

Introduction

The LF502 electromagnetic flowmeter uses Faraday's Law of electromagnetic induction in the same way as conventional electromagnetic flowmeters to measure the flow rate. Position of electrodes in the LF502 is so designed that it can be used even in a partially-filled pipe to measure the flow rate.

Improved functional magnetic field distribution technique enables a high-precision flow measurement continually from low-level to fully-filled flow conditions. This eliminates unnecessary piping work such as lifting the downstream pipe section to fill the detector pipe.

Compared with flowmeters measuring the flow rate by means of flow level, the obstruction less LF502 flowmeter does not usually allow mud, sands and other solid sediment stay at the bottom of the detector pipe and is unaffected by wave or floating solids on the fluid surface.

The AF900 hand-held terminal (HART*¹ communicator) can be used to communicate with the flowmeter from a remote place.

*1: HART protocol (Highway Addressable Remote Transducer) is a communication protocol for industrial sensors recommended by the HCF (HART Communication Foundation).

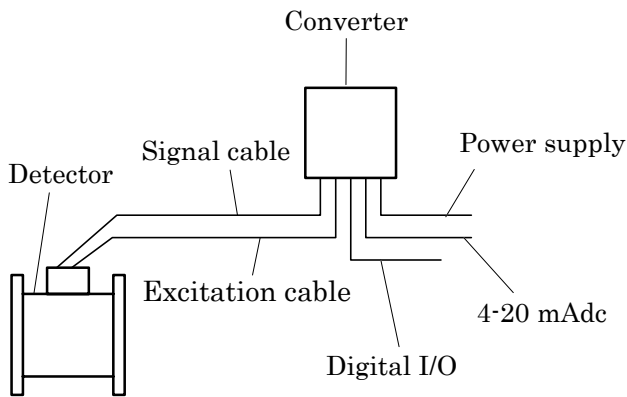


Figure 1. LF502/LF232*F Configuration



Figure 2. LF502 Electromagnetic Flowmeter for Partially-filled Pipes

Specifications

Overall Specifications

Measurement range:

| Meter size | Measurement range |
|-------------|--|
| 6" (150mm) | 0 – 264 GPM(std) to 0 – 1320 GPM (0 – 60 m ³ /h to 0 – 300 m ³ /h) |
| 8" (200mm) | 0 – 484 GPM(std) to 0 – 2420 GPM (0 – 110 m ³ /h to 0 – 550 m ³ /h) |
| 10" (250mm) | 0 – 770 GPM(std) to 0 – 3850 GPM (0 – 175 m ³ /h to 0 – 875 m ³ /h) |
| 12" (300mm) | 0 – 1100 GPM(std) to 0 – 5500 GPM (0 – 250 m ³ /h to 0 – 1250 m ³ /h) |
| 14" (350mm) | 0 – 1540 GPM(std) to 0 – 7700 GPM (0 – 350 m ³ /h to 0 – 1750 m ³ /h) |
| 16" (400mm) | 0 – 1980 GPM(std) to 0 – 9900 GPM (0 – 450 m ³ /h to 0 – 2250 m ³ /h) |
| 20" (500mm) | 0 – 3124 GPM(std) to 0 – 15620 GPM (0 – 710 m ³ /h to 0 – 3550 m ³ /h) |
| 24" (600mm) | 0 – 4400 GPM(std) to 0 – 22000 GPM (0 – 1000 m ³ /h to 0 – 5000 m ³ /h) |

Note: Above flow rate is almost 0 – 3.28 ft/s (std) to 0 – 16.4 ft/s (0 – 1 m/s to 0 – 5 m/s) flow velocity.

Fluid-level range:

| Meter size | Specification |
|------------------------------|--|
| 6" to 12" m (150 to 300m) | 1-1/4"(30mm) to fully-filled condition. |
| 14" to 24" (350 to 600mm) | 10% of inside tube diameter to fully-filled condition. |

Note: The fully-filled condition means a 100% of inside tube diameter.

Accuracy: ±2% FS (when measurement range is standard)

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

Required straight pipe length:

10D minimum on upstream side and
5D minimum on downstream side

Note: D is a nominal meter size.

Fluid conductivity: 100µS/cm minimum

Fluid temperature: 32 to 131 °F (0 to 55 °C)

Ambient temperature: 14 to 122 °F (-10 to 50 °C)

Dimensions and Weights: See figures 3 to 5.

Power supply:

100 to 120 Vac (80 to 132 Vac), 50/60Hz

Power consumption: 50VA (30W) or less

■ **Model LF502 Detector**

Meter sizes: 6" (150 mm), 8" (200 mm), 10" (250 mm), 12" (300 mm), 14" (350 mm), 16" (400 mm), 20" (500 mm), 24"(600 mm)

Fluid pressure:

0 psi or 0 bar (0 MPa) to the pressure limited by flange standard
(fully-filled condition)

Connection flange standards:

ANSI 150, JIS 10K

Structure:

IP67 and NEMA 4X Watertight (std.)
IP68 and NEMA 6P Submersible (opt.)

Coating: Phthalic acid resin coating, pearl-gray colored (standard for watertight type) or black tar epoxy (option for watertight type and specified exclusively for submersible type)

Principal materials:

Case — carbon steel

Measuring pipe — 304 stainless steel

Linings — The following are the standards:

| Meter size | Standard specification |
|--------------------------|------------------------|
| 6" to 16" (150 to 400mm) | EPDM rubber |
| 20" & 24" (500 & 600mm) | Chloroprene rubber |

Electrodes — 316L stainless steel (std.)

Grounding rings — The following are the standards.

| Meter size | Standard specification |
|--------------------------|------------------------|
| 6" to 16" (150 to 400mm) | 316 stainless steel |
| 20" & 24" (500 & 600mm) | 304 stainless steel |

See Table 1 for optional materials and other related information.

Coating: phthalic acid resin coating (std.),
Pearl-gray colored

Cable connection port:

Cable glands: Provided as standard, R(PT) 1/2 male screw.

Applicable diameter: 0.433 to 0.512 inch (11 to 13mm)

■ **Model LF232*F converter**

Input signals

Analog signal — the voltage signal from detector, proportional to process flow rate.

Digital input DI (opt.)

(added when 9th digit of specification code is "3")

Voltage level: High level 20 to 30 V dc

Low level 2 V dc or less

Input resistance: 2.7 kΩ

Number of inputs: 2 points (DI1 and DI2)

DI functions:

For digital input function, either of the following functions can be selected.

• **Range switching**

One Digital Input is used: switching between large and small ranges of forward/reverse, 2-range measurement.

Two Digital Inputs are used: switching between ranges of single direction, 4-range measurement.

• **Totalizer control input**

Totalizer Start/Stop control or Reset/Start

• **Output hold input**

Fixed with set value for current output and pulse output (loop check)

• **Zero adjustment**

Starts zero adjustment (on-stream at zero flow rate) when DI voltage level goes low after remaining high for 10 to 20 seconds.

Output signals

Current output:

4–20mA_{dc} (load resistance 0 to 1KΩ)

Digital output (DO) — One point (std.) and three more point is optionally available as follows.

Digital output DO1 (std.):

Output type: Transistor open collector

Number of outputs: One point

Output capacity : 30V_{dc}, 200mA maximum

Digital output DO2~DO4 (opt.)

(Added when 9th digit of specification code is "3")

Out put type: Solidstate relay output (non polarity)

Number of outputs: 3 points

Output capacity: 150V_{dc}, 150mA maximum or
150V_{ac} (peak to peak),
100mA maximum

DO functions—Four digital output function, either of the following functions can be selected.

• **Totalizer pulse output**

DO1 or DO2 can be selected (Forward direction pulse and reverse direction pulse can be assigned

independently)

In the case of DO1

Pulse rate: 3.6 to 3,600,000 pulses/h

Pulse width: Settable within the range of 0.3 to 500ms

In the case of DO2

Pulse rate: 3.6 to 360,000 pulses/h

Pulse width: Settable within the range of 4 to 500ms

• **Rage switching output**

One Digital Output (DO) is used

- Single direction, 2-range switching signal
- Forward/reverse direction switching signal

Two Digital Outputs (DO) are used

- Single direction, 4-range switching signals
- Forward/reverse 2-range switching signals

• **High/low limit alarm output**

An alarm is output when flow rate goes above or below the set-point value

Setting range : -10 to 110% of the settable maximum range

High limit 2 points, low limit 2 points can be set

At the time of alarm output, Normally Open or Normally Closed contact can be selected

• **Preset point output**

Contact ON when totalizer count exceeds the set value

Setting range: 1 to 99999999 count

• **Converter error alarm**

An alarm is output when an operation error is detected by self-diagnosis.

At the time of alarm output, Normally Open or Normally Closed contact can be selected

Communications signal:

A digital communications (HART protocol) signal is superimposed on 4 to 20 mA dc analog output signal.

Load resistance: 240 Ω to 1 k Ω

Load capacitance: 0.25 μ F or less

Load inductance: 4mH or less

(For maximum cable length, about 2km is a guideline length when CVV-S 1.25mm² is used under standard installation condition.)

Note: HART (Highway Addressable Remote

Trans-ducer) is a communications protocol for industrial sensors recommended by the HCF (HART Commu-nication Foundation).

Output display:

16-character×2-line dot-matrix LCD

(With back light).

2 units can be selected from the flowing units: flow velocity, instantaneous flow rate, total flow (forward/reverse/difference flow), total count, %, custom unit.

Parameter settings—Parameters can be set as follows

• **IR Switches:** Various parameters can be set without opening the converter housing using 4 infrared switches (password can be set)

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

• **Digital communication:** The AF 900 hand-held terminal is needed to set parameters.

• **Damping:** 0.5 to 60 s

(Selectable in one second increments)

“**Field re-verification**” **Mag-Prover** – Toshiba’s

Zero span calibration tool allows unit to be re-calibrated and verified using an internal software program. (For more information contact Toshiba International Corp.)

Conditions when power fails:

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

Current output: 0 mA

Digital output : OFF (contact open)

LCD display : No display

Surge protection: Surge protectors are installed in the power supply, excitation circuit, current signal output and digital I/O circuit.

Terminal block structure: 21-pole, screw connection type (M4 screw)

Housing: Aluminum alloy

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

Cable connection ports :

A cable gland is provided for each port.

OD of cable ϕ 11 to 13 mm

Material Nylon 66

G(PF) 1/2 male screws.

Structure: IP67 and NEMA 4X Watertight

Vibration resistance:

No resonance to the following levels of vibration:

- 10 to 55Hz with amplitude of 0.07mm,
- Vibration of 30Hz with 29.4 m/s² in 4h in each direction will not cause any defect to unit.

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

Dimension and Weights:

See Figure 5

Installation

■ **Dimensions**

Separate type LF502 (Meter size 6" and 8")

Unit: inch (mm)

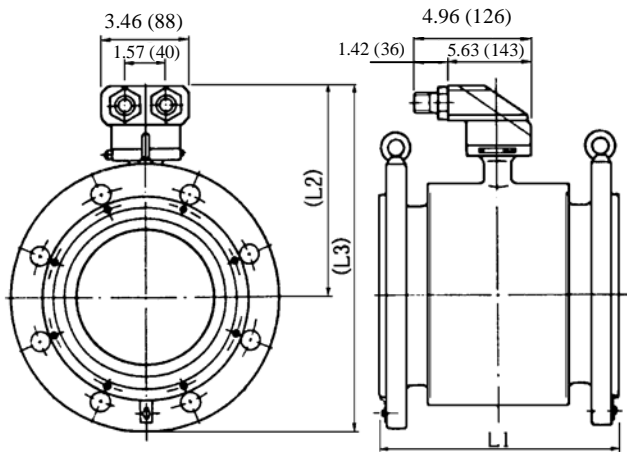


Figure 3. Detector Dimensions for Meter Sizes 6" (150 mm) and 8" (200 mm)

See the following tables for dimensions of L1, L2 and L3 in Figure 3 above, and the number of bolts required for each flange.

ANSI 150 flange dimensions:

| Meter Size (inch) | L1 (inch) | L2 (inch) | L3 (inch) | No. of bolts | Weight (lb) |
|-------------------|-----------|-----------|-----------|--------------|-------------|
| 6 | 10.47 | 9.67 | 15.14 | 8 | Approx. 84 |
| 8 | 11.81 | 10.69 | 17.42 | 8 | Approx. 194 |

JIS 10K flange dimensions:

| Meter Size (mm) | L1 (mm) | L2 (mm) | L3 (mm) | No. of bolts | Weight (kg) |
|-----------------|---------|---------|---------|--------------|-------------|
| 150 | 266 | 246 | 386 | 8 | Approx. 35 |
| 200 | 300 | 271 | 436 | 12 | Approx. 80 |

■ **Dimensions**

Separate type LF502 (Meter size 10" to 24")

Unit: inch (mm)

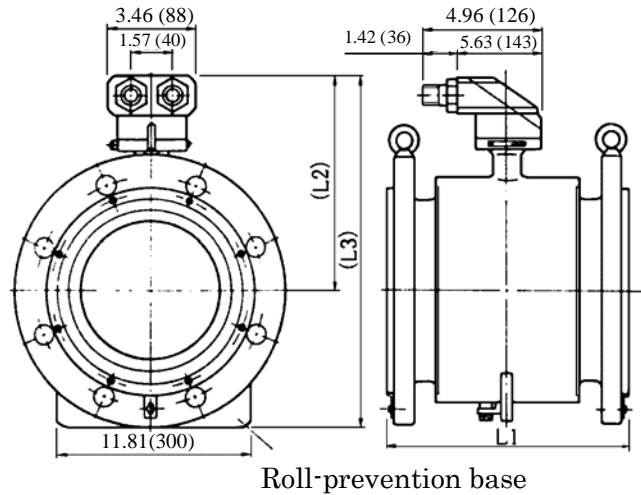


Figure 4. Detector Dimensions for Meter Sizes 10" (250 mm) to 24" (600 mm)

See the following tables for dimensions of L1, L2 and L3 in Figure 4 above, and the number of bolts required for each flange.

ANSI 150 flange dimensions:

| Meter Size (inch) | L1 (inch) | L2 (inch) | L3 (inch) | No. of bolts | Weight (lb) |
|-------------------|-----------|-----------|-----------|--------------|-------------|
| 10 | 13.78 | 12.05 | 20.05 | 12 | 263 |
| 12 | 15.75 | 12.95 | 22.45 | 12 | 318 |
| 14 | 17.72 | 13.74 | 24.24 | 12 | 359 |
| 16 | 19.69 | 15.12 | 26.87 | 16 | 476 |
| 20 | 23.62 | 16.42 | 30.17 | 20 | 527 |
| 24 | 23.62 | 18.46 | 34.46 | 20 | 701 |

JIS 10K flange dimensions:

| Meter Size (mm) | L1 (mm) | L2 (mm) | L3 (mm) | No. of Bolts | Weight (kg) |
|-----------------|---------|---------|---------|--------------|-------------|
| 250 | 350 | 306 | 506 | 12 | Approx. 110 |
| 300 | 400 | 329 | 551 | 16 | Approx. 120 |
| 350 | 450 | 351 | 596 | 16 | Approx. 130 |
| 400 | 500 | 386 | 666 | 16 | Approx. 180 |
| 500 | 600 | 403 | 740 | 20 | Approx. 190 |
| 600 | 600 | 455 | 852 | 24 | Approx. 250 |

■ Dimensions

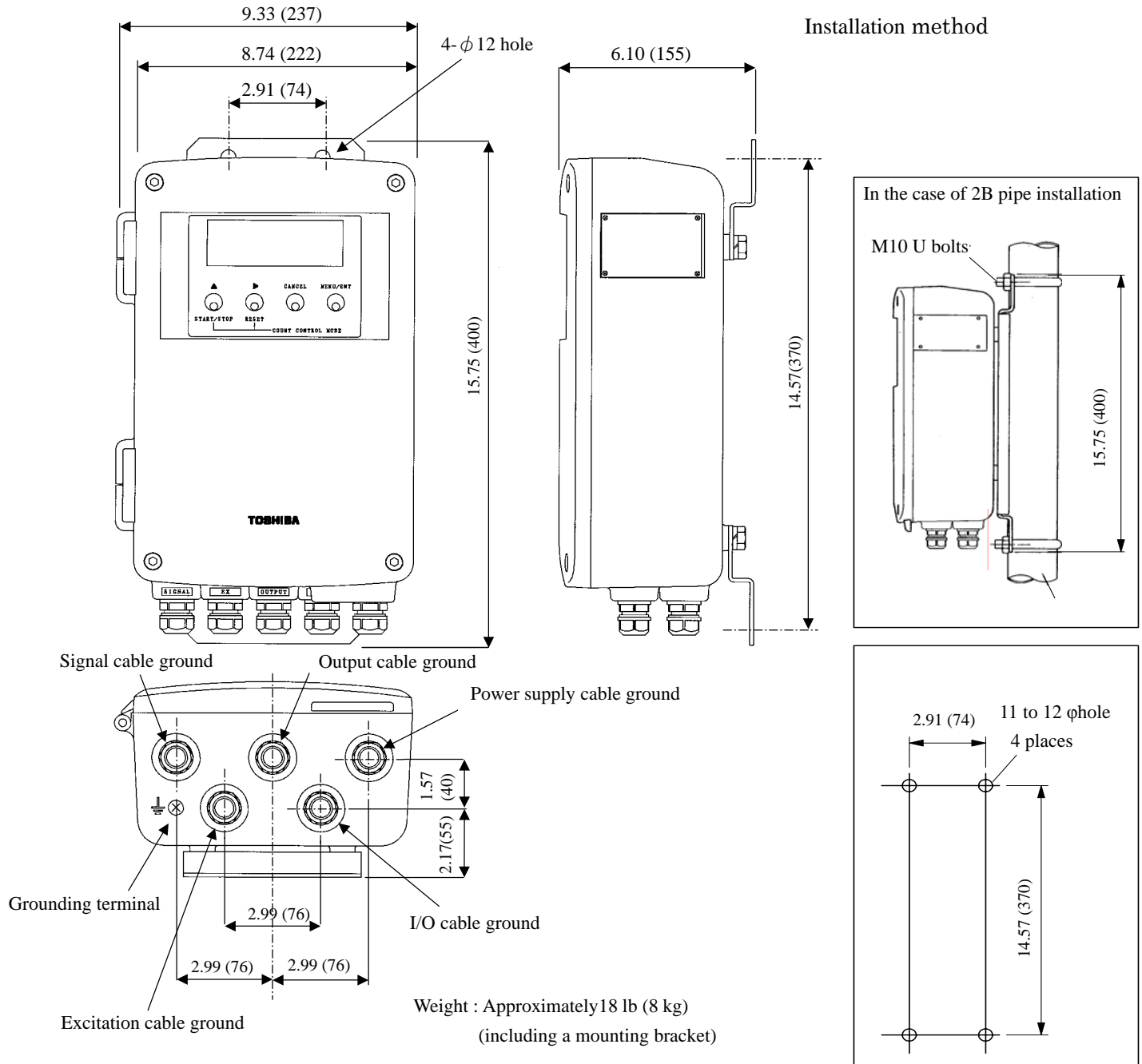


Figure 5. Separate type converter LF232 *F

External Connections

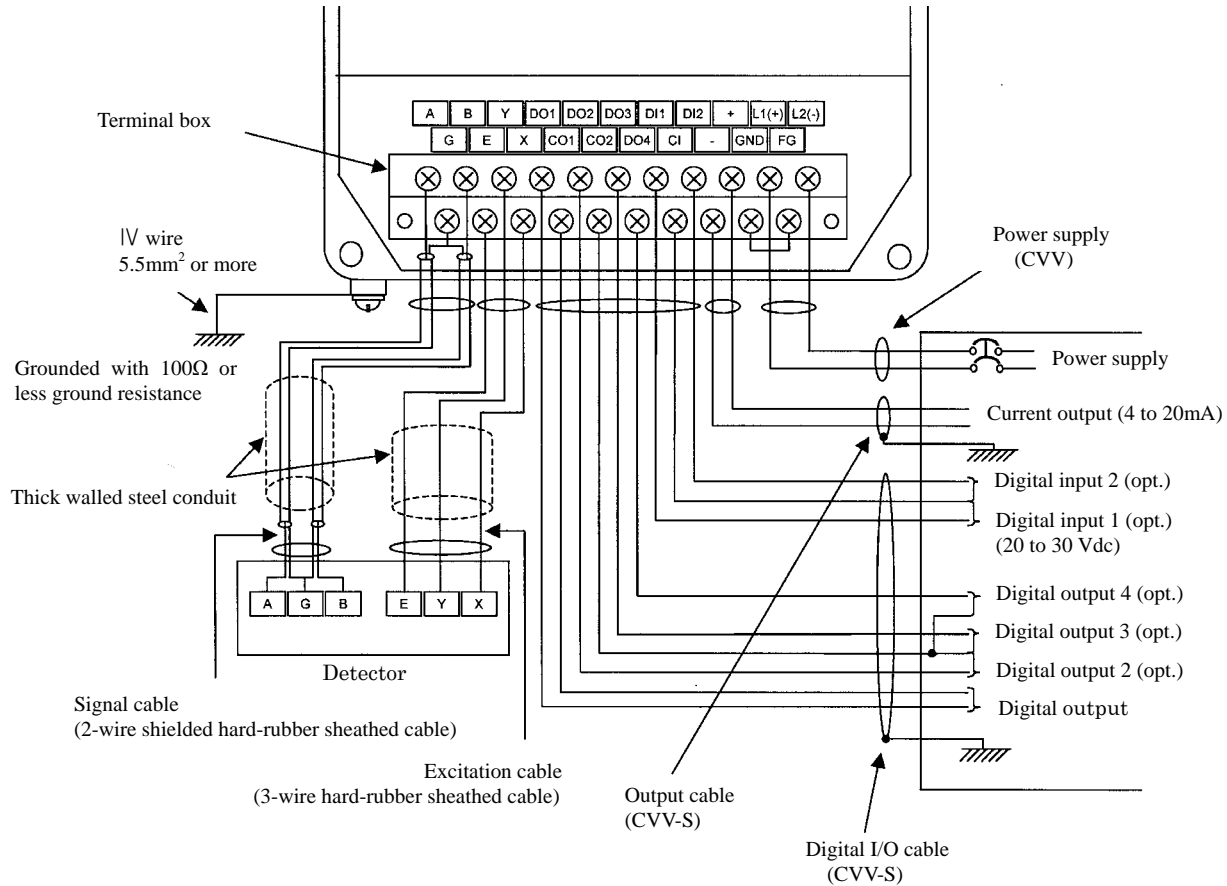


Figure 6. LF502/LF232*F flowmeter Wiring Diagram

Wiring Precautions

- (1) Be sure to use thick walled steel conduit (22 mm) for signal and excitation cable wiring between the detector and converter. The conduit screw is R (PT)1/2. Use flexible conduits at the cable outlets of the detector as needed.
 - (2) Make the grounding wire as short as possible. Do not use a common ground shared with other equipment where earth current may flow. An independent earth ground is recommended.
 - (3) The meter may affect its accuracy when the electric potential of measurement fluid is unstable condition.
- Make the piping of the upstream side and downstream side the same material.
 - When the material of next pipes are conductive like metal, use a 5.5mm² or larger core cable for grounding of detector and wire it at 2 places as follows.
 - Between Grounding terminal at detector body and Grounding ring at upstream side.
 - Between Grounding terminal at detector body and Grounding ring at downstream side.
 - When the material of next pipes are

non-conductive like plastic, use a 5.5mm² or larger core cable for grounding of detector and wire 1 place as follows.

- Between Grounding terminal at detector body and Grounding (100 ohm or less).
- (4) DO1 to DO4 and DI1 to DI2 use the same common terminal (COM). This COM can not connect to other instruments that have their own ground terminal (Power supply for connecting to DI or DO, etc...). Need to wire separately.

■ Piping Precautions

(1) Flange connection

The flowmeter has upstream and downstream flanges on the ends of detector pipe. Connect these flanges with the flanges on both sides of pipeline bore using connection bolts after inserting a gasket between them. See Figure 7. Tighten the bolts in even increments diagonally across.

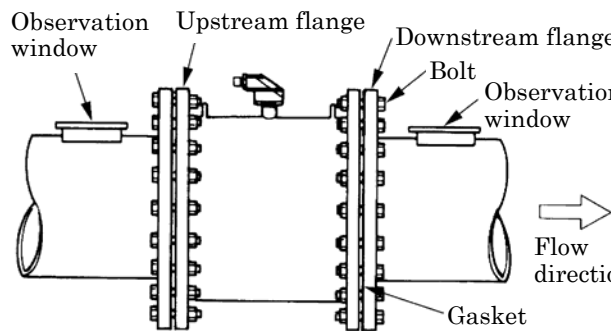


Figure 7. Flange Connection

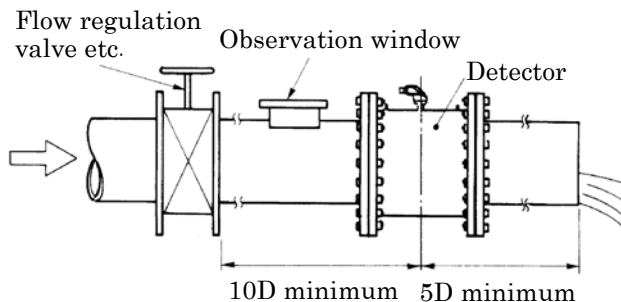
(2) Required straight pipe length

The straight pipe length is required to prevent uneven flow velocity and a disturbance on the fluid surface in the detector pipe. The required straight pipe length should be as follows:

- Downstream side: $L = 5D$ minimum
- Upstream side: $L = 10D$ minimum

where,

L = straight pipe length (straight pipeline length + half length of detector pipe length)



Note: The length of reducers, if used, can be counted as a part of straight pipe length.

Figure 8. Required Straight Pipe Length on Upstream and Downstream Sides

■ About establishment environment

Do not store or install the flowmeter:

- Where there is direct sunlight.
- Where excessive vibration or mechanical shock occurs.
- Where high temperature or high humidity conditions exist.
- Where corrosive atmospheres exist.
- Places that can be submerged under water.
- Where there is sloped floor. To put the flowmeter temporarily on the floor, place it carefully with something, such as stopper, to support it so that the flowmeter will not topple over.

In areas like the following, there may be the case that infrared switches do not function correctly. (If these are unavoidable, use an appropriate cover.)

- (1) Where unit (operation panel) is exposed to direct sunlight, reflection of light onto window pane and diffused light reflection.
- (2) Where smoke and steam may occur.
- (3) Where exposed to direct snow, ice or mud.

■ Ordering Information

1. When ordering the LF502 flowmeter, refer to Table 1 (Type Specification Codes). An entry must be made for each of the columns in each of these tables.
2. Fluid characteristics:
 - (1) Type of fluid to be measured and its characteristics
 - (2) Fluid temperature
 - (3) Fluid pressure
 - (4) Electrical conductivity of the fluid
3. Measuring range
4. Digital I/O specifications
5. Ordering scope:
 - Actual flow calibration data:(Required or not)
6. Other items
 - Specifications other than standard items

Table 1. Specification Code for LF502 detector

| Model | | | | | Specification Code | | | | | | | Description | Size | |
|-------|---|---|---|---|--------------------|---|---|---|----|----|----|--|------|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | | A | B |
| L | F | 5 | 0 | 2 | | | | | | | | | | |
| | | | | | K | | | | | | | LF502 Electromagnetic flowmeter | | |
| | | | | | L | | | | | | | Meter size | | |
| | | | | | M | | | | | | | 6" (150mm) | ● | - |
| | | | | | N | | | | | | | 8" (200mm) | ● | - |
| | | | | | P | | | | | | | 10" (250mm) | ● | - |
| | | | | | Q | | | | | | | 12" (300mm) | ● | - |
| | | | | | R | | | | | | | 14" (350mm) | ● | - |
| | | | | | S | | | | | | | 16" (400mm) | ● | - |
| | | | | | | | | | | | | 20" (500mm) | - | ● |
| | | | | | | | | | | | | 24" (600mm) | - | ● |
| | | | | | A | | | | | | | Standard | ● | ● |
| | | | | | | | | | | | | Connection flange standard | | |
| | | | | | | | | | | | | ANSI 150 | ● | ● |
| | | | | | | | | | | | | JIS 10K | ● | ● |
| | | | | | | | | | | | | Lining | | |
| | | | | | | | | | | | | Chloroprene rubber | - | ● |
| | | | | | | | | | | | | EPDM rubber | ● | ○ |
| | | | | | | | | | | | | Teflon PFA | ○ | - |
| | | | | | | | | | | | | Electrode and Grounding Ring Material | | |
| | | | | | | | | | | | | 316L stainless steel + 316 stainless steel | ● | ○ |
| | | | | | | | | | | | | Titanium + Titanium | ○ | ○ |
| | | | | | | | | | | | | Hastelloy C + Hastelloy C | ○ | ○ |
| | | | | | | | | | | | | 316L stainless steel + 304 stainless steel | ○ | ● |
| | | | | | | | | | | | | Flow and calibration velocity range | | |
| | | | | | | | | | | | | Standard range calibration | ● | ● |
| | | | | | | | | | | | | Coating | | |
| | | | | | | | | | | | | B Phthalic acid resin | ● | ● |
| | | | | | | | | | | | | C Black tar epoxy resin , thickness 0.3mm | ○ | ○ |
| | | | | | | | | | | | | D Black tar epoxy resin , thickness 0.5mm | ○ | ○ |
| | | | | | | | | | | | | E Black tar epoxy resin , thickness 0.5mm (for submersible type) | ○ | ○ |

Code explanation: ●: Standard ○: Option —: Not available

Size groups

- A : 6" (150mm) to 16" (400mm)
- B : 20" (500mm) and 24" (600mm)

Table 2. Specification Code for LF232*F converter

| Model | | | | | Specification Code | | | | | | | Contents | LF232 type |
|-------|---|---|---|---|--------------------|---|---|---|----|----|----|--|------------|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | | |
| L | F | 2 | 3 | 2 | | | | | | | | | |
| | | | | | A | | | | | | | Purpose | |
| | | | | | | | | | | | | Standard | ● |
| | | | | | | | | | | | | Compatible detectors | |
| | | | | | | | | | | | | For Partially-filled pipes (Meter size : 150mm(6") to 600mm(24")) | ● |
| | | | | | | | | | | | | Mounting nuts and bolts | |
| | | | | | | | | | | | | Panel, wall mounting (material : 304 stainless steel) | ● |
| | | | | | | | | | | | | Pipe mounting (material : 304 stainless steel) | ○ |
| | | | | | | | | | | | | Digital input/output | |
| | | | | | | | | | | | | Current output | ● |
| | | | | | | | | | | | | + Digital output points (1 point) | |
| | | | | | | | | | | | | Current output | ○ |
| | | | | | | | | | | | | + Digital output points (4 points) + Digital input points (2 points) | |
| | | | | | | | | | | | | Communication function | |
| | | | | | | | | | | | | HART communication | ● |
| | | | | | | | | | | | | Power supply | |
| | | | | | | | | | | | | 100Vac-120Vac, 50/60Hz | ● |
| | | | | | | | | | | | | A Standard | ● |

Code explanation: ●: Standard ○: Option

ISO9001 and ISO14001 certified.

