

General Specifications

Model SS400
MLSS Analyzer

EXA SS

GS 12E6A1-E

General

The Model SS400 MLSS Analyzer is a measuring system best suited to continuously and consistently measure the concentration of mixed liquor suspended solids (MLSS) in an activated-sludge treatment process found in sewage or industrial wastewater treatment facilities.

The analyzer consists of an MLSS sensor comprising lightemitting and photodetector units, an MLSS converter with a digital display for instant recognition of readings, and one of several types of holders. Designed to be more lightweight and compact for easier handling when compared with conventional equipment, the analyzer also has a construction that allows easy system maintenance.

The SS400G MLSS converter has a measuring range as wide as 500-20000 mg/L (ppm). Microprocessor-based, it has a wealth of self-diagnostic functions and alarm contact outputs like other converters in the EXA series, as well as excellent operability.

The SS300G MLSS sensor uses a measuring method that compares transmitted light with scattered light. The sensor is designed with due care to the arrangement of the optical system. These design makes the sensor less susceptible to disturbing light. The optional jet cleaning unit permits continuous and consistent measurement even in an application where the sensor is exposed to contaminants.

A self-cleaning floating holder is available in addition to free-standing and immersion models, offering a wide range of choices according to the application needs.



FEATURES

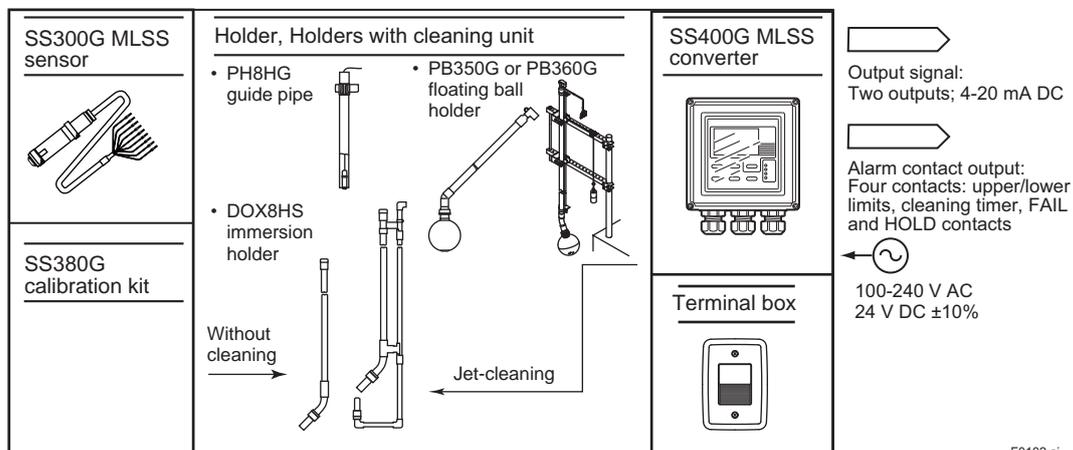
Converter

- Wide output ranges, 0-1000 mg/L to 0-20000 mg/L
- Output in different two ranges
- Abundant contact outputs
- Enhanced self-diagnosis functions including failure in light source

Sensor

- Easy-to-maintain, lightweight, compact probe-like sensor
- Virtually no need for replacing light source and photodetector unit
- Pulse-driven light emission, eliminating effects of disturbing light
- Arrangement of optical system highly immune to effects of light reflecting from boundary surface
- Jet cleaning unit option
- Choice of various types of holders according to application needs

SYSTEM CONFIGURATION

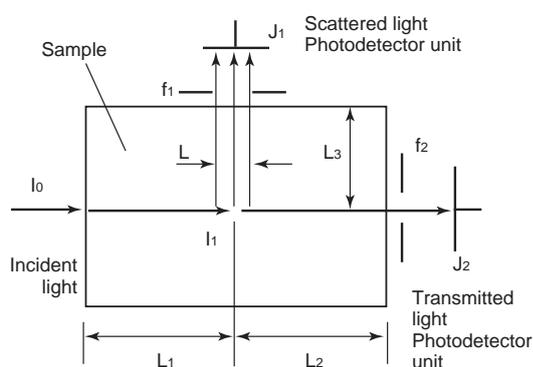


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For details on holders, see the GS 12J05C02-00E general specifications leaflet.

MEASURING PRINCIPLE

Light beams released from the light-emitting unit scatter because of suspended substances in water. The SS400 MLSS analyzer receives transmitted and scattered light beams at its photodetector unit to convert them to an electric signal. The analyzer then compares the transmitted light beams with the scattered ones to calculate the ratio and determine the MLSS concentration. Figure 1 is a brief illustration explaining the measuring principle using the transmitted/scattered light comparison method. Scattered light J_1 and transmitted light J_2 are represented as equations (1) and (2), respectively. Since I_1 in the illustration is represented as equation (3), the ratio of J_1 to J_2 is expressed as equation (4). The MLSS concentration S is therefore determined by equation (5) if the photodetector is configured to satisfy $L_2 = L_3$.



S = Concentration of suspended substances; m = Scatter factor
 C = Concentration of coloring components; k = Absorption factor
 f = Shape factor due to aperture

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Figure 1 Principle of Measurement Using Transmitted/Scattered Light Comparison Method

$$J_1 = f_1 I_1 m S L \exp(-k C L_3) \exp(-m S L_3) \quad \text{equation (1)}$$

$$J_2 = f_2 I_0 \exp(-k C (L_1 + L_2)) \exp(-m S (L_1 + L_2)) \quad \text{equation (2)}$$

$$I_1 = I_0 \exp(-k C L_1) \exp(-m S L_1) \quad \text{equation (3)}$$

$$J_1/J_2 = (f_1/f_2) m S L \exp k C (L_2 - L_3) \exp m S (L_2 - L_3) \quad \text{equation (4)}$$

$$S = (f_2/f_1 m L) (J_1/J_2) \quad \text{equation (5)}$$

The use of the transmitted/scattered light comparison method has made it possible to measure even low concentrations which have been difficult to measure with the conventional scattered-light comparison method. This method eliminates the effects of coloring components. A long-life LED lamp is used as the light source in the light-emitting unit, eliminating both worries about a breakdown in the light source and the need for replacing the light source. The LED lamp is pulsed-driven. Even if disturbing light enters the photodetector unit and raises the baseline, the analyzer eliminates the effects of the light by subtracting V_0 from V_1 to get the difference between the two signals, as shown in Figure 2. The analyzer can thus acquire a signal for the MLSS component only.

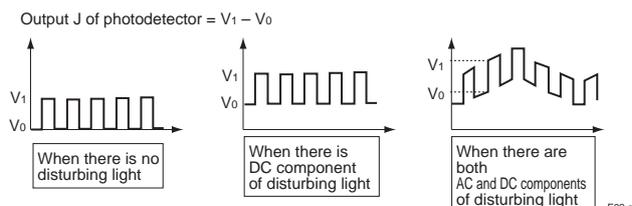


Figure 2 Effects of Disturbing Light in Pulse-Driven Light Emission

The optical system is arranged so that light beams do not directly hit the wall or boundary surface, as shown in Figure 3. This construction makes the sensor hardly susceptible to the effects of light reflecting from the boundary surface.

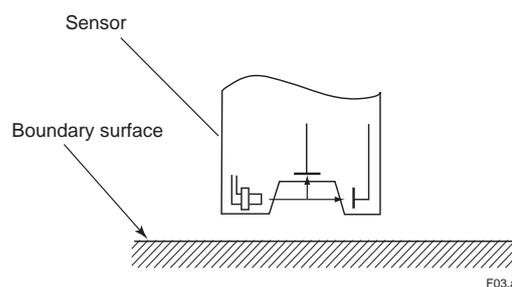


Figure 3 Arrangement of Sensor's Optical System

FUNCTION SPECIFICATIONS

Display and Information Items

The display presents a continuous view of all necessary items of information. Messages appear on the second line, prompting the operator, on an interactive step-by-step basis, as to which key he/she should press. The user interface is simple, consisting of only six touch-sensitive keys accessible through the soft window cover.

Calibration

Before shipment, the SS400 MLSS analyzer is calibrated to a value based on Yokogawa-produced kaolin that is used as the reference substance. The user, therefore, must calibrate the analyzer during setup to the user's own reference substance to define the correction coefficient. In order to get consistent measurements over a prolonged period, the user needs to make zero calibrations at fixed intervals using tap water or other alternative standards, as well as span calibrations using the supplied span-calibrating plate. The value given by the plate is predetermined using Yokogawa-produced kaolin as the reference substance. In the calibration mode using the calibrating plate, the correction coefficient automatically resets to zero and, therefore, values in this mode are different from ones obtained in the measurement mode. A calibration kit is available with the MLSS analyzer for easier calibration.

Cleaning Functions

The sensor of the MLSS analyzer comes with an optional wiper- or jet-cleaning unit. This option is recommended for applications where the sensor may be exposed to contaminants. Note that the option is not available if the sensor is used together with a floating ball holder.

Self-Diagnosis Functions of Sensor

The MLSS analyzer has enhanced self-diagnostic functions that automatically detect a breakdown or open circuit in the sensor's light source, a failure in the converter or other faults. Should a failure be found as a result of diagnosis, the FAIL contact turns on, causing the output signals to go into the "burnout" state, if set accordingly (only output 1 goes into that state in the case of a converter failure). A FAIL marker appears on the display, the LED indicator comes on, and the message line shows an error code, thus allowing the operator to learn the reason for the failure. In addition, the analyzer automatically recognizes a failure in the sensor during calibration, showing an error code (the contacts and burnout function are not activated at that moment).

Alarm and Control Functions

The contact outputs of the MLSS analyzer have the following functions:

- Process alarm
The state of the contact changes if the process value reaches its upper or lower limit.
- Variable parameters:
Setpoint of process value, hysteresis of open/close action and delay time of relay

HOLD Contact Output

Used when, for example, a control room needs to be informed that the output is in a HOLD state during cleaning or system maintenance. The control room itself can learn of this state from the output signal.

Cleaning Contact Output

Used to control the intervals between jet cleanings. The intervals between or duration of cleanings differ depending on the sensor's degree of contamination. Parameters, therefore, must be reset according to the process condition.

- Variable parameters:
Cleaning time, post-cleaning relaxation time and cleaning interval

FAIL Contact Output

Used when a control room needs to be informed of a failure (S4 contact only). If any failure occurs during measurement, the FAIL indicator comes on and this contact turns on, allowing the control room to immediately learn that a failure has occurred. The S4 contact used as the FAIL contact also closes if the power is turned off.

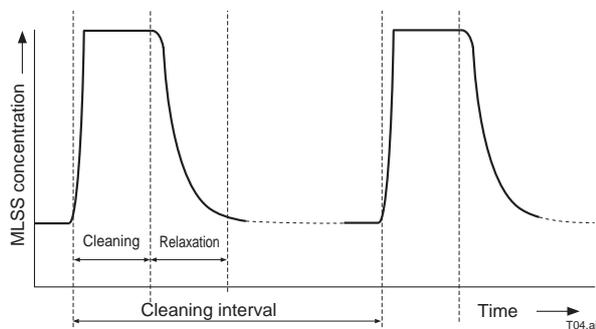


Figure 4 Response During Cleaning

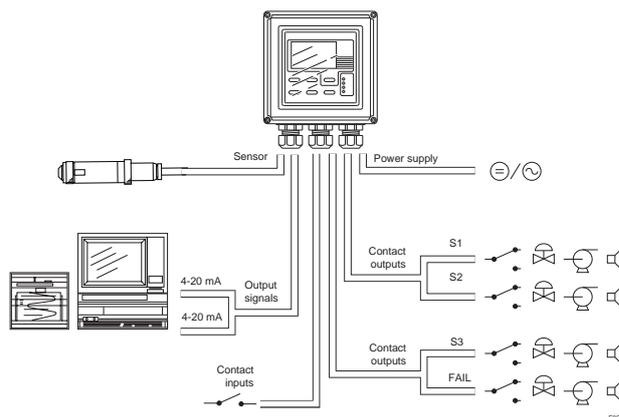


Figure 5 Example of External Wiring

■ STANDARD SPECIFICATIONS

Measuring object: Concentration of mixed liquor suspended solids (MLSS) in an aeration tank in a sewage or industrial wastewater treatment plant

Note: MLSS analyzer cannot be used for measurement of suspended solids (SS) concentration in effluent after aeration treatment, neutralization facilities, and seawater.

When a guide-pipe type sensor is used in excreta disposal facilities, the cable must not come in contact with the liquid. Consult Yokogawa.

Converter

Measuring method: Transmitted/scattered light comparison method

Measuring range: 500-20000 mg/L

Output signal: Two 4-20 mA DC signals; maximum load resistance: 600 Ω

- The range of mA 1 output can be switched by remote control.
- 22 ± 0.5 mA (burnup) or $2 \text{ mA} \pm 0.5$ mA (burndown) can also be selected as an output current during failure
- Both signals (setpoint or the most-recent value) can be retained during system maintenance or cleaning.
- The range of concentration can be set separately for both of these signals.

Output range setting range: Min. 0-1000 mg/L

Max. 0-20000 mg/L, (zero suppression can be set for readings up to 60% of the range, and span should be 1000 mg/L or more.)

Indication: Main display section; LCD six-digit display (maximum reading; 99999.9 mg/L; effective digits; 3 digits, minimum reading; 0.1 mg/L)

Message display section; Six-digit alphanumeric display

Contact output:

Types of alarm: S1, S2 and S3; alarm for upper/lower limits of concentration, HOLD, cleaning
S4; FAIL alarm

Alarm actions: Configurable with on/off output, hysteresis and delay time

Type of contact: Relay (voltage-free)

Capacity: 100 VA maximum at 250 V AC, 2 A
50 W maximum at 30 V DC, 2 A

States of contact:

| Contact | State of Contact at Power-Off | State of Contact at Power-On | |
|---------|-------------------------------|------------------------------|----------------|
| | | When not Activated | When Activated |
| S1 | Open | Open | Closed |
| S2 | Open | Open | Closed |
| S3 | Open | Open | Closed |
| Fail | Close | Open | Closed |

Contact input: Voltage-free contact for remote range selection and start of cleaning
 ON input resistance: 200 Ω or less
 OFF input resistance: 100 kΩ or more
 Ambient temperature: -10° to 55°C
 Relative humidity: 10 to 90% RH (non-condensing)
 Construction: Complies with JIS C0920 watertight, IEC IP65 and NEMA TYPE 4X standards
 Material: Casing; Molded aluminum alloy
 Cover; Polycarbonate
 Hood for sun protection (optional); Carbon steel or Stainless steel
 Mounting brackets (optional); Stainless steel
 Finish: Baked polyurethane coating (standard) or epoxy baked finish (optional)
 Color: Casing; Frosty white (equivalent to Munsell 2.5Y8.4/1.2)
 Cover; Deep sea moss green (equivalent to Munsell 0.6GY3.1/2.0)
 Mounting: JIS 50A (2-inch) pipe-mounted, wall-mounted or panel-mounted
 Power supply: 100-240 V AC, 50/60 Hz
 24 V DC
 Power consumption: 22 VA maximum (AC power)
 5 W maximum (DC power)
 Weight: Approximately 2.5 kg
 Dimensions: 144 (W) × 144 (H) × 135 (D) (mm)
 Cable inlet: Six ports, including sensor cable inlet; equipped with plastic watertight plugs equivalent to DIN PG13.5 (outer diameter of cable: 6-12 mm)
 Cable terminal: 0.13 to 4 mm² in size (only pin terminals can be connected)
 Conduit adapter (optional): G1/2 female thread or 1/2NPT thread
 Regulatory Compliance:
 EMC Regulatory Arrangement in Australia and New Zealand 
 EN 55011 Class A, Group 1
 Korea Electromagnetic Conformity Standard Class A
 한국 전자파적합성 기준

Sensor

Shape: Probe-like Sensor
 Measuring object: Concentration of mixed liquor suspended solids (MLSS) in an aeration tank in a sewage or industrial wastewater treatment plant
 Note: MLSS analyzer can not be used for measurement of suspended solids (SS) concentration in effluent after aeration treatment, neutralization facilities, and seawater.
 When a guide-pipe type sensor is used in excreta disposal facilities, the cable must not come in contact with the liquid. Consult with Yokogawa.
 Measuring principle: Transmitted and scattered light comparison
 Measuring range: 500-20000 mg/L (kaolin standard)

Temperature of measured object: 0-50°C
 Pressure of measured object: 0-200 kPa
 pH of measured object: pH 6 to 8
 Flow velocity: 0.2 to 1 m/sec (depending on holder)
 Cable length: 3, 5, 10, 15 or 20 m (when terminal box used, maximum cable length is 50 m within sensor cable length.)
 Material of wetted part or junction:
 Body; Stainless steel (SUS304 or equivalent)
 Window; glass
 O-ring; nitrile rubber
 Cable; PVC
 Weight: Approximately 0.5 kg plus N x 0.12 kg, where N is cable length m.
 Cleaning unit (optional): Jet cleaning
 Note: No cleaning unit can be used if the sensor is equipped with a floating ball holder.
 Material of jet cleaning unit: Polypropylene, polyethylene and SUS304 (wetted part)
 Utilities of jet cleaning:
 Pressure; water jet 100 to 200 kPa
 air jet 100 to 200 kPa
 Flow rate; water jet 5 to 20 L/min
 air jet 10 to 20 NL/min

Terminal Box

Used to install the converter and sensor unit separately in the distance.
 Ambient temperature: -10 to 50°C
 Construction: Complies with JIS C0920 rainproof standard
 Casing material: Fiberglass-reinforced polycarbonate resin
 Electrical connections:
 Sensor side: JIS A8-equivalent plastic watertight plug
 Converter side: JIS A15-equivalent plastic watertight plug with accessory cable (40 m long maximum); conduit adapter optional
 Casing color: Grayish green (Munsell 2.5GY5.0/1.0)
 Weight: Body; 0.5 kg
 Mounting bracket; 0.7 kg

Calibration Kit

Calibration-purpose vessel
 Magnetic stirrer
 Beaker (300 mL)
 Erlenmeyer flask (250 mL)
 Polyethylene bottle (500 mL)

■ CHARACTERISTICS

Linearity: ±4.5% F.S. (by stable kaolin solution)
 Repeatability: 2% F.S. (by calibration plate)
 Stability: Zero ±2% F.S./day (by city water)
 Span ±2% F.S./day (by calibration plate)
 F.S. means upper setting value of output range.

MODEL AND SUFFIX CODES

MLSS Converter

[Style: S2.2]

| Model | Suffix code | Option code | Description |
|--|------------------------|--------------|---|
| SS400G | ..... | ..... | MLSS Converter |
| — | -N | ..... | Always “-N” |
| Supply voltage | -1 -4 | ..... | 100-240 V AC, 50/60 Hz 24 V DC *1 |
| Language for cautionary notes or other remarks | -J -E | ..... | Japanese English |
| Option | Bracket | /U | Pipe or wall mounting (stainless steel) |
| | | /PM | Panel mounting (stainless steel) |
| | Hood | /H3 | Hood for sun protection (carbon steel) |
| | | /H4 | Hood for sun protection (stainless steel) |
| | Tag plate | /SCT | With stainless-steel tag plate |
| | Finish | /X1 | Epoxy baked finish |
| | Unit | /PPM | Readings in ppm |
| Adapter for conduit installation | | /AFTG | G1/2 (female thread) |
| | | /ANSI | 1/2NPT thread |
| | | /SPS | With screws for salt protection *2 |

*1: NOT 2-wire system

*2: The SUS screws with teflon coating are used at four corners of the cover.

MLSS Sensor

[Style: S2]

| Model | Suffix code | Option code | Description |
|-------------------------|--|-------------|---|
| SS300G | ..... | ..... | MLSS Sensor |
| — | -NN | ..... | Always “-NN” |
| Cable length | -03 -05 -10 -15 -20 | ..... | 3 m 5 m 10 m 15 m 20 m |
| Treatment on cable ends | -PN | ..... | Pin terminals |
| Option | Cleaning unit | /JTJ | Rc1/2 * connection with jet cleaning unit (female thread) |
| | | /JTA | 1/2NPT * connection with jet cleaning unit |
| | Bracket | /MS | Hardware for free-standing installation |

*: Choose this option if a holder is used.

Terminal Box

| Model | Suffix code | Option code | Description |
|----------------------------------|--|------------------------------|--|
| WTB10 | ..... | ..... | Terminal box |
| Application system | -SS1 | ..... | For MLSS analyzer |
| — | -NN | ..... | Always “-NN” |
| Cable length | -00 -05 -10 -20 -30 -40 | ..... | No cable (*1) 5 m 10 m 20 m 30 m 40 m |
| Option | Bracket | /P /W | Pipe mounting Wall mounting |
| Adapter for conduit installation | | /AWTB /ANSI | G1/2 (female thread) 1/2NPT thread |

The cable is a maximum of 50 m long, including the length of the sensor cable.

* 1: The dedicated extension cable should be used.

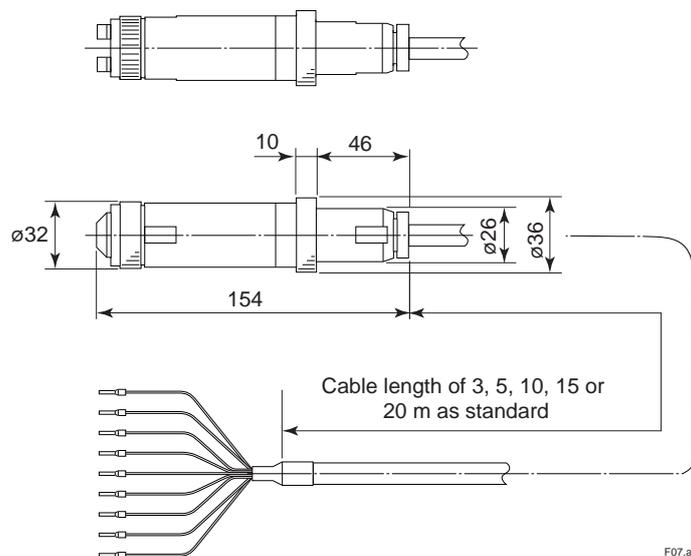
Calibration Kit

| Model | Suffix code | Option code | Description |
|---------------|-------------|-------------|--|
| SS380G | ..... | ..... | Calibration kit for MLSS concentration |
| — | -NN | ..... | Always “-NN” |

EXTERNAL DIMENSIONS

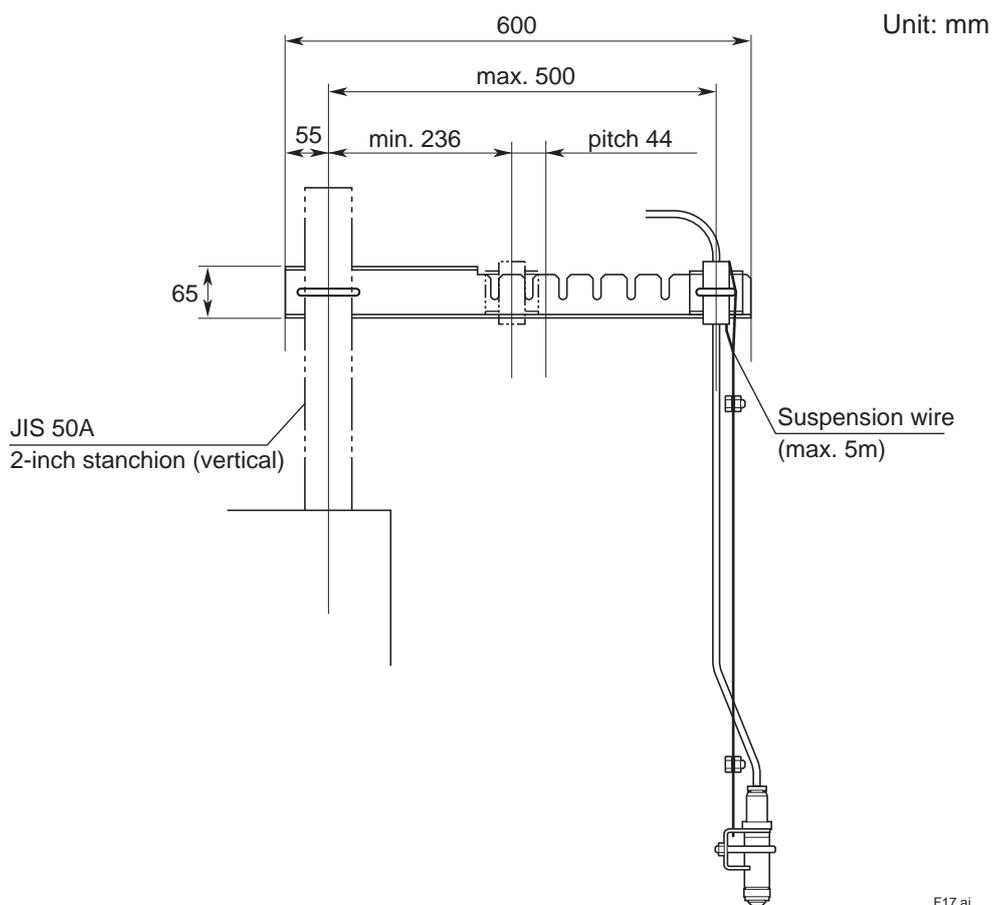
SS300G MLSS Sensor

Unit: mm

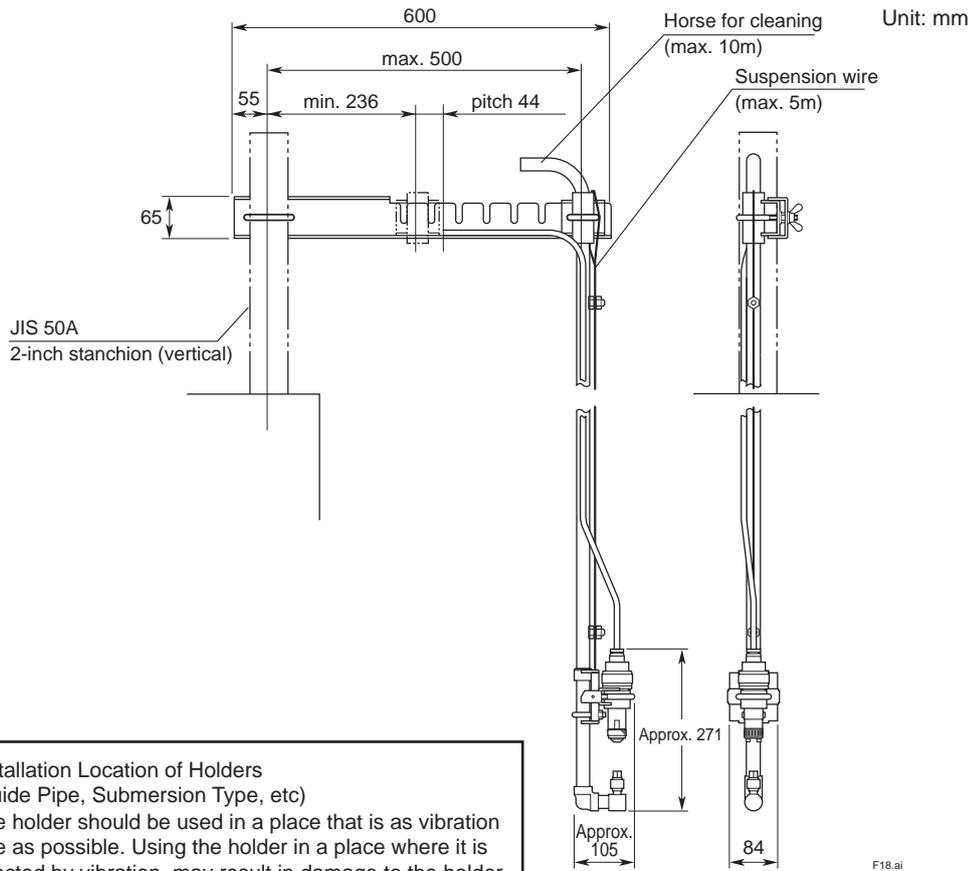


Note Air bubbles or dirt on the MLSS sensor can interfere with accurate measurement, especially in the low concentration level. For such applications, take an appropriate measure, e.g., tilt the sensor approximately 30° or add a cleaning system.

Hardware for Free-standing Installation



Jet Cleaning Unit for Free-standing Installation

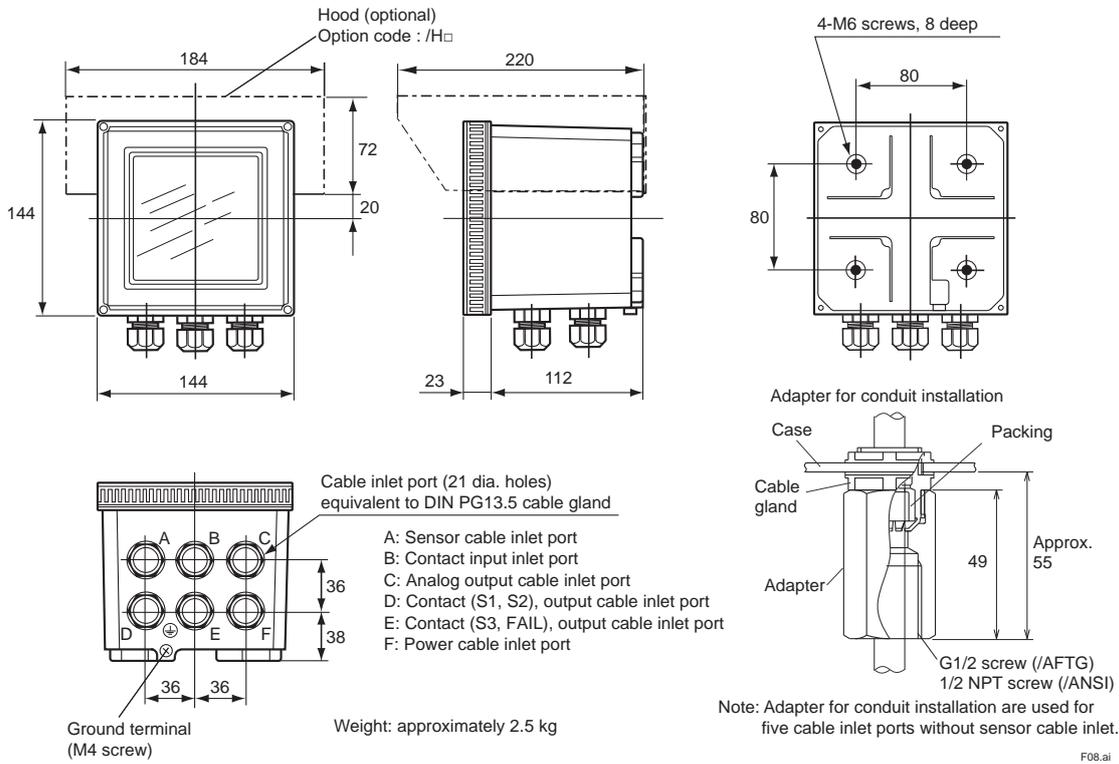


CAUTION



Installation Location of Holders
(Guide Pipe, Submersion Type, etc)
The holder should be used in a place that is as vibration free as possible. Using the holder in a place where it is affected by vibration, may result in damage to the holder.

SS400G MLSS Converter

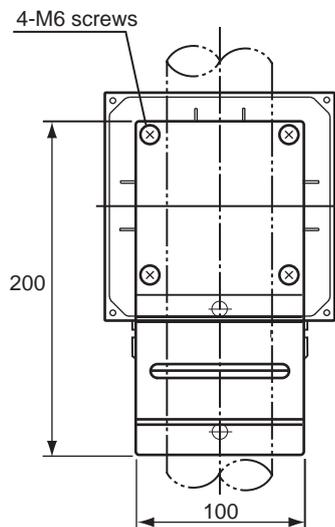
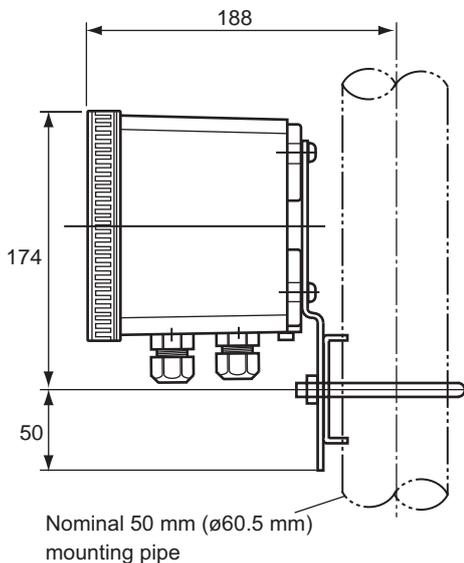


Pipe/Wall Mounting Brackets (Option Code: /U)

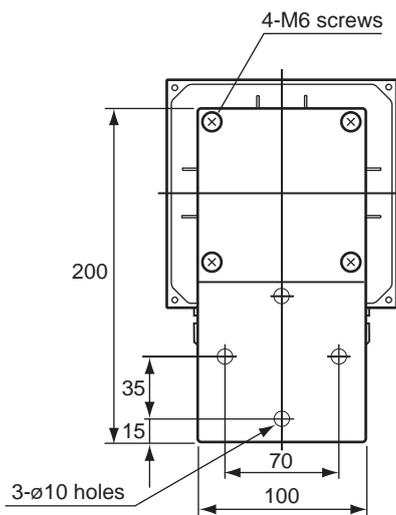
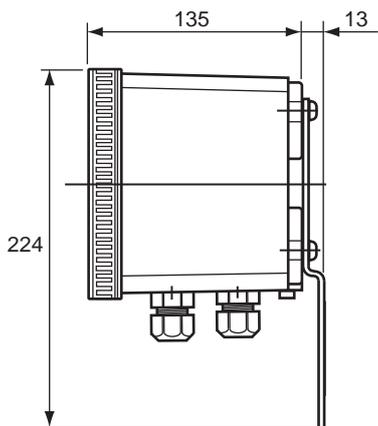
Weight: approximately 0.7 kg

Unit: mm

■ Example of bracket used for pipe mounting



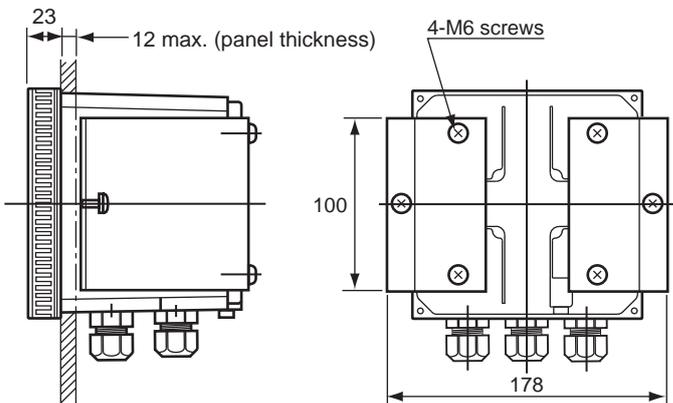
■ Example of bracket used for wall mounting



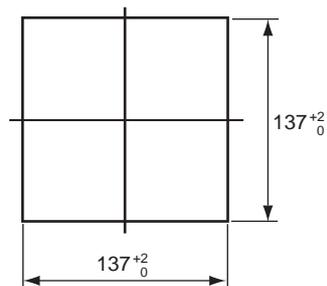
Panel Mounting Brackets (Option Code: /PM)

Weight: approximately 0.4 kg

Unit: mm

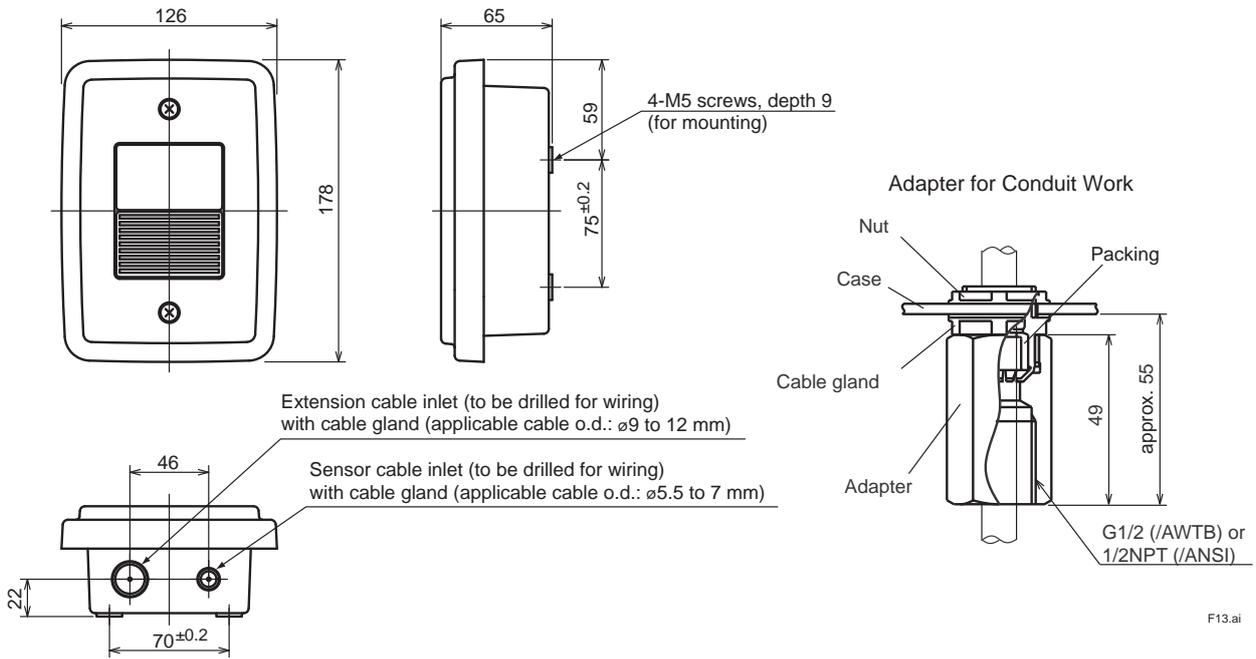


Panel cutout dimensions



WTB10 Relay Terminal Box

Unit: mm

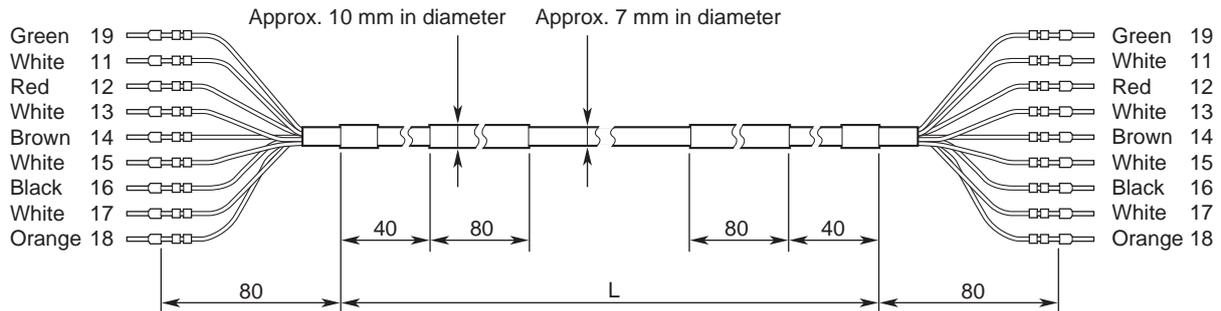


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WTB10-SS□ Terminal Box (first of two)

Dedicated Extension Cable (Not Supplied when Suffix Code “-00” is selected)

Unit: mm

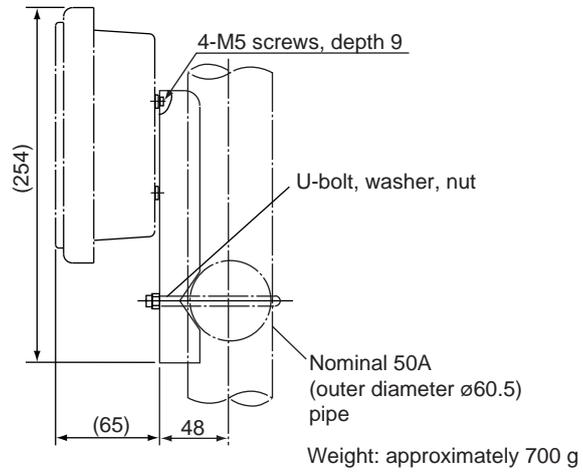
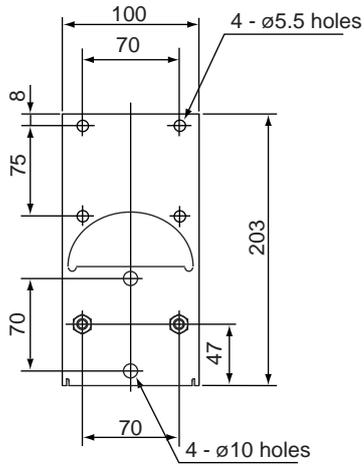


| Models and Suffix codes | L | P/N |
|-------------------------|----------------|---------|
| WTB10 - SS1 - NN - 05 | Approx. 5 000 | K9316SR |
| WTB10 - SS1 - NN - 10 | Approx. 10 000 | K9316SS |
| WTB10 - SS1 - NN - 20 | Approx. 20 000 | K9316ST |
| WTB10 - SS1 - NN - 30 | Approx. 30 000 | K9316SU |
| WTB10 - SS1 - NN - 40 | Approx. 40 000 | K9316SV |

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Pipe Mounting Bracket (Optional)
 (Option Code: /P)

Unit: mm

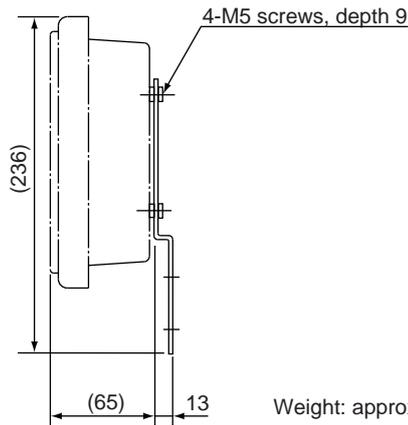
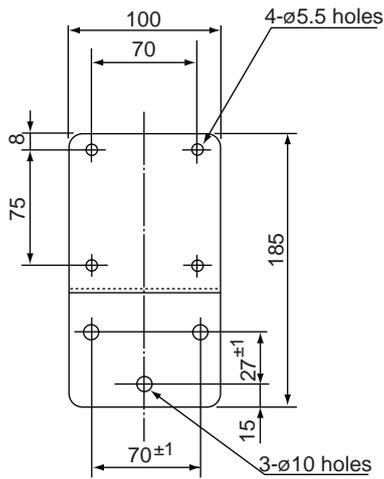


Weight: approximately 700 g

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Wall Mounting Bracket (Optional)
 (Option Code: /W)

Unit: mm

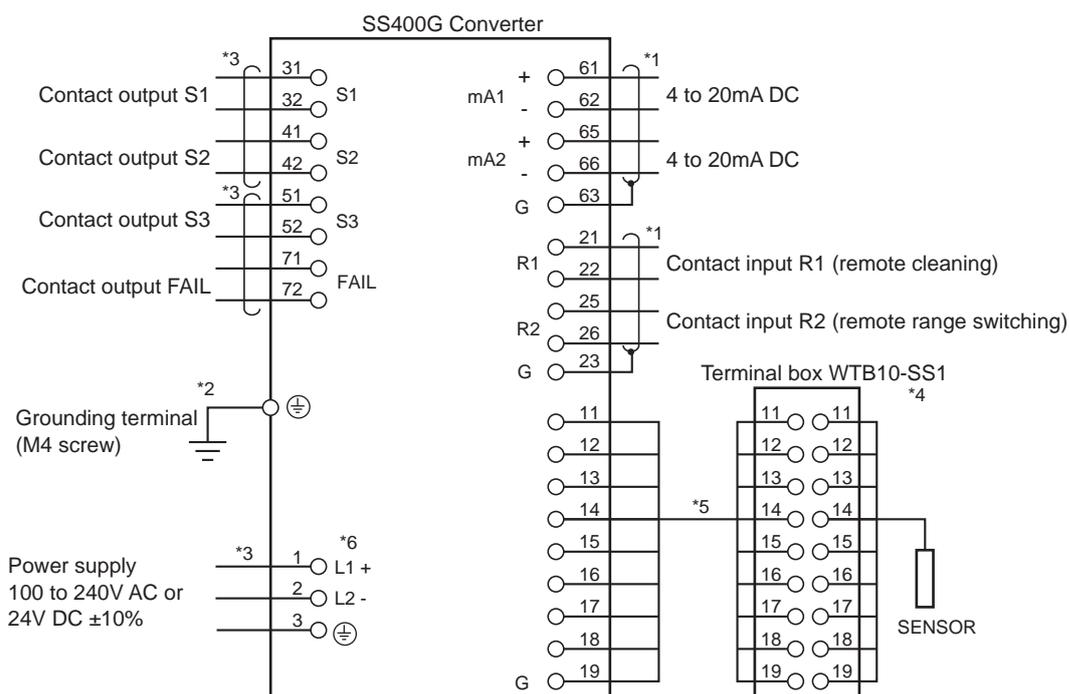


Weight: approximately 300 g

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WTB10-SS□ Terminal Box (second of two)

■ WIRING DIAGRAMS



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- *1: ALWAYS use a 6 to 12 mm OD. shielded cable.
- *2: ALWAYS ground (grounding resistance 100Ω or less) the grounding terminal of the casing of the MLSS converter. (Ground the power cord instead only if the above grounding is not feasible. Do NOT use two-point grounding).
- *3: ALWAYS use a 6 to 12 mm OD. cable.
- *4: Use the terminal box only if the MLSS converter is installed separately from the MLSS sensor. (Normally, the box is unnecessary.)
- *5: Specify this cable using the suffix code for a terminal box.
- *6: For 24 VDC power supply, connect the "+" terminal to L1 and the "-" terminal to L2.