KEYENCE

Radar Level Sensor

NEW FR Series

Stable Level Detection with RADAR for Any Target and Environment

Water | Chemical | Oil | Powder

NEW Standard Level Sensing with RADAR

Benefits of RADAR

Measurement Range

~15 m ~49.2'

Resolution

1 mm 0.04"

Accuracy

±1 mm ±0.04"

It varies depending on the measurement distance.

Continuous Level Detection

Analog Output

0-20 mA/4-20 mA

Digital Output

IO-Link

Point Level Detection

5 (Overflow)

1

2

3

4

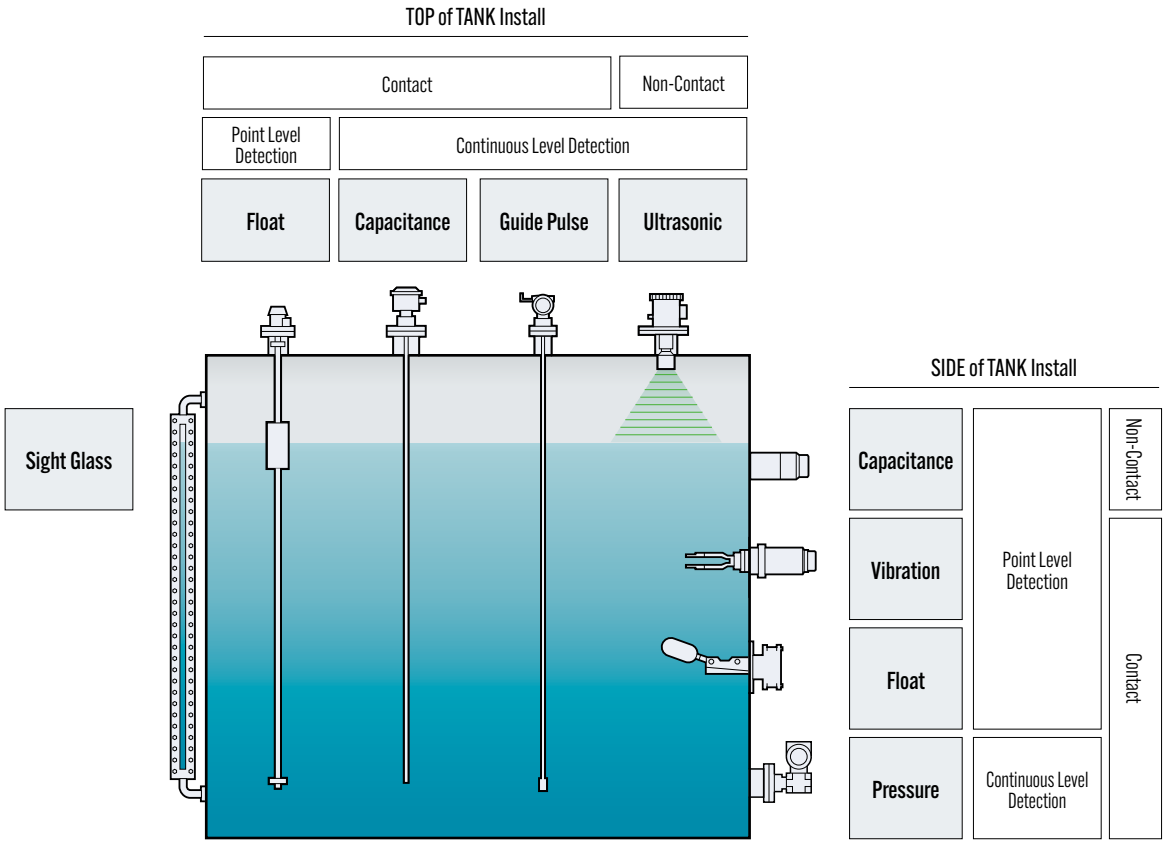
Factors eliminated by RADAR

- Build-Up
- Vapor
- Ripples
- Condensation
- Foam
- Rust / Coating
- Liquid Quality Change
- Obstacles

Control Output

Conventional Level Sensing is Application Specific

There are many types of conventional level sensing technologies on the market, each with their own limitations. Conventional devices are susceptible to issues caused when liquids, environments, or application needs change.



Point Level Detection

This detection style alerts when a singular level is reached. Typically, only providing a single point of detection.

Continuous Level Detection

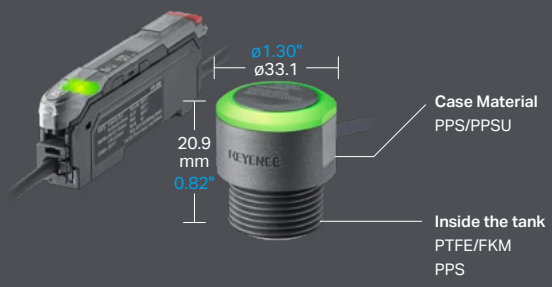
This detection style allows for understanding of the full range of level, continuous monitoring, and measurement.

VERSATILE LINE UP

FR-S Series Short range model

Up to 1.5 m
4.9'

Standard model
FR-S01



Compact / Chemical model
FR-SH01 + FR-SA1

FR-L Series Long range model

Up to 15 m
49.2'

Standard model
FR-LM20L

Chemical model
FR-LP20L

RADAR LEVEL SENSOR **FR Series**

Non-Contact with Stable Detection

- RADAR Technology
- Innovative Functionality

Radar technology finally meets innovation! The FR Series boasts features that allow for accurate detection in any environment to achieve various applications.

Intuitive Design and Structure

- Big 360° Indicator Light
- LCD Display

The FR Series is designed to ensure easy set up and monitoring. The indicator lights can be seen from any angle and the LCD screen makes programming easy.

Unmatched Ease of Use

- Various Dedicated Brackets
- Customizable I/O

The FR Series has over a dozen different bracket options which will help with any mounting requirements along with custom I/O to fit any project need.

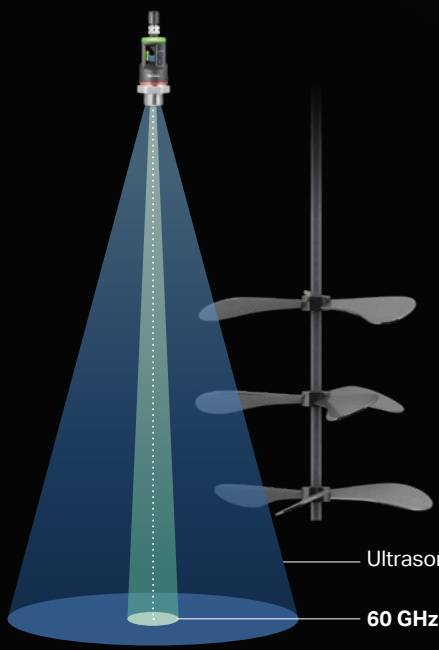
RADAR TECHNOLOGY

Radar device

Horn

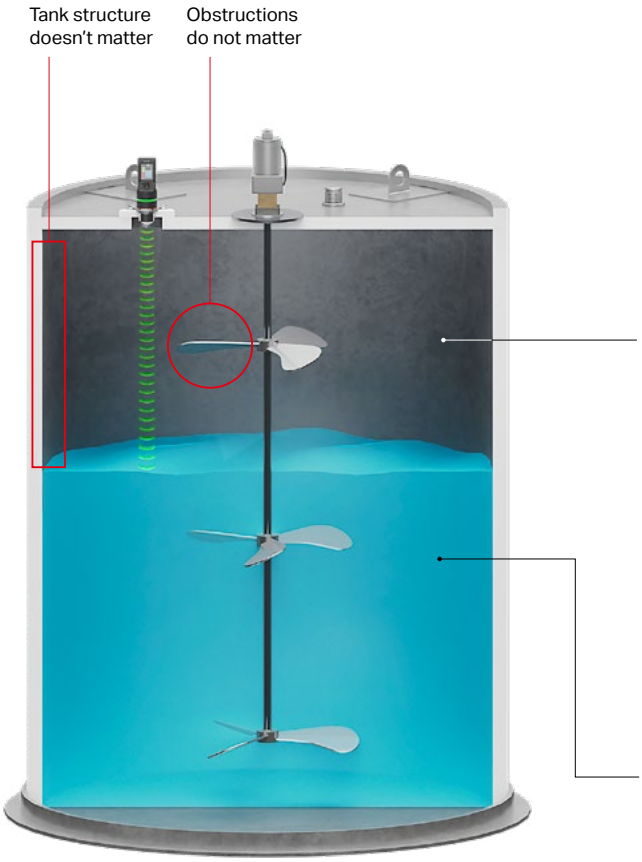
Lens

60 GHz radar



Ultrasonic

60 GHz Radar

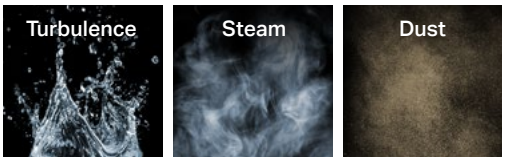


Mount Anywhere

The FR Series can be mounted anywhere without any limitations. Unlike typical level sensors that have rigid mounting requirements, the FR Series offers versatile mounting to meet the needs of any application. No more false detections caused by incorrect mounting.

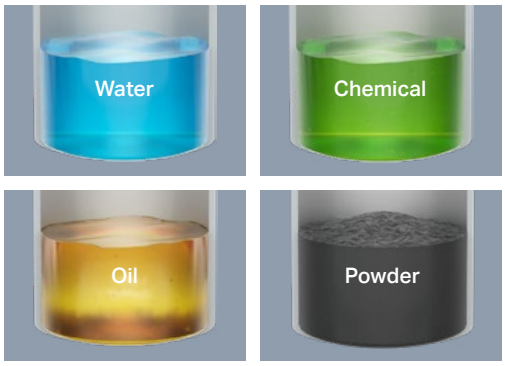
Install in Any Environment

Many level sensor technologies have significant issues with the environment. The FR Series can handle a variety of harsh environmental conditions, such as steam, smoke, dust, etc.

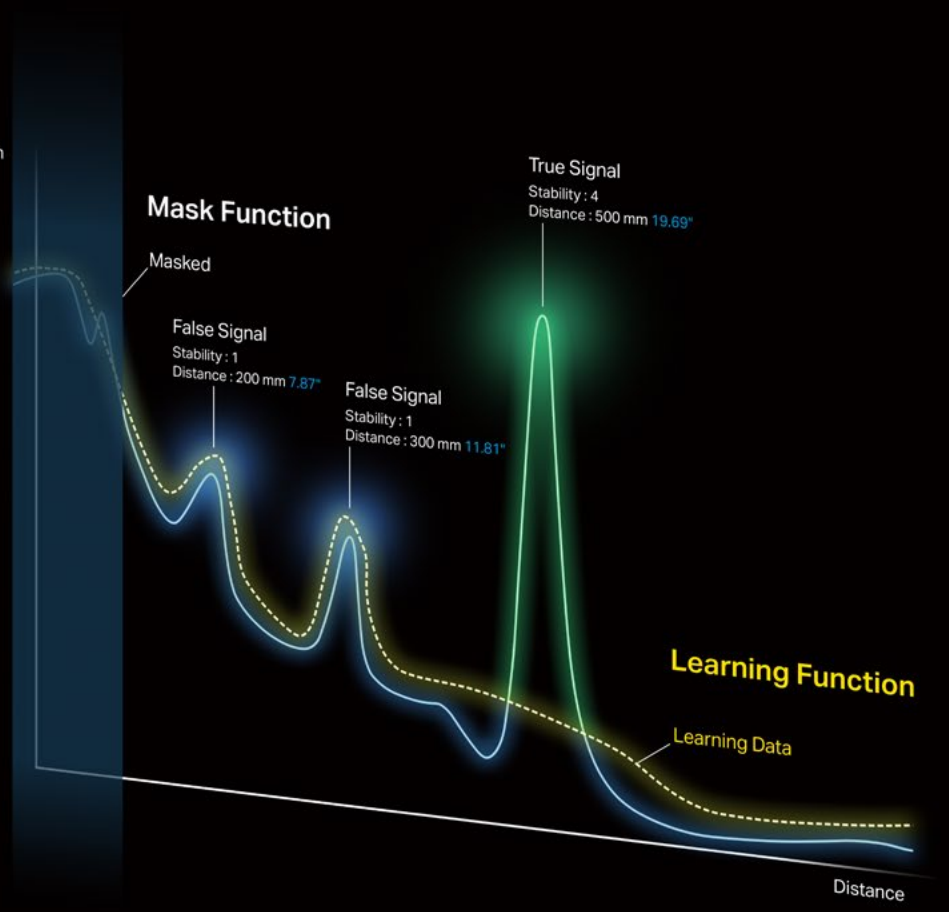


Detect Any Target

The FR Series has the benefit of using RADAR so different targets do not play a factor in detection. The FR Series can detect a wide range of mediums such as water, chemicals, oils, and even powders.



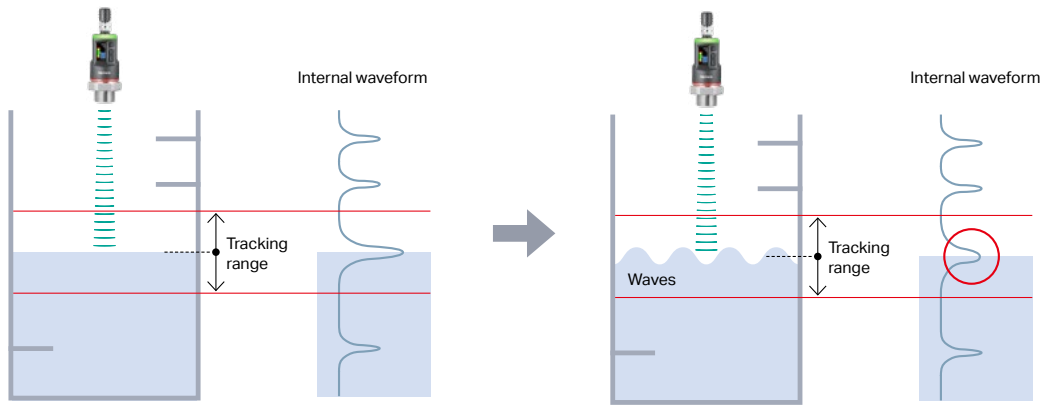
INNOVATIVE FUNCTIONALITY



Tracking Function

The Tracking Function is one of the main features leading to extremely stable detection.
Once the level is detected, a custom range can be set ensuring a stable read out.
This is beneficial when agitation, turbulence, or splashing occurs.

Continuously identifies signals within the tracking range



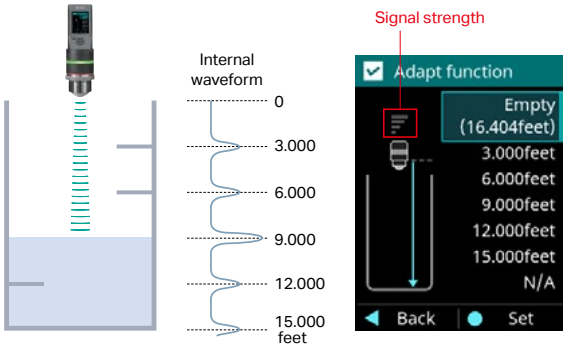
Adapt Function

No more manually adjusting echo curves! The Adapt Function makes set up easy and quick. The sensor will detect all level points it currently sees then select which one is the correct level height of the medium.

Adapt Function Flow

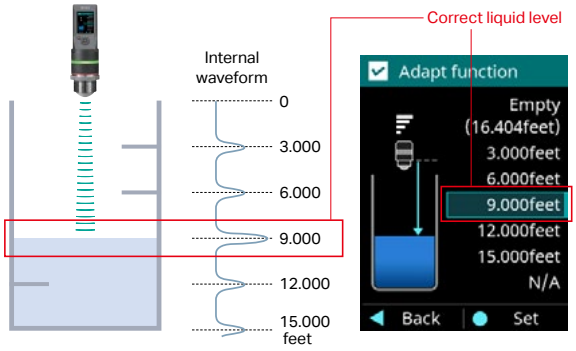
1 Automatically sense all signals

The FR Series makes it easy to understand what the RADAR sensor is detecting. It will automatically run and list out all possible detection points.



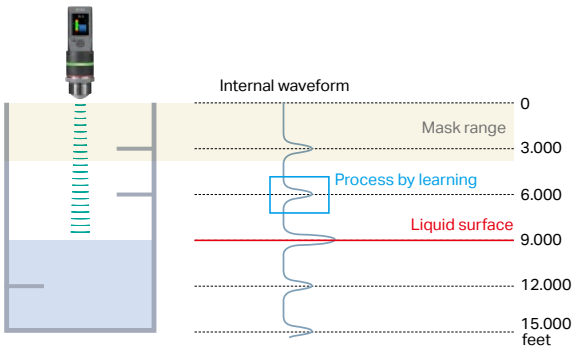
2 Easily select the correct level height

Once the FR Series shows the list of all detection points, now all that is needed to do is select the correct height of the actual level.



3 Automatically optimize internal settings

Once the correct level height is selected, the FR Series will automatically change other settings to optimize detection and increase stability by automatically masking out unwanted signals.



BIG 360° INDICATOR

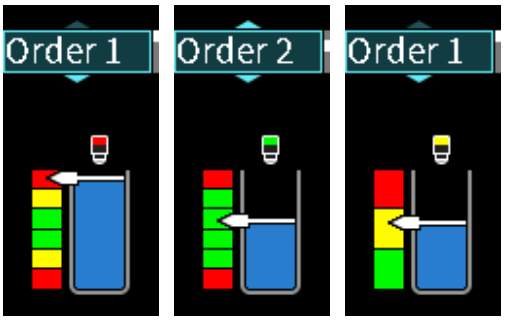
IMPRESSIVE LCD DISPLAY

Understanding at a Glance

Easily be able to tell where level is by glancing at the bright indicator lights. No more having to access the HMI or program code to be able to remotely see where level is.

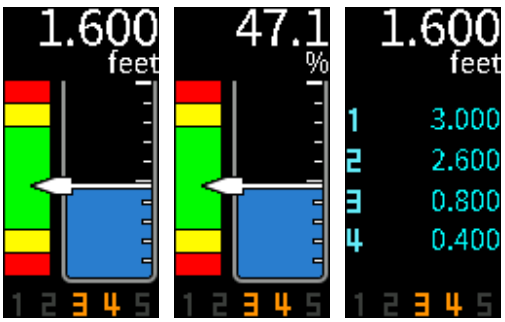
Customize the Lights

The set up can be customized to fit the application. There are multiple options to choose from to make the most sense for maintenance and others involved.



Valuable On-Screen Display

Quick understanding of level data is easily seen on the sensor screen vs needing to dig into HMI/PLCs. This ensures easy install and operation.



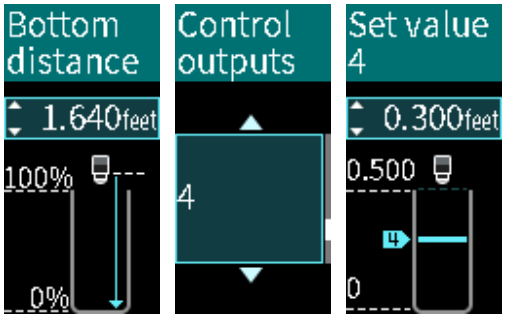
VARIOUS DEDICATED BRACKETS

Easy Installation for Any Tank Application

Regardless of which style tank may be used, there are plenty of pre-made bracket options to choose from. These brackets are strong, easy to install, and inexpensive.

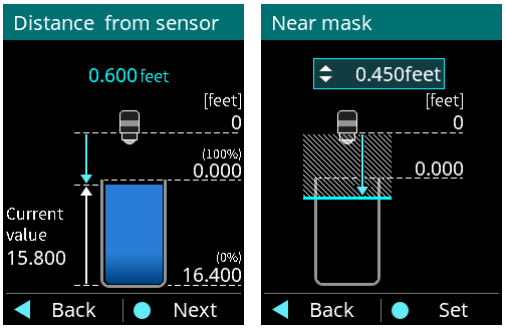
Easy Setup and Configuration

Initial set up will take minutes to complete. The screen makes selecting options easy, no need for extra software or devices, ensuring effortless navigation without complexity.

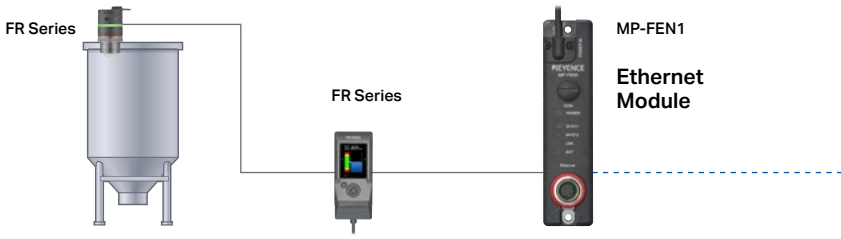


Easily Make Adjustments After Mounting

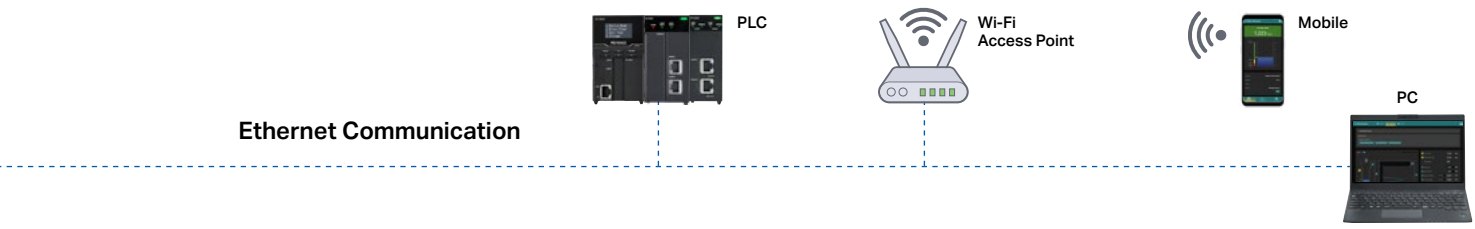
There are different features that can be utilized in order to dial in the sensor and ignore any unexpected changes in the tank. Easily adjust the settings directly on the device.



Programless Monitoring, Settings, And Diagnostics With Web Server Function

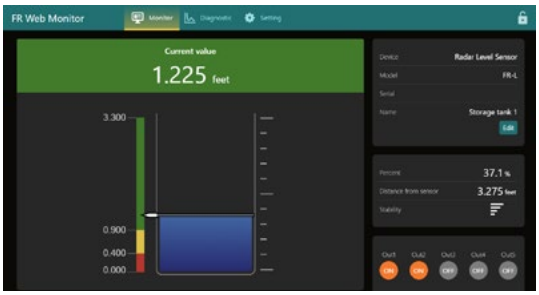


Remote Monitoring over Wi-Fi with Laptop or Mobile



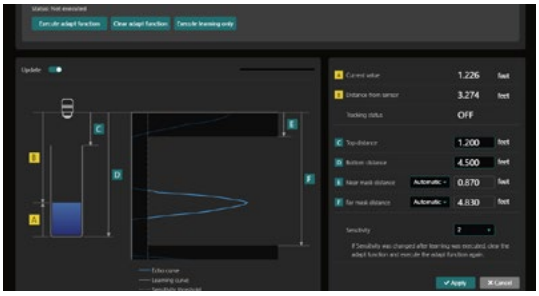
Status Monitoring

Easily monitor the level and sensor status remotely without having to be standing near the FR Series.



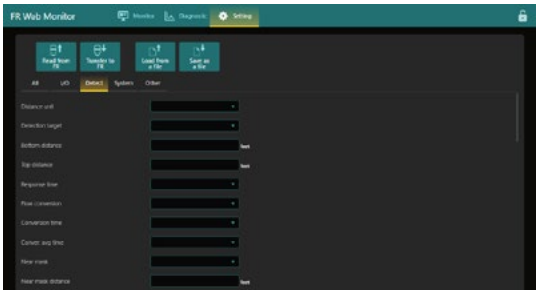
Visual Feedback

Without relying on traditional echo curves, the FR Series will graph out your data in the click of a button.



Remotely Program

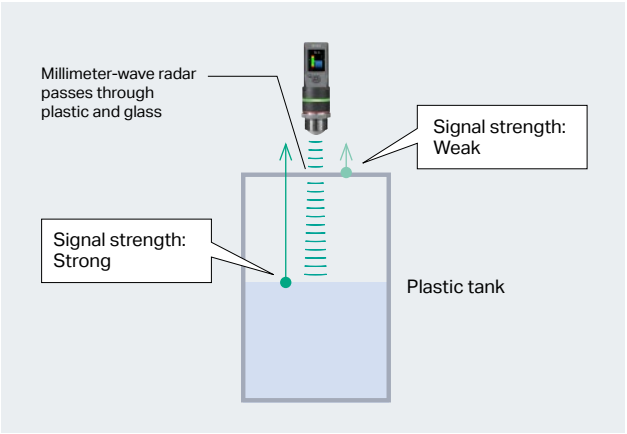
Easily program the FR Series remotely without having to rely on Bluetooth connectivity or hands-on set up.



Other Features

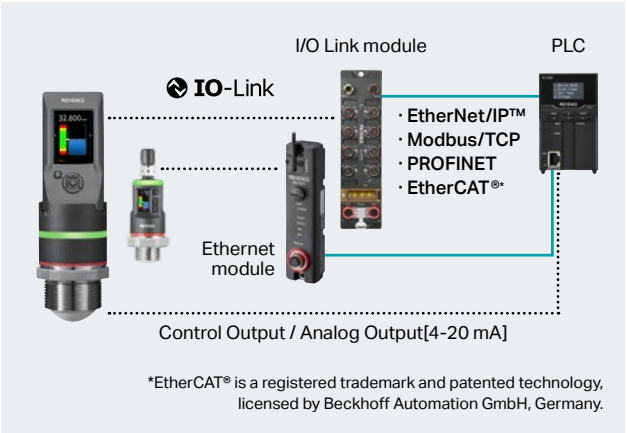
Detect Through Resin

Easily detect any liquid/medium inside of a plastic tank. The FR Series utilizes RADAR technology, which provides stable detection through plastic and enables flexible integration.



Customizable I/O

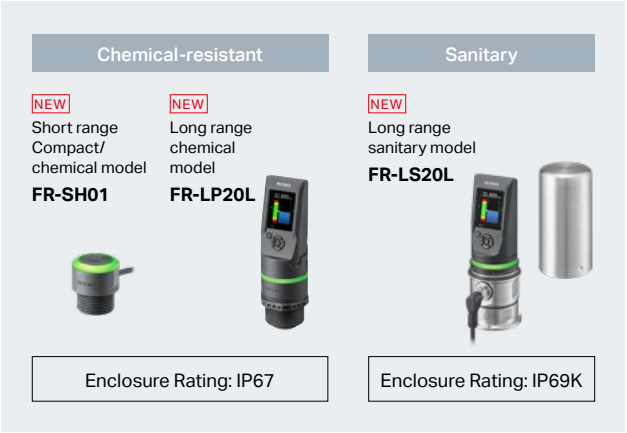
The FR Series offers many ways to integrate back to controls. With 5 digital outputs, 4-20 mA analog, and IO Link, this sensor can communicate in various ways with controls systems.



*EtherCAT® is a registered trademark and patented technology, licensed by Beckhoff Automation GmbH, Germany.

Chemical / Sanitary Models Are Available

Level sensing applications are commonly in harsh, dirty, or sanitary rated environments. The FR Series contains a variety of models that can withstand any condition.



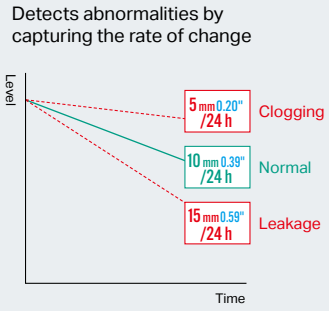
Maintenance Free

Traditional level sensors are susceptible to build-up and dirt. The FR Series is designed to withstand any environment, making routine maintenance unnecessary.

Accumulated Level Mode

[Short-range type only]

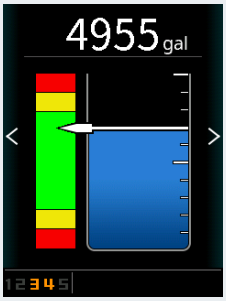
Easily see a percentage of level inside of the tank instead of relying on the actual level measurement. Making it easy to read for anyone involved.

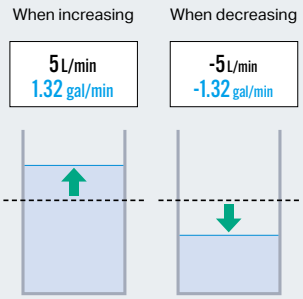


Flow Conversion Mode

[Long-range type only]

The FR Series can detect gradual changes in level measurement and calculate a flow rate change over time, as long as certain parameters of the application are input.





HAZARDOUS ENVIRONMENT RATED

The FR Series is rated for Explosion-Proof or Intrinsically Safe environments without sacrificing sensor capabilities.

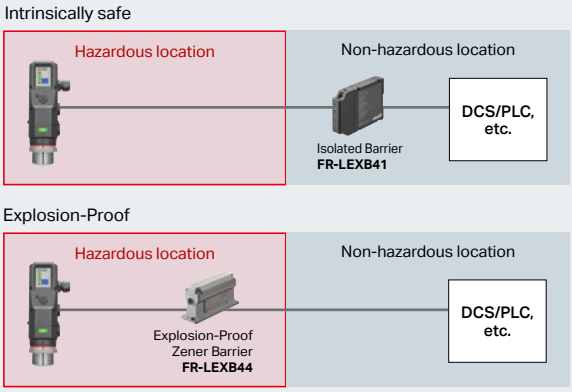
NEW

Long-Range Radar Level Sensor
2-Wire Explosion-Proof Model
FR-LEX20L

FR-LW20L (Standard model) without explosion-proof specifications are also available

Compatible Explosion-Proof and Intrinsically Safe Needs

The FR Series covers any needs for hazardous location requirements. The same sensor has options to fit in either location while maintaining the rating needed for any application.

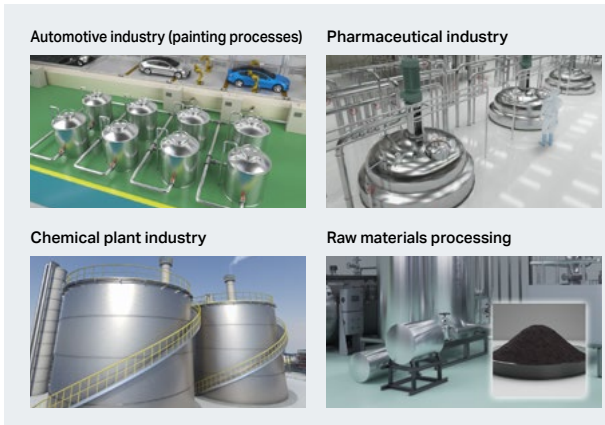


Special Display for Easy Understanding

The display makes it easy to understand the current level status and performance. The special Reflective LCD display allows for quick and simple visuals in outdoor conditions.

For Any Hazardous Process

There are many different processes that require Hazardous ratings. The FR Series can stably detect various liquids and powders while maintaining the rating needed for any location.



Find a Solution for Any Tank Within the Facility

Dispensers

Liquids | **FR-S01**

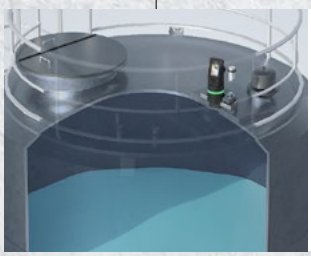
Can be installed in pressurized tanks. The amount remaining in the tank can be checked in real time, letting users know when to refill.

Assembly machine

Ingredient tank

Filling machine

Casting machine



Ingredient tank

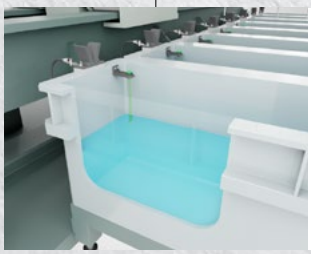
Liquids | **FR-LP20L**

Corrosive liquids such as chemicals, powders, solids and other substances can be detected without contact, making it possible to detect a wide range of materials.

Release agent tank

Liquids | **FR-S01**

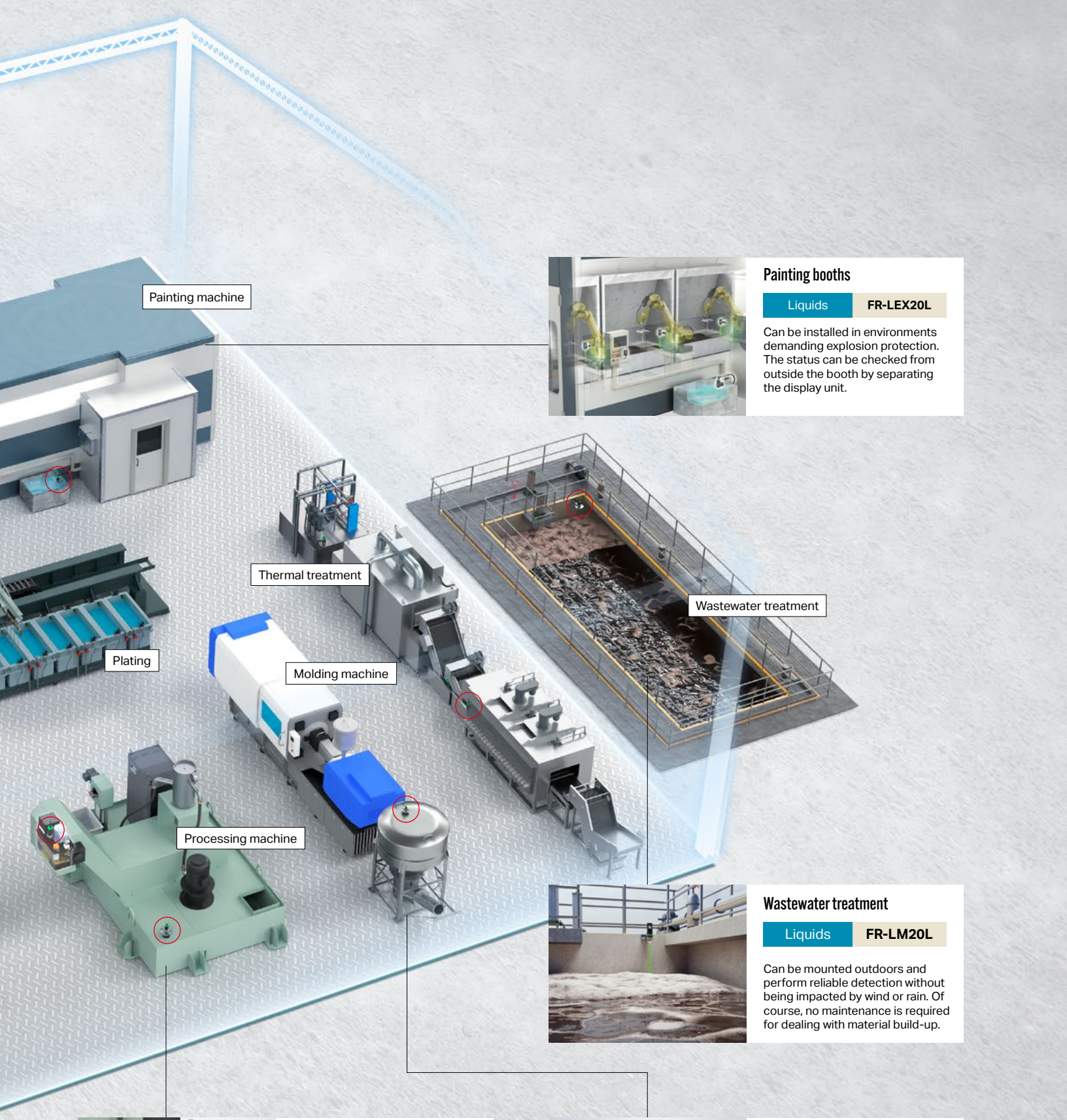
Accurate measurements of usage volumes can reduce the man-hours required for daily inspections. Oil-based liquids can also be detected.



Plating tank

Liquids | **FR-SH01**

Can be installed even where space is limited. The plastic type is highly resistant to chemicals, making it ideal for use even in chemical environments.



Painting booths

Liquids **FR-LEX20L**

Can be installed in environments demanding explosion protection. The status can be checked from outside the booth by separating the display unit.

Wastewater treatment

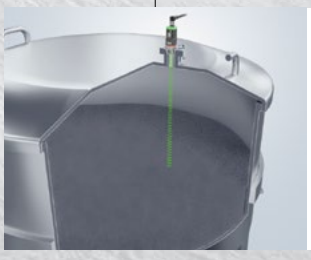
Liquids **FR-LM20L**

Can be mounted outdoors and perform reliable detection without being impacted by wind or rain. Of course, no maintenance is required for dealing with material build-up.

Coolant tank

Liquids **FR-S01**

Stable detection is possible without being impacted by waves. No maintenance is required to deal with the build-up of dirt or chips.

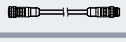
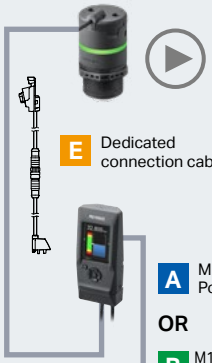


Plastic pellet tank

Plastic **FR-S01**

Detects a variety of pellets without being impacted by color. Scaling is possible even if the bottom of the tank is not flat.

STEP 1 | STEP 2 | STEP 3 | STEP 4 **Select detecting distance and model**

Range	Model	Cable Configuration
Short up to 1.5 m (4.9')	Standard model (metal) **FR-S01** 	**Use as built-in display**   **A** M12 8-pin Power Cable **OR** **B** M12 8-pin to M12 4-pin cable (for IO-Link)
	Compact/ Chemical model — 5 m 16.4' Dedicated Connector Cable type **FR-SH01** 	**Use as separated display**  **C** Display Unit **FR-SA1 FR-SA2 FR-SA1C FR-SA0** **D** M8 4-pin Power Cable *Only for FR-SA1C
Long up to 15 m (49.2')	Standard model (metal) **FR-LM20L** 	**Use as built-in display**  **A** M12 8-pin Power Cable **OR** **B** M12 8-pin to M12 4-pin cable (for IO-Link) PLC(I/O) IO-Link Master, etc.
	Chemical model **FR-LP20L** 	**Use as separated display** *only for FR-LM20L/FR-LP20L  **E** Dedicated connection cable **A** M12 8-pin Power Cable **OR** **B** M12 8-pin to M12 4-pin cable (for IO-Link) PLC(I/O) IO-Link Master, etc.  *The main unit can be separated into the sensor head section and the display unit.
	Sanitary model **FR-LS20L** 	
	2-wire model — Explosion-proof type **FR-LEX20L** Standard type **FR-LW20L** 	

Page27, for more detail of Sanitary Model

Page28, for more detail of 2-wire Model

STEP 1 | STEP 2 | STEP 3 | STEP 4

Select Cables and display unit

A M12 8-pin Power Cable

Type	Appearance	Model	Connector		Material		Length
			Female	Male	cable	connector	
Standard		**OP-88893**	M12 8-pin Straight	Strand wire	PVC	SUS316L	2 m 6.6'
		OP-88894					5 m 16.4'
		OP-88895					10 m 32.8'
		**OP-88896**	M12 8pin L-shape	Strand wire			2 m 6.6'
		OP-88897					5 m 16.4'
		OP-88898					10 m 32.8'
Oil resistant		**OP-87582**	M12 8pin Straight	Strand wire	PUR	Zinc nickel plating	2 m 6.6'
		OP-87583					5 m 16.4'
		OP-87584					10 m 32.8'
		**OP-87586**	M12 8pin L-shape	Strand wire			2 m 6.6'
		OP-87587					5 m 16.4'
		OP-87588					10 m 32.8'
Chemical resistant		**OP-88899**	M12 8pin Straight	Strand wire	Chemical-resistant PVC	PBT	10 m 32.8'
		**OP-88900**	M12 8pin L-shape	Strand wire			2 m 6.6'
		OP-88901					5 m 16.4'
		OP-88902					10 m 32.8'

When extending

Type	Appearance	Model	Connector		Material		Length
			Female	Male	cable	connector	
Standard		**OP-88903**	M12 8-pin L-shape	M12 8-pin straight	PVC	SUS316L	10 m 32.8'
		**OP-88904**	M12 8-pin straight	M12 8-pin straight			
Chemical resistant		**OP-88905**	M12 8-pin L-shape	M12 8-pin straight	Chemical-resistant PVC	PBT	10 m 32.8'

B M12 8-pin to M12 4-pin cable

Type	Appearance	Model	Connector		Material		Length
			Female	Male	cable	connector	
Standard for IO-Link		**OP-88444**	M12 8-pin straight	M12 4-pin straight	PVC	Nickel-plated brass	2 m 6.6'
		OP-88445					5 m 16.4'
		OP-88446					10 m 32.8'

C Display Unit

Type	Appearance	Model	Input/output	Cable	Adding an expansion unit
Cable Type Main Unit		**FR-SA1**	4 outputs 1 analog output 1 output / 1 external input* *Selectable	PVC 2 m 6.6' Strand wire, 8-core	With FR-SA1 as the main unit, up to 12 FR-SA2 units can be connected With NU Series as the main unit, up to 16 FR-SA2 units can be connected
Cable Type Expansion Unit		**FR-SA2**	4 outputs 1 output / 1 external input* *Selectable	PVC 2 m 6.6' Strand wire, 5-core	
M8 Connector Type Main Unit	IO-Link 	**FR-SA1C**	1 output / IO-Link* 1 output/1 external input / 1 analog output* *Selectable	None (M8 4pin male connector)	Adding expansion unit not possible
Zero Line Type Expansion Unit		**FR-SA0**	*via NU series	None	Up to 16 units can be added to NU series. Network Communication Unit NU Series 

D M8 4-pin Power Cable

*Only for FR-SA1C

Appearance	Model	Connector		Material		Length
		Female	Male	cable	connector	
	**OP-88714**	M8 4-pin Straight	Strand wire	PVC	Nickel-plated brass	2 m 6.6'
	OP-88715					5 m 16.4'
	OP-88716					10 m 32.8'

When extending

Appearance	Model	Connector		Material		Length
		Female	Male	cable	connector	
	**OP-88673**	M8 4-pin Straight	M8 4-pin Straight	PVC	Nickel-plated brass	2 m 6.6'
	OP-88672					10 m 32.8'

E Dedicated connection cable

Type	Appearance	Model	Connector	Material		Length
				cable	connector	
Standard		**FR-LMS5**	Dedicated connector	PVC	SUS316L	5 m 16.4'
Chemical resistant		**FR-LPS5**		Chemical-resistant PVC	PBT	

When extending

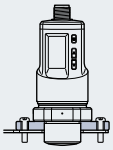
Appearance	Model	Connector		Material		Length
		Female	Male	Female	Male	
	**OP-88906**	M12 4-pin straight	M12 4-pin straight	PVC	SUS316L	5 m 16.4'
	**OP-88907**			Chemical-resistant PVC	PBT	

STEP 1 | STEP 2 | **STEP 3** | STEP 4 — **Select the mounting method**

Mounting hardware required for mounting on a top plate

Attaching a general mounting bracket

No nuts required, no concern of falling / Through-hole and screw hole machining on the top plate



*The customer must provide mounting screws for the top plate.

Short range (up to 1.5 m (4.9')) — Standard | Compact liquid chemical

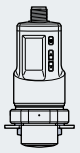
General mounting bracket
OP-88872 SUS304
OP-88874 PPS

Long range (up to 15 m (49.2')) — Standard | Liquid chemicals | 2 Wire Standard | 2 Wire EX

General mounting bracket
OP-88881 SUS304
OP-88919 PPS

Nut mounting

Through-hole machining on the top plate



Short range (up to 1.5 m (4.9')) — Standard | Compact liquid chemical

Nut
OP-87642 SUS303
OP-88876 PPS

Gasket
OP-87548 Inorganic fiber and oil-resistant rubber
OP-87562 FKM
*Not needed if sealing is not required

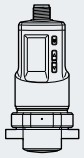
Long range (up to 15 m (49.2')) — Standard | Liquid chemicals | 2 Wire Standard | 2 Wire EX

Nut
OP-88883 SUS304
OP-88887 PPS

Gasket
OP-88890 Inorganic fiber and oil-resistant rubber
OP-88891 FKM
OP-88892 FFKM
*Not needed if sealing is not required

Screw mounting

G screw hole machining on the top plate



Short range (up to 1.5 m (4.9')) — Standard | Compact liquid chemical

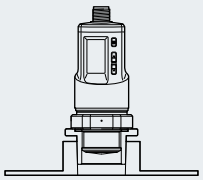
Gasket
OP-87548 Inorganic fiber and oil-resistant rubber
OP-87562 FKM
*Not needed if sealing is not required

Long range (up to 15 m (49.2')) — Standard | Liquid chemicals | 2 Wire Standard | 2 Wire EX

Gasket
OP-88890 Inorganic fiber and oil-resistant rubber
OP-88891 FKM
OP-88892 FFKM
*Not needed if sealing is not required

NPT mounting

NPT screw hole machining on the top plate



Short range (up to 1.5 m (4.9')) — Standard | Compact liquid chemical

NPT mounting bracket
OP-88879 SUS303

Gasket
OP-87548 Inorganic fiber and oil-resistant rubber
OP-87562 FKM
*Not needed if sealing is not required

Long range (up to 15 m (49.2')) — Standard | Liquid chemicals | 2 Wire Standard | 2 Wire EX

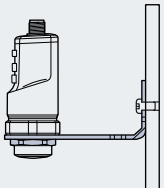
NPT mounting bracket
OP-88884 SUS303

Gasket
OP-88890 Inorganic fiber and oil-resistant rubber
OP-88891 FKM
OP-88892 FFKM
*Not needed if sealing is not required

Mounting hardware required for mounting on an inner wall

Attaching a side mounting bracket

M6 screw hole machining on the side face



*The customer must provide mounting screws for the side.

Short range (up to 1.5 m (4.9')) — Standard | Compact liquid chemical

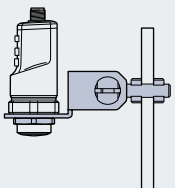
Side mounting bracket
OP-88873 SUS304
*One SUS303 nut (OP-87642) is included
OP-88875 PPS
*One PPS nut (OP-88876) is included

Long range (up to 15 m (49.2')) — Standard | Liquid chemicals | 2 Wire Standard | 2 Wire EX

Side mounting bracket
OP-88882 SUS304
*One SUS304 nut (OP-88883) is included
OP-88886 PPS
*One PPS nut (OP-88887)is included

Adjustable mounting bracket

ø11 ø0.43" hole machining on the side face / Can be adjusted to the desired angle

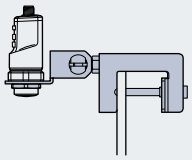


Short range (up to 1.5 m (4.9')) — Standard | Compact liquid chemical

Adjustable mounting bracket
FR-SB33
SUS304/Zinc Die Cast Nickel Plating/Iron Nickel Plating
*One SUS303 nut (OP-87642) is included

Mounting hardware required if attaching with a clamp

Clamp mounting
No machining is required on the tank

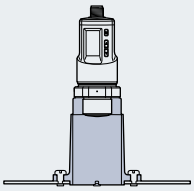


Short range (up to 1.5 m (4.9')) — Standard | Compact liquid chemical

Clamp mounting bracket
FR-SB32
SUS304/Zinc Die Cast Nickel Plating/Iron Nickel Plating
*One SUS303 nut (OP-87642) is included

Mounting hardware required if mounting at a distance

Attaching an offset mounting bracket
ø50 ø1.97" through-hole and M6 screw hole machining on the top plate



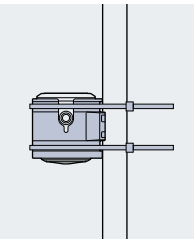
Short range (up to 1.5 m (4.9')) — Standard | Compact liquid chemical

Offset mounting bracket
FR-SB31
Aluminum die casting

*The customer must provide mounting screws for the top plate.

Mounting hardware required when mounting where space is not available

Attaching a compact mounting bracket
Only applicable to FR-SH01 / M3 screw hole machining on the side face or cable tie-mounted



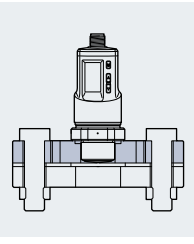
Short range (up to 1.5 m (4.9')) — Compact liquid chemical

Compact mounting bracket
FR-SB34
PPS
*Two cable ties are included

*If mounting with screws, the customer must provide the screws.

Mounting hardware required for mounting on flanges/ferrules

Flange mounting
If a tank has a flange



Short range (up to 1.5 m (4.9')) — Standard | Compact liquid chemical

Flange mounting bracket
OP-88877
SUS304 JIS10K 20-32A equivalent
*One FKM gasket (OP-87562) is included

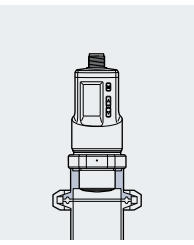
Long range (up to 15 m (49.2')) — Standard | Liquid chemicals | 2 Wire Standard | 2 Wire EX

Flange mounting bracket
OP-88880
SUS304 JIS5K 50A/10K 50A equivalent
*One FKM gasket (OP-88891) is included

OP-88885
PVC JIS5K 50A/10K 50A equivalent
*One FKM gasket (OP-88891) is included

*Flange gaskets, bolts and nuts must be provided by the customer.

Ferrule mounting
If the tank is equipped with a ferrule



Short range (up to 1.5 m (4.9')) — Standard | Compact liquid chemical

Ferrule mounting bracket
OP-88878
1.5S Ferrule SUS316L
* One FKM gasket (OP-87562) is included.

Long range (up to 15 m (49.2')) — Standard | Liquid chemicals | Sanitary | 2 Wire Standard | 2 Wire EX

Ferrule mounting bracket

OP-88888
2S Ferrule

OP-88889
2S Ferrule (with leakage port)

Gasket

OP-88920
EPDM

*One EPDM gasket (not sold separately) is included

*The customer must provide ferrule gaskets and clamps.

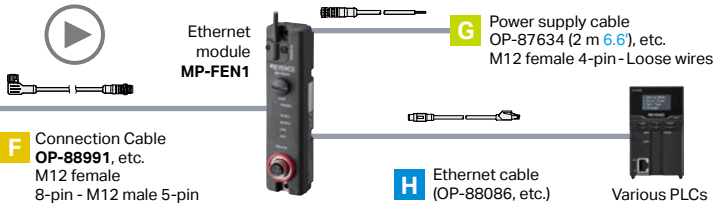
STEP 1 | STEP 2 | STEP 3 | **STEP 4** | **Select options as needed**

Industrial Ethernet communications [optional]

Ethernet module

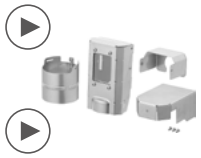
Model	Supported protocols
MP-FEN1	EtherNet/IP™ PROFINET Modbus/TCP MC Protocol/SLMP

[Device configuration]
FR Main unit



	Type	Appearance	Model	Connector		Material		Length
				Female	Male	cable	connector	
F M12 8-pin to M12 5-pin Cable	Standard connection cable		**OP-88991**	M12 8-pin L-shape	M12 5-pin Straight	PVC	SUS316L	2 m 6.6'
			OP-88992					5 m 16.4'
			OP-88993					10 m 32.8'
	Chemical resistant connection cable		**OP-88994**			Chemical-resistant PVC	PBT	2 m 6.6'
			OP-88995					5 m 16.4'
			OP-88996					10 m 32.8'
G M12 4-pin Power Cable	Power supply cable		**OP-87634**	M12 4-pin straight	Strand wire	PVC	Nickel-plated brass	2 m 6.6'
			OP-87272					5 m 16.4'
			OP-87635					10 m 32.8'
H M12 4-pin to RJ45 Network Cable	Ethernet cable		**OP-88086**	RJ45	M12 4-pin straight	PUR	Zinc nickel plating	2 m 6.6'
			OP-88087					5 m 16.4'
			OP-88088					10 m 32.8'

Other Options [optional]

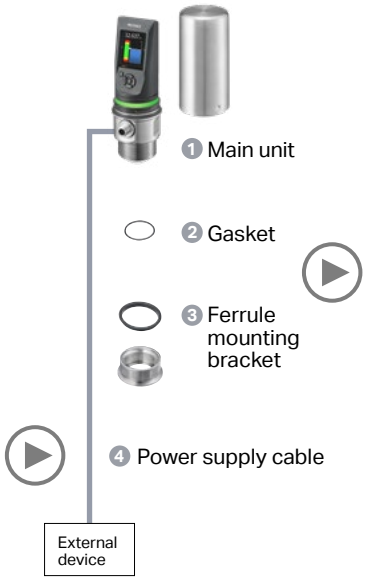
Name	Appearance	Model	Material	Compatible Model
Protective cover		**FR-SP1**	SUS304	[Short Model] FR-S01
		**FR-LMP1**	SUS304 Screw: SUS	[Long Model] FR-LM20L FR-LP20L
Panel Mounting Bracket		**FR-LB1**	PBT/ POM Screw: SUS	[Long Model] FR-LM20L FR-LP20L
Rear Mounting Bracket		**FR-LB2**	SUS304 Screw: SUS	[Long Model] FR-LM20L FR-LP20L

*Use the protection cover when installing outdoors.

Name	Appearance	Model	Material	Compatible model
Amplifier Securing Bracket		**OP-88245**	PC	FR-SA1 (C)
End Unit for amplifier		**OP-26751**	PC, stainless steel, screw: iron (nickel plating)	FR-SA1(C) FR-SA2 FR-SA0 FR-LEXB41 FR-LEXB42
Sensor Head Connector		**OP-88921**	PA	FR-SH01

For Sanitary Use

Option1 Sanitary Model + Gasket + Ferrule mounting bracket



*The display unit cannot be separated

*FDA-compliant materials used for wetted parts

1 Select the main unit

External Appearance	Model	
 IO-Link	**FR-LS20L**	Sanitary model

2 Select a gasket

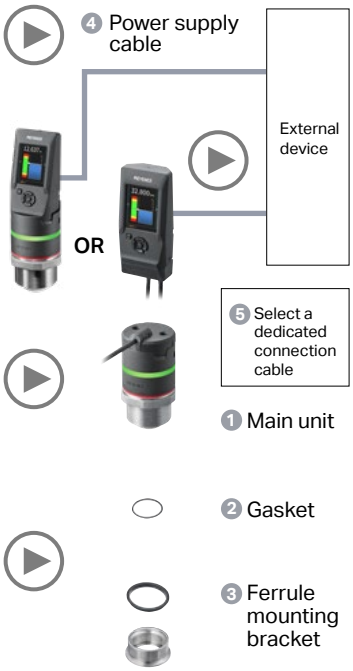
External Appearance	Model	Applications and materials
	**OP-88920**	Internal gasket for ferrule mounting bracket (OP-88888/88889). Material: EPDM

3 Select a ferrule mounting bracket

External Appearance	Model	Applications and materials
	**OP-88889**	This is a 2S ferrule mounting bracket with a leakage port on the side. Vapour leaks can be noticed when there is a fault with the internal gasket. Use this when performing Sterilization in Place (SIP), etc. Ferrule mounting bracket: SUS316L Gasket: EPDM

4 Select a power supply cable Select from A or B in pg.23

Option2 Standard Model + Gasket + Ferrule mounting bracket *can be separated



*FDA-compliant materials used for wetted parts

1 Select the main unit

External Appearance	Model	
 IO-Link	**FR-LM20L**	Standard model

2 Select a gasket

External Appearance	Model	Applications and materials
	**OP-88920**	Internal gasket for ferrule mounting bracket (OP-88888/88889). Material: EPDM

3 Select a ferrule mounting bracket

External Appearance	Model	Applications and materials
	**OP-88888**	This is a standard 2S ferrule mounting bracket. Ferrule mounting bracket: SUS316L Gasket: EPDM
	**OP-88889**	This is a 2S ferrule mounting bracket with a leakage port on the side. Vapour leaks can be noticed when there is a fault with the internal gasket. Use this when performing Sterilization in Place (SIP), etc. Ferrule mounting bracket: SUS316L Gasket: EPDM

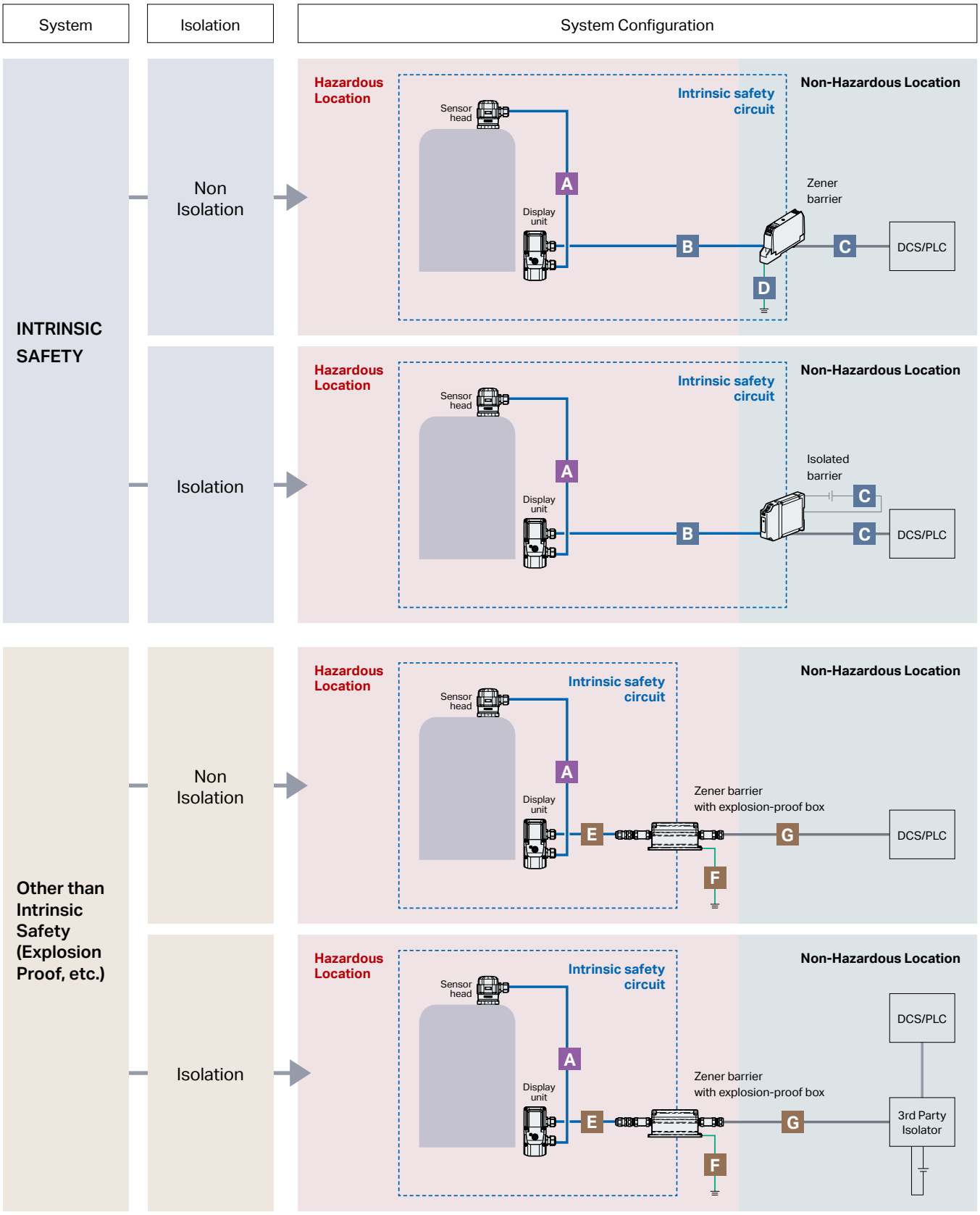
4 Select a power supply cable
Select from A or B on pg.23

When Using as separated display

5 Select a dedicated connection cable
Select from E on pg.23

For Intrinsic Safety / Explosion-Proof Use

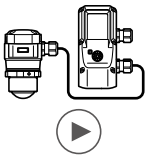
① Select System Configuration



② Select Main Unit

External Appearance	Model Number	Model Type	Input/Output	Explosion-Proof Specifications*1
	**FR-LEX20L**	Explosion-proof model	2-wire system	Intrinsically safe*2 Class I, Zone 0, AEx ia IIC T4 Ga / Class I, Division 1, Groups A, B, C, D, T4 or Class I, Zone 0, AEx ia IIB T4 Ga / Class I, Division 1, Groups C, D, T4*3

*1 Refer to "Explosion-Proof Specifications" (pg.34).
*2 Always use with a barrier.
*3 Varies depending on the barrier used.
*Select cable from B for built-in type



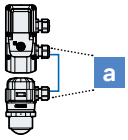
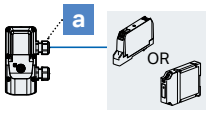
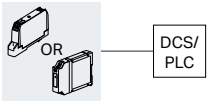
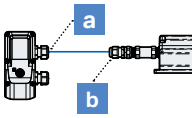
*The sensor head and display unit can be separated.

③ Select Barrier *1

External Appearance	Model	Type	Input/Output	Explosion-Proof Specifications*2
	**FR-LEXB41**	Isolated barrier	2-wire input supply + analog output	[AEx ia Ga] IIC or [AEx ia Ga] IIB [AEx ia Da] IIIC
	**FR-LEXB42**	Zener barrier	2-wire system	[AEx ia Ga] IIB [AEx ia Da] IIIC
NPT 1/2 	**FR-LEXB44***3	Zener barrier with explosion-proof box	2-wire system	AEx db [ia Ga] IIB T4 Gb AEx tb [ia Da] IIIC T135°C Db

*1 When using a self-provided barrier, customers should select it according to the electrical rating in "Explosion-Proof Specifications" (pg. 34).
*2 Refer to "Explosion-Proof Specifications" (pg.34).
*3 Use FR-LEXB43 in Japan. Please contact KEYENCE for details.

④ Select Cables / Cable Gland

			a Cable Gland		b Cable Gland		Cable		
			Thread Size	Max Width Across Corners	Thread Size	Max Width Across Corners	O.D.	No. of Conductors	AWG
For separated display	**A** Display and Sensor head connection 	using cable gland comes with FR-LEX20L	(Accessory of FR-LEX20L)		—		6 to 12 mm 0.24" to 0.47"	6	16 to 26
		using cable gland provide from 3rd party	M20	Max. 31 mm 1.22"	—	—	(Depending on the gland)	6	16 to 26
Wiring details for Intrinsic safety unit	**B** Sensor to barrier connection 	using cable gland comes with FR-LEX20L	(Accessory of FR-LEX20L)		—	—	6 to 12 mm 0.24" to 0.47"	2	12 to 26 for FR-LEXB41 12 to 24 for FR-LEXB42
		using cable gland provide from 3rd party	M20	Max. 33 mm 1.30"	—	—	(Depending on the gland)	2	
	C Barrier to PLC/ DCS connection 	—	—	—	—	—	—	4 for FR-LEXB41 2 for FR-LEXB42	12 to 26 for FR-LEXB41 12 to 24 for FR-LEXB42
	D Ground connection 	—	—	—	—	—	—	1	Use thicker cable than B
Wiring details for Explosion-proof unit	**E** Sensor to barrier connection 	using cable gland comes with FR-LEX20L	(Accessory of FR-LEX20L)		NPT 1/2	No limitation for Max Width Across Corners	6 to 12 mm 0.24" to 0.47"	2	12 to 24
		using cable gland provided from 3rd party	M20	Max. 33 mm 1.30"			(Depending on the gland)	2	12 to 24
	G Barrier to PLC/ DCS connection 	—	NPT 1/2	No limitation for Nut Width Across Corners	—	—	(Depending on the gland)	2	12 to 24
	F Ground connection 	—	—	—	—	—	—	1	Min. 11

⑤ Other Options

Name	Appearance	Model	Material	Compatible model
Protective cover		**FR-LEXP1***	SUS304 Screws: SUS	[Long model] FR-LEX20L/ FR-LW20L
Exchange cable gland		**OP-88908**	PA/ EPDM	FR-LEX20L/ FR-LW20L (2 included with main unit)
Rear Mounting Bracket		**FR-LB2**	SUS304 Screw: SUS	[Long Model] FR-LEX20L FR-LW20L

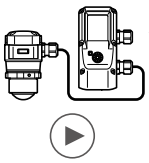
*Use the protection cover when installing outdoors.

⑥ Select Bracket from pg.24-25

2 wire standard model

External Appearance	Model Number	Model Type	Input/Output
	**FR-LW20L**	Standard type	2 wire

*Select cable from B for built-in type
*Select cable from A for separated type



*The sensor head and display unit can be separated.

For Outdoor Use

The FR Series can be confidently utilized outdoors by using the protection cover and separating the unit for easier programming.

Outdoor protection cover

Use as built-in display

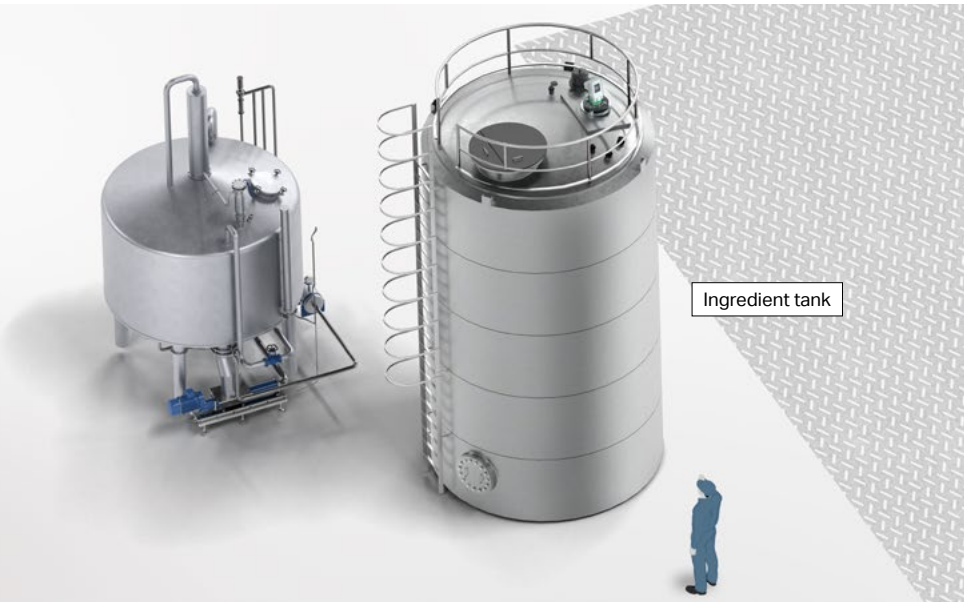
Use as separated display

Compatible Model Long Range
FR-LM20L
FR-LP20L
FR-LW20L
FR-LEX20L

Protection Cover
FR-LMP1/FR-LEXP1

Long Range Detection up to 49.2' If Outdoors

For outdoor use and enclosed tanks only. The FR Series boasts a long-range to help with any liquid or powder detection in outdoor tanks and silos. Utilizing the outdoor rated protection cover and web server function can help with set up and reliability long term.



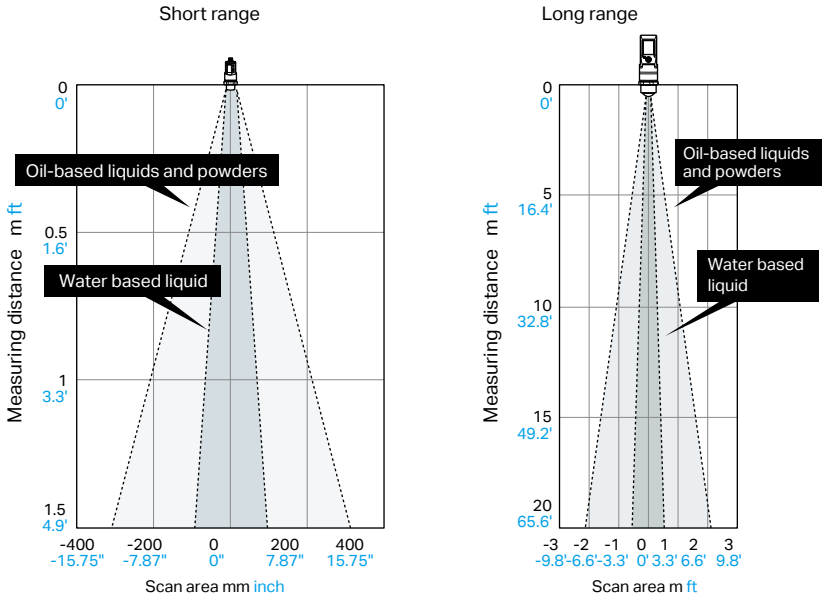
Difference by models

	Appearance	Radar Power	Place to install	Model	Range
Standard model (metal)		Low	Indoor / Outdoor	**FR-LM20L**	Up to 15 m 49.2'
Chemical model		Low	Indoor / Outdoor	**FR-LP20L**	Up to 15 m 49.2'
2-wire explosion-proof model		Low	Indoor / Outdoor	**FR-LEX20L**	Up to 15 m 49.2'
2-wire standard model		Low	Indoor / Outdoor	**FR-LW20L**	Up to 15 m 49.2'

The FR Series has scan area characteristics as shown in the figure to the right, and the area to be considered depends on the target.

It is possible to detect more stably by positioning the device so that there are no metal obstructions within the area shown to the right.

If that cannot be done, diagnostic functions can be carried out to ensure stable detection.



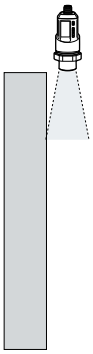
Typical values (short range)

Measuring Distance	Scan area	
	Water based liquid	Oil-based liquids and powders
0.5 m 1.6'	Approx. ø80 ø3.15"	Approx. ø220 ø8.66"
1 m 3.3'	Approx. ø130 ø5.12"	Approx. ø415 ø16.34"
1.5 m 4.9'	Approx. ø185 ø7.28"	Approx. ø610 ø24.02"

Typical values (long range)

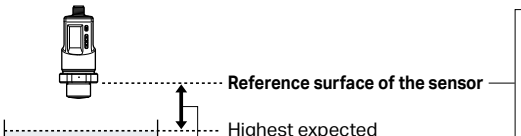
Measuring Distance	Scan area	
	Water based liquid	Oil-based liquids and powders
1 m 3.3'	Approx. ø100 ø3.94"	Approx. ø260 ø10.24"
3 m 9.8'	Approx. ø200 ø7.87"	Approx. ø680 ø26.77"
5 m 16.4'	Approx. ø310 ø12.20"	Approx. ø1100 ø43.31"
10 m 32.8'	Approx. ø570 ø22.44"	Approx. ø2150 ø84.65"
15 m 49.2'	Approx. ø830 ø32.68"	Approx. ø3200 ø125.98"
20 m 65.6'	Approx. ø1100 ø43.31"	Approx. ø4250 ø167.32"

*In the case of a metal wall that has only a slightly uneven surface, there is no problem even if the wall is inside the scan area.

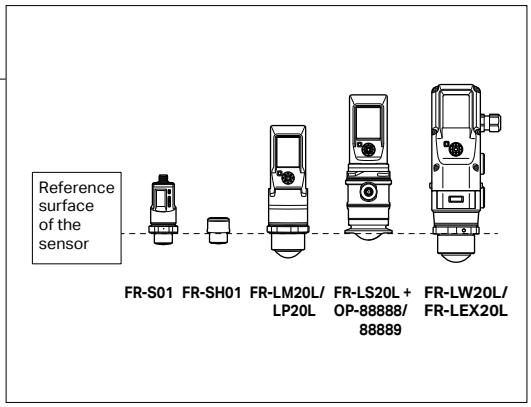


Detection can be unstable at short distances.
It is recommended that the reference plane of the sensor's main unit be installed at least the distance indicated on the right from the highest position of expected liquid level.

However, if the environment is free of foam or adhesive material, it may be possible to use the product with a lesser distance.



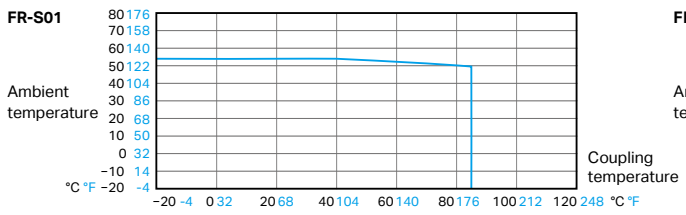
Water based liquid	100 mm 3.94" (short range) 50 mm 1.97" (long range)
Oil-based liquid (specific relative permittivity less than 3)	120 mm 4.72" (short range) 70 mm 2.76" (long range)
Powder	170 mm 6.69"

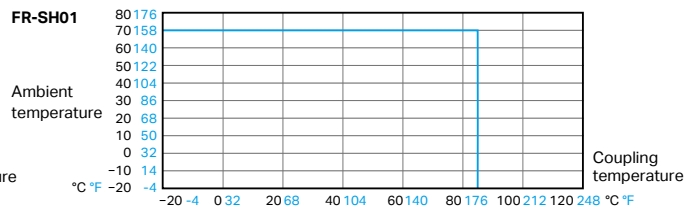


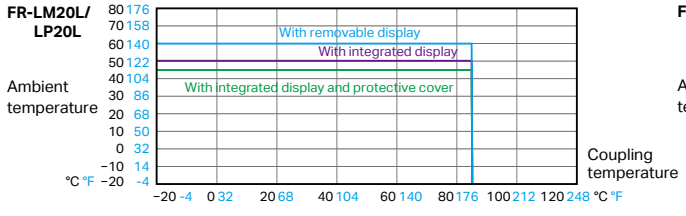
Sensor Unit

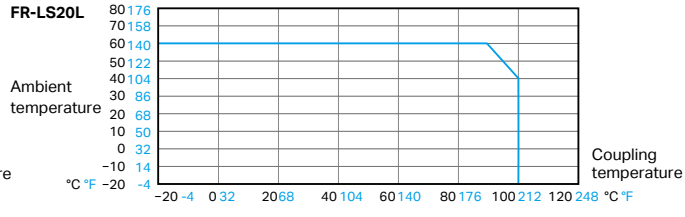
Model		Short range		Long range		
		Standard model	Compact chemical model	Standard model	Chemical model	Sanitary model
		FR-S01	**FR-SH01**	**FR-LM20L**	**FR-LP20L**	**FR-LS20L**
Measuring range*1		Up to 1.5 m 4.9'		Up to 15 m 49.2'		
Display range*1		Up to 2 m 6.6'		Up to 25 m 82.0'		
Relative Permittivity*2		2 or higher		2 or higher		
Resolution		1 mm 0.04"		1 mm 0.04"		
Accuracy*3		Up to 0.1 m 0.3': ±20 mm 0.79"; 0.1 to 0.3 m 0.3' to 1.0': ±5 mm 0.20"; 0.3 to 1.5 m 1.0' to 4.9': ±1 mm 0.04"		Up to 0.1 m 0.3': ±10 mm 0.39"; 0.1 to 10 m 0.3' to 32.8': ±1 mm 0.04"; 10 to 15 m 32.8' to 49.2': ±2 mm 0.08"		
Response time		0.4 s, 1.5 s, 4 s (default value), 10 s		0.4 s, 1.5 s, 4 s (default value), 10 s		
Tank pressure		-0.1 to +1 MPa	-0.1 to +0.1 MPa	-0.1 to +1 MPa	-0.1 to +0.1 MPa	-0.1 to +1 MPa
Material	Tank interior	Lens: PTFE Internal packing: FKM Joint: SUS304	Lens: PTFE Internal packing: FKM Joint: PPS	Lens: PTFE Internal packing: FKM Joint: SUS304	Lens: PTFE Internal packing: FKM Joint: PPS	Lens: PTFE Ferrule Internal Packing: EPDM (when using OP-88920) Ferrule: SUS316L (when using OP-88888/88889)
	Housing	PBT PAR	PPS PPSU	PPS PET PAR	PPS PPSU	SUS304
Connection diameter		G3/4 (20 A)	G3/4 (20 A)	G1-1/2 (40 A)	G1-1/2 (40 A)	2 S ferrule
Output	No. of control outputs	Maximum 5	–	Maximum 5		
	Control output/ auxiliary output	NPN/PNP open collector (switching type) 30 VDC or less, max 50 mA for each Residual voltage of 1.4 V or less (50 mA or less) N.O./N.C. Switching type IO2 is switchable to IO-Link IO5 is switchable to external input	–	NPN/PNP open collector (switching type) 30 VDC or less, max 50 mA for each Residual voltage of 1.4 V or less (50 mA or less) N.O./N.C. Switching type IO2 is switchable to IO-Link		
	Analog output	0–20 mA/4–20 mA maximum load resistance 260 Ω (Response time: 0.2 s after judgment output is confirmed [90% response])	–	0–20 mA/4–20 mA maximum load resistance 260 Ω (Response time: 0.2 s after judgment output is confirmed [90% response])		
External input		Short-circuit current: 1.5 mA or less Input time 500 ms or more	–	–		
Network compatibility		IO-Link v1.1/COM2	–	IO-Link v1.1/COM2		
Analog output accuracy*4	Resolution	1 mm 0.04"	–	1 mm 0.04"		
	Zero accuracy	±0.1 mA (zero point = 4 mA)	–	±0.1 mA (zero point = 4 mA)		
	F.S. accuracy	±0.2 mA (full-scale = 20 mA)	–	±0.2 mA (full-scale = 20 mA)		
Environmental resistance	Operating ambient temperature	–20°C to +55°C*5, *6 -4°F to +131°F (no freezing)	–10 to +70°C*5, *6 14°F to 158°F (No freezing)	Display part when combined and separated: –20 to +50°C -4°F to+122°F(no freezing)*5, *6 Head when separated: –20 to +60°C -4°F to+140°F(no freezing)*5, *6	Display part when combined and separated: –10 to +50°C 14°F to 122°F (no freezing)*5, *6 Head when separated: –10 to +60°C 14°F to 140°F (no freezing)*5, *6	–20°C to +60°C*5, *6 -4°F to+140°F (no freezing)
	Operating ambient humidity	Up to 85% RH (no condensation)				
	Temperature of coupling used	–20 to +85°C -4°F to +185°F (no freezing)*5, *6	–10 to +85°C 14°F to 185°F (no freezing)*5, *6	–20 to +85°C -4°F to +185°F (no freezing)*5, *6	–10 to +85°C 14°F to 185°F (no freezing)*5, *6	–20 to +100°C -4°F to+ 212°F (no freezing)*5, *6
	Vibration resistance	10–500 Hz Power spectral density: 0.816 G²; X, Y and Z directions				
	Shock resistance	100 m/s² (10 G), 16 ms pulses, 1000 times each for X, Y and Z directions				
Enclosure rating		IP67 (IEC60529)		IP67 (IEC60529), Enclosure Type 4X (NEMA250)		IP67 (IEC60529), IP69K (ISO20653)
Protection circuit		Protection against reverse power connection, power supply surges, output overcurrent protection, and output surges				
Power voltage		24 VDC + 25%/–20% Including ripple Class 2 or LPS	–	24 VDC + 25%/–20% Including ripple Class 2 or LPS		
Power Consumption (Excluding Load Current)		80 mA or less	–	106 mA or less	98 mA or less	106 mA or less
Weight		Approx. 170 g 6.00 oz	FR-SH01: Approx. 140 g 4.94 oz	Approx. 600 g 21.16 oz	Approx. 400 g 14.11 oz	Approx. 900 g 31.75 oz

*1 Guaranteed value in water with the recommended installation. Static water can be measured up to the edge of the lens. An undetectable area on the short-range side is created owing to the environment and measurement medium. The maximum measuring distance is also shortened. *2 Measurement may not be possible depending on the shape and environment of the target. *3: This is the guaranteed value from verification performed at KEYENCE inspection facilities. Measurement errors may occur depending on the customer's environment. *4: This is the guaranteed value from verification performed at KEYENCE inspection facilities with a load resistance of 250 Ω. Measurement errors may occur depending on the customer's environment. *5 Details of the operating temperature range of each model are shown below. The FR-S01 and FR-LM20L/LP20L can be used up to an ambient temperature setpoint of 10°C 50°F by selecting "Off when not in Operation" under "Screen Brightness."









*6 When performing SIP with FR-S01/FR-LM20L/LP20L/LS20L, be sure to turn off the power and perform at an ambient temperature of 40°C 104°F or less and an internal temperature of 130°C 266°F or less for up to one hour. In addition, always install the KEYENCE optional ferrule mounting bracket and internal gasket.

* The FR Series uses 60 GHz wireless. Always follow the rules, conventions, regulations, and laws of the country or region in which you use the device.

Amplifier unit

Model		Short Separated Amplifier Unit			
		FR-SA1	**FR-SA2**	**FR-SA1C**	**FR-SA0**
Cable/connector		Cable	Cable	M8 connector	Zero line
Main Unit/Expansion Unit		Main Unit	Expansion Unit	Main Unit	Expansion unit
Response time		0.4 s, 1.5 s, 4 s (default value), 10 s			
Output	No. of control outputs	Maximum 5		Maximum 2	0
	Control output/ auxiliary output	NPN/PNP open collector (switchable) up to 30 VDC or less, max 50 mA for each Total 750 mA or less for the entire amplifier when adding five or more expansion units Residual voltage 1.4 V or less (50 mA or less) N.O./N.C. switchable IO5 is switchable to external input		NPN/PNP open collector (switchable) Up to 30 VDC or less, max 50 mA for each Residual voltage of 1.4 V or less (50 mA or less) N.O./N.C. Switching type IO1 is switchable to IO-Link IO2 is switchable to analog output/ external input	–
	Analog output	0–20 mA/4-20 mA Maximum load resistance 260 Ω (Response time: 0.2 s (90% response) after control output is confirmed)	–	0–20 mA/4–20 mA Maximum load resistance 260 Ω (Response time: 0.2 s (90% response) after control output is confirmed)	–
External input		Short circuit current: 1.5 mA or less Input time: 500 ms or more			–
External communication		—	NU Series compatibility	IO-Link v1.1/COM2	NU Series compatibility
Analog output Precision*1	Resolution	1 mm 0.04"	—	1 mm 0.04"	–
	Zero accuracy	±0.1 mA (zero point = 4 mA)	—	±0.1 mA (zero point = 4 mA)	–
	Full-scale accuracy	±0.2 mA (full-scale = 20 mA)	—	±0.2 mA (full-scale = 20 mA)	–
Expansion		Connected to FR-SA1 (with FR-S01 connected): up to 8 units (9 units total including main unit)*2 Connected to FR-SA1 (with FR-SH01(C) connected): up to 12 units (13 units total including main unit)*2 FR-SA2 is connected to NU series: up to 16 units*6		—	With NU series connected: up to 16 units*7 (17 units total including main unit)
Protection circuit		Protection against reverse power connection, power supply surges, output overcurrent protection, and output surges			
Power voltage		24 VDC +25%/−20%*3 *4 including ripple, Class2 or LPS			
Power Consumption (Excluding Load Current)		When FR-S01 is connected: up to 1940 mW or less (72 mA or less at 24 V) When FR-SH01(C) is connected: up to 1560 mW or less (56 mA or less at 24 V)	When FR-S01 is connected: up to 1690 mW or less (60 mA or less at 24 V) When FR-SH01(C) is connected: up to 1310 mW or less (48 mA or less at 24 V)	1880 mW or less (63 mA or less at 24 V)	1620 mW max. (53 mA max. at 24 V)
Environmental resistance	Operating ambient temperature	−20°C to +55°C -4°F to +131°F (no freezing)*5			
	Operating ambient humidity	Up to 85% RH (no condensation)			
Material		PC			
Weight		Approx. 100 g 3.53 oz	Approx. 90 g 3.17 oz	Approx. 20 g 0.71 oz	Approx. 20 g 0.71 oz

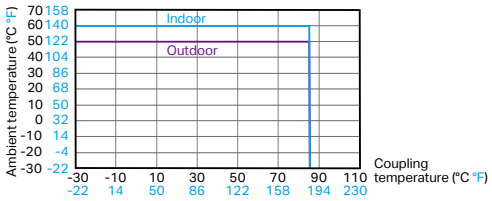
*1 With a load resistance of 250 Ω, this value is guaranteed by KEYENCE inspection facilities. Errors may occur due to your environment.
*2 You can increase the number of expansion units possible in the system by lowering the total analog output current below 750 mA. For details, contact your nearest KEYENCE office.
*3 When expanding the system by one or more FR-SA2 units with the FR-S01 connected or by eight or more FR-SA2 units with the FR-SH01 connected, use a power voltage of 21.6 V or higher.
*4 When expanding the system by four or more FR-SA0 units with the FR-S01 connected or by ten or more FR-SA0 units with the FR-SH01 connected, use a power voltage of 21.6 V or higher
*5 When expanding the system by 1 expansion unit, ensure the ambient temperature is 50°C 122°F or less. When expanding the system by 2 or more expansion units, ensure the ambient temperature is 45°C 113°F or less.
*6 When expanding the system by six or more units with the FR-S01 connected or by eight or more units with the FR-SH01 connected, contact your nearest KEYENCE office.
*7 When expanding the system by 13 or more units with the FR-SH01 connected, contact your nearest KEYENCE office.

Sensor Unit

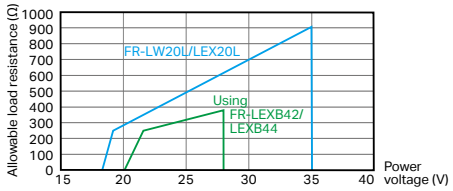
Model		2-wire standard model	2-wire explosion-proof model	2-wire explosion-proof model (when using an Isolated barrier)	2-wire explosion-proof model (when using a Zener barrier)	2-wire explosion-proof model (when using a Zener barrier with a flameproof enclosure)
		FR-LW20L	**FR-LEX20L**	**FR-LEXB41**	**FR-LEXB42**	**FR-LEXB44**
Measurement range*1		Up to 15 m 49.2'				
Display range*1		Up to 25 m 82.0'				
Relative Permittivity*2		2 or more				
Resolution		1 mm 0.04"				
Accuracy*3		Up to 0.1 m 0.3': ±10 mm 0.39"; 0.1 to 10 m 0.3' to 32.8' : ±1 mm 0.04"; 10 to 20 m 32.8' to 65.6': ±2 mm 0.08"				
Response time		1 s, 4 s (default value), 10 s, 25 s				
Tank pressure		-0.1 to +1 MPa (-0.1 to +0.1 MPa below -20°C -4°F)				
Materials	Tank interior	Lens: PTFE; Internal seal: FKM; Fastener: SUS304	Lens: PTFE; Internal seal: FFKM; Fastener: SUS304			
	Housing	PPS PC PA	PPS PC PA Internal potting agent: Epoxy resin	Barrier: PC	Barrier: PC	Explosion-proof enclosure: Aluminium die casting, NBR Cable glands: Nickel-plated brass, chloroprene
Connection diameter		G1-1/2 (40A)				
Outputs	No. of control outputs	1	–			
	Control output/ auxiliary output	Transistor output (NPN open collector) Common independent type 35 VDC or less, 50 mA max. Residual voltage of 4.0 V or less (50 mA or less) N.O./N.C. switching	–			
	Analog output	See separately for 4 to 20 mA maximum load resistance*6 (Response time: 3 s after internal value is confirmed [90% response])				
Analog output precision*4	Resolution	1 mm 0.04"				
	Zeroing accuracy	±0.1 mA (zero point = 4 mA)				
	F.S. accuracy	±0.2 mA (full scale = 20 mA)				
Environmental resistance	Operating ambient temperature	-30 to +60°C -22 to 140°F*5 (no freezing)	-30 to +60°C -22 to 140°F*5 (no freezing)	Barrier: -30 to +60°C -22 to 140°F (no freezing)		
	Temperature of coupling used	-30 to +85°C -22 to 185°F (no freezing)				
	Operating ambient humidity	Up to 85% RH (no condensation)				
	Vibration resistance	10 to 500 Hz; Power spectral density: 0.816 G² X, Y and Z directions				
	Shock resistance	100 m/s² (10 G), 16 ms pulses, 1000 times each in X, Y and Z directions				
Enclosure rating		IP67 (IEC60529), Enclosure Type 4X (NEMA250)	IP67 (IEC60529), Enclosure Type 4X (NEMA250)	Barrier: Not specified	Barrier: Not specified	Explosion-proof enclosure : IP67 (IEC60529) Enclosure Type 4X (NEMA250)
Protection circuit		Reverse power connection protection, power supply surge protection, output short-circuit protection, output surge protection	Reverse power connection protection, power supply surge protection	Reverse power connection protection, power supply surge protection		
Power voltage		18.3 to 35 VDC. See separately for allowable load resistance based on the power voltage*6	18.3 to 35 VDC. See separately for allowable load resistance based on the power voltage*6	24 VDC +25%/-10%	20.1 to 28 VDC*6	
Power consumption (including analog output; excluding load current)		752.5 mW or less	752.5 mW or less	3 W or less	602 mW or less	602 mW or less
Weight		Approx. 920 g 32.45 oz	Approx. 920 g 32.45 oz	Barrier: Approx. 320 g 11.28 oz	Barrier: Approx. 100 g 3.52 oz	Flameproof enclosure + barrier (without cable glands): Approx. 1300 g 45.85 oz

*1 Guaranteed value in water with the recommended installation. In still water, measurement is possible with water up to the edge of the lens. An undetectable area is present at short range owing to the environment and measurement medium. The maximum measuring range is also reduced. *2 Measurement may not be possible depending on the environment and shape of the target. *3: Guaranteed value from verification performed at KEYENCE inspection facilities. Measurement errors may occur depending on the customer's environment. *4 Guaranteed value from verification performed at KEYENCE inspection facilities with a load resistance of 250 Ω. Measurement errors may occur depending on the customer's environment.

*5 Details of the operating temperature range are shown below.



*6 The allowable load resistance based on the power voltage of each model is as below.



*The FR Series uses 60 GHz wireless. Always follow the rules, conventions, regulations and laws of the country or region in which the device is used.

Explosion-Proof Specifications

IECEx

Model	2-wire explosion-proof model	2-wire explosion-proof model (when using an Isolated barrier)	2-wire explosion-proof model (when using a Zener barrier)	2-wire explosion-proof model (when using a Zener barrier with a flameproof enclosure)
	FR-LEX20L	**FR-LEXB41**	**FR-LEXB42**	**FR-LEXB43*1/LEXB44**
Explosion-proof performance	Ex ia IIC T4 Ga or Ex ia IIB T4 Ga Ex ia IIIC T135°C Da	[Ex ia Ga] IIC or [Ex ia Ga] IIB [Ex ia Da] IIIC	[Ex ia Ga] IIB [Ex ia Da] IIIC	Ex db [ia Ga] IIB T4 Gb Ex tb [ia Da] IIIC T135°C Db
Zone	Zone 0/20	Do not install in a hazardous location (associated apparatus*2)		Zone 1/21
Electrical ratings	Ui: 35 VDC Ii: 142.4 mA Pi: 1000 mW Li: 26.2 nH Ci: 79 nF	Um: 250 VRMS Uo: 26.78 VDC Io: 115.307 mA Po: 772 mW Lo (IIC): 0.2 mH Co (IIC): 0.092 µF Lo (IIB): 0.2 mH Co (IIB): 0.72 µF	Um: 250 VRMS Uo: 34.33 VDC Io: 112.007 mA Po: 961.3 mW Lo: 1.0 mH Co: 0.37 µF	
Temperature	-30°C -22°F ≤ Ta ≤ 60°C 140°F -30°C -22°F ≤ Tp ≤ 85°C 185°F	–	–	Explosion-proof enclosure: -30°C -22°F ≤ Ta ≤ 60°C 140°F

ATEX and UKEX

Model	2-wire explosion-proof model	2-wire explosion-proof model (when using an Isolated barrier)	2-wire explosion-proof model (when using a Zener barrier)	2-wire explosion-proof model (when using a Zener barrier with a flameproof enclosure)
	FR-LEX20L	**FR-LEXB41**	**FR-LEXB42**	**FR-LEXB44**
Explosion-proof performance	II 1 G Ex ia IIC T4 Ga or II 1 G Ex ia IIB T4 Ga II 1 D Ex ia IIIC T135°C Da	II (1) G [Ex ia Ga] IIC or II (1) G [Ex ia Ga] IIB II (1) D [Ex ia Da] IIIC	II (1) G [Ex ia Ga] IIB II (1) D [Ex ia Da] IIIC	II 2 (1) G Ex db [ia Ga] IIB T4 Gb II 2 (1) D Ex tb [ia Da] IIIC T135°C Db
Zone	Zone 0/20	Do not install in a hazardous location (associated apparatus*2)		Zone 1/21
Electrical ratings	Ui: 35 VDC Ii: 142.4 mA Pi: 1000 mW Li: 26.2 nH Ci: 79 nF	Um: 250 VRMS Uo: 26.78 VDC Io: 115.307 mA Po: 772 mW Lo (IIC): 0.2 mH Co (IIC): 0.092 µF Lo (IIB): 0.2 mH Co (IIB): 0.72 µF	Um: 250 VRMS Uo: 34.33 VDC Io: 112.007 mA Po: 961.3 mW Lo: 1.0 mH Co: 0.37 µF	
Temperature	-30°C -22°F ≤ Ta ≤ 60°C 140°F -30°C -22°F ≤ Tp ≤ 85°C 185°F	–	–	Explosion-proof enclosure: -30°C -22°F ≤ Ta ≤ 60°C 140°F

*1 FR-LEXB43 is Japan model. Contact your local KEYENCE representative for more details.
*2 Associated apparatus are devices that comprise both intrinsically safe and non-intrinsically safe circuits. The FR-LEX20L meets the requirements for intrinsically safe construction when used in conjunction with associated apparatus.

Type Approval of Electrical Equipment for Use in Explosive Atmospheres

Model	2-wire explosion-proof model	2-wire explosion-proof model (when using an Isolated barrier)	2-wire explosion-proof model (when using a Zener barrier)	2-wire explosion-proof model (when using a Zener barrier with a flameproof enclosure)
	FR-LEX20L	**FR-LEXB41**	**FR-LEXB42**	**FR-LEXB43**[*1]
Explosion-proof performance	Ex ia IIC T4 Ga or Ex ia IIB T4 Ga Ex ia IIIC T135°C Da	[Ex ia Ga] IIC or [Ex ia Ga] IIB [Ex ia Da] IIIC	[Ex ia Ga] IIB [Ex ia Da] IIIC	Ex db [ia Ga] IIB T4 Gb Ex tb [ia Da] IIIC T135°C Db
Zone	Zone 0/20	Do not install in a hazardous location (associated apparatus[*2])		Zone 1/21
Electrical ratings	Ui: 35 VDC Ii: 142.4 mA Pi: 1000 mW Li: 26.2 nH Ci: 79 nF	Um: 250 VRMS Uo: 26.78 VDC Io: 115.307 mA Po: 772 mW Lo (IIC): 0.2 mH Co (IIC): 0.092 µF Lo (IIB): 0.2 mH Co (IIB): 0.72 µF	Um: 250 VRMS Uo: 34.33 VDC Io: 112.007 mA Po: 961.3 mW Lo: 1.0 mH Co: 0.37 µF	
Temperature	-30°C -22°F ≤ Ta ≤ 60°C 140°F -30°C -22°F ≤ Tp ≤ 85°C 185°F	–	–	Explosion-proof enclosure: -30°C -22°F ≤ Ta ≤ 60°C 140°F

NRTL/ACO

Model	2-wire explosion-proof model	2-wire explosion-proof model (when using an Isolated barrier)	2-wire explosion-proof model (when using a Zener barrier)	2-wire explosion-proof model (when using a Zener barrier with a flameproof enclosure)
	FR-LEX20L	**FR-LEXB41**	**FR-LEXB42**	**FR-LEXB44**
Explosion-proof performance	Class I, Zone 0, AEx ia IIC T4 Ga/Zone 20, AEx ia IIIC T135°C Da/ Class I, Division 1, Groups A, B, C, D, T4/Class II, Division 1, Groups E, F, G, T135°C/Class III, Division 1 or Class I, Zone 0, AEx ia IIB T4 Ga/Zone 20, AEx ia IIIC T135°C Da/ Class I, Division 1, Groups C, D, T4/Class II, Division 1, Groups E, F, G, T135°C / Class III, Division 1	[AEx ia Ga] IIC or [AEx ia Ga] IIB/ [AEx ia Da] IIIC Intrinsically safe circuit for Class I, Division 1, Groups A, B, C, D or Class I, Division 1, Groups C, D/Class II, Division 1, Groups E, F, G/ Class III, Division 1	[AEx ia Ga] IIB/ [AEx ia Da] IIIC Intrinsically safe circuit for Class I, Division 1, Groups C, D/ Class II, Division 1, Groups E, F, G/ Class III, Division 1	Class I, Zone 1, AEx db [ia Ga] IIB T4 Gb/ Zone 21, AEx tb [ia Da] IIIC T135°C Db/ Class I, Division 1, Groups C, D, T4/ Class II, Division 1, Groups E, F, G, T135°C / Class III, Division 1
Zone/Division	Zone 0/20 Division 1	Do not install in a hazardous location (associated apparatus[*2])		Zone 1/21 Division 1
Electrical ratings	Ui: 35 VDC Ii: 142.4 mA Pi: 1000 mW Li: 26.2 nH Ci: 79 nF	Um: 250 VRMS Uo: 26.78 VDC Io: 115.307 mA Po: 772 mW Lo (IIC): 0.2 mH Co (IIC): 0.092 µF Lo (IIB): 0.2 mH Co (IIB): 0.72 µF	Um: 250 VRMS Uo: 34.33 VDC Io: 112.007 mA Po: 961.3 mW Lo: 1.0 mH Co: 0.37 µF	
Temperature	-30°C -22°F ≤ Ta ≤ 60°C 140°F -30°C -22°F ≤ Tp ≤ 85°C 185°F	–	–	Explosion-proof enclosure: -30°C -22°F ≤ Ta ≤ 60°C 140°F

*1 FR-LEXB43 is Japan model. Contact your local KEYENCE representative for more details. *2 Associated apparatus are devices that comprise both intrinsically safe and non-intrinsically safe circuits. The FR-LEX20L meets the requirements for intrinsically safe construction when used in conjunction with associated apparatus.

MP-FEN1 Ethernet Module

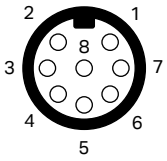
Model		MP-FEN1
Ethernet specifications	Compliant standard	IEEE802.3u (100BASE-TX)
	Transmission rate	100 Mbps (100BASE-TX)
	Transmission media	Category 5 or higher STP (shielded twisted pair)
	Connector type	M12, 4-pin, female, D-code
	Maximum cable length	100 m 328.1' (between nodes)
	Supported networks	EtherNet/IP®, PROFINET, Modbus/TCP, MC protocol/SLMP
Number of connectible models/units	When connected to the FR Series	FR: 1
EtherNet/IP®	Supported functions	Cyclic communication (Implicit messaging) Message communication (Explicit messaging)
	Number of connections	16
	Supported connections	Input Only, Exclusive Owner
	RPI (communication cycle)	4 to 10,000 ms
PROFINET	Compatible network	PROFINET IO communication
	Supported functions	Cyclic communication (data I/O communication) Acyclic communication (record data communication)
	Conformance class	Compliant with Conformance Class B
	Conformance test version	Compliant with ver. 2.42
	Applicable protocols	LLDP, SNMP, DCP
	Net load	Class 2
	Cyclic update time	4 to 2048 ms
MODBUS/TCP	Communication method	TCP/IP
	Compatible configuration	Server
	Maximum number of simultaneous client connections	4
MC protocol/ SLMP	Communication method	TCP/IP, UDP/IP
	Maximum number of connections	4
	Compatible frames	QnA-compatible 3E frame, 4E frame
	Data format	Binary/ASCII
Power supply specifications	Connector type	M12, 4 pins, A-code, cable length: 50 cm 19.69"
	Power supply voltage	24 VDC +25%/-20% (including ripple), Class 2 or LPS
	Current consumption	40 mA *1
Environmental resistance	Enclosure rating	IP67 (IEC60529)
	Ambient temperature	−20 to 60°C -4 to +140°F
	Ambient humidity	35%RH to 85%RH (no condensation)
	Vibration resistance	10 to 500 Hz; power spectral density: 0.816 G^2/Hz; X, Y, and Z directions
	Shock resistance	100 m/s^2, XYZ axes, 1000 times for each axis
Material		Case: PBT/PAR Connector: Nickel-plated brass
Weight		Approx. 150 g 5.29 oz

*1 When connecting to the FD-R Series: 190 mA max.

Pin layout/Cable wire color

Short range standard model, long range standard model/liquid chemical model/sanitary model

Connector pin layout for power cable



Pin No.	Wire color	Description
1	White	Analog output
2	Brown	24 VDC power supply
3	Green	Control output 3
4	Yellow	Control output 4
5	Grey	Control output 1
6	Pink	Control output 2*1
7	Blue	0 V
8	Red	Control output 5/ External Input*2

*1 IO-Link compatible wire when connected to IO-Link devices
*2 Short range only

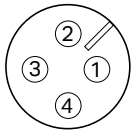
Short range amplifier unit

Cable type (**FR-SA1/SA2**)

Wiring colors	Description
White*	Analog output
Brown*	24 VDC power supply
Green	Control output 3
Yellow	Control output 4
Grey	Control output 1
Pink	Control output 2
Blue*	0 V
Red	Control output 5/ External Input

* FR-SA1 only

M8 Connector Type (**FR-SA1C**)

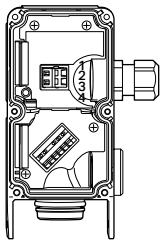


Pin No.	Wire color	Description
1	Brown	24 VDC power supply
2	White	Control output 2/ external input/ analog output
3	Blue	0 V
4	Black	Control output 1*

* IO-Link compatible wire when connected to IO-Link devices

Long-range 2-wire standard model/2-wire explosion-proof model

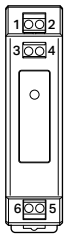
Sensor Unit



Terminal number	Function
1	4-20 mA (+)
2	4-20 mA (–)
3*	OUT (+)
4*	OUT (–)

*2-wire standard model only

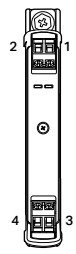
Isolated Barrier



Terminal number	Function
1	POWER (+)
2	POWER (–)
3	4-20 mA (+)
4	4-20 mA (–)

Terminal number	Function
5	SENSOR (–)
6	SENSOR (+)

Zener Barrier



Terminal number	Function
1	4-20 mA (+)
2	4-20 mA (–)

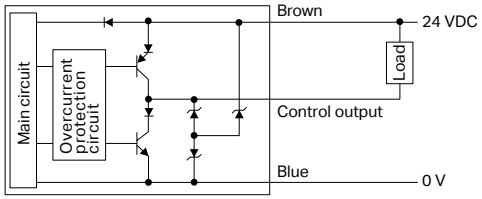
Terminal number	Function
3	SENSOR (+)
4	SENSOR (–)

I/O Circuit Diagrams

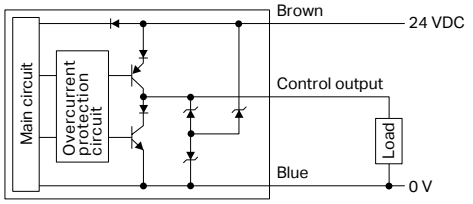
Short-range standard model/Compact liquid chemical model/Long-range standard model/Liquid chemical model/Sanitary model

Control output

When NPN is selected

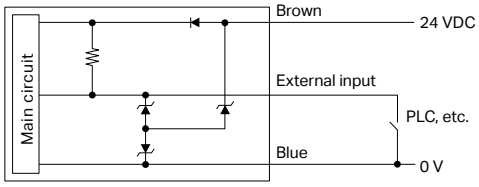


When PNP is selected

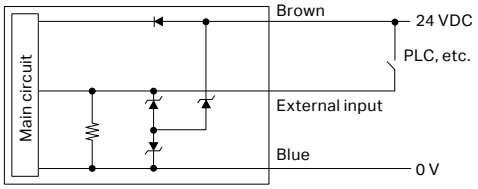


External input

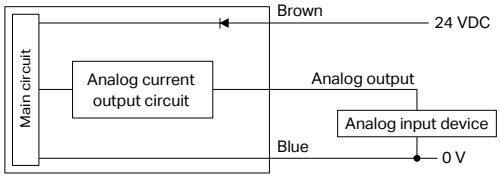
When NPN is selected



When PNP is selected

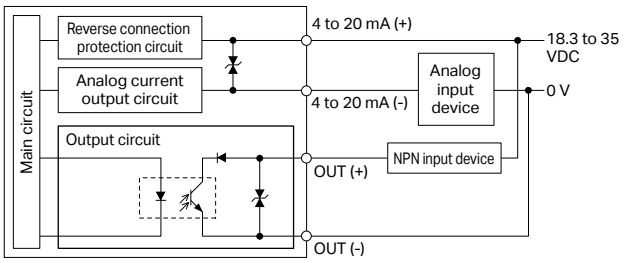


Analog output

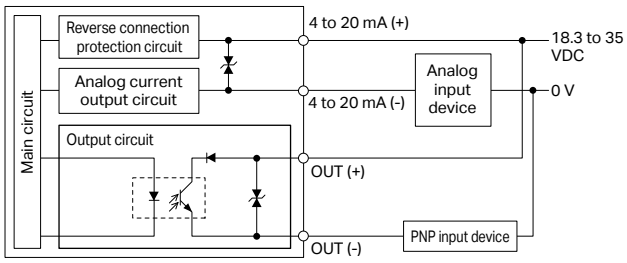


Long-range 2-wire standard model

With NPN input device connected

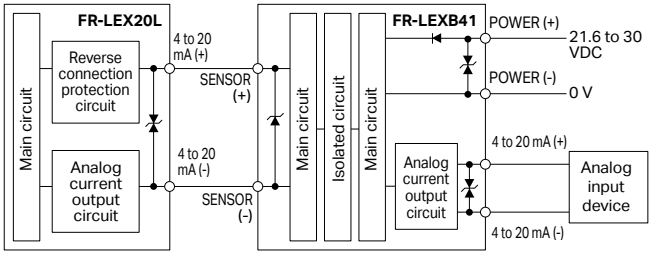


With PNP input device connected

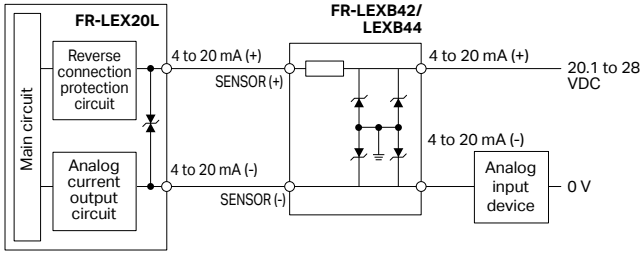


Long-range 2-wire explosion-proof model

When using FR-LEXB41



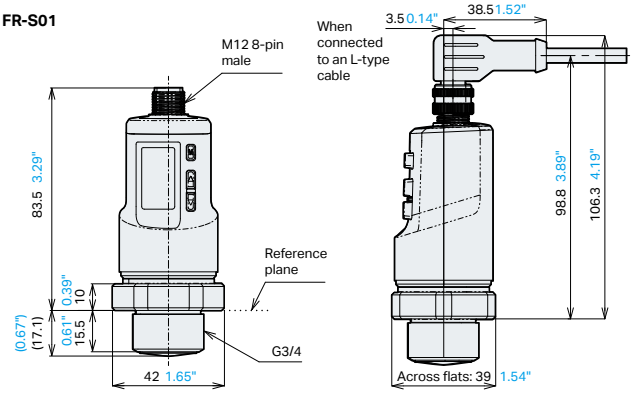
When using FR-LEXB42/LEXB44



Short range

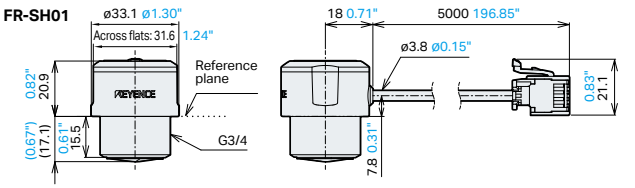
Short range sensor main unit with integrated display Standard

FR-S01

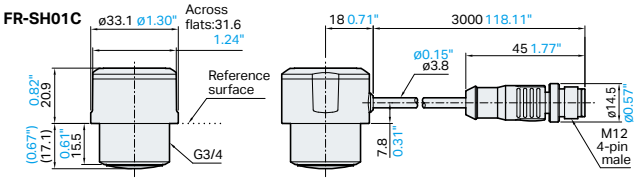


Short range sensor head with separate display Compact liquid chemical

FR-SH01

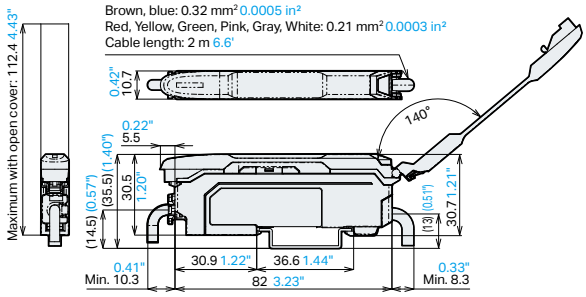


FR-SH01C

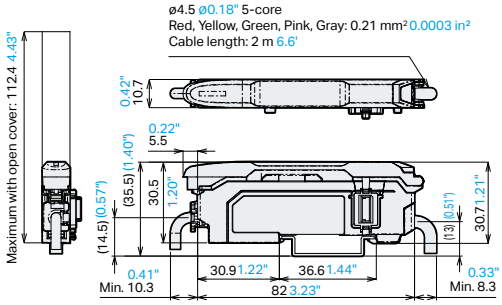


Short range amplifier unit with separate display Standard Compact liquid chemical

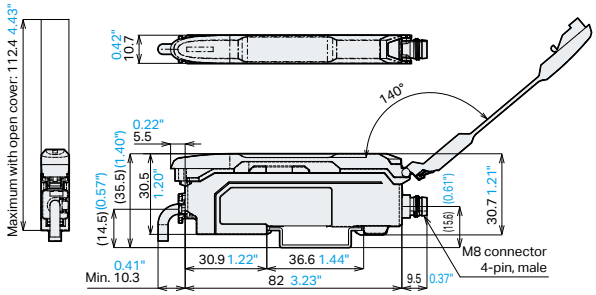
FR-SA1 Main Unit (Cable Type)



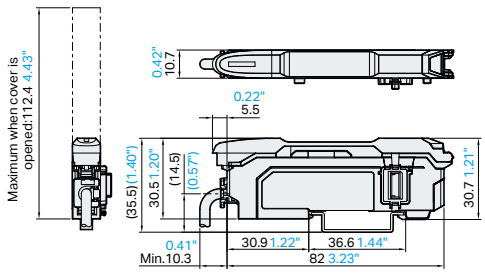
FR-SA2 Expansion Unit (Cable Type)



FR-SA1C Main Unit (M8 Connector Type)

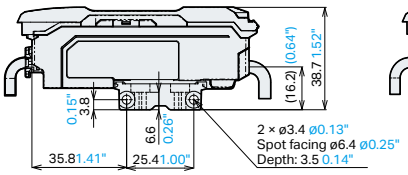


FR-SA0

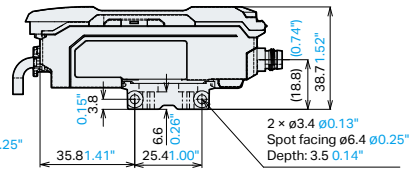


With removable display amplifier securing bracket mounted (when using separately sold option OP-88245) Standard Compact liquid chemical

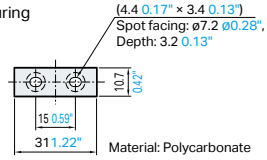
Cable Type

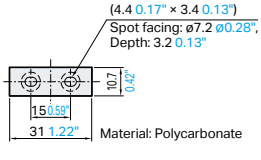


M8 Connector Type



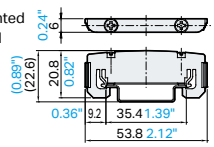
Amplifier securing bracket rear



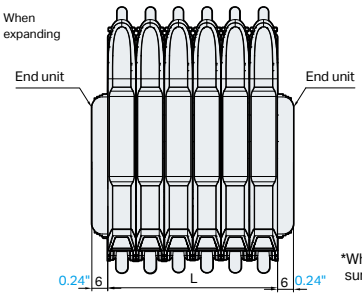


End unit (Separately sold option **OP-26751**)

When mounted on a DIN rail



When expanding

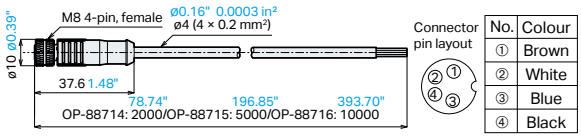


Total units	L (mm inch)
1	10.7 0.42"
2	21.4 0.84"
3	32.1 1.26"
4	42.8 1.69"
5	53.5 2.11"
6	64.2 2.53"
7	74.9 2.95"
8	85.6 3.37"
9	96.3 3.79"

*When using expansion units, be sure to use an end unit.(Options)

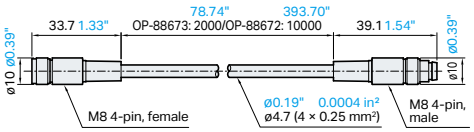
Power supply cable for removable display amplifier Standard Compact liquid chemical

M8-4-pin cable straight loose wire
OP-88714/ 88715/ 88716



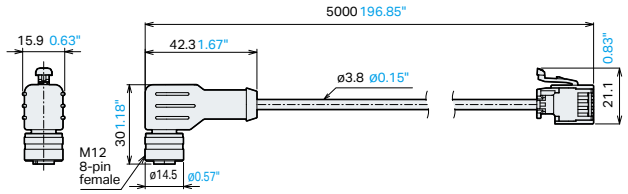
No.	Colour
①	Brown
②	White
③	Blue
④	Black

M8-4pin cable straight to straight
OP-88673/ 88672

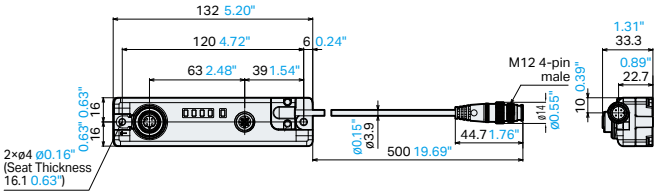


Short range cable for removable display (head to amplifier) Standard

FR-SS5

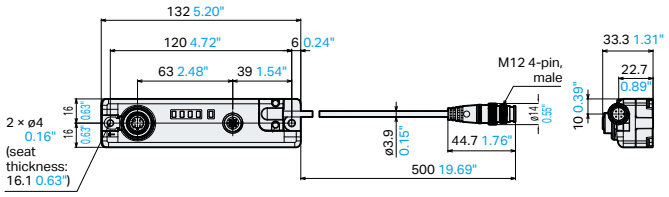


Ethernet Module



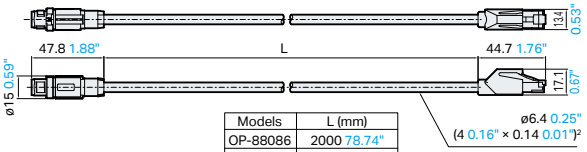
Ethernet Module Main Unit

MP-FEN1



Ethernet Cable

OP-88086/88087/88088

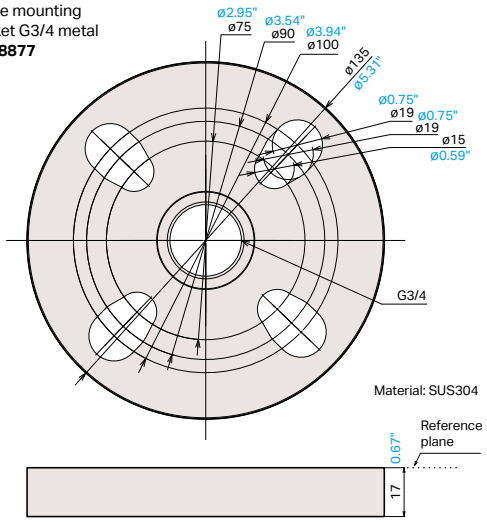


Models	L (mm)
OP-88086	2000 78.74"
OP-88087	5000 196.85"
OP-88088	10000 393.70"

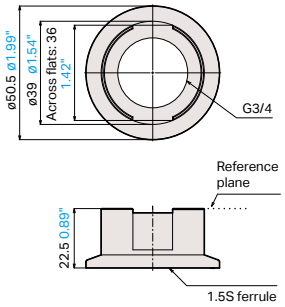
Short range

Short-range mounting brackets Standard Compact liquid chemical

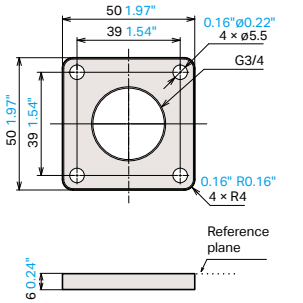
Flange mounting bracket G3/4 metal
OP-88877



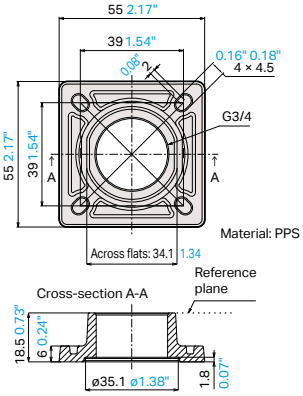
1.5S ferrule mounting bracket
OP-88878



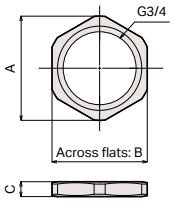
General-purpose mounting bracket G3/4 Metal
OP-88872



General-purpose mounting bracket G3/4 Plastic
OP-88874

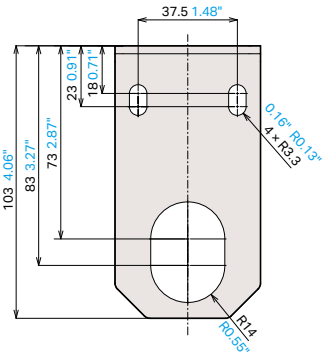


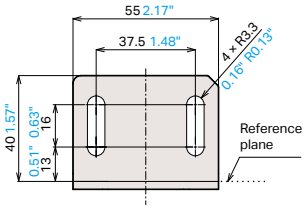
Nut G3/4 metal **OP-87642**
Nut G3/4 plastic **OP-88876**



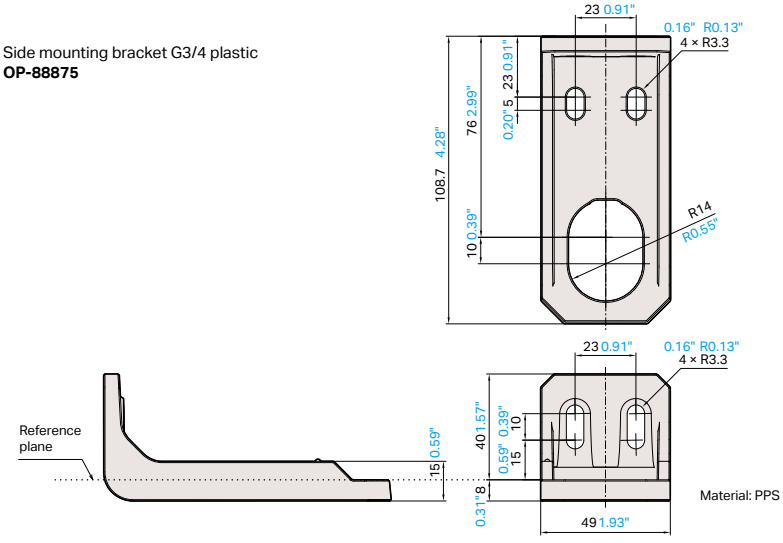
Model	OP-87642	OP-88876
A	35 1.38"	36 1.42"
B	32 1.26"	33 1.30"
C	5 0.20"	7 0.28"
Material	SUS303	PPS

Side mounting bracket G3/4 metal
OP-88873

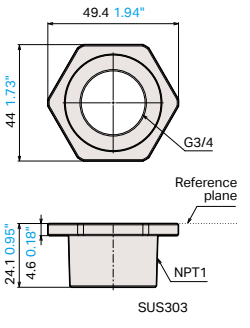




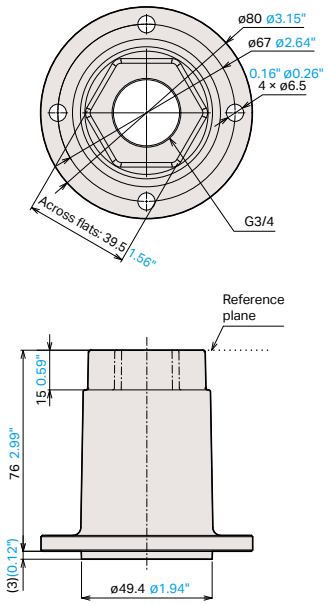
Side mounting bracket G3/4 plastic
OP-88875



NPT mounting bracket
OP-88879

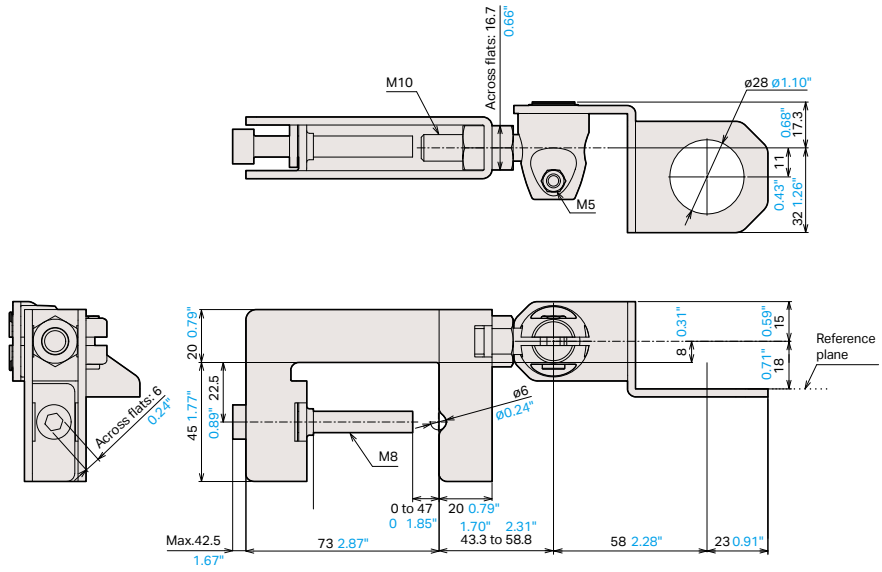


Offset mounting bracket **FR-SB31**



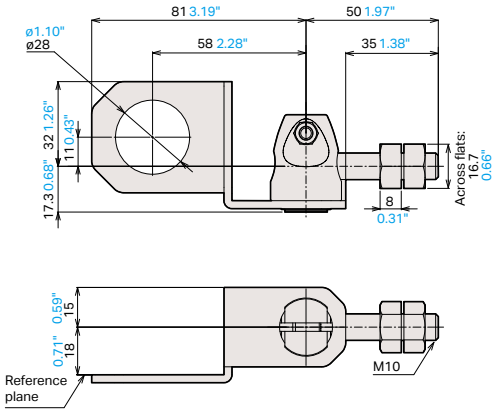
Material: Aluminium die-casting

Clamp mounting bracket **FR-SB32**



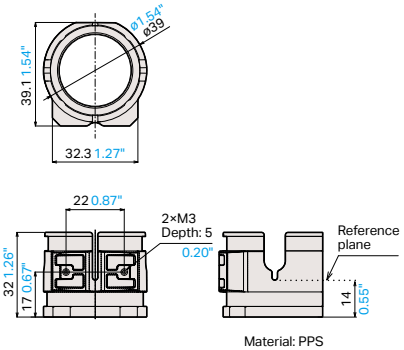
Material: SUS304 (t=3 0.12"), zinc die-cast nickel plating and iron nickel plating

Adjustable mounting bracket **FR-SB33**



Material: SUS304 (t=3 0.12"), zinc die-cast nickel plating and iron nickel plating

Space-saving mounting bracket **FR-SB34**

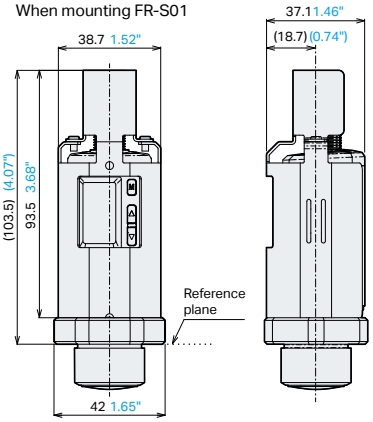


Material: PPS

Protective cover Standard

Protective cover for short range sensor main unit with integrated display
FR-SP1

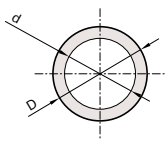
When mounting FR-S01



Material: SUS304
t=1 0.04"

Gasket Standard Compact liquid chemical

Gasket G3/4
Inorganic fiber + oil-resistant rubber: **OP-87548**
FKM: **OP-87562**

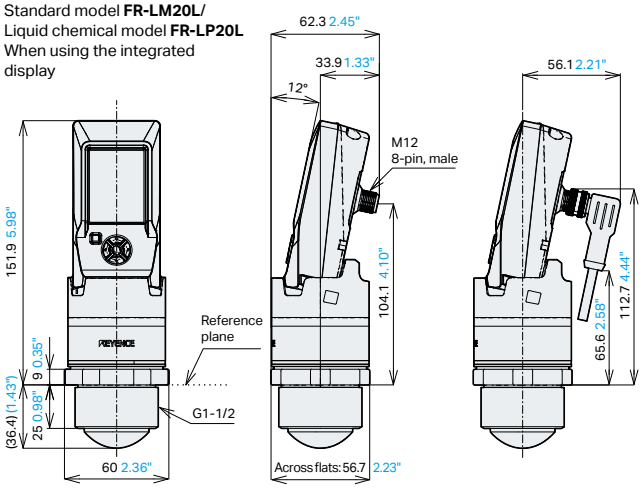


Model	D	d	t
OP-87548	ø36 ø1.42"	ø26.8 ø1.06"	t = 1.5 0.06"
OP-87562	ø35.6 ø1.40"	ø26.8 ø1.06"	t = 2 0.08"

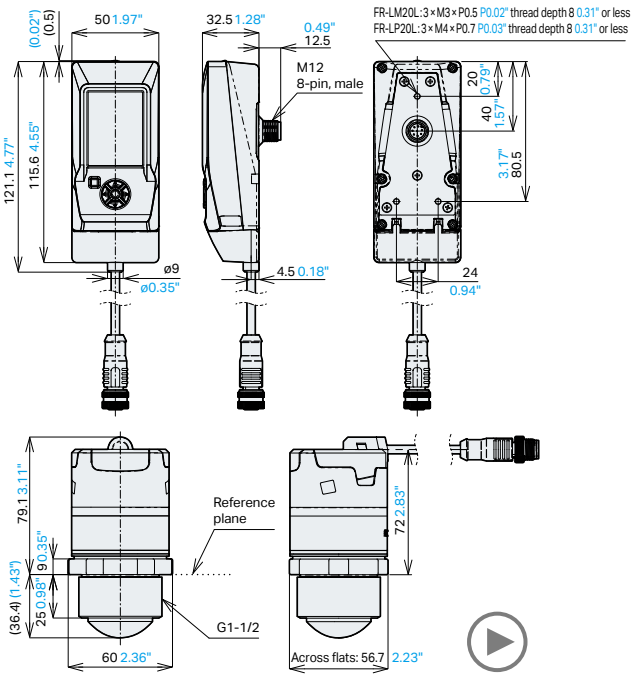
Long range

Long range Sensor main unit Standard Liquid chemicals

Standard model **FR-LM20L**/
Liquid chemical model **FR-LP20L**
When using the integrated display

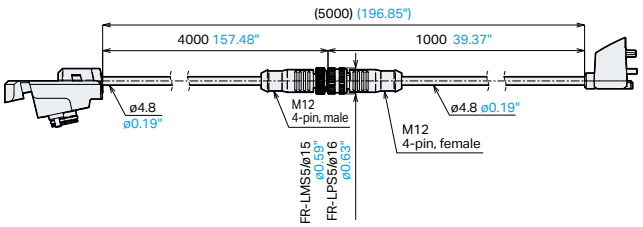


Using removable display with cable attached



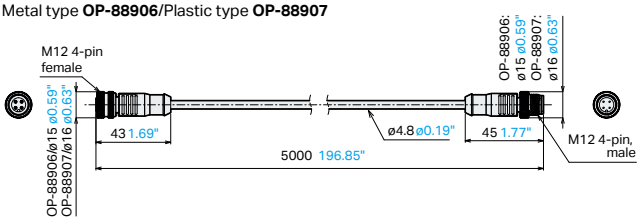
Long range Display isolated cable (head to amplifier) Standard Liquid chemicals

Metal type **FR-LMS5**/Plastic type **FR-LPS5**



Long range Display isolated extension cable Standard Liquid chemicals

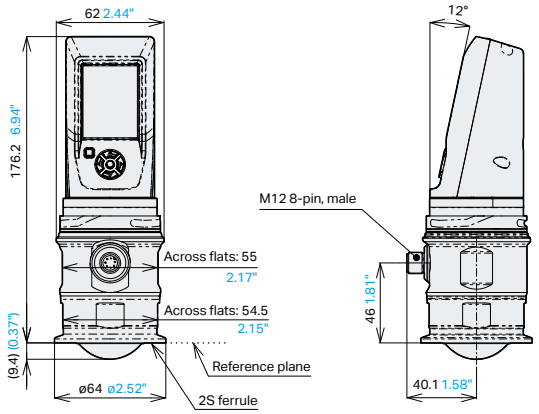
Metal type **OP-88906**/Plastic type **OP-88907**



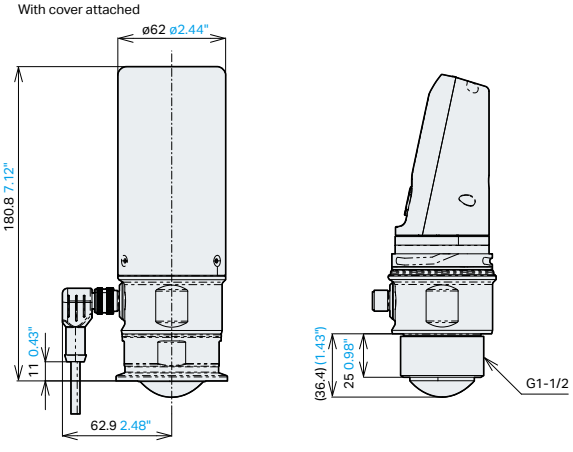
Long range Sensor main unit Sanitary model Sanitary

FR-LS20L

With OP-88888/88889 attached



With cover attached

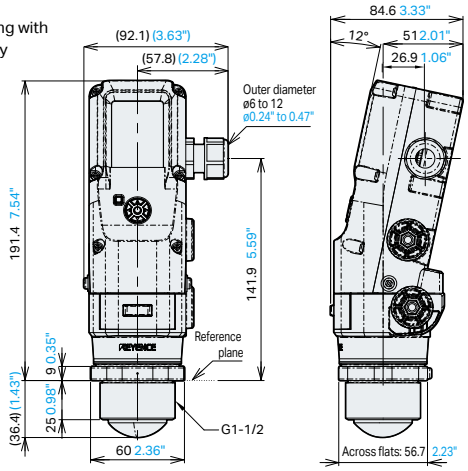


Long-range sensor main unit 2-wire type

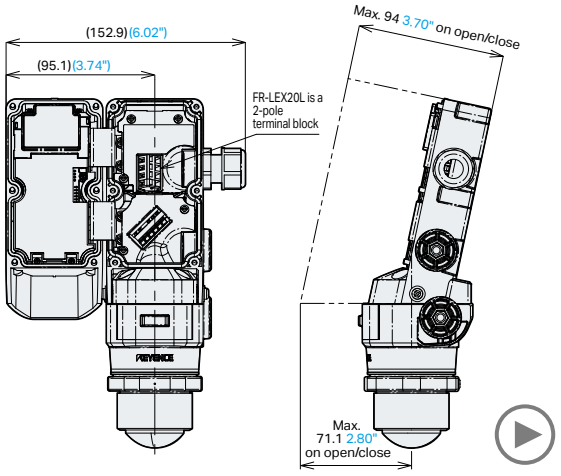
2-wire standard model | 2-wire explosion-proof model

2-wire standard model **FR-LW20L** / 2-wire explosion-proof model **FR-LEX20L**

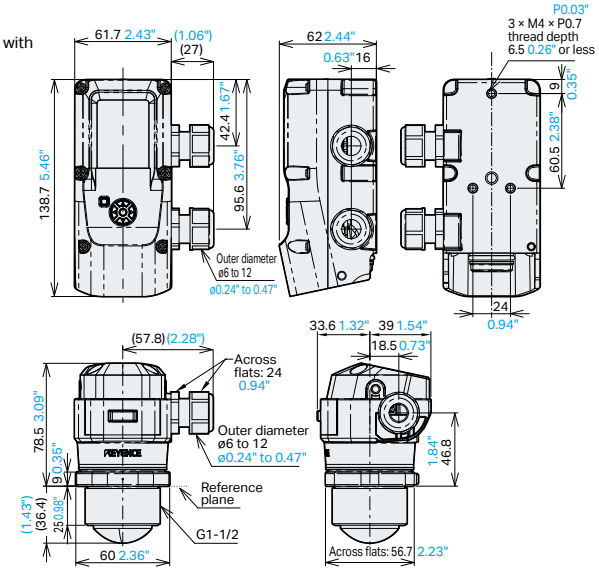
When using with the display attached



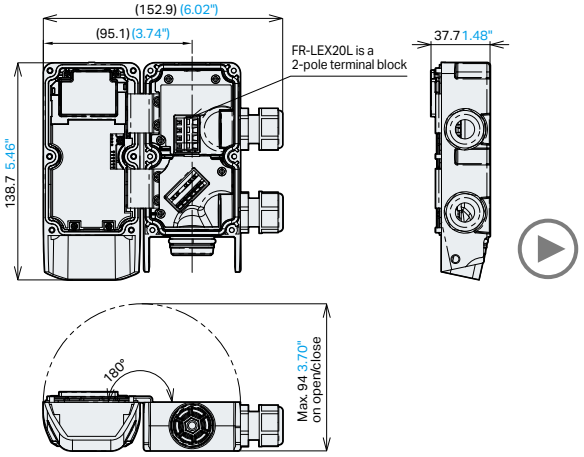
Display open



When using with the display detached



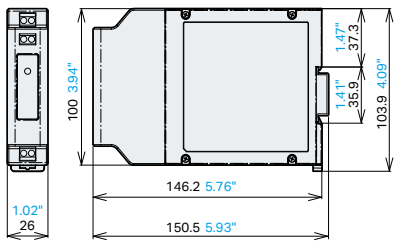
Display open



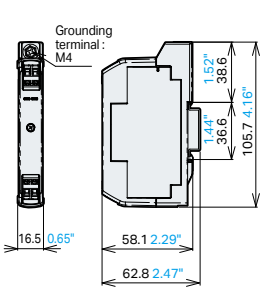
Long-range 2-wire explosion-proof model

2-wire explosion-proof model

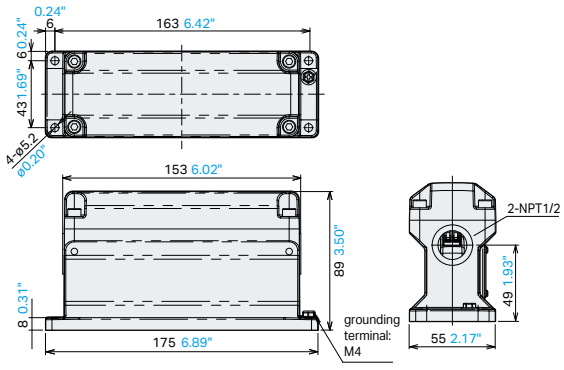
Isolated barrier **FR-LEXB41**



Zener Barrier **FR-LEXB42**



Flameproof Enclosure-Equipped Zener Barrier **FR-LEXB44**



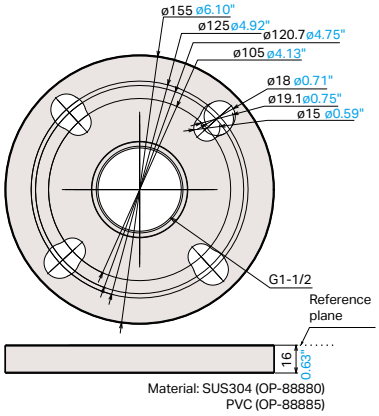
Long range

Mounts for long range

Standard | Liquid chemicals | 2-wire standard model | 2-wire explosion-proof model

Flange mounting bracket JIS5K/10K 50A equivalent, metal **OP-88880**

Flange mounting bracket JIS5K/10K 50A equivalent, plastic **OP-88885**

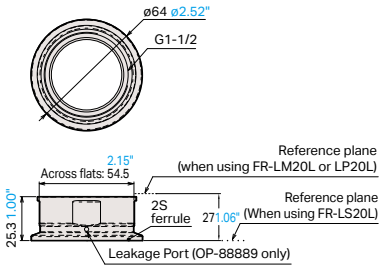


Material: SUS304 (OP-88880)
PVC (OP-88885)

2S Ferrule mounting bracket

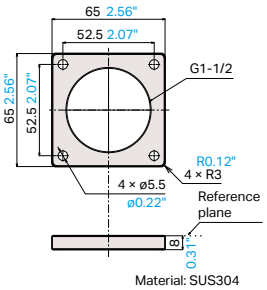
Standard | Liquid chemicals | Sanitary | 2-wire standard model | 2-wire explosion-proof model

OP-88888/88889



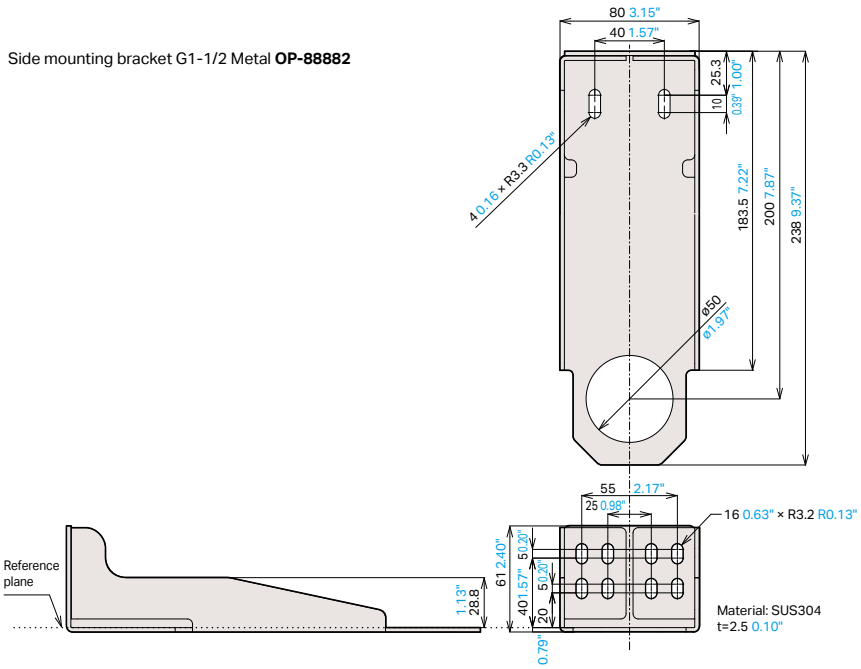
Material: SUS316L

General-purpose mounting bracket G1-1/2 Metal **OP-88881**

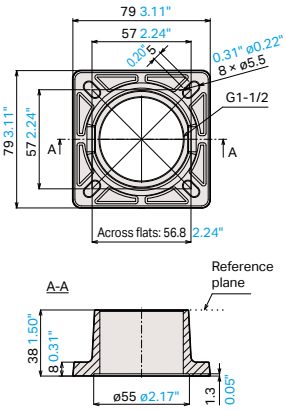


Material: SUS304

Side mounting bracket G1-1/2 Metal **OP-88882**

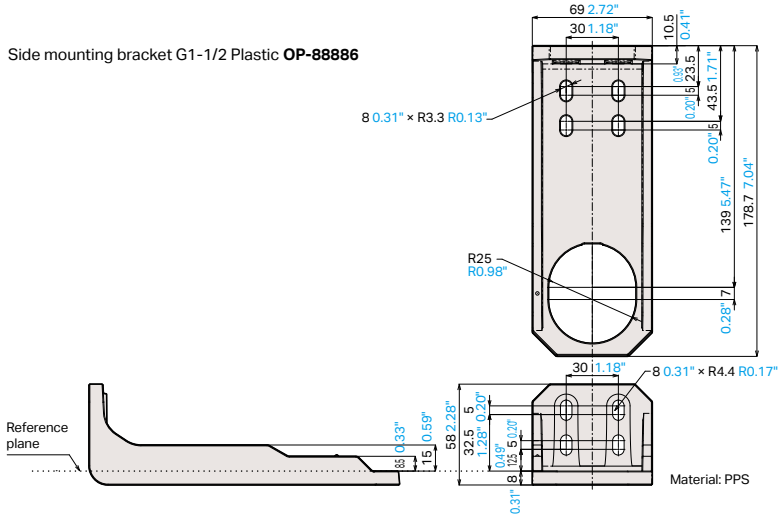


General-purpose mounting bracket G1-1/2 Plastic **OP-88919**



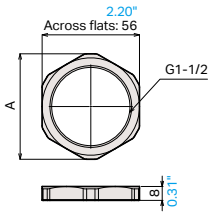
Material: PPS

Side mounting bracket G1-1/2 Plastic **OP-88886**



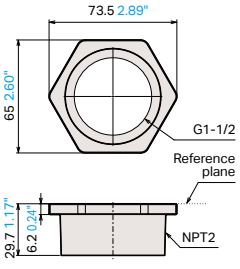
Material: PPS

Nut G1-1/2 Metal **OP-88883**
Nut G1-1/2 Plastic **OP-88887**



Model	OP-88883	OP-88887
A	60.7 2.390"	60.6 2.386"
Material	SUS304	PPS

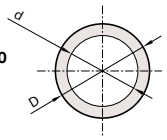
NPT mounting bracket **OP-88884**



SUS303

Gasket Standard Liquid chemicals 2-wire standard model 2-wire explosion-proof model

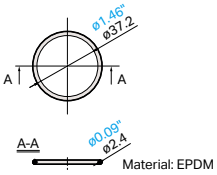
Gasket G1-1/2
Inorganic fiber +
oil-resistant rubber: **OP-88890**
FKM: **OP-88891**
FFKM: **OP-88892**



Model	D	d	t
OP-88890	ø54.5 ø2.15"	ø48.3 ø1.90"	t = 1.5 0.06"
OP-88891	ø54.1 ø2.13"	ø48.3 ø1.90"	t = 1.5 0.06"
OP-88892	ø54.1 ø2.13"	ø48.3 ø1.90"	t = 1.5 0.06"

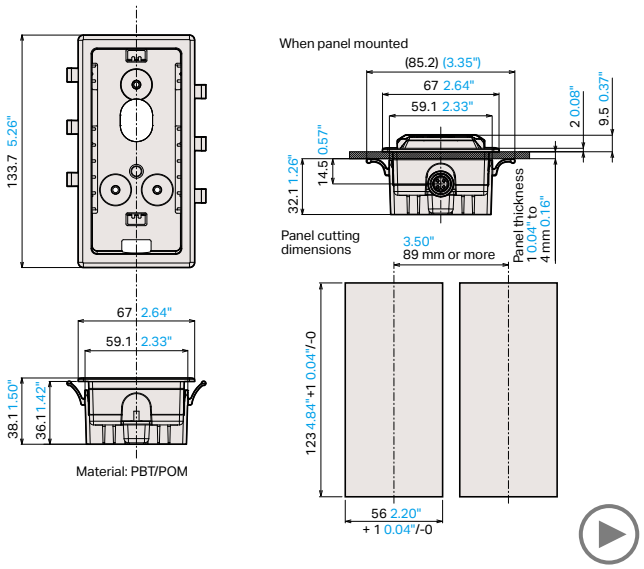
Gasket Standard Liquid chemicals Sanitary 2-wire standard model 2-wire explosion-proof model

Long-range sanitary gasket
OP-88920



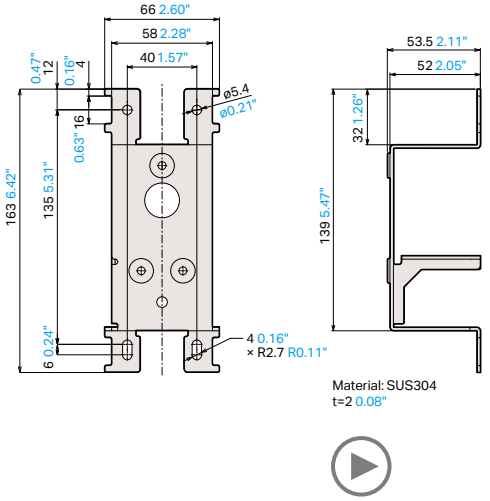
Display unit mounting bracket when using separate long-range display

Display unit panel mounting bracket **FR-LB1** Standard Liquid chemicals



Display unit rear mounting bracket **FR-LB2**

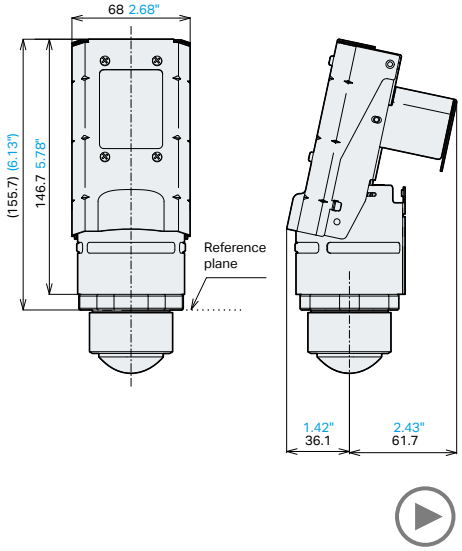
Standard Liquid chemicals 2-wire standard model 2-wire explosion-proof model



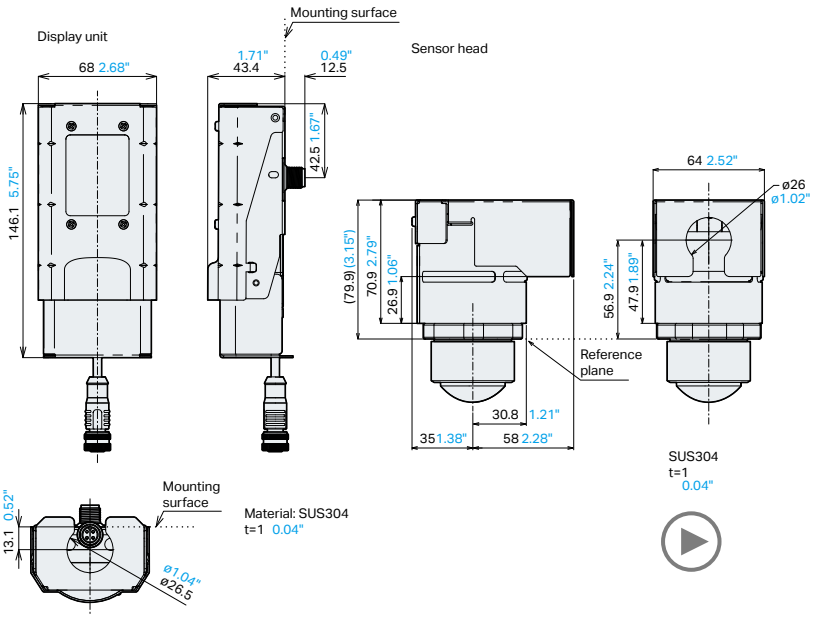
Long-range protection cover Standard Liquid chemicals

Protection cover **FR-LMP1**

With protective cover attached when using integral display unit



With protective cover attached when using separate display

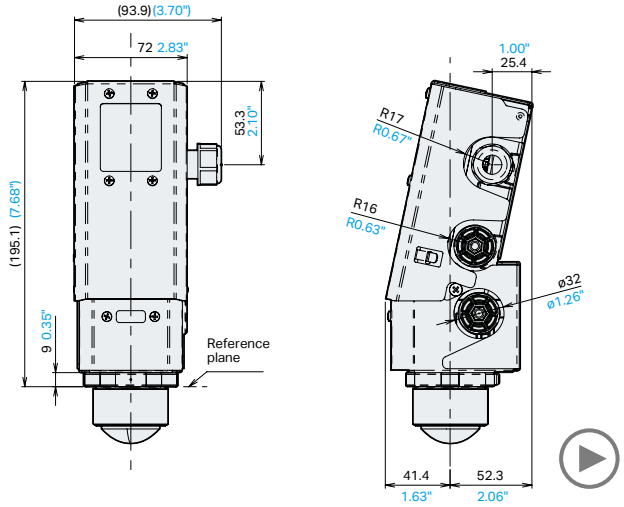


Long range

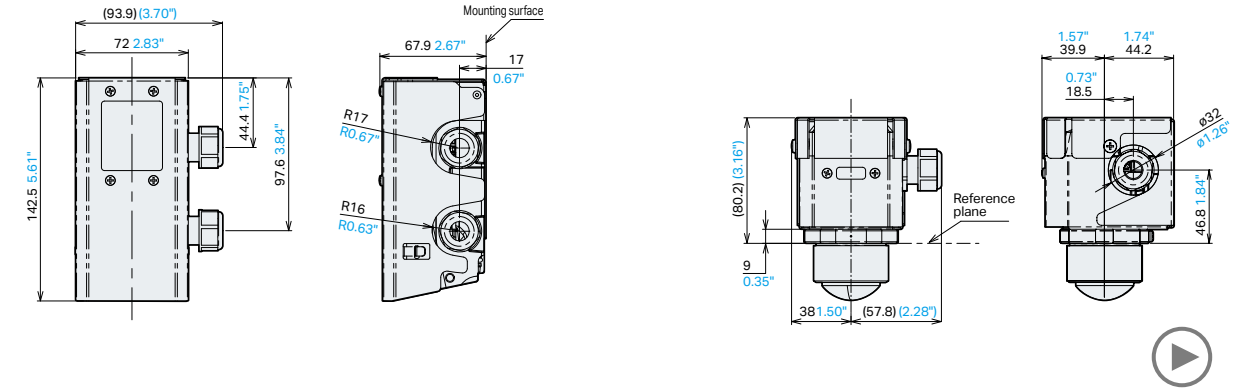
Long-range protection cover 2-wire standard model 2-wire explosion-proof model

Protection cover **FR-LEXP1**

With protective cover installed when using with display attached



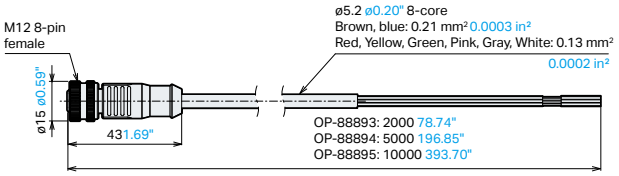
With protective cover installed when using with display detached



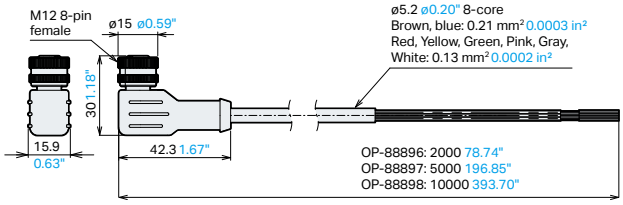
Short range/long range

Power supply cable (standard) Standard Liquid chemicals Sanitary

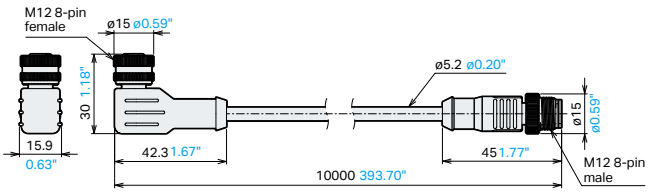
M12-8pin standard loose wire cable Straight **OP-88893/88894/88895**



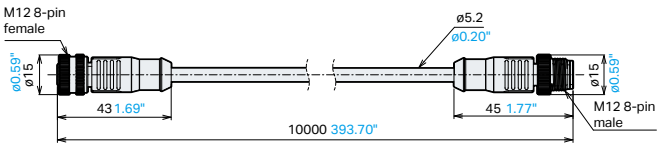
M12-8pin standard loose wire cable L-Shape **OP-88896/88897/88898**



M12-8pin extension cable L-Shape - Straight **OP-88903**

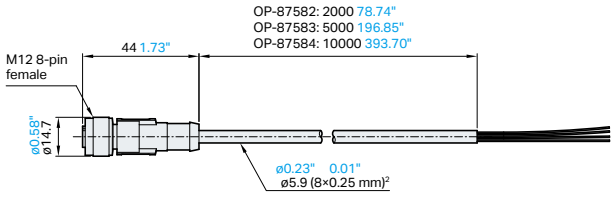


M12-8pin extension cable Straight to Straight **OP-88904**

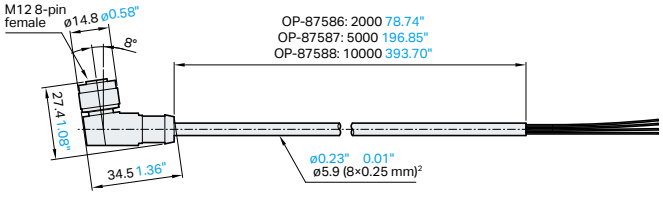


Power supply cable (oil resistant) Standard Liquid chemicals Sanitary

M12-8pin Oil-resistant loose wire cable Straight **OP-87582/87583/87584**

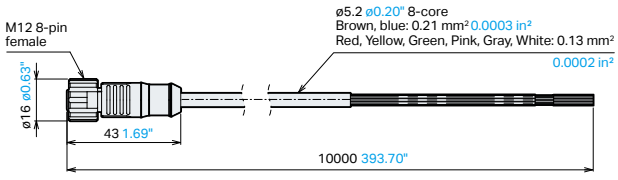


M12-8pin Oil-resistant loose wire cable L-Shape **OP-87586/87587/87588**

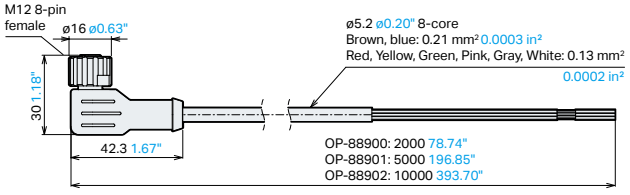


Power supply cable (chemical resistant) Standard Liquid chemicals Sanitary

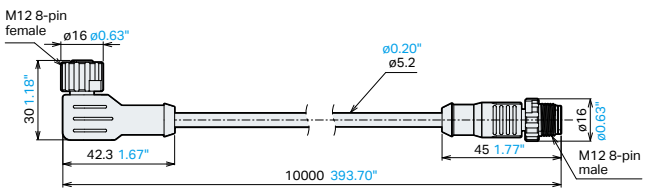
M12-8pin Chemical-resistant loose wire cable Straight **OP-88899**



M12-8pin Chemical-resistant loose wire cable L-Shape **OP-88900/88901/88902**



M12-8pin extension cable L-Shape - Straight **OP-88905**



Pin layout for
M12 8-pin
female connector

Pin layout

Pin No.	Colour
1	White
2	Brown
3	Green
4	Yellow
5	Grey
6	Pink
7	Blue
8	Red

Who Gets Involved With Sensors and Safety Equipment?

SENSORS

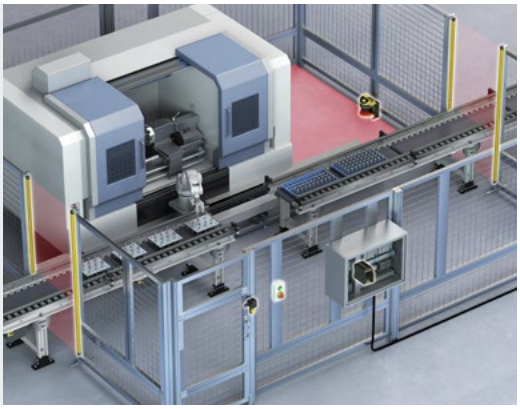
Detect Anything In Any Environment

- Presence/Absence Detection
- Position Confirmation
- Color/Appearance Verification

SAFETY

Ensure Safety In and Around Your Machines

- Access Protection
- Area Protection
- Entrance Monitoring/ Control



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