Input-related Functions” and Chapter C3, “Alarm Function.”

Note

Changing a monitoring parameter or input parameter initializes operation parameters. Therefore, always set the monitoring parameters and input parameters before setting operation parameters.

B3.4 Operation

Once you have completed the setup described in Section B3.1, “Setting Monitoring Parameters” and Section B3.2, “Setting Input Parameters”, the module is ready for operation. To use the alarm function, perform the required setup described in Section B3.3, “Setting Operation Parameters.”

B4. Sample Program

This chapter describes a sample program that uses the temperature monitoring module for monitoring temperatures. It sets the input sampling period and input type, and reads process values. If it detects an error, it reads the error status.

Table B4.1 lists the 5 internal relays used in this sample program, with their intended usage.

Table B4.1 Internal Relays Used in the Sample Program

Relay Number	Name and Usage	Remarks
I00001	Start setup	All parameters to be set are stored internally in the module and thus, do not require set up after each powering up. These relays therefore need to be used only when the module is replaced or when parameters are changed.
I00003	End setup	
I01001	Initialize all parameters	
I01002	Set monitoring parameter	
I01004	Start input type setup	

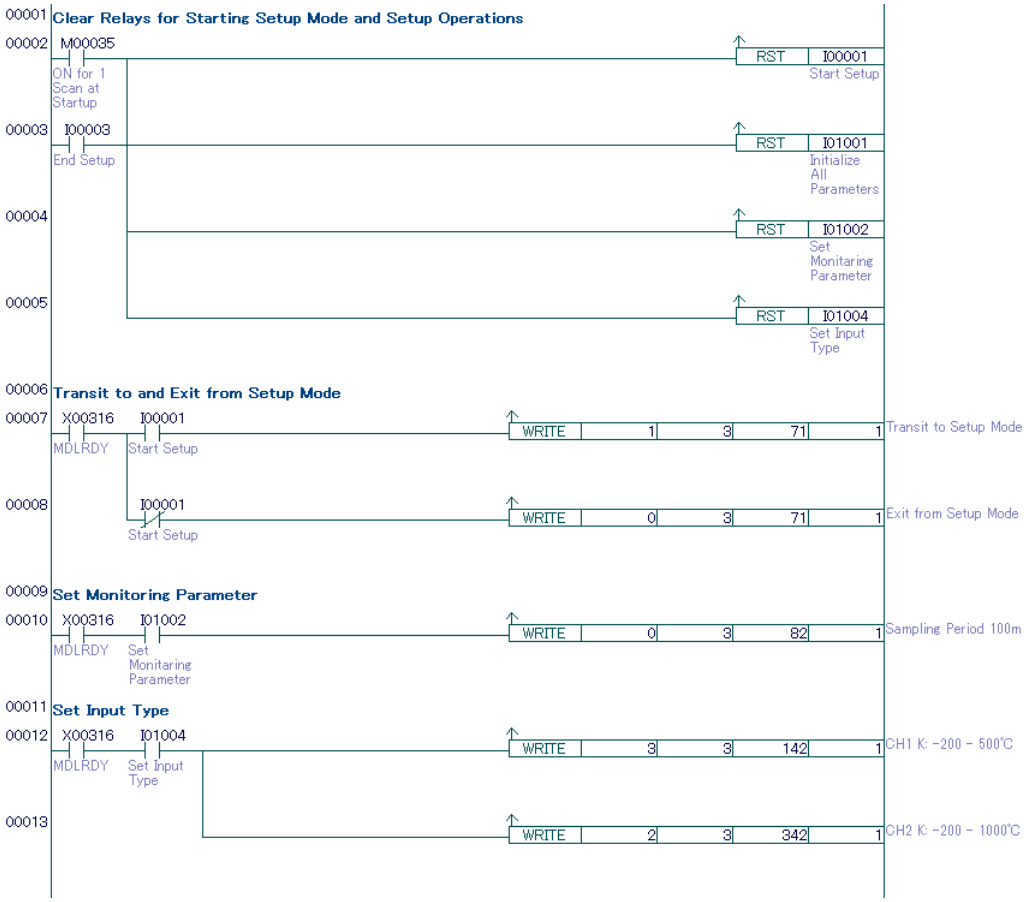


Figure B4.1 Sample Program (1/2)

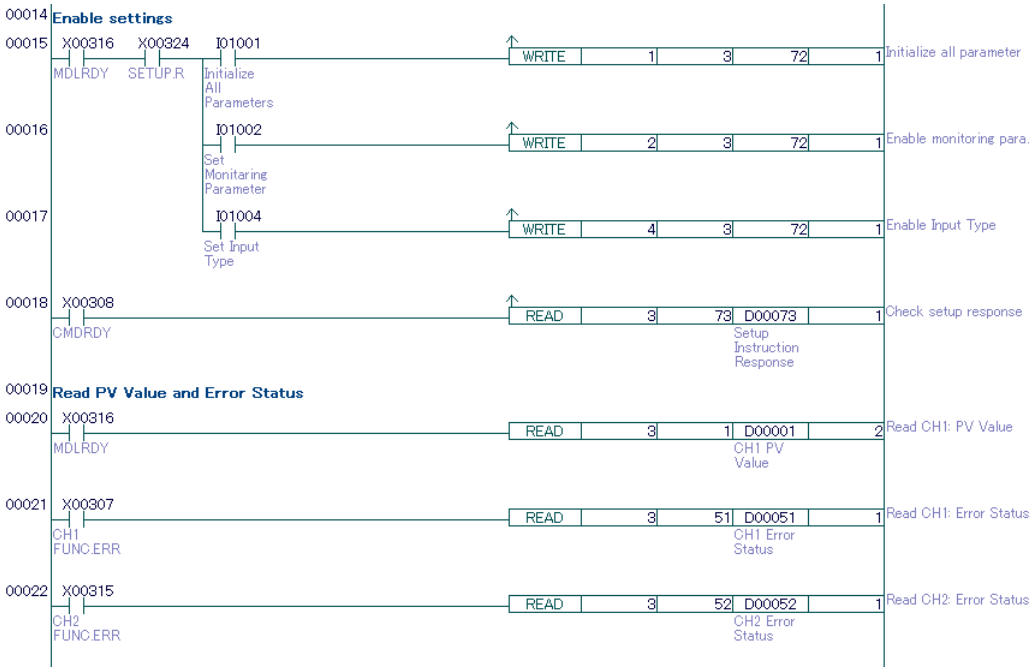


Figure B4.1 Sample Program (2/2)

Note

If a sequence program has a long execution cycle, a rise in the CMDRDY relay may fail to be detected. In such situations, confirm completion of setup by checking that the OPE register is reset to “0”.

Temperature Monitoring Module

PART-C Function Description

IM 34M06H63-02E 3rd Edition

PART-C describes the functions of the module.

The module has four monitoring functions, which can be configured to suit different applications. This part first describes the monitoring mode that defines the relationship among the monitoring functions, and then describes each of the functions.

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C1. Monitoring Mode

The monitoring mode defines the relationship among the four monitoring functions provided in this module. Each monitoring function may be operated independently; alternatively, channels 1 and 2, or channels 3 and 4 may be combined to implement Two-input Changeover mode. For an overview of the various monitoring modes, see Section B3.1.3, "Monitoring Mode."

The monitoring mode is set for a pair of channels, as described above. Register MD12 corresponds to channels 1 and 2, whilst MD34 corresponds to Channels 3 and 4.

Table C1.1 Monitoring Mode

Data Position Number				Symbol	Description	Unit	Data Range	Default Value	Attribute	Stored
CH1	CH2	CH3	CH4							
83				MD12	Monitoring mode	None	0 to 4: See Table C1.2 for details	0	RW	✓
		84		MD34				0	RW	✓

Table C1.2 Monitoring Mode Preset Values and Channels

Symbol	Description	Relationship between Monitoring Mode Preset Value and Channel		
			Odd Channels (1 or 3)	Even Channels (2 or 4)
MD12 MD34	Monitoring mode	0: Single input	Single input	Single input
		1: Two-input changeover	Lower temperature input*1	Higher temperature input
		3: Odd channel disabled	Not used	Single channel input
		4: Both channels disabled	Not used	Not used

*1: Only inputs are used.

The single-input mode and the two-input changeover mode are described in Sections C1.1, "Single-input Mode," and C1.2, "Two-input Changeover Mode," respectively. The Disabled monitoring mode is described in Section C1.3, "Disabled Mode."

Note

The monitoring mode is a monitoring parameter. Changing a monitoring parameter reverts all parameters of the module to their default values.

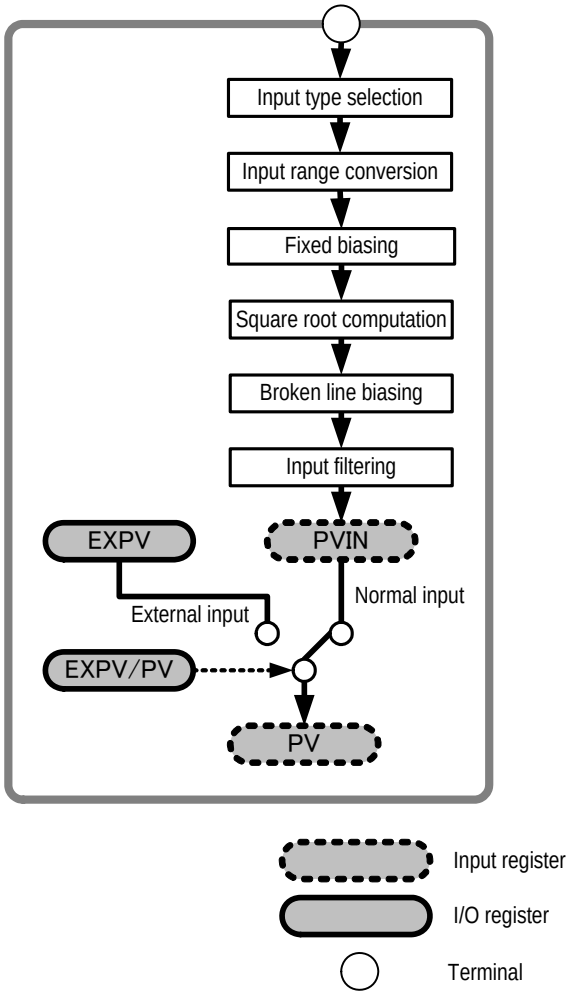
However, switching between Disabled and Single-input monitoring modes, that is, between monitoring modes “0”, “3” and “4” will not initialize the parameters.

Note

The monitoring mode parameter must be enabled before any written content can take effect. For details on how to enable the parameter, see Section B2.3, “How to Enable Settings.”

C1.1 Single-input Mode

The single-input mode is the standard operation mode of the module where each channel operates independently. With the required conditions defined, a channel measures a temperature and provides it as a PV value. For details of each function, see Section C2, "Input-related Functions."



This flowchart illustrates the module functions as functional blocks. Some details are omitted intentionally to facilitate reading.

Figure C1.1 Overview of Single-input Mode

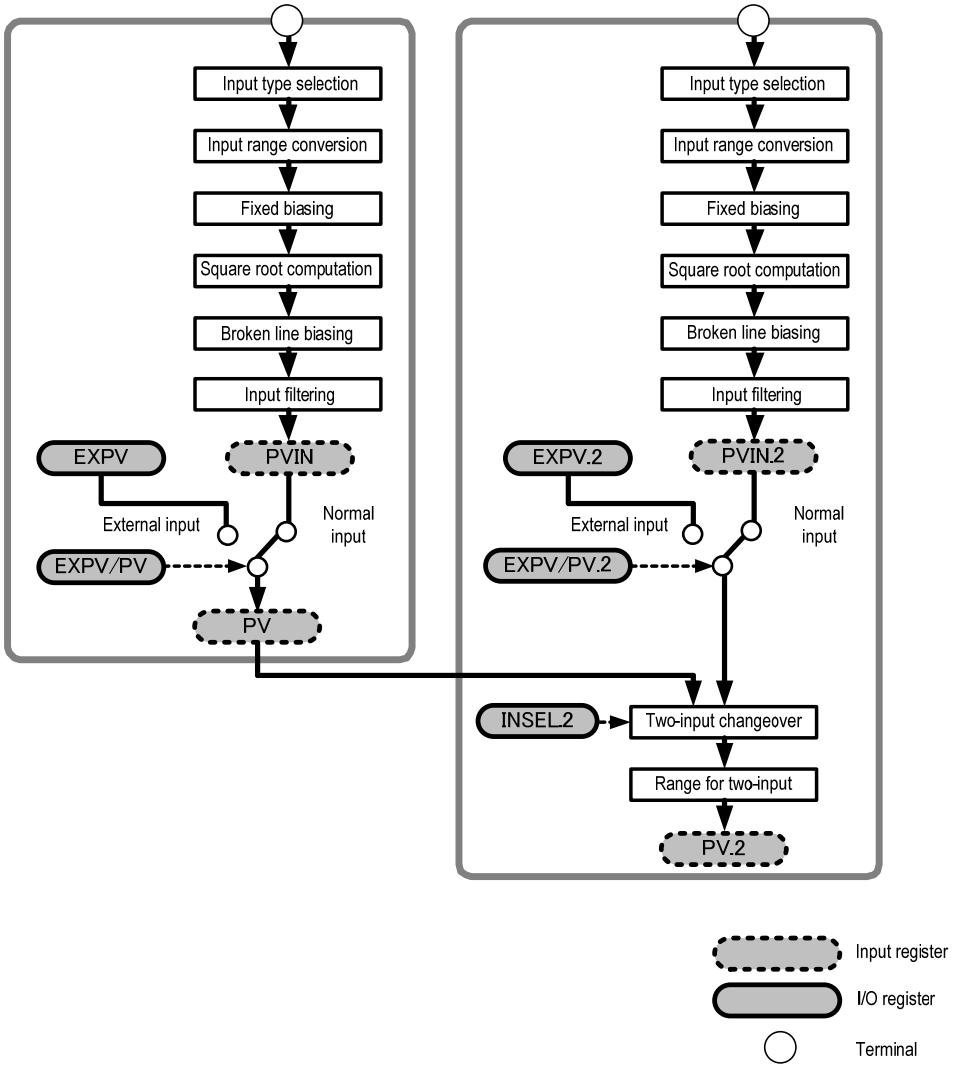
Table C1.3 Parameters for Single-input Mode

Data Position Number				Symbol	Description	Unit	Data Range	Default Value	Attribute	Stored	See Also
CH1	CH2	CH3	CH4								
101	301	501	701	PVIN	Input process value	Industrial unit	From -5.0% to 105.0% of (SH - SL)	–	RO	–	C2.3
102	302	502	702	PV	Process value	Industrial unit	From -5.0% to 105.0% of (PRH - PRL)	–	RO	–	C2.3
108	308	508	708	RUN.STUS	Operating status	None	Each bit is on or off depending on the operating status of the channel.	–	RO	–	C2.5
125	325	525	725	EXPV/PV	External input /normal input selection	None	0: Normal input 1: External input	0	RW	–	C2.12
131	331	531	731	EXPV	External input	Industrial unit	From -5.0% to 105.0% of (SH - SL)	SL	RW	–	C2.12
132	332	532	732	EXRJC	Reference junction temperature	Industrial unit	-100 to 700 (-10.0 to 70.0°C)	0	RW	–	C2.6

The module reads the output from a thermocouple, RTD, or some other temperature sensor and processes it according to the characteristics of the sensor used. It also provides an input filtering function for reducing noise and hence, stabilizing the input, as well as a biasing function to correct sensor-dependent input deviation over the entire input range. For details on these functions, see Section C2, "Input-related Functions."

C1.2 Two-input Changeover Mode

The two-input changeover mode uses two channels of monitoring functions to monitor a single measurement value, by switching between two inputs. In this mode, only parameters of even (2, 4) channels are used for operation. For details on the functions, see Section C2, "Input-related Functions."



This flowchart illustrates the module functions in functional blocks. Some details are intentionally omitted to facilitate understanding.

Figure C1.2 Overview of Two-input Changeover Mode

When channels 1 and 2 are used as a pair, only the input processing function of channel 1 is used. The two-input changeover mode switches between two input processing functions of two channels, for example, to switch between different objects to be monitored according to operation conditions or between two types of sensors according to temperature level.

Table C1.4 Parameters for Two-input Changeover Mode (1/2)

Data Position Number				Symbol	Description	Unit	Data Range	Default Value	Attribute	Stored	See Also
CH1	CH2	CH3	CH4								
83				MD12	Monitoring mode	None	0 to 4: For details, see Table C1.2.	0	RW	✓	C1.
		84		MD34				0	RW	✓	

Table C1.4 Parameters for Two-input Changeover Mode (2/2)

Data Position Number				Symbol	Description	Unit	Data Range	Default Value	Attribute	Stored	See Also
CH1	CH2	CH3	CH4								
101	301	501	701	PVIN	Input process value	Industrial unit	From -5.0% to 105.0% of (SH - SL)	–	RO	–	C2.3
102	302	502	702	PV	Process value	Industrial unit	From -5.0% to 105.0% of (PRH - PRL)	–	RO	–	C2.4
	323		723	INSEL	Input selection	None	0: Input 1 1: Input 2	0	RW	–	C2.11
125	325	525	725	EXPV/PV	External input/normal input selection	None	0: Normal input 1: External input	0	RW	–	C2.11
131	331	531	731	EXPV	External input	Industrial unit	From -5.0% to 105.0% of (SH - SL)	SL	RW	–	C2.12
	361		761	SELMD	Two-input changeover mode	None	0: Automatic changeover according to temperature level 1: Automatic changeover according to two-input changeove upper limit 2: Manual changeover by input selection	0	RW	✓	C2.11
	362		762	SELH	Two-input changeover upper limit	Industrial unit	PRL to PRH; (SELL < SELH. If SELL ≥ SELH, changeover will be with respect to SELH.	PRL+1	RW	✓	
	363		763	SELL	Two-input changeover lower limit			PRL	RW	✓	

■ Inputs 1 and 2 in Two-input Changeover Mode

Table C1.5 Inputs 1 and 2 in Two-input Changeover Mode

Input 1	Input 2	See Also
Processes signals from either the input terminal or external input, depending on the setup. Input 1 should be used for lower temperatures.	Processes signals from either the input terminal or external input, depending on the setup. Input 2 should be used for higher temperatures.	C2, "Input-related Functions."

■ PV Range Setting

In two-input changeover mode, setting up channels 1 and 2, or channels 3 and 4 requires special attention.

First, set the input range (RH and RL) for each channel. To combine the input ranges for two channels for one PV measurement, you must set the PV range (PRH and PRL).

For details, see Section C2.3, "Input Range Setting," and C2.4, "PV Range Setting."

For details on how to switch between the two inputs, see Section C2.11, "Two-input Changeover."

Note

The PV range PRH/PRL is set by default to the input range RH/RL (SH/SL scaling for DC voltage input) of the even channel. Redefine the PV range, as appropriate.

C1.3 Disabled Mode

The Disabled mode suspends one or both monitoring functions for a pair of two channels. The Odd Channel Disabled mode disables channel 1 for a pair of channels 1 and 2, or channel 3 for a pair of channels 3 and 4. The Both Channels Disabled mode disables both channels, that is, channels 1 and 2 for a pair of channels 1 and 2, or channels 3 and 4 for a pair of channels 3 and 4. Monitoring is not performed for a disabled channel.

Even if a channel is disabled, functions for accessing, setting and controlling the channel are still available. If an out-of-range value is written to a disabled channel, an error occurs. If a stored parameter of a disabled changed is changed, the changed parameter is stored.

No input computation, and hence, no input update is performed for a disabled channel. The alarm relay for a disabled channel is forced to OFF.

Note

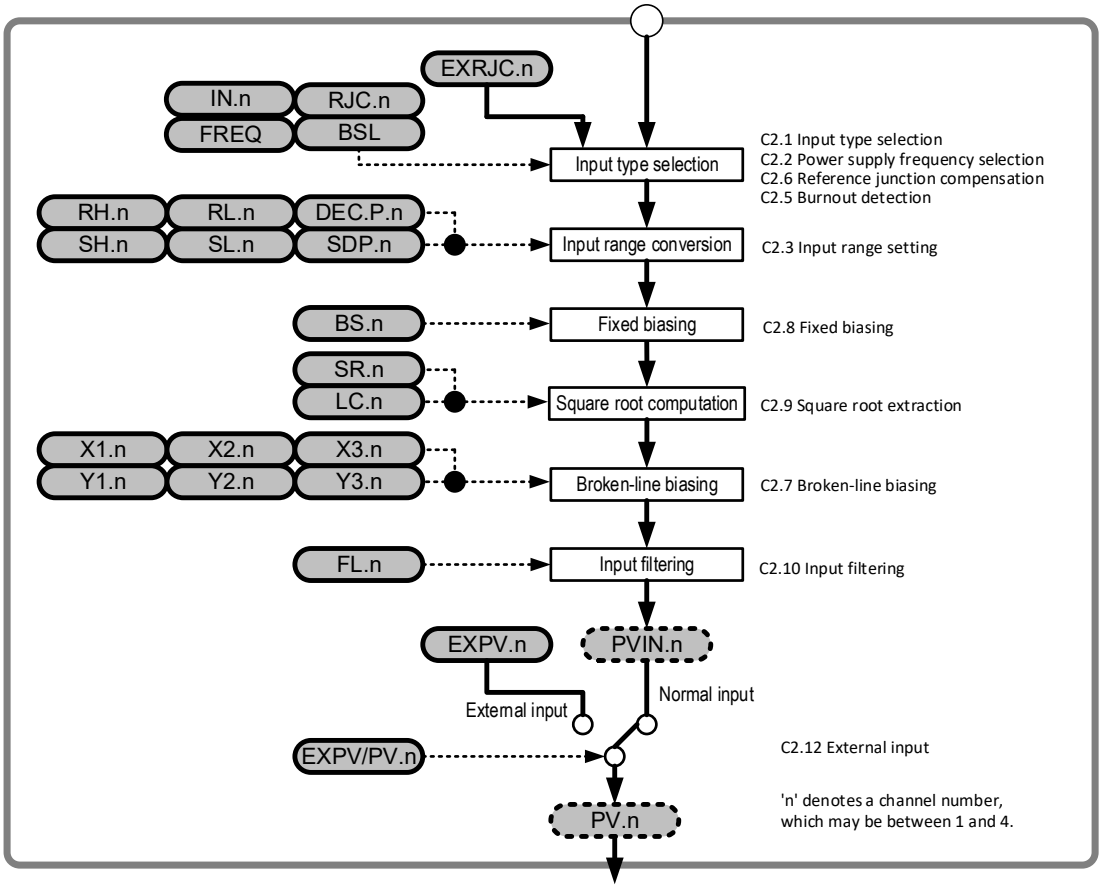
The monitoring mode, which is used to disable a channel, is a monitoring parameter. Changing a monitoring parameter reverts all parameters of the module to their default values.

However, switching between Disabled and Single-input monitoring modes, that is, between monitoring modes “0”, “3” and “4” will not initialize the parameters.

C2. Input-related Functions

Input-related functions are used to setup and control inputs.

Input-related functions perform input-related processing. They also perform processing for the two-input changeover mode, which uses two types of input to achieve wide-range measurements.



Two-input changeover

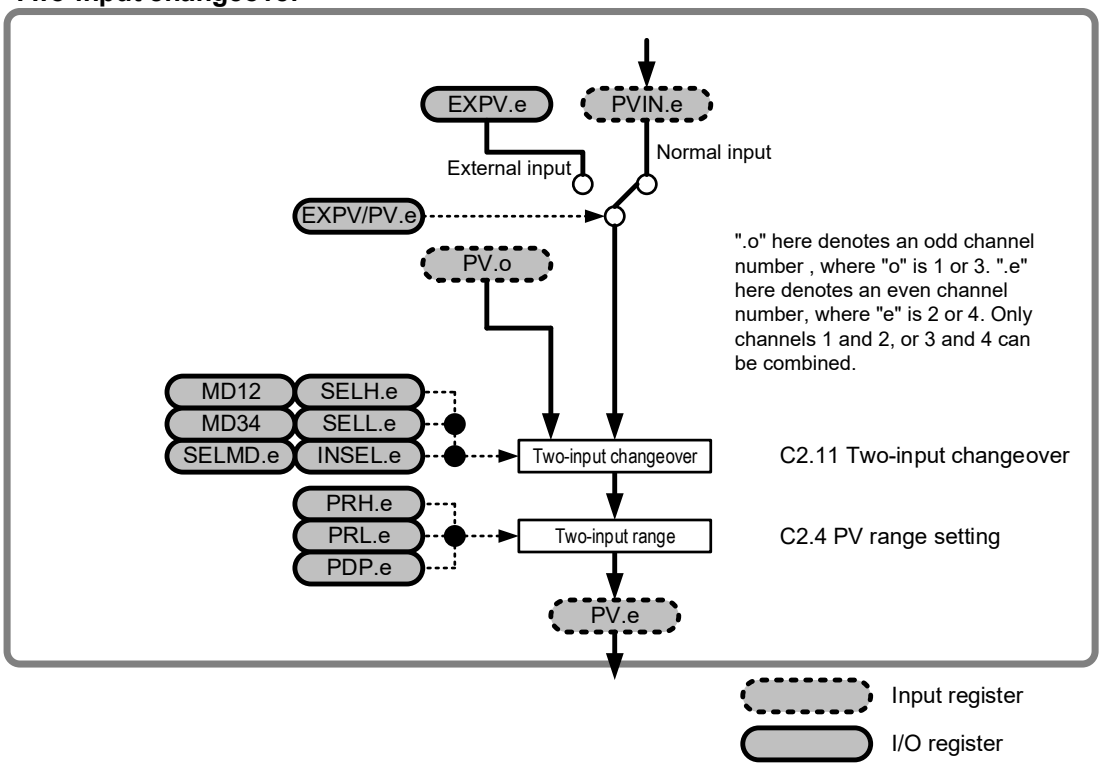


Figure C2.1 Block Diagram of Input-related Functions

Parameters shown in the block diagram are described below.

Table C2.1 Input-related Parameters

Data Position Number				Symbol	Description	Unit	Data Range		Default Value	Attribute	Stored	See Also
CH1	CH2	CH3	CH4									
101	301	501	701	PVIN	Input process value	Industrial unit	From -5.0% to 105.0% of (SH - SL)		–	RO	–	–
102	302	502	702	PV	Process value	Industrial unit	From -5.0% to 105.0% of (PRH - PRL)		–	RO	–	–
123	323	523	723	INSEL	Input selection (only valid for two-input changeover mode)	None	0: Input 1 1: Input 2		0	RW	–	C2.11
125	325	525	725	EXPV/PV	External input /normal input selection	None	0: Normal input 1: External input		0	RW	–	C2.12
131	331	531	731	EXPV	External input	Industrial unit	From -5.0% to 105.0% of (SH - SL)		SL	RW	–	
132	332	532	732	EXRJC	Reference junction temperature	Industrial unit	-100 to 700 (-10.0°C to 70.0°C)		0	RW	–	C2.6
142	342	542	742	IN	Input type selection *1	None	1-31 and 33-56 For details, see Table C2.3, "Input Type Selection."		Depends on switch setting	RW	✓	C2.1
143	343	543	743	RH	Input range upper limit	Industrial unit	See Table C2.3, "Input Type Selection."			RW	✓	C2.3
144	344	544	744	RL	Input range lower limit							
145	345	545	745	DEC.P	Decimal point position	None						
146	346	546	746	SH	Scaling upper limit	Industrial unit	-30000 to 30000; 0 < SH - SL ≤ 30000. Changeable only for DC voltage input with a maximum resolution of 14 bits (16383).	Other than DC voltage input	RH	RW	✓	
								DC voltage input	1000			
147	347	547	747	SL	Scaling lower limit			Other than DC voltage input	RL	RW	✓	
								DC voltage input	0			
148	348	548	748	SDP	Scaling decimal point position	None	0 to 4 Changeable only for DC voltage input	Other than DC voltage input	DEC.P	RW	✓	
								DC voltage input	1			
149	349	549	749	RJC	Reference junction compensation	None	0: Fixed value 1: ON		1	RW	✓	C2.6
150	350	550	750	BSL	Burnout selection (for thermocouple or RTD input)	None	0: OFF 1: Up Scale 2: Down Scale		1	RW	✓	C2.5
	351		751	PRH	PV range upper limit	Industrial unit	-30000 to 30000; 0 < PRH - PRL ≤ 30000. Changeable only for channel 2 or 4 in two-input changeover mode with a maximum resolution of 14 bits (16383).		SH	RW	✓	C2.4
	352		752	PRL	PV range lower limit	Industrial unit			SL	RW	✓	
	353		753	PDP	PV range decimal point position	None	0 to 4 Changeable only for even channels in two-input changeover mode.		SDP	RW	✓	
	361		761	SELMD	Two-input changeover mode	None	0: Automatic changeover using temperature range 1: Automatic changeover using two-input changeover upper limit 2: Manual changeover using input selection		0	RW	✓	C2.11
	362		762	SELH	Two-input changeover upper limit	None	PRL to PRH; (SELL < SELH. If SELL ≥ SELH, changeover will be with respect to SELH.		PRL+1	RW	✓	
	363		763	SELL	Two-input changeover lower limit	None			PRL	RW	✓	
170	370	570	770	AVG	Moving average input filter	None	0 to 1: OFF 2 to 20 times (moving average times)		0	RW	✓	C2.10
171	371	571	771	BS	Input correction (biasing)	Industrial unit	-(SH - SL) to (SH - SL)		0	RW	✓	C2.8
172	372	572	772	FL	First-order lag Input filter	Seconds	0: OFF 1 to 120 seconds		0	RW	✓	C2.10
173	373	573	773	X1	Broken-line input 1	Industrial unit	-5.0% to 105.0% of (SH – SL)		SL	RW	✓	C2.7
174	374	574	774	Y1	Broken-line bias 1	Industrial unit	-(SH-SL) to (SH-SL)		0	RW	✓	
175	375	575	775	X2	Broken-line input 2	Industrial unit	-5.0% to 105.0% of (SH – SL)		SL	RW	✓	
176	376	576	776	Y2	Broken-line bias 2	Industrial unit	-(SH-SL) to (SH-SL)		0	RW	✓	
177	377	577	777	X3	Broken-line input 3	Industrial unit	-5.0% to 105.0% of (SH – SL)		SL	RW	✓	
178	378	578	778	Y3	Broken-line bias 3	Industrial unit	-(SH-SL) to (SH-SL)		0	RW	✓	
179	379	579	779	SR	Square root extraction	None	0: OFF (no square root extraction) 1: ON (square root extraction)		0	RW	✓	C2.9
180	380	580	780	LC	Low cut	Industrial unit	0.0-5.0% of (SH-SL)		1.0% of (SH-SL)	RW	✓	

*1: Input type selector switches must be set with values SW5 = 0 and SW1-4 = OFF, as described in Section A4.1, "Selecting Input Types and Power Frequency," input type selection can be made using software.

C2.1 Input Type Selection

Input types may be selected either using hardware switches (for all channels collectively) or using parameters (for individual channels). Input type selection using parameters is available only when switches SW1-4 = OFF and SW5 = 0. Input type selection by parameters uses the Input Type Selection (IN) parameter. For details on input type selection using switches, see Section A4.1, "Selecting Input Type and Power Supply Frequency."

Table C2.2 Input-related Parameters

Data Position Number				Symbol	Description	Unit	Data Range	Default Value	Attribute	Stored
CH1	CH2	CH3	CH4							
142	342	542	742	IN	Input type selection *1	None	1 to 31, 33 to 56 For details, see Table C2.3, "Input Type Selection."	Depends on switch setting	RW *1	✓

*1: You can also select the input types using hardware switches as described in Section A4.1, "Selecting Input Types and Power Frequency." If a selection is made using hardware switch, the setting cannot be changed by software.

Note

The input parameters, including the input type selection (IN) parameter, must be enabled before their settings can take effect. For details, see Section B2.3, "How to Enable Settings."

Table C2.3 Input Type Selection

Input Type		Instrument Default Range*1	Input Type Selector Switch*2			Software Setting	Input Range				
							Default			Preset Range	
			SW5	SW1-4	SW1-3	IN*3	RL	RH	DEC.P	RL	RH
Software setting *4			0	OFF	X						
Thermocouple	K	-200.0 to 1370.0°C	1	OFF	OFF	1 ($01)	-2000	13700	1	-2700	13700
					ON	33 ($21)	-200	1370	0	-270	1370
		-200.0 to 1000.0°C	2		OFF	2 ($02)	-2000	10000	1	-2700	13700
					ON	34 ($22)	-200	1000	0	-270	1370
		-200.0 to 500.0°C	3		OFF	3 ($03)	-2000	5000	1	-2000	5000
					ON	35 ($23)	-200	500	0	-200	500
	J	-200.0 to 1200.0°C	4		OFF	4 ($04)	-2000	12000	1	-2000	12000
					ON	36 ($24)	-200	1200	0	-200	1200
		-200.0 to 500.0°C	5		OFF	5 ($05)	-2000	5000	1	-2000	5000
					ON	37 ($25)	-200	500	0	-200	500
	T	-270.0 to 400.0°C	6		OFF	6 ($06)	-2700	4000	1	-2700	4000
					ON	38 ($26)	-270	400	0	-270	400
	B	0.0 to 1600.0°C	7		OFF	7 ($07)	0	16000	1	0	18000
					ON	39 ($27)	0	1600	0	0	1800
	S	0.0 to 1600.0°C	8		OFF	8 ($08)	0	16000	1	0	17000
					ON	40 ($28)	0	1600	0	0	1700
	R	0.0 to 1600.0°C	9		OFF	9 ($09)	0	16000	1	0	17000
					ON	41 ($29)	0	1600	0	0	1700
	N	-200.0 to 1300.0°C	A		OFF	10 ($0A)	-2000	13000	1	-2000	13000
					ON	42 ($2A)	-200	1300	0	-200	1300
	E	-270.0 to 1000.0 °C	B		OFF	11 ($0B)	-2700	10000	1	-2700	10000
					ON	43 ($2B)	-270	1000	0	-270	1000
	L	-200.0 to 900.0°C	C		OFF	12 ($0C)	-2000	9000	1	-2000	9000
					ON	44 ($2C)	-200	900	0	-200	900
	U	-200.0 to 400.0°C	D		OFF	13 ($0D)	-2000	4000	1	-2000	4000
					ON	45 ($2D)	-200	400	0	-200	400
	W	0.0 to 1600.0°C	E		OFF	14 ($0E)	0	16000	1	0	23000
					ON	46 ($2E)	0	1600	0	0	2300
	Platinel 2	0.0 to 1390.0°C	F		OFF	15 ($0F)	0	13900	1	0	13900
					ON	47 ($2F)	0	1390	0	0	1390
RTD	JPt100	-200.0 to 500.0°C	0	ON	OFF	16 ($10)	-2000	5000	1	-2000	5000
					ON	48 ($30)	-200	500	0	-200	500
		-200.0 to 200.0°C	1		OFF	17 ($11)	-2000	2000	1	-2000	2000
					ON	49 ($31)	-200	200	0	-200	200
		0.0 to 300.0°C	2		OFF	18 ($12)	0	3000	1	0	3000
					ON	50 ($32)	0	300	0	0	300
		0.00 to 150.00°C	3		OFF	19 ($13)	0	15000	2	-10000	20000
					ON	51 ($33)	0	1500	1	-1000	2000
	Pt100	-200.0 to 850.0°C	4		OFF	20 ($14)	-2000	8500	1	-2000	8500
					ON	52 ($34)	-200	850	0	-200	850
		-200.0 to 500.0°C	5		OFF	21 ($15)	-2000	5000	1	-2000	5000
					ON	53 ($35)	-200	500	0	-200	500
		-200.0 to 200.0°C	6		OFF	22 ($16)	-2000	2000	1	-2000	2000
					ON	54 ($36)	-200	200	0	-200	200
		0.0 to 300.0°C	7		OFF	23 ($17)	0	3000	1	0	3000
					ON	55 ($37)	0	300	0	0	300
		0.00 to 150.00°C	8		OFF	24 ($18)	0	15000	2	-10000	20000
					ON	56 ($38)	0	1500	1	-1000	2000
DC voltage	0-10mV	0.00 to 10.00 mV	9	ON	X	25 ($19)	0	1000	2	0	1000
	0-100mV	0.0 to 100.0 mV	A			26 ($1A)	0	1000	1	0	1000
	0-1V	0.000 to 1.000 V	B			27 ($1B)	0	1000	3	0	1000
	0-5V	0.000 to 5.000 V	D			29 ($1D)	0	5000	3	0	5000
	1-5V	1.000 to 5.000 V	E			30 ($1E)	1000	5000	3	1000	5000
	0-10V	0.00 to 10.00 V	F			31 ($1F)	0	1000	2	0	1000

*1: For thermocouples K, B, S, R, W, and for RTD in the 0.00 to 150.00°C range, the upper and lower input range limits may exceed the default values.
*2: Data stored in the Non-volatile memory is initialized to the hardware switch values when power is turned on. An 'X' symbol in the SW1-3 column indicates that the switch setting is ignored.
*3: "Software Setting" refers to values stored in data register IN. Any value not listed here is ignored.
*4: This is the factory setting. When 'set by software' is selected, the initial value of data register IN is 1 i.e. 'software setting'=1.

C2.2 Power Frequency Selection

Power frequency may be set either by switches or parameters. Power frequency selection by parameters is available only when switches SW1-4 = OFF and SW5 = 0. The default value is then determined by SW1-2.

An appropriate power frequency setting reduces the interference of common-mode noise from the power supply on input signals.

The parameter used is as follows:

Table C2.4 Power Frequency Parameter

Data Position Number	Symbol	Description	Unit	Data Range	Default Value	Attribute	Stored
81	FREQ	Power frequency selection*1	None	0: 50 Hz 1: 60 Hz	0	RW*1	✓

*1: The default value is either 0 or 1 depending on the setting of SW1-2. Power frequency may also be set with SW1-2. For details, see Section A4.1, "Selecting Input Type and Power Frequency." Switch setting takes precedence over parameter setting.

Note

If an input sampling period of 10ms is selected, the common mode noise reduction function is not be enabled regardless of the setting of the power frequency selector switch.

Note

The input parameters, including the input type selection (IN) parameter, must be enabled before their settings can take effect. For details, see Section B2.3, "How to Enable Settings."

C2.3 Input Range Setting

For each instrument range selected, you may define an input range, which is the actual temperature range to be monitored, by specifying upper (RH) and lower (RL) limits within the instrument range. Some input types such as thermocouple W, however, allow an input range that is wider than the instrument range. For more details, see Table C2.3, "Input Type Selection." For example, to define an input range of 200.0-800.0°C for an instrument range of -200.0 to 1200.0°C for a thermocouple J input, set RH = 8000 and RL = 2000 (SH/SL are equal to RH/RL for temperature input). Likewise, to define an input range of 2-4 V for an instrument range of 1.000-5.000 V for DC voltage input with a display range of 0.0-50.0, set RH = 4000, RL = 2000, SDP = 1, SH = 500, and SL = 0.

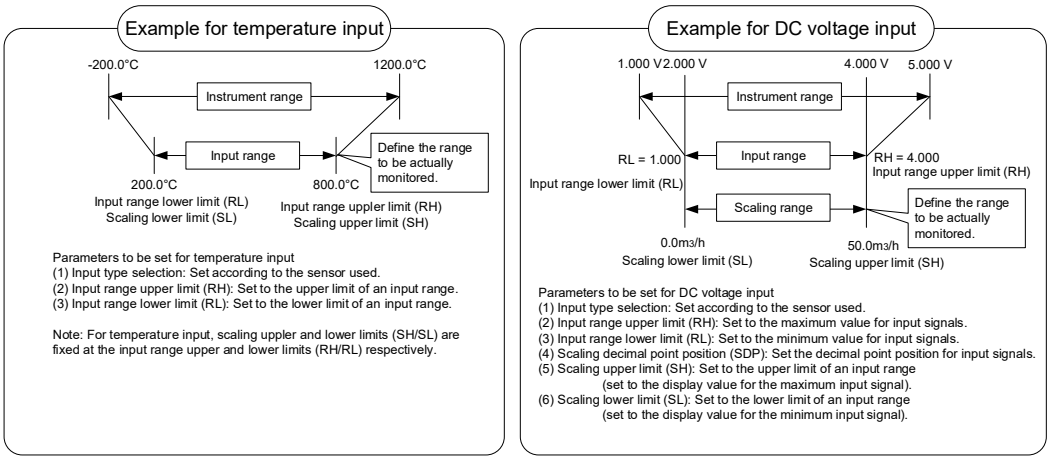


Figure C2.2 Examples of Input Range Setting

As shown in Figure C2.1, "Block Diagram of Input-related Functions," input values within a defined input range undergo computation before it is provided as an input process value, PVIN, to the system. For details on the computations performed, see Sections C2.9, "Square Root Extraction," C2.7, "Broken-line Biasing," C2.8, "Fixed Biasing," and C2.10, "Input Filtering."

Table C2.5 Parameters of Input-related Functions

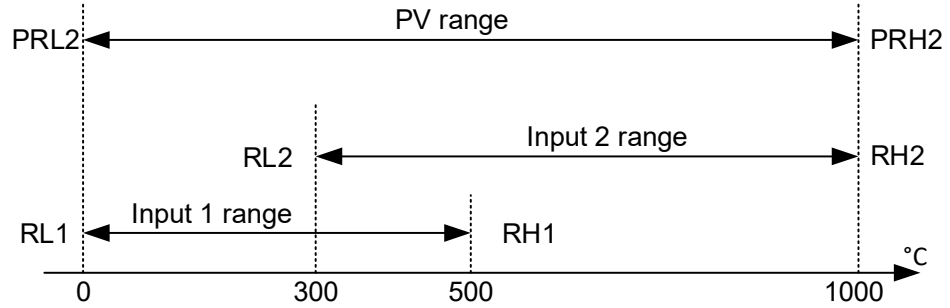
Data Position Number				Symbol	Description	Unit	Data Range		Default Value	Attribute	Stored
CH1	CH2	CH3	CH4								
101	301	501	701	PVIN	Input process value	Industrial unit	From -5.0% to 105.0% of (SH - SL)		–	RO	–
143	343	543	743	RH	Input range upper limit	Industrial unit	See Table C2.3, "Input Type Selection."			RW	✓
144	344	544	744	RL	Input range lower limit						
145	345	545	745	DEC.P	Decimal point position	None				RO	✓
146	346	546	746	SH	Scaling upper limit	None	-30000 to 30000; 0 < SH - SL ≤ 30000. Changeable only for DC voltage input with a maximum resolution of 14 bits (16383).	Other than DC voltage input	RH	RW	✓
								DC voltage input	1000		
147	347	547	747	SL	Scaling lower limit			Other than DC voltage input	RL	RW	✓
								DC voltage input	0		
148	348	548	748	SDP	Scaling decimal point position	None	0 to 4 Changeable only for DC voltage input	Other than DC voltage input	DEC.P	RW	✓
								DC voltage input	1		

Note

Changing an input range does not affect resolution.

C2.4 PV Range Setting (for two-input changeover mode)

The PV range setting defines the range of the output process value in Two-input Changeover mode, in cases where the two input signals have different input ranges. The PV range setting cannot be changed in Single-input mode. For example, if input 1 (channel 1) has input range of 0-500°C (RL=0°C; RH=500°C) and input 2 (channel 2) has input range of 300-1000°C (RL=300°C; RH=1000°C), you may set the PV range of channel 2 to 0-1000°C (PRL=0°C; PRH=1000°C).



In the figure, a number after a parameter symbol denotes a channel number. For example, RL2 means the input range lower limit (RL) for channel 2.

Figure C2.3 Examples of PV Range Setting

Table C2.6 PV Range Parameters

Data Position Number				Symbol	Description	Unit	Data Range	Default Value	Attribute	Stored
CH1	CH2	CH3	CH4							
101	301	501	701	PVIN	Input process value	Industrial unit	From -5.0% to 105.0% of the difference between SH and SL	–	RO	–
102	302	502	702	PV	Process value	Industrial unit	From -5.0% to 105.0% of the difference between PRH and PRL	–	RO	–
	351		751	PRH	PV range upper limit	Industrial unit	-30000 to 30000; 0 < PRH - PRL ≤ 30000. Changeable only for even channels in Two-input Changeover mode with a maximum resolution of 14 bits (16383).	SH	RW	✓
	352		752	PRL	PV range lower limit	Industrial unit		SL	RW	✓
	353		753	PDP	PV range decimal point position	None	0 to 4 Changeable only for even channels in Two-input Changeover mode. Always the same as SDP.	SDP	RW	✓

For details on how to switch between two inputs, see Section C2.11, "Two Input Changeover."

Note

PRH and PRL (PV range) are set by default to RH and RL (input range) of the even channel (2 or 4) for temperature input, or SH and SL (scaling range) of the even channel for DC voltage input. Redefine the PRH and PRL values as required.

C2.5 Burnout Detection

Burnout detection checks for an open circuit on an input.

For thermocouple or RTD input, you may define a burnout condition by specifying a threshold value and the direction of change in the input value. For DC voltage input, burnout detection is not available.

Setting the Burnout Detection parameter to “Up Scale” detects a burnout when the input value rises above 105% of the input range (or the PV range in Two-input Changeover mode).

Setting the Burnout Detection parameter to “Down Scale” detects a burnout when the input value drops below -5.0% of the input range (or the PV range in Two-input Changeover mode).

If the Burnout Detection parameter is set to “OFF”, the input value is undefined when a burnout occurs, and may be equal to the upper or lower limit. Furthermore, the FUNC.ERR relay and the corresponding bit of the RUN.STUS register are also not set. The operation of the alarm when a burnout is detected depends on the input value at that moment.

Table C2.7 Burnout Parameter

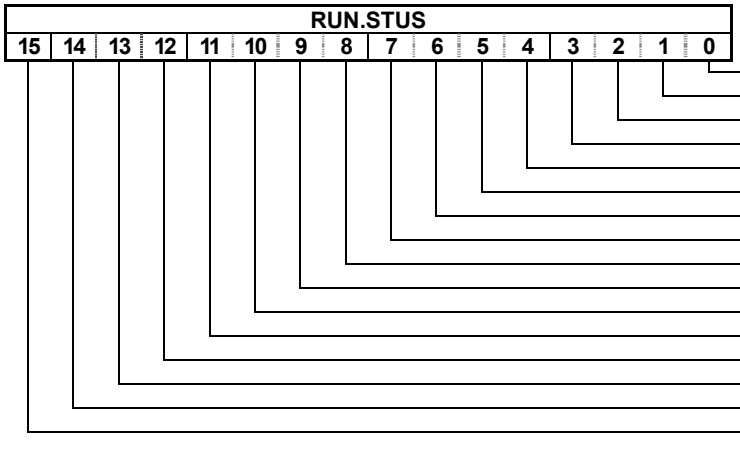
Data Position Number				Symbol	Description	Unit	Data Range	Default Value	Attribute	Stored
CH1	CH2	CH3	CH4							
41	42	43	44	RUN.STUS	Operating status	None	On/off for individual bits.	—	RO	—
108	308	508	708							
150	350	550	750	BSL	Burnout selection	None	0: OFF 1: Up scale 2: Down scale (valid only for thermocouple and RTD input)	1	RW	✓

Table C2.8 Burnout Detection Relay

Input Relay Number X□□□nn*1				Symbol	Description	Data Range
CH1	CH2	CH3	CH4			
X07	X15	X23	X31	FUNC.ERR	Burnout or other error detected*2	0: Normal; 1: Error

*1: □□□ denotes a slot number.
*2: Notifies that a burnout has been detected, or that self-diagnosis has detected an ADC error or some other error that affects normal module operation.

Table C2.9 Operating Status



Bit Pos.	Symbol	Description
0	—	
1	—	
2	—	
3	—	
4	EXPV/PV	0: Normal input, 1: External input
5	—	
6	—	
7	—	
8	B.OUT	PVIN burnout
9	+OVER	PVIN +OVER
10	-OVER	PVIN -OVER
11	B.OUT	PV burnout
12	+OVER	PV +OVER
13	-OVER	PV -OVER
14	—	
15	FUNC.ER	Error detection

A PVIN burnout reflects the input condition of a channel.

A PV burnout in Single-input mode is equivalent to a PVIN burnout.

A PV burnout detected on an even channel in Two-input changeover mode may mean an actual burnout on either the even channel or the odd channel of the pair of channels.

Note

Burnout detection is not performed when EXPV/PV is set to “1: external input”.

C2.6 Reference Junction Compensation

When Reference Junction Compensation (RJC) is set to ‘1: ON’, the temperature of the terminal block of the module is automatically measured and used for reference junction compensation in the thermocouple temperature measurement.

If an external reference point device is used to provide even better reference junction compensation, set RJC to ‘0: Fixed Value’, and set EXRJC to the reference junction temperature.

Table C2.10 Reference Junction Compensation Parameters

Data Position Number				Symbol	Description	Unit	Data Range	Default Value	Attribute	Stored
CH1	CH2	CH3	CH4							
149	349	549	749	RJC	Reference junction compensation setting	None	0: Fixed value 1: ON	1	RW	✓
132	332	532	732	EXRJC	Reference junction temperature (valid when Reference Junction Compensation is set to Fixed Value)	Industrial unit	-100 to 700 (-10.0°C to 70.0°C)	0	RW	–

C2.7 Broken-line Biasing

The broken-line biasing function biases an input value according to its magnitude. This function is especially useful for correcting input values from a degraded sensor. As shown in the figure below, you will define three input values (X) and specify a bias value (Y) for each input value. A corrected value is the sum of an input value and a bias value. Use parameters X1 to X3 (for the X axis) to define three input values, and parameters Y1 to Y3 (for the Y axis) to specify the bias values.

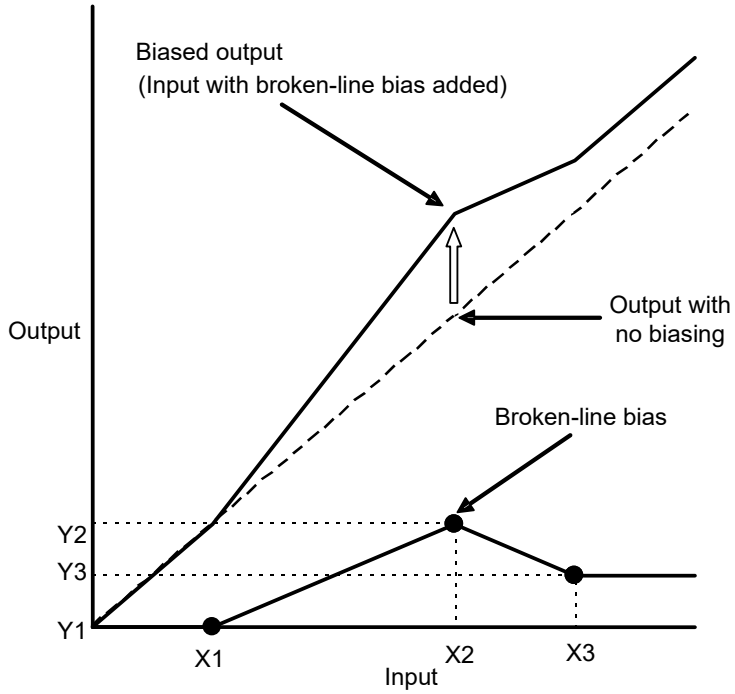


Figure C2.4 Broken-line Biasing Example

Table C2.11 Broken-line Biasing Parameters

Data Position Number				Symbol	Description	Unit	Data Range	Default Value	Attribute	Stored
CH1	CH2	CH3	CH4							
173	373	573	773	X1	Broken-line input 1	Industrial unit	-5.0%to105.0% of (SL to SH)	SL	RW	✓
174	374	574	774	Y1	Broken-line bias 1	Industrial unit	-(SH-SL) to (SH-SL)	0	RW	✓
175	375	575	775	X2	Broken-line input 2	Industrial unit	-5.0%to105.0% of (SL to SH)	SL	RW	✓
176	376	576	776	Y2	Broken-line bias 2	Industrial unit	-(SH-SL) to (SH-SL)	0	RW	✓
177	377	577	777	X3	Broken-line input 3	Industrial unit	-5.0%to105.0% of (SL to SH)	SL	RW	✓
178	378	578	778	Y3	Broken-line bias 3	Industrial unit	-(SH-SL) to (SH-SL)	0	RW	✓

Note

When using the broken-line biasing function, you must specify all broken-line bias related parameters (X1 to X3, and Y1 to Y3). Furthermore, the specified input values (X1 to X3) must be such that $X1 \leq X2 \leq X3$.

C2.8 Fixed Biasing

The fixed biasing function adds a constant bias to input values. The resultant values are used for monitoring.

This function is especially useful when a sensor output is always lower than true values by a fixed amount due to the physical condition of the sensor. For example, it may be used when the temperature of a material in a furnace is indirectly determined by measuring the ambient temperature in the furnace, where a fixed bias is added to the ambient temperature to represent the temperature of the material. The function is also useful for rectifying deviations among outputs from different sensors, which are within precision tolerance, or for correcting the output from a degraded sensor.

Table C2.12 Fixed Biasing Parameter

Data Position Number				Symbol	Description	Unit	Data Range	Default Value	Attribute	Stored
CH1	CH2	CH3	CH4							
171	371	571	771	BS	Fixed bias	Industrial unit	-(SH-SL) to (SH-SL)	0	RW	✓

C2.9 Square Root Extraction

The square root extraction function is especially useful for converting differential pressures measured with a restriction flowmeter using an orifice or nozzle into flow rates. You can also specify a low-cut point below which no square root extraction is done.

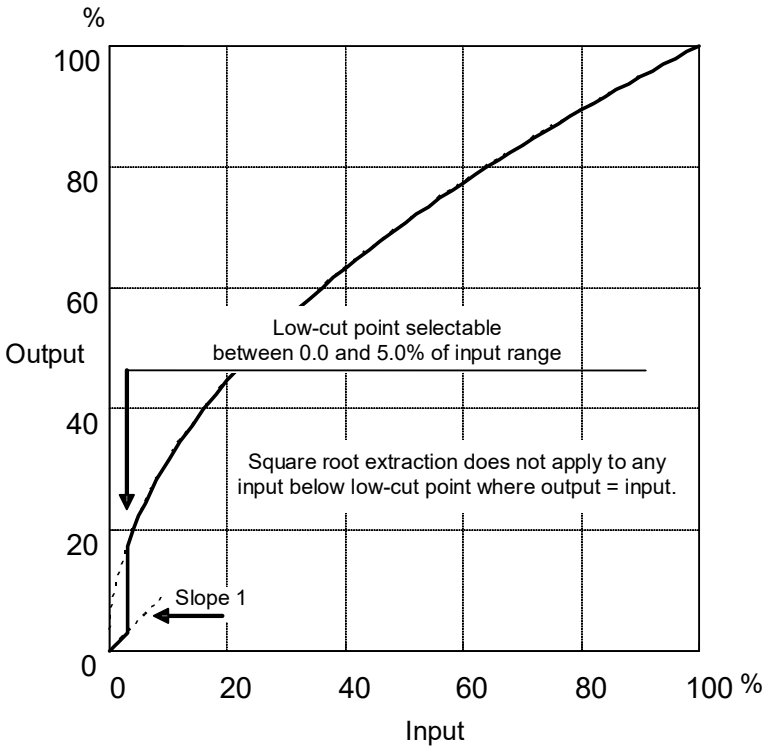


Figure C2.5 Square Root Extraction Example

Table C2.13 Square Root Extraction Parameters

Data Position Number				Symbol	Description	Unit	Data Range	Default Value	Attribute	Stored
CH1	CH2	CH3	CH4							
179	379	579	779	SR	Square root extraction	None	0: OFF (no square root extraction) 1: ON (square root extraction)	0	RW	✓
180	380	580	780	LC	Low-cut	Industrial unit	0.0-5.0% of (SH - SL)	1.0% of (SH - SL)	RW	✓

Note

This function is available only in the DC voltage input mode. It is ignored if specified in thermocouple or RTD input mode.

C2.10 Input Filtering

The input filtering function removes noise from input signals.

When using an input sampling interval of 100ms or 200ms, you can use the first-order lag filter. Note that when using an input sampling period of 10ms, you can use a moving average filter.

It is especially useful for removing high frequency noise from flow rate or pressure input signals.

When a larger time-constant or moving average times is specified for these filters, more noise is removed, and the input signal becomes cleaner and more stable. On the other hand, a larger time-constant or moving average times provides more input filtering, making the module less responsive to changes in the input signal. Thus, the Input Filter parameter should be set to the minimum required value. (see Figure C2.6, and Figure C2.7)

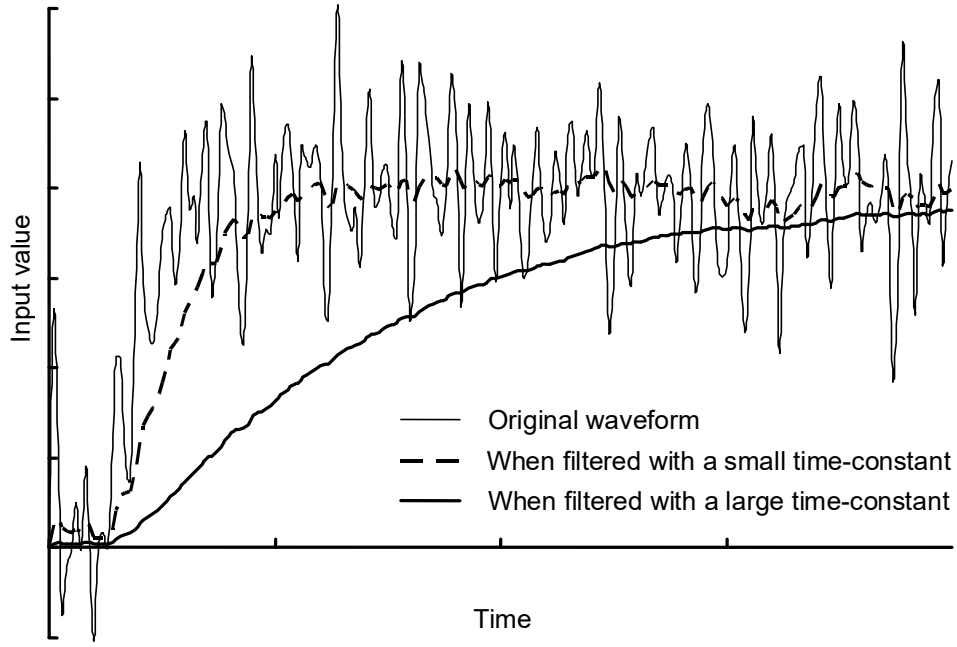


Figure C2.6 How the first-order lag input filter affects Input Signal

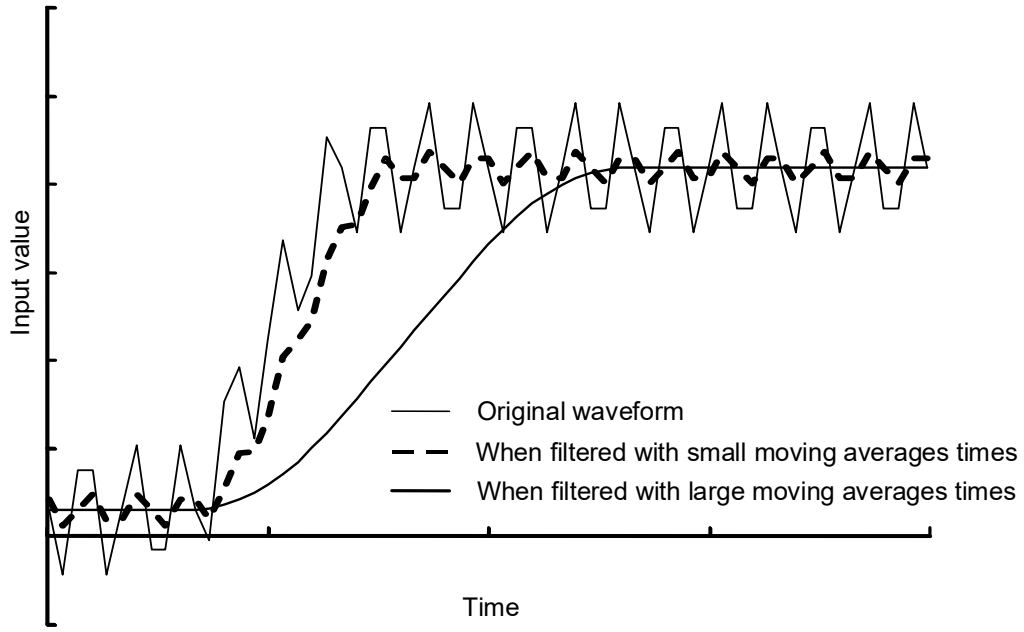


Figure C2.7 How the moving average input filter affects Input Signal

Table C2.14 Input Filter Parameter

Data Position Number				Symbol	Description	Unit	Data Range	Default Value	Attribute	Stored
CH1	CH2	CH3	CH4							
170	370	570	770	AVG	Moving average input filter	None	0 to 1: OFF 2 to 20 times (moving average times)	0	RW	✓
172	372	572	772	FL	First-order lag Input filter	Second	0: OFF; 1-120 seconds	0	RW	✓

Note

If the input sampling period is set to 100ms or 200ms, the moving average input filter (AVG) is disabled.

If the input sampling period is set to 10ms, the first-order lag input filter (FL) is disabled.

C2.11 Two-input Changeover

The two-input changeover function has three modes, which are selected by the SELMD parameter.

Table C2.15 Two-input Changeover Parameters

Data Position Number				Symbol	Description	Unit	Data Range	Default Value	Attribute	Stored
CH1	CH2	CH3	CH4							
	361		761	SELMD	Two-input changeover mode	None	0: Automatic changeover using temperature range 1: Automatic changeover using upper limit 2: Manual changeover using input selection	0	RW	✓
	362		762	SELH	Two-input changeover upper limit	Industrial unit	PRL to PRH if SELL < SELH. If SELL ≥ SELH, changeover occurs with respect to SELH.	PRL+1	RW	✓
	363		763	SELL	Two-input changeover lower limit			PRL	RW	✓
	323		723	INSEL	Input selection	None	0: Input 1 1: Input 2	0	RW	✓

■ Automatic Changeover Using Temperature Range (SELMD: 0)

In this mode, Input 1 is used when it is below the two-input changeover lower limit (SELL), Input 2 is used when it is above the two-input changeover upper limit (SELH), and the average (PV) of Input 1 and Input 2, given by the equation below, is used between SELL and SELH (overlapping range).

$$PV = \left(1 - \frac{input\ 1 - SELL}{SELH - SELL}\right) \times input\ 1 + \left(\frac{input\ 1 - SELL}{SELH - SELL}\right) \times input\ 2$$

Figure C2.8 illustrates how Input 1, Input 2 and the average of Input 1 and Input 2 are selected as the PV.

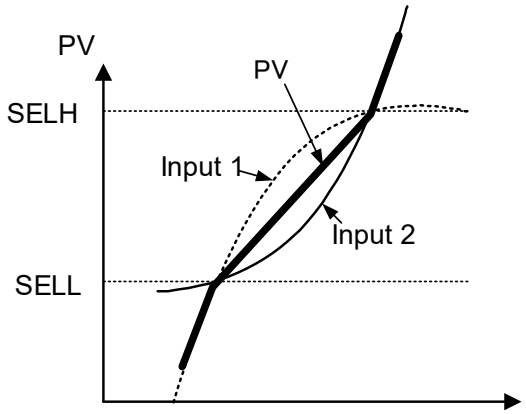


Figure C2.8 PV Value in Changeover Mode

If two inputs have different values, switching between the two inputs may result in an abrupt change in the PV value or a non-continuous PV value. To prevent this, this mode uses the average of the two inputs to compute the PV value in the overlapping range, as shown in the formula above. For this to work, however, you must define input 1 and input 2 with overlapping input ranges.

Note

- Input 1 must be used for the lower temperature range.
- Input 1 and Input 2 must be defined with overlapping ranges.

■ Automatic Changeover Using Upper Limit (SELMD: 1)

In this mode, Input 1 is used when it is not higher than SELH, and Input 2 is used when Input 1 is higher than SELH, as follows:

Input 1 ≤ SELH: Input 1 is selected.

Input 1 > SELH: Input 2 is selected.

■ Manual Changeover Using Input Selection (SELMD: 2)

Switches between input 1 and input 2 according to the Input Selection (INSEL) parameter, as follows:

INSEL = 0: Input 1 is selected.

INSEL = 1: Input 2 is selected.

The PV may change abruptly when changeover is made between Input 1 and Input 2, as illustrated below.

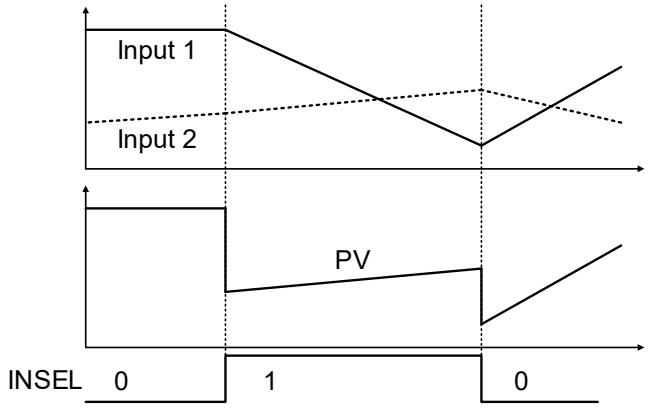


Figure C2.9 Changeover Using Input Selection (INSEL) Parameter

C2.12 External Input

The input value used in monitoring may be switched to an external input, which may be, say, processed data from a CPU module.

An external input must fall within the range of -5.0% to 105.0% of (SL to SH).

Use the EXPV/PV parameter to switch between external input and normal input.

An external input may be used for testing without a thermocouple or sensor connected.

Table C2.16 External Input Parameters

Data Position Number				Symbol	Description	Unit	Data Range	Default Value	Attribute	Stored
CH1	CH2	CH3	CH4							
131	331	531	731	EXPV	External input	Industrial unit	From -5.0% to 105.0% of the difference between SH and SL	SL	RW	–
125	325	525	725	EXPV/PV	External/normal input selection	None	0: Normal input 1: External input	0	RW	–

Note

Burnout detection is not performed if the EXPV/PV parameter is set to “1: External Input”.

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C3. Alarm Function

This chapter describes the alarm functions of the module.

The module has four alarm functions for each channel, which you can define individually using an SP Number. Alarm settings may be changed during operation.

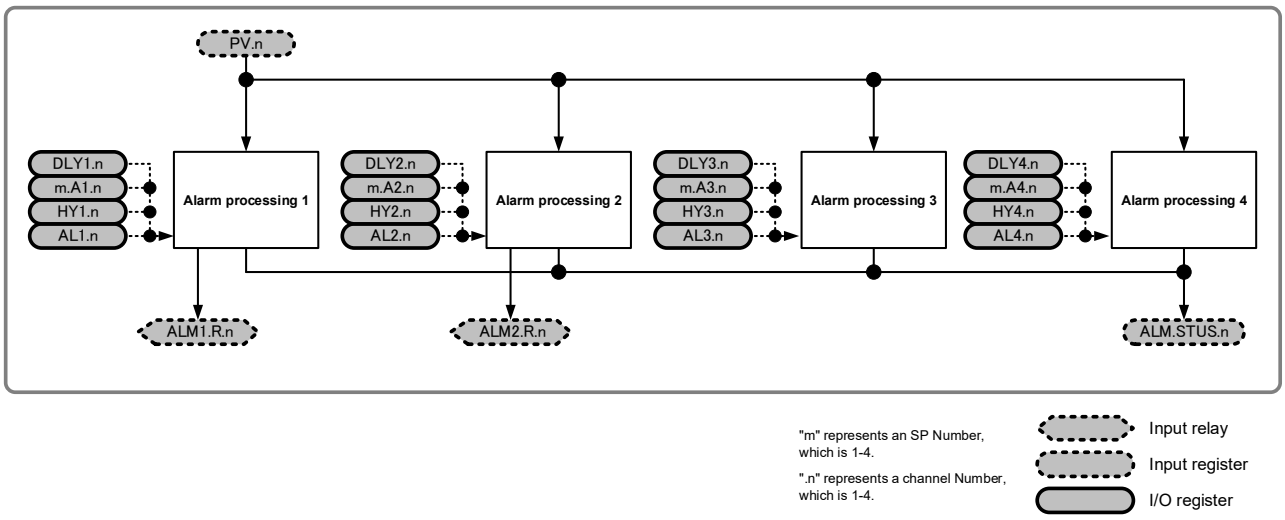


Figure C3.1 Block Diagram of Alarm Functions

Note

Alarms 3 and 4 have no associated input relay. Their statuses are indicated by the corresponding bits of ALM.STUS.

Table C3.1 Alarm Parameters

Data Position Number				Symbol	Description	Unit	Data Range	Default Value	Attribute	Stored
CH1	CH2	CH3	CH4							
102	302	502	702	PV	Process value	Industrial unit	From -5.0% to 105.0% of (PRH - PRL)	–	RO	–
107	307	507	707	CSPNO	Current SP number	None	1 to 4	–	RO	–
109	309	509	709	ALM.STUS	Alarm status	None	Each bit represents an alarm condition, and may be ON or OFF.	–	RO	–
128	328	528	728	SPNO	SP No. selection	None	1 to 4	1	RW	–
202	402	602	802	1.A1	Alarm 1 preset value	Industrial unit	-30000 to 30000	PRH	RW	✓
203	403	603	803	1.A2	Alarm 2 preset value			PRL	RW	✓
204	404	604	804	1.A3	Alarm 3 preset value			PRH	RW	✓
205	405	605	805	1.A4	Alarm 4 preset value			PRL	RW	✓
222	422	622	822	2.A1	Alarm 1 preset value	Industrial unit	-30000 to 30000	PRH	RW	✓
223	423	623	823	2.A2	Alarm 2 preset value			PRL	RW	✓
224	424	624	824	2.A3	Alarm 3 preset value			PRH	RW	✓
225	425	625	825	2.A4	Alarm 4 preset value			PRL	RW	✓
242	442	642	842	3.A1	Alarm 1 preset value	Industrial unit	-30000 to 30000	PRH	RW	✓
243	443	643	843	3.A2	Alarm 2 preset value			PRL	RW	✓
244	444	644	844	3.A3	Alarm 3 preset value			PRH	RW	✓
245	445	645	845	3.A4	Alarm 4 preset value			PRL	RW	✓
262	462	662	862	4.A1	Alarm 1 preset value	Industrial unit	-30000 to 30000	PRH	RW	✓
263	463	663	863	4.A2	Alarm 2 preset value			PRL	RW	✓
264	464	664	864	4.A3	Alarm 3 preset value			PRH	RW	✓
265	465	665	865	4.A4	Alarm 4 preset value			PRL	RW	✓
281	481	681	881	AL1	Alarm 1 type	None	0: OFF 1: Upper limit 2: Lower limit 11: Upper limit with waiting 12: Lower limit with waiting	1	RW	✓
282	482	682	882	AL2	Alarm 2 type			2	RW	✓
283	483	683	883	AL3	Alarm 3 type			1	RW	✓
284	484	684	884	AL4	Alarm 4 type			2	RW	✓
285	485	685	885	HY1	Alarm 1 hysteresis	Industrial unit	0 to (PRH-PRL)	(PRH-PRL) ×0.5%	RW	✓
286	486	686	886	HY2	Alarm 2 hysteresis				RW	✓
287	487	687	887	HY3	Alarm 3 hysteresis				RW	✓
288	488	688	888	HY4	Alarm 4 hysteresis				RW	✓
289	489	689	889	DLY1	Alarm 1 ON delay time	Seconds	0 to 999	0	RW	✓
290	490	690	890	DLY2	Alarm 2 ON delay time				RW	✓
291	491	691	891	DLY3	Alarm 3 ON delay time				RW	✓
292	492	692	892	DLY4	Alarm 4 ON delay time				RW	✓

Table C3.2 Alarm Input Relays

Input relay Number X□□□nn*1				Symbol	Description	Data Range	Interrupt
CH1	CH2	CH3	CH4				
X01	X09	X17	X25	ALM1.R	Alarm 1	0: Normal 1: Alarm 1	✓
X02	X10	X18	X26	ALM2.R	Alarm 2	0: Normal 1: Alarm 2	✓

*1: □□□ represents a slot number

Note

Alarms 3 and 4 have no associated input relay. Their statuses are indicated by the corresponding bits of ALM.STUS.

C3.1 Alarm Types

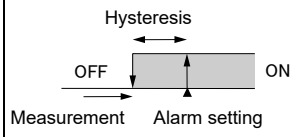
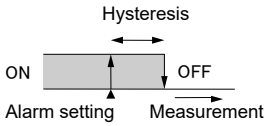
Table C3.3 lists the alarm types. For details on their operations, see Table C3.4.

Table C3.3 List of Alarm Types

Alarm Types	Description	Alarm Types	Description
0	No alarm		
1	Upper limit without waiting	11	Upper limit with waiting
2	Lower limit without waiting	12	Lower limit with waiting

Table C3.4 describes the alarm functions. Alarm types 1 and 2 are without waiting, and alarm types 11 and 12 are with waiting. For details on the wait function, see Section C3.2, "Wait Function."

Table C3.4 Alarm Functions

Alarm Functions	Operation ON/OFF represents an alarm condition.	Alarm Type
No alarm		0
Upper limit		1 11
Lower limit		2 12

Note

The ALM LED on the front panel of the module lights up if any alarm (1-4) is generated in any channel (1-4).

■ Alarm Status

Table C3.5 Alarm Status

ALM.STUS																Bit pos.	Symbol	Descriptions
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	0	ALM1	Alarm 1 generated
																1	ALM2	Alarm 2 generated
																2	ALM3	Alarm 3 generated
																3	ALM4	Alarm 4 generated
																4	ALMW1	Alarm 1 waiting
																5	ALMW2	Alarm 2 waiting
																6	ALMW3	Alarm 3 waiting
																7	ALMW4	Alarm 4 waiting
																8	—	
																9	—	
																10	—	
																11	—	
																12	—	
																13	—	
																14	—	
																15	—	

The data position number of ALM.STUS is 109 for CH1, 309 for CH2, 509 for CH3, or 709 for CH4.

C3.2 Wait Function

When the wait function is specified, the alarm function is temporarily disabled (enters wait state) for a specified period after the following events:

- Power up
- Change in SP number (SPNO)

Figure C3.2 below shows an example of the alarm function when the alarm type is set to Lower Limit with Waiting.

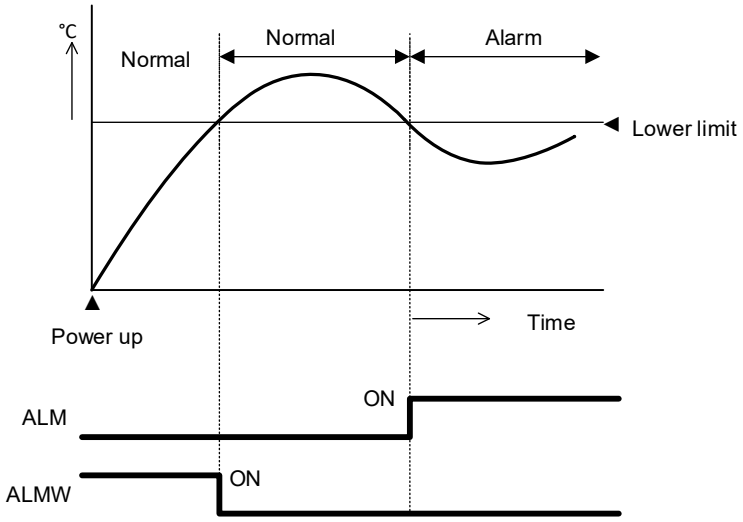


Figure C3.2 Operation of the Wait Function

Note

After an alarm condition is detected, the module again enters wait state if one of the following event occurs:
- Power up
- Change in SP number (SPNO)
- Change in alarm type

C3.3 Alarm Delay Timer

The alarm delay timer function delays the generation of an alarm. The alarm turns on only if the alarm condition persists until a delay timer has timed out.

If an alarm condition disappears before a delay timer has timed out, the timer resets. Changing an alarm type or powering down also resets the delay timer.

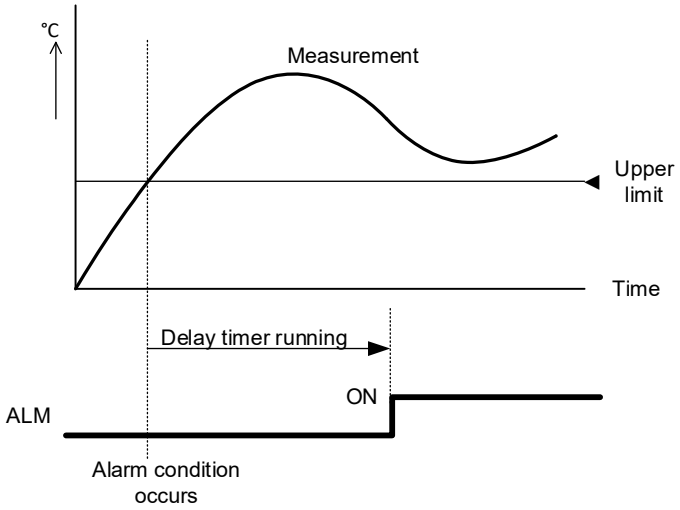


Figure C3.3 Alarm Delay Timer

C3.4 Selecting Alarm Preset Values

There is a set of four alarm preset values A1 to A4, which can be selected by setting the SP Number (SPNO) parameter. Changing the SP Number changes all the alarm preset values at the same time.

Table C3.6 Selection of Alarm Preset Values

SP number (SPNO)	Available Alarm Preset Values
1	1.A1, 1.A2, 1.A3, 1.A4
2	2.A1, 2.A2, 2.A3, 2.A4
3	3.A1, 3.A2, 3.A3, 3.A4
4	4.A1, 4.A2, 4.A3, 4.A4

Note

- Alarm preset value selection does not affect alarm type, alarm hysteresis, or alarm delay timer.
- Alarm preset values A1 to A4 cannot be changed individually.

C4. Disable Backup Function

The Disable Backup Function (NBKUP) parameter can be used to suspend storing of parameters to the Non-volatile memory. Use this function to protect the Non-volatile memory, if parameters are updated frequently.

The module has two types of parameters: stored and non-stored. Stored parameters preserve their data even when the module is powered down. For details on whether a parameter is stored or non-stored, see the individual parameter table or the list of registers.

The default value of the Disable Backup Function (NBKUP) parameter is “0: Enable backup”. With NBKUP=0, if a stored parameter is changed, its data is written to the Non-volatile memory and thus, preserved even if power supply is turned off.

The number of writes to the Non-volatile memory is limited to 10 million (100,000 times before REV:01:00), be careful not to exceed the limit. Once the limit is reached, further writing is not allowed and a hardware failure occurs.

If the Disable Backup Function (NBKUP) parameter is set to “1: Disable backup”, changes to stored parameters are not written to the Non-volatile memory. Thus, when the module is turned off and turned on again, the parameters contain the previous stored values.

Note

Do not attempt to change the value of the Disable Backup Function (NBKUP) parameter from “1: Disable backup” to “0: Enable backup” by writing to the parameter.

To reactivate the backup function, simply switch off and then switch on the module. Since the NBKUP parameter is not a stored parameter, its value will reset to “0: Enable backup” after powering up.

Note

If you update some parameters after changing the NBKUP parameter to “0: Enable backup”, and then switch off and switch on the module, you may find that not all parameter values are what you expect. This is because the module stores parameters only when they are changed.

Table C4.1 Disable Backup Function Parameter

Data Position Number	Symbol	Description	Unit	Data Range	Default Value	Attribute	Stored
75	NBKUP	Disable Backup Function	None	0: Enable backup 1: Disable backup	0	RW	–

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C5. Self-diagnosis Function

This chapter describes how to identify and rectify problems that may occur at start up or during normal operation.

C5.1 How to Check for Errors

When an error occurs, the ERR LED lights up, and the Operating Status (RUN.STUS) and Error Status (ERR.STUS) registers indicate details of the error. For details on how to identify and handle errors, see PART-D, “Troubleshooting”.

C5.2 List of Error Statuses

When an error occurs, the Operating Status (RUN.STUS) and Error Status (ERR.STUS) registers provide error information by turning on relevant bits.

Table C5.1 Error-related Parameters

Data Position Number				Symbol	Description	Unit	Data Range	Default Value	Attribute	Stored
CH1	CH2	CH3	CH4							
41	42	43	44	RUN.STUS	Operating status	None	On/off for individual bits. For details, see Table C5.2.	—	RO	—
108	308	508	708					—	RO	—
								—	RO	—
								—	RO	—
51	52	53	54	ERR.STUS	Error status	None	On/off for individual bits. For details, see Table C5.3.	—	RO	—
110	310	510	710					—	RO	—
								—	RO	—
								—	RO	—

Table C5.2 Operating Status

RUN.STUS

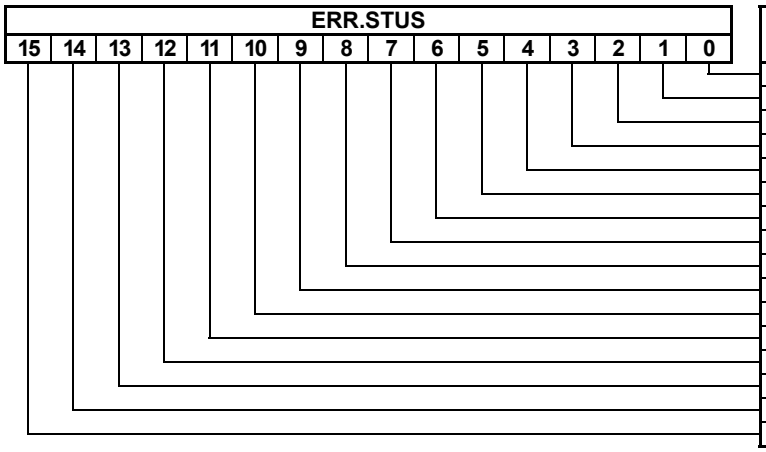
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

Bit Pos.	Symbol	Description
0	—	
1	—	
2	—	
3	—	
4	EXPV/PV	0: Normal, 1: External
5	—	
6	—	
7	—	
8	B.OUT	PVIN burnout
9	+OVER	PVIN + OVER
10	-OVER	PVIN – OVER
11	B.OUT	PV burnout
12	+OVER	PV + OVER
13	-OVER	PV – OVER
14	—	
15	FUNC.ERR	Error detected

PVIN + OVER occurs when input exceeds 105% of the input range, and PVIN - OVER occurs when input is below -5% of the input range. PV + OVER and PV - OVER are equivalent to PVIN + OVER and PVIN - OVER in Single-input mode. In Two-input Changeover mode, PV + OVER occurs when input exceeds 105% of the PV input range of the even channel, and PV - OVER occurs when input is below -5% of the PV input range of the even channel. For details on PVIN burnout and PV burnout, see Section C2.5, "Burnout Detection."

When the FUNC.ERR bit of the RUN.STUS parameter is set, detailed error information is provided in the ERR.STUS parameter.

Table C5.3 Error Status



Bit Pos.	Usage
0	
1	System data error
2	Calibration value error
3	Monitoring/input parameter error
4	Operation parameter error
5	AD converter error
6	RJC error
7	Non-volatile memory error
8	Memory error
9	
10	
11	
12	
13	
14	
15	

Note

- If the first reference junction compensation from the bottom of the terminal block fails, Loop1's RJC error bit is turned on, Loop1-2's reference junction compensation temperature becomes abnormal, and there is an error in the measurement result of Loop1-2 thermocouple.
- If the second reference junction compensation from the bottom of the terminal block fails, Loop2's RJC error bit is turned on, Loop1-4's reference junction compensation temperature becomes abnormal, and there is an error in the measurement result of Loop1-4 thermocouple.
- If the third reference junction compensation from the bottom of the terminal block fails, Loop4's RJC error bit is turned on, Loop3-4's reference junction compensation temperature becomes abnormal, and there is an error in the measurement result of Loop3-4 thermocouple.
- Loop3's RJC error bit does not turn on.
- The reference junction temperature ranges from -10°C to 85°C.If the reference junction compensation temperature becomes abnormal, the value will be within this range.

■ Troubleshooting Errors at Power Up

The following table lists the errors that may be returned by the self-diagnosis procedure at powering up.

Table C5.4 Startup Errors

ERR.STUS (bit position)	ERR LED	Error Condition	Monitor Operation	Measurement	Troubleshooting	Status
Undefined	Off	RAM error	Stops operating.	Unreliable	Hardware failure. Replace the module.	Hardware failure
Undefined	Off	ROM error				
1	Lit	System data error				
2	Lit	Calibration value error	Initializes calibration value and resumes normal operation.	Normal operation (accuracy not guaranteed)		
3	Flashing	Monitoring or input parameter value error	Automatically initializes monitoring or input parameter and resumes normal operation.	Normal operation	Parameters have been initialized. Check and set the parameters again, as required.	
4	Flashing	Operation parameter value error	Automatically initializes operation parameter and resumes normal operation.			

■ Troubleshooting Operation Errors

The tables below list the errors that may be detected during operation.

Table C5.5 Operation Errors (1/2)

ERR.STUS (bit position)	ERR LED	Error Condition	Monitor Operation	Measurement	Troubleshooting	Status
5	Lit	AD converter error	Normal operation	105%	Input type setting	Incorrect wiring
					Replace the module.	Hardware failure
6	Lit	RJC error	The reference contact compensation temperature includes errors, but the operation continues.	The thermocouple measurement value includes reference junction compensation error.	- Check the terminal block connection. *2 - Replace the module.	Terminal block not connected ,Hardware failure
7	Lit	Non-volatile memory error	Normal operation continues using only the RAM until the module is switched off.	Normal operation	Replace the module.	Hardware failure
8	Lit	Memory error *1	Normal operation	Normal operation	Restarting	ECC error

*1: ECC error. ERR is detected, but the module continues to operate. However, as an abnormality has occurred in the internal memory, normal operation cannot be guaranteed. You can usually handle such situations by restarting the FA-M3.

*2: If the 40-pin spring terminal block is not connected, this error will occur.
If the 40-pin spring terminal block is connected, failure of the reference contact compensation element (RJC) is suspected. Consider replacing the 40-pin spring terminal block (part number: T9113PL). If the problem persists even after replacing the 40-pole spring terminal block, the module may be defective.

Table C5.5 Operation Errors (2/2)

ERR.STUS (bit position)	ERR LED	Error Condition	Monitor Operation	Measurement	Troubleshooting	Status
11	Flashing	PV burnout	Depends on BSL burnout selection.	Depends on BSL burnout selection.	Check the sensor and sensor circuit.	Process error
12/13	Off	PV ± OVER	PV = 105% or -5%	Limit values	Check the process.	
Undefined	Undefined	Out of control (due to abnormal power supply or noise)	CPU resets.	Undefined	If switching off and on does not restore normal operation, replace the module.	Hard ware failure

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PART-D Troubleshooting

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PART-D describes how to troubleshoot problems related to the module.

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D1. Before Performing Checks

If you encounter the specific problems, follow the troubleshooting steps given below for a specific problem and correct any inappropriate connection or setup. For details on the errors that are detected by the self-diagnosis function and how to recover from a detected error, see Section C5, "Self-diagnosis Function." For details on register and relay positions, see PART-E, "Relays and Registers."

The temperature monitoring module stores many preset values internally. Sometimes, temporary preset values are written for testing purposes, such as during trial runs and program debugging, and are left uncorrected. They are stored in the module, even after powering off. Such unintentional preset values may result in unexpected operations subsequently. If replacing a module solves a problem, it is highly likely that the replaced module has some invalid preset values. In this case, we recommended that you check all preset values. Alternatively, initialize all preset values to their default (factory setting) and then change individual preset values as required, and check for correct operation. For details on how to initialize all preset values, see Section B2.4, "Initializing All Preset Values."

Note

For efficient setup and monitoring of the module, we recommend that you use “FA-M3 Toolbox for Temperature Control and Monitoring Modules” and the Advanced Function Module Register Monitor of “FA-M3 Programming Tool WideField3”.

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D2. Troubleshooting a Specific Problem

This section describes what you should do if you observe the following phenomena:

(1) Input does not change, or fluctuates excessively.

(2) The ALM or ERR LED indicator is lit or flashing.

(1) Input does not change, or fluctuates excessively

If input does not change, or fluctuates excessively, there may be a problem with sensor connection, module usage, or register preset values. Follow the steps below to locate the cause.

- Confirm that the sensor is securely and correctly connected.
- Confirm that the registers are correctly set. See the table below.

Data Position Number				Symbol	Content	Check Items	See Also
CH1	CH2	CH3	CH4				
71				SETUP	Setup	Is SETUP set to 1? It must be set to 0.	B2.3
81				FREQ	Power supply frequency selection	Is FREQ correctly set to match the frequency of the power supply used? It must be correctly set.	B3.1.1
82				SMP	Input sampling period	Is the channel whose input does not change available for use? If the input sampling period set to “0: 100ms”, channels 3 and 4 cannot be used.	B3.1.2
83				MD12	Monitoring mode	Is the channel whose input does not change available for use? If the channel set to “disabled”, enable it.	B3.1.3
		84		MD34			
142	342	542	742	IN	Input type selection	Is the input type appropriate for the sensor type used? Set the input type to match the sensor used.	B3.2.1
170	370	570	770	AVG	Moving average input filter	Is excessive noise interfering with the input? Set FL to an appropriate value.	C2.10
172	372	572	772	FL	First-order lag input filter		

(2) The ALM or ERR LED indicator is lit or flashing

If the ALM or ERR LED indicator is lit or flashing, an alarm or error has been detected. An input circuit may be incorrectly connected, or the self-diagnosis function may have detected an internal error. Follow the steps below to locate the cause.

- All channels with no sensor connected should be set to Disabled mode.
- For a channel set for DC voltage input, no signal connection must be made to the NC terminals, as shown in Section A4.3.3, "Terminal Wiring Diagram."
- Check that register preset values are appropriate. See the table below.

Data Position Number				Symbol	Content	Check Items	See Also
CH1	CH2	CH3	CH4				
83				MD12	Monitoring mode	All channels with no sensor connected must be set to Disabled mode.	C1.
		84		MD34			
102	302	502	702	PV	Process value	Are values proper?	C2.
107	307	507	708	CSPNO	Current SP number	Is CSPNO correctly set? Are alarm settings correct?	C3.
108	308	508	708	RUN.STUS	Operating status	Is bit 15 set? If so, check ERR.STUS.	C5.
109	309	509	709	ALM.STUS	Alarm status	Is any of bits 0-3 set? If so, check the corresponding alarm type, alarm setting, and alarm hysteresis.	C3.
110	310	510	710	ERR.STUS	Error status	Is any bit set? If so, check the indicated cause.	C5.
202	402	602	802	1.A1	Alarm 1 preset value	If an alarm is detected, check each setting.	C3.
203	403	603	803	1.A2	Alarm 2 preset value		
204	404	604	804	1.A3	Alarm 3 preset value		
205	405	605	805	1.A4	Alarm 4 preset value		
222	422	622	822	2.A1	Alarm 1 preset value		
223	423	623	823	2.A2	Alarm 2 preset value		
224	424	624	824	2.A3	Alarm 3 preset value		
225	425	625	825	2.A4	Alarm 4 preset value		
242	442	642	842	3.A1	Alarm 1 preset value		
243	443	643	843	3.A2	Alarm 2 preset value		
244	444	644	844	3.A3	Alarm 3 preset value		
245	445	645	845	3.A4	Alarm 4 preset value		
262	462	662	862	4.A1	Alarm 1 preset value		
263	463	663	863	4.A2	Alarm 2 preset value		
264	464	664	864	4.A3	Alarm 3 preset value		
265	465	665	865	4.A4	Alarm 4 preset value		
281	481	681	861	AL1	Alarm 1 type		
282	482	682	862	AL2	Alarm 2 type		
283	483	683	863	AL3	Alarm 3 type		
284	484	684	884	AL4	Alarm 4 type		
285	485	685	885	HY1	Alarm 1 hysterisis		
286	486	686	886	HY2	Alarm 2 hysterisis		
287	487	687	887	HY3	Alarm 3 hysterisis		
288	488	688	888	HY4	Alarm 4 hysterisis		

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PART-E Relays and Registers

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PART-E lists all the relays and registers used by the module.

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E1. List of Registers

Table E1.1 Common Process Data (1/2)

Data Position Number				Symbol	Description	Attribute	Stored	See Also
CH1	CH2	CH3	CH4					
1				PV.1	Process values for channels 1 to 4	RO	—	C2.
2				PV.2		RO	—	
3				PV.3		RO	—	
4				PV.4		RO	—	
5					Not used			
6								
7								
8								
9								
10								
11								
12								
13								
14								
15								
16								
17								
18								
19								
20								
21								
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26								
27								
28								
29								
30								
31								
32								
33								
34								
35								
36								
37								
38								
39								
40								
41				RUN.STUS.1	Operating status for channels 1 to 4	RO	—	B2.2.6
42				RUN.STUS.2		RO	—	
43				RUN.STUS.3		RO	—	
44				RUN.STUS.4		RO	—	
45					Not used			
46								
47								
48								
49								
50								

Table E1.1 Common Process Data (2/2)

Data Position Number				Symbol	Description	Attribute	Stored	See Also
CH1	CH2	CH3	CH4					
51				ERR.STUS.1	Error status for channels 1-4	RO	—	C5.
52				ERR.STUS.2		RO	—	
53				ERR.STUS.3		RO	—	
54				ERR.STUS.4		RO	—	
55					Not used			
56								
57								
58								
59								
60								
61								
62								
63								
64								
65								
66								
67								
68								
69								
70								

Table E1.2 Setup Control Parameters and Function Control Parameters

Data Position Number				Symbol	Description	Attribute	Stored	See Also
CH1	CH2	CH3	CH4					
71				SETUP	Setup	RW	—	B2.3
72				OPE	Setup instruction operand	RW	—	
73				STUS	Setup instruction response	RO	—	
74					Not used			
75				NBKUP	Disable backup function	RW	—	C4.
76					Not used			
77				EEP.CNTR	Non-volatile memory Write Counter	RO	—	B2.2.4
78								
79					Not used			
80								

Table E1.3 Monitoring Parameters

Data Position Number				Symbol	Description	Attribute	Stored	See Also
CH1	CH2	CH3	CH4					
81				FREQ	Power supply frequency selection	RW	✓	C2.2
82				SMP	Input sampling period	RW	✓	B3.1.2
83				MD12	Monitoring mode	RW	✓	C1.
84				MD34		RW	✓	
85					Not used			
86								
87								
88								
89								
90				REV	Firmware revision	RO	–	–
91								
92								
93								
94								
95								
96								
97								
98								
99								
100								

Table E1.4 Process Data

Data Position Number				Symbol	Description	Attribute	Stored	See Also
CH1	CH2	CH3	CH4					
101	301	501	701	PVIN	Input process value	RO	—	C2.
102	302	502	702	PV	Process value	RO	—	
103	303	503	703		Not used			
104	304	504	704					
105	305	505	705					
106	306	506	706					
107	307	507	707	CSPNO	Current SP number	RO	—	C3.
108	308	508	708	RUN.STUS	Operating status	RO	—	C10.
109	309	509	709	ALM.STUS	Alarm status	RO	—	C3.
110	310	510	710	ERR.STUS	Error status	RO	—	C10.
111	311	511	711		Not used			
112	312	512	712					
113	313	513	713					
114	314	514	714					
115	315	515	715					
116	316	516	716					
117	317	517	717					
118	318	518	718					
119	319	519	719					
120	320	520	720					

Table E1.5 Operation Control Parameters

Data Position Number				Symbol	Description	Attribute	Stored	See Also
CH1	CH2	CH3	CH4					
121	321	521	721		Not used			
122	322	522	722					
123	323	523	723	INSEL	Input selection	RW	—	C2.11
124	324	524	724		Not used			
125	325	525	725	EXPV/PV	External input/normal input	RW	—	C2.12
126	326	526	726		Not used			
127	327	527	727					
128	328	528	728	SPNO	SP Number selection	RW	—	C3
129	329	529	729		Not used			
130	330	530	730					
131	331	531	731	EXPV	External input	RW	—	C2.12
132	332	532	732	EXRJC	Reference junction temperature (valid when reference junction compensation is disabled)	RW	—	C2.6
133	333	533	733		Not used			
134	334	534	734					
135	335	535	735					
136	336	536	736					
137	337	537	737					
138	338	538	738					
139	339	539	739					
140	340	540	740					

Table E1.6 Input Parameters

Data Position Number				Symbol	Description	Attribute	Stored	See Also
CH1	CH2	CH3	CH4					
141	341	541	741		Not used			
142	342	542	742	IN	Input type selection When the hardware switch is disabled, this parameter selects the input type for each channel. When the hardware switch is enabled, the switch setting selects a common input type for all channels.	RW	✓	C2.1
143	343	543	743	RH	Input range upper limit	RW	✓	C2.3
144	344	544	744	RL	Input range lower limit			
145	345	545	745	DEC.P	Decimal point position	RO	✓	
146	346	546	746	SH	Scaling upper limit	RW	✓	C2.3
147	347	547	747	SL	Scaling lower limit	RW	✓	
148	348	548	748	SDP	Scaling decimal point position	RW	✓	
149	349	549	749	RJC	Reference junction compensation	RW	✓	C2.6
150	350	550	750	BSL	Burnout selection	RW	✓	C2.5
151	351	551	751	PRH	PV range upper limit	RW	✓	C2.4
152	352	552	752	PRL	PV range lower limit	RW	✓	
153	353	553	753	PDP	PV range decimal point position	RW	✓	
154	354	554	754		Not used			
155	355	555	755					
156	356	556	756					
157	357	557	757					
158	358	558	758					
159	359	559	759					
160	360	560	760					

Table E1.7 Operation Parameters (1/3)

Data Position Number				Symbol	Description	Attribute	Stored	See Also
CH1	CH2	CH3	CH4					
161	361	561	761	SELMD	Two-input changeover mode	RW	✓	C2.11
162	362	562	762	SELH	Two-input changeover upper limit	RW	✓	
163	363	563	763	SELL	Two-input changeover lower limit	RW	✓	
170	370	570	770	AVG	Moving average input filter	RW	✓	C2.10
171	371	571	771	BS	Input correction (biasing)	RW	✓	C2.8
172	372	572	772	FL	First-order lag Input filter	RW	✓	C2.10
173	373	573	773	X1	Broken-line input 1	RW	✓	C2.7
174	374	574	774	Y1	Broken-line bias 1	RW	✓	
175	375	575	775	X2	Broken-line input 2	RW	✓	
176	376	576	776	Y2	Broken-line bias 2	RW	✓	
177	377	577	777	X3	Broken-line input 3	RW	✓	
178	378	578	778	Y3	Broken-line bias 3	RW	✓	
179	379	579	779	SR	Square root extraction	RW	✓	C2.9
180	380	580	780	LC	Low cut	RW	✓	
181	381	581	781		Not used			
182	382	582	782					
183	383	583	783					
184	384	584	784					
185	385	585	785					
186	386	586	786					
187	387	587	787					
188	388	588	788					
189	389	589	789					
190	390	590	790					
191	391	591	791					
192	392	592	792					
193	393	593	793					
194	394	594	794					
195	395	595	795					
196	396	596	796					
197	397	597	797					
198	398	598	798					
199	399	599	799					
200	400	600	800					

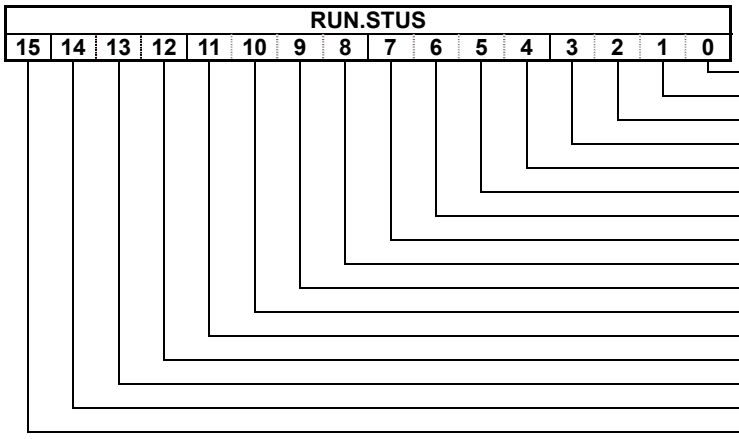
Table E1.7 Operation Parameters (2/3)

Data Position Number				Symbol	Description	Attribute	Stored	See Also
CH1	CH2	CH3	CH4					
201	401	601	801					
202	402	602	802	1.A1	Alarm 1 preset value	RW	✓	C3.
203	403	603	803	1.A2	Alarm 2 preset value	RW	✓	
204	404	604	804	1.A3	Alarm 3 preset value	RW	✓	
205	405	605	805	1.A4	Alarm 4 preset value	RW	✓	
206	406	606	806		Not used			
207	407	607	807					
208	408	608	808					
209	409	609	809					
210	410	610	810					
211	411	611	811					
212	412	612	812					
213	413	613	813					
214	414	614	814					
215	415	615	815					
216	416	616	816					
217	417	617	817					
218	418	618	818					
219	419	619	819					
220	420	620	820					
221	421	621	821					
222	422	622	822	2.A1	Alarm 1 preset value	RW	✓	C3.
223	423	623	823	2.A2	Alarm 2 preset value	RW	✓	
224	424	624	824	2.A3	Alarm 3 preset value	RW	✓	
225	425	625	825	2.A4	Alarm 4 preset value	RW	✓	
226	426	626	826		Not used			
227	427	627	827					
228	428	628	828					
229	429	629	829					
230	430	630	830					
231	431	631	831					
232	432	632	832					
233	433	633	833					
234	434	634	834					
235	435	635	835					
236	436	636	836					
237	437	637	837					
238	438	638	838					
239	439	639	839					
240	440	640	840					

Table E1.7 Operation Parameters (3/3)

Data Position Number				Symbol	Description	Attribute	Stored	See Also
CH1	CH2	CH3	CH4					
241	441	641	841					
242	442	642	842	3.A1	Alarm 1 preset value	RW	✓	C3.
243	443	643	843	3.A2	Alarm 2 preset value	RW	✓	
244	444	644	844	3.A3	Alarm 3 preset value	RW	✓	
245	445	645	845	3.A4	Alarm 4 preset value	RW	✓	
246	446	646	846		Not used			
247	447	647	847					
248	448	648	848					
249	449	649	849					
250	450	650	850					
251	451	651	851					
252	452	652	852					
253	453	653	853					
254	454	654	854					
255	455	655	855					
256	456	656	856					
257	457	657	857					
258	458	658	858					
259	459	659	859					
260	460	660	860					
261	461	661	861					
262	462	662	862	4.A1	Alarm 1 preset value	RW	✓	C3.
263	463	663	863	4.A2	Alarm 2 preset value	RW	✓	
264	464	664	864	4.A3	Alarm 3 preset value	RW	✓	
265	465	665	865	4.A4	Alarm 4 preset value	RW	✓	
266	466	666	866		Not used			
267	467	667	867					
268	468	668	868					
269	469	669	869					
270	470	670	870					
271	471	671	871					
272	472	672	872					
273	473	673	873					
274	474	674	874					
275	475	675	875					
276	476	676	876					
277	477	677	877					
278	478	678	878					
279	479	679	879					
280	480	680	880					
281	481	681	881	AL1	Alarm 1 type	RW	✓	C3.
282	482	682	882	AL2	Alarm 2 type	RW	✓	
283	483	683	883	AL3	Alarm 3 type	RW	✓	
284	484	684	884	AL4	Alarm 4 type	RW	✓	
285	485	685	885	HY1	Alarm 1 hysteresis	RW	✓	C3.
286	486	686	886	HY2	Alarm 2 hysteresis	RW	✓	
287	487	687	887	HY3	Alarm 3 hysteresis	RW	✓	
288	488	688	888	HY4	Alarm 4 hysteresis	RW	✓	
289	489	689	889	DLY1	Alarm 1 ON delay time	RW	✓	C3.3
290	490	690	890	DLY2	Alarm 2 ON delay time	RW	✓	
291	491	691	891	DLY3	Alarm 3 ON delay time	RW	✓	
292	492	692	892	DLY4	Alarm 4 ON delay time	RW	✓	
293	493	693	893		Not used			
294	494	694	894					
295	495	695	895					
296	496	696	896					
297	497	697	897					
298	498	698	898					
299	499	699	899					
300	500	700	900					

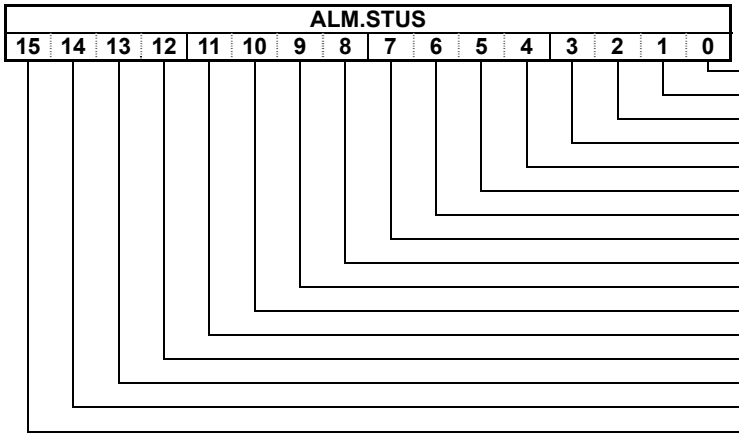
Table E1.8 Operating Status



Bit Pos.	Symbol	Description
0	—	
1	—	
2	—	
3	—	
4	EXPV/PV	0: Normal, 1: External
5	—	
6	—	
7	—	
8	B.OUT	PVIN burnout
9	+OVER	PVIN +OVER
10	-OVER	PVIN -OVER
11	B.OUT	PV burnout
12	+OVER	PV +OVER
13	-OVER	PV -OVER
14	—	
15	FUNC.ERR	Error detected

The data position number of RUN.STUS is 41 or 108 for CH1, 42 or 308 for CH2, 43 or 508 for CH3, or 44 or 708 for CH4.

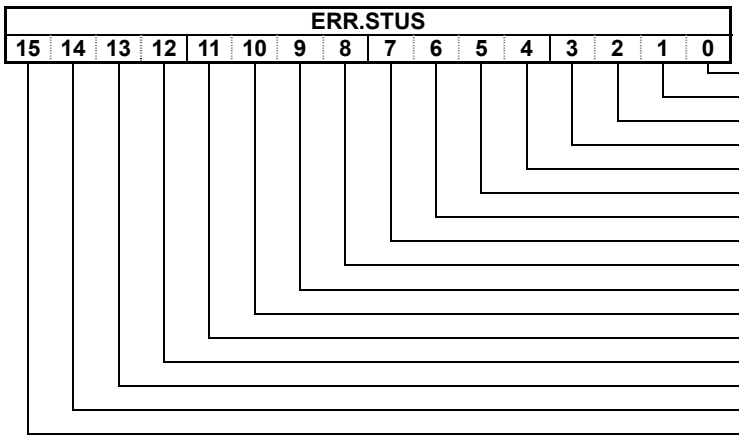
Table E1.9 Alarm Status



Bit Pos.	Symbol	Description
0	ALM1	Alarm 1 generated
1	ALM2	Alarm 2 generated
2	ALM3	Alarm 3 generated
3	ALM4	Alarm 4 generated
4	ALMW1	Alarm 1 waiting.
5	ALMW2	Alarm 2 waiting.
6	ALMW3	Alarm 3 waiting.
7	ALMW4	Alarm 4 waiting.
8	—	
9	—	
10	—	
11	—	
12	—	
13	—	
14	—	
15	—	

The data position number of ALM.STUS is 109 for CH1, 309 for CH2, 509 for CH3, or 709 for CH4.

Table E1.10 Error Status



Bit Pos.	Description
0	—
1	System data error
2	Calibration value error
3	Monitoring/input parameter error
4	Operation parameter error
5	AD converter error
6	RJC error
7	Non-volatile memory error
8	Memory error
9	—
10	—
11	—
12	—
13	—
14	—
15	—

The data position number of ERR.STUS is 51 or 110 for CH1, 52 or 310 for CH2, 53 or 510 for CH3, or 54 or 710 for CH4.

■ Common Precautions for Registers

CAUTION

The Non-volatile memory can be rewritten up to 10 million times (100,000 times before REV:01:00). In situations where the CPU module frequently overwrites the I/O data registers earmarked to be stored by the backup function, the maximum limit for write operations may be reached. To prevent this, turn on the Disable Backup Function parameter. Once the write limit is reached, data backup is no longer allowed and the system enters hardware failure mode. Furthermore, parameter data may be reset at system startup to the default values given in Section B2, "Types of Relays and Registers."

Note

In Tables E1.1 to E1.7, only data registers with specified symbol and description are valid data registers provided with this module. Data registers displayed with gray background or labeled as "not used" in the “Description” column are invalid.

Any data written to an invalid register is ignored, in so far as it has no effect on module operation. If the register is read after the write operation, however, the written value or a register-specific value may be returned. The register-specific value may or may not be a fixed value.

Note

The “Attribute” column in a table indicates whether a register can be read and written. “RO” indicates a read-only register, whilst “RW” indicates a register that can be read, as well as written.

Parameters with "Stored" marked with "-" are not backed up. At power-on or reset start, the value shown in "Default value" is entered.

Parameters with "Stored" marked with "✓" will be backed up to the non-volatile memory but will not be written to the non-volatile memory when the backup function is stopped. The "Default value" of the parameter is the value set at the time of shipment from the factory or at the time of initialization. If the parameter is rewritten while the backup function is enabled, it will be written to the non-volatile memory. At power-on or reset start, the parameter is the value stored in the non-volatile memory.

When the setting of the input type selector switch or the operation parameter is changed, the corresponding and related parameters enter the value shown in "Default value".

E2. List of Relays

Table E2.1 List of Relays

Input Relay Number X□□□nn *1				Symbol	Description	Interrupt	See Also
CH1	CH2	CH3	CH4				
X01	X09	X17	X25	ALM1.R	Alarm 1	✓	C3.
X02	X10	X18	X26	ALM2.R	Alarm 2	✓	
X07	X15	X23	X31	FUNC.ERR	Burnout or error detected *2	✓	C2.5 C5.
X08				CMDRDY	Command processing completed	✓	B2.3
X16				MDLRDY	Module startup completed	✓	B1.3
X24				SETUP.R	Setup mode	✓	B2.3

*1: □□□ denotes the slot number where the module is installed.
*2: Denotes that self-diagnostics has detected a burnout, A/D converter error or other errors, which prohibits normal operation.

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Temperature Monitoring Module

IM 34M06H63-02E 3rd Edition

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