

## Introduction

The electromagnetic flowmeter uses Faraday's Law of electromagnetic induction to measure the process flow. The device consists of two units: a detector, through which the fluid to be measured flows and in which low-level signals proportional to flow rates are obtained; and a converter, which supplies excitation current to the detector, and amplifies the signals from the detector and then processes and converts the signals into the 4–20 mA dc current signal. The LF470 is a small meter size detector designed to measure a small amount of fluids containing substances such as chemicals.

The wetted materials for the LF470 are corrosion resistant ceramic and platinum electrodes and are applicable to almost any kind of fluids. The LF470 is a lightweight palm-sized detector.

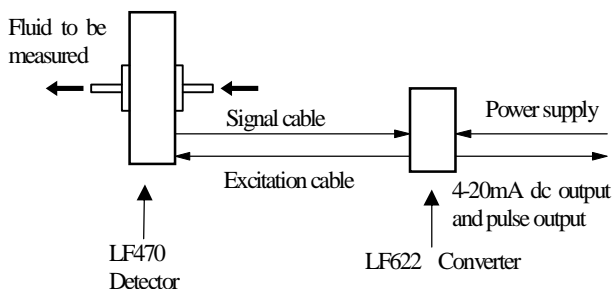
Combining with a LF622 multifunctional converter which has an improved noise-suppression circuit and advanced algorithms. The LF470 is highly resistant to noise and provides a stable output even for fluids containing slurries. IR (Infrared) switches enable parameter setting of the converter without removing the cover. Flow direction can be set in either way, and its unique 128 x 128 dot matrix LCD display allows the LCD to be rotated electronically to 90, 180 and 270 degrees without opening the cover

The AF900 hand-held terminal (HART\*<sup>1</sup> communicator) can be used to communicate with the flowmeter from a remote place. PROFIBUS-PA\*<sup>2</sup> or Modbus\*<sup>3</sup> interface is available as an option.

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

\*2: PROFIBUS is the communication protocol for factory and process automation that the PROFIBUS Organization recommends. Instead of analog control with a conventional analog signal (4-20mA), it is fieldbus which digitizes all signals. Flowmeters support PROFIBUS-PA.

\*3: Modbus is the communication protocol that Modicon Inc. developed. Physical layer is RS485.



**Figure 1. Configuration Diagram**



**LF470**

**LF622**

**Figure 2. Electromagnetic Flowmeter  
LF470/LF622**



Certification number

Z01207

## Specifications

### ■ Overall Specifications

#### Measurement range in terms of flow velocity:

0–0.3 m/s to 0–10 m/s. (0–1.0ft/s to 0–32.8ft/s).

**Accuracy:** The overall accuracy combined with the LF622 converter is shown in the following table.

Flow rate as a percent of range	Accuracy	
	0.3-1.0m/s (1.0-3.3ft/s)	1.0-10m/s (3.3-32.8ft/s)
50 ~ 100%	± 0.8% of FS	± 0.8% of rate
0 ~ 50%	± 0.8% of FS	± 0.4% of FS

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

**Fluid conductivity:** 50µS/cm minimum

**Fluid temperature:**

Pipe connection material	Fluid temperature
Stainless steel and other metals	- 10 ~ + 120 (14 to 248 °F)
Polyvinyl chloride (shock-resistant)	- 10 ~ + 60 (14 to 140 °F)

**Ambient temperature:** –10 to +60 °C (14 to 140 °F)

**Structure:** IP67

**Power consumption:**

- When combined with the LF622 converter:

Standard:10W(14VA)

at AC100V and Excitation current:0.2A

MAX:15W (22VA)

■ **Model LF470 Detectors**

**Fluid pressure:** -0.1 to 1 MPa

**Pipe connection port:**

Standard – Rc (PT) 1/4 thread

Option – See Table 4

**Principal materials:**

**Measurement tube** – Alumina ceramics

**Electrodes** – Platinum

**Pipe connection port:**

Standard – 316 stainless steel

Option –

- Ti (titanium)
- Polyvinyl chloride (shock-resistant) + Ta (Tantalum) for grounding plate
- Polyvinyl chloride (shock-resistant) + Pt-Ir for grounding plate
- Hastelloy C (Equivalent)

**Dedicated preformed cables:**

- Signal cable – 2-wire shielded chloroprene sheathed cable
  - Overall length: 7mm
  - Length: 5m
- Excitation cable – 3-wire chloroprene cable
  - Overall length: 7mm
  - Length: 5m

**Coating:** Pthalic acid resin coating pearl-gray colored

**Mass:** approximately 1.0 kg (2.2 lb)  
(for each size excluding cables)

■ **Model LF622 converters**

**Input signals**

**Analog signal** — the voltage signal from detector, proportional to process flow rate (for LF622 separate type converter).

**Digital input DI**

Signal type: 20 to 30Vdc voltage signal

Input resistance: 2.7kΩ

Number of inputs: one point

**Note:** DI cannot be used with the Modbus communication.

**DI function** — One of the following functions can be assigned to the optional DI signal.

**Range switching** — Selects either the higher or lower range in the unidirectional or bidirectional 2-range setting.

**Totalizer control** — Starts and stops the built-in totalizer.

**Fixed-value outputs** — Outputs fixed-values for current and pulse outputs.

**Output signals**

**Current output:**

4–20mAdc (load resistance 0 to 750Ω)

**Digital outputs** — Two points optionally available as follows.

**Digital output DO1 :**

Output type: Transistor open collector

Number of outputs: One point

Output capacity: 30Vdc, 200mA maximum

**Note:** DO1 cannot be used if Modbus communication connection is 3 lines.

**Digital output DO2 :**

Output type: Solidstate relay output (non polarity)

Number of outputs: One point

Output capacity: 150Vdc, 150mA maximum or 150 V ac (peak to peak), 100mA maximum

**Note:** DO2 cannot be used with the Modbus communication.

**DO1 and DO2 functions** — One of the following functions can be assigned to DO1 and/or DO2

• **Pulse output (available only for DO1,DO2)**

Pulse rate: Max 10kHz (10,000pps) (DO1)

Max 100Hz ( 100pps) (DO2)

(Over 1kpps, auto-setting)

Pulse width: 0.3 to 500ms (but less than half of the period for 100% flow rate)

**Note:** The same and simultaneous pulse is not available between DO1 and DO2.)

• **Multi-range selection outputs (Note 1)**

• **High, High high, Low, and/or Low low alarm outputs (Note 2)**

• **Empty pipe alarm output (Note 2)**

• **Preset count output**

• **Converter failure alarm output (Note 2)**

**Note 1:** Two outputs (DO1 and DO2) are needed for 4-range switching and forward/reverse 2-range switching.

**Note 2:** Normal Open (default set) or Normal Close is selected for alarm outputs when programming.  
When power failure occurs, unit will be fault to Normal Open

**Communications output:**

• **HART(std.)**

Digital signal is superimposed on 4–20mA dc current signal as follows:

Conforms to HART protocol

Load resistance: 240 to 750Ω

Load capacitance: 0.25μF maximum

Load inductance: 4mH maximum

• **PROFIBUS(opt.)**

Protocol : PROFIBUS-PA

Baurate : 31.25kbps

Bus voltage : 9-30VDC

Consumption electric current of bus:less than 16mA

Manufacture Ident-No. : 093B<sub>HEX</sub>

Standard Ident-No. : 9740<sub>HEX</sub>

Slave address : 0-126 (Default address is 126)

Profile : Profile Ver.3.01 for Process Control Devices

Function blocks : AI(Flow) × 1 , Totalizer × 1

• **Modbus(opt.)**

Physical layer : RS485

Protocol : Modbus

Mode : RTU

Baudrate : 4800, 9600, 19200bps

Data length : 8bit

Parity bit : None, Odd, Even

Stop bit : 1bit, 2bit

Error check : CRC-16

Max. station number : 32(with Master device)

Max. cable length : 1.2km (Note)

**Note:** This length is specification of 3 line connection.

**LCD display:**

Full dot-matrix 128×128 dot LCD display (back-light provided)

**Parameter settings** — Parameters can be set as follows:

• **IR Switches:** Three key switches are provided to set configuration parameters.

• **Digital communication:** The AF900 hand-held terminal is needed to set parameters.

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

**Damping:** 0.5 to 60 seconds (selectable in one second increments)

**Zero and span calibration:** Built-in calibration signal source allows converter unit check.

**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 outputs and display will remain as follows when power fails.

- Current output: 0mA dc
- Digital output: OFF
- LCD display: No display

**Power supply:** One of the following can be selected:

- 100 to 240Vac, 50/60Hz (std.) (allowable voltage 80 to 264Vac)
- 24Vdc (allowable voltage 18 to 36Vdc)
- 110Vdc (allowable voltage 90 to 130Vdc)

**Surge protection:** Arresters are installed in the power supply, and current signal output circuit.

**Case:** Aluminum alloy (equivalent of IP 67)

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

**Cable connection ports:**

**Cable glands** —

LF622 :Provided as standard  
 OD of cable 6mm  
 Material Nylon 66  
 G (PF) 1/2 male screws.

**Note:** When PROFIBUS or Modbus option is specified , cable gland size is 6 ~ 8mm for signal cable, 11 ~ 13mm for power cable

**Applicable diameter** — 11 to 13mm  
 (0.433 to 0.512 inch)

**Vibration resistance:**

No resonance to the following levels of vibration:

- 10 to 150Hz with acceleration of 9.8m/s<sup>2</sup>
- Vibration of 30Hz with 29.4 m/s<sup>2</sup> in 4h in each direction will not cause any defect to unit.

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

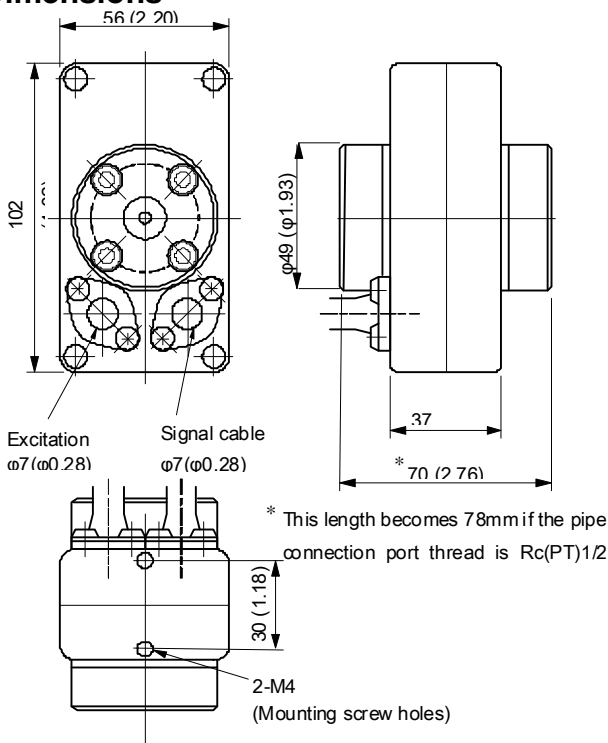
**Converter LF622 dimensions :**

See Figure 5 (for Separate type)

**MTBF:**220,000 hours at 25 deg.C (77 deg.F) based on MIL-HDBK-217F

# Installation

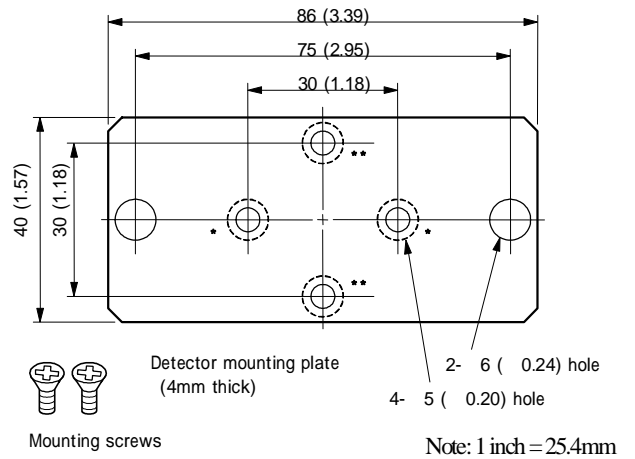
## ■ Dimensions



Note: 1 inch = 25.4mm

Figure3. LF470 Dimensions

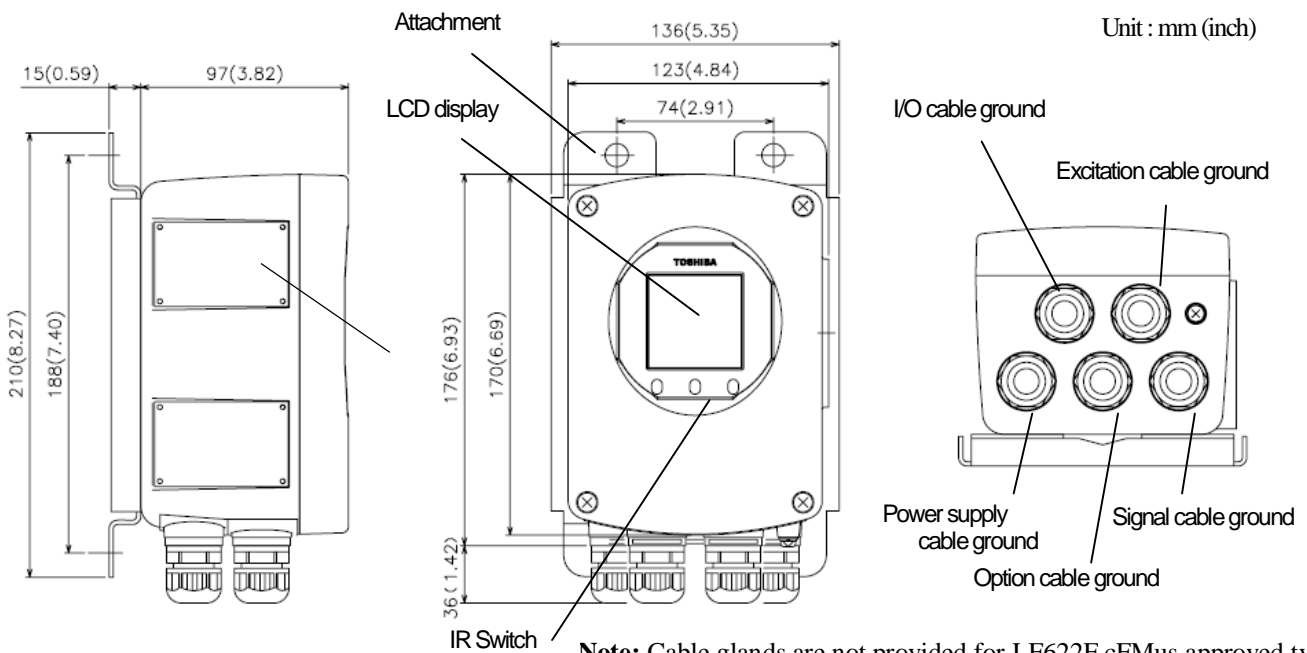
Unit : mm (inch)



Note: 1 inch = 25.4mm

If a mounting plate is needed for the LF470, fix the plate (a) above to the bottom of the LF470. Depending on which pair of screw holes used, the mounting angle changes by 90 ° .

Figure4. LF470 Mounting Board



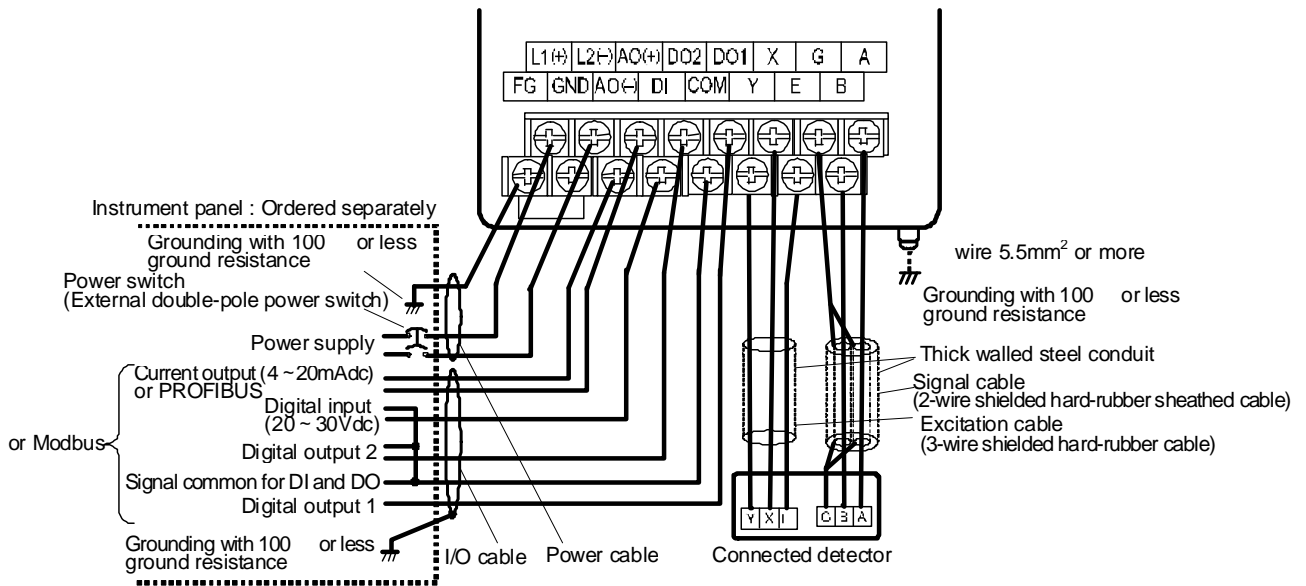
Note: Cable glands are not provided for LF622F cFMus approved type. Refer to the part Cable connection port at detector.

Weight : Approx. 3.5 Kg (7 lb)

Note: 1 inch = 25.4mm

Figure 5. Separate type converter LF622

Separate type LF470/LF622 flowmeter



Symbol	Description	Cable
L1 (+)	Power supply	Power cable
L2 (-)		
GND	Ground (for arrester)	
FG	Frame ground	
DI	Digital Input (20 ~ 30Vdc)	I/O cable
DO1	Digital Output 1	
DO2	Digital Output 2	
COM	Signal Common for DI, DO1, DO2	
+	Current Output (4 ~ 20mAdc)	Shielded cable for PROFIBUS-PA
-	or PROFIBUS	
X	Excitation Output	Excitation cable
Y		
E		
A	Signal Input	Signal cable
B		
G		

Note: Symbol of the terminal is changed as follows for Modbus.

DO2 T+, DI T-, COM T

Symbol	Description	Cable
T+	Modbus(+)	Twist-pair polyethylene insulated vinyl sheath cable (JKEV,AWG24(0.2mm <sup>2</sup> ))
T-	Modbus(-)	
TG	Modbus(GND)	

Figure 6. Separate type LF470/LF622 flowmeters wiring Diagram

**■ Wiring Precautions**

- (1) Connect the following two cables correctly:
  - 1) signal cable (on the right facing the LF470)
  - 2) excitation cable (on the left facing the LF470)
 See figure3.
- (2) Do not bend apply excessive force to these cables.
- (3) DO1, DO2 (opt.), and DI (opt.) use the same common terminal (COM). This COM can not connect to other equipments which have their own ground terminal. (Power supply for connecting to DI or DO, etc...) Need to wire separately.

**■ Wiring Precautions (PROFIBUS or Modbus)**

- (1) For wiring path, avoid places near electrical equipment that may cause electromagnetic induction or electrostatic induction interference (such as a motor, transformer and wireless transmitter).
- (2) Use a PROFIBUS-PA cable or a RS485 twist-pair cable for signal cable. In addition, make sure to use a shielded cable to improve noise resistance. Furthermore, installation of signal cable in metal conduit is recommended.
- (3) General cables are designed for indoor use where cables are not exposed to humidity, rain, etc. When you install cables, make sure to check the operating conditions such as the operating temperature range of the cable by contacting its manufacturer.
- (4) When you carry out cable end treatment of cable, use a dedicated cable stripper etc. so that the core wire of the cable will not be nicked or damaged. In addition, for cables, be careful of allowable maximum bend diameter etc. (Basically, do not install cables in a way cables are twisted or bent.).
- (5) Consider installing a PROFIBUS-PA arrester in the communication path of PROFBUS-PA so that the electromagnetic flowmeter will not be affected by lightning etc.
- (6) The electromagnetic flowmeter is not equipped with terminating resistors. Use the terminating resistor unit for PROFIBUS-PA or junction box, if necessary.
- (7) Only one PROFIBUS-PA cable goes through a cable gland of the Electromagnetic Flowmeter. Please use the junction box at system configuration.
- (8) Install a terminator to flowmeter that connected to end of Modbus network.

**■ Piping Precautions**

- (1) Connect the fluid pipe to the pipe connection port using a joint that matches the Rc (PT) female screw. Use seal tapes when connecting the pipe to the port to prevent a fluid leakage. Do not tighten the connection screw too much.
- (2) Design piping so that the detector's pipe is always filled with the fluid to be measured, whether the

fluid is flowing or not.

- (3) The fluid to be measured must be held still in the pipe when the LF470 is being adjusted. If the fluid can not be stopped after the LF470 installation, install a bypass pipe in parallel with the LF470 flowmeter.

**■ Meter size**

**To select the meter size:**

See Table 1 to 2 and find meter sizes within the velocity of 0.1 to 10m/s (0.3 to 32.8 ft/s) for a specified full-scale (measuring range high limit) flow. Select one that has its full-scale velocity between 1 and 3m/s (3.0 and 10 ft/s).

**Note:** Make sure the full-scale flow rate used for the final planning stage stays within 10m/s (32.8 ft/s) in terms of flow velocity.

**Table 1. Meter size and Flow Velocity(SI unit)**

Unit:L/min

Meter size (mm)	0.3m/s	1m/s	3m/s	10m/s
2.5	0.08835	0.2945	0.884	2.945
4	0.2262	0.7540	2.262	7.540
6	0.5088	1.6967	5.090	16.967

**Table 2. Meter size and Flow Velocity (US unit)**

Unit:gal/min

Meter size (inch)	0.98 ft/s	3 ft/s	10 ft/s	32.8 ft/s
1/10"	0.02334	0.07115	0.2372	0.7781
1/6"	0.05975	0.1821	0.6071	1.992
1/4"	0.1344	0.4098	1.3660	4.482

**■ 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 a sloped floor. To put the flowmeter temporarily on the floor, place it carefully with something, such as a block, 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.

## ■ Calibration Range

If the calibration range is not specified, the standard range as shown below will be used. If the range is specified, we will use the specified range for calibration.

**Table 3. Standard Flow Range**

Meter size mm (inch)	Standard flow range			
	Flow rate (m <sup>3</sup> /h)	Flow velocity (m/s)	Flow rate (gal/min)	Flow velocity (ft/s)
2.5 (1/10)	0.050	2.829	0.500	21.084
4 (1/6)	0.100	2.211	1.500	24.707
6 (1/4)	0.200	1.965	4.000	29.283

**Note:** The unit of "gal/min" is not exchanged (converted) by "m<sup>3</sup>/h".

## Ordering Information

- When ordering the LF470 flowmeters, refer to Tables 4 to 5 (Specification Code).  
An entry must be made for each of the columns in each of these tables.
- Fluid characteristics:
  - Type of fluid to be measured and its characteristics
  - Fluid temperature
  - Fluid pressure
  - Electrical conductivity of the fluid
- Measuring range
- I/O function setting
- Ordering scope:  
Flow calibration data: (required or not)
- Other items  
Specifications other than standard items

**Consult a Toshiba representative before ordering when choosing materials of the wetted parts such as lining, electrodes, and grounding rings.**

**Table 4. Specification Code ( LF470 Detector )**

Model					Specification Code										Description
1	2	3	4	5	6	7	8	9	10	11	12	13	14		
L	F	4	7	0											LF470 Flowmeter
					2										Meter size 2.5 mm (1/10")
					4										4 mm (1/6")
					6										6 mm (1/4")
					D										Converter ( Separate type ) combined LF622
					A										Pipe connection port (adapter)
					B										Rc (PT) 1/4 female screw (standard)
					C										Rc (PT) 1/8 female screw
					D										Rc (PT) 3/8 female screw
					E										Rc (PT) 1/2 female screw
					F										NPT1/4 female screw
					G										NPT3/8 female screw
															NPT1/8 female screw
					A										Pipe connection material
					D										316 stainless steel (standard)
					E										Ti (titanium)
					F										Polyvinyl chloride (shock0-resistance) + Ta (Tantalum) for grounding plate
					H										Polyvinyl chloride (shock0-resistance) + Pt-Ir for grounding plate
															Hastelloy C (Equivalent)
					C										Packing used between main body and pipe connection adapter
					D										Acid-resistant ceramic
					G										Alkali-resistant ceramic
															Ammonia-resistance
					A										Mounting
					B										Not provided
															Provided, 304 stainless steel
					A										Flow and calibration velocity range
					B										0.3 to 10 m/s (standard range calibration)
															0.3 to 10 m/s (specified range calibration)
					A										Cable length
					1										5m (cable dia.7mm)
					2										10m (cable dia.7mm)
					3										15m (cable dia.7mm)
					4										20m (cable dia.7mm)
					5										25m (cable dia.7mm)
					B										30m (cable dia.7mm)
															5m or more
															(extension dia. 12mm+Scotch cast connection)
					A										Coating
					Z										Phthalic acid resin coating pearl-gray colored (standard)
															Other



**Table 5. Specification Code ( LF622 Converter )**

Model				Specification Code										Contents	LF622 type	
1	2	3	4	5	6	7	8	9	10	11	12	13	14			
L	F	6	2												Electromagnetic flowmeter converter	
				2											Separate (Remote) type	●
					A										Purpose Standard	●
						A									Shape Separate type with case	●
							A								Converter mounting fitting None	○
							C								Panel, Accessory for wall mounting (BNP material: SUS304)	●
							E								Accessory for pipe installation (BNP material: SUS304)	○
								2							Digital input/output Digital output points 2 (DO1+DO2) +Digital input point 1 (DI)	●
									1						Current output and Communication function(Note1) Current output + HART communication	●
									2						PROFIBUS communication	○
									3						Modbus (RS485) communication	○
										1					Power supply(Note2) 100Vac-240Vac, 50/60Hz	●
										2					24Vdc	○
										3					110Vdc	○
											F				Instruction manual English	●

Note 1: When Modbus communication is provided, digital output points 1(DO1) and digital output points(DO2), digital input point 1(DI), HART communication cannot be used.

When PROFIBUS communication is provided, current output(4-20mA) and HART communication cannot be used.

Check Table 6 for the details.

Note 2: Select 110Vdc for test report inspected under the condition of 110Vdc.

**Table 6. Communication function and output selection table**

Selection of Function		Availability of outputs			
Code (10 <sup>th</sup> digit)	Selected Communication	4-20mAdc	DO1	DO2	DI
1	HART	✓	✓	✓	✓
2	PROFIBUS	X	✓	✓	✓
3	Modbus	✓	✓ (Note)	X	X

Code explanation: ✓:Available X :Not Available

Note : When digital output 1 function and Modbus communication function are used at one time, TG (signal ground) of the Modbus communication function cannot be connected (2 line connection).

ISO9001 and ISO14001 are certified.



Misuse of this roduct can result in damage to property or human injury.  
Read related manuals carefully before using this product.

Specifications are subject to change without notice.

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