

Radar level sensor

FR Series Long Range 2-

wire Standard Model

(FR-LW20(L)) instruction

Manual

For details on the functions of the FR series and specific usage methods, see the "FR Series User's Manual." If you do not have the "FR Series User's Manual," download it from the Keyence website. Alternatively, contact your nearest sales office. <Keyence website> www.keyence.co.jp

Please read this instruction manual before use. After reading, keep it in a safe place for future reference.

How to read the symbols

In this instruction manual, the following symbols are used to make important information clear at a glance. Please be sure to read them.

	Failure to follow the instructions described here may result in injury or death. Failure to follow the instructions described here
	may result in injury or death. Failure to follow the instructions described here may result in injury or death. Failure to follow the instructions
	described here may result in injury or death. Failure to follow the instructions described here may result in damage to the product itself (your own
	damage) as well as damage to other property.

	This indicates caution regarding operations that must be performed.
	This indicates caution regarding operations that are easy to make mistakes with.
	Indicates matters that will deepen your understanding of the text or information that is useful to know.

For your safety

y General precautions

	• Do not use this product to protect the human body or any part of the human body. • This product is not designed for use in explosion-proof areas, so never use it in explosion-proof areas. • Do not use this product in applications where the operating state of the product may cause serious injury to people or property (power plants, aviation, railways, ships, vehicles, medical equipment, recreational toys, etc.).
	• Do not use the FR-SH01(C) in applications where leaching is a concern (beverages, food, medical use, etc.). When using the FR-LP(H)20(L) in applications where leaching is a concern (beverages, food, medical use, etc.), be sure to use the ferrule attachment tool (OP-88888). • If this product is not used in accordance with our specifications, the product's protection may not function effectively. • When installing this product, perform a risk assessment of the entire system and confirm that appropriate risk reduction has been implemented. To ensure that the entire system operates safely even in the event of an abnormality, provide appropriate protective measures without using this product.
	• At the time of starting or operating, the functions and performance of our products are operating normally. Please make sure that it is installed before using it. • In the unlikely event that our product breaks down, please take sufficient safety measures to prevent various damages.
	• Clean the sanitary model (FR-LS20(L)) before use. • When using our products in combination with other equipment, the product may not function and perform to its full potential depending on the usage conditions and environment, so please consider this before use. • When using this product in acidic or alkaline media, in a sanitary environment, or for applications such as electroplating, check the resistance of the sensor material to the media.

y Notes on media

	If conductive components in the medium adhere to the bottom of the unit, the measured value may exceed the upper limit. Clean the bottom of the unit to remove any attached material.
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y Handling precautions

	• When detecting high-temperature liquid, the metal parts of the product may also become hot and cause burns. Do not touch the metal parts during operation. • Do not touch the threads on the main body as they are sharp.
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y Installation precautions

	To prevent accidents, avoid installing the product in the following locations: • Locations where the product is subjected to vibrations or shocks that exceed its environmental resistance • Locations where the ambient temperature is outside the range of the ambient temperature for use • Locations where the humidity around the product is not 85% RH or less (no condensation) • Locations with sudden temperature changes • Locations where there are volatile flammable substances, solvents or corrosive gases • Locations where strong magnetic or electric fields are generated
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	To improve noise resistance, consider the following points when installing the product. It may cause malfunction. • When using I/O-Link, keep the power cable length to 20m or less. • Install the product as far away as possible from power lines. • Keep the product away from devices that generate strong electric or magnetic fields (solenoids, choppers, etc.). Please install them as far apart as possible. • Input/output signal lines should be routed separately from power lines and high voltage lines. Power supply • Noise superimposed on the power supply may cause the unit to malfunction. Use a DC stabilized power supply that uses an isolation Ground the terminal. If the recommended installation conditions described in this manual are not followed, detection may not be stable there is.
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Notes on regulations and standards y About CE and

UKCA marking We have confirmed that this product meets the essential requirements of EU directives and UK regulations based on the following requirements. If you use this product in EU countries or the UK, please bear in mind the following requirements.

y RE Directive (CE) and Radio Equipment Regulations (UKCA)

•Operating frequency: 58 - 63GHz •Maximum
wireless output: FR-S(H)01(C): -12.81dBm (0.05mW)
FR-LM(H)20(LP)(H)20/LS20/LW20/LEX20: -5.89dBm (0.26mW)
FR-LM(H)20(LP)(H)20/LS20/LW20/LEX20L: -17.36dBm (0.018mW) These requirements do not guarantee that the entire machinery incorporating this product satisfies the essential requirements of the RE Directive and the Radio Equipment Regulations. It is the responsibility of the manufacturer of the machinery to verify the conformity of the entire machinery.

y About CSA certification This product complies with the following CSA and UL standards and has been CSA certified. • Applicable standards CAN/CSA C22.2 No.61010-1 UL61010-1

When using this product as a CSA certified product, please note the following requirements. •

Overvoltage category

I • Pollution degree 3 (FR-S(H)01(C)/SA1/SA2/SA1C/SA0/LS20(L)) • Pollution degree 4 (FR-LM(H)20(L)/LP(H)20(L)) • Install at an altitude of 5000m or less. • Install in accordance with the CEC (Canadian Electrical Code), (NEC (National Electrical Code) and other local regulations. In addition, use a CSA/UL Listed certified power supply with Class 2 output as specified in the CEC and NEC.

y Wireless Precautions • The FR

series uses the 60 GHz band. • Be sure to use the FR series in accordance with the rules, regulations, and laws of the country or region in which it is used. please.
• When used near devices that use the same frequency band as this unit, such as wireless LAN devices, microwave ovens, industrial heating equipment, and medical high-frequency equipment, radio interference may occur, causing the measurement speed to slow down or making it impossible to perform measurements. • In the frequency band used by this unit, in addition to industrial, scientific, and medical equipment, indoor radio stations (radio stations requiring a license) for mobile identification, specific low-power radio stations (radio stations not requiring a license), and amateur radio stations (radio stations requiring a license) are operated, which are used in factory production lines, etc. 1. Before using this unit, make sure that indoor radio stations for mobile identification, specific low-power radio stations, and amateur radio stations are not operating nearby. 2. In the unlikely event that radio interference occurs between this unit and indoor radio stations for mobile identification, immediately change the frequency used or stop emitting radio waves, and contact the following contact information to discuss measures to avoid interference (for example, installing a partition, etc.).
3. If you experience any other problems, such as harmful radio interference caused by this device to specific low-power radio stations for mobile identification or amateur radio stations, please contact the following. Contact: Keyence Corporation Telephone: 06-6379-1151.

• Do not disassemble or modify this unit as this is prohibited by the Radio Law.

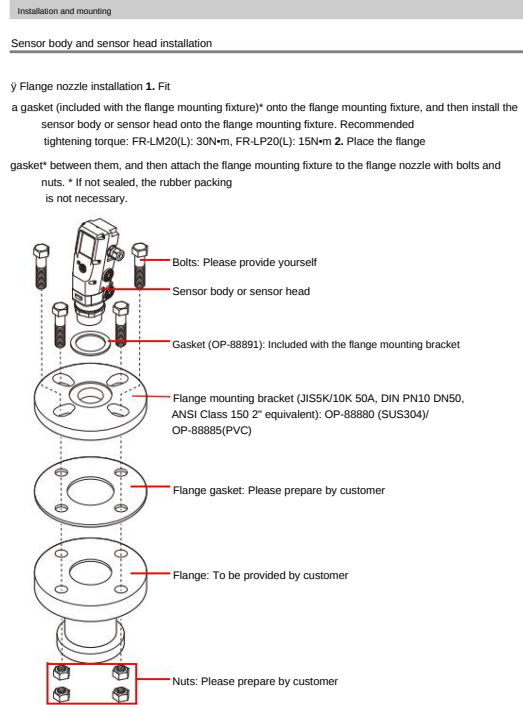
This device is classified as specific wireless equipment under the Radio Law of Japan, and has been certified for its construction design in accordance with the standards set forth in the Radio Law.

■ Precautions on radio communication (FR-LW20L)

- This device complies with part 15 of the FCC Rules.
- Operation is subject to the following two conditions:
(1) This device may not cause harmful interference, and
(2) This device must accept any interference received, including interference that may cause undesired operation.
- FCC CAUTION Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment. Note: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment.
- This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications.
- Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.
- This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment and meets the FCC radio frequency (RF) Exposure Guidelines.
- This equipment should be installed and operated keeping the radiator at least 20cm or more away from person's body.
- This device contains licence-exempt transmitter(s)/receiver(s) that comply with Innovation, Science and Economic Development Canada's licence-exempt RSS(s). Operation is subject to the following two conditions:
1. This device may not cause interference.
2. This device must accept any interference, including interference that may cause undesired operation of the device.
- L'émetteur/récepteur exempt de licence contenu dans le présent appareil est conforme aux CNR d'Innovation, Sciences et Développement économique Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes :
1. L'appareil ne doit pas produire de brouillage;
2. L'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.
- This equipment complies with ISED radiation exposure limits set forth for an uncontrolled environment and meets RSS-102 of the ISED radio frequency (RF) Exposure rules.
- This equipment should be installed and operated keeping the radiator at least 20cm or more away from person's body.
- Cet équipement est conforme aux limites d'exposition aux rayonnements énoncées pour un environnement non contrôlé et respecte les règles d'exposition aux fréquences radioélectriques (RF) CNR-102 de l'ISDE.
- Cet équipement doit être installé et utilisé en gardant une distance de 20 cm ou plus entre le radiateur et le corps humain.

■ Precautions on radio communication (FR-LW20)

- This device complies with part 15 of the FCC Rules.
- Operation is subject to the following two conditions:
(1) This device may not cause harmful interference, and
(2) This device must accept any interference received, including interference that may cause undesired operation.
- This equipment should be used outdoors.
- FCC CAUTION Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment. Note: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment.
- This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications.
- Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.
- This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment and meets the FCC radio frequency (RF) Exposure Guidelines.
- This equipment should be installed and operated keeping the radiator at least 20 cm or more away from person's body.



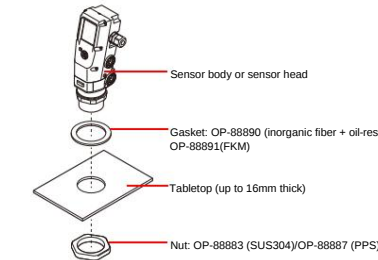
y Direct mounting to the top plate (nut mounting)

1 Drill a y49 hole in the top plate. 2 Fit a

gasket* onto the mounting thread of the sensor body or sensor head, and insert the mounting thread of the sensor body or sensor head into the hole in the top plate. 3 Attach the nut from the

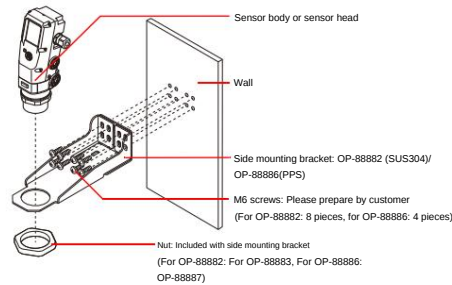
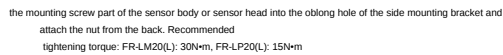
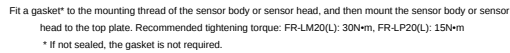
back of the top plate. Recommended tightening torque:

FR-LM20(L): 30 N·m, FR-LP20(L): 15 N·m • If not sealed, the gasket is not necessary.



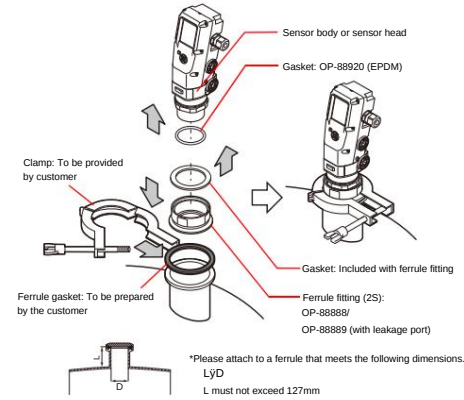
1 Attach the mounting screw part of the sensor body or sensor head to the general-purpose mounting fixture.

hole and four screw holes for fastening the mounting fixture in the top plate, and fasten the general-purpose mounting fixture to the top plate with screws.

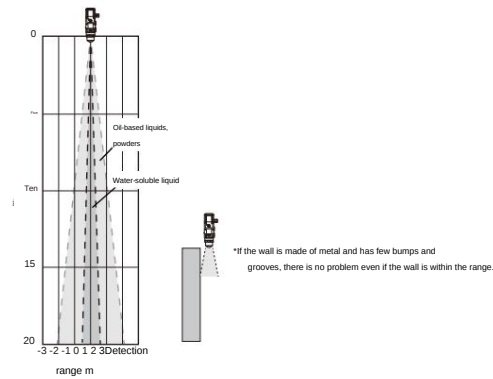


3. Attach the ferrule attachment tool to the sensor body or sensor head. Recommended tightening torque: FR-LM20(L)/LS20(L): 30 N•m, FR-LP20(L): 15 N•m 4. Attach the ferrule gasket to the ferrule, and then use the clamp to attach the sensor.

Install the bracket.

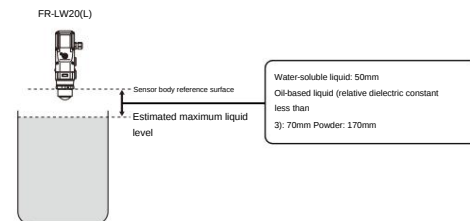


Install the sensor so that there are no metal obstacles within the following range.
If the above conditions cannot be met, perform the adjustment function. For details
on the adjustment function, refer to the FR series user's manual.



Detection may become unstable if the sensor is placed too close.

We recommend that the sensor be placed at the recommended distance below from the expected upper limit of the liquid level. However, if the environment is free of bubbles or adhesions, the sensor may be usable at a closer distance.



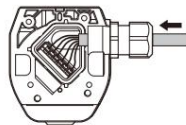
The housing can be rotated approximately 340°. After fixing it to a fixture, rotate the housing while fixing the hexagonal part with a wrench, and orient the display in any direction.

The diagram consists of two parts. The left part shows a close-up of a terminal block with a screwdriver being used to tighten a screw, securing a cable. The right part shows the internal wiring of a device, with a shielded cable connected to a terminal block and its shield connected to earth on the wiring board side.

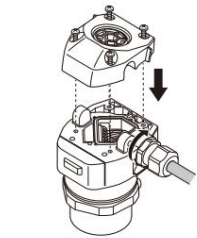
► **Important:**

- Push the cables all the way in. • To check that the wiring is correct, gently pull each cable after wiring. Stretch it and make sure it does not come loose.
- Connect the shield of the shielded cable to earth on the wiring board side.

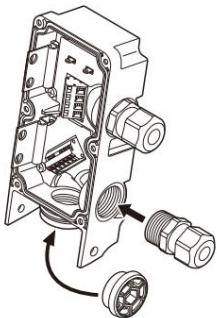
 Important • Push the cables all the way in. • To check that the wiring is correct, gently pull each cable after wiring. Stretch it and make sure it does not come loose.



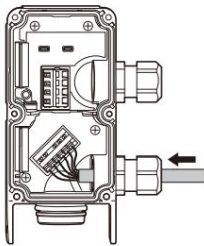
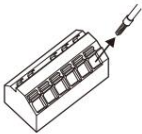
9. Tighten the nut of the cable gland.
(Tightening torque: 4.0Nym)
Also, attach the sensor head cover.
(Tightening torque: 0.5Nym)



10Cable insertion port cover on the side of the display unit and attach it to the bottom of the display unit.
(Tightening torque: 2.0Nym)
The side of the display has an attached cable grater.
Install the screws (tightening torque K: 4.0Nym)



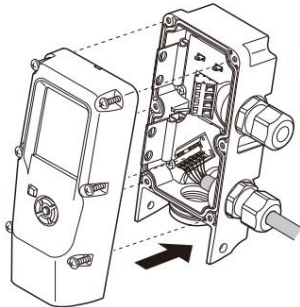
11 Attach the separate cable to the cable on the side of the display.
Route the wires through the ground and into the terminal block.
Masu.
After wiring, tighten the nut of the cable gland.
Tighten. (Tightening torque: 4.0N-m)



Sensor head side	Display side
Terminal Block Terminal Number	Terminal Block Terminal Number
1	1
2	2
3	3
4	4
5	5
6	6

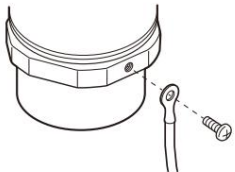
• Push the cable all the way in.
To check that the wiring is done correctly, gently pull each cable after wiring.
Stretch it and make sure it does not come loose.

12 Close the front of the display unit and tighten the six screws.
(Recommended tightening torque XXNym)



⚠ Caution	Please turn off the power when performing wiring work.
▶ Important	When closing the case, be careful not to pinch the wires.

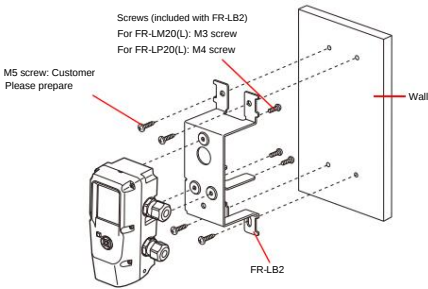
13Connect the ground wire to the ground terminal (M4 screw) on the hexagonal part of the sensor head.
When connecting a ground wire, connect the ground wire to the ground terminal (M4 screw) on the hexagonal part of the sensor head.
Connect the wires.



Use the following dimensions for the round terminals, please.

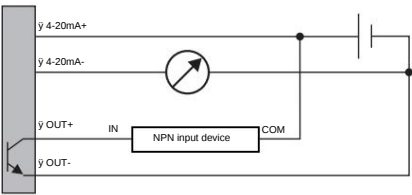
B (outer): 8.5mm or less
d (inside): 94.5 or more
• Round terminal compatible dimensions

γ Installation of display (in case of separate display)
Fix the display unit with the rear mounting bracket FR-LB2.

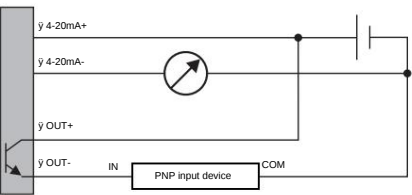


γ Wiring with external devices

< Wiring example to NPN input device >

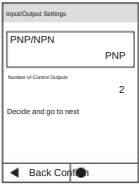


<Wiring example to PNP input device>



Initial settings at first startup

When you start the application for the first time, please perform the following initial settings.
• Use the γγ keys to select each parameter and the • Enter key to confirm. • Press the γ key to return to the previous screen.



The predefined values are the color values.

Language/ Language	ENGLISH JAPANESE CHINESE DEUTSCH
Detection	Water-soluble liquids Oil-based liquids Powders
target	mm m
Distance unit Display value scaling	OFF ON
Display value units *1	No unit mL L hL m3 g kg t mm m %
Decimal point position *1	99999 9999.9 999.99 99.999 9.9999
Tank Shape *1	Straight tank Spherical tank Cylindrical tank (horizontal) Conical bottom tank Pyramid bottom tank Sloped bottom tank Multi-point correction
Distance to bottom	0 to 25000mm
Distance to top	0 to 25000mm
Height of bottom γ1/2	0 to 25000mm
Tank capacity *1	0 to 99999
Number of multi-point correction points *1 *3 2 to 32	
First point _ Height *1 *3 *4 0 to 99999	
1st _ Current value *1 *3 *4 0 to 99999	
point Level-linked	OFF 2 3 4 5
indicator Indicator pattern	No.1 No.2 No.3 Only green lights off
*6 Indicator setting value 1*5	0 to 99999

*1 Only displayed when "Display value scaling" is set to [ON].
*2 Only when "Tank shape" is selected as [Cone bottom tank], [Pyramid bottom tank], or [Sloped bottom tank] It shows.
*3 Only displayed when [Multi-point correction] is selected for "Tank shape".
*4 Depending on the value selected in "Number of multi-point corrections", points 2 to 32 will be displayed.
*5 Depending on the value selected in the "Level Linkage Indicator", 1 to 5 is displayed.
This will not be displayed if [OFF] is selected for [Number of multi-point corrections].
*6 The number of selectable patterns varies depending on the setting of the "Level Linkage Indicator."

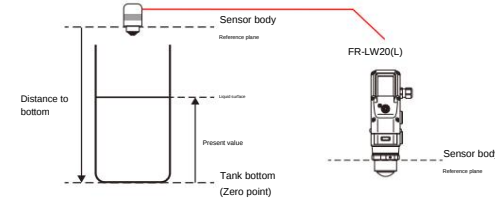
• What to detect

If the dielectric constant of the object being measured is 3 or more, select [Water-soluble liquids]. If it is less than 3, select [Oil-based liquid].
For liquids, select [Powder].
If you select [Only Liquid], the area near the bottom of the tank will be automatically masked.
Please refer to the user's manual for details.

⚠ Important note: If the wrong detection target is selected, the liquid level may not be detected correctly.

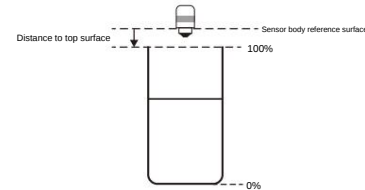
• Distance to bottom

Enter the distance from the sensor body reference surface to the tank bottom. When using a mounting bracket
For the position of the sensor body reference surface, please check the external dimension drawing in the catalog, etc.
This position is set as the zero point (0%), and the height from the bottom of the tank to the liquid level is displayed as the current value.



• Distance to top surface

Enter the distance from the sensor body reference surface to the top surface of the tank.
When displayed as a percentage, this position will be 100%.

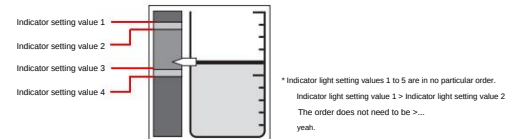


• Display value scaling

OFF: The liquid level is displayed as height.
ON: The displayed value is scaled and converted into volume or mass.
Scaling can be done by selecting the tank shape or by using any conversion table with up to 32 points for multi-point correction.
You can enter a blue
For details on multi-point correction, please refer to the user's manual.

Indicator Light Pattern

The lighting pattern of the ring indicator can be selected according to the liquid level.
The color of the indicator light is also linked to the color bar on the current value screen.



The number of selectable indicator light patterns varies depending on the level-linked indicator light you set.
Please choose from the options below.
If you want a different pattern, select Custom. Custom Settings
Please refer to the user manual for details on how to do this.

Level Linkage Indicator light	Pattern 1	Pattern 2	Pattern 3	Green only		Lights out
OFF					green	
2	red green	green red				
3	red yellow green	green yellow red	red green red			
Four	red green yellow red	green yellow red				
Five	red yellow green yellow red					

Adjustment Function

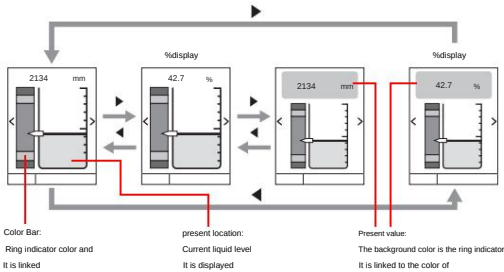
After completing the initial settings, we recommend that you perform the adjustment function.
This allows for more stable detection.

procedure:
On the current value screen, press the MENU key to enter the menu screen and select "Adjustment function".
image:

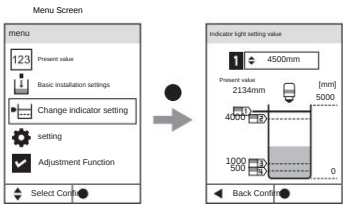
- Reference
- For details, refer to the FR series user's manual.
 - When [Only Liquid] is selected in [Detection Target] or detection is unstable, initial settings are complete. After that, a screen for performing the adjustment function will be displayed.

Basic Usage

y Current value screen



y Changing the indicator light setting value
On the current value screen, press the MENU key to enter the menu screen, and select Change indicator setting value.
image:
Use the y/j keys to adjust the setting value, then press the <Enter key> to confirm.



y Key lock
This function locks the keys to prevent accidental operation. If you do not want to change the settings easily it is useful for the following:
If you want to require a password to unlock the key lock, set "Key Lock Method" to [PIN Code
Please set it to [PIN].
How to activate and release the key lock:
y Press and hold the MENU key and y key simultaneously for more than 3 seconds.
If "Key lock method" is set to [With PIN code], you will need to enter the PIN code to unlock the please.

Reference

If the PIN code is incorrect, an error will occur and the screen will return to the normal screen with the keys locked. I will.

y Initializing settings
On the current value screen, press the MODE key to enter the menu screen, then select "Settings" > "Initialize".
image:

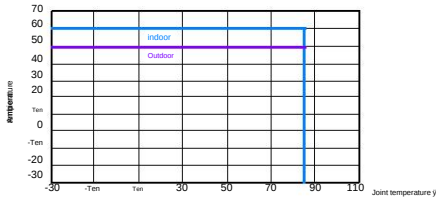
maintenance

- If necessary, clean any deposits or foreign matter from the mounting bracket, sensor body, or the bottom of the sensor head. Please clean it up.

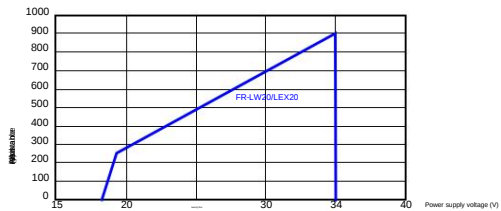
specification

Item	2-wire standard	
	FR-LW20(L)	
Measurement range ^{*1}	FR-LW20: Up to 20m FR-LW20L: Up to 15m	
Display range ^{*2}	~ 25m	
Measurement medium	2 or more	
relative dielectric constant Resolution	1mm	
Precision ^{*3}	Up to 0.1m: ±10mm 0.1 to 10m: ±1mm 10 to 20m: ±2mm	
Response	1s, 4s (default), 10s, 25s	
Time Tank Pressure	-0.1 to 1 MPa (depending on temperature)	
Material	Inside the tank	Lens: PTFE
	Inner packing: FKM	Fastening part: SUS304
Chassis	PPS PBT PC PA	
Connection port size	G1-1/2(40A)	
output	Number of Control Outputs	1
	Control Output / Auxiliary Output	Transistor output (NPN open collector) Common independent type DC30V or less, max. 50mA Residual voltage 1.4V or less (50mA or less) NPN/C switchable
	Analog Output	4-20mA Maximum load resistance: see separate page (Response time: 1.5s [90% response] after judgment output is confirmed)
	Resolution	1mm
Analog output	Zero Accuracy	±0.1mA (zero point = 4mA)
Force Precision	FS Accuracy	±0.2mA (full scale = 20mA)
Environmental resistance	Ambient temperature	-30 to +60y (no freezing) ^{*5}
	Ambient humidity	~ 85% RH (no condensation)
	Joint temperature	-30 to +85y (no freezing)
	Median resistance	10 to 500Hz Power Spectral Density: 0.816G2 in X, Y, and Z directions
	Shock Resistant	100m/s2 (10G) 16ms pulse, 1000 times in each of the XYZ directions
Protective structure	IP67 (IEC60529), Enclosure Type 4X (NEMA250)	
Protection Circuit	Power reverse polarity protection, power surge protection, output overcurrent protection, output surge protection	
Power supply voltage	DC 18.3 to 35V*6	
Current consumption (including analog output (excluding load current) Weight	752.5mW or less	
	FR-LW20(L): Approx. 920g	

- *1 Guaranteed value in water with recommended installation. If the water is static, it is possible to measure up to the edge of the lens.
Due to the relationship between the environment and the measurement medium, a dead zone occurs on the near side.
The distance will be shorter.
- *2 Measurement may not be possible depending on the shape of the object or the environment.
- *3 Guaranteed value based on our testing equipment. Errors may occur depending on the customer's environment.
- *4 Guaranteed value when load resistance is 250y by our testing equipment. Errors may occur depending on the customer's environment.
It will live.
- *5 Details of the operating temperature range are as follows:



*6 Details of the allowable load resistance according to the power supply voltage are as follows:



Warranty Information

1. Applicable Products
The warranty set forth below applies to products manufactured and sold by our company (hereinafter referred to as "applicable products").
To do.
In addition, consumables such as relays and batteries built into the target products are not covered.
Thank you.
2. Warranty Period
The warranty period for the applicable products is one year after delivery to your designated location.
3. Warranty Coverage
(1) If a failure occurs within the above warranty period for reasons attributable to our company, we will replace the product free of charge.
However, even if it is within the warranty period, the following reasons will apply:
In the event of a malfunction, the product will not be covered by the warranty.
Even if this is done, the starting date of the warranty period will be the original delivery date of the target product.
Mass.
y The following items are not included in the instruction manual, user manual, or separately agreed specifications.
Failures caused by improper external conditions, environment, handling or usage.
y Failures caused by anything other than the target product, such as the design of your equipment or software
chassis
- 3) Malfunctions caused by modifications or repairs made by parties other than our company.
4. Consumable parts listed in the instruction manual, user manual, etc. are properly maintained.
A failure that could have been prevented if it had been replaced.
- 5) Failure due to reasons that could not have been foreseen with the level of science and technology at the time of shipment by our company.
y Other external factors not responsible for the Company, such as disasters such as fires, earthquakes, and floods, and voltage abnormalities.
Failure due to the above reasons.
- (2) The scope of the warranty is limited to the above (1) and does not cover secondary damage (including damage to equipment.
Any damages incurred due to the use of the product, including damage to equipment, loss of business opportunities, lost profits, etc. are not covered by the warranty.
to come.
- 4.Applications
Our products are designed and manufactured as general-purpose products for general industry.
Therefore, the following uses are not intended and therefore are not applicable.
It'll enjoy having this.
However, please consult with us in advance and confirm the product specifications at your own responsibility.
After confirming the specifications and performance, you will be asked to take necessary safety measures.
In such cases, the above provisions will be applicable.
In this case, the scope of the warranty will be the same as above.
y Huge impacts on human life and property are expected for nuclear power plants, aviation, railways, ships, vehicles, medical equipment, etc.
Facilities to be used
y Public facilities such as electricity, gas, and water
3) Applications that require high levels of consideration and caution regarding safety similar to those listed in 1) and 2) above.

J 1040-1

お問い合わせ

0120-663-000

最寄りの担当営業所に直接つながります。
一部のIP電話からはご利用いただけません。

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株式会社 キーエンス

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