Instruction Manual

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Instrument Model Number_____

Instrument Serial Number _____

TMF-100
Sanitary Ceramic
Electromagnetic Flowmeter

Form Number AIC2031

NOTICE

This Manual is designed to assist in installing, operating, and maintaining the TMF-100 electromagnetic flowmeter. For safety reasons, and to obtain the optimum performance from the flowmeter, read this Manual thoroughly before working with the product. Keep the Manual within easy reach for reference whenever needed.

The flowmeter to which this Manual refers is NOT designed for applications in which the functioning of this product is critical to human safety, such as:

- Main control systems of nuclear power plants; safety systems in nuclear facilities or other critical control lines directly affecting human safety.
- Control systems of medical equipment, including life support machines.

NOTES

1. The reproduction of the contents of this Manual in any form, whether wholly or in part, is not permitted without explicit prior consent and approval.
2. The information contained in this Manual is subject to change or review without prior notice.
3. Be sure to follow all safety, operating and handling precautions described in this Manual and the regulations in force in the country in which this product is to be used.

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SAFETY PRECAUTIONS

Safety signs and labels affixed to the product and/or described in this manual give important information for using the product safely. They help prevent damage to property and obviate hazards for persons using the product.
Make yourself familiar with signal words and symbols used for safety signs and labels. Then read the safety precautions that follow to prevent an accident involving personal injury, death or damage to property.

Explanation of signal words

The signal word or words are used to designate a degree or level of hazard seriousness. The signal words used for the product described in this manual are WARNING and CAUTION.

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

Safety symbols

The following symbols are used in safety signs and labels affixed to a product and/or in the manual for giving safety instructions.

	Indicates an action that is prohibited. Simply DON'T do this action.The prohibited action is indicated by a picture or text inside or next to the circle
	Indicates an action that is mandatory. DO this action.The mandatory action is indicated by a picture or text inside or next to the circle.
	Indicates a potential hazard. The potentially hazardous situation is indicated by a picture or text inside or next to the triangle.

SAFETY PRECAUTIONS (continued)

Safety Precautions for Installation and Wiring

⚠ WARNING

■ Do not use the TMF in an **explosive atmosphere**.

DON'T

Using this product in an explosive atmosphere can cause explosion.

CAUTION

■ **Turn off mains power** before working on pipes.

DO

Working on pipes while power is applied can cause **electric shock**.

■ Use an **appropriate device** to carry and install the TMF.

DO

If this product falls to the ground, injury, or malfunction of or damage to the product, can be caused.

■ **Install a switch and fuse** to isolate the TMF from mains power.

DO

Power supply from mains power can cause **electric shock** or **circuit break-down**.

■ **Do not modify or disassemble** the TMF unnecessarily.

DON'T

Modifying or disassembling this product can cause electric shock, malfunction of or damage to this product.

■ **Turn off mains power** before conducting wiring work.

DO

Wiring while power is applied can cause **electric shock**.

■ **Ground** the TMF **independently from power equipment.**

DO

Operating this product without grounding can cause electric shock or malfunction.

■ Do not conduct wiring work **with bare hands**.

DON'T

Remaining electric charge even if power is turned off can still cause **electric shock.**

■ Use crimped terminal lugs for the terminal board and GND terminal.

DO

Loose connections can cause **electric shock, fire from excessive current or system malfunction.**

■ Do not work on piping and wiring **with wet hands**.

DON'T

Wet hands may result in **electric shock**.

The label shown left is placed near the terminal board for power input.
(A black border and symbol on yellow triangle)
Be alert to electric shock.

SAFETY PRECAUTIONS (continued)

Safety Precautions for Maintenance and Inspection

⚠ CAUTION

■ Do not touch the TMF main body when **high temperature fluid** is being measured.

DON'T

The fluid raises the main body temperature and can cause **burns** when touched.

■ Do not conduct wiring work when power is applied.

DON'T

Wiring while power is applied can cause electric shock.

■ Do not conduct wiring work **with wet hands**.

DON'T

Wet hands may result in electric shock.

The label shown left is placed near the terminal board for power input. (A black border and symbol on yellow triangle) Be alert to electric shock.

■ Do not use a **fuse other than the one specified**.

DON'T

Using a fuse other than the one specified can cause system failure, damage or malfunction.

Use a rated fuse as follows:

Fuse rating:

- 1A/250V for 100 to 240Vac or 110Vdc
- 2A/250V for 24 V dc

Dimensions:

Diameter 5.2 mm x 20 mm

Melting time characteristic:

Normal blow

Disclaimer

Anderson does not accept liability for any damage or loss, material or personal, caused as a direct or indirect result of the operation of this product in connection with, or due to, the occurrence of any event of force majeure (including fire or earthquake) or the misuse of this product, whether intentional or accidental.

Handling Precautions

■ **To obtain the optimum performance from the TMF flowmeter for years of continuous operation, observe the following precautions.**

(1) Do not store or install the flowmeter in:

- places where there is direct sunlight. If this is unavoidable, use an appropriate sunshade.
- places where excessive vibration or mechanical shock occurs.
- places where high temperature or high humidity conditions obtain.
- places where corrosive atmospheres obtain.
- places submerged under water.

To put the flowmeter temporarily on the floor, place it carefully with something to support it so that the flowmeter will not topple over.

(2) Execute wiring securely and correctly.Ground the flowmeter with 100 ohm or less ground resistance. Avoid a common ground used with other equipment where earth current may flow. An independent ground is preferable

(3) Do not remove the quick disconnect cable connectors from the converter housing.

(4) The converter housing covers are tightened securely at the time of shipment. Do not remove these covers unless it is necessary to wire new cables or replace old ones. Tighten the covers securely again if they have been removed.

(5) Make sure the fluid to be measured will not freeze in the detector pipe. This can cause damage to the detector pipe.

(6) Select appropriate wetted materials suited for the process fluid to be measured. Otherwise, fluid leakage due to corrosion can be caused.

Handling Precautions (continued)

(7) Observe the following precautions when you open the converter housing cover:
- Do not open the cover in the open air unprotected against rain or wind. This can cause electric shock or cause damage to the flowmeter electronics.
- Do not open the cover under high ambient temperature or high humidity conditions or in corrosive atmospheres. This can cause deterioration of system accuracy or cause damage to the flowmeter electronics.

(8) This product may cause interference to radio and television sets if they are used near the installation site. Use metal conduits etc. for cables to prevent this interference.

(9) Radio transmitters such as transceivers or cellular phones may cause interference to the flowmeter if they are used near the installation site. Observe the following precautions when using them:
- Do not use a transceiver whose output power is more than 5 W.
- Move the antenna of a transceiver or a cellular phone at least 50 cm away from the flowmeter and signal cables when using it. Do not use a radio transmitter or a cellular phone near the flowmeter while it is operating online. The transmitter or cellular phone's output impulse noise may interfere with the flowmeter.
- Do not install a radio transmitter antenna near the flowmeter and signal cables.

(10) For reasons of flowmeter failure, inappropriate parameters, unsuitable cable connections or poor installation conditions, the flowmeter may not operate properly. To prevent any of these problems causing a system failure, it is recommended that you have preventive measures designed and installed on the flowmeter signal receiving side.

Table of Contents

1. Product Inspection and Storage

Upon arrival of the product package, open the package and check the items contained inside. If you do not intend to install the product soon after opening the package, store the product and other related items in a place such as described in 1.2 below.

1.1 Product Inspection

The TMF electromagnetic flowmeter is shipped in a cardboard container filled with shock-absorbing materials. Open the package carefully and check as follows:

- Make sure the following items are included in the package.

  (1) Model TMF Electromagnetic Flowmeter 1

  (2) Instruction Manual 1

  (3) Quick Disconnect Cables (if specified) 2

- Inspect the flowmeter for indications of damage that may have occurred during shipment.
- Make sure the type and specifications of the flowmeter are in accordance with the ordered specifications.

If you cannot find the items listed above or any problem exists, contact your nearest Anderson representative.

1.2 Storage

To store the TMF flowmeter after opening the package, select a storing place as follows and keep it under the conditions described below:

(1) Avoid places where there is direct sunlight, rain or wind.

(2) Store the product in a well-ventilated place. Avoid places of extremely high humidity or extremely high or low temperature. The following environment is recommended:

- **Humidity range: 10 to 90% RH (no condensation)**
- **Storage temperature: –15 to +65° C**

(3) Avoid places where vibrations or mechanical shock occur.

(4) Do not leave the converter housing cover open. Open the cover only when you actually start wiring cables. Leaving the cover open can cause gradual deterioration of circuit isolation.

(5) To put the flowmeter temporarily on the floor, place it carefully with something to support it so that the flowmeter will not topple over

2. Overview

The TMF electromagnetic flowmeter measures the volumetric flow rates of electrically conductive materials on the basis of Faraday's Law of electromagnetic induction. The device consists of two units: the TMF detector, through which the fluid to be measured flows, and the TMF converter, which receives the electromotive force signals from the detector, then converts the signals into the 4–20 mA DC or pulse signal. These two units for the TMF are integrally mounted.

Features

The TMF ceramics type electromagnetic flowmeter has the following features:

- Fluid flow is not obstructed and pressure loss is negligible.
- The process fluid's temperature, pressure, density or flow conditions have no effect on the accuracy of the flowmeter.
- The structure is authorized by the 3-A SANITARY STANDARDS SYMBOL ADMINISTRATIVE COUNCIL. The authorization number is No.1107. And this sanitary standard is No.28-03.

- The flowmeter output is directly proportional to the process flow rate, thus it is easy to read its output.

The TMF electromagnetic flowmeter has the following additional features:

(1) High accuracy, ±0.5% of rate is possible for 0.3–10 m/s velocity range. 0.1 to 0.3 m/s range is available optionally.

(2) The flowmeter can be used to measure fluids with solids (such as slurries) for the reasons stated below:

- The TMF-100's original noise-suppression circuit with signal processing capabilities ensures a stable output.

(3) The flowmeter has various flow measurement output and control functions as standard specifications and the LCD display for convenient parameter settings.

- These functions can be selected with control keys on the panel.

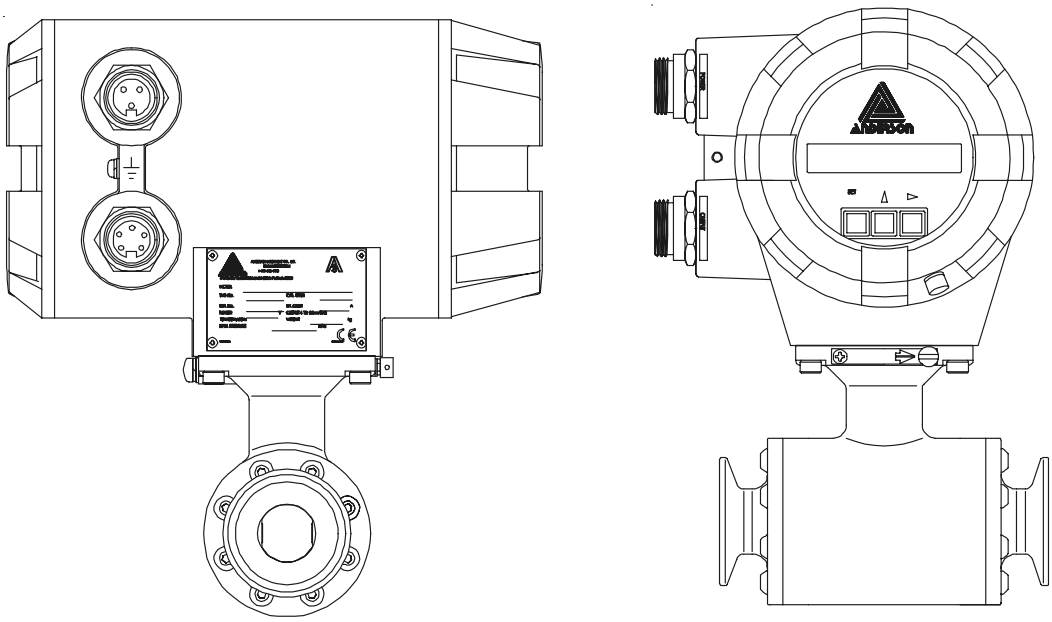
(4) An easy-to-read LCD display (2-line X 16-character display)

- The backlit LCD display can be read even under poor lighting conditions.

3. Names of Parts

The outline drawing of the TMF flowmeter is shown in Figure 3.1 and the internal views of the TMF converter are shown in Figures 3.2 and 3.3.

■ **Outline Drawing**



TMF with LCD display

Figure 3.1 Outline drawing of TMF-100 Flowmeter

■ **Terminal Board of TMF-100 Converter**

Opening housing cover for terminal board shown in “Outline Drawing”, terminal board of the TMF-100 converter is shown below.

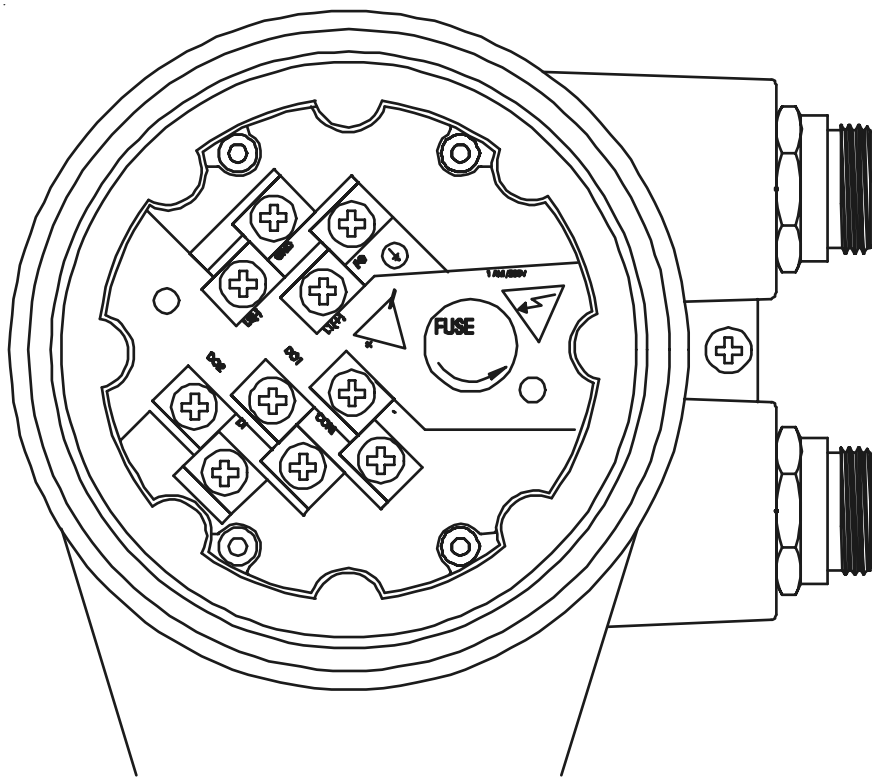
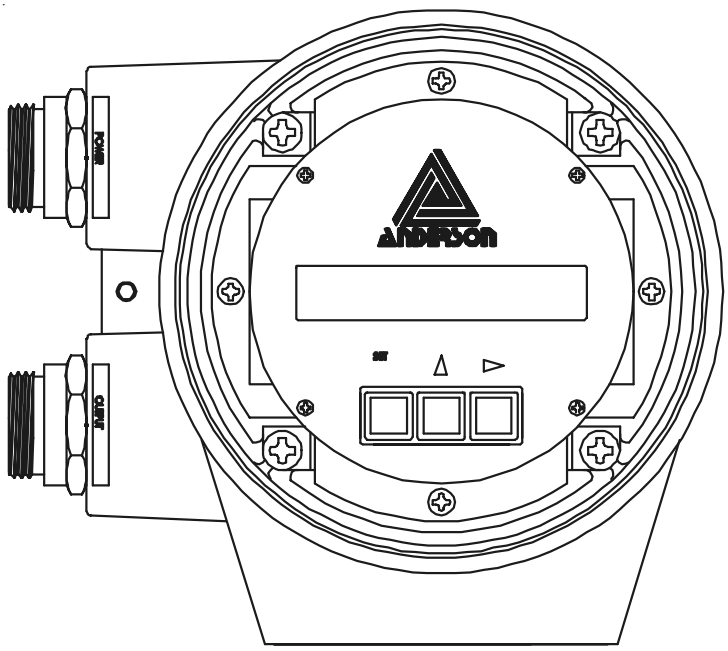


Figure 3.2 Terminal Board of TMF-100 Converter

■ **Control switch or keys of TMF-100 Converter**

Opening housing cover for internal electronics or LCD display shown inn“Outline Drawing”, control switch or keys of TMF-100 converter is shown here.



TMF-100 with LCD Display

Figure 3.3 Control switch or keys of TMF-100 Converter

4. Installation

⚠ WARNING

■ Do not use the TMF-100 in an **explosive atmosphere**.

DON'T

Using this product in an explosive atmosphere can cause **explosion**.

⚠ CAUTION

■ **Install a switch and fuse to isolate the TMF-100 from main power.**

DO

Power supply from main power can cause **electric shock** or **circuit breakdown.**

■ Use an appropriate device to carry and install the TMF-100.

DO

If his product **falls to the ground**, injury, or malfunction of or damage to the product, can be caused.

■ **Do not modify or disassemble the TMF-100 unnecessarily.**

DON'T

Modifying or disassembling this product can cause **electric shock**, **malfunction or damage to this product.**

Ground the TMF independently from power equipment.

DO

Operating this product without grounding can cause **electric shock** or **malfunction**.

■ **Do not work on piping and wiring with wet hands.**

DON'T

Wet hands may result in **electric shock**

The label shown left is placed near the terminal board for power input. (A black border and symbol on yellow triangle)
Be alert to **electric shock**.

4.1 Location

To select the installation site, follow the precautions described below:

- Avoid places where fluid runs in a pulsating form.
- Avoid places within the immediate proximity of equipment producing electrical interference (such as motors, transformers, radio transmitters, electrolytic cells, or other equipment causing electromagnetic or electrostatic interference).
- Avoid places where excessive pipe vibration occurs.
- Avoid places where there is direct sunlight. If this is unavoidable, use an appropriate shade
- Avoid places where corrosive atmospheres or high humidity conditions obtain.
- Avoid places of too great an elevation or constricted areas where clearance for installation or maintenance work is not provided.
- Design piping so that the detector pipe is always filled with fluid, whether the fluid is flowing or not.
- The TMF detector has no adjustable piping mechanism. Install an adjustable short pipe where needed.
- Chemical injections should be conducted on the downstream side of the flowmeter.

4.2 Mounting Procedure

⚠ CAUTION

- **Use an appropriate device to carry and install the TMF-100.**

  DO

  If his product **falls to the ground**, injury, of malfunction of or damage to the product, can be caused.

- **Turn off mains power before working on pipes.**

  DON'T

  Working on pipes while power is applied can cause **electric shock**.

(1) ISO2852 clamp type piping connection method

As shown in Figure 4.1, welding the ferrule to the process piping, and install a gasket between the grooves on the piping end of the detector and that of the welded ferrule, and then put a clamp over the piping joint area and tighten the screws of the clamp.

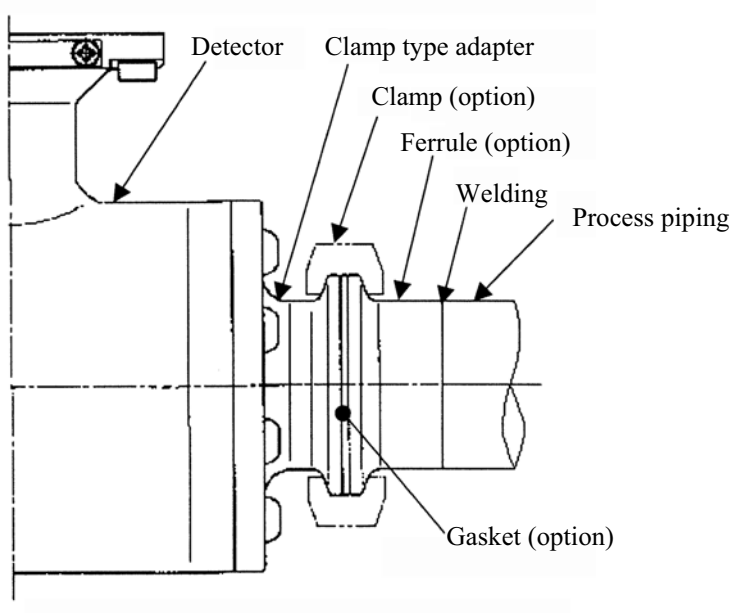


Figure 4.1 Clamp Type Piping Connection Method

⚠ Caution

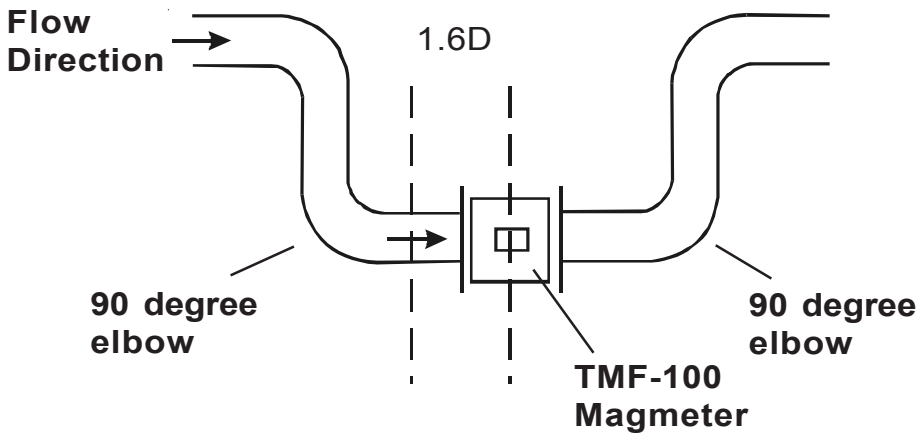
The bolts fixing the clamp type adapter or the screw type adapter to the detector are adjusted when shipped from the factory. If the bolts are loosened, this can cause leakage of liquid.
Do not loosen the fixing bolts.

4.3 Piping Connections

(1) Required Pipe Length

If various joints are used upstream of the detector outlet, the straight pipe length as shown in Table 4.1 is required.

4.1 Required straight pipe length on the upstream side



D = Pipe Diameters

Piping Diagram

NOTES

1. The length of a reducer, if connected, can be counted as a part of the straight pipe length.
2. No straight pipe length is needed on the downstream side. If a butterfly valve is installed downstream of the detector, do not let the valve plate protrude into the pipe of the detector

(2) Pipe Orientation

The detector may be installed in horizontal, vertical or sloping pipe runs as shown in Figure 4.3. However, except for horizontal installation, fluid should flow from lower to upper directions. See Figure 4.3.

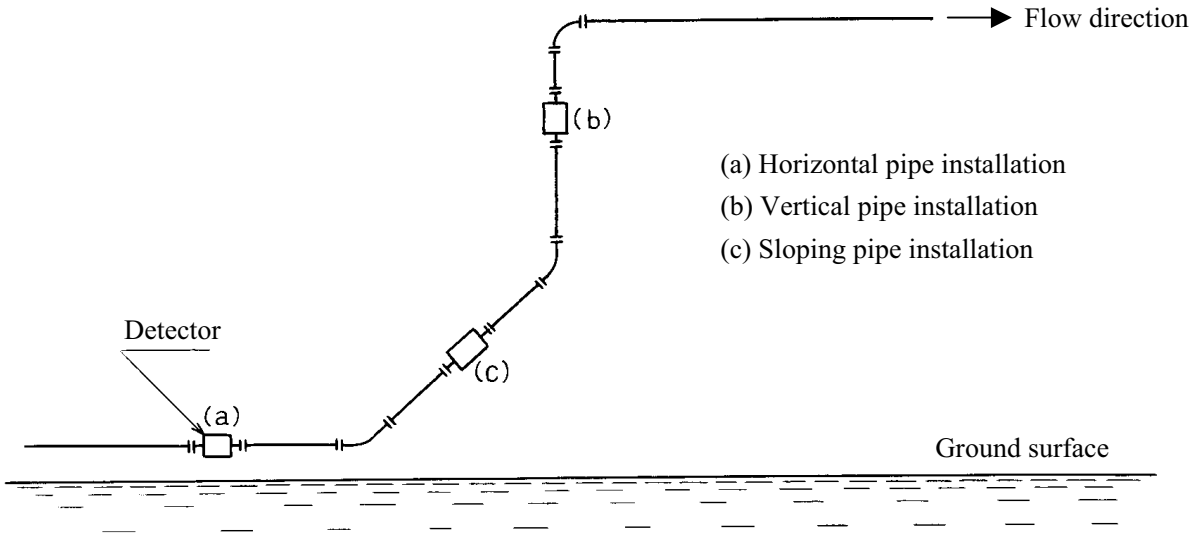


Figure 4.3 Detector Piping Orientation

The electrodes should be positioned horizontally against the ground surface in any piping installation. See Figure 4.4.

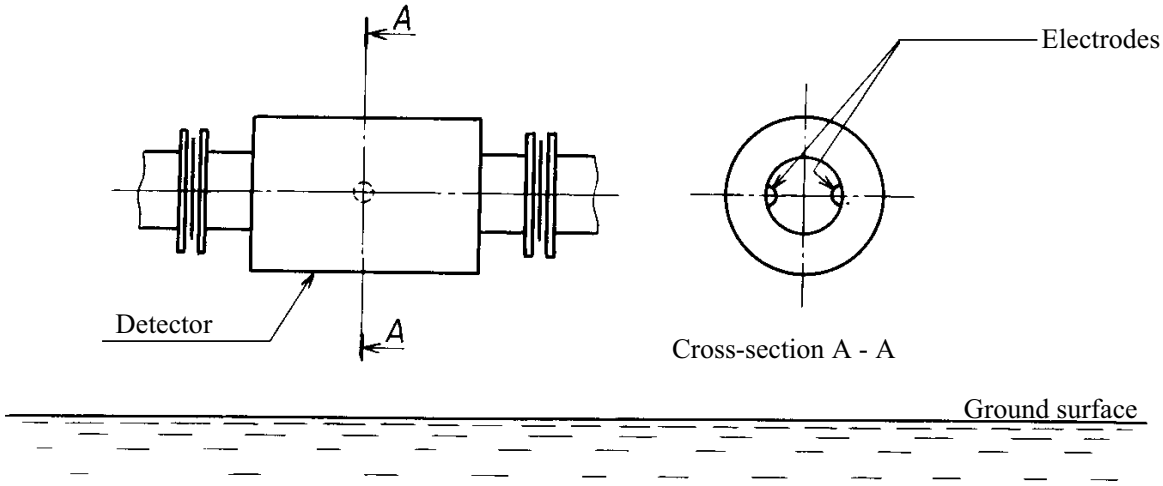


Figure 4.4 Installation position of the detector

(3) Flow Direction

Install the detector in accordance with the flow direction arrow on the detector. See Figure 4.5. If the actual flow runs opposite to the specified flow direction, the following display and output appears. (For bidirectional multi-range measurement, see 10.3, “Multi-range Functions.”).

- **LCD display:** Instantaneous flow rate—indicates negative values, Totalized flow—no counts added.
- **Output:** Current output — 4.0 mA output; Pulse output—No pulses

For bidirectional range measurement, the flow in opposite direction results in a positive output value. See 10.3, “Multi-range Functions.”

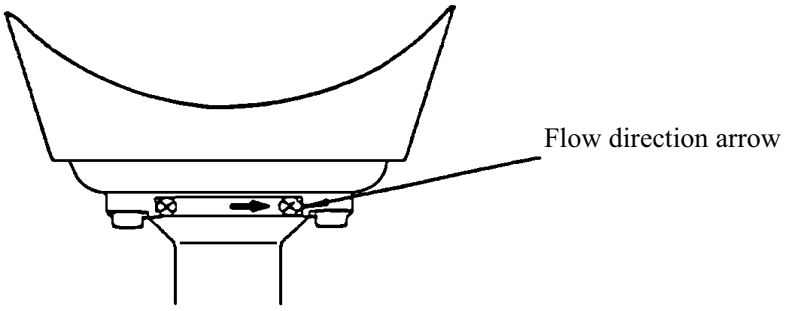


Figure 4.5 Flow direction arrow on the detector

(4) Preventing an Empty Pipe Condition

Design an upright pipe run (Figure 4.6) or sufficient head pressure (Fig. 4.7) at the downstream detector outlet if there is a possibility of the detector pipe becoming emptied.

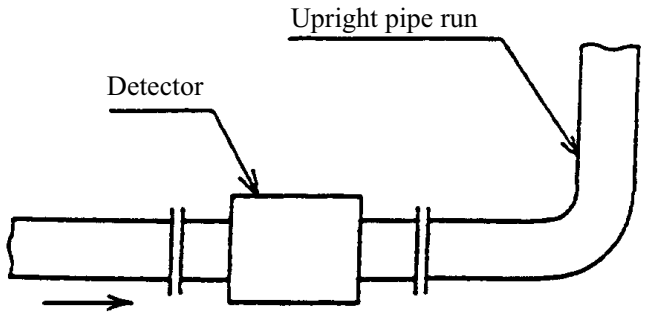


Figure 4.6 Detector with an upright pipe run at downstream outlet

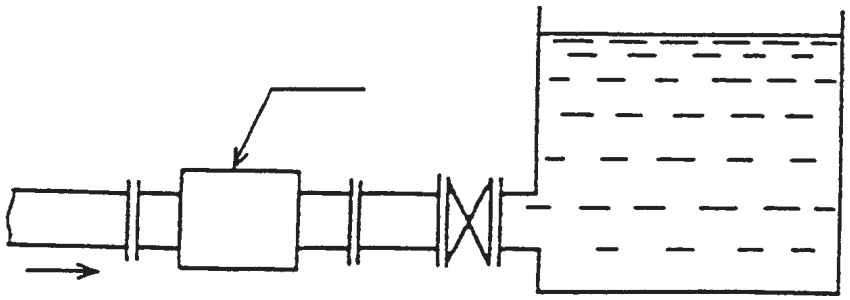


Figure 4.7 Detector with sufficient head pressure at downstream outlet

(5) Supporting Pipe

Fix the relevant pipes installed on both sides of the detector by attaching fittings, etc. to support the pipe. By supporting the pipes, not only the pipe vibration is reduced, but also the damage to the pipes by the electromagnetic flowmeter's weight and the fluid mass. It also protects fluid leakage at flange face (see Figures 4.8 and 4.9).

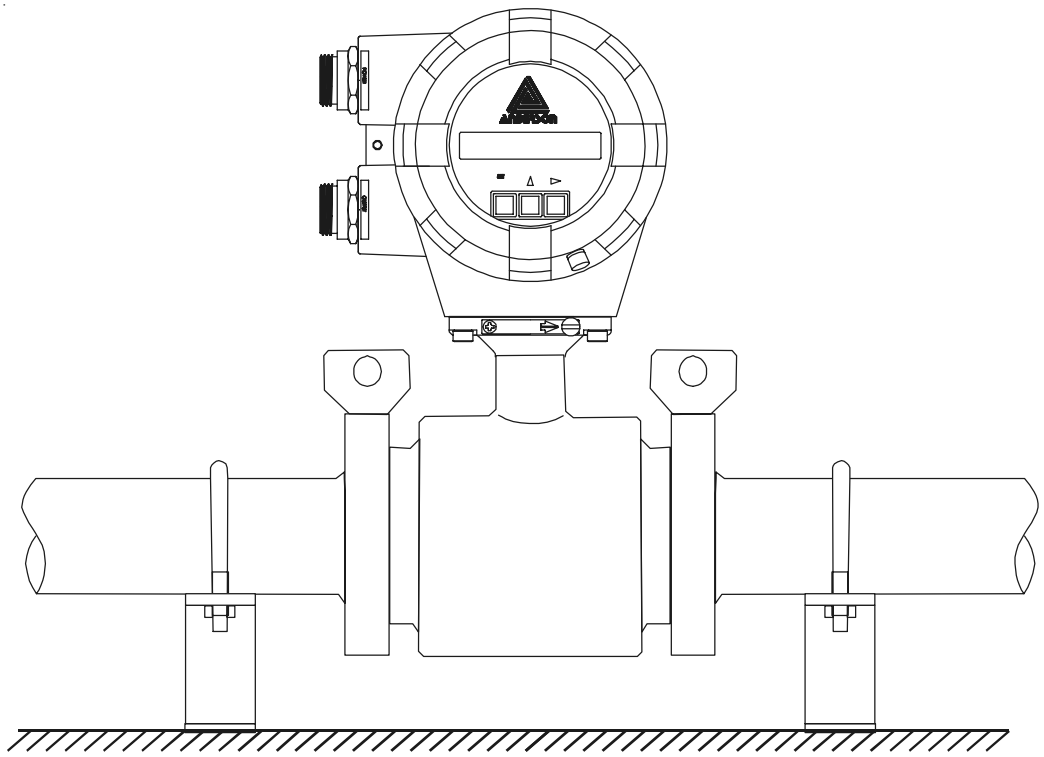


Figure 4.8 Example of Pipe Fixing Procedure

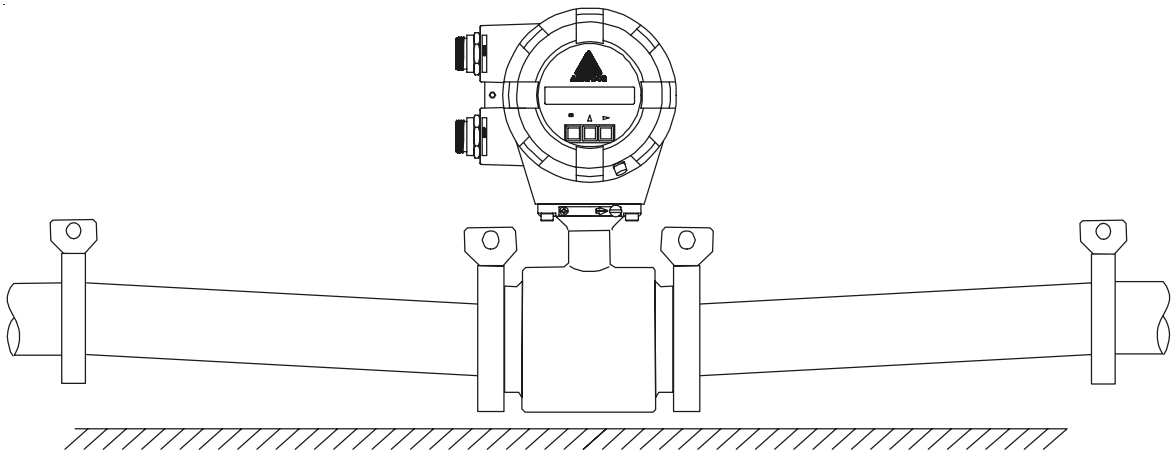


Figure 4.9 Model Diagram of Unsupported Pipes

(6) Grounding

The grounding terminal of the TMF flowmeter should be grounded with 100 ohm or less ground resistance. Use a heavy copper braid or wire (cross-sectional area 5.5 mm^2 minimum) to ground the terminal and make it as short as possible. The terminal is M4 size and an M4-size crimped ring lug should be used to connect the wire to the terminal. Avoid a common ground where earth current may flow. An independent ground is preferable. See Figure 4.12.

To prevent a two-point grounding, ground the shielded cable on the receiving instrument side.

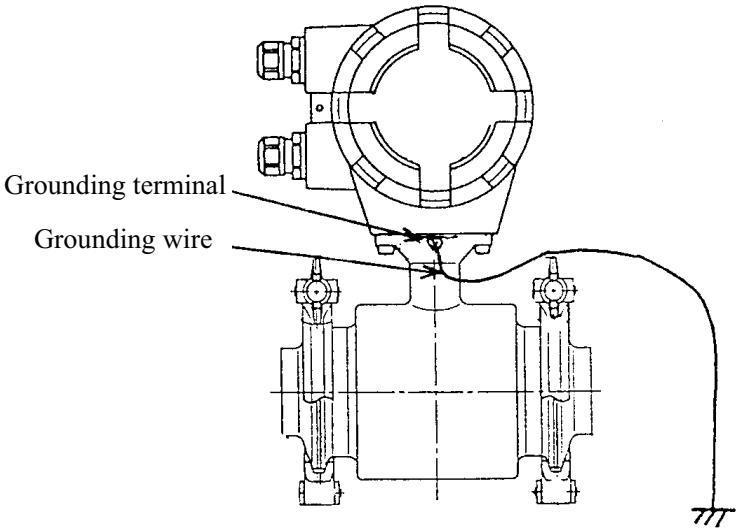


Figure 4.12 Grounding Procedure

5. Wiring

<table>
<tr><th colspan="2">⚠ CAUTION</th></tr>
<tr><td>■ Do not work on piping and wiring with wet hands.
 
DON’T
Wet hands can cause system failure.</td><td>Ground the TMF properly.
 
DO
Operating this product without a grounding can cause system malfunction.</td></tr>
<tr><td>■ Do not modify or disassemble the TMF unnecessarily.
 
DON’T
Modifying or disassembling this product can cause electric shock, malfunction of or damage to this product.</td><td> 
The label shown left is placed near the terminal board for power input.Be alert to electric shock.</td></tr>
</table>

Flowmeter accuracy may be affected by the way wiring is executed. Proceed with wiring taking the following precautions:

(1) Select the cable runs away from electrical equipment (motors, transformers, or radio transmitters) which causes electromagnetic or electrostatic interference.

(2) Deterioration of flowmeter circuit insulation occurs if the converter interior or cable ends get wet or humidified. This in turn causes malfunction of flowmeter or noise problems. Avoid a rainy day if the flowmeter is to be installed outdoors. Even indoors, prevent water from splashing over the flowmeter. Try to finish the wiring as quickly as possible

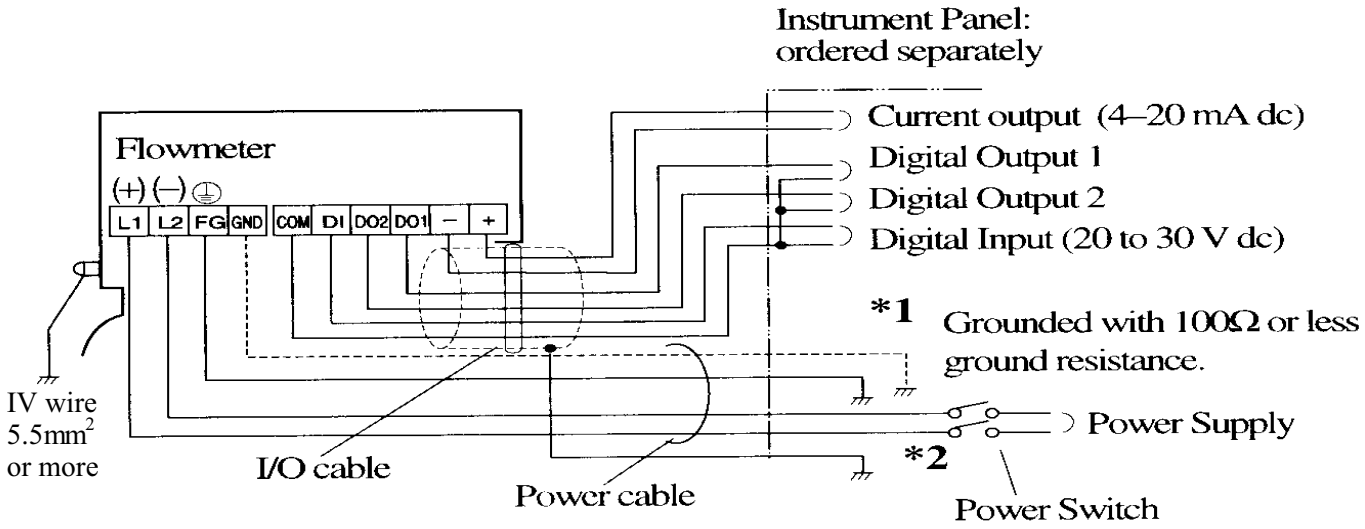
(3) The converter has a surge-absorbing barrier installed inside. Therefore, do not conduct a withstand voltage test for the converter. To check the insulation of the converter, use a voltage of 250 V dc or less.

5.1 Cables

CAUTION:
To prevent moisture ingression, NEMA 4X quick disconnect receptacles have been provided. Mating quick disconnect cables should always be utilized. Do not replace with other sealtight or conduit connections.

5.2 External Device Connections and Grounding

The terminal board connections of the TMF-100 flowmeter are shown in Figure 5.1. Proceed with wiring as described in Section 5.4, “Wiring Procedure.”
If power supply is specified as DC, use L1 as positive (+) and L2 as negative (–) terminals.



***1** To use the arresters, ground the GND terminal using the wire shown in broken line.

***2** Locate an external double-pole power switch on the power line near the flowmeter and within easy operation. Mark one the switch as the disconnecting device for the flowmeter.

Use an appropriate switch of the rating shown below:

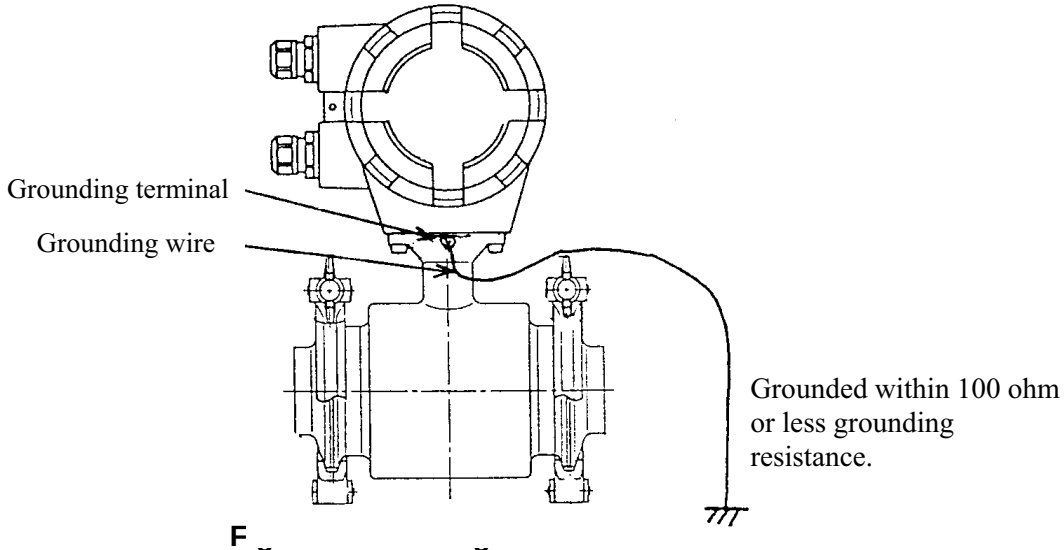
Recommended switch rating;	Rating	250 V ac, 6A or more
	Inrush current	15 A or more

Figure 5.1 Terminal Block Connections

IMPORTANT

(1) The grounding terminal of the TMF-100 flowmeter should be grounded with 100 ohm or less ground resistance. Use a heavy copper braid or wire (cross-sectional area 5.5 mm^2 minimum) to ground the terminal and make it as short as possible. The terminal is M4 size and an M4-size crimped ring lug should be used to connect the wire to the terminal. Avoid a common ground where earth current may flow. An independent ground is preferable. See Figure 5.2.

(2) To prevent a two-point grounding, ground the shielded cable on the receiving instrument side.



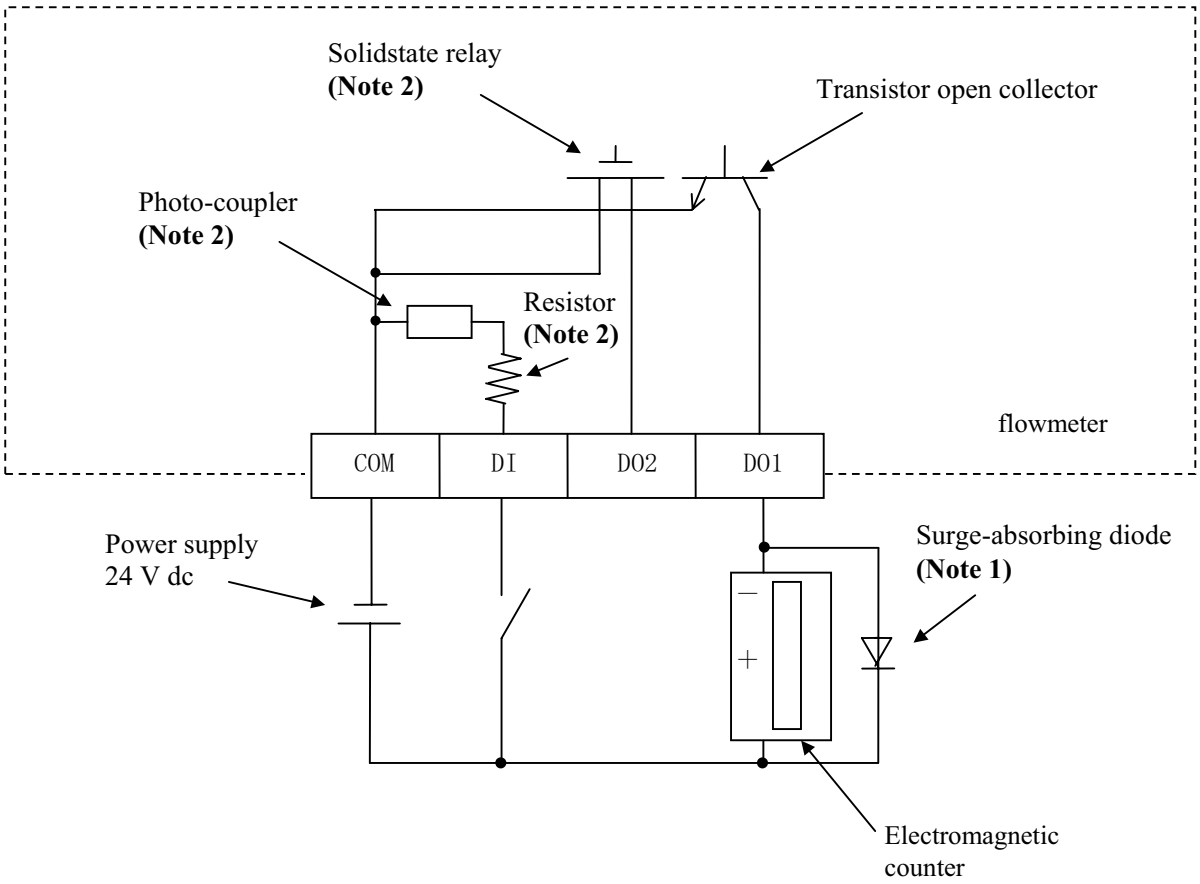
F

5.3 Digital I/O Connections

Digital I/O terminals consist of contact output terminals (standard DO1 and optional DO2), voltage signal input terminal (DI, optional), and signal common terminal (COM). Each terminal (DO1, DO2 and DI) is isolated from internal circuits. Terminal (COM) is the signal common for the other three terminals (DO1, DO2 and DI).

Functions can be assigned for each terminal with the LCD control keys (option). See Chapter 10, “Digital I/O Functions.”

To connect an electromagnetic relay or counter to the contact output terminal (DO1 or DO2), put a surge-absorbing diode into the input circuit of the relay or counter. See Figure 5.3 for an example of electromagnetic counter connection.



Note 1: Use a surge-absorbing diode of the rating: current rating 1A and voltage rating 200 V minimum.

Note 2: The Solidstate relay, photo-coupler and resistor are not provided for the standard model (the one with no digital I/O specifications). Leave the terminals for DO2 and DI open.

Figure 5.3 Electromagnetic Counter Connection Example

5.4 Wiring Procedure

Cable termination and cable connections are described below.

5.4.1 Cable Termination

INTERNAL CONNECTIONS FOR RECEPTACLES

Receptacle wire colors	24 VDC version		120 VAC version	
	Con 1(5 cond)	Con 2 (5 cond)	Con 1 (3 cond)	Con 2 (5 cond)
Red (Pin 2)	L1(+)	DI	See Below	DI
White (Pin 1)	+Loop	Not used		+Loop
Green (Pin 3)	-Loop	DO2		-Loop
Orange (Pin 4)	Not used	DO1		D01
Black (Pin 5)	L2 (-)	Com		Com

Receptacle wire colors	120 VAC version
	Con 1(3 cond)
White (Pin 3)	L2 (-)
Green (Pin 1)	Grd
Black (Pin 2)	L1(+)

CONNECTIONS BY THE CUSTOMER

Liquidtight Conduit	Molded Cordset	Belden Cable wire colors*	24 VDC version		120 VAC version	
			Con 1(5 cond)	Con 2 (5 cond)	Con 1 (3 cond)	Con 2 (5 cond)
Red	Blue	Red	L1 (+) (Pin 2)	DI (Pin 2)	See Below	DI (Pin 2)
White	Black	White	+Loop (Pin 1)	Not used		+Loop (Pin 1)
Green	Gray	Green	-Loop (Pin 3)	D02 (Pin 3)		-Loop (Pin 3)
		Blue	Not used	Not used		Not used
Orange	Brown	Brown	Not used	D01 (Pin 4)		D01 (Pin 4)
Black	White	Black	L2 (-) (Pin 5)	Com (Pin 5)		Com (Pin 5)

Liquidtight conduit & molded cordset	Belden Cable wire colors*	120 VAC version
		Con 1(3 cond)
White	White	L2 (-) (Pin 3)
Green	Green	Grd (Pin 1)
Black	Black	L1 (+) (Pin 2)

* Field wireable cables

5 pin receptacle — Use Belden 6-cond cable (24AWG, foil shield & drain wire)

3 pin receptacle — Use Belden 3 cond cable (16 AWG)

6. Operation

CAUTION

- **Do not touch the TMF main body when high temperature fluid is being measured.**

DON'T

The fluid raises the main body temperature and can cause **burns** when touched.

6.1 Preparatory check

Follow the procedure described below to prepare before starting the flow measurement.

System Check

- Check the wiring between the converter and related instruments.
- Make sure all the bolts of connection flanges on which the flowmeter is mounted securely tightened.
- Make sure the direction of flow arrow is in accordance with actual flow.
- Make sure the flowmeter is grounded with 100 ohm or less ground resistance.
- Make sure the converter housing covers are securely tightened.

Placing System On-Stream

- Let the fluid go through the detector pipe. When the detector is filled with the fluid, stop the fluid and keep it still in the detector pipe.

Supplying Electric Power

- Make sure the power supply is as specified.

Checking Converter Parameters

- Check the configuration parameter settings. Refer to Chapter 7, "LCD Display and Controls," Chapter 8, "Configuration Parameter Setting," and Chapter 11, "Communications Function."

Zero Adjustment

- Wait for 30 minutes to warm up the flowmeter. Then making sure the fluid holds still in the detector pipe, starts the zero adjustment.
  Refer to 8.2.8, "Zero Adjustment."

On-line Measurement

After checking the items and conducting the zero adjustment as listed above, let the fluid go through the detector pipe. Output (4–20 mA DC, or pulse) directly proportional to the flow rate can be obtained.

7. LCD Display and Controls

You can select the operation mode, change the configuration parameters or execute operation-specific functions using the control keys on the panel. How to operate these keys is described in this chapter.

7.1 Outline

The TMF Converter has an LCD display. The LCD display can be used to set and indicate various configuration parameters. Figure 7.1 shows the front view of LCD display.

(1) Do not open the housing cover for LCD display in the open air unprotected against rain or wind. If you open the housing cover for LCD display in the rain, it can cause electric shock or damage to the flowmeter electronics. If wind blows against the internal circuitry of the converter, the output may fluctuate and fails to indicate correct measuring values.

(2) Do not open the housing cover for LCD display when the ambient humidity is high. By opening the cover in high humidity conditions, the measuring accuracy may be reduced or damage caused to the flowmeter electronics.

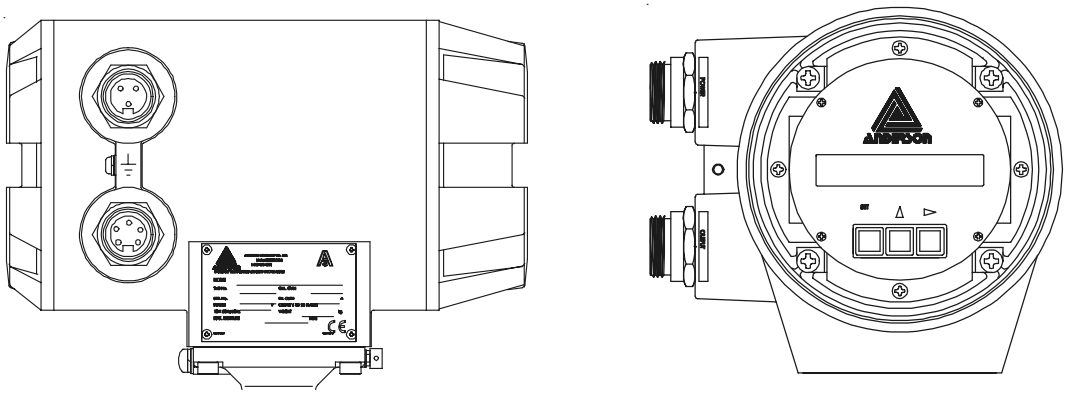


Figure 7.1 TMF Converter with LCD display

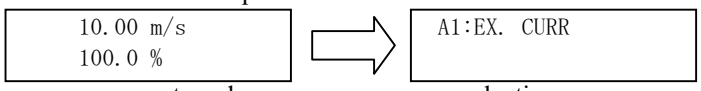
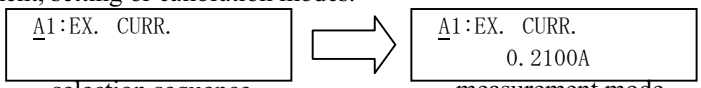
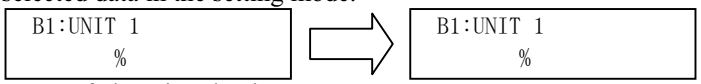
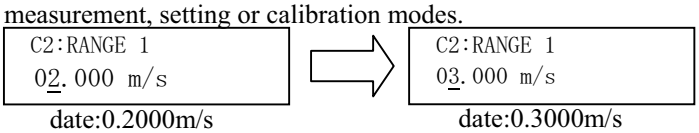
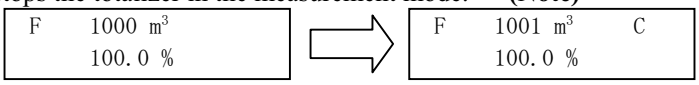
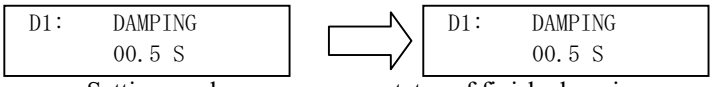
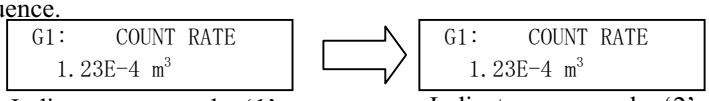
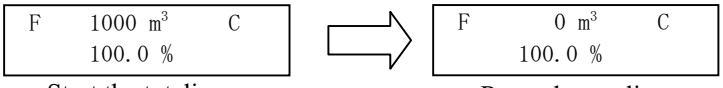
■ **LCD display**

Consists of a 2-line • 16-character liquid crystal display. The backlit display enables an easy-to-read indication even under poor lighting conditions. Instantaneous flow rates or totalized flow in the measurement mode, or configuration parameters in the setting mode can be displayed.

■ Control Keys

Changing the operation mode, checking or changing parameters can be done with these keys. To operate these keys, remove the converter housing cover.

Functions of each control key when pressed are shown in the table below.

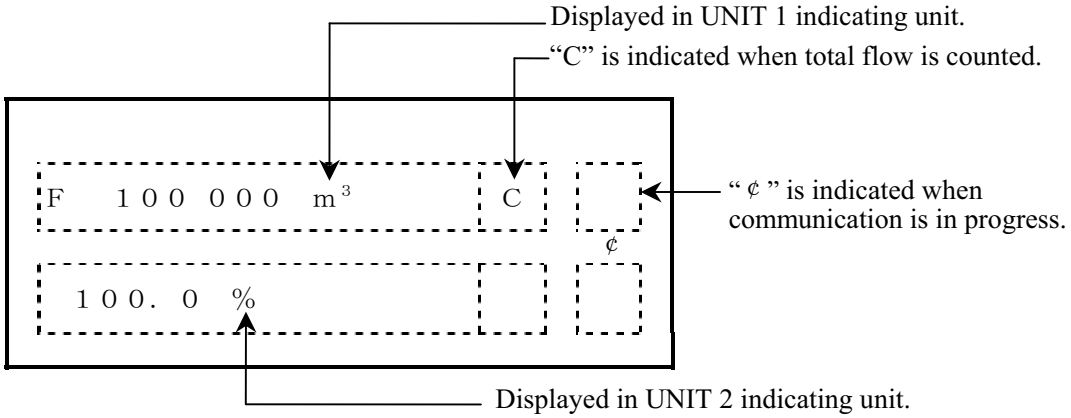
Control keys	Basic functions of control keys
SET	Goes into the items selection sequence.  measurement mode → selection sequence
	Goes into the detailed-item specifying sequence for each selected item in measurement, setting or calibration modes.  selection sequence → measurement mode
	Stores the selected data in the setting mode.  status of changing the data → status of finish changing parameter
▲	Changes items (alphabet letter and number) in the items selection sequence, and changes parameters (numbers and/or units) in the detailed-item specifying sequence in measurement, setting or calibration modes.  date:0.2000m/s → date:0.3000m/s
	Starts and stops the totalizer in the measurement mode. **(Note)**  Stop the totalizer → Start the totalizer
▶	Changes digits (alphabet letter and number) in the items selection sequence, and starts the detailed-item specifying sequence by indicating the left-most digit with the cursor.  Setting mode → status of finish changing parameter
	Moves the cursor from left to right (from the right end reverts to the left end) in the above sequence.  Indicate cursor under '1' → Indicate cursor under '2'
	Resets the totalizer in the measurement mode. **(Note)**  Start the totalizer → Reset the totalizer

Note: To operate the totalizer, it is preferable to set the indicating unit (UNIT 1 and/or UNIT 2) to one of the units appropriate for totalization just to make sure it is operating correctly. See 10.2, "Totalizer and Pulse Output."

7.2 Display Format

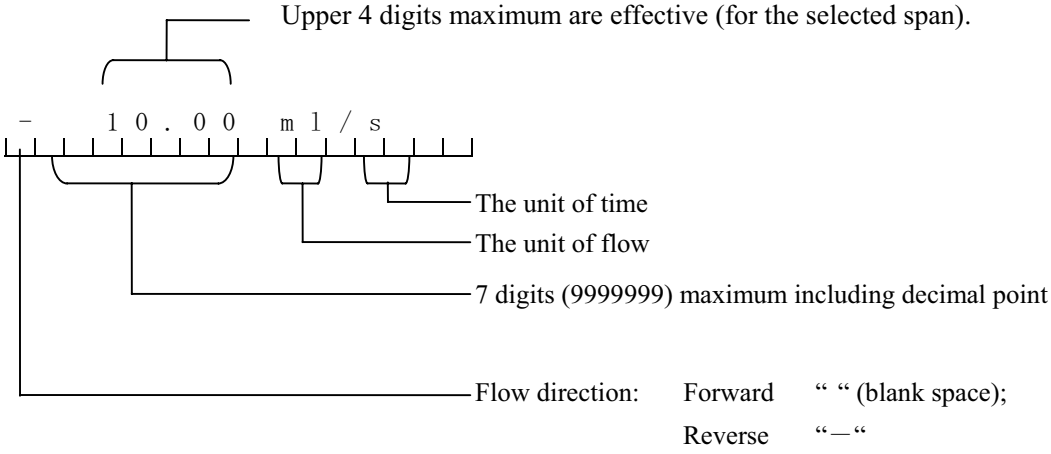
In the measurement mode, measured data is displayed in UNIT 1 (primary indicating unit) and UNIT 2 (secondary indicating unit). To change units of measure, see 8.2.4, “Indicating Unit.”

■ Display Format

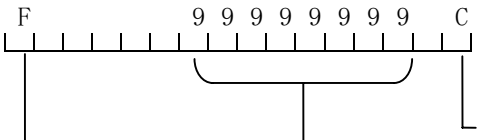


■ Measured Value Display Format

(1) Flow rate



(2) Totalizer



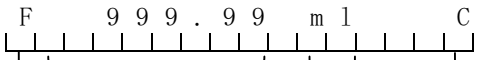
"C" is indicated when total flow is counted.

Increments per counting rate. Refer to 8.2.10, "Counting Rate."
Wraps around after 99999999.

"F" for forward and "R" for reverse direction flow will be displayed

(3) Volumetric flow

Displays down to the smallest digit of counting rate.



"C" is indicated when volumetric flow is counted.

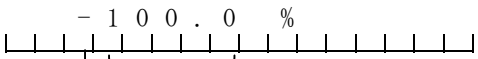
The unit of flow

8 digits (99999999) maximum including decimal point
If the flow count exceeds 99999999, wraps around.

"F" for forward and "R" for reverse direction flow will displayed.

(4) % display

Displayed down to 0.1 %.



Displays up to 125.0 %.

Flow direction: Forward " " (blank space);
Reverse "—"

7.3 Basic operations

Flow measurement in the measurement mode, checking or changing configuration parameters in the setting mode and a converter unit check in the calibration mode are the basic operations of the TMF-100 converter.

7.3.1 Mode Change

The TMF converter has three operation modes: measurement, setting and calibration. The system stays in the measurement mode after the power is turned on. To change the mode to the setting or calibration mode, press [SET] and select the desired item using [◂] and [▾] keys. To return to the measurement mode, select "0" (MEASURE MODE) for the number column of configuration items (such as A0 or B0). See 7.4, "Configuration Items Selection Table."

■ **Measurement mode**

: measures the process flow and displays and outputs the measured process values. The flowmeter can measure the flow velocity, flow rates, or totalized flow. The flowmeter first goes into this mode when power is turned on.

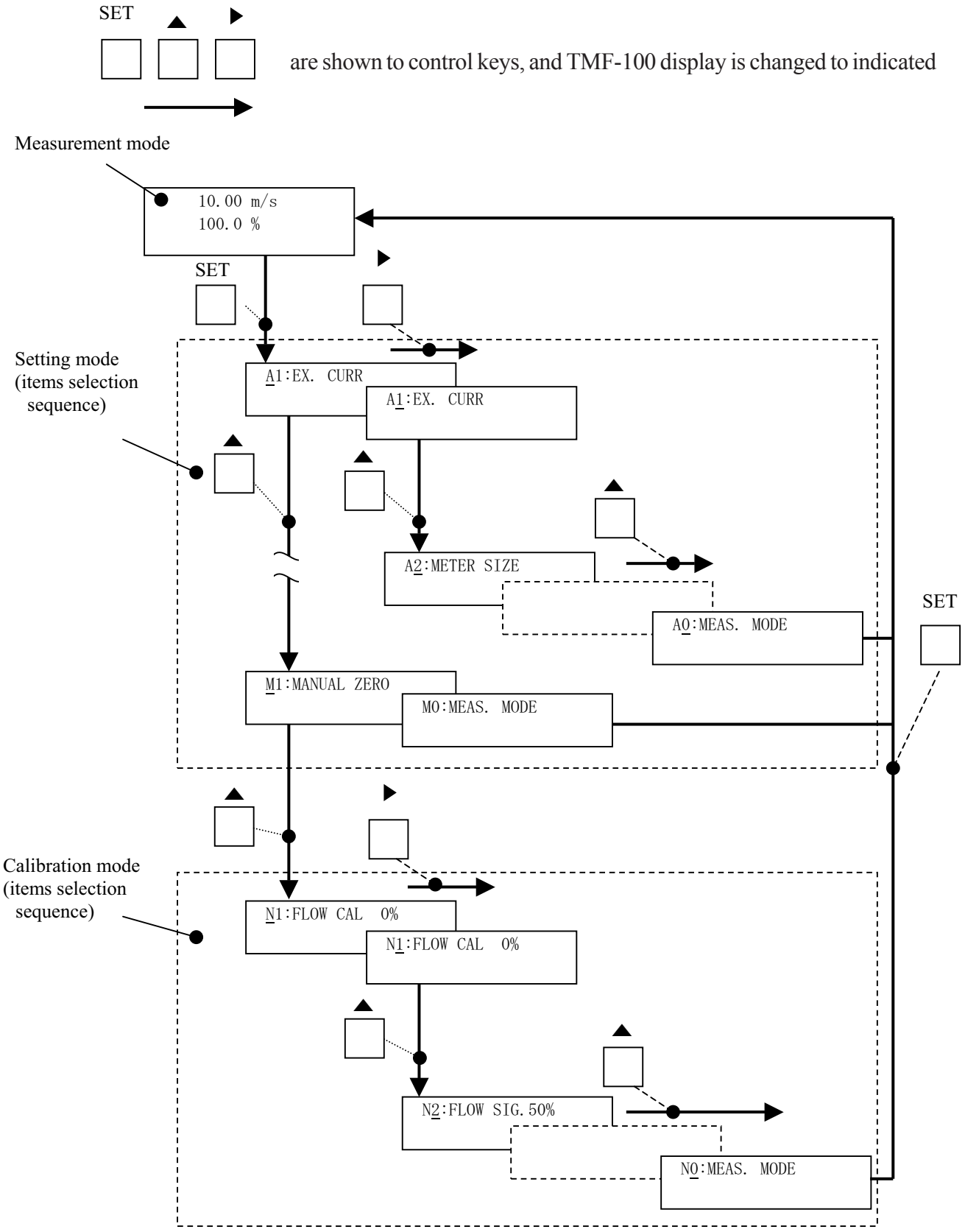
■ **Setting mode**

: used to check or change various configuration parameters used in the measurement mode. These parameter values are displayed while checking or changing these values but the flowmeter outputs the measured process values as in the measurement mode. See 7.4, "Configuration Items Selection Table" and 8.2, "Checking or Changing Parameters" for details. Configuration items are from A1, A2, A3 to M1.

■ **Calibration mode**

: used to check the converter internal circuits. The internally generated simulation signal is used to check the measuring span and excitation current value. The current output of the flowmeter changes in accordance with the simulation signal. The status of each digital output is held to the value just before the system moved into the calibration mode. See 7.4, "Configuration Items Selection Table" and Chapter 9, "Calibration" for details. Configuration items are from N1 to N4.

Change mode flow



7.3.2 Configuration Parameter Selection in Setting and Calibration Modes

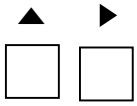
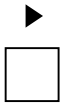
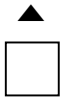
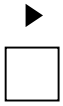
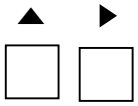
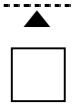
Proceed as follows to select the desired items, to check or change the item value.

■ **To select the desired item :**

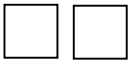
Key operation	Display example	Description
	10.00 m/s 100.0 %	Measure value displays.(Measuremento mode)
SET □	A1: EX. CURR.	Pressing [SET], the system changes to the items selection sequence. **(Note)** And the cursor appears under alphabet (A).
▲ □	B1: UNIT1	Change the alphabet to "B" by pressing [▲]. * If cursor is the number, the number is increased by pressing [▲].
▶ □	B1: UNIT1	Then move the cursor to the number by pressing [▶] * If cursor is the number, the cursor is changed to the alphabet by pressing [▶].
▲ ▶ □ □	C2: RANGE 1	Selects the desired item (indicated by an alphabet letter and a number) first by selecting the digit (alphabet or number) with [▶] and then changing the value with [▲]. The example shows "C2:RANGE 1"

Note: See 7.5"Password Input"for details about Password-input mode

■ **To change the value:**

Key operation	Display example	Description
	C2: RANGE 1	Items selection sequence displays. Selects the desired item (indicated by an alphabet letter and a number) first by selecting the digit (alphabet or number) with [▶] and then changing the value with [▲].The example shows “C2:RANGE 1”
SET 	C2: RANGE 1 02.000 m/s	Press [SET] to select the desired item setting value. And the cursor disappears and the item setting value displays. You can check it.
	C2: RANGE 1 02.000 m/s	Pressing [▶], the cursor appears. Parameter changing sequence
	C2: RANGE 1 12.000 m/s	Change the value by pressing [▲].
	C2: RANGE 1 12.000 m/s	Then move the cursor to another digit by pressing [▶].
	C2: RANGE 1 05.000 m/s	Change the value by pressing [▲]. Then move the cursor to another digit by pressing [▶] and change the value. In this example repeat this process until the display shows “05. 000m/s
SET 	C2: RANGE 1 05.000 m/s	By pressig [SET], flickers the selected value to confirm changes made for the selected item.
	C2: RANGE 1 02.000 m/s	By pressing [▲], to return to the parameter changing sequence.
SET 	C2: RANGE 1 05.000 m/s	By pressing [SET], stores the indicated value and stop flickering of data.

■ **To return to measurement value:**

Key operation	Display example	Description
	C2: RANGE 1 0.5000 m/s	Checking the setting value or after setted the value.
SET 	C2: RANGE 1	By pressing [SET], return to the items selection sequence.
▶ 	C2: RANGE 1	Items selection sequence displays. Then move the cursor to the number by pressing [▶] * If cursor is the number, the number is changed to the alphabet by pressing [▶].
▲ 	C3: RANGE 2	Change the alphabet to "B" by pressing [▲]. * If cursor is the number, the number is increased by pressing [▲].
▲ ▶ 	C0: MEAS. MODE	By pressing [▶] and [▲], select "0:MEAS. MODE" The example shows "C0:MEAS. MODE"
SET 	10.00 m/s 100.0 %	Pressing [SET], returns to measurement mode.

7.4 Configuration Items Selection Table

In the setting and calibration modes, configuration items can be selected as shown below. For example, the excitation current can be selected by the item A1. To change the parameters for the selected items, see the following chapters. To return to the measurement mode, select “0” for the number (such as A0).

Setting mode items (A1, A2, A3 to M1): See Chapter 8, “Configuration Parameter Setting.” Calibration mode item (N1 to N4): See Chapter 9, “Calibration.”

	0	1	2	3	4	5	6
A	*1	Excitation Current *2	Meter Size *2	Excitation Frequency *2	Password *2		
B	*1	Indicating Unit 1	Indicating Unit 2				
C	*1	Range Type *2	Range 1 *2	Range 2 *2	Range 3 *2	Range 4 *2	Range Hysteresis *2
D	*1	Damping Constant	Low Cutoff	4-20 mA Alm. Output *2			
E	*1	Zero Adjustment					
F	*1	DO1 Function *2	DO2 Function *2	DI Function *2	DO1 Alarm Active Set *2	DO2 Alarm Active Set *2	DI Det.Level *2
G	*1	Counting Rate * 2	Pulse Width *2				
H	*1	Preset Count *2	Preset Funct *2				
I	*1	High Alarm Set *2	High Alarm Value *2	Low Alarm Set *2	Low Alarm Value *2		
J	*1	Empty Pipe Alarm					
K	*1	Rate-of-change Limit	Control Limit Time				
L	*1	Fixed-value Output *2	Fixed-current Output *2	Fixed-pulse Output *2			
M	*1	Zero Offset Adjustment					
N	*1	Flow Rate Cal 0% *2	Flow Rate Sig 50% *2	Flow Rate Cal 100% *2	Exciting Current Check		

*1: Returns to the measurement mode.
*2: Password-protected parameter

7.5 Password Input

The converter for special specifications have the password .That protects from calibrating and changing part of parameter that influences measurement.
See 7.4 ”Configuration Items Selection Table” for details of password-protected parameter.

* See 8.2.17 “Password” for password change and check procedure
* Setting ‘000’ to the password disables protection allowing review/change of all parameters.

■ **To input password:**

The following example shows how to input password.
Example: 123

Key operation	Display example	Description
	10.00 m/s 100.0 %	Measure value displays.(Measuremento mode)
SET □	PASSWORD INPUT 000	Pressing [SET], password input mode and the cursor appears.
▲ □	PASSWORD INPUT 100	Change the value by pressing [▲].
▲ ▶ □ □	PASSWORD INPUT 100 120 123	Move the cursor to another digit by pressing [▶] and change the value by pressing [▲]. In this example repeat this process until the display shows “123.”
SET □	PASSWORD INPUT 123	Pressing [SET], the cursor disappears and the changed display flickers. Press [SET] again to input the value.
SET □	A1: EX. CURR.	Whether input password agrees or dose not agree , the items selection sequence, “A1:EX. CURR” appears. But if input password does not agree, you can not change setting parameter and calibrate. See 7.4 ”Configuration Items Selection Table” for details.

8. Configuration Parameter Setting

8.1 Configuration Items

To check or change parameters, first select the desired configuration item as described in 7.3.2. The configuration items are listed below. See each section for detailed procedure.

Section	Configuration item	Display example	
8.2.1	Excitation Current	A1: EX. CURR.	0.2100 A
8.2.2	Meter Size	A2: METER SIZE	50 mm
8.2.3	Excitation Frequency	A3: EX. FREQ.	24 Hz
8.2.4	Indicating unit	B1: UNIT 1	m/s
8.2.5	Range Type Span (range) Hysteresis	C1: RANGE TYPE C2: RANGE 1 C6: RANGE HYST	1:SINGLE 01.000 m/s 05.0 %
8.2.6	Damping Constant	D1: DAMPING	05.0 s
8.2.7	Low Cutoff	D2: LOW CUT	05.0 %
8.2.8	Zero Adjustment	E1: ZERO ADJUST.	0.1 %
8.2.9	Digital I/O	F1: DO1 FUNCT.	1: H ALM
8.2.10	Counting Rate Pulse Width	G1: COUNT RATE G2: PLS. WIDTH	6.00E-11 020 ms
8.2.11	Preset Count	H1: PRESET COUNT	00009000
8.2.12	High/Low Alarm Alarm Limit Value	I1: H.ALARM SET I2: H.ALARM VAL	ON +100.0 %
8.2.13	Empty Pipe Alarm	J1: EMPTY ALM	0:OFF
8.2.14	Rate-of-change Limit Control Limit Time	K1: LIMIT RATE K2: LIMIT TIME	05.5 % 01 s
8.2.15	Fixed-value Output	L1: FIXED OUT	OFF
8.2.16	Zero Offset Adjustment	M1: MANUAL ZERO	-000.1 %
8.2.17	Password *	A4: PASSWORD	123
8.2.18	4-20mA Alarm Output *	D3: 4-20 ALM.OUT	1:4.0mA
8.2.19	DI detective Level *	F6: DI DET.LEVEL	1: H LEVEL
8.2.20	Preset Function *	H2: PRESET FUNCT	0:HOLD

8.2 Checking or Changing Parameters

8.2.1 Excitation Current

Proceed as follows to check or change the excitation current setting value.

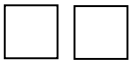
■ **To check the exciting current setting value:**

Key operation	Display example	Description
SET 	A2: METER SIZE 50mm	Press [SET] first to start the items selection sequence and select **A2: METER SIZE** from among the configuration items using [▶] and [▲] keys. Then press [SET] again to display the exciting current setting value.
SET 	A2: METER SIZE 50mm	Pressing [SET], the system returns to the items selection sequence.

■ **To change the excitation current setting value:**

IMPORTANTThe exciting current value is factory set when shipped. Do not change the value unless the value differs from that written on the nameplate of the flowmeter.

The following example shows how to change the excitation current setting value from 0.1900A to 0.2150A.

Key operation	Display example	Description
SET 	**A1: EX. CURR.** **0.1900A**	Press [SET] first to start the items selection sequence and select **A1: EX. CURR** from among the configuration items using [▶] and [▲] keys. Then press [SET] again to display the excitation current setting value (0.1900 A in this example).
▶ 	**A1: EX. CURR.** **0.1900A**	Pressing [▶], the cursor appears. Then press [▶] as many times as necessary to move the cursor to the digit to be changed.
▲ ▶ 	**A1: EX. CURR.** **0.2900A** **0.2100A** **0.2150A**	Change the value by pressing [▲]. Then move the cursor to another digit by pressing [▶] and change the value. In this example repeat this process until the display shows "0.2150A." **(Note)**
SET 	**A1: EX. CURR.** **0.2150A**	Pressing [SET], the cursor disappears and the changed display flickers. Press [SET] again to save the value.
SET 	**A1: EX. CURR.**	Pressing [SET], the system returns to the items selection sequence.

Note: The valid range is from 0.0500A to 0.2300A. If you try to set the value above 0.2400A, the error message * H. OVER SPEC appears. Set the value within the valid range.

8.2.2 Meter Size

Proceed as follows to check or change the meter size of the detector.

■ **To check the meter size:**

Key operation	Display example	Description
SET □	**A1: EX. CURR.** **0.2100A**	Press [SET] first to start the items selection sequence and select **A1: EX. CURR.** from among the configuration items using [▶] and [▲] keys. Then press [SET] again to display the exciting current setting value.
SET □	**A1: EX. CURR.**	Pressing [SET], the system returns to the items selection sequence.

■ **To change the meter size:**

> **IMPORTANT**Meter size is factory set when shipped. Do not change the meter size unless it differs from the specified value.

The following example shows how to change the meter size from 50 mm to 100 mm.

Key operation	Display example	Description
SET 	**A2: METER SIZE** **50 mm**	Press [SET] first to start the items selection sequence and select **A2: METER SIZE** from among the configuration items using [▶] and [▲] keys. Press [SET] again to display the current meter size (50 mm in this example).
▶ 	**A2: METER SIZE** **5<u>0</u> mm**	Pressing [▶], the cursor appears.
▲ 	**A2: METER SIZE** **10<u>0</u> mm**	Select "100 mm" by pressing [▲] as many times as necessary. **(Note)**
SET 	**A2: METER SIZE** **100 mm**	Pressing [SET], the cursor disappears and the changed display flickers. Press [SET] again to save the value.
SET 	**<u>A</u>2: METER SIZE**	Pressing [SET], the system returns to the items selection sequence.

Note: The meter size is changed as shown below by pressing [▲].

→ 2.5 mm ⋯ 15 mm → 100 mm ⋯ 600 mm → 0.1 in ⋯ 0.5 in → 4 in ⋯ 24 in ⟶

If the meter size has been changed, other values (such as span and counting rate) will be affected depending on the measuring unit used. Therefore, check those values if you have changed the meter size.

8.2.3 Excitation Frequency

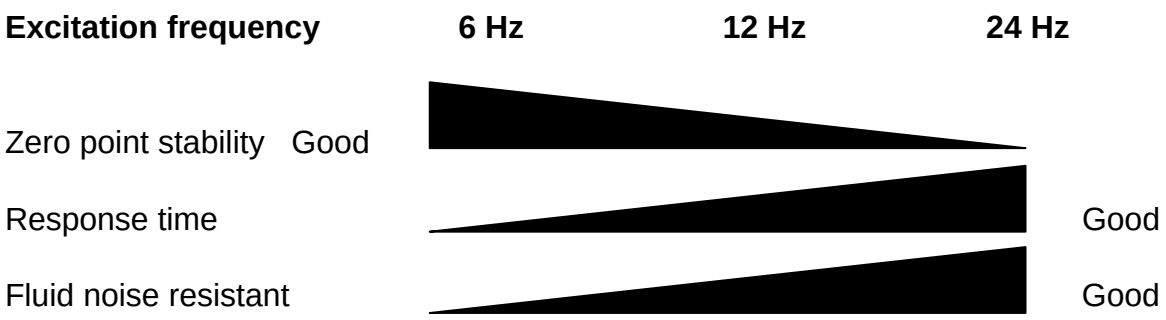
Proceed as follows to check or change the excitation frequency.

■ **To check the excitation frequency:**

Key operation	Display example	Description
SET 	**A3: EX. FREQ.** **24 Hz**	Press [SET] first to start the items selection sequence and select **A3: EX. FREQ.** from among the configuration items using [▶] and [▲] keys. Then press [SET] again to display the current excitation frequency.
SET 	**A3: EX. FREQ.**	Pressing [SET], the system returns to the items selection sequence.

■ **To change the excitation frequency:**

The excitation frequency can be selected from 6 , 12 and 24 Hz. The characteristics of the flowmeter change in accordance with the selected frequency as shown below. 24 Hz is the default setting when shipped from the factory.



The following example shows how to change the excitation frequency from 24 Hz to 12 Hz.

Key operation	Display example	Description
SET □	**A3: EX. FREQ.** **24 Hz**	Press [SET] first to start the items selection sequence and select **A3: EX. FREQ.** from among the configuration items using [▶] and [▲] keys. Press [SET] again to display the current excitation frequency (24 Hz in this example).
▶ □	**A3: EX. FREQ.** **2<u>4</u> Hz**	Pressing [▶], the cursor appears.
▲ □	**A3: EX. FREQ.** **1<u>2</u> Hz**	Select "12 Hz" by pressing [▲] twice. The excitation frequency changes as follows: 6 Hz → 12 Hz → 24 Hz →
SET □	**A3: EX. FREQ.** **12 Hz**	Pressing [SET], the cursor disappears and the changed display flickers. Press [SET] again to save the value.
SET □	**<u>A</u>3: EX. FREQ.**	Pressing [SET], the system returns to the items selection sequence.

8.2.4 Indicating Unit

You can select one of the 29 engineering units listed below as an indicating unit.

- **Flow velocity:** m/s, (ft/s)
- **Flow rate:** m^3/s, m^3/min, m^3/h, m^3/d
  l/s, l/min, l/h, l/d
  ml/s, ml/min, ml/h, ml/d
  (bbl/s), (bbl/min), (bbl/h), (bbl/d)
  (gal/s), (gal/min), (gal/h), (gal/d)
- **Volumetric flow (totalized flow):** m^3, l, ml, (gal)
- **Other units:** %, COUNT (totalized flow without a unit), RANGE (1 to 4)
- **(• Code of volumetric flow direction:**
  F(fixed forward flow), R(fixed reverse flow),
  B(automatic selection bi-directional flow) **)**

Notes

1. Units in parentheses, such as “bbl”, “gal” and “ft” are shown only when the meter size is selected in inches. They are not shown when the meter size is selected in mm.
2. If COUNT or RANGE is selected, the display is shown as follows:
   COUNT: displays totalized flow counts (8 digits) without a unit.
   RANGE: displays the range number (1 to 4).

Two indicating units (primary unit: UNIT 1, secondary unit: UNIT 2) can be selected. Proceed as follows to check or change these two indicating units.

■ **To check the indicating units:**

Key operation	Display example	Description
SET □	**B1: UNIT 1** **%**	Press [SET] first to start the items selection sequence and select **B1: UNIT 1** from among the configuration items using [▶] and [▲] keys. Then press [SET] again to display the current primary indicating unit.
SET □	**B1: UNIT 1**	Pressing [SET], the system returns to the items selection sequence.

Primary indicating unit and secondary indicating unit can be selected by the following configuration items:

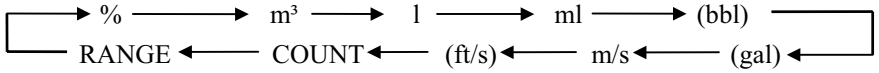
B1: UNIT 1 primary indicating unit
B2: UNIT 2 secondary indicating unit

■ **To change the indicating unit (1):**

The following example shows how to change the primary indicating unit from % to ml/s.

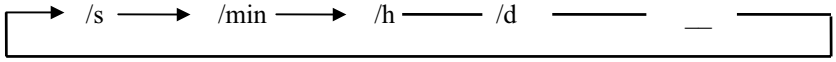
Key operation	Display example	Description
SET □	**B1: UNIT 1** **%**	Press [SET] first to start the items selection sequence to select **B1: UNIT 1** from among the configuration items using [▶] and [▲] keys Then press [SET] again to display the current primary indicating unit (% in this example).
▶ □	**B1: UNIT 1** **%**	Pressing [▶], the cursor appears.
▲ □	**B1: UNIT 1** **ml B**	Select "ml" as the first unit of primary indicating unit by pressing [▲] as many times as necessary. **(Note1)**
▶ □	**B1: UNIT 1** **ml _ B**	Pressing [▶], the cursor moves to the second unit (time unit) of primary indicating unit.
▲ □	**B1: UNIT 1** **ml/s**	Select "s" as the second unit (time unit) of primary indicating unit by pressing [▲] as many times as necessary. **(Note 2)**
SET □	**B1: UNIT 1** **ml/s**	Pressing [SET], the cursor disappears and the changed display flickers. Press [SET] again to save the unit.
SET □	**B1: UNIT 1**	Pressing [SET], the system returns to the item selection sequence.

Notes: 1. The first unit (volumetric units etc.) changes as shown below:



Units in parentheses, such as "bbl", "gal" and "ft" are shown only when the meter size is selected in inches. They are not shown when the meter size is selected in mm.

2. The second unit (time unit) changes as shown below:

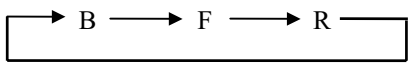


■ **To change the indicating unit (2):**

The following example shows how to change the primary indicating unit from m^3F to m^3R.

Key operation	Display example	Description
SET 	**B1: UNIT 1** **m^3 F**	Press [SET] first to start the items selection sequence to select **B1: UNIT 1** from among the configuration items using [▶] and [▲] keys Then press [SET] again to display the current primary indicating unit (m^3 F in this example).
▶ 	**B1: UNIT 1** **m^3 F**	Pressing [▶], the cursor appears.
▶ 	**B1: UNIT 1** **m^3 F**	Pressing [▶], the cursor moves to the second unit (time unit) of primary indicating unit.
▶ 	**B1: UNIT 1** **m^3 F**	Pressing [▶], the cursor moves to the third unit (code of volumetric flow direction) of primary indicating unit.
▲ 	**B1: UNIT 1** **m^3 R**	Select "R" as the third unit (code of volumetric flow direction) of primary indicating unit by pressing [▲] as many times as necessary. **(Note 1)**
SET 	**B1: UNIT 1** **m^3 R**	Pressing [SET], the cursor disappears and the changed display flickers. Press [SET] again to save the unit.
SET 	**B1: UNIT 1**	Pressing [SET], the system returns to the item selection sequence.

Notes. The third unit (code of volumetric flow direction) changes as shown below:



8.2.5 Span (range)

You can set the following constants in this setting item:

(1) Range type
(2) Span
(3) Unit of span (can be changed only in range 1)
(4) Hysteresis

(1) Range type

You can select a single range or multiple ranges. Select one from five types shown below:

Range type	Description
1. SINGLE	Single range
2. 4F-0R	Unidirectional flow, automatic selection of multiple ranges
3. 2F-2R	Bidirectional flows, automatic selection of multiple ranges
4. EXT. 2F-0R	Unidirectional flow, multiple ranges selected by external signal
5. EXT. 2F-2R	Bidirectional flows, multiple ranges selected by external signal

(2) Span (range)

■ Span can be set and displayed as follows for flow velocity and flow rates:

- Flow velocity: 01.000 m/s (three digits after the decimal point)
- Flow rates: 2.83E+3 m/H (three digits and exponential)

■ Valid range of span is 0.1 m/s to 10 m/s in terms of flow velocity.

If you try to set the span outside of this range, one of the following messages appears:
* H. OVER SPEC. (if the set value exceeds 10 m/s)
* L. OVER SPEC. (if the set value is less than 0.1 m/s)

Try again to set the span within the specified range.

■ When multiple ranges are used, the following must be observed:

- Range 1 > Range 2 > Range 3 > Range 4 (unidirectional flow, multiple ranges)
- Range 1 > Range 2, Range 3 > Range 4 (bidirectional flows, multiple ranges)

If you try to set the ranges not conforming to the above, the following message appears:
* MULTI RNG ERR

Try again to set the ranges as specified above.

■ Totalization counting rate

If you have changed the span while the counting rate is set for totalization, the counting rate for 100% output may have exceeded the maximum counting capacity.
In this kind of event, the following message appears and the system goes to the counting rate setting sequence.
* H. OVER C RATE or L. OVER C RATE

Set the counting rate (See 8.2.10”Counting Rate”) for the newly set span.

(3) Unit of span

One of the following engineering units for the span be selected. The unit is set for the range 1 and the same unit applies automatically to other ranges—range 2, range 3 and range 4.

- **Flow velocity:** m/s, (ft/s)
- **Flow rate:** m^3/s, m^3/min, m^3/h, m^3/d
  l/s, l/min, l/h, l/d
  ml/s, ml/min, ml/h, ml/d
  (bbl/s), (bbl/min), (bbl/h), (bbl/d)
  (gal/s), (gal/min), (gal/h), (gal/d)

Units in parentheses, such as “bbl”, “gal” and “ft” are shown only when the meter size is selected in inches. They are not shown when the meter size is selected in mm.

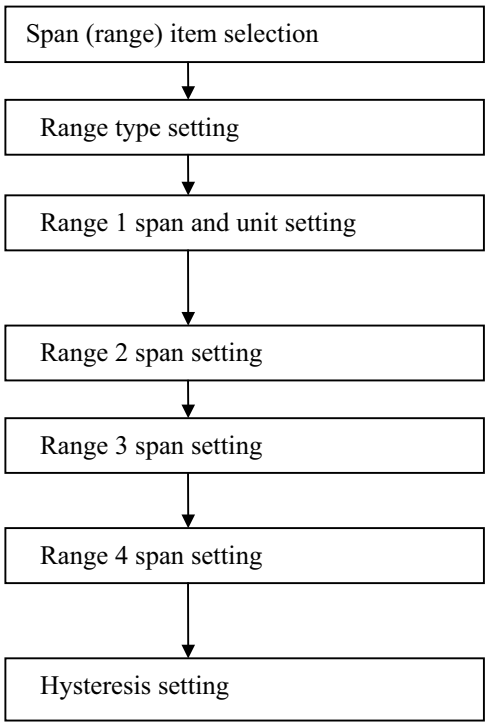
If you change the unit, the new span based on the newly set unit will be automatically displayed.

(4) Hysteresis

The hysteresis is the dead band used when multiple ranges are switched. The hysteresis can be set from 0 to 25% in increments of 0.1%. The hysteresis setting is needed only when automatic selection of multiple ranges is used.

[The setting sequence]

The following is the setting sequence of span (range).



If multiple range is selected, compulsory range 1 to range 4 and hysteresis settings are displayed.

■ **To check each constant:**

Key operation	Display example	Description
SET 	**C2: RANGE 1** **02.000 m/s**	Press [SET] first to start the items selection sequence and select **C2: RANGE 1** from among the configuration items using [▶] and [▲] keys. Then press [SET] again to display the current span for Range 1.
SET 	**C2: RANGE 1**	Pressing [SET], the system returns to the items selection sequence.

Range type, Span. Hysteresis can be selected by the configuration items as follows:

Range type	C1:	RANGE TYPE
Span of Range 1	C2:	RANGE 1
Span of Range 2	C3:	RANGE 2
Span of Range 3	C4:	RANGE 3
Span of Range 4	C5:	RANGE 4
Hysteresis	C6:	RANGE HYST

■ **To change the range type:**

Range type should be changed before changing the span.
The following example shows how to change the range type from 1 to 3.

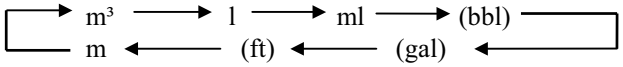
Key operation	Display example	Description
SET 	**C1: RANGE TYPE** **1:SINGLE**	Press [SET] first to start the items selection sequence and select **C1: RANGE TYPE** from among the configuration items using [▶] and [▲] keys. Then press [SET] again to display the current range type.
▶ 	**C1: RANGE TYPE** **1:SINGLE**	Pressing [▶], the cursor appears.
▲ 	**C1: RANGE TYPE** **3:2F-2R**	Select Range type 3 (3: 2F-2R) by pressing [▲] twice.
SET 	**C1: RANGE TYPE** **3:2F-2R**	Pressing [SET], the cursor disappears and the changed display flickers. Press [SET] again to store the changed type.
SET 	**C1: RANGE TYPE**	Pressing [SET], the system returns to the items selection sequence.

■ **To change the span (range):**

The following example shows how to change the span of Range 1 from 2.0 m/s to 100 l/min.

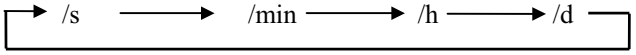
Key operation	Display example	Description
SET □	**C2: RANGE 1** **02.000 m/s**	Press [SET] first to start the items selection sequence and select **C2: RANGE 1** from among the configuration items using [▶] and [▲] keys. Then press [SET] again to display the current span of Range 1 (2.0 m/s in this example).
▶ □	**C2: RANGE 1** **02.000 m/s**	Pressing [▶], the cursor appears. Then press [▶] as many times as necessary to move the cursor to the position for the measuring unit.
▲ □	**C2: RANGE 1** **3.93E+0 l/s** **2.36E+2 l/min**	Select "l" as the first unit of the measuring unit by pressing [▲] as many times as necessary. **(Note1)** Similarly, pressing [▶] to move the cursor to the second unit (time unit), select "min." **(Note 2)** (The displayed span automatically changes in accordance with the newly selected unit.)
▶ □	**C2: RANGE 1** **2.36E+2 l/min**	Press [▶] as many times as necessary to move the cursor to the digit of span to be changed.
▲ □	**C2: RANGE 1** **1.36E+2 l/min** **1.00E+2 l/min**	Change the value by pressing [▲]. Then move the cursor to another digit by pressing [▶] and change the value. In this example repeat this process until the display shows "1.00E+2"(=100) l/m.
SET □	**C2: RANGE 1** **1.00E+2 l/min**	Pressing [SET], the cursor disappears and the changed display flickers. Press [SET] again to store the changed span and unit.
SET □	**C2: RANGE 1**	Pressing [SET], the system returns to the items selection sequence.

Notes 1. The first unit of the measuring unit changes as shown below:



Units in parentheses (bbl, ft and gal) are shown only when the meter size is selected in inches.

2. The second unit of the measuring unit changes as shown below:



However, the following first and second unit combinations cannot be selected: m/min, m/h, m/d, ft/min, ft/h, ft/d.

■ **To change the hysteresis:**

The hysteresis is set at 3% (default) when shipped from the factory.
The following example shows how to change the hysteresis from 3% to 5%.

Key operation	Display example	Description
SET 	**C6: RANGE HYST** **03.0 %**	Press [SET] first to start the items selection sequence and select **C6: RANGE HYST** from among the configuration items using [▶] and [▲] keys. Then press [SET] again to display the current hysteresis (3.0% in this example).
▶ 	**C6: RANGE HYST** **03.0 %**	Pressing [▶], the cursor appears.
▶ 	**C6: RANGE HYST** **03.0 %**	Press [▶] to move the cursor to the desired digit to change.
▲ 	**C6: RANGE HYST** **05.0 %**	Change the value to "5" by pressing [▲] twice. (if necessary, move the cursor to another digit and change the value).**(Note)**
SET 	**C6: RANGE HYST** **05.0 %**	Pressing [SET], the cursor disappears and the changed display flickers. Press [SET] again to store the changed hysteresis.
SET 	**C6: RANGE HYST**	Pressing [SET], the system returns to the item selection sequence.

Note: If you try to set the hysteresis above 25.0 %, an error message "* H. OVER SPEC." appears.

8.2.6 Damping Constant

The damping constant is used to moderate output fluctuations. (The larger the damping constant, the more the output is averaged. But the response to an input change will be slower.) The damping constant can be set as follows:

0.0 sec, 0.5 sec and 1 to 60 sec (in increments of 1 second)

Note: 0.0 sec setting will work as equal to 0.1 sec damping constant.
Setting value exceeding 60 sec will be automatically set to 60 sec.

Proceed as follows to check or change the damping constant.

■ **To check the damping constant:**

Key operation	Display example	Description
SET 	**D1: DAMPING** **02.0 s**	Press [SET] first to start the items selection sequence and select **D1: DAMPING** from among the configuration items using [▶] and [▲] keys. Then press [SET] again to display the current damping constant.
SET 	**D1: DAMPING**	Pressing [SET], the system returns to the items selection sequence.

■ **To change the damping constant:**

The following example shows how to change the damping constant from 0.5 sec to 10 sec.

Key operation	Display example	Description
SET □	**D1: DAMPING** **00.5 s**	Press [SET] first to start the items selection sequence and select **D1: DAMPING** from among the configuration items using [▶] and [▲] keys. Then press [SET] again to display the current damping constant (0.5 s).
▶ □	**D1: DAMPING** **00.5 s**	Pressing [▶], the cursor appears. (If necessary, press [▶] to move the cursor to the digit to be changed.)
▲ □	**D1: DAMPING** **10.5 s 10.0 s**	Change the value to "1" by pressing [▲]. Then move the cursor to another digit by pressing [▶] and change the value. In this example repeat this process until the display shows "10.0 s." **(Note)**
SET □	**D1: DAMPING** **10.0 s**	Pressing [SET], the cursor disappears and the changed display flickers. Press [SET] again to store this data.
SET □	**D1: DAMPING**	Pressing [SET], the system returns to the items selection sequence.

8.2.7 Low Cutoff

The low cutoff is the value set just above 0% flow rate. Flow rates below this level are treated as 0% and subsequent outputs as 0% current output. The low cutoff can be set from 0 to 10% of the span and in increments of 0.1%. Proceed as follows to check or change the low cutoff value.

■ **To check the low cutoff value:**

Key operation	Display example	Description
SET 	**D2: LOW CUT** **01.0 %**	Press [SET] first to start the items selection sequence to select **D2: LOW CUT** from among the configuration items using [▶] and [▲] keys. Press [SET] again to display the current low cutoff value.
SET 	**D2: LOW CUT**	Pressing [SET], the system returns to the items selection sequence.

■ **To change the low cutoff value:**

The following example shows how to change the low cutoff value from 1.0 % to 3.0 %.

Key operation	Display example	Description
SET □	**D2: LOW CUT** **01.0 %**	Press [SET] first to start the items selection sequence and select **D2: LOW CUT** from among the configuration items using [▶] and [▲] keys. Press [SET] again to display the current low cutoff value (1.0% in this example).
▶ □	**D2: LOW CUT** **01.0 %**	Pressing [▶], the cursor appears. Then press [▶] to move the cursor to the digit to be changed.
▲ □	**D2: LOW CUT** **03.0 %**	Change the value to "3" by pressing [▲] twice. **(Note)** (If necessary, move the cursor to another digit by pressing [▶] and change the value.)
SET □	**D2: LOW CUT** **03.0 %**	Pressing [SET], the cursor disappears and the changed display flickers. Press [SET] again to store the value.
SET □	**D2: LOW CUT**	Pressing [SET], the system returns to the items selection sequence.

Note: If you try to set the low cutoff value above 10 % of the span, an error message * H. OVER SPEC appears. Set the value within the specified range.

8.2.8 Zero Adjustment

To conduct the zero adjustment of the flowmeter, the fluid in the detector pipe must be held still.

- If the fluid cannot be stilled by any means, see 8.2.16, "Zero Offset Adjustment."

To start the zero adjustment, follow the procedure described below.

Key operation	Display example	Description
SET □	**E1: ZERO DJUST** **01.0 %**	Press [SET] first to start the items selection sequence and select **E1: ZERO ADJUST** from among the configuration items using [▶] and [▲] keys. Then press [SET] again to display the current flow rate (1.0% in this example).
▶ □	**ADJUST READY** **01.1 %**	Pressing [▶], "**ADJUST READY**" appears as shown left and the system is ready for zero adjustment. **(Note 1)**
SET □	*** ZERO ADJUST**	Pressing [SET], "*** ZERO ADJUST**" appears as shown left and the system starts the zero adjustment. The zero adjustment takes about 3 to 6 seconds. **(Note 2)**
————	**E1: ZERO ADJUST** **00.0 %**	Newly adjusted zero point appears.
SET □	**E1: ZERO ADJUST**	Pressing [SET], the system returns to the items selection sequence.

Notes

1. To cancel the zero adjustment, press [♦]. The system returns to the point where zero point is displayed.
2. Zero adjustment duration depends on the excitation frequency (24 Hz: 3 sec, 12 Hz and 6 Hz: 6 sec).

8.2.9 Digital I/O

You can select the various digital I/O functions shown below. See Chapter 10, ”Digital I/O Functions.” for details.

■ **Digital Output Functions (DO1 is standard and DO2 is optional)**

DO1, DO2 items	Digital output functions
0: NO USE	Not used
1: H ALM	High limit alarm output
2: L ALM	Low limit alarm output
3: EMPTY ALM	Empty pipe alarm output
4: RNG SIG 1	Multi-range output No. 1
5: RNG SIG 2	Multi-range output No. 2
6: PRESET	Preset point output
7: CONV. ALM	Converter failure alarm output
8: PULSE OUT	Pulse output (automatic selection bi-directional flow) **(Note 1)**
9: PULSE OUT FRD.	Pulse output (fixed forward flow) **(Note 1)**
A: PULSE OUT REV.	Pulse output (fixed reverse flow) **(Note 1)**

Note 1: Pulse output can be chosen only for DO1(8:PULSE OUT).

■ **Digital Input Function**

DI function	Digital input function
0: NO USE	Not used
1: C STA/STP	Totalizer Start/Stop
2: C RES/STA	Totalizer Reset/Start
3: RANGE SW	Remote selection of multi-range
4: ZERO ADJ.	Zero adjustment start
5: FIXED OUT	Fixed-value output control

■ **Digital Output Active Status (Only for Alarm outputs)**

DO1, DO2 Items	Output Action
0: NORMAL CLOSE	Normal; contact close, Alarm out; contact open **(Note 2)**
1: NORMAL OPEN	Normal; contact open, Alarm out; contact close **(Note 2)**

■ **Digital Input Detective Level (Only for Counter Control)**

Proceed as follows to check or change the digital I/O functions.

■ **To check the digital I/O functions:**

Key operation	Display example	Description
SET 	**F1: DO1 FUNCT.** **1:H ALM**	Press [SET] first to start the items selection sequence and select **F1: DO1 FUNCT.** from among the configuration items using [▶] and [▲] keys. Then press [SET] again to display the current DO1 function.
SET 	**F1: DO1 FUNCT.**	Pressing [SET], the system returns to the items selection sequence.

Digital output 1 (DO1), digital output 2 (DO2) and digital input (DI) can be selected by the configuration items as follows:

Digital output 1 (DO1)	F1: DO1 FUNCT.
Digital output 2 (DO2)	F2: DO2 FUNCT.
Digital input (DI)	F3: DI FUNCT.
Active status of DO1	F4: DO1 ALM ACT.
Active status of DO2	F5: DO2 ALM ACT.

The active status of Digital output can be selected from Normal Open and Normal Close for Alarm outputs which are the Converter alarm, the High/Low limit alarm and the Empty alarm. If the function except these alarms is selected as DO1 or DO2 function, the active status is ignored.

■ **To change the digital I/O functions:**

The following example shows how to change the DO1 function from No. 1 to No. 3.

Key operation	Display example	Description
SET 	**F1: DO1 FUNCT.** **1:H ALM**	Press [SET] first to start the items selection sequence and select **F1: DO1 FUNCT.** from among the configuration items using [▶] and [▲] keys. Then press [SET] again to display the current DO1 function (1: H ALM in this example).
▶ 	**F1: DO1 FUNCT.** **1:H ALM**	Pressing [▶], the cursor appears.
▲ 	**F1: DO1 FUNCT.** **3:EMPTY ALM**	Change the value to "3" by pressing [▲] twice.
SET 	**F1: DO1 FUNCT.** **3:EMPTY ALM**	Pressing [SET], the cursor disappears and the new DO1 function display flickers. Press [SET] again to save the new function.
SET 	**F1: DO1 FUNCT.**	Pressing [SET], the system returns to the items selection sequence.

8.2.10 Counting Rate (pulse rate)

When the totalizer is used for total flow measurement, per-count (pulse) value is the counting rate. Pulse output is also available for external totalization. In this item, the counting rate and the pulse width for pulse output can be checked or changed. The counting rate is set using three digits and exponential quotient.

For example, 0.123 m^3 ❻ 1.23E–1 m^3
(1.23 x 10^{-1} m^3)

Proceed as follows to check or change the counting rate.

■ **To check the counting rate and pulse width:**

Key operation	Display example	Description
SET □	**G1: COUNT RATE** **1.00E–2m³**	Press [SET] first to start the items selection sequence and select **G1: COUNT RATE** from among the configuration items using [▶] and [▲] keys. Then press [SET] again to display the current counting rate.
SET □	**G1: COUNT RATE**	Pressing [SET], the system returns to the items selection sequence.

Counting rate and pulse width can be selected by the configuration items as follows:

Counting rate	G1: COUNT RATE
Pulse width	G2: PLS. WIDTH

NOTES

1. The counting rate should be set so that its rate for 100% flow rate output is within the range from 3.6 to 3600000 pulses/h. If you try to set the counting rate outside of this range, an error message * H. OVER SPEC or * L. OVER SPEC appears.
   Set the counting rate within the specified range.

Example
Case Range:3600m^3/h (1m^3/s)

Counting rate (pulse rate)
Min.: 3600(m^3/h) / 3600000(pulses/h) =0.001 m^3=1 l
Max.: 3600(m^3/h) / 3.6(pulses/h) =1000 m^3

2. The pulse width can be set from 0.5ms to 500ms. The pulse width should be set to less than half of the pulse rate for 100% flow rate output. Even if the value over 500ms is inputted, the pulse width is set to 500ms.
   When the pulse width is set to 0 (zero), it will be automatically set to half of the pulse rate for 100% flow rate output. If this calculated value is over 100ms, the pulse width is set to 100ms.

   Example1
   Case Range :3600m^3/h (1m^3/s)
   Counting rate(pulse rate) :0.001m^3

   the pulse rate for 100% flow rate
   : 3600(m^3/h) / 0.001(m^3) =3600000pulses/h=1000pulses/p
   the pulse rate= 1ms
   *the pulse width(Max.) = 1ms / 2 = 0.5ms

   Example2
   Case Range :3600m^3/h (1m^3/s)
   Counting rate(pulse rate) :1000m^3

   the pulse rate for 100% flow rate
   : 3600(m^3/h) / 1000(m^3) =3.6pulses/h=0.001pulses/p
   the pulse rate= 1000000ms
   the pulse width(Max.) = 1000000ms / 2 = 500000ms
   but, the pulse width is 500ms Max.
   * the pulse width(Max.) = 500ms

   Example3
   Case Range :3600m^3/h (1m^3/s)
   Counting rate(pulse rate) :1m^3
   Setting pulse width :0ms (automatically set)

   the pulse rate for 100% flow rate
   : 3600(m^3/h) / 1(m^3) =3600pulses/h=1pulses/p
   the pulse rate= 1000ms
   the pulse width(Max.) = 1000ms / 2 = 500ms
   but, the pulse width that automatically set is 100ms Max.
   * the pulse width (Max.) = 100ms

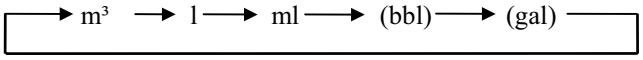
3. To operate the totalizer, it is preferable to set the indicating unit (UNIT1 and/or UNIT 2) to one of the units appropriate for totalization just to make sure it is operating correctly.

■ **To change the counting rate:**

The following example shows how to change the counting rate from 0.01 m• to 0.9 l.

Key operation	Display example	Description
SET □	**G1: COUNT RATE** **1.00E–2m³**	Press [SET] first to start the items selection sequence and select **G1: COUNT RATE** from among the configuration items using [▶] and [▲] keys. Then press [SET] again to display the current counting rate (1.00E–2m³ = 0.01 m³).
▶ □	**G1: COUNT RATE** **1.00E–2m³**	Pressing [▶], the cursor appears. Then press [▶] as many times as necessary to move the cursor to of measuring unit.
▲ □	**G1: COUNT RATE** **1.00E–2l** **9.00E–1l**	Select "l" as the measuring unit by pressing [▲]. **(Note)** Then move the cursor to the desired digit by pressing [▶] and change the value. In this example repeat this process until the display shows "9.00E–1l."
SET □	**G1: COUNT RATE** **9.00E–1l**	Pressing [SET], the cursor disappears and the new counting rate display flickers. Press [SET] again to store the new counting rate.
SET □	**G1: COUNT RATE**	Pressing [SET], the system returns to the items selection sequence.

Note: The unit changes as shown below by pressing [▲].



8.2.11 Preset Count Value

The preset count value is used to preset the totalizer. The preset count value can be set from 0 to 99999999.

NOTE

Totalizer counting is effective only for the specified direction flow.

To operate the totalizer, it is preferable to set the indicating unit (UNIT 1 and/or UNIT 2) to one of the units appropriate for totalization just to make sure it is operating correctly.

Preset function may also be selected. For detail, see 8.2.20 “Preset Function”.

Proceed as follows to check or change the preset count value.

■ **To check the preset count value:**

Key operation	Display example	Description
SET 	**H1: PRESET** **00000300**	Press [SET] first to start the items selection sequence and select **H1: PRESET** from among the configuration items using [▶] and [▲] keys. Then press [SET] again to display the preset count value.
SET 	**H1: PRESET**	Pressing [SET], the system returns to the items selection sequence.

■ **To change the preset count value:**

The following example shows how to change the preset count value from 500 to 1000.

Key operation	Display example	Description
SET □	**H1: PRESET** **00000500**	Press [SET] first to start the items selection sequence and select **H1: PRESET** from among the configuration items using [▶] and [▲] keys. Then press [SET] again to display the preset count value (500 in this example).
▶ □	**H1: PRESET** **00000500**	Pressing [▶], the cursor appears. Then press [▶] as many times as necessary to move the cursor to the desired digit to be changed.
▲ □	**H1: PRESET** **00001500** **00001000**	Change the value by pressing [▲]. Then move the cursor to another digit by pressing [▶] and change the value. In this example repeat this process until the display shows "1000."
SET □	**H1: PRESET** **00001000**	Pressing [SET], the cursor disappears and the new preset count value display flickers. Press [SET] again to save the new preset count value.
SET □	**H1: PRESET**	Pressing [SET], the system returns to the items selection sequence.

8.2.12 High and Low Limit Alarms

The high and low limit alarms can be set to output an alarm signal when the flow rate exceeds the high or low limit set value. When this alarm occurs, a H. ALARM or L. ALARM message appears. This high and low limit alarm function can each be enabled or disabled in this item. The high and low limit values can be set from –10% to 110% of the span of the range (Range 1) in increments of 0.5%.

Proceed as follows to check or change the high and low limit values.

■ **To check the high and low limit values:**

Key operation	Display example	Description
SET □	**I1: H. ALARM SET** **ON**	Press [SET] first to start the items selection sequence and select **I1: H ALARM SET** from among the configuration items using [▶] and [▲] keys. Then press [SET] again to display the high limit alarm enable/disable status.
SET □	**I1: H. ALARM SET**	Pressing [SET], the system returns to the items selection sequence.

High/low limit alarm enable/disable status and high/low limit value can be selected by the configuration items as follows:

High limit alarm enable/disable status	I1: H. ALARM SET
High limit value	I2: H. ALARM VAL
Low limit alarm enable/disable status	I3: L. ALARM SET
Low limit value	I4: L. ALARM VAL

■ **To change the high/low limit alarm status and its alarm limit value:**

The following example shows how to change the high limit alarm enable/disable status from OFF to ON and change the high limit value from +100 % to +105 %.

Key operation	Display example	Description
SET □	**I1: H. ALARM SET** **OFF**	Press [SET] first to start the items selection sequence and select **I1: H. ALARM SET** from among the configuration items using [▶] and [▲] keys. Then press [SET] again to display the high limit alarm enable/disable status (OFF at this point).
▶ □	**I1: H. ALARM SET** **OFF**	Pressing [▶], the cursor appears.
▲ □	**I1: H. ALARM SET** **ON**	Change the status by pressing [▲]. **(Note 1)**
SET □	**I2: H. ALARM VAL** **+100.0%**	Pressing [SET], the cursor disappears and the changed status flickers. Press [SET] again to save the status. Then the system goes to the item **I2: H. ALARM VAL**, and displays the current high limit value (+100.0%).
▶ □	**I2: H. ALARM VAL** **+100.0%**	Move the cursor to the digit to be changed.
▲ □	**I2: H. ALARM VAL** **+105.0%**	Change the value to "5" by pressing [▲] five times. **(Note 2)** (If necessary, move the cursor to another digit by pressing [▶] and change the value.)
SET □	**I2: H. ALARM VAL** **+105.0%**	Pressing [SET], the cursor disappears and the changed high limit value display flickers. Press [SET] again to save the value.
SET □	**I2: H. ALARM VAL**	Pressing [SET], the system returns to the items selection sequence.

Notes:

1. If the high limit alarm enable/disable status is set to OFF, the subsequent high limit value setting sequence will not come out.
2. If you try to set the value above +110% or below –10% of the span, the error messages
   *H. OVER SPEC or *L. OVER SPEC, respectively, appear. Set the high or low limit value within the specified range.

■ **To change the high/low limit value:**

The following example shows how to change the high limit value from +105 % to +103 %.

Key operation	Display example	Description
SET □	**I2: H. ALARM VAL** **+105.0%**	Press [SET] first to start the items selection sequence and select **I2: H. ALARM VAL** from among the configuration items using [▶] and [▲] keys. Then press [SET] again to display the current high limit value (+105.0% in this example).
▶ □	**I2: H. ALARM VAL** **±105.0%**	Pressing [▶], the cursor appears. Then press [▶] as many times as necessary to move the cursor to the digit to be changed.
▲ □	**I2: H. ALARM VAL** **+103.0%**	Change the value to "3" by pressing [▲] as many times as necessary. **(Note)** (If necessary, move the cursor to another digit by pressing [▶] and change the value.)
SET □	**I2: H. ALARM VAL** **+103.0%**	Pressing [SET], the cursor disappears and the changed high limit value display flickers. Press [SET] again to save the value.
SET □	**I2: H. ALARM VAL**	Pressing [SET], the system returns to the items selection sequence.

Note: If you try to set the value above +110% or below –10% of the span, the error messages *H. OVER SPEC or *L. OVER SPEC, respectively appear. Set the high limit value within the specified range.

8.2.13 Empty Pipe Alarm

The empty pipe alarm is used to notify that the detector pipe is not filled with fluid. If an empty pipe condition occurs, a message * EMPTY appears. You can enable or disable this function here.

■ Empty Pipe Alarm Functions

Empty pipe alarm	Function
0: OFF	Disable empty pipe alarm
1: ON LEVEL1	Enable empty pipe alarm (detective level high)
2: ON LEVEL2	Enable empty pipe alarm (detective level middle)
3: ON LEVEL3	Enable empty pipe alarm (detective level low)

NOTE: When setting enable empty pipe alarm, normally select "1:ON LEVEL1". When more sensitivity is required to detect empty pipe alarm, select "2:ON LEVEL2" or "3:ON LEVEL3".

Proceed as follows to check or change the empty pipe alarm enable/disable status.

■ To check the empty pipe alarm enable/disable status:

Key operation	Display example	Description
SET □	**J1: EMPTY ALM** **ON**	Press [SET] first to start the items selection sequence and select **J1: EMPTY ALM** from among the configuration items using [▶] and [▲] keys. Then press [SET] again to display the current empty pipe alarm enable/disable status.
SET □	**J1: EMPTY ALM**	Pressing [SET], the system returns to the items selection sequence.

■ **To change the empty pipe alarm enable/disable status**

The following example shows how to change empty alarm from NO.1 to NO.0.

Key operation	Display example	Description
SET 	**J1: EMPTY ALM** **1:ON LEVEL1**	Press [SET] first to start the items selection sequence and selec **J1: EMPTY ALM** from among the configuration items using [▶] and [▲] keys. Then press [SET] again to display the current empty pipe alarm enable/disable status. (In this example ON LEVEL1 will be displayed.)
▶ 	**J1: EMPTY ALM** **1:ON LEVEL1**	Pressing [▶], the cursor appears.
▲ 	**J1: EMPTY ALM** **0:OFF**	Select “0:OFF” by pressing [▲].
SET 	**J1: EMPTY ALM** **0:OFF**	Pressing [SET], the cursor disappears and the selected status display flickers. Press [SET] again to save the status.
SET 	**J1: EMPTY ALM**	Pressing [SET], the system returns to the items selection sequence.

8.2.14 Rate-Of-Change Limit

The rate-of-change limit is used to eliminate high electrical noise contained in the process flow signal.

To check electrical noise, two parameters are defined:

rate-of-change limit (set in percent value of the span) and

control limit time (set in units of seconds).

Normally the flowmeter produces the analog output signal by sampling the flow rate signal at 1/24 (or 1/12) of a second sampling rate. If the sampled value exceeds the set “rate-of-change” limit value based on the averaged flow rate value up until the sampled time, the system will reject that sampled value.

The result will be that the averaged value including the rate-of-change limit value, in place of the rejected sampled value, will be the output. However, if the limit-exceeding sampled value continues for the same flow direction for more than the preset control limit time, that data will be used as the output signal. The setting ranges for these two parameters are as follows:

- **Rate-of-change limit**
  0 to 30 %/sampling rate (in increments of 0.5 %)
  Where the sampling rate is either 1/24, 1/12 or 1/6 of a second depending on the excitation frequency as shown below:

Excitation frequency	Sampling rate
24 Hz	1/24 sec
12 Hz or 6 Hz	1/12 sec

- **Control limit time:** 0 to 20 sec (in increments of 1 second)

NOTE

If “0” is set in either of these parameters, the rate-of-change limit function is disabled. Proceed as follows to check or change the rate-of-change limit value and the control limit time.

■ **To check the rate-of-change limit value and the control limit time:**

Key operation	Display example	Description
SET 	**K1: LIMIT RATE** **05.0 %**	Press [SET] first to start the items selection sequence and select **K1: LIMIT RATE** from among the configuration items using [▶] and [▲] keys. Then press [SET] again to display the current rate-of-change limit time.
SET 	**K1: LIMIT RATE**	Pressing [SET], the system returns to the items selection sequence.

Rate-of-change limit value and control limit time can be selected by the configuration items as follows:

Rate-of-change limit value	K1:	H. LIMIT RATE
Control limit time	K2:	H. LIMIT TIME

■ **To change the rate-of-change limit value:**

The following example shows how to change the rate-of-change limit value from 10.0 % to 15.0 %.

Key operation	Display example	Description
SET □	**K1: LIMIT RATE** **10.0 %**	Press [SET] first to start the items selection sequence and select **K1: LIMIT RATE** from among the configuration items using [▶] and [▲] keys. Then press [SET] again to display the current rate-of-change limit value (10.0 % in this example).
▶ □	**K1: LIMIT RATE** **1̲0.0 %**	Pressing [▶], the cursor appears. Then press [▶] as many times as necessary to move the cursor to the digit to be changed.
▲ □	**K1: LIMIT RATE** **1̲5.0 %**	Change the value to "5" by pressing [▲] five times. **(Note)** (If necessary, move the cursor to the next digit to be changed by pressing [▶], and change the value.).
SET □	**K1: LIMIT RATE** **15.0 %**	Pressing [SET], the cursor disappears and changed rate-of-change limit value display flickers. Press [SET] again to save the value.
SET □	**K̲1: LIMIT RATE**	Pressing [SET], the system returns to the items selection sequence.

Note: If you try to set the value outside the valid range, an error message * H. OVER SPEC appears. Set the value within the specified range.

To change the control limit time, select the item K2: LIMIT TIME.

8.2.15 Fixed-Value Output

The fixed-value output is used to output a fixed current and a fixed pulse output independent of the flow rate signal. (The fixed pulse output is available only when DO1 is used for PULSE OUT function.) The fixed-value output can be set in the ranges described below. (Current output and pulse output can be set and output at the same time.)

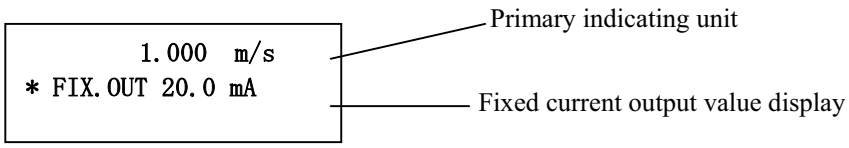
- **Fixed current output:** 3 to 24 mA (in increments of 0.1 mA)
- **Fixed pulse output:** 0 to 1000 pps (in increments of 1 pps)

If you have disabled this function (set to OFF), you do not have to set the subsequent current and pulse output values.

When this function is enabled (set to ON), the measured data is displayed with the primary indicating unit only on the first line of the display and the fixed current output is displayed on the second line of the display. Other data output and display conditions are as follows:

- **Current output:** User-set current output
- **Pulse output:** Pulse output with a user-set counting rate
- **Digital output(s):** Previous status is retained (excluding pulse output).
- **Data Display:** Instantaneous flow rates and flow velocity (no totalization)

Display example:



This fixed-value output function does not work in the calibration mode.
Proceed as follows to check or change the enable/disable status of the fixed-value output and its output values.

■ **To check the enable/disable status of the fixed-value output and its output values:**

Key operation	Display example	Description
SET □	**L1: FIXED OUT** **ON**	Press [SET] first to start the items selection sequence and select **L1: FIXED OUT** from among the configuration items using [▶] and [▲] keys. Then press [SET] again to display the fixed-value output enable/disable status.
SET □	**L1: FIXED OUT**	Pressing [SET], the system returns to the items selection sequence.

Fixed-value output enable/disable status, fixed current output and fixed pulse output can be selected by the configuration items as follows:

Fixed-value enable/disable status	L1:	FIXED	OUT
Fixed current output	L2:	FIX.	CURR.
Fixed pulse output	L3:	FIX.	PULSE

■ **To change the enable/disable status of the fixed-value output and its output values:**

The following example shows how to enable the fixed-value output function and to set its fixed current output to 20 mA DC.

Key operation	Display example	Description
SET □	**L1: FIXED OUT** **OFF**	Press [SET] first to start the items selection sequence and select **L1: FIXED OUT** from among the configuration items using [▶] and [▲] keys. Then press [SET] again to display the current fixed-output enable/disable status (OFF in this example).
▶ □	**L1: FIXED OUT** **OFF**	Pressing [▶], the cursor appears
▲ □	**L1: FIXED OUT** **ON**	Select "ON" by pressing [▲].
SET □	**L2: FIX. CURR.** **10.0 mA**	Pressing [SET], the selected status (ON) flickers. Press [SET] again to save the status. Then the system goes to the fixed current value setting sequence.
▶ □	**L2: FIX. CURR.** **10.0 mA**	Move the cursor to the digit to be changed.
▲ □	**L2: FIX. CURR.** **20.0 mA**	Change the value to "2" by pressing [▲] twice. (If necessary, move the cursor to another digit by pressing [▶] and change the value.) **(Note 1)**
SET □	**L3: FIX. PULSE** **100 PPS**	Pressing [SET], the cursor disappears and the changed value display flickers. Press [SET] again to save the value. Then the system goes to the fixed pulse output setting sequence. **(Note 2)**
SET □	**L3: FIX. PULSE** **100 PPS**	Pressing [SET], the cursor disappears and the fixed pulse output value flickers. Press [SET] again to save the value.
SET □	**L3: FIX. PULSE**	Pressing [SET], the system returns to the items selection sequence.

Notes:

1. If you try to set the fixed-value output above the allowable range, an error message * H. OVER SPEC appears. Try to set the value within the specified range.
2. If PULSE OUT is not selected for digital output, the subsequent pulse output setting sequence will not be displayed.

■ **To change the fixed pulse output value:**

The following example shows how to change the fixed pulse output value from 50 pps to 100 pps.

Key operation	Display example	Description
SET 	**L3: FIX. PULSE** **050 PPS**	Press [SET] first to start the items selection sequence and select **L3: FIX. PULSE** from among the configuration items using [▶] and [▲] keys. Then press [SET] again to display the current fixed pulse output value (50 pps in this example).
▶ 	**L3: FIX. PULSE** **050 PPS**	Pressing [▶], the cursor appears. (if necessary, move the cursor by pressing [▶] to the digit to be changed.)
▲ 	**L3: FIX. PULSE** **150 PPS** **100 PPS**	Change the value to "1" by pressing [▲]. Then move the cursor to another digit to change and change the value. In this example repeat this process until the display shows "100 pps."
SET 	**L3: FIX. PULSE** **100 PPS**	Pressing [SET], the cursor disappears and the changed value display flickers. Press [SET] again to save the value.
SET 	**L3: FIX. PULSE**	Pressing [SET], the system returns to the items selection sequence.

Fixed current output value can be changed by selecting the configuration item L2: FIX. CURR.

8.2.16 Zero Offset Adjustment

Zero offset can be applied to make the flowmeter outputs comparable to process values measured by other instruments. If the zero adjustment described in 6.2 requiring a zero flow rate condition can be performed, this zero offset adjustment is not needed. When the zero adjustment is completed, zero offset will be automatically cleared to zero.

Zero offset can be set in the range described below:

Zero offset: ±0.125 m/s (±1.25 % of 10 m/s — maximum range) maximum

Proceed as follows to check or change the zero offset value.

■ To check the zero offset value:

Key operation	Display example	Description
SET □	**M1: MANUAL ZERO** **+002.5 %**	Press [SET] first to start the items selection sequence and select **M1: MANUAL ZERO** from among the configuration items using [▶] and [▲] keys. Then press [SET] again to display the current zero offset value
SET □	**M1: MANUAL ZERO**	Pressing [SET], the system returns to the items selection sequence.

■ To change the zero offset value:

Calculate the zero offset value with the following equation:

Zero offset value (%) = {(actual flow rate) – (TMF-100 measured value)}

The zero offset value should be calculated in percent value for Range 1. See the following example.

(Example)

Measured Condition	Flow Rate	% in measuring span
Actual flow rate obtained from instrument	10.0 m^3/min	50%
TMF-100 measured value	10.5 m^3/min	52.5%
Zero offset		-2.5%

If zero offset is set to –2.5 %, the TMF-100 converter will output 50.0 % flow rate instead of 52.5%.

The following example shows how to change the zero offset value from +1.0% to –2.5%.

Key operation	Display example	Description
SET □	**M1: MANUAL ZERO** **+001.0%**	Press [SET] first to start the items selection sequence and select **M1: MANUAL ZERO** from among the configuration items using [▶] and [▲] keys. Then press [SET] again to display the current zero offset value.
▶ □	**M1: MANUAL ZERO** **+001.0%**	Pressing [▶], the cursor appears. (If necessary, press [▶] as many times as necessary to move the cursor to the desired digit to change.)
▲ □	**M1: MANUAL ZERO** **-001.0%** **-002.0%** **-002.5%**	Change the sign code ("+" to "–") by pressing [▲]. Then move the cursor to another digit by pressing [▶] and change the value. In this example repeat this process until the display shows "–002.5 %." **(Note)**
SET □	**M1: MANUAL ZERO** **-002.5%**	Pressing [SET], the cursor disappears and the changed value display flickers. Press [SET] again to save the value.
SET □	**M1: MANUAL ZERO**	Pressing [SET], the system returns to the setting items selection sequence.

Note: If you try to set the value above +0.125 m/s or below –0.125 m/s, the error messages * H. OVER SPEC or * L. OVER SPEC, respectively, appears.
Set the value within ±0.125 m/s.

8.2.17 Password

Proceed as follows to check or change the password.

■ **To check the password:**

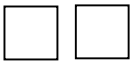
Key operation	Display example	Description
SET 	**A4: PASSWORD** **123**	Press [SET] first to start the items selection sequence and select **A4: PASSWORD** from among the configuration items using [▶] and [▲] keys Then press [SET] again to display the current password(123).
SET 	**A4: PASSWORD**	Pressing [SET], the system returns to the items selection sequence.

Note: If the wrong password is entered in the password input mode, display will appear as follows:

Key operation	Display example	Description
SET 	**A4: PASSWORD** *******	Press [SET] first to start the items selection sequence and select **A4: PASSWORD** from among the configuration items using [▶] and [▲] keys Then press [SET] again to display the "***" .
SET 	**A4: PASSWORD**	Pressing [SET], the system returns to the items selection sequence.

■ **To change the password:**

The following example shows how to change the password from 123 to 453.

Key operation	Display example	Description
SET 	**A4: PASSWORD** **123**	Press [SET] first to start the items selection sequence and select **A4: PASSWORD** from among the configuration items using [▶] and [▲] keys. Press [SET] again to display the current password (123 in this example). Case of inputting wrong password in the password input mode, the current password doesn't appear, but "***" appears.
▶ 	**A4: PASSWORD** **1**23	Pressing [▶], the cursor appears. Then press [▶] as many times as necessary to move the cursor to digit to be changed.
▲ ▶ 	**A4: PASSWORD** **4**23 **45**3	Change the value by pressing [▲]. Then move the cursor to another digit by pressing [▶] and change the value. In this example repeat this process until the display shows "453" **(Note)**
SET 	**A4: PASSWORD** **456**	Pressing [SET], the cursor disappears and the changed display flickers. Press [SET] again to save the value.
SET 	**A4: PASSWORD**	Pressing [SET], the system returns to the items selection sequence.

Note:

1. Setting "000" to the password, password input mode disables protection. All parameters can be changed.
2. If password is set, be sure to record for future reference. In the event a password is lost, refer to next page.

*Lost password (reading out password)

Proceed as follows **only** in case of forgetting password.

Note:

To prevent unauthorized access, be sure to control distribution of the following recovery procedure:

■ **Readout the password:**

The following example shows how to readout the password .

Key operation	Display example	Description
		Before turning on power, open the housing cover for LCD display, and short-circuit between TT-RST and TT-G that is located in back of the operational panel with a clip type cable. (refer to figure 8.1) Next, turn on power, LCD, back-light bright will show.
	10.00 m/s 100.0 %	Open the clip-type ale. LCD displays "SIGNAL CHECK", then displays measured data. (measurement mode).
SET □	PASSWORD INPUT 000	Pressing [SET], password input mode and the cursor appears.
▲ ▶ □ □	PASSWORD INPUT 100 120 123	Change the value by pressing [▲].and [▶].
SET □	PASSWORD INPUT 123	Pressing [SET], the cursor disappears and the changed display flickers. Press [SET] again to input the value.
SET □	A1: EX. CURR.	Whether input password agrees or dose not agree, the items selection sequence, "A1:EX. CURR" appears. .
▲ ▶ □ □	A4: PASSWORD	Select **A4: PASSWORD** from among the configuration items using [▶] and [▲] keys .
SET □	A4: PASSWORD 123	Press [SET] again to display the current password(123).

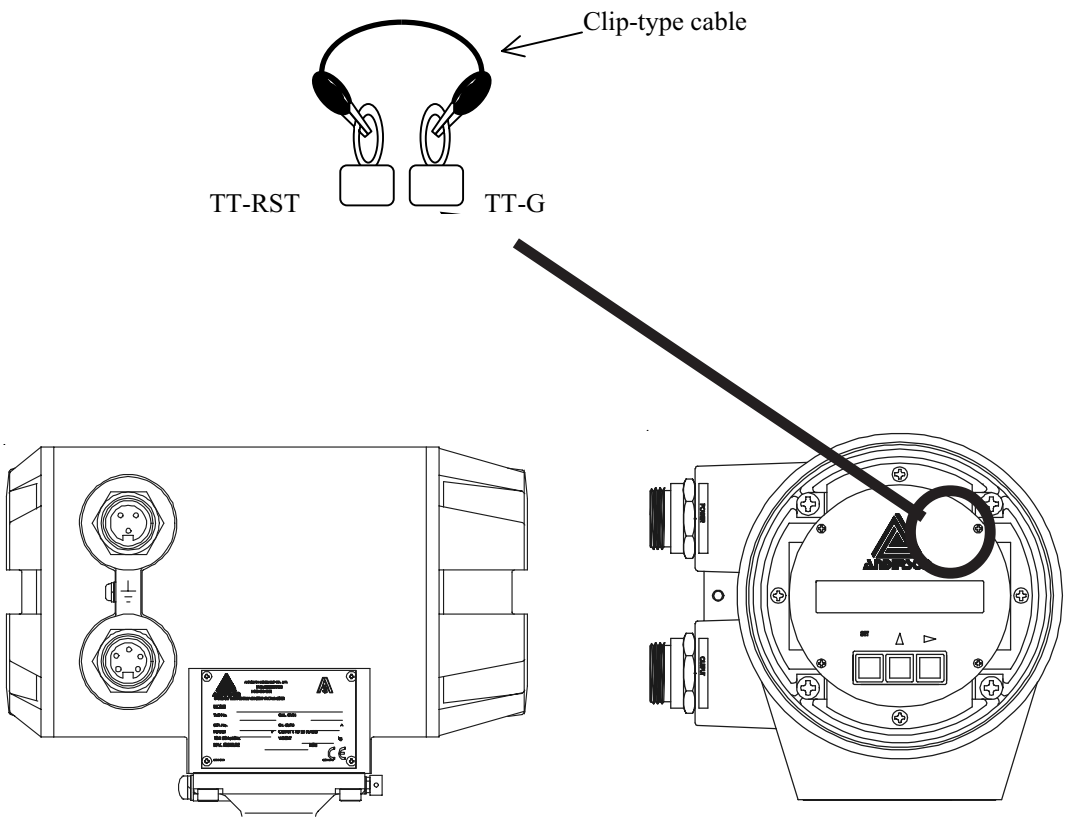


Figure 8.1

8.2.18 4-20mA Alarm Output

The 4-20mA Alarm output may be associated with converter alarms, empty pipe alarm, or self-diagnostic alarms.

You can select the various current output value at converter alarms shown below.

■ 4-20mA Alarm output Functions

4-20 ALM. Out items	Current Output Value at Converter Alarms
0: UNDER 3.0mA	Under 3.0mA output
1: 4.0mA	4.0mA output
2: HOLD	Measured data hold
3: OVER 24.0mA	Over 24.0mA output

Proceed as follows to check or change the output function.

■ To check the 4-20mA Alarm output functions:

Key operation	Display example	Description
SET 	**D3: 4-20 ALM.OUT** **1:4.0mA**	Press [SET] first to start the items selection sequence and select **D3: 4-20 ALM.OUT** from among the configuration items using [▶] and [▲] keys. Then press [SET] again to display the 4-20 ALM.OUT function.
SET 	**D3: 4-20 ALM. OUT**	Pressing [SET], the system returns to the items selection sequence.

■ **To change the 4-20mA Alarm output functions:**

The following example shows how to change the 4-20mA Alarm output function from No. 1 to No. 3.

Key operation	Display example	Description
SET 	**D3: 4-20 ALM. OUT** **1:4.0mA**	Press [SET] first to start the items selection sequence and select **D3 4-20 ALM.OUT** from among the configuration items using [▶] and [▲] keys. Then press [SET] again to display the current burn out function (1: 4.0mA in this example).
▶ 	**D3: 4-20 ALM. OUT** **1:4.0mA**	Pressing [▶], the cursor appears.
▲ 	**D3: 4-20 ALM. OUT** **3:24.0mA**	Change the value to "3" by pressing [▲] twice.
SET 	**D3: 4-20 ALM. OUT** **3:24.0mA**	Pressing [SET], the cursor disappears and the new burn out function display flickers. Press [SET] again to save the new function.
SET 	**D3: 4-20 ALM. OUT**	Pressing [SET], the system returns to the items selection sequence.

8.2.19 DI detective Level

In case of counter (pulse output) control is selected as DI, you can set detective level, H level or L level.

■ DI detective Level (only if counter control is selected as DI):

DI DET.LEVEL Items	Digital input function	Counter control signal
0: L LEVEL	**DI 1:C STA/STP (Totalizer Start/Stop)**	H level signal input: COUNTER STOP L level signal input: COUNTER START
	DI 2:C RES/STA (Totalizer Reset/Start)	H level signal input: COUNTER START L level signal input: COUNTER RESET
1: H LEVEL	**DI 1:C STA/STP (Totalizer Start/Stop)**	H level signal input: COUNTER START L level signal input: COUNTER STOP
	DI 2:C RES/STA (Totalizer Reset/Start)	H level signal input: COUNTER RESET L level signal input: COUNTER START

The detective level of DI can be selected from H level and L level for Counter control (totalizer Start/Stop the totalizer Reset/Start). If any other function is selected as DI function, the detective level is ignored.

Proceed as follows to check or change the DI detective level.

■ To check the DI detective level:

Key operation	Display example	Description
SET □	**F6:DI DET.LEVEL** **1:H LEVEL**	Press [SET] first to start the items selection sequence and select **F6: DI DET. LEVEL** from among the configuration items using [▶] and [▲] keys. Then press [SET] again to display the DI detective level.
SET □	F6:DI DET.LEVEL	Pressing [SET], the system returns to the items selection sequence.

■ **To change the DI detective level:**

The following example shows how to change the DI detective level from H level to L level.

Key operation	Display example	Description
SET 	**F6:DI DET.LEVEL** **1:H LEVEL**	Press [SET] first to start the items selection sequence and select **F6: DI DET. LEVEL** from among the configuration items using [▶] and [▲] keys. Then press [SET] again to display the current preset level function (1: H LEVEL in this example).
▶ 	**F6:DI DET.LEVEL** **1:H LEVEL**	Pressing [▶], the cursor appears.
▲ 	**F6:DI DET.LEVEL** **0:L LEVEL**	Change the value to "0:L LEVEL" by pressing [▲] .
SET 	**F6:DI DET.LEVEL** **0:L LEVEL**	Pressing [SET], the cursor disappears and the new preset level function display flickers. Press [SET] again to save the new function.
SET 	**F6:DI DET.LEVEL**	Pressing [SET], the system returns to the items selection sequence.

8.2.20 Preset Function

The various preset point output functions shown below can be selected.

■ Preset Point Output Functions

DI function	Preset point output level function
0: HOLD	Output status level hold
1: 50ms PULSE	Pulse out (pulse width 50ms)
2: 500ms PULSE	Pulse out (pulse width 500ms)

Proceed as follows to check or change the preset point output functions.

■ To check the preset functions:

Key operation	Display example	Description
SET □	**H2: PRESET FUNCT** **0:HOLD**	Press [SET] first to start the items selection sequence and select **H2: PRESET FUNCT** from among the configuration items using [▶] and [▲] keys. Then press [SET] again to display the current preset level function.
SET □	**H2 PRESET FUNCT**	Pressing [SET], the system returns to the items selection sequence.

■ **To change the preset functions:**

The following example shows how to change the preset level function from No. 0 to No. 1.

Key operation	Display example	Description
SET 	**H2: PRESET FUNCT** **0:HOLD**	Press [SET] first to start the items selection sequence and select **H2: PRESET FUNCT** from among the configuration items using [▶] and [▲] keys. Then press [SET] again to display the current preset level function (0: HOLD in this example).
▶ 	**H2: PRESET FUNCT** **0:HOLD**	Pressing [▶], the cursor appears.
▲ 	**H2: PRESET FUNCT** **1:50ms PULSE**	Change the value to "1" by pressing [▲] .
SET 	**H2: PRESET FUNCT** **1:50ms PULSE**	Pressing [SET], the cursor disappears and the new preset level function display flickers. Press [SET] again to save the new function.
SET 	**H2: PRESET FUNCT**	Pressing [SET], the system returns to the items selection sequence.

9. Calibration

9.1 Calibration Items

You can conduct the following in the calibration mode:

- Check or calibrate the zero and span of the TMF100 converter by using a simulation signal.
- Check of the excitation current.

To change the mode to the calibration mode, see 7.3.1, “Mode Change.”

IMPORTANT: To check or change the zero and span of the converter, follow the procedure described below. Settings have been checked and calibrated prior to shipment from the factory. Do not change these settings unless it is necessary to calibrate in the field.

Calibration items are listed below. See each section for detailed procedure.

Section	Configuration item	Display example		Page
9.2.1	0 % flow rate calibration	**N1:FLOW CAL 0%**	**0.0 %**	103
9.2.2	50 % flow rate calibration	**N2:FLOW SIG.50%**	**50.0 %**	104
9.2.3	100 % flow rate calibration	**N3:FLOW CAL100%**	**100.0 %**	105
9.2.4	Excitation current	**N4:EX. CURR.DSP.**	**0.2100 A**	106

9.2 Calibration Using Converter Signal Source

9.2.1 0 % Flow Rate Calibration

■ To check the zero point of flow measurement:

Key operation	Display example	Description
SET	**N1:FLOW CAL 0%** **0.0 %**	Press [SET] first to start the items selection sequence and select **N1: FLOW CAL 0%** from among the configuration items using [▶] and [▲] keys. Then press [SET] again to go into the calibration mode and calculate and display zero point using a simulation signal.
SET	**N1:FLOW CAL 0%**	Pressing [SET], the system returns to the items selection sequence.

■ To change the zero and span of the converter:

Key operation	Display example	Description
SET	**N1:FLOW CAL 0%** **0.1 %**	Press [SET] first to start the items selection sequence and select **N1: FLOW CAL 0%** from among the setting items using [▶] and [▲] keys. Then press [SET] again to go into the calibration mode and calculate and display zero point using a simulation signal.
▶	**ADJUST READY** **0.1 %**	Pressing [▶], "**ADJUST READY"** appears as shown left and the system goes into a calibration ready condition. **(Note 1)**
———	**N1:FLOW CAL 0%** *** CAL.0% ADJ.**	Pressing [SET], "*** CAL. 0% ADJ.**" appears as shown left and the system starts the zero calibration. The zero calibration takes about 3 to 6 seconds. **(Note 2)**
SET	**N1:FLOW CAL 0%** **0.0 %**	Newly calibrated zero point appears.
SET	**N1:FLOW CAL 0%**	Pressing [SET], the system returns to the items selection sequence.

Notes:

1. To cancel zero calibration, press [♦]. The system returns to the point where the zero point display appears.
2. Calibration time depends on the excitation frequency (24 Hz: 3 sec, 12 Hz and 6 Hz: 6 sec).

9.2.2 50 % Flow Rate Calibration

Using the converter's internal calibration circuit, the system can calibrate the 50% flow rate point. The 50% flow rate point calibration must be executed after conducting the 100% flow rate (span) calibration. The 50% flow rate calibration may differ depending on the 100% flow rate calibration result.

■ To check the 50% flow rate point of flow measurement:

Key operation	Display example	Description
SET □	**N2:FLOW SIG 50%** **50.1 %**	Press [SET] first to start the items selection sequence and select **N2: FLOW SIG 50%** from among the configuration items using [▶] and [▲] keys. Then press [SET] again to go into the calibration mode and calculate and display 50% flow rate point using a simulation signal.
SET □	**N2:FLOW SIG 50%**	Pressing [SET], the system returns to the items selection sequence.

■ To change the 50% flow rate point of the converter:

Key operation	Display example	Description
SET □	**N2:FLOW SIG 50%** **50.1 %**	Press [SET] first to start the items selection sequence and select **N2: FLOW SIG 50%** from among the configuration items using [▶] and [▲] keys. Then press [SET] again to go into the calibration mode and calculate and display 50% flow rate point using a simulation signal.
▶ □	**ADJUST READY** **50.1 %**	Pressing [▶], "**ADJUST READY"** appears as shown left and the system goes into a calibration ready condition. **(Note 1)**
————	**N2:FLOW SIG 50%** *** CAL. 50% ADJ.**	Pressing [SET], "*** CAL. 50% ADJ.**" appears as shown left and the system starts the 50% calibration. The zero calibration takes about 3 to 6 seconds. **(Note 2)**
SET □	**N2:FLOW SIG 50%** **50.0 %**	Newly calibrated 50% flow rate point appears.
SET □	**N2:FLOW SIG 50%**	Pressing [SET], the system returns to the items selection sequence.

Notes:

1. To cancel 50% flow rate calibration, press [♦]. The system returns to the point where 50% flow rate is displayed.
2. Calibration time depends on the excitation frequency (24 Hz: 3 sec, 12 Hz and 6Hz: 6 sec).

9.2.3 100 % Flow Rate (Span) Calibration

Using the converter's internal calibration circuit, the system can calibrate the 100% flow rate point (hereafter called span).

■ To check the span of the converter:

Key operation	Display example	Description
SET □	**N3:FLOW CAL100%** **100.1 %**	Press [SET] first to start the items selection sequence and select **N3: FLOW CAL 100%** from among the configuration items using [▶] and [▲] keys. Then press [SET] again to go into the calibration mode and calculate and display the span using a simulation signal.
SET □	**N3:FLOW CAL100%**	Pressing [SET], the system returns to the items selection sequence.

■ To change the span of the converter:

Key operation	Display example	Description
SET □	**N3:FLOW CAL100%** **100.1 %**	Press [SET] first to start the items selection sequence and select **N3: FLOW CAL100%** from among the configuration items using [▶] and [▲] keys. Then press [SET] again to go into the calibration mode and calculate and display 100% flow rate point using a simulation signal.
▶ □	**ADJUST READY** **100.1 %**	Pressing [▶], "**ADJUST READY"** appears as shown left and the system goes into a calibration ready condition. **(Note 1)**
————	**N3:FLOW CAL100%** *** CAL. 100% ADJ.**	Pressing [SET], "*** CAL. 100% ADJ.**" appears as shown left and the system starts the 100% calibration. The zero calibration takes about 3 to 6 seconds. **(Note 2)**
SET □	**N3:FLOW CAL100%** **100.0 %**	Newly calibrated 100% flow rate point appears.
SET □	**N3:FLOW CAL100%**	Pressing [SET], the system returns to the items selection sequence.

Notes:

1. To cancel the span calibration, press [◆]. The system returns to the point where 100% flow rate is displayed.
2. Calibration time depends on the excitation frequency (24 Hz: 3 sec, 12 Hz and 6Hz: 6 sec).

9.2.4 Checking the Excitation Current Value

You can monitor the excitation current value. The excitation current value is factory adjusted when shipped. Contact Anderson Technical Services if any change is necessary.

■ To check the excitation current value:

Key operation	Display example	Description
SET 	**N4:EX. CURR.DSP.** **0.2100 mA**	Press [SET] first to start the items selection sequence and select **N4: EX. CURR. DSP.** from among the configuration items using [▶] and [▲] keys. Then press [SET] again to display the excitation current value.
SET 	**N4:EX. CURR.DSP.**	Pressing [SET], the system returns to the items selection sequence.

10. Digital I/O Functions

Digital I/O functions described below can be assigned for DO1, DO2 and DI.

Functions	Description
Totalization	■ The converter totalizes volumetric flow values. ■ The totalized flow can be output as a pulse signal (DO1 only) scaled by a user-specified factor (counting rate). ■ The totalizer and pulse signal (DO1 only) can be controlled (starts, stops and resets) with an external signal (DI).
Multiple Ranges	■ Multiple measuring ranges can be switched according to the process flow rates either automatically or by an external signal (DI).
Forward and Reverse flow measurements	■ Forward and reverse flows can be measured. The forward and reverse flow measurements can be used together with multiple range switching function.
High and Low Limit Alarms	■ Outputs an alarm signal (DO1 or DO2) when the process signal exceeds or stays below the limit values.
Empty Pipe Alarm	■ The detector pipe must be filled with fluid all the time. When it is not filled with fluid, the converter outputs an alarm signal (DO1 or DO2).
Totalizer Preset Point	■ When the totalized flow reaches its preset count value, the converter outputs a contact output signal (DO1 or DO2).
Remote Zero Adjustment	■ Zero adjustment (on-stream at zero flow rate) can be started by an external signal (DI).
Fixed-value Output	Fixed current output and fixed pulse output can be used to check a process loop circuit. An external signal (DI) can also be used to control this fixed-value output.
Converter Failure Alarm	■ The converter outputs an alarm signal (DO1 or DO2) if an error such as memory error or excitation circuit error occurs.

10.1 Digital I/O Specifications

Digital I/O specifications for the TMF100 converter are described below:

■ **Digital Output 1(DO1,)**
Output type: Transistor open collector
Number of outputs: 1
Capacity: 30 V dc, 200 mA maximum

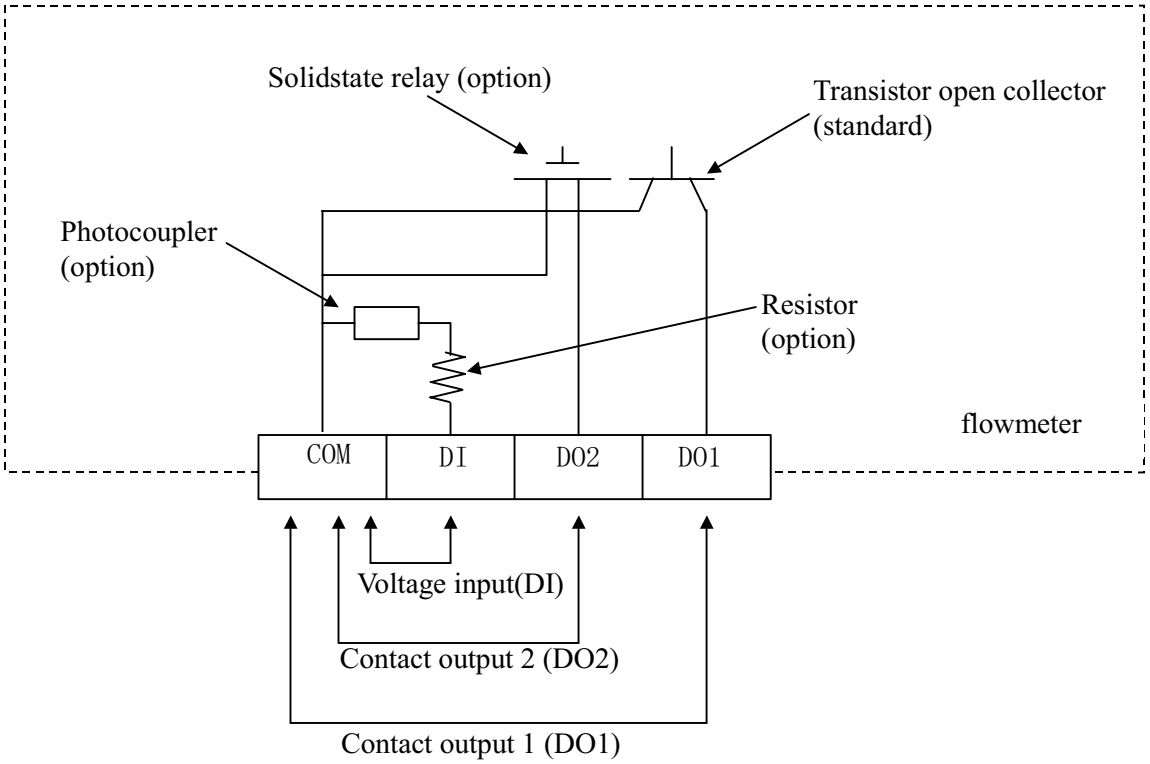
■ **Digital Output 2(DO2)**
Output type: Solidstate relay (non polarity)
Number of outputs: 1
Capacity: 50 V dc, 150 mA maximum

■ **Digital Input (DI)**
Input signal: 20 to 30 V dc voltage signal
- High input level—20 to 30 V dc
- Low input level—2 V dc maximum

Input resistance: Approximately 2.7 kΩ

Number of inputs: One point

- Each I/O terminal can be used as a specified function terminal when selected.
- Terminal COM is the signal COMMON for the other three terminals (DO1, DO2 and DI).
- Each terminal is isolated from the internal circuits.
  (The output terminals are not isolated from each other.)



10.2 Totalizer and Pulse Output

To use the totalizer and pulse output for external use, proceed as follows.

Counting Rate and Pulse Width Settings

■ Set the counting rate (flow volume per count) and the pulse width. Refer to 8.2.10, “Counting Rate”.

* The counting rate should be set so that its rate for 100% flow rate output is within the range from 3.6 to 3600000 pulses/h. **(Note 4.)**
* The pulse width can be set from 0.5ms to 500ms. the pulse width should be set to less than half of the pulse rate for 100% flow rate output. **(Note 5.)**

Set the pulse width in accordance with response time of receiving instruments. If the pulse output is not used, pulse width setting is not needed.

DO function setting

■ Select DO1 as a pulse output contact signal. Refer to 8.2.9, “Digital I/O” This is not needed if the pulse output is not used.

DI function setting (Note 1.)

■ Set one of the DI functions. Refer to 8.2.9, “Digital I/O”

Indicating Unit Setting

■ Select an indicating unit for UNIT 1 and/or UNIT 2 among units for totalization (m^3, l ,ml ,bbl, gal or COUNT) , and for direction (F, R or B) **(Note 1)**

Measurement Mode

■ Set the operation mode of the system to the measurement mode.Refer to 7.3.1, “Mode Change.”

continued on next page

continued from previous page

Clear (reset) the totalizer.

■ Clear (reset) the totalizer by pressing [◂▸] key.If you have changed the counting rate, clear (reset) the totalizer before you start the totalizer

Start the totalizer.

■ Start the totalizer by pressing [▾] key and make sure “C” is shown on the display. **(Note 2)**

Notes:

1. It is preferable to set the indicating unit (UNIT 1 and/or UNIT 2) to one of the units appropriate for totalization just to make sure it is operating correctly.

2. If the indicating unit (UNIT 1 and/or UNIT 2) is not the one for totalization, “C” does not appear on the display.

3. Example for counting rate:

Example
Case Range:3600m^3/h (1m^3/s)

Counting rate(pulse rate)
Min.: 3600(m^3/h) / 3600000(pulses/h) =0.001 m^3=1 l
Max.: 3600(m^3/h) / 3.6(pulses/h) =1000 m^3

5. Example for pulse width:

Example1

Case Range :3600m^3/h (1m^3/s)

Counting rate(pulse rate) :0.001m^3

the pulse rate for 100% flow rate

: 3600(m^3/h) / 0.001(m^3) =3600000pulses/h=1000pulses/p

the pulse rate= 1ms

*the pulse width(Max.) = 1ms / 2 = 0.5ms

Example 2

Case Range :3600m^3/h (1m^3/s)

Counting rate(pulse rate) :1000m^3

the pulse rate for 100% flow rate

: 3600(m^3/h) / 1000(m^3) =3.6pulses/h=0.001pulses/p

the pulse rate= 1000000ms

the pulse width(Max.) = 1000000ms / 2 = 500000ms

but, the pulse width is 500ms Max.

* the pulse width(Max.) = 500ms

Example 3

Case Range :3600m^3/h (1m^3/s)

Counting rate(pulse rate) :1m^3

Setting pulse width :0ms (automatically set)

the pulse rate for 100% flow rate

: 3600(m^3/h) / 1(m^3) =3600pulses/h=1pulses/p

the pulse rate= 1000ms

the pulse width(Max.) = 1000ms / 2 = 500ms

but, the pulse width that automatically set is 100ms Max.

* the pulse width (Max.) = 100ms

Totalizer Operation

■ Using control keys on the panel

To start, stop or clear (reset) the totalizer, follow the procedure described below:

Key operation	Display example	Description
▲ □	F 1 C 1.2300 m/s	Starts the totalizer (and pulse output).“C” for counting will be displayed and either “F” for forward or “R” for reverse flow direction will also be displayed.
▲ □	F 123 1.23000 m/s	Stops the totalizer (and pulse output).C” shown on the display disappears.
▶ □	F 0 1.23000 m/s	Clears (resets) the totalizer (and pulse output)

NOTES

1. If volumetric code set to “B” for indicating UNIT 1 and/or UNIT 2, the following will result:
   (1) Setting a bi-directional (forward and reverse) multi-range, the display shows either forward or reverse flow counts depending on the flow direction.
   (2) Setting a unidirectional multi-range or single-range, the display shows only forward flow counts depending on the flow direction.

2. Setting indicating UNIT 1 and/or UNIT 2 to units of totalization (m•, l ,ml ,bbl, gal or COUNT), and also selecting a Code of volumetric.(F or R) will result in the following:
   (1) Setting code of volumetric F, the display shows forward flow counts.
   (2) Setting code of volumetric R, the display shows reverse flow counts.

3. When [◂•] is pressed, the flow counts for both directions will be cleared to zero.

4. Non-volatile memory is used to store the totalizer counter value. Therefore, the value will be retained in the memory even if the power is off.

■ Using the DI signal

Remote operations for the totalizer and pulse output can be conducted using the DI signal. The following functions in the table can be performed. See 8.2.9 “Digital I/O” to select these functions.

You can select Digital Input Detective Level (H or L) (Only for Counter Control). For detail, see 8.2.19 “Digital Input Detective Level”

* Select H level(1:H LEVEL) : DI signal(detective level: H level)”.
* Select L level(0:L LEVEL) : DI signal(detective level: L level)”.

DI signal(detective level: H level)

Digital input (DI) Functions	**DI voltage level**	**Totalizer and pulse output**
Totalizer Start/Stop	L level	Starts the totalizer and the pulse output.
	H level	Stops the totalizer and the pulse output.
Totalizer Reset/Start	H level	Stops and clears (resets) the totalizer.
	L level	Starts the totalizer and the pulse output.

DI signal (detective level: L level)

Digital input (DI) Functions	**DI voltage level**	**Totalizer and pulse output**
Totalizer Start/Stop	L level	Starts the totalizer and the pulse output.
	H level	Stops the totalizer and the pulse output.
Totalizer Reset/Start	H level	Starts the totalizer and the pulse output.
	L level	Stops and clears (resets) the totalizer.

10.3 Multi-range Functions

Multi-range functions can be set under the configuration item “RANGE TYPE.” Refer to 8.2.6, “Span (Range).” Four types of multi-range configurations are available as shown below:

(1) Automatic selection of unidirectional flow multi-range

(2) Automatic selection of bidirectional flows multi-range

(3) Remote selection of unidirectional flow multi-range with an external signal

(4) Remote selection of bidirectional flows multi-range with an external signal

Proceed as follows to use the multi-range functions.

Range setting

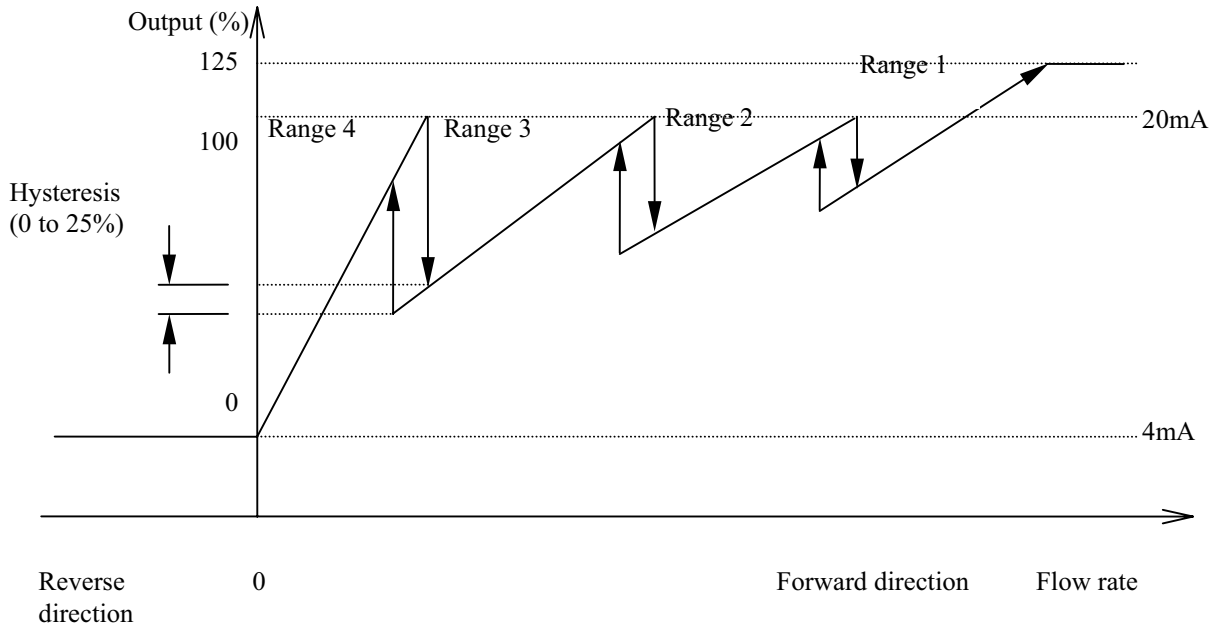
- Set as follows referring to 8.2.5, “Span (Range),”
  1. Select “RANGE TYPE.”
  2. Set the span for ranges 1 to 4.
  3. Set the hysteresis value.

DO/DI function setting

- Set DO1 and/or DO2 (option) to use them as range outputs. Refer to 8.2.9, “Digital I/O”
- To select ranges with a remote signal, use DI (option) as a remote signal. Refer to 8.2.9, “Digital I/O”

■ **Output performance of multi-range functions**

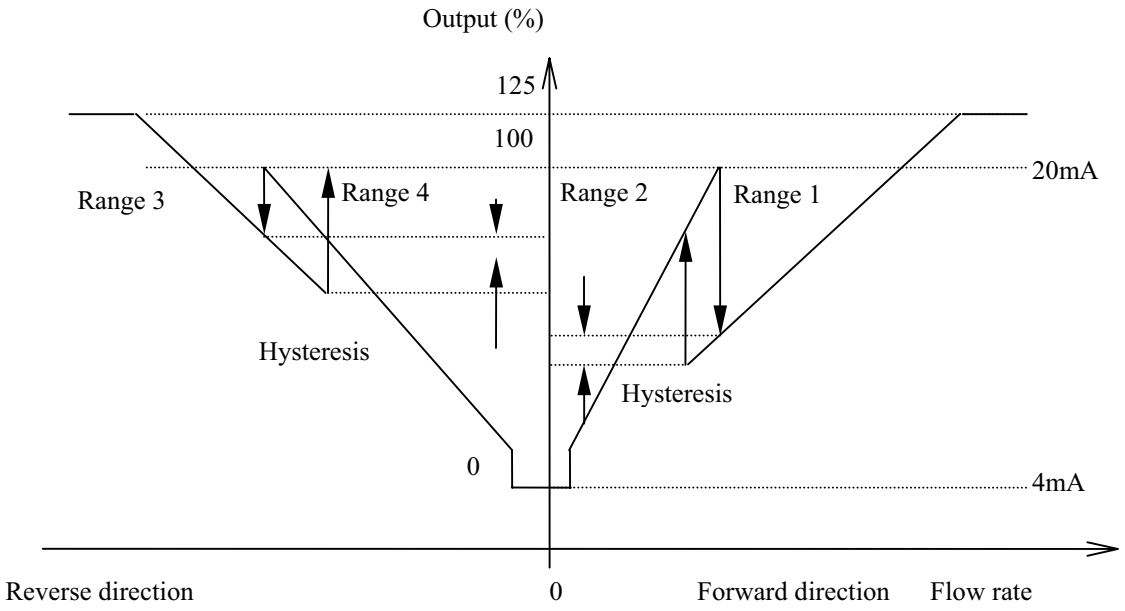
(1) Automatic selection of unidirectional flow multi-range



Range output	Output status			
No. 1	ON	OFF	ON	OFF
No. 2	ON	ON	OFF	OFF

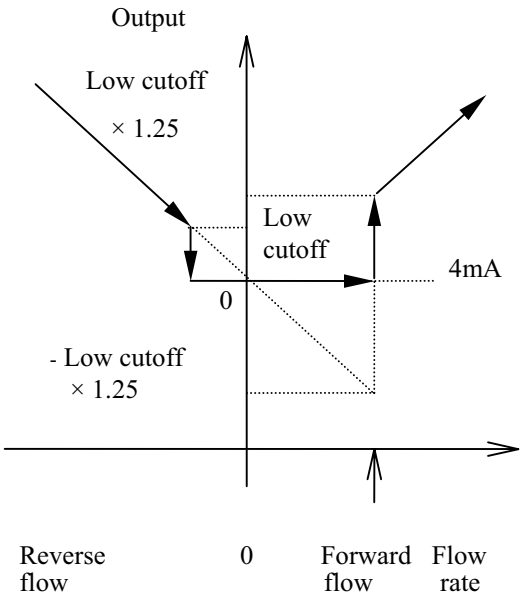
Note: The current output for opposite direction flow is 4 mA.

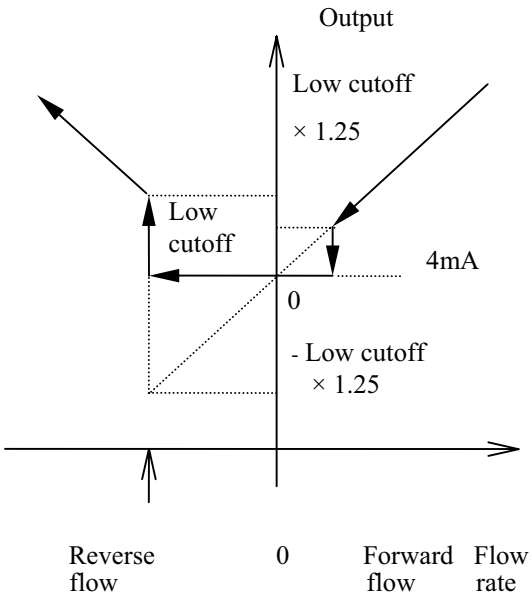
(2) Automatic selection of bidirectional flows multi-range



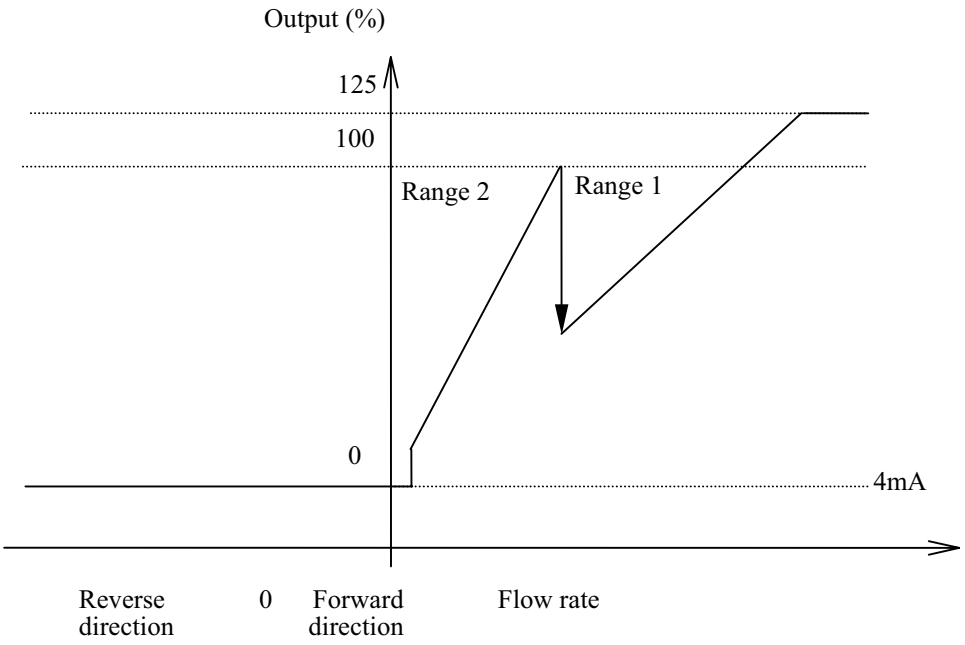
Range output	Output status			
No.1	ON	OFF	ON	OFF
No.2	ON		OFF	

■ **Reverse to Forward direction change** ■ **Forward to Reverse direction change**





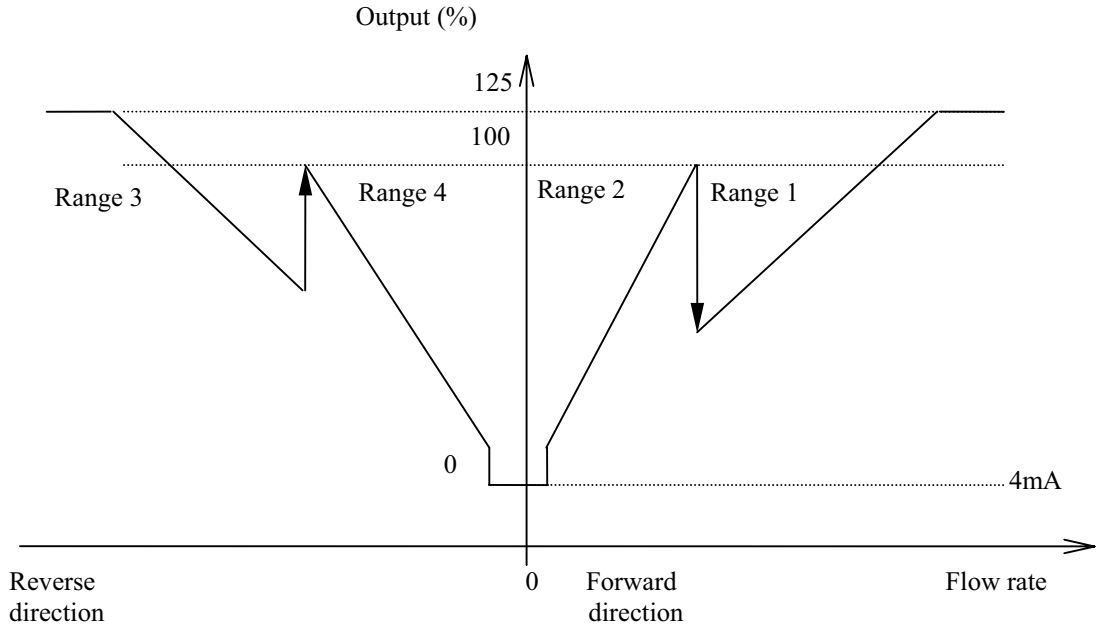
(3) Remote selection of unidirectional flows multi-range with an external signal



External signal	H level input	L level input
Rangte output No. 1	ON	OFF

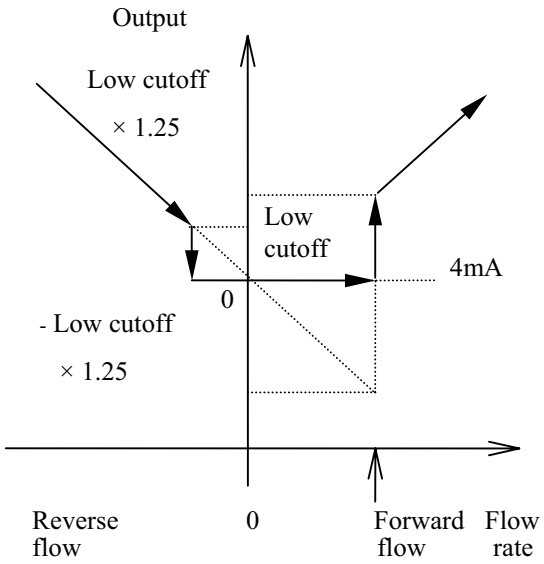
Note: The current output for opposite direction flow is 4 mA.

(4) Remote selection of bidirectional flows multi-range with an external signal

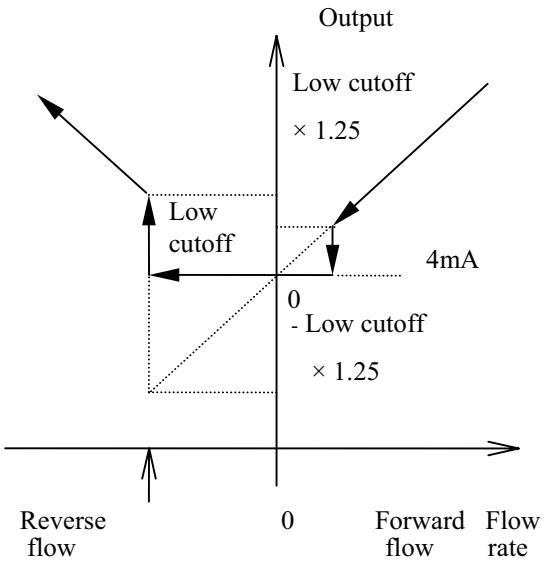


External signal	L level	H level	H level	L level
Range output No. 1	OFF	ON	ON	Off
Range output No. 2	ON		OFF	

■ Reverse to Forward direction change



■ Forward to Reverse direction change



10.4 High and Low Limit Alarms

Proceed as follows to use the high and low limit alarms:

High and Low limit value setting

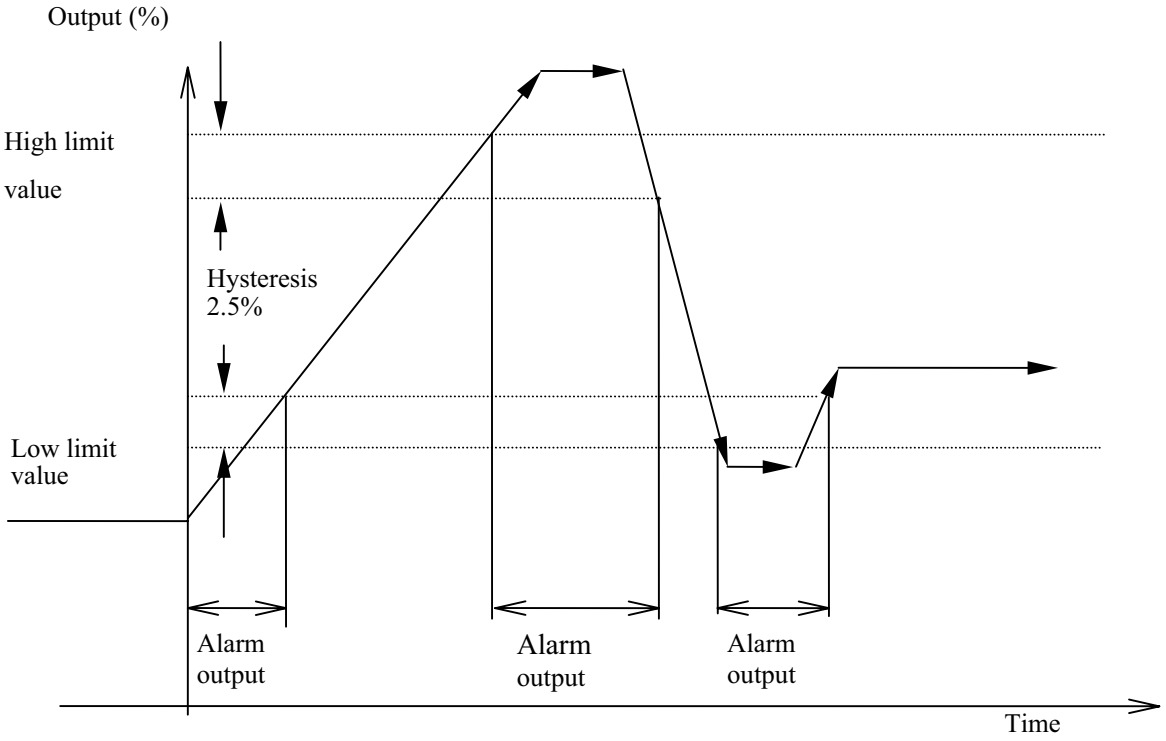
- Set the high and/or low limit alarm enable/disable status to ON and set the limit value for high and/or low alarm. See 8.2.12, “High and Low Limit Alarms.” To disable the high or low limit alarm, set its enable/disable status to OFF.

DO function setting

- Set DO1 and/or DO2 (option) as high and/or low limit alarm outputs, and select the active status, Normal Open or Normal Close.See 8.2.9, “Digital I/O”

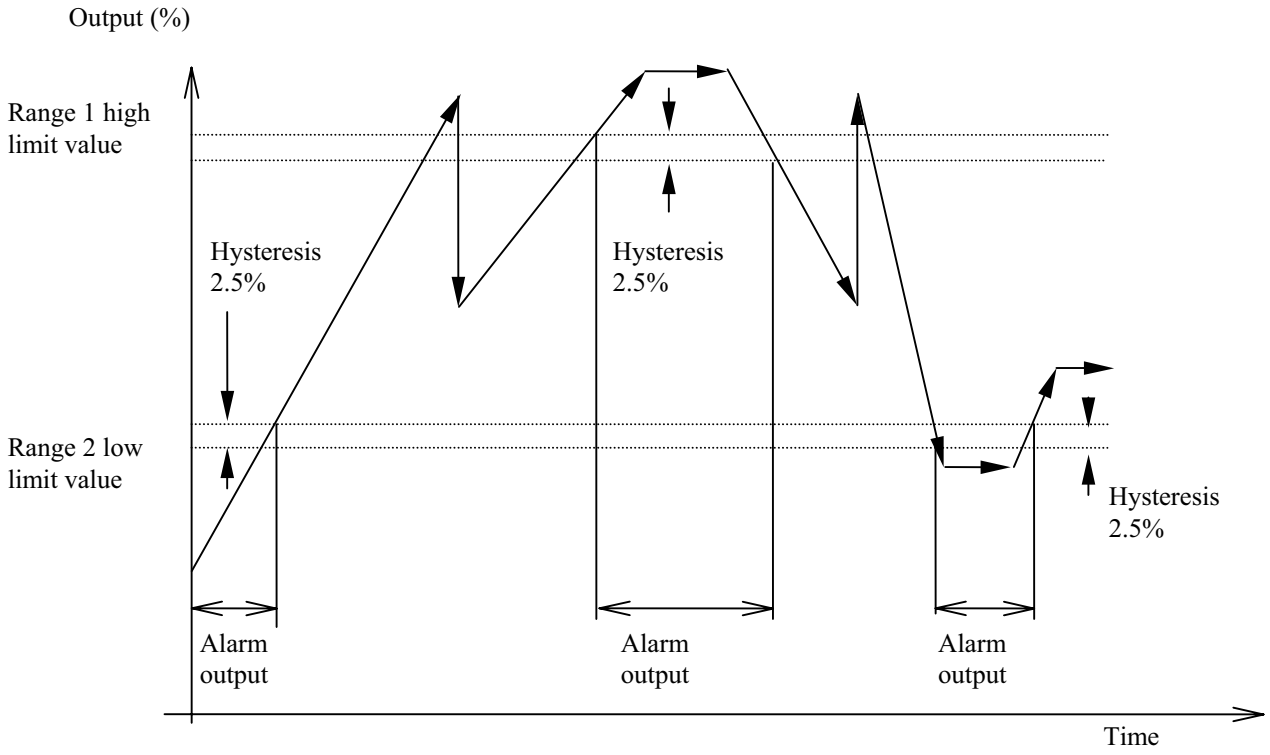
■ High and Low Limit Alarm Output Performance

(1) Single range performance



(2) Multi-range performance

In an example shown below, a low limit alarm is set for the Range 2 and a high limit alarm is set for the Range 1.



Note: Alarm output contacts are open while the convgerter is powered off.

10.5 Empty Pipe Alarm

Proceed as follows to use the empty pipe alarm output.

Alarm output setting

■ Set the empty alarm enable/disable status to ON. See 8.2.13, “Empty Pipe Alarm.”

DO function setting

■ Set DO1 or DO2 (option) as the empty pipe alarm output, and select the active status, Normal Open or Normal Close. See 8.2.9, “Digital I/O” If you use the empty pipe alram function but not an external output, this setting is not needed.

■ Output conditions when an empty pipe alram occurs:

- 4-20mA output: 4mA.
  For additional detail, see See 8.2.18” 4-20mA Alarm Output”.
- Totalizer and pulse output: Totalizer and pulse output are stopped.
- Measured data display: Zero is indicated for instantaneous flow rate.
- Alarm output: Condition programmed in the Digital output function and active status set.

Note: Alarm output contacts are open while the converter is powered off.

See Chapter 12, “Self-Diagnostics and Warning Functions.” to use the empty pipe alarm function.

10.6 Preset Point Output

Using this preset point output function, you can output a contact signal when the totalized flow reaches its preset value. Proceed as follows to use this function.

Totalizer setting

- Set necessary parameters and selections to use the totalizer. See 10.2, “Totalizer and Pulse Output.”

Preset value setting

- Set the desired preset value. See 8.2.11, “Preset Count Value.” In addition, select the desired preset point output function. 8.2.20,”Preset Function”

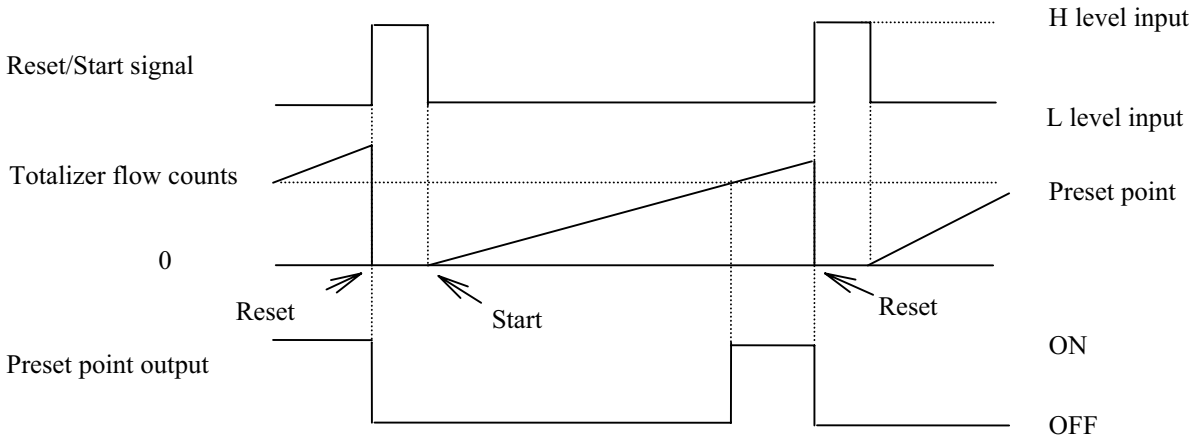
DO/DI function setting

- Set DO1 or DO2 for use as a preset point output. See 8.2.9, “Digital I/O”n
  To clear (reset) the totalizer with an external signal, set DI as a Reset/Start signal. In addition, select Digital Input Detective Level. 8.2.19 “DI detective Level”.

  Note: If you use the control keys on the panel to clear (reset) the totalizer, this setting is not needed.

■ **Preset point output performance (1)**

The following is an example for preset point output (output status level hold mode) in which the totalizer is reset with an external signal (DI detective level is H).

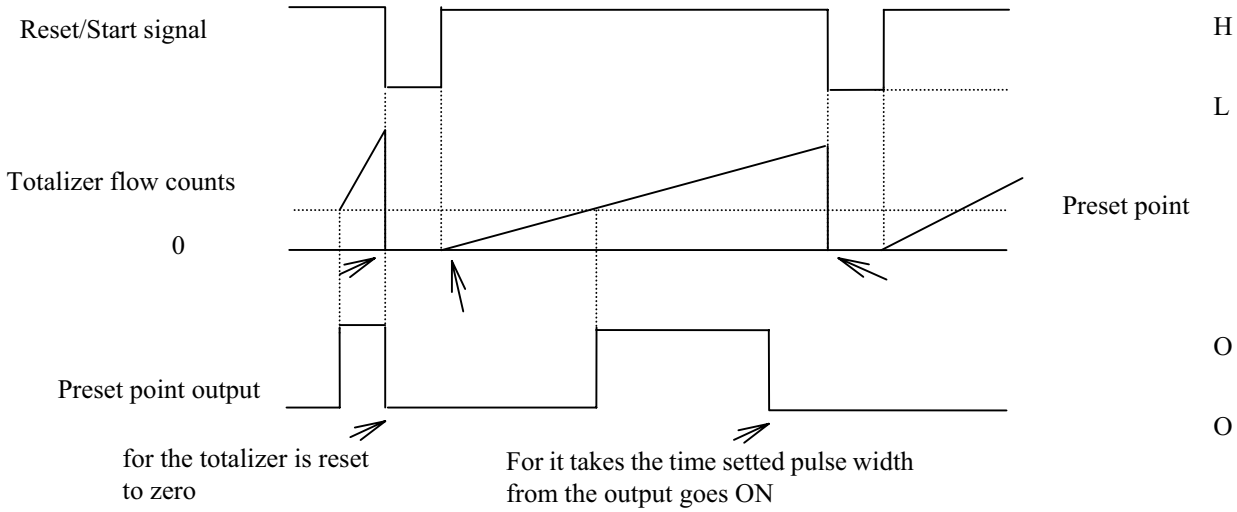


Input/Output signal time chart

- When the Reset/Start signal is in H level, the totalizer is reset to zero and stops counting.
- When the Reset/Start signal goes to L level, the totalizer starts counting.
- The preset point output goes ON when the totalizer counts reaches the preset point, and the output goes OFF when the totalizer is reset to zero.

■ **Preset point output performance (2)**

The following is an example for preset point output (pulse out mode) in which the totalizer is reset with an external signal (DI detective level is L).

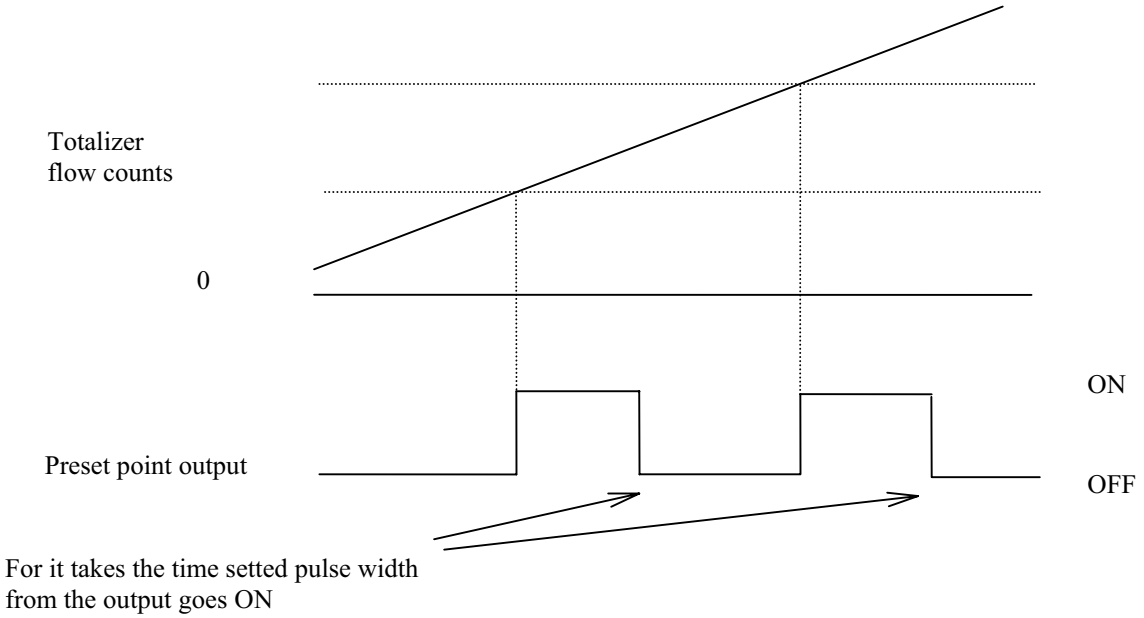


- When the Reset/Start signal is in L level, the totalizer is reset to zero and stops counting.
- When the Reset/Start signal goes to H level, the totalizer starts counting.
- The preset point output goes ON when the totalizer counts reaches the preset point.
- The output goes OFF when the totalizer is reset to zero or when it takes the time setted pulse width from the output goes ON.

■ **Preset point output performance (3)**

The following is an example for preset point output (pulse out mode)

Setting preset count:100



- The preset point output goes ON when the totalizer counts reaches the preset point (100 in this example). And the next preset point (200 in this example ; current preset point :100 and preset count :100 makes 200) is setted. In this example repeat this process .
- The output goes OFF when it takes the time setted pulse width from the output goes ON.

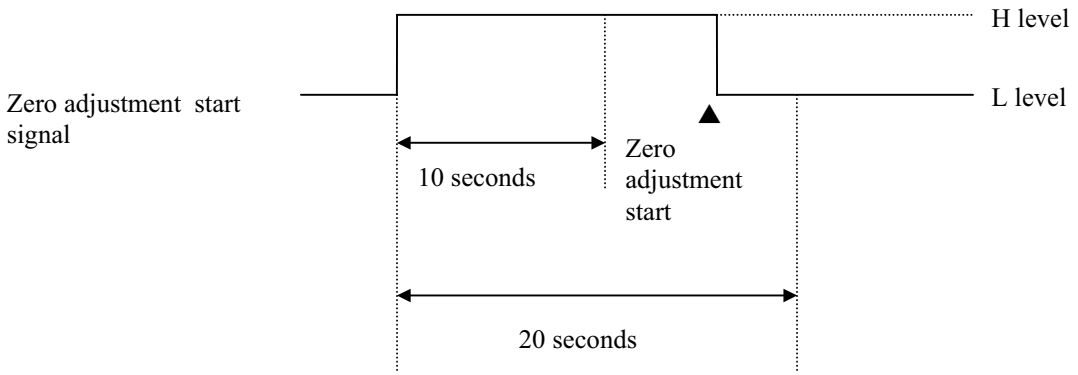
NOTE: If preset pulse is setted and preset pulse width is longer than the interval of that totalizer reaches the preset point, the output can't be form pulse out.
If pulse output is needed, set preset count according to shown below.

Preset Pulse Width	The Interval of that Totalizer reaches the Preset Point	Example) Count rate:0.01 l Flow verosity:10 l/s Totalizer count up rate:1ms/COUNT
50ms	More than 100ms	Preset Count:more than 100
500ms	More than 1000ms	Preset Count:more than 1000

10.7 Remote Zero Adjustment

On-stream zero adjustment in a zero flow rate condition can be started with an external signal. To do this, set DI as a zero adjustment start signal. See 8.2.9, “Digital I/O”

■ Start signal requirements:



The start signal must be set to H level first, then it must go to L level after the passage of more than 10 seconds but not more than 20 seconds, as shown above. (If the signal does not go to L level within this specified period, it will be ignored.) As soon as the signal goes to L level, zero adjustment sequence starts.

10.8 Remote Selection of Fixed Value Output

A user-specified current output and pulse output can be selected with a DI signal.
Proceed as follows to use this function:

Fixed-value setting

- Set the fixed-value for current output and for pulse output. See 8.2.15, “Fixed-Value Output.” Set the fixed-value output enable/disable status to “OFF.”If the pulse output is not used, fixed-value setting for pulse output is not needed.

DI function setting

- Set DI to use as a fixed-value output control signal. See 8.2.9, “Digital I/O ”

Control signal input conditions:

Control signal input level	4 –20 mA and pulse output
L level	Outputs the measured value.
H level	Outputs the fixed-value.

10.9 Converter Failure Alarm

When one or more of the following converter errors occur in a self-diagnostics sequence, an alarm signal can be output. To use this function, set DO1 or DO2 to use as an alarm output signal. See Chapter 12, “Self-Diagnostics and Warning Functions” for details of each alarm status.

■ Self-diagnostics errors

Self-diagnostics error (LCD display)	Error contents
ROM ERROR	ROM error
RAM ERROR	RAM error
PARAMETER FAIL	System parameter error
EX. CURR. OPEN	Excitation circuit open
EX. CURR ERROR	Excitation current error
ADC. ERROR	ADC error
INVALID TOTAL	Invalid totalizer counts

■ Output conditions

Active status of Alarm output can be selected as follows,

- Normal Open; transistor / relay contact is closed when an error occurs.
- Normal Close; transistor/relay contact is open when an error occurs.

Note: Alarm output contacts are open while the converter is powered off.

12. Self-Diagnostics and Alarms

Self-diagnostic items and their error or alarm messages are described below.

12.1 Self-diagnostics

The TMF-100 converter has a self-diagnostics function to detect such problems as setting error, I/O error or converter hardware failure and shows the resulting error or alarm messages on the LCD display (optional) or on the AF100 hand-held terminal through the HART protocol communications. The error or alarm messages and their corrective actions are described below.

■ Setting error

If you try to set the value or measuring unit out of the range specified for each item, one of the following error messages appears.

Error message	Description	Corrective action
* H. OVER SPEC.	Setting value exceeds the allowable high limit.	Try to set the value within the specified range.
* L. OVER SPEC.	Setting value goes below the allowable low limit.	
* H. OVER C RATE	Counting rate exceeds the allowable high limit.	
* L. OVER C RATE	Counting rate goes below the allowable low limit.	
* MULTI RNG ERR	Span is not appropriate for multi-range configuration.	Try to set the span as specified.

■ High and low limit alarms

If the flow rate reading goes out of the set range, one of the following messages appears. If the high or low limit alarm enable/disable status is set to OFF, its alarm function (high or low) is disabled. See 8.2.15, “High and Low Limit Alarms.”

Alarm message	Description	Corrective action
H. ALARM	Flow rate reading exceeds the high limit.	Arrange so that the reading stays below the high limit.
L. ALARM	Flow rate reading goes below the low limit.	Arrange so that the reading stays above the low limit.

■ Empty pipe alarm

If the detector pipe is not filled with fluid, the following message appears. Design piping so that the detector pipe is always filled with the fluid to be measured. If the empty alarm enable/disable status is set to OFF, this function is disabled. See 8.2.13, “Empty Pipe Alarms.”

Alarm message	Description	Corrective action
EMPTY	Detector pipe is not filled with fluid.	Arrange piping so that the detector pipe is always filled with fluid.

Precautionary notes on using the empty pipe alarm

(1) The flowmeter detects an empty pipe condition by monitoring the impedance and signal level between the flow signal lines connected to a pair of electrodes. Therefore, the following factors may trigger an erroneous empty pipe alarm:
- Opening or loose connection of flow signal lines
- The fluid to be measured carrying air bubbles
- Contamination of the electrode with non-conductive deposits

(2) If the flowmeter is not grounded properly or if it is in an environment where high electrical noise exists, the empty pipe alarm may not function properly. Under these conditions, the reliability of flowmeter accuracy itself is compromised. Try to ground the flowmeter securely to an independent ground and relocate the cable runs to prevent noise from entering into the flowmeter circuit.

(3) If the fluid still remains in the detector pipe, or the internal wall of the detector pipe is contaminated with electrically conductive deposits, the impedance between the signal lines will not go high and the empty pipe alarm may not work. In this kind of event, try to use other means to detect an empty pipe condition (such as a pump stop signal or a signal from a valve).

■ Analog to Digital Converter hardware failure

The system checks the internal circuitry at the time of power-up for all error items, and checks continuously for the specified items as described below. If an error is detected, one of the messages shown in the table will be displayed.

If multiple errors occur, their messages will be displayed cyclically. The diagnostics items concerning the excitation cable, and excitation circuit, are detected using the ADC circuit.

Thus, if the ADC fails, No. 4 (excitation cable) and No. 5 (excitation circuit) errors can not be detected correctly.

Note: The diagnostic system is based on the CPU in the flowmeter. Therefore, in the event of a CPU failure, no accurate diagnostics or error message display can be obtained.

No.	Error message	Description	Corrective action
1	* ROM ERROR *	ROM error	Internal components or printed-circuit board must be repaired or replaced. Contact your nearest Toshiba representative.
2	* RAM ERROR *	RAM error	
3	PARAMETER FAIL	System parameter error	
4	EX. CURR. OPEN	Excitation cables are not connected.	Connect the excitation cables correctly.
5	EX. CURR. ERROR	An error occurred in the excitation circuit.	Internal components or printed-circuit board must be repaired or replaced. Contact your nearest Toshiba representative.
6	ADC. ERROR	ADC error	
7	INVALID TOTAL	Totalizer data was destroyed due to external noise. (No message appears if totalization is not used.)	The error message disappears if you press the reset key.

NOTES

1. Errors No. 1 to No. 3 can be detected only at the time of power-up. The flowmeter does not start measurement if any one of these errors is detected. If these errors occur after power-up, the flowmeter cannot detect these errors, and thus may indicate and output incorrect data.

2. Errors No. 4 to No. 6 may not be detected even if the errors result in incorrect flowmeter accuracy, because of characteristic differences in components used to detect these errors.

3. CPU error cannot be detected. If the CPU stops, the watchdog timer resets the internal circuits and the flowmeter starts again from the initial power-up condition. Depending on CPU condition, the flowmeter may not indicate and output correct data.

12.2 Output Status for Errors and Alarms

The flowmeter data display, current and pulse outputs will become as follows if an error or alarm occurs.

Error or alarm message	Data display	Current output (4–20mA)	Totalizer and pulse output	Remarks
ROM ERROR (Note 1)	———	4mA **(Note 3)**	Stopped	After power-up, no measurement starts.
RAM ERROR	———		Stopped	
PARAMETER FAIL (Note 2)	Zero		Stopped	———
EX. CURR OPEN	Zero		Stopped	Zero adjustment (on-stream at zero flow rate) cannot be conducted.
EX. CURR ERROR	Zero		Stopped	———
ADC. ERROR	Zero		Stopped	———
EMPTY	Zero		Stopped	Zero adjustment (on-stream at zero flow rate) cannot be conducted.
INVALID TOTAL	Measured data	Measured data	Measured data	The error message disappears if you clear (reset) the totalizer.
H.ALARM	Measured data	Measured data	Measured data	———
L.ALARM	Measured data	Measured data	Measured data	———

Notes

1. The display and output may not be as indicated depending on the nature of the ROM error.
2. If parameters related to the current output are defective, the current output may not be exactly 4mA.
3. An alternate value may be set for the 4-20mA Alarm Output. For detail, see See 8.2.18”4-20mA Alarm Output ”.

13. Maintenance and Troubleshooting

⚠ CAUTION

■ **Do not conduct wiring work when power is applied.**

DON'T

Wiring while power is applied can cause electric shock.

■ **Do not touch the TMF-100 main body when high temperature fluid is being measured.**

DON'T

The fluid raises the main body temperature and can cause burns.

13.1 Maintenance

■ Calibration

The TMF-100 converter has a reference signal generating circuit. This reference signal can be used to check the zero and span of the converter for the purpose of instrumentation maintenance or periodic inspection. See Chapter 9, "Calibration."

■ Fuse

The fuse can be taken out by unscrewing the cap of the fuse holder. Check that the fuse is not damaged. To ensure proper protection, it is recommended that the fuse be replaced every three years.

Type of fuse used: Glass tube fuse (normal blow type) 1 piece
Rating: 1A, 250 V for 100 to 240 VAC power supply
2A, 250 V for 24 V dc power supply
Dimensions: Diameter 5.2 mm • 20 mm

■ LCD display

If the characters displayed on the LCD are dimmed or blurred, the LCD display may require replacement. Contact your nearest certified Anderson representative.

■ Washing and cleaning inside the detector measuring pipe

When measuring liquid that contains conductive solids and the flowmeter is used for a long time under this condition, material may accumulate on the inside wall of the detector measuring pipe. This may cause the flowmeter's reduced indication value. If a symptom of reduced indication value occurs, and the flowmeter's calibration/check does not show any problems of the flowmeter, check to be sure that deposits have not accumulated on the inside wall of the detector measuring pipe. If found, clean and remove the accumulated material with soft brush. When the accumulated material is removed, the flowmeter should return to proper display.

Care should be taken not to damage the lining, or gasket, on the piping end of the detector main unit. When the flowmeter is used in a place where this symptom is likely to occur, we recommend that you establish a periodic inspection cycle. Clean the wall of the detector measuring pipe if buildup occurs.

* Depending on the conditions of liquid, one year in general is a recommended period for cleaning.

CAUTION:

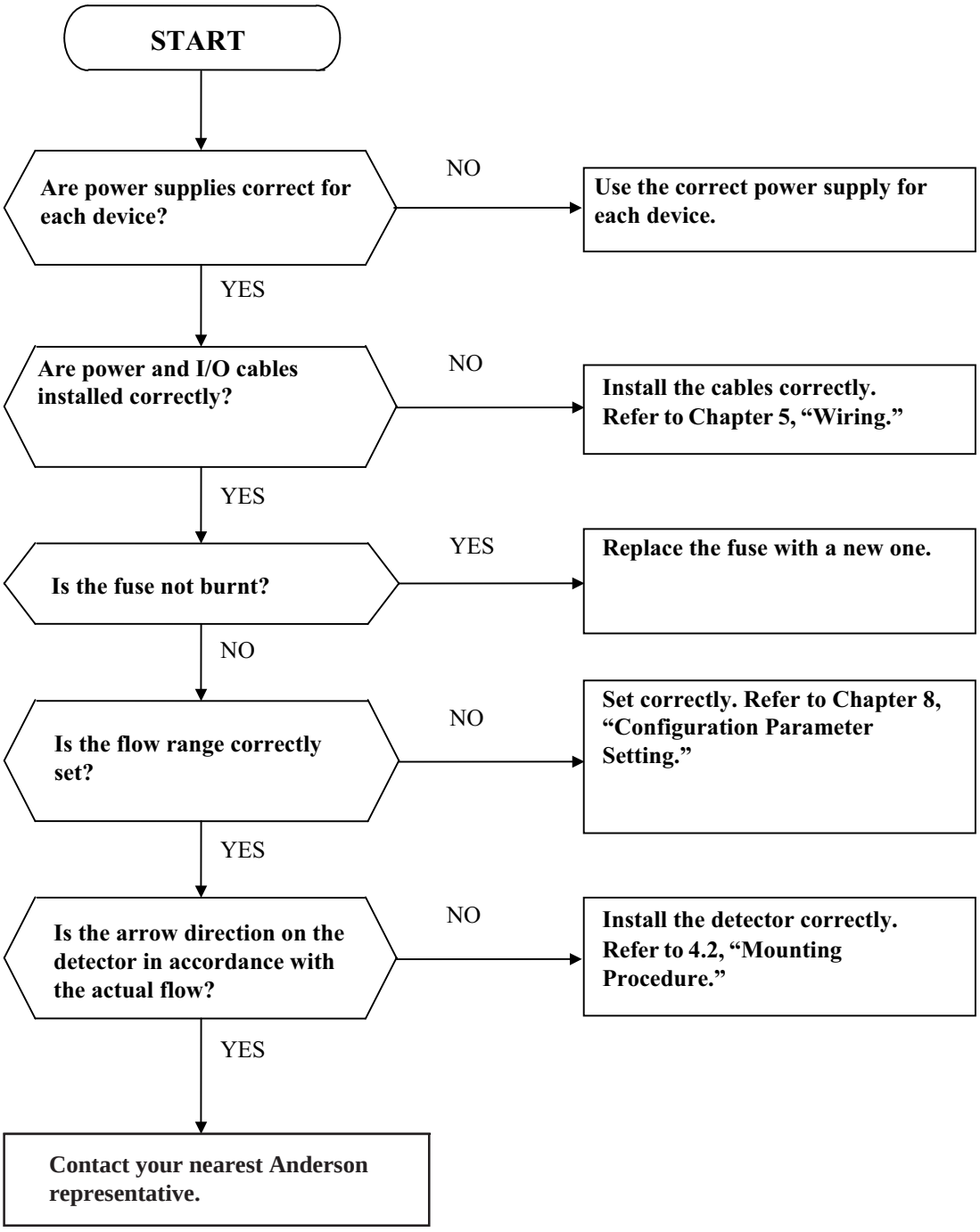
Be sure line is empty, and temperature has cooled prior to removing meter for inspection.

* In general, increasing the flowrate in the pipe will result in less accumulation problems. It is recommended that the meter size be such that the flowrate becomes 3.3 m/s or more, for a line where accumulation occurs often.

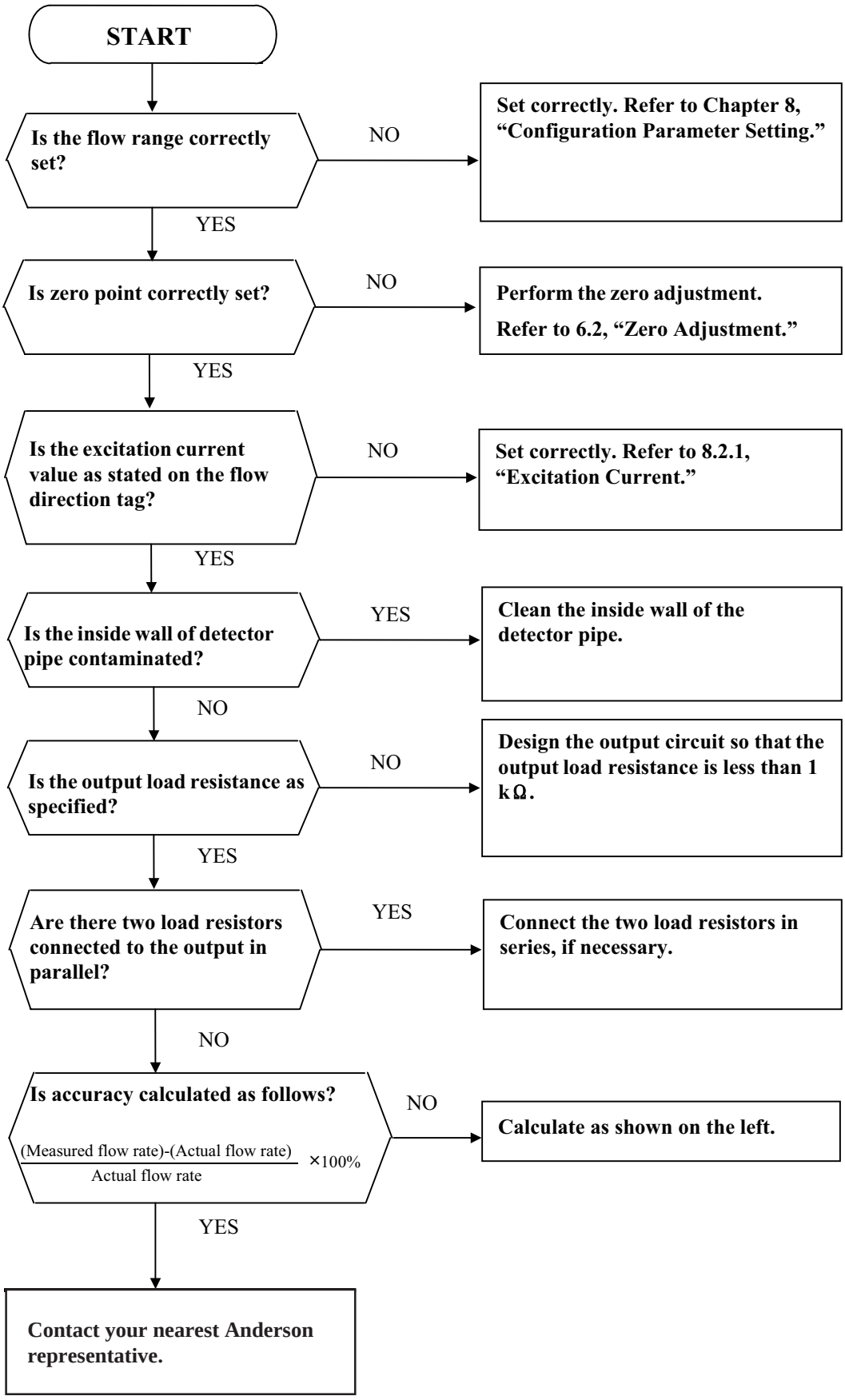
13.2 Troubleshooting

If a problem occurs while using the TMF-100, follow the flowcharts described below prior to calling your Anderson Service Representative

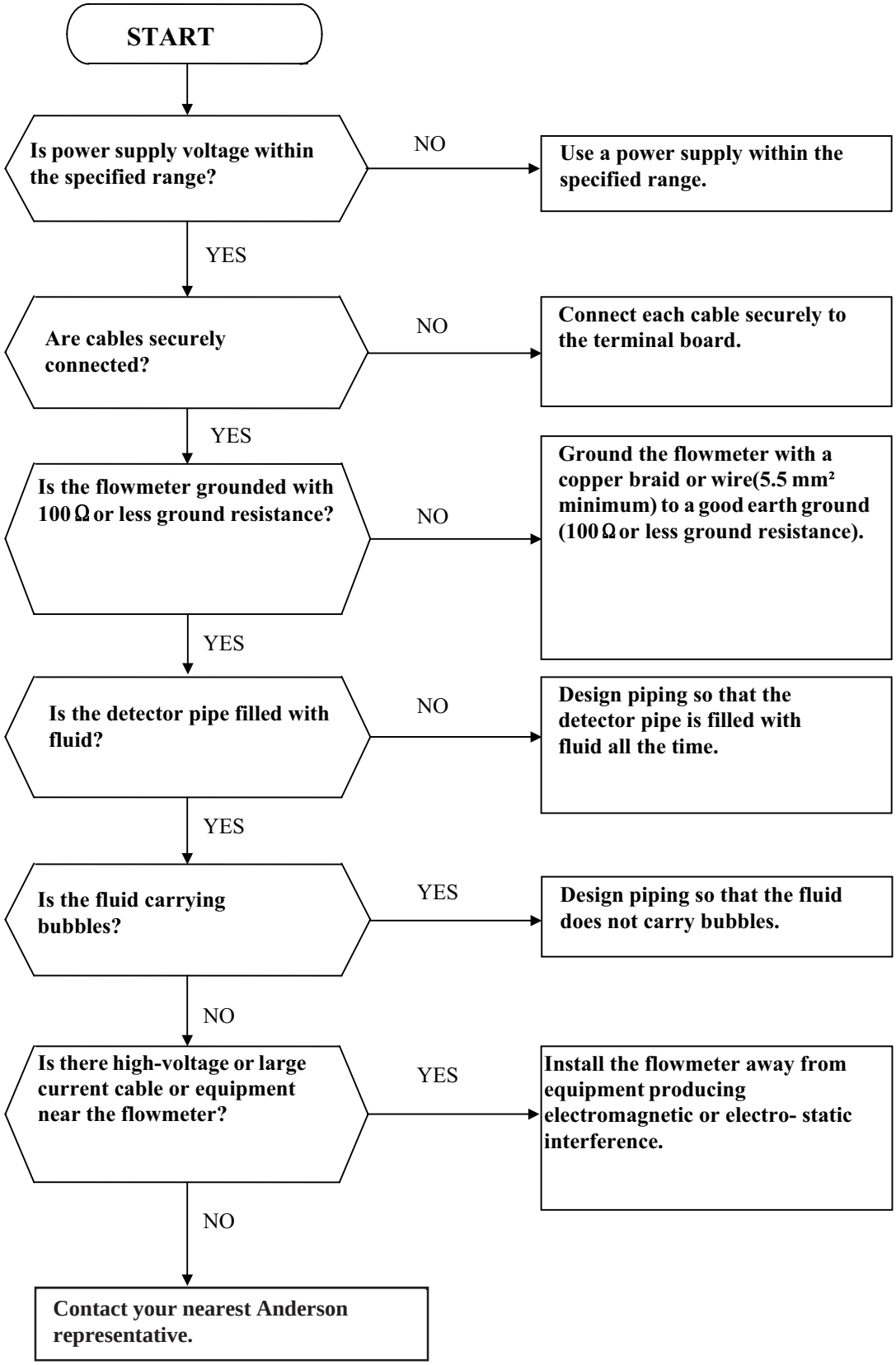
(1) Flow rate is not indicated.



(2) Flow rate indication is not correct.



(3) Flow rate indication is not stable.



14. Principle of Operation

The operating principle of the electromagnetic flowmeter is based on Faraday's Law of electromagnetic induction. It is designed to measure the volumetric flow rate of fluid. An insulated pipe of diameter D is placed vertically to the direction of a magnetic field with flux density B (see Figure 14.1). When an electrically conductive fluid flows in the pipe, an electrode voltage E is induced between a pair of electrodes placed at right angles to the direction of magnetic field. The electrode voltage E is directly proportional to the average fluid velocity V.

The following expression is applicable to the voltage.

$E = K \times B \times D \times V$ [V] ..... (Eq. 14.1)

E = induced electrode voltage [V]
K = constant
B = magnetic flux density [T]
D = meter pipe diameter [m]
V = vluid velocity [m/s]

Volumetric flow rate Q [m^3/s] is:

$$Q = \frac{\pi \times D^2}{4} \times V \quad \text{.....(Eq. 14.2)}$$

Using the Equation 14.1 and 14.2

$$E = K \times B \times D \times \frac{4}{\pi \times D^2} \times Q$$

$$E = \frac{4 \times K \times B}{\pi \times D} \times Q \quad \text{.....(Eq. 14.3)}$$

Therefore, volumetric flow rate is directly proportional to the induced voltage.

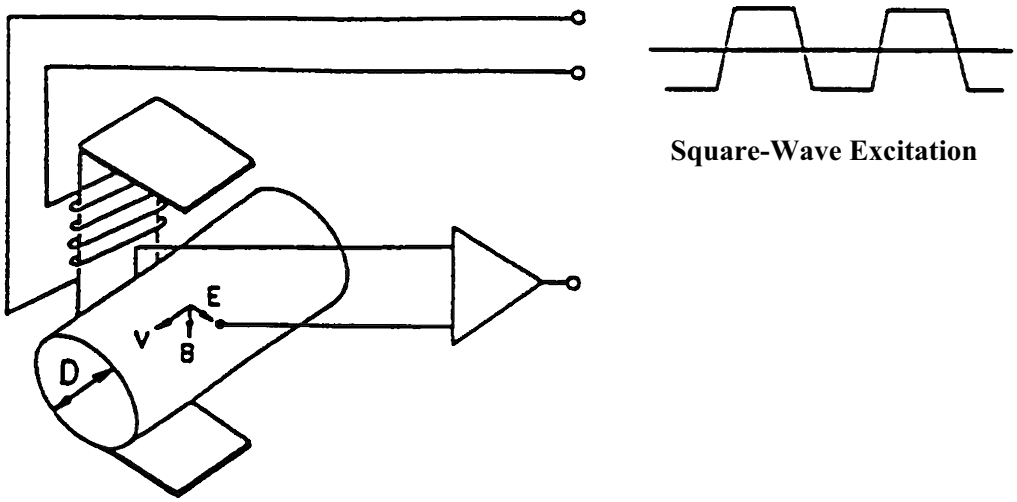


Figure 14.1 Principle of Operation

The TMF100 electromagnetic flowmeter uses the square-wave excitation method, which provides long-term stable operation. With square-wave excitation, the TMF 100 offers reliable measurement without being affected by electrostatic or electromagnetic interference, or electrochemical polarization between the electrodes and the fluid to be measured.

15. Specifications

The flowmeter specifications and the type specification code used when ordering the flowmeter are described in this chapter.

15.1 Flowmeter Specifications

■ Overall Specifications

Measurement range in terms of flow velocity:
0–0.3 m/s to 0–10 m/s (0–0.1 m/s to 0–0.3 m/s range is available optionally)
System accuracy: See the following table.

Table 15.1 System accuracy

Flow rate as a percentage of range	Accuracy		
	0.1–0.3 m/s (0.3-1.0 ft/s)	0.3 – 1.0 m/s (1.0-3.3 ft/s)	1.0–10 m/s (3.3-32.8 ft/s)
0 to 20%	————		±0.1% FS
20 to 100%	————		±0.5% of rate
0 to 50%	±0.25% FS		————
50 to 100%	±0.5% of rate		————

Note: The accuracy above is measured under standard operating conditions at Anderson's calibration facility.

Fluid conductivity: 5 µS/cm minimum
Fluid temperature: –10 to + 160 °C (14 to 248°F)
Ambient temperature: –10 to +60 °C (14 to 140°F)
Dimensions and Mass: See Chapter 16, "Outline Dimensions."

■ TMF100 Detector

Meter size: 25 mm (1”), 40 mm (1 1/2”), 50 mm (2”), 80 mm (3”), 100 mm (4”)

Connection type: ISO 2852 Clamp connection

Note: Tri-clamp® can connect instead of ISO 2852 clamp.
Tri-clamp® is a registered trademark for Tri-Clover Inc.

Fluid pressure: – 0.1 MPa to 2 MPa (or to pressure standard for flanges)

Principal materials

Case: 304 stainless steel
Lining: Alumina ceramic tube
Electrodes: 316L stainless steel (Standard)
Ferrule: 304 stainless steel (Standard)
Seal gasket: Silicon rubber
Structure: IP67 (NEMA 4X) Watertight
3A standard (Approved for 3A standard)
Coating: No coating

■ TMF100 Converter

Input signal

Digital input DI

Signal type: 20 to 30 V dc voltage signal
Input resistance: 2.7 kΩ
Number of inputs: One point

Output signals

Current output: 4 to 20 mA DC (load resistance 0 to 1 kΩ)

Digital outputs

Digital output DO1:

Output type: Transistor open collector
Number of outputs: One point
Output capacity: 30 V DC, 200 mA maximum

Digital output:

Output type: Solid state relay (non polarity)
Number of outputs: One point
Output capacity: 50 V DC, 150 mA maximum

DI function — One of the following functions can be assigned for the DI signal.

Range switching — Selects one of two ranges in the 2-range setting or selects either the higher or lower range in the bidirectional 2-range setting.
Totalizer control — "Starts and stops" or "Resets and Starts" the totalizer.
Fixed-value outputs — Outputs fixed-values for current output and pulse output.
Zero adjustment — Starts zero adjustment (on-stream at zero flow rate).

DO1 and DO2 functions — One of the following functions can be assigned for DO1 and/or DO2.

- **Pulse output (available only for DO1)**
  Pulse rate: 3.6 to 3600000 pulses/hour
  Pulse width: 0.5 to 500 ms
  (but less than half of the period of pulse output for 100% flow rate)
- **Multi-range selection outputs**
  One output used: (1) 2-range switching for unidirectional flow
  (DO1 or DO2) (2) Forward/Reverse flow range switching
  Two outputs used: (1) 4-range switching for unidirectional flow
  (DO1 and DO2) (2) 2-range switching for Forward and Reverse flows
- **High and/or low limit alarms outputs**
  Outputs an alarm signal if the process flow rate goes above or below the set limits.
  Output status is programmable.
  Setting range: –10 to 110% of the span (range)
  Output status: Normal Open or Normal Close selected
- **Empty pipe alarm output**
  Outputs an alarm signal when the detector pipe is not filled with fluid.
  Output status: Normal Open or Normal Close selected
- **Preset point output**
  Outputs a signal when the totalized flow reaches the preset value.
  Setting range: 1 to 99999999 counts
  Output status: Contact ON (closed)
- **Converter failure alarm**
  Outputs a signal if an error occurs when self-diagnostics is conducted.
  Output status: Normal Open or Normal Close selected

Damping: 0.5 to 60 seconds (selectable in increments of 1 second)

Parameter setting — Parameters can be set as follows:

TMF100 with LCD display: Three control keys are provided to set configuration parameters.

Zero and span calibration:

Built-in calibration signal source allows converter unit check.

Zero adjustment:

Zero point adjustment can be started by pressing the switch in the converter.

Conditions when power fails:

The outputs and display will indicate as follows when power fails. Parameter values are stored in non-volatile memory and the values will be restored when the power returns to normal condition.

Current output: 0 mA dc
Digital output: OFF (Open)
LCD display: No display

Power supply:

One of the following can be selected:

- 100 to 240 VAC (Allowable voltage 80 to 264 VAC), 50/60 Hz (standard) .
- 24 VDC (Allowable voltage 20.4 to 28.8 VDC)

Arrester:

Arresters are installed in the power supply and current signal output circuit.
To properly utilize the arresters, attach earth ground point to the GND terminal. (See Chapter 5, “Wiring.”)

Housing: Aluminum alloy

Coating: Acrylic resin-baked coating, pearl-gray colored

Structure: IP67 (NEMA 4) Watertight

Cable connection port — Quick Disconnect provided.

Wiring holes in converter: G(PF) 1/2 thread

Vibration resistance

No resonance to the following levels of vibration:

- 10 to 60 Hz, amplitude 0.07 mm;
- 60 to 150 Hz with acceleration of 9.8 m/s^2.

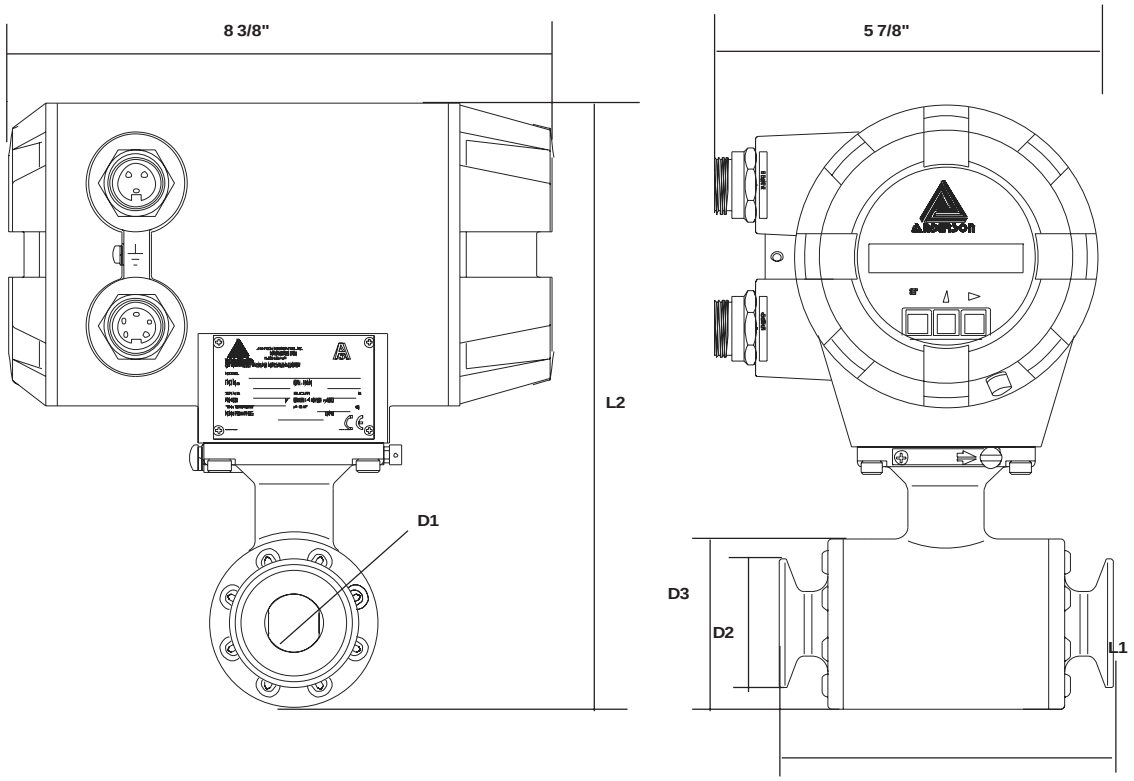
No problem occurs after application of 30 Hz, 29.4 m/s vibration in any axis for four (4) hours.

Note: Avoid using the flowmeter in an environment with constant vibration.

15.2 Type Specification Code

16. Outline Dimensions

- **Meter size 40mm(1 1/2”) to 100mm(4”) for ISO2852 clamp type**



Meter size (inch)	Joint size (ISO2852)	L1 (inch)	L2 (inch)	D1 (inch)	D2 (inch)	D3 (inch)	Weight (lb)
1”	1”	5 1/8”	9 1/4”	7/8”	2”	2 5/8”	approx.13.2
1 1/2”	1 1/2”	5 7/8”	10 1/4”	1 3/8”	2”	3 3/8”	approx.15.4
2”	2”	6 1/4”	10 7/8”	1 7/8”	2 1/2”	4”	approx.17.6
3”	3”	6 3/4”	11 7/8”	2 7/8”	3 5/8”	5”	approx.22.0
4”	4”	7 7/8”	13 1/8”	3 7/8”	4 5/8”	6 1/4”	approx.30.9

Appendix 1 Electromagnetic Compatibility and Low Voltage Safety

Electromagnetic Flowmeter TMF-100 has been confirmed to comply with the requirements of the EMC directive 89/336/EEC and the low voltage directive 93/68/EEC.

EMC directive

This device has been tested in a typical configuration in accordance with the following standards in an industrial environment.

- Generic emission standard EN50081-2
  - Conducted RF emissions EN55011
  - Radiated RF emissions EN55011
- Generic immunity standard EN50082-2
  - Conducted RF immunity ENV50141
  - Radiated RF immunity ENV50140/ENV50204
  - Electrostatic discharge EN61000-4-2
  - Fast transient burst EN61000-4-4

The above EMC tests have been carried out with the flowmeter installed properly in accordance with this instruction manual. However, there is no guarantee that interference will not occur in a particular installation.

To reduce interference to or from other equipment, please check the following installation points.

(1) Use shielded cables for all I/O cables.

(2) If this device is installed in an area where RFI exists, deviation of the current output signal may result. In this case, ferrite cores will be required on each I/O cable. Please contact Anderson if problems arise.

(3) This device is designed to be used in an industrial environment and may cause reception interference to radio, television or wireless communications. In this case, relocate the receiving antenna.

(4) The use of a transceiver or wireless equipment near this device may cause interference. If deviation of the output signal appears during use of a radio, increase the distance between the converter or the signal cable and the antenna.

Low voltage directive

- Low voltage standards EN61010-1
  Environmental conditions: