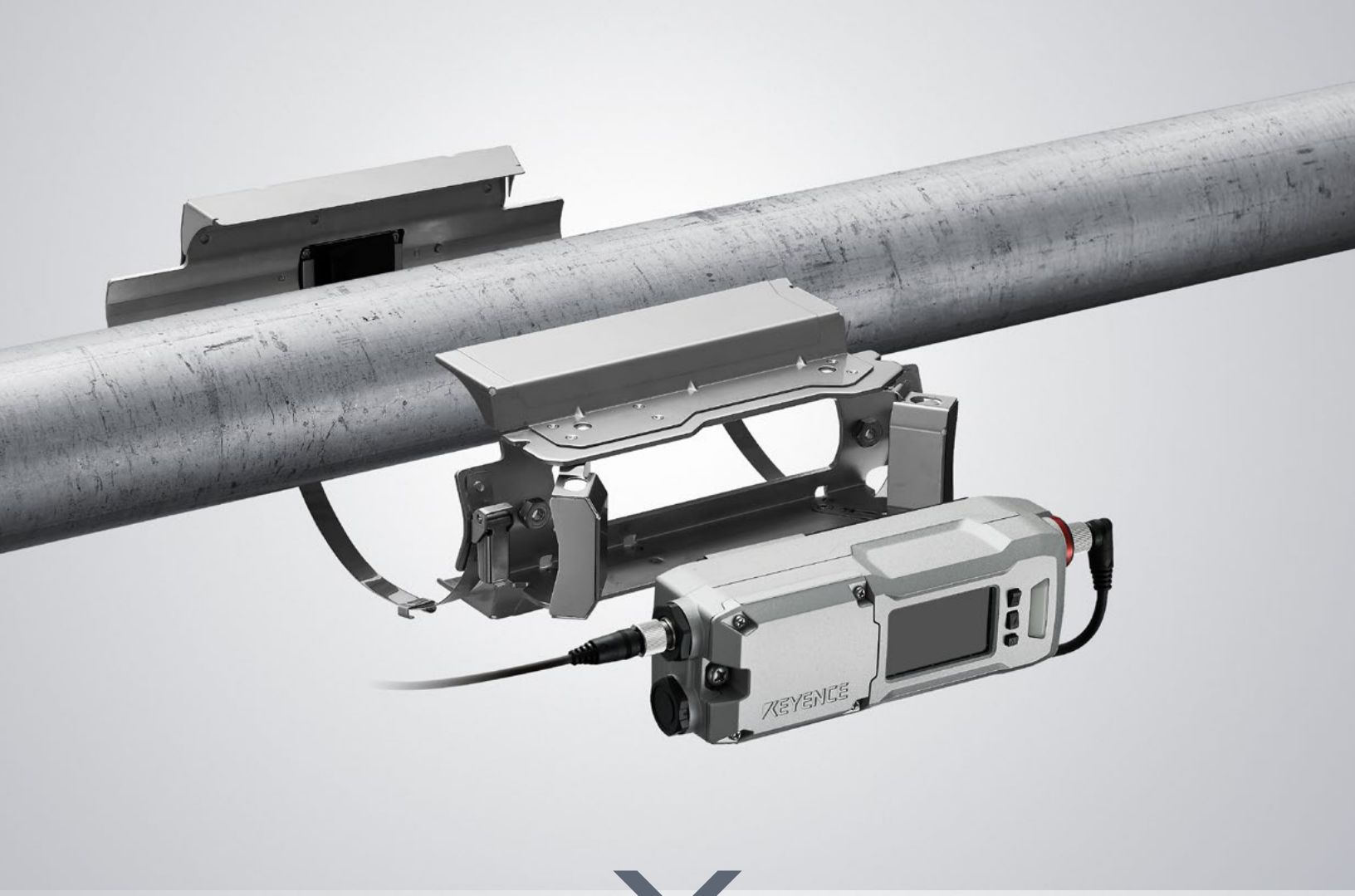
KEYENCE

Clamp-On Flow Meter

FD-R Series

All You Need To Do Is

Clamp-On


KEYENCE


KEYENCE
421
300

Clamp-On Flow Meter

FD-R Series

INNOVATIVE INSTALLATION

- Mounted securely in minutes
- No pipe modifications necessary

LIMITLESS USES

- Compatible with various pipes and liquids
- Versatile features for any situation

LASTING RELIABILITY

- Consistently stable detection
- Completely non-invasive setup

FD-R50

FD-R80

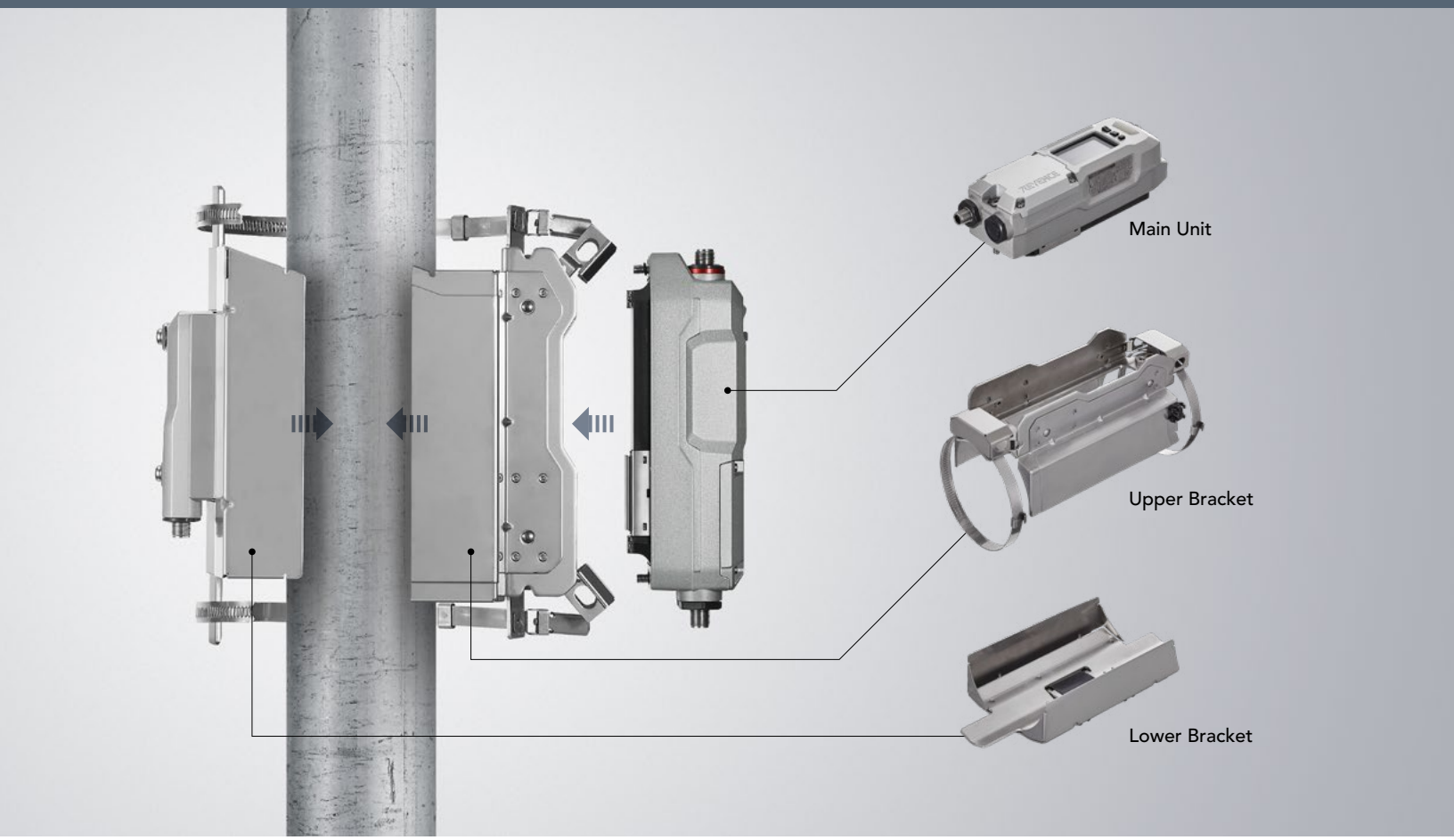
FD-R125

FD-R200

IO-Link CE cULus

INNOVATIVE INSTALLATION

Mounted in Minutes



Three Pieces and as few as Four Screws

All models feature a simple three piece design, consisting of the lower bracket, upper bracket, and main unit. These pieces are quickly and easily secured to the pipe with either 4 or 6 screws

Repeatable Setup

Regardless of who installs the unit, the results will always be repeatable. The intuitive bracket design removes the guess work from installation and ensures consistent mounting by anyone.

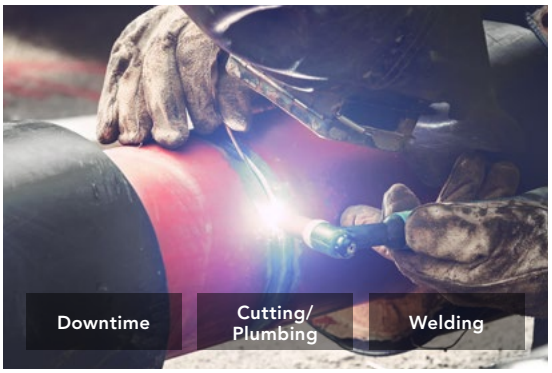
Rugged Yet Lightweight Design

The FD-R brackets are expertly designed to be durable enough to withstand the rigors of the factory environment, yet light enough to be installed by just a single individual.

Benefits of the Clamp-On Design

No Pipe Modification Necessary

The difficulties commonly associated with installing a new flow meter are eliminated by simply Clamping-On. This design eliminates the need to cut pipes, thread pipes, shut down machines, contract plumbers/ engineers, weld segments, and much more.

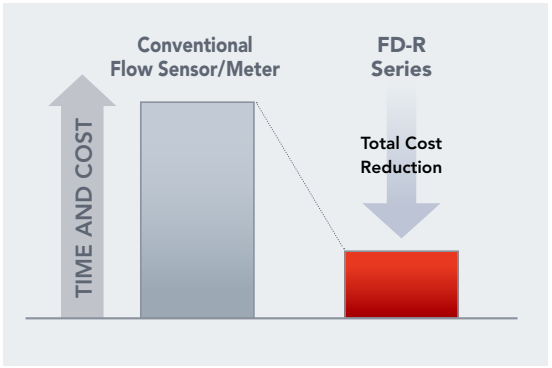


No Special Tools Needed

All it takes is a single Phillips-head screwdriver to install the FD-R securely to an existing pipe. This ensures that proper installation can be achieved by any member of the team without the need for special tools or specialized knowledge.

Greatly Reduced Costs

The elimination of the time and money associated with pipe modification, machine downtime, and additional component purchasing, allows the FD-R to be utilized with all machines for continuous process improvement. Justification has never been easier.



LIMITLESS USES

Ideal in Nearly any Situation

Detectable Fluids

Water | DI Water | Oil | Chemicals | Product

Compatible Pipe Materials

Stainless Steel | Iron | Copper | PVC | Resin

Available Sizes

1 1/2" to **2"** (44 mm to 64 mm)*

2 1/2" to **3"** (64 mm to 100 mm)*

4" to **5"** (100 mm to 152 mm)*

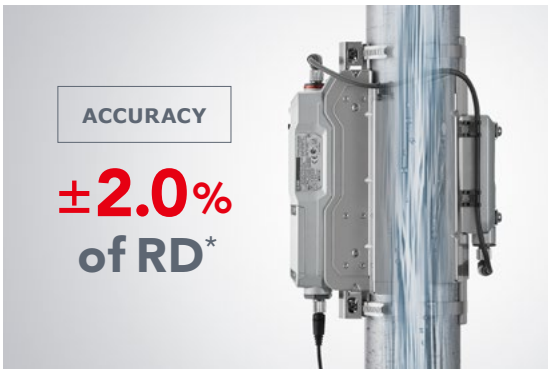
6" to **8"** (152 mm to 220 mm)*

*Pipe Outer Diameter

Versatile Features for all Applications

Impressive Accuracy

The measurement accuracy specifications associated with the FD-R allow it to be used for both general sensing applications and situations requiring more precise monitoring. This makes it easier than ever before to properly detect flow.



*Please see the specifications.

Superior Environmental Resistance

IP65/67	IP69K	NEMA 4X*

Whether being used indoors or outdoors, in the cleanest or the dirtiest environments, the FD-R Series is designed to last. The ratings above ensure proper operation regardless of contact with liquids or dust in the environment.

*Enclosure Type 4X (NEMA 250)

Integrated Temperature Monitoring

Temperature and flow monitoring can now be achieved simultaneously with just one device. Quickly and easily monitor a range of temperatures using the Integrated Temperature Monitoring function.

Accuracy : ±3°C ±5.4°F*

*-20 to 50°C -4 to 122°F, ambient temperature is 25°C 77°F

LASTING RELIABILITY

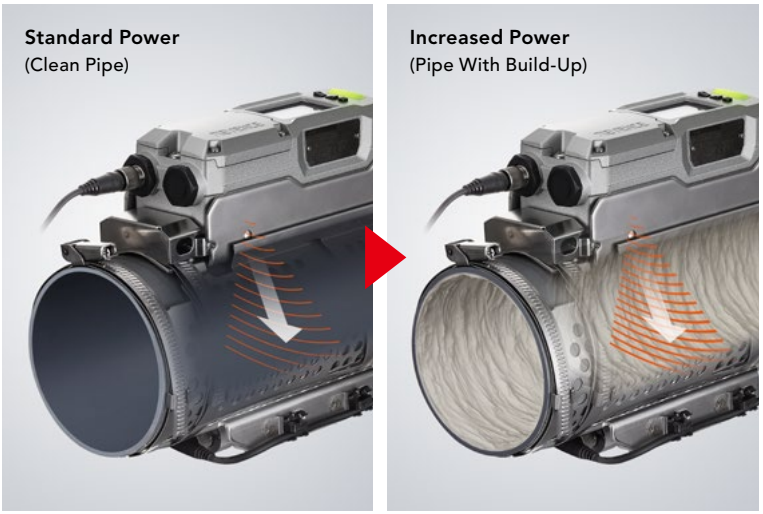
Dependable Detection That Lasts

High Powered Signal

The FD-R utilizes an ultrasonic signal 20X stronger than conventional models.

Automatic Build-Up Resistance

The FD-R automatically increases its signal strength to blast through harsh build-up for lasting detection.

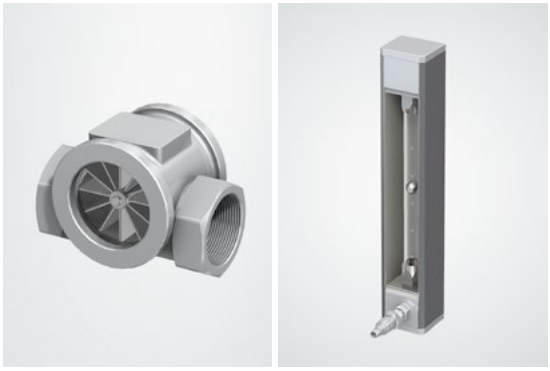


The already powerful signal will automatically increase its strength when build-up is detected

Downtime Eliminated

Completely Non-Invasive Setup

The design of the FD-R Series ensures that there will be zero impact on the flow system. Unlike conventional models (mechanical, thermal, etc.), this removes concerns associated with pressure loss, contamination, flow obstructions, and/or liquid leakage.



No Adjustments Necessary

The robust mounting provided by the FD-R brackets eliminates the need for any adjustments after the unit has been installed. Unlike conventional ultrasonic flow meters that stop working due to physical contact or build-up, the FD-R Series provides consistently stable detection that lasts.

Built-In Predictive Maintenance

Using Conditional Monitoring, it is possible to easily identify potential flow concerns early and prevent them from causing downtime. This is possible using multiple outputs and the easy to read display, which can show flow as a percentage of an optimum value.

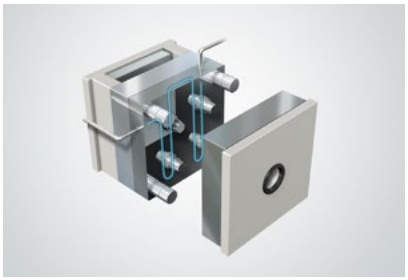
ADDITIONAL FUNCTIONALITY

Detection Modes

Typical flow control

[STD] Mode

The output turns ON when the instantaneous flow rate is above or below a user defined threshold.



Flow range control

[AREA] Mode

The output turns ON when the instantaneous flow rate falls outside or inside a user defined window.

Totalizing flow

[TOTAL] Mode

The output turns ON after a user defined amount of liquid has passed.

Available I/O

Control Outputs	Analog Outputs	External Input	IO-Link
PNP/NPN Single/Dual Flow & Temperature	4 to 20 mA 0 to 20 mA Single/Dual Flow & Temperature	Reset Flow Rate Zero Shift Origin Adjustment	Instantaneous Flow Total Accumulated Flow Settings Information

Easily Reviewable Data

Quickly check historic flow and temperature data through the display on the FD-R Series using its built-in data recorder.

Types of Data

- Instantaneous flow rate
- Temperature
- Total accumulated flow
- Event information

Frequency of Recording

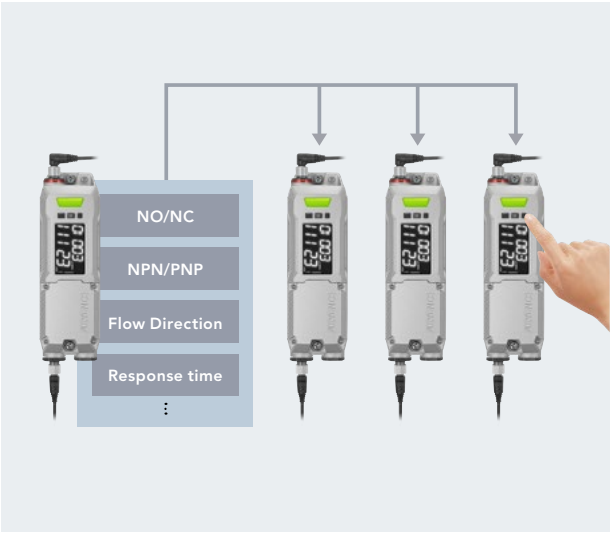
- Once every 5 minutes*
- Once per day
- Once per week
- Once per month

* Instantaneous flow rate and temperature only

Simulation Mode

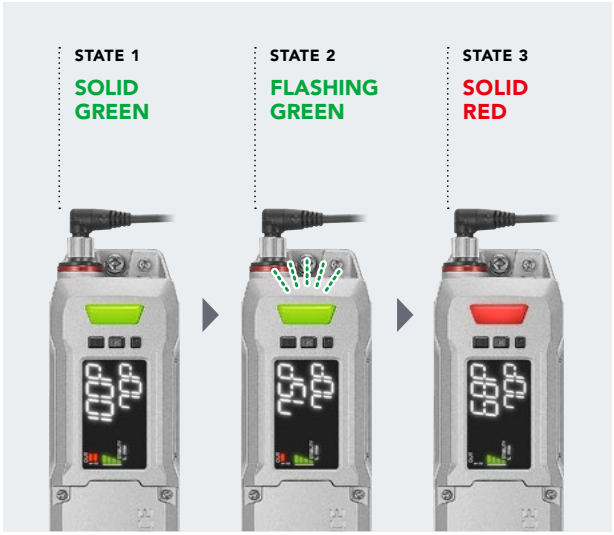
Conveniently check that the outputs are connected properly without needing to change the actual flow rate or temperature.

Quick Setting Code



All it takes is a 10 digit code to seamlessly transfer settings from one unit to any number of additional units.

Highly Visible Indicator



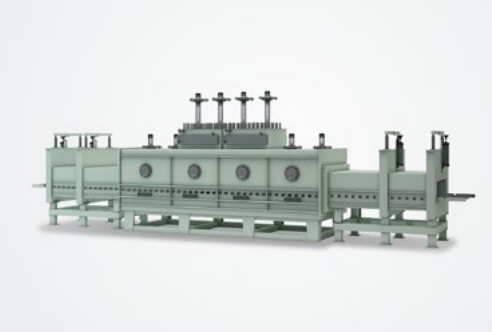
The highly visible indicator and display provide clear indications of the current situation for hassle-free troubleshooting.

AC/DC Compatible

Perfectly integrate into any system with the ability to operate using either AC or DC power supplies.

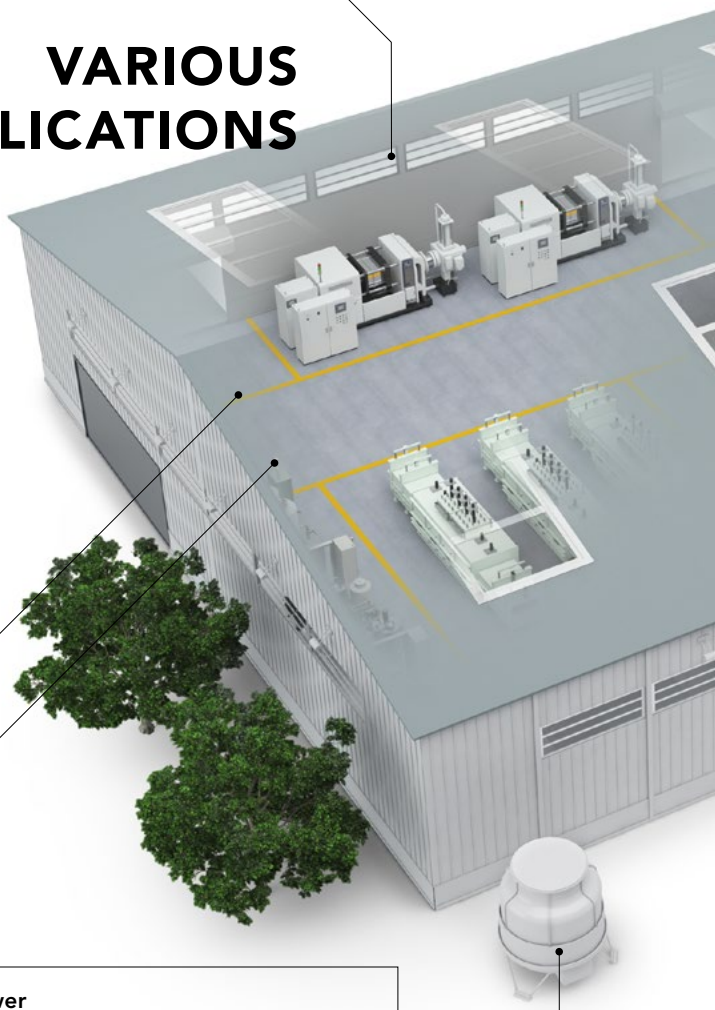
VARIOUS APPLICATIONS

Furnace/Annealing Machine



Processing Machine

Die Casting Machine



Stirrer

Chiller

Cooling Tower

Two-Solution Mixer

Sterilization Machine

Plating Machine

Concrete Mixer

Waste Water System

COMPLETE PROCESS MONITORING

Extend Beyond Flow Sensing To Understand the Full System

Look at more than just flow!

Concentration | Temperature | Level

Introducing Complete Process Solutions

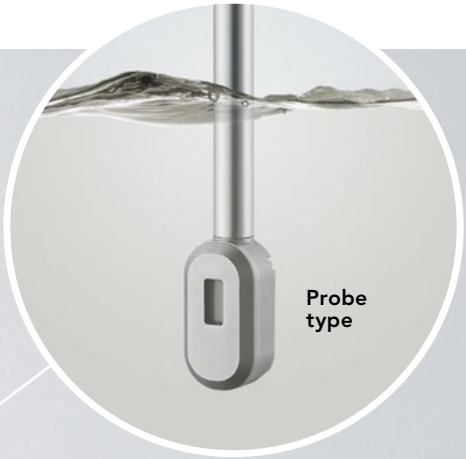
Monitor and manage multiple variables all through one centralized device.

The FD-R Series can be connected to the FI-1000 Series display unit with ease. The display unit can then be connected to up to two additional devices to pull in process data related to temperature, level, and/or concentration. This helps provide a complete picture of machine performance.

The FI-1000 display can connect to the FD-R Series as well as two additional devices

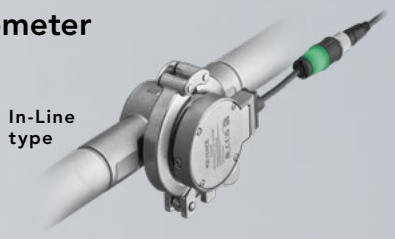
FI-1000 Display Unit NEW

Multi-Port



+ Concentration

Digital Refractometer
FI-C Series NEW



+ Temperature

Temperature Sensor
FI-T Series NEW

+ Level

Sensing Guide Pulse Level Sensor
FL Series

STEP 1 Main Unit Selection

① Select the main unit by referencing the size of the pipe the unit will be mounted on. ▶ ② Confirm the rated flow velocity and flow rate ranges are acceptable for the application

Supported pipe size (Outer diameter)	Appearance	Model	Rated flow velocity range	Flow rate range (Typical)	Weight
1 1/2" (40A) (ø44 to ø55 ø1.73" to ø2.17")		**FD-R50**	0.3 m/s to 5 m/s	36 to 400 L/min 9 to 100 gal/min 2.4 to 24 m³/h	Approx. 2.5 kg 5.51 lb
2" (50A) (ø55 to ø64 ø2.17" to ø2.52")				36 to 600 L/min 9 to 150 gal/min 2.4 to 36 m³/h	
2 1/2" (65A) (ø64 to ø83 ø2.52" to ø3.27")		**FD-R80**		90 to 1000 L/min 24 to 260 gal/min 5.4 to 60 m³/h	Approx. 3.0 kg 6.61 lb
3" (80A) (ø83 to ø100 ø3.27" to ø3.94")				90 to 1500 L/min 24 to 390 gal/min 5.4 to 90 m³/h	
4" (100A) (ø100 to ø127 ø3.94" to ø5.00")		**FD-R125**		220 to 2500 L/min 60 to 660 gal/min 12 to 150 m³/h	Approx. 3.3 kg 7.28 lb
5" (125A) (ø127 to ø152 ø5.00" to ø5.98")				220 to 3700 L/min 60 to 990 gal/min 12 to 220 m³/h	
6" (150A) (ø152 to ø191 ø5.98" to ø7.52")		**FD-R200**		570 to 5500 L/min 150 to 1400 gal/min 36 to 330 m³/h	Approx. 3.5 kg 7.72 lb
8" (200A) (ø191 to ø220 ø7.52" to ø8.66")				570 to 9500 L/min 150 to 2500 gal/min 36 to 570 m³/h	

*The minimum flow rates (zero cut flow rates) can be changed in the settings.

When Connecting to the FI-1000 Display Unit

Display Unit
FI-1000
The FD-R Series can be connected to this separate display, which can also be connected to up to two additional devices. (DC Power Supply Required.)

M12 power supply cable
Power supply cable for FI-1000 (M12 6-core loose wire).
FD-HCB2
2 m 6.6' PVC
FD-HCB10
10 m 32.8' PVC

FD-R Series connection cable
OP-88671
M12 4 pin on one side (to connect to the FD-R), the other side is a proprietary connector for FI-1000 connection, cable length 2 m 6.6'.

FD-R Series connection extension cable
This is a connector cable with M12 4-pin on one side and M12 4-pin on the other side, which can be connected together for up to 20 m with OP-88671 (2 m 6.6').
OP-85503 2 m 6.6' PVC **OP-88075** 2 m 6.6' PUR
OP-85504 5 m 16.4' PVC **OP-88076** 5 m 16.4' PUR

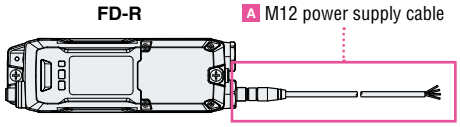
Separate display unit bracket
FD-HB1
This is a bracket for mounting the display unit.

Display unit protection cover
FD-HP1

STEP 2 Cable / Cable Gland Selection Necessary parts differ based on supplied power type (AC/DC)

When supplying DC power to the unit

Select the M12 power supply cable based upon cable length and indoor or outdoor usages

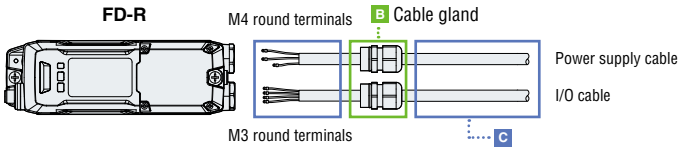


A M12 power supply cable

Specifications	Appearance	Model	Length	Material	Weight
Indoor use (standard)		**OP-75721**	2 m 78.74'	PVC Brass nickel plating	Approx. 55 g 1.94 oz
		OP-85502	10 m 393.70'		Approx. 220 g 7.76 oz
Indoor use (oil resistant)		**OP-87636**	2 m 78.74'	PUR Zinc nickel plating	Approx. 75 g 2.65 oz
		OP-87637	10 m 393.70'		Approx. 260 g 9.17 oz
Outdoor use		**OP-88196**	10 m 393.70'	PUR SUS316L	Approx. 310 g 10.93 oz

When supplying AC power to the unit

Detach the covers on the end of the unit and install the cable glands



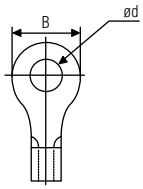
B Cable gland

Appearance	Material	Compatible cable outer diameter	Number of pieces	Model	Weight
	PA/FKM/EPDM	ø7 to ø12	2 Pieces	**OP-88199**	Approx. 20 g 0.71 oz 2 pieces

C Compatible cables and terminals (To be obtained from a 3rd party)

Type		Finished outer diameter	Nominal cross-sectional area	No. of Wires
Cable	Power supply cable	ø7 to ø12*1	1.75 mm² or more*2	3*2
	I/O cable		0.3 mm² or more	4*3

Type		Size	Outer size of the round part B	Inside of the round part d
Round terminal	For power supply cable	M4	ø8.5 or less	ø4.3 or more
	For I/O cable	M3	ø5.5 or less	ø3.2 or more



*1 Finished outer diameter of the cable when using OP-88199
*2 Please use a two-wire cable with nominal cross area of 0.5 mm² or greater to ground the sensor when performing grounding with the protective grounding terminal of the main unit case
*3 The ch.2 core wire is not required when the ch.2 function is not being used.
*4 Use cables with heat resistance of 90°C 194°F or higher for the power cable and the I/O cable depending on the temperature conditions. Please see the specifications.

▮When using a non-KEYENCE cable gland

The threading on FD-R main unit is G1/2. When using M20 or NPT1/2 cable glands, please use the thread conversion couplings below

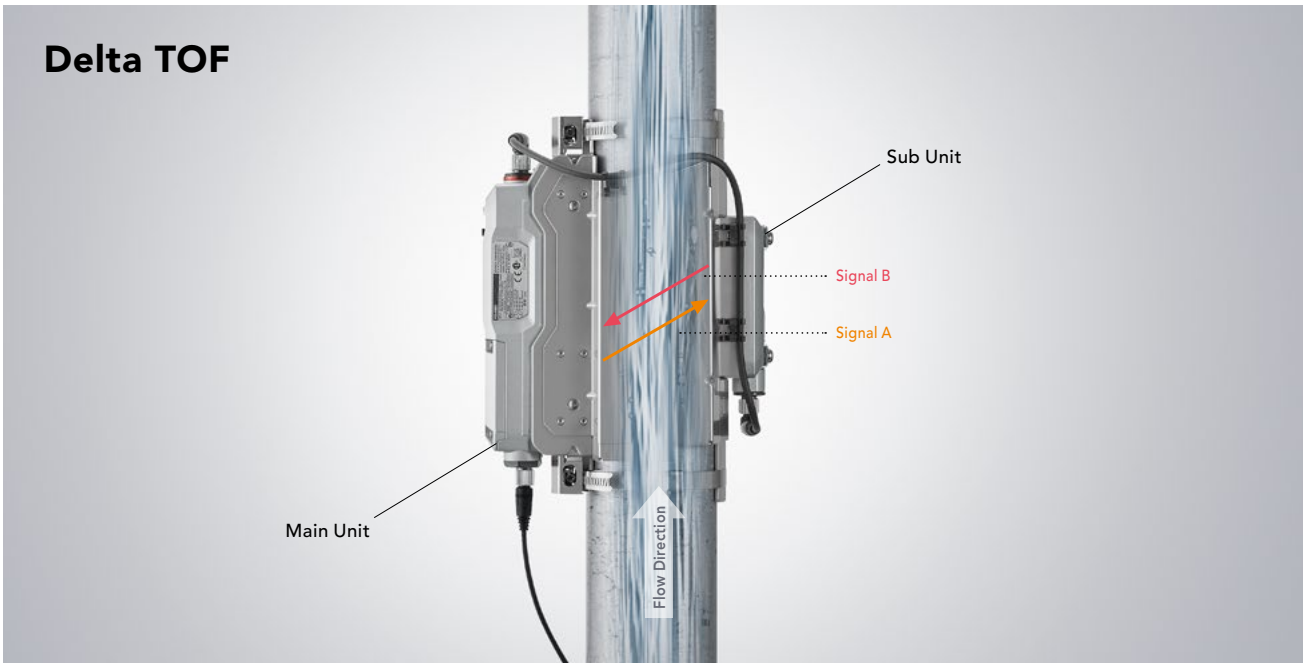
Appearance	Material	Size Conversion	Number of pieces	Model	Weight
	Brass nickel plating FKM	G1/2 → M20	1 Piece	**OP-88200**	Approx. 30 g 1.06 oz
		G1/2 → NPT 1/2		**OP-88201**	Approx. 35 g 1.23 oz

*If the compatible cable outer diameter or the effective thread depth is not appropriate, the specifications for the enclosure rating cannot be met. Therefore, fluid may enter into the product, leading to electric shock and damage.

STEP 3 Optional Parts Selection

Description	Appearance	Model	Usage	Weight
Protection cover		**FD-RP1**	Prevent damage to the main unit or unintended settings changes Material : SUS304, Polycarbonate	Approx. 285 g 10.05 oz
Modular cable		**OP-26487**	Send recorded data stored in FD-R to a computer	Approx. 72 g 2.54 oz
RS-232C conversion adapter [9-pin]		**OP-26401**		Approx. 25 g 0.88 oz

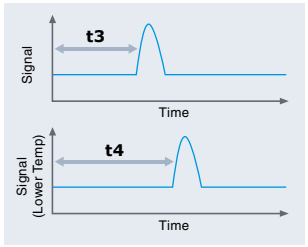
OPERATING PRINCIPLE AND TECHNOLOGY



Conventional ultrasonic flow meters measure flow by monitoring the time it takes for an ultrasonic pulse to travel from a transmitting element to a receiving element. As the flow rate increases, the signal is accelerated and the transmission time decreases. This transmission time can then be directly correlated to the instantaneous flow rate. The FD-R Series improves upon this method of detection by simultaneously monitoring two signals (one moving in the direction of flow and one moving against the direction of flow). By doing this, the readings remain consistent and stable regardless of external factors such as clogging or temperature changes.

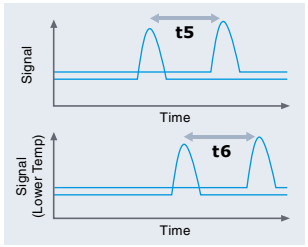
Basic Principle

The duration of the pulse is easily influenced by external factors.



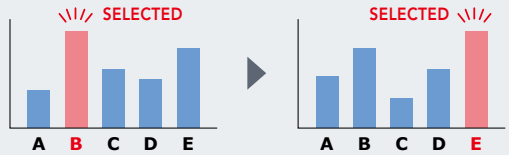
Delta TOF

External factors do not affect detection as the time DIFFERENCE between signals A and B remains the same.



Optimal Frequency Selection

The most appropriate frequency to use may change over time due to environmental factors.



After initial installation, Frequency B is used

After the pipe gets dirty, Frequency E is used

Unlike conventional flow meters, which typically use only one frequency for their ultrasonic signal, the FD-R Series continuously tests various frequencies to determine the ideal fit in every situation. By selecting the signal that travels through the pipe, liquid, and potential build-up with the least amount of loss, the FD-R Series is able to ensure proper flow monitoring.

Automatic Build-Up Resistance

Receiving signal drops due to build-up

Transmitter power increased for stable detection

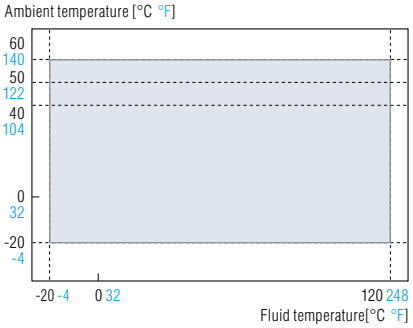
The stable transmission of the ultrasonic signal is imperative for consistently stable detection. Build up or rust on the inside of a pipe can become problematic over time for conventional flow sensors. By utilizing the Automatic Build-Up Resistance Function, the FD-R automatically adjusts its power to compensate for this build-up and provide lasting stable detection.

SPECIFICATIONS

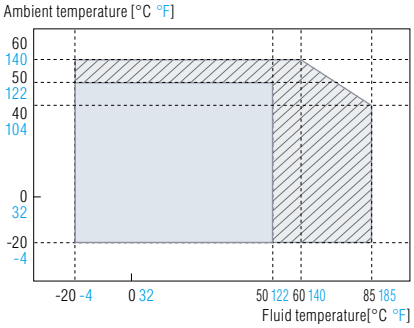
Model		FD-R50		FD-R80		FD-R125		FD-R200	
Supported pipe diameter	DN (Diameter Nominal)	40 A	50 A	65 A	80 A	100 A	125 A	150 A	200 A
	NPS (Nominal Pipe Size)	1 1/2"	2"	2 1/2"	3"	4"	5"	6"	8"
	Outer diameter of pipe (mm)	ø44 to ø55 1.73" to 2.17"	ø55 to ø64 2.17" to 2.52"	ø64 to ø83 2.52" to 3.27"	ø83 to ø100 3.27" to 3.94"	ø100 to ø127 3.94" to 5.00"	ø127 to ø152 5.00" to 5.98"	ø152 to ø191 5.98" to 7.52"	ø191 to ø220 7.52" to 8.66"
Supported pipe materials		Metal/resin*1							
Supported fluids		Various liquids (i.e. water, oils, chemicals)*1							
Fluid temperature		-20 to +120°C -4.0 to +248 °F (no freezing on the pipe surface)*2							
Rated flow velocity range		5.0 m/s							
	Flow rate range (Typical)	(400 L/min 100 gal/min 24 m³/h)	(600 L/min 150 gal/min 36 m³/h)	(1000 L/min 260 gal/min 60 m³/h)	(1500 L/min 390 gal/min 90 m³/h)	(2500 L/min 660 gal/min 150 m³/h)	(3700 L/min 990 gal/min 220 m³/h)	(5500 L/min 1400 gal/min 330 m³/h)	(9500 L/min 2500 gal/min 570 m³/h)
Zero cut (default)*3		0.3 m/s							
	Flow rate (Typical)	(36 L/min 9 gal/min 2.4 m³/h)		(90 L/min 24 gal/min 5.4 m³/h)		(220 L/min 60 gal/min 12 m³/h)		(570 L/min 150 gal/min 36 m³/h)	
Display method		Dual row, 5-digit display with white, 14-segment LED; Large status indicator; Output indicators; Stability indicator; Unit indicator							
Display update cycle		Approx. 3 Hz							
Display resolution		0.1 / 1 (L/min)		1 (L/min)					
Response time		0.5 s / 1.0 s / 2.5 s / 5.0 s / 10.0 s / 30.0 s / 60.0 s / 120.0 s / 200.0 s (variable)							
Measurement accuracy	Between 20 and 100% of F.S.	±2.0% of RD*4, 5							
	Between 6 and 20% of F.S.	±0.4% of F.S.*4, 5							
Zero point error		±0.5% of F.S.*4, 6							
Hysteresis		Variable							
Flow units		L/min, m³/h, gal/min							
Integrated flow unit display		1/10/100/1000/10000 (L)							
Pipe temperature measurement accuracy (ambient operating temperature of 25°C 77°F)*4		±3°C ±5.4°F (liquid temperature of -20 to + 50°C, -4 to +122°F) ±5°C ±9°F (liquid temperature of 50 to +120°C, 122 to 248°F)							
Wiring specifications	Power supply	DC power supply: M12 4-pin connector/AC power supply: M4 screw terminal block (selectable)							
	I/O	When using a DC power supply: M12 4-pin connector/when using an AC power supply: M3 screw terminal block							
I/O *7 (selectable)	Control output (ch.1/ch.2)	Control output/Integrated pulse output/Error output/Temperature alarm, NPN/PNP setting switchable, open collector output 30 VDC or less, max. 100 mA/ch., residual voltage: 2.5 V or less							
	Analog output (ch.1/ch.2)	Flow rate analog output/Temperature analog output and 4-20 mA / 0-20 mA (selectable), load resistance: 500 Ω or less							
	External input (ch.2)	Integrated flow reset input/Flow rate zero input/Origin adjustment input (selectable), short-circuit current: 1.5 mA or less, input time: 20 ms or more							
Rating	Power supply voltage	20 to 30 VDC including 10% ripple (P-P), Class 2/100 to 240 VAC - 15% or + 10%(50/60 Hz)							
	Current consumption	When using a DC power supply: 200 mA or less (load current excluded),400 mA or less (load current included) When using an AC power supply: 15 VA or less							
Protection circuit		Power supply reverse connection protection, Power supply surge protection, Short-circuit protection for each output, Surge protection for each output							
Environmental resistance	Enclosure rating	IP65/67(IEC60529), IP69K(ISO20653), Enclosure Type 4X(NEMA250)							
	Ambient temperature	-20 to +60°C -4.0 to 140 °F (no freezing)*2							
	Ambient humidity	5 to 90%RH (no condensation)							
	Vibration resistance	10 to 55 Hz, compound amplitude 1.5 mm 0.06", XYZ axes 2 hours for each axis							
	Shock resistance	100 m/s², 16 ms pulse, XYZ axes, 1000 times for each axis							
Material	Main unit	Body: aluminum die-casting + coating/PPS, display: reinforced glass, connectors: SUS304-equivalent							
	Unit rear	Rubber							
	Upper/lower bracket	SUS304							
Weight	Main unit	Approx. 1.0 kg							
	Upper/lower bracket (including sub unit)	Approx. 1.5 kg 3.31 lb		Approx. 2.0 kg 4.41 lb		Approx. 2.3 kg 5.07 lb		Approx. 2.5 kg 5.51 lb	
Main unit size		218.5 mm × 66.9 mm × 70.7 mm 8.60" × 2.63" × 2.78"							

*1 Liquid must allow for the passage of an ultrasonic pulse, as well as not contain large air pockets or excessive bubbles. Detection may be unstable due to the type and status of the pipes.
*2 Perform derating depending on the ambient temperature and liquid temperature when using an AC power supply.
*3 The zero cut flow rate can be changed in the settings.
*4 This value is guaranteed by KEYENCE inspection facilities. Errors will be introduced by the type and status of the pipes, the type and temperature of the fluid, and the zero cut flow rate.
*5 This is the value when considering linearity + span error + repeatability in a stable environment of 25°C 77°F.
*6 It is possible to enhance the precision of zero point error by performing an origin adjustment.
*7 IO-Link: Compatible with Specification v1.1 / COM2 (38.4 kbps) The setting file can be downloaded from the KEYENCE website (http://www.keyence.com). If using the unit in an environment where downloading the file is not accessible via Internet, contact your nearest KEYENCE office. IO-Link is either registered trademarks or trademarks of PROFIBUS Nutzerorganisation e.V. (PNO)

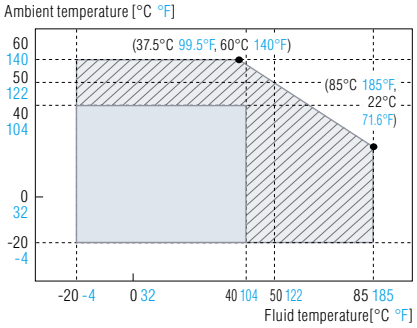
Temperature range when supplying DC power to the unit



Temperature range when supplying AC power to this product



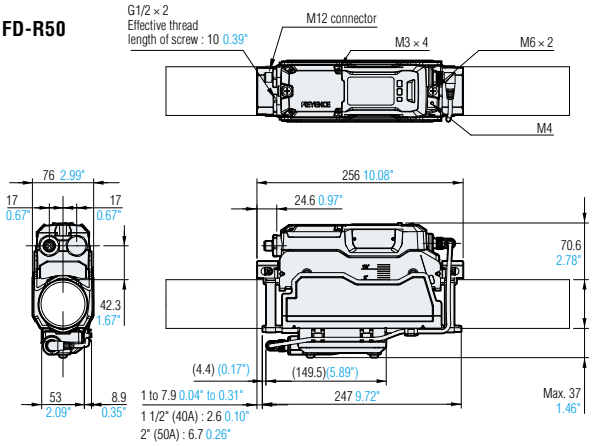
Temperature range when supplying AC power to the unit and being exposed to radiation such as direct sunlight.



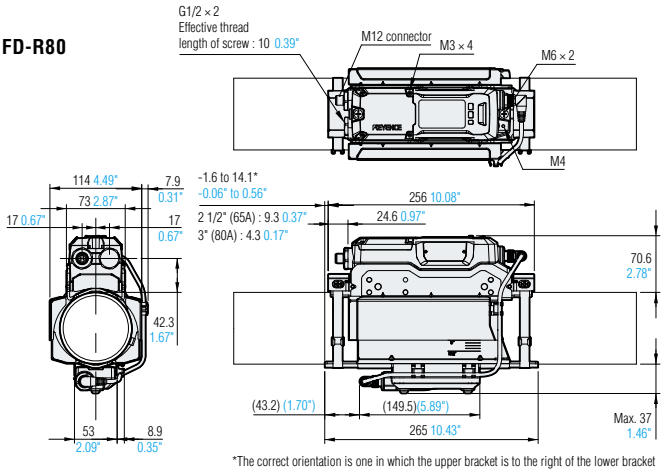
When using the FD-R Series in the temperature condition shown by oblique lines, use cables with heat resistance of 90°C 194°F or higher for the power cables and the I/O cables.

Flow meter

FD-R50

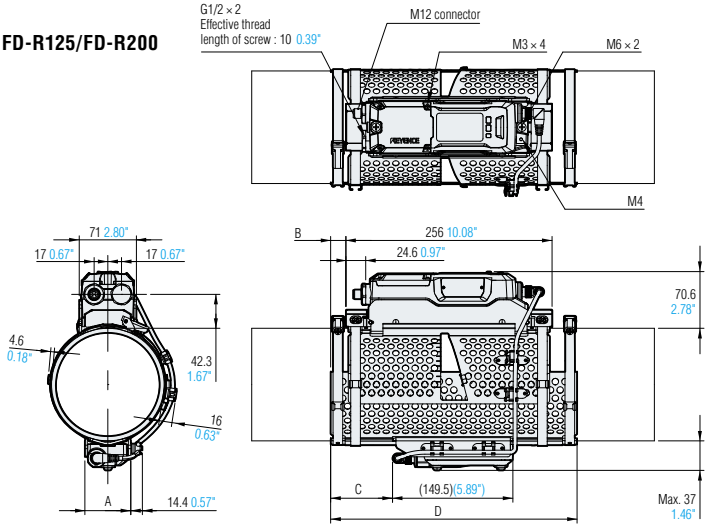


FD-R80



*The correct orientation is one in which the upper bracket is to the right of the lower bracket

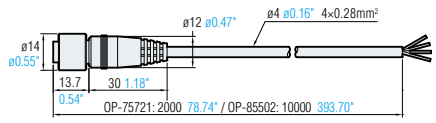
FD-R125/FD-R200



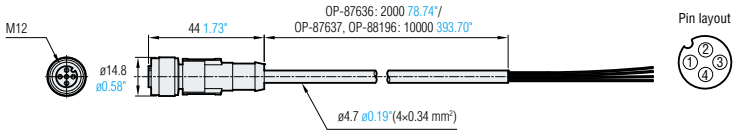
	FD-R125	FD-R200
A	57 2.24"	62 2.44"
B	14.1 to 34.6 0.56" to 1.36" 4"(100 A): 29 1.14" 5"(125 A): 19 0.75"	17.1 to 42.9 0.67" to 1.69" 6"(150 A): 37.6 1.48" 8"(200 A): 18.5 0.73"
C	(76.9)(3.03")	(104.3)(4.11")
D	306 12.05"	315 12.40"

M12 power supply cable

Indoor use (standard) (OP-75721/85502)



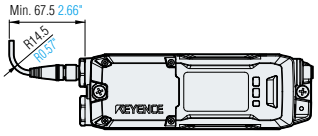
Indoor use (oil resistant) / Outdoor use (OP-87636/87637/88196)



Pin layout

No.	Color
①	Brown
②	White
③	Blue
④	Black

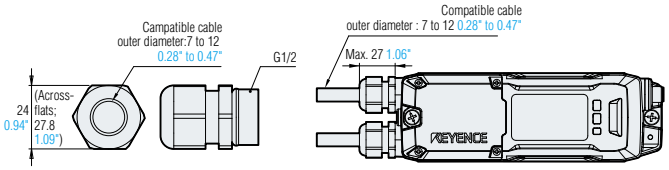
When the M12 power supply cable is attached



Cable gland

OP-88199

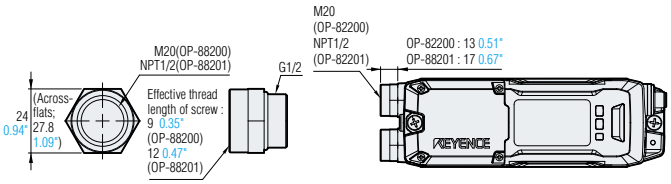
When the cable glands are attached



Thread conversion coupling

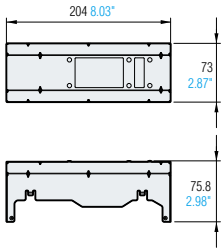
OP-88200/88201

When the thread conversion couplings are attached

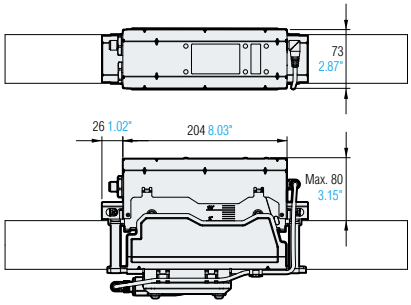


Protection cover

FD-RP1

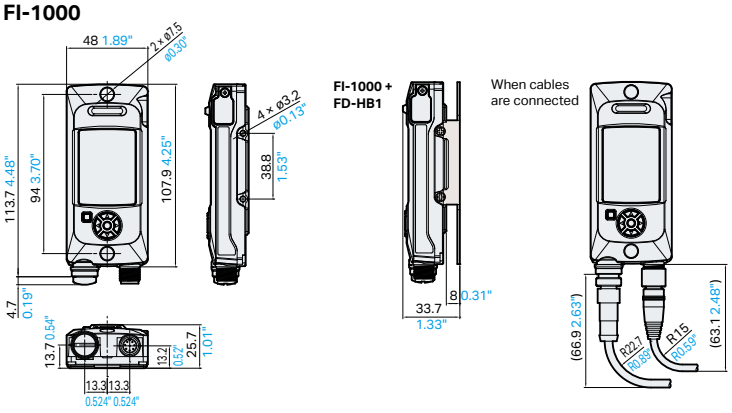


When the protection cover is attached



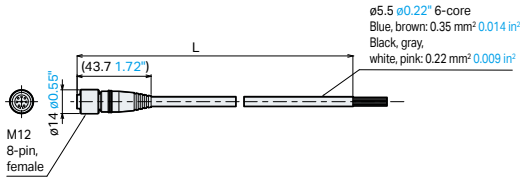
Display Unit

FI-1000



FI-1000 power supply cables

M12 power supply cable 8-core **FD-HCB2/HCB10**



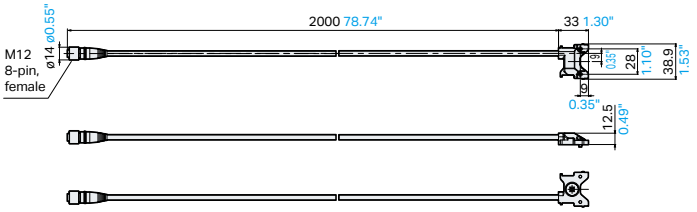
Model	L
FD-HCB2	2000 6.6'
FD-HCB10	10,000 32.6'

Pin layout

No.	Color
①	–
②	–
③	Black
④	Gray
⑤	Brown
⑥	White
⑦	Blue
⑧	Pink

FD-R Series connection cable

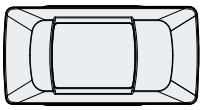
OP-88671

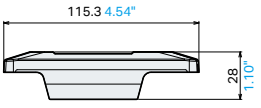


FI-1000 display unit protection cover

FD-HP1

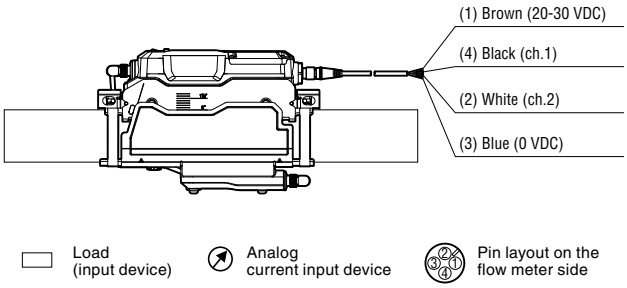
Polysulfone



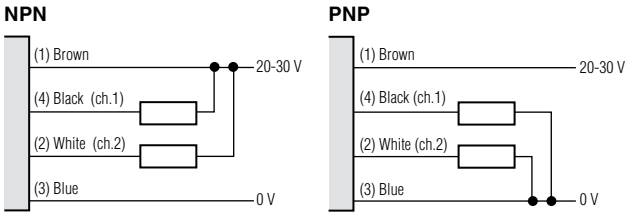


When supplying DC power to the unit

The wiring varies depending on the selected functions.

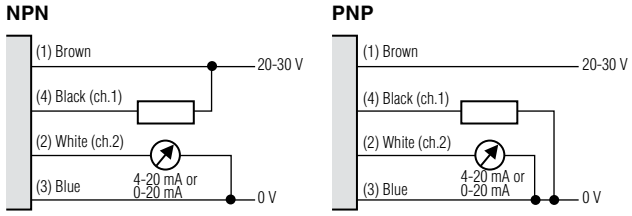


When ch.1: OUT, ch.2: OFF or ch.1: OUT, ch.2: OUT are selected

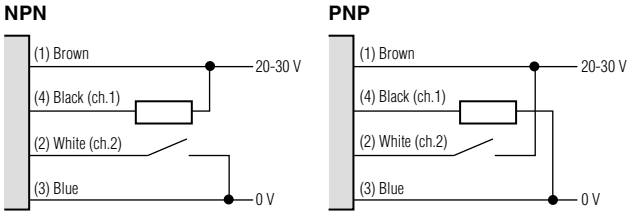


When you select ch.1: OUT, ch.2: OFF, independently insulate the white wire (2).

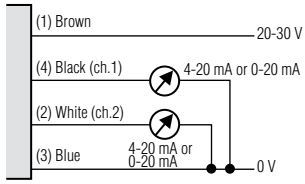
When ch.1: OUT, ch.2: Analog are selected



When ch.1: OUT, ch.2: input are selected

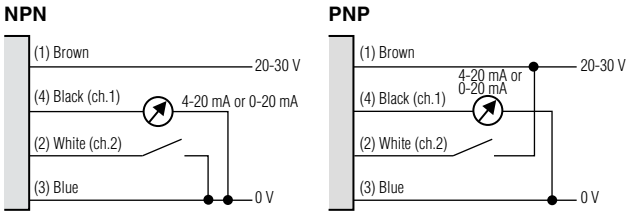


When ch.1: Analog, ch.2: OFF or ch.1: Analog, ch.2: Analog are selected

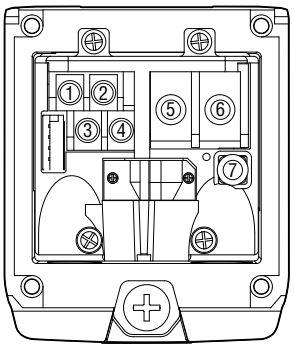


When you select ch.1: Analog, ch.2: OFF, independently insulate the white wire (2).

When ch.1: Analog , ch.2: Input are selected



When supplying AC power to the unit



Terminal block number	Terminal signal	Purpose
(1)	ch.1	ch.1
(2)	ch.2 *1	ch.2
(3)	COM+*2	Common (+)
(4)	COM-	Common (-)
(5)	L	Power supply
(6)	N	
(7)	PE*3	Protective grounding terminal

*1 The ch.2 core wire is not required when the ch.2 function is not being used.
*2 The COM+ core wire is not required, when the analog outputs are used only.
*3 PE is only required when the terminal block of the main unit is used to perform grounding.
*4 The I/O terminal block (parts [1] to [4]) and the AC terminal block (parts [5] and [6]) are insulated.

Standalone Display Unit (FI-1000)

Model		FI-1000
Display		QVGA 2.0 model: color LCD, status indicator light
Display update cycle		Approx. 10 times/second
Heat calculation function*1	Unit	MJ/h, kW, kBTU/h, GJ/h, MW, MBTU/h
	Display resolution	Instantaneous value (MJ/h): 0.01/0.1/1 (default value 0.1); Integrated value (MJ): 0.01/0.1/1 (default value 0.1)
	Pulse output increments (MJ)	0.02–999.99
Data accumulation	Accumulation period	Approx. 1 year
	Data reading	USB2.0
Power supply I/O connector		M12 8-pin connector (male)
I/O (switchable)	Output (Ch1/2/3/4)	NPN/PNP setting switching, open collector output 30 VDC or less, max. 100 mA/ch or less, residual voltage 2.5 V or less
	Analog output (Ch1/2)	4–20 mA/0–20 mA (switchable), load resistance 500 Ω or less
	External input (Ch2/3)	Short circuit current: 1.5 mA or less; input time: 20 ms or more
Power supply	Power voltage	20–30 VDC, ripple (P-P) 10% included, Class 2/LPS
	Current consumption	55 mA or less (display unit standalone, excluding load current)*2
Protection circuit		Protection against reverse power connection, power supply surges, output short circuits, and output surges
Network compatibility		IO-Link*3
Environmental resistance	Enclosure rating	IP65/IP67 (IEC60529)*4
	Operating ambient temperature	–20°C to +50°C –4°F to +122°F (no freezing)
	Operating ambient humidity	35–85% RH (no condensation)
	Vibration resistance	10–500 Hz; Power spectral density: 0.816 G^2/Hz; X, Y and Z directions
	Shock resistance	100 m/s^2 (approx. 10 G), 16 ms pulses, 1000 times each for X, Y and Z directions
Material		Body: PPS / PET / POM; Display window: PAR
Weight		Approx. 120 g 4.23 oz

*1 Available when the separately sold flow meter FD-R Series and two temperature sensors are connected.
*2 455 mA or less including load. When connecting devices such as temperature sensors, please add on the current consumption of each sensor (to a maximum of 830 mA or less).
*3 Supports IO-Link specification v.1.1/COM2 (38.4 kbps). Setting files can be downloaded from the KEYENCE website (www.keyence.com). IO-Link is a trademark or registered trademark of PROFIBUS Nutzerorganisation e.V. (PNO).
*4 When a USB connection is in use, IP65/67 compliance is impaired.

When using FI-1000

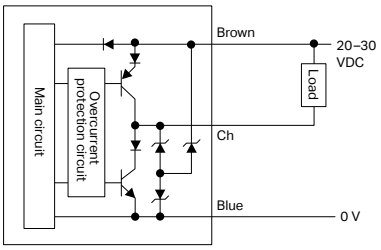
The FI-1000 Series allows users to allocate control outputs, external inputs, and analog outputs to 4 different I/O channels (Ch1 to Ch4) according to the settings.

Wire color	Function
Brown	Power supply + 20 – 30 V
Blue	GND
Black (Ch1)*1	Control output or analog output (selectable)
White (Ch2)	Control output, analog output, or external input (selectable)*2
Gray (Ch3)	Control output or external input (selectable)*2
Pink (Ch4)	Control output (fixed)

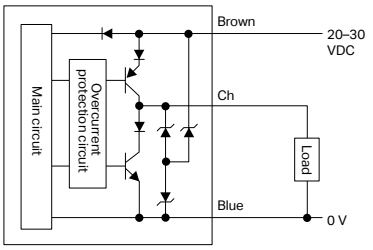
*1 IO-Link wire during IO-Link communication.
*2 Two external input wires are required for the bank input function, set Ch2 and Ch3 to external input to use this function.

(1) Wiring of channel to which control output has been selected

When NPN is selected

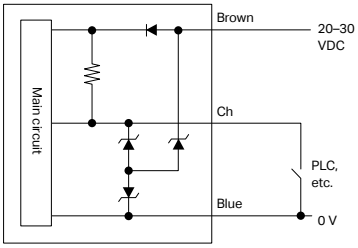


When PNP is selected

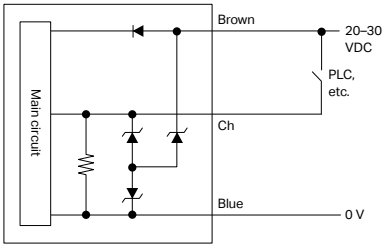


(2) Wiring of channel to which external input has been selected

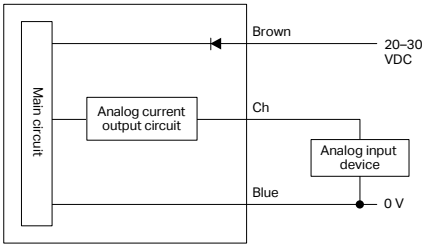
When NPN is selected



When PNP is selected



(3) Wiring of channel to which analog output has been selected

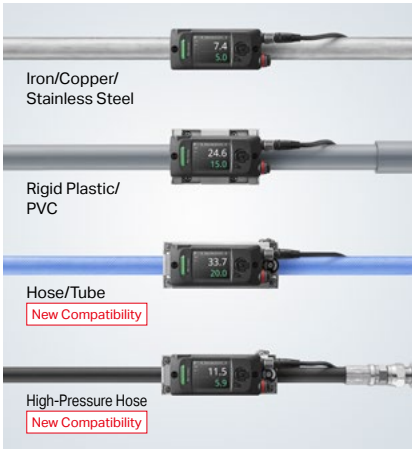


*Can be switched to 4–20 mA or 0–20 mA using the settings

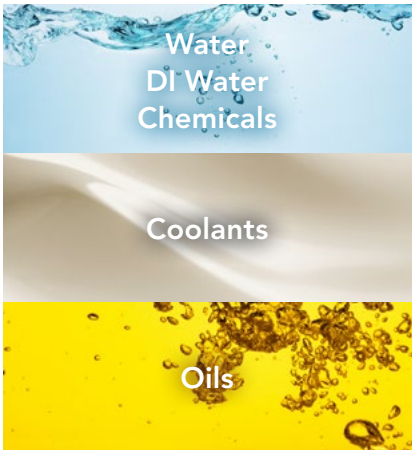
Clamp-On Flow Sensor FD-H Series

Utilize Anywhere

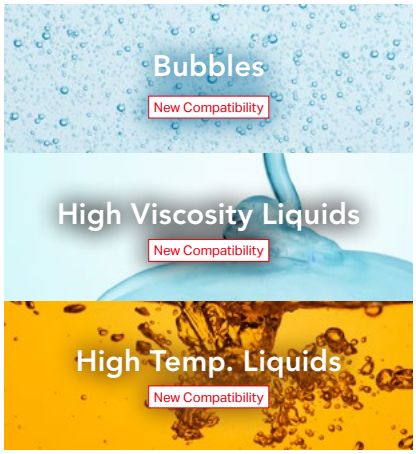
Any Pipe



Any Liquid



Any Condition



Lineup

Standard Type

Model	Rated flow	Supported pipe sizes	Pipe outer diameter
FD-H10	20 L/min 5.3 gal/min	1/4" (8 A)	ø13–16 ø0.51"–0.63"
	30 L/min 7.9 gal/min	3/8" (10 A)	ø16–18 ø0.63"–0.71"
FD-H20	60 L/min 15.9 gal/min	1/2" (15 A)	ø18–23 ø0.71"–0.91"
	100 L/min 26.4 gal/min	3/4" (20 A)	ø23–28 ø0.91"–1.10"
FD-H32	200 L/min 52.8 gal/min	1" (25 A)	ø28–37 ø1.10"–1.46"
	300 L/min 79.3 gal/min	1 1/4" (32 A)	ø37–44 ø1.46"–1.73"

Rigid piping
Built-in temperature sensor
Compatible with fluids with bubbles
IO-Link

High-Temperature Type

Model	Rated flow	Supported pipe sizes	Pipe outer diameter
FD-H10K	20 L/min 5.3 gal/min	1/4" (8 A)	ø13–16 ø0.51"–0.63"
	30 L/min 7.9 gal/min	3/8" (10 A)	ø16–18 ø0.63"–0.71"
FD-H20K	60 L/min 15.9 gal/min	1/2" (15 A)	ø18–23 ø0.71"–0.91"
	100 L/min 26.4 gal/min	3/4" (20 A)	ø23–28 ø0.91"–1.10"
FD-H32K	200 L/min 52.8 gal/min	1" (25 A)	ø28–37 ø1.10"–1.46"
	300 L/min 79.3 gal/min	1 1/4" (32 A)	ø37–44 ø1.46"–1.73"

Rigid piping
Compatible with fluids with bubbles
IO-Link

Hose Type

Model	Rated flow	Pipe outer diameter
FD-H22F	60 L/min 15.9 gal/min	ø13–22.9 ø0.51"–0.90"
FD-H32F	200 L/min 52.8 gal/min	ø23–32.9 ø0.91"–1.295"
FD-H47F	300 L/min 79.3 gal/min	ø33–47.9 ø1.299"–1.886"
FD-H63F	500 L/min 132.1 gal/min	ø48–63 ø1.89"–2.48"

Hoses/Tubes
High-viscosity liquid compatible
IO-Link

140°C 284°F or lower

Between
140–180°C
284–356°F

Ultra-high-temperature couplant Required

If the fluid temperature exceeds 140°C 284°F, it is necessary to change the couplant and separate the display unit from the sensor.

FD-HK1: for FD-H10K
FD-HK2: for FD-H20K
FD-HK3: for FD-H32K

Stabilization bracket Optional

Can be used to secure hose models to walls, etc. Can be used with any of the four different hose models.
FD-HFB1

Power supply cables Required

Dedicated power supply cable

Appearance	Model	Overview
	FD-HCB2	M12 power supply cable 6-core cable PVC 2 m 6.6'
	FD-HCB10	M12 power supply cable 6-core cable PVC 10 m 32.8'

For IO-Link communication

Can be converted to 4 pins using the below.

Appearance	Model	Overview
	FD-HCC2	M12 power supply cable 8-pin female to 4-pin male PVC 2 m 6.6'
	FD-HCC10	M12 power supply cable 8-pin female to 4-pin male PVC 10 m 32.8'
	FD-HCC0	8-pin female to 4-pin male adapter

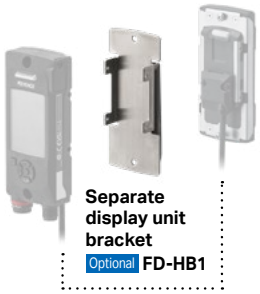
Accessories (Display Unit Related)

Heavy Duty Protection Cover
Standard models only

Heavy duty protection cover
FD-HP2

Heavy duty power supply cable
FD-HCB10G
M12 6-core cable
PVC 10 m 32.8'

Display unit protection cover Optional
FD-HP1



Separate display unit bracket Optional **FD-HB1**

*Can also be used with the FI-1000.

Connection cable when separating the display Optional

A dedicated cable for when using the display unit separated from the sensor.

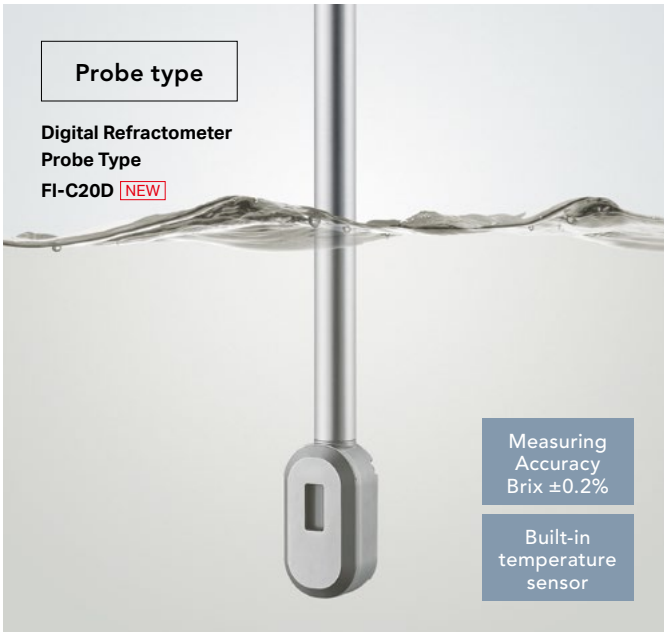
Appearance	Model	Overview
	FD-HCS2	Display unit separation connection cable PVC 2 m 6.6'

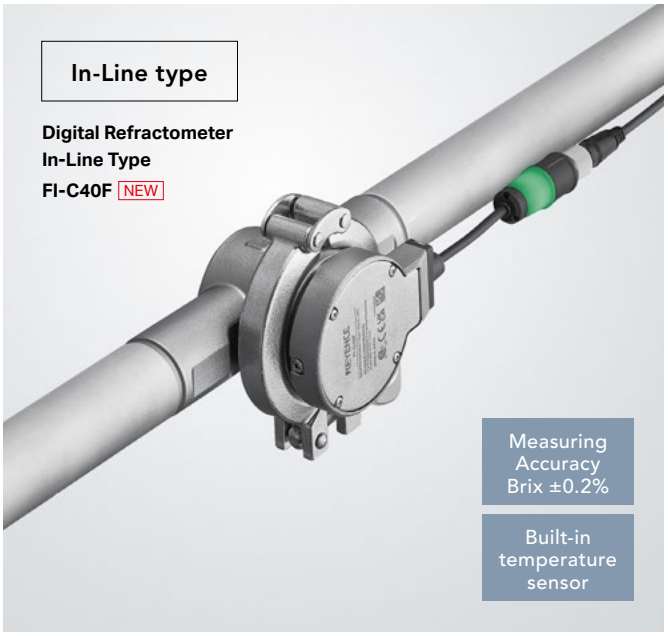
Can be extended an additional 18 m 59.1' (for a total of 20 m 65.6') using these M12-M12 connector cables.

	OP-85503	2 m 6.6' PVC
	OP-85504	5 m 16.4' PVC
	OP-88075	2 m 6.6' PUR
	OP-88076	5 m 16.4' PUR

■ To output historical data to a PC: USB cable OP-51580 (2 m 6.6') or OP-86941 (5 m 16.4') can be used. Historical data that can be output includes: 1) Instantaneous data and stability for every 10 seconds over the past 7 days, 2) Instantaneous data and stability for every 10 minutes over the past year, 3) Accumulated flow data for every hour over the past year, 4) Accumulated heat transfer data for every hour over the past year, and 5) Up to 100 events.

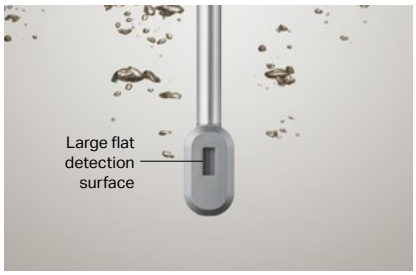
Digital Refractometer FI-C Series





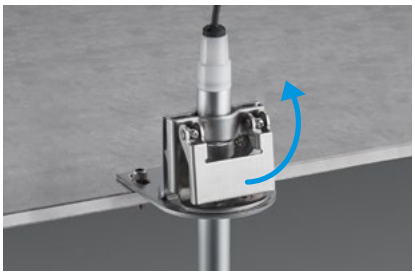
Stable & Reliable Detection

Stably measure the refractivity (Brix%) of the liquid regardless of bubbles or build-up.



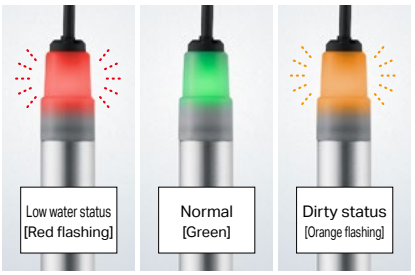
Tool-Free Maintenance

No tools are required to remove and clean the units, greatly minimizing downtime.



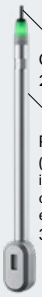
Large Status Indicator

Understand the current situation at a glance, including recognizing potential issues.



Lineup

Probe Type



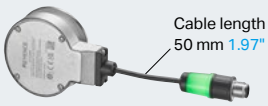
Model	Installation
FI-C20D	Probe type

Options

Appearance	Model	Overview
	**FI-CDB1**	Dedicated bracket for probe type
	FI-CD1	Extension pipe* 0.4 m 1.3'
	FI-CD2	Extension pipe* 0.8 m 2.6'

*Only one extension pipe can be used per setup

In-Line Type



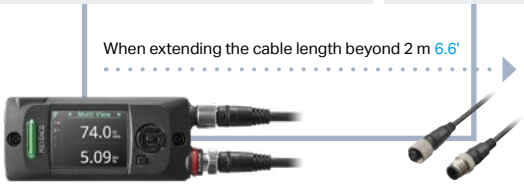
Model	Installation
FI-C40F	2S ferrule attached to dedicated pipe attachment

Options

Appearance	Model	Overview
	**FI-CF1**	Pipe attachment Rc3/4
	FI-CF3	Pipe attachment NPT3/4
	**FI-CF2**	Pipe attachment Rc1-1/2
	FI-CF4	Pipe attachment NPT1-1/2

Display unit

FI-1000 Display Unit or FD-H Series is necessary



M12 4-pin to M12 4-pin cable

Maximum extension of 20 m 65.6' from display unit to concentration sensor (with FI-C40F cable length considered to be 0 m 0')

Model	Overview
OP-85503	2 m 6.6' PVC
OP-85504	5 m 16.4' PVC
OP-88075	2 m 6.6' PUR
OP-88076	5 m 16.4' PUR

Small pipes
⅛" to ½"

Clamp-On Temperature Sensor
FI-T8/T15 NEW
Attach to the pipe with two screws

Medium/large pipes
¾" to 8"

Clamp-On Temperature Sensor
FI-T25/T50/T100/T200 NEW
Attach to the pipe with metallic bands

Easy Installation

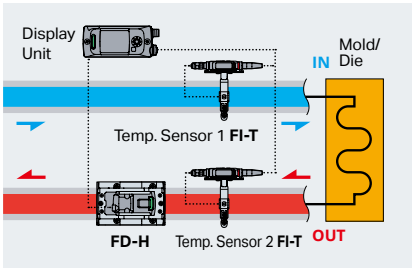
No pipe modifications necessary. The unit clamps onto the pipe in seconds.

Dedicated Display Amplifier

The easy to read OLED display allows users to understand the current situation quickly.

Heat Transfer Monitoring

Connect multiple units to a flow sensor to determine heat transfer in to or out of a system.



Lineup

Model	Supported pipe sizes	Pipe outer diameter
FI-T8	1/8", 1/4" (6 A/8 A)	ø8–14 ø0.31"–0.55"
FI-T15	3/8", 1/2" (10 A/15 A)	ø14–22ø0.55"–0.87"
FI-T25	3/4", 1" (20 A/25 A)	ø22–38 ø0.87"–1.50"
FI-T50	1 1/4", 1 1/2", 2" (32 A/40 A/50 A)	ø38–70 ø1.50"–2.76"
FI-T100	2 1/2", 3", 3 1/2", 4" (65 A/80 A/90 A/100 A)	ø70–126 ø2.76"–4.96"
FI-T200	5", 6", 8" (125 A/150 A/200 A)	ø126–220 ø4.96"–8.66"

*If using the FI-T temperature sensor on its own, use a 4-pin M8 connector cable. (Examples: OP-87625 (PVC, 2 m 6.6'), OP-87626 (PVC, 10 m 32.8'), OP-87628 (PUR, 2 m 6.6'), OP-87629 (PUR, 10 m 32.8')

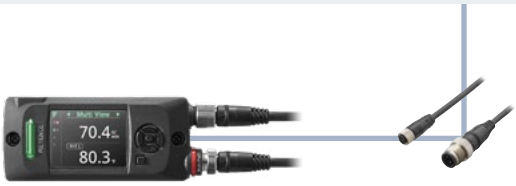
Display amplifier

Cable length:
Approx.
250 mm 9.84"

Head

M8-M8 extension cable
Optional
Maximum extension of 20 m 65.6' from display amplifier to head
OP-88673 PVC 2 m 6.6'
OP-88672 PVC 10 m 32.8'

Display unit
Can be connected to FI-1000 or FD-H Series for complete process solution.



M8 4-pin to M12 4-pin cable
Maximum extension of 20 m 65.6' from the display unit to the temperature sensor display amplifier

Model	Overview
OP-88456	2 m 6.6' PVC
OP-88457	5 m 16.4' PVC
OP-88071	2 m 6.6' PUR
OP-88072	5 m 16.4' PUR

Trouble-Free Level Sensing

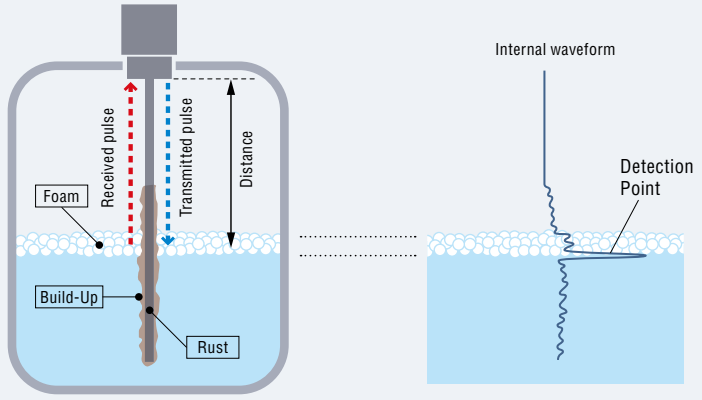
FL Series - Sensing Guide Pulse Level Sensor

Completely Eliminate **FALSE TRIPS** Caused By:

Foam	Build-Up	Rust

Consistently Stable Level Detection

The FL Series utilizes the innovative sensing guide pulse method of level detection. This style of level detection works by transmitting an electrical pulse down a probe and measuring the amount of time it takes to reflect off the liquid surface and back to sensor.



Distance is determined by measuring the time it takes for the signal to be sent and received.

The FL Series ignores build-up and foam by detecting only the peak of the returned signal.

Compatible with Various Applications

Fluid Compatibility		Tank Size Compatibility	Application Compatibility
Water	Oil	Probe Length 0.2 to 2 m 0.6' to 6.6'	4 Independent Outputs
Chemicals	Viscous Liquids		4 to 20 mA Analog Output
			Stability and Alarm Outputs

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