

Introduction

The LQ510 Sanitary Density Meter is designed for application using clamp connection in the food and beverage industries.

The LQ510 uses microwave phase shift technology to determine concentrations of solids in the material to be measured flowing through pipes. It can perform a stable density measurement because this technology is not affected by flow velocity along with pigment of the fluid, and also is not easily affected by contaminants and low process pressure rate. As the LQ510 has no moving parts, it is reliable and virtually maintenance free.

Since LQ510 can be operated from its operation panel and can also be operated from remote places using the optional AF900 hand-held terminal with HART protocol.



Figure 2. LQ510 Sanitary Density Meter

Specifications

Overall Specifications

Measurement method:

Microwave phase difference method

Measurement range:

Meter size	50 mm (2")
Span (*2)	2 to 50 %TS (*1)
Lower limit setting range (4 mA)	0 to 48%TS
Upper limit setting range (20 mA)	2 to 50%TS
Setting increments	0.1%TS

- *1 TS (Total Solids) = Soluble materials + Non-soluble materials
- *2 Span = Density measurement range upper side – Density measurement range lower side
- *3 The object to be measured is required to be free from cavities and have fluidity. Contact Toshiba for measurement ranges other than those described above

Repeatability:

Meter size	50 mm (2")
Repeatability	±0.02%TS

Note 1 : Phase measurement performance of the converter is converted to density values.

Note 2 : Verifiable repeatability using a simulated test solution;

Meter size	50 mm (2")	
Density (consistency) determination repeatability	For the full scale value of 2%TS or greater	±2%FS
	For the full scale value of less than 2%TS	

Marginal errors in testing such as uneven density distribution are also included in the characteristics using a simulated test solution shown above. The values are taken at measuring points above 5% of full-scale using simulated reagent.

<Notice>
The LQ510 requires a full pipe to measure the density (consistency). Contact Toshiba before installation in the following cases:
 <Possibility of unfilled condition>
(a) When it is installed at the discharge of a pump.
(b) When installation is horizontal, and unfilled condition occurs inside the pipe.
(c) A process where the pipe becomes unfilled when the operation is stopped.

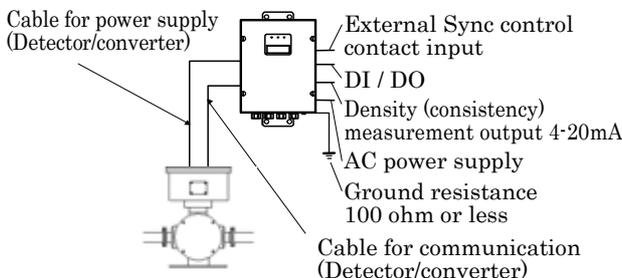


Figure 1. LQ510 Configuration Diagram

Standard Configuration

- **Density (Consistency) Meter:** 1 set (Detector and converter separate mounted)
- **Accessories:** 1 set (see Table 1 below)

Table 1. Standard Accessories

Items	Specifications	Quantity
Power supply cable	Between detector and converter (*1)	10 m (32.8 ft)
Communication cable	Between detector and converter (*1)	10 m (32.8 ft)
Fuse	2A(T), 250 V (glass tube, 5.2 dia. x 20 mm)	2
Document	Instruction manual	1

Note 1 : Need to prepare a power supply cable for the LQ510. Refer to the section of cable specifications at the overall specifications in detail.

The full-scale value is the maximum value on the upper side of the density measurement range. If the density distribution in the piping is uneven, manually obtained analysis value and the density meter indicated value may be different.

Linearity:

In the case of 2%TS or more in full-scale, ±2%FS

Note: The values are taken at measuring points above 5% of full-scale using simulated reagent.

Meter size	50 mm (2")
Full-scale 2% TS or more	±2%FS
Less than full-scale 2% TS	

Electrical Resolution:

Meter size	50 mm (2")
Electrical resolution	0.002%TS

Note 1: Phase measurement performance of the converter is converted to density values.

Note 2: Verifiable resolution using a simulated test solution;

Meter size	50 mm (2")
Resolution	0.1%TS

* The verifiable resolution value refers to the value which is verified through a test of the density difference which can be resolved as a density meter output. Marginal errors in testing such as uneven density distribution and environmental variations are also included in this value.

Ambient Environmental conditions:

Temperature: 0 to 50°C (32 to 122 °F)

Humidity: 5 to 90%RH (No condensation)

Structure:

Detector Immersion-proof type (IP67: Immersion-proof type or equivalent)

Converter Waterproof type (IP65: Waterproof type or equivalent)

Note : Outdoor installation is possible. However, provide a sunshade for the converter section if direct sunlight is unavoidable.

3A standard: Approved as standard.

Vibration resistance:

No resonance to the following levels of vibration:

(1) Applying vibration of a resonant frequency in 5 to 150 Hz range in x, y and z directions for 30 minutes each totaling 90 minutes, and no deterioration of performance nor damage shall be found.

However, acceleration is as follows

- Detector: 4.9m/s²
- Converter: 4.9m/s²

(2) Applying vibration of 5 to 150 to 5 Hz with the acceleration shown in (1) above for 3 minutes and this is repeated 10 times for each direction of vibration totaling 90 minutes, and no deterioration of performance nor damage shall be found

Note: Avoid using the LQ510 in an environment with constant vibration.

Weight: Refer to Outline Dimensions (Table 3).

Microwave power: 10 mW

Cables: See the Table 2

Table 2. Cable specifications

Specifications	Cables Between detector (RF part)and converter (*1)		Power supply cable of LQ510 (*2)
	Power supply (24Vdc)	Communication	
Cable type	CVVS-2C-2S	CVVS-5C-1.25S	CVV-3C-2S
Cross-sectional area (*3)	2 mm ²	1.25 mm ²	2 mm ²
Number of cores	2	5	3
Cable diameter (*4)	11 to 13 mm ²	11 to 13 mm ²	11 to 13 mm ²

*1 10m (32.8 ft) length is packed as standard.

*2 Need to prepare this cable by the customer.

*3 Need to use a sheathed cable.

*4 If the diameter of the cable is smaller than the inside diameter of the packing, enlarge the cable diameter to the same size as the packing by wrapping around the cable.

This dimension is coming from a diameter of the cable gland of the LQ510.

Detector Specifications

Meter size: 50mm (2")

Flange standard and maximum working pressure:

Connection method	Fluid pressure
Sanitary clamp method (ISO2852)	-0.1MPa to Pressure defined by sanitary clamp standard (ISO2852)

Note: Tri-clamp® can be connected instead of ISO 2852 clamp.

Note: Tri-clamp® is a registered trademark of Tri-Clover Inc..

Fluid temperature:

0 to 100 °C (32 to 212 °F) (Not freezing)

Note:The inside of the pipe should be kept below 130 °C and for the duration not exceeding 20 minutes when the temperature inside should be increased in such an occasion as pipe cleaning.

Allowable fluid conductivity:

Meter size	Fluid conductivity
50 mm (2")	20 mS/cm maximum

Note 1: If the electrical conductivity of the fluid exceeds the specification value, microwave signals attenuates and correct measurement becomes difficult.

Note 2: Precautions about measuring fluids
When measuring density in liquids containing conductive particles such as the carbon particles of activated carbon or metal powder, density measurement may be affected by conductive particles. Avoid using the density meter for the fluids like these. For details, please contact Toshiba.

Note 3: To check the effect on the measured value caused by electric conductivity changes, salt (NaCl) is used.

Material contacting liquid:**Main pipe:** SUS316L**Temperature detector holder:** SUS 316L**Applicator window:** Polyetheretherketone
(PEEK[®], PK450)**Seal gasket:**(Liquid contacting section) silicon rubber
(conformed to FDA)**(Non-liquid contacting section) Fluorine rubber****Note:** Do not apply this density meter to fluids that may corrode, deteriorate or degenerate the above liquid contacting materials. For details, please contact Toshiba**Applicator:**

A pair of applicators provided for microwave reception/transmission.

Temperature detector:

RTD (resistance temperature detector) (Pt100)

Fitting:

Direct fitting to vertical or horizontal piping. (Refer to the section of Piping Precautions.)

SIP cleaning condition:Less than 130°C (266 °F) **for 20 minutes maximum****Note:** Avoid cleaning which gives a harmful degradation for wetting parts. They may not keep ability for sanitary and sealing.

Make sure all materials at wetting parts that are suitable for your CIP or not before cleaning.

■ Converter Specifications**Output signals****• Density measurement output:**4-20mA_{dc} (load resistance 750 Ω or less; insulated output.)**• Density meter fault or maintenance signal:**

Semiconductor contact output capacitance 125VAC, 0.1A (resistive load)

The contact opens when in fault, and it closes when in normal

* When the density meter converter is in error or in maintenance (setting change) mode, the contact will be open.

Communication signals:Digital signals are sent superimposed on the 4 to 20mA_{dc} signal line (based on the HART*1 protocol).

Load resistance: 240 to 750Ω

Load capacity: 0.25μF maximum

Communication is possible under these conditions

*1 Abbreviated from Highway Addressable Remote Transducer as the name of an industrial sensor communications protocol recommended by HCF (HART

Communication Foundation).

Note: Various operations can be made from remote places by connecting the cable terminals of a communication hand-held terminal (option) to the output terminals of 4-20mA_{dc} signal. For the specification regarding the communication hand-held terminal, refer to the AF900 specification.**Input signals****• External synchronized input signal:**

No-voltage "a" contact

Note 1: this contact signal synchronizes with the pump operation.

Use a contact with the capacitance of at least 24VDC and 1A.

This signal is used to take external synchronized operation with the flow of measured substances including the pump operation.

Contact close: measurement implemented,
Contact open: measurement stopped.

This function is used to perform measurement synchronized with the flow of the material to be measured in operation such as an intermittent pump operation when the material to be measured does not flow continuously or when there is a possibility of piping or a tank being emptied. While the pump is stopped, the material to be measured either descends or floats and the indicated value may fluctuate. Therefore, perform measurement only when the pump is in operation using the external synch function.

• Density correction factor switching signal:

Voltage signal 2 points

Input voltage H level: 20 to 30VDC
L level: 2VDC or less

Input resistance: Approx. 3kΩ

Using this signal, the density correction factor can be changed into 4 types of values from remote places and measurements corresponding to 4 different objects to be measured or 4 kinds of mixed fluids (brands) of different component substances or compounding ratios can be made.

• Conductivity correction signal:4-20mA_{dc} (corresponding to conductivity level of 0 to 10mS/cm)

To perform conductivity correction, prepare a conductivity meter and install it in a place where conductivity can be measured correctly and steadily and enter the obtained conductivity correction signal here.

Update cycle of density measurement output and display:

Approx. 1 second

Moving average function:

Density measured values are output as moving averages of 1 to 999 measurements made approximately every 1 second.

This output is used when the averaged output is required for density control or other purpose.

Rate-of-change limit:

Rate-of-change width: 0.00 to 9.99%TS,
Count: 0 to 99

This is a function to limit a sudden output change by eliminating signals that cause sudden output changes in such cases as when a sudden density change occurs or air bubbles are mixed in the liquid to be measured. You can set the condition of the rate-of-change limit using the rate-of-change width and how many times the change occurs (count)

Additive correction function:

Capable of handling up to ten brands, this function performs the sensitivity correction appropriate to the additives type and compound ratio in accordance with the parameters that are registered in advance.

Data save function:

Measurement data of up to 256 points can be saved in an arbitrary measurement period (1 to 1800 minutes). If data is saved in 10 minute interval, data of more than 42 hours can be saved.

Arrestor:

Mounted as standard on the current output and AC power supply lines..

Operation console (inside the converter):

Used for verifying, changing and manipulating various data.

Five control switches

Display: LCD of 4 lines by 20 characters (dot matrix)

Power supply:

100 to 240Vac 50/60Hz

(Allowable voltage: 85 to 264Vac)

Note 1: An additional power supply is required when choosing an optional environmental temperature specification type (-20 to 50 °C). Refer to the section of Environmental conditions in detail.

Power consumption:

Approx. 25VA (100Vac)

Approx. 35VA (240Vac)

Case material: 304 stainless steel

Installation

■ Outline Dimensions

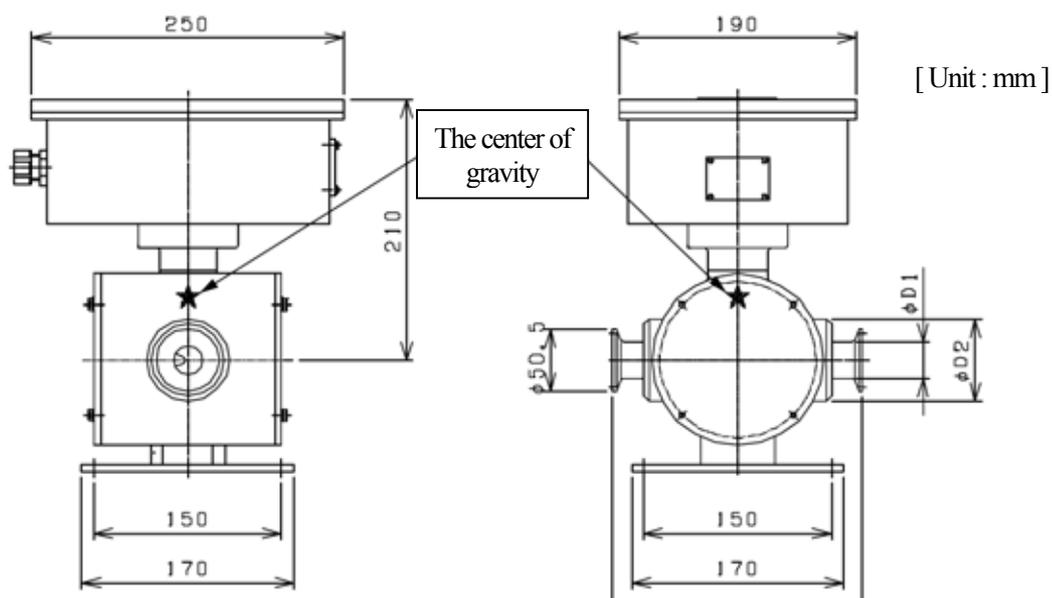


Figure 3. LQ510 detector outline dimensions

Table 3. LQ510 detector outline dimensions

Meter size	ϕ D1	ϕ D2	Mass (kg)
50	47.8	86	Approx. 16

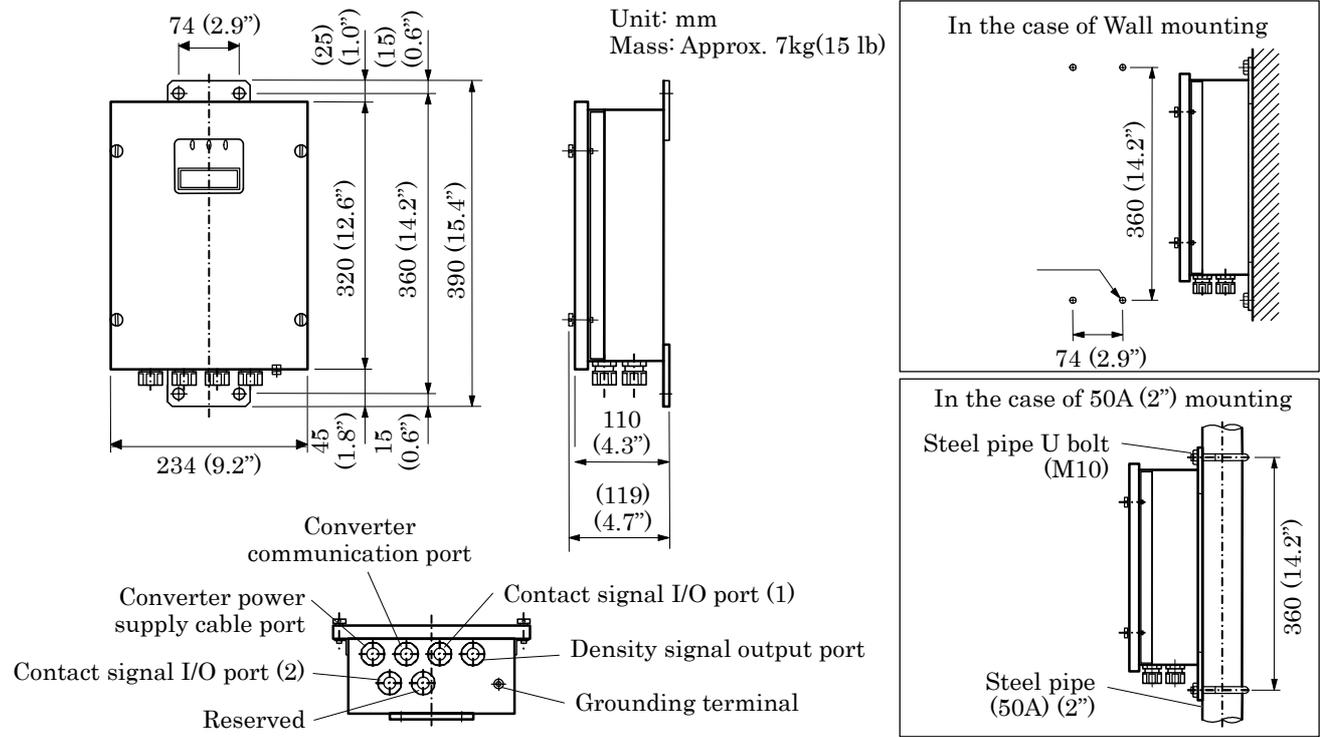


Figure 4. LQ510 Converter outline dimensions

■ Installation Precautions

- (1) Choose a place that is free of vibrations and corrosive gasses, and has ample space for maintenance.
- (2) Secure maintenance space around the converter and detector RF section. (Refer to Figure 5)
- (3) In the case of outdoor installation, provide covering against sun and rain.
- (4) It is recommended that the converter be installed about 1.5m (the position of windows) from the floor. The LCD display stays on the front panel of the density meter. Install the converter in a location and orientation easy to see this LCD display.
- (5) Do not install the meter in a place where there is a possibility of leakage of flammable or explosive gas.
- (6) Do not install the meter in any of the following places:
 - A place where condensation due to a sudden temperature change occurs.
 - A place where extreme low or high temperatures occur outside the specification range.
 - A place near the equipment generating strong radio waves or electric fields.
- (7) Install the meter in a place where air bubbles are not generated, inside the pipe is always filled, and sedimentation and accumulation of solid matters do not occur.
- (8) Install the meter in a place where density distribution is uniform. If the distribution inside the pipe is uneven, manual analysis data and the indicated value of the density meter may not show the same value.
- (9) Ensure that the flow rate of the fluid to be measured is 0.6m/s or more.
- (10) Make sure the upstream and downstream pipes have enough strength to hold the density meter. If it is not possible, provide a supporting base to hold the density meter.
- (11) The liquid contacting materials of this meter are Detector pipe: SUS316L, Measuring window: Polyetheretherketone, O-ring: Silicon rubber, Liquid temperature sensor: SUS316L. Install the meter in a place where measuring liquid or environment does not corrode these materials.
- (12) When multiple density meters are installed, a combination of each converter and its detector should be kept correctly. If the converter is installed with a different detector, density measurement may not be performed correctly.

■ Piping Precautions

- (1) Install the meter in a place where density distribution is uniform. If the density distribution in the density meter pipe is uneven, manually obtained analysis value and the density meter indicated value may be different.
- (2) Install the density meter in a location where the material to be measured flows and fills inside the detector pipe and bubbles do not remain. If the material to be measured does not fill the pipe or bubbles remain, a measurement error occurs or the density indication fluctuates. If there is a possibility of such a condition, we recommend you to avoid installing the density meter on the suction side of a pump and instead install it on the pump discharge side.
- (3) Avoid such a location where the measured matter will settle and build up on the bottom of the density meter.
- (4) Avoid such a location which will allow bubbles to move into the pipe line.
- (5) We recommend that this density meter should be installed to a vertical piping system. Horizontal installation can also be used with the same performance but under the following conditions, vertical installation must be recommended:
 - a) Bubbles may stay in the pipe.
 - b) Slow flow speed or other factors may cause the measured matter to sink or float substantially making the distribution of the measured-matter density uneven in the pipe.
 - c) The main pipe has been enlarged thus using the density meter of a diameter greater than that of the main pipe.
- (6) When installing on the horizontal piping, make sure that RF section must be on the top for purposes of maintenance and performance assurance (in other words, so that the paired applicator sections are placed directly side by side).(See Figure 9)
- (7) This density meter does not distinguish between the upstream side and the downstream side. Neither does it require a straight tube length. Install it in a direction that will make maintenance easy.
- (8) When you anticipate a marginal error between the side-to-side dimensions of this density meter and the installation space of the piping line, prepare a loose mechanism in advance.
- (9) To minimize the impact of the bubbles mingled, it is recommended that the meter be installed on a location as far as possible from the pipe outlet for air release but still within the distance where a reasonable degree of hydraulic pressure is applied.
- (10) In the event that the density meter may no longer be full of the fluid while the pump is shut down or the density distribution in the density meter may become uneven, make sure to take measurements only while the pump is operating by using the external interlock function.
- (11) Take necessary measures to prevent vibration from a pump or other equipment applied to the density meter transmitted through the piping.
- (12) On both the upstream and downstream sides of the density meter, install stop valves. Furthermore, between these valves and the density meter, install the sampling port, the zero water supply port, the air release port, the drain port with a stop valve attached respectively. In the event that the flow of the pipe line cannot be stopped, provide a bypass pipe halfway with a stop valve attached. When performing zero point calibration, these are needed to discharge the measured matter out of the density meter through its drain port and fill up the meter with fresh water of zero density. (See Figure 7 and Figure 8)
- (13) As for gaskets to be used in piping, select the one with the dimension conforming to the flange standard and of the material appropriate for the substance to be measured.
- (14) The front side of the density meter's converter section is equipped with an LCD density display section. When installing the meter, choose a location and direction in which this density display section will be easily visible.
- (15) If the cover of the density meter is removed or the density meter is disassembled while the meter is powered, radio waves will leak out. (However, the amount is about equal to PHS and one tenth of mobile phones.)
- (16) For both horizontal and vertical piping systems, install a support stand under the density meter with bolts put through the installation holes (M8 size) on the bottom of the density meter as shown in Figure 6. Then install the support stand together with the density meter to a solid ground or wall. Bolts (four M8 bolts) are not attached as accessories of the density meter. Please prepare these bolts separately

NOTE:

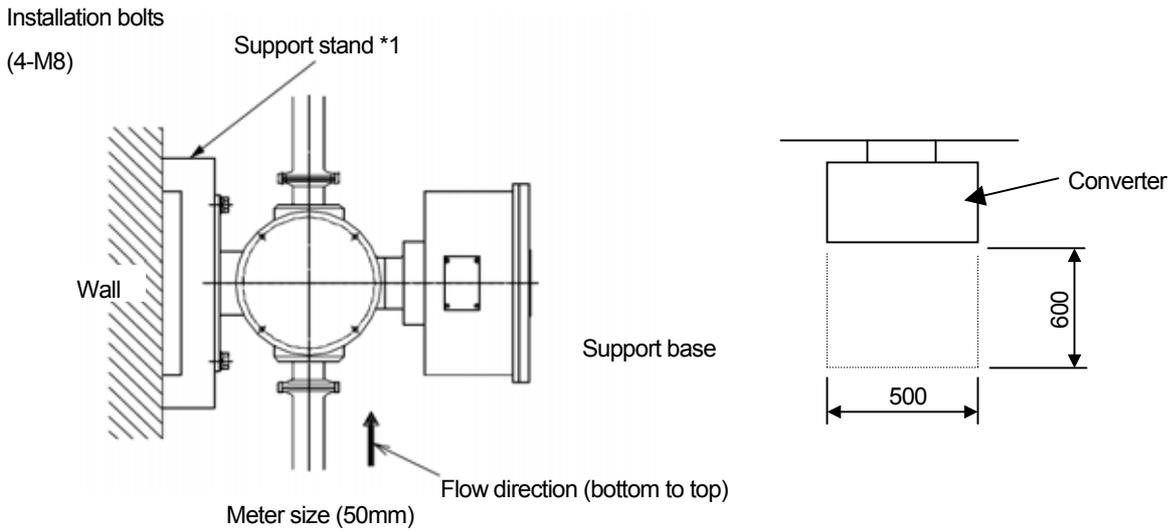
- **Sampling valve:**
Used to extract fluids for manual analysis. Install this valve to the side of the pipe in the case of horizontal installation. It is recommended that a 1-inch ball valve be installed to the side of the pipe.
- **Zero point water valve:**
Used to supply drinking water (density or consistency 0%) to the detector pipe for zero point adjustment. Install this valve at the top of the pipe in the case of horizontal installation. It is recommended that a 1-inch ball valve be installed in the top of the pipe and zero point water is supplied through this inlet using a vinyl hose etc.
If valve water pipe is connected to this valve, air cannot be extracted. Therefore, another valve (vent valve) is needed to extract air.
- **Vent valve:**
Used to vent process fluids to open air when

performing zero adjustment. This helps the drinking water (density or consistency 0%) enter the detector pipe easily. Install this valve

in the top of the pipe in the case of horizontal installation.

- **Drain valve:**

Used to drain the fluids before supplying drinking water (density or consistency 0%) to the detector pipe for zero adjustment. Install this valve at the lowest point of the pipe. It is recommended that a 1-inch ball valve be installed at the lowest point of the pipe.



Note *1 When you install the meter, make sure to set up a stand strong enough to support the meter (mass: see Pages 6 and 7.)

Figure 5. Space for Maintenance

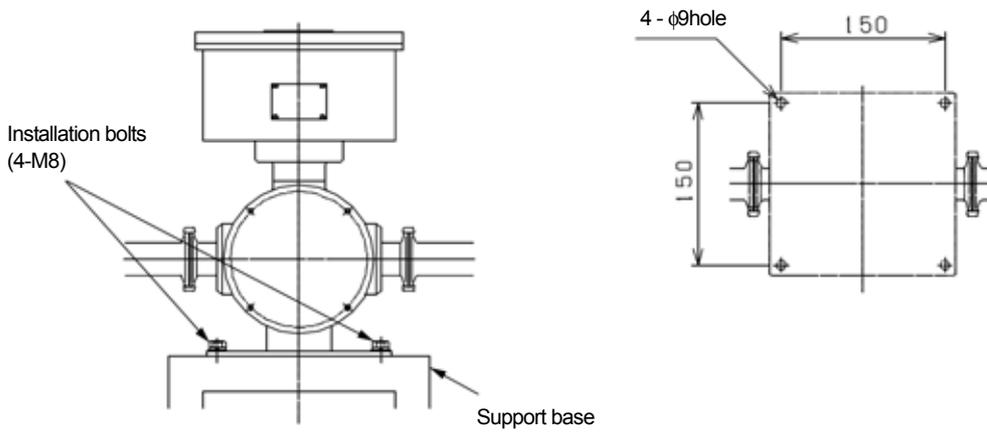


Figure 6. Example of Pipe Securing Method

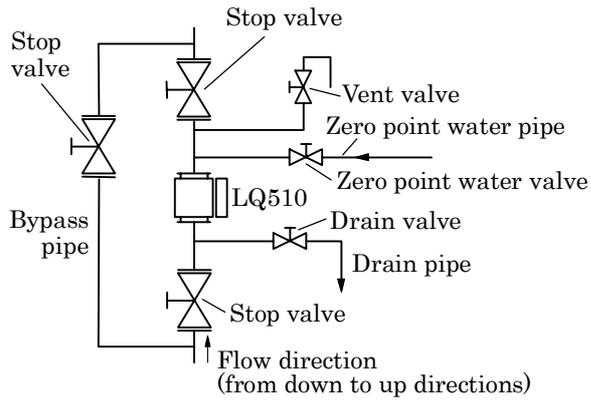


Figure 7. Recommended Installation (vertical installation)

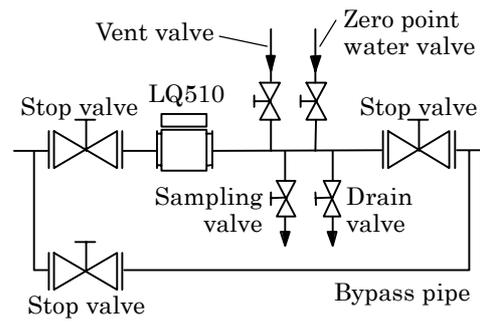
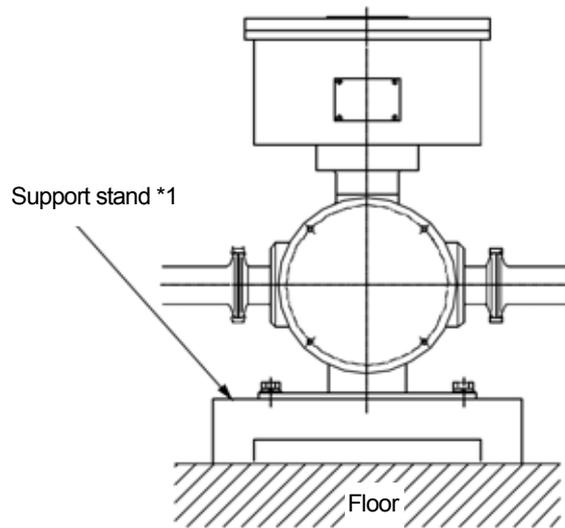


Figure 8. Recommended Installation (horizontal installation)



Note *1 When you install the meter, make sure to set up a stand strong enough to support the meter (mass: see Pages 6 and 7.)

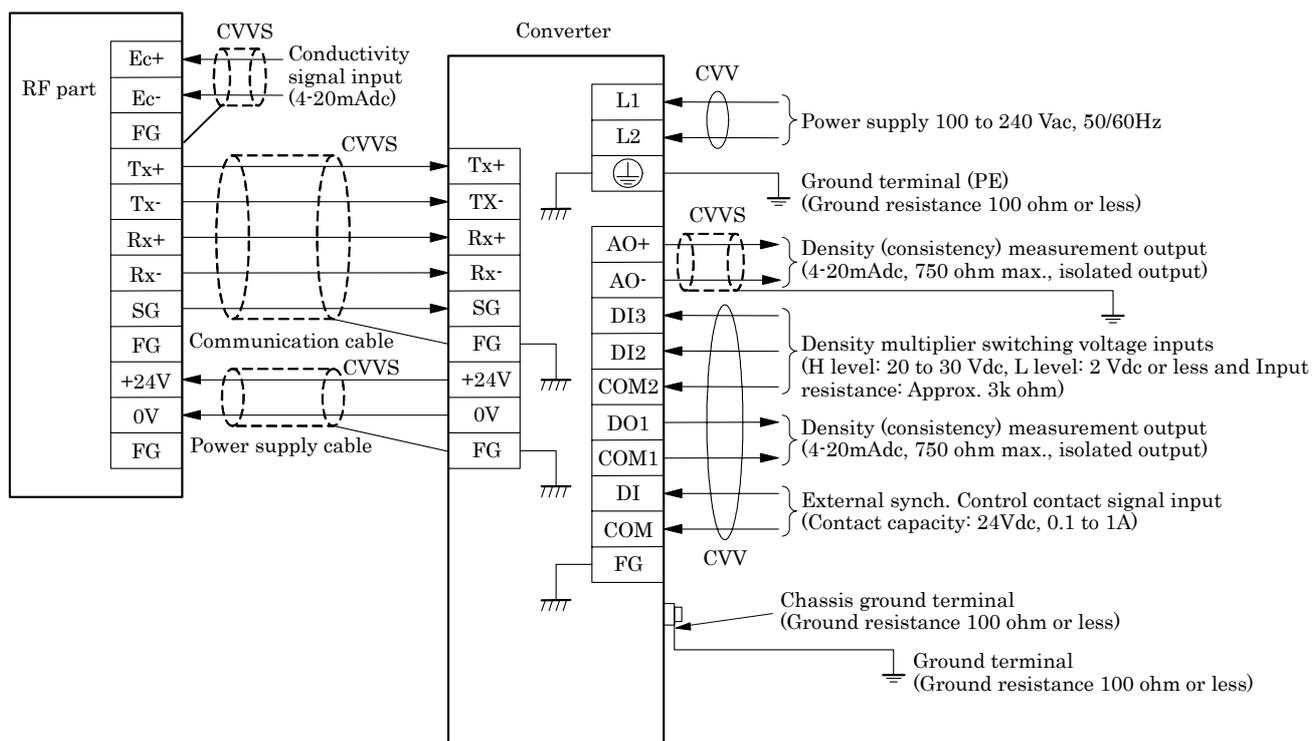
Figure 9. Pipe Installation

■ Wiring Precautions

- (1) A density meter has to be separated from the power supply line when performing the maintenance and inspection operation. A fuse must be installed on the power supply side to protect a switch and the power. A power requirement for this unit is approximately 24VA (at 100VAC), 35VA (at 240VAC).
- (2) Grounding resistance should be 100 Ω or less and the grounding should be made independently from the one used for power equipment.
- (3) To connect between the detector and the converter, use the attached power cable (to supply DC power supply) and communication cable. Connect these cables by matching the terminal symbols of the detector RF section's terminal block (can be seen when the RF section cover is removed) and the converter's terminal block with those shown on each cable.
- (4) Use power cables of 2 mm² or more in sectional area and its voltage drop should be 2V maximum. In addition, use an M4 size crimped terminal for each terminal connections.
- (5) Consider wiring when installed so that vibration or sway will not be applied to cables. Install the cables in thick-walled steel conduit. Install the thick-walled steel conduit to the wiring port of the density meter about 1m from the port, and then use flexible conduit from there to the density meter.
- (6) Output signal wires should be installed in thick walled steel conduit and separated from AC power supply, control signal, alarm signal and other wires that may become a source of noise.
- (7) Signal wires of the density meter measured value (4-20 mA output) should be a 2-conductor shielded cable (CVVS 2 mm²) and the grounding of the shield should be made on the receiving instrument side. When conductivity correction is employed, use the same type of 2-conductor shielded cable (CVVS 2 mm²) for conductivity signal wires and the grounding of the shield should be made on the receiving instrument side.
- (8) Cable wiring port is airtight with gland and packing; therefore, tighten the cable gland securely when wiring is completed. Applicable cable sizes are 11 to 13 mm in diameter. If the cable diameter is smaller than the inside diameter of the gasket, wind tape or something around the cable until the cable diameter becomes about the size of the inside diameter of the gasket.
- (9) Tighten terminal screws securely. Appropriate tightening torque for terminal block screws is 1.2 N · m (1.4 N · m MAX)
- (10) Do not apply power when the density meter

is not installed properly in the piping system. Leakage of radio waves may cause interference with other equipment. If the case cover is removed or the density meter is disassembled while power is applied, leakage of radio waves occurs. Therefore, turn off the power beforehand. (However, the output of radio waves is about 10mW, in the same level of PHS and less than 1/10 of mobile phones.)

- (11) For wiring between the converter and the measuring section, make sure to connect the dedicated cable A and the dedicated cable B as indicated by the band marks on the cables. If connected erroneously, failure or erroneous operation can occur
- (12) For wiring between the converter and the measuring section, make sure to use the dedicated cable A and the dedicated cable B provided as accessories. If other cables are used, erroneous operation can occur.



Notice 1: Do not connect to the “FG” terminals neither communication cable nor power supply cable in the detector side.

Notice 2: Either “PE” terminal on the terminal block in the converter on the chassis ground terminal of the unit should be grounded with 100 ohm or less ground.

Notice 3: Ground the shielded cable on the receiving instrument side.

Figure 10. External connections

● **Wiring when communications function is used**

By connecting the cable lead of the optional AF900 hand-held terminal to the density (consistency) measurement output, you can operate the LQ510 from remote places.

- 1) Make sure the load resistance of 4-20mA dc line of output is between $240\ \Omega$ and $750\ \Omega$, and the load capacitance is $0.25\ \mu\text{F}$ maximum.
- 2) The AF900's cable lead can be connected to the LQ510 anywhere along the current output line. For example, the cable lead may be connected to the signal terminals on the receiving side in the control room. See Figure 11.

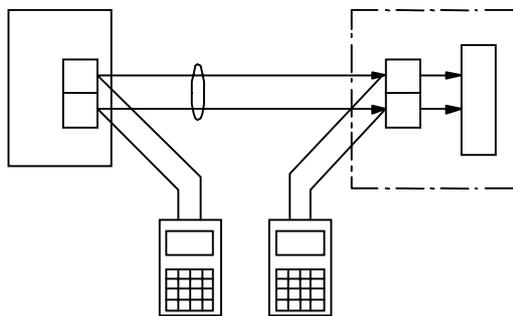


Figure 11. Wiring for communication function

Ordering Information

When ordering the LQ510, refer to Table 4. Type Specification Code. An entry must be made for each of the columns.

The following items must also be specified:

1. Fluid characteristics:
 - Type of material to be measured
 - Density (consistency) (max., normal, min.)
 - Temperature (max., normal, min.)
 - Pressure (max., normal, min.)
 - Conductivity (max., normal)
2. Measurement range
3. Tag number (specify "None" if not needed)
4. Hand-held terminal Required or not (Refer to Table 5 below.)
5. Other specific items

**Table 4. Type Specification Code
(LQ510 Density (consistency) Meter)**

TYPE					CAT Code									SPECIFICATION	
1	2	3	4	5	6	7	8	9	10	11	12	13	14		
L	Q	5	1	0											Sanitary Density meter
					A										Standard
						0	5								Meter Size 50mm (2S)
								H							Mounting Style Sanitary Clamp connection (ISO2852) type
									A						Purpose Standard
										A					Wetting parts 316L stainless steel (standard)
														A	Cable length between detector (RF part) & converter 10 m (32.8 ft) (standard) 20 m (65.6 ft) 30 m (98.4 ft) 40 m (131.2 ft) 50 m (164 ft)
														B	
														C	
														D	
														E	

Note 1: Toshiba recommends to using our specified cable.

**Table 5. Type Specification Code
(AF900 Hand-held Terminal)**

Model					Specification Code							Description	
1	2	3	4	5	6	7	8	9	10	11	12		
A	F	9	0	0									Hand-held terminal
					L	Q	3						For use with LQ series
								A					Display language English
									A	A	3		Standard

ISO9001 and ISO14001 are certified.



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

Specifications are subject to change without notice.
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