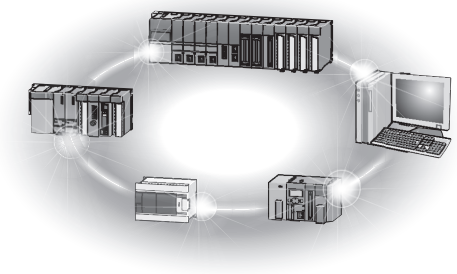
MITSUBISHI ELECTRIC

Mitsubishi Programmable Controller

AJ65BT-68TD Thermocouple Temperature Input Module User's Manual



● SAFETY PRECAUTIONS ●

(Read these precautions before using this product.)

Before using this product, please read this manual and the relevant manuals carefully and pay full attention to safety to handle the product correctly.

These precautions apply only to Mitsubishi equipment. Refer to the CPU module user's manual for a description of the programmable controller system safety precautions.

In this manual, the safety precautions are classified into two levels: "⚠WARNING" and "⚠CAUTION".

⚠WARNING	Indicates that incorrect handling may cause hazardous conditions, resulting in death or severe injury.
⚠CAUTION	Indicates that incorrect handling may cause hazardous conditions, resulting in minor or moderate injury or property damage.

Under some circumstances, failure to observe the precautions given under "⚠CAUTION" may lead to serious consequences.

Observe the precautions of both levels because they are important for personal and system safety.

Make sure that the end users read this manual and then keep the manual in a safe place for future reference.

[Design Precautions]

⚠WARNING

- In the case of a communication failure in the network, data in the master module are held.
  Check the communication status information (SB, SW) and configure an interlock circuit in the sequence program to ensure that the entire system will operate safely.

⚠CAUTION

- Do not install the control lines or communication cables together with the main circuit lines or power cables.
  Keep a distance of 100mm (3.94 inches) or more between them.
  Failure to do so may result in malfunction due to noise.

[Installation Precautions]

⚠CAUTION
• Use the programmable controller in an environment that meets the general specifications in this manual. Failure to do so may result in electric shock, fire, malfunction, or damage to or deterioration of the product. • For protection of the switches, do not remove the cushioning material before installation. • Securely fix the module with a DIN rail or mounting screws. Tighten the screws within the specified torque range. Undertightening can cause drop of the screw, short circuit or malfunction. Overtightening can damage the screw and/or module, resulting in drop, short circuit, or malfunction. • Do not directly touch any conductive part of the module. Doing so can cause malfunction or failure of the module.

[Wiring Precautions]

⚠CAUTION
• Shut off the external power supply for the system in all phases before wiring. Failure to do so may result in damage to the product. • After installation or wiring, attach the included terminal cover to the module before turning it on for operation. Undertightening can cause short circuit or malfunction. • Ground the FG terminals to the protective ground conductor dedicated to the programmable controller. Failure to do so may result in malfunction. • Use applicable solderless terminals and tighten them within the specified torque range. If any spade solderless terminal is used, it may be disconnected when the terminal screw comes loose, resulting in failure. • Check the rated voltage and terminal layout before wiring to the module, and connect the cables correctly. Connecting a power supply with a different voltage rating or incorrect wiring may cause a fire or failure. • Tighten the terminal screw within the specified torque range. Undertightening can cause short circuit or malfunction. Overtightening can damage the screw and/or module, resulting in drop, short circuit, or malfunction. • Prevent foreign matter such as dust or wire chips from entering the module. Such foreign matter can cause a fire, failure, or malfunction.

[Wiring Precautions]

⚠CAUTION
• Place the cables in a duct or clamp them. If not, dangling cable may swing or inadvertently be pulled, resulting in damage to the module or cables or malfunction due to poor contact. • Do not install the control lines or communication cables together with the main circuit lines or power cables. Failure to do so may result in malfunction due to noise. • When disconnecting the cable from the module, do not pull the cable by the cable part. Loosen the screws of connector before disconnecting the cable. Failure to do so may result in damage to the module or cable or malfunction due to poor contact.

[Startup and Maintenance Precautions]

⚠CAUTION
• Do not touch any terminal while power is on. Doing so may cause malfunction. • Shut off the external power supply for the system in all phases before cleaning the module or retightening the terminal screws. Failure to do so may cause the module to fail or malfunction. Undertightening the terminal screws can cause short circuit or malfunction. Overtightening can damage the screw and/or module, resulting in drop, short circuit, or malfunction. • Do not disassemble or modify the modules. Doing so may cause failure, malfunction, injury, or a fire. • Do not drop or apply strong shock to the module. Doing so may damage the module. • Shut off the external power supply for the system in all phases before mounting or removing the module to or from the panel. Failure to do so may cause the module to fail or malfunction. • After the first use of the product, do not mount/remove the terminal block to/from the module more than 50 times. (IEC 61131-2 compliant) • Before handling the module, touch a grounded metal object to discharge the static electricity from the human body. Failure to do so may cause the module to fail or malfunction.

[Disposal Precautions]

⚠CAUTION
• When disposing of this product, treat it as an industrial waste.

● CONDITIONS OF USE FOR THE PRODUCT ●

(1) Mitsubishi programmable controller ("the PRODUCT") shall be used in conditions;
i) where any problem, fault or failure occurring in the PRODUCT, if any, shall not lead to any major or serious accident; and
ii) where the backup and fail-safe function are systematically or automatically provided outside of the PRODUCT for the case of any problem, fault or failure occurring in the PRODUCT.

(2) The PRODUCT has been designed and manufactured for the purpose of being used in general industries.
MITSUBISHI SHALL HAVE NO RESPONSIBILITY OR LIABILITY (INCLUDING, BUT NOT LIMITED TO ANY AND ALL RESPONSIBILITY OR LIABILITY BASED ON CONTRACT, WARRANTY, TORT, PRODUCT LIABILITY) FOR ANY INJURY OR DEATH TO PERSONS OR LOSS OR DAMAGE TO PROPERTY CAUSED BY the PRODUCT THAT ARE OPERATED OR USED IN APPLICATION NOT INTENDED OR EXCLUDED BY INSTRUCTIONS, PRECAUTIONS, OR WARNING CONTAINED IN MITSUBISHI'S USER, INSTRUCTION AND/OR SAFETY MANUALS, TECHNICAL BULLETINS AND GUIDELINES FOR the PRODUCT.
("Prohibited Application")
Prohibited Applications include, but not limited to, the use of the PRODUCT in;
- Nuclear Power Plants and any other power plants operated by Power companies, and/or any other cases in which the public could be affected if any problem or fault occurs in the PRODUCT.
- Railway companies or Public service purposes, and/or any other cases in which establishment of a special quality assurance system is required by the Purchaser or End User.
- Aircraft or Aerospace, Medical applications, Train equipment, transport equipment such as Elevator and Escalator, Incineration and Fuel devices, Vehicles, Manned transportation, Equipment for Recreation and Amusement, and Safety devices, handling of Nuclear or Hazardous Materials or Chemicals, Mining and Drilling, and/or other applications where there is a significant risk of injury to the public or property.

Notwithstanding the above, restrictions Mitsubishi may in its sole discretion, authorize use of the PRODUCT in one or more of the Prohibited Applications, provided that the usage of the PRODUCT is limited only for the specific applications agreed to by Mitsubishi and provided further that no special quality assurance or fail-safe, redundant or other safety features which exceed the general specifications of the PRODUCTs are required. For details, please contact the Mitsubishi representative in your region.

Revisions

* The manual number is noted at the lower left of the back cover.

Print Date	*Manual Number	Revision
Apr., 1998	SH(NA)-3304-A	First printing
Jul., 2005	SH(NA)-3304-B	Addition Conformation to the EMC Directive and Low Voltage Instruction, WARRANTY Correction SAFETY PRECAUTIONS, Section 2.2, 5
Dec., 2006	SH(NA)-3304-C	Correction SAFETY PRECAUTIONS, Section 2.1, 3.9.4, 4.3, Chapter 5
Dec., 2010	SH(NA)-3304-D	Addition CONDITIONS OF USE FOR THE PRODUCT Correction SAFETY PRECAUTIONS, About Manuals, Compliance with the EMC and Low Voltage Directives, About Generic Terms and Abbreviations, Chapter 1, Section 2.1, 2.2, 3.1, 3.2, 3.5, 3.8.1, 3.9.4, 4.2 to 4.4, 4.7, 5.1 to 5.3, 5.6, 6.1, 6.4, Appendix 4 Deletion Section 4.7.1 Renumbering Section 4.7.2 to 4.7.4 → Section 4.7.1 to 4.7.3

Japanese Manual Version SH-3651-F

Introduction

Thank you for purchasing the Mitsubishi Graphic Operation Terminal.

Before using the equipment, please read this manual carefully to develop full familiarity with the functions and performance of the graphic operation terminal you have purchased, so as to ensure correct use.

Please forward a copy of this manual to the end user.

Table of Contents

About Manuals

The following are manuals related to this product.
Request for the manuals as needed according to the chart below.

Related Manuals

Manual Name	Manual No. (Type code)
CC-Link System Master/Local Module Type AJ61BT11/A1SJ61BT11 User's Manual This manual explains about the system configuration, performance specifications, functions, handling, wiring and troubleshooting of AJ61BT11and A1SJ61BT11. (Sold separately)	IB-66721 (13J872)
CC-Link System Master/Local Module Type AJ61QBT11/A1SJ61QBT11 User's Manual This manual explains about the system configuration, performance specifications, functions, handling, wiring and troubleshooting of AJ61QBT11and A1SJ61QBT11. (Sold separately)	IB-66722 (13J901)
CC-Link System Master/Local Module User's Manual Describes the system configuration, performance specifications, functions, handling, wiring and troubleshooting of the QJ61BT11N. (Sold separately)	SH-080394E (13JR64)
Type AnSHCPU/AnACPU/AnUCPU/QCPU-A (A Mode) Programming Manual (Dedicated Instructions) Describes the instructions extended for the AnSHCPU/AnACPU/AnUCPU. (Sold separately)	IB-66251 (13J742)
MELSEC-L CC-Link System Master/Local Module User's Manual Describes the system configuration, Performance specifications, functions, handling, wiring and troubleshooting of the L26CPU-BT and LJ61BT11. (Sold separately)	SH-080895ENG (13JZ41)

Compliance with the EMC and Low Voltage Directives

(1) For programmable controller system

To configure a system meeting the requirements of the EMC and Low Voltage Directives when incorporating the Mitsubishi programmable controller (EMC and Low Voltage Directives compliant) into other machinery or equipment, refer to the "EMC AND LOW VOLTAGE DIRECTIVES" chapter of the User's Manual for the CPU module used.

The CE mark, indicating compliance with the EMC and Low Voltage Directives, is printed on the rating plate of the programmable controller.

(2) For the product

For the compliance of this product with the EMC and Low Voltage Directives, refer to the "CC-Link module" section in the "EMC AND LOW VOLTAGE DIRECTIVES" chapter of the User's Manual for the CPU module used.

About Generic Terms and Abbreviations

Unless otherwise specified, this manual uses the following generic terms and abbreviations to explain the AJ65BT-68TD Thermocouple Input Module. Temperature input module.

Generic Term/ Abbreviation	Description
GX Developer	Product name of the software package for the MELSEC programmable controllers.
GX Works2	
ACPU	Generic term for A0J2CPU, A0J2HCPU, A1CPU, A2CPU, A2CPU-S1, A3CPU, A1SCPU, A1SCPUC24-R2, A1SHCPU, A1SJCPU, A1SJCPU-S3, A1SJHCPU, A1NCPU, A2NCPU, A2NCPU-S1, A3NCPU, A3MCPU, A3HCPU, A2SCPU, A2SHCPU, A2ACPU, A2ACPU-S1, A3ACPU, A2UCPU, A2UCPU-S1, A2USCPU, A2USCPU-S1, A2USHCPU-S1, A3UCPU and A4UCPU.
QnACPU	Generic term for Q2ACPU, Q2ACPU-S1, Q2ASCPU, Q2ASCPU-S1, Q2ASHCPU, Q2ASHCPU-S1, Q3ACPU, Q4APU and Q4ARCPU.
QCPU (A mode)	Generic term for Q02CPU-A, Q02HCPU-A and Q06HCPU-A.
QCPU (Q mode)	Generic term for Q00JCPU, Q00CPU, Q01CPU, Q02CPU, Q02HCPU, Q06HCPU, Q12HCPU, Q25HCPU, Q02PHCPU, Q06PHCPU, Q12PHCPU, Q25PHCPU, Q12PRHCPU, Q25PRHCPU, Q00UJCPU, Q00UCPU, Q01UCPU, Q02UCPU, Q03UDCPU, Q04UDHCPU, Q06UDHCPU, Q10UDHCPU, Q13UDHCPU, Q20UDHCPU, Q26UDHCPU, Q03UDECPU, Q04UDEHCPU, Q06UDEHCPU, Q10UDEHCPU, Q13UDEHCPU, Q20UDEHCPU, Q26UDEHCPU. Q50UDEHCPU and Q100UDEHCPU.
LCPU	Generic term for L02CPU, L26CPU-BT.
Master station	Station that controls a data link system. One station is required for one system.
Local station	Station that has a programmable controller CPU and can communicate with the master station and other local stations.
Remote I/O station	Station that handles only bit unit information. (Input/output from/to external device) (AJ65BTB1-16D, AJ65SBTB1-16D, etc.)
Remote device station	Station that handles bit unit information and word unit information. (Input/output from/to external device, analog data conversion)
Remote station	Generic term for remote I/O station and remote device station. Controlled by the master station.
Intelligent device station	Station that can perform transient transmission, e.g. AJ65BT-R2. (Local station included)
Master module	Generic term for modules that can be used as the master station.
SB	Link special relay (for CC-Link) Bit unit information that indicates the module operation status or data link status of the master station/local station. Represented as SB for convenience.
SW	Link special register (for CC-Link) 16-bit unit information that indicates the module operation status or data link status of the master station/local station. Represented as SW for convenience.
RX	Remote input (for CC-Link) Information input from a remote station to the master station in bit unit. Represented as RX for convenience.
RY	Remote output (for CC-Link) Information output from the master station to a remote station in bit unit. Represented as RY for convenience.

Generic Term/ Abbreviation	Description
RWw	Remote register (write area for CC-Link) Information output from the master station to a remote device station in 16-bit unit. Represented as RWw for convenience.
RWr	Remote register (read area for CC-Link) Information input from a remote device station to the master station in 16-bit unit. Represented as RWr for convenience.

Packing List

This product consists of the following items.

Product name	Quantity
AJ65BT-68TD thermocouple input module	1
AJ65BT-68TD Thermocouple Temperarure Input Module User's Manual (Hardware)	1

1. OVERVIEW

This user's manual explains the specifications, handling, programming methods, etc. of the AJ65BT-68TD Thermocouple Input Module (hereinafter referred to as AJ65BT-68TD) used as a remote device station for the CC-Link system.

The AJ65BT-68TD is a module that converts the thermocouple input values from outside the programmable controller to the temperature values or scaling values of 16-bit signed BIN data.

1.1 Features

The following are the features of the AJ65BT-68TD.

(1) Temperature – digital conversion is possible at eight channels in one module
One AJ65BT-68TD module may perform up to eight channels of temperature – digital conversions.

(2) Thermocouples conforming the JIS standard may be used.
Seven types of thermocouples (K, E, J, T, B, R and S) that conform to the JIS standard may be used.
Also, a thermocouple may be chosen independently for each channel

(3) Conversion enabling and disabling
Conversion may be enabled or disabled for each individual channel. By disabling the conversion of channels that are not used, generation of unnecessary wire breakage detection flags may be prevented and sampling time may be reduced.

(4) Wire breakage detection is possible
The thermocouple and compensating conductor breakage may be detected for each channel.

(5) Sampling processing and travel average processing may be designated
As a conversion processing method, sampling processing and travel average processing may designated for each channel.

(6) Cold junction compensation is possible using Pt100 temperature-measuring resistor
Since a Pt100 temperature-measuring resistor is connected, cold junction compensation is performed automatically.

(7) Pt100 cold junction compensation enable/disable setting is possible
By disabling the cold junction compensation by the Pt100 temperature-measuring resistor, cold junction compensation may be performed at outside the module.
If the cold junction compensation accuracy ±1 °C of the Pt100 temperature-measuring resistor may not be ignored as a tolerance, cold junction compensation accuracy may be increased by installing a high-accuracy ice bus to outside of the module.

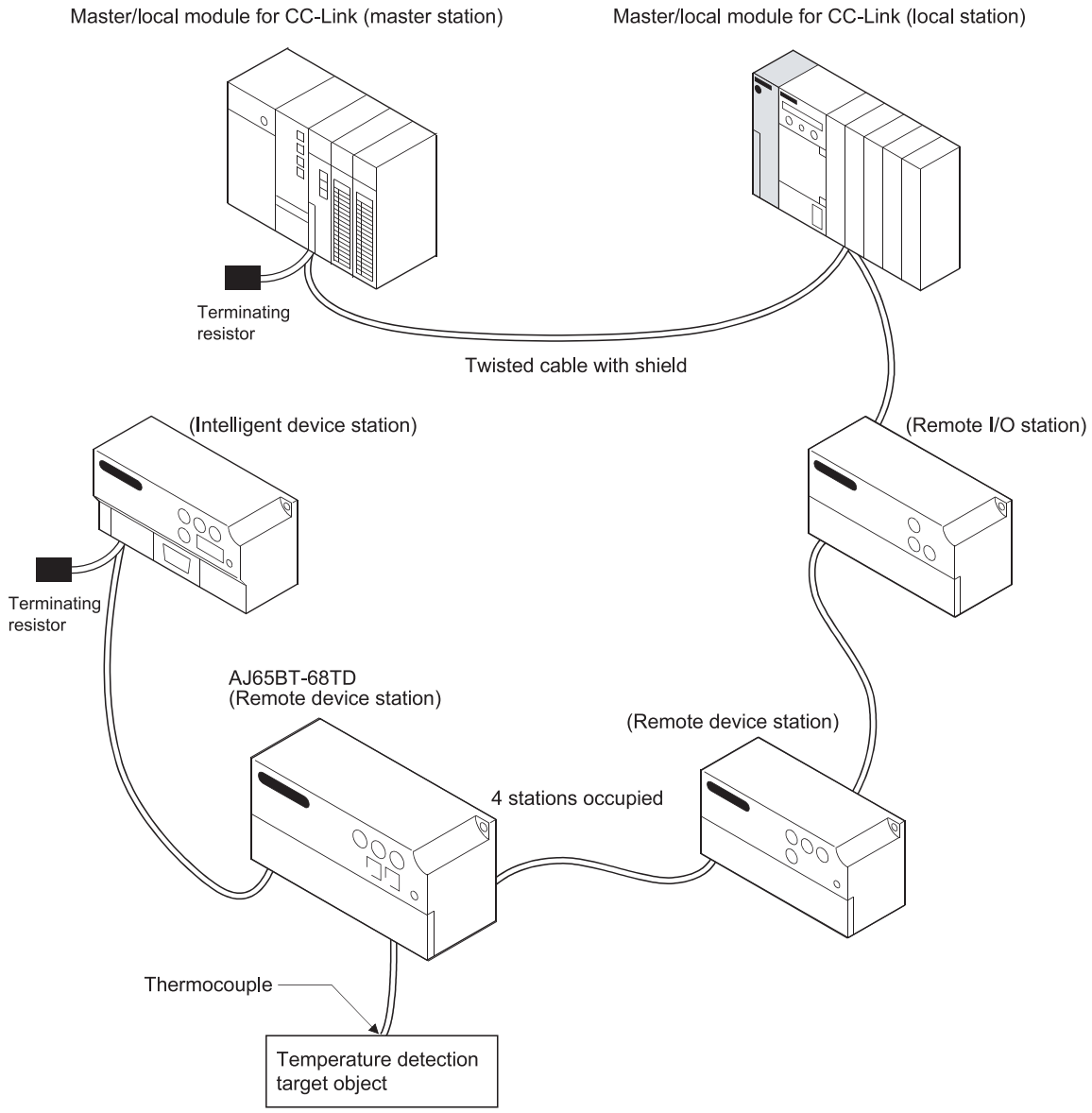
(8) Error compensation can be performed by setting the offset/gain value
Error compensation may be performed individually at each channel by setting the offset/gain value.
Also, the offset/gain value may be selected to use a user setting value or factory setting value.

2. SYSTEM CONFIGURATION

System configuration when using the AJ65BT-68TD is explained below.

2.1 Overall Configuration

The overall configuration when using the AJ65BT-68TD is shown below.



The maximum overall distance for the system is as follows (varies depending on transmission speed setting).

156 kbps : 1200 m (3937 ft.)
625 kbps : 600 m (1968.5 ft.)
2.5 Mbps : 200 m (656.2 ft.)
5 Mbps : 150 m (492.1 ft.)
10 Mbps : 100 m (328.1 ft.)

2.2 Applicable System

This section explains the applicable system.

(1) Applicable master modules

For available master modules, visit the CC-Link Partner Association (CLPA) website at:
http://www.cc-link.org/

REMARK

Check the specifications of the master module before use

(2) Restrictions on use of CC-Link dedicated instructions (RLPA, RRPA)

The CC-Link dedicated instructions may not be used depending on the programmable controller CPU and master module used.
For details of the restrictions, refer to the A series master module user's manual, and the Programing Manual type AnSHCPU/AnACPU/AnUCPU/QCPU (A mode) (Dedicated Instructions).
This module does not allow the use of the dedicated instructions other than RLPA and RRPA.
Refer to Section 5.5 for a program example using the dedicated instructions (RLPA, RRPA).

3. SPECIFICATIONS

This section explains the AJ65BT-68TD the general specifications, performance specifications, and transmission specifications.

3.1 General Specification

This section explains the AJ65BT-68TD general specifications.

<table>
<tr><th>Item</th><th colspan="6">Specifications</th></tr>
<tr><td>Ambient operating temperature</td><td colspan="6">0 to 55 °C</td></tr>
<tr><td>Ambient storage temperature</td><td colspan="6">-20 to 75 °C</td></tr>
<tr><td>Ambient operating humidity</td><td colspan="6">10 to 90 %RH, Non-condensing</td></tr>
<tr><td>Ambient storage humidity</td><td colspan="6">10 to 90 %RH, Non-condensing</td></tr>
<tr><td rowspan="5">Vibration resistance</td><td rowspan="5">Conforming to JIS B 3502, IEC 61131-2</td><td></td><td>Frequency</td><td>Acceleration</td><td>Amplitude</td><td>Sweep count</td></tr>
<tr><td rowspan="2">For intermittent vibration</td><td>5 to 9Hz</td><td>—</td><td>3.5mm (0.14inches)</td><td rowspan="2">10 times each in X, Y, Z directions</td></tr>
<tr><td>9 to 150Hz</td><td>9.8 m/s^2 (1 G)</td><td>—</td></tr>
<tr><td rowspan="2">For continuous vibration</td><td>5 to 9Hz</td><td>—</td><td>1.75mm (0.069inches)</td><td rowspan="2">—</td></tr>
<tr><td>9 to 150Hz</td><td>4.9 m/s^2 (0.5 G)</td><td>—</td></tr>
<tr><td>Shock resistance</td><td colspan="6">Conforming to JIS B 3502, IEC 61131-2
(147 m/s^2 (15 G), 3 times in each of 3 directions X Y Z)</td></tr>
<tr><td>Operating ambience</td><td colspan="6">No corrosive gases</td></tr>
<tr><td>Operating elevation*3</td><td colspan="6">2000 m (6562 ft.) max.</td></tr>
<tr><td>Installation location</td><td colspan="6">Control panel</td></tr>
<tr><td>Over voltage category *1</td><td colspan="6">II max.</td></tr>
<tr><td>Pollution level *2</td><td colspan="6">2 max.</td></tr>
</table>

*1 : This indicates the section of the power supply to which the equipment is assumed to be connected between the public electrical power distribution network and the machinery within the premises. Category II applies to equipment for which electrical power is supplied from fixed facilities. The surge voltage withstand level for up to the rated voltage of 300 V is 2500 V.

*2 : This index indicates the degree to which conductive material is generated in terms of the environment in which the equipment is used. Pollution level 2 is when only non-conductive pollution occurs. A temporary conductivity caused by condensation must be expected occasionally.

*3 : Do not use or store the programmable controller under pressure higher than the atmospheric pressure of altitude 0m.
Doing so can cause a malfunction.
When using the programmable controller under pressure, please contact your sales representative.

3.2 Performance Specifications

The performance specifications of the AJ65BT-68TD are shown below.

<table>
<tr><th colspan="2">Item</th><th>Specifications</th></tr>
<tr><td colspan="2">Temperature sensor input</td><td>-200 to 1700 °C</td></tr>
<tr><td rowspan="2">Output</td><td>Detected temperature</td><td>16-bit signed binary (-2000 to 17000 : value to one decimal place multiplied by 10)</td></tr>
<tr><td>Scaling value</td><td>16-bit signed binary (0 to 2000)</td></tr>
<tr><td colspan="2">Applicable thermocouples and temperature measurement range accuracy</td><td>
<table>
<tr><th>Applicable thermocouple type</th><th>Temperature measurement range [°C]</th><th>Conversion accuracy (When ambient operating temperature is 25 ±5 °C)</th><th>Temperature characteristic (Per 1 °C of ambient operating temperature change)</th></tr>
<tr><td>B</td><td>600 to 1700</td><td>± 2.5 °C</td><td>± 0.4 °C</td></tr>
<tr><td rowspan="2">R</td><td>0 to 200</td><td rowspan="2">± 2.0 °C</td><td>± 0.4 °C</td></tr>
<tr><td>200 to 1600</td><td>± 0.3 °C</td></tr>
<tr><td rowspan="2">S</td><td>0 to 200</td><td rowspan="2">± 2.0 °C</td><td>± 0.4 °C</td></tr>
<tr><td>200 to 1600</td><td>± 0.3 °C</td></tr>
<tr><td rowspan="2">K</td><td>-200 to 0</td><td rowspan="8">±0.5 °C or ±0.25 % of the measured temperature, whichever is greater</td><td>±0.06 °C or ±0.3 % of the measured temperature, whichever is greater</td></tr>
<tr><td>0 to 1200</td><td>±0.06 °C or ±0.02 % of the measured temperature, whichever is greater</td></tr>
<tr><td rowspan="2">E</td><td>-200 to 0</td><td>±0.06 °C or ±0.3 % of the measured temperature, whichever is greater</td></tr>
<tr><td>0 to 800</td><td>±0.06 °C or ±0.02 % of the measured temperature, whichever is greater</td></tr>
<tr><td>J</td><td>0 to 750</td><td>±0.06 °C or ±0.02 % of the measured temperature, whichever is greater</td></tr>
<tr><td rowspan="2">T</td><td>-200 to 0</td><td>±0.06 °C or ±0.3 % of the measured temperature, whichever is greater</td></tr>
<tr><td>0 to 350</td><td>±0.06 °C or ±0.02 % of the measured temperature, whichever is greater</td></tr>
</table>
</td></tr>
<tr><td colspan="2">Cold junction compensation accuracy</td><td>± 1.0 °C</td></tr>
<tr><td colspan="2">Overall accuracy</td><td>Depends on *1 calculation expression</td></tr>
<tr><td colspan="2">Maximum resolution</td><td>B, R, S : 0.3 °C K, E, J, T : 0.1 °C</td></tr>
<tr><td colspan="2">Conversion speed (sampling time)</td><td>45 ms/channel *2 ms/ch</td></tr>
<tr><td colspan="2">Absolute maximum input</td><td>± 5 V</td></tr>
<tr><td colspan="2">Number of analog input points</td><td>8 channels + Pt100 connection channel</td></tr>
<tr><td colspan="2">Insulation method</td><td>Thermocouple input to CC-Link transmission : Transformer insulation
Between channels : Transformer insulation</td></tr>
</table>

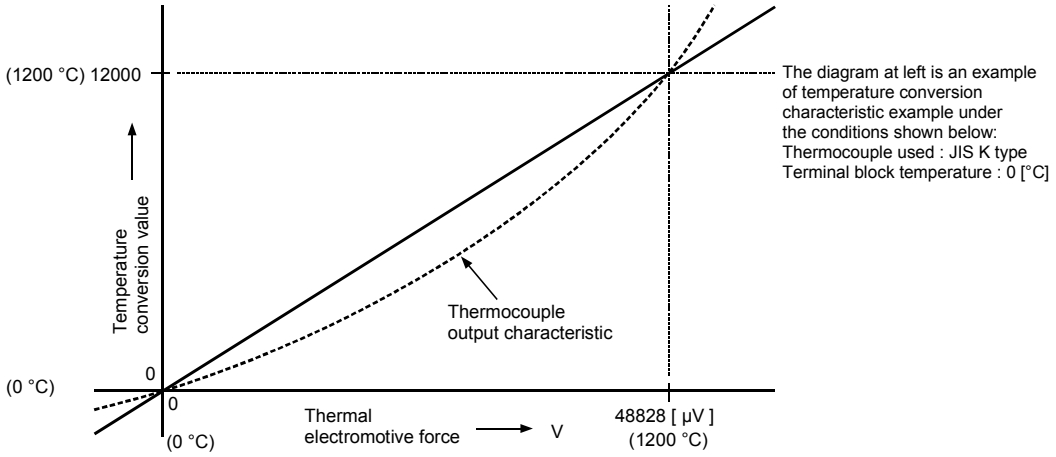
Item	Specifications	
CC-Link station type	Remote device station	
Number of occupied stations	4 Stations : RX/RY 128 points each RWw/RWr 16 points each	
Transmission speed/maximum transmission distance	Refer to Section 3.4	
Maximum number of connected modules	16 modules	
Connection cable	CC-Link dedicated cable	
Noise durability	Depends on noise simulator of noise voltage at 500 Vp-p, noise width at 1 ms and noise frequency at 25 to 60 Hz	
Dielectric withstand voltage	Between batch power supply system and ground Between batch power supply system and batch communication system Between batch communication system and batch thermocouple input Between batch thermocouple input and ground	500 V AC, 1 minute
Insulation resistor	Between batch power supply system and ground Between batch power supply system and batch communication system Between batch communication system and batch thermocouple input Between batch thermocouple input and ground	500 V DC, more than 10 M Ω by the insulation resistance taster
Connected terminal block	27-point terminal blocks (M3.5 × 7 screws)	
Applicable wire size	0.75 to 2.00 mm^2	
Applicable solderless terminal	RAV 1.25-3.5, RAV 2-3.5 (conforms to JIS C 2805)	
Allowable momentary power failure period	1 ms	
Module installation screw	Screws M4 × 0.7 mm × 16 mm or larger (tightening torque range 78 to 118 N · cm {8 to 12 kg · cm}) May be attached using DIN rails	
Applicable DIN rail	TH35-7.5Fe, TH35-7.5Al, TH35-15Fe (conforms to JIS C 2812)	
External power supply	24V DC (18 to 30V DC)	
Internal consumption current	0.081 A	
Weight	0.40 (0.88) kg (lb)	

*1 Overall accuracy computation method is as follows:
(Overall accuracy) = (Conversion accuracy) + (Temperature characteristics) × (Ambient operating temperature change) + (Cold junction compensation accuracy)
The ambient operating temperature change refers to the value that falls outside the range of 25 ±5 °C.
Example) The overall accuracy when using thermocouple K, measured temperature 150 °C, ambient operating temperature 35 °C will be:
(±0.5 °C) + (±0.06 °C) × (5 °C) + (±1 °C) = ±1.8 °C

*2 Conversion speed is the time required to convert the input temperature to the corresponding digital value and store it into the remote register.
When using multiple channels, the conversion speed becomes "45ms × number of channels that are conversion enabled".

3.3 Temperature/Digital Conversion Characteristics

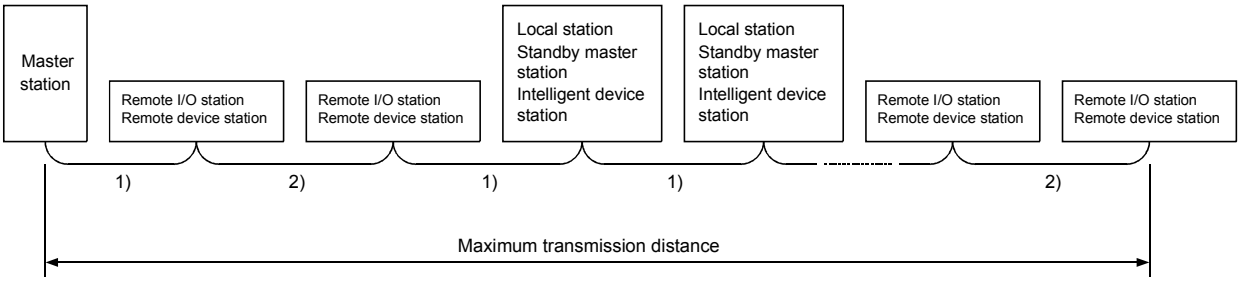
Since the thermal electromotive force has a non-linear characteristic, it must undergo the linearize processing before being written in the remote register.
An example of detected temperature characteristic in respect to the thermocouple input value is shown below.



3.4 Maximum Transmission Distance over the CC-Link System

The maximum transmission distance over the CC-Link system is shown below.

1) Regardless of the setting of the transmission speed, the cable length must be "greater than 2 m (6.6 ft.)" long between a mater or local station, intelligent device station and the adjacent stations.
2) For 5 Mbps and 10 Mbps transmission speeds, the maximum transmission distance will differ according to the cable length between the remote I/O station and remote device station, so exercise caution.



Transmission speed	1)	2)	Maximum transmission distance
156 kbps	2 m (6.6 ft.) or more	30 cm (11.8 in.) or more	1200 m (3937 ft.)
625 kpbs		30 cm (11.8 in.) or more	600 m (1968.5 ft.)
2.5 Mpbs		30 cm (11.8 in.) or more	200 m (656.2 ft.)
5 Mbps		60 cm (23.6 in.) or more	150 m (492.1 ft.)
		30 to 59 cm (11.8 to 23.2 in.)	110 m (360.9 ft.)
10 Mbps		1 m (3.3 ft.) or more	100 m (328.1 ft.)
		60 to 99 cm (23.6 to 39 in.)	80 m (262.5 ft.)
		30 to 59 cm (11.8 to 23.2 in.)	50 m (164 ft.)

3.5 Data Link Processing Time

For the AJ65BT-68TD, the data link processing time shown below will be required in order to execute each function.
For details on link scan time, refer to the AJ61BT11/A1SJ61BT11 CC-Link System Master/Local Module User's Manual or the AJ61QBT11/A1SJ61QBT11 CC-Link System Master/Local Module User's Manual.

(1) Mater station (RY) → Remote device station (RY) processing time

[Expression]

SM + LS × 3 + Remote device station processing time (90 ms) [ms]
AJ65BT-68TD

SM : Master station sequence program scan time
LS : Link scan time

(2) Master station (RWw) → Remote device station (RWw) processing time

[Expression]

SM + LS × 3 + Remote device station processing time (90 ms) [ms]
AJ65BT-68TD

SM : Master station sequence program scan time
LS : Link scan time

(3) Master station (RX) ← Remote Device Station (RX) Processing Time

[Expression]

SM + LS × 2 + Remote device station processing time (1 ms) [ms]
AJ65BT-68TD

SM : Master station sequence program scan time
LS : Link scan time

(4) Master station (RWr) ← Remote Device Station (RWr) Processing Time

[Expression]

SM + LS × 2 + Remote device station processing time (1 ms) [ms]
AJ65BT-68TD

SM : Master station sequence program scan time
LS : Link scan time

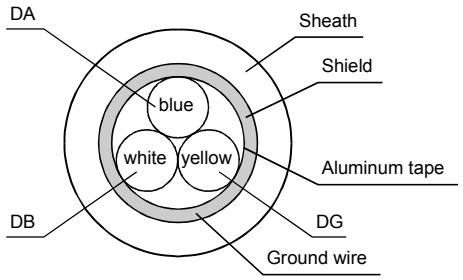
POINT

The above are examples of processing time until the control of the output signal to the AJ65BT-68TD from the programmable controller CPU or until input signals or remote registers are read.

The maximum time that takes for updating the detected temperature read by the programmable controller CPU is "data link processing time + sampling time."

3.6 Twisted Cable Specifications

The twisted cable specifications and recommended cables for use with the CC-Link is explained below.
Also, the performance of the CC-Link may not be guaranteed when using cables other than recommended ones as shown below.
The recommended cable names and specifications are shown in the table below.

Item	Specification
Type	FANC–SB 0.5 mm^2 × 3
Contact	Mitsubishi Electric System Service, Inc. Kurashige Denkou, Inc.
Cable type	Twisted shielded cable
Conductor cross-sectional area	0.5 mm^2
Conductor resistance (20 °C)	37.8 Ω/km or less
Conductive resistance	10000 MΩ km or more
Dielectric withstand voltage	500 V DC one minute
Static capacity (1 kHz)	60 nF/km or less
Characteristic impedance (1 MHz)	100 ± 15 Ω
Cross-sectional diagram	
External dimensions	7 mm (0.28 in.)
Approximate mass	65 kg / km

3.7 Function List

Below is a function list of the AJ65BT-68TD.

Item	Description	Reference section
Wire breakage detection	• Detects wire breakage for the connected thermocouple by channel.	Section 3.8.3
Conversion enable/disable designation	• Performs conversion enable/disable settings by channel. • Sampling time may be reduced by disabling the conversion at channels not in use.	Section 3.8.4
Sampling processing/travel average processing designation	• Designates sampling processing or travel average processing by channel.	Section 3.8.5
Thermocouple type selection	• The thermocouple type to be used may be set for each channel or in batch.	Section 3.8.6
Pt100 cold junction compensation enable/disable designation	• Designates the Pt100 cold junction compensation enable/disable. • By disabling the Pt100 cold junction compensation, a high-accuracy ice bus is set outside of the module to increase the cold junction compensation accuracy.	Section 3.8.7
Measured temperature upper/lower limit value setting	• Sets the upper and lower limits of the measured temperature by channel.	Section 3.9.2
Detected temperature storage	• A value to one decimal place (16-bit signed binary) will be stored in the remote register.	Section 3.9.3
Scaling value storage	• The detected temperature value will be scaled to a value of 0 to 2000 within the upper and lower limits and stored.	Section 3.9.4
Error compensation by offset/gain value setting	• Error compensation is performed by setting the offset/gain values.	Section4.4

3.8 I/O Signals in Respect to the Master Module

The assignment of I/O signals and the functions is explained.

3.8.1 I/O signal list

The AJ65BT-68TD uses 128 points for input and 128 points for output in respect to the data for the master module.
The I/O signal assignment and the name of each signal are shown in the table below.
Device RX indicates an input signal to the master module from the AJ65BT-68TD, and device RY indicates an output signal from the master module to the AJ65BT-68TD.

Signal direction : AJ65BT-68TD → Master module		Signal direction : Master module → AJ65BT-68TD	
Device No.	**Signal name**	**Device No.**	**Signal name**
RXn0	CH.1 conversion completion flag	RYn0	CH.1 conversion enable flag
RXn1	CH.2 conversion completion flag	RYn1	CH.2 conversion enable flag
RXn2	CH.3 conversion completion flag	RYn2	CH.3 conversion enable flag
RXn3	CH.4 conversion completion flag	RYn3	CH.4 conversion enable flag
RXn4	CH.5 conversion completion flag	RYn4	CH.5 conversion enable flag
RXn5	CH.6 conversion completion flag	RYn5	CH.6 conversion enable flag
RXn6	CH.7 conversion completion flag	RYn6	CH.7 conversion enable flag
RXn7	CH.8 conversion completion flag	RYn7	CH.8 conversion enable flag
RXn8	CH.1 wire breakage detection flag	RYn8	CH.1 sampling/travel average processing designation flag
RXn9	CH.2 wire breakage detection flag	RYn9	CH.2 sampling/travel average processing designation flag
RXnA	CH.3 wire breakage detection flag	RYnA	CH.3 sampling/travel average processing designation flag
RXnB	CH.4 wire breakage detection flag	RYnB	CH.4 sampling/travel average processing designation flag
RXnC	CH.5 wire breakage detection flag	RYnC	CH.5 sampling/travel average processing designation flag
RXnD	CH.6 wire breakage detection flag	RYnD	CH.6 sampling/travel average processing designation flag
RXnE	CH.7 wire breakage detection flag	RYnE	CH.7 sampling/travel average processing designation flag
RXnF	CH.8 wire breakage detection flag	RYnF	CH.8 sampling/travel average processing designation flag
RX (n+1) 0	CH.1 measurement range over flag (lower limit)	RY (n+1) 0	CH.1 type "K" thermocouple selection flag
RX (n+1) 1	CH.1 measurement range over flag (upper limit)	RY (n+1) 1	CH.1 type "E" thermocouple selection flag
RX (n+1) 2	CH.2 measurement range over flag (lower limit)	RY (n+1) 2	CH.1 type "J" thermocouple selection flag
RX (n+1) 3	CH.2 measurement range over flag (upper limit)	RY (n+1) 3	CH.1 type "T" thermocouple selection flag
RX (n+1) 4	CH.3 measurement range over flag (lower limit)	RY (n+1) 4	CH.1 type "B" thermocouple selection flag
RX (n+1) 5	CH.3 measurement range over flag (upper limit)	RY (n+1) 5	CH.1 type "R" thermocouple selection flag
RX (n+1) 6	CH.4 measurement range over flag (lower limit)	RY (n+1) 6	CH.1 type "S" thermocouple selection flag
RX (n+1) 7	CH.4 measurement range over flag (upper limit)	RY (n+1) 7	Use prohibited
RX (n+1) 8	CH.5 measurement range over flag (lower limit)	RY (n+1) 8	CH.2 type "K" thermocouple selection flag
RX (n+1) 9	CH.5 measurement range over flag (upper limit)	RY (n+1) 9	CH.2 type "E" thermocouple selection flag
RX (n+1) A	CH.6 measurement range over flag (lower limit)	RY (n+1) A	CH.2 type "J" thermocouple selection flag
RX (n+1) B	CH.6 measurement range over flag (upper limit)	RY (n+1) B	CH.2 type "T" thermocouple selection flag
RX (n+1) C	CH.7 measurement range over flag (lower limit)	RY (n+1) C	CH.2 type "B" thermocouple selection flag
RX (n+1) D	CH.7 measurement range over flag (upper limit)	RY (n+1) D	CH.2 type "R" thermocouple selection flag
RX (n+1) E	CH.8 measurement range over flag (lower limit)	RY (n+1) E	CH.2 type "S" thermocouple selection flag
RX (n+1) F	CH.8 measurement range over flag (upper limit)	RY (n+1) F	Use prohibited

Signal direction : AJ65BT-68TD → Master module		Signal direction : Master module → AJ65BT-68TD	
Device No.	**Signal name**	**Device No.**	**Signal name**
RX (n+2) 0	CH.1 write data error flag	RY (n+2) 0	CH.3 type "K" thermocouple selection flag
RX (n+2) 1	CH.2 write data error flag	RY (n+2) 1	CH.3 type "E" thermocouple selection flag
RX (n+2) 2	CH.3 write data error flag	RY (n+2) 2	CH.3 type "J" thermocouple selection flag
RX (n+2) 3	CH.4 write data error flag	RY (n+2) 3	CH.3 type "T" thermocouple selection flag
RX (n+2) 4	CH.5 write data error flag	RY (n+2) 4	CH.3 type "B" thermocouple selection flag
RX (n+2) 5	CH.6 write data error flag	RY (n+2) 5	CH.3 type "R" thermocouple selection flag
RX (n+2) 6	CH.7 write data error flag	RY (n+2) 6	CH.3 type "S" thermocouple selection flag
RX (n+2) 7	CH.8 write data error flag	RY (n+2) 7	Use prohibited
RX (n+2) 8	E^2PROM abnormal flag	RY (n+2) 8	CH.4 type "K" thermocouple selection flag
RX (n+2) 9	Test mode flag	RY (n+2) 9	CH.4 type "E" thermocouple selection flag
RX (n+2) A	Use prohibited	RY (n+2) A	CH.4 type "J" thermocouple selection flag
RX (n+2) B		RY (n+2) B	CH.4 type "T" thermocouple selection flag
RX (n+2) C		RY (n+2) C	CH.4 type "B" thermocouple selection flag
RX (n+2) D		RY (n+2) D	CH.4 type "R" thermocouple selection flag
RX (n+2) E		RY (n+2) E	CH.4 type "S" thermocouple selection flag
RX (n+2) F		RY (n+2) F	Use prohibited
RX (n+3) 0		RY (n+3) 0	CH.5 type "K" thermocouple selection flag
RX (n+3) 1		RY (n+3) 1	CH.5 type "E" thermocouple selection flag
RX (n+3) 2		RY (n+3) 2	CH.5 type "J" thermocouple selection flag
RX (n+3) 3		RY (n+3) 3	CH.5 type "T" thermocouple selection flag
RX (n+3) 4		RY (n+3) 4	CH.5 type "B" thermocouple selection flag
RX (n+3) 5		RY (n+3) 5	CH.5 type "R" thermocouple selection flag
RX (n+3) 6		RY (n+3) 6	CH.5 type "S" thermocouple selection flag
RX (n+3) 7		RY (n+3) 7	Use prohibited
RX (n+3) 8		RY (n+3) 8	CH.6 type "K" thermocouple selection flag
RX (n+3) 9		RY (n+3) 9	CH.6 type "E" thermocouple selection flag
RX (n+3) A		RY (n+3) A	CH.6 type "J" thermocouple selection flag
RX (n+3) B		RY (n+3) B	CH.6 type "T" thermocouple selection flag
RX (n+3) C		RY (n+3) C	CH.6 type "B" thermocouple selection flag
RX (n+3) D		RY (n+3) D	CH.6 type "R" thermocouple selection flag
RX (n+3) E		RY (n+3) E	CH.6 type "S" thermocouple selection flag
RX (n+3) F		RY (n+3) F	Use prohibited
RX (n+4) 0		RY (n+4) 0	CH.7 type "K" thermocouple selection flag
RX (n+4) 1		RY (n+4) 1	CH.7 type "E" thermocouple selection flag
RX (n+4) 2		RY (n+4) 2	CH.7 type "J" thermocouple selection flag
RX (n+4) 3		RY (n+4) 3	CH.7 type "T" thermocouple selection flag
RX (n+4) 4		RY (n+4) 4	CH.7 type "B" thermocouple selection flag
RX (n+4) 5		RY (n+4) 5	CH.7 type "R" thermocouple selection flag
RX (n+4) 6		RY (n+4) 6	CH.7 type "S" thermocouple selection flag
RX (n+4) 7		RY (n+4) 7	Use prohibited
RX (n+4) 8		RY (n+4) 8	CH.8 type "K" thermocouple selection flag
RX (n+4) 9		RY (n+4) 9	CH.8 type "E" thermocouple selection flag
RX (n+4) A		RY (n+4) A	CH.8 type "J" thermocouple selection flag
RX (n+4) B		RY (n+4) B	CH.8 type "T" thermocouple selection flag
RX (n+4) C		RY (n+4) C	CH.8 type "B" thermocouple selection flag
RX (n+4) D		RY (n+4) D	CH.8 type "R" thermocouple selection flag
RX (n+4) E		RY (n+4) E	CH.8 type "S" thermocouple selection flag
RX (n+4) F		RY (n+4) F	Use prohibited

Signal direction : AJ65BT-68TD → Master module		Signal direction : Master module → AJ65BT-68TD	
Device No.	**Signal name**	**Device No.**	**Signal name**
RX (n+5) 0	Use prohibited	RY (n+5) 0	All CH. batch type "K" thermocouple selection flag
RX (n+5) 1		RY (n+5) 1	All CH. batch type "E" thermocouple selection flag
RX (n+5) 2		RY (n+5) 2	All CH. batch type "J" thermocouple selection flag
RX (n+5) 3		RY (n+5) 3	All CH. batch type "T" thermocouple selection flag
RX (n+5) 4		RY (n+5) 4	All CH. batch type "B" thermocouple selection flag
RX (n+5) 5		RY (n+5) 5	All CH. batch type "R" thermocouple selection flag
RX (n+5) 6		RY (n+5) 6	All CH. batch type "S" thermocouple selection flag
RX (n+5) 7		RY (n+5) 7	Pt100 cold junction compensation disable flag
RX (n+5) 8		RY (n+5) 8	Use prohibited
to		to	
RX (n+7) 6		RY (n+7) 6	
RX (n+7) 7		RY (n+7) 7	Offset/gain value selection flag
RX (n+7) 8	Initial data processing request flag	RY (n+7) 8	Initial data processing completion flag
RX (n+7) 9	Initial data setting completion flag	RY (n+7) 9	Initial data setting request flag
RX (n+7) A	Error status flag	RY (n+7) A	Error reset request flag
RX (n+7) B	Remote READY	RY (n+7) B	Use prohibited
RX (n+7) C	Use prohibited	RY (n+7) C	
to		to	
RX (n+7) F		RY (n+7) F	

n : Addresses assigned to the master module by the station number setting.

POINT

Do not turn on the output signals that are prohibited in respect to the remote device from the master module.

If the prohibited signals are output, the programmable controller system may malfunction.

3.8.2 I/O signal functions

The function of each I/O signal for the AJ65BT-68TD is explained below.

(1) Input signal

Device No.	Signal name	Description
RXn0 to RXn7	CH. ☐ conversion completion flag	The conversion completion flag turns on when the detected temperature value converted at each channel is stored in the remote register after power on or a hardware reset. If the travel average processing is running, it will turn on when the detected temperature value is converted and stored in the remote register after the travel average processing has completed. The conversion completion flag changes according to the conditions listed below. • When conversion disabled is changed to enabled The temperature detection of the enabled channels will be commenced. After the detected temperature values are stored in the remote register, the conversion completion flag is turned on for the corresponding channel. • When conversion enabled is changed to disabled The conversion completion flag is turned off for the corresponding channel. For the values stored in the remote register, the data immediately prior to the disable setting are retained.
RXn8 to RXnF	CH. ☐ wire breakage detection flag	For the thermocouple input circuit for all channels, when only a single section of the I/O signal lines including the thermocouple is broken, the wire breakage detection flag is turned on for the corresponding channel. The detected temperature value when a wire breakage detection flag is turned on will be maintained at the normal value immediately prior to the wire breakage, and then the conversion completion flag will be turned off. After the wire breakage has been removed, the wire breakage detection flag may be turned off by turning on the error reset request flag. Also, after the breakage has been fixed, the updating of detected temperatures value will be resumed regardless of whether or not the wire breakage detection flag is reset, and after the first update has been completed the conversion completion flag will turn on once again.
RX (n+1) 1 to RX (n+1) F	CH. ☐ measurement range over flag	When a detected temperature value that falls outside of the upper and lower limits set in the remote register is detected, the measurement range over flag is turned on for the corresponding channel. When the detected temperature value returns to inside the range, it is reset (off) automatically.
RX (n+2) 1 to RX (n+2) 7	CH. ☐ write data error flag	When a value exceeding the specification is written in the write-only area of the remote register (upper and lower limit setting) or when multiple types of thermocouples are selected in the thermocouple selection flag, the write data error is turned on for the corresponding channel. After the cause of the write data error has been removed, the flag may be turned off by turning on the error reset request flag.
RX (n+2) 8	E^2PROM abnormal flag	After power on or a hardware reset, the internal memory (E^2PROM for offset/gain value storage) is checked, and it turns on if there is an error. At such times, the conversion function will stop. When this flag turns on, the error reset request flag may not be used to reset (off) because the module itself is malfunctioning (hardware error).
RX (n+2) 9	Test mode flag	Turns on during test mode. Turns off when reverted to normal mode.

Device No.	Signal name	Description
RX (n+7) 8	Initial data processing request flag	After power on or a hardware reset, this is turned on because the AJ65BT-68TD requests the initial data setting . After the initial data processing is complete (initial data processing request flag RY(n+7)8 is turned on), it turns off.
RX (n+7) 9	Initial data setting completion flag	Turns on when initial data setting request (initial data setting request flag RY(n+7)9 is turned on) is made. After the initial data setting request flag is turned off when initial data setting is complete, this also turns off.
RX (n+7) A	Error status flag	Turns on when wire breakage detection flag/write data error flag/E^2PROM error flag turns on. After the cause of the error has been removed, the flag may be reset (off) by turning on the error reset request flag, but since the E^2PROM error flag cannot be reset, this flag may also not be reset.
RX (n+7) B	Remote READY	After power on or a hardware reset, this flag turns on when the initial data setting is complete and the detected temperature value at the conversion-enabled channel has been stored in the remote register. Will not turn on when all channels are conversion disabled. It will turn off for two seconds when the offset/gain switch is set to [OFFSET] during test mode or when changed from [GAIN] to [SET]. Used as an interlock for read and write in respect to the master module.

(2) Output signal

Device No.	Signal name	Description
RYn0 to RYn7	CH. ☐ conversion enable flag	It is possible to designate the conversion enabled or disabled for each channel. By disabling the conversion at channels not in use, generation of unnecessary wire breakage detection flags may be prevented and sampling time may be reduced. ON : Conversion enabled ····· wire breakage detection is conducted at the same time the temperature of the target object is taken. OFF : Conversion disabled ···· neither temperature taking or wire breakage detection is conducted. By setting of conversion enable/disable, the following changes are made. • When conversion is changed from disabled → enabled Temperature detection of the enabled channel is commenced. After the detected temperature value of the corresponding channel is stored in the remote register, the conversion completion flag of the corresponding channel is turned on. • When the conversion is changed from enabled → disabled. The conversion completion flag is turned off for the corresponding channel. For the detected temperature value stored in the remote register, the data immediately prior to the disable setting will be retained.
RYn8 to RYnF	CH. ☐ sampling processing/ travel average processing designation flag	It is possible to designate the sampling processing or travel average processing for each independent channel. ON : Travel average processing OFF : Sampling processing In travel average processing, an average value of four detected temperature value samples that were taken during each sampling time is calculated and stored in the remote register. • When changed from sampling processing → travel average processing The conversion completion flag for the corresponding channel is turned off. An average value of four detected temperature value samples is calculated, and after it has been stored to the remote register the conversion completion flag of the corresponding channel is turned on. • When changed from travel average processing → sampling processing The conversion completion flag is turned off for the corresponding channel. After the most recent detected temperature value is stored in the remote register, the conversion completion flag for the corresponding channel is turned on. Note : This flag is only valid when the initial data processing completion flag (RY (n+7) 8) or initial data setting request flag (RY (n+7) 9) is on.

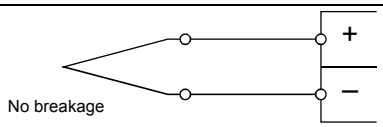
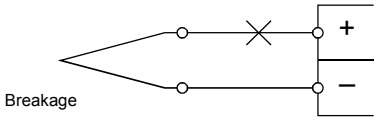
Device No.	Signal name	Description
RY (n+1) 0 to RY (n+1) 6	CH.1 thermocouple selection flag	Selects the type of thermocouple to be connected to each channel. Only the flags appropriate for the thermocouple to be used are turned on. It is read as the set value when the initial data processing request flag is turned on. When the flag is off after power on or a hardware reset, the K type is selected. Also, when multiple thermocouple selection flags are turned on, the write data error flag is turned on and the previously selected thermocouple type is retained. Refer to the I/O signal list for the correspondence between each signal and thermocouple type. Note : This flag is only valid when the initial data processing compensation flag (RY(n+7)8) or initial data setting request flag (RY (n+7) 9) is on.
RY (n+1) 8 to RY (n+1) E	CH.2 thermocouple selection flag	
RY (n+2) 0 to RY (n+2) 6	CH.3 thermocouple selection flag	
RY (n+2) 8 to RY (n+2) E	CH.4 thermocouple selection flag	
RY (n+3) 0 to RY (n+3) 6	CH.5 thermocouple selection flag	
RY (n+3) 8 to RY (n+3) E	CH.6 thermocouple selection flag	
RY (n+4) 0 to RY (n+4) 6	CH.7 thermocouple selection flag	
RY (n+4) 8 to RY (n+4) E	CH.8 thermocouple selection flag	
RY (n+5) 0 to RY (n+5) 6	All CH. batch thermocouple selection flag	All channels are selected to the same thermocouple in batch. This flag takes priority over the thermocouple selection flag for individual channels. The thermocouple selection flag for individual channels may only be used when this flag is off. Also, when multiple batch thermocouple selection flags are turned on, the write data error flag is turned on and the previously selected thermocouple type is retained. Refer to the I/O signal list for the correspondence between each signal and thermocouple type. Note : This flag is only valid when the initial data processing compensation flag (RY(n+7)8) or initial data setting request flag (RY (n+7) 9) is on.
RY (n+5) 7	Pt100 cold junction compensation disable flag	The detected temperature value to be stored in the remote register can be selected from a value that has undergone cold junction compensation by Pt100 temperature-measuring resistor, and a value that has not (the cold junction compensation is performed externally). ON : Cold contact compensation is not performed by the Pt100 temperature-measuring resistor. OFF : Cold contact compensation is performed by the Pt100 temperature-measuring resistor. Note : This flag is only valid when the initial data processing compensation flag (RY(n+7)8) or initial data setting request flag (RY (n+7) 9) is on.

Device No.	Signal name	Description
RY (n+7) 7	Offset/gain value selection flag	Select whether or not the offset/gain value will be set to "user setting" or "factory setting." At the product shipment from factory, the same values for the factory settings are stored in the E^2PROM for storing the user setting offset/gain values. ON : Factory setting (Offset-gain, 100.0 Ω (0 °C equivalent) -300 °C) OFF : User setting Note : This flag is only valid when the initial data processing compensation flag (RY (n+7) 8) or initial data setting request flag (RY (n+7) 9) is on.
RY (n+7) 8	Initial data processing completion flag	After power on or hardware reset, the initial data are set in the module by turning this flag on during the initial data processing request . Used when designating sampling processing/travel average processing designation, selecting offset/gain value, setting upper and lower limits, Pt100 cold junction compensation enable/disable designation or selecting thermocouples.
RY (n+7) 9	Initial data setting request flag	Turned on when changing the initial values. Used when designating sampling processing/travel average processing, selecting offset/gain value, setting upper and lower limits, or Pt100 cold junction compensation enable/disable designation.
RY (n+7) A	Error reset request flag	When this flag is turned on, the wire breakage detection flag/write data error flag are reset (turned off), and the error status flags are reset at the same time. However, the E^2PROM error flag may not be reset (turned off) and therefore the error status flag will remain on.

n : Address assigned to the master module by the station number setting.

3.8.3 Wire breakage detection

The AJ65BT-68TD detects wire breakage in the thermocouple or compensating conductor used for each channel, and turns on the wire breakage detection flag (RXn8 to RXnF) for the corresponding channel.
On the AJ65BT-68TD, the wire breakage detection are performed for channels that are enabled for conversion.
The relationships between the wire breakage detection and conversion enable/disable are shown below.

Connection status	Conversion enabled/disabled setting	Wire breakage detection flag
 No breakage	Conversion enabled	OFF
	Conversion disabled	
 Breakage	Conversion enabled	ON
	Conversion disabled	OFF
 No connection	Conversion enabled	ON
	Conversion disabled	OFF

POINT

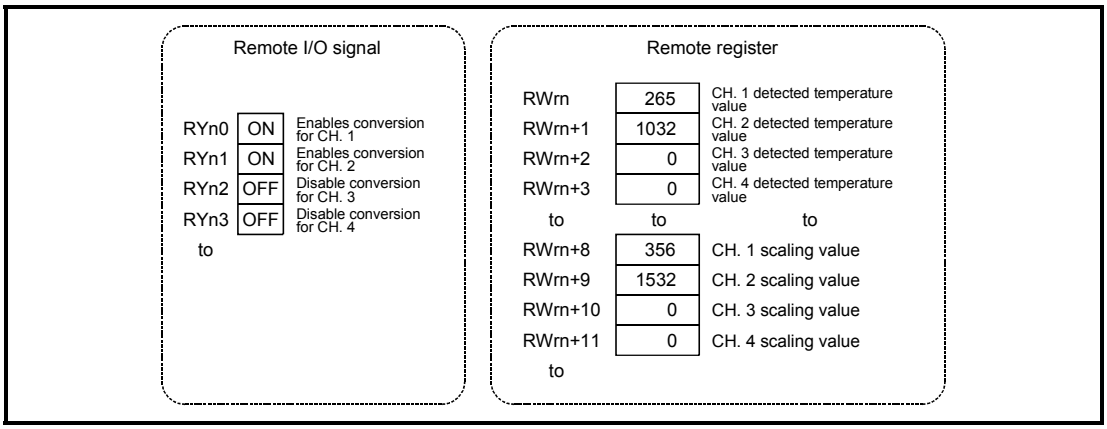
- Be sure to set the channels having no thermocouple attached to "conversion disabled." If a channel having no thermocouple attached is set to "conversion enabled," the wire breakage detection flag will turn on.
- The channels for which wire breakage detection turned on will retain the normal detected temperature value immediately prior to the breakage detection, and the conversion completion flag for the corresponding channel will turn off.
  When the detected breakage is fixed, updating of detected temperature value after repair will be resumed and the conversion completion flag will be turned on again.
- For thermocouple wiring details, refer to Section 4.7.

3.8.4 Conversion enable/disable designation

Conversion may be enabled or disabled for each channel individually.
The setting of the conversion is made through the CH. ☐ conversion enable flags (RYn0 to RYn7).

Setting	Description
ON	Wire breakage detection is conducted at the same time the temperature of the target object is taken.
OFF	Neither temperature detection nor wire breakage detection is conducted.

AJ65BT-68TD



(1) Relationship between conversion enable/disable designation and sampling time

By disabling conversion at the channels not in use, sampling time may be reduced.

<If all channels are conversion enabled>

45 ms × 8 channels = 360 ms (= sampling time)

<If only one channel is conversion enabled>

45 ms × 1 channel = 45 ms (= sampling time)

(2) Changes caused by switching conversion enable/disable designation

<When changed from conversion disabled → enabled>

Sampling of the enabled channels will be commenced.

After the detected temperature values are stored in the remote register, the conversion completion flag is turned on for the corresponding channel.

<When changed from conversion enabled → disabled>

Sampling of the disabled channels will be stopped.

The conversion completion flag is turned off for the corresponding channel.

For the detected temperature value stored in the remote register, the data immediately prior to the disable setting will be retained.

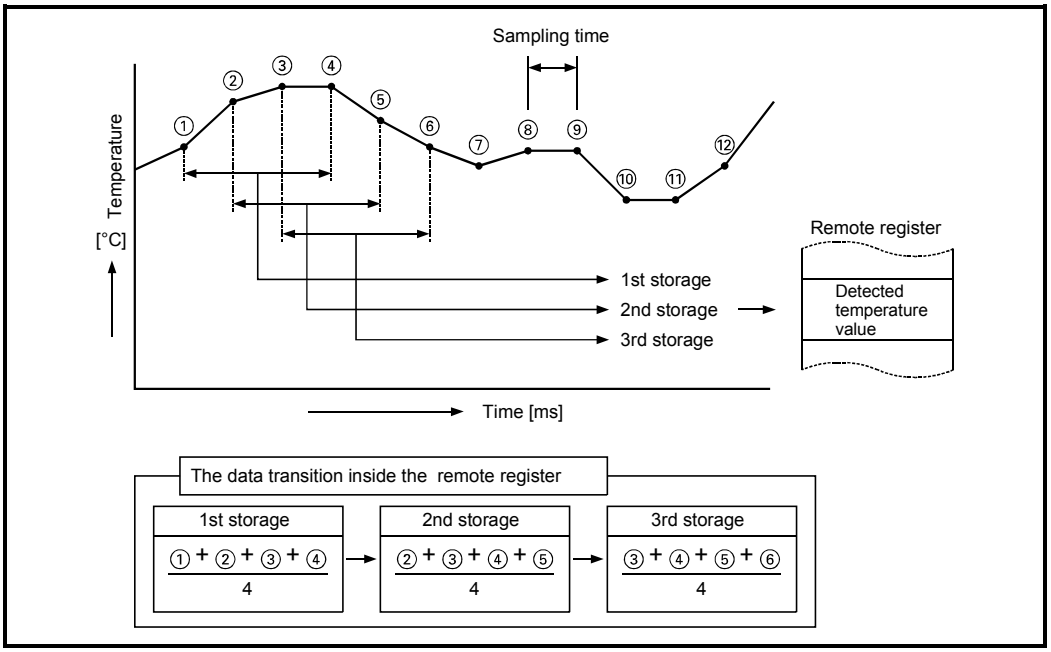
3.8.5 Sampling processing/travel average processing designation

The AJ65BT-68TD may designate sampling processing or travel average processing for each individual channel.
The setting of sampling processing or travel average processing is made through the CH. ☐ sampling processing/travel average processing designation flags (RYn8 to RYnF).

Setting	Description
ON	Travel average processing
OFF	Sampling processing

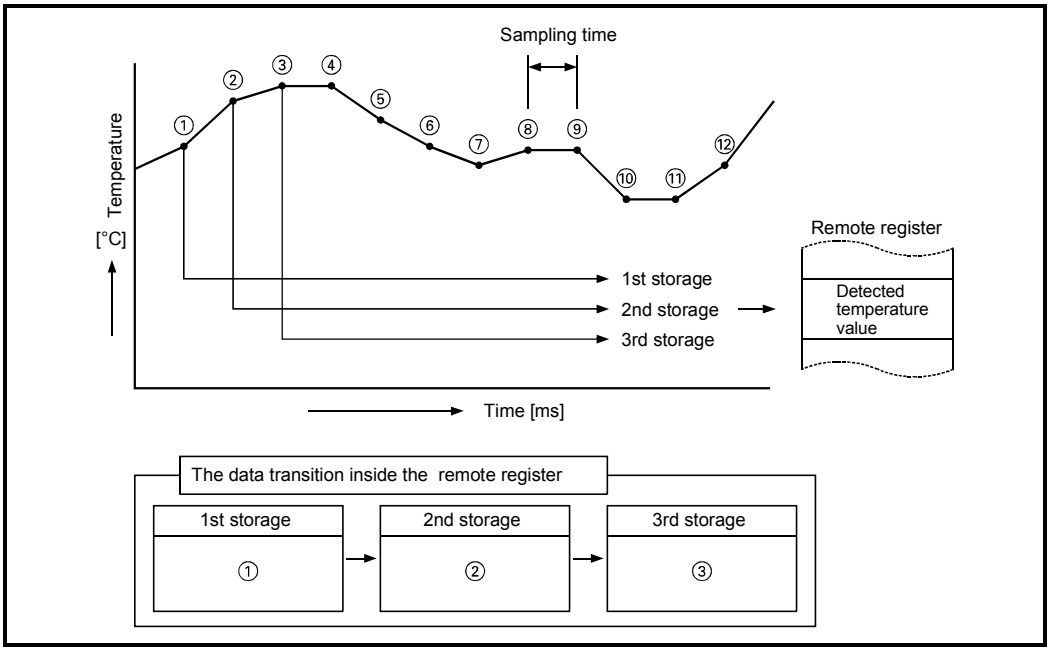
(1) Travel average processing

The average of the four detected temperature values that have been taken during each sampling time (current value + three previous values) is calculated and stored in the remote register.
Also, since the average processing travels for each sampling, the most recent measured temperature value may be obtained.
By using this, a scaling value can be obtained using the detected temperature value that has undergone the average processing and stored in the remote register.



(2) Sampling processing

Stores the detected temperature value and scaling value are stored in the remote register by each sampling time.



(3) Changes caused by altering sampling processing/travel average processing settings

<When changed from sampling processing → travel average processing>

The conversion completion flag is turned off for the corresponding channel.

After an average of four previously detected temperature values is calculated and stored to the remote register, the conversion completion flag for the corresponding channel is turned on.

<When changed from travel average processing → sampling processing>

The conversion completion flag is turned off for the corresponding channel.

After the most recent detected temperature value is stored in the remote register, the conversion completion flag for the corresponding channel is turned on.

3.8.6 Thermocouple type selection

The AJ65BT-68TD can select the thermocouple to use for individual channels or all channels in batch.

(1) When selecting the thermocouple to use for individual channels

The CH. ☐ "K" to "S" type thermocouple selection flags are used to select the thermocouple used for each channel.

Only the flags corresponding to the thermocouple used at each channel are turned on.

The CH. ☐ "K" to "S" type thermocouple selection flags are valid only when the all-channel batch "K" to "S" type thermocouple selection flag shown below is not selected.

Example) When selecting "S" type for the thermocouple used at CH. 1.

CH. ☐ type "K" to "S" thermocouple selection flag	Signal description
CH.1 "K" type thermocouple selection flag	OFF
CH.1 "E" type thermocouple selection flag	
CH.1 "J" type thermocouple selection flag	
CH.1 "T" type thermocouple selection flag	
CH.1 "B" type thermocouple selection flag	
CH.1 "R" type thermocouple selection flag	
CH.1 "S" type thermocouple selection flag	ON

(2) When selecting a thermocouple for all channels in batch

The all-channel batch "K" to "S" type thermocouple selection flag is used to select types of thermocouple to be used by all channels in batch.

Only the flags corresponding to the thermocouple to be used are turned on.

This takes priority over the CH. ☐ "K" to "S" type thermocouple selection flag described above.

POINT

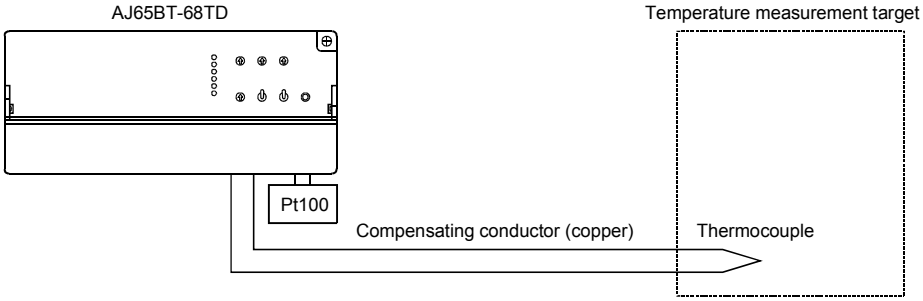
When multiple thermocouple selection flags are turned on with both the CH. ☐ "K" to "S" type thermocouple selection flag and all-channel batch "K" to "S" type thermocouple selection flag, the write data error flag turns on. At the same time, the error status flag will turn on and the previously selected thermocouple types will be retained.

3.8.7 Pt100 cold junction compensation enable/disable designation

The AJ65BT-68TD can designate the enabling/disabling of the cold junction compensation by the Pt100 temperature-measuring resistor.
By designating the enabling/disabling of the cold junction compensation by the Pt100 temperature-measuring resistor, the detected temperature value to be stored in the remote register may be switched between the value obtained using the Pt100 temperature-measuring resistor and not using the Pt100 temperature-measuring resistor (when performing cold junction compensation externally).
The enabling/disabling of cold junction compensation by the Pt100 temperature-measuring resistor is performed using the Pt100 cold junction compensation disable flag (RY (n+5) 7).

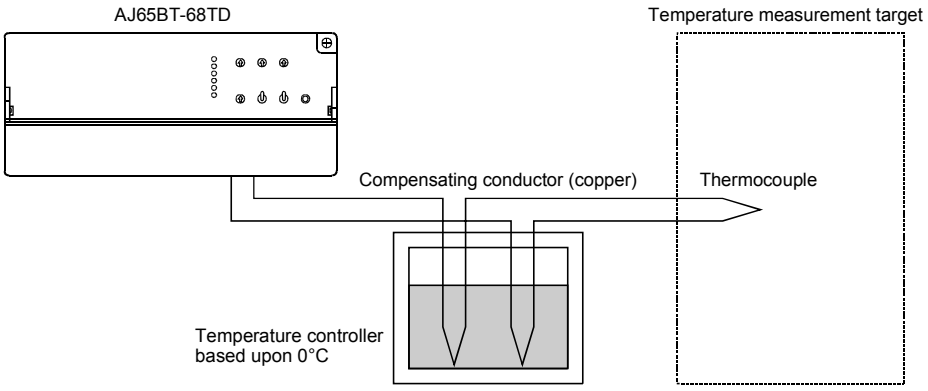
Setting	Description
ON	Do not use the Pt100 temperature-measuring resistor for cold junction compensation.
OFF	Use the Pt100 temperature-measuring resistor for cold junction compensation.

(1) When using the Pt100 temperature-measuring resistor for cold junction compensation
The cold junction compensation is automatically performed by using the Pt100 temperature-measuring resistor supplied with the AJ65BT-68TD.



(2) When performing cold junction compensation externally
Perform the following when the cold junction compensation accuracy (±1 °C) by the Pt100 temperature-measuring resistor supplied with the AJ65BT-68TD may not be ignored as a tolerance. Since the module may be guided without any change in thermal electromotive force generated at the tip of the thermocouple, the cold junction compensation accuracy may be increased by installing a high accuracy temperature controller based upon 0°C* to outside of the module.

* The temperature controller based upon 0°C has a structure in which a thermocouple and lead wire are connected inside a pot, inside of which is maintained at 0°C.
Therefore, the thermal electromotive force generated at the contact point of the thermocouple and contact area of the lead wire is 0 V, preventing the excess thermal electromotive force that leads to errors in readings.



3.9 Remote Register

The AJ65BT-68TD is equipped with remote registers for data communication with the master module. The assignment and data structure of the remote register are explained below.

3.9.1 Remote register assignment

The remote register assignments are shown in the table below.

Communication direction	Address	Description	Default value	Reference section
Master → Remote	RWwm	CH. 1 lower limit value (0.1 °C units)	Measured temperature range for the currently selected thermocouple	Section 3.9.2
	RWwm+1	CH. 1 upper limit value (0.1 °C units)		
	RWwm+2	CH. 2 lower limit value (0.1 °C units)		
	RWwm+3	CH. 2 upper limit value (0.1 °C units)		
	RWwm+4	CH. 3 lower limit value (0.1 °C units)		
	RWwm+5	CH. 3 upper limit value (0.1 °C units)		
	RWwm+6	CH. 4 lower limit value (0.1 °C units)		
	RWwm+7	CH. 4 upper limit value (0.1 °C units)		
	RWwm+8	CH. 5 lower limit value (0.1 °C units)		
	RWwm+9	CH. 5 upper limit value (0.1 °C units)		
	RWwm+10	CH. 6 lower limit value (0.1 °C units)		
	RWwm+11	CH. 6 upper limit value (0.1 °C units)		
	RWwm+12	CH. 7 lower limit value (0.1 °C iunits)		
	RWwm+13	CH. 7 upper limit value (0.1 °C units)		
	RWwm+14	CH. 8 lower limit value (0.1 °C units)		
	RWwm+15	CH. 8 upper limit value (0.1 °C units)		
Remote → Master	RWrn	CH. 1 detected temperature value(0.1 °C units)	0	Section 3.9.3
	RWrn+1	CH. 2 detected temperature value(0.1 °C units)		
	RWrn+2	CH. 3 detected temperature value(0.1 °C units)		
	RWrn+3	CH. 4 detected temperature value(0.1 °C units)		
	RWrn+4	CH. 5 detected temperature value(0.1 °C units)		
	RWrn+5	CH. 6 detected temperature value(0.1 °C units)		
	RWrn+6	CH. 7 detected temperature value(0.1 °C units)		
	RWrn+7	CH. 8 detected temperature value(0.1 °C units)		
	RWrn+8	CH. 1 scaling value		Section 3.9.4
	RWrn+9	CH. 2 scaling value		
	RWrn+10	CH. 3 scaling value		
	RWrn+11	CH. 4 scaling value		
	RWrn+12	CH. 5 scaling value		
	RWrn+13	CH. 6 scaling value		
	RWrn+14	CH. 7 scaling value		
	RWrn+15	CH. 8 scaling value		

m,n : Address assigned to the master module by the station number setting

3.9.2 High and low limit settings

The AJ65BT-68TD can set the measured temperature range (upper and lower limits) for each channel to the remote register (RWwm to RWwm+15)
The value of the detected temperature value range for the thermocouple set by the thermocouple selection flag is used by default.
However, since this is a write-only remote register, the set upper and lower limit values cannot be read.

(1) Upper and lower limit value setting range

Thermocouple type	Default value		Possible upper and lower limit value setting range
	Lower limit	Upper limit	
K	-2000	12000	-2000 to 12000
E	-2000	8000	-2000 to 8000
J	0	7500	0 to 7500
T	-2000	3500	-2000 to 3500
B	6000	17000	6000 to 17000
R	0	16000	0 to 16000
S	0	16000	0 to 16000

(2) Setting/changing methods for the upper and lower limit values

- When setting the upper and lower limits
  After writing desired values to the remote register, perform power on or hardware reset. The values are set when the initial data processing request flag turns on.
  After the changes, turn on the initial data processing completion flag.
- Changing the upper and lower limits
  After writing desired values to the remote register, the values are changed by turning on the initial data setting request flag.
  After the changes, the initial data setting completion flag will turn on.

POINT

- If the measured values are not within the upper and lower limit range, the measurement range over flag is turned on for the corresponding channel.
  When the detected temperature value returns to within the upper and lower limit range, the measurement range over flag is reset (turned off) automatically.
- When a value outside the measured temperature range is written, or the values for upper and lower limits are switched (upper limit value ≤ lower limit value), a setting error occurs and a write data error flag is turned on for the corresponding channel. At the same time, the error status flag is turned on.

3.9.3 Detected temperature value

The measurable temperature range for the AJ65BT-68TD is between -200 °C and 1700 °C.
The temperature read by each channel is converted to a detected temperature value that has undergone the linearize processing and cold junction compensation, and stored to the remote register.
The detected temperature value is measured to one decimal place and multiplied by 10, then stored as a 16-bit signed BIN data.
If the detected temperature value is negative, it is stored as a complement of 2.

<When the detected temperature value is 123.025 [°C] ····· 1230 is stored.>

b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
0	0	0	0	0	1	0	0	1	1	0	0	1	1	1	0

<When the detected temperature value is -123.025 [°C] ····· -1230 is stored.>

b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
1	1	1	1	1	0	1	1	0	0	1	1	0	0	1	0

3.9.4 Scaling value

The detected temperature value will be scaled to a value of 0 to 2000 within the set upper and lower limit range, and stored.
The scaling value is stored as a 16-bit signed BIN data. Also, when processing the travel average, the scaling value will be travel-averaged.

<When the scaling value is 1230 ····· 1230 is stored.>

b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
0	0	0	0	0	1	0	0	1	1	0	0	1	1	1	0

The calculation method for scaling value is shown below.

$$\text{Scaling value} = \frac{\text{Detected temperature value} - \text{Lower limit value}}{\text{Upper limit value} - \text{Lower limit value}} \times 2000$$

Example) If the high and low value setting range for the measured temperature of CH1 is 0 °C to 2000 °C (lower limit 0, upper limit 12000) and 100 °C (detected temperature value 1000) is to be scaled:

$$\text{Scaling Value} = \frac{1000 - 0}{1200 - 0} \times 2000 = 1666.6 \cdots$$

The first decimal digit will be rounded.

$$= 1667$$

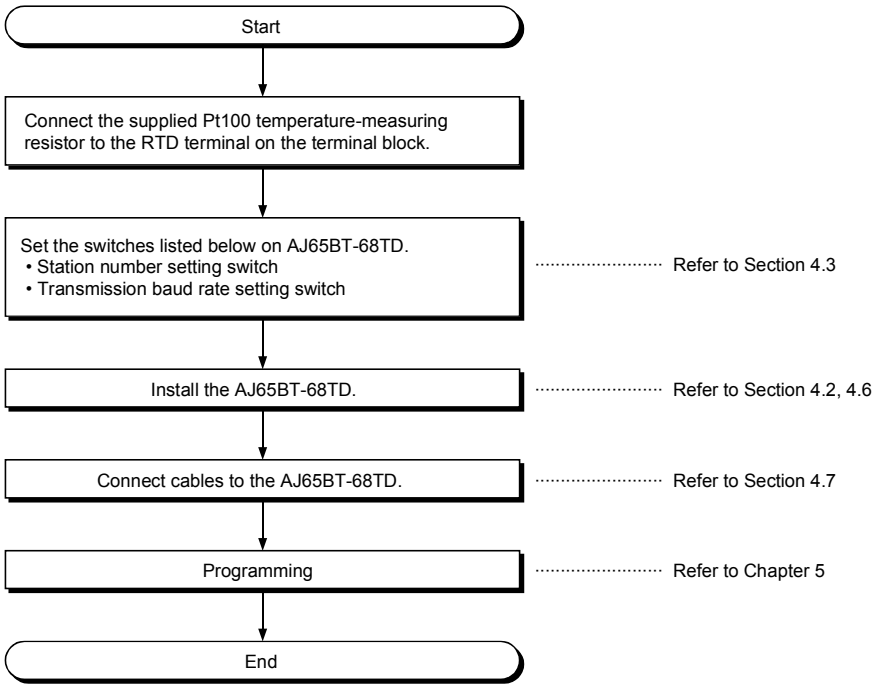
Stored in the remote register.

4. SETTING AND PROCEDURE BEFORE OPERATION

The procedure before operation of AJ65BT-68TD, part identification and setting, and the wiring method are explained below.

4.1 Procedure before Operation

The procedure before operation of AJ65BT-68TD is explained below.



4.2 Handling Precautions

The handling precautions for AJ65BT-68TD is explained below.

⚠CAUTION

- Securely fix the module with a DIN rail or mounting screws. Tighten the screws within the specified torque range.
  Undertightening can cause drop of the screw, short circuit or malfunction.
  Overtightening can damage the screw and/or module, resulting in drop, short circuit, or malfunction.
- For protection of the switches, do not remove the cushioning material before installation.
- Do not directly touch any conductive part of the module.
  Doing so can cause malfunction or failure of the module.
- Tighten the terminal screw within the specified torque range.
  Undertightening can cause short circuit or malfunction.
  Overtightening can damage the screw and/or module, resulting in drop, short circuit, or malfunction.
- Prevent foreign matter such as dust or wire chips from entering the module.
  Such foreign matter can cause a fire, failure, or malfunction.
- Do not touch any terminal while power is on.
  Doing so may cause malfunction.
- Do not disassemble or modify the modules.
  Doing so may cause failure, malfunction, injury, or a fire.
- Do not drop or apply strong shock to the module.
  Doing so may damage the module.
- Shut off the external power supply for the system in all phases before mounting or removing the module to or from the panel.
  Failure to do so may cause the module to fail or malfunction.
- When disposing of this product, treat it as an industrial waste.
- Before handling the module, touch a grounded metal object to discharge the static electricity from the human body.
  Failure to do so may cause the module to fail or malfunction.

(1) Tighten the module mounting screws and terminal block screws within the following ranges.

Screw area	Tightening torque range
Module installation screws (M4 screw)	0.78 to 1.18 N • m
Terminal block terminal screws (M3.5 screw)	0.59 to 0.88 N • m
Terminal bolck installation screws (M4 screw)	0.98 to 1.37 N • m

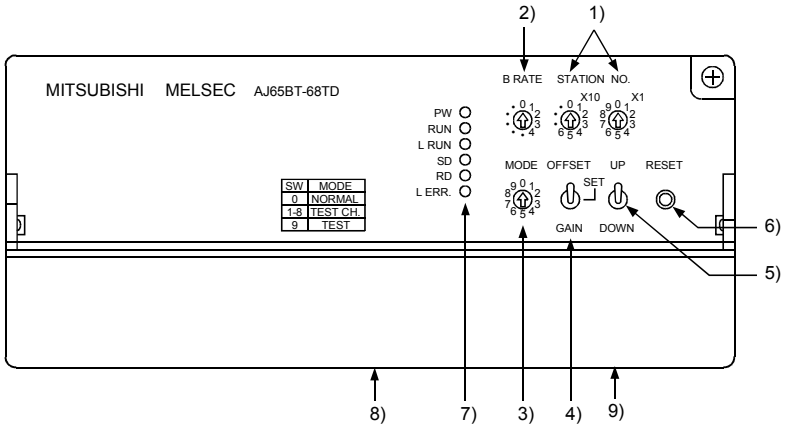
(2) When using a DIN rail adapter, install the DIN rail considering the precautions described below.

(a) Applicable DIN rail types (conform to JIS C 2812)
TH35-7.5Fe
TH35-7.5Al
TH35-15Fe

(b) Space between DIN rail installation screws
When installing a DIN rail, tighten the screws with a space of less than 200 mm (7.9 in.).

4.3 Part Identification and Setting

The part identification and setting method for AJ65BT-68TD is explained below.



No.	Name	Description
1)	Station setting switch STATION NO. ×10 ×1	Sets the station number of AJ65BT-68TD in the range of 1 to 61. " × 10" sets the ten's place for a station number. " × 1" sets the one's place for a station number. (Factory setting : 0)
2)	Transmission baud rate setting switch B RATE	Sets the transmission speed of AJ65BT-68TD (for data link).

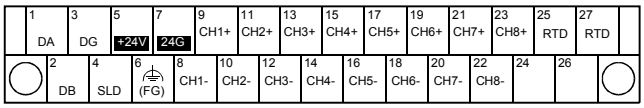
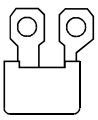
Setting No.	Transmission baud rate
0	156 kbps (factory setting)
1	625 kbps
2	2.5 Mbps
3	5 Mbps
4	10 Mbps
Other than 0 to 4	Unused (if a number other than 0 to 4 is used, the "L. ERR" LED is lit and communication error occurs.)

3) Mode switch
MODE

0	NORMAL	During a normal operation, select this to end the test mode. (Factory setting)
1 to 8	TEST CH.	At a test mode, select a channel to perform error compensation.
9	TEST	When executing error compensation, select TEST to enter the test mode after 2 seconds.

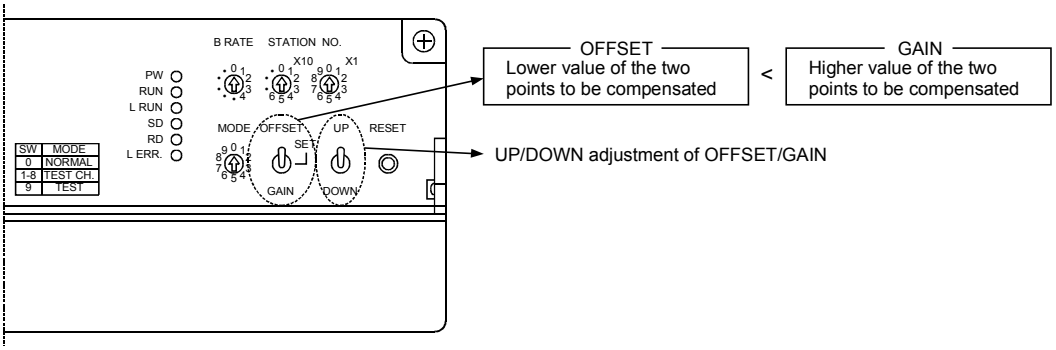
4) Offset/gain setting switch
OFFSET
SET
GAIN

OFFSET	Compensation mode of offset value
GAIN	Compensation mode of gain value
SET	Store the detected temperature value when the position is switched from OFFSET/GAIN to SET as an offset value/gain value, in the internal memory of AJ65BT-68TD.

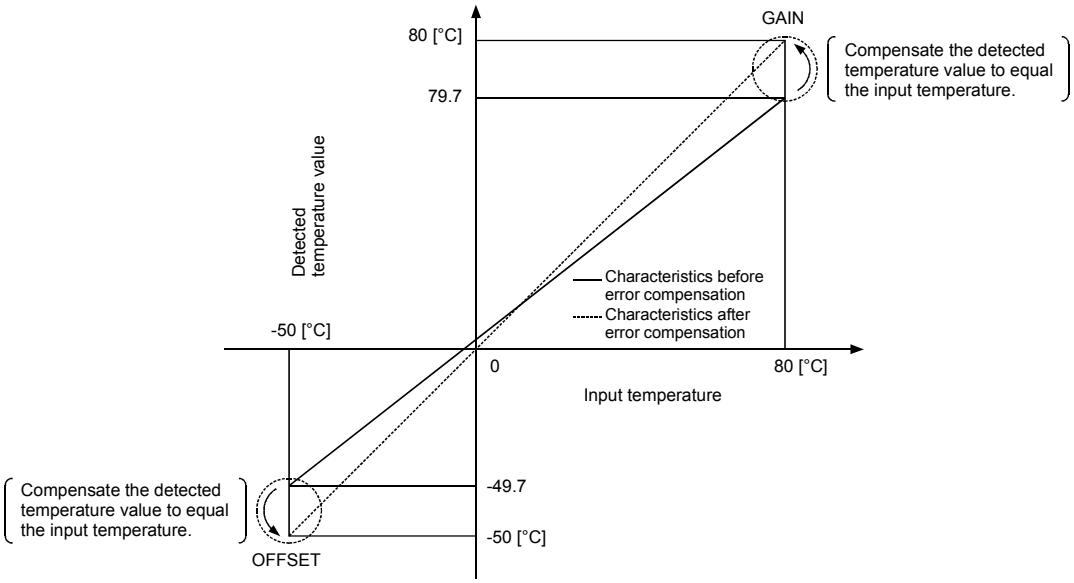
<table>
<tr><th>No.</th><th>Name</th><th>Description</th></tr>
<tr><td>5)</td><td>UP/DOWN switch
UP
 
DOWN</td><td>Increase/decrease the offset value/gain value of the channel selected by the mode switch.
ON for less than 1.5 seconds : increase/decrease 0.025 °C at a time.
ON for more than 1.5 seconds : increase/decrease 0.1 °C per 0.04 seconds.</td></tr>
<tr><td>6)</td><td>Reset switch
RESET
  </td><td>Hardware reset
Initialize the remote register and operation processing of AJ65BT-68TD.
The initial data processing request flag turns on by turning the switch on.</td></tr>
<tr><td>7)</td><td>LED for operation status display
PW ○
RUN ○
L RUN ○
SD ○
RD ○
L ERR. ○</td><td>
<table>
<tr><td>PW</td><td colspan="2">ON : Power is on
OFF : Power is off</td></tr>
<tr><td rowspan="2">RUN</td><td>Normal mode</td><td>ON : Normal operation
Flicker : Read data error occurred
OFF : 24 V DC power failure or WDT error</td></tr>
<tr><td>Test mode</td><td>Flickers : When the offset/gain setting switch is set at OFFSET or GAIN
Flickers at 0.5-second intervals during normal error compensation
Flickers at 0.1-second intervals when the following invalid error compensation has been attempted:
• A temperature conversion value out of the temperature input range was set.
• Setting was made so that the gain value minus the offset value is smaller than 10°C.
(* In this case, the offset or gain value will not be set even if the offset/gain setting switch is set at SET.)
OFF: The offset/gain setting switch is set at SET</td></tr>
<tr><td>L RUN</td><td colspan="2">ON : Normal communication
OFF : Communication disconnected (time over error)</td></tr>
<tr><td>SD</td><td colspan="2">Turns on during data transmission</td></tr>
<tr><td>RD</td><td colspan="2">Turns on during data receiving</td></tr>
<tr><td>L ERR.</td><td colspan="2">ON : Communication data error (CRC error)
Station number, baud rate switch setting error
Flicker : Station number or baud rate switch is changed
OFF : Normal communication</td></tr>
</table>
</td></tr>
<tr><td>8)</td><td>Terminal block</td><td> 
</td></tr>
<tr><td>9)</td><td>Temperature-measuring resistor Pt 100
  </td><td>The temperature-measuring resistor to measure the terminal block temperature. (Supplied with the module)</td></tr>
</table>

4.4 Error Compensation by the Offset Value/Gain Value Setting

The AJ65BT-68TD error compensation is a function that compensates values at arbitrary 2 points (offset value/gain value) within the usage temperature range at system startup or when a correct temperature cannot be detected.
The error compensation is executed by reading the detected temperature value in the remote register using a sequence program and monitoring the values using a peripheral device.



The following shows the characteristic of detected temperature value with respect to the input temperature.



* The error compensation may be executed using a standard DC voltage generator instead of inputting the temperature directly to a thermocouple.

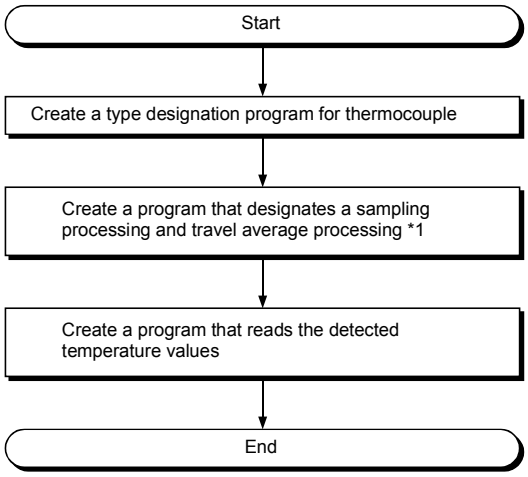
Power value of a standard DC voltage generator	=	Thermal electromotive force of a thermocouple with respect to the input temperature to be the offset value/gain value.

POINT

- The offset value/gain value can be obtained with a high accuracy when error compensation is carried out at the minimum and maximum temperatures in the range used.
- Set the offset value/gain value while reading the detected temperatures values.
- Always set the offset and gain values within the allowable temperature input range so that the gain value minus offset value is greater than or equal to 10°C.
  If an invalid error compensation (out of allowable temperature input range, gain value minus offset value is smaller than 10°C) is performed, the RUN LED flickers at a high speed (at 0.1 second intervals) and the offset value/gain value will not be set even if the offset value/gain value setting switch is set at SET.
- The offset value and gain value are stored inside AJ65BT-68TD and are not erased even at power off.

4.4.1 Initial settings for error compensation

The following shows the initial settings using a program designed for executing error compensation.



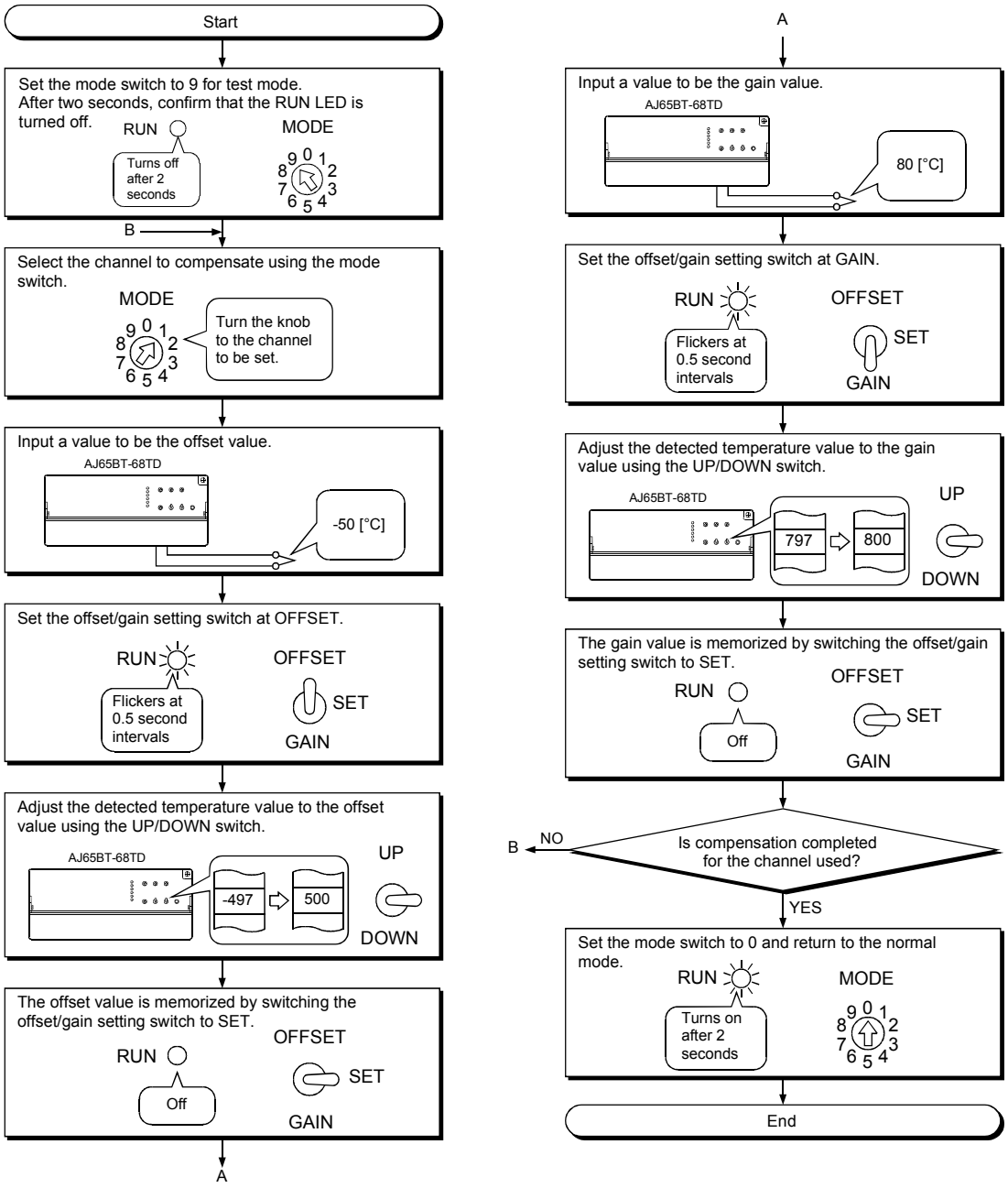
*1 Only when executing error compensation with the value detected by travel average processing.

POINT

- Perform the initial settings for error compensation prior to entering the test mode (at normal mode).
- During the test mode, disable the designation of the conversion enable/disable specification flag, and enable conversion for the automatically selected channels and disable for the unselected channels.

4.4.2 Error compensation procedure

The following shows the flow of error compensation.



POINT

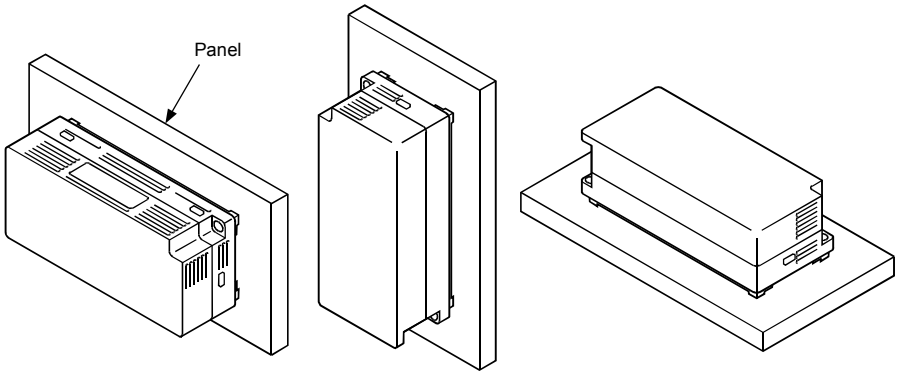
Once an offset value or gain value is set in the test mode, the set value cannot be confirmed (the set value is retained in the internal memory.)

4.5 Station Number Setting

The buffer memory address of the master module in which control I/O signal information and read/write data are stored, is determined depending on the station number setting on the AJ65BT-68TD.
For details, refer to AJ61BT11/A1SJ61BT11 CC-Link System Master Local Module User's Manual or AJ61QBT11/A1SJ61QBT11 CC-Link System Master Local Module User's Manual.

4.6 Orientation of Module Installation

The following shows the possible orientation for AJ65BT-68TD installation.



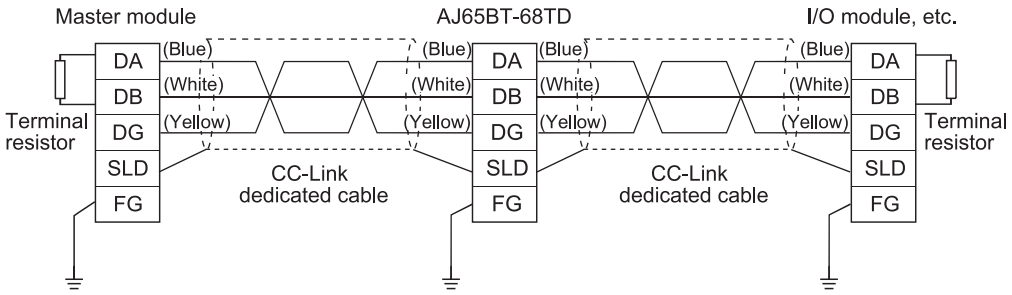
When installing alongside the panel

When installing on the panel

4.7 Wiring

4.7.1 Wiring example with CC-Link modules

The following shows the connection between the AJ65BT-68TD and master module using twisted cables.



POINT

For the modules at both ends of the data link, make sure to connect the "terminal resistor" that is attached to a master module (connect between DA and DB).

4.7.2 Precautions when wiring to a thermocouple

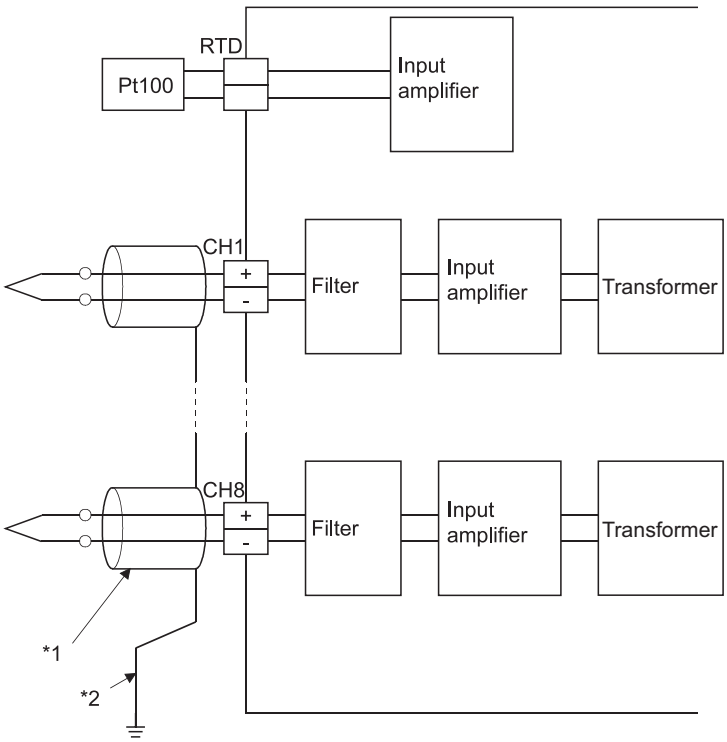
To obtain maximum performance from the functions of AJ65BT-68TD and improve the system reliability, a wiring with high durability against noise is required. The following describes the external wiring precautions.

(1) Use separate cables for the AC and the external input signals of the AJ65BT-68TD, in order not to be affected by the AC side surge or conductivity.

(2) Always place a thermocouple at least 10 cm (3.94 in.) apart from the main circuit line and AC control circuit line. Place a thermocouple sufficiently apart from circuits with high frequency, such as high-voltage lines and inverter load main circuits. If they are placed close to each other, the thermocouple is influenced more easily by the noise, surge, or conductivity.

4.7.3 Wiring example with thermocouple

The following shows the wiring example between AJ65BT-68TD and thermocouple.



*1 Be sure to use the shielded compensating conductor for the cable.

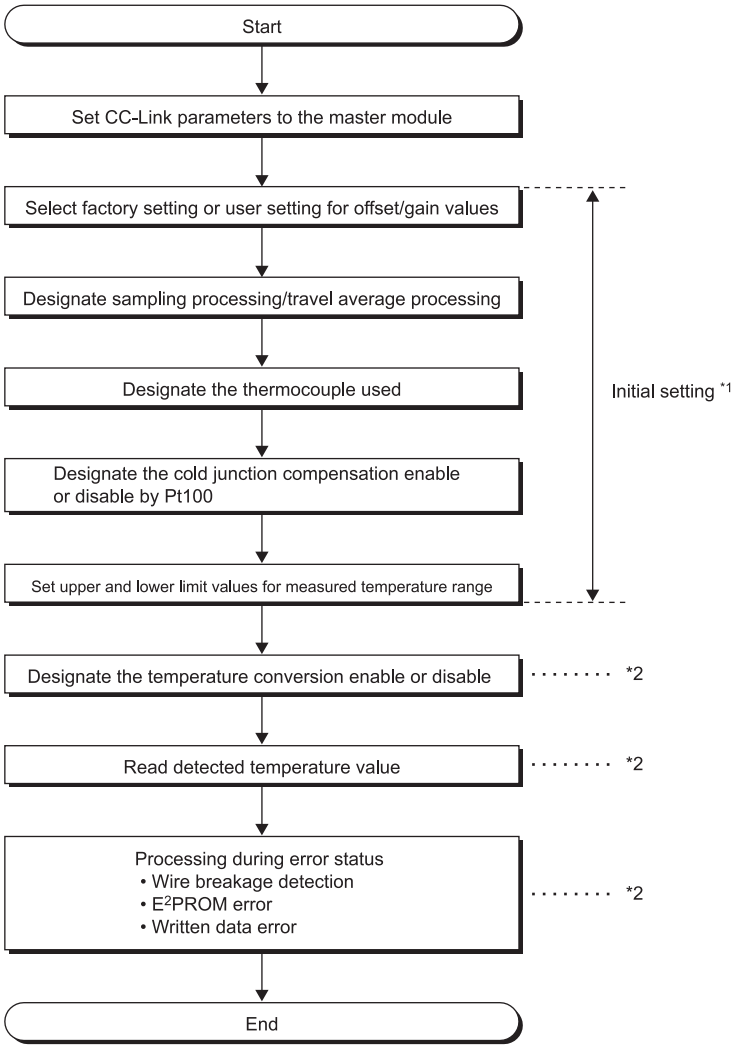
*2 Be sure to ground.

5. PROGRAMMING

The programming procedure, basic programming for read and write, as well as programming examples are explained below.
When utilizing the program examples introduced in this chapter for an actual system, fully verify that controllability in the target system has no problems.
Refer to the user's manual (details) of the master module used for the master module, to Section 3.9 for the remote registers, and to the AnSHCPU/AnACPU/AnUCPU/QCPU-A (A mode) programming manual (dedicated Instructions) for details of the dedicated instructions.

5.1 Programming Procedure

Create a program that operates the AJ65BT-64RD connected to the master module in the following procedure:



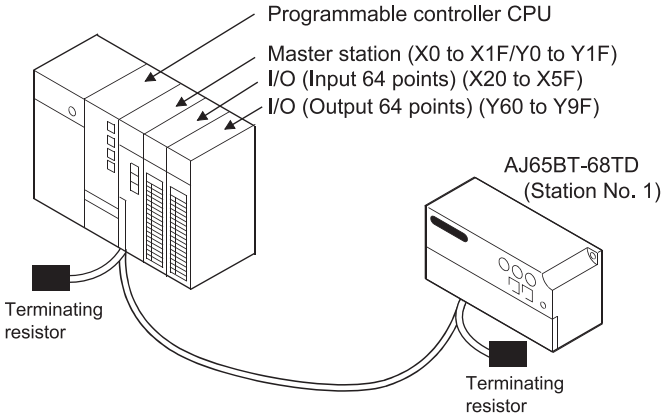
*1 When the QCPU (Q mode) is used, initial setting can be made by the remote device station initialization procedure registration function. When the ACPU, QCPU (A mode) or QnACPU is used, use a sequence program to make the setting.

*2 Setting cannot be made by the remote device station initialization procedure registration function. Use a sequence program to make the setting.

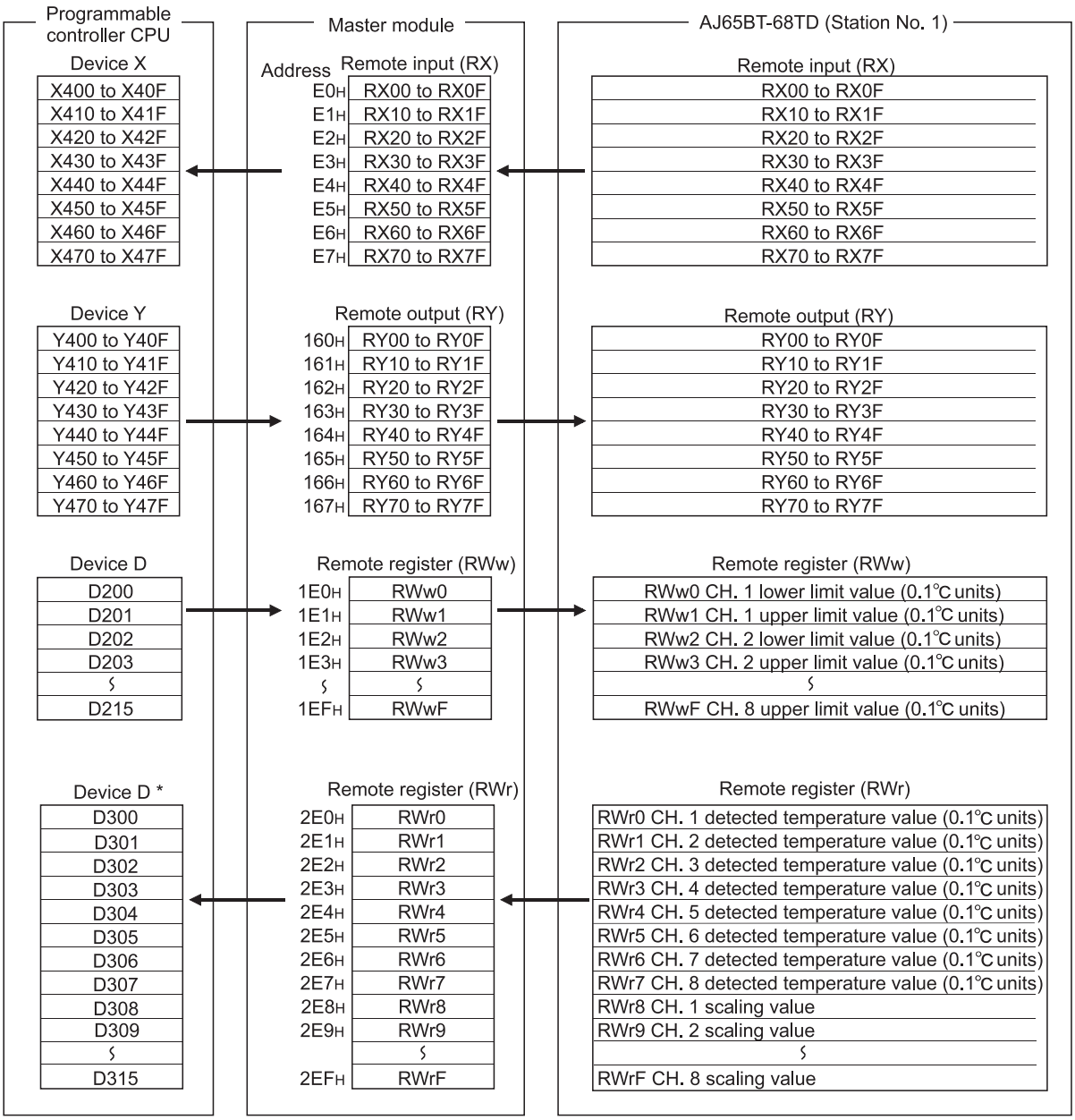
5.2 Program Example Conditions

The program examples given in this chapter have been created under the following conditions.

(1) System configuration



(2) Relationships between programmable controller CPU, master module and AJ65BT-68TD



* RWr0 to RWrF are assigned to D456 to D471 in the program example that uses the RRPA instruction (auto refresh parameter setting) on the ACPU/QCPU (A mode) (Refer to Section 5.5).

POINT

Depending on the used CPU module, the devices used in the program examples of this chapter may not be applicable. For the device setting ranges, refer to the user's manual of the used CPU module.

For example, when the A1SCPU is used, devices X100, Y100 and later are not applicable. Use devices such as B and M.

(3) Initial setting

Setting item	Description
CH. 1 sampling processing/travel average processing designation flag (RY08)	Travel average processing
CH. 2 sampling processing/travel average processing designation flag (RY09)	Travel average processing
All CH. batch “K” type thermocouple selection flag (RY50)	“K” type thermocouple for all channels
Pt100 cold junction compensation disable flag (RY57)	Cold junction compensation is performed by the Pt100 temperature-measuring resistor.
Offset/gain value selection flag (RY77)	Factory setting
CH.1 Lower limit value (0.1°C units) (RWw0)	0
CH.1 Upper limit value (0.1°C units) (RWw1)	5000
CH.2 Lower limit value (0.1°C units) (RWw2)	0
CH.2 Upper limit value (0.1°C units) (RWw3)	5000

(4) Other settings

Setting item	Description
CH. 1 conversion enable flag (RY00)	Conversion enable
CH. 2 conversion enable flag (RY01)	Conversion enable

5.3 Program Examples when QCPU (Q Mode) Is Used

The network parameters and auto refresh parameters have been set by GX Developer.
Initial setting can be made easily by using the remote device station initialization procedure registration function.

(1) Parameter setting

(a) Network parameter setting

	1
Start I/O No	0000
Operational setting	Operational settings
Type	Master station
Master station data link type	PLC parameter auto start
Mode	Remote net(Ver.1 mode)
All connect count	1
Remote input(RX)	
Remote output(RY)	
Remote register(RWr)	
Remote register(RWw)	
Ver.2 Remote input(RX)	
Ver.2 Remote output(RY)	
Ver.2 Remote register(RWr)	
Ver.2 Remote register(RWw)	
Special relay(SB)	
Special register(SW)	
Retry count	3
Automatic reconnection station count	1
Stand by master station No.	
PLC down select	Stop
Scan mode setting	Asynchronous
Delay infomation setting	0
Station information setting	Station information
Remote device station initial setting	Initial settings
Interrupt setting	Interrupt settings

Station No.	Station type	Expanded cyclic setting	Exclusive station count	Remote station points	Reserve/invalid station select	Intelligent buffer select(word)		
						Send	Receive	Automatic
1/ 1	Remote device station	single	Exclusive station 4	128 points	No setting			

(b) Auto refresh parameter setting

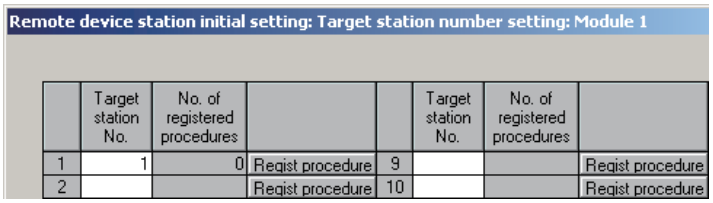
	1
Start I/O No	0000
Operational setting	Operational settings
Type	Master station
Master station data link type	PLC parameter auto start
Mode	Remote net(Ver.1 mode)
All connect count	1
Remote input(RX)	X400
Remote output(RY)	Y400
Remote register(RWr)	D300
Remote register(RWw)	D200
Ver.2 Remote input(RX)	
Ver.2 Remote output(RY)	
Ver.2 Remote register(RWr)	
Ver.2 Remote register(RWw)	
Special relay(SB)	SB0
Special register(SW)	SW0
Retry count	3
Automatic reconnection station count	1
Stand by master station No.	
PLC down select	Stop
Scan mode setting	Asynchronous
Delay infomation setting	0
Station information setting	Station information
Remote device station initial setting	Initial settings
Interrupt setting	Interrupt settings

(2) Initial setting by remote device station initialization procedure registration function

(a) Target station number setting

Set the target station number of initial setting.

Set the target station number to "1".



(b) Procedure registration setting

The initial setting is registered to the AJ65BT-68TD when the initial data processing request flag (RX78) turns ON and Remote device station initialization procedure registration (SB0D) is set.

The following table indicates the setting results of the initial setting.

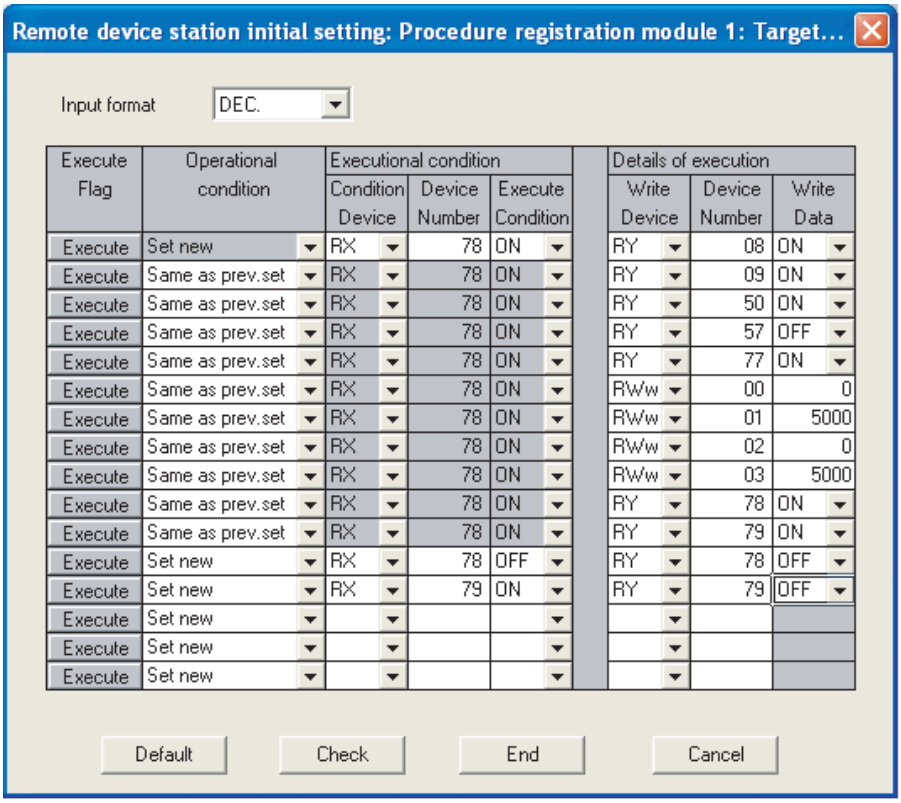
Procedure execution condition	Execution
Initial data processing request flag (RX78) turns ON	CH. 1 sampling processing/travel average processing designation flag is set to the travel average processing. (RY08: ON)
	CH. 2 sampling processing/travel average processing designation flag is set to the travel average processing. (RY09: ON)
	All CH. batch thermocouple selection flag is set to “K” type thermocouple for all channels. (RY50: ON)
	Pt100 cold junction compensation disable flag is set up to enable cold joint compensation by RTD Pt100. (RY57: OFF)
	Offset/gain value selection flag is set to the factory setting. (RY77: ON)
	CH.1 Lower limit value (0.1℃ units) is set to 0. (RWw0: 0)
	CH.1 Upper limit value (0.1℃ units) is set to 5000. (RWw1: 5000)
	CH.2 Lower limit value (0.1℃ units) is set to 0. (RWw2: 0)
	CH.2 Upper limit value (0.1℃ units) is set to 5000. (RWw3: 5000)
	Initial data processing completion flag (RY78) is turned ON.
	Initial data setting request flag (RY79) is turned ON.
Initial data processing request flag (RX78) turns OFF	Initial data processing completion flag (RY78) is turned OFF.
Initial data setting completion flag (RX79) turns ON	Initial data setting request flag (RY79) is turned OFF.

POINT

(1) When the remote device station initialization procedure registration command (SB000D) is turned OFF after initial processing, all the RY signals that turned ON in the initial procedure registration turn OFF. Hence, turn ON the "CH. ☐ conversion enable flag" in a sequence program.

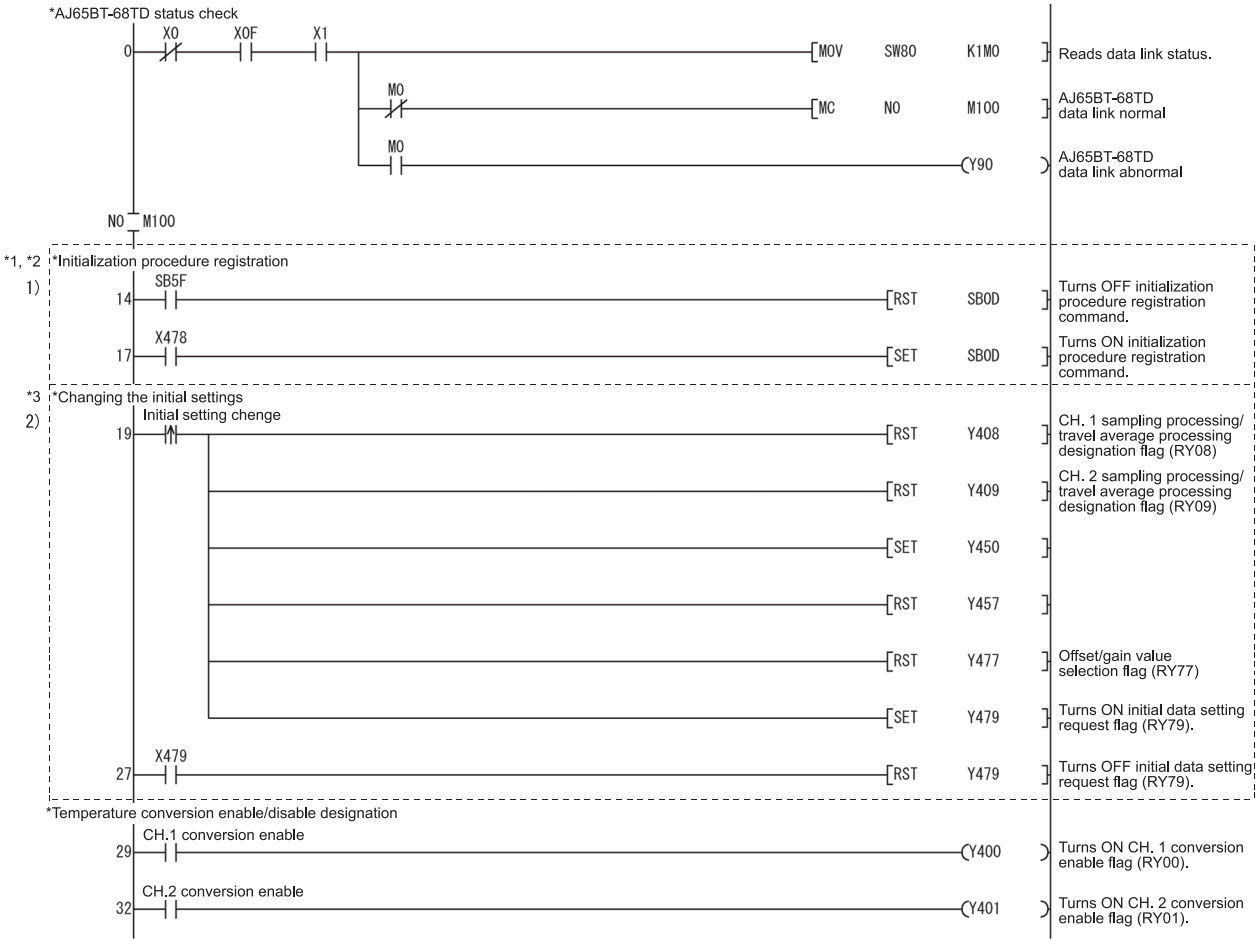
(2) When the initial setting (CH. ☐ sampling processing/travel average processing designation flag, CH. ☐ thermocouple selection flag, all CH. batch thermocouple selection flag, Pt100 cold junction compensation disable flag, offset/gain selection flag) is changed, the remote device station initialization procedure registration function cannot be used.
Use a sequence program to change the initial setting.

(c) Setting result
The setting result is shown below.



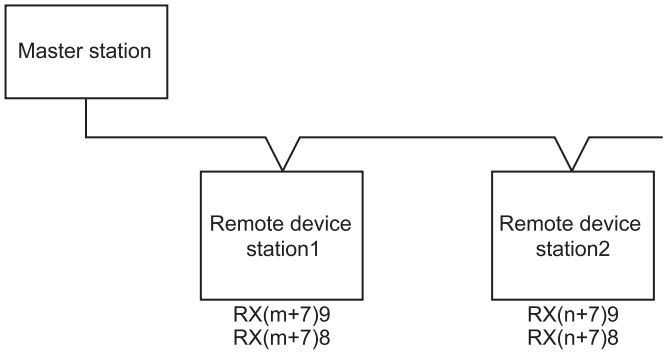
Execute Flag	Operational condition	Condition Device	Device Number	Execute Condition	Write Device	Device Number	Write Data
Execute	Set new	RX	78	ON	RY	08	ON
Execute	Same as prev.set	RX	78	ON	RY	09	ON
Execute	Same as prev.set	RX	78	ON	RY	50	ON
Execute	Same as prev.set	RX	78	ON	RY	57	OFF
Execute	Same as prev.set	RX	78	ON	RY	77	ON
Execute	Same as prev.set	RX	78	ON	RWw	00	0
Execute	Same as prev.set	RX	78	ON	RWw	01	5000
Execute	Same as prev.set	RX	78	ON	RWw	02	0
Execute	Same as prev.set	RX	78	ON	RWw	03	5000
Execute	Same as prev.set	RX	78	ON	RY	78	ON
Execute	Same as prev.set	RX	78	ON	RY	79	ON
Execute	Set new	RX	78	OFF	RY	78	OFF
Execute	Set new	RX	79	ON	RY	79	OFF
Execute	Set new						
Execute	Set new						
Execute	Set new						

(3) Program example

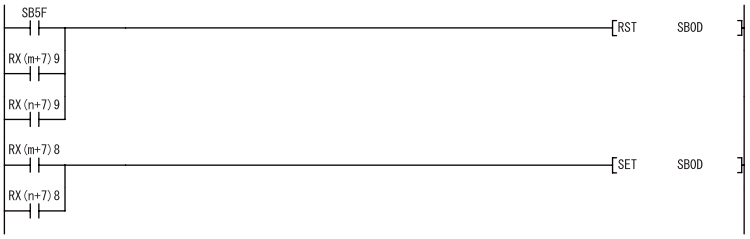


*1: When making remote device station initialization procedure registration to multiple stations, correct the program within the dotted line 1) as shown below.

[System configuration]



[Corrected program]



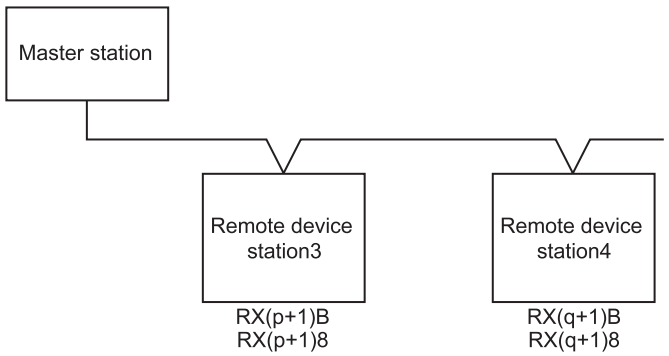
- RX(m+7)9 and RX(n+7)9 are initial data setting completion flags.
- RX(m+7)8 and RX(n+7)8 are initial data processing request flags.

Insert the remote READY and initial data processing request flags for all the stations, to which the remote device station initialization procedure registration has been made, into the program.

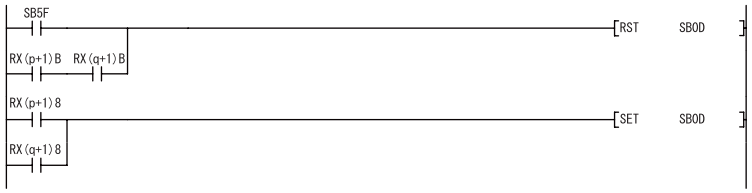
[Usage in combination with other remote device stations]

(1) Depending on the remote device stations to be used, the program enclosed by the dotted line 1) has two programming patterns as shown in the above and the below figures.
(To check which pattern can be used, refer to the manual for the remote device to be used.)

[System configuration]



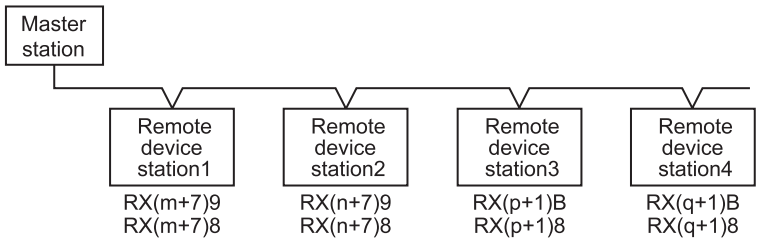
[Corrected program]



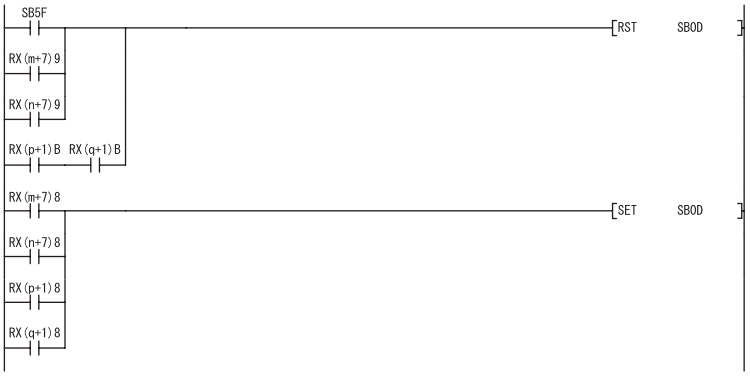
- RX(p+1)B and RX(q+1)B are remote READY.
- RX(p+1)8 and RX(q+1)8 are initial data processing request flags.

(2) When using the program enclosed by the dotted line 1) in combination with other remote device stations, correct the program as shown below.

[System configuration]



[Corrected program]

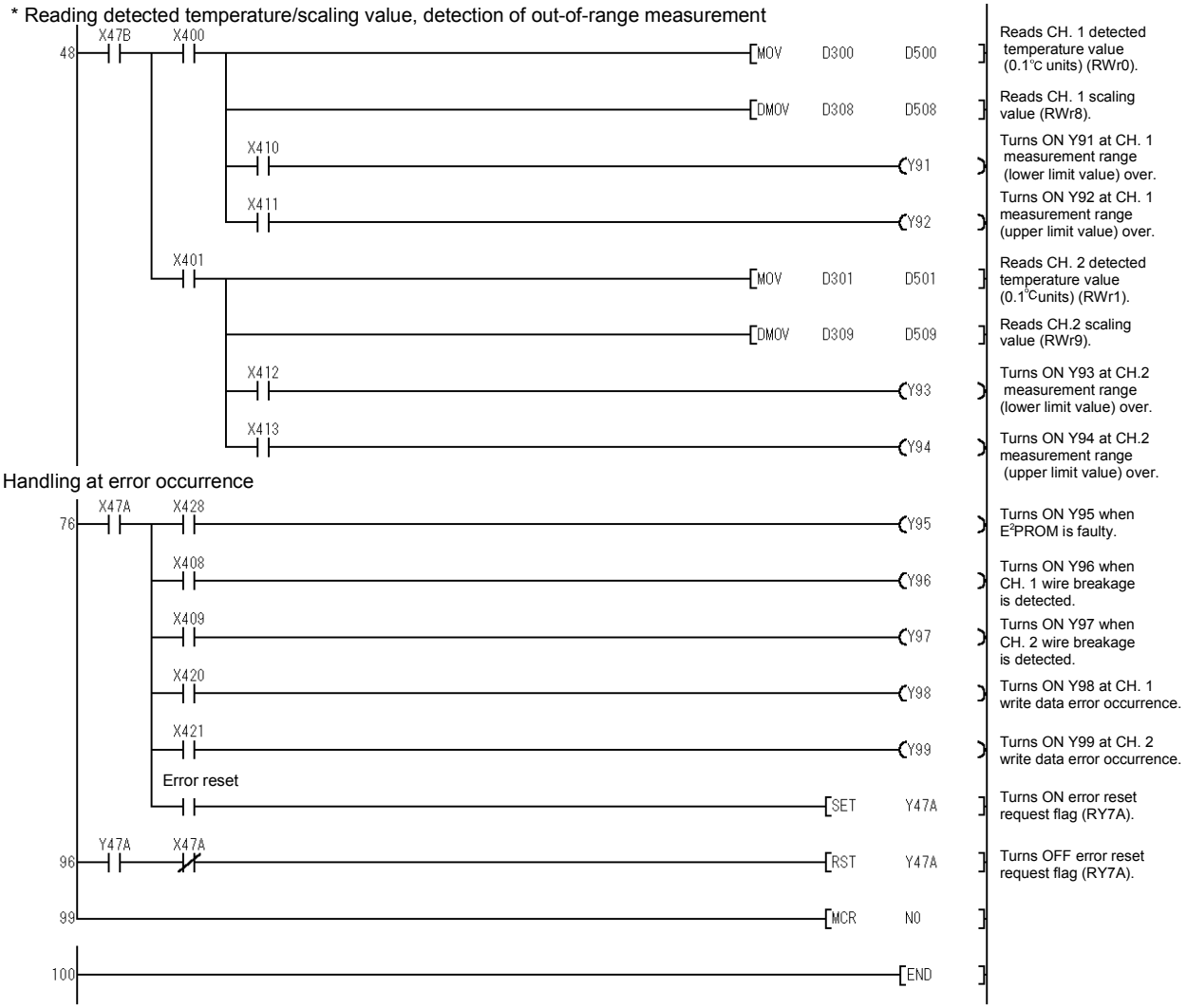


Note that the master module can register the initialization procedure of only the specified station out of the multiple remote device stations.
The master module supporting this function is the QJ61BT11N which serial No's first 5 digits is 08032 or later.
Fro details, refer to the CC-Link System Master/Local Module User's Manual, "CHAPTER 4 FUNCTIONS"

*2: Before the communication program is executed with remote device stations, the program enclosed by the dotted line 1) enables the initial setting by using the SB0D (remote device station initialization procedure registration instruction) and SB5F (completion status of remote device station initialization procedure). Initialization processing can't be made only by the parameter setting of GX Developer.

*3: The program enclosed by the dotted line 2) is necessary only when the initial settings are changed.

* Reading detected temperature/scaling value, detection of out-of-range measurement



5.4 Program Examples when QnACPU Is Used

The network parameters and auto refresh parameters have been set by GX Developer.

(1) Parameter setting

(a) Network parameter setting

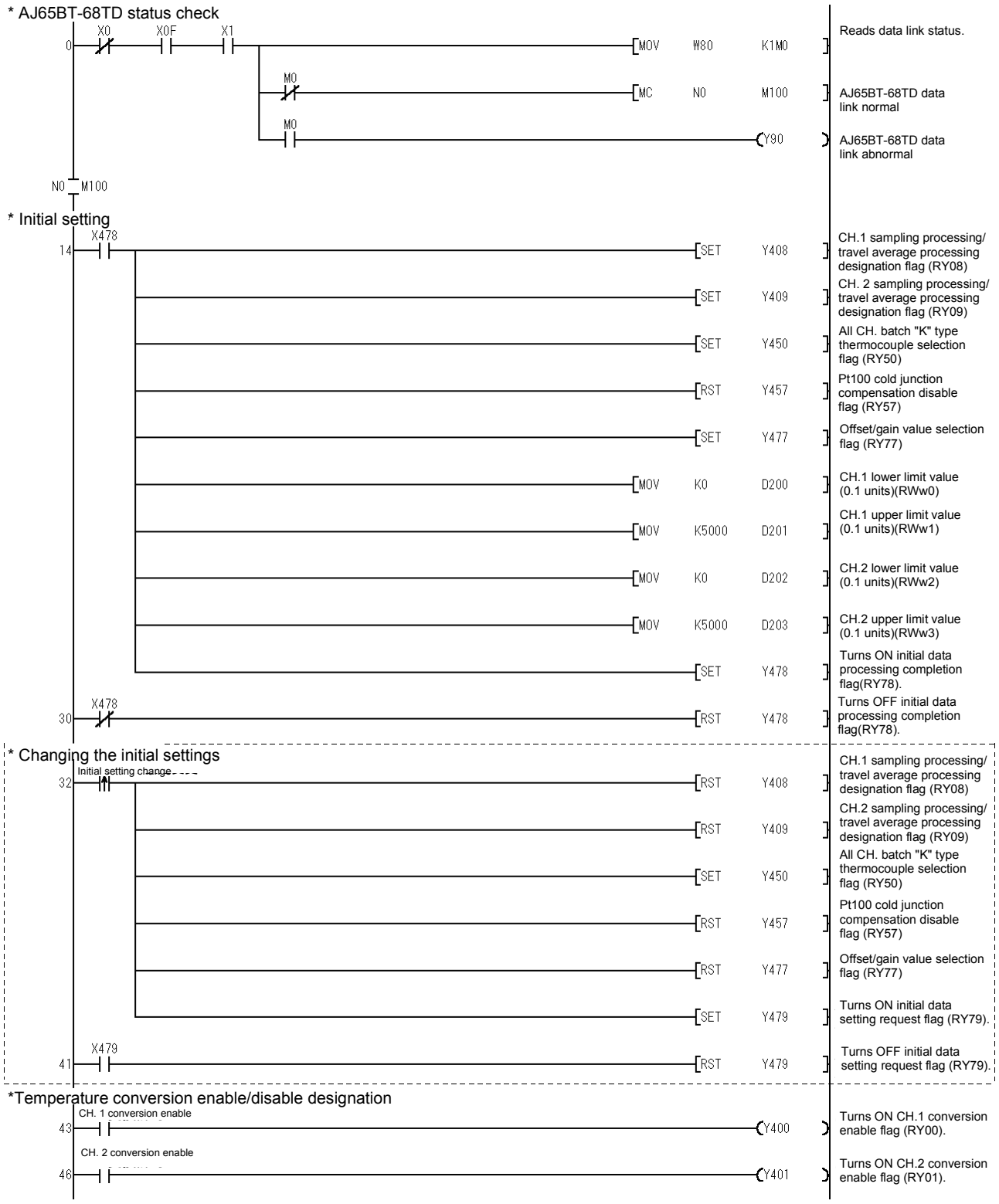
	1
Start I/O No.	0000
Type	Master station
All connect count	1
Remote input(RX)	
Remote output(RY)	
Remote register(RWr)	
Remote register(RWw)	
Special relay(SB)	
Special register(SW)	
Retry count	3
Automatic reconnection station count	1
Wait master station No.	0
PLC down select	Stop
Scan mode setting	Asynchronously
Delay information setting	0
Station information setting	Station information

Station No.	Station type	Exclusive station count	Reserve/invalid station select	Send	Receive	Automatic
1	Remote device station	Exclusive station 4	No setting			

(b) Auto refresh parameter setting

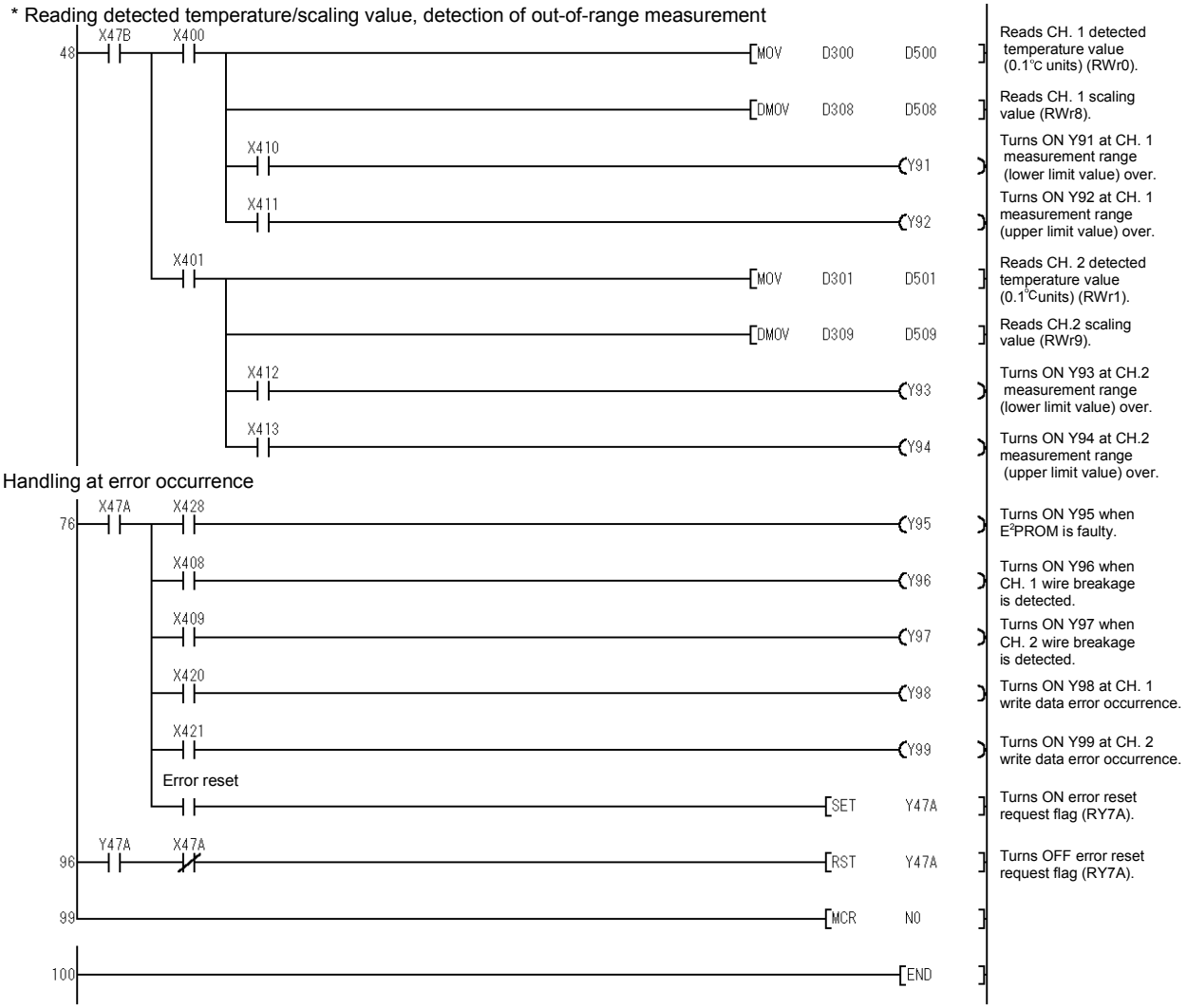
	1
Start I/O No.	0000
Type	Master station
All connect count	1
Remote input(RX)	X400
Remote output(RY)	Y400
Remote register(RWr)	D300
Remote register(RWw)	D200
Special relay(SB)	B0
Special register(SW)	W0
Retry count	3
Automatic reconnection station count	1
Wait master station No.	0
PLC down select	Stop
Scan mode setting	Asynchronously
Delay information setting	0
Station information setting	Station information

(2) Program example



*The program within the dotted frame is necessary only when the initial setting is changed.

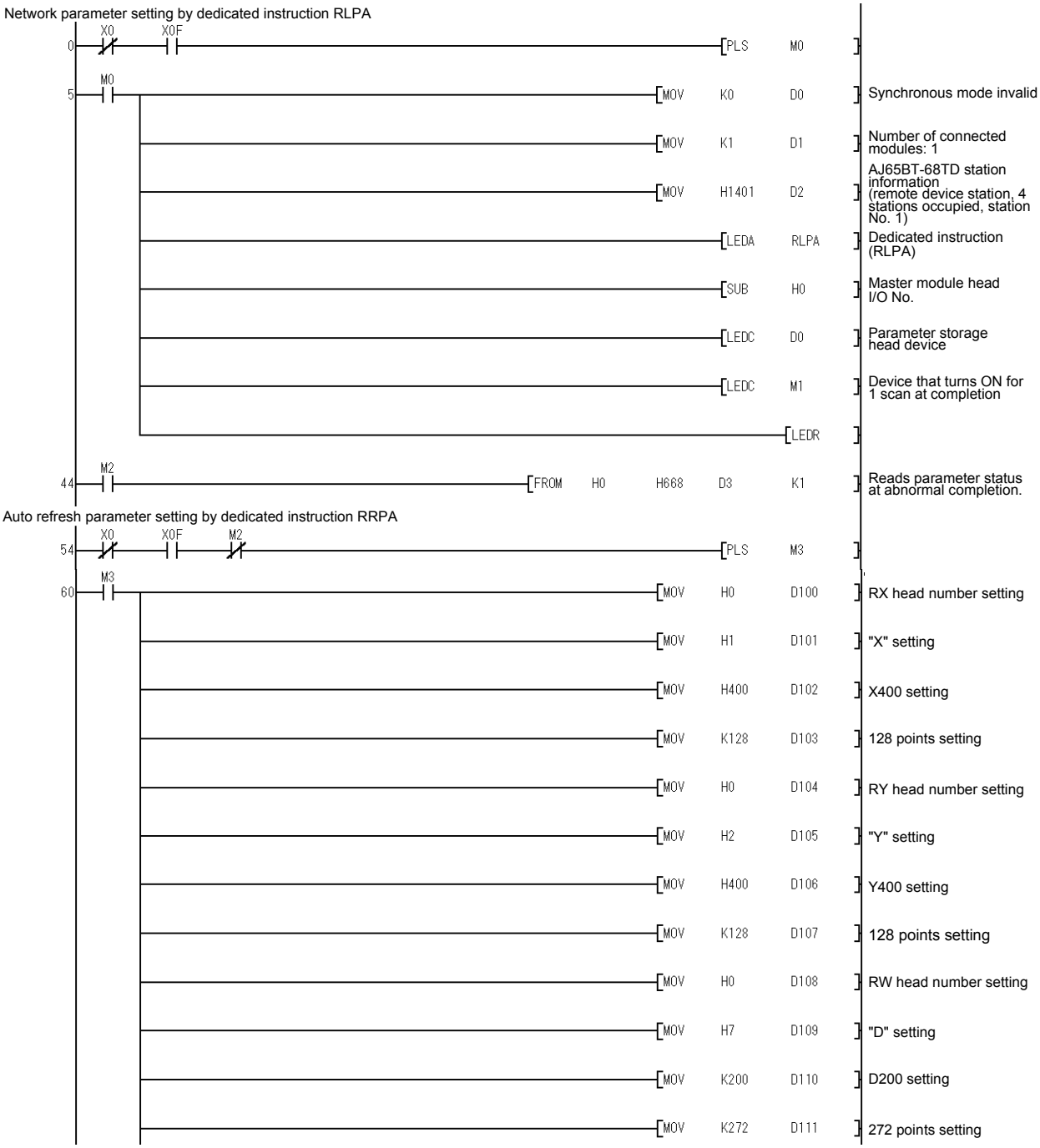
* Reading detected temperature/scaling value, detection of out-of-range measurement

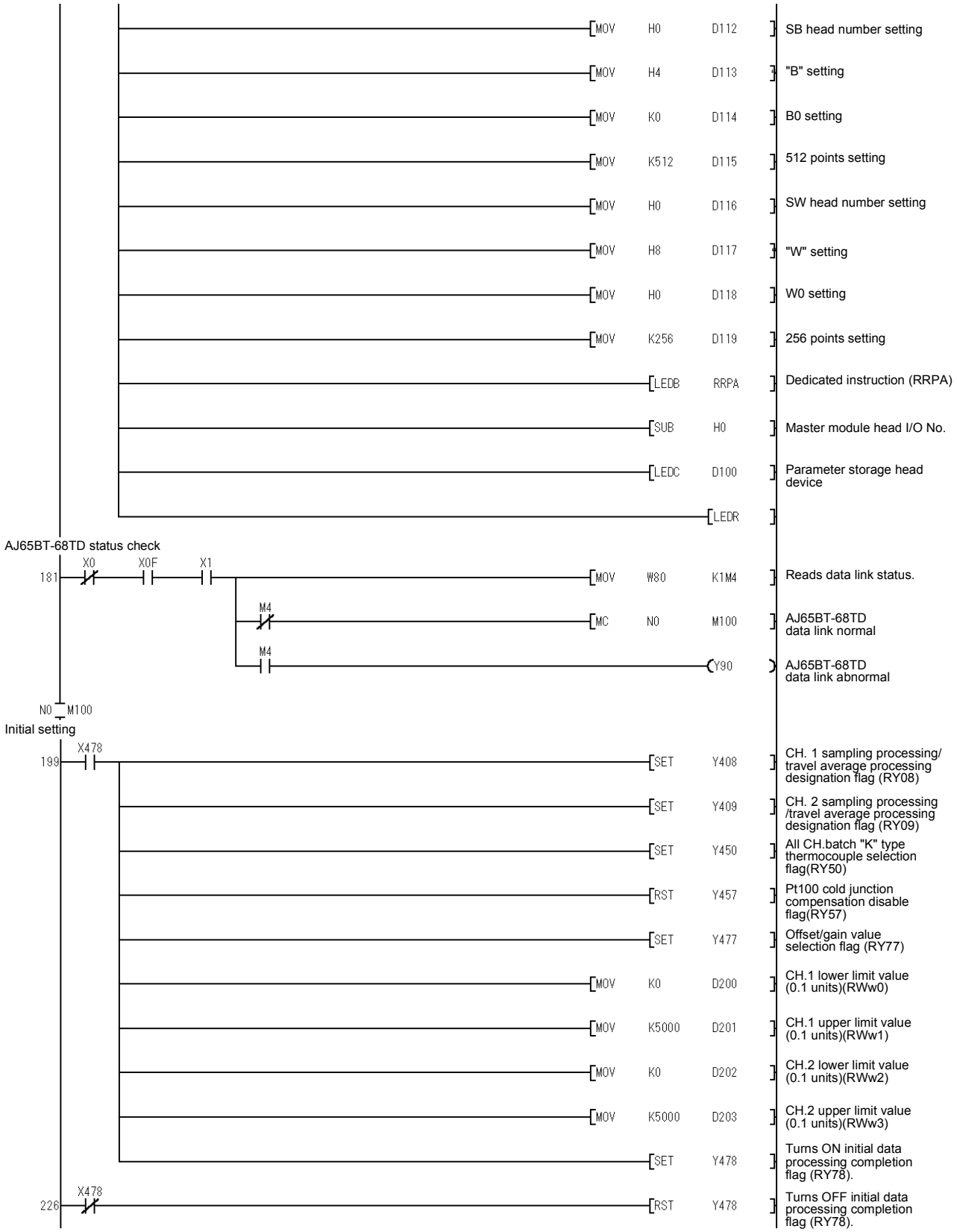


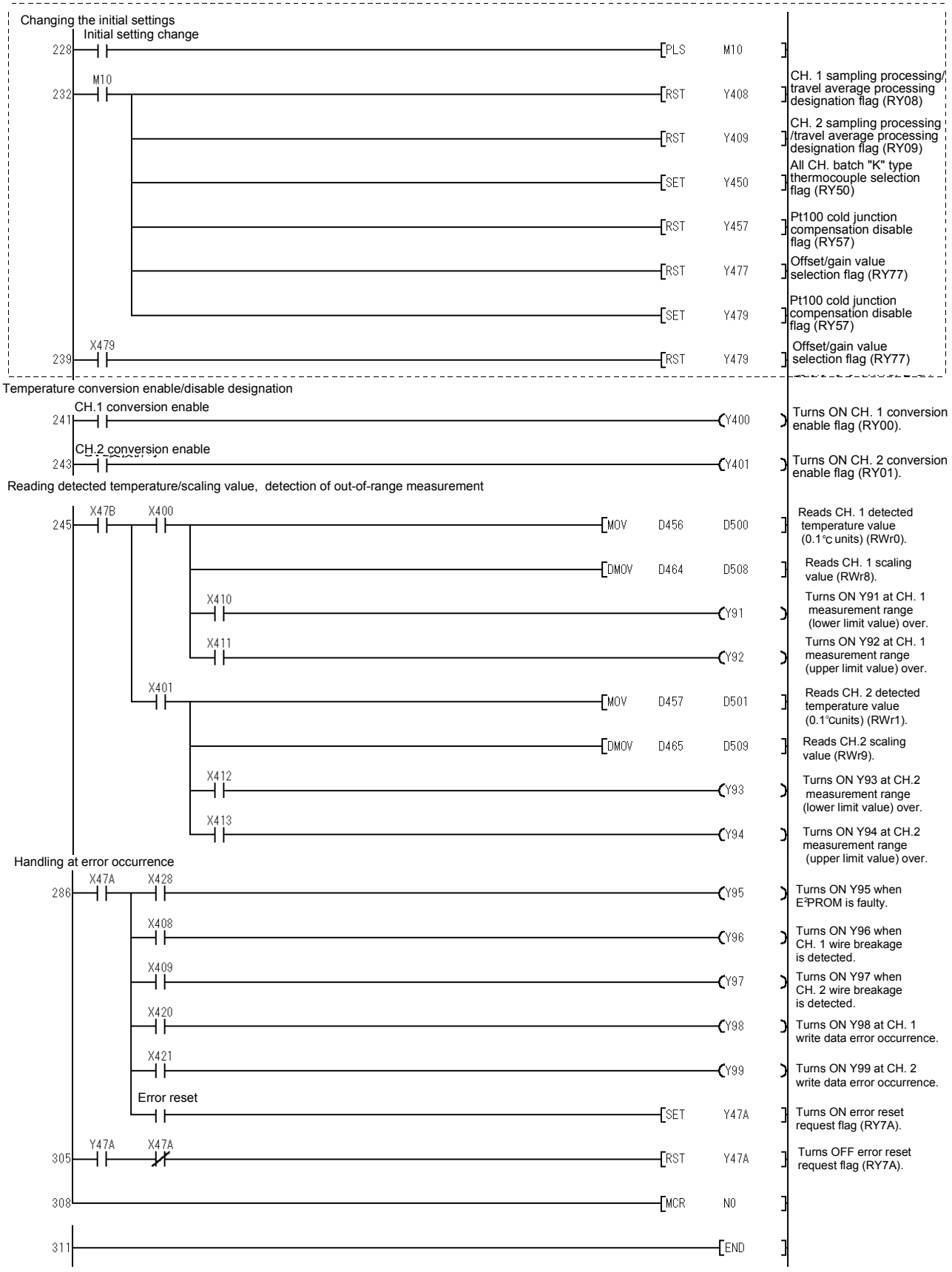
5.5 Program Example when ACPU/QCPU (A Mode) Is Used (Dedicated Instructions)

The network parameters and auto refresh parameters have been set by the sequence program.

(1) Program example




MOV H0 D112
SB head number setting
MOV H4 D113
"B" setting
MOV K0 D114
B0 setting
MOV K512 D115
512 points setting
MOV H0 D116
SW head number setting
MOV H8 D117
"W" setting
MOV H0 D118
W0 setting
MOV K256 D119
256 points setting
LEDB RRPA
Dedicated instruction (RRPA)
SUB H0
Master module head I/O No.
LEDC D100
Parameter storage head device
LEDR
AJ65BT-68TD status check
181
X0
X0F
X1
MOV W80 K1M4
Reads data link status.
M4
MC N0 M100
AJ65BT-68TD data link normal
M4
Y90
AJ65BT-68TD data link abnormal
N0 M100
Initial setting
199
X478
SET Y408
CH. 1 sampling processing/ travel average processing designation flag (RY08)
SET Y409
CH. 2 sampling processing /travel average processing designation flag (RY09)
SET Y450
All CH.batch "K" type thermocouple selection flag(RY50)
RST Y457
Pt100 cold junction compensation disable flag(RY57)
SET Y477
Offset/gain value selection flag (RY77)
MOV K0 D200
CH.1 lower limit value (0.1 units)(RWw0)
MOV K5000 D201
CH.1 upper limit value (0.1 units)(RWw1)
MOV K0 D202
CH.2 lower limit value (0.1 units)(RWw2)
MOV K5000 D203
CH.2 upper limit value (0.1 units)(RWw3)
SET Y478
Turns ON initial data processing completion flag (RY78).
226
X478
RST Y478
Turns OFF initial data processing completion flag (RY78).

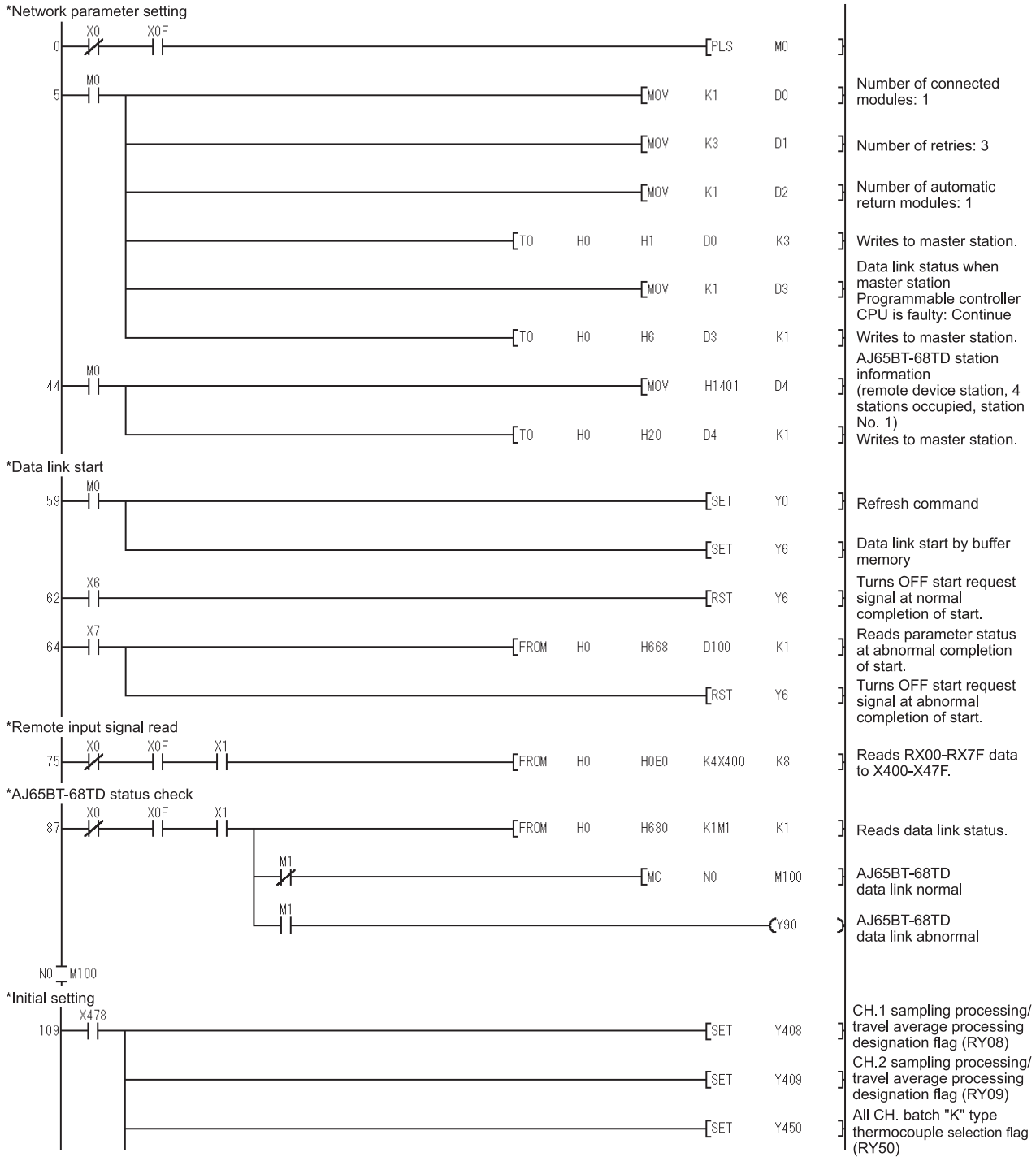


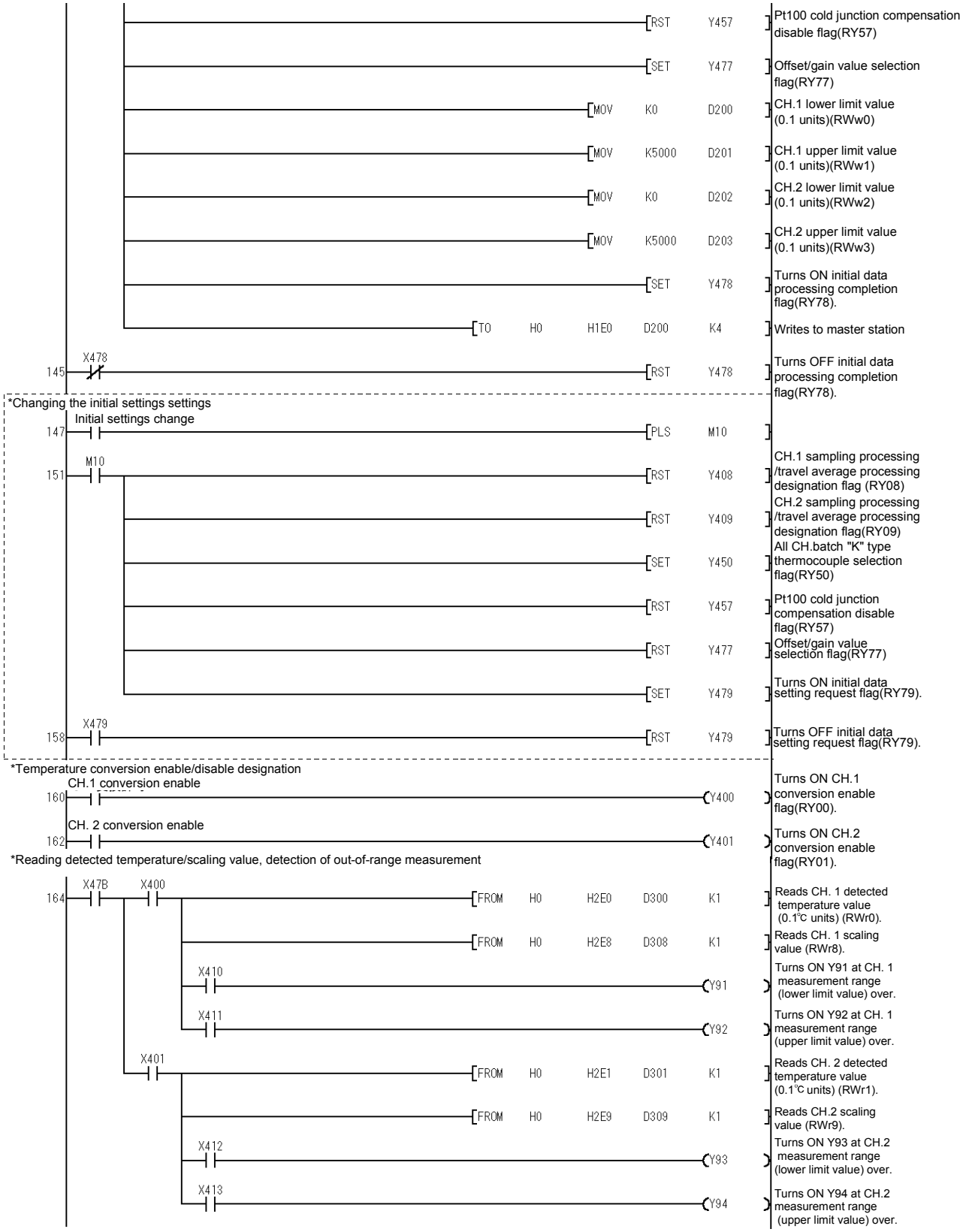
*The program within the dotted frame is necessary only when the initial setting is changed.

5.6 Program Example when ACPU/QCPU (A Mode) Is Used (FROM/TO Instructions)

The network parameters have been set by the sequence program.

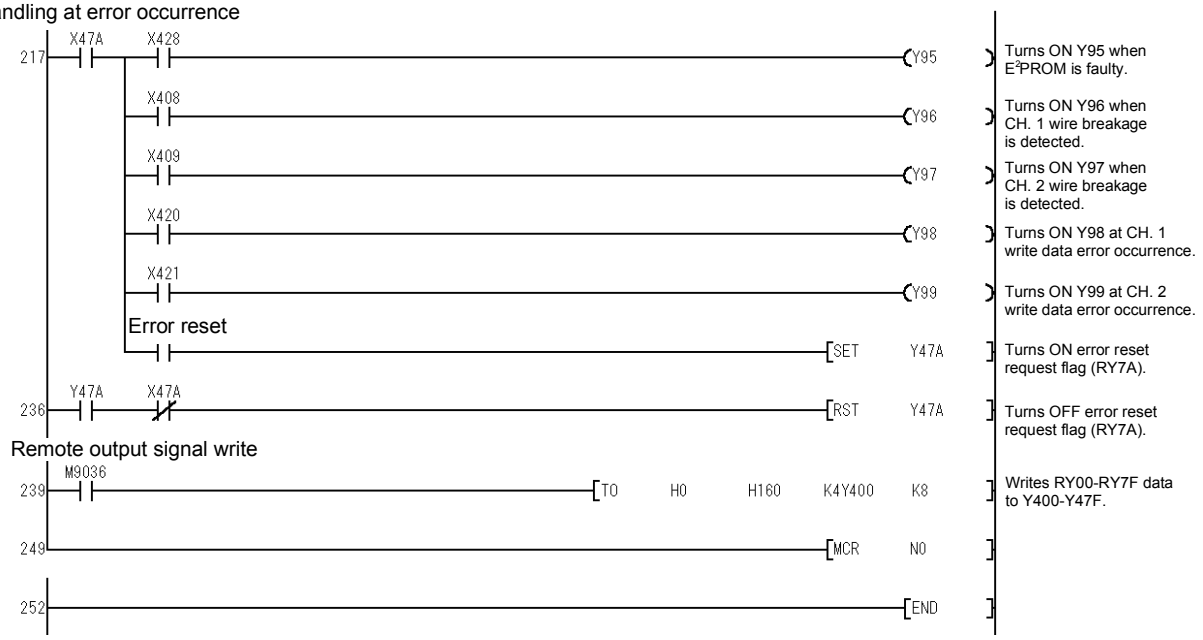
(1) Program example





*The program within the dotted frame is necessary only when the initial setting is changed.

* Handling at error occurrence



6. TROUBLESHOOTING

The general troubleshooting methods for using AJ65BT-68TD is explained below.

6.1 Cause of Errors and Corrective Actions by LED Indication

The following describes the error confirmation method using the LEDs on AJ65BT-68TD.
For the errors associated with the programmable controller CPU and master module, refer to the user's manual for the programmable controller CPU and master module, respectively.

(1) When AJ65BT-68TD's "RUN" LED is off

Cause	Corrective action
Watchdog timer error occurred.	Confirm the watchdog timer error with the master module's special link register, then restart the power to AJ65BT-68TD *1. If "RUN" LED does not come on after power restart, contact the nearest representative or branch regarding the problem, as hardware may be faulty.
24 V DC power is not supplied to AJ65BT-68TD, or voltage is insufficient.	Check the voltage of 24 V DC power supply.
At test mode, the offset/gain setting switch is positioned at SET.	After setting offset/gain, position the mode switch to 0 (NORMAL).

(2) When AJ65BT-68TD's "RUN" LED flikers at 0.5-second intervals

Cause	Corrective action
At test mode, the offset/gain setting switch is positioned at OFFSET or GAIN.	After setting offset/gain, position the mode switch to 0 (NORMAL).

(3) When AJ65BT-68TD's "RUN" LED flikers at 0.1-second intervals

Cause	Corrective action
The all-channel-batch thermocouple selection is overlapped. Or, if a thermocouple is selected for each channel, the selection of a thermocouple is overlapped for the same channel.	Verify the thermocouple selection, then set a valid thermocouple using the initial data and switch on the error reset request flag (RY(n+7)A).
A value out of the allowable setting range was set for the upper and lower limit of the temperature measurement range, or the upper limit value is smaller than or equal to the lower limit value.	Verify the channel in which a write error has been occurred using the write data error flag, then set a valid value using the initial data and switch on the error reset request flag (RY(n+7)A).
The offset or gain value set in the test mode is out of the allowable setting range. Or, the gain value minus offset value is smaller than 10°C.	Verify the allowable setting range and set a valid offset or gain value. Or, set the offset and gain values so that the gain value minus offset value is greater than or equal to 10°C.

(4) When AJ65BT-68TD's "L RUN" LED is off

Cause	Corrective action
Cables are broken or shorted.	Look for the broken or shorted transmission cables and repair them.
The master station has the stopped data link.	Confirm that no error has occurred in the master station.
Duplicate station number.	Correct the station number setting of the duplicate module, then restart the power *1.
The setting switch is set outside the range (station number 0, or 62 or greater, transmission speed 5 to 9).	Correct the setting switch setting, then restart the power *1.

(5) When AJ65BT-68TD's "L ERR" LED flikers

Cause	Corrective action
The setting of station number switch or transmission speed switch is changed during normal operation.	Reinstate the station number or transmission speed setting to the original setting before the change, then restart the power. *1. If "L RUN" LED does not come on after power restart, contact the nearest representative or branch regarding the problem, as hardware may be faulty.
The station number switch or transmission speed switch is faulty.	If "L ERR" LED starts to flicker while in operation even though no change has been made to the switch setting, contact the nearest representative or branch regarding the problem, as hardware may be faulty.

(6) When AJ65BT-68TD's "L ERR" LED is on

Cause	Corrective action
The setting switch is set outside the range (station number 0, or 62 or greater, transmission speed 5 to 9).	Correct the setting switch setting, then restart the power. *1
Forgot to install the terminal resistor.	Confirm whether the terminal resistor is installed. If the terminal resistor is not connected, connect it, then restart the power. *1
AJ65BT-68TD or transmission cable is affected by noise.	• Ground (class 3 grounding) the both ends of shield of the twisted cable via SLD and FG of each module. • Securely ground the FG terminal of the module. • When performing pipe wiring, securely ground the pipe.

*1 Restart power : Turn on the power supply again, or turn on the reset switch.

6.2 When Wire Breakage Detection Flag is On

Cause	Corrective action
Connection between thermocouple and compensating conductor is incomplete.	Securely connect the thermocouple and compensating conductor.
Terminal screw is loose.	Tighten the terminal screws within the specified torque range.
The connected thermocouple or compensating conductor has wire breakage.	Check the continuity of thermocouple and compensating conductor, and replace the broken thermocouple or compensating conductor.
The channel to which thermocouple is not connected is designated as conversion enabled.	Confirm the channels for which the conversion enable is designated and channel to which thermocouple is connected, then correct the conversion enable designation.

6.3 When E^2PROM Error Flag is On

Cause	Corrective action
Error in the internal memory storing the offset value/gain value set by user	Restart power for AJ65BT-68TD. *1 If the E^2PROM error flag is still on after power restart, contact the nearest representative or branch regarding the problem, as hardware may be faulty.

*1 Restart power : Turn on the power supply again, or turn on the reset switch.

6.4 When Detected Temperature Value cannot be Read

Cause	Corrective action
The channel used is designated as conversion disabled.	Designate the channel as conversion enable in sequence program.
Programmable controller CPU or master module error	Confirm the programmable controller CPU and master module.

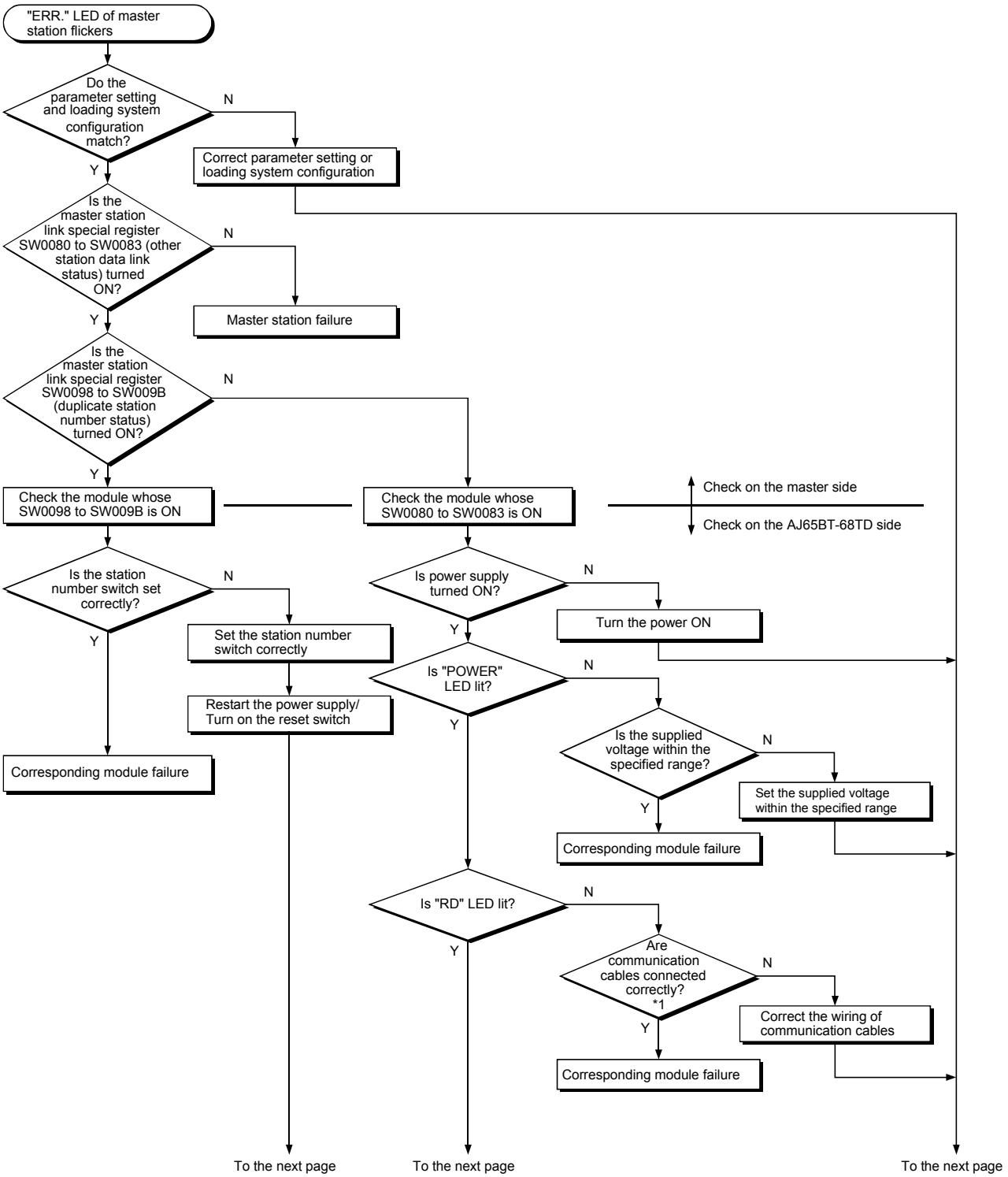
6.5 When Detected Temperature Value is Abnormal

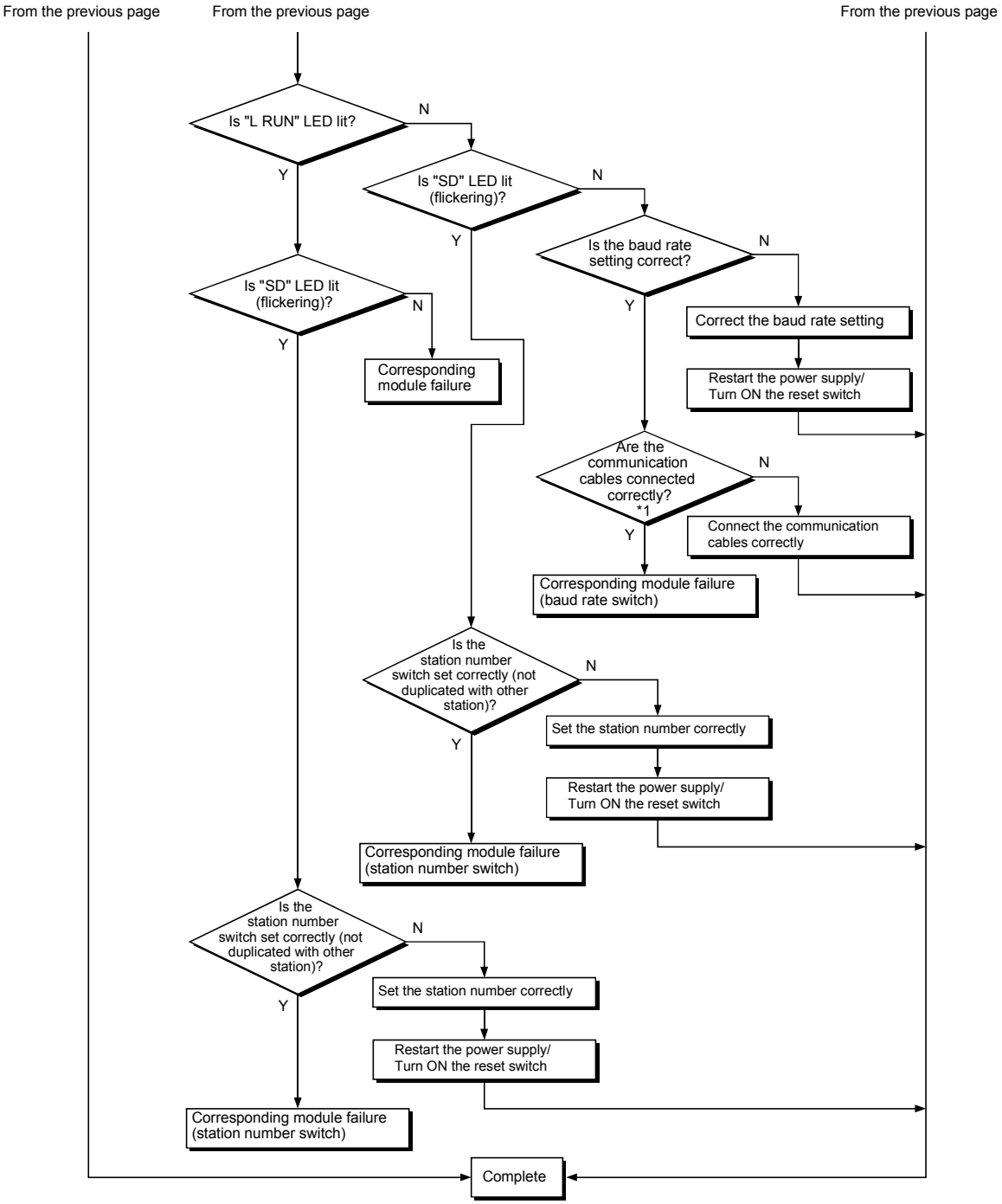
Cause	Corrective action
The thermocouple connected is different from what is designated.	Designate the thermocouple connected.
Affected by noise.	Confirm the influence from grounding and adjacent devices, then take measures against noise.
The Pt100 temperature-measuring resistor that performs cold contact compensation, is either broken off or disconnected from the terminal block.	Confirm the connection and continuity of the Pt100 temperature-measuring resistor on the terminal block, and connect or replace the Pt100 temperature-measuring resistor.
When performing cold contact compensation externally, the cold contact compensation by Pt100 temperature-measuring resistor is enabled.	At the initial data setting, set the Pt100 cold contact compensation disable flag (RY(n+5)7) to on.

6.6 When There is a Communication Error between Master Station and AJ65BT-68TD

If the station number duplicate bit is turned on in the link special register SW0098 to SW009B (duplicate station number status), check the corresponding station number of AJ65BT-68TD using the following flow.

Troubleshooting flow when "ERR" LED of master station is flickering





*1 Check for short-circuits, reversed connection, wire breakage, terminal resistor, FG connection, overall distance and station-to-station distance.

APPENDIX

Appendix 1 Usual Operation Limits and Superheated Operating Limits

JIS C1602-1995

Component symbol	Old symbol (reference)	Wire diameter mm	Usual operation limit °C	Superheated operating limit °C
B	—	0.50	1500	1700
R	—	0.50	1400	1600
S				
K	CA	0.65	650	850
		1.00	750	950
		1.60	850	1050
		2.30	900	1100
		3.20	1000	1200
E	CRC	0.65	450	500
		1.00	500	550
		1.60	550	600
		2.30	600	750
		3.20	700	800
J	IC	0.65	400	500
		1.00	450	550
		1.60	500	600
		2.30	550	750
		3.20	600	750
T	CC	0.32	200	250
		0.65	200	250
		1.00	250	300
		1.60	300	350

Note : The usual operation limit refers to the temperature limit of the air in which the module can be continuously used.
The superheated operating limit refers to the limit of temperature at which the module can be used in a short period of time in unavoidable cases.

Appendix 2 Allowable Temperature Differences

JIS C1602-1995

Component symbol	Old symbol (reference)	Measured temperature	Class	Allowable difference
B	—	600 °C or more but less than 1700 °C	0.5 class	±4 °C, or ±0.5 % of the measured temperature
R	—	0 °C or more but less than 1600 °C	0.25 class	±1.5 °C, or ±0.25 % of the measured temperature
S				
K	CA	0 °C or more but less than 1000 °C	0.4 class	±1.5 °C, or ±0.4 % of the measured temperature
		0 °C or more but less than 1200 °C	0.75 class	±2.5 °C, or ±0.75 % of the measured temperature
		-200 °C or more but less than 0 °C	1.5 class	±2.5 °C, or ±1.5 % of the measured temperature
E	CRC	0 °C or more but less than 800 °C	0.4 class	±1.5 °C, or ±0.4 % of the measured temperature
		0 °C or more but less than 800 °C	0.75 class	±2.5 °C, or ±0.75 % of the measured temperature
		-200 °C or more but less than 0 °C	1.5 class	±2.5 °C, or ±1.5 % of the measured temperature
J	IC	0 °C or more but less than 750 °C	0.4 class	±1.5 °C, or ±0.4 % of the measured temperature
		0 °C or more but less than 750 °C	0.75 class	±2.5 °C, or ±0.75 % of the measured temperature
T	CC	0 °C or more but less than350 °C	0.4 class	±0.5 °C, or ±0.4 % of the measured temperature
		0 °C or more but less than350 °C	0.75 class	±1 °C, or ±0.75 % of the measured temperature
		-200 °C or more but less than 0 °C	1.5 class	±1 °C, or ±1.5 % of the measured temperature

Note : The allowable difference refers to the maximum allowable limit for the difference between the resultant temperature of a conversion from thermal electromotive force using a standard thermal electromotive force chart, and the temperature at temperature detector contact.
The greater value of °C or % will take effect for the allowable difference.

Appendix 3 Thermal Electromotive Force Chart

Type B

Appendix 3.1 Standard Thermal Electromotive Force of B

JIS C1602-1995 (Conform to IEC584-1(1977), IEC 584-2-(1982)) **Unit μV**

Temperature (°C)	0	1	2	3	4	5	6	7	8	9	Temperature (°C)
0	0	0	0	-1	-1	-1	-1	-1	-2	-2	0
10	-2	-2	-2	-2	-2	-2	-2	-2	-3	-3	10
20	-3	-3	-3	-3	-3	-2	-2	-2	-2	-2	20
30	-2	-2	-2	-2	-2	-1	-1	-1	-1	-1	30
40	0	0	0	0	0	1	1	1	2	2	40
50	2	3	3	3	4	4	4	5	5	6	50
60	6	7	7	8	8	9	9	10	10	11	60
70	11	12	12	13	14	14	15	15	16	17	70
80	17	18	19	20	20	21	22	22	23	24	80
90	25	26	26	27	28	29	30	31	31	32	90
100	33	34	35	36	37	38	39	40	41	42	100
110	43	44	45	46	47	48	49	50	51	52	110
120	53	55	56	57	58	59	60	62	63	64	120
130	65	66	68	69	70	72	73	74	75	77	130
140	78	79	81	82	84	85	86	88	89	91	140
150	92	94	95	96	98	99	101	102	104	106	150
160	107	109	110	112	113	115	117	118	120	122	160
170	123	125	127	128	130	132	134	135	137	139	170
180	141	142	144	146	148	150	151	153	155	157	180
190	159	161	163	165	166	168	170	172	174	176	190
200	178	180	182	184	186	188	190	192	195	197	200
210	199	201	203	205	207	209	212	214	216	218	210
220	220	222	225	227	229	231	234	236	238	241	220
230	243	245	248	250	252	255	257	259	262	264	230
240	267	269	271	274	276	279	281	284	286	289	240
250	291	294	296	299	301	304	307	309	312	314	250
260	317	320	322	325	328	330	333	336	338	341	260
270	344	347	349	352	355	358	360	363	366	369	270
280	372	375	377	380	383	386	389	392	395	398	280
290	401	404	407	410	413	416	419	422	425	428	290
300	431	434	437	440	443	446	449	452	455	458	300
310	462	465	468	471	474	478	481	484	487	490	310
320	494	497	500	503	507	510	513	517	520	523	320
330	527	530	533	537	540	544	547	550	554	557	330
340	561	564	568	571	575	578	582	585	589	592	340
350	596	599	603	607	610	614	617	621	625	628	350
360	632	636	639	643	647	650	654	658	662	665	360
370	669	673	677	680	684	688	692	696	700	703	370
380	707	711	715	719	723	727	731	735	738	742	380
390	746	750	754	758	762	766	770	774	778	782	390
400	787	791	795	799	803	807	811	815	819	824	400
410	828	832	836	840	844	849	853	857	861	866	410
420	870	874	878	883	887	891	896	900	904	909	420
430	913	917	922	926	930	935	939	944	948	953	430
440	957	961	966	970	975	979	984	988	993	997	440
450	1002	1007	1011	1016	1020	1025	1030	1034	1039	1043	450
460	1048	1053	1057	1062	1067	1071	1076	1081	1086	1090	460
470	1095	1100	1105	1109	1114	1119	1124	1129	1133	1138	470
480	1143	1148	1153	1158	1163	1167	1172	1177	1182	1187	480
490	1192	1197	1202	1027	1212	1217	1222	1227	1232	1237	490

Type B

JIS C1602-1995 (Conform to IEC584-1(1977), IEC 584-2-(1982)) **Unit μV**

Temperature (°C)	0	1	2	3	4	5	6	7	8	9	Temperature (°C)
500	1242	1247	1252	1257	1262	1267	1272	1277	1282	1288	500
510	1293	1298	1303	1308	1313	1318	1324	1329	1334	1339	510
520	1344	1350	1355	1360	1365	1371	1376	1381	1387	1392	520
530	1397	1402	1408	1413	1418	1424	1429	1435	1440	1445	530
540	1451	1456	1462	1467	1472	1478	1483	1489	1494	1500	540
550	1505	1511	1516	1522	1527	1533	1539	1544	1550	1555	550
560	1561	1566	1572	1578	1583	1589	1595	1600	1606	1612	560
570	1617	1623	1629	1634	1640	1646	1652	1657	1663	1669	570
580	1675	1680	1686	1692	1698	1704	1709	1715	1721	1727	580
590	1733	1739	1745	1750	1756	1762	1768	1774	1780	1786	590
600	1792	1798	1804	1810	1816	1822	1828	1834	1840	1846	600
610	1852	1858	1864	1870	1876	1882	1888	1894	1901	1907	610
620	1913	1919	1925	1931	1937	1944	1950	1956	1962	1968	620
630	1975	1981	1987	1993	1999	2006	2012	2018	2025	2031	630
640	2037	2043	2050	2056	2062	2069	2075	2082	2088	2094	640
650	2101	2107	2113	2120	2126	2133	2139	2146	2152	2158	650
660	2165	2171	2178	2184	2191	2197	2204	2210	2217	2224	660
670	2230	2237	2243	2250	2256	2263	2270	2276	2283	2289	670
680	2296	2303	2309	2316	2323	2329	2336	2343	2350	2356	680
690	2363	2370	2376	2383	2390	2397	2403	2410	2417	2424	690
700	2431	2437	2444	2451	2458	2456	2472	2479	2485	2492	700
710	2499	2506	2513	2520	2527	2534	2541	2548	2555	2562	710
720	2569	2576	2583	2590	2597	2604	2611	2618	2625	2632	720
730	2639	2646	2653	2660	2667	2674	2681	2688	2696	2703	730
740	2710	2717	2724	2731	2738	2746	2753	2760	2767	2775	740
750	2782	2789	2796	2803	2811	2818	2825	2833	2840	2847	750
760	2854	2862	2869	2876	2884	2891	2898	2906	2913	2921	760
770	2928	2935	2943	2950	2958	2965	2973	2980	2987	2995	770
780	3002	3010	3017	3025	3032	3040	3047	3055	3062	3070	780
790	3078	3085	3093	3100	3108	3116	3123	3131	3138	3146	790
800	3154	3161	3169	3177	3184	3192	3200	3207	3215	3223	800
810	3230	3238	3246	3254	3261	3269	3277	3285	3292	3300	810
820	3308	3316	3324	3331	3339	3347	3355	3363	3371	3379	820
830	3386	3394	3402	3410	3418	3426	3434	3442	3450	3458	830
840	3466	3474	3482	3490	3498	3506	3514	3522	3530	3538	840
850	3546	3554	3562	3570	3578	3586	3594	3602	3610	3618	850
860	3626	3634	3643	3651	3659	3667	3675	3683	3692	3700	860
870	3708	3716	3724	3732	3741	3749	3757	3765	3774	3782	870
880	3790	3798	3807	3815	3823	3832	3840	3848	3857	3865	880
890	3873	3882	3890	3898	3907	3915	3923	3932	3940	3949	890
900	3957	3965	3974	3982	3991	3999	4008	4016	4024	4033	900
910	4041	4050	4058	4067	4075	4084	4093	4101	4110	4118	910
920	4127	4135	4144	4152	4161	4170	4178	4187	4195	4204	920
930	4213	4221	4230	4239	4247	4256	4265	4273	4282	4291	930
940	4299	4308	4317	4326	4334	4343	4352	4360	4369	4378	940
950	4387	4396	4404	4413	4422	4431	4440	4448	4457	4466	950
960	4475	4484	4493	4501	4510	4519	4528	4537	4546	4555	960
970	4564	4573	4582	4591	4599	4608	4617	4626	4635	4644	970
980	4653	4662	4671	4680	4689	4698	4707	4716	4725	4734	980
990	4743	4753	4762	4771	4780	4789	4798	4807	4816	4825	990

Type B

JIS C1602-1995 (Conform to IEC584-1(1977), IEC 584-2-(1982)) **Unit μV**

Temperature (°C)	0	1	2	3	4	5	6	7	8	9	Temperature (°C)
1000	4834	4843	4853	4862	4871	4880	4889	4898	4908	4917	1000
1010	4926	4935	4944	4954	4963	4972	4981	4990	5000	5009	1010
1020	5018	5027	5037	5046	5055	5065	5074	5083	5092	5102	1020
1030	5111	5120	5130	5139	5148	5158	5167	5176	5186	5195	1030
1040	5205	5214	5223	5233	5242	5252	5261	5270	5280	5289	1040
1050	5299	5308	5318	5327	5337	5346	5356	5365	5375	5384	1050
1060	5394	5403	5413	5422	5432	5441	5451	5460	5470	5480	1060
1070	5489	5499	5508	5518	5528	5537	5547	5556	5566	5576	1070
1080	5585	5595	5605	5614	5624	5634	5643	5653	5663	5672	1080
1090	5682	5692	5702	5711	5721	5731	5740	5750	5760	5770	1090
1100	5780	5789	5799	5809	5819	5828	5838	5848	5858	5868	1100
1110	5878	5887	5897	5907	5917	5927	5937	5947	5956	5966	1110
1120	5976	5986	5996	6006	6016	6026	6036	6046	6055	6065	1120
1130	6075	6085	6095	6105	6115	6125	6135	6145	6155	6165	1130
1140	6175	6185	6195	6205	6215	6225	6235	6245	6256	6266	1140
1150	6276	6286	6296	6306	6316	6326	6336	6346	6356	6367	1150
1160	6377	6387	6397	6407	6417	6427	6438	6448	6458	6468	1160
1170	6478	6488	6499	6509	6519	6529	6539	6550	6560	6570	1170
1180	6580	9591	6601	6611	6621	6632	6642	6652	6663	6673	1180
1190	6683	6693	6704	6714	6724	6735	6745	6755	6766	6776	1190
1200	6786	6797	6807	6818	6828	6838	6849	6859	6869	6880	1200
1210	6890	6904	6911	6922	6932	6942	6953	6963	6974	6984	1210
1220	6995	7005	7016	7026	7037	7047	7058	7068	7079	7089	1220
1230	7100	7110	7121	7131	7142	7152	7163	7173	7184	7194	1230
1240	7205	7216	7226	7237	7247	7258	7269	7279	7290	7300	1240
1250	7311	7322	7332	7343	7353	7364	7375	7385	7396	7407	1250
1260	7417	7428	7439	7449	7460	7471	7482	7492	7503	7514	1260
1270	7524	7535	7546	7557	7567	7578	7589	7600	7610	7621	1270
1280	7632	7643	7653	7664	7675	7686	7697	7707	7718	7729	1280
1290	7740	7754	7761	7772	7783	7794	7805	7816	7827	7837	1290
1300	7848	7859	7870	7881	7892	7903	7914	7924	7935	7946	1300
1310	7957	7968	7979	7990	8001	8012	8023	8034	8045	8058	1310
1320	8066	8077	8088	8099	8110	8121	8132	8143	8154	8165	1320
1330	8176	8187	8198	8209	8220	8231	8242	8253	8264	8275	1330
1340	8286	8298	8309	8320	8331	8342	8353	8364	8375	8386	1340
1350	8397	8408	8419	8430	8441	8453	8464	8475	8486	8497	1350
1360	8508	8519	8530	8542	8553	8564	8575	8586	8597	8608	1360
1370	8620	8631	8642	8653	8664	8675	8687	8698	8709	8720	1370
1380	8731	8743	8754	8765	8776	8787	8799	8810	8821	8832	1380
1390	8844	8855	8866	8877	8889	8900	8911	8922	8934	8945	1390
1400	8956	8967	8979	8990	9001	9013	9024	9035	9047	9058	1400
1410	9069	9080	9092	9103	9114	9126	9137	9148	9160	9171	1410
1420	9182	9194	9205	9216	9228	9239	9251	9262	9273	9285	1420
1430	9296	9307	9319	9330	9342	9353	9364	9376	9387	9398	1430
1440	9410	9421	9433	9444	9456	9457	9478	9490	9501	9513	1440
1450	9524	9536	9547	9558	9570	9581	9593	9604	9616	9627	1450
1460	9639	9650	9662	9673	9684	9696	9707	9719	9730	9742	1460
1470	9753	9765	9776	9788	9799	9811	9822	9834	9845	9857	1470
1480	9868	9880	9891	9903	9914	9926	9937	9949	9961	9972	1480
1490	9984	9995	10007	10018	10030	10041	10053	10064	10076	10088	1490

Type B

JIS C1602-1995 (Conform to IEC584-1(1977), IEC 584-2-(1982)) **Unit μV**

Temperature (°C)	0	1	2	3	4	5	6	7	8	9	Temperature (°C)
1500	10099	10111	10122	10134	10145	10157	10168	10180	10192	10203	1500
1510	10215	10226	10238	10249	10261	10273	10284	10296	10307	10319	1510
1520	10331	10342	10354	10365	10377	10389	10400	10412	10423	10435	1520
1530	10447	10458	10470	10482	10493	10505	10516	10528	10540	10551	1530
1540	10563	10575	10586	10598	10609	10621	10633	10644	10656	10668	1540
1550	10679	10691	10703	10714	10726	10738	10749	10761	10773	10784	1550
1560	10796	10808	10819	10831	10843	10854	10866	10877	10889	10901	1560
1570	10913	10924	10936	10948	10959	10971	10983	10994	11006	11018	1570
1580	11029	11041	11053	11064	11076	11088	11099	11111	11123	11134	1580
1590	11146	11158	11169	11181	11193	11205	11216	11228	11240	11251	1590
1600	11263	11275	11286	11298	11310	11321	11333	11345	11357	11368	1600
1610	11380	11392	11403	11415	11427	11438	11450	11462	11474	11485	1610
1620	11497	11509	11520	11532	11544	11555	11567	11579	11591	11602	1620
1630	11614	11626	11637	11649	11661	11673	11684	11696	11708	11719	1630
1640	11731	11743	11754	11766	11778	11790	11804	11813	11825	11836	1640
1650	11848	11860	11871	11883	11895	11907	11918	11930	11942	11953	1650
1660	11965	11977	11988	12000	12012	12024	12035	12047	12059	12070	1660
1670	12082	12094	12105	12117	12129	12141	12152	12164	12176	12187	1670
1680	12199	12211	12222	12234	12246	12257	12269	12281	12292	12304	1680
1690	12316	12327	12339	12351	12363	12374	12386	12398	12409	12421	1690
1700	12433	12444	12456	12468	12479	12491	12503	12514	12526	12538	1700
1710	12549	12561	12572	12584	12596	12607	12619	12631	12642	12654	1710
1720	12666	12677	12689	12701	12712	12724	12736	12747	12759	12770	1720
1730	12782	12794	12805	12817	12829	12840	12852	12863	12875	12887	1730
1740	12898	12910	12921	12933	12945	12956	12968	12980	12991	13003	1740
1750	13014	13026	13037	13049	13061	13072	13084	13095	13107	13119	1750
1760	13130	13142	13153	13165	13176	13188	13200	13211	13223	13234	1760
1770	13246	13257	13269	13280	13292	13304	13315	13327	13338	13350	1770
1780	13361	13373	13384	13396	13407	13419	13430	13442	13453	13465	1780
1790	13476	13488	13499	13511	13522	13534	13545	13557	13568	13580	1790
1800	13591	13603	13614	13626	13637	13649	13660	13672	13683	13694	1800
1810	13706	13717	13729	13740	13752	13763	13775	13786	13797	13809	1810
1820	13820										1820

REMARK

Standard contact temperature is 0 °C.

Appendix 3.2 Standard Thermal Electromotive Force of R

Type R

JIS C1602-1995 (Conform to IEC584-1(1977), IEC 584-2-(1982)) **Unit μV**

Temperature (°C)	0	-1	-2	-3	-4	-5	-6	-7	-8	-9	Temperature (°C)
-50	-226										-50
-40	-188	-192	-196	-200	-204	-208	-211	-215	-219	-223	-40
-30	-145	-150	-154	-158	-163	-167	-171	-175	-180	-184	-30
-20	-100	-105	-109	-114	-119	-123	-128	-132	-137	-141	-20
-10	-51	-56	-61	-66	-71	-76	-81	-86	-91	-95	-10
0	0	-5	-11	-16	-21	-26	-31	-36	-41	-46	0
Temperature (°C)	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**Temperature (°C)**
0	0	5	11	16	21	27	32	38	43	49	0
10	54	60	65	71	77	82	88	94	100	105	10
20	111	117	123	129	135	141	147	153	159	165	20
30	171	177	183	189	195	201	207	214	220	226	30
40	232	239	245	251	258	264	271	277	284	290	40
50	296	303	310	316	323	329	336	343	349	356	50
60	363	369	376	383	390	397	403	410	417	424	60
70	431	438	445	452	459	466	473	480	487	494	70
80	501	508	516	523	530	537	544	552	559	566	80
90	573	581	588	595	603	610	618	625	632	640	90
100	647	655	662	670	677	685	693	700	708	715	100
110	723	731	738	746	754	761	769	777	785	792	110
120	800	808	816	824	832	839	847	855	863	871	120
130	879	887	895	903	911	919	927	935	943	951	130
140	959	967	976	984	992	1000	1008	1016	1025	1033	140
150	1041	1049	1058	1066	1074	1082	1091	1099	1107	1116	150
160	1124	1132	1141	1149	1158	1166	1175	1183	1191	1200	160
170	1208	1217	1225	1234	1242	1251	1260	1268	1277	1285	170
180	1294	1303	1311	1320	1329	1337	1346	1355	1363	1372	180
190	1381	1389	1398	1407	1416	1425	1433	1442	1451	1460	190
200	1469	1477	1486	1495	1504	1513	1522	1531	1540	1549	200
210	1558	1567	1575	1584	1593	1602	1611	1620	1629	1639	210
220	1648	1657	1666	1675	1684	1693	1702	1711	1720	1729	220
230	1739	1748	1757	1766	1775	1784	1794	1803	1812	1821	230
240	1831	1840	1849	1858	1868	1877	1886	1895	1905	1914	240
250	1923	1933	1942	1951	1961	1970	1980	1989	1998	2008	250
260	2017	2027	2036	2046	2055	2064	2074	2083	2093	2102	260
270	2112	2121	2131	2140	2150	2159	2169	2179	2188	2198	270
280	2207	2217	2226	2236	2246	2255	2265	2275	2284	2294	280
290	2304	2313	2323	2333	2342	2352	2362	2371	2381	2391	290
300	2401	2410	2420	2430	2440	2449	2459	2469	2479	2488	300
310	2498	2508	2518	2528	2538	2547	2557	2567	2577	2587	310
320	2597	2607	2617	2626	2636	2646	2656	2666	2676	2686	320
330	2696	2706	2716	2726	2736	2746	2756	2766	2776	2786	330
340	2796	2806	2816	2826	2836	2846	2856	2866	2876	2886	340
350	2896	2906	2916	2926	2937	2947	2957	2967	2977	2987	350
360	2997	3007	3018	3028	3038	3048	3058	3068	3079	3089	360
370	3099	3109	3119	3130	3140	3150	3160	3171	3181	3191	370
380	3201	3212	3222	3232	3242	3253	3263	3273	3284	3294	380
390	3304	3315	3325	3335	3346	3356	3366	3377	3387	3397	390

Type R

JIS C1602-1995 (Conform to IEC584-1(1977), IEC 584-2-(1982)) **Unit μV**

Temperature (°C)	0	1	2	3	4	5	6	7	8	9	Temperature (°C)
400	3408	3418	3428	3439	3449	3460	3470	3480	3491	3501	400
410	3512	3522	3533	3543	3553	3564	3574	3585	3595	3606	410
420	3616	3627	3637	3648	3658	3669	3679	3690	3700	3711	420
430	3721	3732	3742	3753	3764	3774	3785	3795	3806	3816	430
440	3827	3838	3848	3859	3869	3880	3891	3901	3912	3922	440
450	3933	3944	3954	3965	3976	3986	3997	4008	4018	4029	450
460	4040	4050	4061	4072	4083	4093	4104	4115	4125	4136	460
470	4147	4158	4168	4179	4190	4201	4211	4222	4233	4244	470
480	4255	4265	4276	4287	4298	4309	4319	4330	4341	4352	480
490	4363	4373	4384	4395	4406	4417	4428	4439	4449	4460	490
500	4471	4482	4493	4504	4515	4526	4537	4548	4558	4569	500
510	4580	4591	4602	4613	4624	4635	4646	4657	4668	4679	510
520	4690	4701	4712	4723	4734	4745	4756	4767	4778	4789	520
530	4800	4811	4822	4833	4844	4855	4866	4877	4888	4899	530
540	4910	4922	4933	4944	4955	4966	4977	4988	4999	5010	540
550	5021	5033	5044	5055	5066	5077	5088	5099	5111	5122	550
560	5133	5144	5155	5166	5178	5189	5200	5211	5222	5234	560
570	5245	5256	5267	5279	5290	5301	5312	5323	5335	5346	570
580	5357	5369	5380	5391	5402	5414	5425	5436	5448	5459	580
590	5470	5481	5493	5504	5515	5527	5538	5549	5561	5572	590
600	5583	5595	5606	5618	5629	5640	5652	5663	5674	5686	600
610	5697	5709	5720	5731	5743	5754	5766	5777	5789	5800	610
620	5812	5823	5834	5846	5857	5869	5880	5892	5903	5915	620
630	5926	5938	5949	5961	5972	5984	5995	6007	6018	6030	630
640	6041	6053	6065	6076	6088	6099	6111	6122	6131	6146	640
650	6157	6169	6180	6192	6204	6215	6227	6238	6250	6262	650
660	6273	6285	6297	6308	6320	6332	6343	6355	6367	6378	660
670	6390	6402	6413	6425	6437	6448	6460	6472	6484	6495	670
680	6507	6519	6531	6542	6554	6566	6578	6589	6601	6613	680
690	6625	6636	6618	6660	6672	6684	6695	6707	6719	6731	690
700	6743	6755	6766	6778	6790	6802	6814	6826	6838	6849	700
710	6861	6873	6885	6897	6909	6921	6933	6945	6956	6968	710
720	6980	6992	7004	7016	7028	7040	7052	7064	7076	7088	720
730	7100	7112	7124	7136	7148	7160	7172	7184	7296	7208	730
740	7220	7232	7244	7256	7268	7280	7292	7304	7316	7328	740
750	7340	7352	7364	7376	7389	7401	7413	7425	7437	7449	750
760	7461	7473	7485	7498	7510	7522	7534	7546	7558	7570	760
770	7583	7595	7607	7619	7631	7644	7656	7668	7680	7692	770
780	7705	7717	7729	7741	7753	7766	7778	7790	7802	7815	780
790	7827	7839	7854	7861	7876	7888	7901	7913	7925	7938	790
800	7950	7962	7974	7987	7999	8011	8024	8036	8048	8061	800
810	8073	8086	8098	8110	8123	8135	8147	8160	8172	8185	810
820	8197	8209	8222	8234	8247	8259	8272	8284	8296	8309	820
830	8321	8334	8346	8359	8371	8384	8396	8409	8421	8434	830
840	8446	8459	8471	8484	8496	8509	8521	8534	8546	8559	840
850	8571	8584	8597	8609	8622	8634	8617	8659	8672	8685	850
860	8697	8710	8722	8735	8748	8760	8773	8785	8798	8811	860
870	8823	8836	8849	8861	8874	8887	8899	8912	8925	8937	870
880	8950	8963	8975	8988	9001	9014	9026	9039	9052	9065	880
890	9077	9090	9103	9115	9128	9141	9154	9167	9179	9192	890

Type R

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Temperature (°C)	0	1	2	3	4	5	6	7	8	9	Temperature (°C)
900	9205	9218	9230	9243	9256	9269	9282	9294	9307	9320	900
910	9333	9346	9359	9371	9384	9397	9410	9423	9436	9449	910
920	9461	9474	9487	9500	9513	9526	9539	9552	9565	9578	920
930	9590	9603	9616	9629	9642	9655	9668	9681	9694	9707	930
940	9720	9733	9746	9759	9772	9785	9798	9811	9824	9837	940
950	9850	9863	9876	9889	9902	9915	9928	9941	9954	9967	950
960	9980	9993	10006	10019	10032	10046	10059	10072	10085	10098	960
970	10111	10124	10137	10150	10163	10177	10190	10203	10216	10229	970
980	10242	10255	10268	10282	10295	10308	10321	10334	10347	10361	980
990	10374	10387	10400	10413	10427	10440	10453	10466	10480	10493	990
1000	10506	10519	10532	10546	10559	10572	10585	10599	10612	10625	1000
1010	10638	10652	10665	10678	10692	10705	10718	10731	10745	10758	1010
1020	10771	10785	10798	10811	10825	10838	10851	10865	10878	10891	1020
1030	10905	10918	10932	10945	10958	10972	10985	10998	11012	11025	1030
1040	11039	11052	11065	11079	11092	11106	11119	11132	11146	11159	1040
1050	11173	11186	11200	11213	11227	11240	11253	11267	11280	11294	1050
1060	11307	11321	11334	11348	11361	11375	11388	11402	11415	11429	1060
1070	11442	11456	11469	11483	11496	11510	11524	11537	11551	11564	1070
1080	11578	11591	11605	11618	11632	11646	11659	11673	11686	11700	1080
1090	11714	11727	11741	11754	11768	11782	11795	11809	11822	11836	1090
1100	11850	11863	11877	11891	11904	11918	11931	11945	11959	11972	1100
1110	11986	12000	12013	12027	12041	12054	12068	12082	12096	12109	1110
1120	12123	12137	12150	12164	12178	12191	12205	12219	12233	12246	1120
1130	12260	12274	12288	12301	12315	12329	12342	12356	12370	12384	1130
1140	12397	12411	12425	12439	12453	12466	12480	12494	12508	12521	1140
1150	12535	12549	12563	12577	12590	12604	12618	12632	12616	12659	1150
1160	12673	12687	12701	12715	12729	12742	12756	12770	12784	12798	1160
1170	12812	12825	12839	12853	12867	12881	12895	12909	12922	12936	1170
1180	12950	12961	12978	12992	13006	13019	13033	13047	13061	13075	1180
1190	13089	13103	13117	13131	13145	13158	13172	13186	13200	13214	1190
1200	13228	13242	13256	13270	13281	13298	13311	13325	13339	13353	1200
1210	13367	13381	13395	13400	13123	13437	13451	13465	13479	13493	1210
1220	13507	13521	13535	13549	13563	13577	13590	13604	13618	13632	1220
1230	13646	13660	13674	13688	13702	13716	13730	13744	13758	13722	1230
1240	13786	13800	13814	13828	13812	13856	13870	13884	13898	13912	1240
1250	13926	13940	13954	13968	13982	13996	14010	14024	14038	14052	1250
1260	14066	14081	14095	14109	14123	14137	14151	14165	14179	14193	1260
1270	14207	14221	14235	14249	14263	14277	14291	14305	14319	14333	1270
1280	14347	14361	14375	14390	14404	14418	14432	14446	14460	14474	1280
1290	14488	14502	14516	14530	14544	14558	14572	14586	14601	14615	1290
1300	14629	14643	14657	14671	14685	14699	14713	14727	14741	14755	1300
1310	14770	14784	14798	14812	14826	14840	14854	14868	14882	14896	1310
1320	14911	14925	14939	14953	14967	14981	14995	15009	15023	15037	1320
1330	15052	15066	15080	15094	15108	15122	15136	15150	15164	15179	1330
1340	15193	15207	15221	15235	15249	15263	15277	15291	15306	15320	1340
1350	15334	15348	15362	15376	15390	15401	15419	15433	15447	15461	1350
1360	15475	15489	15503	15517	15531	15546	15560	15574	15588	15602	1360
1370	15616	15630	15645	15659	15673	15687	15701	15715	15729	15743	1370
1380	15758	15772	15786	15800	15814	15828	15842	15856	15871	15885	1380
1390	15899	15913	15927	15941	15955	15969	15984	15998	16012	16026	1390

Type R

JIS C1602-1995 (Conform to IEC584-1(1977), IEC 584-2-(1982)) **Unit μV**

Temperature (°C)	0	1	2	3	4	5	6	7	8	9	Temperature (°C)
1400	16040	16054	16068	16082	16097	16111	16125	16139	16153	16167	1400
1410	16181	16196	16210	16224	16238	16252	16266	16280	16294	16309	1410
1420	16323	16337	16351	16365	16379	16393	16407	16422	16436	16450	1420
1430	16464	16478	16492	16506	16520	16534	16549	16563	16577	16591	1430
1440	16605	16619	16633	16647	16662	16676	16690	16704	16718	16732	1440
1450	16746	16760	16774	16789	16803	16817	16831	16845	16859	16873	1450
1460	16887	16901	16915	16930	16944	16958	16972	16986	17000	17014	1460
1470	17028	17042	17056	17071	17085	17099	17113	17127	12141	17155	1470
1480	17169	17183	17197	17211	17225	17240	17254	17268	17282	17296	1480
1490	17310	17324	17338	17352	17366	17380	17394	17408	17423	17437	1490
1500	17451	17465	17479	17493	17507	17521	17535	17549	17563	17577	1500
1510	17591	17605	17619	17633	17647	17661	17676	17690	17704	17718	1510
1520	17732	17746	17760	17774	17788	17802	17816	17830	17844	17858	1520
1530	17872	17886	17900	17914	17928	17942	17956	17970	17984	17998	1530
1540	18012	18026	18040	18054	18068	18082	18096	18110	18124	18138	1540
1550	18152	18166	18180	18194	18208	18222	18236	18250	18264	18278	1550
1560	18292	18306	18320	18334	18348	18362	18376	18390	18404	18417	1560
1570	18431	18445	18459	18473	18487	18501	18515	18529	18513	18557	1570
1580	18571	18585	18599	18613	18627	18640	18654	18668	18682	18696	1580
1590	18710	18724	18738	18752	18766	18779	18793	18807	18821	18835	1590
1600	18849	18863	18877	18891	18904	18918	18932	18946	18960	18974	1600
1610	18988	19002	19015	19029	19013	19057	19071	19085	19098	19112	1610
1620	19126	19140	19154	19168	19181	19195	19209	19223	19237	19250	1620
1630	19264	19278	19292	19306	19319	19333	19347	19361	19375	19388	1630
1640	19402	19416	19430	19444	19457	19471	19485	19499	19512	19526	1640
1650	19540	19554	19567	19581	19595	19609	19622	19636	19650	19663	1650
1660	19677	19691	19705	19718	19732	19746	19759	19773	19787	19800	1660
1670	19814	19828	19841	19855	19869	19882	19896	19910	19923	19937	1670
1680	19951	19964	19978	19992	20005	20019	20032	20016	20060	20073	1680
1690	20087	20100	20114	20127	20141	20154	20168	20181	20195	20208	1690
1700	20222	20235	20249	20262	20275	20289	20302	20316	20329	20342	1700
1710	20356	20369	20382	20396	20409	20422	20436	20449	20462	20475	1710
1720	20488	20502	20515	20528	20541	20554	20567	20584	20591	20607	1720
1730	20620	20633	20646	20659	20672	20685	20698	20711	20724	20736	1730
1740	20749	20762	20775	20788	20801	20813	20826	20839	20852	20864	1740
1750	20877	20890	20902	20915	20928	20940	20953	20965	20978	20990	1750
1760	21003	21015	21027	21010	21052	21065	21077	21089	21101		1760

REMARK

Standard contact temperature is 0 °C.

Appendix 3.3 Standard Thermal Electromotive Force of S

Type S

JIS C1602-1995 (Conform to IEC584-1(1977), IEC 584-2-(1982)) **Unit μV**

Temperature (°C)	0	-1	-2	-3	-4	-5	-6	-7	-8	-9	Temperature (°C)
-50	-236										-50
-40	-194	-199	-203	-207	-211	-215	-219	-224	-228	-232	-40
-30	-150	-155	-159	-164	-168	-173	-177	-181	-186	-190	-30
-20	-103	-108	-113	-117	-122	-127	-132	-136	-141	-146	-20
-10	-53	-58	-63	-68	-73	-78	-83	-88	-93	-98	-10
0	0	-5	-11	-16	-21	-27	-32	-37	-42	-48	0
Temperature (°C)	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**Temperature (°C)**
0	0	5	11	16	22	27	33	38	44	50	0
10	55	61	67	72	78	84	90	95	101	107	10
20	113	119	125	131	137	143	149	155	161	167	20
30	173	179	185	191	197	204	210	216	222	229	30
40	235	241	248	254	260	267	273	280	286	292	40
50	299	305	312	319	325	332	338	345	352	358	50
60	365	372	378	385	392	399	405	412	419	426	60
70	433	440	446	453	460	467	474	481	488	495	70
80	502	509	516	523	530	538	545	552	559	566	80
90	573	580	588	595	602	609	617	624	631	639	90
100	646	653	661	668	675	683	690	698	705	713	100
110	720	727	735	743	750	758	765	773	780	788	110
120	795	803	811	818	826	834	841	819	857	865	120
130	872	880	888	896	903	911	919	927	935	942	130
140	950	958	966	974	982	990	998	1006	1013	1021	140
150	1029	1037	1045	1053	1061	1069	1077	1085	1094	1102	150
160	1110	1118	1126	1134	1142	1150	1158	1167	1175	1183	160
170	1191	1199	1207	1216	1224	1232	1240	1249	1257	1265	170
180	1273	1282	1290	1298	1307	1315	1323	1332	1340	1348	180
190	1357	1365	1373	1382	1390	1399	1407	1415	1424	1432	190
200	1441	1449	1458	1466	1475	1483	1492	1500	1509	1517	200
210	1526	1534	1543	1551	1560	1569	1577	1586	1594	1603	210
220	1612	1620	1629	1638	1646	1655	1663	1672	1681	1690	220
230	1698	1707	1716	1724	1733	1742	1751	1759	1768	1777	230
240	1786	1794	1803	1812	1821	1829	1838	1847	1856	1865	240
250	1874	1882	1891	1900	1909	1918	1927	1936	1944	1953	250
260	1962	1971	1980	1989	1998	2007	2016	2025	2034	2043	260
270	2052	2061	2070	2078	2087	2096	2105	2114	2123	2132	270
280	2141	2151	2160	2169	2178	2187	2196	2205	2214	2223	280
290	2232	2241	2250	2259	2268	2277	2287	2296	2305	2314	290
300	2323	2332	2311	2350	2360	2369	2378	2387	2396	2405	300
310	2415	2424	2433	2442	2451	2461	2470	2479	2488	2497	310
320	2507	2516	2525	2534	2544	2553	2562	2571	2581	2590	320
330	2599	2609	2618	2627	2636	2646	2655	2664	2674	2683	330
340	2692	2702	2711	2720	2730	2739	2748	2758	2767	2776	340
350	2786	2795	2805	2814	2823	2833	2842	2851	2861	2870	350
360	2880	2889	2899	2908	2917	2927	2936	2946	2955	2965	360
370	2974	2983	2993	3002	3012	3021	3031	3040	3050	3059	370
380	3069	3078	3088	3097	3107	3116	3126	3135	3145	3154	380
390	3164	3173	3183	3192	3202	3212	3221	3231	3240	3250	390

Type S

JIS C1602-1995 (Conform to IEC584-1(1977), IEC 584-2-(1982)) **Unit μV**

Temperature (°C)	0	1	2	3	4	5	6	7	8	9	Temperature (°C)
400	3259	3269	3279	3288	3298	3307	3317	3326	3336	3346	400
410	3355	3365	3374	3384	3394	3403	3413	3423	3432	3442	410
420	3451	3461	3471	3480	3490	3500	3509	3519	3529	3538	420
430	3548	3558	3567	3577	3587	3596	3606	3616	3626	3635	430
440	3645	3655	3664	3674	3684	3694	3703	3713	3723	3732	440
450	3742	3752	3762	3771	3781	3791	3801	3810	3820	3830	450
460	3840	3850	3859	3869	3879	3889	3898	3908	3918	3928	460
470	3938	3917	3957	3967	3977	3987	3997	4006	4016	4026	470
480	4036	4046	4056	4065	4075	4085	4095	4105	4115	4125	480
490	4134	4144	4154	4164	4174	4184	4194	4204	4213	4223	490
500	4233	4243	4253	4263	4273	4283	4293	4303	4313	4323	500
510	4332	4342	4352	4362	4372	4382	4392	4402	4412	4422	510
520	4432	4442	4452	4462	4472	4482	4492	4502	4512	4522	520
530	4532	4542	4552	4562	4572	4582	4592	4602	4612	4622	530
540	4632	4642	4652	4662	4672	4682	4692	4702	4712	4722	540
550	4732	4742	4752	4762	4772	4782	4793	4803	4813	4823	550
560	4833	4843	4853	4863	4873	4883	4893	4904	4914	4924	560
570	4934	4944	4954	4964	4974	4984	4995	5005	5015	5025	570
580	5035	5045	5055	5066	5076	5086	5096	5106	5116	5127	580
590	5137	5147	5157	5167	5178	5188	5198	5208	5218	5228	590
600	5239	5249	5259	5269	5280	5290	5300	5310	5320	5331	600
610	5341	5351	5361	5372	5382	5392	5402	5413	5423	5433	610
620	5443	5454	5464	5474	5485	5495	5505	5515	5526	5536	620
630	5546	5557	5567	5577	5588	5598	5608	5618	5629	5639	630
640	5619	5660	5670	5680	5691	5701	5712	5722	7732	5743	640
650	5753	5763	5774	5784	5791	5805	5815	5826	5836	5846	650
660	5857	5867	5878	5888	5898	5909	5919	5930	5940	5950	660
670	5961	5971	5982	5992	6003	6013	6024	6034	6044	6055	670
680	6065	6076	6086	6097	6107	6118	6128	6139	6149	6160	680
690	6170	6181	6191	6202	6212	6223	6233	6244	6254	6265	690
700	6275	6286	6296	6307	6317	6328	6338	6349	6360	6370	700
710	6381	6391	6402	6412	6423	6434	6444	6455	6465	6476	710
720	6486	6497	6508	6518	6529	6539	6550	6561	6571	6582	720
730	6593	6603	6614	6624	6635	6646	6656	6667	6678	6688	730
740	6699	6710	6720	6731	6742	6752	6763	6774	6784	6795	740
750	6806	6817	6827	6838	6849	6859	6870	6881	6892	6902	750
760	6913	6924	6934	6945	6956	6967	6977	6988	6999	7010	760
770	7020	7031	7042	7053	7064	7074	7085	7096	7107	7117	770
780	7128	7139	7150	7161	7172	7182	7193	7204	7215	7226	780
790	7236	7247	7258	7269	7280	7291	7302	7312	7323	7334	790
800	7345	7356	7367	7378	7388	7399	7410	7421	7432	7443	800
810	7454	7465	7476	7487	7497	7508	7519	7530	7541	7552	810
820	7563	7574	7585	7596	7607	7618	7629	7640	7651	7662	820
830	7673	7684	7695	7706	7717	7728	7739	7750	7761	7772	830
840	7783	7794	7805	7816	7827	7838	7849	7860	7871	7882	840
850	7893	7904	7915	7926	7937	7948	7959	7970	7981	7992	850
860	8003	8014	8026	8037	8018	8059	8070	8081	8092	8103	860
870	8114	8125	8137	8148	8159	8170	8181	8192	8203	8214	870
880	8226	8237	8248	8259	8270	8281	8293	8304	8315	8326	880
890	8337	8348	8360	8371	8382	8393	8404	8416	8427	8438	890

Type S

JIS C1602-1995 (Conform to IEC584-1(1977), IEC 584-2-(1982)) **Unit μV**

Temperature (°C)	0	1	2	3	4	5	6	7	8	9	Temperature (°C)
900	8449	8460	8472	8483	8494	8505	8517	8528	8539	8550	900
910	8562	8573	8584	8595	8607	8618	8629	8640	8652	8663	910
920	8674	8685	8697	8708	8719	8731	8742	8753	8765	8776	920
930	8787	8798	8810	8821	8832	8844	8855	8866	8878	8889	930
940	8900	8912	8923	8935	8946	8957	8969	8980	8991	9003	940
950	9014	9025	9037	9048	9060	9071	9082	9094	9105	9117	950
960	9128	9139	9151	9162	9174	9185	9197	9208	9219	9231	960
970	9242	9254	9265	9277	9288	9300	9311	9323	9334	9345	970
980	9357	9368	9380	9391	9403	9414	9426	9437	9449	9460	980
990	9472	9483	9495	9506	9518	9529	9541	9552	9564	9576	990
1000	9587	9599	9610	9622	9633	9645	9656	9668	9680	9691	1000
1010	9703	9714	9726	9737	9749	9761	9772	9784	9795	9807	1010
1020	9819	9830	9842	9853	9865	9877	9888	9900	9911	9923	1020
1030	9935	9916	9958	9970	9981	9993	10005	10016	10028	10040	1030
1040	10051	10063	10075	10086	10098	10110	10121	10133	10145	10156	1040
1050	10168	10180	10191	10203	10215	10227	10238	10250	10262	10273	1050
1060	10285	10297	10309	10320	10332	10344	10356	10367	10379	10391	1060
1070	10403	10414	10426	10438	10450	10461	10473	10485	10497	10509	1070
1080	10520	10532	10544	10556	10567	10579	10591	10603	10615	10626	1080
1090	10638	10650	10662	10674	10686	10697	10709	10721	10733	10745	1090
1100	10757	10768	10780	10792	10804	10816	10828	10839	10851	10863	1100
1110	10875	10887	10899	10911	10922	10934	10946	10958	10970	10982	1110
1120	10991	11006	11017	11029	11041	11053	11065	11077	11089	11101	1120
1130	11113	11125	11136	11148	11160	11172	11184	11196	11208	11220	1130
1140	11232	11244	11256	11268	11280	11291	11303	11315	11327	11339	1140
1150	11351	11363	11375	11387	11399	11411	11423	11435	11447	11459	1150
1160	11471	11483	11495	11507	11519	11531	11542	11554	11566	11578	1160
1170	11590	11602	11614	11626	11638	11650	11662	11674	11686	11698	1170
1180	11710	11722	11734	11746	11758	11770	11782	11794	11806	11818	1180
1190	11830	11842	11854	11866	11878	11890	11902	11914	11926	11939	1190
1200	11951	11963	11975	11987	11999	12011	12023	12035	12047	12059	1200
1210	12071	12083	12095	12107	12119	12131	12143	12155	12167	12179	1210
1220	12191	12203	12216	12228	12240	12252	12264	12276	12288	12300	1220
1230	12312	12324	12336	12348	12360	12372	12384	12397	12409	12421	1230
1240	12433	12445	12457	12469	12481	12493	12505	12517	12529	12542	1240
1250	12554	12566	12578	12590	12602	12614	12626	12638	12650	12662	1250
1260	12675	12687	12699	12711	12723	12735	12747	12759	12771	12783	1260
1270	12796	12808	12820	12832	12844	12856	12868	12880	12892	12905	1270
1280	12917	12929	12941	12953	12965	12977	12989	13001	13014	13026	1280
1290	13038	13050	13062	13074	13086	13098	13111	13123	13135	13147	1290
1300	13159	13171	13183	13195	13208	13220	13232	13244	13256	13268	1300
1310	13280	13292	23305	13317	13329	13341	13353	13365	13377	13390	1310
1320	13402	13414	13426	13438	13450	13462	13474	13487	13499	13511	1320
1330	13523	13535	13547	13559	13572	13584	13596	13608	13620	13632	1330
1340	13644	13657	13669	13681	13693	13705	13717	13729	13742	13754	1340
1350	13766	13778	13790	13802	13814	13826	13839	13851	13863	13875	1350
1360	13887	13899	13911	13921	13936	13948	13960	13972	13984	13996	1360
1370	14009	14021	14033	14045	14057	14069	14081	14094	14106	14118	1370
1380	14130	14142	14154	14166	14178	14191	14203	14215	14227	14239	1380
1390	14251	14263	14276	14288	14300	14312	14324	14336	14348	14360	1390

Type S

JIS C1602-1995 (Conform to IEC584-1(1977), IEC 584-2-(1982)) **Unit μV**

Temperature (°C)	0	1	2	3	4	5	6	7	8	9	Temperature (°C)
1400	14373	14385	14397	14409	14421	14433	14445	14457	14470	14482	1400
1410	14494	14506	14518	14530	14542	14554	14567	14579	14591	14603	1410
1420	14615	14627	14639	14651	14664	14676	14688	14700	14712	14724	1420
1430	14736	14748	14760	14773	14785	14797	14809	14821	14833	14845	1430
1440	14857	14869	14881	14894	14906	14918	14930	14942	14954	14966	1440
1450	14978	14990	15002	15015	15027	15039	15051	15063	15075	15087	1450
1460	15099	15111	15123	15135	15148	15160	15172	15184	15196	15208	1460
1470	15220	15232	15244	15256	15268	15280	15292	15304	15317	15329	1470
1480	15341	15353	15365	15377	15389	15401	15413	15425	15437	15449	1480
1490	15461	15473	15485	15497	15509	15521	15534	15546	15558	15570	1490
1500	15582	15594	15606	15618	15630	15642	15654	15666	15678	15690	1500
1510	15702	15714	15726	15738	15750	15762	15774	15786	15798	15810	1510
1520	15822	15834	15846	15858	15870	15882	15894	15906	15918	15930	1520
1530	15942	15954	15966	15978	15990	16002	16014	16026	16038	16050	1530
1540	16062	16074	16086	16098	16110	16122	16134	16146	16158	16170	1540
1550	16182	16194	16205	16217	16229	16241	16253	16265	16277	16289	1550
1560	16301	16313	16325	16337	16349	16361	16373	16385	16396	16408	1560
1570	16420	16432	16444	16456	15468	16480	16492	16504	16516	16527	1570
1580	16539	16551	16563	16575	16587	16599	16611	16623	16634	16646	1580
1590	16658	16670	16682	16694	16706	16718	16729	16741	16753	16765	1590
1600	16777	16789	16801	16812	16824	16836	16848	16860	16872	16883	1600
1610	16895	16907	16919	16931	16943	16954	16966	16978	16990	17002	1610
1620	17013	17025	17037	17049	17061	17072	17084	17096	17108	17120	1620
1630	17131	17143	17155	17167	17178	17190	17202	17214	17225	17237	1630
1640	17249	17261	17272	17284	17296	17308	17319	17331	17343	17355	1640
1650	17366	17378	17390	17401	17413	17425	17437	17448	17460	17472	1650
1660	17483	17495	17507	17518	17530	17542	17553	17565	175577	17588	1660
1670	17600	17612	17623	17635	17647	17658	17670	17682	17693	17705	1670
1680	17717	17728	17740	17751	17763	17775	17786	17798	17809	17821	1680
1690	17832	17844	17855	17867	17878	17890	17901	17913	17924	17936	1690
1700	17947	17959	17970	17982	17993	18004	18016	18027	18039	18050	1700
1710	18061	18073	18084	18095	18107	18118	18129	18140	18152	18163	1710
1720	18174	18185	18196	18208	18219	18230	18241	18252	18263	18274	1720
1730	18285	18297	18308	18319	18330	18341	18352	18362	18373	18384	1730
1740	18395	18406	18417	18428	18439	18449	18460	18471	18482	18493	1740
1750	18503	18514	18525	18535	18546	18557	18567	18578	18588	18599	1750
1760	18609	18620	15630	18641	18651	18661	18672	18682	18693		1760

REMARK

Standard contact temperature is 0 °C.

Appendix 3.4 Standard Thermal Electromotive Force of K

Type K

JIS C1602-1995 (Conform to IEC584-1(1977), IEC 584-2-(1982)) **Unit μV**

Temperature (°C)	0	-1	-2	-3	-4	-5	-6	-7	-8	-9	Temperature (°C)
-270	-6458										-270
-260	-6441	-6444	-6446	-6448	-6450	-6452	-6453	-6455	-6456	-6457	-260
-250	-6404	-6408	-6413	-6417	-6421	-6425	-6429	-6432	-6435	-6438	-250
-240	-6344	-6351	-6358	-6364	-6370	-6377	-6382	-6388	-6393	-6399	-240
-230	-6262	-6271	-6280	-6289	-6297	-6306	-6314	-6322	-6329	-6337	-230
-220	-6158	-6170	-6181	-6192	-6202	-6213	-6223	-6233	-6243	-6252	-220
-210	-6035	-6048	-6061	-6074	-6087	-6099	-6111	-6123	-6135	-6147	-210
-200	-5891	-5907	-5922	-5936	-5951	-5965	-5980	-5994	-6007	-6021	-200
-190	-5730	-5747	-5763	-5780	-5797	-5813	-5829	-5845	-5861	-5876	-190
-180	-5550	-5569	-5588	-5606	-5624	-5642	-5660	-5678	-5695	-5713	-180
-170	-5354	-5374	-5395	-5415	-5435	-5454	-5474	-5493	-5512	-5531	-170
-160	-5141	-5463	-5185	-5207	-5228	-5250	-5271	-5292	-5313	-5333	-160
-150	-4913	-4936	-4960	-4983	-5006	-5029	-5052	-5074	-5097	-5119	-150
-140	-4669	-4694	-4719	-4744	-4768	-4793	-4817	-4841	-4865	-4889	-140
-130	-4411	-4437	-4463	-4490	-4516	-4542	-4567	-4593	-4618	-4644	-130
-120	-4138	-4166	-4194	-4221	-4249	-4276	-4303	-4330	-4357	-4384	-120
-110	-3852	-3882	-3911	-3939	-3968	-3997	-4025	-4054	-4082	-4110	-110
-100	-3554	-3584	-3614	-3645	-3675	-3705	-3734	-3764	-3794	-3823	-100
-90	-3243	-3274	-3306	-3337	-3368	-3400	-3431	-3462	-3492	-3523	-90
-80	-2920	-2953	-2986	-3018	-3050	-3083	-3115	-3147	-3179	-3211	-80
-70	-2587	-2620	-2654	-2688	-2721	-2755	-2788	-2821	-2854	-2887	-70
-60	-2243	-2278	-2312	-2347	-2382	-2416	-2450	-2485	-2519	-2553	-60
-50	-1889	-1925	-1961	-1996	-2032	-2067	-2103	-2138	-2173	-2208	-50
-40	-1527	-1564	-1600	-1637	-1673	-1709	-1745	-1782	-1818	-1854	-40
-30	-1156	-1194	-1231	-1268	-1305	-1343	-1380	-1417	-1453	-1490	-30
-20	-778	-816	-854	-892	-930	-968	-1006	-1043	-1081	-1119	-20
-10	-392	-431	-470	-508	-547	-586	-624	-663	-701	-739	-10
0	0	-39	-79	-118	-157	-197	-236	-275	-314	-353	0

Temperature (°C)	0	1	2	3	4	5	6	7	8	9	Temperature (°C)
0	0	39	79	119	158	198	238	277	317	357	0
10	397	437	477	517	557	597	637	677	718	758	10
20	798	838	879	919	960	1000	1041	1081	1122	1163	20
30	1203	1244	1285	1326	1366	1407	1448	1489	1530	1571	30
40	1612	1653	1694	1735	1776	1817	1858	1899	1941	1982	40
50	2023	2064	2106	2147	2188	2230	2271	2312	2354	2395	50
60	2436	2478	2519	2561	2602	2644	2685	2727	2768	2810	60
70	2851	2893	2934	2976	3017	3059	3100	3142	3184	3225	70
80	3267	3308	3350	3391	3433	3474	3516	3557	3599	3640	80
90	3682	3723	3765	3806	3848	3889	3931	3972	4013	4055	90
										357	
100	4096	4138	4179	4220	4262	4303	4344	4385	4427	4468	100
110	4509	4550	4591	4633	4674	4715	4756	4797	4838	4879	110
120	4920	4961	5002	5043	5084	5124	5165	5206	5247	5288	120
130	5328	5369	5410	5450	5491	5532	5572	5613	5653	5694	130
140	5735	5775	5815	5856	5896	5937	5977	6017	6058	6098	140
										357	

Type K

JIS C1602-1995 (Conform to IEC584-1(1977), IEC 584-2-(1982)) **Unit μV**

Temperature (°C)	0	1	2	3	4	5	6	7	8	9	Temperature (°C)
150	6138	6179	6219	6259	6299	6339	6380	6420	6460	6500	150
160	6540	6580	6620	6660	6701	6741	6781	6821	6861	6901	160
170	6941	6981	7021	7060	7100	7140	7180	7220	7260	7300	170
180	7340	7380	7420	7460	7500	7540	7579	7619	7659	7699	180
190	7739	7779	7819	7859	7899	7939	7979	8019	8059	8099	190
										357	
200	8138	8178	8218	8258	8298	8338	8378	8418	8458	8499	200
210	8539	8579	8619	8659	8699	8739	8779	8819	8860	8900	210
220	8940	8980	9020	9061	9101	9141	9181	9222	9262	9302	220
230	9343	9383	9423	9464	9504	9545	9585	9626	9666	9707	230
240	9747	9788	9828	9869	9909	9950	9991	1031	10072	10113	240
250	10153	10194	10235	10276	10316	10357	10398	10439	10480	10520	250
260	10561	10602	10643	10684	10725	10766	10807	10848	10889	10930	260
270	10971	11012	11053	11094	11135	11176	11217	11259	11300	11341	270
280	11382	11423	11465	11506	11547	11588	11630	11671	11712	11753	280
290	11795	11836	11877	11919	11960	12001	12043	12084	12126	12167	290
300	12209	12250	12291	12333	12374	12416	12457	12499	12540	12582	300
310	12624	12665	12707	12748	12790	12831	12873	12915	12956	12998	310
320	13040	13081	13123	13165	13206	13248	13290	13334	13373	13415	320
330	13457	13498	13540	13582	13624	13665	13707	13749	13791	13833	330
340	13874	13916	13958	14000	14042	14084	14126	14167	14209	14251	340
350	14293	14335	14377	14419	14461	14503	14545	14587	14629	14671	350
360	14713	14755	14797	14839	14881	14923	14965	15007	15049	15091	360
370	15133	15175	15217	15259	15301	15343	15385	15427	15469	15511	370
380	15554	15596	15638	15680	15722	15764	15806	15849	15891	15933	380
390	15975	16017	16059	16102	16144	16186	16228	16270	16313	16355	390
400	16397	16439	16482	16524	16566	16608	16651	16693	16735	16778	400
410	16820	16862	16904	16947	16989	17031	17074	17116	17158	17201	410
420	17243	17285	17328	17370	17413	17455	17497	17540	17582	17624	420
430	17667	17709	17752	17794	17837	17879	17921	17964	18006	18049	430
440	18091	18134	18176	18218	18261	18303	18346	18388	18431	18473	440
450	18516	18558	18601	18643	18686	18728	18771	18813	18856	18898	450
460	18941	18983	19026	19068	19111	19154	19196	19239	19281	19324	460
470	19366	19409	19451	19494	19537	19579	19622	19664	19707	19750	470
480	19792	19835	19877	19920	19962	20005	20048	20090	20133	20175	480
490	20218	20261	20303	20346	20389	20431	20474	20516	20559	20602	490
500	20644	20687	20730	20772	20815	20857	20900	20943	20985	21028	500
510	21071	21113	21156	21199	21241	21284	21326	21369	21412	21454	510
520	21497	21540	21582	21625	21668	21710	21753	21796	21838	21881	520
530	21924	21966	22009	22052	22094	22137	22179	22222	22265	22307	530
540	22350	22393	22435	22478	22521	22563	22606	22649	22691	22734	540
550	22776	22819	22862	22904	22947	22990	23032	23075	23117	23160	550
560	23203	23245	23288	23331	23373	23416	23458	23501	23544	23586	560
570	23629	23671	23714	23757	23799	23842	23884	23927	23970	24012	570
580	24055	24097	24140	24182	24225	24267	24310	24353	24395	24438	580
590	24480	24523	24565	24608	24650	24693	24735	24778	24820	24863	590

Type K

JIS C1602-1995 (Conform to IEC584-1(1977), IEC 584-2-(1982)) **Unit μV**

Temperature (°C)	0	1	2	3	4	5	6	7	8	9	Temperature (°C)
600	24905	24948	24990	25033	25075	25118	25160	25203	25245	25288	600
610	25330	25373	25415	25458	25500	25543	25585	25627	25670	25712	610
620	25755	25797	25840	25882	25924	25967	26009	26052	26094	26136	620
630	26179	26221	26263	26306	26348	26390	26433	26475	26517	26560	630
640	26602	26644	26687	26729	26771	26814	26856	26898	26940	26983	640
650	27025	27067	27109	27152	27194	27236	27278	27320	27363	27405	650
660	27447	27489	27531	27574	27616	27658	27700	27742	27784	27826	660
670	27869	27911	27953	27995	28037	28079	28121	28163	28205	28247	670
680	28289	28332	28374	28416	28458	28500	28542	28584	28626	28668	680
690	28710	28752	28794	28835	28877	28919	28961	29003	29045	29087	690
700	29129	29171	29213	29255	29297	29338	29380	29422	29464	29506	700
710	29548	29589	29631	29673	29715	29757	29798	29840	29882	29924	710
720	29965	30007	30049	30090	30132	30174	30216	30257	30299	30341	720
730	30382	30424	30466	30507	30549	30590	30632	30674	30715	30757	730
740	30798	30840	30881	30923	30964	31006	31047	31089	31130	31172	740
750	31213	31255	31296	31338	31379	31421	31462	31504	31545	31586	750
760	31628	31669	31710	31752	31793	31834	31876	31917	31958	32000	760
770	32041	32082	32124	32165	32206	32247	32289	32330	32371	32412	770
780	32453	32495	32536	32577	32618	32659	32700	32742	32783	32824	780
790	32865	32906	32947	32988	33029	33070	33111	33152	33193	33234	790
800	33275	33316	33357	33398	33439	33480	33521	33562	33603	33644	800
810	33685	33726	33767	33808	33848	33889	33930	33971	34012	34053	810
820	34093	34134	34175	34216	34257	34297	34338	34379	34420	34460	820
830	34501	34542	34582	34623	34664	34704	34745	34786	34826	34867	830
840	34908	34948	34989	35029	35070	35110	35151	35192	35232	35273	840
850	35313	35354	35394	35435	35475	35516	35556	35596	35637	35677	850
860	35718	35758	35798	35839	35879	35920	35960	36000	36041	36081	860
870	36121	36162	36202	36242	36282	36323	36363	36403	36443	36484	870
880	36524	36564	36604	36644	36685	36725	36765	36805	36845	36885	880
890	36925	36965	37006	37046	37086	37126	37166	37206	37246	37286	890
900	37326	37366	37406	37446	37486	37526	37566	37606	37646	37686	900
910	37725	37765	37805	37845	37885	37925	37965	38005	38044	38084	910
920	38124	38164	38204	38243	38283	38323	38363	38402	38442	38482	920
930	38522	38561	38601	38641	38680	38720	38760	38799	38839	38878	930
940	38918	38958	38997	39037	39076	39116	39155	39195	39235	39274	940
950	39314	39353	39393	39432	39471	39511	39550	39590	39629	39669	950
960	39708	39747	39787	39826	39866	39905	39944	39984	40023	40062	960
970	40101	40141	40180	40219	40259	40298	40337	40376	40415	40455	970
980	40494	40533	40572	40611	40651	40690	40729	40768	40807	40846	980
990	40885	40924	40963	41002	41042	41081	41120	41159	41198	41237	990
1000	41276	41315	41354	41393	41431	41470	41509	41548	41587	41626	1000
1010	41665	41704	41743	41781	41820	41859	41898	41937	41976	42014	1010
1020	42053	42092	42131	42169	42208	42247	42286	42324	42363	42402	1020
1030	42440	42479	42518	42556	42595	42633	42672	42711	42749	42788	1030
1040	42826	42865	42903	42942	42980	43019	43057	43096	43134	43173	1040

Type K

JIS C1602-1995 (Conform to IEC584-1(1977), IEC 584-2-(1982)) **Unit μV**

Temperature (°C)	0	1	2	3	4	5	6	7	8	9	Temperature (°C)
1050	43211	43250	43288	43327	43365	43403	43442	43480	43518	43557	1050
1060	43595	43633	43672	43710	43748	43787	43825	43863	43901	43940	1060
1070	43978	44016	44054	44092	44130	44169	44207	44245	44283	44321	1070
1080	44359	44397	44435	44473	44512	44550	44588	44626	44664	44702	1080
1090	44740	44778	44816	44853	44891	44929	44967	45005	45043	45081	1090
1100	45119	45157	45194	45232	45270	45308	45346	45383	45421	45459	1100
1110	45497	45534	45572	45610	45647	45685	45723	45760	45798	45836	1110
1120	45873	45911	45948	45986	46024	46061	46099	46136	46174	46211	1120
1130	46249	46286	46324	46361	46398	46436	46473	46511	46548	46585	1130
1140	46623	46660	46697	46735	46772	46809	46847	46884	46921	46958	1140
1150	46995	47033	47070	47107	47144	47181	47218	47256	47293	47330	1150
1160	47367	47404	47441	47478	47515	47552	47589	47626	47663	47700	1160
1170	47737	47774	47811	47848	47884	47921	47958	47995	48032	48069	1170
1180	48105	48142	48179	48216	48252	48289	48326	48363	48399	48436	1180
1190	48473	48509	48546	48582	48619	48656	48692	48729	48765	48802	1190
1200	48838	48875	48911	48948	48984	49021	49057	49093	49130	49166	1200
1210	49202	49239	49275	49311	49348	49384	49420	49456	49493	49529	1210
1220	49565	49601	49637	49674	49710	49746	49782	49818	49854	49890	1220
1230	49926	49962	49998	50034	50070	50106	50142	50178	50214	50250	1230
1240	50286	50322	50358	50393	50429	50465	50501	50537	50572	50608	1240
1250	50644	50680	50715	50751	50787	50822	50858	50894	50929	50965	1250
1260	51000	51036	51071	51107	51142	51178	51213	51249	51284	51320	1260
1270	51355	51391	51426	51461	51497	51532	51567	51603	51638	51673	1270
1280	51708	51744	51779	51814	51849	51885	51920	51955	51990	52025	1280
1290	52060	52095	52130	52165	52200	52235	52270	52305	52340	52375	1290
1300	52410	52445	52480	52515	52550	52585	52620	52654	52689	52724	1300
1310	52759	52794	52828	52863	52898	52932	52967	53002	53037	53071	1310
1320	53106	53140	53175	53210	53244	53279	53313	53348	53382	53417	1320
1330	53451	53486	53520	53555	53589	53623	53658	53692	53727	53761	1330
1340	53795	53830	53864	53898	53932	53967	54001	54035	54069	54104	1340
1350	54138	54172	54206	54240	54274	54308	54343	54377	54411	54445	1350
1360	54479	54513	54547	54581	54615	54619	54683	54717	54751	54785	1360
1370	54819	54852	54886								1370

REMARK

Standard contact temperature is 0 °C.

Appendix 3.5 Standard Thermal Electromotive Force of E

Type E

JIS C1602-1995 (Conform to IEC584-1(1977), IEC 584-2-(1982)) **Unit μV**

Temperature (°C)	0	-1	-2	-3	-4	-5	-6	-7	-8	-9	Temperature (°C)
-270	-9835										-270
-260	-9797	-9802	-9808	-9813	-9817	-9821	-9825	-9828	-9831	-9833	-260
-250	-9718	-9728	-9737	-9746	-9754	-9762	-9770	-9777	-9784	-9790	-250
-240	-9604	-9617	-9630	-9642	-9654	-9666	-|9677	-9688	-9698	-9709	-240
-230	-9455	-9471	-9487	-9503	-9519	-9534	-9548	-9563	-9577	-9591	-230
-220	-9274	-9293	-9313	-9331	-9350	-9368	-9386	-9404	-9421	-9438	-220
-210	-9063	-9085	-9107	-9129	-9151	-9172	-9193	-9214	-9234	-9254	-210
-200	-8825	-8850	-8874	-8899	-8923	-8947	-8971	-8994	-9017	-9040	-200
-190	-8561	-8588	-8616	-8643	-8669	-8696	-8722	-8748	-8774	-8799	-190
-|180	-8273	-8303	-8333	-8362	-8391	-8420	-8449	-8477	-8505	-8533	-180
-170	-7963	-7995	-8027	-8059	-8090	-8121	-8152	-8183	-8213	-8243	-170
-160	-7632	-7666	-7700	-7733	-7767	-7800	-7833	-7866	-7899	-7931	-160
-150	-7279	-7315	-7351	-7387	-7423	-7458	-7493	-7528	-7563	-7597	-150
-140	-6907	-6945	-6983	-7021	-7058	-7096	-7133	-7170	-7206	-7243	-140
-130	-6516	-6556	-6596	-6636	-6675	-6714	-6753	-6792	-6831	-6869	-130
-120	-6107	-6149	-6191	-6232	-6273	-6314	-6355	-6396	-6436	-6476	-120
-110	-5681	-5724	-5767	-5810	-5853	-5896	-5939	-5981	-6023	-6065	-110
-100	-5237	-5282	-5327	-5372	-5417	-5461	-5505	-5549	-5593	-5637	-100
-90	-4777	-4824	-4871	-4917	-4963	-5009	-5055	-5101	-5147	-5192	-90
-80	-4302	-4350	-4398	-4446	-4494	-4542	-4589	-4636	-4687	-4731	-80
-70	-3811	-3861	-3911	-3960	-4009	-4058	-4107	-4156	-4205	-4254	-70
-60	-3306	-3357	-3408	-3459	-3510	-3561	-3611	-3661	-3711	-3761	-60
-50	-2787	-2840	-2892	-2944	-2996	-3048	-3100	-3152	-3204	-3255	-50
-40	-2255	-2309	-2362	-2416	-2469	-2523	-2576	-2629	-2682	-2735	-40
-30	-1709	-1765	-1820	-1874	-1929	-1984	-2038	-2093	-2147	-2201	-30
-20	-1152	-1208	-1264	-1320	-1376	-1432	-1488	-1543	-1599	-1654	-20
-10	-582	-639	-697	-754	-811	-868	-925	-982	-1039	-1095	-10
0	0	-59	-117	-176	-234	-292	-350	-408	-466	-524	0

Temperature (°C)	0	1	2	3	4	5	6	7	8	9	Temperature (°C)
0	0	59	118	176	235	294	354	413	472	532	0
10	591	651	711	770	830	890	950	1010	1071	1131	10
20	1192	1252	1313	1373	1434	1495	1556	1617	1678	1740	20
30	1801	1862	1924	1986	2047	2109	2171	2233	2295	2357	30
40	2420	2482	2545	2607	2670	2733	2795	2858	2921	2984	40
50	3048	3111	3174	3238	3301	3365	3429	3492	3556	3620	50
60	3685	3749	3813	3877	3942	4006	4071	4136	4200	4265	60
70	4330	4395	4460	4526	4591	4656	4722	4788	4853	4919	70
80	4985	5051	5117	5183	5249	5315	5382	5448	5514	5581	80
90	5648	5714	5781	5848	5915	5982	6049	6117	6184	6251	90
100	6319	6386	6454	6522	6590	6658	6725	6794	6862	6930	100
110	6998	7066	7135	7203	7272	7341	7409	7478	7547	7616	110
120	7685	7754	7823	7892	7962	8031	8101	8170	8240	8309	120
130	8379	8449	8519	8589	8659	8729	8799	8869	8940	9010	130
140	9081	9151	9222	9292	9363	9434	9505	9576	9647	9718	140
150	9789	9860	9931	10003	10074	10145	10217	10288	10360	10432	150
160	10503	10575	10647	10719	10791	10863	10935	11007	11080	11152	160
170	11224	11297	11369	11442	11514	11587	11660	11733	11805	11878	170
180	11951	12024	12097	12170	12243	12317	12390	12463	12537	12610	180
190	12684	12757	12831	12904	12978	13052	13126	13199	13273	13347	190

Type E

JIS C1602-1995 (Conform to IEC584-1(1977), IEC 584-2-(1982)) **Unit μV**

Temperature (°C)	0	1	2	3	4	5	6	7	8	9	Temperature (°C)
200	13421	13495	13569	13644	13718	13792	13866	13941	14015	14090	200
210	14164	14239	14313	14388	14463	14537	14612	14687	14762	14837	210
220	14912	14987	15062	15137	15212	15287	15362	15438	15513	15588	220
230	15664	15739	15815	15890	15966	16044	16117	16193	16269	16344	230
240	16420	16496	16572	16648	16724	16800	16876	16952	17028	17104	240
250	17181	17257	17333	17409	17486	17562	17639	17715	17792	17868	250
260	17945	18021	18098	18175	18252	18328	18405	18482	18559	18636	260
270	18713	18790	18867	18944	19021	19098	19175	19252	19330	19407	270
280	19484	19561	19639	19716	19791	19871	19948	20026	20103	20181	280
290	20259	20336	20414	20492	20569	20647	20725	20803	20880	20958	290
300	21036	21114	21192	21270	21348	21426	21504	21582	21660	21739	300
310	21817	21895	21973	22051	22130	22208	22286	22365	22443	22522	310
320	22600	22678	22757	22835	22914	22993	23071	23150	23228	23307	320
330	23386	23464	23543	23622	23701	23780	23858	23937	24016	24095	330
340	24174	24253	24332	24411	24490	24569	24648	24727	24806	24885	340
350	24964	25044	25123	25202	25281	25360	25440	25519	25598	25678	350
360	25757	25836	25916	25995	26075	26154	26233	26313	26392	26472	360
370	26552	26631	26711	26790	26870	26950	27029	27109	27189	27268	370
380	27348	27428	27507	27587	27667	27747	27827	27907	27986	28066	380
390	28146	28226	28306	28386	28466	28546	28626	28706	28786	28866	390
400	28946	29026	29106	29186	29266	29346	29427	29507	29587	29667	400
410	29747	29827	29908	29988	30068	30148	30229	30309	30389	30470	410
420	30550	30630	30711	30791	30871	30952	31032	31112	31193	31273	420
430	31354	31434	31515	31595	31676	31756	31837	31917	31998	32078	430
440	32159	32239	32320	32400	32481	32562	32642	32723	32803	32884	440
450	32965	33045	33126	33207	33287	33368	33449	33529	33610	33691	450
460	33772	33852	33933	34014	34095	34175	34256	34337	34418	34498	460
470	34579	34660	34741	34822	34902	34983	35064	35145	35226	35307	470
480	35387	35468	35549	35630	35711	35792	35873	35954	36034	36115	480
490	36196	36277	36358	36439	36520	36601	36682	36763	36843	36924	490
500	37005	37086	37167	37248	37329	37410	37491	37572	37653	37734	500
510	37815	37896	37977	38058	38139	38220	38300	38381	38462	38543	510
520	38624	38705	38786	38867	38948	39029	39110	39191	39272	39353	520
530	39434	39515	39596	39677	39758	39839	39920	40001	40082	40163	530
540	40243	40324	40405	40486	40567	40648	40729	40810	40891	40972	540
550	41053	41134	41215	41296	41377	41457	41538	41619	41700	41781	550
560	41862	41943	42024	42105	42185	42266	42347	42428	42509	42590	560
570	42671	42751	42832	42913	42994	43075	43156	43236	43317	43398	570
580	43479	43560	43640	43721	43802	43883	43963	44044	44125	44206	580
590	44285	44367	44448	44529	44609	44690	44771	44851	44932	45013	590
600	45093	45174	45255	45335	45416	45497	45577	45658	45738	45819	600
610	45900	45980	46064	46141	46222	46302	46383	46463	46544	46624	610
620	46705	46785	46866	46946	47027	47107	47188	47268	47349	47429	620
630	47509	47590	47670	47751	47831	47911	47992	48072	48152	48233	630
640	48313	48393	48474	48554	48634	48715	48795	48875	48955	49035	640
650	49116	49196	49276	49356	49436	49517	49597	49677	49757	49837	650
660	49917	49997	50077	50157	50238	50318	50398	50478	50558	50638	660
670	50718	50798	50878	50958	51038	51118	51197	51277	51357	51437	670
680	51517	51597	51677	51757	51837	51916	51996	52076	52156	52236	680
690	52315	52395	52475	52555	52634	52714	52794	52873	52953	53033	690

Type E

JIS C1602-1995 (Conform to IEC584-1(1977), IEC 584-2-(1982)) **Unit μV**

Temperature (°C)	0	1	2	3	4	5	6	7	8	9	Temperature (°C)
700	53112	53192	53272	53351	53431	53510	53590	53670	53749	53829	700
710	53908	53988	54067	54147	54226	54306	54385	54465	54544	54624	710
720	54703	54782	54862	54941	55021	55100	55179	55259	55338	55417	720
730	55497	55576	55655	55734	55814	55893	55972	56051	56131	56210	730
740	56289	56368	56447	56526	56606	56685	56764	56843	56922	57001	740
750	57080	57159	57238	57317	57396	57475	57554	57633	57712	57791	750
760	57870	57949	58028	58107	58186	58265	58343	58422	58501	58580	760
770	58659	58738	58816	58895	58974	59053	59131	59210	59289	59367	770
780	59446	59525	59604	59682	59761	59839	59918	59997	60075	60154	780
790	60232	60311	60390	60468	60547	60625	60704	60782	60860	60939	790
800	61017	61096	61174	61253	61331	61409	61488	61566	61644	61723	800
810	61801	61879	61958	62036	62114	62192	62271	62349	62427	62505	810
820	62583	62662	62740	62818	62896	62974	63052	63130	63208	63286	820
830	63364	63442	63520	63598	63676	63754	63832	63910	63988	64066	830
840	64144	64222	64300	64377	64455	64533	64611	64689	64766	64844	840
850	64922	65000	65077	65155	65233	65310	65388	65465	65543	65621	850
860	65698	65776	65853	65931	66008	66086	66163	66241	66318	66396	860
870	66473	66550	66628	66705	66782	66860	66937	67014	67092	67169	870
880	67246	67323	67400	67478	67555	67632	67709	67786	67863	67940	880
890	68017	68094	68174	68248	68325	68402	68479	68556	68633	68710	890
900	68787	68863	68940	69017	69094	69171	69247	69324	69401	69477	900
910	69554	69631	69707	69784	69860	69937	70013	70090	70166	70243	910
920	70319	70396	70472	70548	70625	70701	70777	70854	70930	71006	920
930	71082	71159	71235	71311	71387	71463	71539	71615	71692	71768	930
940	71844	71920	71996	72072	72147	72223	72299	72375	72454	72527	940
950	72603	72678	72754	72830	72906	72981	73057	73133	73208	73284	950
960	73360	73435	73511	73586	73662	73738	73813	73889	73964	74040	960
970	74115	74190	74266	74341	74417	74492	74567	74643	74718	74793	970
980	74869	74944	75019	75095	75170	75245	75320	75395	75471	75546	980
990	75621	75696	75771	75847	75922	75997	76072	76147	76223	76298	990
1000	76373										1000

Appendix 3.6 Standard Thermal Electromotive Force of J

Type J

JIS C1602-1995 (Conform to IEC584-1(1977), IEC 584-2-(1982)) **Unit μV**

Temperature (°C)	0	-1	-2	-3	-4	-5	-6	-7	-8	-9	Temperature (°C)
-210	-8095										-210
-200	-7890	-7912	-7934	-7955	-7976	-7996	-8017	-8037	-8057	-8076	-200
-190	-7659	-7683	-7707	-7731	-7755	-7778	-7801	-7824	-7846	-7868	-190
-180	-7403	-7429	-7456	-7482	-7508	-7534	-7559	-7585	-7610	-7634	-180
-170	-7123	-7152	-7181	-7209	-7237	-7265	-7293	-7321	-7348	-7376	-170
-160	-6821	-6853	-6883	-6914	-6944	-6975	-7005	-7035	-7064	-7094	-160
-150	-6500	-6533	-6566	-6598	-6631	-6663	-6695	-6727	-6759	-6790	-150
-140	-6159	-6194	-6229	-6263	-6298	-6332	-6366	-6400	-6433	-6467	-140
-130	-5801	-5838	-5874	-5910	-5946	-5982	-6018	-6054	-6089	-6124	-130
-120	-5426	-5465	-5503	-5541	-5578	-5616	-5653	-5690	-5727	-5764	-120
-110	-5037	-5076	-5116	-5155	-5194	-5233	-5272	-5311	-5350	-5388	-110
-100	-4633	-4674	-4714	-4755	-4796	-4836	-4877	-4917	-4957	-4997	-100
-90	-4215	-4257	-4300	-4342	-4384	-4425	-4467	-4509	-4550	-4591	-90
-80	-3786	-3829	-3872	-3916	-3959	-4002	-4045	-4088	-4130	-4173	-80
-70	-3344	-3389	-3434	-3478	-3522	-3566	-3610	-3654	-3698	-3742	-70
-60	-2893	-2938	-2984	-3029	-3075	-3120	-3165	-3210	-3255	-3300	-60
-50	-2431	-2478	-2524	-2571	-2617	-2663	-2709	-2755	-2801	-2847	-50
-40	-1961	-2008	-2055	-2103	-2150	-2197	-2244	-2291	-2338	-2385	-40
-30	-1482	-1530	-1578	-1626	-1674	-1722	-1770	-1818	-1865	-1913	-30
-20	-995	-1044	-1093	-1142	-1190	-1239	-1288	-1336	-1385	-1433	-20
-10	-501	-550	-600	-650	-699	-749	-798	-847	-896	-946	-10
0	0	-50	-101	-151	-201	-251	-301	-351	-401	-451	0

Temperature (°C)	0	1	2	3	4	5	6	7	8	9	Temperature (°C)
0	0	50	101	151	202	253	303	354	405	456	0
10	507	558	609	660	711	762	814	865	916	958	10
20	1019	1071	1122	1174	1226	1277	1329	1381	1433	1485	20
30	1537	1589	1641	1693	1745	1797	1849	1902	1954	2006	30
40	2059	2111	2164	2216	2269	2322	2374	2427	2480	2532	40
50	2585	2638	2691	2744	2797	2850	2903	2956	3009	3062	50
60	3116	3169	3222	3275	3329	3382	3436	3489	3543	3596	60
70	3650	3703	3757	3810	3864	3918	3971	4025	4079	4133	70
80	4187	4240	4294	4348	4402	4456	4510	4564	4618	4672	80
90	4726	4781	4835	4889	4943	4997	5052	5106	5160	5215	90
100	5269	5323	5378	5432	5487	5541	5595	5650	5705	5759	100
110	5814	5868	5923	5977	6032	6087	6141	6196	6251	6306	110
120	6360	6415	6470	6525	6579	6634	6689	6744	6799	6854	120
130	6909	6964	7019	7074	7129	7184	7239	7294	7349	7404	130
140	7459	7514	7569	7624	7679	7734	7789	7844	7900	7955	140
150	8010	8065	8120	8175	8231	8286	8341	8396	8452	8507	150
160	8562	8618	8673	8728	8783	8839	8894	8949	9005	9060	160
170	9115	9171	9226	9282	9337	9392	9448	9503	9559	9614	170
180	9669	9725	9780	9836	9891	9947	10002	10057	10113	10168	180
190	10224	10279	10335	10390	10446	10501	10557	10612	10668	10723	190

Type J

JIS C1602-1995 (Conform to IEC584-1(1977), IEC 584-2-(1982)) **Unit μV**

Temperature (°C)	0	1	2	3	4	5	6	7	8	9	Temperature (°C)
200	10779	10834	10890	10945	11001	11056	11112	11167	11223	11278	200
210	11334	11389	11445	11501	11556	11612	11667	11723	11778	11834	210
220	11889	11945	12000	12056	12111	12167	12222	12278	12334	12389	220
230	12445	12500	12556	12611	12667	12722	12778	12833	12889	12944	230
240	13000	13056	13111	13167	13222	13278	13333	13389	13444	13500	240
250	13555	13611	13666	13722	13777	13833	13888	13944	13999	14055	250
260	14110	14166	14221	14277	14332	14388	14443	14499	14554	14609	260
270	14665	14720	14776	14831	14887	14942	14998	15053	15109	15164	270
280	15219	15275	15330	15386	15441	15496	15552	15607	15663	15718	280
290	15773	15829	15884	15940	15995	16050	16106	16161	16216	16272	290
300	16327	16383	16438	16493	16549	16604	16659	16715	16770	16825	300
310	16881	16936	16991	17046	17102	17157	17212	17268	17323	17378	310
320	17434	17489	17544	17599	17655	17710	17765	17820	17876	17931	320
330	17986	18041	18097	18152	18207	18262	18318	18373	18428	18483	330
340	18538	18594	18649	18704	18759	18814	18870	18925	18980	19035	340
350	19090	19146	19201	19256	19311	19366	19422	19477	19532	19587	350
360	19642	19697	19753	19808	19863	19918	19973	20028	20083	20139	360
370	20194	20249	20304	20359	20414	20469	20525	20580	20635	20690	370
380	20745	20800	20855	20911	20966	21021	21076	21131	21186	21241	380
390	21297	21352	21407	21462	21517	21572	21627	21683	21738	21793	390
400	21848	21903	21958	22014	22069	22124	22179	22234	22289	22345	400
410	22400	22455	22510	22565	22620	22676	22731	22786	22841	22896	410
420	22952	23007	23062	23117	23172	23228	23283	23338	23393	23449	420
430	23504	23559	23614	23670	23725	23780	23835	23891	23946	24001	430
440	24057	24112	24167	24223	24278	24333	24389	24444	24499	24555	440
450	24610	24665	24721	24776	24832	24887	24943	24998	25053	25109	450
460	25164	25220	25275	25331	25386	25442	25497	25553	25608	25664	460
470	25720	25775	25831	25886	25942	25998	26053	26109	26165	26220	470
480	26276	26332	26387	36443	26499	26555	26610	26666	26722	26778	480
490	26834	26889	26945	27001	27057	27113	27169	27225	27281	27337	490
500	27393	27449	27505	27561	27617	27673	27729	27785	27841	27897	500
510	27953	28010	28066	28122	28178	28234	28291	28347	28403	28460	510
520	28516	28572	28629	28685	28741	28798	28854	28911	28967	29024	520
530	29080	29137	29194	29250	29307	29363	29420	29477	29534	29590	530
540	29647	29704	29761	29818	29874	29931	29988	30045	30102	30159	540
550	30216	30273	30330	30387	30444	30502	30559	30616	30673	30730	550
560	30788	30845	30902	30960	31017	31074	31132	31189	31247	31304	560
570	31362	31419	31477	31535	31592	31650	31708	31766	31823	31881	570
580	31939	31997	32055	32113	32171	32229	32287	32345	32403	32461	580
590	32519	32577	32636	32694	32752	32810	32869	32927	32985	33044	590
600	33102	33161	33219	33278	33337	33395	33454	33513	33571	33630	600
610	33689	33748	33807	33866	33925	33984	34043	34102	34161	34220	610
620	34279	34338	34397	34457	34516	34575	34635	34694	34754	34813	620
630	34873	34932	34992	35051	35111	35171	35230	35290	35350	35410	630
640	35470	35530	35590	35650	35710	35770	35830	35890	35950	36010	640

Type J

JIS C1602-1995 (Conform to IEC584-1(1977), IEC 584-2-(1982)) **Unit μV**

Temperature (°C)	0	1	2	3	4	5	6	7	8	9	Temperature (°C)
650	36071	36131	36191	36252	36312	36373	36433	36494	36554	36615	650
660	36675	36736	36797	36858	36918	36979	37040	37101	37162	37223	660
670	37284	37345	37406	37467	37528	37590	37651	37712	37773	37835	670
680	37896	37958	38019	38081	38142	38204	38265	38327	38389	38450	680
690	38512	38574	38636	38698	38760	38822	38884	38946	39008	39070	690
700	39132	39194	39256	39318	39381	39443	39505	39568	39630	39693	700
710	39755	39818	39880	39943	40005	40068	40131	40193	40256	40319	710
720	40382	40445	40508	40570	40633	40696	40759	40822	40886	40949	720
730	41012	41075	41138	41201	41265	41328	41391	41455	41518	41581	730
740	41645	41708	41772	41835	41899	41962	42026	42090	42153	42217	740
750	42281	42344	42408	42472	42536	42599	42663	42727	42791	42855	750
760	42919	42983	43047	43111	43175	43239	43303	46367	43431	43495	760
770	43559	43624	43688	43752	43817	43881	43945	44010	44074	44139	770
780	44203	44267	44332	44396	44461	44525	44590	44655	44719	44784	780
790	44848	44913	44977	45042	45107	45171	45236	45301	45365	45430	790
800	45494	45559	45624	45688	45753	45818	45882	45947	46011	46076	800
810	46141	46205	46270	46334	46399	46464	46528	46593	46657	46722	810
820	46786	46851	46915	46980	47044	47109	47173	47238	47302	47367	820
830	47431	47495	47560	47624	47688	47753	47817	47881	47946	48010	830
840	48074	48138	48202	48267	48331	48395	48459	48523	48587	48651	840
850	48715	48779	48843	48907	48971	49034	49098	49162	49226	49290	850
860	49353	49417	49481	49544	49608	49672	49735	49799	49862	49926	860
870	49989	50052	50116	50179	50243	50306	50369	50432	50495	50559	870
880	50622	50685	50748	50811	50874	50937	51000	51063	51126	51188	880
890	51251	51314	51377	51439	51502	51565	51627	51690	51752	51815	890
900	51877	51940	52002	52064	52127	52189	52251	22314	52376	52438	900
910	52500	52562	52624	52686	52748	52810	52872	52934	52996	53057	910
920	53119	53181	53243	53304	53366	53427	53489	53550	53612	53673	920
930	53735	53796	53857	53919	53980	54041	54102	54164	54225	54286	930
940	54347	54408	54469	54530	54591	54652	54713	54773	54834	54895	940
950	54956	55016	55077	55138	55198	55259	55319	55380	55440	55501	950
960	55561	55622	55682	55742	55803	55863	55923	55983	56043	56104	960
970	56164	56224	56284	56344	56404	56464	56524	56584	56643	56703	970
980	56763	56823	56883	56942	57002	57062	57121	57181	57240	57300	980
990	57360	57419	57479	57538	57597	57657	57716	57776	57835	57894	990
1000	57953	58013	58072	58131	58190	58249	58309	58368	58427	58486	1000
1010	58545	58604	58663	58722	58781	58840	58899	58957	59016	59075	1010
1020	59134	59193	59252	59310	59369	59428	59487	59545	59604	59663	1020
1030	59721	59780	59838	59897	59956	60014	60073	60131	60190	60248	1030
1040	60307	60365	60423	60482	60540	60599	60657	60715	60774	60832	1040
1050	60890	60949	61007	61065	61123	61182	61240	61298	61356	61415	1050
1060	61473	61531	61589	61647	61705	61763	61822	61880	61938	61996	1060
1070	62054	62112	62170	62228	62286	62344	62402	62460	62518	62576	1070
1080	62634	62692	62750	62808	62866	62924	62982	63040	63098	63156	1080
1090	63214	63271	63329	63387	63445	63503	63561	63619	63677	63734	1090

Type J

JIS C1602-1995 (Conform to IEC584-1(1977), IEC 584-2-(1982)) **Unit μV**

Temperature (°C)	0	1	2	3	4	5	6	7	8	9	Temperature (°C)
1100	63792	63850	63908	63966	64024	64081	64139	64197	64255	64313	1100
1110	64370	64428	64486	64544	64602	64659	64717	64775	64833	64890	1110
1120	64948	65006	65064	65121	65179	65237	65295	65352	65410	65468	1120
1130	65525	65583	65641	65699	65756	65814	65872	65929	65987	66045	1130
1140	66102	66160	66218	66275	66333	66391	66448	66506	66564	66621	1140
1150	66679	66737	66794	66852	66910	66967	67025	67082	67140	67198	1150
1160	67255	67313	67370	67428	67486	67543	67601	67658	67716	67773	1160
1170	67831	67888	67946	68003	68061	68119	68176	68234	68291	68348	1170
1180	68406	68463	68521	68578	68636	68693	68751	68808	68865	68923	1180
1190	68980	69037	69095	69152	69209	69267	69324	69381	69439	69496	1190
1200	69553										1200

REMARK

Standard contact temperature is 0 °C.

Appendix 3.7 Standard Thermal Electromotive Force of T

Type T

JIS C1602-1995 (Conform to IEC584-1(1977), IEC 584-2-(1982)) **Unit μV**

Temperature (°C)	0	-1	-2	-3	-4	-5	-6	-7	-8	-9	Temperature (°C)
-270	-6258										-270
-260	-6232	-6236	-6239	-6242	-6245	-6248	-6251	-6253	-6255	-6256	-260
-250	-6180	-6187	-6193	-6198	-6204	-6209	-6214	-6219	-6223	-6228	-250
-240	-6105	-6114	-6122	-6130	-6138	-6146	-6153	-6160	-6167	-6174	-240
-230	-6007	-6017	-6028	-6038	-6049	-6059	-6068	-6078	-6087	-6096	-230
-220	-5888	-5901	-5914	-5926	-5938	-5950	-5962	-5973	-5985	-5996	-220
-210	-5753	-5767	-5782	-5795	-5809	-5823	-5836	-5850	-5863	-5876	-210
-200	-5603	-5619	-5634	-5650	-5665	-5680	-5695	-5710	-5724	-5739	-200
-190	-5439	-5456	-5473	-5489	-5506	-5523	-5539	-5555	-5571	-5587	-190
-180	-5261	-5279	-5297	-5316	-5334	-5351	-5369	-5387	-5404	-5421	-180
-170	-5070	-5089	-5109	-5128	-5148	-5167	-5186	-5205	-5224	-5242	-170
-160	-4865	-4886	-4907	-4928	-4949	-4969	-4989	-5010	-5030	-5050	-160
-150	-4648	-4671	-4693	-4715	-4737	-4759	-4780	-4802	-4823	-4844	-150
-140	-4419	-4443	-4466	-4489	-4512	-4535	-4558	-4581	-4604	-4626	-140
-130	-4177	-4202	-4226	-4251	-4275	-4300	-4324	-4348	-4372	-4395	-130
-120	-3923	-3949	-3975	-4000	-4026	-4052	-4077	-4102	-4127	-4152	-120
-110	-3657	-3684	-3711	-3738	-3765	-3791	-3818	-3844	-3871	-3897	-110
-100	-3379	-3407	-3435	-3463	-3491	-3519	-3547	-3574	-3602	-3629	-100
-90	-3089	-3118	-3148	-3177	-3206	-3235	-3264	-3293	-3322	-3350	-90
-80	-2788	-2818	-2849	-2879	-2910	-2940	-2970	-3000	-3030	-3059	-80
-70	-2476	-2507	-2539	-2571	-2602	-2633	-2664	-2695	-2726	-2757	-70
-60	-2153	-2186	-2218	-2251	-2283	-2316	-2348	-2380	-2412	-2444	-60
-50	-1819	-1853	-1887	-1920	-1954	-1987	-2021	-2054	-2087	-2120	-50
-40	-1475	-1510	-1545	-1579	-1614	-1648	-1683	-1717	-1751	-1785	-40
-30	-1121	-1157	-1192	-1228	-1264	-1299	-1335	-1370	-1405	-1440	-30
-20	-757	-794	-830	-867	-904	-940	-976	-1013	-1049	-1085	-20
-10	-383	-421	-459	-496	-534	-571	-608	-646	-683	-720	-10
0	0	-39	-77	-116	-154	-193	-231	-269	-307	-345	0

Temperature (°C)	0	1	2	3	4	5	6	7	8	9	Temperature (°C)
0	0	39	78	117	156	195	234	273	312	352	0
10	391	431	470	510	549	589	629	669	709	749	10
20	790	830	870	911	951	992	1033	1074	1114	1155	20
30	1196	1238	1279	1320	1362	1403	1445	1486	1528	1570	30
40	1612	1654	1696	1738	1780	1823	1865	1908	1950	1993	40
50	2036	2079	2122	2165	2208	2251	2294	2338	2381	2425	50
60	2468	2512	2556	2600	2643	2687	2732	2776	2820	2864	60
70	2909	2953	2998	3043	3087	3132	3177	3222	3267	3312	70
80	3358	3403	3448	3494	3539	3585	3631	3677	3722	3768	80
90	3814	3860	3907	3953	3999	4046	4092	4138	4185	4232	90
100	4279	4325	4372	4419	4466	4513	4561	4608	4655	4702	100
110	4750	4798	4845	4893	4941	4988	5036	5084	5132	5180	110
120	5228	5277	5325	5373	5422	5470	5519	5567	5616	5665	120
130	5714	5763	5812	5861	5910	5959	6008	6057	6107	6156	130
140	6206	6255	6305	6355	6404	6454	6504	6554	6604	6654	140
150	6704	6754	6805	6855	6905	6956	7006	7057	7107	7158	150
160	7209	7260	7310	7361	7412	7463	7515	7566	7617	7668	160
170	7720	7771	7823	7874	7926	7977	8029	8081	8133	8185	170
180	8237	8289	8341	8393	8445	8497	8550	8602	8654	8707	180
190	8759	8812	8865	8917	8970	9023	9076	9129	9182	9235	190

Type T

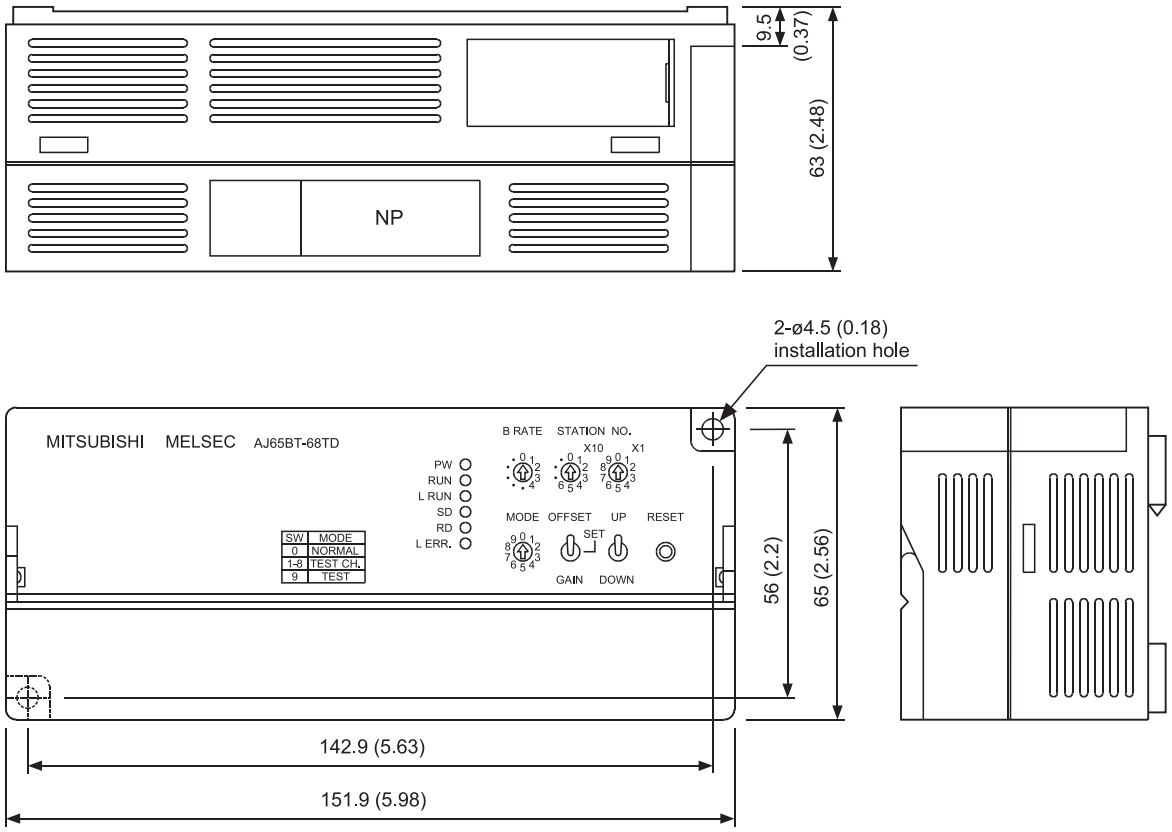
JIS C1602-1995 (Conform to IEC584-1(1977), IEC 584-2-(1982)) **Unit μV**

Temperature (°C)	0	1	2	3	4	5	6	7	8	9	Temperature (°C)
200	9288	9341	9395	9448	9501	9555	9608	9662	9715	9769	200
210	9822	9876	9930	9984	10038	10092	10146	10200	10254	10308	210
220	10362	10417	10471	10525	10580	10634	10689	10743	10798	10853	220
230	10907	10962	11017	11072	11127	11182	11237	11292	11347	11403	230
240	11458	11513	11569	11624	11680	11735	11791	11846	11902	11958	240
250	12013	12069	12125	12181	12237	12293	12349	12405	12461	12518	250
260	12574	12630	12687	12743	12799	12856	12912	12969	13026	13082	260
270	13139	13196	13253	13310	13366	13423	13480	13537	13595	13652	270
280	13709	13766	13823	13881	13938	13995	14053	14110	14168	14226	280
290	14283	14341	14399	14456	14514	14572	14630	14688	14746	14804	290
300	14862	14920	14978	15036	15095	15153	15211	15270	15328	15386	300
310	15445	15503	15562	15621	15679	15738	15797	15856	15914	15973	310
320	16032	16091	16150	16209	16268	16327	16387	16446	16505	16564	320
330	16624	16683	16742	16802	16861	16921	16980	17040	17100	17159	330
340	17219	17279	17339	17399	17458	17518	17578	17638	17698	17759	340
350	17819	17879	17939	17999	18060	18120	18180	18241	18301	18362	350
360	18422	18483	18543	18604	18665	18725	18786	18847	18908	18969	360
370	19030	19091	19152	19213	19274	19335	19396	19457	19518	19579	370
380	19641	19702	19763	19825	19886	19947	20009	20070	20132	20193	380
390	20255	20317	20378	20440	20502	20563	20625	20687	20748	20810	390
400	20872										400

REMARK

Standard contact temperature is 0 °C.

Appendix 4 External Dimensions Diagram



(Unit: mm (in.))

MEMO

WARRANTY

Please confirm the following product warranty details before using this product.

1. Gratis Warranty Term and Gratis Warranty Range

If any faults or defects (hereinafter "Failure") found to be the responsibility of Mitsubishi occurs during use of the product within the gratis warranty term, the product shall be repaired at no cost via the sales representative or Mitsubishi Service Company.

However, if repairs are required onsite at domestic or overseas location, expenses to send an engineer will be solely at the customer's discretion. Mitsubishi shall not be held responsible for any re-commissioning, maintenance, or testing on-site that involves replacement of the failed module.

[Gratis Warranty Term]

The gratis warranty term of the product shall be for one year after the date of purchase or delivery to a designated place.

Note that after manufacture and shipment from Mitsubishi, the maximum distribution period shall be six (6) months, and the longest gratis warranty term after manufacturing shall be eighteen (18) months. The gratis warranty term of repair parts shall not exceed the gratis warranty term before repairs.

[Gratis Warranty Range]

(1) The range shall be limited to normal use within the usage state, usage methods and usage environment, etc., which follow the conditions and precautions, etc., given in the instruction manual, user's manual and caution labels on the product.

(2) Even within the gratis warranty term, repairs shall be charged for in the following cases.

1. Failure occurring from inappropriate storage or handling, carelessness or negligence by the user. Failure caused by the user's hardware or software design.
2. Failure caused by unapproved modifications, etc., to the product by the user.
3. When the Mitsubishi product is assembled into a user's device, Failure that could have been avoided if functions or structures, judged as necessary in the legal safety measures the user's device is subject to or as necessary by industry standards, had been provided.
4. Failure that could have been avoided if consumable parts (battery, backlight, fuse, etc.) designated in the instruction manual had been correctly serviced or replaced.
5. Failure caused by external irresistible forces such as fires or abnormal voltages, and Failure caused by force majeure such as earthquakes, lightning, wind and water damage.
6. Failure caused by reasons unpredictable by scientific technology standards at time of shipment from Mitsubishi.
7. Any other failure found not to be the responsibility of Mitsubishi or that admitted not to be so by the user.

2. Onerous repair term after discontinuation of production

(1) Mitsubishi shall accept onerous product repairs for seven (7) years after production of the product is discontinued. Discontinuation of production shall be notified with Mitsubishi Technical Bulletins, etc.

(2) Product supply (including repair parts) is not available after production is discontinued.

3. Overseas service

Overseas, repairs shall be accepted by Mitsubishi's local overseas FA Center. Note that the repair conditions at each FA Center may differ.

4. Exclusion of loss in opportunity and secondary loss from warranty liability

Regardless of the gratis warranty term, Mitsubishi shall not be liable for compensation of damages caused by any cause found not to be the responsibility of Mitsubishi, loss in opportunity, lost profits incurred to the user by Failures of Mitsubishi products, special damages and secondary damages whether foreseeable or not , compensation for accidents, and compensation for damages to products other than Mitsubishi products, replacement by the user, maintenance of on-site equipment, start-up test run and other tasks.

5. Changes in product specifications

The specifications given in the catalogs, manuals or technical documents are subject to change without prior notice.

SH(NA)-3304-D(1012)MEE
MODEL: AJ65BT-68TD-U-E
MODEL CODE: 13JL52

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