YAMATAKE

Electromagnetic Calorimeter
Model: MCM10A

User's Manual

Yamatake Corporation

CM2-MCM100-2001
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Unpacking and Inspecting the Flowmeter

Unpacking the product

The device is a precision instrument and should be handled with care to prevent damage or breakage.

After unpacking the device, verify that the following items are contained:

- The device itself
- Standard accessories
- Test report

Verifying the Specifications

The specifications of this device are written on its attached identification plate. Compare these specifications with those listed in the Appendix, “System Standard Specifications and Model Numbers”, and verify that all specifications on the plate are correct, paying special attention to the following:.

- Detector bore diameter
- Flange rating

Inquiries

If you have any questions regarding the specifications of this device, contact your nearest Yamatake Corporation office or Yamatake Corporation representative. When making an inquiry, make sure to provide the model number and product number of this device.

Storage

When storing this device before use, observe these precautions:

- Store it indoors at room temperature (25°C or 77°F) and humidity (65%), safety away from vibration or shock.
- Store it in its packed and shipped state.

When storing this device after use, follow these steps:

- Rinse the inside of the detector with water to remove the adhering measured fluid and dry off the water.
- Attach the converter cover and waterproof gland to keep out moisture.
- Replace the product in its original packing.
- Store it indoors at normal temperature and humidity, safety away from vibration or shock.

Safety

About this manual

This manual contains information and warnings that must be observed to keep the model MCM10A Electromagnetic Calorimeter operating safely. Correct installation, correct operation and regular maintenance are essential to ensure safety while using this device.

For the correct and safe use of this Electromagnetic Calorimeter, it is essential that both operating and service personnel follow generally accepted safety procedures in addition to the safety precautions specified in this manual.

The following symbols are used in this manual to alert you to possible hazards:

⚠ WARNING

Denotes a potentially hazardous situation which, if not avoided, could result in death or serious injury.

⚠ CAUTION

Failure to observe these precautions may produce dangerous conditions that could result in operator injury or in physical damage to the device.

Safety message

Carefully read this section before installing or operating this device.

⚠ WARNING

ELECTRIC SHOCK HAZARD! Turn the power supply OFF before opening the converter cover.

⚠ WARNING

This detector is heavy. Dropping it could cause personal injury or damage to the device.

⚠ WARNING

Before removing the unit, make sure that there is no residual liquid or pressure inside the piping and the detector to avoid personal injury or damage to the unit.

⚠ CAUTION

Switch the control equipment to manual control before terminating Electromagnetic Calorimeter operation and shutting off the output to the control equipment. This action prevents the power shut-off from directly affecting the control equipment.

⚠ CAUTION

Install the Electromagnetic Calorimeter in a location with an ambient temperature of 0 to 50°C (32 to 122°F) and an ambient humidity of 5 to 85% RH (no condensation) to prevent equipment malfunction or output errors.

⚠ CAUTION

Do not install the Electromagnetic Calorimeter near high-current power lines, motors or transformers to prevent damage from electromagnetic induction, which can cause equipment malfunction or output errors.

⚠ CAUTION

Do not install the Electromagnetic Calorimeter in a location subject to direct sunlight, wind, rain, severe vibration, or in a highly corrosive atmosphere. The converter and detector can be damaged. The Electromagnetic Calorimeter is for indoor use only.

⚠ CAUTION

Be sure to ground the welding power transformer when welding near the Electromagnetic Calorimeter to avoid output errors.

⚠ CAUTION

DO NOT use the Electromagnetic Calorimeter to ground a welder. It can damage the Electromagnetic Calorimeter.

⚠ CAUTION

The detector must be grounded (grounding resistance is < 100 Ω) to avoid output fluctuation, zero point instability or output drift.

⚠ CAUTION

Measurable process fluids of the Electromagnetic Calorimeter are chilled water, water with glycol, water and hot water. No corrosive fluid and no abrasive fluid is applicable. Corrosive fluid and abrasive fluid can damage the Electromagnetic Calorimeter.

⚠ CAUTION

If the pipe is not filled, output errors will occur.

⚠ CAUTION

Do not rotate the unit more than 180° (one half rotation). Any further rotation can disconnect wiring.

After removing the screws, do not pull on the converter. You can break the lead wire.

When you move the converter, make sure the O-ring remains in the groove to insure an air-tight seal when the unit is reassembled.

⚠ CAUTION

Before installing the detector, make sure any foreign matter is flushed from the interior passage of the detector. Residual foreign matter could cause output fluctuations.

Do not touch the electrodes or allow oil or fat to come into contact with them to avoid output fluctuations.

Align the direction mark on the detector in the direction of the liquid flow. Misalignment can result in a negative output.

⚠ CAUTION

The correct fastening torque must be used to prevent leakage. To avoid damage to the detector, do not exceed the listed fastening torque.

⚠ CAUTION

Before installing the detector, make sure that the pipe is exactly straight and centered. Any irregularity could cause leakage or other hazards.

⚠ CAUTION

Never attempt to force the detector between two flange if the space is too narrow. It can damage the detector.

⚠ CAUTION

Make certain the bore diameters of the pipe and the detector are exactly the same and install the detector so that the gasket does not protrude into the inner bore of the pipe, as this could result in leakage or other hazards.

⚠ CAUTION

Tighten each bolt a little at a time and apply uniform pressure to all the bolts. If leakage continues after tightening the bolts, make sure that the pipe is not off center, then continue to tighten each bolt a little at a time.

⚠ CAUTION

Using a gasket with too small a diameter can affect the flow velocity distribution, resulting in inaccurate measurement.

Using a gasket with too large a diameter can cause leakage. Also, any solid substance in the fluid to be measured could accumulate between the gasket and the flange, resulting in inaccurate measurement.

⚠ CAUTION

The use of rubber gaskets and a lower fastening torque is not recommended and can cause insufficient surface pressure between the lining and the grounding ring, resulting in leakage.

⚠ CAUTION

Insufficient grounding can cause output fluctuations, instability of the zero point, or output drift. Secure single point grounding with a grounding resistance of 100 Ω or less is recommended.

Do not ground a welder to the detector to avoid damaging the detector.

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Chapter 1 : Introduction

This chapter contains an overview of the model MCM10A Electromagnetic Calorimeter. It describes definitions for all major parts and their functions.

1-1 : Overview

System operation

The Electromagnetic Calorimeter consists of a detector and a converter combination which operates on the principle of Faraday's law. This product is available in integral configuration.

- Integral: detector and converter are installed as an integrated unit on the pipe.

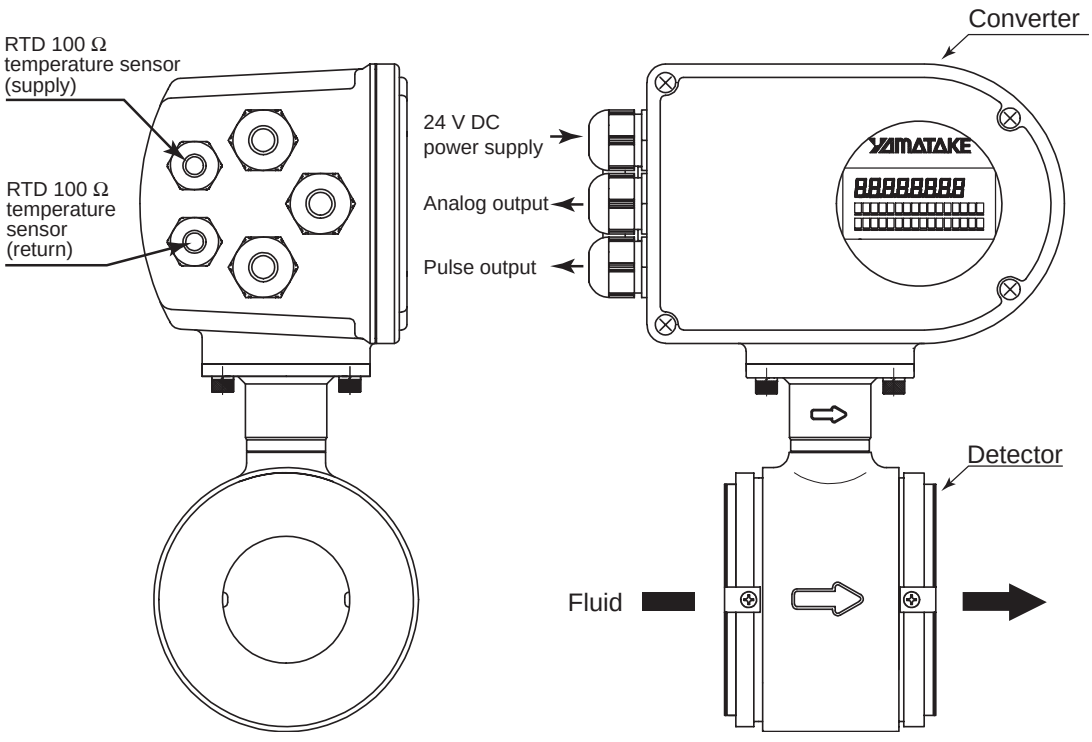


Figure 1-1 Integral system

System configuration

Figure 1-2 shows a sample system configuration.

In this system, the unit outputs flow rate with 4 to 20mA DC analog signal and consumed calorific value with pulse (open collector) by having two temperature inputs of supply and return.

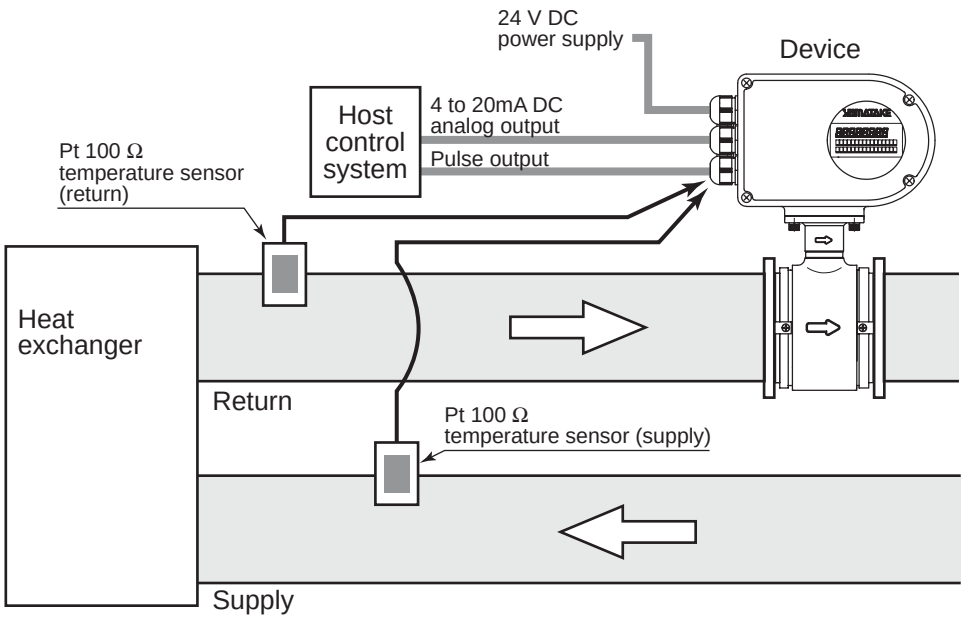


Figure 1-2 System configuration

1-2 : Structure and Functions

Structure of the converter

Main components

This unit consists of the converter main body, the converter cover, display board and waterproof gland.

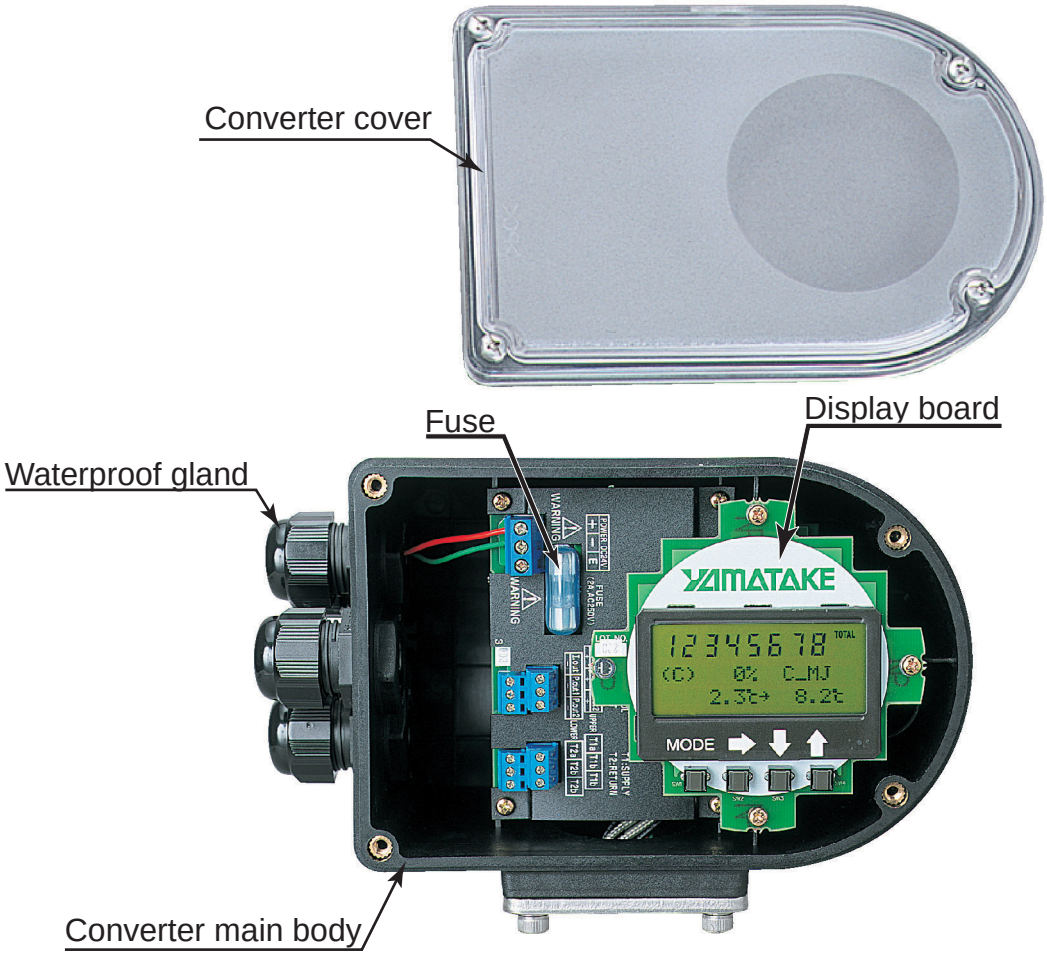


Figure 1-3 Structure of the converter

Converter parts and explanation

The following table describes the various parts of the unit.

Name	Description
Converter main body	• Converts electromotive force generated in the detector into the flow rate and calculates consumed calorific value by multiplying flow rate and temperature difference between supply and return. • Outputs the flow rate as an analog signal and consumed calorific value as pulse.
Display board	• Indicates the flow rate or the totalized calorific value or the process fluid temperatures of supply and return. • The calorimeter functions can be changed using the four keys on the panel.
Converter cover	• Protects electronics in the converter from moisture or dust.
Waterproof gland	• Prevents water or dust penetration from cable conduits.

Structure of the detector

Major parts of the detector

Figure 1-4 shows the structure and the description of Electromagnetic Calorimeter.

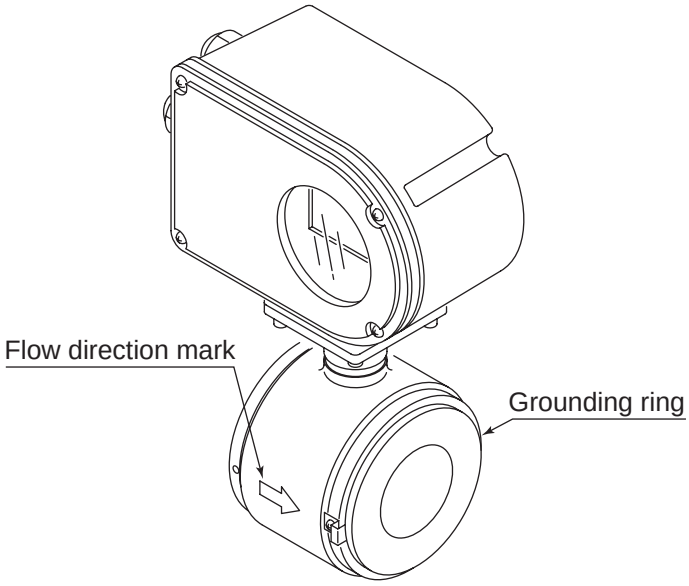


Figure 1-4 Wafer type description

Names and functions of parts

This table explains the major parts of the detector.

Name	Description
Flow direction mark	• Indicates the direction of fluid flow. Mount the detector so that the measured fluid flows in the direction indicated by this mark.
Electrodes	• The electrodes detect an electromotive force signal proportional to the flow rate of the fluid passing through the detector.
Grounding rings	• The grounding rings keep reference voltage as zero by grounding.

Chapter 2 : Installing the Device

This selection describes the installation and wiring of the Electromagnetic Calorimeter.

Depending on the piping material, the required parts or the method of the installation of this device vary.

Installation is explained in the following order:

- Criteria for selecting the installation environment.
- An outline of the method of installing the device.
- Detailed methods of installation depending on the piping material.

2-1 : Before Installing

Criteria for selecting the installation site

Introduction

In order to make full use of the functions of the device, select an optimal installation site by following the selection criteria below.

Environment

⚠ CAUTION

- Install the unit inside the building.
- Install the unit in a location with an ambient temperature of 0 to +50°C (32 to +122°F) and a relative humidity of 5 to 85%. Failing to meet these requirements could cause damage to the device or output errors.
- Install the unit away from high-current power lines, motors and transformers to prevent damage from electromagnetic induction. Failing to meet this requirement could cause output errors.
- Do not install the unit in a location subject to severe vibration or a highly corrosive atmosphere. Failing to meet this requirement could break the neck of the detector or cause other damage.
- Install the unit as far away as possible from direct sunlight. Failing to meet this requirement could cause output errors.

Fluid to be measured

⚠ CAUTION

- The measurable fluid of this device is water or water with glycol. No corrosive fluid is applicable.
- The location for your calorimeters must meet the following conditions. Failing to meet these requirements could cause output errors and fluctuations.
- A location where the electrical conductivity of the fluid to be measured matches the stated specification (specs vary according to the converter used) and is more or less constant.
- A location where the fluid to be measured can be regarded as electrochemically homogenized. For example, if two fluids are mixed at an upstream point, the installation must be where the two fluids are mixed homogeneously by the time they reach the measurement point.
- A location where the distribution of suspended matter, if any, can be regarded as nearly homogenized.

Precautions to observe after installing

⚠ CAUTION

(1) After installing this unit, do not use it as a foothold as this can damage the unit.

(2) The converter cover must be shut tightly as the electronics in the converter can be damage by condensation.

⚠ WARNING

(1) When removing this unit, make sure there is no residual liquid or pressure inside the piping and the detector. Any residual liquid or pressure can cause injury.

Detector position

- Install the Electromagnetic Calorimeter in the return pipe.
- Position the detector so that its internal detector passage is continuously filled with the fluid being measured. Figure 2-1 shows examples of positions that fulfill this condition.

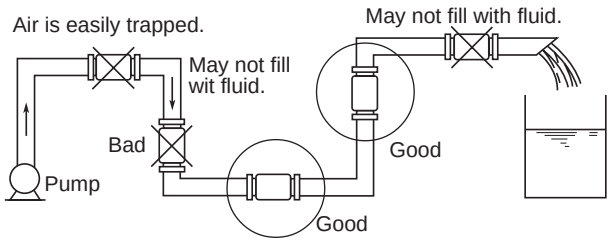


Figure 2-1 Proper placement of the detector

⚠ CAUTION

- Fill the pipe with liquid and install the detector in a location that satisfies the conditions circled above. If the pipe is not filled it can cause an output error.

- When the fluid to be measured is of high viscosity, connecting the detector to a vertical pipe is recommended (in order to secure an axial symmetrical flow).
- Install a straight pipe section between the upstream and downstream positions. For the length of the straight pipe section, refer to the figure below.

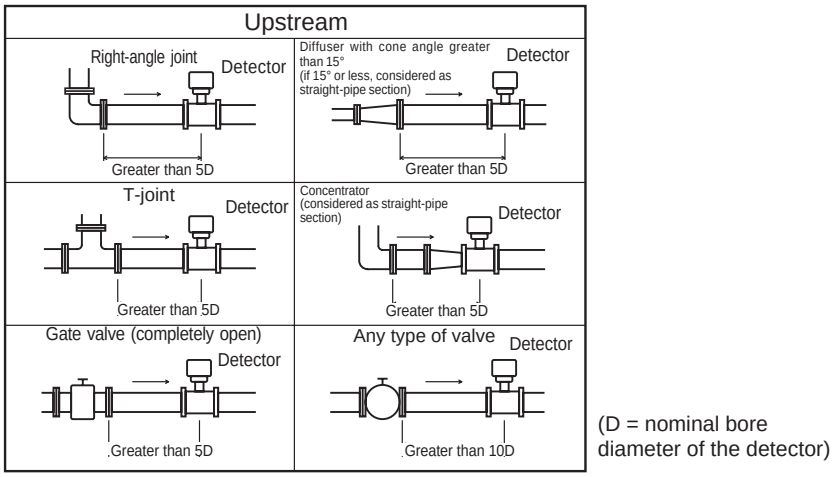


Figure 2-2 Straight pipe section on the upstream side of the detector

- Although a pipe section is not necessary on the downstream side, secure a section of at least 2D eccentric flow appears.
- Select a place where there is no major pulsation flow. (Install the detector in a location distant from a pump.)
- Secure the space required for maintenance of the device.

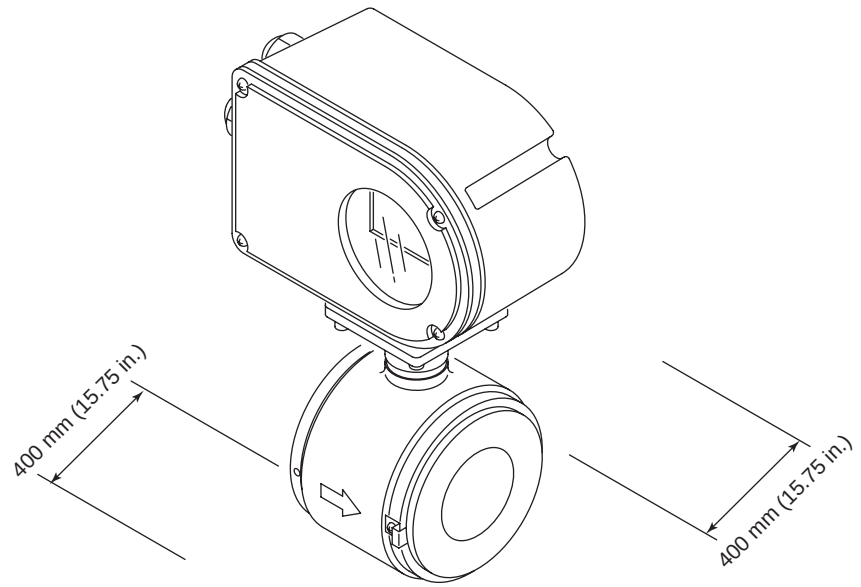


Figure 2-3 Space allowance for maintenance

Direction of the converter

Introduction

In some locations, the direction of the converter may be unsuitable if the detector is installed as it is shipped. In such a case, the converter can be repositioned.

After selecting an installation site, adjust the direction of the converter in advance by the method shown below.

Repositioning the converter

The converter can be repositioned at right angles. Follow the procedure below.

Step	Procedure
1	Using an M5 hex wrench, remove the four screws securing the converter.
2	Holding the detector, rotate the converter horizontally to the desired position. **⚠ CAUTION** • Do not rotate the unit more than 180° (one half rotation). Any greater rotation can break wiring parts. • If the converter is removed, make sure that the O-ring, which provides an air-tight seal, is still fitted into the O-ring groove.
3	Using a hex wrench, re-tighten the four screws to secure the converter.

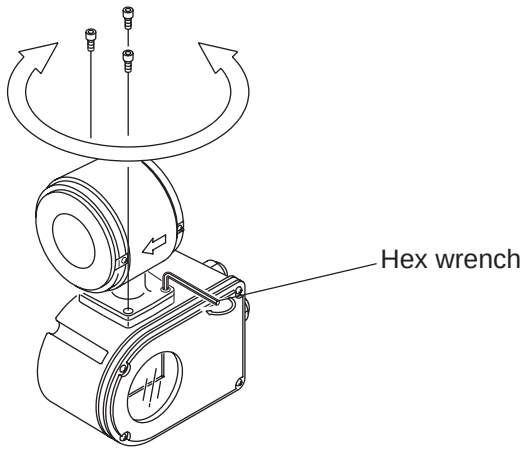


Figure 2-4 Repositioning the converter

⚠ CAUTION

After removing the screws, do not pull hard on the converter. Otherwise, the lead wire inside can break.

2-2 : Method of Installation

2-2-1: Installing a wafer type detector

Basic installation method

Introduction

The device can installed as a wafer or flange unit. Referring to the appropriate method of installation, install the unit properly.

Installation example

Figure 2-5 basic method for installing the device.

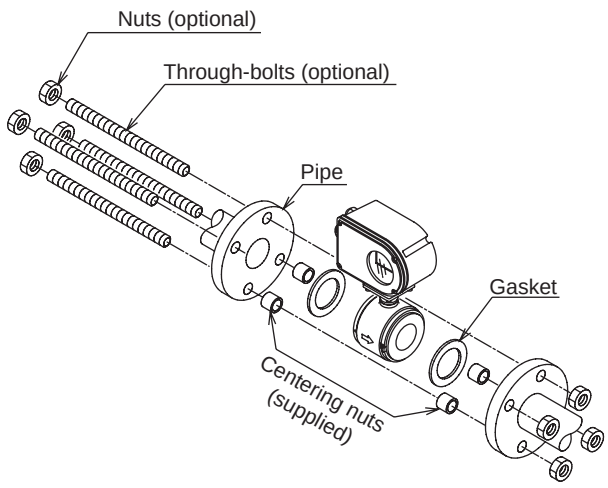


Figure 2-5 Device installation example of the wafer type detector

⚠ CAUTION

Be careful in handling this unit. It is heavy; dropping it accidentally could cause injury.

Fastening torque

⚠ CAUTION

Table 2-1 shows the fastening torque for each pipe bore. Using centering hardware, apply the prescribed fastening torque to prevent any liquid leak from the pipe.

Table 2-1 Fastening torque levels

Nominal detector bore	Fastening torque
25 mm (1 in.)	20 to 30 N•m (14.5 to 21.7 ft•lb)
40, 50, 65, 80 mm (1.6, 2, 2.6, 3.1 in.)	30 to 50 N•m (21.7 to 36.2 ft•lb)
100 mm (4 in.)	50 to 70 N•m (36.2 to 50.6 ft•lb)
150 mm (6 in.)	80 to 100 N•m (57.9 to 72.3 ft•lb)
200 mm (8 in.)	90 to 100 N•m (65.1 to 72.3 ft•lb)

The flanges used should be such that the area of contact with the gasket is maximized, as shown in Figure 2-6.

Flange shape

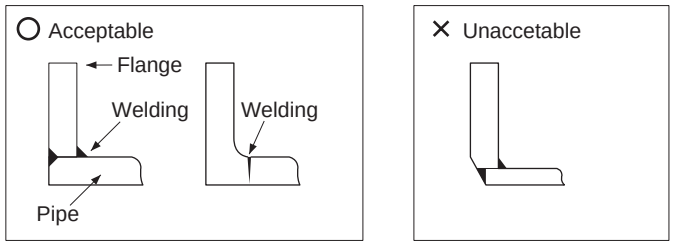


Figure 2-6 Flange shape

⚠ CAUTION

- Before installing the detector be sure to flush out any foreign matter that may be present in interior passage of the detector. Residual foreign matter could cause output fluctuations.
- Do not touch the electrodes or allow oil or fat to come into contact with them. It could cause output fluctuations.
- Align the flow direction mark on the detector with the direction of the liquid flow. Misalignment could result in a negative output.

⚠ WARNING

Before installing the detector make sure that the pipe is exactly straight and centered. Any irregularity in these respects could cause leakage or other hazards.

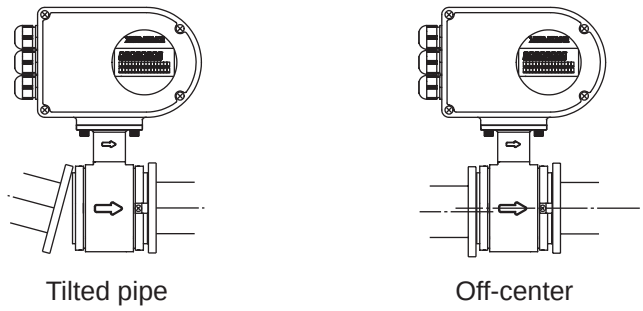


Figure 2-7 Example of incorrect installations (1)

⚠ CAUTION

Never force the device between two flanges when the space is too narrow. It can damage the unit.

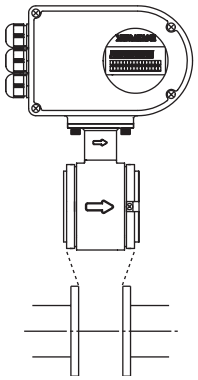


Figure 2-8 Example of incorrect installations (2)

⚠ WARNING

Ensure the bore diameters of the pipe and the detector are exactly the same, install the detector so that the gasket does not protrude into the inner bore of the pipe, as this could result in leakage or other hazards.

⚠ CAUTION

Tighten each bolt a little at a time and apply uniform pressure to all the bolts while fastening them. If leakage does not stop on completion of fastening, make sure that the pipe is not off center, then tighten the bolts little by little. Install the detector carefully so that the fastening torque does not exceed the prescribed limit; otherwise the unit could be damaged.

Parts necessary for installation

Introduction

The following parts are necessary for the installation of the detector;

- Centering nuts (four supplied)
- Connecting bolts and nuts (available separately)
- Gaskets: Required for seal between grounding rings and pipe flanges.
- Protective plate: Required when connecting the detector to polyvinyl chloride (PVC) piping.

Centering nuts

To install the detector, use centering nuts to ensure the exact alignment of the pipe and the detector.

Slip the centering bolts onto the through-bolts, and set the detector on top of the nuts so that the nuts are on four sides of the detector.

The positions of the centering nuts depend on the direction in which the detector is installed.

For the positions of the centering nuts, refer to Figure 2-9 and Figure 2-10.

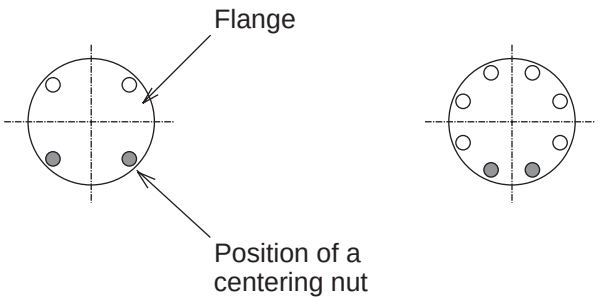


Figure 2-9 Horizontal centering of the detector
(Position two centering nuts against each flange)

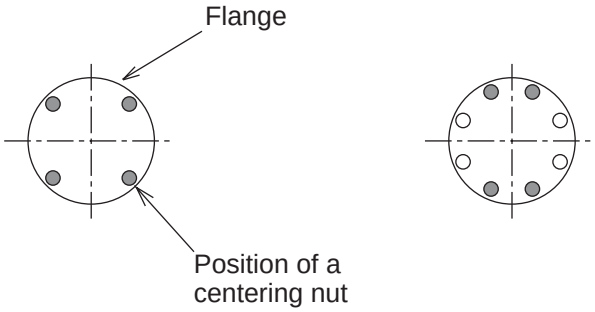


Figure 2-10 Vertical centering of the detector
(Position the four centering nuts on the bottom flange)

Gaskets

Secure gaskets. We recommend gasket material such as joint sheet or PTFE. For the bore diameters of the gaskets, refer to Table 2-2. We do not recommend the use of rubber gaskets. Observe the precautions below.

⚠ CAUTION

- Too small a gasket diameter may affect the flow velocity distribution resulting in inaccurate measurements.
- Too large a gasket diameter may cause leakage. Also, any solid substance in the fluid to be measured could accumulate between the gasket and the flange, resulting in inaccurate measurements.

Table 2-2 Recommended inner diameters of gaskets

Unit of measurement: mm (in.)

Nominal diameter dimensions	25 (1)	40 (1.5)	50 (2)	65 (2.5)	80 (3)	100 (4)	150 (6)	200 (8)
Internal diameter	25.5 ±1 (1.0 ±0.04)	40.5 ±1 (1.6 ±0.04)	52 ±1 (2.05 ±0.04)	65 ±1 (2.56 ±0.04)	79 ±1 (3.11 ±0.04)	104 ±1 (4.09 ±0.04)	151 ±1 (5.94 ±0.04)	200 ±1 (7.87 ±0.04)

If you install the detector at a lower torque level using rubber gaskets, you must use gaskets with the bore and external diameters shown in Table 2-3 for the respective pipe bore. Depending on the grounding ring material, two gaskets of different thicknesses may be required. (See Figure 2-14.)

Table 2-3 Inner and outside diameters of rubber gaskets (0.5 to 1 mm [0.02 to 0.04 in.] thick)

Unit of measurement: mm (in.)

Nominal diameter dimensions	25 (1)	40 (1.5)	50 (2)	65 (2.5)	80 (3)	100 (4)	150 (6)	200 (8)
Internal diameter	25.5 ±1 (1.0 ±0.04)	40.5 ±1 (1.6 ±0.04)	52 ±1 (2.05 ±0.04)	65 ±1 (2.56 ±0.04)	79 ±1 (3.11 ±0.04)	104 ±1 (4.09 ±0.04)	151 ±1 (5.94 ±0.04)	200 ±1 (7.87 ±0.04)
External diameter	50 ±1 (2.0 ±0.04)	68 ±1 (2.7 ±0.04)	84 ±1 (3.3 ±0.04)	104 ±1 (4.1 ±0.04)	114 ±1 (4.4 ±0.04)	139 ±1 (5.4 ±0.04)	190 ±1 (7.4 ±0.04)	240 ±1 (9.4 ±0.04)

Table 2-4 Inner and outside diameters of rubber gaskets (3 to 4 mm [0.12 to 0.16 in.] thick)

Unit of measurement: mm (in.)

Nominal diameter dimensions	25 (1)	40 (1.5)	50 (2)	65 (2.5)	80 (3)	100 (4)	150 (6)	200 (8)
Internal diameter	25.5 ±1 (1.0 ±0.04)	40.5 ±1 (1.6 ±0.04)	52 ±1 (2.05 ±0.04)	65 ±1 (2.56 ±0.04)	79 ±1 (3.11 ±0.04)	104 ±1 (4.09 ±0.04)	151 ±1 (5.94 ±0.04)	200 ±1 (7.87 ±0.04)
External diameter	50 ±1 (2.0 ±0.04)	68 ±1 (2.7 ±0.04)	84 ±1 (3.3 ±0.04)	104 ±1 (4.1 ±0.04)	114 ±1 (4.4 ±0.04)	139 ±1 (5.4 ±0.04)	190 ±1 (7.4 ±0.04)	240 ±1 (9.4 ±0.04)

Selecting an installation method

⚠ CAUTION

The necessary materials and the installation method vary according to the material of the pipe on which the detector is to be installed. Select the appropriate method of installation after confirming the specifications of the detector to be installed and the conditions of installation. Improper installation may result in leakage or damage to the pipe flanges.

Installation method according to materials

Select the appropriate installation method from the table below.

Pipe material	See page
Metal	page 2-16
PVC	page 2-17

Installation on horizontal pipe

⚠ CAUTION

Improper installation may result in leakage or damage to the pipe flanges.

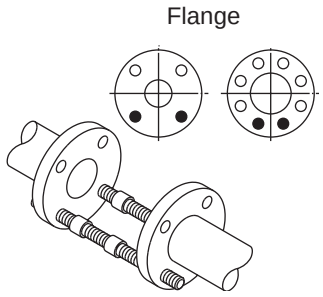
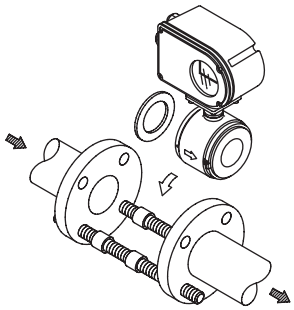
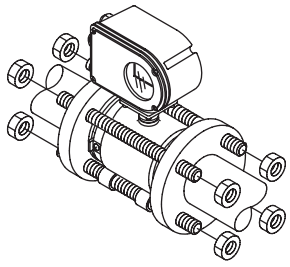
Required parts

The following parts are required:

- Through-bolts and nuts
- Centering nuts
- Gaskets: The required gasket material will vary according to the material of the pipe on which the detector is to be installed. See the installation procedures for different pipe materials described on page 2-16 to page 2-17.

Procedure

Follow this procedure to install the detector on a horizontal pipe.

Step	Action	Drawing
1	• Insert through-bolts in the flange holes shown by black dots in the drawing. Slip two centering nuts onto each through-bolt before inserting the bolts.	
2	• Turn the detector so that the direction mark on the detector matches the direction of fluid flow. • Insert the detector and gaskets between the pipe flanges. • Position the detector so that it sits on top of the centering.	
3	• Make sure that the detector remains properly centered. • Make sure that the gaskets do not protrude beyond the edges of the pipe flanges. • When you have checked these items, insert the remaining through-bolts into the flange holes and tighten the bolts evenly using the appropriate fastening torque given on page 2-7.	

Installation on vertical pipe

⚠ CAUTION

Improper installation may result in leakage or damage to the pipe flanges.

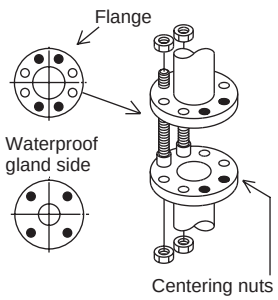
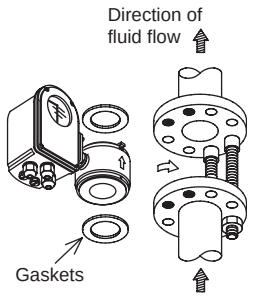
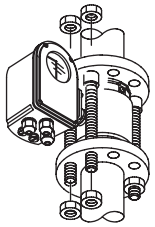
Required parts

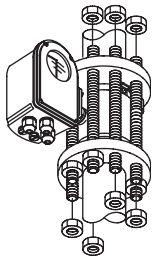
The following parts are required:

- Through-bolt and nuts
- Centering nuts
- Gaskets: The required gasket material will vary according to the material of the pipe on which the detector is to be installed. See the installation procedures for different pipe materials described on page 2-16 to page 2-17.

Procedure

Follow this procedure to install the detector on a horizontal pipe.

Step	Action	Drawing
1	• Of the flange holes shown by black dots in the drawing, insert through-bolts into the two holes at the back and fasten them lightly with nuts. Slip one centering nut onto each through bolt before inserting the bolts.	
2	• Turn the detector so that the direction mark on the detector matches the direction of fluid flow. • Insert the detector and gaskets between the pipe flanges.	
3	• Insert through-bolts fitted with one centering nut each into the remaining two flange holes shown by black dots in steps 1 and 2.	

Step	Action	Drawing
4	• Make sure that the detector remains properly centered. • Make sure that the gaskets do not protrude beyond the edges of the pipe flanges. • When you have checked these items, insert the remaining through-bolts into the flange holes and tighten the bolts evenly using the appropriate fastening torque given on page 2-7.	

Installation on metal pipe

Introduction

The installation method described in this section corresponds to the following combination of pipe and grounding ring materials. For the installation method corresponding to any other combination, refer to the page 2-12.

Pipe material: Metal

Grounding ring material: Stainless steel

Required parts

The following parts are required:

- Through-bolts and nuts
- Centering nuts
- Gaskets: We recommend non-rubber gaskets such as those made of joint sheet or PTFE.

  For recommended bore diameters, refer to Table 2-2 on page 2-11. Although rubber gaskets may be used, it is not possible to reduce the fastening torque.

Installation procedure

- Install the detector as shown in Figure 2-11. The torque level for tightening the bolts is not related to the gasket material. See Table 2-1 on page 2-8 for the appropriate torque. For the inner diameter of the gaskets, see Table 2-2 on page 2-11.
- To use rubber gaskets for a low fastening torque, refer to page 2-17.

⚠ CAUTION

Please note that the use of rubber gaskets and a lower fastening torque may result in insufficient surface pressure between the lining and the grounding ring, resulting in leakage.

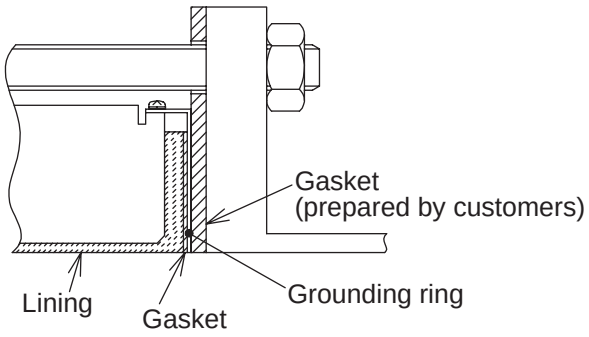


Figure 2-11 Installation on metal pipe

Installation on PVC pipe

Introduction

The installation method described in this section corresponds to the following combination of pipe and grounding ring materials. For the installation method corresponding to any other combination, refer to the table on page 2-12.

Pipe material: PVC

Grounding ring material: stainless steel

Required parts

The following parts are required:

- Through-bolts and nuts
- Centering nuts
- Gaskets: Non-rubber gaskets are recommended (i.e. joint sheet or PTFE). See Table 2-2 on page 2-11 for the recommended bore diameters.
- Protective plate: Use the protective plate if bolt tightening at the specified torque threatens to warp or damage the PVC pipe. See Figure 2-13 for an illustration of the protective plate.

Installation procedure

The installation procedure varies with such conditions as the fastening torque and the need for a protective plate. Choose one of the following three methods as applicable.

1. Use this method to install the detector with a specified fastening torque. Install the detector as shown in Figure 2-12. The torque level for tightening the bolts is not related to the gasket material. See Table 2-1 on page 2-8 for the appropriate torque. For the inner diameter of the gaskets, see Table 2-2 on page 2-11.

⚠ CAUTION

Please note that the use of rubber gaskets and a lower fastening torque may result in insufficient surface pressure between the lining and the grounding ring, resulting in leakage.

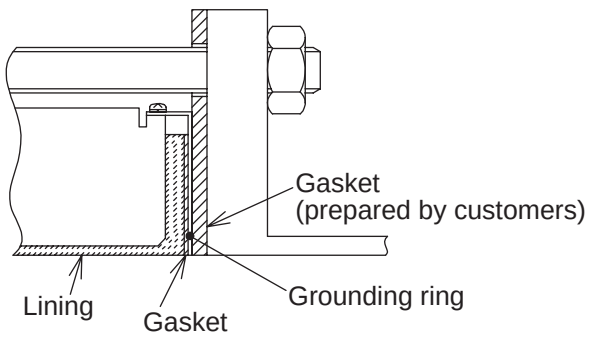


Figure 2-12 Installation on PVC pipe

2. Use this method to install the detector using a protective plate to prevent the PVC pipe from being deformed or damaged when the bolts are tightened with the specified torque.

   Install the protective plate between the outer side of the PVC flange and the detector, as shown in Figure 2-13. The protective plate protects the PVC pipe from deformation or damage when secured at the specified torque. The torque level is unrelated to the pipe or grounding ring material. See Table 2-1 on page 2-8 for the appropriate torque.

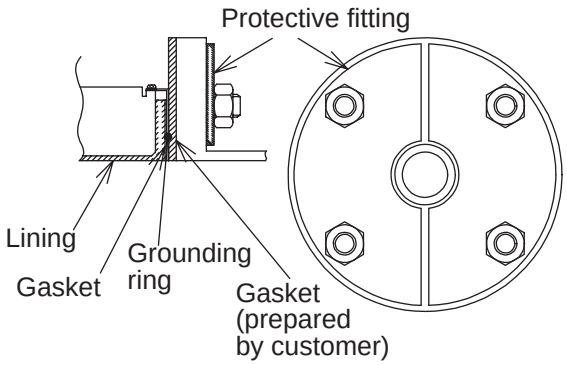


Figure 2-13 Installation on PVC pipe with protective plate

3. Use this method to install the detector using a low fastening torque and rubber gaskets.

   With the rubber gasket in the position shown in Figure 2-14, attach the detector to the pipe. Fasten the bolts with a torque that provides a leakproof joint. In this case, use the two kinds of rubber gaskets made of the same material.

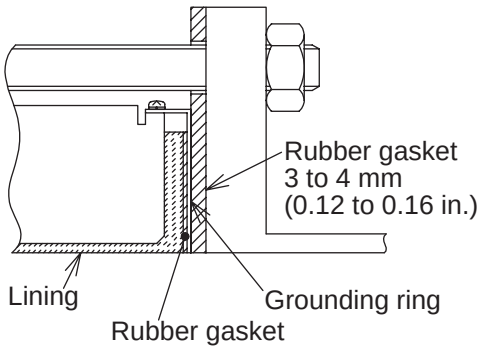


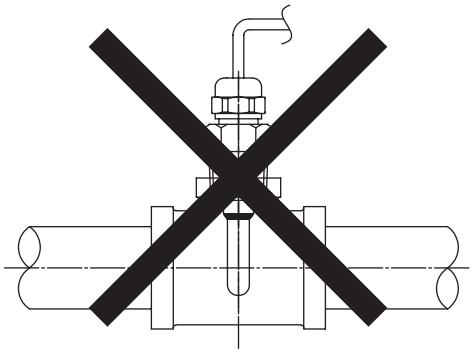
Figure 2-14 Installation on PVC pipe with rubber gasket

2-2-2: Installing temperature sensors

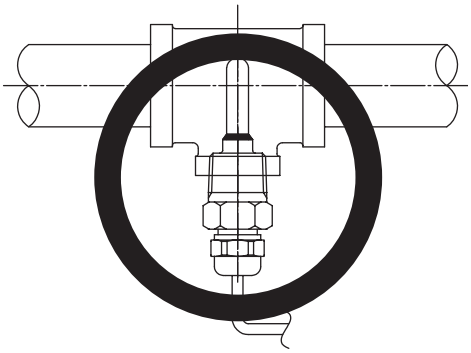
Mounting position of temperature sensors

Installation example

If the temperature sensor is installed with tee pipe joint, make sure mounting position is as shown in Figure 2-15.



Air is easily trapped thus resulting error of temperature measurement.



Good mounting position

Figure 2-15 Mounting position of temperature sensor

Installation location of temperature sensor

Installing temperature sensor in upstream side

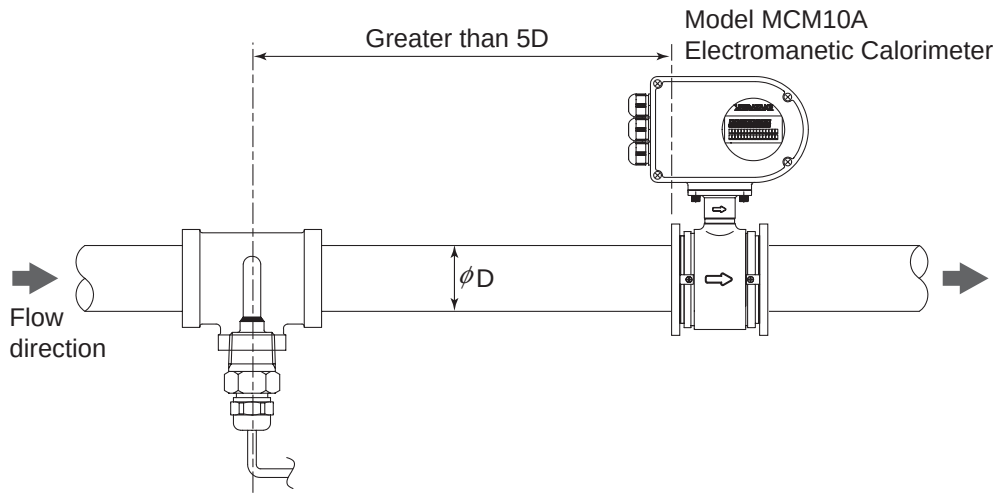


Figure 2-16 Installing temperature sensor in upstream side

Installing temperature sensor in downstream side

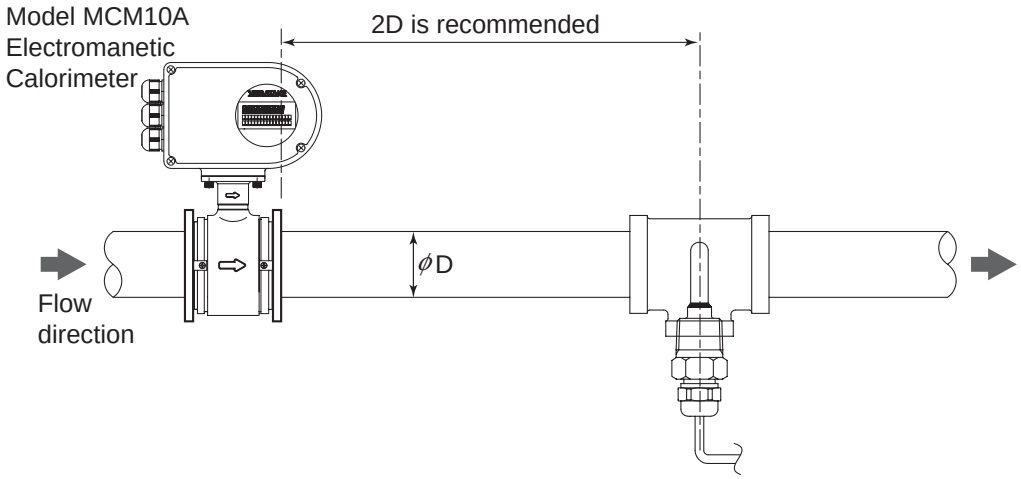


Figure 2-17 Installing temperature sensor in downstream side

2-3 : Electrical wiring

Introduction

24 V DC ±10% power supply is used. The following electrical wiring considerations are explained here:

- Connecting model MCM10A
- Terminal arrangement
- Converter terminal tables
- Grounding
- Cable specifications
- Temperature sensor wiring
- Installing wire cables
- Analog output wiring
- Pulse output wiring

~Note *This Electromagnetic Calorimeter is designed for a 24 V DC power supply.*

Connecting model MCM10A

Figure 2-18 shows the terminal block of the Electromagnetic Calorimeter main body.

⚠ WARNING

During wiring, turn OFF the power supply before opening the cover in order to prevent the danger of electric shock. DO NOT perform wiring work while the power is ON, as it may result in electric shock.

~Note
- *Perform wiring according to the directions in order to prevent equipment damage.*
- *Be sure to confirm the polarity of the power line wiring. Incorrect wiring may cause damage to the device.*

Terminal arrangement

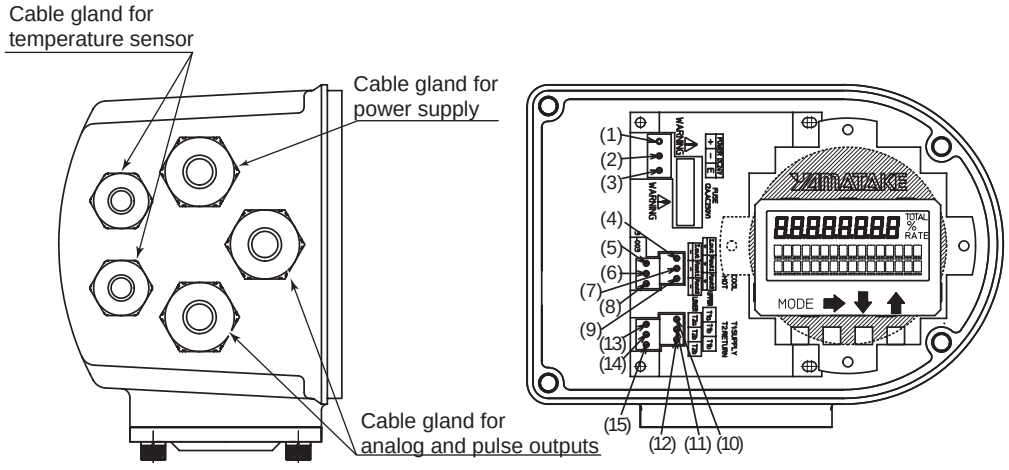


Figure 2-18 Terminal arrangement

Converter terminal table

No.	Meaning	Symbol
(1)	Power supply 24 V DC +	+
(2)	Power supply 24 V DC -	-
(3)	Grounding	E
(4)	Analog output -	I. out -
(5)	Analog output +	I. out +
(6)	Pulse output - for cooling	P. out1 -
(7)	Pulse output + for cooling	P. out1 +
(8)	Pulse output - for heating	P. out2 -
(9)	Pulse output + for heating	P. out2 +
(10)	Supply side Pt 100 Ω sensor	T1a
(11)	Supply side Pt 100 Ω sensor	T1b
(12)	Supply side Pt 100 Ω sensor	T1b
(13)	Return side Pt 100 Ω sensor	T2a
(14)	Return side Pt 100 Ω sensor	T2b
(15)	Return side Pt 100 Ω sensor	T2b

Grounding

- Grounding should be from the terminal E.
- Grounding resistance should be less than 100 Ω.
- For the purpose of grounding, make sure to use 3 core cable for power supply cable.

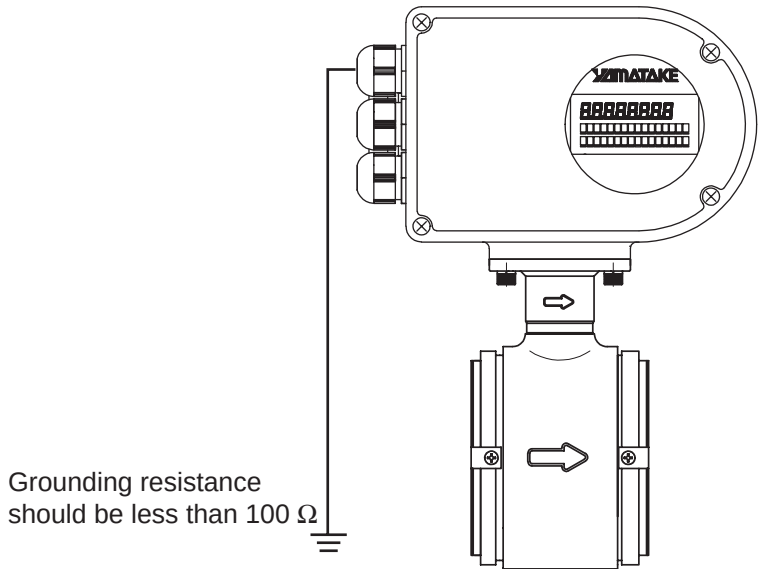


Figure 2-19 Grounding

Cable specifications

Meaning	Symbol	Optimum conductor size	Optimum cable outer diameter	Recommended cable
Power supply 24 V DC +	+	AWG 14 to 22	6 to 12 mm (0.24 to 0.47 in.)	3 core CVV cable
Power supply 24 V DC	-	AWG 14 to 22	6 to 12 mm (0.24 to 0.47 in.)	3 core CVV cable
Grounding	E	AWG 14 to 22	6 to 12 mm (0.24 to 0.47 in.)	3 core CVV cable
Analog output -	I. out -	AWG 16 to 26	6 to 12 mm (0.24 to 0.47 in.)	2 core KEVS cable
Analog output +	I. out +	AWG 16 to 26	6 to 12 mm (0.24 to 0.47 in.)	2 core KEVS cable
Pulse output - for cooling	P. out1 -	AWG 16 to 26	6 to 12 mm (0.24 to 0.47 in.)	2 or 4 core KEVS cable
Pulse output + for cooling	P. out1 +	AWG 16 to 26	6 to 12 mm (0.24 to 0.47 in.)	2 or 4 core KEVS cable
Pulse output - for heating	P. out2 -	AWG 16 to 26	6 to 12 mm (0.24 to 0.47 in.)	2 or 4 core KEVS cable
Pulse output + for heating	P. out2 +	AWG 16 to 26	6 to 12 mm (0.24 to 0.47 in.)	2 or 4 core KEVS cable
Supply side Pt 100 Ω sensor	T1a	AWG 16 to 26	4 to 8 mm (0.16 to 0.31 in.)	
Supply side Pt 100 Ω sensor	T1b	AWG 16 to 26	4 to 8 mm (0.16 to 0.31 in.)	
Supply side Pt 100 Ω sensor	T1b	AWG 16 to 26	4 to 8 mm (0.16 to 0.31 in.)	
Return side Pt 100 Ω sensor	T2a	AWG 16 to 26	4 to 8 mm (0.16 to 0.31 in.)	
Return side Pt 100 Ω sensor	T2b	AWG 16 to 26	4 to 8 mm (0.16 to 0.31 in.)	
Return side Pt 100 Ω sensor	T2b	AWG 16 to 26	4 to 8 mm (0.16 to 0.31 in.)	

Temperature sensor wiring

Temperature sensor should be 3-wire Pt 100 Ω sensor, IEC 751 class A or JIS C 1604 class A. Be sure to confirm the temperature sensor type (IEC or JIS). Refer to Figure 2-20 for wiring. In case of IEC type Pt 100 Ω sensor, white wire should be connected to terminal T1a / T2a and red wires should be connected to terminal T1b / T2b.

In case of JIS type Pt 100 Ω sensor, red wire should be connected to terminal T1a/ T2a and white wires should be connected to terminal T1b/ T2b.

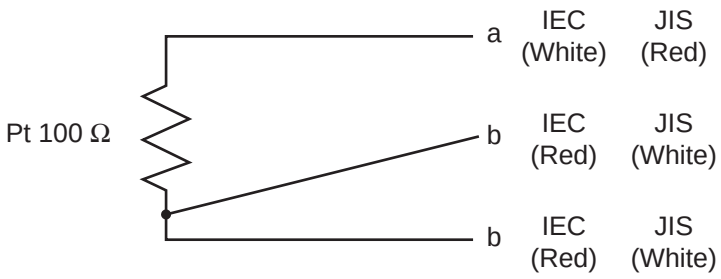


Figure 2-20 Temperature sensor wiring

Meaning	Symbol	Optimum conductor size	Optimum cable outer diameter	Recommended cable
Supply side Pt 100 Ω sensor	T1a	AWG 16 to 26	4 to 8 mm (0.16 to 0.31 in.)	IEC (white), JIS (red)
Supply side Pt 100 Ω sensor	T1b	AWG 16 to 26	4 to 8 mm (0.16 to 0.31 in.)	IEC (red), JIS (white)
Supply side Pt 100 Ω sensor	T1b	AWG 16 to 26	4 to 8 mm (0.16 to 0.31 in.)	IEC (red), JIS (white)
Return side Pt 100 Ω sensor	T2a	AWG 16 to 26	4 to 8 mm (0.16 to 0.31 in.)	IEC (white), JIS (red)
Return side Pt 100 Ω sensor	T2b	AWG 16 to 26	4 to 8 mm (0.16 to 0.31 in.)	IEC (red), JIS (white)
Return side Pt 100 Ω sensor	T2b	AWG 16 to 26	4 to 8 mm (0.16 to 0.31 in.)	IEC (red), JIS (white)

Installing the wiring cable

When installing the cable connecting this product to the control equipment, the following precautions must be observed:

- Run the wiring away from equipment that may cause noise, such as high-capacity transformers, motors or power supplies. DO NOT install the cable in the same tray or duct as other power cables, as output errors may result.
- Wiring with electrical tube and duct is recommended to keep out water and protect the wire from external damage. Also, be sure to use a water-proof gland at the conduit connection.

Analog output wiring

The analog output wiring is shown in Figure 2-21.

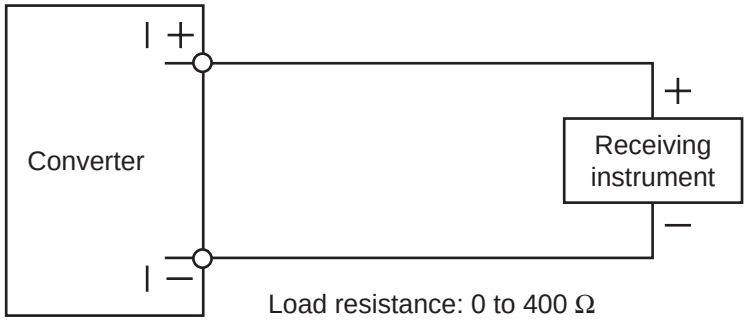


Figure 2-21 Wiring diagram for analog output

~Note *Miswiring of polarity may cause damage to the equipment. Recheck the wiring position carefully.*

Pulse output wiring

The pulse output is an open collector output. Pay close attention to voltage and polarity when wiring.

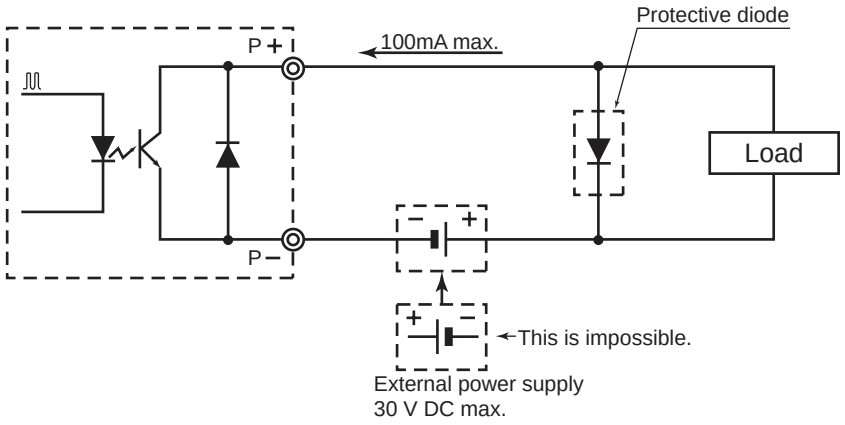


Figure 2-22 Wiring diagram for pulse output

~Note *Miswiring of polarity may cause damage to the equipment. Recheck the wiring position carefully.*

Use an external power supply with voltage and capacity that satisfy the specifications.

Chapter 3 : Operating and Termination of the Measuring System

Outline of this chapter

This chapter explains the procedures for start-up of the Electromagnetic Calorimeter and making zero adjustment. It also describes termination of the measuring system. When starting-up and operating this product for the first time, carefully follow the explanations given in this chapter.

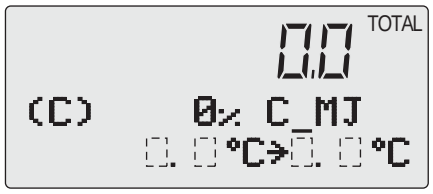
Before using this product, be sure to perform the following settings as instructed in this chapter:

- Setting the resistances at 0°C and 100°C for each temperature sensor connected to the Electromagnetic Calorimeter.

3-1 : Start-up

Procedure

Start-up the Electromagnetic Calorimeter according to the following steps:

Step	Procedure
1	Verify the Electromagnetic Calorimeter detector is properly installed on the pipe.
2	Verify the wiring has been completed properly.
3	Charge the Electromagnetic Calorimeter with the fluid to be measured, and make the fluid stands still.
4	Verify that no fluid is leaking from the flange to which the Electromagnetic Calorimeter is attached.
5	Turn the power to the Electromagnetic Calorimeter ON.
6	The LCD display should appear as follows:  Start-up of the Electromagnetic Calorimeter has now been completed.

3-2 : Preparation before measurement

Zero adjustment

Introduction

After start-up, be sure to zero the Electromagnetic Calorimeter. Conduct zero adjustment using the data-setting device, filling the detector with process fluid.

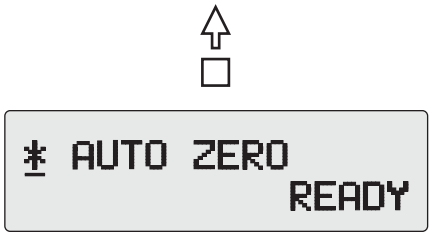
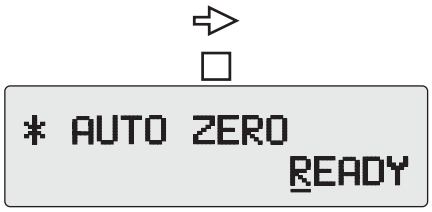
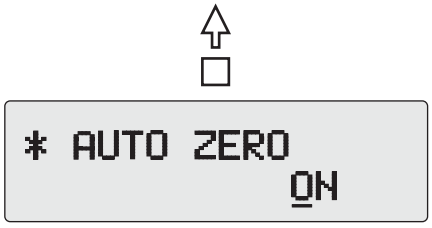
Method using the data-setting device

Introduction

Adjust the Electromagnetic Calorimeter so the flow when the fluid in the detector stands still is measured as zero.

~Note

- *Zero adjustment is very important for accurate flow rate measurement. Be sure to zero the flowmeter before it is first operated.*
- *Before zero adjustment, verify that the Electromagnetic Calorimeter is correctly grounded (grounding resistance 100 Ω or less) and that the fluid in the detector has been filled up and is still. Zero adjustment becomes possible when the flow speed is 0.2 m/s (.66 ft./sec.) or less, but wait until the fluid completely stops (flow speed: 0.0 m/s) for accurate adjustment. Otherwise, output errors may result.*

Step	Screen / Button	Procedure
1		Push the MODE button. The OPERATOR'S MODE screen appears for approximately two seconds followed by the DAMPING screen.
2		Push the UP button once to move to the AUTO ZERO screen.
3		Push the RIGHT SHIFT button once to move the cursor to READY to indicate that the system is ready for zeroing.
4		Push the UP button once to start the auto zero adjustment. The large numerical display flashes and READY changes to ON during adjustment. When the zero adjustment is complete, the flashing stops and ON changes back to READY. Zero adjustment takes approximately 15 seconds.

Step	Screen / Button	Procedure
5	MODE □	Push the MODE button to return MEASURING MODE to save the zero setting.

⚠ CAUTION

You must return to MEASURING MODE within ten minutes to save the new value before the system resets it to the previously saved value.

3-3 : Stopping

⚠ CAUTION

Before stopping the Electromagnetic Calorimeter operation and shutting off the output to the control equipment, be sure to switch the control equipment to manual control. This will prevent the power shut-off on this unit from directly affecting the control equipment.

Procedure

Perform the following steps to stop Electromagnetic Calorimeter operation:

Step	Procedure
1	Switch the control equipment connected to the Electromagnetic Calorimeter to the manual control mode.
2	Turn the power switch of the Electromagnetic Calorimeter off.

3-4 : Setting the resistances at 0°C and 100°C for each Pt 100 Ω temperature sensor connected to the Electromagnetic Calorimeter

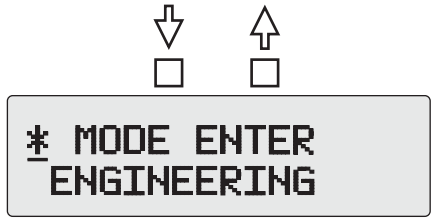
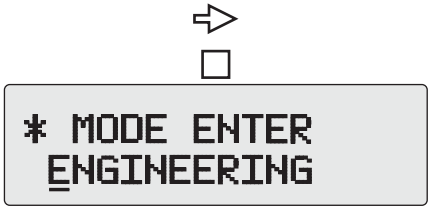
Introduction

For the accurate calorie consumption measurement, the Electromagnetic Calorimeter has temperature sensor compensation function.

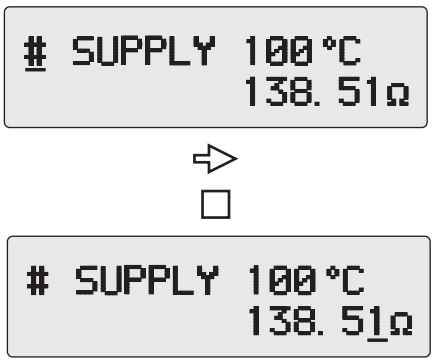
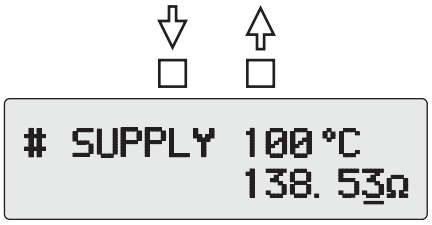
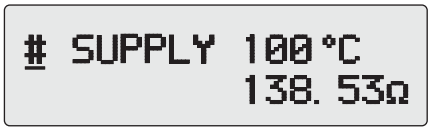
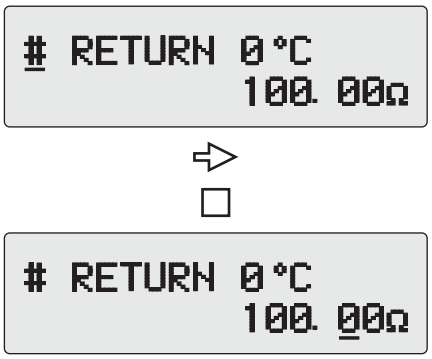
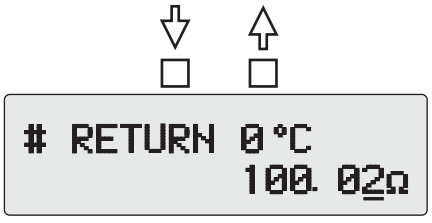
By setting the resistances of the Pt 100 Ω temperature sensors at 0°C and 100°C, the tolerance of each temperature sensor is compensated.

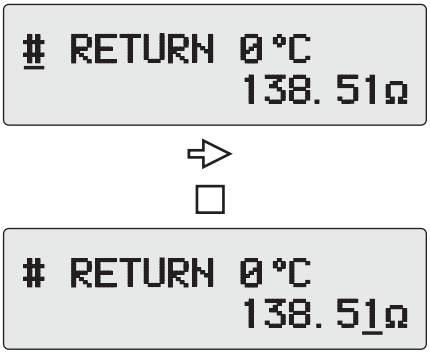
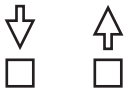
Procedure

Before setting the resistances, verify the temperature sensors are properly connected to the device. Check the temperature sensor resistances provided by the temperature sensor supplier.

Step	Screen / Button	Procedure
1		Push the MODE button. The OPERATOR'S MODE screen appears for approximately two seconds followed by the DAMPING screen.
2		Use the DOWN or UP button to cycle through the screens until the MODE ENTER screen displaying ENGINEERING appears.
3		Push the RIGHT SHIFT button to move the cursor to ENGINEERING.
4		Push the UP button to select.

Step	Screen / Button	Procedure
5	# ENGINEERING MODE # ID SET XXXXXXXXX	The ENGINEERING MODE screen appears for approximately two seconds followed by the ID SET screen. Note that the mode indicator has changed to indicate ENGINEERING MODE (#). As long as the cursor remains under the mode indicator, pushing the DOWN or UP button cycles through the screens available in this mode.
6	# SUPPLY 0°C 100.00Ω	Use the DOWN or UP button to cycle through the screen until the SPPLY 0°C screen appears.
7	⇨ □ # SUPPLY 0°C 100.00Ω	Push the RIGHT SHIFT button until the cursor is at the resistance to be changed. **Default setting:** 100.00 Ω
8	⇩ □ ⇧ □ # SUPPLY 0°C 099.90Ω	Use the DOWN or UP button to change the value according to the value supplied by the temperature sensor supplier.
9	⇨ □	Push the RIGHT SHIFT button until the cursor is back at the mode indicator.
10	# SUPPLY 0°C 099.90Ω	Check the cursor is at mode indicator (#).
11	⇧ □	Push the UP button to move to the SUPPLY 100°C screen.

Step	Screen / Button	Procedure
12		SUPPLY 100°C screen appears. Push the RIGHT SHIFT button until the cursor is at the resistance to be changed. **Default setting:** 138.51 Ω
13		Use the DOWN or UP button to change the value according to the value supplied by the temperature sensor supplier.
14		Push the RIGHT SHIFT button until the cursor is back at the mode indicator.
15		Check the cursor is at mode indicator (#).
16		Push the UP button to move to the RETURN 0°C screen.
17		RETURN 0°C screen appears. Push the RIGHT SHIFT button until the cursor is at the resistance to be changed. **Default setting:** 100.00 Ω
18		Use the DOWN or UP button to change the value according to the value supplied by the temperature sensor supplier.

Step	Screen / Button	Procedure
19		Push the RIGHT SHIFT button until the cursor is back at the mode indicator.
20		Check the cursor is at mode indicator (#).
21		Push the UP button to move to the RETURN 100°C screen.
22		RETURN 100°C screen appears. Push the RIGHT SHIFT button until the cursor is at the resistance to be changed. **Default setting:** 138.51 Ω
23	 	Use the DOWN or UP button to change the value according to the value supplied by the temperature sensor supplier.
24		Push the RIGHT SHIFT button until the cursor is back at the mode indicator.
25	MODE 	Push the MODE button to return to MEASURING MODE to save the new values. **⚠ CAUTION** You must return to MEASURING MODE within ten minutes to save the new values before the system resets them to the previously saved values.

Chapter 4 : Operation Using the Data-Setting Device

Outline of this chapter

This chapter explains how to operate this product using the data setting-device.

The device can be operated using the four keys on the data-setting device.

- Read page 4-2 to page 4-7 to understand the functions and operation of the data setting device, then operate the “How to enter the OPERATOR’S MODE”.

4-1 : Functions of the Data-Setting Device

Data-setting device

Names of parts

Figure 4-1 shows the parts of the data-setting device.

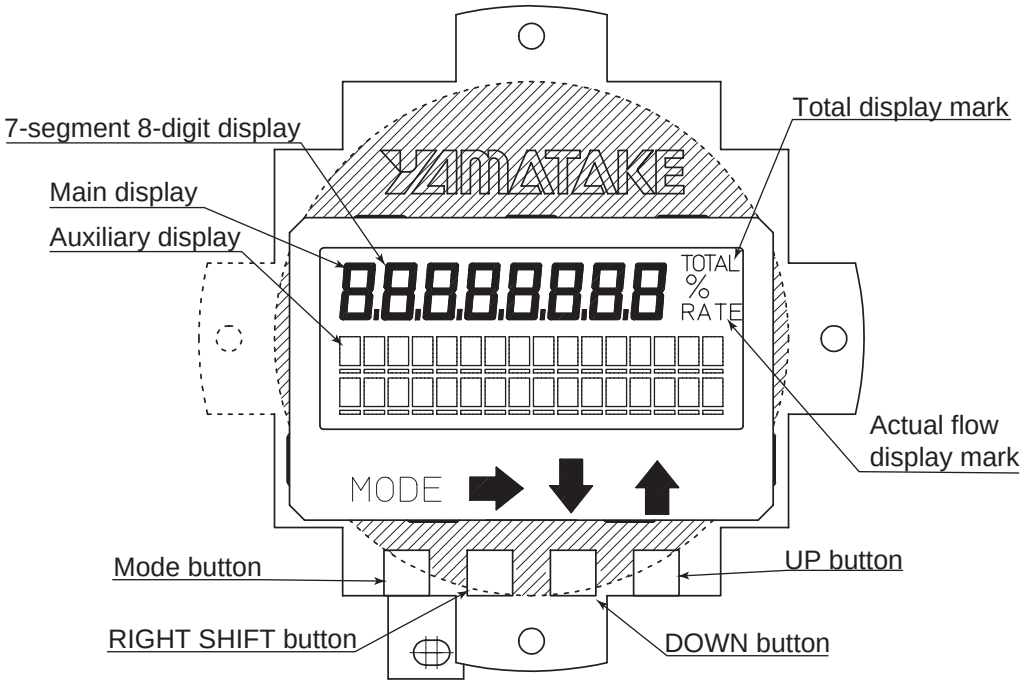


Figure 4-1 Names of data-setter parts

Parts names and explanation

The display that appears on the data-setting device is explained below.

- Totalized calorific value indication.

  The display indicates “TOTAL” for the totalized calorific value.

- Flow rate indication

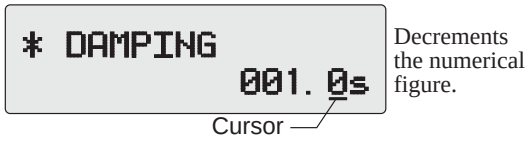
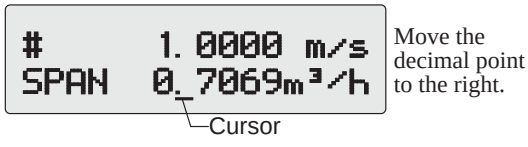
  The display indicates “RATE” for actual flow rate. The percent flow rate is always indicated in the auxiliary display.

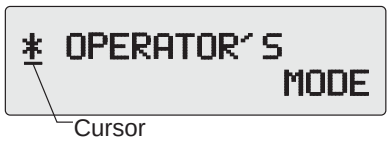
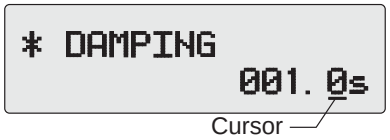
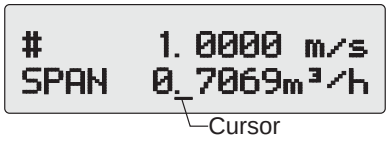
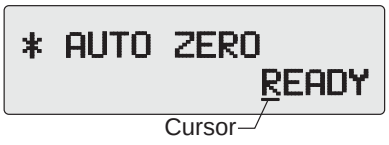
Section	Explanation
7-segment 6-digit display	• Indicates the totalized calorific value. By pushing UP or DOWN button, instantaneous calorific value or actual flow rate is display for 60 seconds. After 60 seconds, the display automatically indicates the totalized calorific value.
Totalized calorific value indicator (TOTAL)	• Indicates that the totalized calorific value is currently displayed.

Section	Explanation
Actual flow rate indicator (RATE)	• Indicates that actual flow rate is currently displayed.
Auxiliary display	• During the MEASURING MODE, indicates a mode of cooling or heating. • Indicates the percent flow rate. • Indicates the calorific value unit with its mode (cooling or heating). • Indicates the temperature of supply and return. (supply temperature → return temperature)

Part names and explanation

The following is an explanation of the various buttons on the data-setting device.

Name	Explanation
Mode button MODE □	• Enter the OPERATOR'S MODE. • After changing the parameters or internal data in the ENGINEERING MODE or MAINTENANCE MODE, press this button to write the data into memory.
Right-shift button ⇨ □	• Shift the cursor to the right.
Down button ⇩ □	• Change the parameter at the cursor position. • Display the previous screen. When the cursor is located at the far left of the upper row (*, #, >)  When the cursor is located at a numerical figure:  When the cursor is located at the decimal point: 

Name	Explanation
Up button ⇧ □	• Change the parameter at the cursor position. • Display the next screen. When the cursor is located at the far-left of the upper row (*, #, >):  Changes the screen. When the cursor is located at a numerical figure:  Increments the numerical figure. When the cursor is located at the decimal point:  Move the decimal point to the left. When the cursor is located at "READY":  Starts operation when pushed.

Operating the display / Data-setting device

Outline of the various modes

The following four modes are available on the device.

Mode	Explanation
MEASURING MODE	This mode indicates the measuring status.
OPERATOR'S MODE Mode indicator: 	The operator setting mode is used for data that is registered or changed frequently. This includes damping time constant, auto-zero adjustment, counter reset value, counter reset for cooling and heating mode, auto spike cut function selection and averaging function selection. **~Note** *Registered or changed data is temporarily written to memory when input, but will return to the previous status within ten minutes unless it is saved. (exception: only counter reset will not return to the previous status even after ten minutes.)* *To save the data, be sure to press the MODE button to open the MEASURING MODE.* *When the mode changes to the MEASURING MODE, the data will be written into memory.*
ENGINEERING MODE Mode indicator: 	This is the engineering setting mode. It is used for data that is registered or changed less frequently that in the OPERATOR'S MODE. This includes ID function setting, detector data, temperature sensor data, flow rate span, calorific value range and unit, hysteresis width, pulse data, low-flow cut, output at error. **~Note** *When registering or changing data, be sure to press the MODE button to write it to non-volatile memory. Rewriting occurs when the mode is changed to the MEASURING MODE by pressing the MODE button.*

Mode	Explanation
MAINTENANCE MODE Mode indicator: 	This is the maintenance setting mode. It is used when adjustment or verification is needed at regular maintenance periods, or when an abnormality occurs. This mode includes loop check, output adjustment. This mode is further divided into the following three modes: OUTPUT CHECK MODE CALIBRATION MODE CRITICAL MODE **~Note** • *CALIBRATION MODE and CRITICAL MODE contain adjustments and operations that are very important for calorific value measurement and flow rate measurement. When operating these modes, fully check the details of the adjustments to be made. Missetting will prevent measurement.* • *When registering or changing data, be sure to press the MODE button to write it to non-volatile memory. Rewriting occurs when the mode is changed to the MEASURING MODE by pressing the MODE button.*

How to enter the OPERATOR'S MODE

1. Push the MODE button.

The OPERATOR'S MODE screen appears for approximately two seconds followed by the DAMPING screen.

How to return to the MEASURING MODE

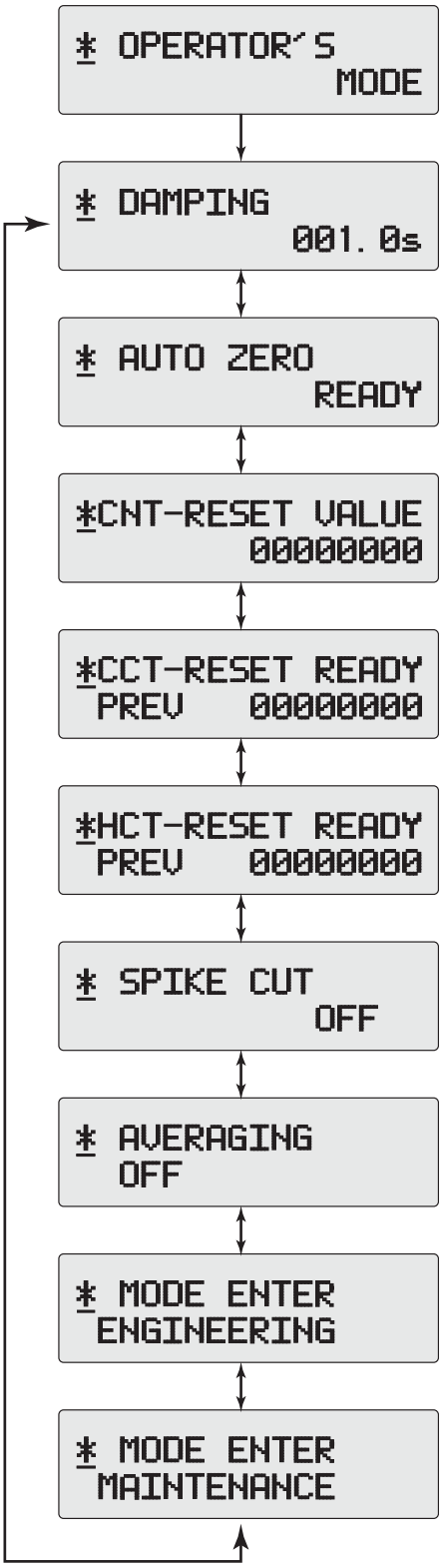
1. Push the MODE button.
2. The screen will automatically return to the MEASURING MODE.

Automatic resuming to the MEASURING MODE

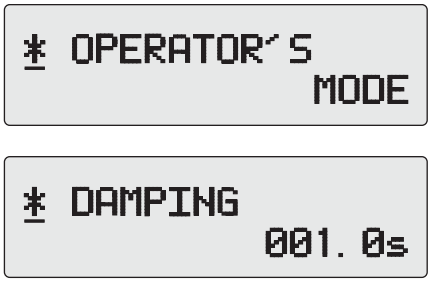
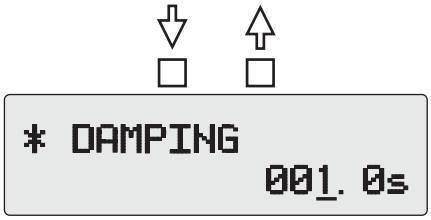
When the button is not operated more than ten minutes, it automatically resumes to the MEASURING MODE with the previous data / canceling the changed data input.

4-2 : Operating in the OPERATOR'S MODE

4-2-1 LCD display flow



4-2-2 Setting the damping time constant

Step	Screen / Button	Procedure
1		Push the MODE button. The OPERATOR'S MODE screen appears for approximately two seconds followed by the DAMPING screen.
2		Push the RIGHT SHIFT button until the cursor is at the value to be changed. (In the example, the button is pushed three times.)
3		Use the DOWN or UP button to change the numerical value. **Default setting:** 1.0 second **Setting range:** 0.5 to 199.9 seconds
4		Push the RIGHT SHIFT button until the cursor is back at the mode indicator.
5		Push the MODE button to return to MEASURING MODE to save the damping time value. **⚠ CAUTION** You have only ten minutes to return to MEASURING MODE to save this new value before the system resets it to the previously saved value.

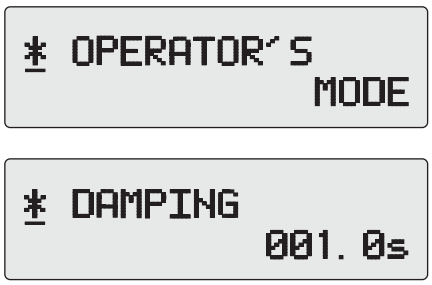
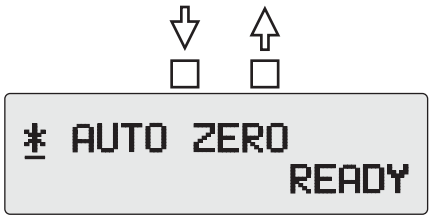
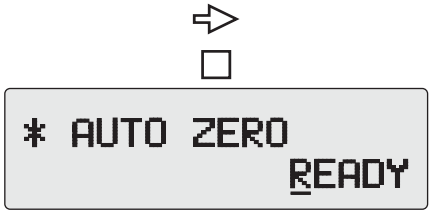
4-2-3 Zero adjustment

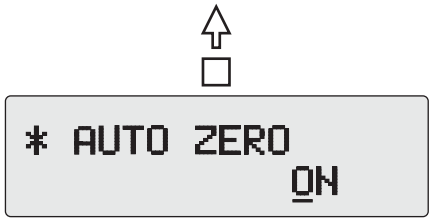
This function adjusts the flowmeter part of the Electromagnetic Calorimeter so that the measured flow rate is zero when the fluid stands still in the detector.

⚠ CAUTION

Before operating the Electromagnetic Calorimeter for the first time, be sure to zero it. Zero adjustment is very important for accurate calorific value measurement.

Before zeroing the flowmeter part of the Electromagnetic Calorimeter, make sure the detector is properly grounded (grounding resistance must be less than 100 Ω), that the detector is filled with the fluid to be measured and that the fluid is standing still. Zero adjustment is possible with a flow speed of 0.2 m/s (0.656 ft./s) or less, but the flow speed should be 0.0 m/s (0.0 ft./s) for accurate measurement. Output errors can result from improper zeroing.

Step	Screen / Button	Procedure
1		Push the MODE button. The OPERATOR'S MODE screen appears for approximately two seconds followed by the DAMPING screen.
2		Use the DOWN or UP button to cycle through the screens until the AUTO ZERO screen appears.
3		Push the RIGHT SHIFT button once to move the cursor to READY to indicate that the system is ready for zeroing.

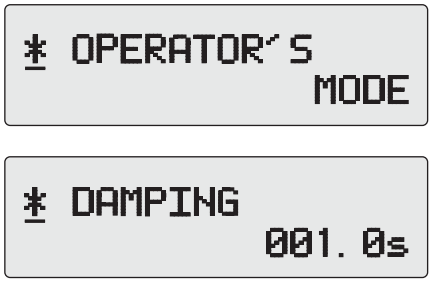
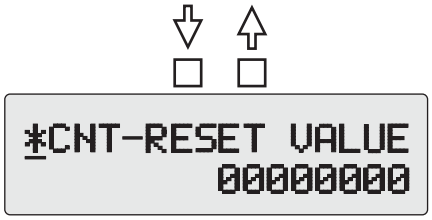
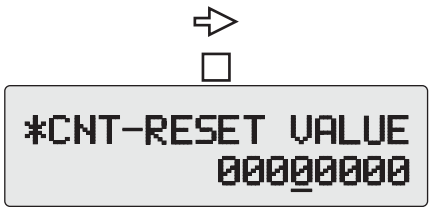
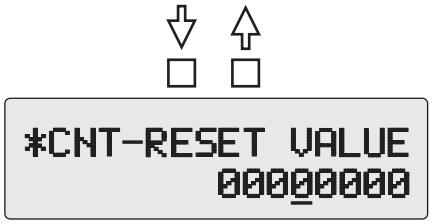
Step	Screen / Button	Procedure
4		Push the UP button once to select READY and start the auto zero adjustment. The large numerical display flashes and READY changes to ON during adjustment. When the zero adjustment is complete, the flashing stops and ON changes to back to READY. Zero adjustment takes approximately 15 seconds.
5		Push the RIGHT SHIFT button until the cursor is back at the mode indicator
6	MODE	Push the MODE button to return to MEASURING MODE to save the zero setting. **⚠ CAUTION** You must return to MEASURING MODE within ten minutes to save this new value before the system resets it to the previously saved value.

4-2-4 Setting the reset value of the built-in calorific value counter

This function sets the starting value of the built-in calorific value counter.

⚠ CAUTION

This function is prepared only for recovering missing totalized calorific value due to some problems. Please do not use this function in normal operation. This function will rewrite the totalized calorific value stored in the memory.

Step	Screen / Button	Procedure
1		Push the MODE button. The OPERATOR'S MODE screen appears for approximately two seconds followed by the DAMPING screen.
2		Use the DOWN or UP button to cycle through the screens until the CNT-RESET value screen appears.
3		Push the RIGHT SHIFT button as many times as is necessary to move the cursor to the value to be changed. (In the example, the button is pushed four times.) **Default setting:** 00000000 **Setting range:** 00000000 to 99999999
4		Use the DOWN or UP button to change the numerical value.
5		Push the RIGHT SHIFT button until the cursor is back at the mode indicator.

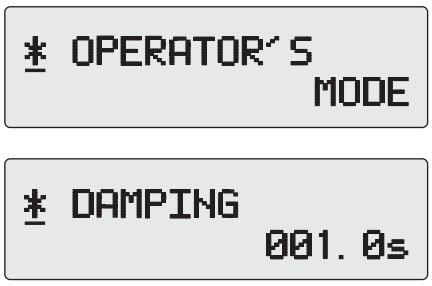
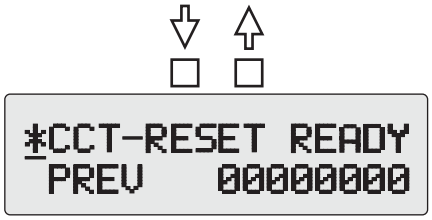
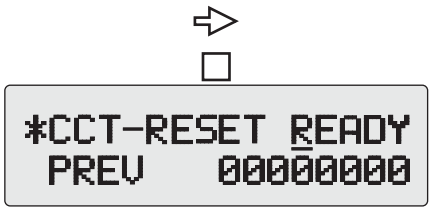
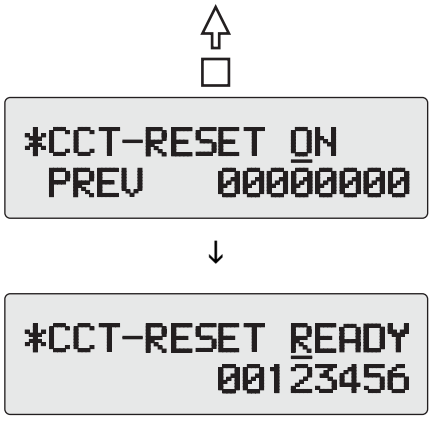
Step	Screen / Button	Procedure
6	MODE □	Push the MODE button to return to MEASURING MODE to save the new value. **⚠ CAUTION** You must return to MEASURING MODE within ten minutes to save this new value before the system resets it to the previously saved value.

4-2-5 Resetting the totalized calorific value of the built-in counter for cooling mode

This function resets the totalized calorific value of the built-in counter for cooling mode as the value set in “4-2-4 Setting the reset value of the built-in calorific value counter”.

⚠ CAUTION

This function is prepared only for recovering missing totalized calorific value due to some problems. Please do not use this function in normal operation. This function will rewrite the totalized calorific value stored in the memory.

Step	Screen / Button	Procedure
1		Push the MODE button. The OPERATOR’S MODE screen appears for approximately two seconds followed by the DAMPING screen.
2		Use the DOWN or UP button to cycle through the screens until the CCT-RESET screen appears.
3		Push the RIGHT SHIFT button once to move the cursor to READY.
4		Push the UP button to select READY and reset the counter. READY changes to ON as the counter resets and then changes back to READY when it’s done.

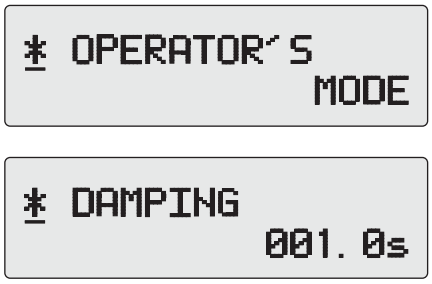
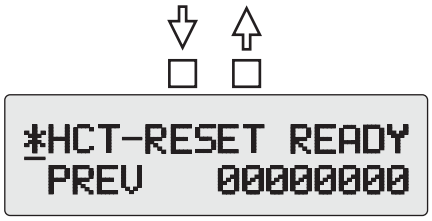
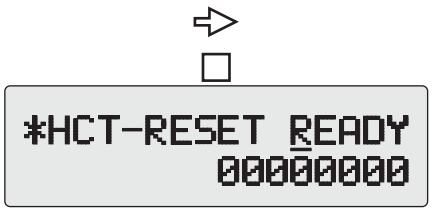
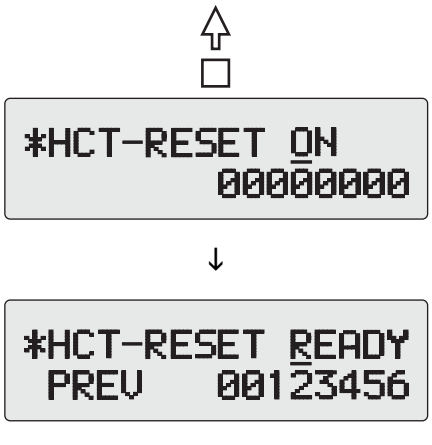
Step	Screen / Button	Procedure
5		Push the RIGHT SHIFT button until the cursor is back at the mode indicator.
6		Push the MODE button to return to MEASURING MODE to save the new value. **⚠ CAUTION** You must return to MEASURING MODE within ten minutes to save this new value before the system resets it to the previously saved value.

4-2-6 Resetting the totalized calorific value of the built-in counter for heating mode

This function resets the totalized calorific value of the built-in counter for heating mode as the value set in section “4-2-4 Setting the reset value of the built-in calorific value counter”.

⚠ CAUTION

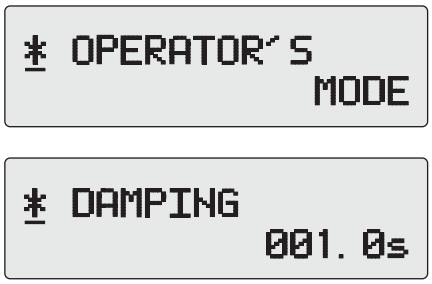
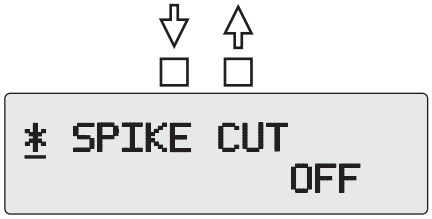
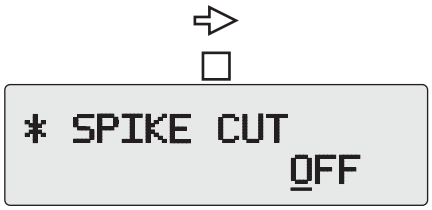
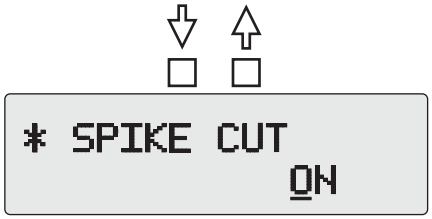
This function is prepared only for recovering missing totalized calorific value due to some problems. Please do not use this function in normal operation. This function will rewrite the totalized calorific value stored in the memory.

Step	Screen / Button	Procedure
1		Push the MODE button. The OPERATOR’S MODE screen appears for approximately two seconds followed by the DAMPING screen.
2		Use the DOWN or UP button to cycle through the screens until the HCT-RESET screen appears.
3		Push the RIGHT SHIFT button once to move the cursor to READY.
4		Push the UP button to select READY and reset the counter. READY changes to ON as the counter resets and then changes back to READY when it’s done.

Step	Screen / Button	Procedure
5		Push the RIGHT SHIFT button until the cursor is back at the mode indicator.
6		Push the MODE button to return to MEASURING MODE to save the new value. **⚠ CAUTION** You must return to MEASURING MODE within ten minutes to save this new value before the system resets it to the previously saved value.

4-2-7 Selecting auto spike cut function

This function eliminates steep noise spikes in the flow rate.

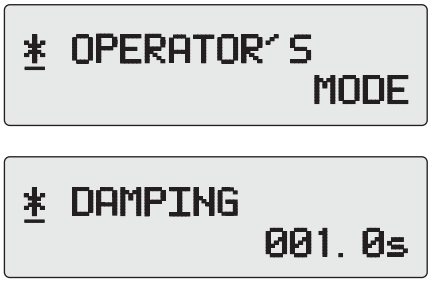
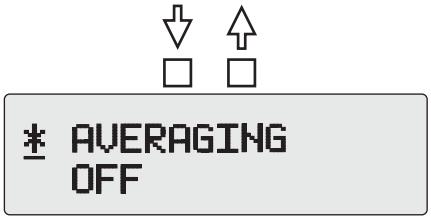
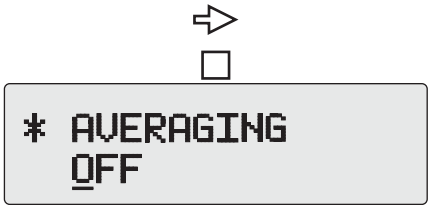
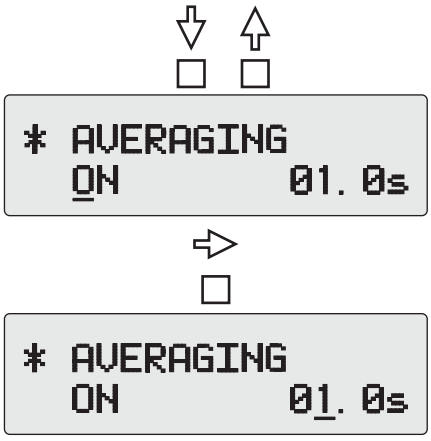
Step	Screen / Button	Procedure
1		Push the MODE button. The OPERATOR'S MODE screen appears for approximately two seconds followed by the DAMPING screen.
2		Use the DOWN or UP button to cycle through the screens until the AUTO SPIKE CUT screen appears.
3		Push the RIGHT SHIFT button once to move the cursor to OFF.
4		Push the DOWN or UP button to change the selection to ON.
5		Push the RIGHT SHIFT button until the cursor is back at the mode indicator.
6		Push the MODE button to return to MEASURING MODE to save the new value. **⚠ CAUTION** You must return to MEASURING MODE within ten minutes to save this new value before the system resets it to the previously saved value.

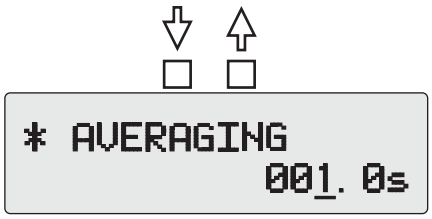
4-2-8 Selecting averaging function

This function is used for accurate flow measurement when the measured fluid has pulsation.

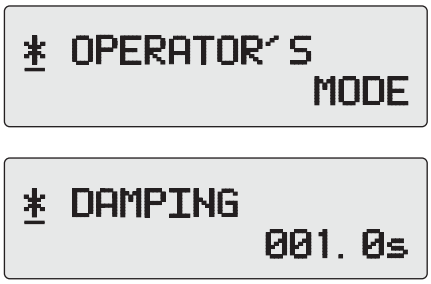
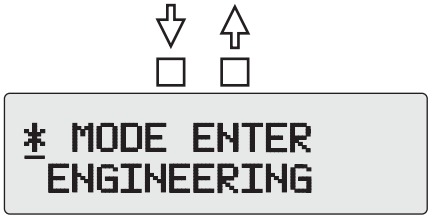
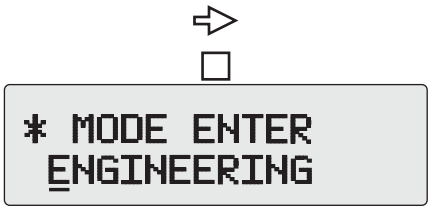
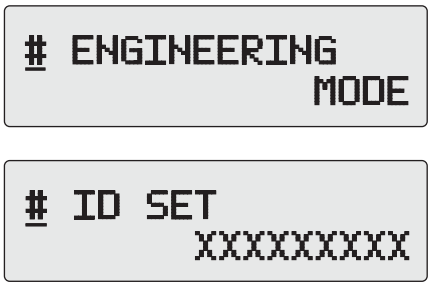
⚠ CAUTION

This function is prepared only for pulsation flow. Please do not use this function if there is no pulsation flow.

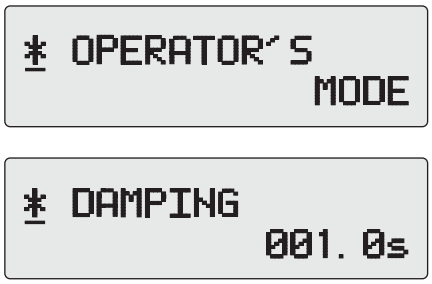
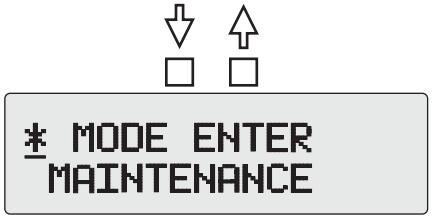
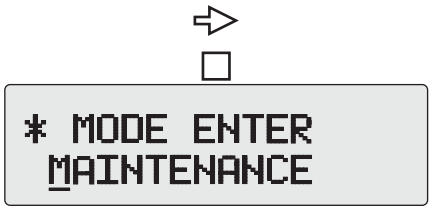
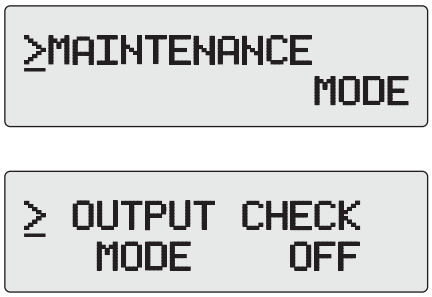
Step	Screen / Button	Procedure
1		Push the MODE button. The OPERATOR'S MODE screen appears for approximately two seconds followed by the DAMPING screen.
2		Use the DOWN or UP button to cycle through the screens until the AVERAGING screen appears.
3		Push the RIGHT SHIFT button once to move the cursor to OFF.
4		Push the DOWN or UP button to change the selection to ON. Then push the RIGHT SHIFT button until the cursor is at the value to be changed. (In the example, the button is pushed twice.)

Step	Screen / Button	Procedure
5		Use the DOWN or UP button to change the numerical value. The input value should be same as the fluid pulsation cycle. **Default setting:** 1.0 second **Setting range:** 1.0 to 30.0 seconds
6		Push the RIGHT SHIFT button until the cursor is back at the mode indicator.
7		Push the MODE button to return to MEASURING MODE to save the new value. **⚠ CAUTION** You must return to MEASURING MODE within ten minutes to save this new value before the system resets it to the previously saved value.

4-2-9 Selecting the ENGINEERING MODE

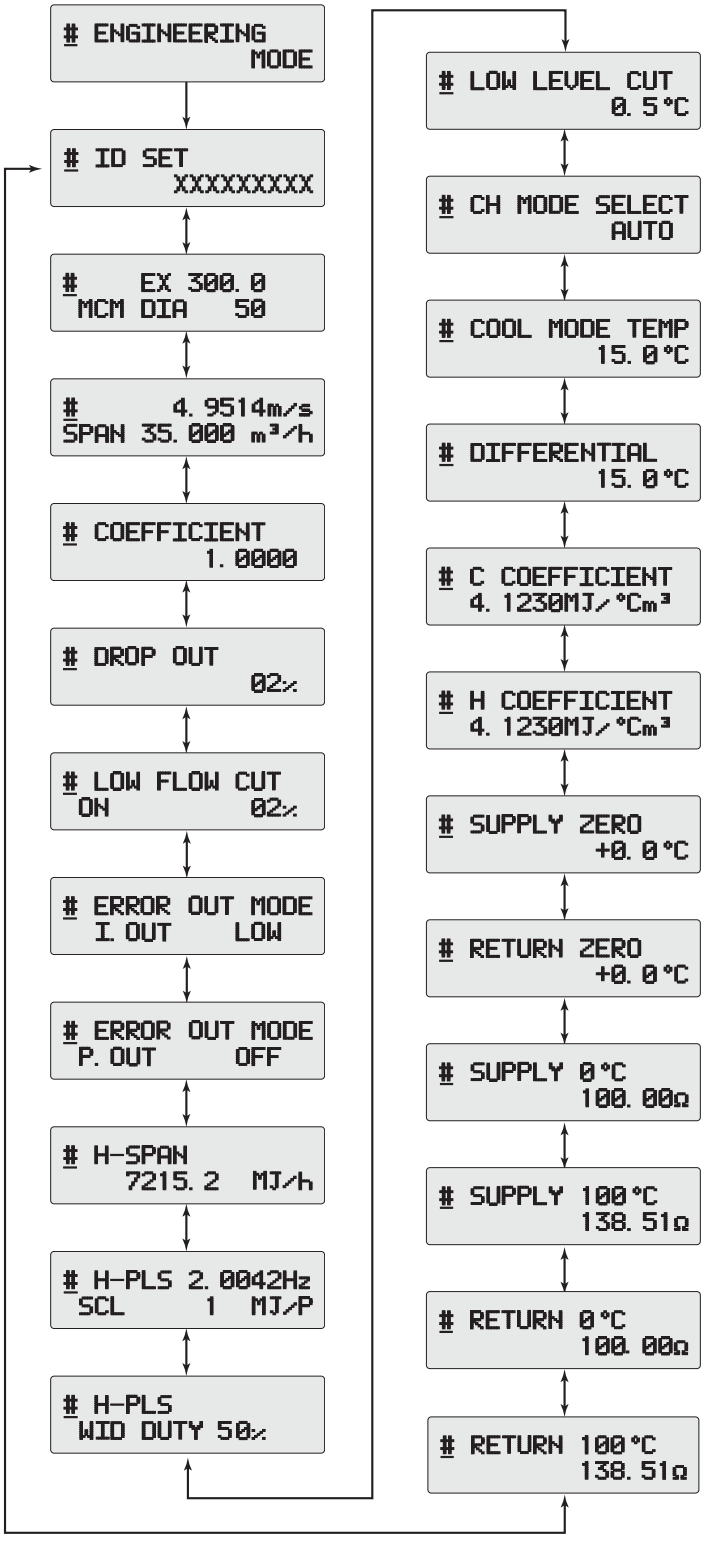
Step	Screen / Button	Procedure
1		Push the MODE button. The OPERATOR'S MODE screen appears for approximately two seconds followed by the DAMPING screen.
2		Use the DOWN or UP button to cycle through the screens until the MODE ENTER screen appears displaying ENGINEERING.
3		Push the RIGHT SHIFT button once to move the cursor to ENGINEERING.
4		Push the UP button to select.
5		The ENGINEERING MODE screen appears for approximately two seconds followed by the ID SET screen. Note that the mode indicator has changed to indicate ENGINEERING MODE (#). As long as the cursor remains under mode indicator, pushing the DOWN or UP button cycles through the screens available in this mode.

4-2-10 Selecting the MAINTENANCE MODE

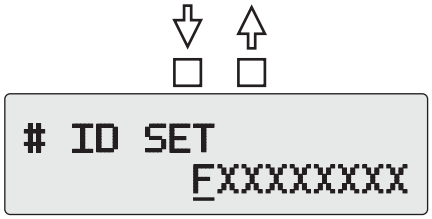
Step	Screen / Button	Procedure
1		Push the MODE button. The OPERATOR'S MODE screen appears for approximately two seconds followed by the DAMPING screen.
2		Use the DOWN or UP button to cycle through the screens until the MODE ENTER screen appears displaying MAINTENANCE.
3		Push the RIGHT SHIFT button once to move the cursor to MAINTENANCE.
4		Push the UP button to select.
5		The MAINTENANCE MODE screen appears for approximately two seconds followed by the OUTPUT CHECK screen. Note that the mode indicator has changed to indicate MAINTENANCE MODE (>). As long as the cursor remains under mode indicator, pushing the DOWN or UP button cycles through the screens available in this mode.

4-3 : Displaying the ENGINEERING MODE

4-3-1 LCD display flow (ENGINEERING MODE)

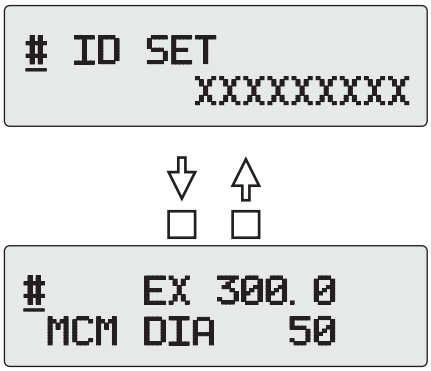


4-3-2 Setting the ID

Step	Screen / Button	Procedure
1		Enter ENGINEERING MODE (see 4-2-9). In ENGINEERIGN MODE, the ID SET screen is the first screen that appears.
2		Push the RIGHT SHIFT button until the cursor is at the character to be changed. **Default setting:** XXXXXXXX
3		Use the DOWN or UP button to change the character. Cycle through the following alphanumeric characters to select the required one: ABCDFEFGHIJKLMNOPQRST UVWXYZ (SPACE) - / . 0123456789
4		Use the RIGHT SHIFT button to choose another character and repeat step 3 and 4 until the entire ID number is set.
5		Push the RIGHT SHIFT button until the cursor is back at the mode indicator.
6		Push the MODE button to return to MEASURING MODE to save the new value. **⚠ CAUTION** You must return to MEASURING MODE within ten minutes to save this new value before the system resets it to the previously saved value.

4-3-3 Detector data set-up

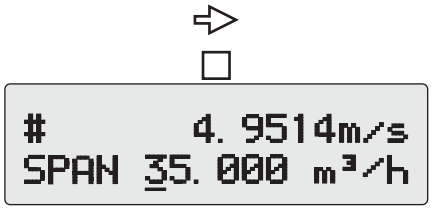
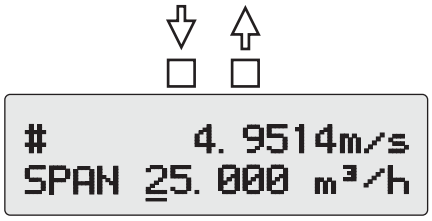
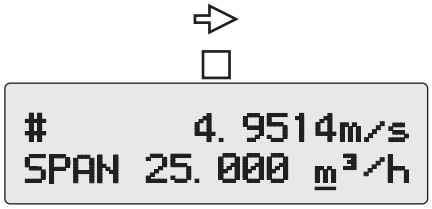
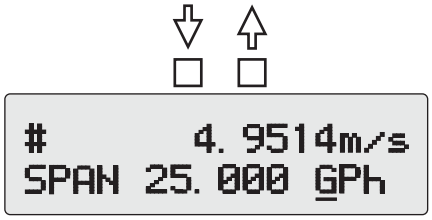
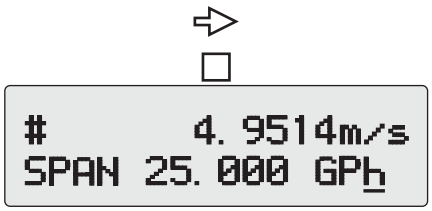
This function is to verify the detector data. In this screen, the Detector Diameter (DIA) can be checked. The detector data in this screen is fully calibrated in the factory. Make sure that no configuration in this screen is available.

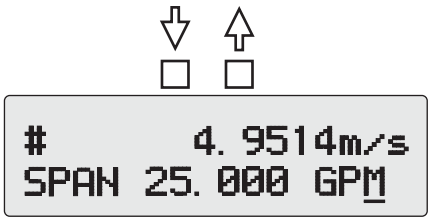
Step	Screen / Button	Procedure
1		Enter ENGINEERING MODE (see 4-2-9). (The first screen in this mode is always the ID SET screen.) Use DOWN or UP button to cycle through the screens until the DETECTOR DATA (EX/DIA) screen appears. Check if the detector diameter is the same size as you purchase.
2		Push the RIGHT SHIFT button until the cursor is back at the mode indicator.
3		Push the MODE button to return to MEASURING MODE.

4-3-4 Setting the flow rate range

This function is used to set the flow rate range (the value when the flow rate output reaches 100%). In this screen, three values can be changed:

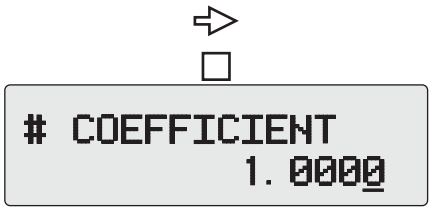
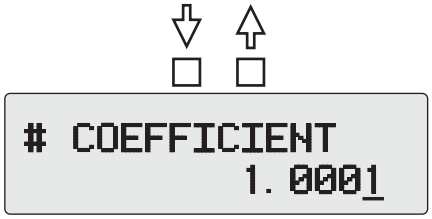
Flow rate value, flow rate unit and time unit.

Step	Screen / Button	Procedure
1		Enter ENGINEERING MODE (see 4-2-9). (The first screen in this mode is always the ID SET screen.) Use DOWN or UP button to cycle through the screens until the SPAN (range) screen appears.
2		Push the RIGHT SHIFT button until the cursor is at the flow rate value to be changed. Maximum flow rate range is the value that the flow velocity becomes 5.0000 m/s. **Default setting:** Refer to the default values table (see page A-2)
3		Push the DOWN or UP button to change the value.
4		Use the RIGHT SHIFT button to move the cursor to the flow rate unit.
5		Push the DOWN or UP button to change the unit. **Available units:** m3, l, cm3, GPH, kGPH, mGPH, BPH, IGPH, kIGPH, mIGPH
6		Use the RIGHT SHIFT button to move the cursor to the time unit.

Step	Screen / Button	Procedure
7		Push the DOWN or UP button to change the unit. **Available units:** h, min., s, d.
8		Push the RIGHT SHIFT button until the cursor is back at the mode indicator.
9		Push the MODE button to return to MEASURING MODE to save the new value. **⚠ CAUTION** You must return to MEASURING MODE within ten minutes to save this new value before the system resets it to the previously saved value.

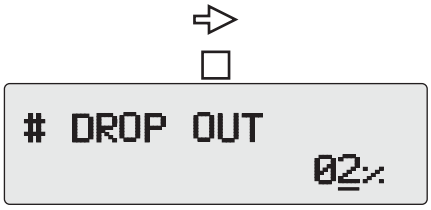
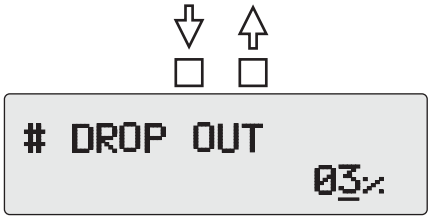
4-3-5 Setting the coefficient

This function changes the coefficient, which multiples the output flow rate in the main display.

Step	Screen / Button	Procedure
1		Enter ENGINEERING MODE (see 4-2-9). (The first screen in this mode is always the ID SET screen.) Use DOWN or UP button to cycle through the screens until the COEFFICIENT screen appears.
2		Push the RIGHT SHIFT button until the cursor is at the flow rate value to be changed. **Default setting:** 1.0000 **Setting range:** 0.1000 to 5.9999
3		Push the DOWN or UP button to change the value.
4		Push the RIGHT SHIFT button until the cursor is back at the mode indicator.
5		Push the MODE button to return to MEASURING MODE to save the new value. **⚠ CAUTION** You must return to MEASURING MODE within ten minutes to save this new value before the system resets it to the previously saved value.

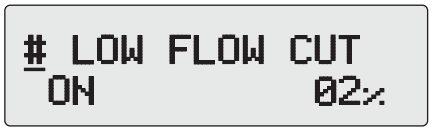
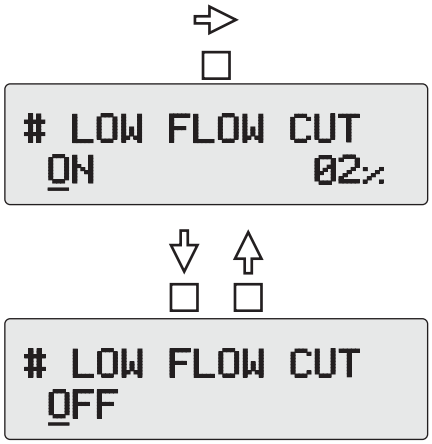
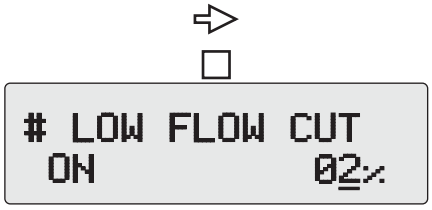
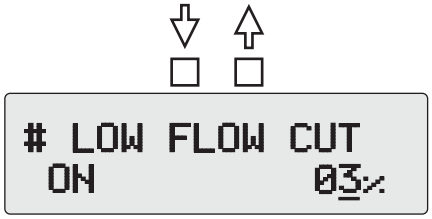
4-3-6 Setting the dropout value

This function is used to set the dropout value for the pulse output. The pulse output will be cut off at this point to avoid flow pulsation in range values close to zero, thus preventing incorrect totalization of the calorific value. Pulse counting pauses when the flow rate reaches this preset percentage of the set range.

Step	Screen / Button	Procedure
1		Enter ENGINEERING MODE (see 4-2-9). (The first screen in this mode is always the ID SET screen.) Use DOWN or UP button to cycle through the screens until the DROP OUT screen appears.
2		Push the RIGHT SHIFT button once to move the cursor to the DROP OUT value. **Default setting:** 02% **Setting range:** 0% to 10%
3		Push the DOWN or UP button to change the value.
4		Push the RIGHT SHIFT button until the cursor is back at the mode indicator.
5		Push the MODE button to return to MEASURING MODE to save the new value. **⚠ CAUTION** You must return to MEASURING MODE within ten minutes to save this new value before the system resets it to the previously saved value.

4-3-7 Setting the low flow cutoff

This function is used to set the low flow cutoff value. When the flow rate reaches the entered value, the current output is cutoff to avoid errors due to flow pulsation in range value close to zero.

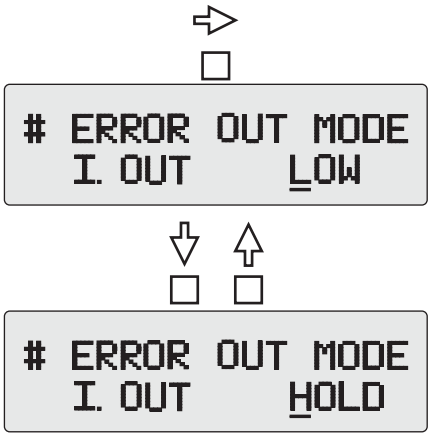
Step	Screen / Button	Procedure
1		Enter ENGINEERING MODE (see 4-2-9). (The first screen in this mode is always the ID SET screen.) Use DOWN or UP button to cycle through the screens until the LOW FLOW CUT screen appears.
2		If the low flow cutoff function is unnecessary, push the RIGHT SHIFT button once to move the cursor to ON. **Default setting:** ON Then push DOWN or UP button to change the selection to OFF.
3		In case of changing the low flow cutoff value, push the RIGHT SHIFT button once to move the cursor to the LOW FLOW CUT value. **Default setting:** 02% **Setting range:** 0% to 10%
4		Push the DOWN or UP button to change the value.
4		Push the RIGHT SHIFT button until the cursor is back at the mode indicator.
5		Push the MODE button to return to MEASURING MODE to save the new value. **⚠ CAUTION** You must return to MEASURING MODE within ten minutes to save this new value before the system resets it to the previously saved value.

4-3-8 Selecting failsafe mode for current output

This function is used to determine the analog output direction when the Electromagnetic Calorimeter detects a critical status condition.

⚠ CAUTION

The failsafe mode is very important for overall safety of the control process. Choose the failsafe direction carefully, as equipment damage can result from a wrong choice.

Step	Screen / Button	Procedure
1		Enter ENGINEERING MODE (see 4-2-9). (The first screen in this mode is always the ID SET screen.) Use DOWN or UP button to cycle through the screens until the ERROR OUT MODE screen appears displaying I.OUT.
2		Push the RIGHT SHIFT button once to move the cursor to LOW. **Default setting:** LOW **Available selection:** LOW, HOLD, HIGH Then push DOWN or UP button to change the selection.
3		Push the RIGHT SHIFT button until the cursor is back at the model indicator.
4		Push the MODE button to return to MEASURING MODE to save the new value. **⚠ CAUTION** You must return to MEASURING MODE within ten minutes to save this new value before the system resets it to the previously saved value.

4-3-9 Selecting failsafe mode for pulse output

This function is used to determine the pulse output direction when the Electromagnetic Calorimeter detects a critical status condition.

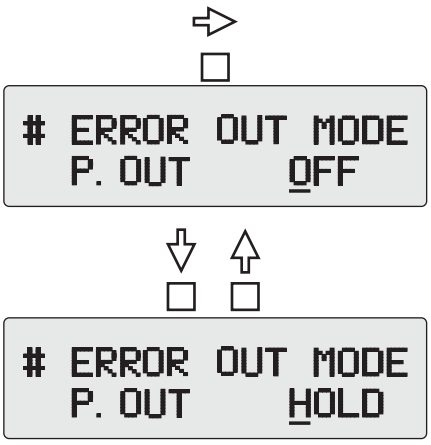
The following is pulse output direction of the failsafe mode.

OFF: Outputs no pulse

HOLD: Pulse output signal held at its present state.

⚠ CAUTION

The failsafe mode is very important for overall safety of the control process. Choose the failsafe direction carefully, as equipment damage can result from a wrong choice.

Step	Screen / Button	Procedure
1		Enter ENGINEERING MODE (see 4-2-9). (The first screen in this mode is always the ID SET screen.) Use DOWN or UP button to cycle through the screens until the ERROR OUT MODE screen appears displaying P.OUT.
2		Push the RIGHT SHIFT button once to move the cursor to OFF. **Default setting:** OFF **Available selection:** OFF, HOLD Then push DOWN or UP button to change the selection.
3		Push the RIGHT SHIFT button until the cursor is back at the mode indicator.
4		Push the MODE button to return to MEASURING MODE to save the new value. **⚠ CAUTION** You must return to MEASURING MODE within ten minutes to save this new value before the system resets it to the previously saved value.

4-3-10 Setting the calorific value range

This function is used to set the calorific value range.

The calorific value range is calculated by the following expression.

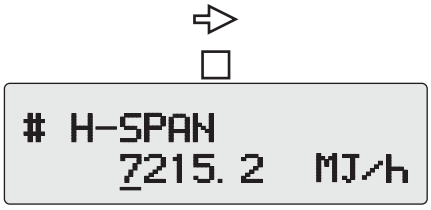
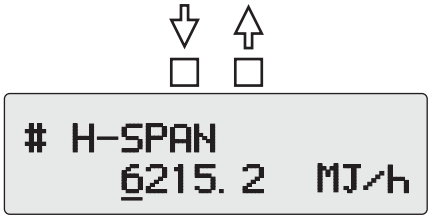
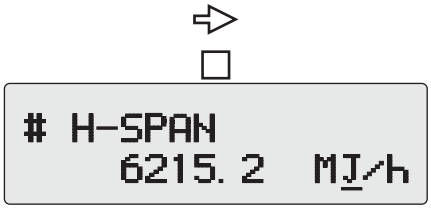
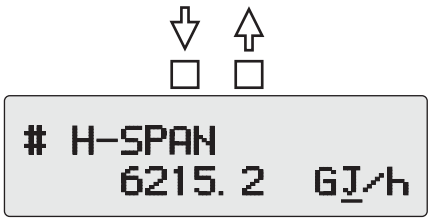
Calorific value range = (calorific value coefficient) × (max. temperature difference) × (max. flow rate)

If the measured fluid is water, this device has the calorific value coefficient of water as default (4.123 MJ/m3°C).

This value is used to determine the pulse output frequency based on the selected pulse scale. The pulse output frequency is calculated with the following expression.

Pulse output frequency (Hz) = (calorific value range) / (pulse scale × 3600)

In this screen, the following can be changed: calorific value and calorific value unit.

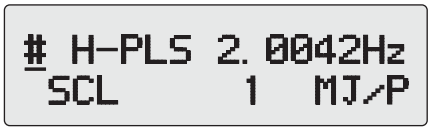
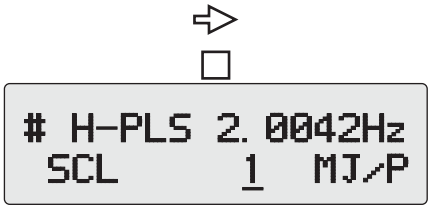
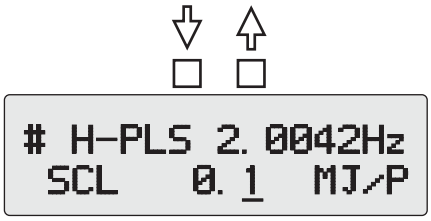
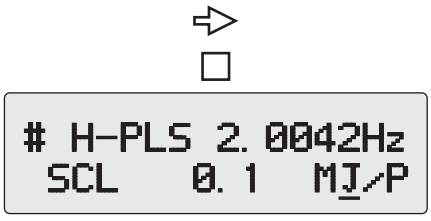
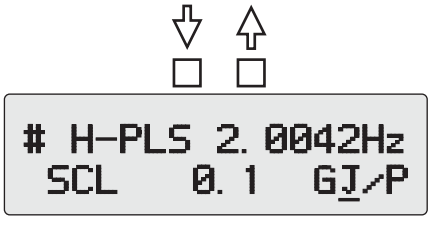
Step	Screen / Button	Procedure
1		Enter ENGINEERING MODE (see 4-2-9). (The first screen in this mode is always the ID SET screen.) Use DOWN or UP button to cycle through the screens until the H-SPAN screen appears.
2		Push the RIGHT SHIFT button until the cursor is at the H-SPAN value to be changed. **Default setting:** Refer to the default values table (see page A-2)
3		Push the DOWN or UP button to change the value.
4		Use the RIGHT SHIFT button to move the cursor to the calorific value unit.
5		Push the DOWN or UP button to change the unit. **Available units:** MJ/h, GJ/h, Mcal/h, Gcal/h, kBTU/h, MBTU/h.

Step	Screen / Button	Procedure
6	⇨ □	Push the RIGHT SHIFT button until the cursor is back at the mode indicator.
7	MODE □	Push the MODE button to return to MEASURING MODE to save the new value. ⚠ **CAUTION** You must return to MEASURING MODE within ten minutes to save this new value before the system resets it to the previously saved value.

4-3-11 Setting the pulse scale

This function is used to set the calorific value per pulse and associated units. The pulse scale should be set so that the frequency (shown in upper right of the auxiliary display) will not exceed 27.77 Hz and will not be below 0.0001 Hz.

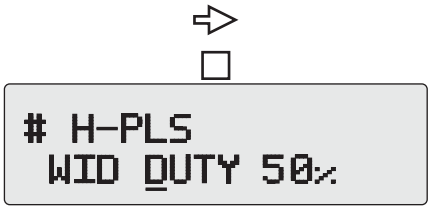
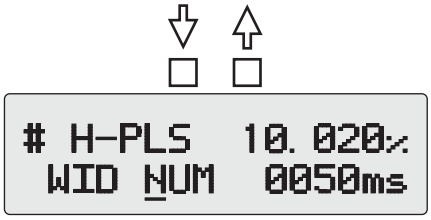
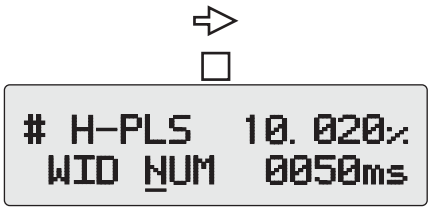
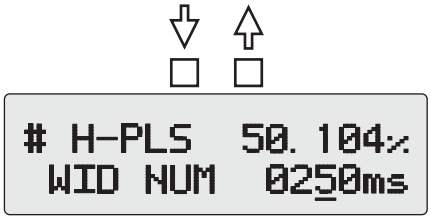
In this screen, the following can be changed: Pulse scale and calorific value unit.

Step	Screen / Button	Procedure
1		Enter ENGINEERING MODE (see 4-2-9). (The first screen in this mode is always the ID SET screen.) Use DOWN or UP button to cycle through the screens until the H-PLS screen appears displaying SCL.
2		Push the RIGHT SHIFT button once to move the cursor to the H-PLS scale value to be changed. **Available values:** 0.01, 0.1, 1
3		Push the DOWN or UP button to change the value.
4		Use the RIGHT SHIFT button to move the cursor to the calorific value unit.
5		Push the DOWN or UP button to change the unit. **Available units:** MJ/P, GP/J, Mcal/P, Gcal/P, kBTU/P, MBTU/P.
6		Push the RIGHT SHIFT button until the cursor is back at the mode indicator.

Step	Screen / Button	Procedure
7	MODE □	Push the MODE button to return to MEASURING MODE to save the new value. **⚠ CAUTION** You must return to MEASURING MODE within ten minutes to save this new value before the system resets it to the previously saved value.

4-3-12 Setting the pulse width

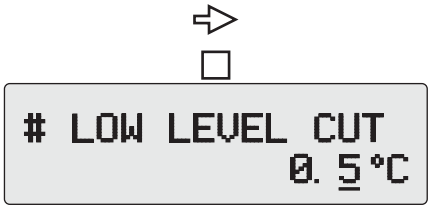
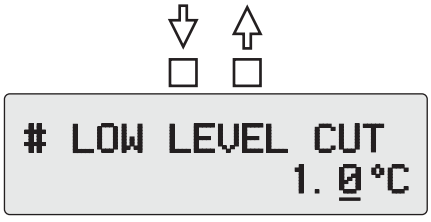
This function is used to set the pulse width for the pulse output. The pulse width determines the pulse duty ratio. The ratio basically defines the pulse ON time versus the pulse OFF time as a percentage of the total pulse cycle. For optimum pulse counting, the on or off pulse duty ration must not exceed 70%. (The duty ratio is displayed in the upper right of the auxiliary display.)

Step	Screen / Button	Procedure
1		Enter ENGINEERING MODE (see 4-2-9). (The first screen in this mode is always the ID SET screen.) Use DOWN or UP button to cycle through the screens until the H-PLS screen appears displaying WID.
2		Push the RIGHT SHIFT button once to move the cursor to the DUTY to change the selection of the pulse width. **Default setting:** DUTY 50%
3		Push the DOWN or UP button to change the selection to the numerical pulse width.
4		Push the RIGHT SHIFT button until the cursor is at the pulse width.
5		Push the DOWN or UP button to change the pulse width.
6		Push the RIGHT SHIFT button until the cursor is back at the mode indicator.

Step	Screen / Button	Procedure
7	MODE □	Push the MODE button to return to MEASURING MODE to save the new value. ⚠ **CAUTION** You must return to MEASURING MODE within ten minutes to save this new value before the system resets it to the previously saved value.

4-3-13 Setting the low level cutoff

This function is used to set the low level cutoff value for the temperature difference. The temperature difference will be fixed at zero at this point to avoid incorrect totalization of the calorific value. Thus pulse counting pauses when the temperature difference reaches this preset value.

Step	Screen / Button	Procedure
1		Enter ENGINEERING MODE (see 4-2-9). (The first screen in this mode is always the ID SET screen.) Use DOWN or UP button to cycle through the screens until the LOW LEVEL CUT screen appears.
2		Push the RIGHT SHIFT button until the cursor is at the value to be changed. **Default setting:** 0.5°C **Setting range:** 0.0°C to 9.9°C
3		Push the DOWN or UP button to change the value.
4		Push the RIGHT SHIFT button until the cursor is back at the mode indicator.
5		Push the MODE button to return to MEASURING MODE to save the new value. **⚠ CAUTION** You must return to MEASURING MODE within ten minutes to save this new value before the system resets it to the previously saved value.

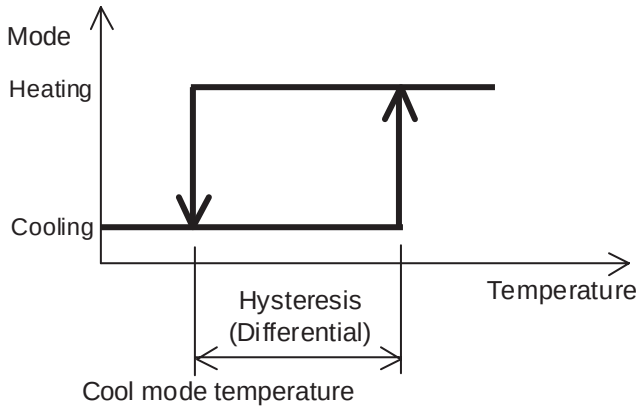
4-3-14 Selecting the calorific value measurement mode

This function is used to select the calorific value measurement mode, cooling, heating or automatic change mode. In the automatic change mode, the device determines the calorific value measurement mode automatically by monitoring temperature inputs.

Step	Screen / Button	Procedure
1	# CH MODE SELECT AUTO	Enter ENGINEERING MODE (see 4-2-9). (The first screen in this mode is always the ID SET screen.) Use DOWN or UP button to cycle through the screens until the CH MODE SELECT screen appears displaying AUTO.
2	⇨ □ # CH MODE SELECT AUTO	Push the RIGHT SHIFT button to move the cursor to AUTO. **Default setting:** AUTO **Setting range:** AUTO, COOL, HOT
3	⇩ ⇧ □ □ # CH MODE SELECT COOL	Push the DOWN or UP button to change the selection.
4	⇨ □	Push the RIGHT SHIFT button until the cursor is back at the mode indicator.
5	MODE □	Push the MODE button to return to MEASURING MODE to save the new value. **⚠ CAUTION** You must return to MEASURING MODE within ten minutes to save this new value before the system resets it to the previously saved value.

4-3-15 Setting the changeover temperature from heating mode to cooling mode

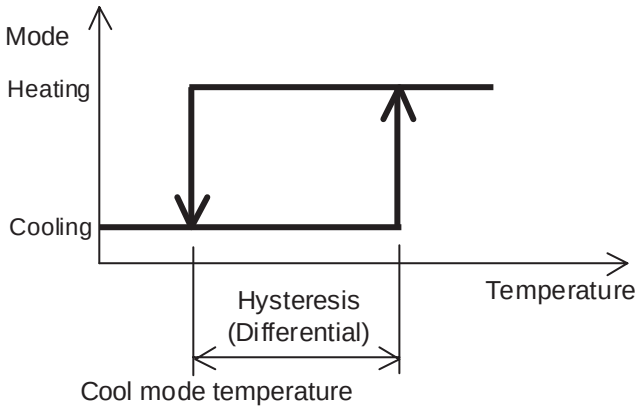
This function is used to set the changeover value to switch the calorific value measurement mode from heating to cooling by automatic change mode function. This value is set for supply temperature.



Step	Screen / Button	Procedure
1	# COOL MODE TEMP 15.0°C	Enter ENGINEERING MODE (see 4-2-9). (The first screen in this mode is always the ID SET screen.) Use DOWN or UP button to cycle through the screens until the COOL MODE TEMP screen appears.
2	⇨ □ # COOL MODE TEMP 15.0°C	Push the RIGHT SHIFT button until the cursor is at the COOL MODE TEMP value to be changed. **Default setting:** 15°C **Setting range:** 0.0°C to 99.9°C
3	⇩ ⇧ □ □ # COOL MODE TEMP 10.0°C	Push the DOWN or UP button to change the value.
4	⇨ □	Push the RIGHT SHIFT button until the cursor is back at the model indicator.
5	MODE □	Push the MODE button to return to MEASURING MODE to save the new value. ⚠ **CAUTION** You must return to MEASURING MODE within ten minutes to save this new value before the system resets it to the previously saved value.

4-3-16 Setting hysteresis (differential) of the automatic change mode

This function is used to set the hysteresis for the transfer point of the automatic mode change from cooling to heating. This value is set for supply temperature.



Step	Screen / Button	Procedure
1	# DIFFERENTIAL 15.0°C	Enter ENGINEERING MODE (see 4-2-9). (The first screen in this mode is always the ID SET screen.) Use DOWN or UP button to cycle through the screens until the DIFFERENTIAL screen appears.
2	⇨ □ # DIFFERENTIAL 15.0°C	Push the RIGHT SHIFT button until the cursor is at the DIFFERENTIAL value to be changed. **Default setting:** 15°C **Setting range:** 0.0°C to 99.9°C
3	⇩ ⇧ □ □ # DIFFERENTIAL 20.0°C	Push the DOWN or UP button to change the value.
4	⇨ □	Push the RIGHT SHIFT button until the cursor is back at the model indicator.
5	MODE □	Push the MODE button to return to MEASURING MODE to save the new value. **⚠ CAUTION** You must return to MEASURING MODE within ten minutes to save this new value before the system resets it to the previously saved value.

4-3-17 Setting the calorific value coefficient for cooling mode

This function is used to set or change the calorific value coefficient for cooling mode.

The calorific value coefficient for water is set in this device as the factory default value (4.123 MJ/°C m3).

If the fluid to be measured includes some brine or antifreeze material like ethylene glycol, calculate the calorific value coefficient with the following expression.

Calorific value coefficient = (Density) × (Specific heat)

Note that the unit of calorific value coefficient is MJ /m3°C. Calculate the calorific value coefficient of the fluid to be measured with the unit of MJ/°C m3.

Step	Screen / Button	Procedure
1	# C COEFFICIENT 4.1230MJ/°Cm³	Enter ENGINEERING MODE (see 4-2-9). (The first screen in this mode is always the ID SET screen.) Use DOWN or UP button to cycle through the screens until the C COEFFICIENT screen appears.
2	⇨ □ # C COEFFICIENT 4.1230MJ/°Cm³	Push the RIGHT SHIFT button until the cursor is at the C COEFFICIENT value to be changed. **Default setting:** 4.1230 MJ/°Cm3 **Setting range:** 0.1000 to 9.9999
3	⇩ ⇧ □ □ # C COEFFICIENT 4.5230MJ/°Cm³	Push the DOWN or UP button to change the value.
6	⇨ □	Push the RIGHT SHIFT button until the cursor is back at the model indicator.
5	MODE □	Push the MODE button to return to MEASURING MODE to save the new value. **⚠ CAUTION** You must return to MEASURING MODE within ten minutes to save this new value before the system resets it to the previously saved value.

4-3-18 Setting the calorific value coefficient for heating mode

This function is used to set or change the calorific value coefficient for heating mode.

The calorific value coefficient for water is set in this device as the factory default value (4.123 MJ/°C m3).

If the fluid to be measured includes some brine or antifreeze material like ethylene glycol, calculate the calorific value coefficient with the following expression.

Calorific value coefficient = (Density) × (Specific Heat)

Note that the unit of calorific value coefficient is MJ /m3°C. Calculate the calorific value coefficient of the fluid to be measured with the unit of MJ/°C m3.

Step	Screen / Button	Procedure
1	# H COEFFICIENT 4.1230MJ/°Cm³	Enter ENGINEERING MODE (see 4-2-9). (The first screen in this mode is always the ID SET screen.) Use DOWN or UP button to cycle through the screens until the H COEFFICIENT screen appears.
2	⇨ □ # H COEFFICIENT 4.1230MJ/°Cm³	Push the RIGHT SHIFT button until the cursor is at the H COEFFICIENT value to be changed. **Default setting:** 4.1230 MJ/°Cm3 **Setting range:** 0.1000 to 9.9999
3	⇩ ⇧ □ □ # H COEFFICIENT 4.5230MJ/°Cm³	Push the DOWN or UP button to change the value.
4	⇨ □	Push the RIGHT SHIFT button until the cursor is back at the model indicator.
5	MODE □	Push the MODE button to return to MEASURING MODE to save the new value. **⚠ CAUTION** You must return to MEASURING MODE within ten minutes to save this new value before the system resets it to the previously saved value.

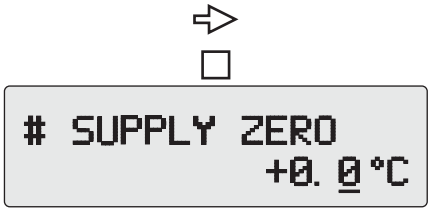
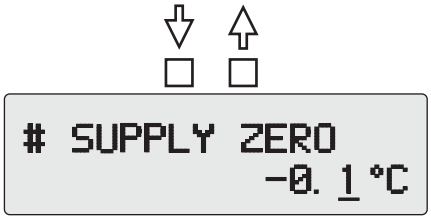
4-3-19 Adjusting the deviation between two temperature sensors (Adjustment for supply temperature sensor)

This function is used to adjust the deviation between supply and return temperature sensors connected to this device. This function is valuable if the resistances of the temperature sensor at 0°C and 100°C are unknown. **If the resistances of the temperature sensor at 0°C and 100°C are known, skip this section and see section 4-3-21 through 4-3-24 and follow the procedures.**

Put the two temperature sensors in water at room temperature. Check the supply temperature and the return temperature indicated on the display.

If the supply temperature sensor indicates +0.2°C higher value than return temperature sensor, refer to the following procedure for accurate calorific value measurement.

1) Input –0.2°C in the SUPPLY ZERO screen. (4-3-19) or
2) Input +0.2°C in the RETURN ZERO screen. (4-3-20) or
3) Input –0.1°C in the SUPPLY ZERO screen and input +0.1°C in the RETURN ZERO screen.

Step	Screen / Button	Procedure
1		Enter ENGINEERING MODE (see 4-2-9). (The first screen in this mode is always the ID SET screen.) Use DOWN or UP button to cycle through the screens until the SUPPLY ZERO screen appears.
2		Push the RIGHT SHIFT button until the cursor is at the SUPPLY ZERO value to be changed. **Default setting:** 0.0°C **Setting range:** -9.9°C to 9.9°C
3		Push the DOWN or UP button to change the value.
4		Push the RIGHT SHIFT button until the cursor is back at the model indicator.
5		Push the MODE button to return to MEASURING MODE to save the new value. **⚠ CAUTION** You must return to MEASURING MODE within ten minutes to save this new value before the system resets it to the previously saved value.

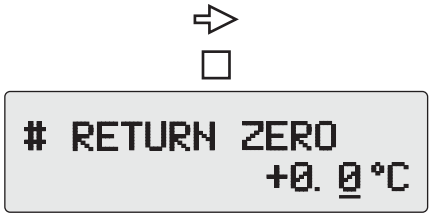
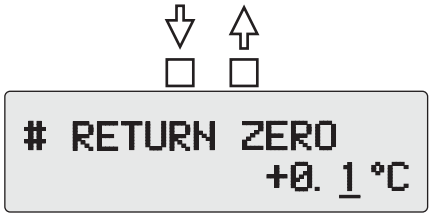
4-3-20 Adjusting the deviation between two temperature sensors (Adjustment for return temperature sensor)

This function is used to adjust the deviation between supply and return temperature sensors connected to this device. This function is valuable if the resistances of the temperature sensor at 0°C and 100°C are unknown. **If the resistances of the temperature sensor at 0°C and 100°C are known, skip this section and see section 4-3-21 through 4-3-24 and follow the procedures.**

Put the two temperature sensors in water at room temperature. Check the supply temperature and the return temperature indicated on the display.

If the supply temperature sensor indicates +0.2°C higher value than return temperature sensor, refer to the following procedure for accurate calorific value measurement.

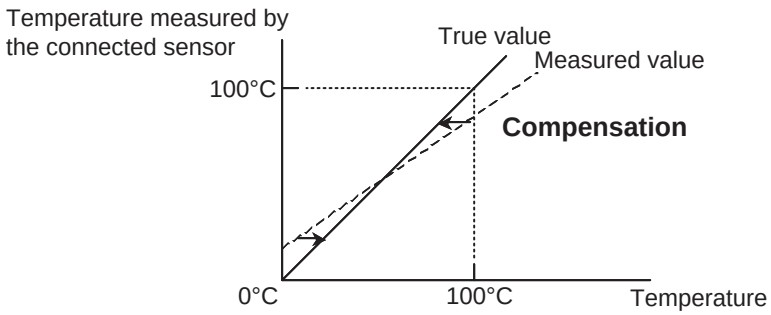
1) Input –0.2°C in the SUPPLY ZERO screen. (4-3-19) or
2) Input +0.2°C in the RETURN ZERO screen. (4-3-20) or
3) Input –0.1°C in the SUPPLY ZERO screen and input +0.1°C in the RETURN ZERO screen.

Step	Screen / Button	Procedure
1		Enter ENGINEERING MODE (see 4-2-9). (The first screen in this mode is always the ID SET screen.) Use DOWN or UP button to cycle through the screens until the RETURN ZERO screen appears.
2		Push the RIGHT SHIFT button until the cursor is at the RETURN ZERO value to be changed. **Default setting:** 0.0°C **Setting range:** -9.9°C to 9.9°C
3		Push the DOWN or UP button to change the value.
4		Push the RIGHT SHIFT button until the cursor is back at the model indicator.
5		Push the MODE button to return to MEASURING MODE to save the new value. **⚠ CAUTION** You must return to MEASURING MODE within ten minutes to save this new value before the system resets it to the previously saved value.

4-3-21 Setting resistance of supply temperature sensor at 0°C (Compensation)

This function is used to set the resistance of supply temperature sensor at 0°C. By setting the resistances of Pt 100 Ω temperature sensor at 0°C and 100°C, the tolerance of the supply temperature sensor is compensated.

Before setting the resistances, verify the temperature sensors are properly connected to this device. Check the temperature sensor resistances provided by the temperature sensor supplier.

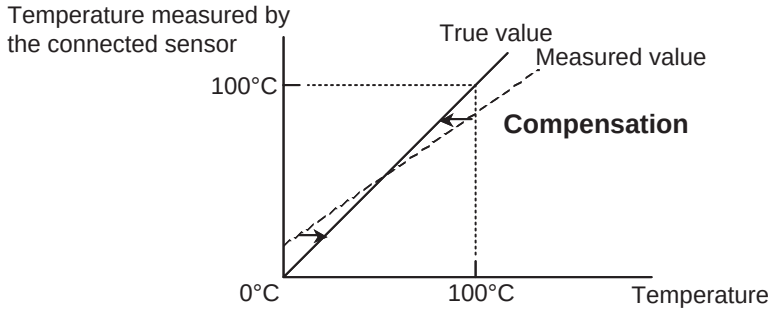


Step	Screen / Button	Procedure
1	# SUPPLY 0°C 100.00Ω	Enter ENGINEERING MODE (see 4-2-9). (The first screen in this mode is always the ID SET screen.) Use DOWN or UP button to cycle through the screens until the SUPPLY 0°C screen appears.
2	⇨ □ # SUPPLY 0°C 100.00Ω	Push the RIGHT SHIFT button until the cursor is at the resistance value to be changed. **Default setting:** 100.00 Ω **Setting range:** 90.00 Ω to 150.00 Ω
3	⇩ ⇧ □ □ # SUPPLY 0°C 099.90Ω	Push the DOWN or UP button to change the value.
4	⇨ □	Push the RIGHT SHIFT button until the cursor is back at the model indicator.
5	MODE □	Push the MODE button to return to MEASURING MODE to save the new value. ⚠ **CAUTION** You must return to MEASURING MODE within ten minutes to save this new value before the system resets it to the previously saved value.

4-3-22 Setting resistance of supply temperature sensor at 100°C (Compensation)

This function is used to set the resistance of supply temperature sensor at 100°C. By setting the resistances of Pt 100 Ω temperature sensor at 0°C and 100°C, the tolerance of the supply temperature sensor is compensated.

Before setting the resistances, verify the temperature sensors are properly connected to this device. Check the temperature sensor resistances provided by the temperature sensor supplier.



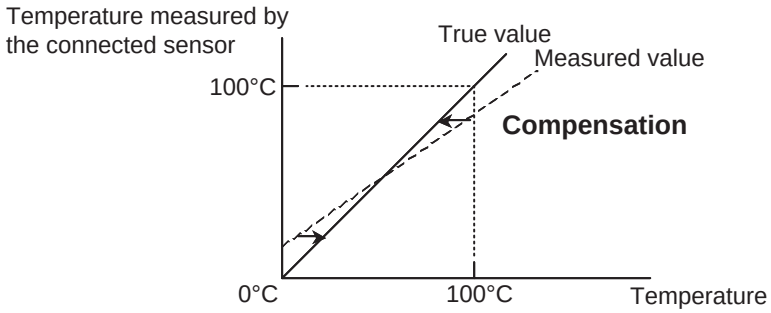
Step	Screen / Button	Procedure
1	# SUPPLY 100°C 138.51Ω	Enter ENGINEERING MODE (see 4-2-9). (The first screen in this mode is always the ID SET screen.) Use DOWN or UP button to cycle through the screens until the SUPPLY 100°C screen appears.
2	⇨ □ # SUPPLY 100°C 138.51Ω	Push the RIGHT SHIFT button until the cursor is at the resistance value to be changed. **Default setting:** 138.51 Ω **Setting range:** 90.00 Ω to 150.00 Ω
3	⇩ ⇧ □ □ # SUPPLY 100°C 138.53Ω	Push the DOWN or UP button to change the value.
4	⇨ □	Push the RIGHT SHIFT button until the cursor is back at the model indicator.
5	MODE □	Push the MODE button to return to MEASURING MODE to save the new value. **⚠ CAUTION** You must return to MEASURING MODE within ten minutes to save this new value before the system resets it to the previously saved value.

4-3-23 Setting resistance of return temperature sensor at 0°C (Compensation)

This function is used to set the resistance of return temperature sensor at 0°C.

By setting the resistances of Pt 100 Ω temperature sensor at 0°C and 100°C, the tolerance of the return temperature sensor is compensated.

Before setting the resistances, verify the temperature sensors are properly connected to this device. Check the temperature sensor resistances provided by the temperature sensor supplier.



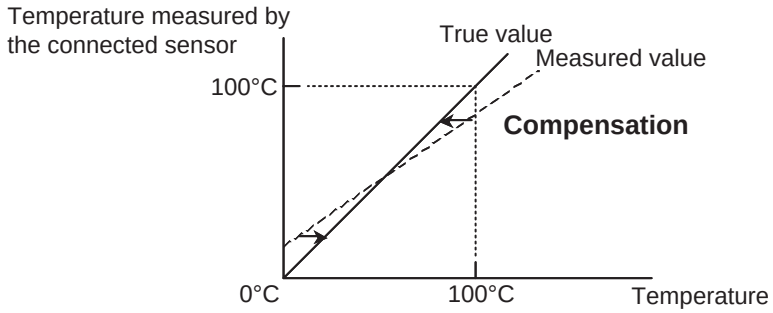
Step	Screen / Button	Procedure
1	# RETURN 0°C 100.00Ω	Enter ENGINEERING MODE (see 4-2-9). (The first screen in this mode is always the ID SET screen.) Use DOWN or UP button to cycle through the screens until the RETURN 0°C screen appears.
2	⇨ □ # RETURN 0°C 100.00Ω	Push the RIGHT SHIFT button until the cursor is at the resistance value to be changed. **Default setting:** 100.00 Ω **Setting range:** 90.00 Ω to 150.00 Ω
3	⇩ ⇧ □ □ # RETURN 0°C 099.90Ω	Push the DOWN or UP button to change the value.
4	⇨ □	Push the RIGHT SHIFT button until the cursor is back at the model indicator.
5	MODE □	Push the MODE button to return to MEASURING MODE to save the new value. **⚠ CAUTION** You must return to MEASURING MODE within ten minutes to save this new value before the system resets it to the previously saved value.

4-3-24 Setting resistance of return temperature sensor at 100°C (Compensation)

This function is used to set the resistance of return temperature sensor at 100°C.

By setting the resistances of Pt 100 Ω temperature sensor at 0°C and 100°C, the tolerance of the return temperature sensor is compensated.

Before setting the resistances, verify the temperature sensors are properly connected to this device. Check the temperature sensor resistances provided by the temperature sensor supplier.



Step	Screen / Button	Procedure
1	# RETURN 100°C 138.51Ω	Enter ENGINEERING MODE (see 4-2-9). (The first screen in this mode is always the ID SET screen.) Use DOWN or UP button to cycle through the screens until the RETURN 100°C screen appears.
2	⇨ □ # RETURN 100°C 138.51Ω	Push the RIGHT SHIFT button until the cursor is at the resistance value to be changed. **Default setting:** 138.51 Ω **Setting range:** 90.00 Ω to 150.00 Ω
3	⇩ ⇧ □ □ # RETURN 100°C 138.53Ω	Push the DOWN or UP button to change the value.
4	⇨ □	Push the RIGHT SHIFT button until the cursor is back at the model indicator.
5	MODE □	Push the MODE button to return to MEASURING MODE to save the new value. **⚠ CAUTION** You must return to MEASURING MODE within ten minutes to save this new value before the system resets it to the previously saved value.

Chapter 5 : Maintenance and Troubleshooting

Outline of this chapter

This chapter describes the maintenance and inspection procedures for the Electromagnetic Calorimeter and the information that should be referred to during troubleshooting.

First, this chapter explains the procedures used to check the converter functions. The items to be checked are as follows.

- Output signal loop check

  Analog output

  Pulse output (two outputs, one for cooling mode, the other for heating mode)

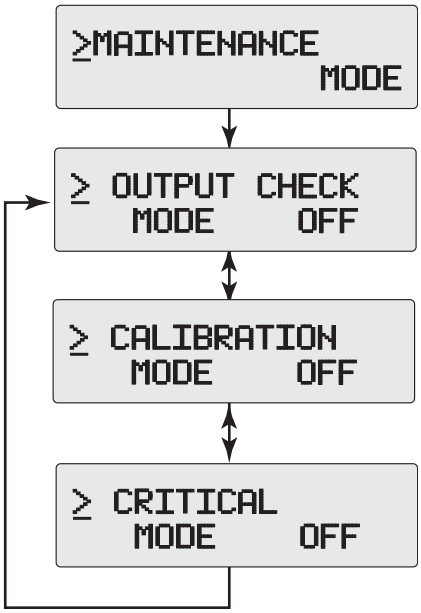
- Output signal calibration

  Analog output

These items serve to aid an early detection of the cause of abnormalities in converter operation.

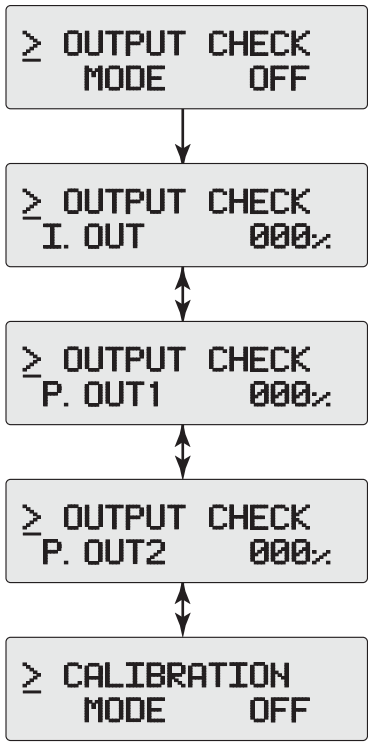
This chapter also explains the troubleshooting procedure and the shipping data recovery procedure.

5-1 : Displaying the MAINTENANCE MODE



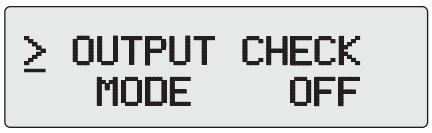
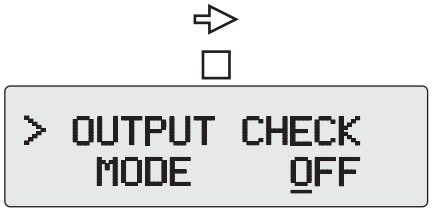
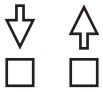
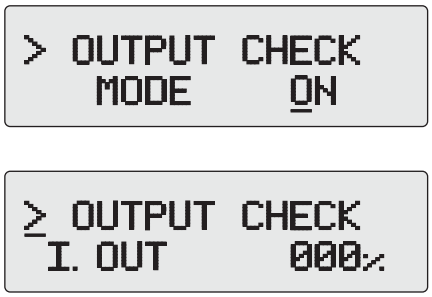
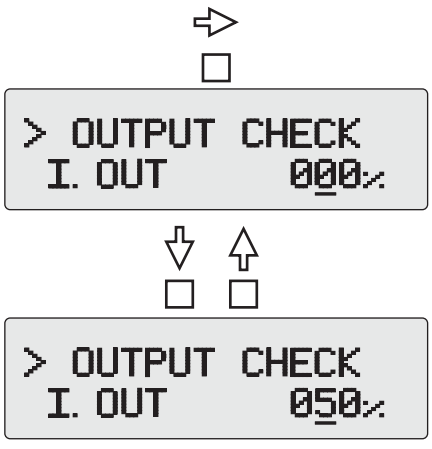
5-1-1 Displaying the OUTPUT CHECK MODE

5-1-1-1 LCD display flow



5-1-1-2 Analog output check

The analog output can be checked by using the Electromagnetic Calorimeter as a constant-current generator. Other instruments in the current output loop, such as recorders and controllers can be checked. Using the display board, you can instruct the Electromagnetic Calorimeter converter to change its output to values between 0 (4mA) to 100 (20mA) percent and maintain that output. This makes it easy to verify loop operation through accurate simulation of converter output signals before bringing the loop on line.

Step	Screen / Button	Procedure
1		Enter MAINTENANCE MODE (see 4-2-10). (The first screen in this mode is always the OUTPUT CHECK MODE screen.)
2		Push the RIGHT SHIFT button until the cursor is at OFF.
3		Push the DOWN or UP button to enter OUTPUT CHECK MODE.
4		The OUTPUT CHECK MODE ON screen appears for approximately two seconds followed by the OUTPUT CHECK screen displaying I.OUT.
5		Use the RIGHT SHIFT button until the cursor is at values to be changed. Use DOWN or UP button to change the value. Check the analog output loop.

Step	Screen / Button	Procedure
6	⇨ □	Push the RIGHT SHIFT button until the cursor is back at the mode indicator.
7	MODE □	Push the MODE button to return to MEASURING MODE. **⚠ CAUTION** The value set in this screen will not be saved as this is a function for the maintenance.

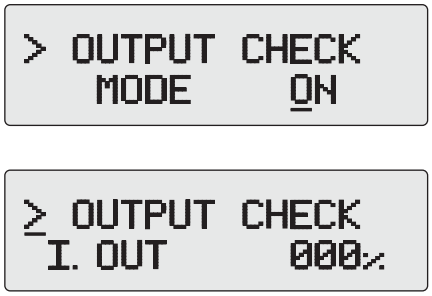
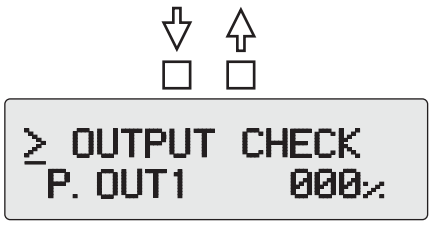
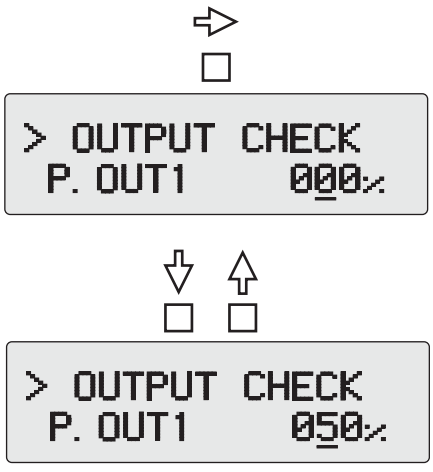
5-1-1-3 Pulse output check (Pulse output 1: Cooling mode)

The Electromagnetic Calorimeter can be used as a pulse generator simulate a pulse output to a counter.

You can instruct the Electromagnetic Calorimeter to change its pulse output to values between 0 to 100 percent.

⚠ CAUTION

If this function is turned ON, the built-in counter starts counting automatically. In order not to lose the totalized calorific value accumulated in the built-in counter, record the totalized calorific value before using this function. After the pulse out check, recover the totalized calorific value by using Counter Rest function (see 4-2-5).

Step	Screen / Button	Procedure
1		Enter OUTPUT CHECK MODE (see 5-1-1-2). (The first screen in this mode is always the OUTPUT CHECK MODE screen displaying I.OUT.)
2		Use the DOWN or UP button to cycle through the screens until the P.OUT 1 screen appears.
3		Push the RIGHT SHIFT button until the cursor is at values to be changed Use DOWN or UP button to change the value. Check the pulse output.
4		Push the RIGHT SHIFT button until the cursor is back at the mode indicator.

Step	Screen / Button	Procedure
5	MODE □	Push the MODE button to return to MEASURING MODE. **⚠ CAUTION** The value set in this screen will not be saved as this is a function for the maintenance.

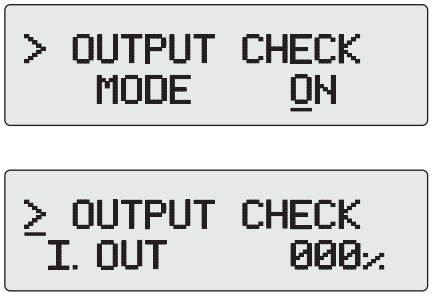
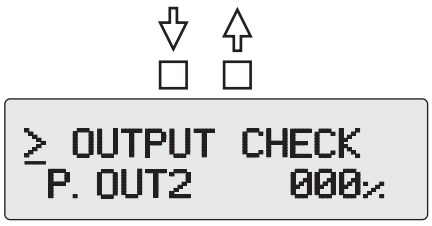
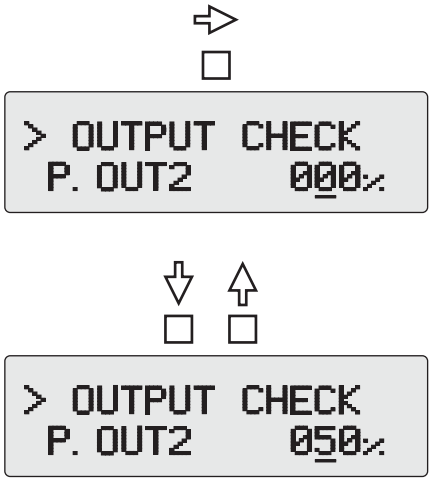
5-1-1-4 Pulse output check (Pulse output 2: Heating mode)

The Electromagnetic Calorimeter can be used as a pulse generator simulate a pulse output to a counter.

You can instruct the Electromagnetic Calorimeter to change its pulse output to values between 0 to 100 percent.

⚠ CAUTION

If this function is turned ON, the built-in counter starts counting automatically. In order not to lose the totalized calorific value accumulated in the built-in counter, record the totalized calorific value before using this function. After the pulse out check, recover the totalized calorific value by using Counter Rest function (see 4-2-5).

Step	Screen / Button	Procedure
1		Enter OUTPUT CHECK MODE (see 5-1-1-2). (The first screen in this mode is always the OUTPUT CHECK MODE screen displaying I.OUT.)
2		Use the DOWN or UP button to cycle through the screens until the P.OUT 2 screen appears.
3		Push the RIGHT SHIFT button until the cursor is at values to be changed. Use DOWN or UP button to change the value. Check the pulse output.

Step	Screen / Button	Procedure
4	⇨ □	Push the RIGHT SHIFT button until the cursor is back at the mode indicator.
5	MODE □	Push the MODE button to return to MEASURING MODE. **⚠ CAUTION** The value set in this screen will not be saved as this is a function for the maintenance.

5-1-2 Displaying the CALIBRATION MODE

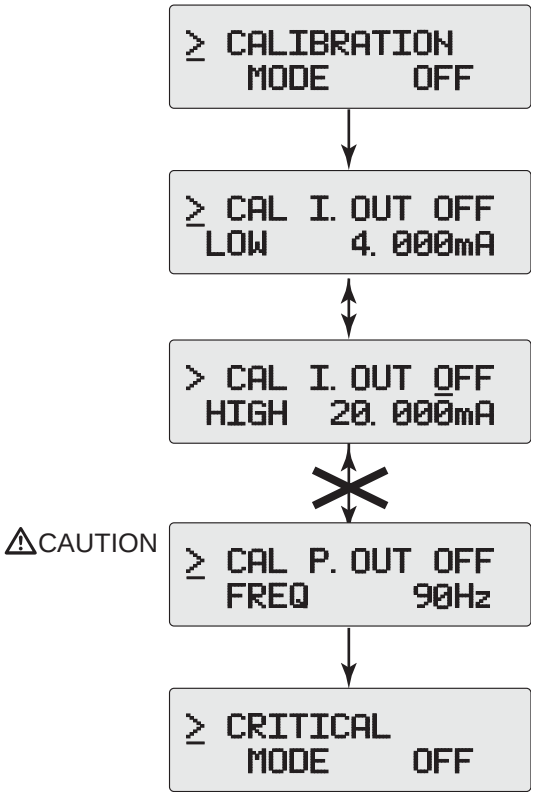
Calibration summary

The Electromagnetic Calorimeter does not typically require recalibration at periodical intervals to maintain accuracy. If you think the Electromagnetic Calorimeter needs recalibration, follow the procedures described in this section.

This section contains the following calibration factors.

- Analog Output Calibration: 4mA
- Analog Output Calibration: 20mA
- Pulse Output Calibration

5-1-2-1 LCD displaying flow



⚠ CAUTION

CAL P.OUT function is only for Yamatake service/maintenance specialist.

Please do not enter this screen.

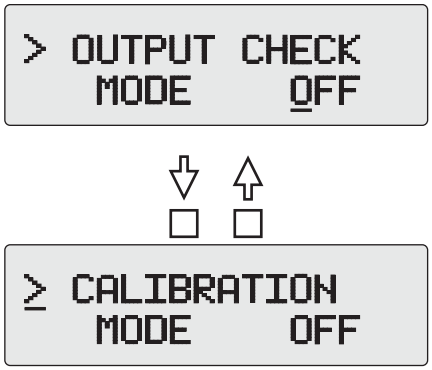
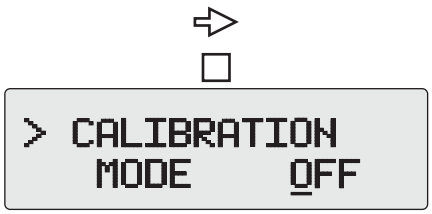
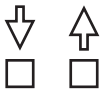
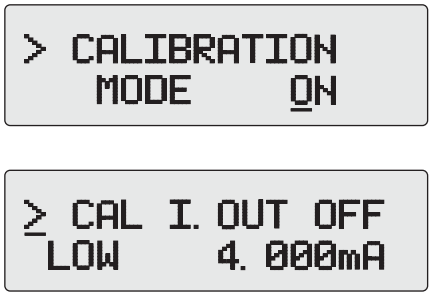
If this function is turned ON, the built-in counter starts counting automatically. In order not to lose the totalized calorific value accumulated in the built-in counter, record the totalized calorific value before using this function. After the pulse out check, recover the totalized calorific value by using Counter Rest function (see 4-2-5).

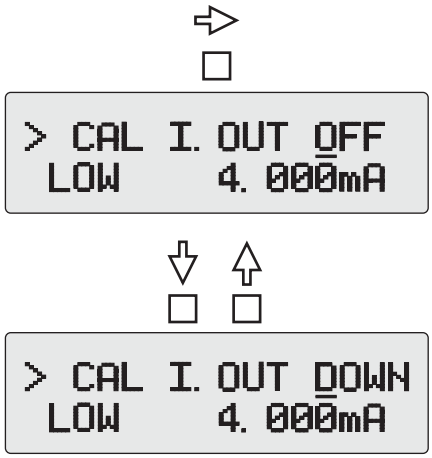
5-1-2-2 Analog output calibration (I.OUT LOW)

You can verify (calibrate) the Electromagnetic Calorimeter's analog output at its 0 and 100% levels by using the Electromagnetic Calorimeter in its Output Check mode (5-1-1-2).

Before the analog output calibration, prepare a precision milliammeter or voltmeter (0.03% accuracy or better).

Connect the a precision milliammeter or voltmeter to the analog output terminal to check readings.

Step	Screen / Button	Procedure
1		Enter MAINTENANCE MODE (see 4-2-10). (The first screen in this mode is always the OUTPUT CHECK MODE screen.) Use the DOWN or UP button to cycle through the screens until the CALIBRATION MODE screen appears.
2		Push the RIGHT SHIFT button once to move the cursor to OFF.
3		Push DOWN or UP button enter CALIBRATION MODE.
4		The CALIBRATION MODE ON screen appears for approximately two seconds followed by the CAL I.OUT screen displaying LOW.

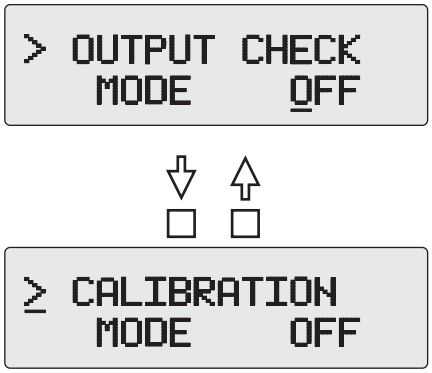
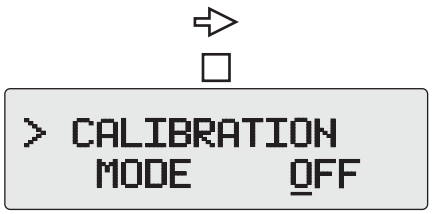
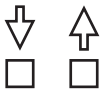
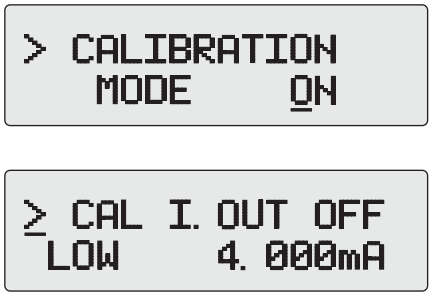
Step	Screen / Button	Procedure
5		Push the RIGHT SHIFT button once to move the cursor to OFF. Check the readings of the milliammeter or voltmeter. If you think the I.OUT LOW value needs calibration, adjust I.OUT LOW value by pushing DOWN or UP button. The DOWN button decrements the output. The UP button increments the output.
6		Push the RIGHT SHIFT button until the cursor is back at the mode indicator.
7	MODE □	Push the MODE button to return to MEASURING MODE. **⚠ CAUTION** You must return to MEASURING MODE within ten minutes to save this new value before the system resets it to the previously saved value.

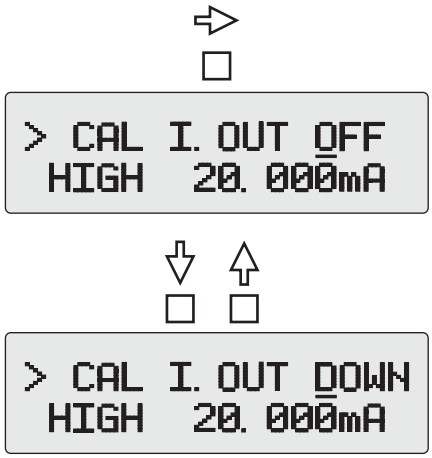
5-1-2-3 Analog output calibration (I.OUT HIGH)

You can verify (calibrate) the Electromagnetic Calorimeter's analog output at its 0 and 100% levels by using the Electromagnetic Calorimeter in its Output Check mode (5-1-1-2).

Before the analog output calibration, prepare a precision milliammeter or voltmeter (0.03% accuracy or better).

Connect the a precision milliammeter or voltmeter to the analog output terminal to check readings.

Step	Screen / Button	Procedure
1		Enter MAINTENANCE MODE (see 4-2-10). (The first screen in this mode is always the OUTPUT CHECK MODE screen.) Use the DOWN or UP button to cycle through the screens until the CALIBRATION MODE screen appears.
2		Push the RIGHT SHIFT button once to move the cursor to OFF.
3		Push DOWN or UP button enter CALIBRATION MODE.
4		The CALIBRATION MODE ON screen appears for approximately two seconds followed by the CAL I.OUT screen displaying LOW.
5		Push the UP button once to move the cursor to the CAL I.OUT HIGH screen.

Step	Screen / Button	Procedure
6		Push the RIGHT SHIFT button once to move the cursor to OFF. Check the readings of the milliammeter or voltmeter. If you think the I.OUT HIGH value needs calibration, adjust the I.OUT HIGH value by pushing DOWN or UP button. The DOWN button decrements the output. The UP button increments the output.
7		Push the RIGHT SHIFT button until the cursor is back at the mode indicator.
8	MODE	Push the MODE button to return to MEASURING MODE. **⚠ CAUTION** You must return to MEASURING MODE within ten minutes to save this new value before the system resets it to the previously saved value.

5-1-2-4 Pulse output calibration

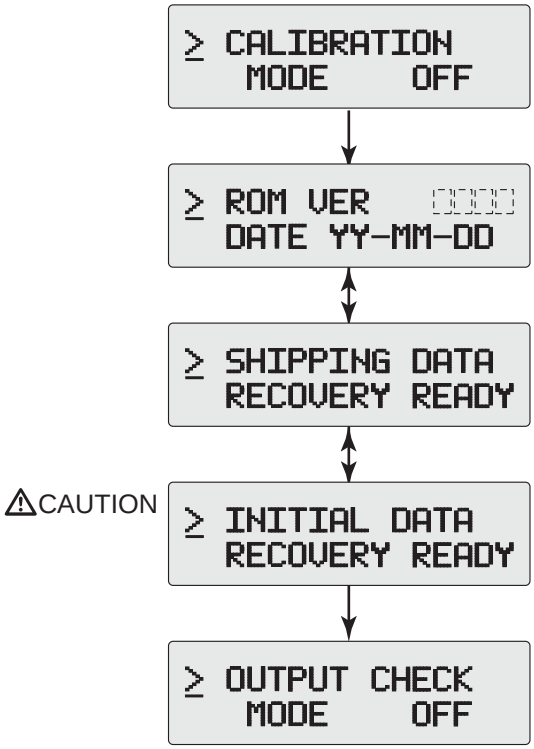
⚠ CAUTION

This function is only for Yamatake service/maintenance specialist. Please do not enter this screen.

If this function is turned ON, the built-in counter starts counting automatically. In order not to lose the totalized calorific value accumulated in the built-in counter, record the totalized calorific value before using this function. After the pulse out check, recover the totalized calorific value by using Counter Rest function (see 4-2-5).

5-1-3 Displaying the CRITICAL MODE

5-1-3-1 LCD display flow



⚠ CATUION

INITIAL DATA RECOVERY function is only for Yamatake service/maintenance specialist.

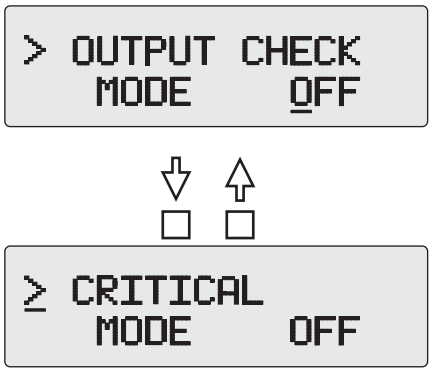
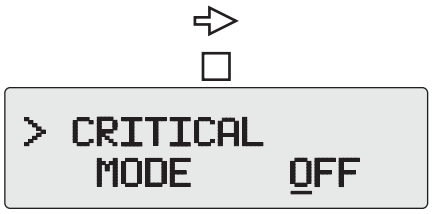
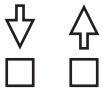
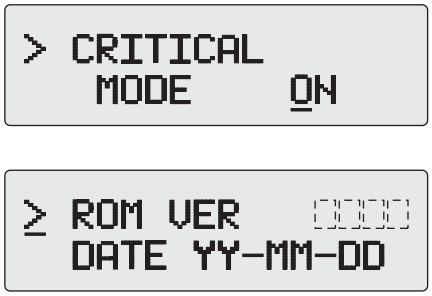
Please do not use this function.

If this function is turned ON, all calibrated data will be missing. The device needs to be back to the factory to calibrate again.

5-1-3-2 Verifying ROM version

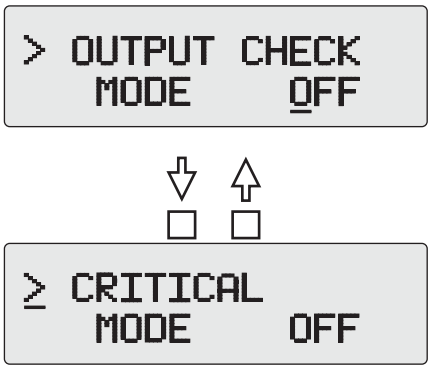
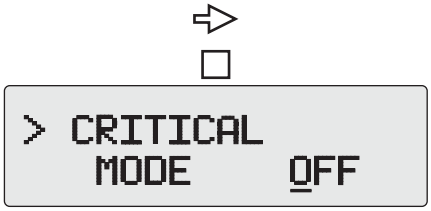
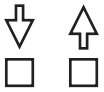
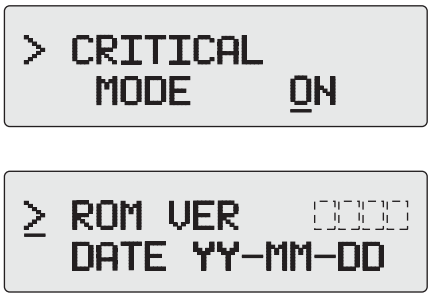
You can verify the ROM version of the Electromagnetic Calorimeter.

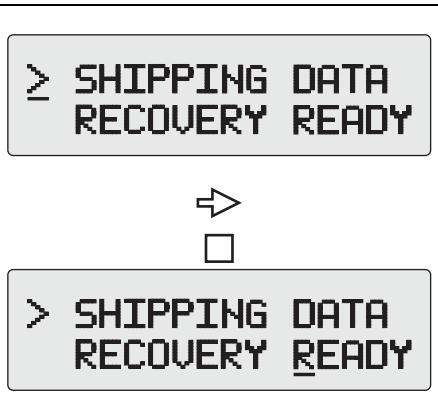
No configuration is available in this screen.

Step	Screen / Button	Procedure
1		Enter MAINTENANCE MODE (see 4-2-10). (The first screen in this mode is always the OUTPUT CHECK MODE screen.) Use the DOWN or UP button to cycle through the screens until the CRITICAL MODE screen appears.
2		Push the RIGHT SHIFT button once to move the cursor to OFF.
3		Push DOWN or UP button enter CRITICAL MODE.
4		The CRITICAL MODE ON screen appears for approximately two seconds followed by the ROM VERSION screen. Check the ROM version and its date.
5		Push the RIGHT SHIFT button until the cursor is back at the mode indicator.
6		Push the MODE button to return to MEASURING MODE.

5-1-3-3 Shipping data recovery

You can return the Electromagnetic Calorimeter to factory settings/default values for pertinent operational and configuration parameters. These parameters are entered before the unit is shipped, so they are commonly referred to as “shipping data”. They include factory calibration data and factory settings or initial default settings for customer configuration data.

Step	Screen / Button	Procedure
1		Enter MAINTENANCE MODE (see 4-2-10). (The first screen in this mode is always the OUTPUT CHECK MODE screen.) Use the DOWN or UP button to cycle through the screens until the CRITICAL MODE screen appears.
2		Push the RIGHT SHIFT button once to move the cursor to OFF.
3		Push DOWN or UP button enter CRITICAL MODE.
4		The CRITICAL MODE ON screen appears for approximately two seconds followed by the ROM VERSION screen.
5		Push the UP button once to move the cursor to the SHIPPING DATA RECOVERY screen.

Step	Screen / Button	Procedure
6		Push the RIGHT SHIFT button to move the cursor to the READY.
7		Push the UP button to start the SHIPPING DATEA RECOVERY.
8		Push the RIGHT SHIFT button until the cursor is back at the mode indicator.
9		Push the MODE button to return to MEASURING MODE.

5-1-3-4 Initial data recovery

⚠ CAUTION

INITIAL DATA RECOVERY function is only for Yamatake service/maintenance specialist.

Please do not use this function.

If this function is turned ON, all calibrated data will be missing. The device needs to be back to the factory to calibrate again.

5-2 : Troubleshooting

Overview

Introduction

If a problem occurs at Electromagnetic Calorimeter start-up and operation, the following three causes should be considered:

- Inconsistency between the Electromagnetic Calorimeter's specifications and the actual operating conditions
- Missetting or misoperation
- Electromagnetic Calorimeter malfunction

If a problem occurs during operation, the device's self-diagnostic function will classify it as critical or non-critical. It will indicate this and respond accordingly.

Perform the proper correction measures, referring to the troubleshooting guidelines described in this section.

Critical failures

Critical problems may obstruct Electromagnetic Calorimeter operation, if not corrected, ultimately damage the calorimeter. When critical trouble occurs during Electromagnetic Calorimeter operation, an error message will appear on the converter's display panel and the calorimeter will continue to output the preset value in the abnormality treatment (fail-safe) direction. The error message and the self-diagnostic results will be visible on the display panel.

Example:

CPU CHECK ERROR: This massage appears if the ROM or RAM is in abnormal condition.

Non-critical failures

Non-critical problems will not seriously affect Electromagnetic Calorimeter operation. When an error occurs during Electromagnetic Calorimeter operation and is regarded as a non-critical problem by the converter self-diagnostics, the output will not burn-out and the Electromagnetic Calorimeter will continue to output the measured value.

Errors at Start-up

Troubleshooting

When a problem occurs at start-up, perform the following procedures. If the problem remains, it is possible that the Electromagnetic Calorimeter has been damaged. Contact your Yamatake representative.

Trouble	Check points and treatment
No indication on display panel at power-up	• Check the converter power supply specification. • Make sure the ambient temperature is not below 0°C (32°F)
No output at power-up	• Verify the signal line is correctly connected.
No pulse output	• Verify the pulse output line is correctly connected.

Errors during operation

Troubleshooting

When a problem occurs during operation, perform the following procedures:

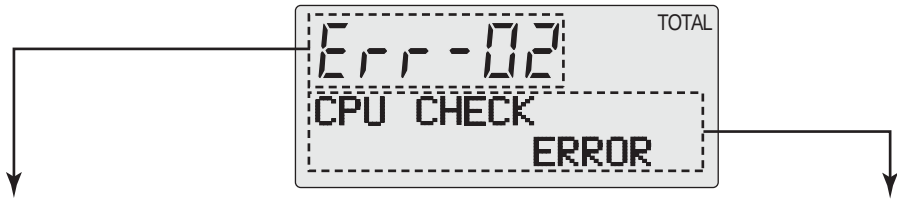
1. Check against the table on this page for symptoms of the error. If found, perform the steps indicated in the table.
2. When the problem cannot be solved, it is possible that the Electromagnetic Calorimeter has been damaged. Contact your Yamatake representative.

Trouble	Check points and treatment
Output fluctuates excessively beyond the estimated flow rate range	• Verify the Electromagnetic Calorimeter is correctly grounded. • Verify the damping time constant is set correctly. • Clean the electrodes.
Output exceeds 100%	• Verify the range is set correctly. • Verify the zero point is correctly adjusted. • Verify the converter is correctly calibrated. • Verify the converter is not in the constant current mode.
Output remains 0%	• Verify the pipe is not empty. If it is empty, the empty detection function will be operating. • Verify the signal line is correctly connected. • Verify the valves are open on the upstream and downstream sides. • Verify the converter is not in the constant current mode. • Verify the flow rate is not in the low-flow cutoff range.
Output has burnt out	• Refer to “Error messages and counter measures (display)” to perform measures.
Pulse output is too large or too small for the calorific value	• Verify the pulse scale and width are set correctly. • Verify the converter is correctly calibrated. • Verify the pulse counter specification is proper. • Verify the drop-out value is correctly set between 0 and 10%.

Error messages and counter measures (display)

Hardware check

Hardware check is executed in the MEASURING MODE. Perform the proper counter measures immediately. While an error code (Err-02 to Err-08) is being displayed, the output will be the value as preset in the ENGINEERING MODE.



Error code	Error contents	Solution	LCD display
Err-02	ROM or RAM is faulty.	1. Restore power	CPU CHECK ERROR
Err-04	Non-volatile memory is faulty.	1. Restore power	NVM CHECK ERROR
Err-05	Analog / digital converter is not operating properly.	1. Restore power	ADC CHECK ERROR
Err-06	Power supply voltage is too low.	1. Check the power supply voltage.	POWER DOWN ERROR
Err-07	Supply temperature sensor is faulty.	1. Restore power 2. Check if the supply temperature sensor wiring is correct. 3. Replace the supply temperature sensor.	SUPPLY SENSOR ERROR
Err-08	Return temperature sensor is faulty.	1. Restore power 2. Check if the return temperature sensor wiring is correct. 3. Replace the return temperature sensor.	RETURN SENSOR ERROR

Checking for mis-setting

Missetting diagnostics are executed in the ENGINEERING MODE.

When a setting is incorrect, the error will be displayed for one second and then the incorrectly-set screen will appear.

(To view the error contents again, press the MODE button.)

Press the MODE button and the data will return to the status obtaining before entering the ENGINEERING MODE.

Error codes for non-critical failures

Error code	Error contents	Solution	LCD display
Err-11	Mismatch of diameter and detector type.	1. Check diameter and detector and enter proper data	TYPE-DIA ERROR
Err-21	Span setting of 6 m/s or more	1. Check the SPAN, DIA, TYPE setting.	SPAN ERROR OVER 6 m/s
Err-31	Built-in counter will be overflowed in 1,000 hours.	1. Check pulse scale 2. calorific value range and 3. unify the unit.	COUNTER OVERFLOW IN 1000h
Err-32	Pulse frequency too large or too small. Until for span is different from that of pulse's. Example: Span MJ/h Pulse MBTU/P	1. Check pulse scale, and 2. pulse frequency settings. 3. unify the unit.	PULSE WEIGHT SETTING ERROR
Err-33	Pulse width too large. DUTY 70% or more at pulse frequency output	1. Check pulse width 2. pulse scale, and 3. span setting	PULSE SPAN OVER DUTY

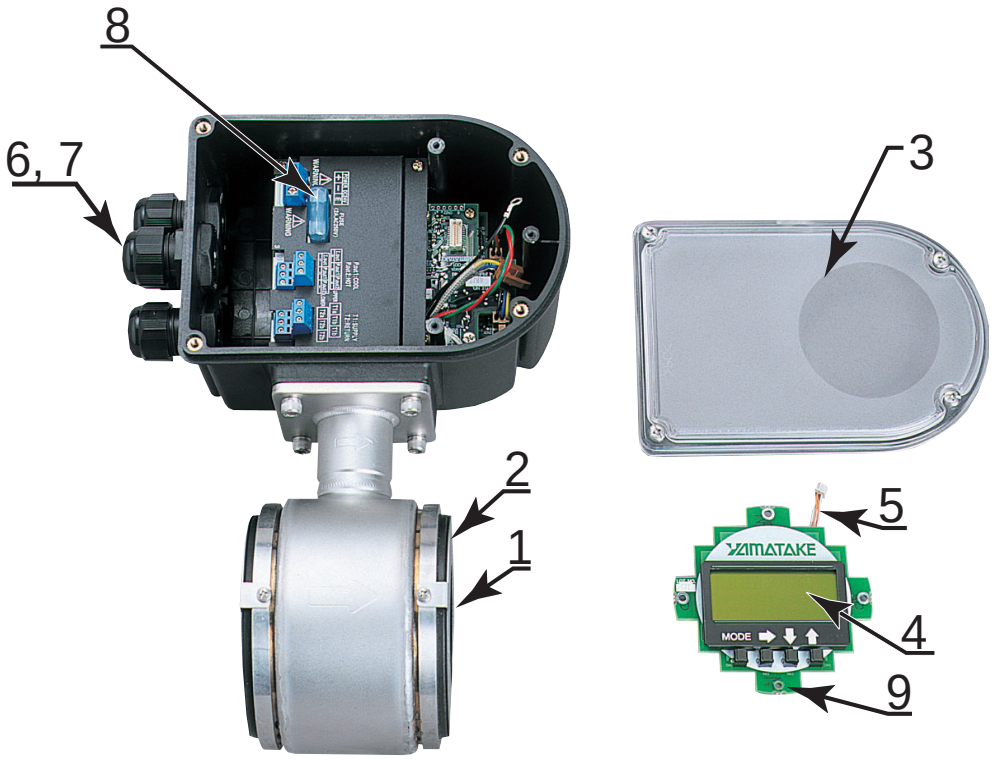
Message without error code

The messages described in this section are non-critical error caused by the process / environment. Check the process / environment as mentioned below:

Screen	Description
OVER LIMIT AUTO ZERO ERROR	Flow speed is over +/-0.2m/s. Check the measured fluid stands still.
OVER LIMIT +/- 115.0%	The flow rate is +/-115% or over against the setting flow range. Check the setting flow range, i.e. flow rate value and flow rate unit.
EMPTY STATUS	The flowtube is empty. Check the flowtube is filled with the measured fluid.
NOT CALIBRATED	The Electromagnetic Calorimeter is not calibrated. This message appears when Initial Recovery function is used. Use Shipping Data Recovery function so that the device recovers the factory default settings.
TEMP DIFFERENCE UNDER -0.5°C	Configuration mismatch between the temperature difference and the calorific value measurement mode (cooling/heating). Check if the supply temperature sensor is connected to the return temperature sensor input terminal. Check the calorific value measurement mode Selection is correctly made.
REVERSE FLOW UNDER -10.0%	The Electromagnetic Calorimeter measures reverse flow. Check if the device is installed correctly to meet the measured fluid flow direction. Check if the measured fluid flows backward.
OVER LIMIT HEAT 115.0%	The instantaneous calorific value is 115% or over against the setting calorific value range. Check the setting calorific value range, i.e. calorific value and calorific value unit.

Appendix

Model MCM10A Electromagnetic Calorimeter replacement parts



No.	Name	Part number	Necessary numbers for one unit
1	Grounding ring for 25mm	80382724-001	2
	Grounding ring for 40mm	80382725-001	2
	Grounding ring for 50mm	80382725-002	2
	Grounding ring for 65mm	80382725-003	2
	Grounding ring for 80mm	80382725-004	2
	Grounding ring for 100mm	80382725-005	2
2	Gasket for 25mm	80382748-001	2
	Gasket for 40mm	80382748-002	2
	Gasket for 50mm	80382748-003	2
	Gasket for 65mm	80382748-004	2
	Gasket for 80mm	80382748-005	2
	Gasket for 100mm	80382748-006	2
3	Cover assembly	80382737-001	1
4	LCD board	80382689-001	1
5	LCD cable assembly	80382686-001	1
6	Water-proof gland for signal and power supply cable	80382754-001	3
7	Water-proof gland for temperature sensor	80382754-002	2
8	Fuse	83957091-004	1
9	Tapping screw	HS355-130-103	3

Factory default setting value table

Default values

OPERATOR'S MODE

Parameters	25 mm	40 mm	50 mm	65 mm	80 mm	100 mm	150 mm	200 mm
DAMPING	1.0 s	1.0 s	1.0 s	1.0 s	1.0 s	1.0 s	1.0 s	1.0 s
CNT-RESET value	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
CCT-RESET	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
HCT-RESET	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
SPIKE CUT	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
AVERAGING	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF

ENGINEERING MODE

Parameters	25 mm	40 mm	50 mm	65 mm	80 mm	100 mm	150 mm	200 mm
ID SET	xxxxxxxx	xxxxxxxx	xxxxxxxx	xxxxxxxx	xxxxxxxx	xxxxxxxx	xxxxxxxx	xxxxxxxx
EX	Calibrated value	Calibrated value	Calibrated value	Calibrated value	Calibrated value	Calibrated value	Calibrated value	Calibrated value
TYPE	MCM	MCM	MCM	MCM	MCM	MCM	MCM	MCM
DIA	025	040	050	065	080	100	150	200
SPAN	8 m3/h	20 m3/h	35 m3/h	60 m3/h	90 m3/h	140 m3/h	300 m3/h	560 m3/h
COEFFICIENT	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
DROP OUT	2%	2%	2%	2%	2%	2%	2%	2%
LOW FLOW CUT	2%	2%	2%	2%	2%	2%	2%	2%
ERROR OUT MODE I.OUT	LOW	LOW	LOW	LOW	LOW	LOW	LOW	LOW
ERROR OUT MODE P.OUT	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
H-SPAN	1649.20	4123.00	7215.30	12369.0	18553.5	28861.0	61845.0	115444.0
H-PLS SCL?	0.1MJ	1MJ	1MJ	1MJ	0.1GJ	0.1GJ	0.1GJ	0.1GJ
H-PLS WID	DUTY 50%	DUTY 50%	DUTY 50%	DUTY 50%	DUTY 50%	DUTY 50%	DUTY 50%	DUTY 50%
LOW LEVEL CUT	0.5ºC	0.5ºC	0.5ºC	0.5ºC	0.5ºC	0.5ºC	0.5ºC	0.5ºC
CH MODE SELECT	AUTO	AUTO	AUTO	AUTO	AUTO	AUTO	AUTO	AUTO
COOL MODE TEMP	15.0ºC	15.0ºC	15.0ºC	15.0ºC	15.0ºC	15.0ºC	15.0ºC	15.0ºC
DIFFERENTIAL	15.0ºC	15.0ºC	15.0ºC	15.0ºC	15.0ºC	15.0ºC	15.0ºC	15.0ºC
C COEFFICIENT	4.1230MJ /ºCm3	4.1230MJ /ºCm3	4.1230MJ /ºCm3	4.1230MJ /ºCm3	4.1230MJ /ºCm3	4.1230MJ /ºCm3	4.1230MJ /ºCm3	4.1230MJ /ºCm3
H COEFFICIENT	4.1230MJ /ºCm3	4.1230MJ /ºCm3	4.1230MJ /ºCm3	4.1230MJ /ºCm3	4.1230MJ /ºCm3	4.1230MJ /ºCm3	4.1230MJ /ºCm3	4.1230MJ /ºCm3
SUPPLY ZERO	+0.0ºC	+0.0ºC	+0.0ºC	+0.0ºC	+0.0ºC	+0.0ºC	+0.0ºC	+0.0ºC
RETURN ZERO	+0.0ºC	+0.0ºC	+0.0ºC	+0.0ºC	+0.0ºC	+0.0ºC	+0.0ºC	+0.0ºC
SUPPLY 0ºC	100.00Ω	100.00Ω	100.00Ω	100.00Ω	100.00Ω	100.00Ω	100.00Ω	100.00Ω
SUPPLY 100ºC	138.51Ω	138.51Ω	138.51Ω	138.51Ω	138.51Ω	138.51Ω	138.51Ω	138.51Ω
RETURN 0ºC	100.00Ω	100.00Ω	100.00Ω	100.00Ω	100.00Ω	100.00Ω	100.00Ω	100.00Ω
RETURN 100ºC	138.51Ω	138.51Ω	138.51Ω	138.51Ω	138.51Ω	138.51Ω	138.51Ω	138.51Ω

Electromagnetic Calorimeter system standard specifications and model number

MCM10A	-				-	

Size	25 mm	025		
	40 mm	040		
	50 mm	050		
	65 mm	065		
	80 mm	080		
	100 mm	100		
	150mm	150		
	200 mm	200		
Power supply	DC24V		G	
Centering jig (customer's piping)	Wafer JIS10K			11
	Wafer JIS20K			12
	Wafer ANSI150			21
	Wafer DIN PN10			41
	Wafer DIN PN16			42

X	None
B	Traceability certificate
C	Carbon steel Bolts & Nuts
K	Setting customer's requested range

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