Digital Panel Meters 40 Series

THERMOCOUPLE INPUT DIGITAL PANEL METER

(4 digits, process meter)

Model: 40DT

OPERATING MANUAL

MG CO., LTD. www.mgco.jp
5-2-55 Minamitsumori, Nishinari-ku, Osaka 557-0063 JAPAN

CONTENTS

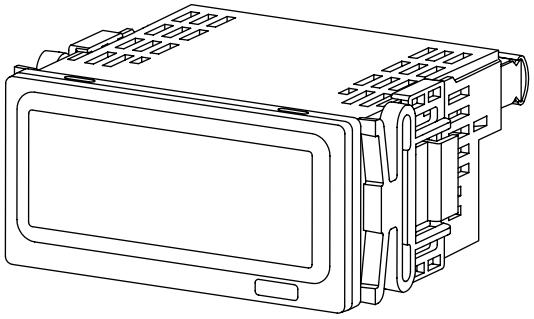
1. INTRODUCTION

1.1 BEFORE USE....

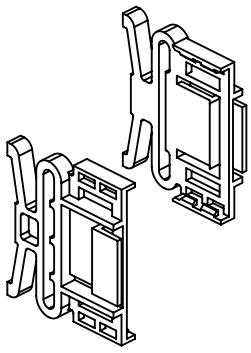
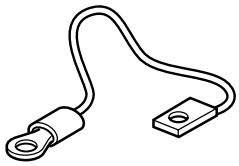
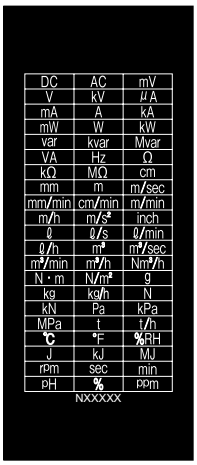
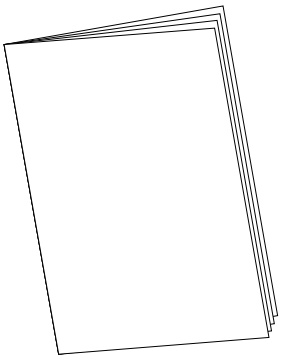
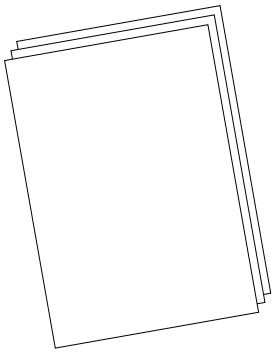
Thank you for choosing us. Before use, please check contents of the package you received as outlined below.

■ PACKAGE INCLUDES

Digital panel meter



Accessories

Mounting bracket (2) 	CJC sensor (1)  (screwed to the input terminals)	Engineering unit sticker label sheet (1) 
Instruction manual 	Ordering Information Sheet  (included with the option code '/SET' only)	

■ MODEL NO.

Confirm Model No. marking on the product to be exactly what you ordered.

1.2 **SAFETY PRECAUTIONS** (that must be observed)

The following signs are used in this manual to provide precautions required to ensure safe usage of the unit. Please understand these signs and graphic symbols, read the manual carefully and observe the description.

The following signs show seriousness of safety hazard or damage occurred when used wrongly with the signs ignored.

⚠ WARNING	Indicates a potentially hazardous situation which, if not avoided, may result in serious injury or death.
⚠ CAUTION	Indicates a potentially hazardous situation which, if not avoided, may result in injury or in property damage.

Indicates prohibitions.	Indicates mandatory cautions.	Indicates cautions.

⚠ WARNING

CAUTION

For safety, make sure that wiring is performed by qualified personnel only.
- Failure to do so may result in a fire, electric shock or injury.

CAUTION
ELECTRIC SHOCK

Do not touch the terminals while the power is on.
- Doing so may result in electric shock.

CAUTION
ELECTRIC SHOCK

Do not touch anything except for the buttons in removing the front panel.
- Doing so may result in malfunction or electric shock.

MANDATORY
CAUTION

Check the connection diagram carefully before wire connection.
- Failure to do so may result in malfunction, a fire or electric shock.

MANDATORY
CAUTION

Provide safety measures outside of the unit to ensure safety in the whole system if an abnormality occurs due to malfunction of the unit or another external factor affecting the unit's operation.

PROHIBITION
TO BE WET

Do not splash water on the unit.
- Doing so may result in a fire, electric shock or injury.

MANDATORY
CAUTION

Stop using the unit immediately if smokes, unusual smell or abnormal noises come(s) from it.
- Using the unit continuously may result in a fire or electric shock.

MANDATORY CAUTION

Stop using the unit if it is dropped or damaged.
- Using the unit continuously may result in a fire or electric shock.

MANDATORY CAUTION

Tighten the terminal block with a specified torque.
- Excessive fastening may result in damage of the terminal screws and loose screws may occasionally result in ignition.

PROHIBITION

Do not throw the unit into the fire.
- Doing so may result in rupture of the electronic component.

⚠ CAUTION

PROHIBITION TO DISCOMPOSE

Never discompose or remodel the unit.
- Doing so may result in electric shock, malfunction or injury.

PROHIBITION

Do not connect or remove the unit while its power is on.
- Doing so may result in electric shock, malfunction or injury.

MANDATORY CAUTION

Do not allow fine shavings or wire scraps to enter the unit in machining screws or wiring.
- Doing so may result in malfunction of the unit.

MANDATORY CAUTION

Make sure to attach the terminal cover.
- Failure to do so may result in electric shock.

MANDATORY CAUTION

Do not remove the front panel except in setting parameters.
- Doing so may result in malfunction due to mixing of foreign substances.

MANDATORY CAUTION

Be aware of static electricity in operating buttons.
- Failure to do so may result in malfunction.

PROHIBITION

Do not pull the wires connecting to the unit.
- Doing so may result in electric shock, damage of the unit or injury.

PROHIBITION

Do not use the unit in an atmosphere where combustible gas is present.
- Doing so may result in inflammation, ignition, or smoke.

PROHIBITION

Do not cover the ventilation slits with cables, etc.
- Doing so may result in malfunction or heating.

1.3 POINTS OF CAUTION

■ CONFORMITY WITH EU DIRECTIVES

- This equipment is suitable for Pollution Degree 2 and Installation Category II (transient voltage 2500 V). Reinforced insulation (input to power: 300 V) is maintained. Prior to installation, check that the insulation class of this unit satisfies the system requirements.
- The equipment must be installed such that appropriate clearance and creepage distances are maintained to conform to CE requirements. Failure to observe these requirements may invalidate the CE conformance.
- Our products conforming to the EU Directives conforms to the standards required based on the premise that they are built into various equipment, apparatus or control panels to use. Because the EMC performance depends on the configuration, wiring or arrangement of the equipment, apparatus and control panels you build, it is necessary for you to make such equipment, apparatus or control panels to conform finally to the CE Marking by yourselves.

⚠ CAUTION

This product conforms to the EMC Directive for electrical and electronic apparatus intended for use in industrial environments. If it is used in the residential environments, it may cause radio interference, and the user is requested to take appropriate measures.

■ ENVIRONMENT

Install the unit within the installation specifications.

- Indoors use.
- Environmental temperature must be within -10 to +55°C (14 to 131°F) with relative humidity within 30 to 90% RH without condensing.
- Altitude up to 2000 meters.
- Provide sufficient space around the unit for heat dissipation.
- Mount the unit to a panel between 1.6 and 8 mm thick.
- Install the unit in a well-ventilated place in order to prevent internal temperature rise.
- Refer to “PANEL CUTOUT” to install several units. In mounting the unit with other equipment side by side, provide sufficient space between them, according to the dimensions in the panel cutout.
- Do not use the unit under the following environments:
  - Where the unit is exposed to direct sunlight, rain or wind. (The unit is not designed for outdoor use.)
  - Where condensation may occur due to extreme temperature changes.
  - Where corrosive or flammable gas is present.
  - Where heavy dust, iron powder or salt is present in the air.
  - Where organic solvent such like benzine, thinner, and alcohol, or strong alkaline materials such like ammonia and caustic soda may attach to the unit, or where such materials are present in the air.
  - Where the unit is subject to continuous vibration or physical impact.
  - Where there are high-voltage lines, high-voltage equipment, power lines, power equipment, equipment with transmission unit such like a ham radio equipment, or equipment generating large switching surges around the unit.

■ WIRING

- In order to prevent potential electric shock, wire the unit after turning off the power supply and making sure that the power is not supplied to the cable.
- In order to enable the operator to turn off the power input immediately, install a switch or a circuit breaker according to the relevant requirements in IEC 60947-2 and properly indicate it.
- Be sure to confirm the name and polarity of each terminal before wiring to the terminal block.
- Do not connect anything to unused terminals.
- Be sure to attach the terminal cover to prevent electric shock.

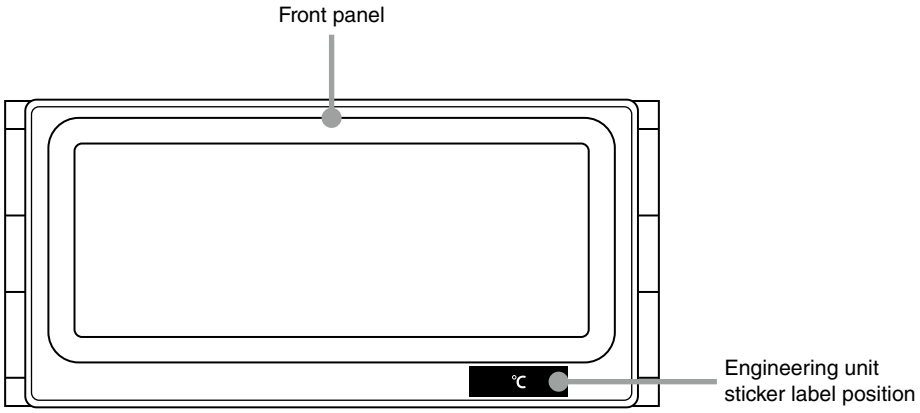
■ HANDLING CAUTIONS

- The unit is designed to function as soon as power is supplied, however, a warm up for 10 minutes is required for satisfying complete performance described in the data sheet.
- Use the unit within the noted supply power voltage and rated load.
- Clean the surface of the unit with wet soft cloth. Do not use organic solvent such like benzine, thinner and alcohol. Doing so may result in deformation or discoloration of the unit.
- When abnormality is found such like smokes, unusual smell and abnormal noises coming from the unit, immediately cut the power supply and stop using it.

1.4 COMPONENT IDENTIFICATION

■ FRONT VIEW

• With Front Panel



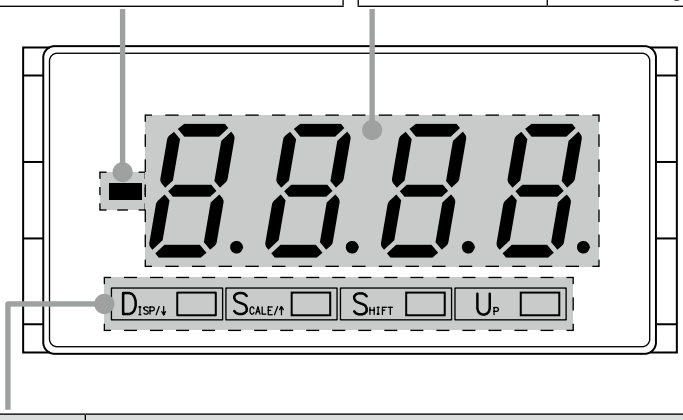
NOTE

- The engineering unit sticker label position is our recommended position.
- When an engineering unit is specified by the Ordering Information Sheet, the unit(s) will be shipped with the sticker label put on the above position.

• Without Front Panel

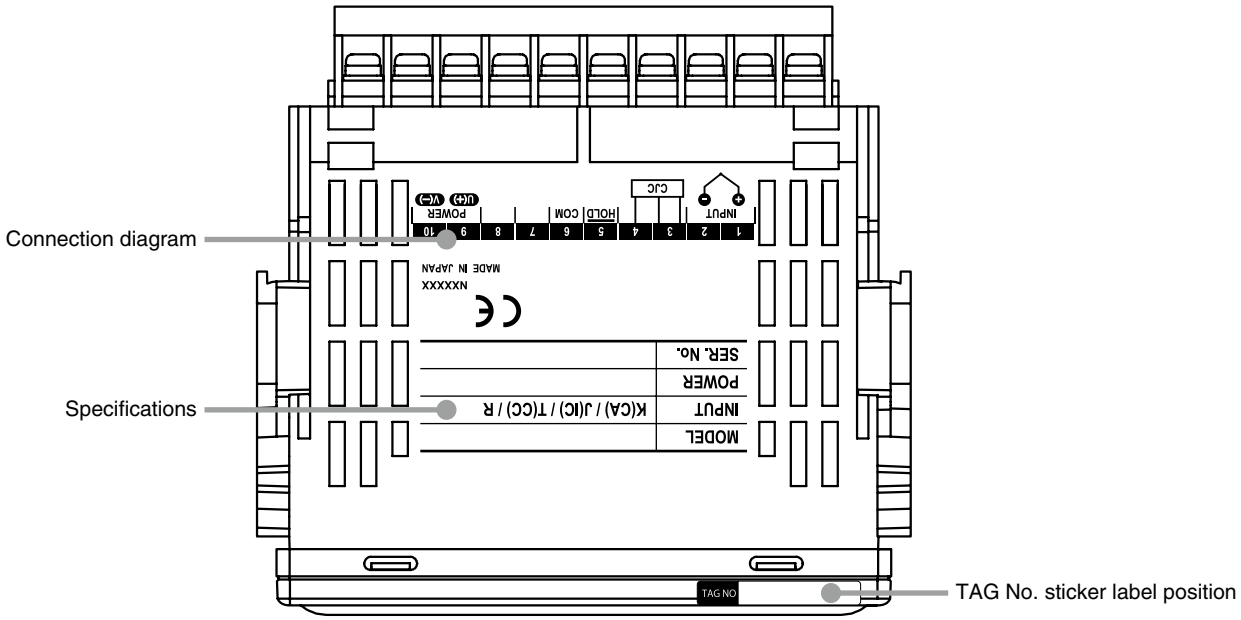
COMPONENT	FUNCTION
Polarity indicator	Turns on when negative value is displayed.

COMPONENT	FUNCTION
4-digit display	Indicates present value, setting value and error messages. Range: 0 to 9999



BUTTON	FUNCTION
DISP/↓	Used to move on to the display setting mode; or to shift through setting items in each setting mode.
SCALE/↑	Used to move on to the zero & span adjustment mode; or to shift through setting items in each setting mode.
SHIFT	Used to move on to the setting standby status of each setting mode and to shift through display digits in each setting item.
UP	Used to change setting values in a setting standby mode.

■ **TOP VIEW**



NOTE

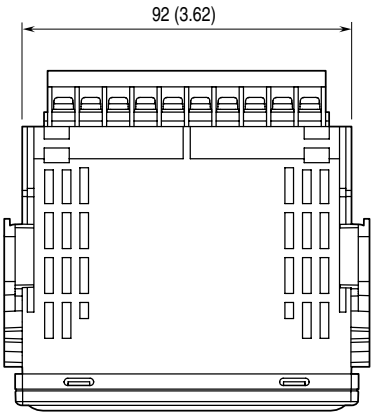
- Contents of the specification label depend on the specifications.
- The tag No. label sticker position is our recommended position.
- When a tag No. is specified, the unit(s) will be shipped with the tag No. sticker label put on the above position. Max. 17 alphanumeric characters can be specified. Please consult us.

1.5 INSTALLATION

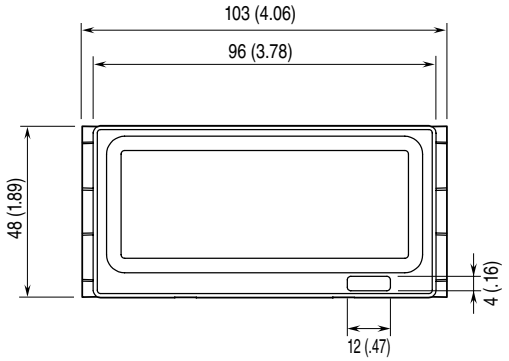
1.5.1 EXTERNAL DIMENSIONS

unit: mm (inch)

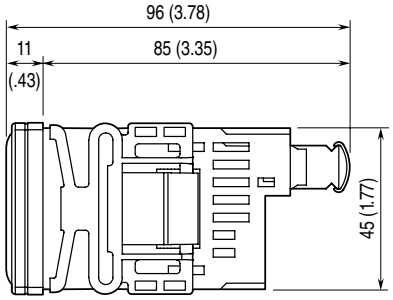
■ **TOP VIEW**



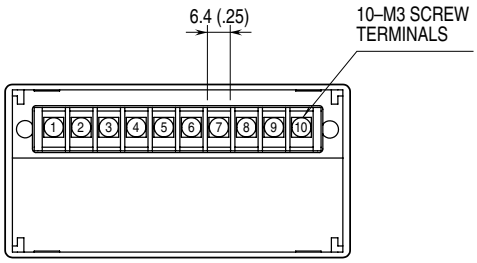
■ **FRONT VIEW**



■ **SIDE VIEW**

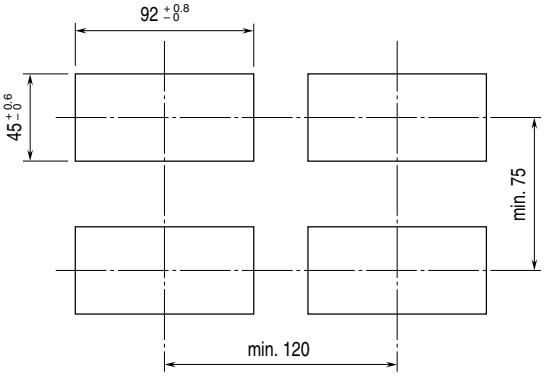


■ **REAR VIEW**



1.5.2 PANEL CUTOUT DIMENSIONS

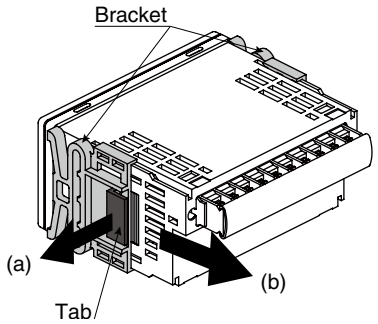
unit: mm



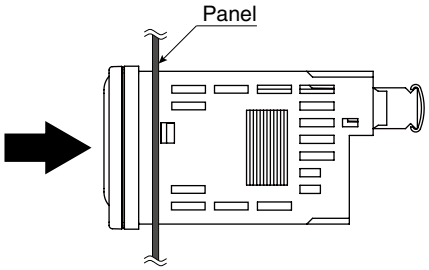
Panel thickness: 1.6 to 8.0 mm

1.5.3 INSTALLATION

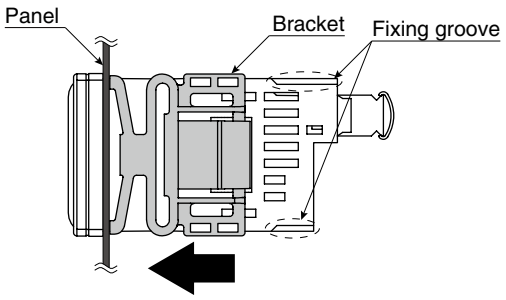
(1) Remove the mounting brackets.
   (a) Flip a tab of a bracket.
   (b) Then pull the bracket toward the terminal block to remove it.



(2) Insert the unit into the panel cutout.



(3) Push the mounting brackets into the grooves on both sides of the rear module, until they hit the panel's rear side.



1.6 WIRING INSTRUCTIONS

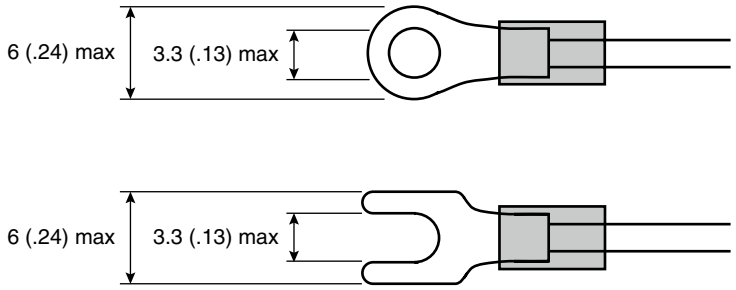
1.6.1 CAUTION IN WIRING

- For safety, make sure that wiring is performed by qualified personnel only.
- In order to prevent potential electric shock, wire the unit after turning off the power supply and making sure that the power is not supplied to the cable.
- Be sure to confirm the name and polarity of each terminal before wiring to it.
- Do not connect anything to unused terminals.
- We offer a series of lightning surge protectors for protection against induced lightning surges. Please contact us to choose appropriate models.

1.6.2 RECOMMENDED SOLDERLESS TERMINAL

- Use solderless terminals for M3. Refer to the drawings below.

unit: mm (inch)

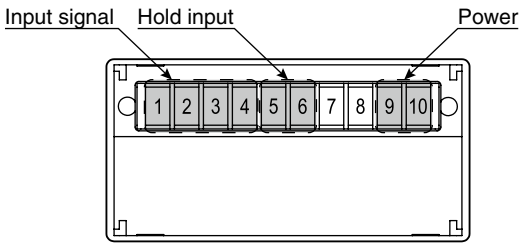


Applicable wire size: 0.25 to 1.65 mm^2
Torque: 0.6 N·m
Recommended manufacturer: Japan Solderless Terminal MFG. Co., Ltd., Nichifu Co., Ltd.

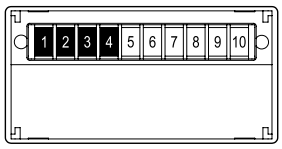
IMPORTANT

- Insulated solderless terminals are recommended.
- In using non-insulated solderless terminals, cover them with insulating caps or tubes.
- Ring tongue terminals are recommended rather than spade tongue terminals to prevent from falling off.

1.6.3 TERMINAL ASSIGNMENT



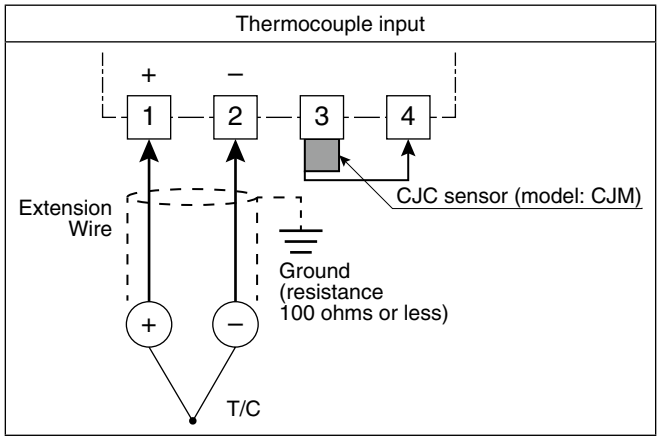
1.6.4 WIRING INPUT SIGNAL



Connect a thermocouple or extension wires.

IMPORTANT

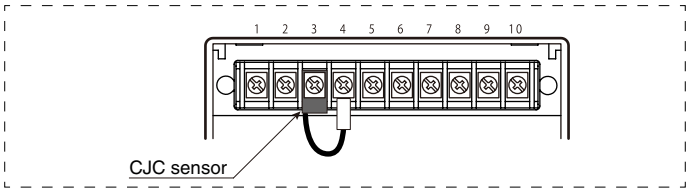
- Be sure to confirm the polarity of the thermocouple and compensation leadwires in wiring.
- Wire the unit with the thermocouple using the extension wires with the same characteristics as the thermocouple.
- Be careful not to change the temperature around the terminal block. Take care that wind from a fan does not hit it directly.
- Mount the CJC sensor regardless of the CJC sensor setting.
- Take measures to reduce noise as much as possible, e.g. by using shielded twisted pair wires for the input signal. Ground the input shield to the most stable earth to prevent noise troubles.
- Do not connect anything to unused terminals.



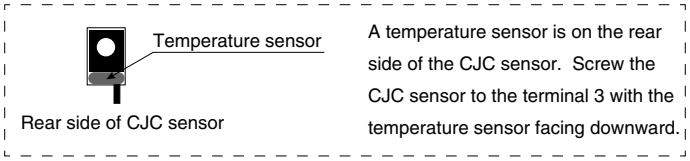
NOTE

■ HOW TO SCREW COLD JUNCTION COMPENSATION (CJC) SENSOR

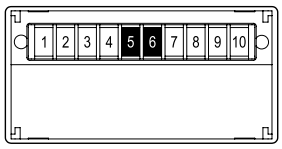
- Mount the CJC sensor to the terminals 3 and 4 as shown in the following figure.



- Confirm the front/rear of the CJC sensor.



1.6.5 WIRING HOLD INPUT

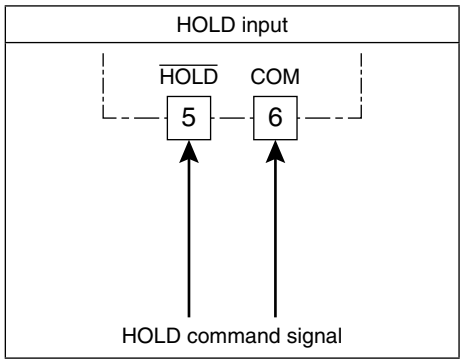


Displayed value is held with an external HOLD command input.
Connect the contact across $\overline{\text{HOLD}}$ to COM as shown in the following figure.
Close the contact to hold the value.

Detecting voltage	Approx. 5 V DC, 1 mA
Detecting level	≤ 1.5 V

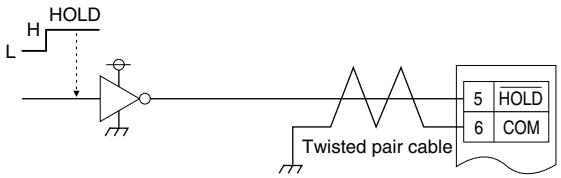
IMPORTANT

- Be sure to confirm the input polarity in wiring.
- The HOLD input is not isolated from the internal circuit.

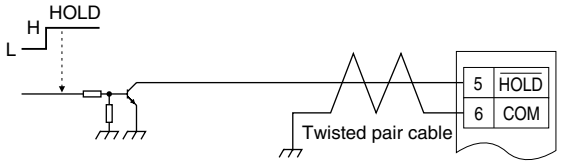


■ WIRING EXAMPLES

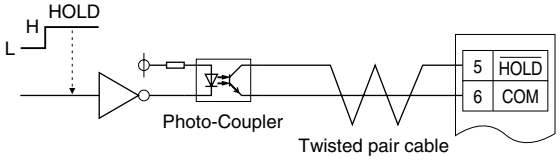
(a) 5V–CMOS, TTL



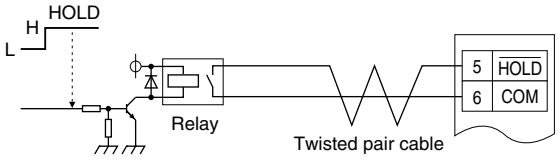
(b) Transistor



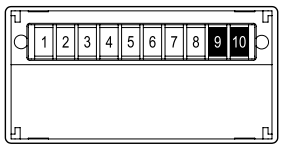
(c) Photo-Coupler



(d) Relay



1.6.6 WIRING POWER

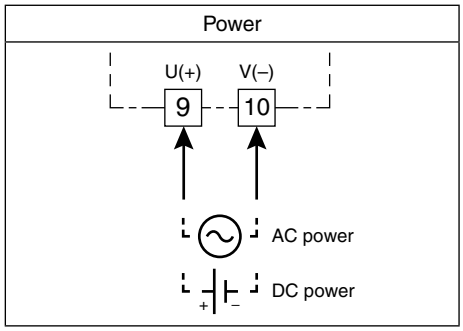


Connect power according to the power input code. The power specifications are shown in the following table.

CODE	RATING	PERMISSIBLE RANGE
K3	100 to 120 V AC	85 to 132 V AC, 47 – 66 Hz approx. 1.0 VA
L3	200 to 240 V AC	170 to 264 V AC, 47 – 66 Hz approx. 1.0 VA
R	24 V DC	±20% approx. 0.3 W

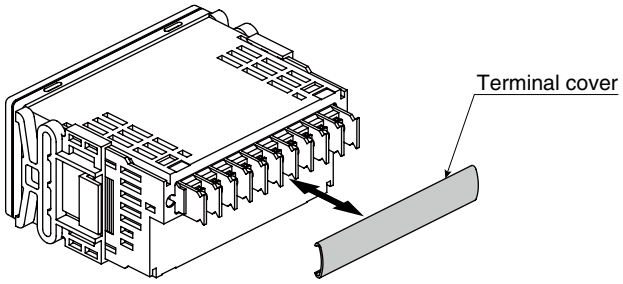
IMPORTANT

- For safety, make sure that wiring is performed by qualified personnel only.
- In order to prevent potential electric shock, wire the unit after turning off the power supply and making sure that the power is not supplied to the cable.
- Use wires as thick as possible and twist them from the end.
- For DC power, confirm the polarity.



1.6.7 ATTACHING/REMOVING TERMINAL COVER

Attach the terminal cover for safety after wiring.



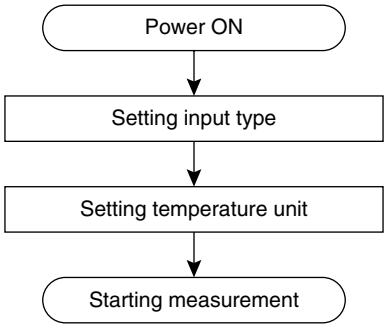
2. BASIC SETTING AND OPERATION

2.1 BASIC SETTING

This section describes flow and procedure of the basic setting.
The following shows the flow and procedure to set the input type to the thermocouple T (CC) and the temperature unit to °C as an example.

2.1.1 BASIC SETTING FLOW

The basic setting is as shown in the following flowchart.

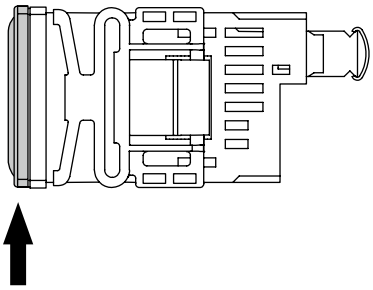


2.1.2 MOUNTING/REMOVING FRONT PANEL

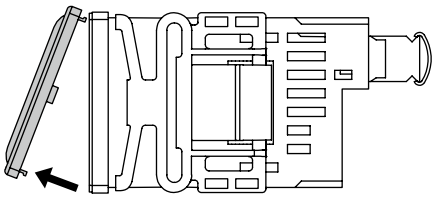
- Set parameters with the buttons inside the front panel. Remove the panel in setting.
- Mount the panel after configuration.

■ REMOVING FRONT PANEL

(1) Hold up the front panel.

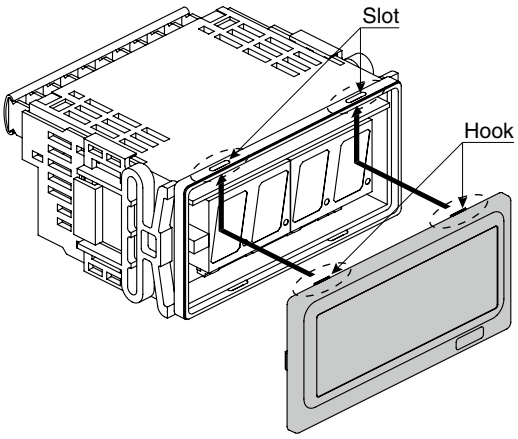


(2) Remove the panel from downside.

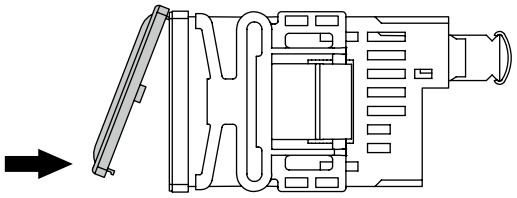


■ **MOUNTING FRONT PANEL**

(1) Insert the front panel hook into the case upside slots of the unit.



(2) Push the panel hook into the case downside slots of the unit.



NOTE

- Be sure to confirm the direction of the front panel in mounting.
- Make sure that there is no misalignment or space between the unit and the panel after mounting.

2.1.3 BASIC SETTING PROCEDURE

The following shows the procedure to set the input type to the thermocouple T (CC) and the temperature unit to °C as an example. Set a thermocouple and temperature unit to use. Refer to 3. SETTING INPUT TYPE for details of setting.

■ **PARAMETER LIST FOR BASIC SETTING**

Parameters used in the basic setting are as shown in the following table.

PARAMETER	SETTING VALUE	SETTING
Input type	T	T (CC) thermocouple
Temperature unit	C	Temperature indication in °C

■ BASIC SETTING PROCEDURE

The basic setting procedure is as follows.

1 Confirm the wiring, turn on the power and move on to Zero & Span Adjustment Mode (measurement stopped).

- Hold down SCALE/↑ button for 3 seconds or more.

2 Set input type.

- Press SHIFT button to shift the display into the setting standby mode and UP button to select the input type.

3 Set temperature unit.

- Press DISP/↓ or SCALE/↑ button to apply the new setting and go to the next or previous parameter setting.
- Press SHIFT button to shift the display into the setting standby mode and UP button to select the temperature unit.

4 Return to Measuring Mode (measurement started).

- Hold down DISP/↓ or SCALE/↑ button for 1 second or more to apply the new setting and return to Measuring Mode.

2.2 BASIC SETTING OPERATION AND INSTRUCTIONS

This section describes basic operation and instructions when setting parameters.

2.2.1 BASIC SETTING OPERATION

Parameters can be grouped into two setting types, “numerical value setting” and “setting value selection”. Basic operation of each type is as shown below.

■ NUMERICAL VALUE SETTING

1 **Press SHIFT button to shift the display into the setting standby mode.**

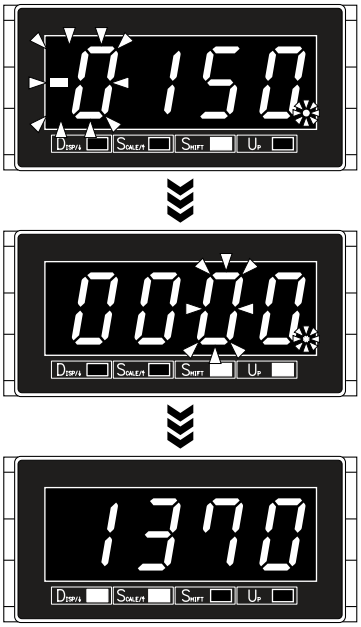
• The 4th digit starts blinking.

2 **Press SHIFT and UP buttons to set a numerical value.**

• Press SHIFT button to go to the next digit.
• Press UP button to change the blinking value.

3 **Press DISP/↓ or SCALE/↑ button to apply the new setting.**

• The next or previous parameter setting is indicated.

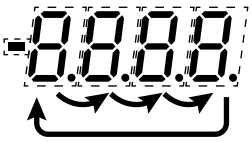


*1 Display depands on the settings.

NOTE

■ SHIFTING DIGITS

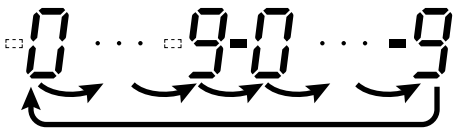
Each time pressing SHIFT button, the blinking digit moves to the right.



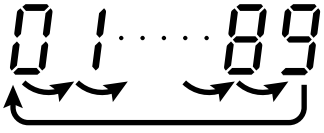
■ SETTING A NUMERICAL VALUE

• Each time pressing UP button, the numeral is incremented by 1.
• The negative sign (-) must be set together with the 4th digit. For example, set ‘-0040’ instead of ‘-40’.

• 4th digit



• Other digits



■ **SETTING VALUE SELECTION**

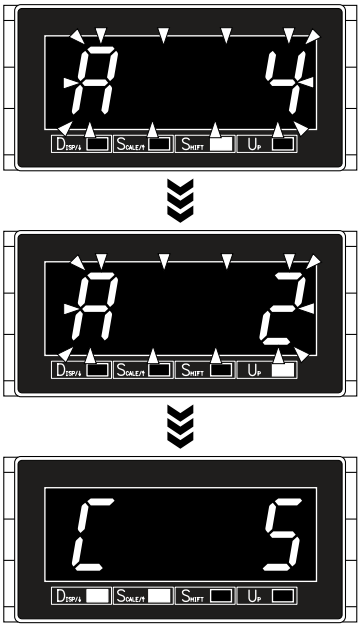
1 **Press SHIFT button to shift the display into the setting standby mode.**

• The current set value starts blinking.

2 **Press UP button to select your desired setting value.**

3 **Press DISP/↓ or SCALE/↑ button to apply the new setting.**

• The next or previous parameter setting is indicated.



*1 Display depands on the settings.

2.2.2 INSTRUCTIONS ON BASIC OPERATION

■ **IF THE FRONT BUTTONS ARE LEFT UNTOUCHED…**

• The indication turns on with applying the last changes after approximately 1 minute while it is in the setting standby mode.
• The display goes back automatically to Measuring Mode after approximately 1 minute in one of the other modes.

■ **TO ABORT A SETTING…**

• Hold down SHIFT button for 3 seconds or more to return to Measuring Mode without applying the last changes while the display is in the setting standby mode.
• If you get lost in a setting mode, you can execute initialization. Refer to 13.2 INITIALIZING SETTING VALUES.

3. SETTING INPUT TYPE

Set input type according to the thermocouple to use.

3.1 INPUT TYPE LIST

■ TEMPERATURE UNIT: °C

DISPLAY	FUNCTION	OPERATIONAL RANGE	CONFORMANCE RANGE	DEFAULT VALUE
K	K (CA)	-180 to +1400	-150 to +1370	K
J	J (IC)	-210 to +1030	-180 to +1000	
T	T (CC)	-200 to +430	-170 to +400	
R	R	170 to 1790	380 to 1760	

■ TEMPERATURE UNIT: °F

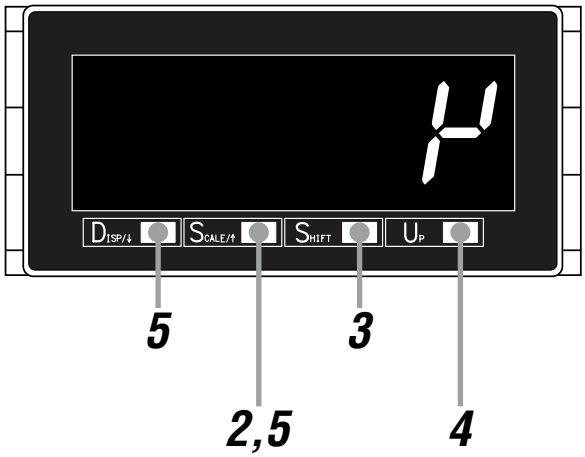
DISPLAY	FUNCTION	OPERATIONAL RANGE	CONFORMANCE RANGE	DEFAULT VALUE
K	K (CA)	-292 to +2552	-238 to +2498	K
J	J (IC)	-346 to +1886	-292 to +1832	
T	T (CC)	-328 to +806	-274 to +752	
R	R	338 to 3254	716 to 3200	

IMPORTANT

The display accuracy is assured within the conformance range though indicating within the operational range is available.

3.2 OPERATING PROCEDURE

Procedures to change the input type 'K' (default) to 'T' (thermocouple T (CC)) are described here.



NOTE

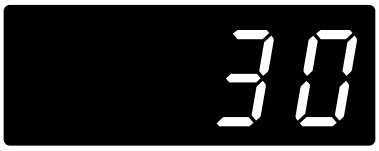
The left figure shows a display example. The display depends on the settings.

1 **Confirm the wiring, and turn on the power.**

- All the indications turn on for approximately 3 seconds and then the display moves on to Measuring Mode.

■ Immediately after power on (all indicators on)

■ Measuring Mode



*1 Display depends on the settings and input.

NOTE

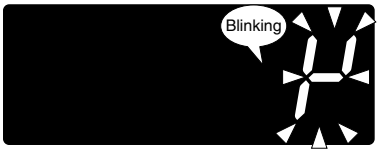
- Indication 'S.ERR' may blink, which shows the input out of the permissible range and does not show the unit failure.
- Indication 'B.ERR' may blink, which shows the input open or out of the range and does not show the unit failure.

2 **Hold down SCALE/↑ button for 3 seconds or more to move on to Zero & Span Adjustment Mode.**

- The input type is indicated.

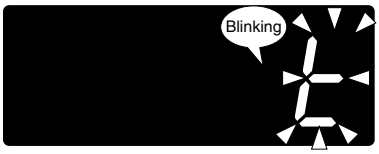
3 **Press SHIFT button to shift the display into the setting standby mode.**

- The indication 'K' starts blinking, to which you can apply changes.



4 **Press UP button to select the input type.**

• Select 'T' (thermocouple T (CC)).



5 **Press DISP/↓ or SCALE/↑ button to apply the new setting.**

• And the next parameter setting is indicated.

NOTE

- Press DISP/↓ button, and the zero adjustment will be indicated, or the temperature unit 'F' will be indicated with the temperature unit set to °F.
- Press SCALE/↑ button, and the temperature unit 'C' or 'F' will be indicated depending on the setting.

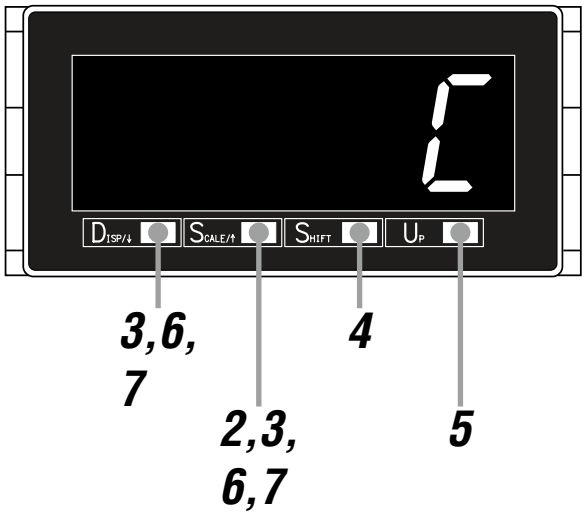
6 **■ TO GO ON TO SET THE TEMPERATURE UNIT,**
Skip to Step 3 in "4. SETTING TEMPERATURE UNIT".

■ TO QUIT,
Hold down DISP/↓ or SCALE/↑ button for 1 second or more to return to Measuring Mode.

4. SETTING TEMPERATURE UNIT

The temperature indication in °C ('C') or °F ('F') can be selected. The default value is °C.

4.1 OPERATING PROCEDURE



NOTE

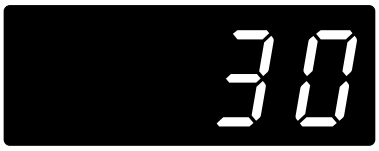
- Procedures to change 'C' to 'F' are described here.
- To change 'F' to 'C', the procedures are same. Select 'C' in Step 5.

1 **Confirm the wiring, and turn on the power.**

- All the indications turn on for approximately 3 seconds and then the display moves on to Measuring Mode.

■ Immediately after power on (all indicators on)

■ Measuring Mode



*1 Display depends on the settings and input.

NOTE

- Indication 'S.ERR' may blink, which shows the input out of the permissible range and does not show the unit failure.
- Indication 'B.ERR' may blink, which shows the input open or out of the range and does not show the unit failure.

2 **Hold down SCALE/↑ button for 3 seconds or more to move on to Zero & Span Adjustment Mode.**

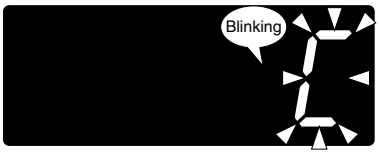
- The input type is indicated.

3 **Press DISP/↓ or SCALE/↑ button to go to the temperature unit setting.**

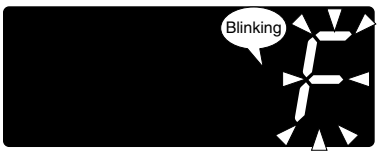
- 'C' is indicated.

4 **Press SHIFT button to shift the display into the setting standby mode.**

• The indication starts blinking, to which you can apply changes.



5 **Press UP button to select 'F'.**



6 **Press DISP/↓ or SCALE/↑ button to apply the new setting.**

• And the next parameter setting is indicated.

NOTE

- Press DISP/↓ button, and the input type will be indicated.
- Press SCALE/↑ button, and the span adjustment will be indicated, or the input type will be indicated with the temperature unit set to °F.

7 **Hold down DISP/↓ or SCALE/↑ button for 1 second or more to return to Measuring Mode.**

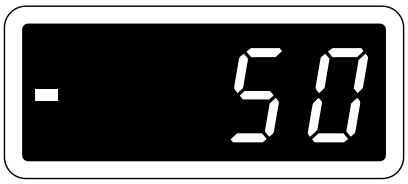
5. OPERATION

Make sure that -50 to +400°C with the thermocouple T (CC) is correctly indicated.

IMPORTANT

Before operating, make sure that the wiring is correct, the input and the power supply are within the specification range.

1 **Provide -50°C input and make sure that -50°C is indicated.**

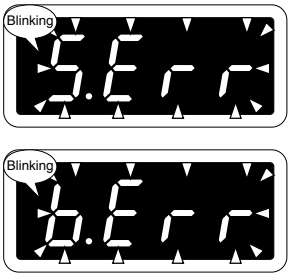


*1 Display depends on the settings and input.

NOTE

■ **WHEN THE FOLLOWING IS INDICATED…**

- When 'S.ERR' is indicated, the input is not applied correctly. Check the input type, thermocouple and input wiring.
- When 'B.ERR' is indicated, one or some of the input wires is/are disconnected, or the input is beyond the 'S.ERR' indication range. Check the input type, thermocouple and input wiring.



2 **Provide 400°C input and make sure that 400°C is indicated.**

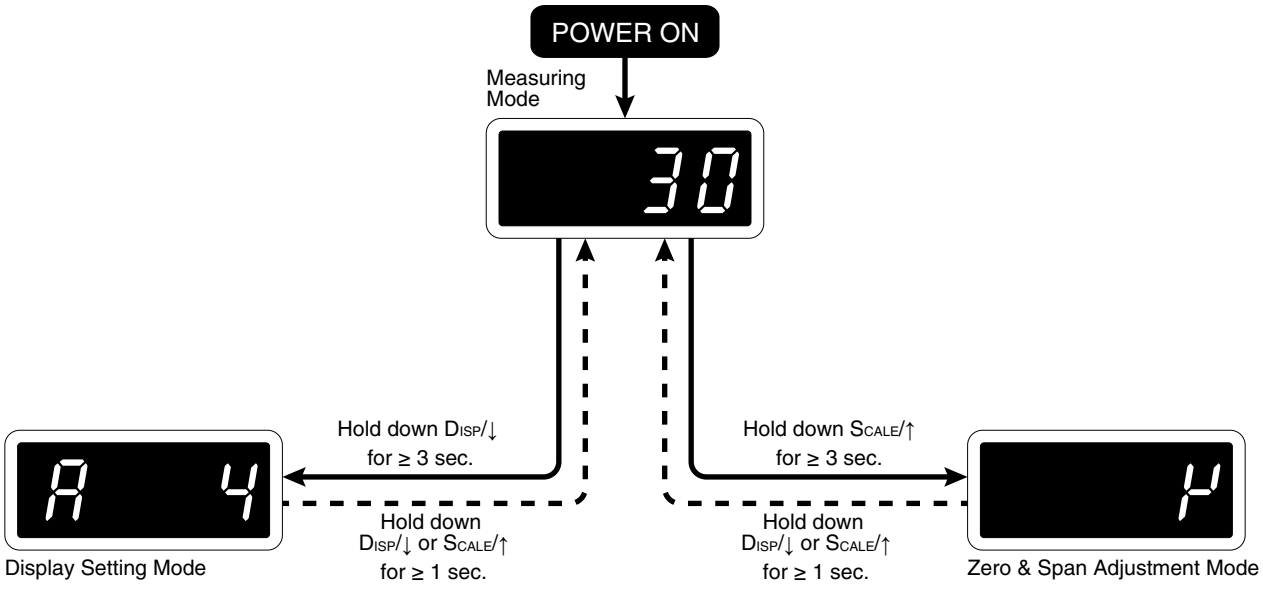
6. PARAMETER CONFIGURATION

■ MODE

Parameters can be grouped in several modes.
The 40DT has modes as shown in the following table.

MODE	FUNCTION	MEASUREMENT
Measuring	Normal measurement state where the unit takes in input. When the power is supplied, the unit operates in Measuring Mode.	Measuring
Zero & Span Adjustment	Basic settings such like input type and temperature unit, and also zero & span adjustments can be performed.	Measuring stopped
Display Setting	Moving average, brightness and CJC sensor can be set. Settings can be initialized. Also the firmware version can be confirmed.	

■ MODE TRANSITION



■ TRANSITION FROM MEASURING MODE TO EACH MODE

To Zero & Span Adjustment Mode	Hold down SCALE/↑ button for 3 seconds or more.
To Display Setting Mode	Hold down DISP/↓ button for 3 seconds or more.

■ TRANSITION FROM EACH MODE TO MEASURING MODE

Hold down DISP/↓ or SCALE/↑ button for 1 second or more to return to Measuring Mode.

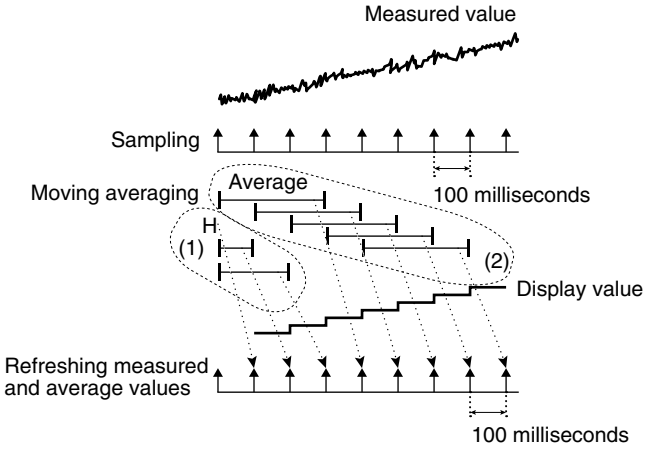
7. AVERAGING INPUT

Moving average processing of measured values is configurable. The number of samples in processing the moving average can be selected in the following table. This operation averages sampled values, and then, averages with a new sample added and the oldest one omitted. Such operation is repeated as shown in the following figure. For instance, when 'A 4' is selected, the moving average processing with 4 samples (400 millisecond intervals) is repeated. Moving average is used to remove periodic varied noise superimposed on the input signal and suppress the display flickering.

■ NUMBER OF SAMPLES

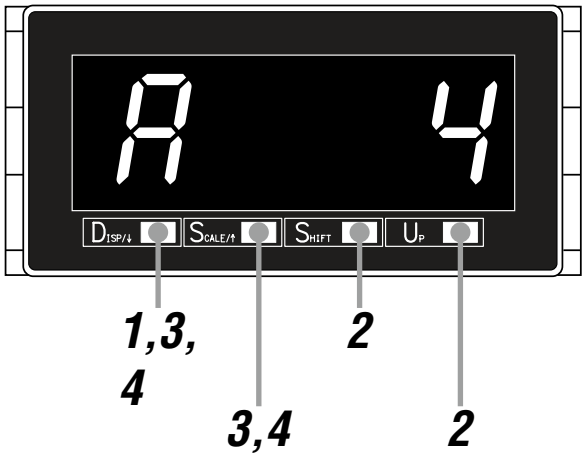
DISPLAY	FUNCTION	DEFAULT VALUE
A oFF	No moving averaging	A 4
A 2	Moving average with 2 samples (200 millisecond intervals)	
A 4	Moving average with 4 samples (400 millisecond intervals)	
A 8	Moving average with 8 samples (800 millisecond intervals)	
A 16	Moving average with 16 samples (1600 millisecond intervals)	

■ EXAMPLE OF MOVING AVERAGE WITH 4 SAMPLES



(1) The moving average operation starts immediately after the power is on or the moving average is set. Until the sampling No. reaches the set value, all samples are averaged every 100 milliseconds.
(2) After the sampling No. reaches the set value, a new sample is added to be averaged with the oldest one omitted. Such operation is repeated.

7.1 OPERATING PROCEDURE



NOTE

The following figures are display examples. The displays depend on the settings.

1 **Hold down DISP/↑ button for 3 seconds or more to move on to Display Setting Mode.**

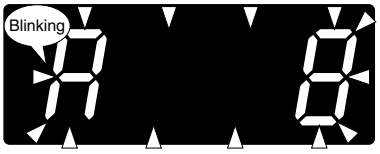
• The moving average sampling No. is indicated.

NOTE

'AOFF', 'A 2', 'A 4', 'A 8' or 'A 16' is indicated depending on the setting.

2 **Press SHIFT or UP button to select.**

• Select one among 'AOFF', 'A 2', 'A 4', 'A 8' and 'A 16'.



3 **Press DISP/↓ or SCALE/↑ button to apply the new setting.**

• And the next parameter setting is indicated.

NOTE

• Press DISP/↓ button, and the brightness 'C 1', 'C 2', 'C 3', 'C 4' or 'C 5' will be indicated depending on the setting.
• Press SCALE/↑ button, and the version indication will be indicated.

4 **Hold down DISP/↓ or SCALE/↑ button for 1 second or more to return to Measuring Mode.**

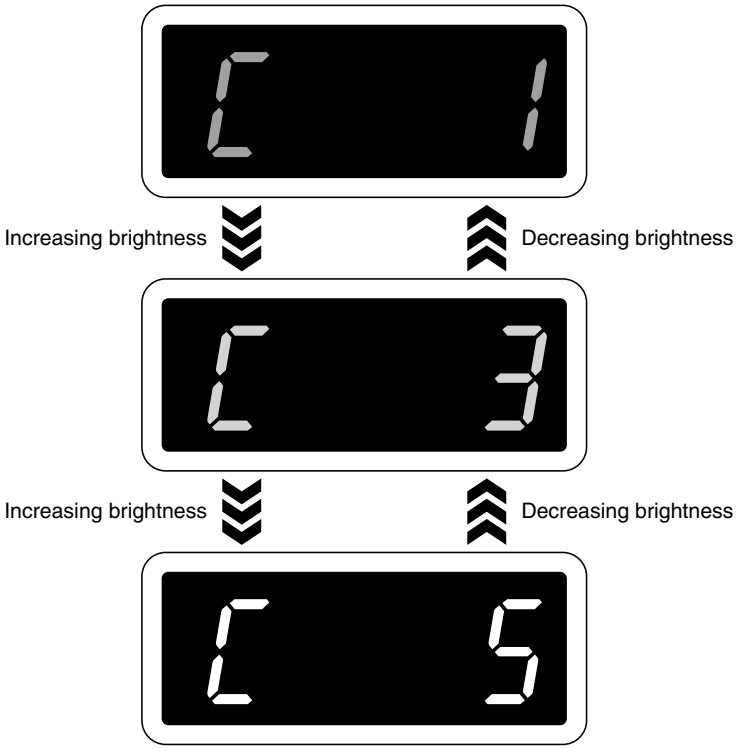
8. ADJUSTING BRIGHTNESS OF DISPLAY

The brightness of the display can be adjusted (figures below). The brightness can be selected in the following table.

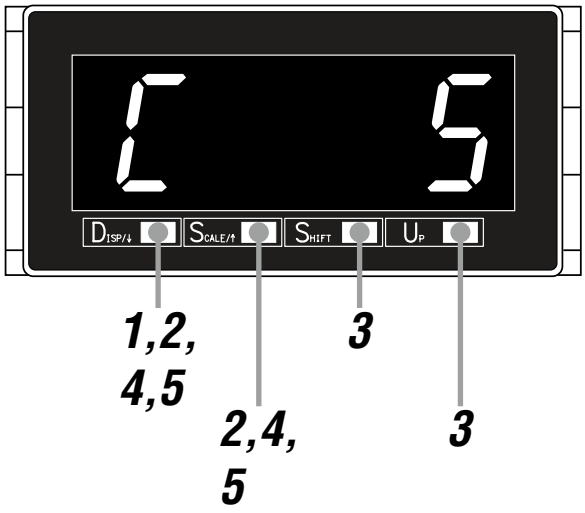
■ DISPLAY BRIGHTNESS

DISPLAY	FUNCTION	DEFAULT VALUE
C 1	Brightness level 1 (dark)	C 5
C 2	Brightness level 2	
C 3	Brightness level 3	
C 4	Brightness level 4	
C 5	Brightness level 5 (bright)	

■ ADJUSTMENT IMAGE



8.1 OPERATING PROCEDURE



NOTE

The following figures are display examples. The displays depend on the settings.

1 **Hold down DISP/↑ button for 3 seconds or more to move on to Display Setting Mode.**

• The moving average sampling No. is indicated.

NOTE

'AOFF', 'A 2', 'A 4', A 8' or 'A 16' is indicated depending on the setting.

2 **Press DISP/↓ or SCALE/↑ button to go to the brightness setting.**

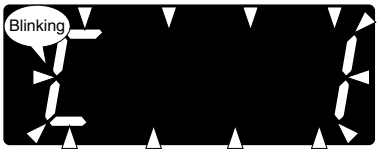
• The brightness is indicated.

NOTE

'C 1', 'C 2', 'C 3', 'C 4' or 'C 5' is indicated depending on the setting.

3 **Press SHIFT or UP button to select.**

• Select one among 'C 1', 'C 2', 'C 3', 'C 4' and 'C 5'.



4 **Press DISP/↓ or SCALE/↑ button to apply the new setting.**

• And the next parameter setting is indicated.

NOTE

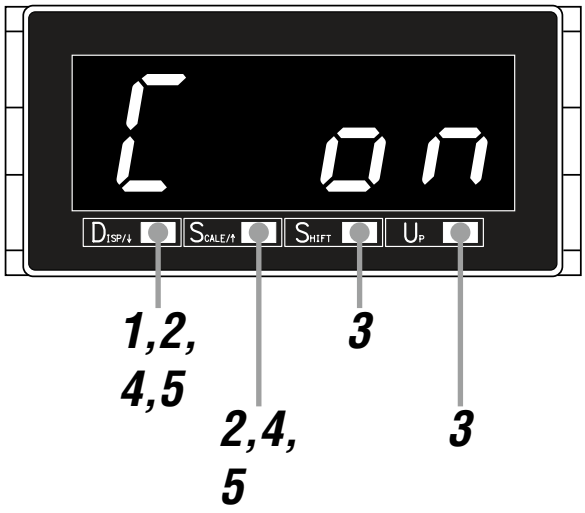
• Press DISP/↓ button, and the CJC sensor 'COFF' or 'C ON' will be indicated depending on the setting.
• Press SCALE/↑ button, and the moving average sampling No. 'AOFF', 'A 2', 'A 4', A 8' or 'A 16' will be indicated depending on the setting.

5 **Hold down DISP/↓ or SCALE/↑ button for 1 second or more to return to Measuring Mode.**

9. SETTING COLD JUNCTION COMPENSATION (CJC) SENSOR

Temperature difference between the measuring point (temperature measuring junction) and the terminals of the 40DT (reference junction) generates thermal electromotive force (emf). When the temperature at the reference junction varies, the emf also varies even though the temperature at the measuring junction is same. To solve the problem, electrical compensation is performed by detecting the temperature at the reference junction with a temperature sensor and adding the emf for the temperature, which is called reference or cold junction compensation. The temperature sensor to detect the temperature at the reference junction is called reference or cold junction sensor.
To use the CJC sensor of the 40DT, enable the CJC sensor 'C ON'. When an external reference junction compensator is used, disable it 'COFF'. The default is 'C ON'.

9.1 OPERATING PROCEDURE



NOTE

- Procedures to change 'C ON' to 'COFF' are described here.
- To change 'COFF' to 'C ON', the procedures are same. Select 'C ON' in Step 3.

1 **Hold down DISP/↑ button for 3 seconds or more to move on to Display Setting Mode.**

- The moving average sampling No. is indicated.

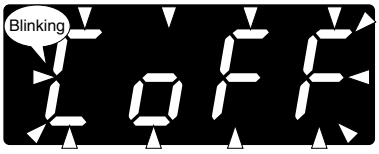
NOTE

'AOFF', 'A 2', 'A 4', A 8' or 'A 16' is indicated depending on the setting.

2 **Press DISP/↓ or SCALE/↑ button to go to the CJC sensor setting.**

- 'C ON' is indicated.

3 **Press SHIFT or UP button to select 'COFF'.**



4 **Press DISP/↓ or SCALE/↑ button to apply the new setting.**

• And the next parameter setting is indicated.

NOTE

• Press DISP/↓ button, and the initialization 'ROFF' will be indicated.
• Press SCALE/↑ button, and the brightness 'C 1', 'C 2', 'C 3', 'C 4' or 'C 5' will be indicated depending on the setting.

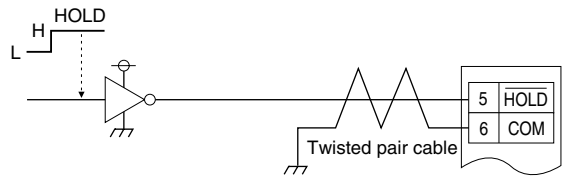
5 **Hold down DISP/↓ or SCALE/↑ button for 1 second or more to return to Measuring Mode.**

10. HOLDING DISPLAY

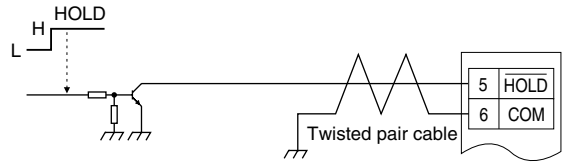
Displayed value is held with an external HOLD command input. Connect the contact across $\overline{\text{HOLD}}$ to COM as shown in the following figures. Close the contact to hold the value.

■ WIRING EXAMPLES

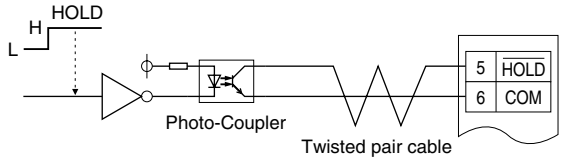
(a) 5V–CMOS, TTL



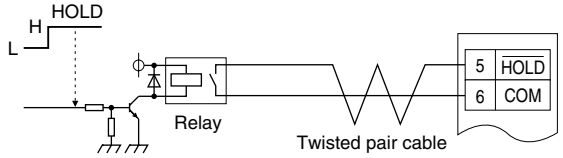
(b) Transistor



(c) Photo-Coupler



(d) Relay



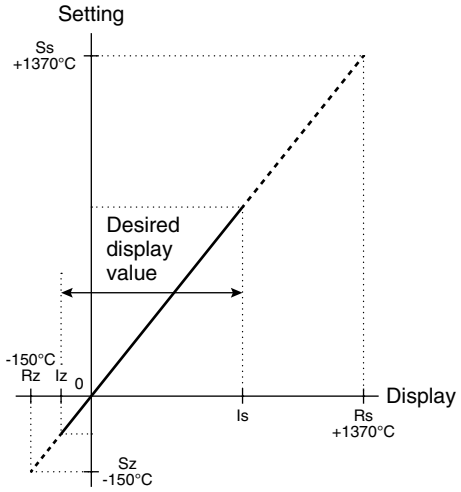
NOTE

- When the unit detects burnout, 'B.ERR' is indicated even while the HOLD command is input.
- While the HOLD command is input, the display keeps the value at the HOLD command turning on, even though the input is out of range.
- In supplying power with the HOLD command on, 'B.ERR' is indicated.

11. USER CALIBRATION

The 40DT does not have a function to calibrate (adjust) the input signal. When there is an offset in displayed temperature, compensate as the procedure shown below.

(1) Calculate the values (compensated display values: 0%, 100%) which cancel the difference between max./min. values to set (desired display values: 0%, 100%) and measured values (actual display values: 0%, 100%).
(2) Obtain the values parallel shifted from the compensated display values 0% and 100% to the measurement range 0% and 100%.
(3) Set the values obtained in step (2) as zero and span adjustments.



Refer to the example shown below to calculate the zero/span adjustment.

Example: The display range is set to 0 to 800°C (desired display values) by using K thermocouple, however the display shows -5 to +805°C (actual display values).

• Compensated display value calculation

$Dz = Iz - Cz + Iz$

$Ds = Is - Cs + Is$

$Dz = 0 - (-5) + 0 = 5$

$Ds = 800 - 805 + 800 = 795$

Iz	Desired display value 0%
Is	Desired display value 100%
Cz	Actual display value 0%
Cs	Actual display value 100%
Dz	Compensated display value 0%
Ds	Compensated display value 100%

• Zero/span adjustment setting value calculation

$$Sz = \frac{Rz \times Dspan + Dz \times Is - Ds \times Iz}{Ispan}$$

$$Ss = \frac{Rs \times Dspan + Dz \times Is - Ds \times Iz}{Ispan}$$

Rz	Measurement range 0% (conformance range 0%)
Rs	Measurement range 100% (conformance range 100%)
Dspan	Compensated display value span (Ds – Dz)
Ispan	Desired display value span (Is – Iz)
Sz	Zero adjustment
Ss	Span adjustment

$$Sz = \frac{-150 \times 790 + 5 \times 800 - 795 \times 0}{800}$$

$$= \frac{-118500 - 4000 - 0}{800} = \frac{-114500}{800} = -143.125 \approx -143$$

$$Ss = \frac{1370 \times 790 + 5 \times 800 - 795 \times 0}{800}$$

$$= \frac{1082300 + 4000 - 0}{800} = \frac{1086300}{800} = 1357.875 \approx 1358$$

By the above calculations, zero/span adjustment value settings are as shown below.
Zero adjustment = -0143
Span adjustment = 1358

IMPORTANT

- The zero & span adjustments are not indicated with the temperature unit set to Fahrenheit (°F).
- The zero & span adjustments are effective even when the temperature unit is switched to Fahrenheit (°F).
- To compensate the offset in the displayed temperature with the temperature unit set to Fahrenheit (°F), switch the unit to Celsius (°C), set the zero and span adjustments with the offset converted in °C. Then return the temperature unit to °F.

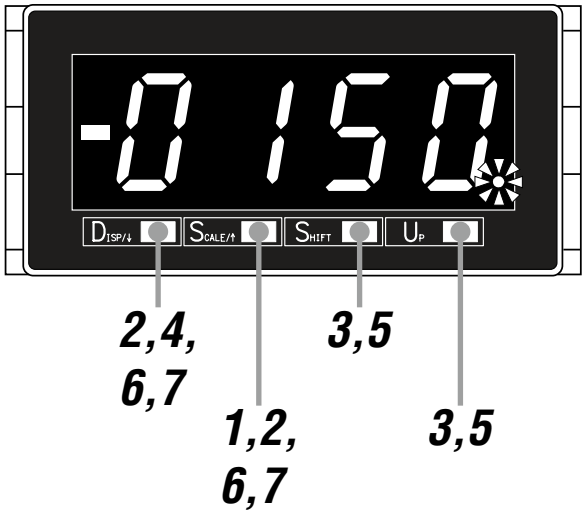
  °C = (°F – 32) × 5 / 9

NOTE

To distinguish from the span adjustment, the first decimal point blinks in setting the zero adjustment.

11.1 ZERO/SPAN ADJUSTMENT

11.1.1 OPERATING PROCEDURE



NOTE

The following figures are display examples. The displays depend on the settings.

1 **Hold down SCALE/↑ button for 3 seconds or more to move on to Zero & Span Adjustment Mode.**

- The input type is indicated.

2 **Press DISP/↓ or SCALE/↑ button to go to the zero adjustment setting.**

- The zero adjustment is indicated.
- The first decimal point starts blinking.

3 **Press SHIFT button to shift the display into the setting standby mode, and press SHIFT and UP buttons to set.**

- The forth digit starts blinking, to which you can apply changes.
- Set any value within the range of -9999 to 9999.

4 **Press DISP/↓ button to apply the new value and go to the span adjustment setting.**

- The zero adjustment is registered.
- The span adjustment is indicated.

5 **Press SHIFT button to shift the display into the setting standby mode, and press SHIFT and UP buttons to set.**

- The forth digit starts blinking, to which you can apply changes.
- Set any value within the range of -9999 to 9999.

6 **Press DISP/↓ or SCALE/↑ button to apply the new value.**

- The span adjustment is registered.
- And the next parameter setting is indicated.

NOTE

- Press DISP/↓ button, and the temperature unit 'C' will be indicated.
- Press SCALE/↑ button, and the zero adjustment will be indicated.

7 **Hold down DISP/↓ or SCALE/↑ button for 1 second or more to return to Measuring Mode.**

12. INSPECTION / CLEANING

To use the unit in the normal and best conditions, inspect and clean the unit routinely or periodically.

- When the front panel have dirt, wipe them with wet soft cloth. Do not use organic solvent such like benzine, thinner and alcohol. Doing so may result in deformation or discoloration of the unit.
- Make sure that abnormality such like smokes, unusual smell or abnormal noises is not found. Using the unit continuously with such abnormality may result in a fire or electric shock.
- Check the terminal screws periodically. In checking the screws, for safety, interrupt electricity to the power and input.
- Make sure periodically that the mounting brackets are fixed tightly. Loosened brackets may cause drop of the unit.

13. TROUBLESHOOTING

13.1 ERROR MESSAGES

DISPLAY	ERROR MESSAGE	WHAT TO DO
SErr blinking	The input signal is out of the permissible range.	Set the input signal within the permissible range.
bErr blinking	The input signal shows breaking of wire.	Check the input signal.

NOTE

While an external HOLD command is input, the display keeps the value at the HOLD command turning on, even though the input is out of range.

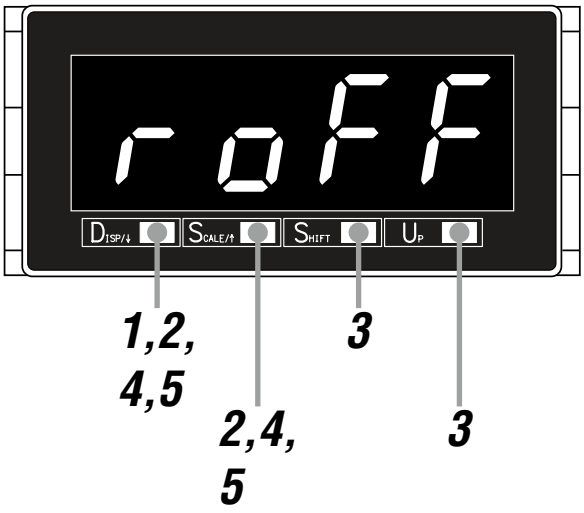
13.2 INITIALIZING SETTING VALUES

To restart setting from the default state, initialization can be used. Refer to attached 14.3 PARAMETER LIST for the default values.

IMPORTANT

- Currently set parameters will be lost after an initialization. It is recommended to record the parameters before initialization.
- Even if the unit is shipped with the specified parameters with the option code '/SET', such parameters will be lost after an initialization. Be careful that the initialization does not recover the ex-factory settings.

13.2.1 OPERATING PROCEDURE



1 **Hold down DISP/↑ button for 3 seconds or more to move on to Display Setting Mode.**

- The moving average sampling No. is indicated.

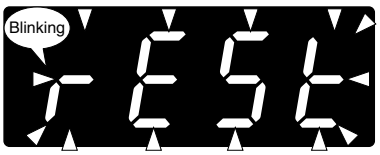
NOTE

'AOFF', 'A 2', 'A 4', 'A 8' or 'A 16' is indicated depending on the setting.

2 **Press DISP/↓ or SCALE/↑ button to go to the initialization.**

• 'ROFF' is indicated.

3 **Press SHIFT or UP button to select 'REST'.**



4 **Press DISP/↓ or SCALE/↑ button to execute the initialization.**

• The settings are initialized and then the next parameter setting is indicated.

NOTE

• Press DISP/↓ button, and the version indication will be indicated.
• Press SCALE/↑ button, and the CJC sensor 'C ON' will be indicated.

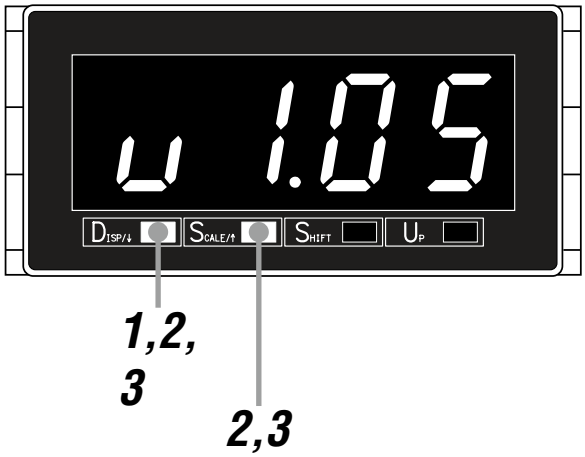
5 **Hold down DISP/↓ or SCALE/↑ button for 1 second or more to return to Measuring Mode.**

13.3 CONFIRMING FIRMWARE VERSION

The firmware version of the unit can be confirmed.
Confirm the version in the following cases:

- The display is different from the one described in the operating manual.
- The firmware version is necessary to consult us for troubles.

13.3.1 OPERATING PROCEDURE



1 **Hold down DISP/↑ button for 3 seconds or more to move on to Display Setting Mode.**

- The moving average sampling No. is indicated.

NOTE

'AOFF', 'A 2', 'A 4', A 8' or 'A 16' is indicated depending on the setting.

2 **Press DISP/↓ or SCALE/↑ button to go to the version indication.**

- The firmware version number is indicated.

NOTE

The displays depend on the firmware version number.

3 **Hold down DISP/↓ or SCALE/↑ button for 1 second or more to return to Measuring Mode.**

14. APPENDICES

14.1 SPECIFICATIONS

■ GENERAL SPECIFICATIONS

Construction		Panel flush mounting
Connection		M3 screw terminals (torque 0.6 N·m)
Screw terminal		Nickel-plated steel
Housing material		Flame-resistant resin (gray)
Isolation		Input to power
Cold junction compensation		CJC sensor attached to the input terminals
Setting (front button)	Zero & span adjustment mode	Input type, zero adjustment, span adjustment, temperature unit
	Display setting mode	Moving average, brightness, CJC sensor, initialization, version indication
A/D conversion		Σ – Δ
Sampling rate		10 times/sec. (100 msec.)
Averaging		None or moving average

■ DISPLAY

Display	4 digits of 20.3 mm (0.8 inch) height, 7-segment, red LED
Display range	-9999 to 9999
Minimum display/setting scale	1°C or 1°F
Zero indication	Higher-digit zeros are suppressed
Over-range indication	'S.ERR' blinks surpassing the permissible range. 'B.ERR' blinks at burnout.

■ INPUT SPECIFICATIONS

Thermocouple	Input resistance	1 MΩ minimum
	Burnout sensing	≤ 0.1 μA
	Usable range (conformance range)	K (CA) -150 to +1370°C or -238 to +2498°F
		J (IC) -180 to +1000°C or -292 to +1832°F
		T (CC) -170 to +400°C or -274 to +752°F
		R 380 to 1760°C or 716 to 3200°F
	Operational range	K (CA) -180 to +1400°C or -292 to +2552°F
		J (IC) -210 to +1030°C or -346 to +1886°F
		T (CC) -200 to + 430°C or -328 to +806°F
		R 170 to 1790°C or 338 to 3254°F
Hold input		Dry contact input
	Detecting level	≤ 1.5 V
	Sensing	Approx. 5 V DC, 1 mA

■ INSTALLATION

Power consumption	AC power	K3: 100 – 120 V AC	Operational voltage range 85 – 132 V, 47 – 66 Hz Approx. 1.0 VA
		L3: 200 – 240 V AC	Operational voltage range 170 – 264 V, 47 – 66 Hz Approx. 1.0 VA
	DC power	R: 24 V DC	Operational voltage range 24 V ±20% Ripple 10% p-p max. Approx. 0.3 W
Operating temperature		-10 to +55°C (14 to 131°F)	
Operating humidity		30 to 90% RH (non-condensing)	
Mounting		Panel flush mounting	
Weight		210 g (0.46 lb)	

■ PERFORMANCE

Accuracy	K narrow range (-150 – +400°C, -238 – +752°F): ±1°C rdg ±1 digit, ±2°F rdg ±1 digit
	K wide range (400 – 1370°C, 752 – 2498°F): ±3°C rdg ±1 digit, ±6°F rdg ±1 digit
	J: ±1°C rdg ±1 digit, ±2°F rdg ±1 digit
	T: ±1°C rdg ±1 digit, ±2°F rdg ±1 digit
	R: ±3°C rdg ±1 digit, ±6°F rdg ±1 digit
Cold junction compensation error	±3°C at 25 ±10°C ±5.4°F at 77 ±18°F
Temp. coefficient	±0.1°C/°C
Line voltage effect	±2 digits over voltage range
Insulation resistance	≥ 100 MΩ with 500 V DC
Dielectric strength	1500 V AC @ 1 minute (input to power to ground)

■ STANDARDS & APPROVALS

EU conformity	EMC Directive EMI EN 61000-6-4 EMS EN 61000-6-2 Low Voltage Directive EN 61010-1 Installation Category II Pollution degree 2 Input to power: Reinforced insulation (300 V) RoHS Directive

14.2 MODEL NUMBERING

Code number: **40DT–T1–[1][2]**

INPUT

T1: K (CA) (usable range -150 to +1370°C, -238 to +2498°F)
J (IC) (usable range -180 to +1000°C, -292 to +1832°F)
T (CC) (usable range -170 to +400°C, -274 to +752°F)
R (usable range 380 to 1760°C, 716 to 3200°F)

[1] POWER INPUT

AC Power
K3: 100 – 120 V AC (operational voltage range 85 – 132 V, 47 – 66 Hz)
L3: 200 – 240 V AC (operational voltage range 170 – 264 V, 47 – 66 Hz)
DC Power
R: 24 V DC (operational voltage range 24 V ±20%, ripple 10% p-p max.)

[2] OPTIONS

Blank: None
/Q: With options (specify the specification)

■ SPECIFICATIONS OF OPTION: Q

COATING (For the detail, refer to our web site.)
Moving parts and indicators are not coated.
/C01: Silicone coating
/C02: Polyurethane coating
/C03: Rubber coating

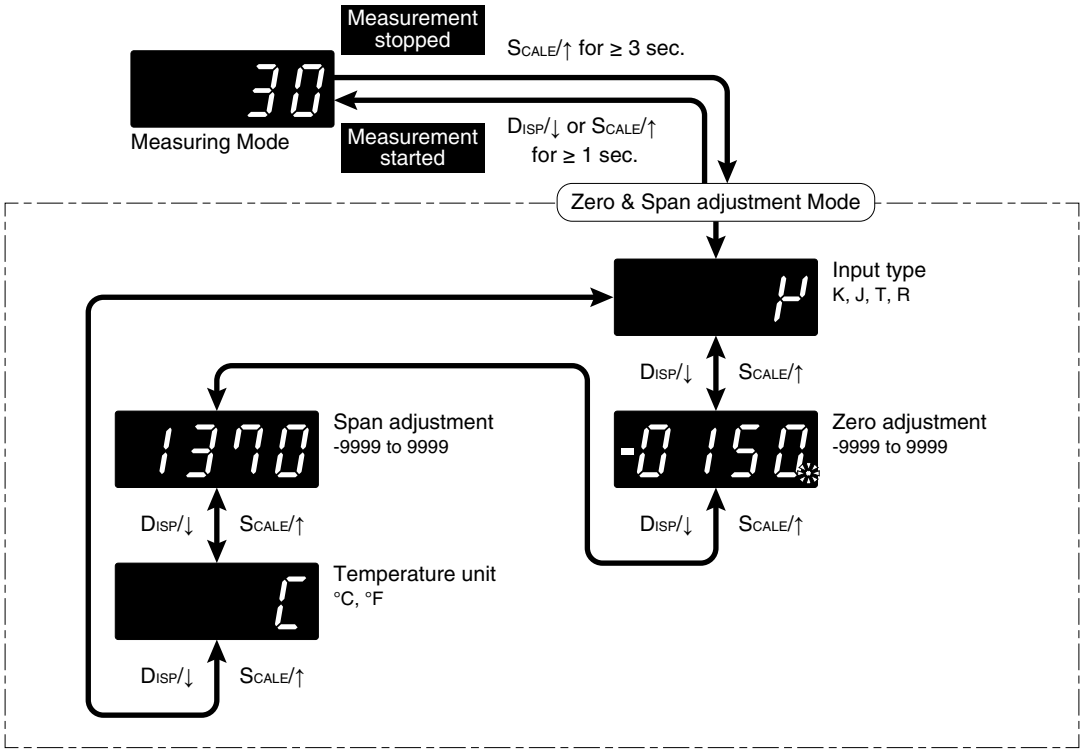
EX-FACTORY SETTING
/SET: Preset according to the Ordering Information Sheet (No. ESU-9535)

14.3 PARAMETER LIST

MODE	PARAMETER	SETTING RANGE	DISPLAY	DEFAULT VALUE	DECIMAL POINT POSITION	UNIT
Measuring	Present value	-9999 – 9999	----	----	----	°C/°F
Zero & span adjustment	Input type	K, J, T, R	P, J, E, r	P	----	----
	Zero adjustment	-9999 – 9999	-9999 to 9999	-0150	----	°C
	Span adjustment	-9999 – 9999	-9999 to 9999	1370	----	°C
	Temperature unit	°C, °F	C, F	C	----	----
Display setting	Moving average	None, 2, 4, 8, 16	AOFF, A 2, A 4, A 8, A 16	A 4	----	Sample
	Brightness	1 (dark) to 5 (bright)	L 1, L 2, L 3, L 4, L 5	L 5	----	----
	CJC Sensor	ON, OFF	C on, COFF	C on	----	----
	Initialization	OFF, initialization	rOFF, rESt	rOFF	----	----
	Version indication	----	----	----	----	----

14.4 PARAMETER MAP

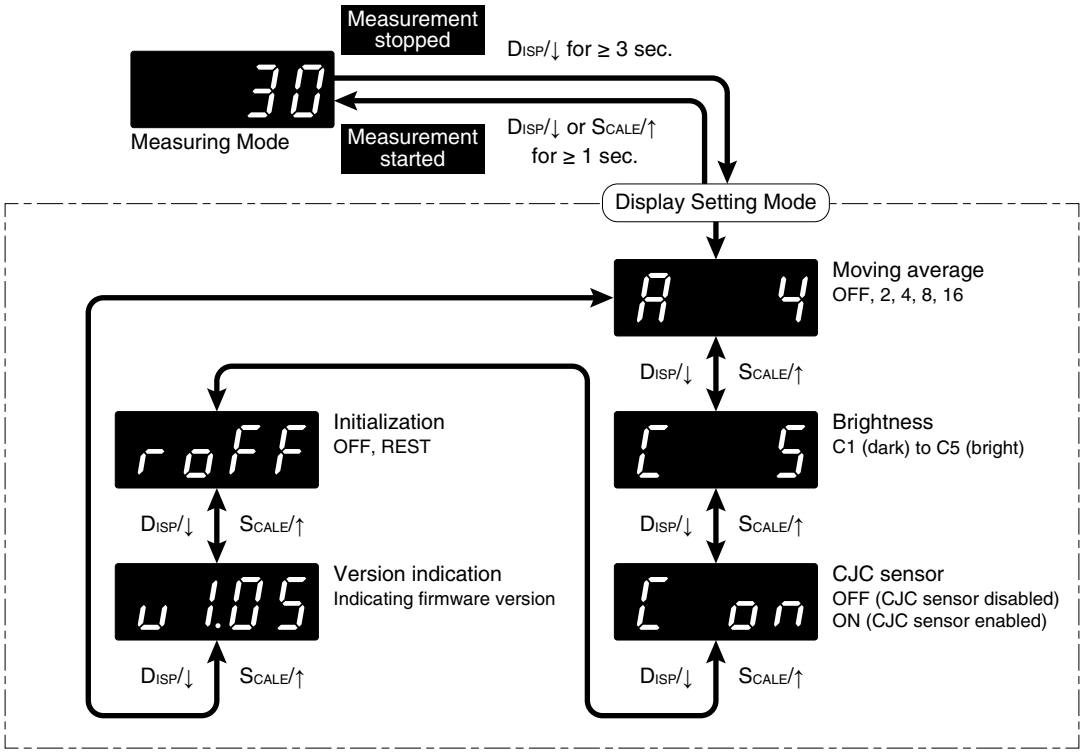
14.4.1 ZERO & SPAN ADJUSTMENT MODE



NOTE

- The display depends on the settings and input.
- When the temperature unit is set to Fahrenheit (°F), moving to the zero/span adjustment is not available.

14.4.2 DISPLAY SETTING MODE

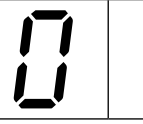


NOTE

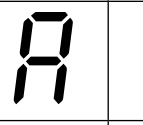
- The display depends on the settings and input.
- Version indication is for indication only, not for setting.

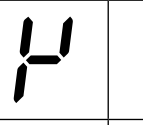
14.5 CHARACTER SET

■ **NUMERALS**

0	1	2	3	4	5	6	7	8	9
									

■ **ALPHABET**

A	B	C	D	E	F	G	H	I	J
									

K	L	M	N	O	P	Q	R	S	T
									

U	V	W	X	Y	Z