
**User's
Manual**

**Model TB400G
Surface Scattering Light Turbidity Meter
[Style: S3]**

IM 12E04A02-02E

INTRODUCTION

Thank you for purchasing TB400G Surface Scattering Light Turbidity Meter.

This User's Manual contains all essential information for the user to make full use of TB400G.

Please read the following documents that are attached to the product before installing and using the TB400G. The attached documents vary according to the specifications.

Contents	Document number
FLXA402 4-Wire Converter Start-up and Safety Precautions	IM 12A01F01-01EN
PH450G pH/ORP Converter	IM 12B07C05-01E
PH8EFP KCl Filling type pH Sensor	IM 12B7J1-01E
PUS400G Ultrasonic Oscillator	IM 19C1B3-01E
FC400G Free Available Chlorine Analyzer (Non-Reagent Type)	IM 12F5A1-01E

An exclusive User's Manual might be attached to the products whose suffix codes or option codes contain the code "Z" (made to customers' specifications). Please read it along with this manual.

■ Specification Check

When the instrument arrives, unpack the package with care and check that the instrument has not been damaged during transportation. Please check that the product received meet the specified specifications by confirming the model code indicated on the nameplate. For details of the model code, refer to Section 2.3.

■ Before Measurement

The TB400G turbidimeter is preset with defaults prior factory shipment. Before measurement, verify that these factory default settings meet the operating conditions and if necessary, reconfigure parameters. For checking the default settings and recording changed parameters, use an Operation Parameter Setting List at the end of this manual.

■ Signal Words

Throughout this user's manual, you will find several different types of symbols are used to identify different sections of text. This section describes these icons.

CAUTION

This symbol gives information essential for understanding the operations and functions.

NOTE

This symbol indicates information that complements the present topic.

■ Symbol of unit "liter"

In this manual, the unit "liter" is described using the symbol of "L", not "l". On the real Turbidity Meter, the unit "liter" of the display unit is described as "l". So, the real display unit of turbidity is "mg/l", not "mg/L".

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- We do not use TM or ® mark to indicate those trademarks or registered trademarks in this user's manual.

SAFETY PRECAUTIONS

■ Safety, Protection, and Modification of the Product

- In order to protect the system controlled by the product and the product itself and ensure safe operation, observe the safety precautions described in this user's manual. We assume no liability for safety if users fail to observe these instructions when operating the product.
- If this instrument is used in a manner not specified in this user's manual, the protection provided by this instrument may be impaired.
- If any protection or safety circuit is required for the system controlled by the product or for the product itself, prepare it separately.
- Be sure to use the spare parts approved by Yokogawa Electric Corporation (hereafter simply referred to as YOKOGAWA) when replacing parts or consumables.
- Modification of the product is strictly prohibited.
- The following symbols are used in the product and user's manual to indicate that there are precautions for safety:

■ Notes on Handling User's Manuals

- Please hand over the user's manuals to your end users so that they can keep the user's manuals on hand for convenient reference.
- Please read the information thoroughly before using the product.
- The purpose of these user's manuals is not to warrant that the product is well suited to any particular purpose but rather to describe the functional details of the product.
- No part of the user's manuals may be transferred or reproduced without prior written consent from YOKOGAWA.
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■ Warning and Disclaimer

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Model TB400G

Surface Scattering Light Turbidity Meter

[Style: S3]

IM 12E04A02-02E 10th Edition

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1. OVERVIEW

The applications of turbidimeters, which have been used for operation or control of filtration plants, are expanding into turbidity detection in chemical processes and in measurement of suspended solid particulates in various types of industrial wastewater.

Model TB400G Surface Scattering Light Turbidity Meter is a process turbidimeter employing the principle of measuring surface-scattered light. This instrument has the following features.

- High performance, high reliability
- Self-diagnostic functions (such as detection of a disconnected lamp, automatic converter checking functions, and upper and lower limit alarms).
- Choice of functionality (such as automatic cleaning, range-free function, automatic zero calibration, etc).
- Easy maintenance through small, light-weight, and accessible design.
- No window surfaces to become contaminated.
- Bubble rejection signal processing.

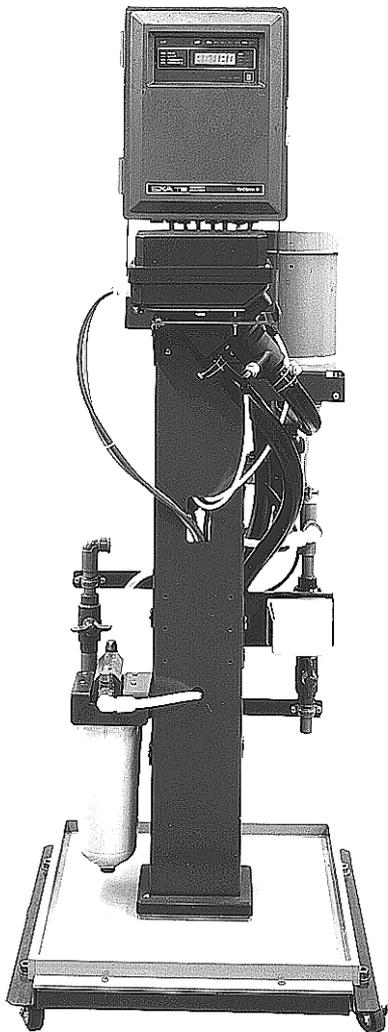


Figure 1.1 External View of the TB400G Surface Scattering Light Turbidity Meter (with automatic cleaning and automatic zero calibration)

1.1 System Configuration

The TB400G Surface Scattering Light Turbidity Meter comprises a detector, converter and sampling system (which supplies process sample water, zero-calibration water (“zero water”), and cleaning water). This instrument is classified into three types depending on the specifications for the sampling system. However, if specified in advance, the detector and converter may be delivered separately.

Here, four types of the instrument, including the delivery of detector and converter separately, will be described. Details on the detector and converter are described in Section 1.2, “Operating Principle”.

1.1.1 TB400G-□-□-NN, -KC (without sampling system)

The detector and converter are available separately and can be assembled into any sampling system.

The flowrate condition for sample is 1.5 to 2 L/min. If the flowrate exceeds this range, satisfy the flowrate condition by providing a head tank (constant-level chamber) or the like.

For measurements of low turbidity (less than 200 mg/L), prepare a sampling system which can supply the zero water (tap water filtered with a zero-turbidity filter).

1.1.2 TB400G-□-□-A1 (with sampling system, without automatic cleaning or automatic zero calibration)

This is a system which combines the detector and converter with a sampling system to manually supply process sample, zero water, and cleaning water (see subsection 2.6.1).

The measuring water flows into a header tank (constant-level chamber), serving also as a bubble separation tank, after passing the ball valve located after the tap water inlet port.

Debubbled sample in this tank flow into the measuring cell in the detector at a constant flowrate, and drains through the drain outlet after overflowing at the measuring cell.

The cleaning water passes the ball valve located after the tap water inlet port and flows into the measuring cell in the detector from the cell side. The cleaning water then starts swirling and removes dirt on the measuring cell wall. The dirt, together with the opening the ball valve mounted under the header tank.

During zero check, the zero water is filtered by passing through a zero-turbidity filter from the tap water inlet. This zero water flows into the measuring cell in the detector via the head tank through a tube separate from that for the sample and drains through the drain outlet.

1.1.3 TB400G-□-□-A2 (with automatic cleaning and without automatic zero calibration)

This is a system which comprises the TB400G-□-□-A1 model with the automatic cleaning function added (see subsection 2.6.2).

The sampling system of this system incorporates a solenoid valve at the cleaning water tube and an electric motor-operated valve under the header tank. These provisions automatically clean the measuring cell under the detector in a sequence preset in the converter.

1.1.4 TB400G-□-□-A3 (with automatic cleaning and zero calibration)

This is a system which comprises the TB400G-□-□-A1 model with the automatic cleaning and automatic zero calibration functions added (see subsection 2.6.3).

The sampling system of this system incorporates solenoid valves at the cleaning water tubing and zero calibration tubing and electric motor-operated valves under the header tank and at the measuring-water tubing. These provisions automatically clean the measuring cell in the detector and perform zero calibration in a sequence preset in the converter.

1.2 Operating Principle

The operating principle of the Surface Scattering Light Turbidity Meter employs a method of measuring the amount of the light scattering that takes place close to the surface of the water sample. The measuring system comprises a detector and a converter. This section describes the meter configuration and operating principle.

The detector is comprises a measuring cell and a detecting section. Sample that flows into the measuring cell from the bottom of the cell overflows at the top of the cell.

Meanwhile, a tungsten lamp closed inside the detector emits light onto the surface of the sample through a system of lenses. This light is separated into scattered, reflected, and transmitted light on the water's surface. The transmitted light and reflected light are absorbed in a dark area equivalent to a black body.

This scattered-light intensity (L) is proportional to the turbidity as shown here:

$$L = K \cdot Q \cdot S$$

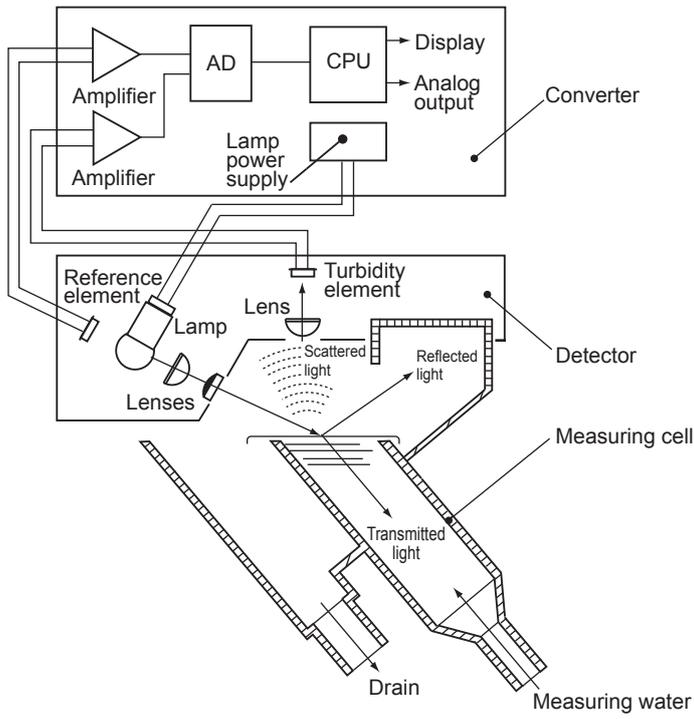
Where K: a constant relative to turbidity,
S: turbidity,
Q: amount of light from the lamp.

The scattered light is detected by a turbidity element (a silicon photodiode). It is focused onto the element with a lens inside the detecting section. This gives the scattered light signal to the converter.

In addition, a reference element is incorporated in the detecting section to hold the amount a light (Q) from the lamp constant, and it also provides a light-detection signal to the converter.

The measuring circuit of the converter is sealed in a housing of aluminum alloy together with the operating panel and a terminal block for external wiring. This measuring circuit amplifies and calculates the input from the turbidity element in the detector and outputs a signal (1 to 5 V DC or 4 to 20 mA DC) corresponding to the measuring range.

The converter also calculates the reference element input from the detector to control the lamp voltage so that the amount of light from the lamp is constant.



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Figure 1.2 Operating Principle

2. SPECIFICATIONS

2.1 Standard Specifications

- Measurement: Turbidity of tap water, river water, and water used in general processes
- Measurement method: Surface scattering-light measurement
- Measuring Range: 0-2 to 0-2000 mg/L
- Display: 4-digit LED display (resolution; 0.01 mg/L, maximum display value; 2200 mg/L)
- Display Unit: "mg/L (default)" or "度", selectable
- Note: "FTU" unit, a turbidity unit when formazin standard is used, is also available. Since the instrument uses kaolin standard, reference sensitivity calibration using formazin standard is required for the FTU display.
In this manual, the unit "liter" is described as "L". Real display unit is "mg/l". The unit "度" means degree.
- Output Range: 3 range switching
Remote or local (default) range switching, selectable
Auto or manual (default) range, selectable
For auto range, changeover point is user configurable.
3 ranges are user configurable. The span should be 20% or more of the upper range limit or 2 mg/L (default), whichever is greater.
- Analog Output Signal: 4 to 20 mA DC (maximum load resistance: 550 Ω) or 1 to 5 V DC (output resistance: 100 Ω or less)
- Digital Output Signal: Conforms to RS-232C
- Communication Specifications:
- Data format: ASCII
 - Data length: 8 bits
 - Baud rate: 1200 bps
 - Parity: None
 - Start bit: 1 bit
 - Stop bit: 2 bits
- Transmission method: Mono-directional (transmission only), asynchronous system
- Communication Data:
- Measured turbidity values: Converter's display data (turbidity indicated value) are transmitted.
Data consists of 6 characters including signs and decimal points.
- Example 1: #0050.0^{C_RL_F}
- Example 2: #001.00^{C_RL_F}
- Example 3: #-00.50^{C_RL_F}
- Example 4: #_O.L_ _^{C_RL_F}
- Note: A space code is transmitted by "_"
- High/low alarm signal: Transmitted continuously when high/low limit is detected.
#ALARMCRLF
- Range output signal: Transmitted once when range is changed over.
- Range 1: #RANGE1^{C_RL_F}
- Range 2: #RANGE2^{C_RL_F}
- Range 3: #RANGE3^{C_RL_F}
- Auto cleaning/calibration signal: Transmitted once when auto cleaning or calibration starts and ends. Note that this is not transmitted when cleaning or calibration is manually performed in <MAINT.> mode.
- Start: #CLEANING_START^{C_RL_F}
- End: #CLEANING_END^{C_RL_F}
- Maintenance/measurement signal: Transmitted once when mode is switched.
- Maintenance: #MAINTENANCE^{C_RL_F}
- Measurement: #MEASURE^{C_RL_F}

Failure signal: Transmitted continuously when failure occurs. Transmitted in succession when multiple failures occur.
 #ERR**^C_R^L_F error numbers (11, 12, 13, 14, 15, 18, 25, 26) in **.
 Example 1: #ERR11^C_R^L_F
 Example 2: #ERR11_ERR18^C_R^L_F
 Note: A space code is transmitted by “_”

Data Update Interval: Approx. 1 second
 Cable Length: 10 m max.
 Contact Output: Maintenance output (during maintenance)
 Fail output (when an error is detected)
 Range output (corresponding to the output range selected) (shared COM)
 High/low limit alarm (default) or auto calibration/cleaning output, selectable.

Type of contact output	Power off	Power on *1	
		Not in Action	In Action
Maintenance	Closed	Open	Closed
Fail	Open	Closed	Open
High/low alarm	Closed	Closed	Open
Auto zero calibration/cleaning	Closed	Open	Closed

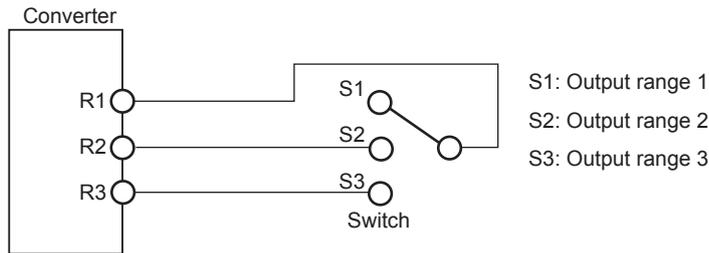
*1: Contact status (open/closed) when power is turned on is user configurable.

Contact Rating:

Maximum switching voltage: 250 V AC or 220 V DC (resistive load)
 Maximum carrying current: 2 AAC or 2 A DC (resistive load)
 Maximum switching capacity: 120 VA or 60 W (resistive load)

Contact Input: Remote range switching (shared COM)

On input resistance: 200 Ω or less
 Off input resistance: 100 kΩ or more



Remote Range Switching Diagram

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Converter's Functions:

Display Function:

Data: LED display – turbidity, lamp voltage, turbidity element detecting current, reference element detecting current, analog output in %, analog output in mA, zero point error and slope.
 Operation status: Lamp – <MEAS.>, <MAINT>, <PROGRAM 1> and <PROGRAM 2> modes.
 Indicator – output signal, HOLD, CAL, WASH, FAIL
 Instrument status: Indicator – lamp and each solenoid valve.

Maintenance Functions (<MAINT.> mode):

Zero calibration, shift calibration, span calibration, sensitivity correction calibration, manual start of auto cleaning, manual start of auto zero calibration, error code indication, error reset and calibration of lamp control reference value.

Setting Functions:

<PROGRAM.1> mode: Setting of output range, average coefficient, output value in failure condition, bi-linear output, high alarm, low alarm and spike detection function.
 <PROGRAM.2> mode: Setting of auto cleaning time and auto zero calibration time, and selection of enabling/disabling failure detection functions.

Automatic Cleaning Function:	Water jet cleaning. Cleaning time and interval are user configurable. (When auto cleaning is specified)
Automatic Zero Calibration Function:	Zero point calibration using zero water (When auto cleaning/zero calibration is specified)
Error Detection Function:	Turbidity overrange, lamp disconnection, lamp voltage failure, AD circuit failure, memory failure and CPU failure.
Check Function:	Converter operation check
Manual Calibration:	
Zero calibration:	Using zero water or light source off zero (selectable)
Span calibration:	Using calibration plate
Other Functions	Breakpoint line-segment (bi-linear) output, upper and lower limits alarms
Material:	
Detector:	Modified black PPE (wetted part)
Piping:	Hard PVC, polyethylene resin, and polypropylene resin (all for wetted parts)
Stanchion:	Carbon steel or stainless steel
Converter:	Aluminum alloy casting
Finish and Color:	
Converter:	Baked polyurethane resin finish Color; Munsell 0.6GY3.1/2.0 and Munsell 2.5Y8.4/1.2
Stanchion:	Baked polyurethane resin finish Color; Munsell 0.6GY3.1/2.0
Ambient Temperature:	-5 to 50°C (sample and tap water freeze in winter may need protection against freezing)
Ambient Humidity:	5 to 95%RH (non-condensing)
Storage Temperature:	-30 to 70°C
Installation Location:	Indoors (For outdoor installation, a protection against rain is required separately)
Installation:	Detector and converter: Pipe- or rack- mounted With sampling system: Anchor bolt mounting
Piping Connection:	
With sampling system:	Drain: VP40 Others: VP16
Without sampling system:	25 mm ID hose joint
Cable Inlet:	5 cable glands (bottom of the converter)
Applicable wire:	6 to 12 mm, 9 to 11 mm when with arrester option
Wiring:	Power, analog output, digital output, contact output, contact input and ground (using the ground terminal inside the converter or the ground terminal on the outside of the case)
Power Supply:	100/110 V AC, 50/60 Hz, or 200/220 V AC, 50/60 Hz
Noise filter assembly:	(only for TB400G-□-□-KC)
Ambient temperature:	-10 to 50°C (no dew condensation allowed)
Storage temperature:	-25 to 70°C
Construction:	JIS C 0920 Watertight (IP53)
Power Consumption:	
Detector and converter:	50 VA or less, respectively
With sampling system:	200 VA or less (in full specifications, excluding combination instruments)
Weight:	Detector: Approx. 3 kg Converter: Approx. 9 kg With sampling system: Approx. 50 kg (in full specifications, excluding combination instruments)
Dimensions:	Detector: 245 (W) x 250 (H) x 200 (D) mm Converter: 260 (W) x 340 (H) x 150 (D) mm With stanchion: 530 (W) x 1450 (H) x 550 (D) mm

- Water Sample:
 - With sampling system:
 - Flow rate: 2 to 10 L/min
 - Pressure: 20 to 500 kPa
 - Temperature: 0 to 50°C (Ambient temperature should not exceed 30°C)
 - Without sampling system:
 - Flow rate: 1.5 to 2 L/min
 - Temperature: 0 to 50°C (Ambient temperature should not exceed 30°C)
- Zero Water and Cleaning Water (Tap Water): (With Sampling System)
 - Turbidity: 2 mg/L or less
 - Temperature: 0 to 50°C (Ambient temperature should not exceed 30°C)
 - Pressure: 100 to 500 kPa
 - Flow rate:
 - Zero water: 2 to 10 L/min
 - Cleaning water: 3 to 6 L/min
 - Consumption:
 - Zero water: Approx. 380 L/day (at a flow rate of 2 L/min)
 - Cleaning water: Approx. 90 L/min (at a flow rate of 3 L/min)
(when auto cleaning/zero calibration is enabled and time setting is factory default)

2.2 Characteristics

- Linearity (when using kaolin standard):
 - Upper range limit of 1000 mg/L (degrees) or less; $\pm 2\%$ of upper range limit
 - Upper range limit of 2000 mg/L (degrees) or less; $\pm 5\%$ of upper range limit
- Linearity (when using polystyrene latex standard):
 - Upper range limit of 100 mg/L or less; $\pm 2\%$ of upper range limit
- Repeatability:
 - Standard solution; 2% of upper range limit
- Supply voltage effects: $\pm 1\%$ of upper range limit / within $\pm 10\%$ of rated voltage
- Ambient temperature effects: $\pm 1\%$ of upper range limit / 10°C (when using calibration plate)
- Response Time: 2 minutes or less
(90% response, with sampling system, flow rate of 3 L/min)
- Warm-up Time: Approx. 30 minutes

Regulatory Compliance (for TB400G-□-□-KC)
 Korea Electromagnetic Conformity Standard Class A 한국 전자파적합성 기준

A급 기기 (업무용 방송통신기자재)
 이 기기는 업무용(A급) 전자파적합기기로서 판매자 또는
 사용자는 이 점을 주의하시기 바라며, 가정외의 지역에서
 사용하는 것을 목적으로 합니다.

2.3 Model and Suffix Codes

[Style: S3]

Model	Suffix Code	Option Code	Description
TB400G	.....	.....	Surface Scattering Light Turbidity Meter
Output	-4	.....	4 to 20 mA DC
	-5	.....	1 to 5 V DC
Power supply	-1	.....	100 V AC, 50/60 Hz
	-3	.....	110 V AC, 50/60 Hz
	-6	.....	200 V AC, 50/60 Hz
	-7	.....	220 V AC, 50/60 Hz
Device configuration and Application	-NN	.....	Without sampling system, automatic cleaning, or automatic zero calibration *1
	-A1	.....	With sampling system, but without automatic cleaning or automatic zero calibration
	-A2	.....	With sampling system and automatic cleaning, but without automatic zero calibration
	-A3	.....	With sampling system, automatic cleaning, and automatic zero calibration
	-KC	.....	For Korea. Without sampling system. (without cleaning, without auto.zero calibration) *8
Optional specification	Mounting bracket	/P	Mounting bracket: For pipe mounting *2
		/R	Mounting bracket: For rack mounting *2
	Piping	/B	Tie-in with rear piping *3
	Stanchion material	/S	Stainless steel stanchion *3
	Bubble treatment	/L	Bubble retardant for low range *3 *4
	Tag plate	/SCT	Stainless steel tag plate
	Combination analyzer	/PHN5	With PH450G pH meter (without ultrasonic cleaning) *3 *5
		/PHN6	With FLXA402 (without ultrasonic cleaning) *3 *5
		/PHU5	With PH450G pH meter (with ultrasonic cleaning) *3 *5
		/PHU6	With FLXA402 (with ultrasonic cleaning) *3 *5
	Arrestor PSL calibration	/TT3	With 500 mL KCl reserve tank for pH sensor *5
		/FC	With non-reagent type free available chlorine analyzer *3 *5
		/ARS	With arrestor *6
	/PSL	Calibration using polystyrene latex *7	

- *1: A de-foaming tank (head tank) is to be provided. It is to be installed to adjust the sample flow to the detector at 1.5 to 2 L/min.
- *2: These options are available for the specification of "without sampling system" (suffix code: -NN, -KC).
- *3: These options are available for the specification of "with sampling system" (suffix code: -A1, -A2 or -A3).
- *4: When measuring range is low (200 mg/L or less) and if air bubbles are likely to be formed on the sample, this option is to be specified. When measuring range is high (more than 200 mg/L), this option is not to be specified. Because air bubbles in high ranges don't disturb the measurement, and because clogging or reduction of flow rate may occur at the removal port of air bubbles on the flow line.
- *5: A pH meter with necessary units, or non-reagent type free available chlorine analyzer should be purchased separately. Both of a pH meter and non-reagent type free available chlorine analyzer can not be installed together on the TB400G. Available model & suffix codes are as follows;
Non-reagent type free available chlorine analyzer (refer to the GS 12F5A1-E)
FC400G-□□□*A/ST (for /FC)
* The power supply of FC400G is to be suitable for the power supply of TB400G.
pH meter (refer to the GS 12B07B02-E, GS 12J05C02-00E, GS 12A01F01-01EN, and GS 12B07C05-01E)
pH sensor
PH8EFP-03-TN-TT1-N-G*A (for /PHN□ or /PHU□, without /TT3)□
PH8EFP-03-TN-TT3-N-G*A (for /PHN□ or /PHU□, and /TT3)
pH holder
PH8HF-PP-JPT-T-NN-NN*A (without cleaning) (for /PHN□)
PH8HF-PP-JPT-T-S3-C1*A (with ultrasonic cleaning) (for /PHU□)
pH converter
FLXA402-A-B-AJ-P1-NN-A2-WR-N-N-J-NN (for /PHN6 or /PHU6)
PH450G-A-J (for /PHN5 or /PHU5)
Ultrasonic oscillator
PUS400G-NN-NN-□-J
* The power supply of PUS400G is to be suitable for the power supply of TB400G.
- *6: This option is not available for the options of /PHN□, /PHU□ or /FC.
- *7: Polystyrene latex solution of which concentration is 2 degrees is used as a standard solution to calibrate the TB400G. Without this option, the standard TB400G is calibrated with a Kaolin solution.
- *8: No additional specifications other than "/P", "/R" and "/SCT" can be chosen.

2.4 Accessories

Item	Quantity	Remarks
Standard calibration plate	1	Housed in the converter
Silicone cloth	1	
Lamp	1	As a spare
Fuse	4 each	1 A and 3 A (as spares)
Pipe mounting bracket (optional)	1 set	When specifying option code "/P"
Rack mounting bracket (optional)	1 set	When specifying option code "/R"
Soft PVC tube, 1 m	2	For detector piping (for without sampling system)
Clamp	2	For detector piping (for without sampling system)

2.5 External Dimensions

Dimensions, piping and internal wiring diagram for the TB400G are shown on following pages. For figure numbers to be referred corresponding each models and codes are shown in the Table 2.1. Table 2.1 uses following signs.

FC: free available chlorine analyzer, pH: pH meter,
 US: ultrasonic oscillator, ARS: arrester,
 Yes: installed, No: not installed, Op: optionally installed

Table 2.1 **Index of dimensions, piping and internal wiring diagram**

Model and codes (option)	FC	pH	US	ARS	Dimensions	Piping	Wiring *1
TB400G-□-□-NN	No	No	No	No	Fig. 2.1.1		
TB400G-□-□-KC	No	No	No	No	Fig. 2.1.2		
TB400G-□-□-A1(/ARS) (Bottom Piping)	No	No	No	Op	Fig. 2.2.1	Fig. 2.14	Fig. 2.33
TB400G-□-□-A1(/ARS)/B (Rear Piping)	No	No	No	Op	Fig. 2.2.2		
TB400G-□-□-A2(/ARS) (Bottom Piping)	No	No	No	Op	Fig. 2.3.1	Fig. 2.21	
TB400G-□-□-A2(/ARS)/B (Rear Piping)	No	No	No	Op	Fig. 2.3.2		
TB400G-□-□-A3(/ARS) (Bottom Piping)	No	No	No	Op	Fig. 2.4.1	Fig. 2.22	
TB400G-□-□-A3(/ARS)/B (Rear Piping)	No	No	No	Op	Fig. 2.4.2		
TB400G-□-□-A1/PHU□ (Bottom Piping)	No	Yes	Yes	No	Fig. 2.5.1a/b	Fig. 2.23	Fig. 2.31
TB400G-□-□-A1/PHU□/B (Rear Piping)	No	Yes	Yes	No	Fig. 2.5.2a/b		
TB400G-□-□-A2/PHU□(Bottom Piping)	No	Yes	Yes	No	Fig. 2.6.1a/b	Fig. 2.24	
TB400G-□-□-A2/PHU□/B (Rear Piping)	No	Yes	Yes	No	Fig. 2.6.2a/b		
TB400G-□-□-A3/PHU□(Bottom Piping)	No	Yes	Yes	No	Fig. 2.7.1a/b	Fig. 2.25	
TB400G-□-□-A3/PHU□/B (Rear Piping)	No	Yes	Yes	No	Fig. 2.7.2a/b		
TB400G-□-□-A1/PHN□(Bottom Piping)	No	Yes	No	No	Fig. 2.8.1a/b	Fig. 2.23	Fig. 2.30
TB400G-□-□-A1/PHN□/B (Rear Piping)	No	Yes	No	No	Fig. 2.8.2a/b		
TB400G-□-□-A2/PHN□(Bottom Piping)	No	Yes	No	No	Fig. 2.9.1a/b	Fig. 2.24	
TB400G-□-□-A2/PHN□/B (Rear Piping)	No	Yes	No	No	Fig. 2.9.2a/b		
TB400G-□-□-A3/PHN□(Bottom Piping)	No	Yes	No	No	Fig. 2.10.1a/b	Fig. 2.25	
TB400G-□-□-A3/PHN□/B (Rear Piping)	No	Yes	No	No	Fig. 2.10.2a/b		
TB400G-□-□-A1/FC (Bottom Piping)	Yes	No	No	No	Fig. 2.12.1	Fig. 2.26	Fig. 2.32
TB400G-□-□-A1/FC/B (Rear Piping)	Yes	No	No	No	Fig. 2.11.2		
TB400G-□-□-A2/FC (Bottom Piping)	Yes	No	No	No	Fig. 2.12.1	Fig. 2.27	
TB400G-□-□-A2/FC/B (Rear Piping)	Yes	No	No	No	Fig. 2.12.2		
TB400G-□-□-A3/FC (Bottom Piping)	Yes	No	No	No	Fig. 2.13.1	Fig. 2.28	
TB400G-□-□-A3/FC/B (Rear Piping)	Yes	No	No	No	Fig. 2.13.2		

*1: First of all see Figure 2.29 and Table 2.2, then refer to described Figure in this table also.

2.5.1 TB400G-□-□-NN, -KC

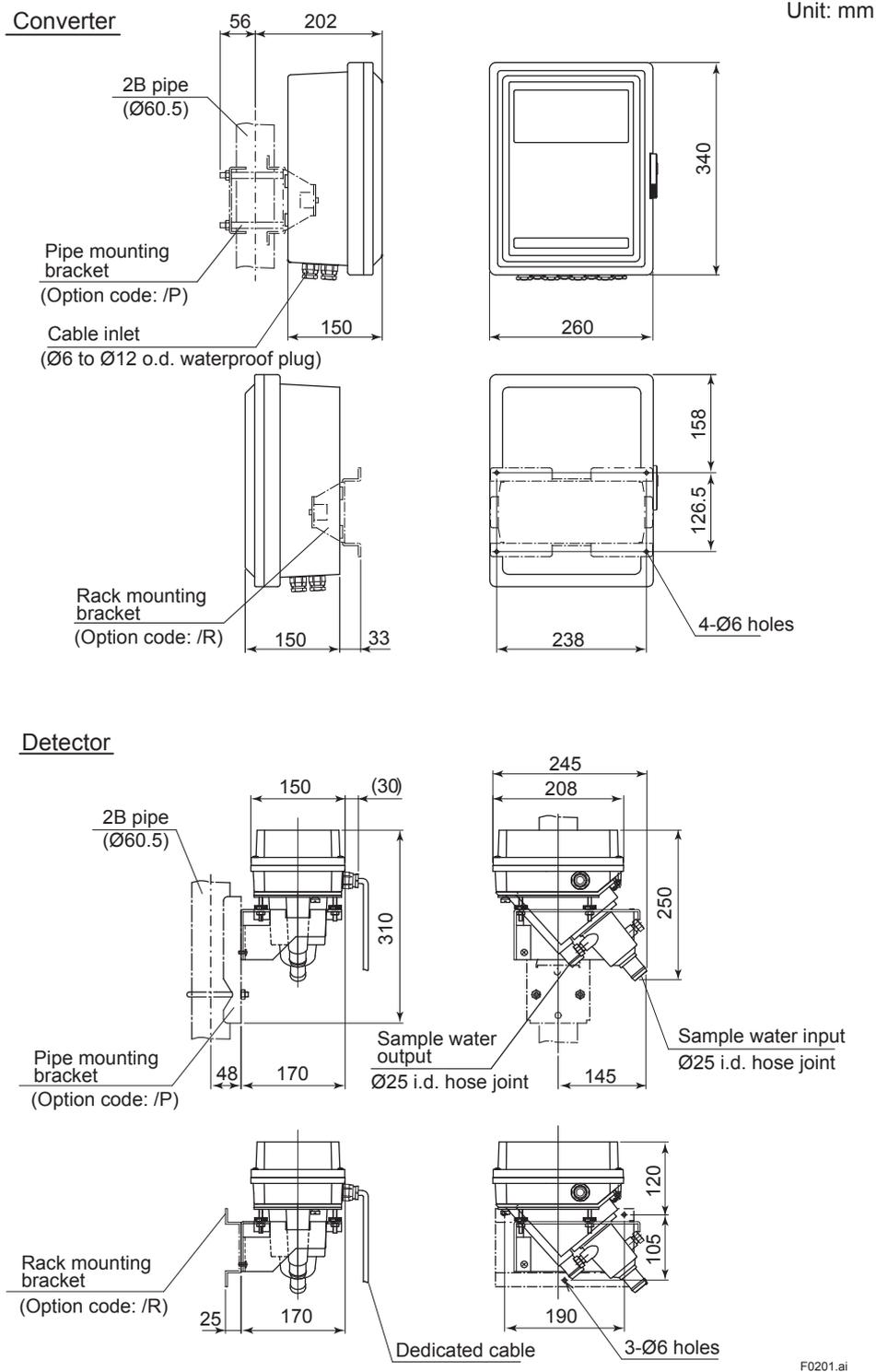
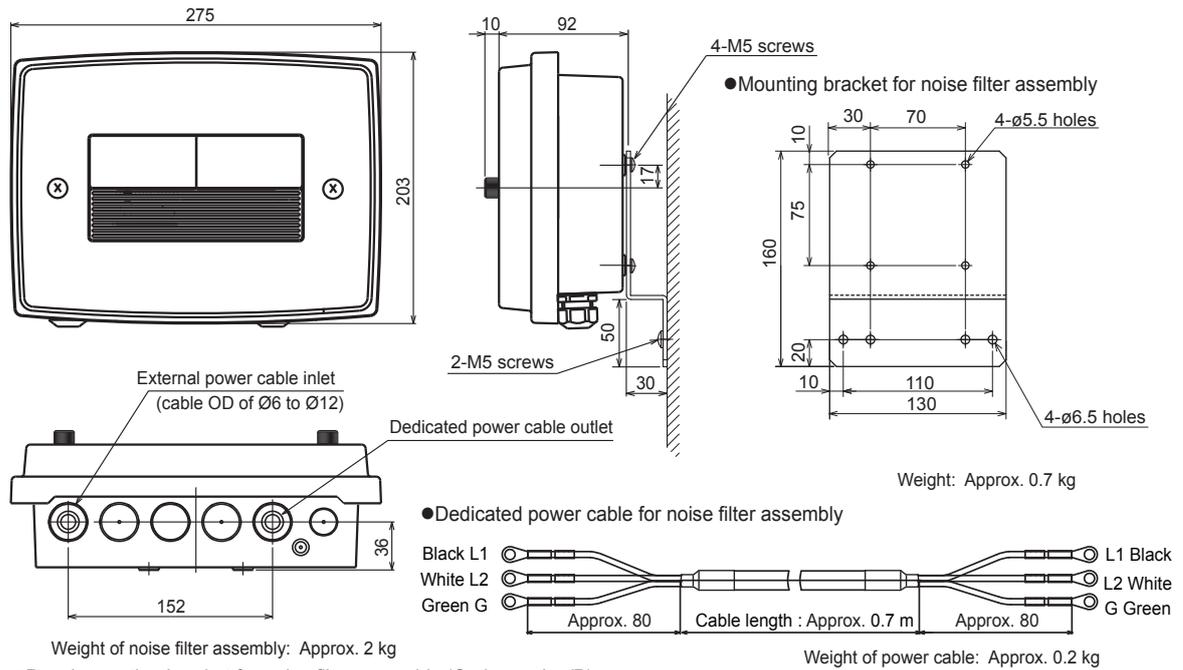


Figure 2.1.1 TB400G-□-□-NN External Dimensions

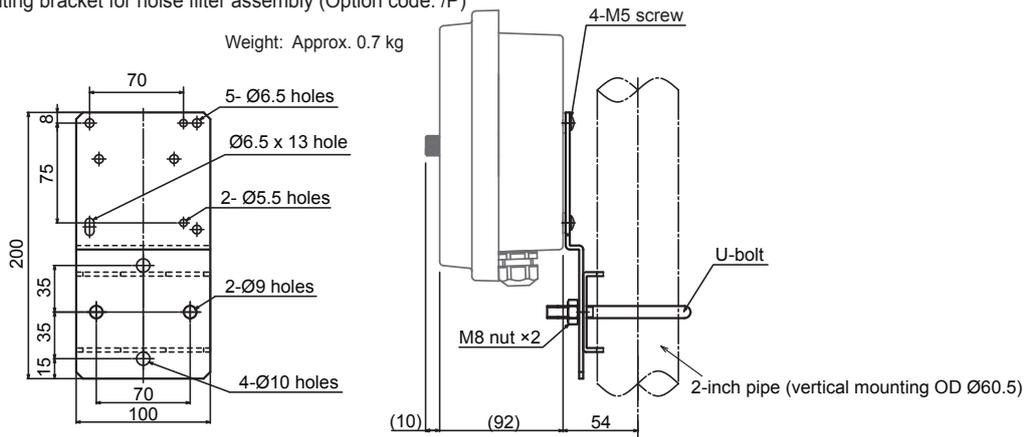
Unit: mm

The converter and the detector are the same as figure 2.1.1.

- Noise filter assembly



- Panel mounting bracket for noise filter assembly (Option code: /P)



In the case of optional cord /P, the standard mounting bracket for noise filter assembly is not attached.

Figure 2.1.2 TB400G-□-□-KC External Dimensions

2.5.2 TB400G-□-□-A1

Unit: mm

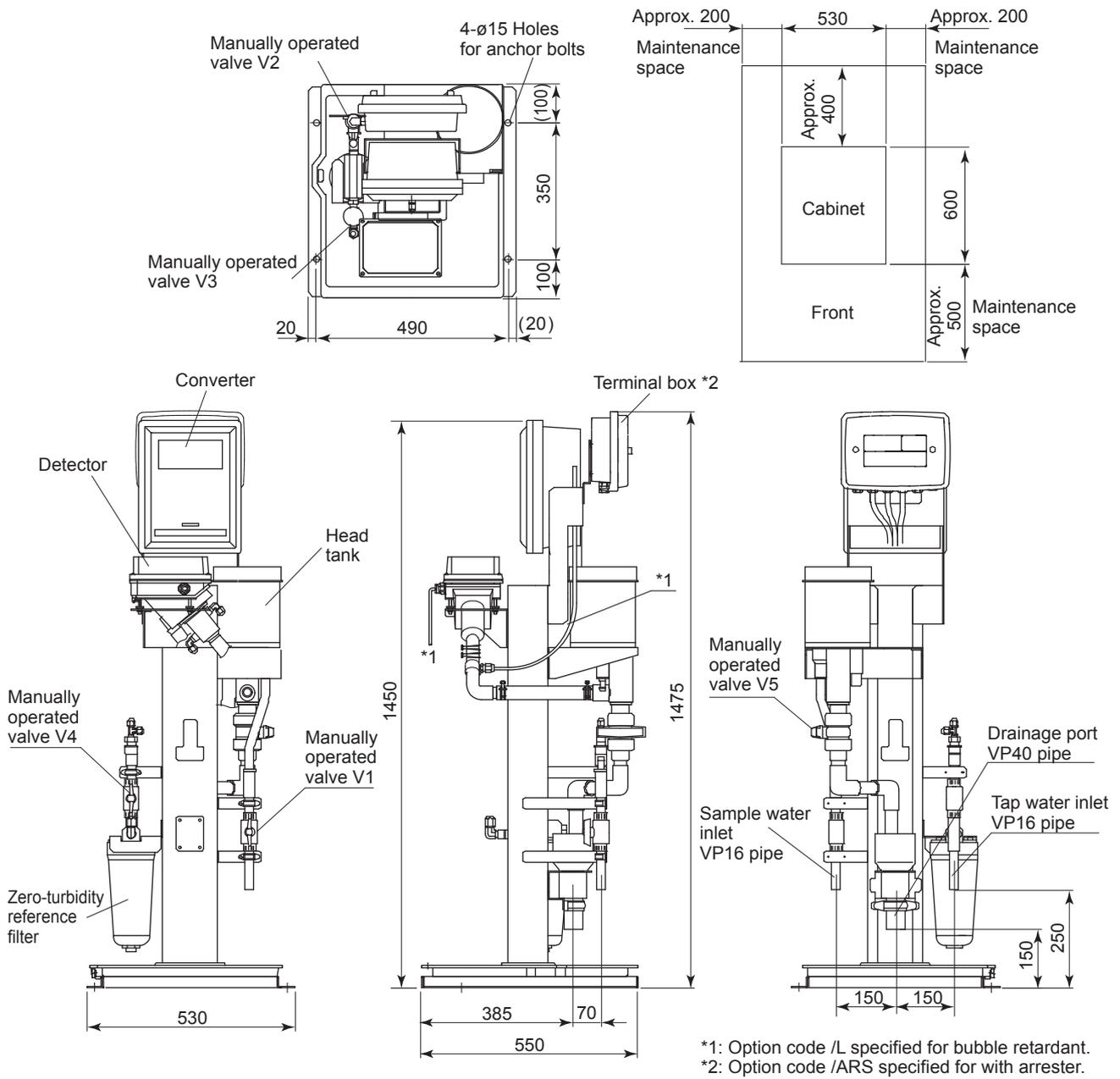


Figure 2.2.1 TB400G-□-□-A1 (Bottom Piping) External Dimensions

Weight: Approx. 50kg

Unit: mm

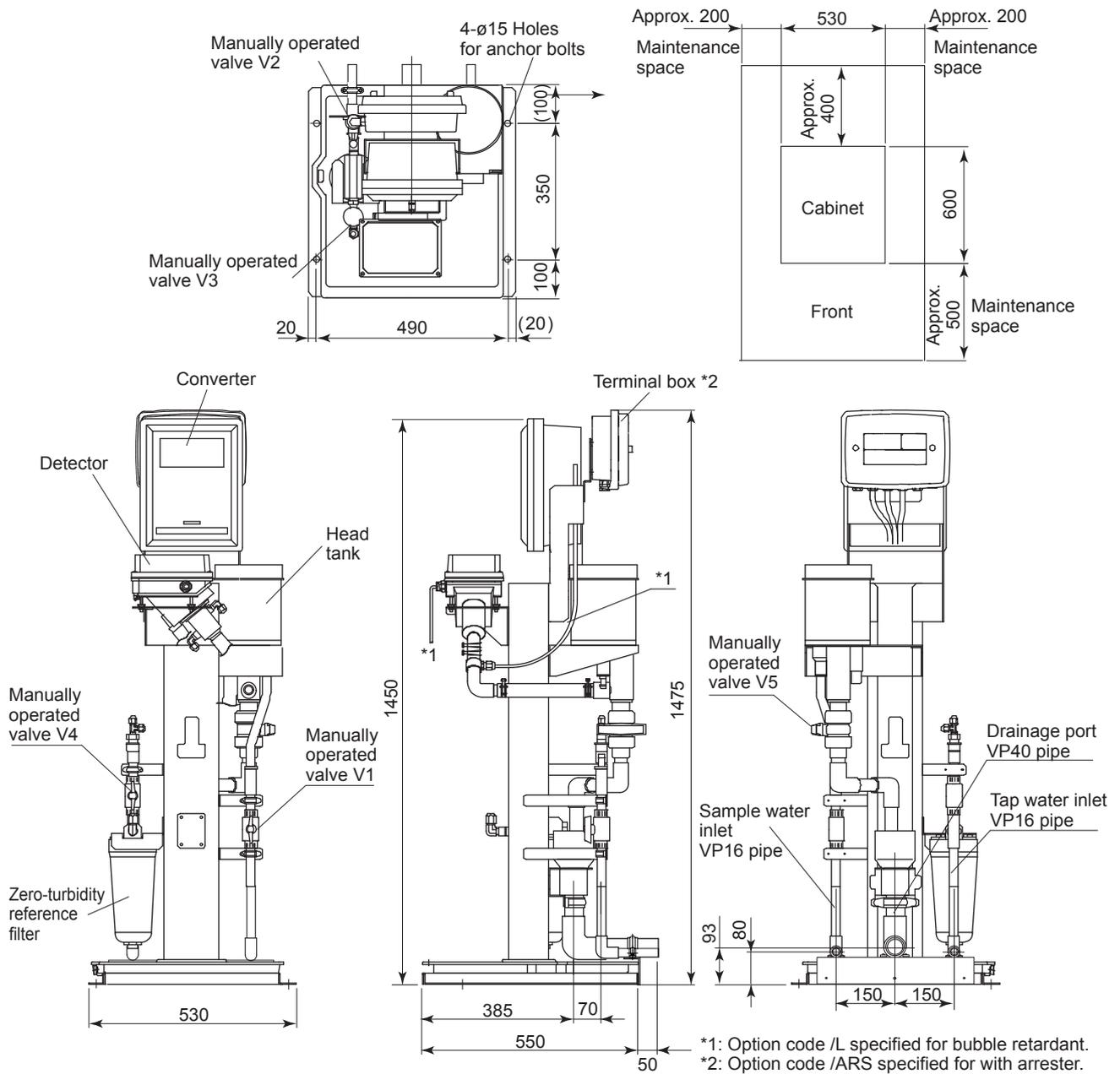


Figure 2.2.2 TB400G-□-□-A1/B (Rear Piping) External Dimensions

Weight: Approx. 50kg

2.5.3 TB400G-□-□-A2

Unit: mm

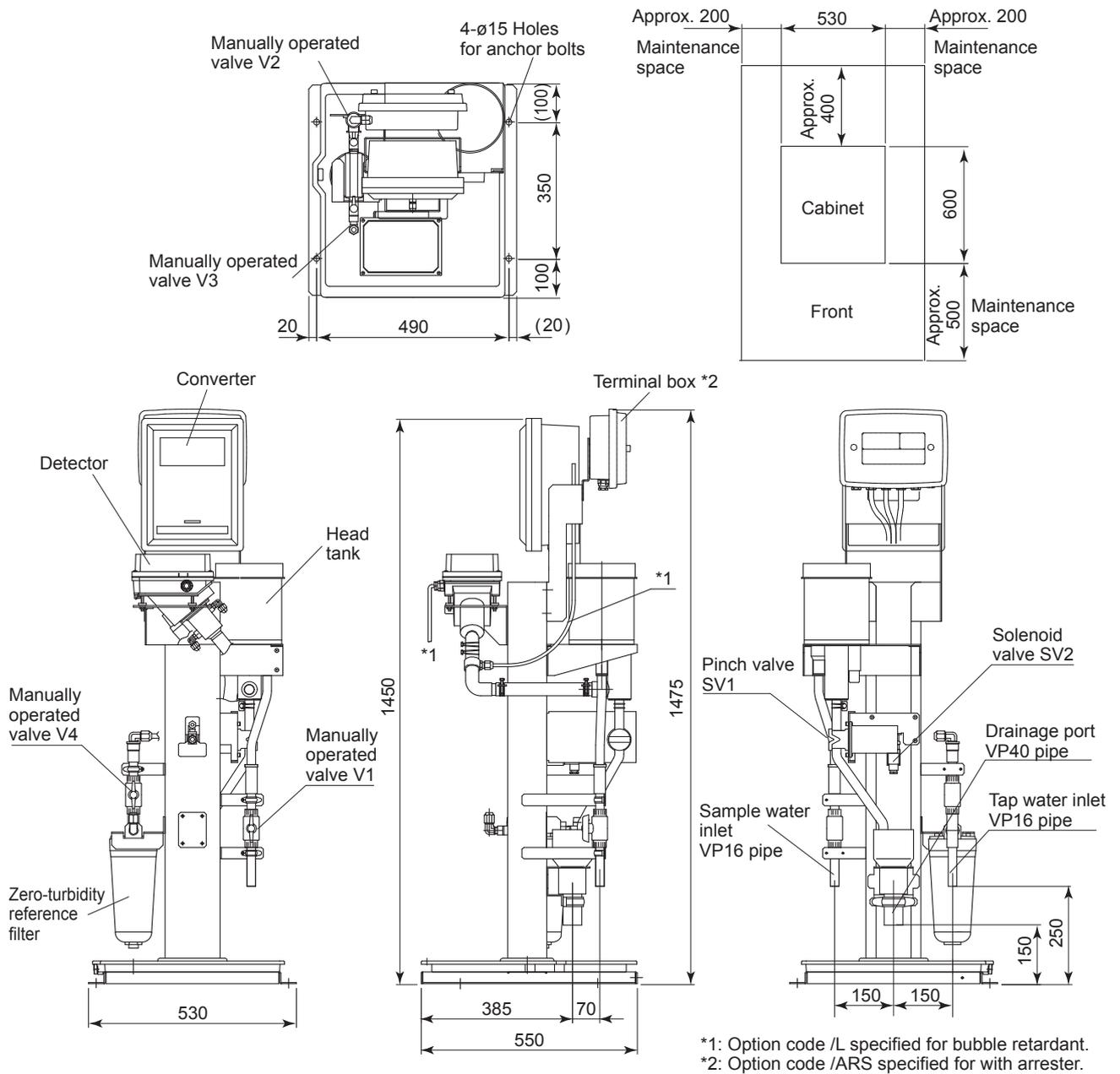


Figure 2.3.1 TB400G-□-□-A2 (Bottom Piping) External Dimensions

Weight: Approx. 50kg

Unit: mm

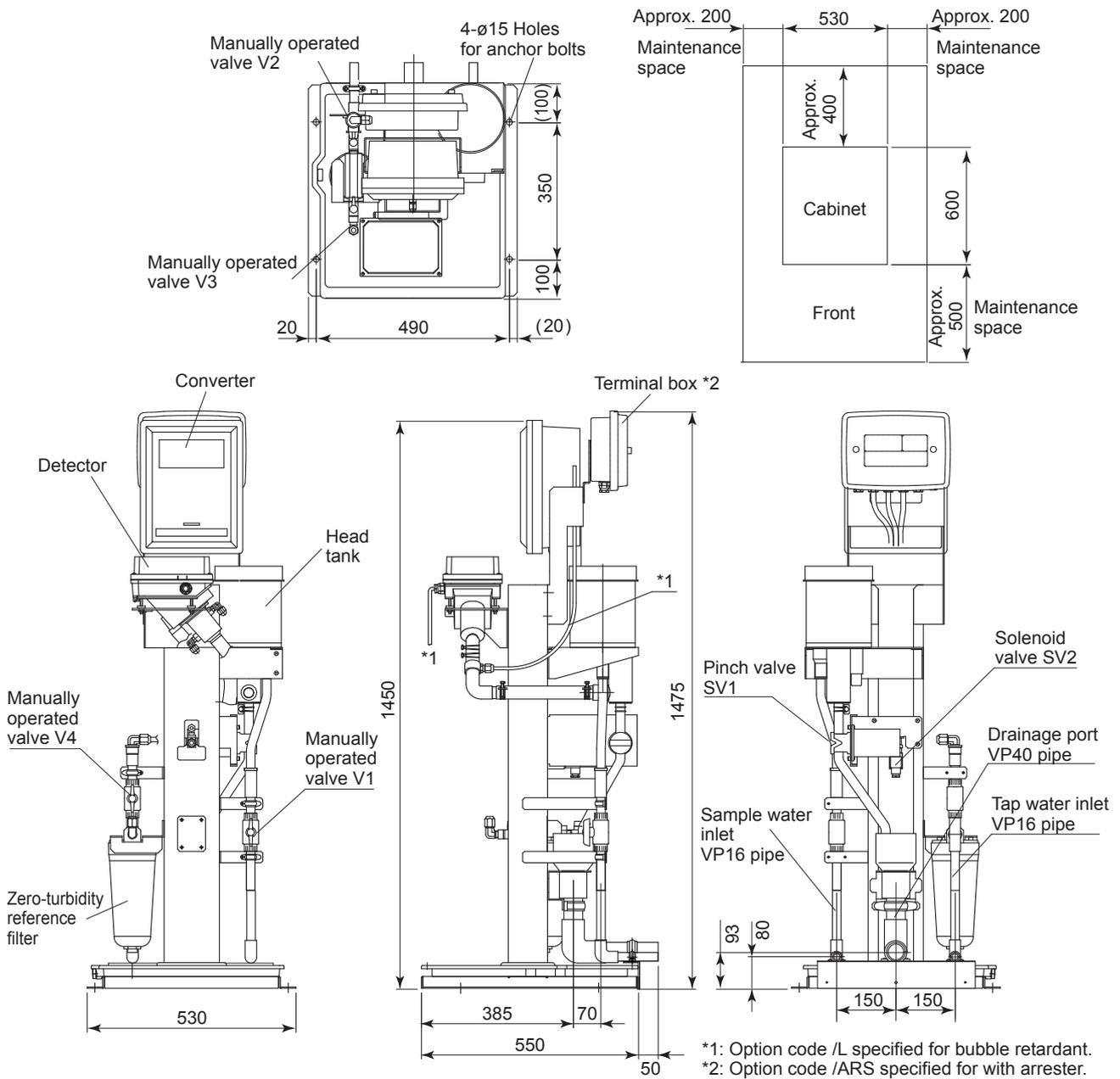


Figure 2.3.2 TB400G-□-□-A2/B (Rear Piping) External Dimensions

Weight: Approx. 50kg

2.5.4 TB400G-□-□-A3

Unit: mm

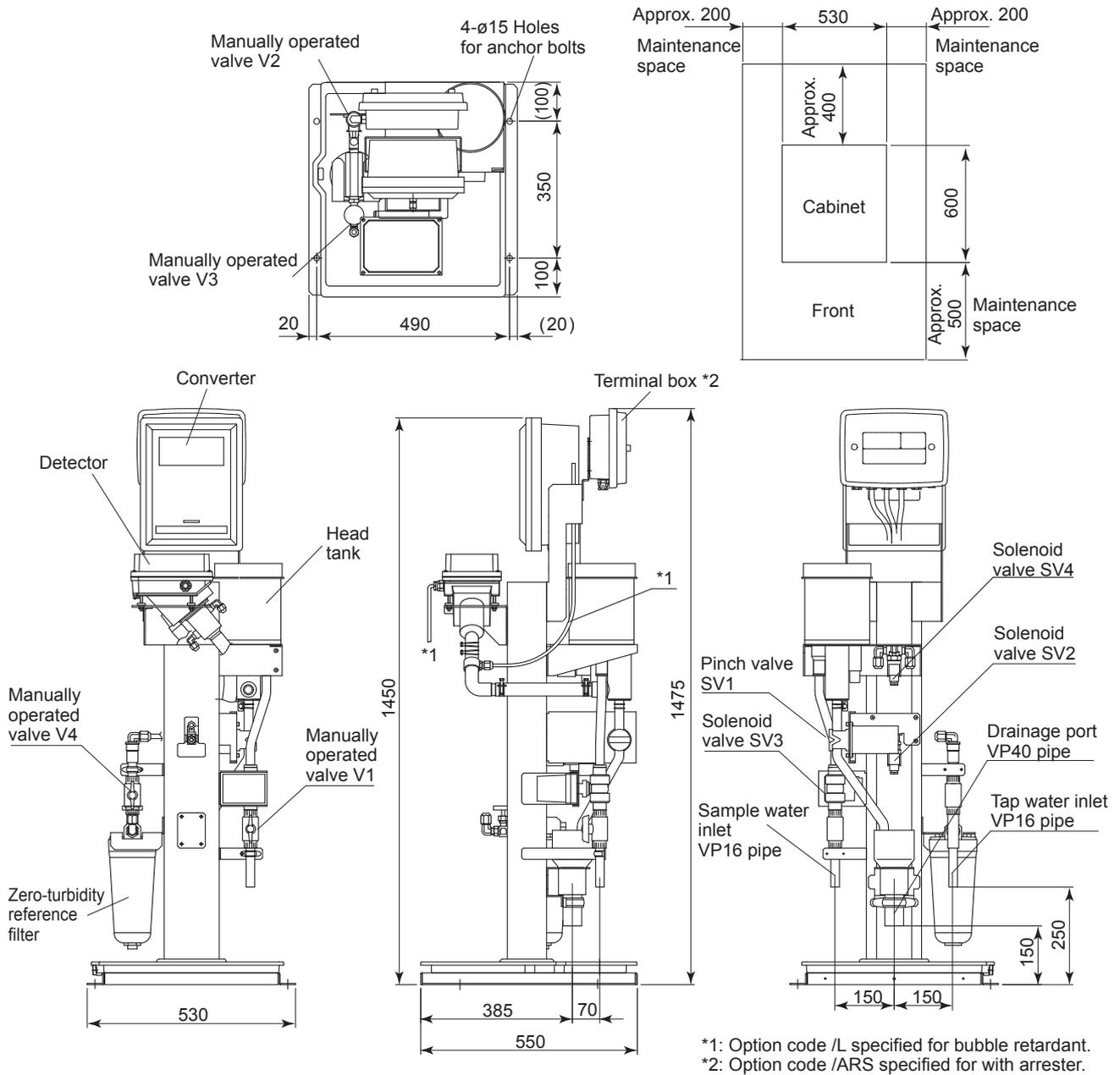


Figure 2.4.1 TB400G-□-□-A3 (Bottom Piping) External Dimensions

Weight: Approx. 50kg

Unit: mm

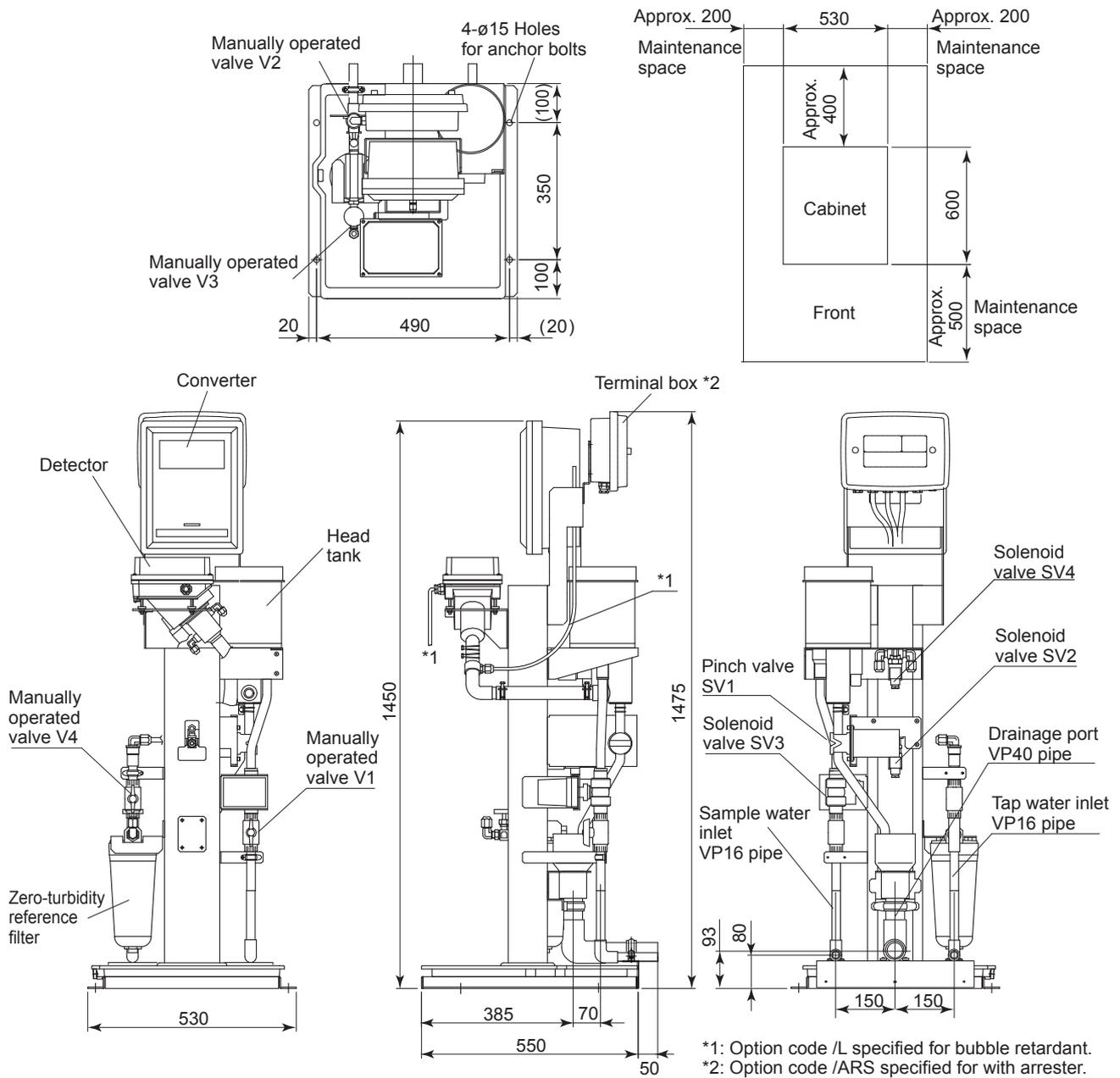


Figure 2.4.2 TB400G-□-□-A3/B (Rear Piping) External Dimensions

Weight: Approx. 50kg

2.5.5 TB400G-□-□-A1/PHU□

Unit: mm

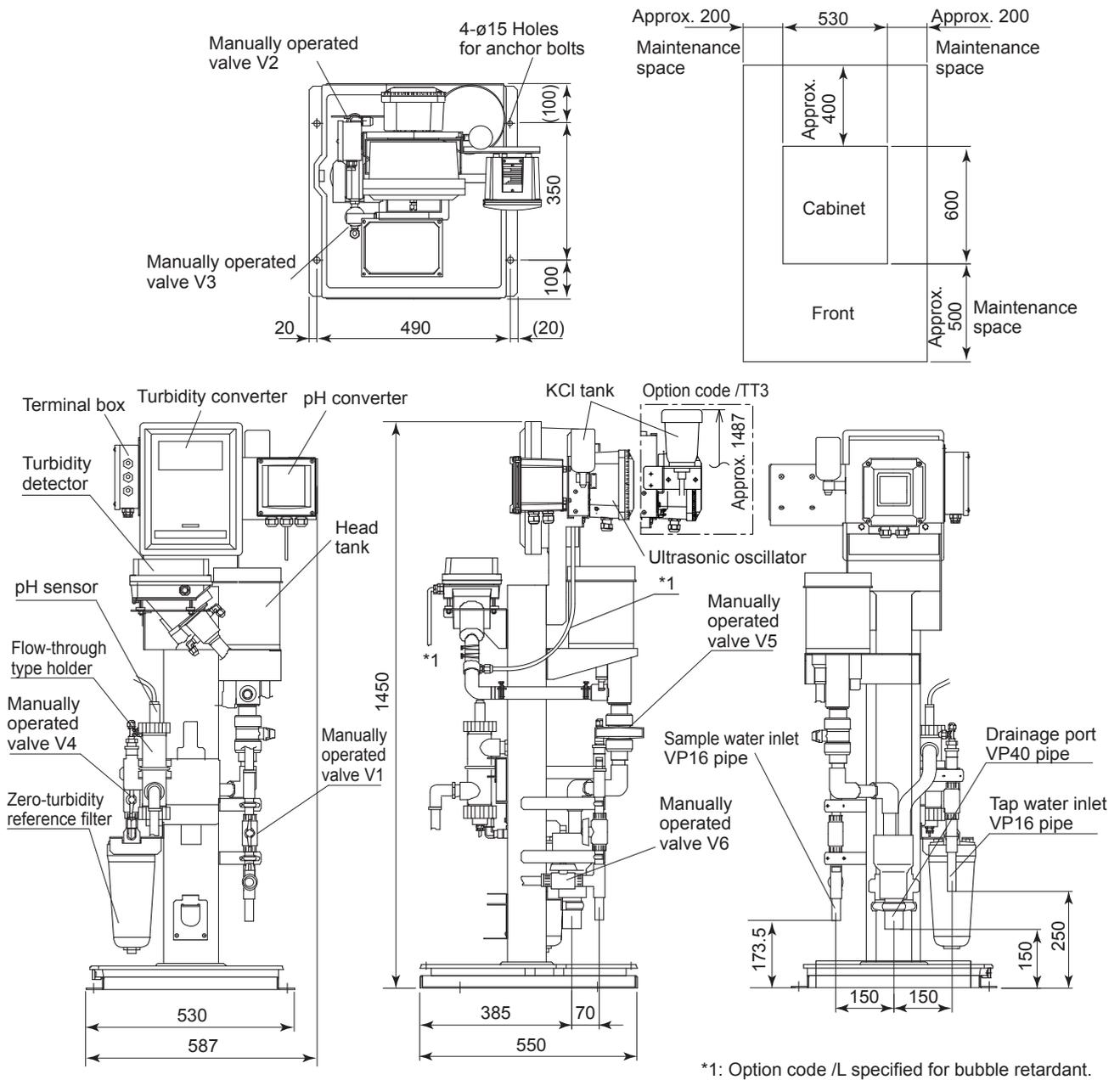
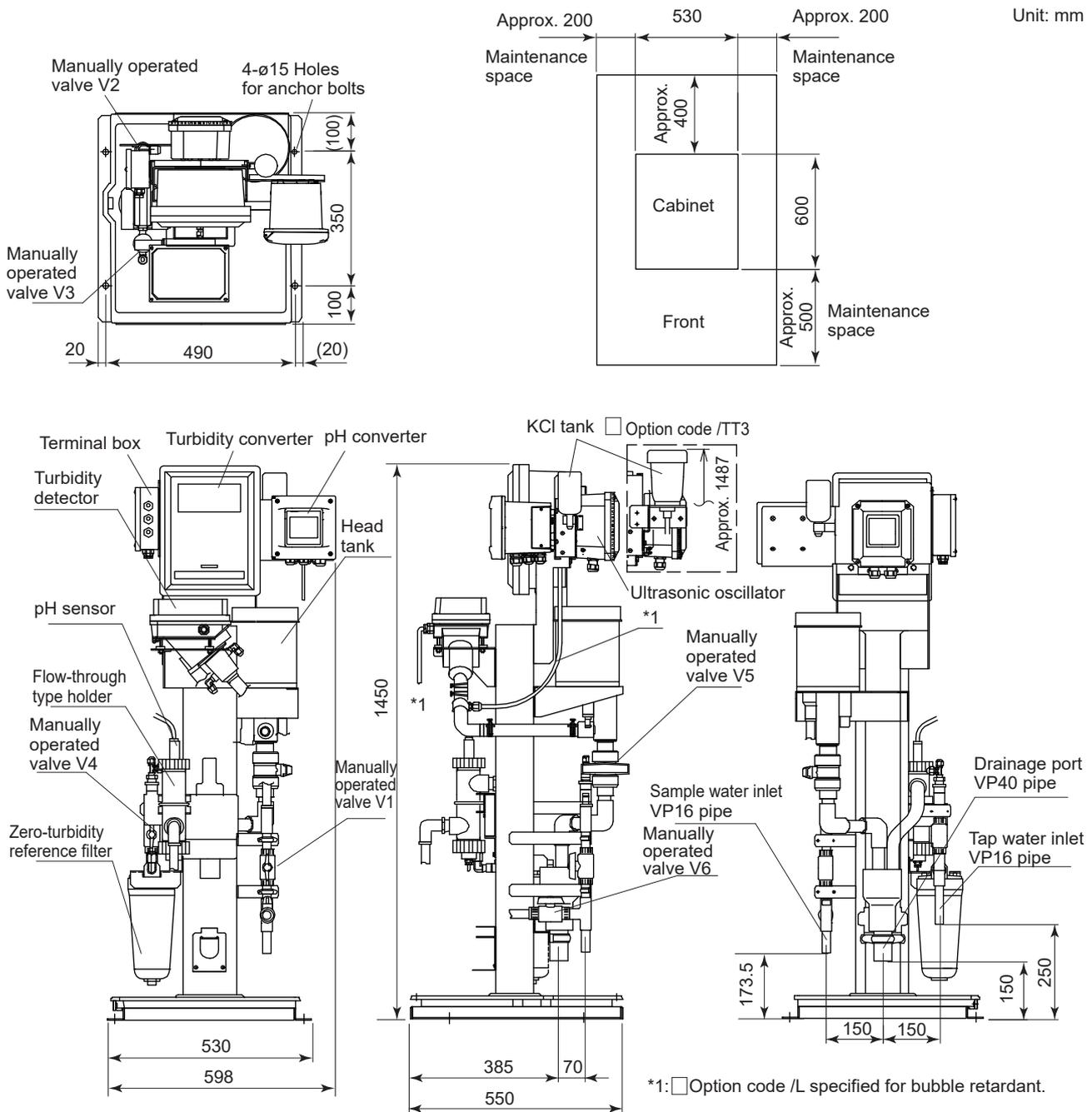


Figure 2.5.1a TB400G-□-□-A1/PHU 5 (Bottom Piping) External Dimensions

Weight: Approx. 60kg



Weight: Approx. 60 kg

Figure 2.5.1b TB400G-□-□-A1/PHU6 (Bottom Piping) External Dimensions

Unit: mm

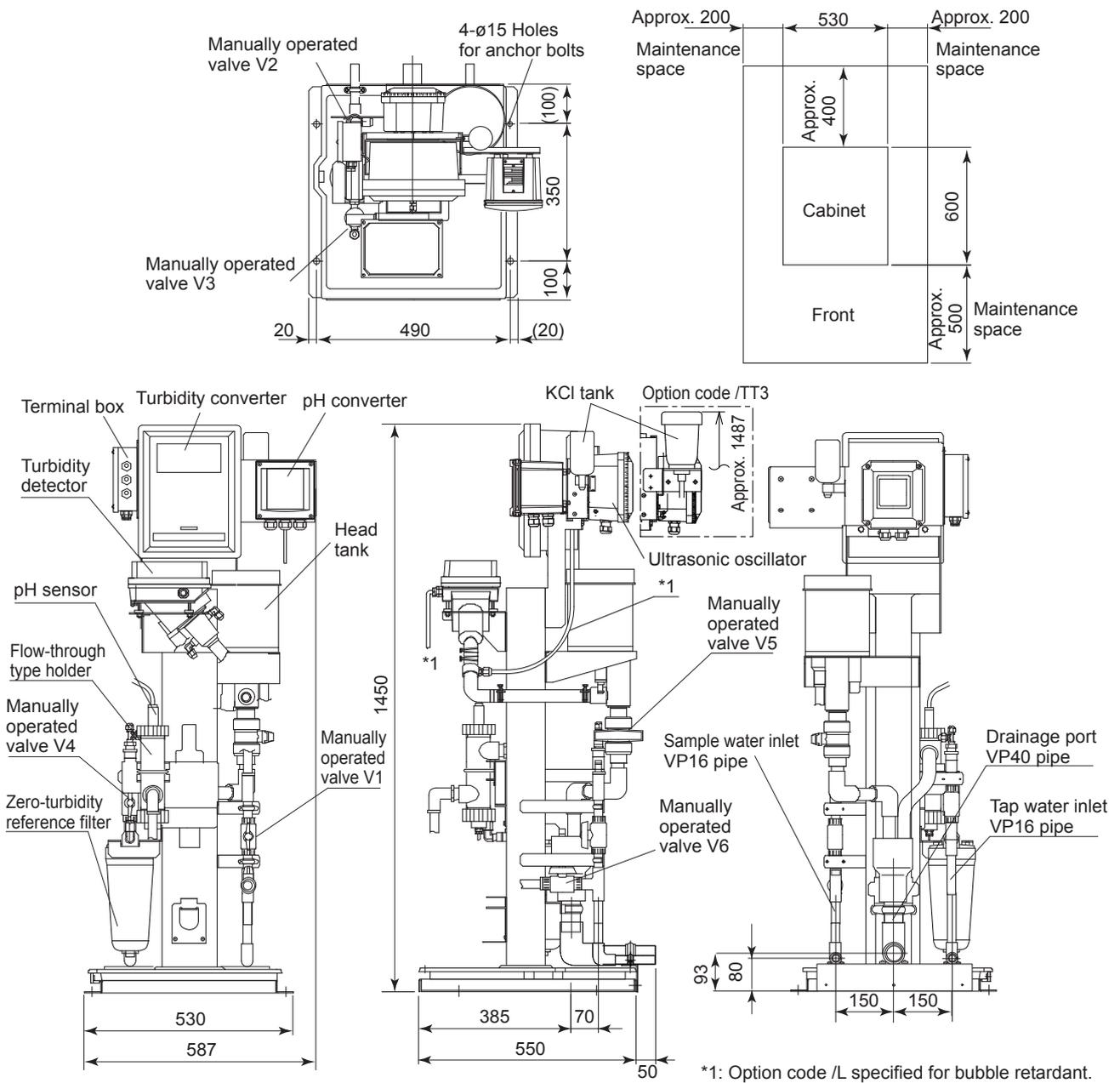
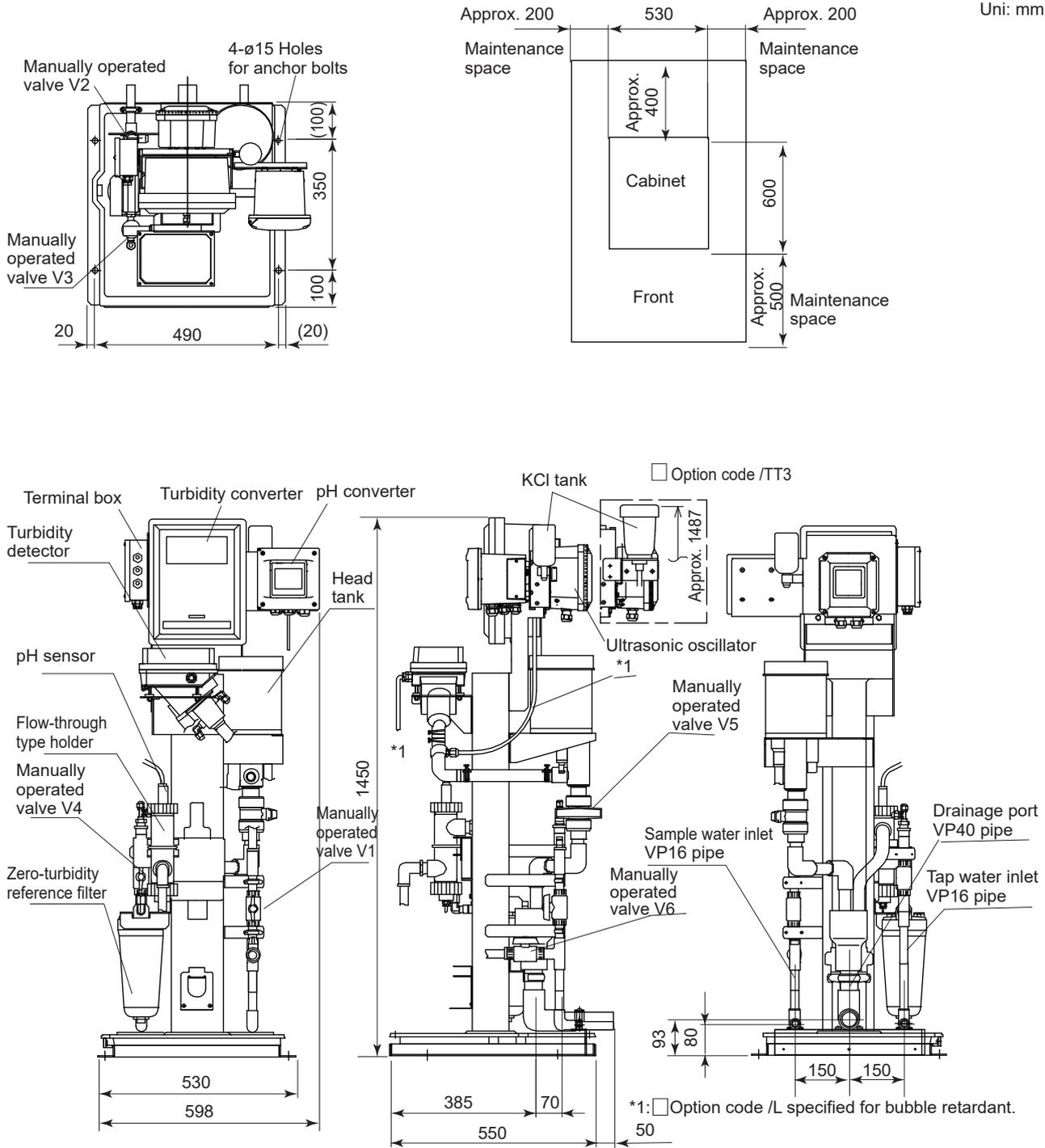


Figure 2.5.2a TB400G-□-□-A1/PHU5/B (Rear Piping) External Dimensions

Weight: Approx. 60kg

Uni: mm



Weight: Approx. 60 kg

Figure 2.5.2b TB400G-□-□-A1/PHU6/B (Rear Piping) External Dimensions

2.5.6 TB400G-□-□-A2/PHU□

Unit: mm

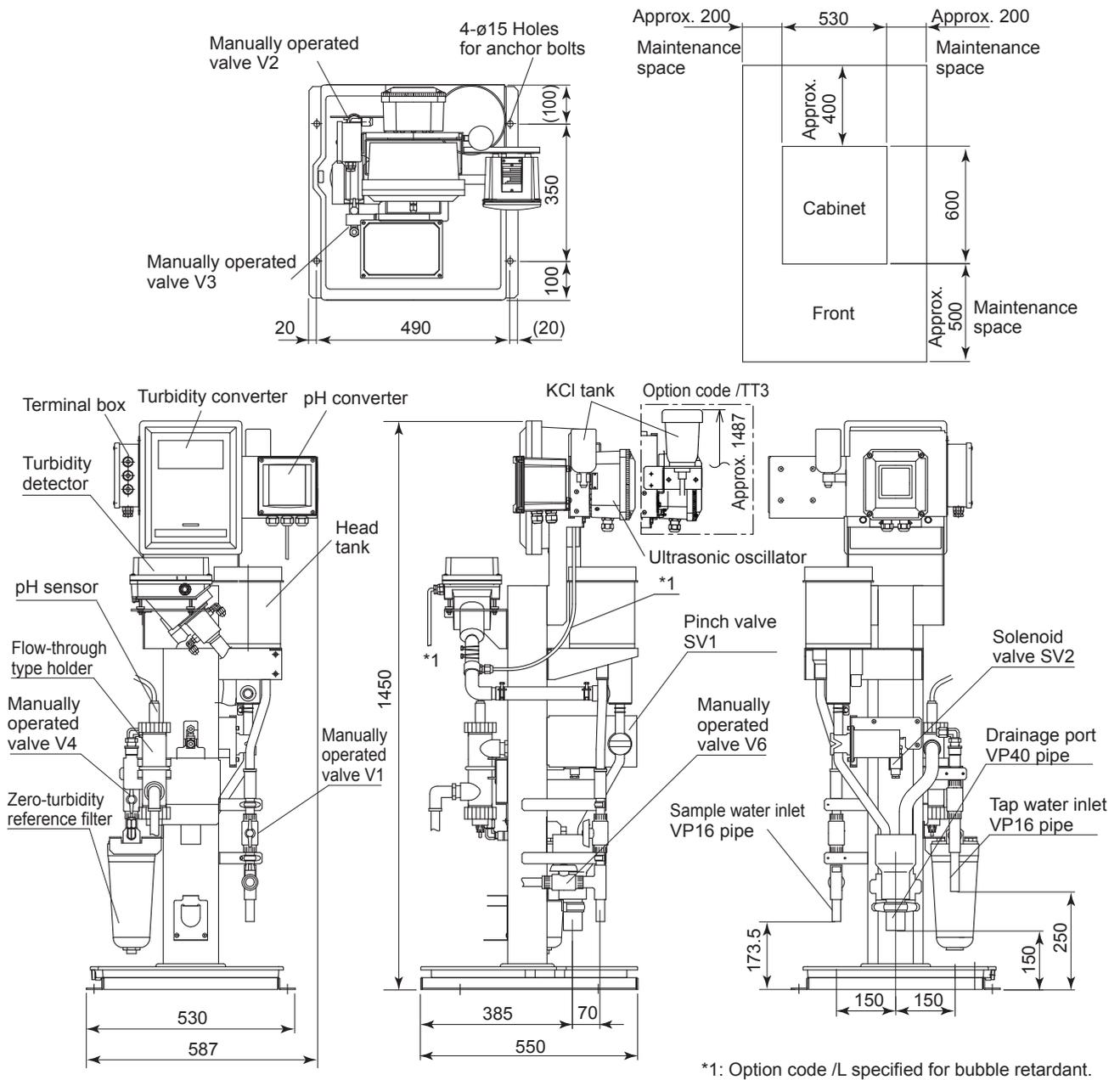


Figure 2.6.1a TB400G-□-□-A2/PHU5 (Bottom Piping) External Dimensions

Weight: Approx. 60kg

Unit: mm

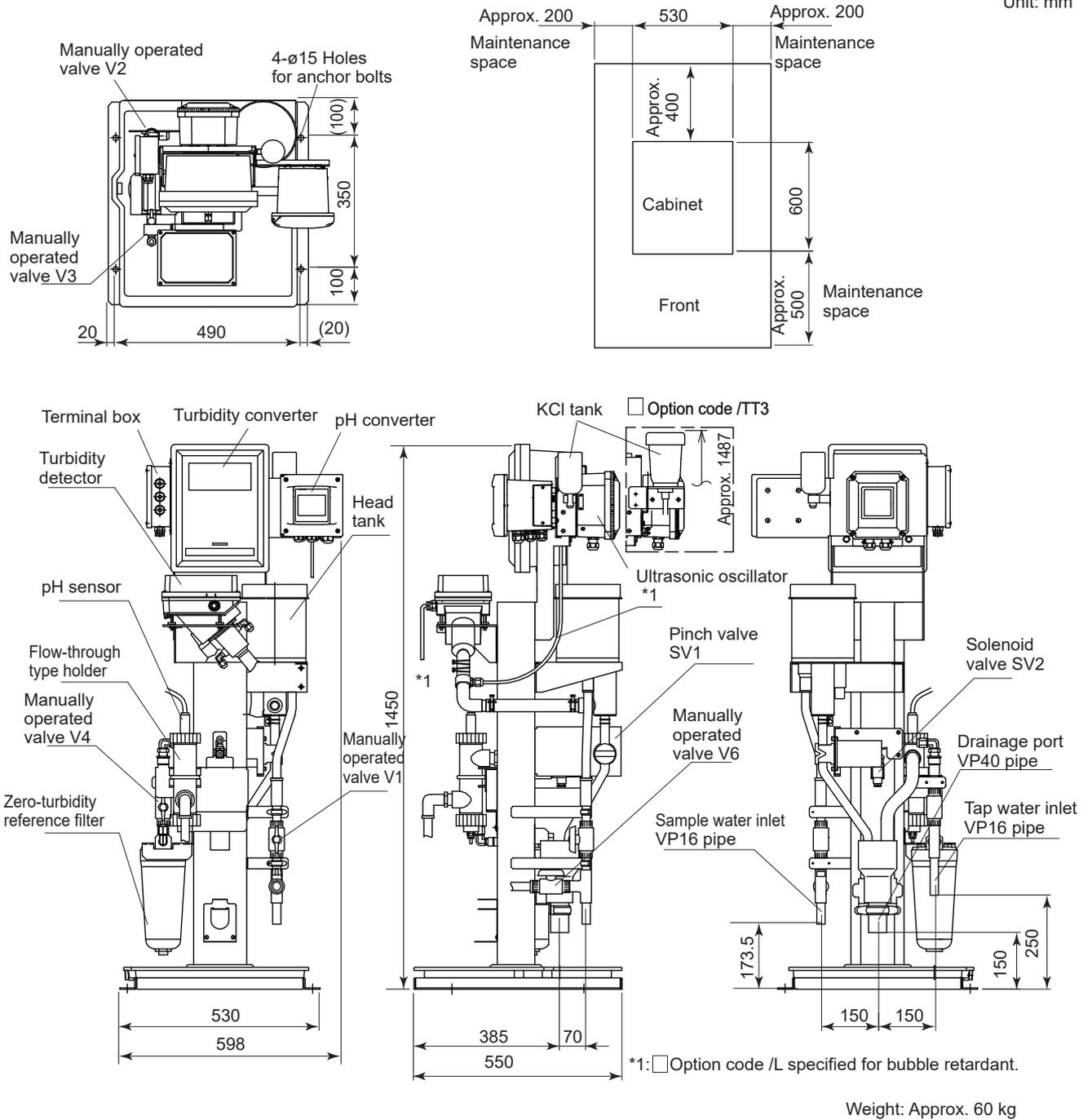


Figure 2.6.1b TB400G-□-□-A2/PHU6 (Bottom Piping) External Dimensions

Unit: mm

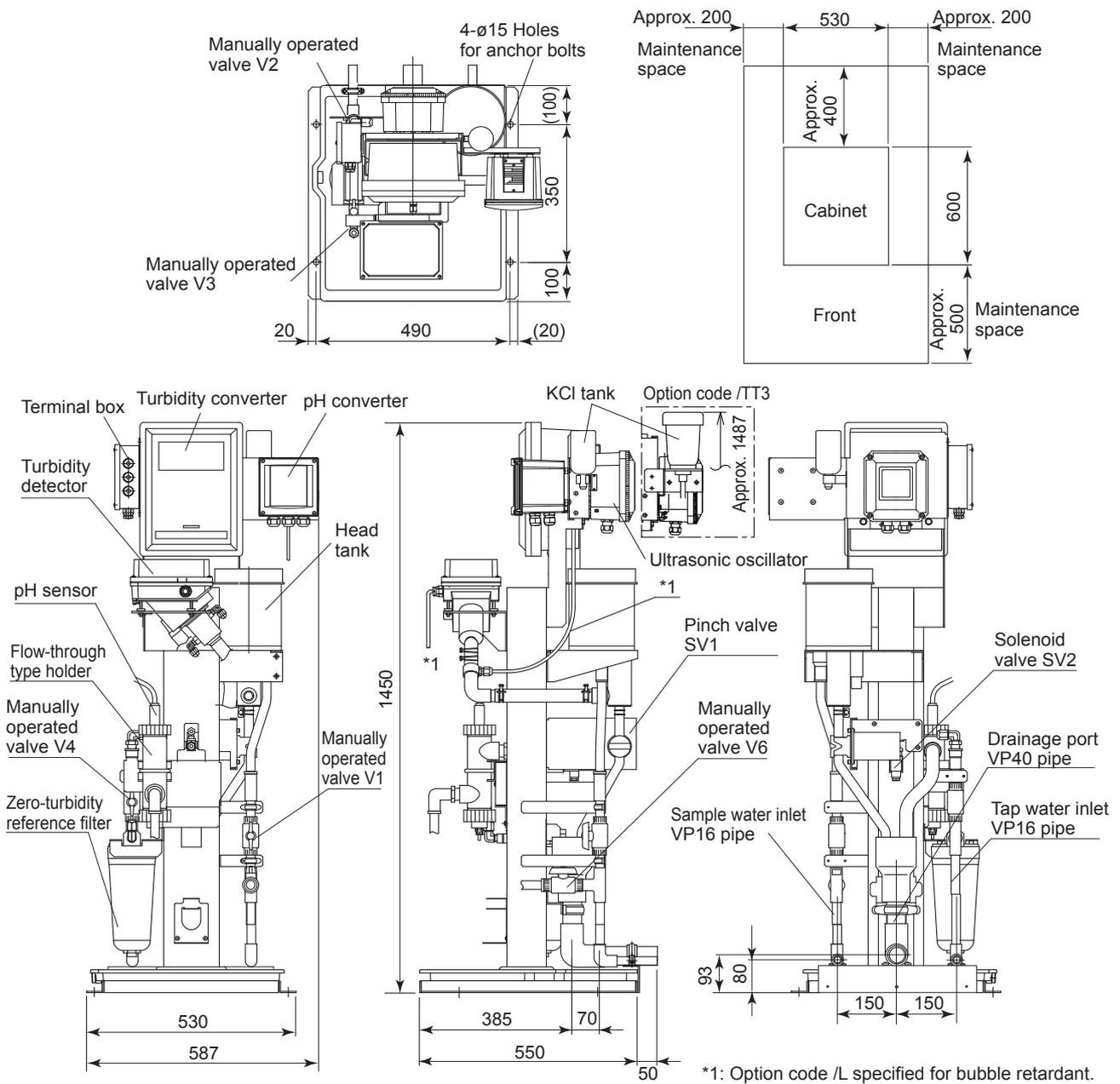


Figure 2.6.2a TB400G-□-□-A2/PHU5/B (Rear Piping) External Dimensions

Weight: Approx. 60kg

Unit: mm

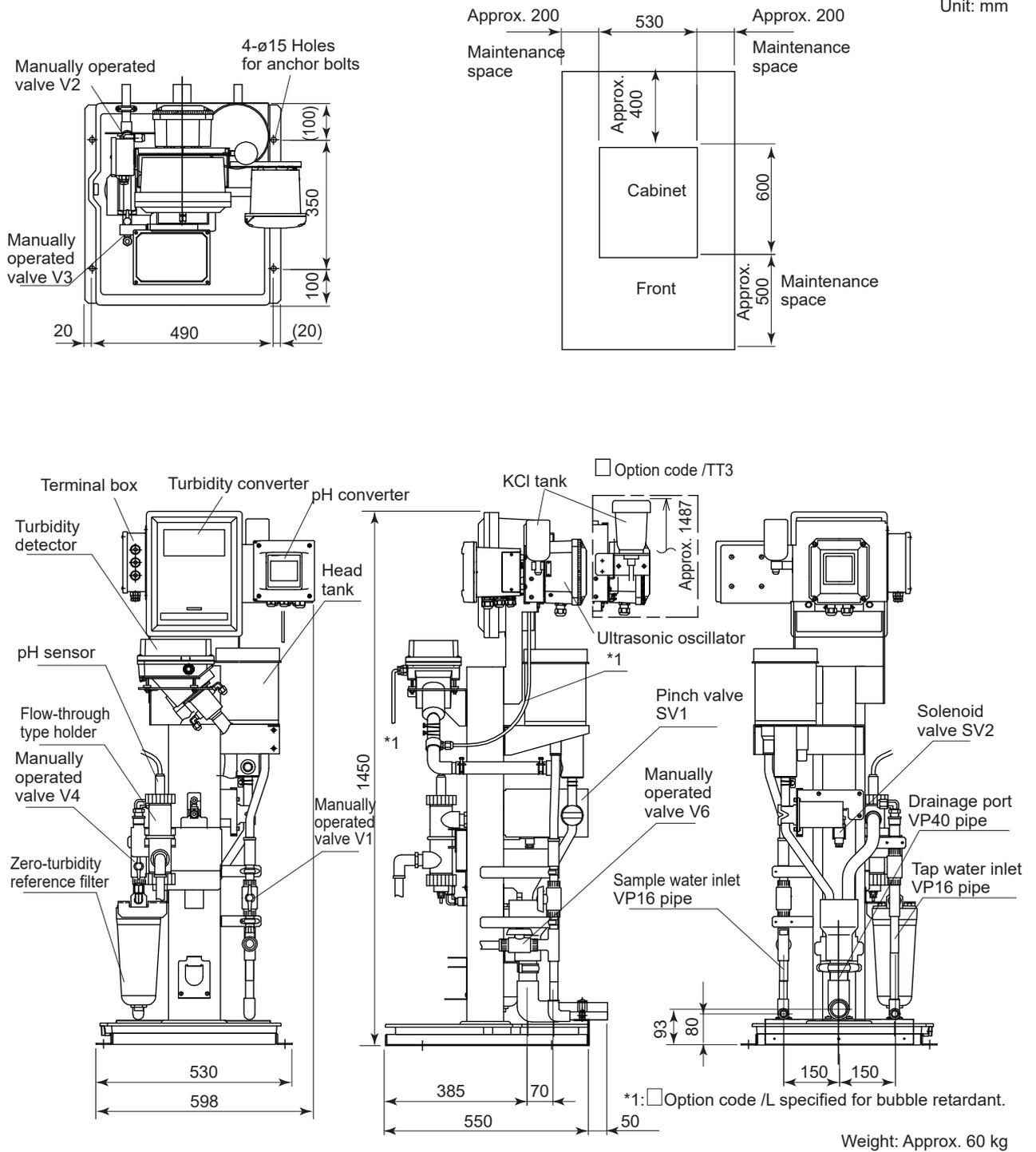


Figure 2.6.2b TB400G-□-□-A2/PHU6/B (Rear Piping) External Dimensions

2.5.7 TB400G-□-□-A3/PHU□

Unit: mm

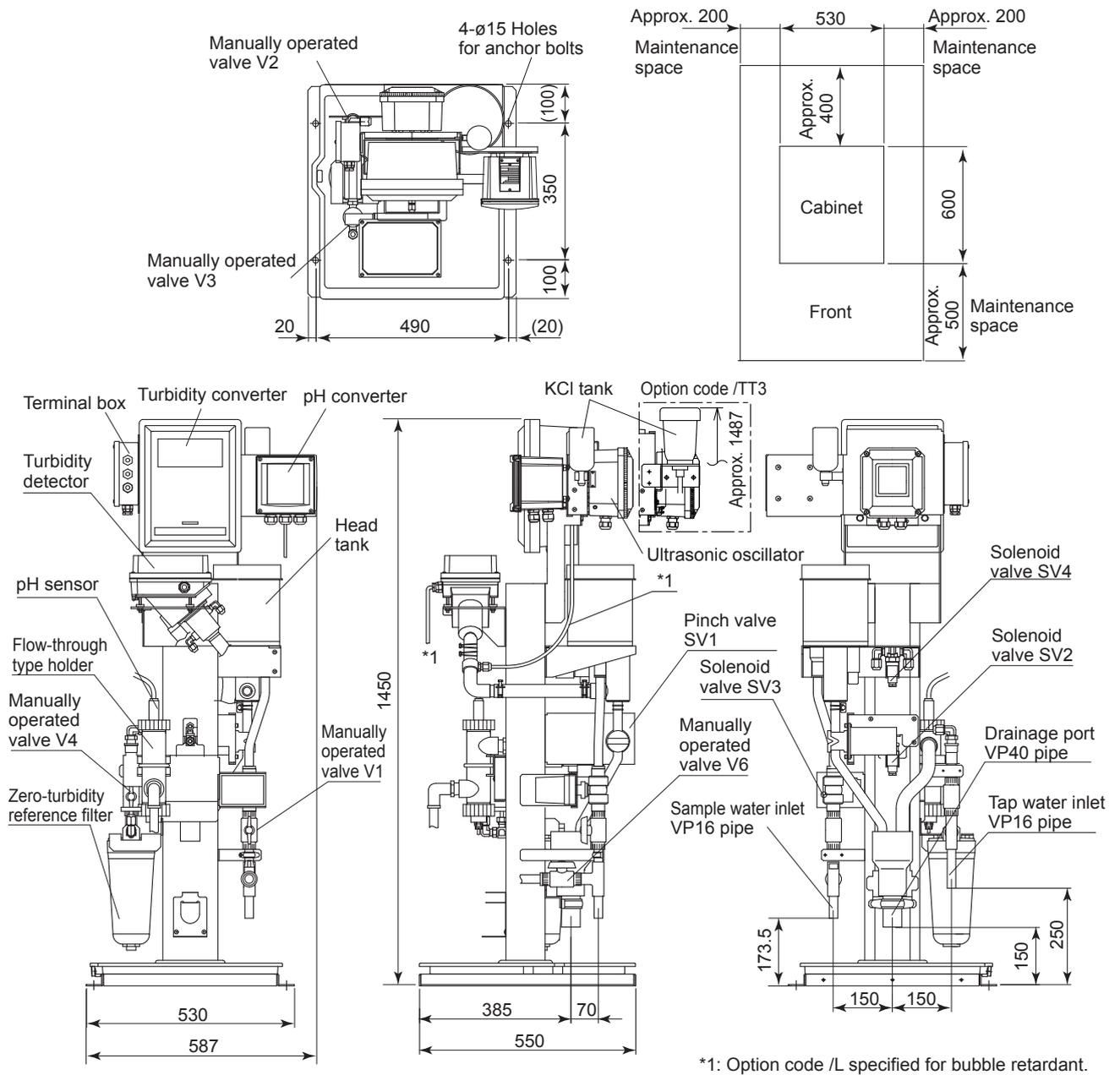
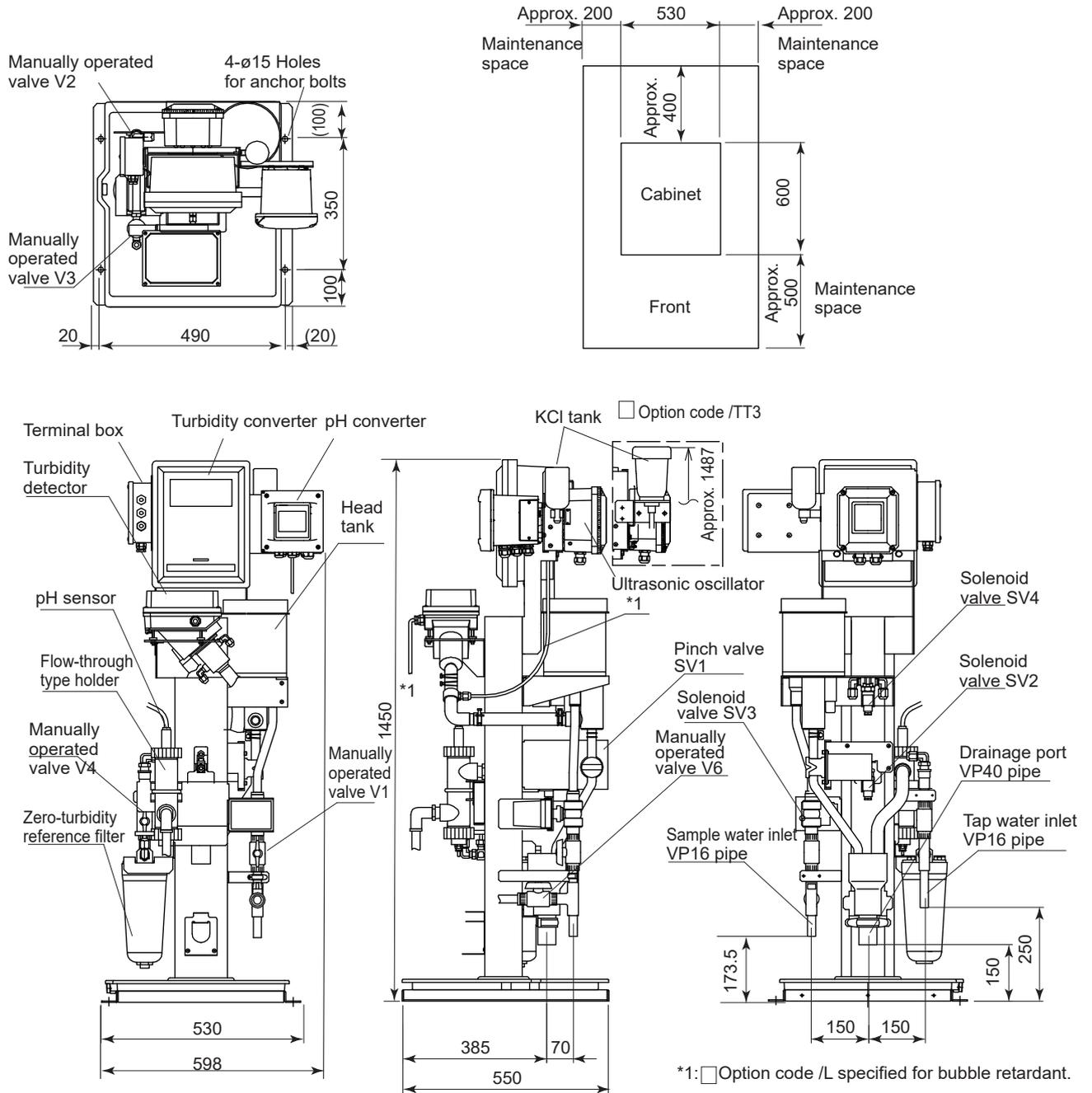


Figure 2.7.1a TB400G-□-□-A3/PHU5 (Bottom Piping) External Dimensions

Weight: Approx. 60kg

Unit: mm



Weight: Approx. 60 kg

Figure 2.7.1b TB400G-□-□-A3/PHU6 (Bottom Piping) External Dimensions

Unit: mm

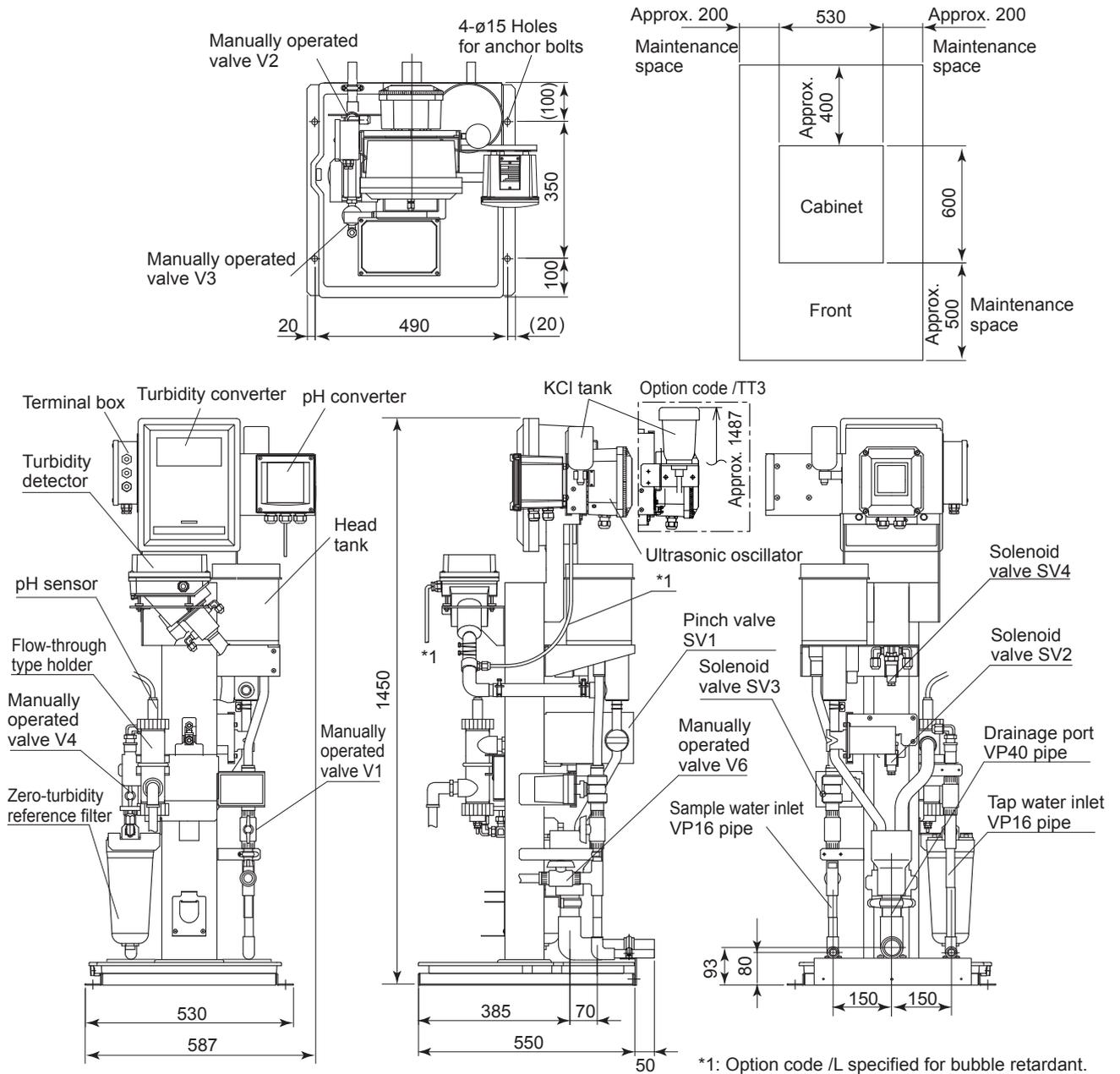


Figure 2.7.2a TB400G-□-□-A3/PHU5/B (Rear Piping) External Dimensions

Weight: Approx. 60kg

Unit: mm

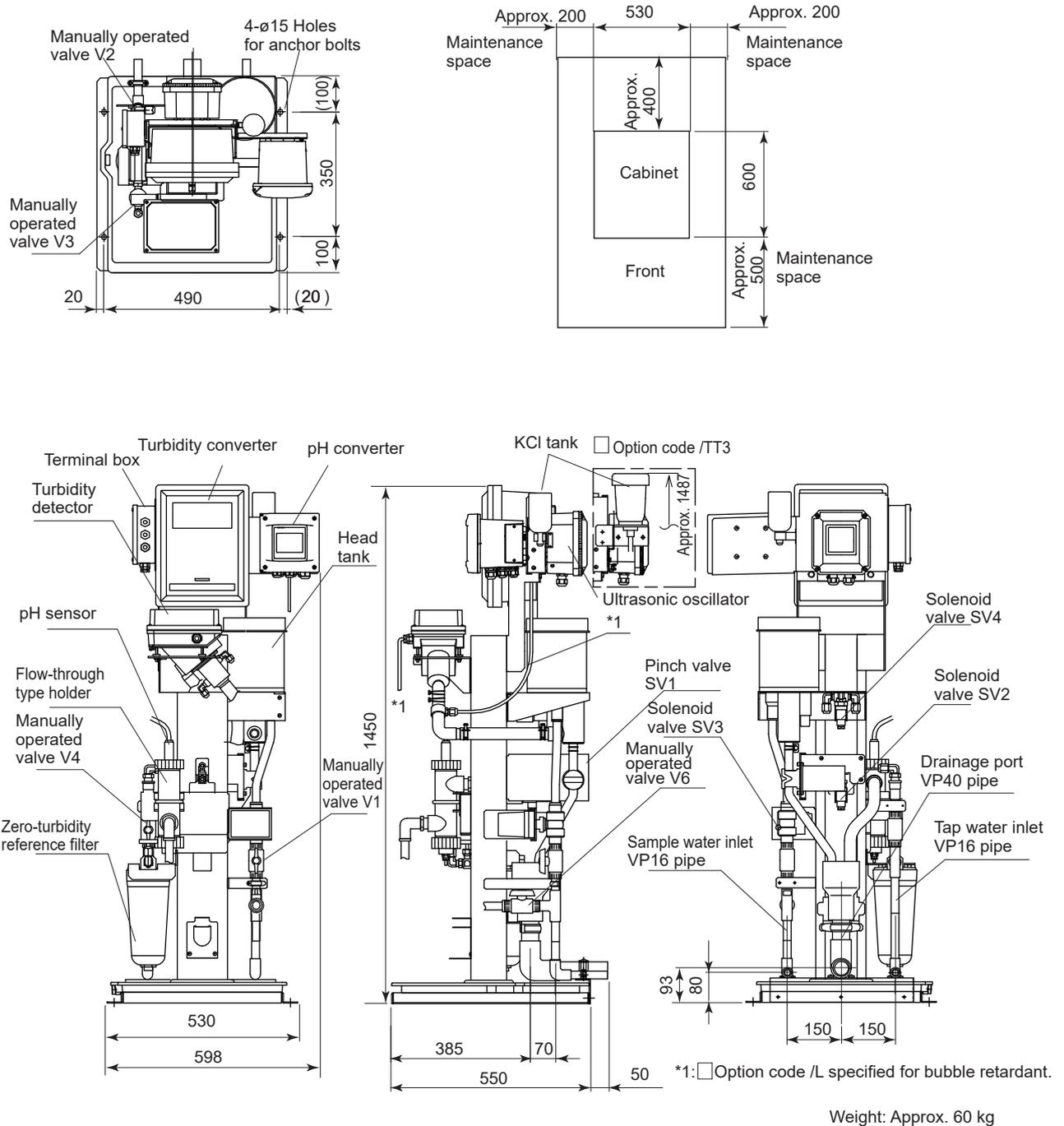


Figure 2.7.2b TB400G-□-□-A3/PHU6/B (Rear Piping) External Dimensions

2.5.8 TB400G-□-□-A1/PHN□

Unit: mm

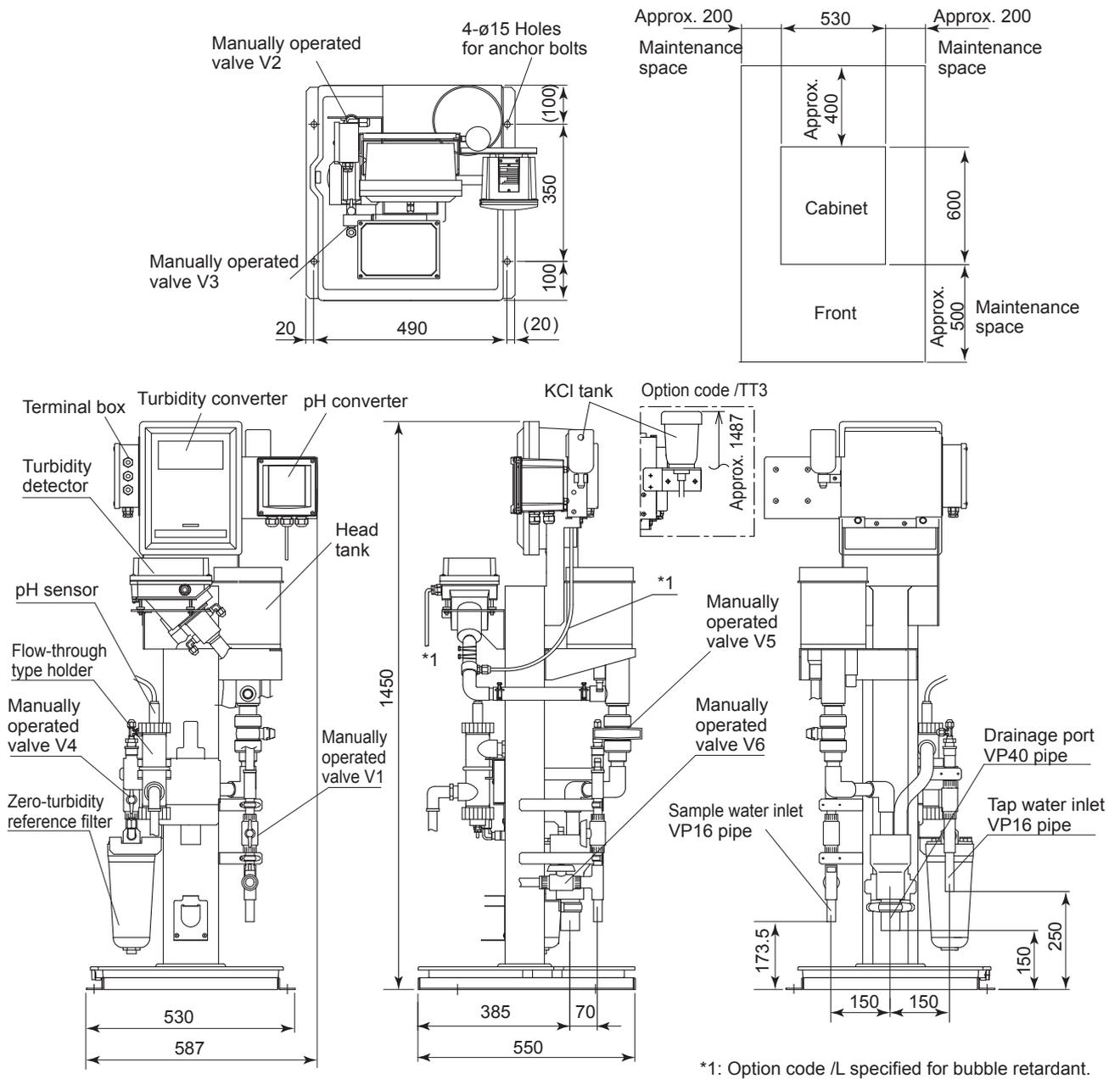
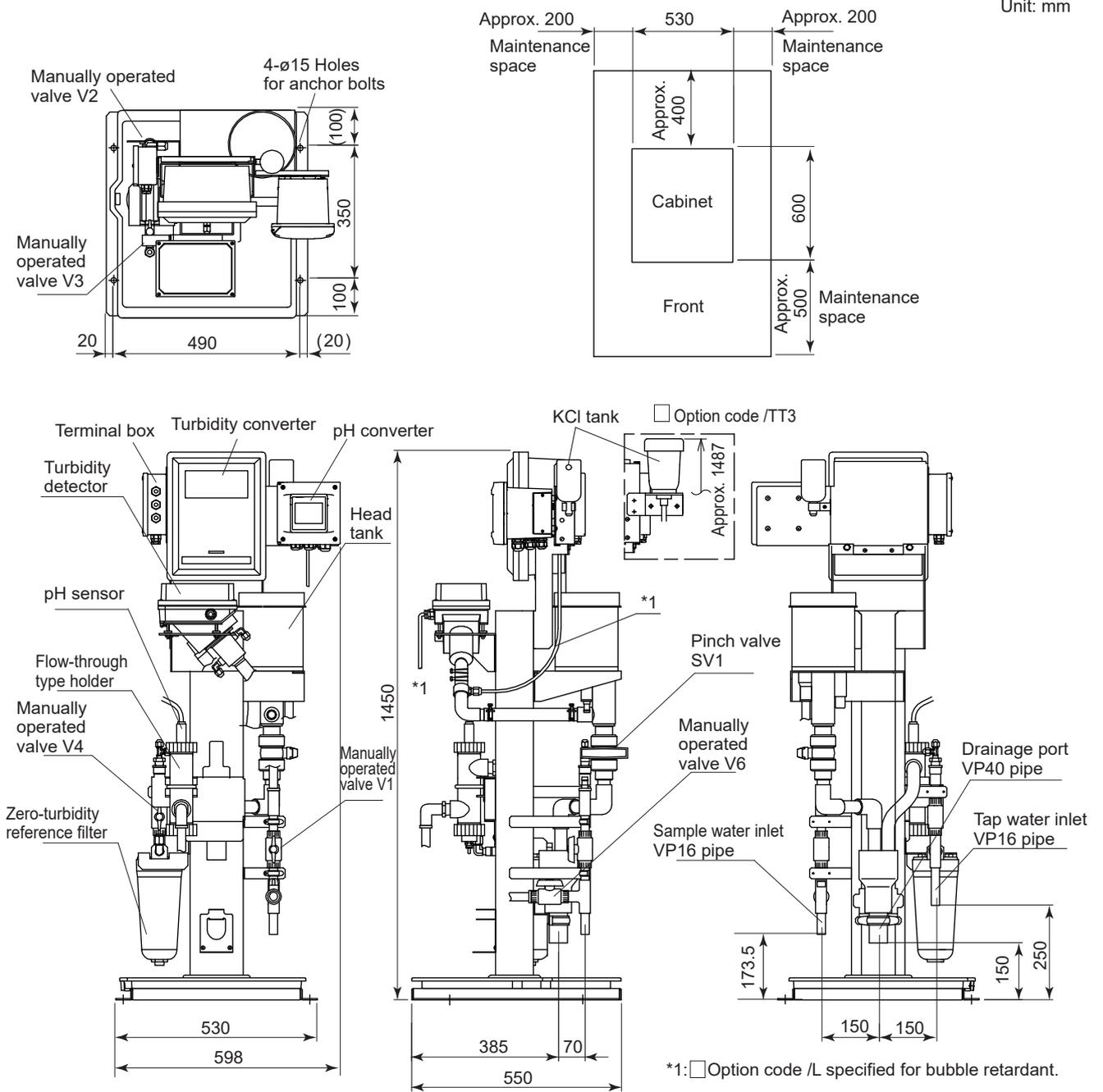


Figure 2.8.1a TB400G-□-□-A1/PHN5 (Bottom Piping) External Dimensions

Weight: Approx. 56kg

Unit: mm



Weight: Approx. 56 kg

Figure 2.8.1b TB400G-□-□-A1/PHN6 (Bottom Piping) External Dimensions

Unit: mm

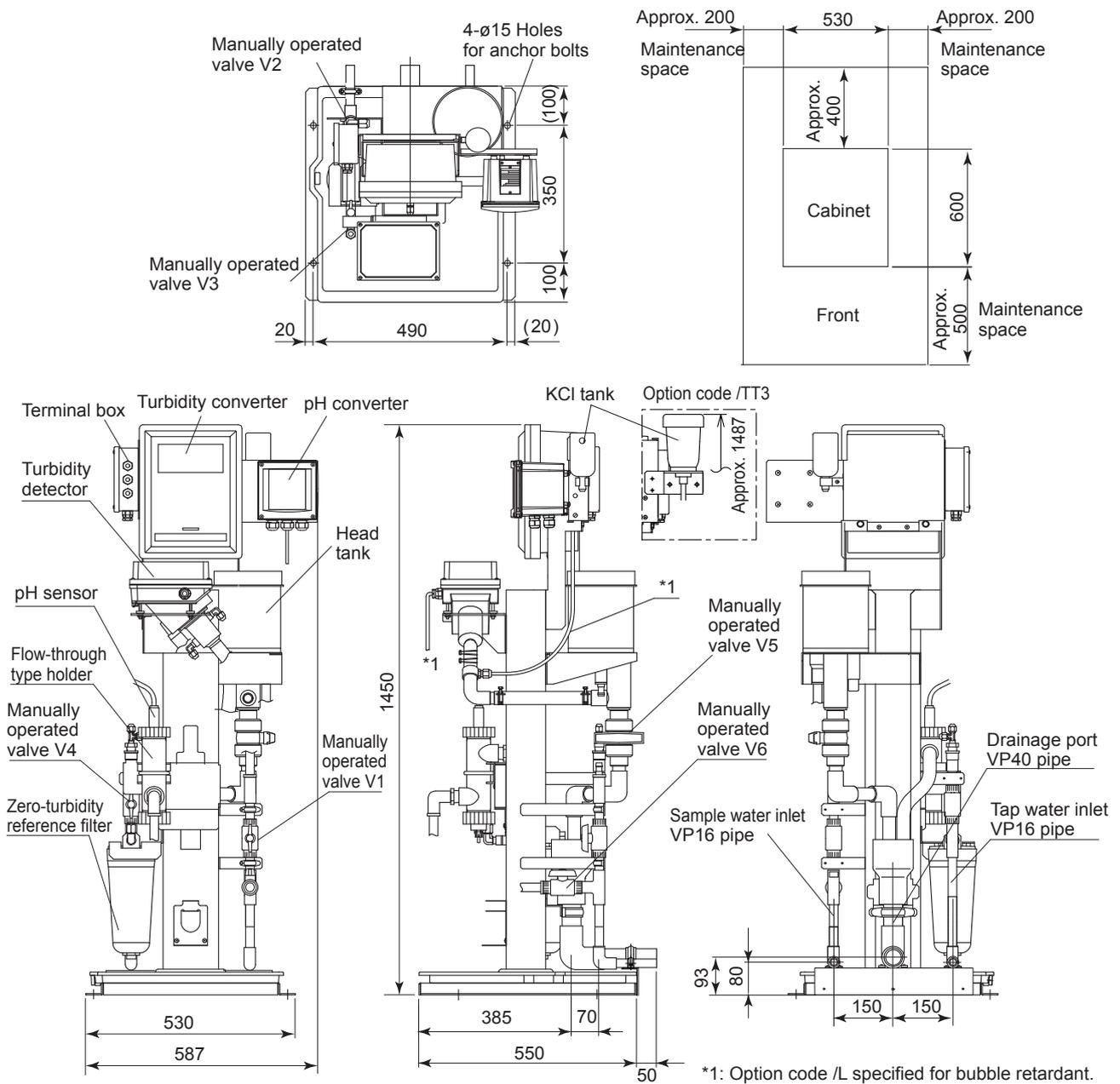


Figure 2.8.2a TB400G-□-□-A1/PHN5/B (Rear Piping) External Dimensions

Weight: Approx. 56kg

Unit: mm

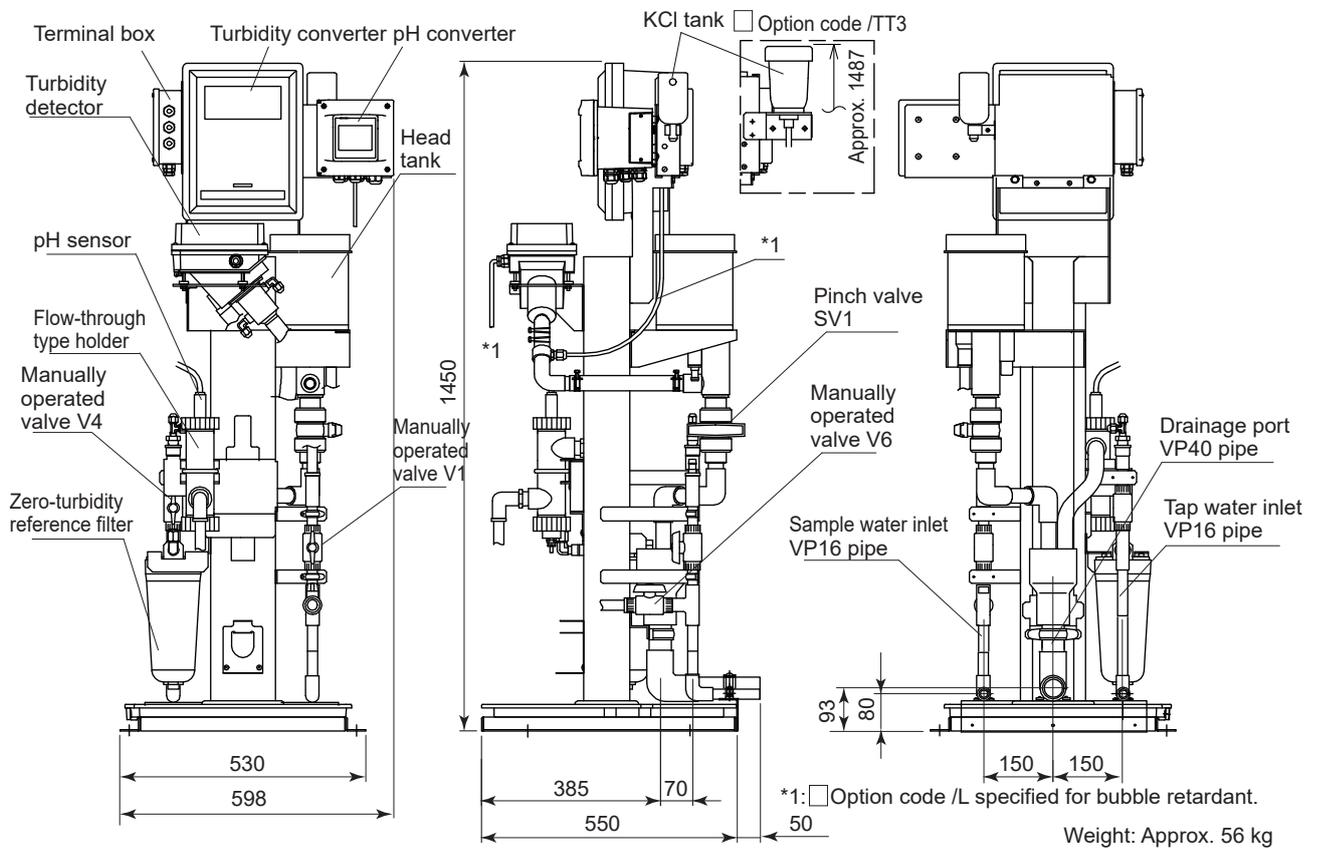
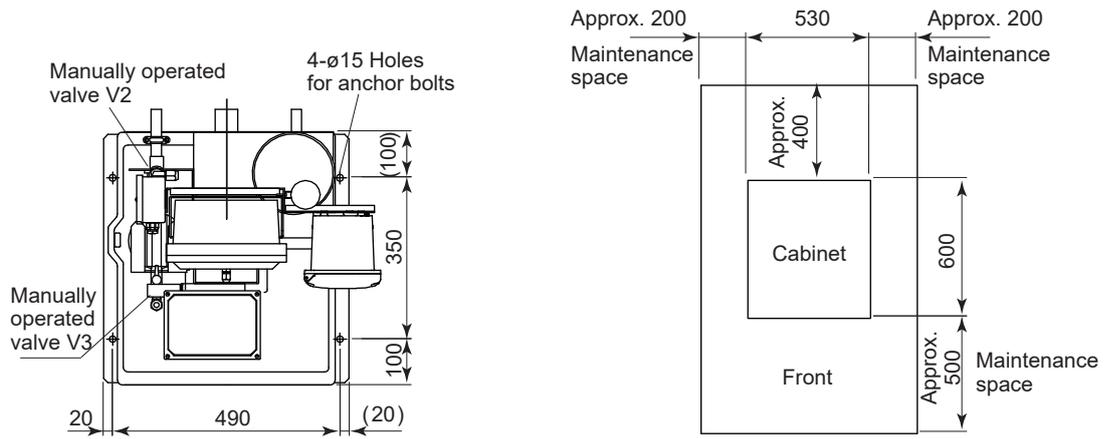


Figure 2.8.2b TB400G---A1/PHN6/B (Rear Piping) External Dimensions

2.5.9 TB400G-□-□-A2/PHN□

Unit: mm

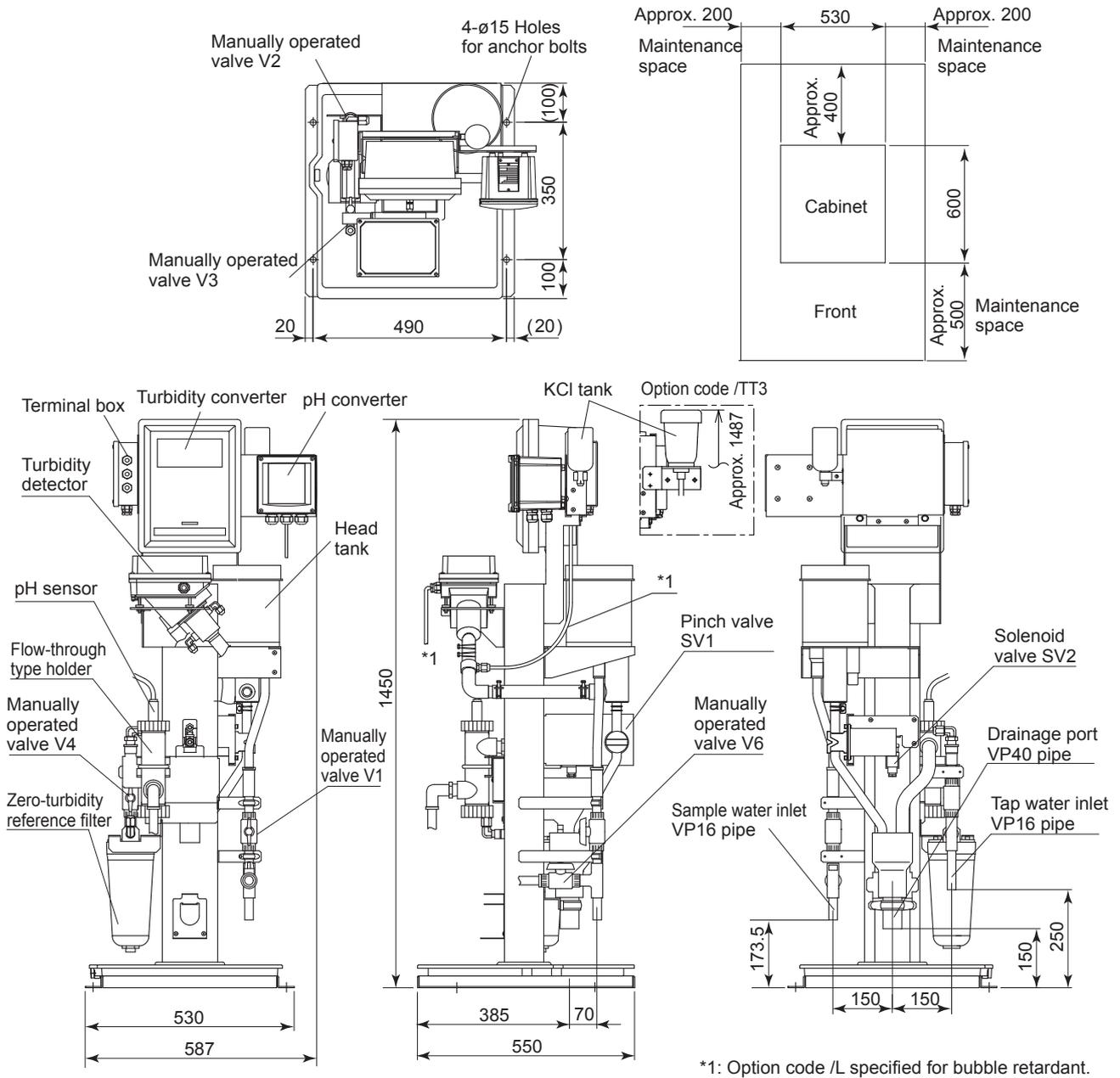


Figure 2.9.1a TB400G-□-□-A2/PHN5 (Bottom Piping) External Dimensions

Weight: Approx. 56kg

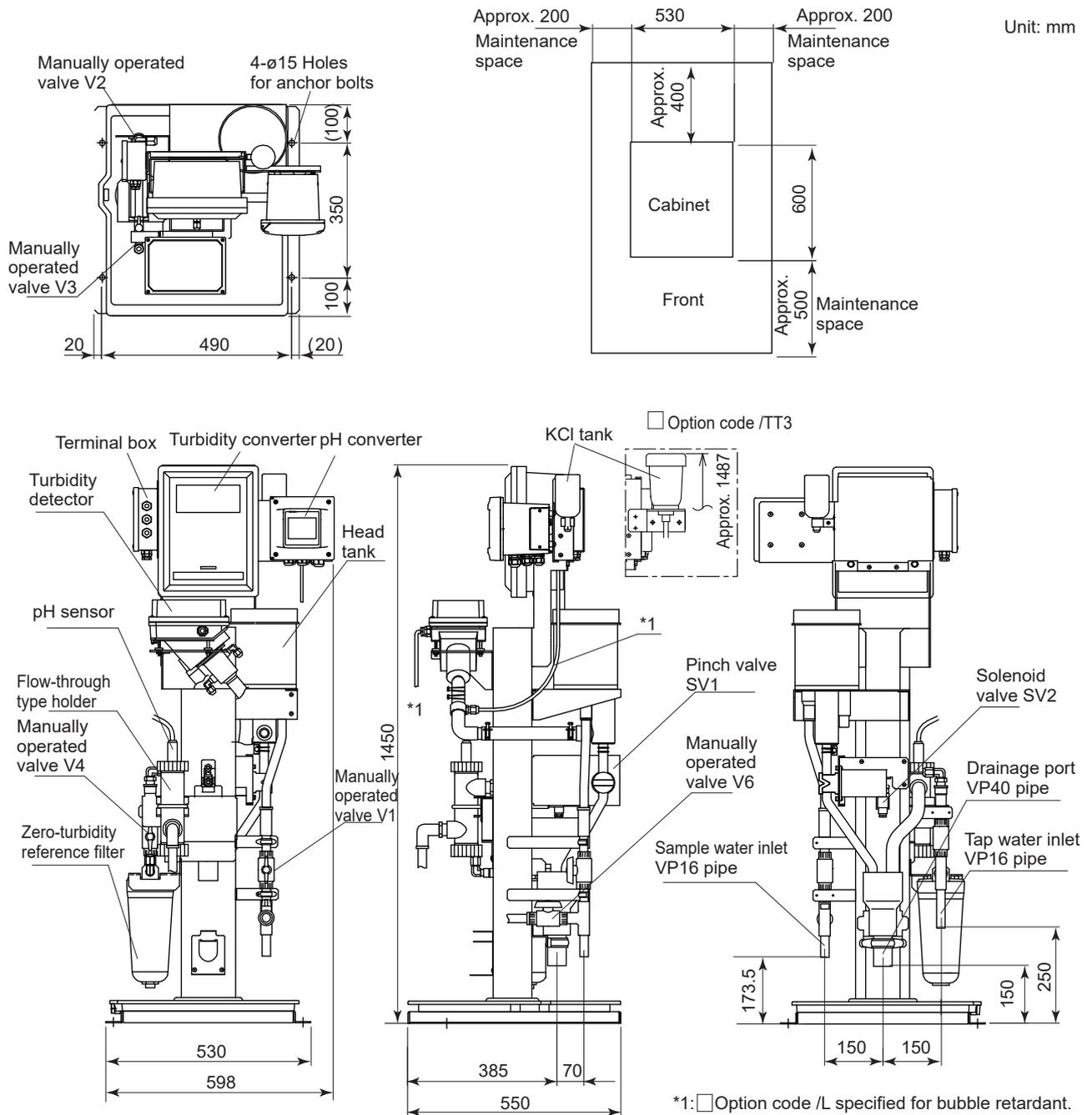


Figure 2.9.1b TB400G-□-□-A2/PHN6 (Bottom Piping) External Dimensions

Weight: Approx. 56 kg

Unit: mm

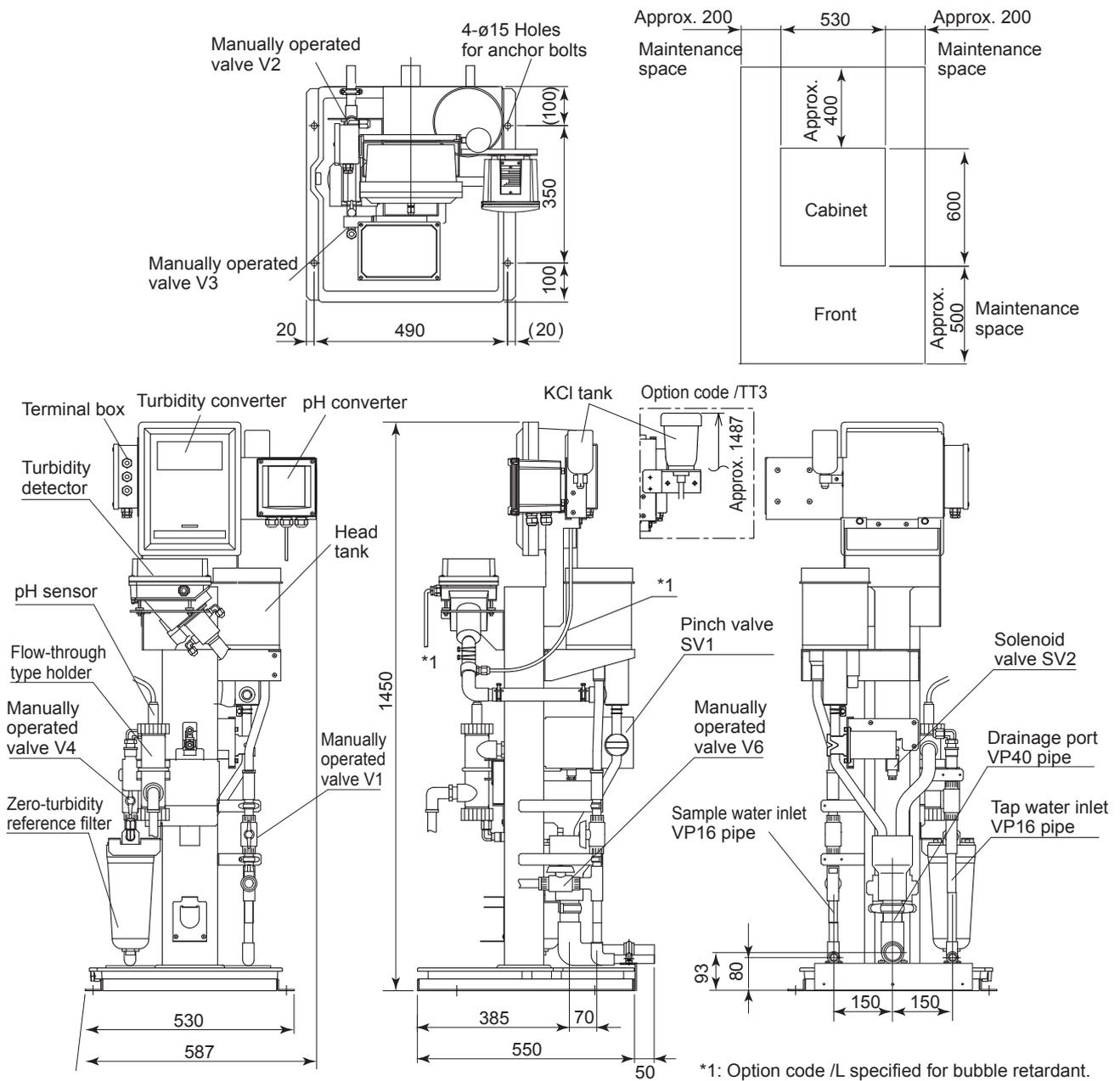
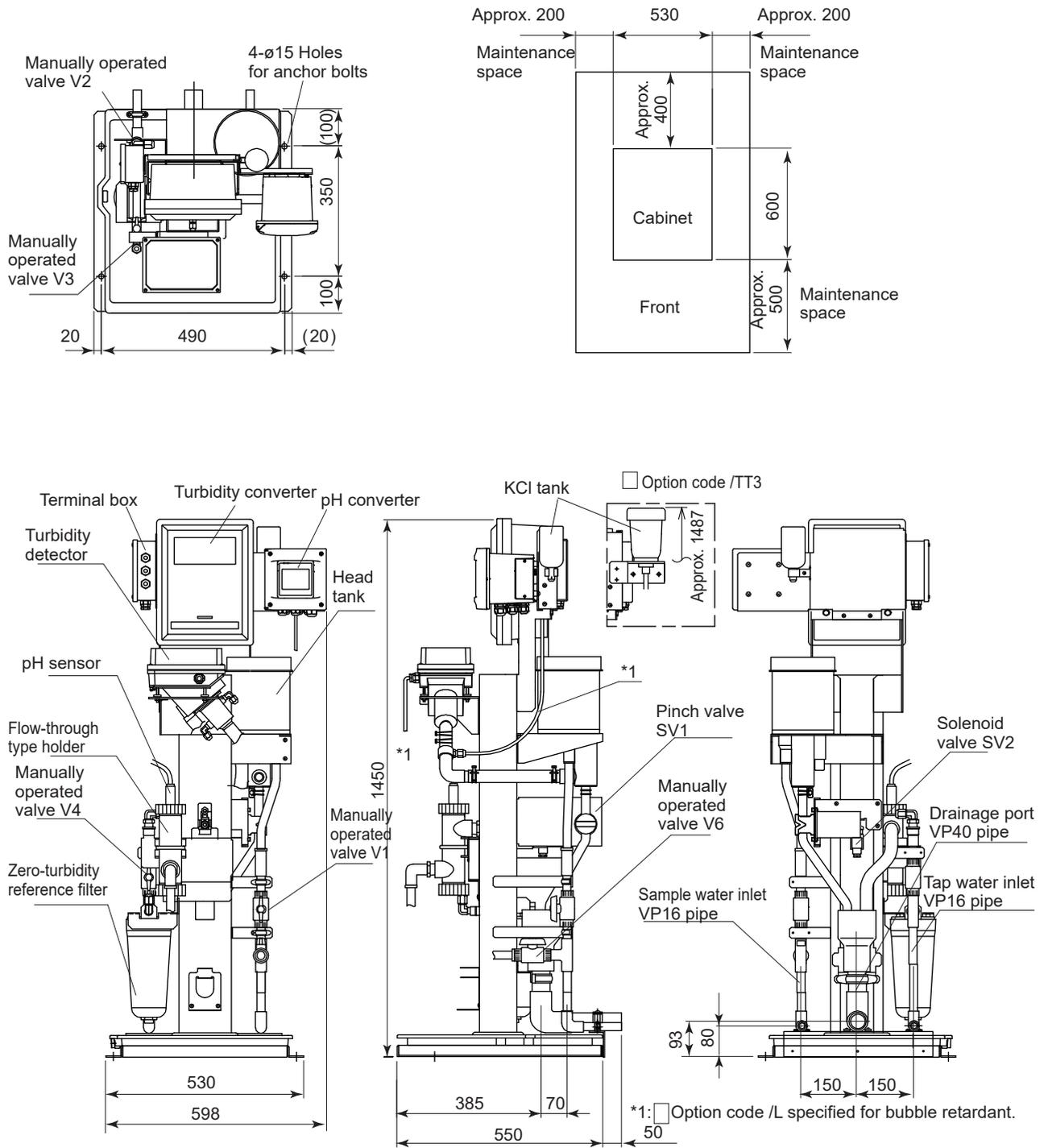


Figure 2.9.2a TB400G-□-□-A2/PHN5 /B (Rear Piping) External Dimensions

Weight: Approx. 56kg

Unit: mm



Weight: Approx. 56 kg

Figure 2.9.2b TB400G-□-□-A2/PHN6/B (Rear Piping) External Dimensions

2.5.10 TB400G-□-□-A3/PHN□

Unit: mm

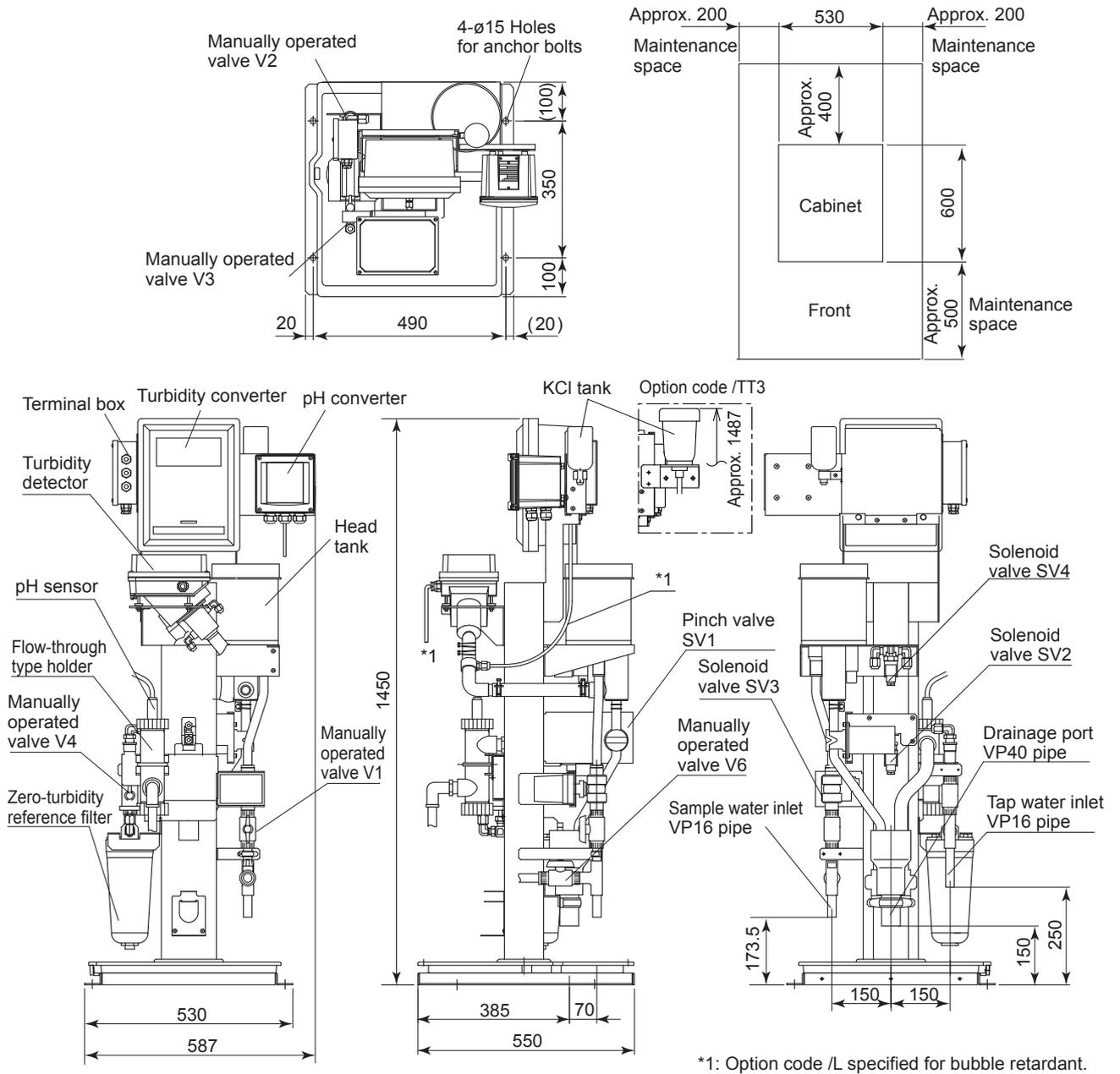
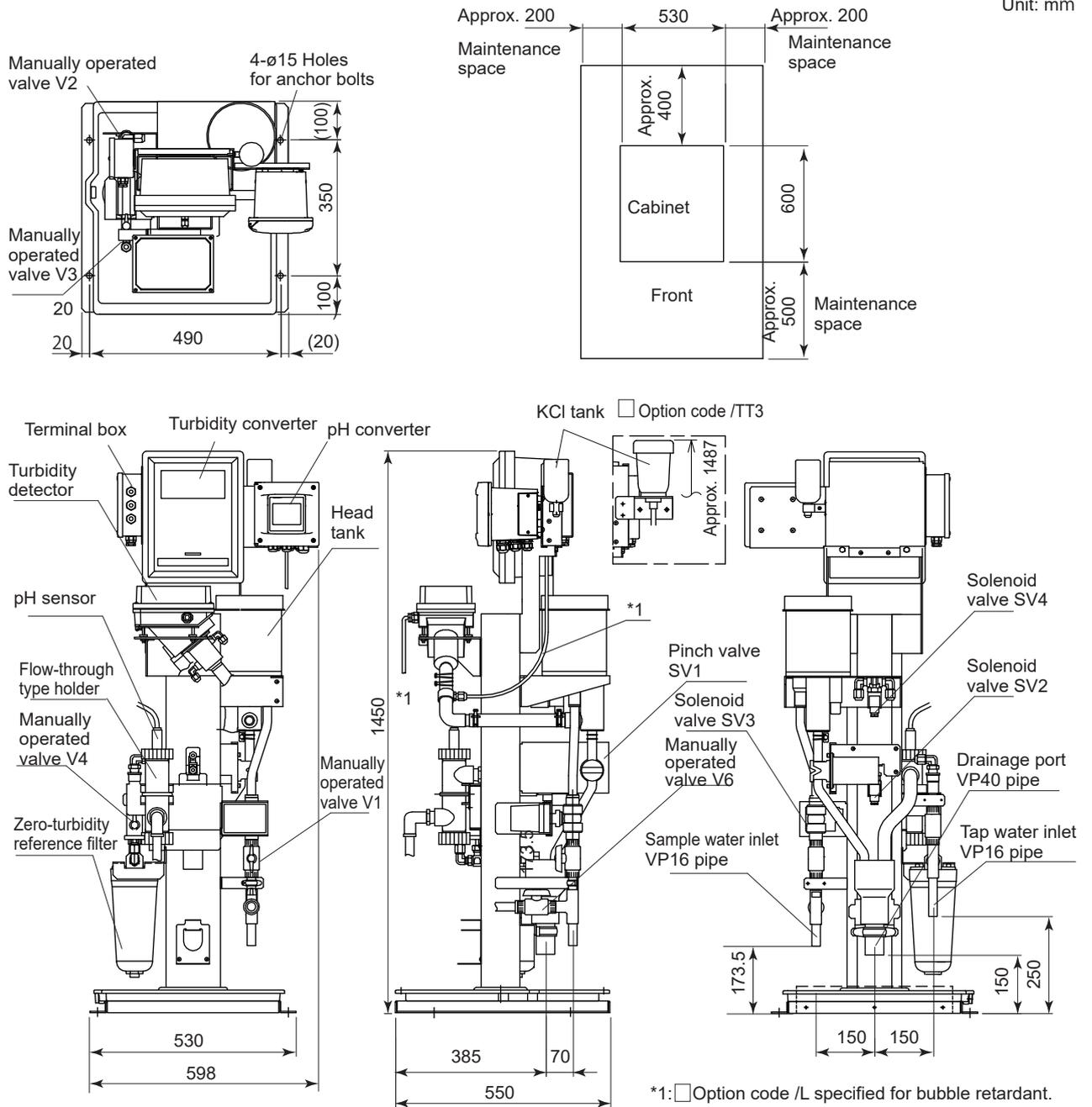


Figure 2.10.1a TB400G-□-□-A3/PHN5 (Bottom Piping) External Dimensions

Weight: Approx. 56kg

Unit: mm



Weight: Approx. 56 kg

Figure 2.10.1b TB400G---A3/PHN6 (Bottom Piping) External Dimensions

Unit: mm

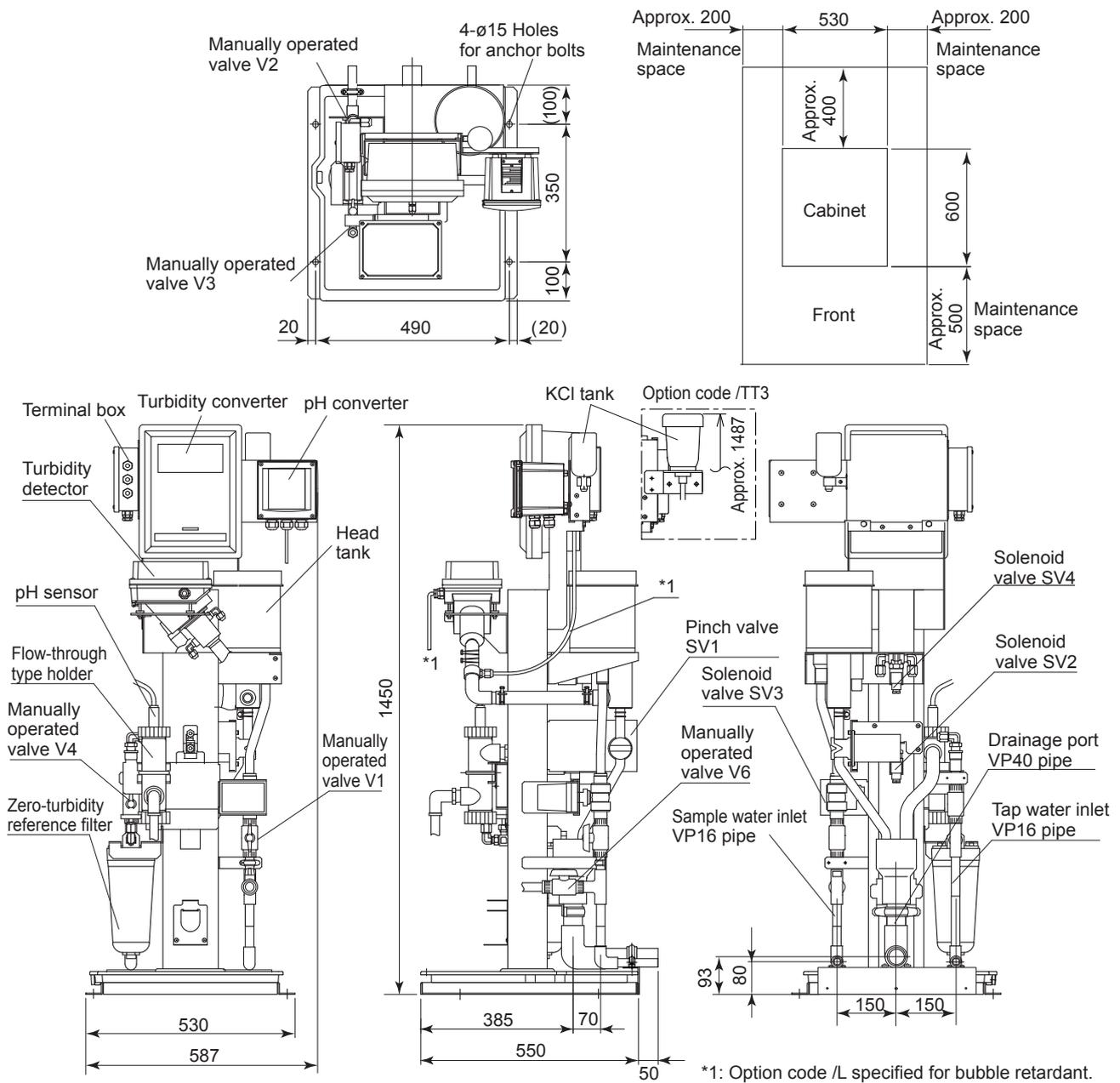
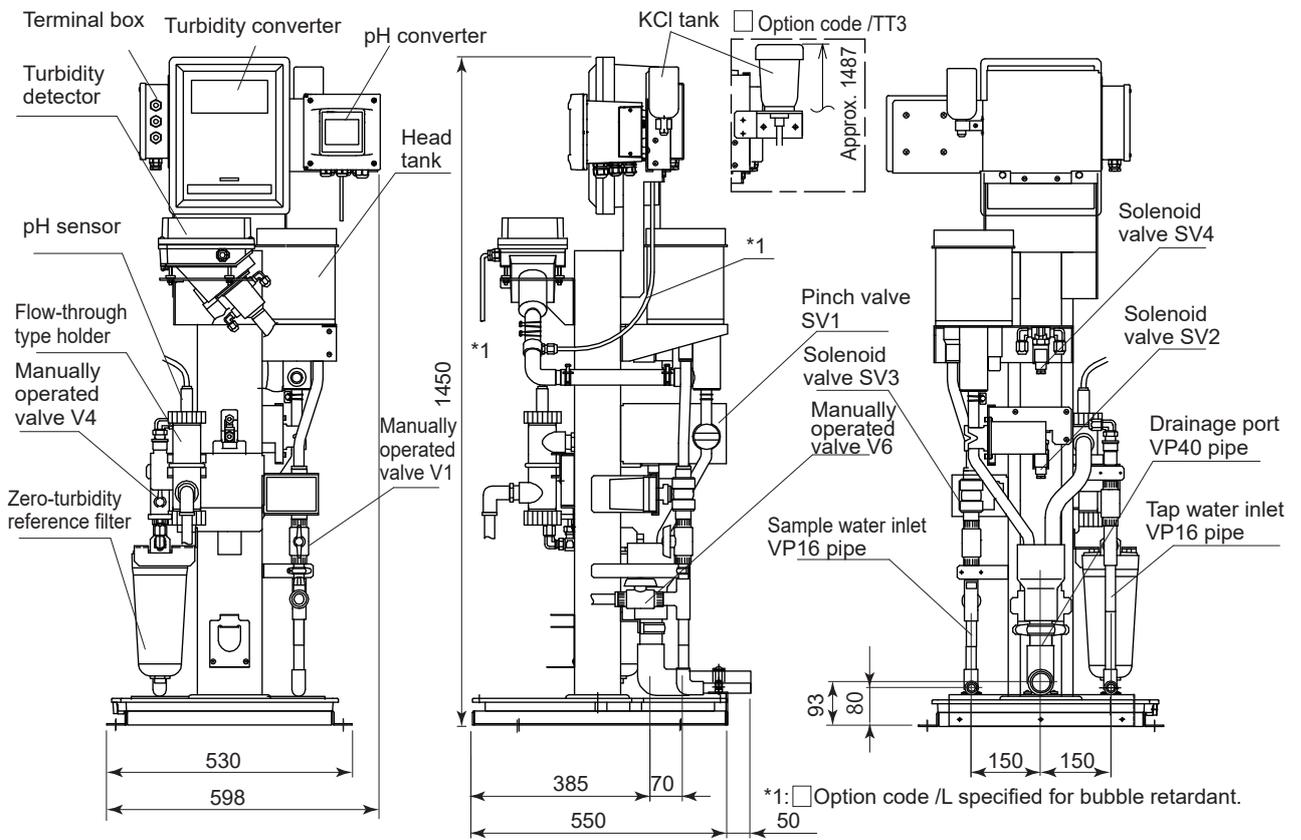
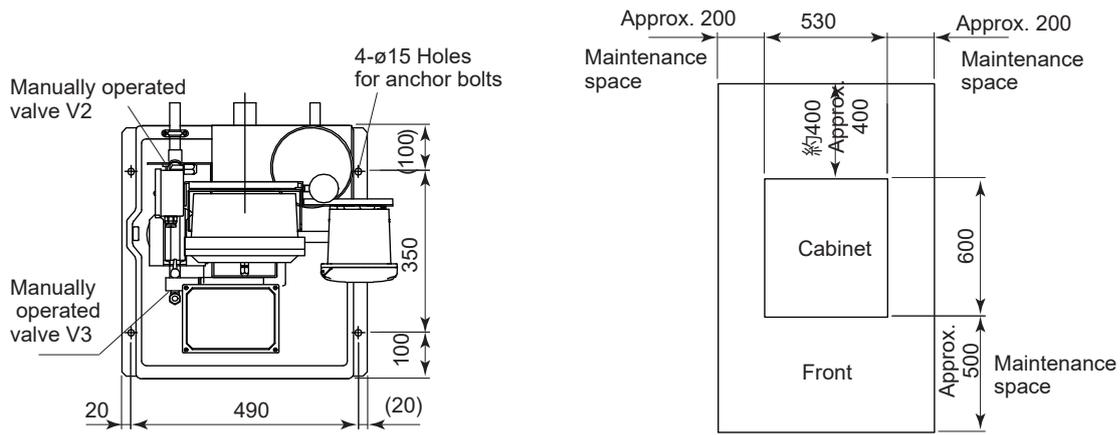


Figure 2.10.2a TB400G-□-□-A3/PHN5/B (Rear Piping) External Dimensions

Weight: Approx. 56kg

Unit: mm



Weight: Approx. 56 kg

Figure 2.10.2b TB400G-□-□-A3/PHN6/B (Rear Piping) External Dimensions

2.5.11 TB400G-□-□-A1/FC

Unit: mm

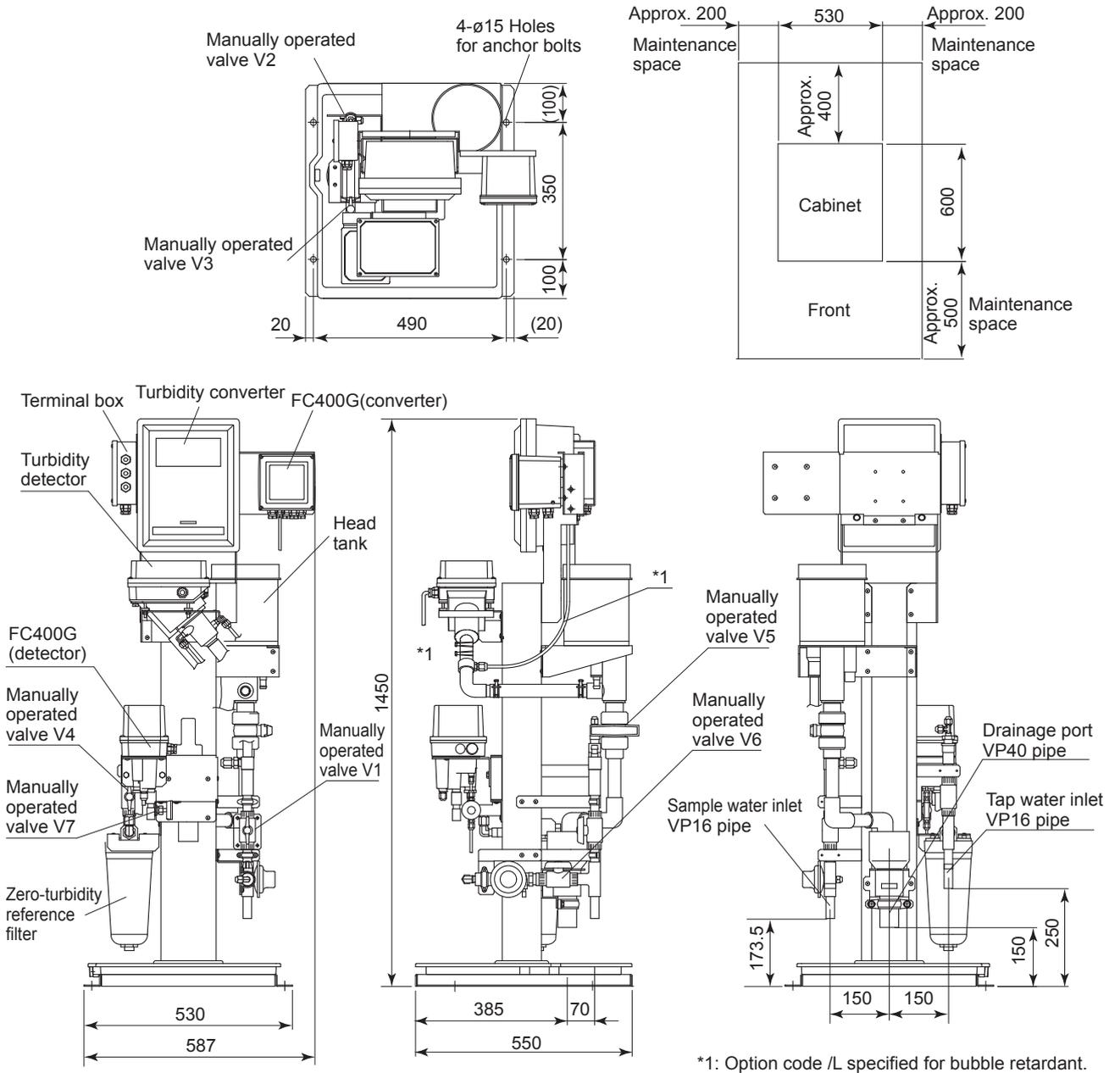


Figure 2.11.1 TB400G-□-□-A1/FC (Bottom Piping) External Dimensions

Weight: Approx. 56kg

Unit: mm

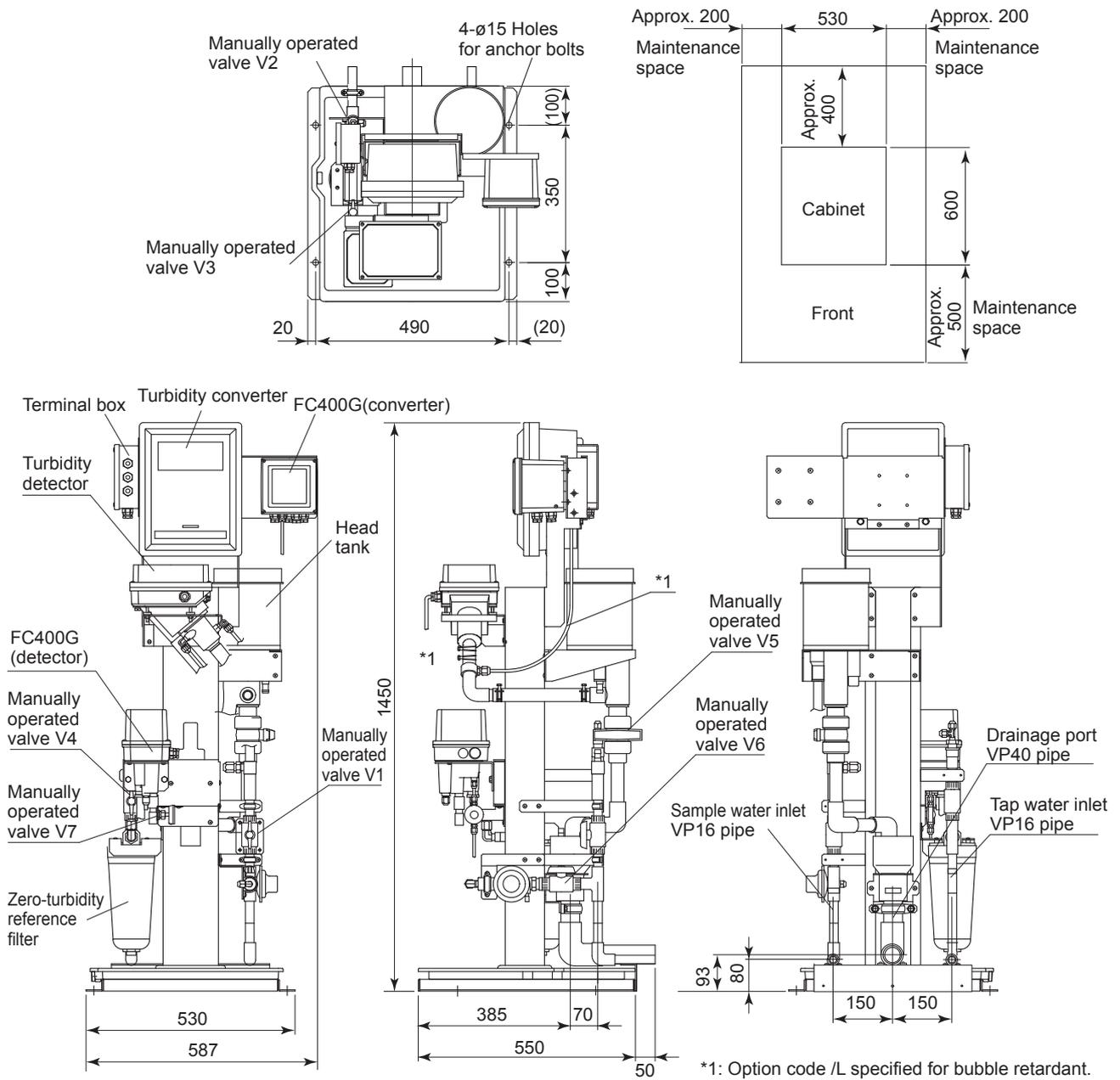


Figure 2.11.2 TB400G-□-□-A1/FC/B (Rear Piping) External Dimensions

Weight: Approx. 56kg

2.5.12 TB400G-□-□-A2/FC

Unit: mm

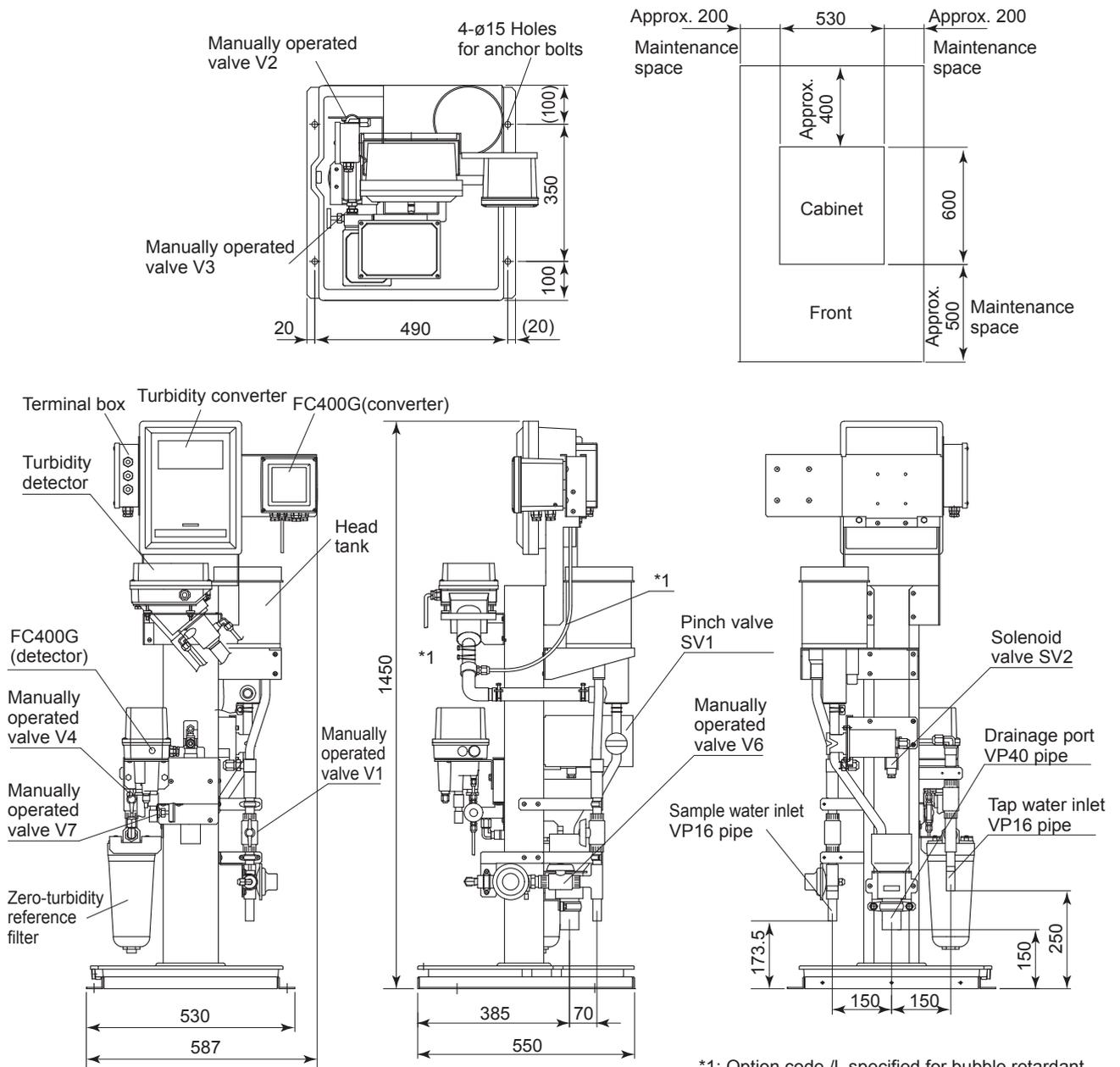


Figure 2.12.1 TB400G-□-□-A2/FC (Bottom Piping) External Dimensions

Weight: Approx. 56kg

Unit: mm

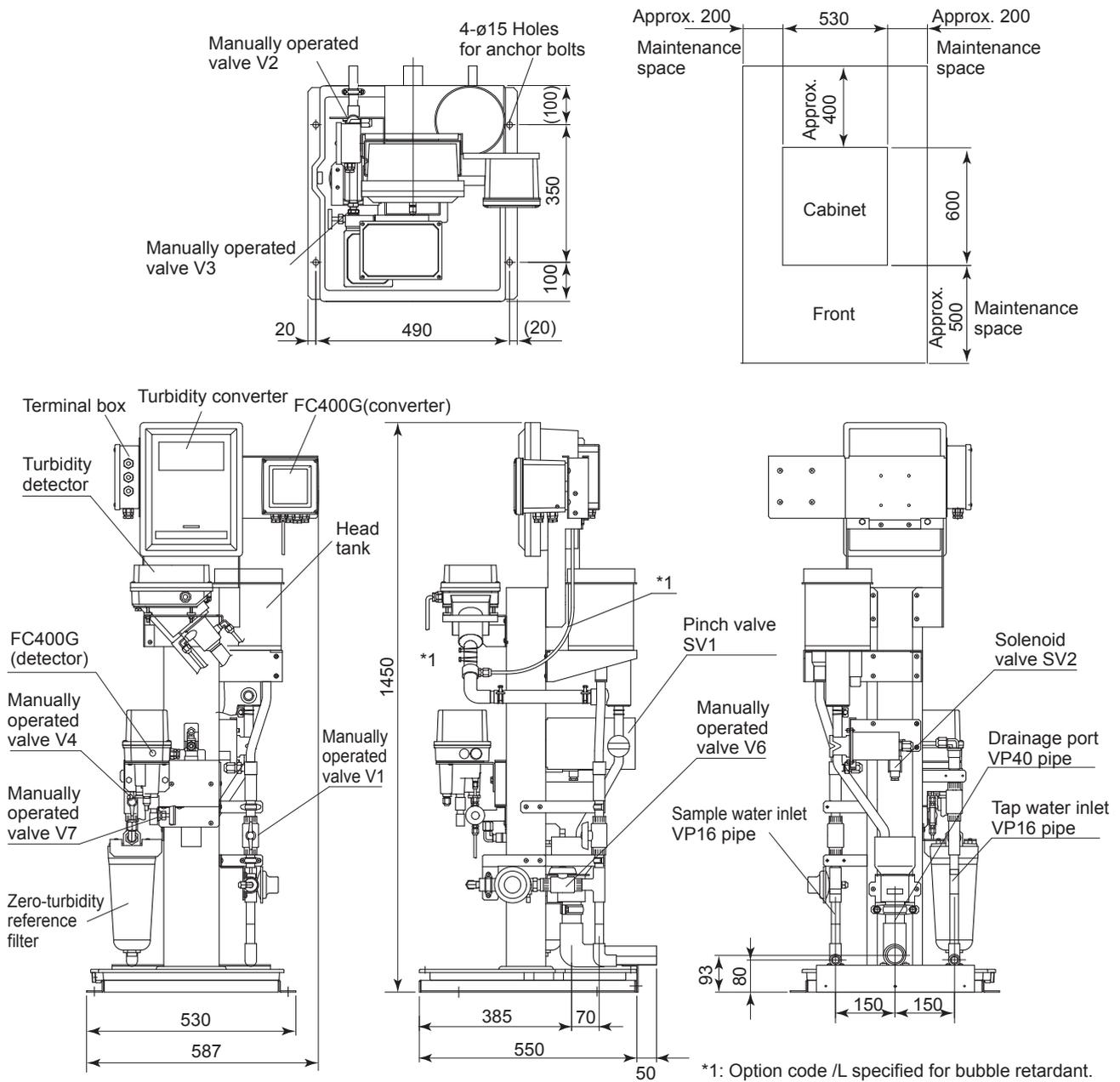


Figure 2.12.2 TB400G-□-□-A2/FC/B (Rear Piping) External Dimensions

Weight: Approx. 56kg

2.5.13 TB400G-□-□-A3/FC

Unit: mm

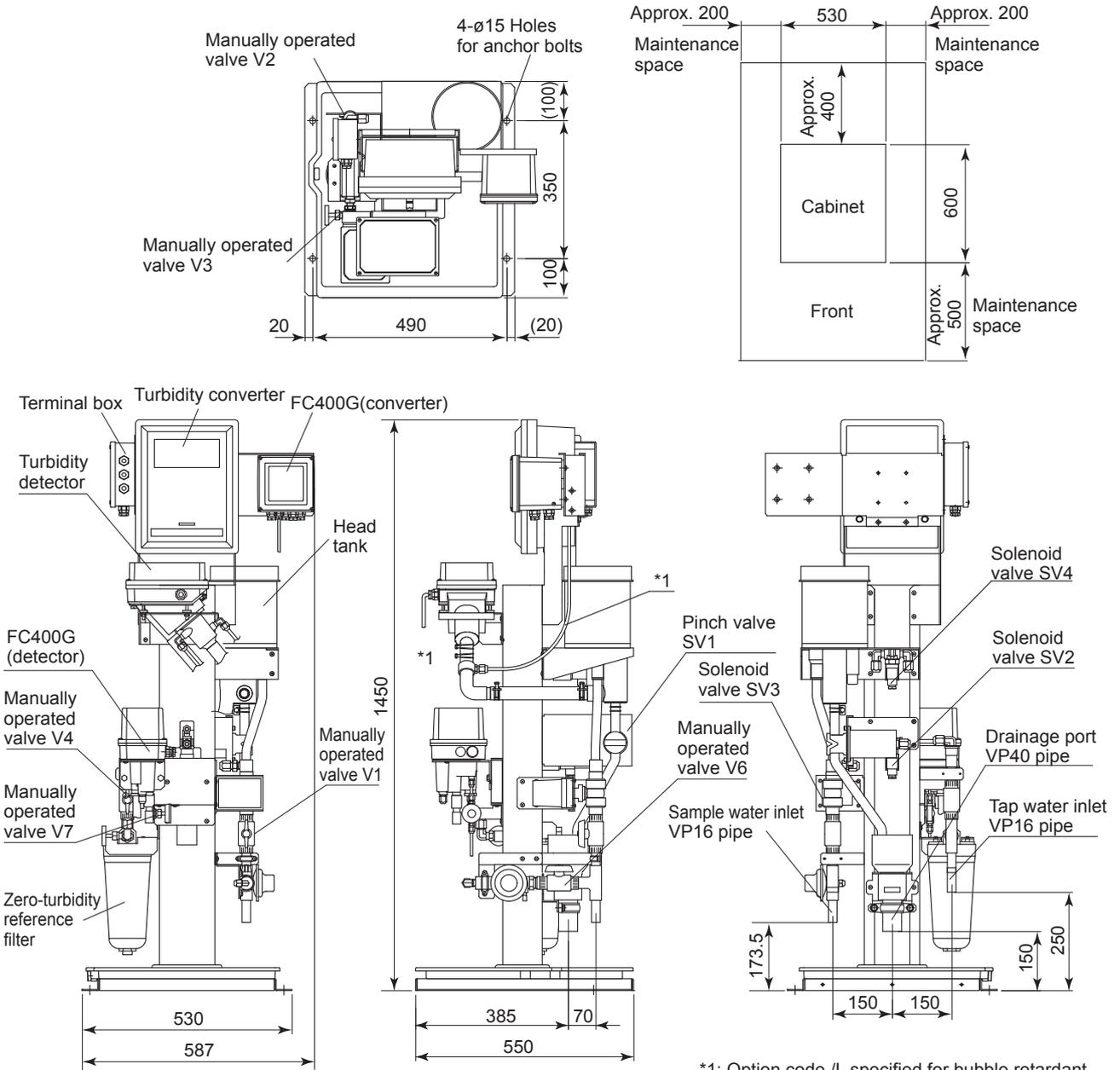


Figure 2.13.1 TB400G-□-□-A3/FC (Bottom Piping) External Dimensions

Weight: Approx. 56kg

Unit: mm

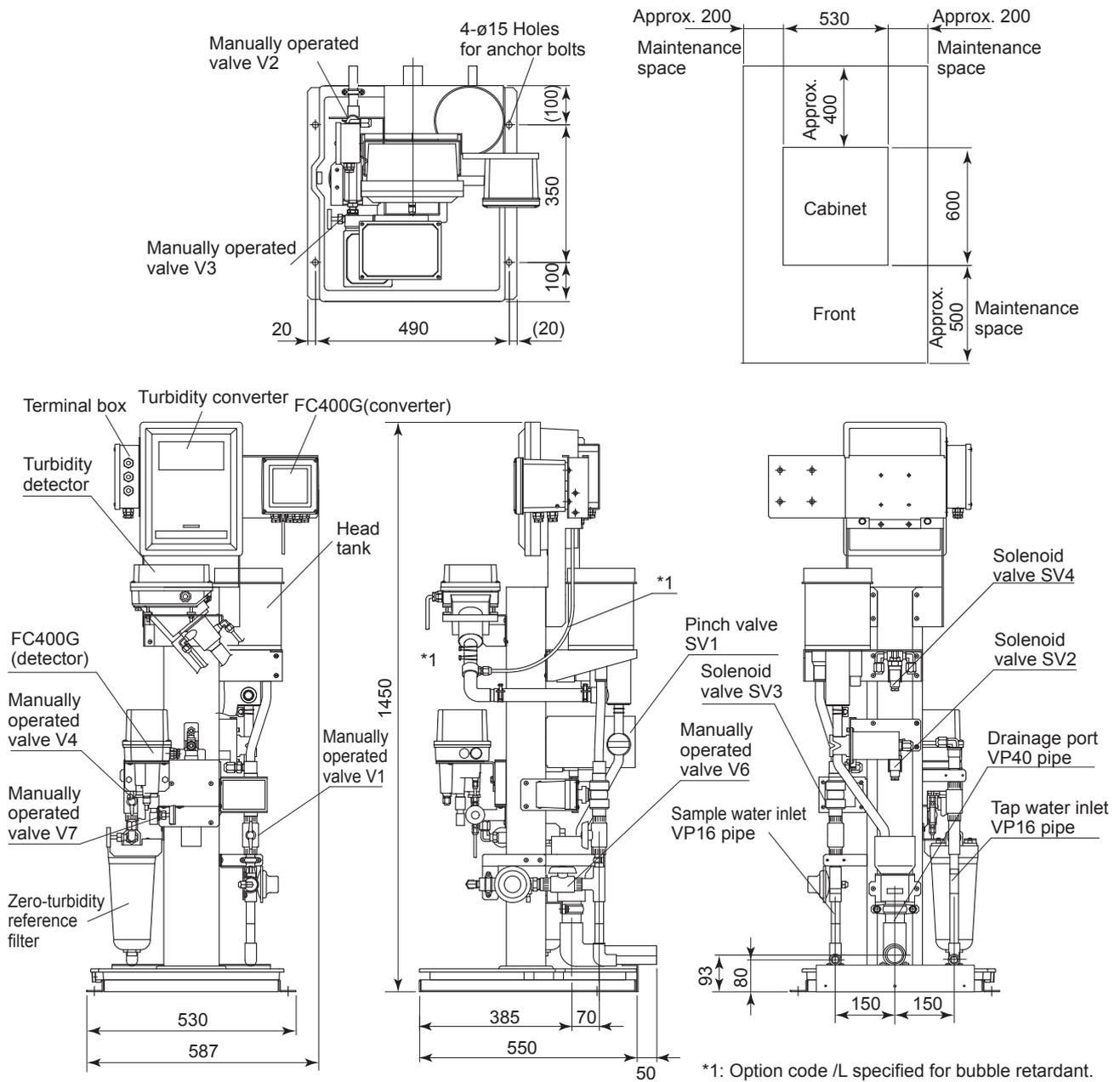
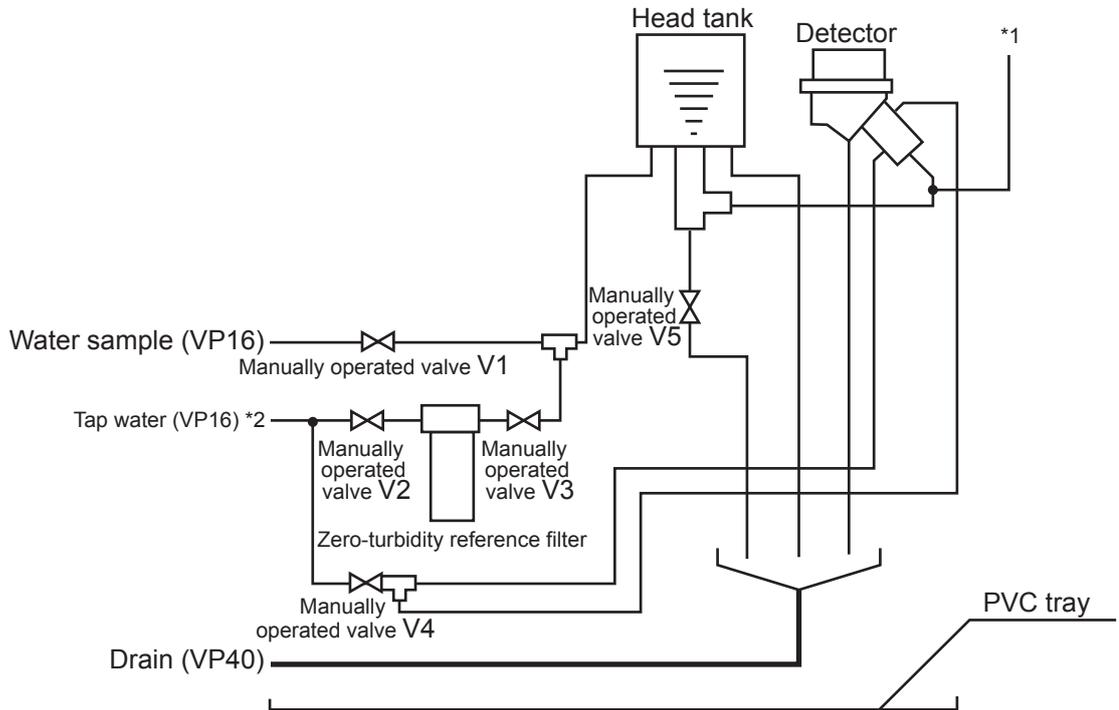


Figure 2.13.2 TB400G-□-□-A3/FC/B (Rear Piping) External Dimensions

Weight: Approx. 56kg

2.6 Piping System Diagrams

2.6.1 TB400G-□-□-A1



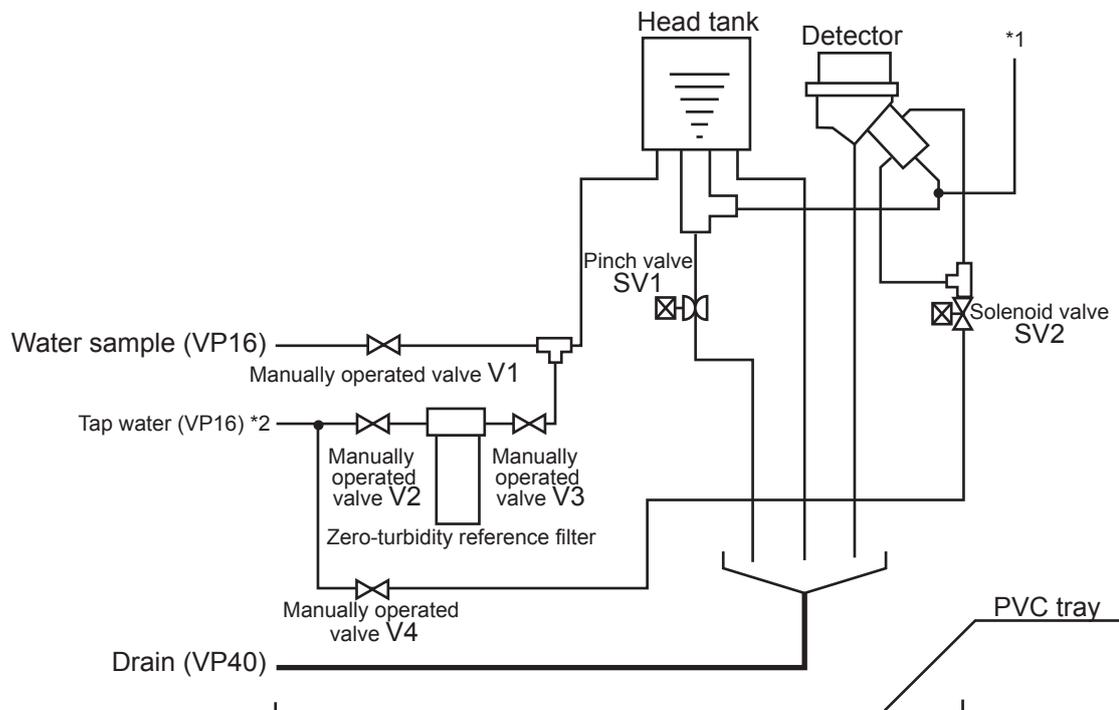
*1: Option Code /L (For bubble retardant)

*2: Reverse flow of tap water should be prevented using with a check valve on the supply line of tap water.

F0214.ai

Figure 2.14 TB400G-□-□-A1 Piping Diagram

2.6.2 TB400G-□-□-A2



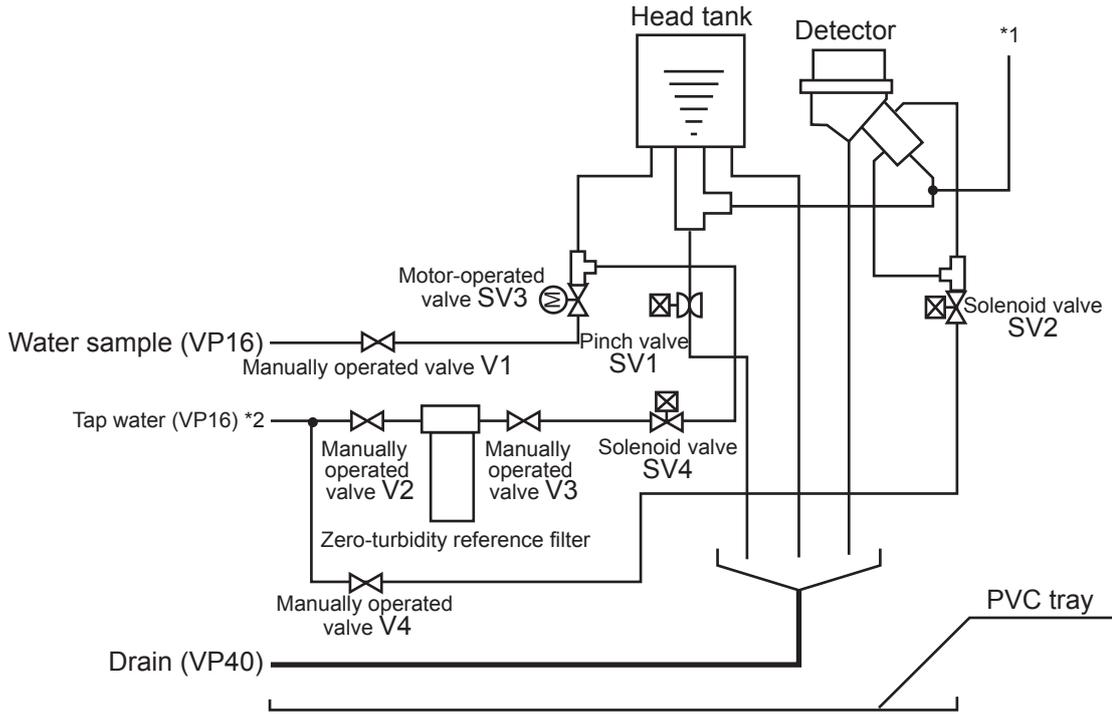
*1: Option Code /L (For bubble retardant)

*2: Reverse flow of tap water should be prevented using with a check valve on the supply line of tap water.

F0215.ai

Figure 2.15 TB400G-□-□-A2 Piping Diagram

2.6.3 TB400G-□-□-A3

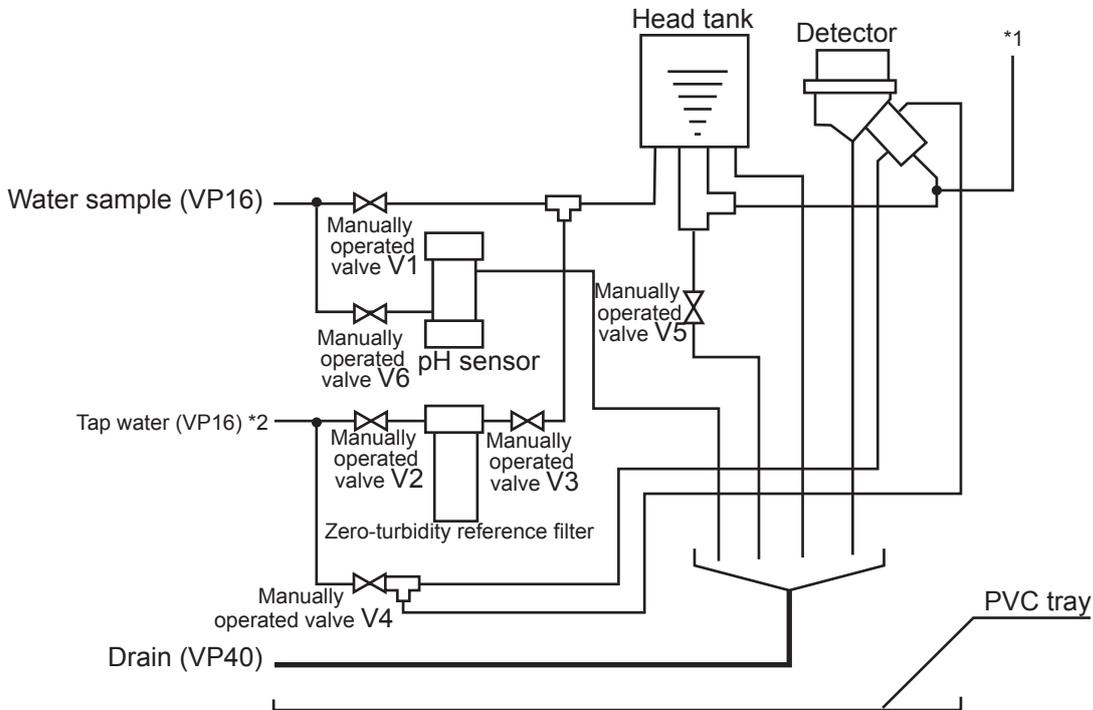


*1: Option Code /L (For bubble retardant)

*2: Reverse flow of tap water should be prevented using with a check valve on the supply line of tap water. F0216.ai

Figure 2.16 TB400G-□-□-A3 Piping Diagram

2.6.4 TB400G-□-□-A1/PHU□, /PHN□

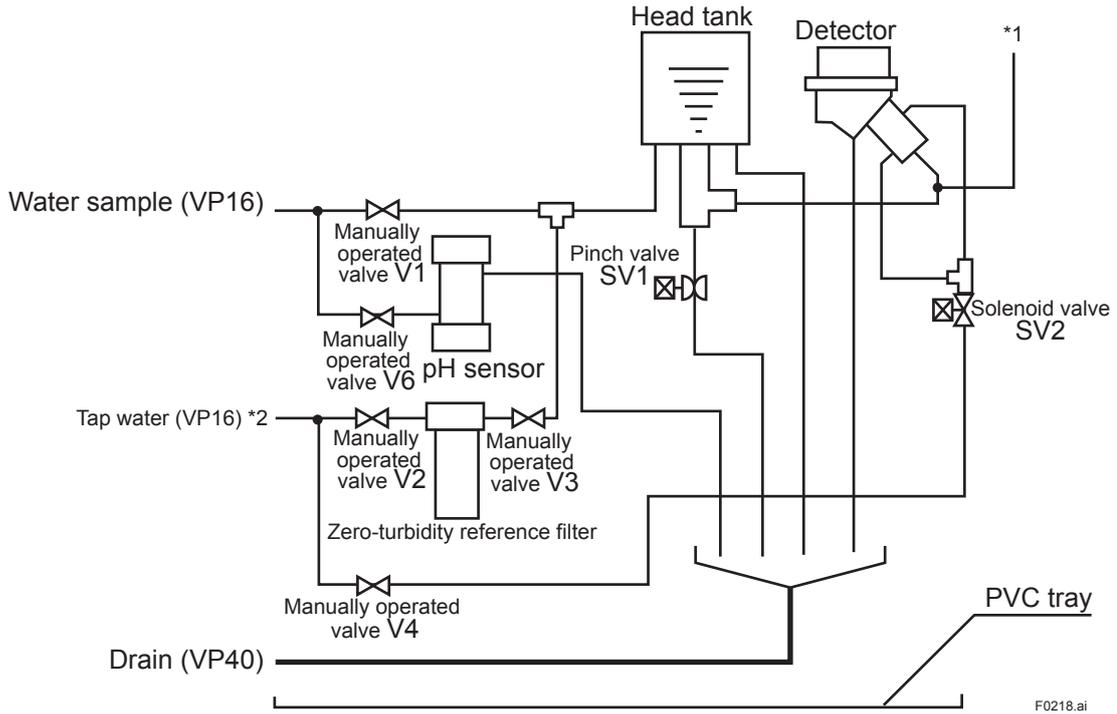


*1: Option Code /L (For bubble retardant)

*2: Reverse flow of tap water should be prevented using with a check valve on the supply line of tap water. F0217.ai

Figure 2.17 TB400G-□-□-A1/PHU□, /PHN□ Piping Diagram

2.6.5 TB400G-□-□-A2/PHU□, /PHN□

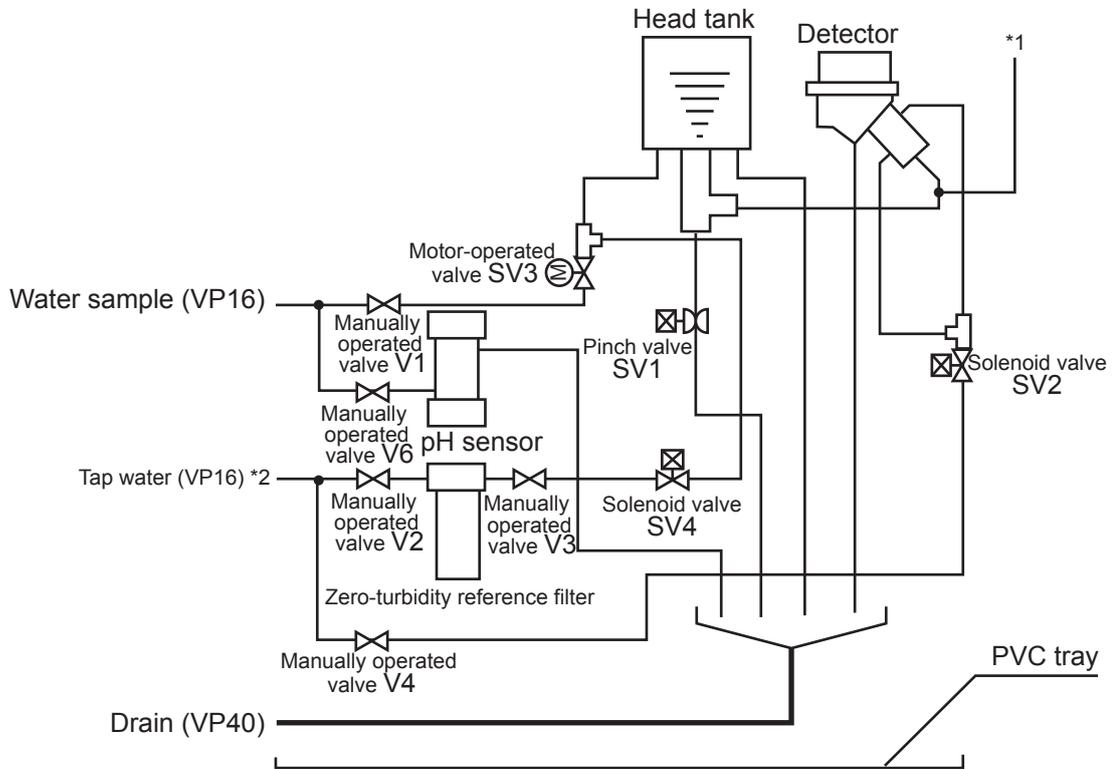


*1: Option Code /L (For bubble retardant)

*2: Reverse flow of tap water should be prevented using with a check valve on the supply line of tap water.

Figure 2.18 TB400G-□-□-A2/PHU□, /PHN□ Piping Diagram

2.6.6 TB400G-□-□-A3/PHU□, /PHN□

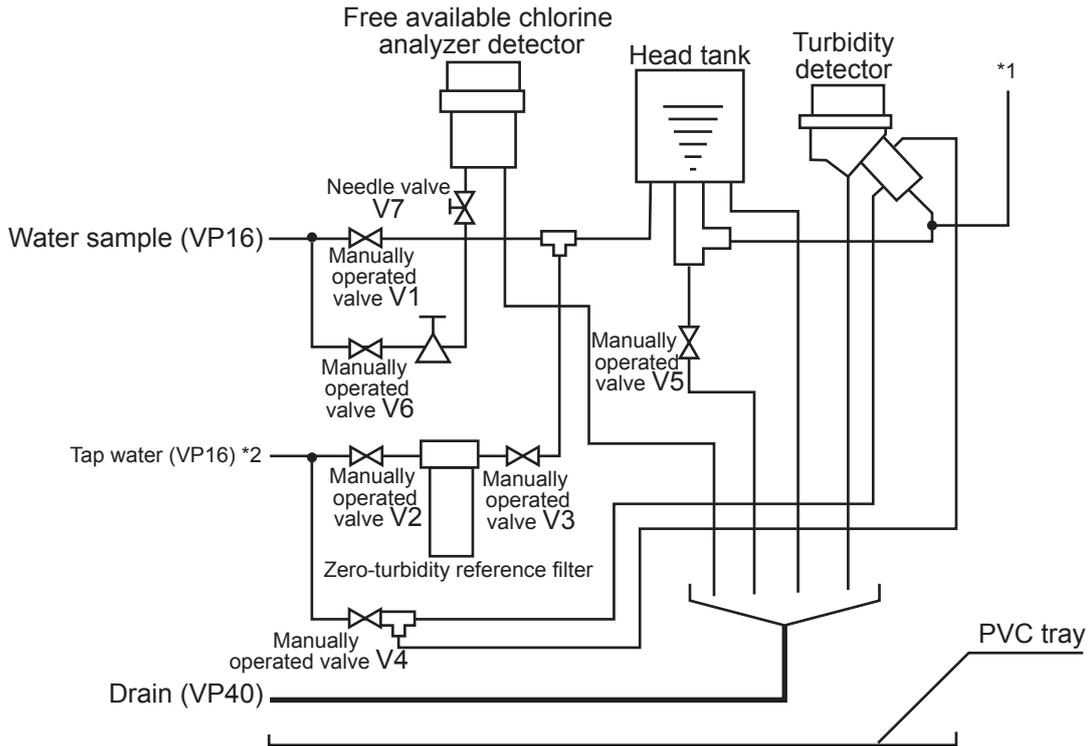


*1: Option Code /L (For bubble retardant)

*2: Reverse flow of tap water should be prevented using with a check valve on the supply line of tap water.

Figure 2.19 TB400G-□-□-A3/PHU□, /PHN□ Piping Diagram

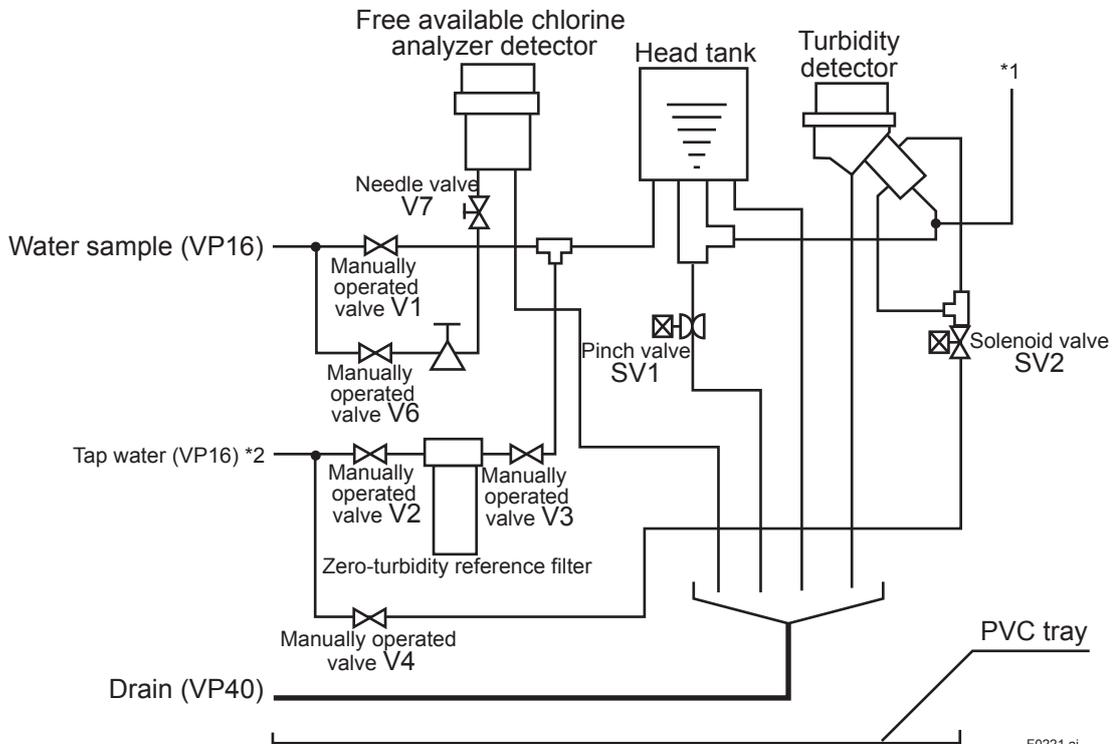
2.6.7 TB400G-□-□-A1/FC



*1: Option Code /L (For bubble retardant) F0220.ai
 *2: Reverse flow of tap water should be prevented using with a check valve on the supply line of tap water.

Figure 2.20 TB400G-□-□-A1/FC Piping Diagram

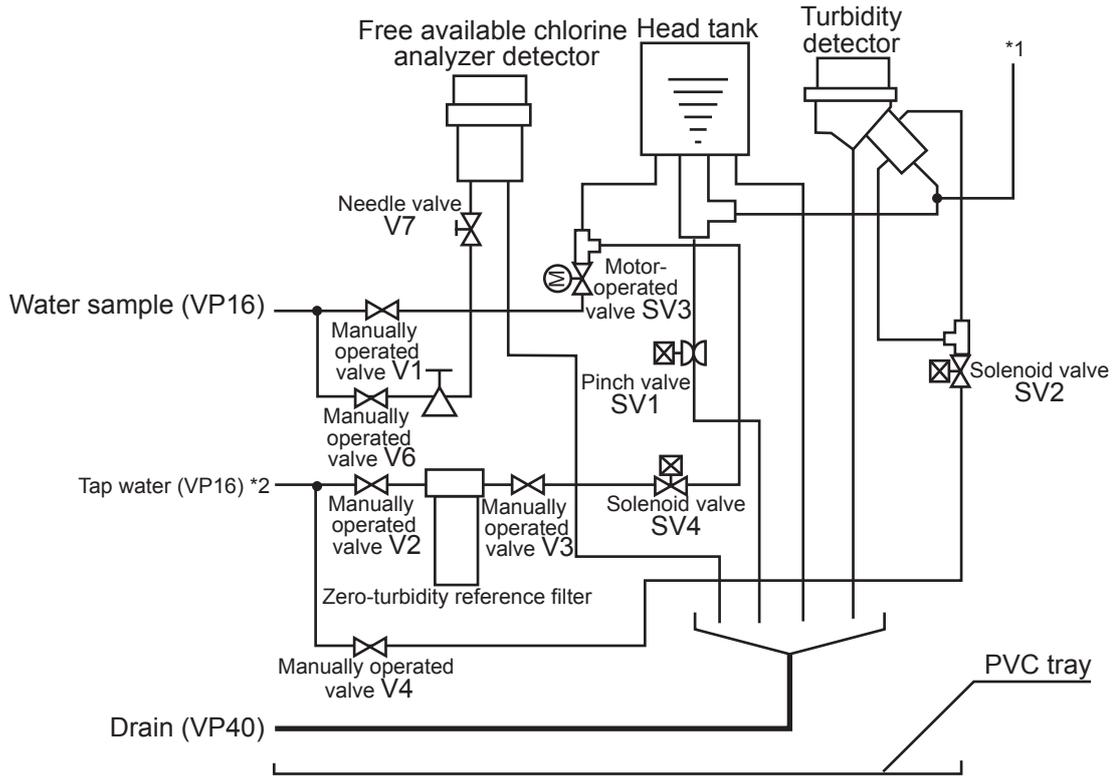
2.6.8 TB400G-□-□-A2/FC



*1: Option Code /L (For bubble retardant) F0221.ai
 *2: Reverse flow of tap water should be prevented using with a check valve on the supply line of tap water.

Figure 2.21 TB400G-□-□-A2/FC Piping Diagram

2.6.9 TB400G-□-□-A3/FC



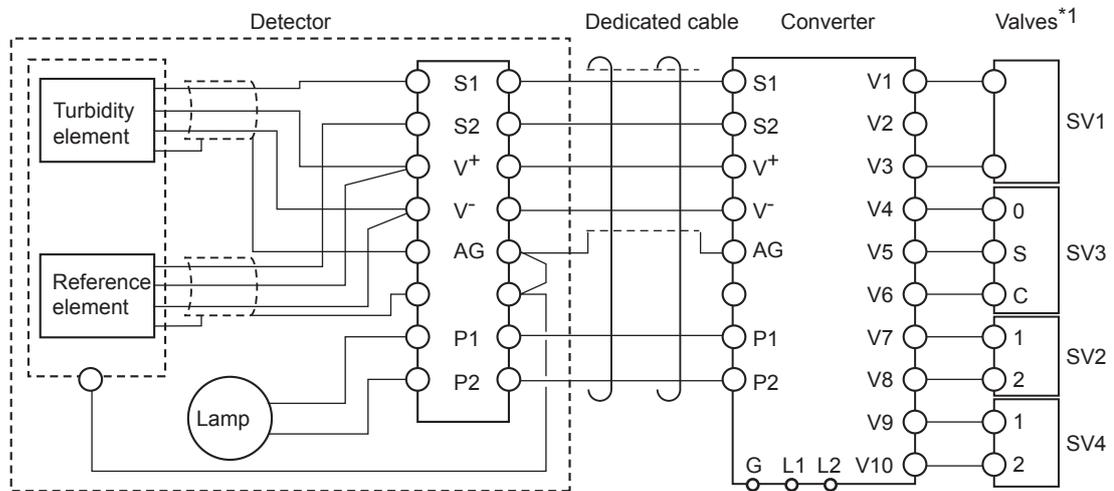
*1: Option Code /L (For bubble retardant)
*2: Reverse flow of tap water should be prevented using with a check valve on the supply line of tap water.

Figure 2.22 TB400G-□-□-A3/FC Piping Diagram

2.7 Internal Wiring Diagram

Figure 2.23 shows the internal wiring diagram of the turbidimeter with a sampling system. For external wiring, see Section 3.3.

If the detector and the converter are to be delivered as separate units, a dedicated cable is shipped connected to the detector.



*1 : Valve connections vary with the specifications as shown Table 2.2.

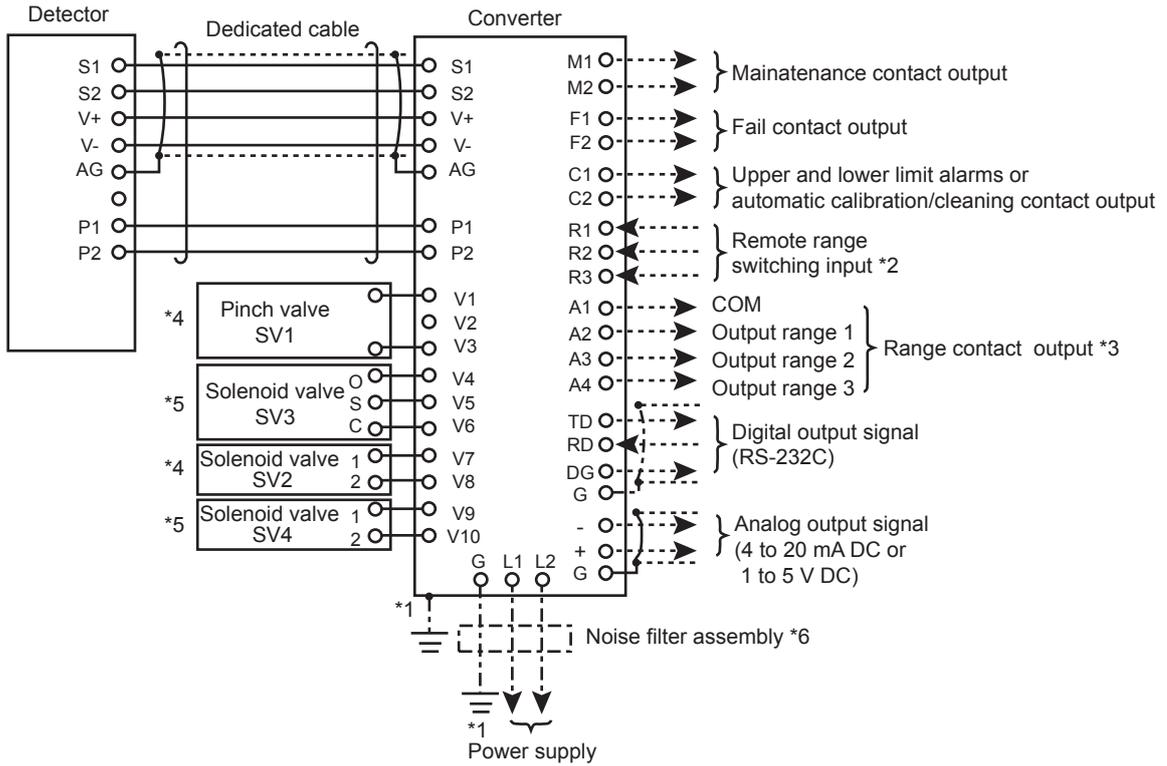
F0223.ai

Figure 2.23 Internal Wiring Diagram

Table 2.2 Specifications and Connections

Suffix code	Specifications with/without sampling system, automatic cleaning and zero calibration	Valves to be connected
-NN, -KC	W/o sampling system, automatic cleaning, or automatic zero calibration	No valve connection
-A1	W/ sampling system, but w/o automatic cleaning or automatic zero calibration	No valve connection
-A2	W/ sampling system and automatic cleaning but w/o automatic zero calibration	SV1, SV2
-A3	W/ sampling system, automatic cleaning, and automatic zero calibration	SV1, SV2, SV3, SV4

● -A3



*1: Ground terminal \perp on the outside of the converter case with a grounding resistance of 100 Ω or less. Ground the power cord instead only if the above grounding is not feasible. (Note) Do not use two-point grounding.

*2: Remote range switching method

Output \ Contact	R1 to R2	R1 to R3
Output range 1	OFF	OFF
Output range 2	ON	OFF
Output range 3	OFF	ON

Resistance (ON): 200 Ω or less
(OFF): 100 kΩ or more

*3: Output range switching method

Output \ Contact	A1 to A2	A1 to A3	A1 to A4
Output range 1	Close	Open	Open
Output range 2	Open	Close	Open
Output range 3	Open	Open	Close

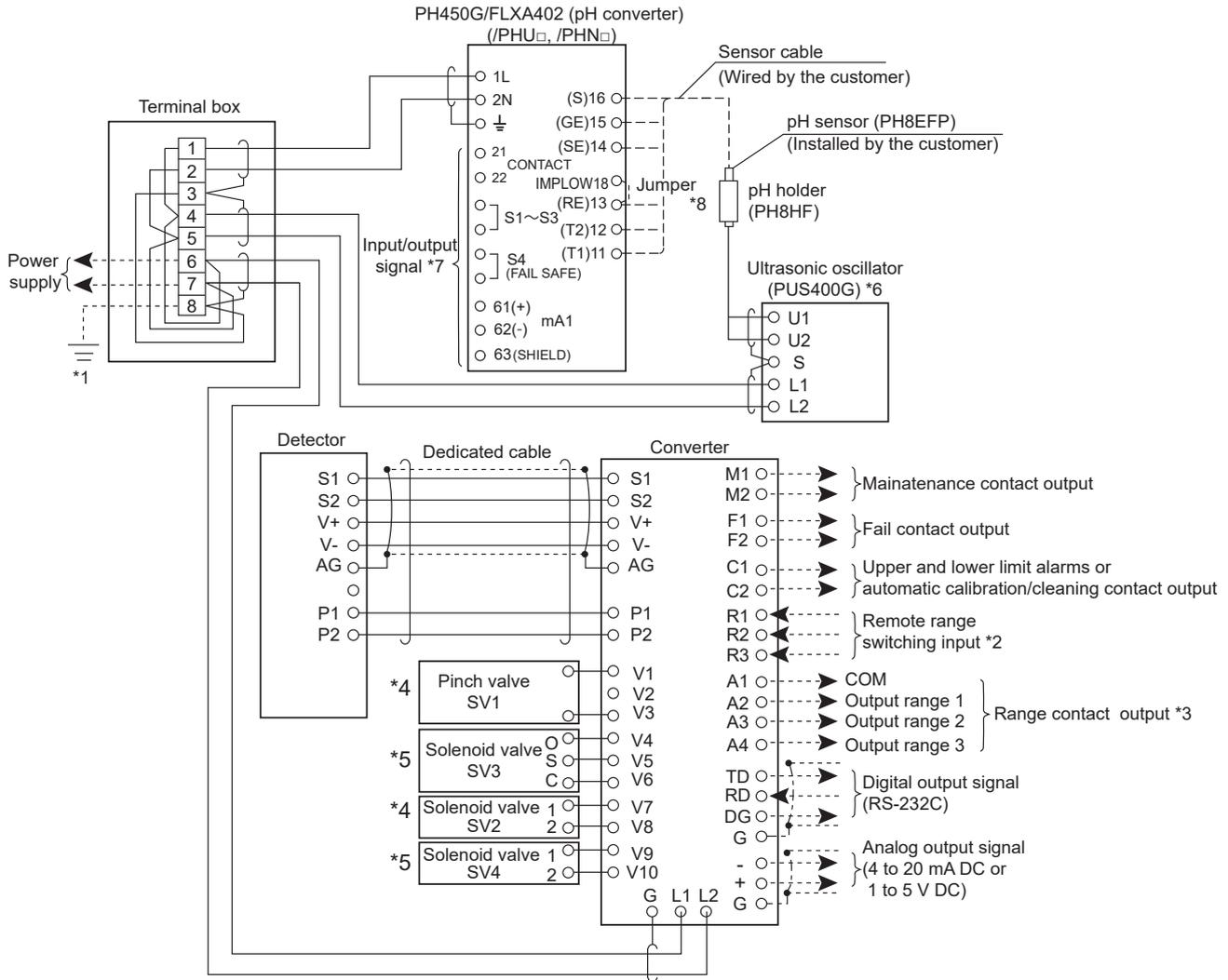
*4: In the case of with automatic cleaning (-A2, -A3)

*5: In the case of with automatic zero calibration (-A3)

*6: Only for Korea (-KC)

Figure 2.24 Internal Wiring Diagram for -A3

● /PHU□, /PHN□



*1: Ground the power cord (8) with a grounding resistance of 100 Ω or less.

*2: Remote range switching method

Output	Contact	R1 to R2	R1 to R3
Output range 1		OFF	OFF
Output range 2		ON	OFF
Output range 3		OFF	ON

Resistance (ON): 200 Ω or less
(OFF): 100 kΩ or more

*3: Output range switching method

Output	Contact	A1 to A2	A1 to A3	A1 to A4
Output range 1		Close	Open	Open
Output range 2		Open	Close	Open
Output range 3		Open	Open	Close

*4: In the case of with automatic cleaning (-A2, -A3)

*5: In the case of with automatic zero calibration (-A3)

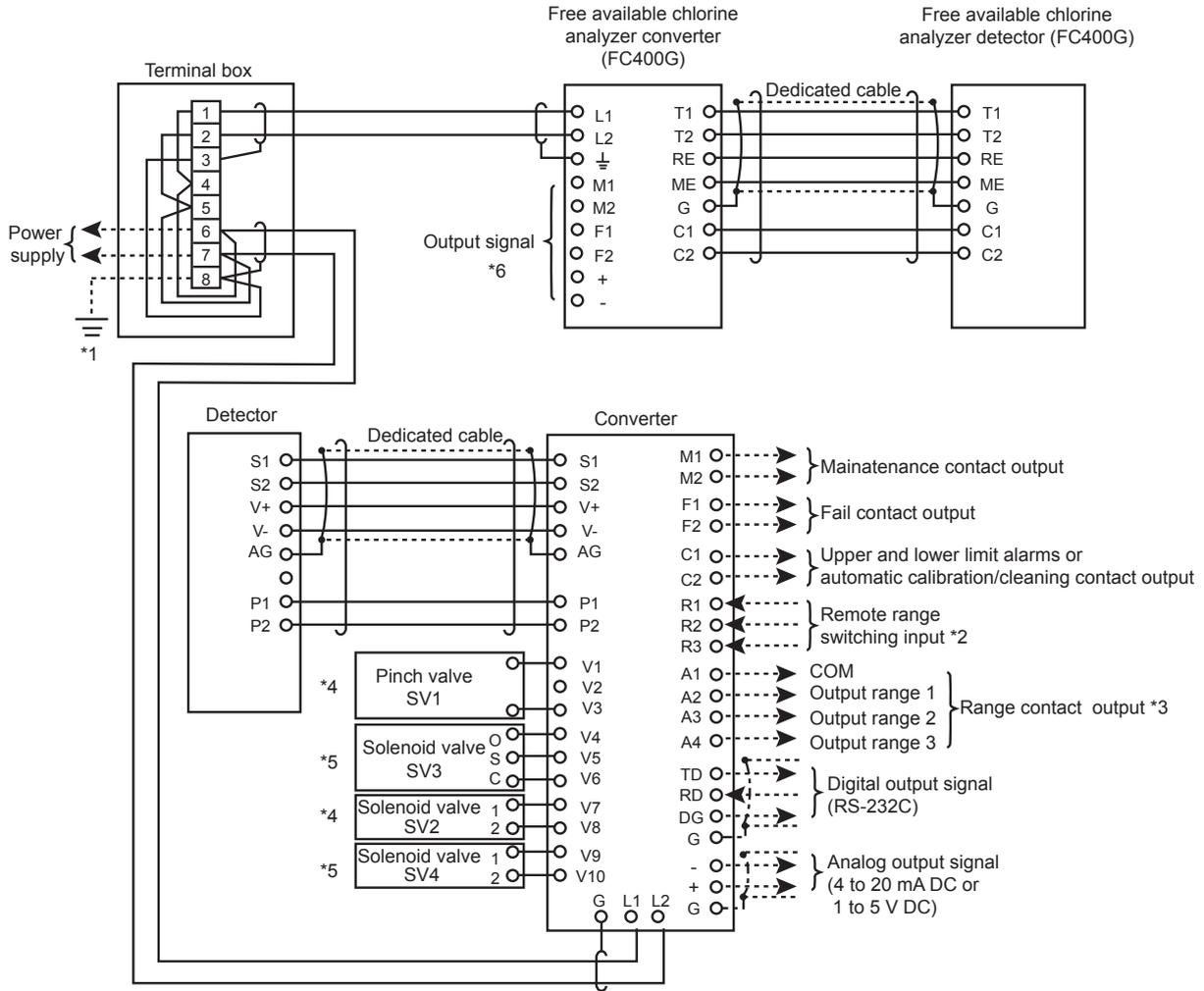
*6: In the case of with ultrasonic cleaning (/PHU□)

*7: Refer to the User's Manual of the PH450G/FLXA402 for details of input/output signals.

*8: Refer to the User's Manual of the PH450G/FLXA402 for details of jumper setting.

Figure 2.25 Internal Wiring Diagram for /PHU□, /PHN□

● /FC



*1: Ground the power cord (8) with a grounding resistance of 100 Ω or less.

*2: Remote range switching method

Output	Contact	R1 to R2	R1 to R3
Output range 1		OFF	OFF
Output range 2		ON	OFF
Output range 3		OFF	ON

Resistance (ON): 200 Ω or less
 (OFF): 100 kΩ or more

*3: Output range switching method

Output	Contact	A1 to A2	A1 to A3	A1 to A4
Output range 1		Close	Open	Open
Output range 2		Open	Close	Open
Output range 3		Open	Open	Close

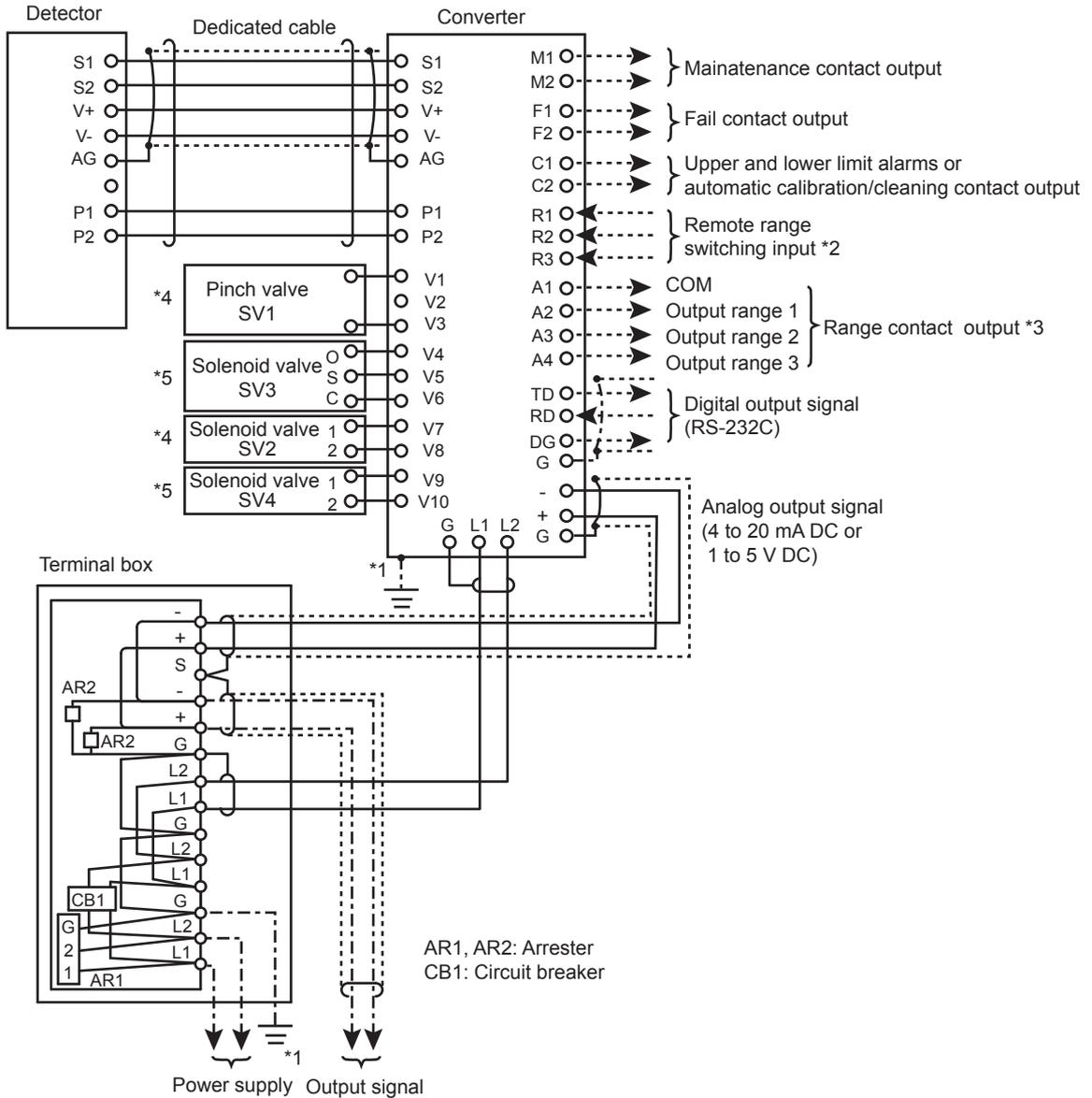
*4: In the case of with automatic cleaning (-A2, -A3)

*5: In the case of with automatic zero calibration (-A3)

*6: Refer to the User's Manual of the FC400G for details of input/output signals.

Figure 2.26 Internal Wiring Diagram for /FC

● /ARS



*1: Ground terminal ⊥ on the outside of the converter case with a grounding resistance of 100 Ω or less. Ground the power cord instead only if the above grounding is not feasible. (Note) Do not use two-point grounding.

*2: Remote range switching method

Output \ Contact	R1 to R2	R1 to R3
Output range 1	OFF	OFF
Output range 2	ON	OFF
Output range 3	OFF	ON

Resistance (ON): 200 Ω or less
(OFF): 100 kΩ or more

*3: Output range switching method

Output \ Contact	A1 to A2	A1 to A3	A1 to A4
Output range 1	Close	Open	Open
Output range 2	Open	Close	Open
Output range 3	Open	Open	Close

*4: In the case of with automatic cleaning (-A2, -A3)

*5: In the case of with automatic zero calibration (-A3)

Figure 2.27 Internal Wiring Diagram for /ARS

3. INSTALLATION, PIPING, AND WIRING

3.1 Installation

3.1.1 Unpacking

The Surface Scattering Light Turbidity Meter is shipped only after being packed so as not to be damaged during transportation. When the turbidimeter is delivered, unpack the meter carefully. If the turbidimeter with a sampling system is delivered, unpack them near the location where they are to be installed.

3.1.2 Installation Location

The Surface Scattering Light Turbidity Meter should be installed in a location where:

- (1) rainwater cannot get inside, such as in a building or a cabinet,
- (2) there is little vibration,
- (3) corrosive gases are not present,
- (4) there is low humidity,
- (5) temperature changes are kept to a minimum and the temperature is maintained between -5 to 50 °C,
- (6) there is enough clearance for maintenance and maintenance work can be easily done,
- (7) drainage can be provided.

3.1.3 Installation

Installation of the Surface Scattering Light Turbidity Meter differs depending on whether the sampling system is provided or not. If the sampling system is provided, secure the entire system with anchor bolts (M12 (12 mm) bolts) to a well-drained “concrete base”. If the sampling system is not provided, mount the detector and converter onto pipes (2-inch pipe) or racks with the special mounting bracket. (See Model Code Option Specification.)

In the case of TB400G-□-□-KC (for Korea), a noise filter assembly is attached. Please refer to a figure of external dimensions for the attachment means of the noise filter assembly.

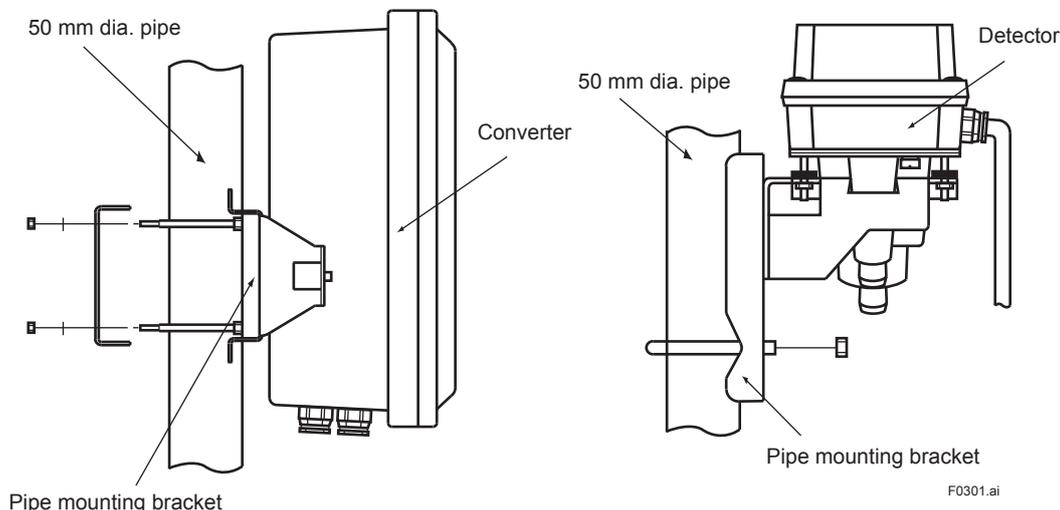


Figure 3.1 Pipe Mounting

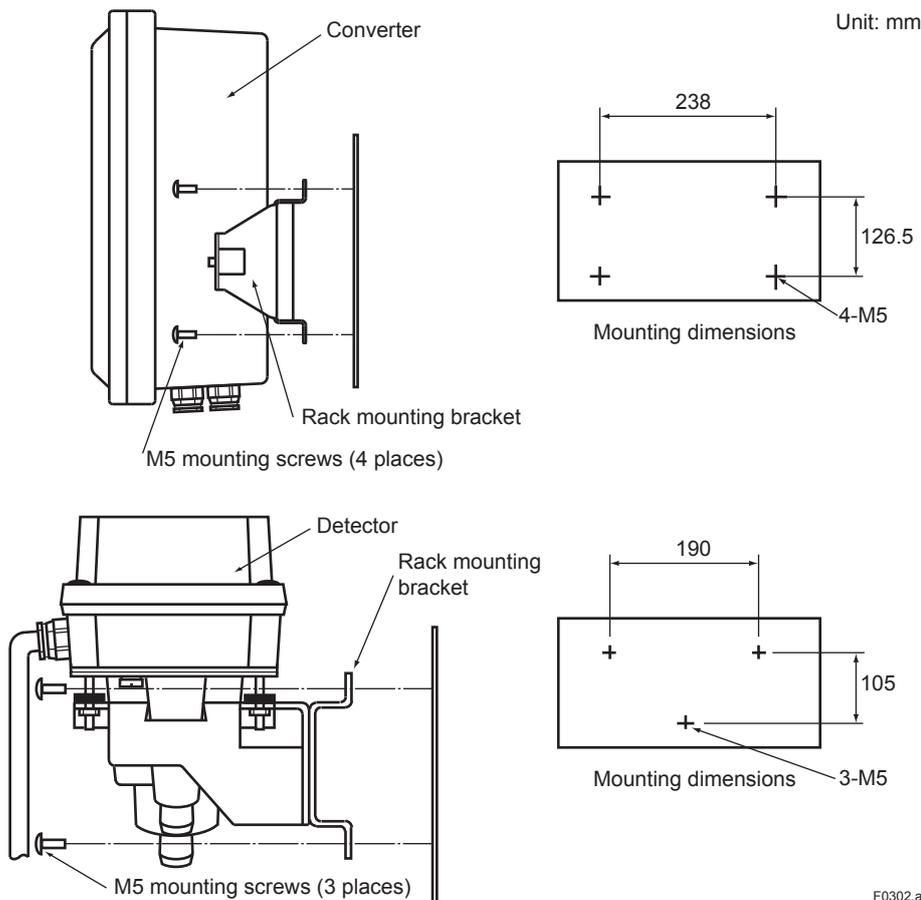


Figure 3.2 Rack Mounting

3.2 Piping

3.2.1 TB400G-□-□-NN, -KC (without sampling system)

(1) Measuring water piping

For a sample flow of 1.5 to 2 L/min, the sample can be introduced directly into the detector. Connect the attached $\varnothing 33$ mm X $\varnothing 25$ mm black soft PVC pipe to the Sample inlet. However, if the sample flow exceeds the range of 1.5 to 2 L/min, satisfy the flow condition by providing, for example, a head tank (constant level tank) also used for bubble removal. In this case, also use an $\varnothing 33$ mm X $\varnothing 25$ mm black soft PVC pipe for the piping connection between the head tank and the detector.

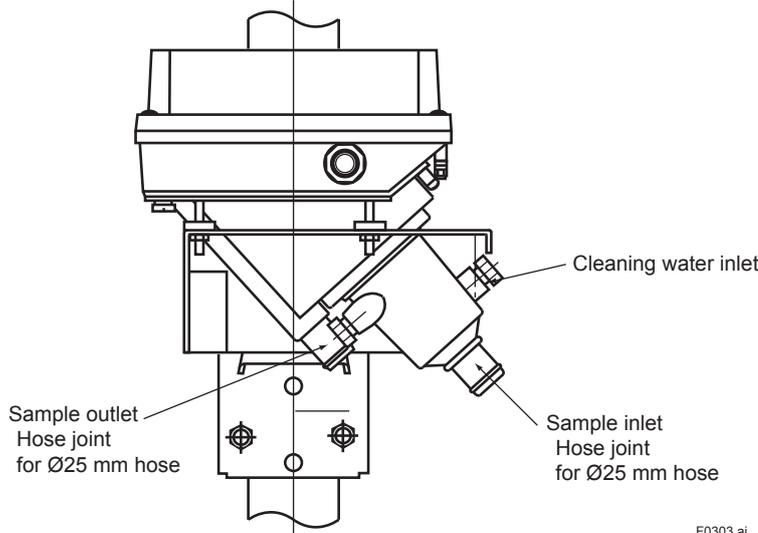
(2) Drain piping

Connect an $\varnothing 33$ mm X $\varnothing 25$ mm black soft PVC pipe to the drain outlet of the detector. In doing this, carefully run the piping so that a trip does not form in the pipe. If water is trapped in the drain piping, the detector may be harmed by becoming flooded.

(3) Cleaning water piping

The cleaning water inlet of the detector is sealed with a blind plug.

Note: If a low turbidity (less than 200 mg/L) is to be measured, prepare a sampling system which allows a supply of zero water (tap water filtered with a zero-turbidity filter).



F0303.ai

Figure 3.3 Detector Piping Connections

3.2.2 TB400G-□-□-A1, -A2, and -A3 (with sampling system)

(1) Sample-water piping

This is piping to supply sample to the detector. The pressure and flow rate for the Sample are 20 to 500 kPa and 2 to 10 L/min, respectively. Piping connections are designed for a rigid PVC pipe of nominal size VP16 (ø22 mm). Do the piping using any flanges or unions conforming to the pipe diameter.

(2) Tap-water piping

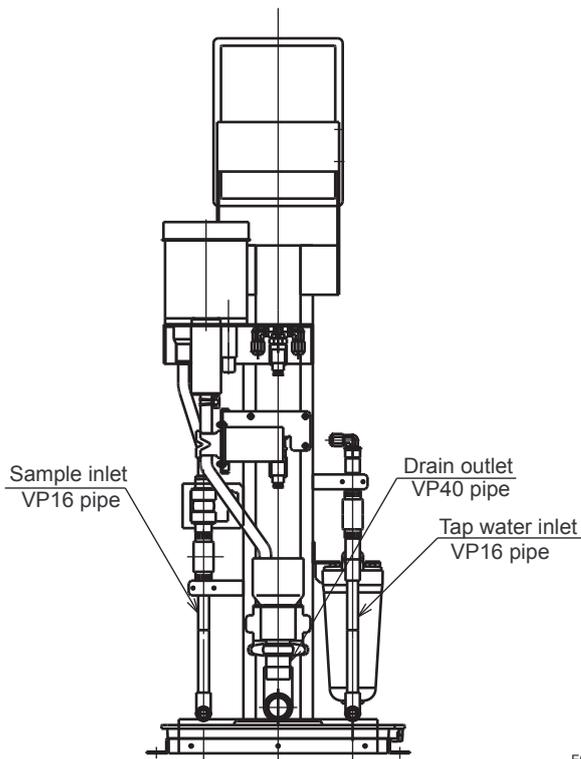
This is piping to supply cleaning water and zero water to the detector. Supply water having a turbidity of 2 mg/L or less, such as tap water. The pressure of the water to be used is 100 to 500 kPa. Piping connections are designed for a rigid PVC pipe of nominal size VP16 (ø22 mm). Do the piping using any fittings conforming to the pipe diameter similar to the piping for sample.

Note: Please consider to install a check valve so that cleaning water does not flow backward in the tap water side.

(3) Drain piping

This is piping for draining the sample and tap water supplied to the detector to a drain or the like. The piping connection is designed for a rigid PVC pipe of nominal size VP40.

Connect such a pipe of nominal size VP40 (VU40) or more and do the piping so that debris does not remain or get trapped or get trapped in the pipe.



F0304.ai

Figure 3.4 Piping Connections for Turbidimeter with Sampling System

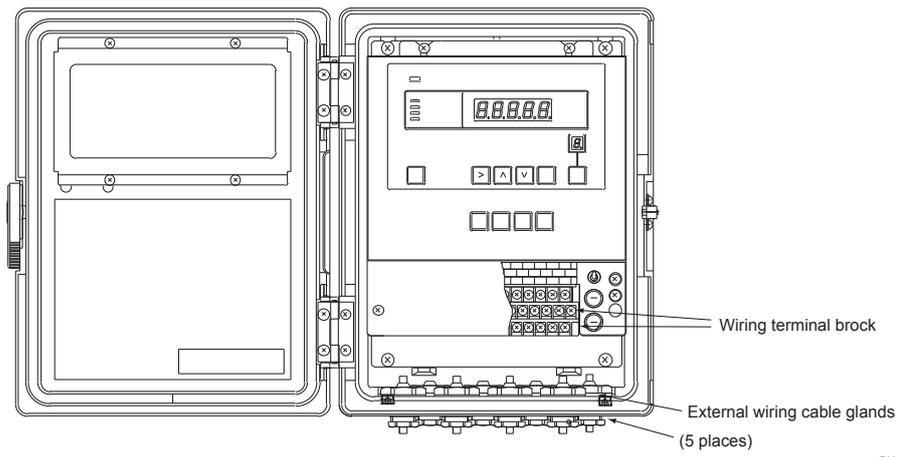


Figure 3.6 Converter External Wiring Terminal Block and Cable Connections

Where as the converter has 5 cable inlet ports. As a rule, use one cable for each port.

Note: Be sure to insert cable gland with blind plugs into the unused cable connections.

3.3.1 Power and Grounding Wiring

[Power Wiring]

This is the wiring to supply power, conforming to the frequency and voltage specifications, to the converter. Connect converter terminals L1 and L2 to the power supply.

Use a two-conductor cable having a finished of $\phi 6$ to $\phi 12$ mm (/ARS : The occasion with the arrester $\phi 9$ to $\phi 11$ mm) for the power wiring.

The cable end-treatment procedure for the end to be connected to the converter is described in the following:

- (1) Strip off about 80 mm of the cable insulation covering from the end.
- (2) Attach clamp terminal lugs fitted to M4 (4 mm) screws to the tips of the conductors.

In the case of TB400G-□-□-KC (for Korea), please wire a noise filter assembly by all means.

[Grounding Wiring]

Do the grounding wiring using the grounding terminal $\frac{\perp}{\perp}$ at the bottom of the converter case. As the grounding terminal is for an M5 (5 mm) screw, connect a grounding conductor whose end is end-treated (obtaining sufficient continuity) and do the grounding (JIS class D, grounding resistance of 100 ohms or less).

Note: If grounding cannot be done using the ground terminal of the converter case, connect the grounding conductor to terminal G (M4 (4 mm) screw) within the converter and ground the conductor on the power supply side. In this case, use 3-conductor or 2-conductor shielded cables for the power and grounding wiring.

Do not use two-point grounding.

3.3.2 Analog Output Wiring

This is the wiring for transmitting a 1 to 5 V DC or 4 to 20 mA DC output signal corresponding to the output range to a receiving instrument such as a recorder. For Wiring, use a 2-conductor shielded cable of finished $\phi 6$ to $\phi 12$ mm (/ARS : The occasion with the arrester $\phi 9$ to $\phi 11$ mm).

The cable end-treatment procedure and connection procedure on the connecting side to the converter are shown below.

- (1) Strip off about 40 mm of the insulation covering and shield from the cable end and solder a leadwire to the root of the exposed shield. Protect the soldered part with wound a insulation tape.
- (2) Make the soldered leadwire length almost the same as other conductor lengths and attach crimp terminal lugs conforming to as M4 (4 mm) screw to the tips of each conductor and this leadwire.
- (3) Connect the cable to the converter terminals + and -. Connect the plus pole conductor to the OUTPUT "+" terminal and the minus pole conductor to the OUTPUT "-" terminal. Also, connect the leadwire of the shield to terminal G. (Do not ground the shield on the receiving side.)

3.3.3 Digital Output Wiring

This is the wiring for outputting turbidity signals and generated failure details as digital signals (through RS-232C). For details of specifications and transmission, see Section 2.1, "Standard Specifications".

For wiring, use a 3-conductor shield cable of finished $\varnothing 6$ to $\varnothing 12$ mm. Limit the cable length up to 10 m.

The cable end-treatment procedure and connection procedure on the connecting side to the converter are shown below.

- (1) Strip off about 40 mm of the insulation covering and shield from the cable end and solder a leadwire to the root of the exposed shield. Protect the soldered part with wound insulation tape.
- (2) Make the soldered leadwire length almost the same as other conductor lengths and attach crimp terminal lugs conforming to an M4 (4 mm) screw to the tips of each conductor and this leadwire.
- (3) Connect the cable to the converter terminals (TD, RD, DG, and G). Connect the conductors as shown in Figure 3.7 (Do not ground the shield on the receiving side).

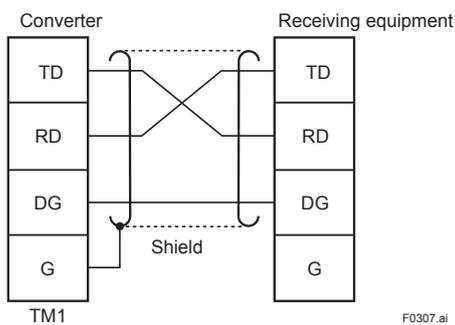


Figure 3.7 Digital Output Wiring Connection

3.3.4 Contact Input and Contact Output (Range Output) Wiring

As output ranges, three types of ranges can be set, and output can be obtained by freely switching these ranges. The output range selection is “remote”, “local” or “auto” mode.

This wiring is applied if the range is changed in “remote” mode (see Section 6.6 (12)) or the range contact output is used.

Use a 2-conductor cable of finished $\varnothing 6$ to $\varnothing 12$ mm for the wiring. However, use a 3-conductor cable when remote range selection only is used and a 4-conductor cable when only range contact output is used.

The on and off contact statuses are identified with the resistance value conditions shown in Table 3.1. In doing wiring, confirm that a contact meeting these conditions is used.

Table 3.1 On/off Identification of Contact Input for Switching “Remote” Range

	On status identification	Off status identification
Resistance value (contact)	200 Ω or less	100 k Ω or more

The cable end-treatment procedure and connection procedure on the converter connection side are shown below.

- (1) Strip off about 40 mm of the cable insulation covering from the end and attach suitable terminal lugs fitted to M4 (4 mm) screws to the tip of each conductor.
- (2) Connect the cable conductors to “remote” range selection terminals R1, R2, and R3 and range contact output terminals A1, A2, A3 and S4.

“Remote” range switching on/off contact input is performed between terminals R1 and R2, and between terminals R1 and R3 (See figure 3.8). The relationship between the on/off contact input and the output range is as shown in Table 3.2.

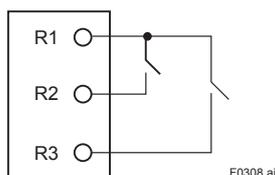


Figure 3.8 Remote Range Switching Contact Input

Table 3.2 Contact Input and Output Range

R1-R2	R1-R3	Output range
OFF	OFF	RANGE 1
ON	OFF	RANGE 2
OFF	ON	RANGE 3

The range contacts can be output as in Figure 3.9.

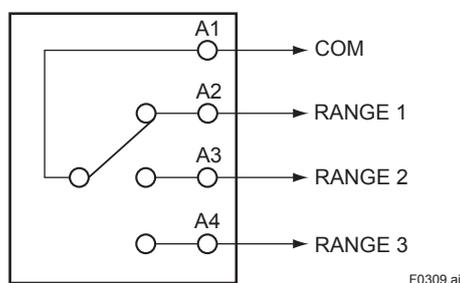


Figure 3.9 Range Contact Output

3.3.5 Contact Output Wiring

The converter outputs contact signals for failure, maintenance, and upper and lower limit alarm or automatic cleaning/in calibration. Use a finished $\varnothing 6$ to $\varnothing 12$ mm cable for this wiring (select a 2-, 4-, or 6-conductor cable depending on the number of contact outputs used). The contact rating for contact output relays is as shown in Table 3.3. For the instrument to be connected, select that which satisfies the conditions in Table 3.3.

Table 3.3 Contact Rating for Contact Output Relay

	DC relay	AC relay
Maximum permissible contact voltage	220 V	250 V
Maximum permissible contact current	2 A	2 A
Maximum permissible contact power	60 W	125 VA

Connect each conductor of the cable to terminals F1, F2, M1, M2, C1, and C2 respectively. Before connection, end-treat the cable conductors. Strip off the cable insulation covering by about 40 mm and attach crimp terminal lugs conforming to M4 (4 mm) screws to each conductor.

Table 3.4 shows the operation of each contact output.

Table 3.4 Contact Output Operation

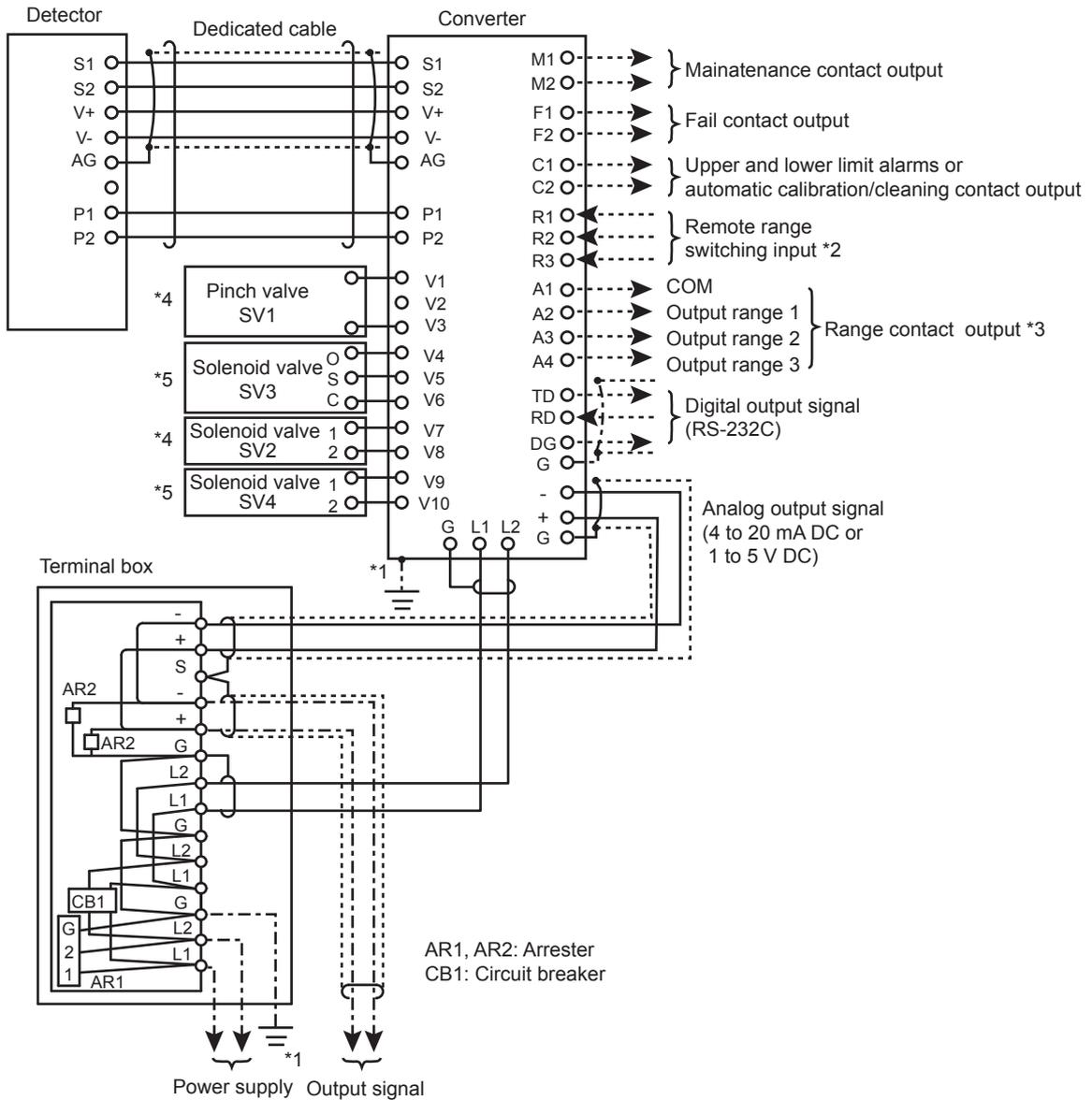
Contact	Operation
M1, M2	Closed (setting upon shipment from the factory) for maintenance (other than the <MEAS.> mode. *2
F1, F2	Open when a failure occurs (setting upon shipment from the factory). *2
C1, C2 *1	Open when the upper or lower alarm is generated (at shipment from the factory). *2 or Closed during automatic calibration or automatic cleaning. *2

*1: Contacts C1 and C2 can be used in two ways: for upper and lower limit alarms and for automatic cleaning and calibration. These can be selected with FUNCTION "E" in the <PROGRAM1> mode. When shipped from the factory, this is set for the upper and lower alarms.

*2: Either open or closed can be selected when the contact operates. Set them with FUNCTIONS "C" to "F" in the <PROGRAM2> mode.

3.3.6 With Arrester (/ARS)

A power supply and signal wire in relay wires in terminal box (refer to figure 3.10).
Cables use 9 to 11 mm.



*1: Ground terminal ⊥ on the outside of the converter case with a grounding resistance of 100 Ω or less.
Ground the power cord instead only if the above grounding is not feasible.
(Note) Do not use two-point grounding.

*2: Remote range switching method

Output \ Contact	R1 to R2	R1 to R3
Output range 1	OFF	OFF
Output range 2	ON	OFF
Output range 3	OFF	ON

Resistance (ON): 200 Ω or less
(OFF): 100 kΩ or more

*3: Output range switching method

Output \ Contact	A1 to A2	A1 to A3	A1 to A4
Output range 1	Close	Open	Open
Output range 2	Open	Close	Open
Output range 3	Open	Open	Close

*4: In the case of with automatic cleaning (-A2, -A3)

*5: In the case of with automatic zero calibration (-A3)

Figure 3.10 External Wiring Diagram for /ARS

4. OPERATION

4.1 Preparation for Operation

For preparation, proceed with the work in turn according to the items in subsections 4.1.1 to 4.1.9.

Since the types and number of values vary with the specifications for sampling, automatic cleaning, and automatic zero calibration (Suffix code: -NN, -KC, -A1, -A2, and -A3), see the piping diagrams in Section 2.6. For meaning of the codes, see Section 2.3.

NOTE

When the detector is opened for preparation, take extreme care not to get the lenses in the detector (in two places) dirty.

If they get dirty, clean the lenses (see Section 7.8).

4.1.1 Checking Piping and Wiring Conditions

Examine that the piping and wiring have been done properly.

4.1.2 Supplying Power

First confirm that the power supply is of the voltage and frequency that meet the specifications. Also, check that the cap of the fuse holder in the converter is securely tightened.

Turn on the power switch in the converter. Then, press the [MODE] key on the converter to go to the <MAINT.> mode.

4.1.3 Supplying Zero Water

If the turbidity to be measured is higher than 200 mg/L, remove the filter element and use tap water directly as zero water.

- (1) Supply tap water of the predetermined specifications (see Section 2.1) to the tap water inlet.
- (2) Close all the values except V2 and SV4 (for the Suffix code: -A3).

Note: Use the value operating keys of the converter to operate SV1, SV2, SV3, and SV4.

- (3) Vent the air by loosening the knob of the air vent on the top of the filter until tap water spills over. After air venting is completed, tighten the knob securely.
- (4) Loosen screw A at the lower part of the detector (see Figure 4.1) to open the detector.
- (5) Gradually open V3 and confirm that the water surface becomes as smooth as a mirror finish as shown in Figure 4.2 (b).

4.1.4 Adjustment for Leveling Detector

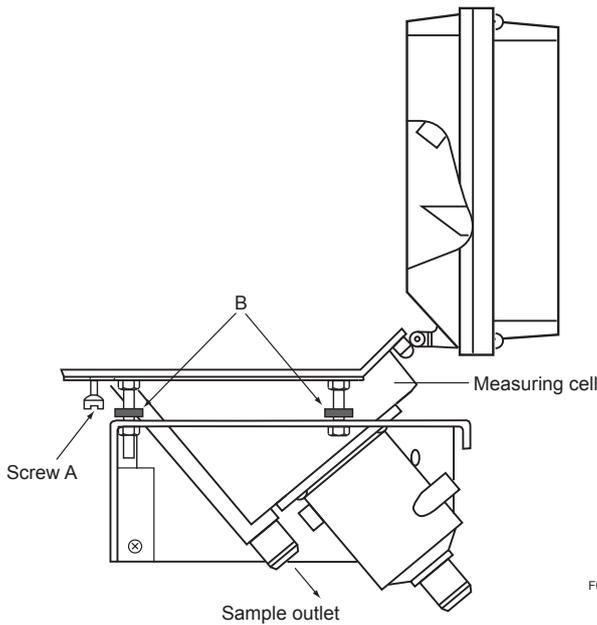


Figure 4.1 Lower Part of Detector

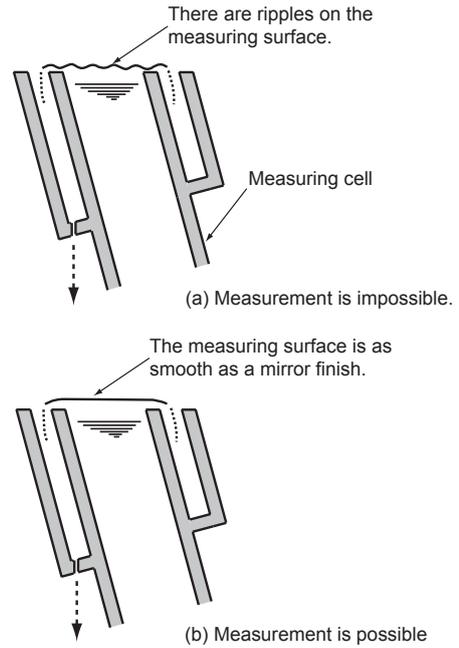


Figure 4.2 Water Level of Detector

- (1) For the turbidimeter with a sampling system, as the detector level has been adjusted before shipment from the factory, normally it is not necessary to be adjusted for horizontal adjustment (adjustment for flowrate of Sec. 4.1.9 is necessary). If the sampling system is not provided, or level adjustment is needed even with the sampling system provided, place a level at the drain outlet of the measuring cell and adjust the level so that the detector is level in two orthogonal directions with the B screws (in four places) shown in Figure 4.1 (see Figure 4.3). If a level is not available, visual adjustment may be acceptable. In this case, make the adjustment so that water spills out uniformly from the drain outlet of the measuring cell.

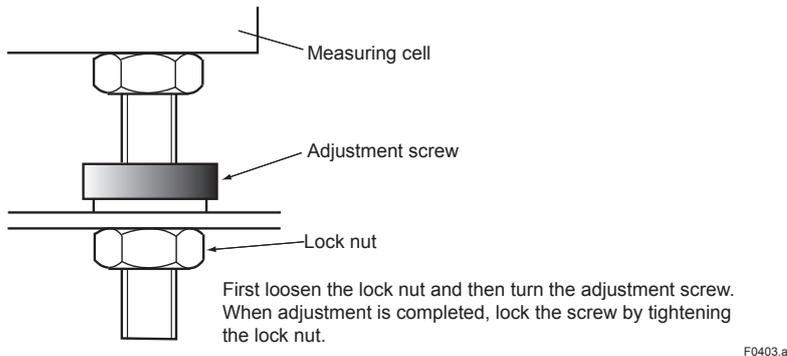


Figure 4.3 Level-Adjustment Screw

4.1.5 Supplying Cleaning Water

Confirm that the flowrate of the cleaning water is adequate when “zero water” is flowing.

- (1) Open cleaning water valve SV2 using the [SV2] key of the converter.

Note 1: There is no SV2 valve for models with Suffix code -NN, -KC, or -A1.

- (2) Open valve V4 and confirm that the water is not splashing.
- (3) Close valve SV2.
- (4) Close the detector.

Note 2: For Suffix code -A1, close V4 and open it subsequently to clean the cell.

4.1.6 Setting Output Range

Set the analog output range selection (local/remote) and the range. (When shipped from the factory, this is set to local range selection and to RANGE1 (0 to 2 mg/L).)

For output range setting, see Section 5.2.

4.1.7 Running-in

Carry out running-in for an hour or more while allowing “zero water” to flow.

4.1.8 Zero and Span Calibrations

After the indication is stable, zero calibration and span calibration is made in use of zero water and calibration plate respectively.

First, carry out zero calibration.

- (1) Set FUNCTION “1” in the <MAINT.> mode. --> “Turbidity value” is displayed.
- (2) Wait for the indication to stabilize, and then press [ENT] --> [>] --> [ENT] keys in this order to carry out zero calibration.

Next, carry out span calibration.

- (1) Set FUNCTION “D.” In the <PROGRAM1> mode and confirm that “on” is displayed. “on” means the calibration using the calibration plate (“on” is set when shipped from the factory).
- (2) Set FUNCTION “4” in the <MAINT.> mode. --> “Turbidity valve” is displayed.
- (3) Set to the drain status.
 - Close V2 and open V5 (for Suffix code: -A1).
 - Close V2 and open SV1 (for Suffix code: -A2).
 - Close SV3, SV4 and open SV1 (for Suffix code: -A3).
- (4) Loosen screw A at the lower part of the detector to open the detector (see Figure 4.1).
- (5) Set the attached calibration plate as shown in Figure 4.4 (the calibration plate is housed in the converter).
- (6) Close the detector and tighten screw A.
- (7) Wait for the indication to stabilize and press [ENT] --> [>] --> [ENT] to calibrate.
- (8) Open the detector and remove the calibration plate and then tighten screw A.

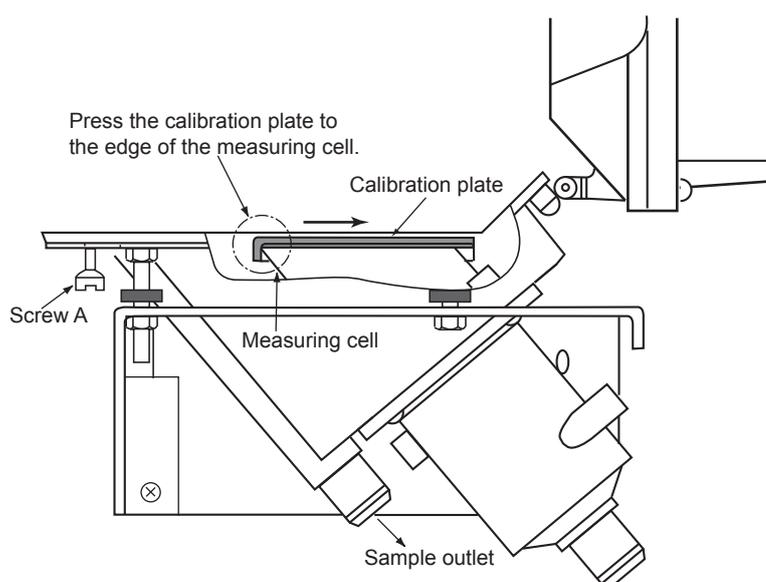


Figure 4.4 Calibration Plate Setting

4.1.9 Supplying Sample and Adjusting Flowrate

- (1) Press the converter [mode] key to get the <MEAS.> mode.
- (2) Place the hand-operated valve in a measuring status (see Section 4.2, Table 4.1).

Note 1: Valves SV1 to SV4 are automatically brought to the measuring status when the <MEAS.> mode is selected.

- (3) Supply the specified flow (2 to 10 L/min) of sample.

Note 2: For the model with the specifications for no sampling system and no automatic cleaning or zero calibration (Suffix code: -NN, -KC), set the flowrate of the Sample at 1.5 to 2 L/min.

4.2 Operation

This section describes measurement in the <MEAS.> mode, the on/off operation of each valve in automatic cleaning and automatic zero calibration, and the settings related to operation.

4.2.1 Starting Measurement

When the [MODE] key in the converter is pressed to move to the <MEAS.> mode, the internal timer starts and analog output hold (set when shipped from the factory) is reset according to the predetermined specifications.

The maintenance contact outputs (M1 and M2) also open (set when shipped from the factory) and the mode information is output only once to the digital output (see the contact output operation in Subsection 3.3.5 and digital communication specifications in Section 2.1).

Table 4.1 shows valve status in the <MEAS.> mode. Valves SV1 to SV4 automatically operate according to the predetermined specifications. The statuses shown in Table 4.1 are those when no automatic cleaning or automatic zero calibration operates.

Table 4.1 Value Statuses When Measurement Is Carried Out

Suffix codes	V1	V2	V3	V4	V5	SV1	SV2	SV3	SV4
-A1	Open	Closed	Closed	Closed	Closed	—	—	—	—
-A2	Open	Open	Closed	Open	—	Closed	Closed	—	—
-A3	Open	Open	Open	Open	—	Closed	Closed	Open	Closed

4.2.2 Automatic Cleaning Operation

When automatic cleaning is specified (Suffix code: -A2 or -A3), the detector is automatically cleaned in the <MEAS.> mode. With measuring water (or zero water) flowing, dirty substances on the measuring cell wall and the measuring surface edge are washed out by jets of cleaning water (tap water) from two outlets on the side of the measuring cell in the detector. After cleaning, dirt on the measuring cell, header tank, and in the piping between the header tank and the detector is washed out by opening the drain outlet of the header tank.

The above cleaning operation is repeated a predetermined number of times.

The information of start or end is output when automatic cleaning is started or ended.

In addition, there are two types depending on the specifications for automatic cleaning.

- **Without automatic zero calibration (Suffix code: -A2)**
- **With automatic zero calibration (Suffix code: -A3)**

The explanation for each types are followed.

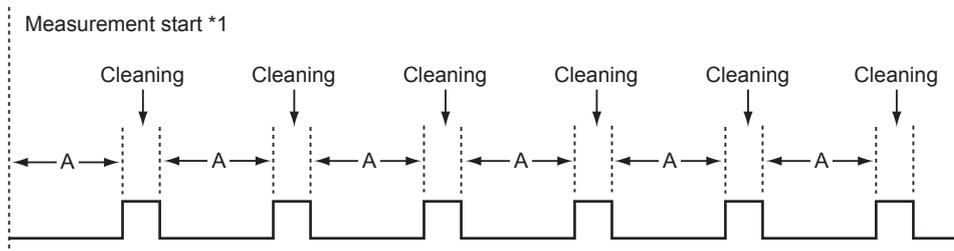
a. Without Automatic Zero Calibration (Suffix code: -A2)

Automatic cleaning can be started in the following two ways:

- **Startup with the internal timer**
- **Startup with FUNCTION "6" in the <MAINT.> mode (see Section 6.5).**

Note: Startup with the internal timer can be selected for execution (on)/stop (off) using FUNCTION "A." in the <PROGRAM1> mode. It has been set to execute (on) when shipped from the factory.

The internal timer operation is shown below. The automatic-cleaning operation is repeated at every preset time of the cleaning period (A) (Figure 4.5).



*1: Measurement start is defined to be the point specified in the following:
 Other mode → <MEAS.> mode
 Power off → Power on (<MEAS.> mode)

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Figure 4.5 Cleaning Period

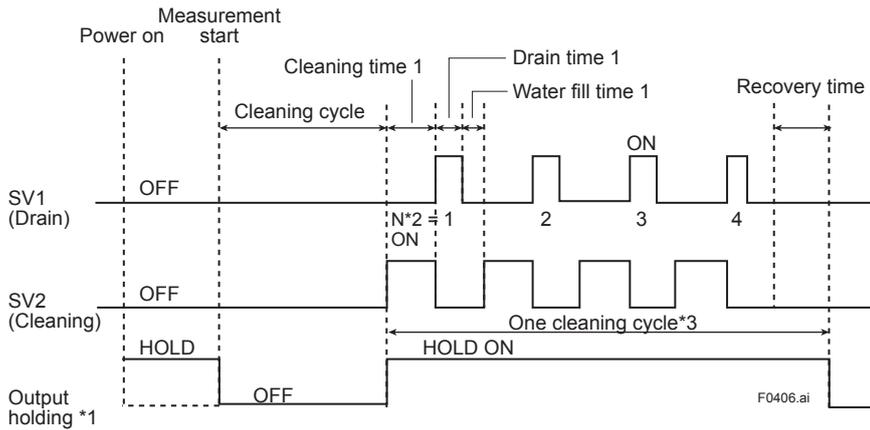
Figure 4.6 shows the automatic-cleaning operation time chart and Table 4.2 the list of settings for automatic cleaning.

<Valve used>

SV1: Drain valve

SV2: Cleaning water valve

<Time chart> Example: N (number of cleaning repetitions) = 4



- *1 During cleaning, the output is always in the hold state. The display is also set to be held using FUNCTION "8." in the <PROGRAM1> mode. Contact outputs C1 and C2 can be used as contacts for the period during cleaning and calibration. This is set using FUNCTION "E." in the <PROGRAM1> mode.
- *2: N; Number of cleaning repeats
- *3: One automatic cleaning cycle = N (cleaning + draining + water filling) + relaxation

Figure 4.6 Automatic-cleaning Operation Time Chart (Suffix code: -A2)

Table 4.2 Cleaning Operation Setpoints

Item	Setting range	Factory setting	Unit	Setting mode	
				Mode	FUNCTION
Cleaning period	0.1 to 24.0	2.0	Hours	PROGRAM 2	1
Cleaning time 1	10 to 120	30	Sec	PROGRAM 2	4
Draining time 1	10 to 120	10	Sec	PROGRAM 2	6
Water filling time 1	10 to 120	100	Sec	PROGRAM 2	8
Relaxation time	30 to 600	150	Sec	PROGRAM 2	A
Number of cleaning repetitions	1 to 20	5	times	PROGRAM 2	3

See Section 6.7 for the setting procedures for each setpoint.

b. With Automatic Zero Calibration (Suffix code: -A3)

Automatic cleaning can be start in the following two ways.

- **Startup with the internal timer.**
- **Startup with FUNCTION “6” in the <MAINT.> mode (see Section 6.5).**

Note: Startup with the internal timer can be selected for execution (on)/stop (off) using FUNCTION “A” in the <PROGRAM1> mode. It has been to execution (on) when shipped from the factory.

The internal timer operation is shown in Figure 4.7.

As shown in the figure, the automatic cleaning operation is repeated at every set time of the cleaning period (A) and automatic zero calibration is implemented once in every 3 repetitions (for cleaning calibration ratio B = 3).

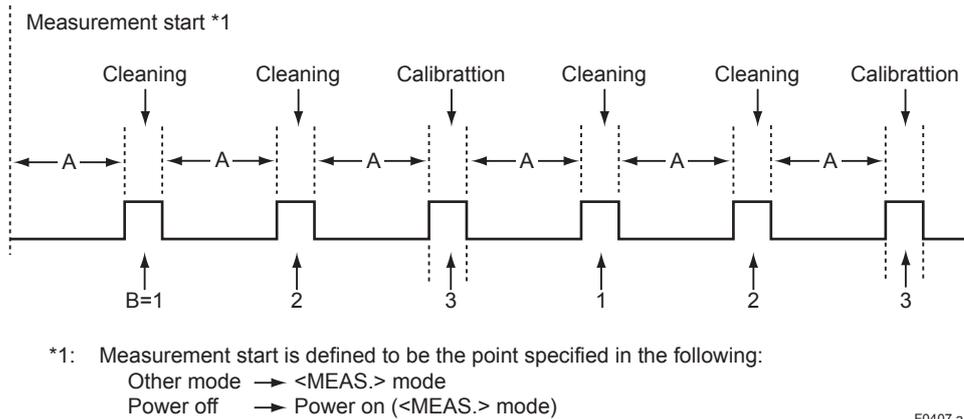


Figure 4.7 Cleaning (calibration) period (Example: for cleaning calibration ratio = 3)

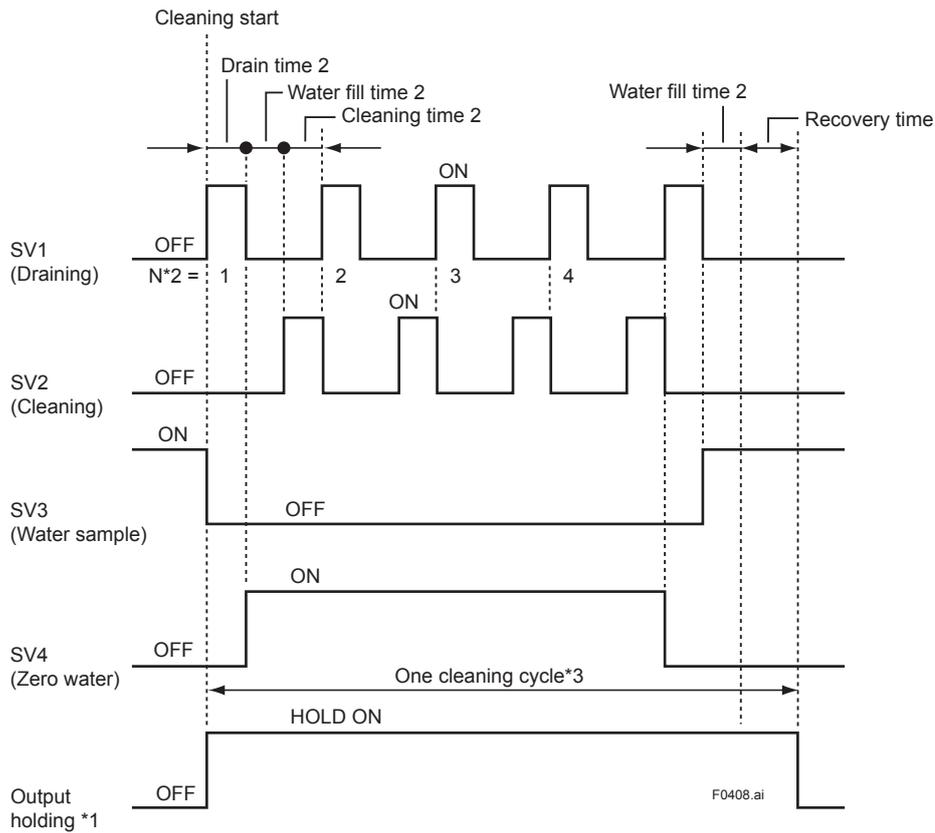
However, if startup of the automatic zero calibration with the internal timer is stopped, the cleaning operation becomes the same as in Figure 4.5 because the automatic zero calibration operation is eliminated.

Figure 4.8 shows the automatic-cleaning operation time chart and Table 4.3 the settings.

<Valve used>

- SV1: Drain valve
- SV2: Cleaning-water valve
- SV3: Measuring-water valve
- SV4: “Zero-water” valve

<Time chart> Example: N (number of cleaning repetitions) = 4



- *1: During cleaning, the output is always in the hold state.
The display is also set to be held using FUNCTION "8." in the <PROGRAM1> mode.
Contact outputs C1 and C2 can be used as contacts for the period during cleaning and calibration. This is set using FUNCTION "E." in the <PROGRAM1> mode.
- *2: N; Number of cleaning repetitions
- *3: One automatic cleaning cycle = N (draining + filling + cleaning) + (draining + filling + recovery)

Figure 4.8 Automatic-cleaning Operation Time Cheat (Suffix code: -A3)

Table 4.3 Setpoints for Automatic Cleaning and Automatic Zero Calibration

Item	Setting range	Factory setting	Unit	Setting mode	
				Mode	FUNCTION
Cleaning period	0.1 to 24.0	2.0	Hours	PROGRAM 2	1
Cleaning calibration ratio	1 to 10	1	times	PROGRAM 2	2
Cleaning time 2	10 to 120	30	Sec	PROGRAM 2	5
Draining time 2	10 to 120	10	Sec	PROGRAM 2	7
Water filling time 2	10 to 120	100	Sec	PROGRAM 2	9
Relaxation time	30 to 600	150	Sec	PROGRAM 2	A
Number of cleaning repetitions	1 to 20	5	times	PROGRAM 2	3

For the setting procedures for each setpoint, see Section 6.7.

4.2.3 Automatic Zero-calibration Operation

If the specifications including automatic zero calibration (Suffix code: -A3) are used, zero calibration is automatically performed. The automatic zero-calibration computation is implemented by passing zero water and at a stabilized indication after performing the same cleaning operation as automatic cleaning in subsection 4.2.2 b.

In addition, at the start and end of automatic zero calibration, all starting and completing digital information is output (see digital communication specifications in Section 2.1).

Automatic zero calibration can be started in the following two ways.

- **Startup with the internal timer (see Figure 4.7).**
- **Startup with FUNCTION "7" in the <MAINT.> mode (see Section 6.5).**

Note: Startup with the internal timer can be selected for execution (on)/stop (off) using FUNCTION "B." in the <PROGRAM1> mode. It has been set to execution (on) when shipped from the factory.

Figure 4.9 shows the automatic zero-calibration operation time chart.

For the setting, see Table 4.3.

<Valve used>

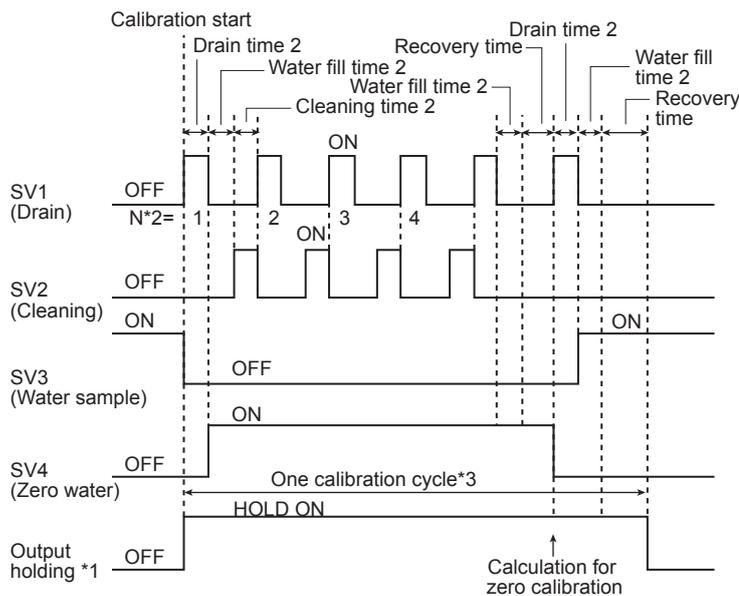
SV1: Drain valve

SV2: Cleaning-water valve

SV3: Measuring-water valve

SV4: "Zero-water" valve

<Time chart> Example: N (number of cleaning repetitions) = 4



- *1: During cleaning, the output is always in the hold state. The display is also set to be held using FUNCTION "8." in the <PROGRAM1> mode. Contact outputs C1 and C2 can be used as contacts for the period during cleaning and calibration. This is set using FUNCTION "E." in the <PROGRAM1> mode.
- *2: N: Number of cleaning repetitions
- *3: One automatic cleaning cycle = N (draining + filling + cleaning) + 2 (draining + filling + relaxation)

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Figure 4.9 Automatic Zero-calibration Time Chart

NOTE

When Option Code, /PHN□, /PHU□ or /FC is specified, a pH sensor for the pH meter and ceramic beads for the non-reagent type free available chlorine detector will be shipped in separate packages. Be sure to install them properly while referring to the relevant user's manuals. Improper installation may result in malfunction or failure.

This instrument starts with the supply of water sample to each equipment. Refer to Section 2.6, "Piping System Diagrams," operate the relevant valves, and set the flow rate of the equipment as follows.

- (1) **pH flow-through holder: 3 to 11 L/min**
- (2) **Non-reagent type free available chlorine detector: 0.1 to 2.5 L/min**

For the operation of each combined equipment, refer to the relevant user's manuals.

5. FUNCTIONS

This chapter describes the functions of the converter. For each function, the relevant topics are listed. For the setting procedures, see Chapter 6, the operation procedure for each FUNCTION in each mode.

5.1 Functions Related to Failure Detection

Table 5.1 shows the failure detection functions.

Table 5.1 Failure Detection Function

Detected item	Details	Generation mode	Error No.	FAIL lamp	Detection on/off setting	
					Mode	FUNCTION
1 Turbidity overrange	This is detected if the measurement signal from the detector is out of the permissible range is approx. +0.5 V to -2.45 V across S1 and AG terminals in the converter.	MEAS.	Err11	○	PRO-GRAM 2	1.
2 Lamp disconnection	This is detected if the lamp goes off and the reference signal drops to approximately -0.5 V or less.	MEAS.	Err12	○	PRO-GRAM 2	2.
3 Lamp voltage failure	This is detected if the lamp voltage is out of the permissible range. The permissible range is approximately 3 V to 6 V across terminals P1 and P2 in the converter.	MEAS.	Err13	○	PRO-GRAM 2	3.
4 AD circuit failure	(1)Detected if analog-to-digital conversion is not completed in the predetermined time. (2)If the converted data are out of the permissible range, this is detected if the input is switched to a simulated input and the converted data are again out of range.	All modes	Err14	○	PRO-GRAM 2	4.
5 Memory comparison failure	Data such as setpoints are stored in two places in the EEPROM. This is detected if the results of regular comparisons of such data do not agree.	All modes	Err15	○	PRO-GRAM 2	5.
6 RAM failure	Detected if the result of a comparison of specified data in writing and reading immediately after turning on power does not agree. If detected, subsequent operations cannot be accepted.	When power is turned on	Err16	○		
7 EEPROM failure	Immediately after turning on power, the data stored in two places in the EEPROM are compared. If they do not agree, this item is detected if the result of the comparison of specified data in writing and reading does not agree. If detected, subsequent operations cannot be accepted.	When power is turned on	Err17	○		
8 Reference signal voltage failure	If the reference signal from the detector is out of the permissible range, this item is detected. The permissible range is approximately +0.5 V to -2.45 V across terminals S2 and AG.	MEAS.	Err18	○	PRO-GRAM 2	6.
9 Zerocalibration range exceeded	Detected when the input value in zero calibration is out of the permissible range. The permissible range is ±10 mV.	When calibration is carried out	Err21	X		
10 Span calibration range exceed	Detected if the input value in span calibration is out of the permissible range. For span calibration (standard solution reference), the permissible range is 50 to 400%. For span calibration (sensitivity correction), the permissible range is 0.25 to 400. For details, see section 5.3 *3.	When calibration is carried out	Err22	X		
11 Zero-shift calibration range exceed	Detected if the zero-correction coefficient in zeroshift calibration is out of the permissible range. The permissible range is ±9 mg/L.	When calibration is carried out	Err23	X		
12 Calibration plate failure	Detected if the input value in span calibration is out of the permissible range. The permissible range is ±50% of the calibration plate setpoint.	When calibration is carried out	Err24	X		
13 Lamp life *1	Detected if the lamp voltage reaches the upper control limit. The upper limit is approx. 4.8 V *4 across terminals P1 and P2.	MEAS.	Err25	○	PRO-GRAM 2	7.
14 Failure in automatic zero calibration *2	Detected if the zero input value in automatic zero calibration is out of the permissible range. The permissible range is ±10 mV.	MEAS.	Err26	○	PRO-GRAM 2	8.
15 High and low alarm *3	Detected if the turbidity signal exceeds the upper or lower limit setpoint. When shipped from the factory, these are set at -10 (lower) and 2200 (upper) mg/L.	MEAS.	"MEAS." flashes.	X	PRO-GRAM 2	9.
16 CPU failure	CPU failure. Normally this does not occur.	All modes	Only the "FAIL" lamp is lit and no operations are accepted.			

- In the "FAIL lamp" column, ○ means the lamp lights and × the lamp goes out.
- The items for detected failures for which both the mode and function are described can be selected for execution/stop of detection (see Section 6.7).
- Errors detected other than in calibration are automatically reset at the time when the cause of failure is removed.

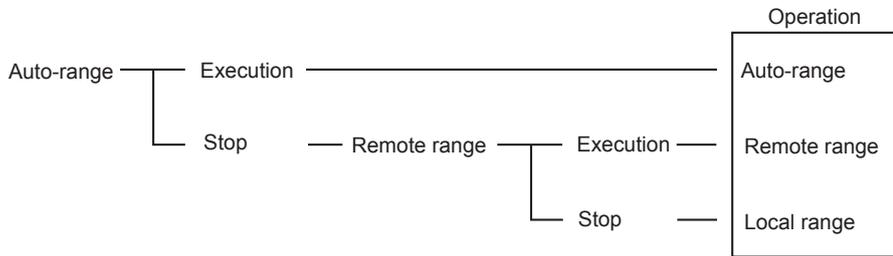
-
- If the "FAIL" lamp is lit, error numbers can be confirmed with FUNCTION "A" in the <MAINT.> mode, while the error can be reset with FUNCTION "B" in the <MAINT.> mode.
 - If the "FAIL" lamp is lit, analog output mode selection (non-hold, hold, or preset) is possible with FUNCTION "5" in the <PROGRAM1> mode.
 - If the "FAIL" lamp is lit, FAIL contact output is also obtained.
 - If an Err11 to 15, Err18, Err25, or Err26 failure is detected, error numbers are output by virtue of digital output (see Section 2.1, digital communication specifications).
 - If Err16 or Err17 is detected, other operations cannot be accepted with the error number displayed.
 - *1: The TB400G controls the lamp voltage so that a constant light quantity is obtained. If the amount of lamp light diminishes, the lamp voltage increases.
Thus, the lamp voltage may be an index for the life of the lamp.
 - *2: Err26 is detected only if the specifications are for automatic zero-calibration (Suffix code: -A3).
 - *3: 15 high and low alarm setpoints can be set using FUNCTION "8" and "9" in the <PROGRAM1> mode.
 - *4: If the program version number is 1.08, the upper limit is set to 4.1 V. (The version number can be confirmed in FUNCTION "E" in <MAINT.> mode. Refer to Subsection 6.5 (13)).
-

5.2 Functions Related to Analog Output

5.2.1 Output Range Selection

The output range can be set up in three ways: auto range, remote range, and local range.

The relationship between these is as shown in Figure 5.1. Table 5.2 shows the setting modes and function numbers related to the output range selection.



Note: The turbidimeter is shipped with the output range set to 1 for the local range.

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Figure 5.1 Output Range Selection

Table 5.2 Function Related to Output Range Selection

Detected item	Details	Mode	FUNCTION
1 Output range 1 setting	The upper and lower limits for analog output 1 are set.	PROGRAM 1	1.
2 Output range 2 setting	The upper and lower limits for analog output 2 are set.	PROGRAM 1	2
3 Output range 3 setting	The upper and lower limits for analog output 3 are set.	PROGRAM 1	3
4 Auto-range selection	The function that automatically switches the output ranges (1, 2, and 3) depending on the turbidity value.	PROGRAM 1	1.
5 Remote range selection	The function that switches the output ranges (1, 2, and 3) by contact inputs (R1, R2, and R3) (when function 4) is "oFF").	PROGRAM 1	2.
6 Local range selection	The function that switches the output ranges (1, 2, and 3) using converter key operations (when function 4) and 5) are "oFF").	PROGRAM 1	3.
7 Auto-range switching point setting	The auto-range switching point is arbitrarily set when auto-range is used.	PROGRAM 1	7

- Corresponding to switching of the output range, the range contact outputs (A1, A2, A3, A4) are switched and the RNG1, RNG2, or RNG3 lamp is lit.
 - (1) Output range 1: Range contact outputs A1 and A2 are closed; RNG1 lamp is lit.
 - (2) Output range 2: Range contact outputs A1 and A3 are closed; RNG2 lamp is lit.
 - (3) Output range 3: Range contact outputs A1 and A4 are closed; RNG3 lamp is lit.
 - When the output range is switched, digital range information is output only once (see Section 2.1, "Digital Communication Specifications").
 - When the turbidimeter is used with auto-range, the output should be set as shown below.
 - (1) Set the Low side of the setting to 0 (display is "L00.00").
 - (2) Set the High side of the setting so that range 1 <= range 2 <= range 3 holds.
 - (3) If two ranges are required, set range 2 = range 3.
 - (4) If one range is required, set range 1 = range 2 = range 3.
 - Range switching timing in auto-range should be taken as follows:
 - (1) The timing of switching from a low range to a higher range is a point where the measured value just becomes larger than the auto-range switching point of the lower range.
 - (2) The timing of switching from a higher range to a lower range is a point where the measured value just becomes smaller than -10% of the auto-range switching point in the lower range (10% is provided for range switching hysteresis).
- Note: Auto-range switching should be set in item 7. When the turbidimeter is shipped from the factory, this is set to 80% of the range.
- In auto-range, the output ranges are switched for contact inputs (R1, R2, and R3).
 - (1) No contact input: Output range 1
 - (2) Contact input (R1, R2) = Closed: Output range 2
 - (3) Contact inputs (R1, R3) = Closed: Output range 3

5.2.2 Other Functions Related to Output

Table 5.3 shows other functions related to analog output and the operation modes and function numbers for setting.

Table 5.3 Other Functions Related to Output

Detected item	Details	Mode	FUNCTION
1 Bi-linear output	Setting of break points when an analog signal is output with line-segment approximation.	PROGRAM 1	6
2 Output hold during maintenance	When maintained (other than the <MEAS.> mode), the function to hold the analog output.	PROGRAM 1	4.
3 Output mode when a failure is detected	Analog output mode (non-hold, hold, or preset) selection when the "FAIL" lamp is lit.	PROGRAM 1	5.
4 Holding an output of 4 mA or less	If a turbidity value becomes smaller than the output range lower limit, the output is held at 4 mA (1 V).	PROGRAM 1	6.
5 Setting of output value if a failure is detected.	If "preset" is selected in function 3), the value set here is output.	PROGRAM 1	5

(1) Bi-linear Output

The point where a setpoint (%) of the output range span (mg/L) corresponds to 59% of the output signal (4 to 20 mA or 1 to 5 V) span is the break point. The setting range is 0 to 100%. Figure 5.2 shows an example of a setting.

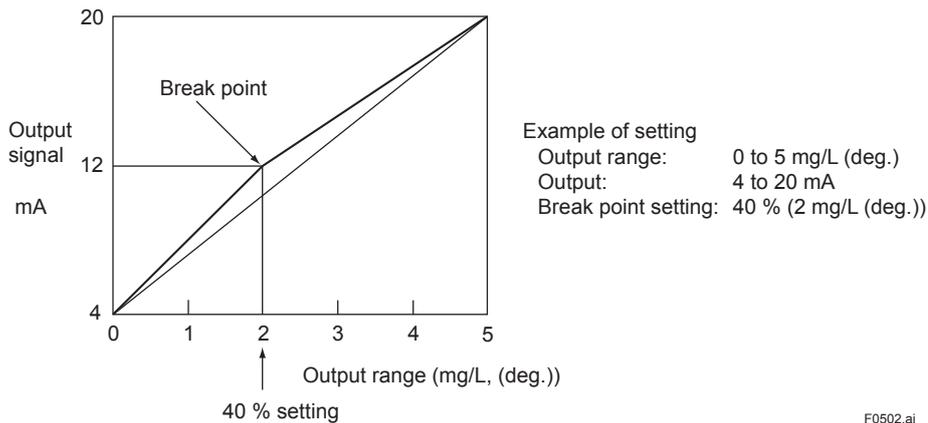


Figure 5.2 Example of Bi-linear Output

If the output range setpoint is determined to be 50%, the output is linear. Also, if set at 0% or 100%, the output is as shown in Figure 5.3 respectively.

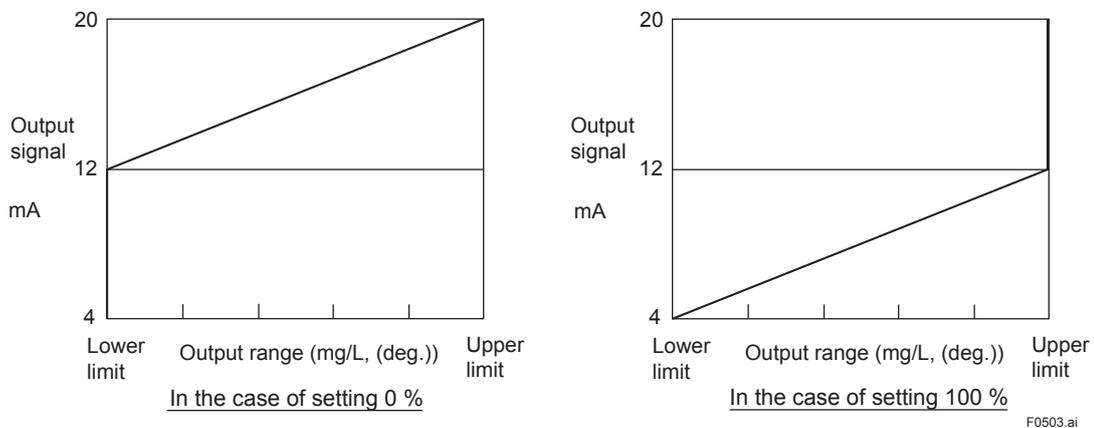


Figure 5.3 Output When the Break Point Is Set at 0% and 100% of the Output Range

5.3 Manual Cleaning and Calibration Functions

Table 5.4 shows a list of manual cleaning and calibration functions. For operation and setting procedures, see the procedures for each mode and the functions in Chapter 6.

Table 5.4 Manual Cleaning and Calibration Functions

Function	Description	Mode	FUNCTION
1 Zero calibration (zero water)	Zero-point calibration using zero water	MAINT.	1
2 Zero calibration (lamp OFF) *1	Zero-point calibration with the lamp turned off When the measurement is over 200 mg/L turbidity, zero calibration can be made at Lamp off.	MAINT.	2
3 Zero-shift calibration *3	A function to make the zero point agree with the desired value.	MAINT.	3
4 Span calibration (calibration plate/ standard solution)	Span calibration using the calibration plate and standard solution. the calibration plate and standard solution should be selected according to function.	MAINT.	4
5 Span calibration (sensitivity correction) *3	A function to make the point at the upper end of the span agree with the desired value	MAINT.	5
6 Manual start of automatic cleaning *2	Cleaning operation can be started in the <MAINT.> mode.	MAINT.	6
7 Manual start of automatic calibration *2	Calibration operation can be started in the <MAINT.> mode.	MAINT.	7
8 Reference sensitivity calibration	Reference span calibration carries out with standard solution upon shipment from the factory. This sensitivity becomes the reference of the slope display and slope failure assessment. Normally, this is not used except upon shipment from the factory.	MAINT.	8
9 Lamp control reference value	The converter lamp voltage is fixed at 3.6 V and the reference signal voltage at the time is stored as the reference. The lamp voltage is controlled by this reference value.	MAINT.	C
10 Setting of calibration plate turbidity value	The calibration plate turbidity value is set (marked at the rear of the calibration plate).	PROGRAM 1	A
11 Setting of zero correction factor	The zero correction factor obtained in item (3) can be displayed and changed.	PROGRAM 1	B
12 Setting of sensitivity correction factor	The sensitivity correction factor obtained in item (5) can be displayed and changed.	PROGRAM 1	C
13 Selection of calibration plate/standard solution	Which span reference is used, either the calibration plate or the standard solution, for span calibration in item (4), is selected.	PROGRAM 1	D.

*1: The difference in the zero point between the procedures using "zero water" and the lamp being off is approximately 1 mg/L.

*2: For the automatic cleaning operation in the <MEAS.> mode, see subsection 4.2.2.
For the automatic calibration operation in the <MEAS.> mode, see subsection 4.2.3.

*3: Normal zero and span calibration is carries out using items (1) or (2) and (4) of Table 5.4 taking the standard solution as the reference (equation 5.1). However, if the indications are to agree with the arbitrary values using a solution other than the standard solution as the reference, calibration with items (3) and (5) of Table 5.4 is carried out. In this case, the zero correction factor and sensitivity correction standard solution (see equation 5.2).

$$T1 = S (V - A) \text{ Eq. 5.1}$$

$$T2 = K (T1 + B) \text{ Eq. 5.2}$$

where,

T1: Turbidity value using standard solution as the reference

S: Span calibration coefficient (referencing to standard solution)

This is calculated when calibrating item (4) in Table 5.4, and the ration of the span calibration coefficient (S0) calculated by reference sensitivity calibration in item (8) in Table 5.4 (normally implemented upon shipment from the factory) to this coefficient, S0/S, is displayed as the slope in item (8).

The permissible range for item (4) in Table 5.4 is 50% <= S0/S <= 400%.

A: Zero-calibration coefficient (referred to standard solution)

This is calculated in calibration for items (1) and (2) in Table 5.4 and the turbidity-converted value of this coefficient (S x A) is displayed as a zero-point error because of item (7) in Table 5.5.

-10 mV <= A <= 10 mV is the permissible range of items (1) and (2) in Table 5.4.

- V: Measuring signal, a voltage signal from the detector
- T2: Turbidity value after correction
- K: Sensitivity correction factor
This is calculated in the calibration of item (5) in Table 5.4, and can be displayed and changed using item (12) in Table 5.4.
The permissible range in items (5) and (12) in Table 5.4 is $0.25 \leq K \leq 4.00$.
- B: Zero-correction coefficient
This is calculated in item (3) in Table 5.4 and can be displayed and changed using item (11) in Table 5.4.
 $-9 \text{ mg/L} \leq B \leq 9 \text{ mg/L}$ is the permissible range for items (3) and (11) in Table 5.4.

- Note 1: Turbidity in the <MEAS.> mode is displayed in T2 (turbidity after correction). However, when the turbidimeter is shipped from the factory, the zero and sensitivity correction factors are 0.0 mg/L and 1, respectively. Thus, $T1 = T2$.
- Note 2: For zero and span calibration of (1), (2), (4), and (8) referencing the standard solution, T1 (turbidity before correction) is always displayed as turbidity.

5.4 Functions Related to Display

In the <MEAS.> mode, each item in Table 5.5 can be selectivity displayed. In addition, Table 5.6 shows the functions related to turbidity display.

Table 5.5 Functions Related to Display

Function	Description	Mode	FUNCTION
1 Turbidity display *1	Turbidity is displayed.	MEAS.	1
2 Lamp voltage display	The lamp voltage in the converter is displayed. *1	MEAS.	2
3 Measured signal current display	The measured value by the receiving element that measures scattered light is displayed in the current value.	MEAS.	3
4 Reference signal voltage display	The signal of the receiving element that controls the lamp light quantity is displayed in the voltage value.	MEAS.	4
5 Analog output % display	The analog output is displayed after being converted into % FS.	MEAS.	5
6 Analog output mA display	The analog output is displayed after being converted into 4 to 20 mA.	MEAS.	6
7 Zero error display	The measured signal in zero calibration does not become 0 mV exactly. This error (mV) is displayed after being converted to turbidity.	MEAS.	7
8 Slope display	Sensitivity at the latest span calibration to the sensitivity at reference sensitivity calibration is displayed in %.	MEAS.	8

*1: Owing to item 3 in Table 5.6, the unit indication can be changed.

Table 5.6 Functions Related to Turbidity Display

Function	Description	Mode	FUNCTION
1 Negative turbidity display hold *1	If the value of the turbidity is negative, the turbidity is fixed at 0.00 mg/L.	PROGRAM 1	7.
2 Display hold automatic cleaning or zero calibration	The display in the automatic cleaning or zero calibration is fixed.	PROGRAM 1	8.
3 Selection of turbidity unit indication	The unit of turbidity indication (mg/L, degree, and FTU) can be selected.	PROGRAM 1	C.

*1: Even if this function is on, a negative value is displayed in other than the <MEAS.> mode.

5.5 Functions Related to Contact Output

An on or off operation can be selected for every contact output.

The output AUX (C1, C2) is used for either upper and lower limit alarm output or automatic cleaning and calibration output.

Table 5.7 Functions Related to Contact Output

Function	Description	Contact	Mode	FUNCTION
Selection of maintenance contact output open or close	Open or closed (factory setting)	M1, M2	PROGRAM 2	C
Selection of FAIL contact output open or close	Open (factory setting) or closed	F1, F2	PROGRAM 2	D
Selection of upper and lower limit alarm output open or close	Open (factory setting) or closed	C1, C2	PROGRAM 2	E
Selection of automatic cleaning or zero calibration output open or close	Open or closed (factory setting)	C1, C2	PROGRAM 2	F
Selection of C1 and C2 outputs	Selection of upper and lower limit alarm output or automatic cleaning or calibration output	C1, C2	PROGRAM 2	E.

5.6 Other Functions

Table 5.8 shows other functions.

Table 5.8 Other Functions

Function	Description	Mode	FUNCTION
Converter check	It can be confirmed that the converter operates normally.	MAINT.	9
Setting of turbidity signal average factor	Setting of the average factor of turbidity indication analog output	PROGRAM 1	4

5.6.1 Overview of the Spike Detection Function

If air bubbles occur or dust is present on the sample surface of the detector's measuring cell at which the light is scattered, the reading, in general, rises rapidly. The fluctuation is dependent on the size of air bubbles or dust and their behavior on the sample surface.

A head tank is supplied when the TB400G with a sampling system is specified. It is for removing air bubbles and thus for preventing them from reaching the detector. In rare cases, however, air bubbles occur and grow in the pipe between the head tank and the detector, and rise to the surface of the measuring cell, resulting in reading fluctuation.

The converter has a signal averaging function with a user-configurable averaging factor.

Small changes in readings due to air bubbles or dust can be compensated for, to some degree, by increasing the averaging factor. However, it is not practical to set the averaging factor too high because it can cause a delay in the response of the turbidity signal.

The spike detection function is the one of detecting and suppressing a rapid change due to air bubbles or dust, preventing it from affecting the reading and output. (Note that this function is available in models with ROM number K9410SE with version 1.04 or later).

How It Functions

To suppress a rapid change due to air bubbles or dust, the TB400G:

- Checks a turbidity signal before averaging;
- Calculates the difference between the current signal and the previous signal;
- Compares the difference with the Detection Level;
- If it is less than the Detection Level, proceeds to averaging and gives the turbidity reading;
- If it is greater than the Detection Level, holds the output for a specified Hold Time period;
- During that period, suspends the Detection Level check;
- After the Hold Time has elapsed, averages signals without the Detection Level check for a specified Sampling Time period and gives turbidity readings; and,
- After the Sampling Time has elapsed, performs the Detection Level check again.

Instructions for Use

The spike detection function is effective in processes where turbidity changes are relatively small under normal conditions, but it may not be suitable for processes where rapid changes occur often. Even if rapid changes do not usually occur, this function may be activated and may cause a delay in the response of the reading or output if stepwise turbidity changes occur occasionally. Therefore, before using this function process conditions should be carefully considered, and in order to use it properly, determine optimum setpoints for the operating conditions while changing them little by little.

When using the function, pay attention to the following.

- Adjust the Detection Level according to the degree of reading change due to air bubbles or dust.
- If an excessively long Hold Time is set, the turbidimeter may not be able to detect a change in reading that may have occurred and should have been recognized as a real change.
- If the function is responsible for the delay in the response of the turbidity reading, try setting the Sampling Time longer without changing the Hold Time.
- When an abnormal turbidity reading is suspected, turn off the function once and wait for a while and see. The function may have prevented the turbidimeter from giving readings properly.

5.6.2 Settings of Spike Detection Function

To enable the function, set necessary parameters in <PROGRAM1> mode following the procedure below.

- Turn ON the function (FUNCTION “F.”)
- Set the Detection Level (FUNCTION “D”)
- Set the Hold Time (FUNCTION “E”)
- Set the Sampling Time (FUNCTION “F”)

a. Detection Level (%)

The Detection Level is a value used to determine whether a reading is a spike due to air bubbles or dust or not. It is defined as a percentage of the upper limit of the analog output range currently selected. The percentage setpoint is converted to the corresponding turbidity signal in the computer. (The ratio of the sensitivity correction factor is also calculated automatically).

For the Detection Level check, a pre-averaging turbidity value is used. To determine the

Detection Level, it may be needed to know the degree of fluctuation in pre-averaging turbidity signals. Set the averaging factor to 1 in FUNCTION “4” in <PROGRAM1> mode to allow the turbidimeter to give turbidity readings directly without averaging.

Check readings to know the degree of fluctuation. Generally, the Detection Level is set to a value greater than the fluctuation.

b. Hold Time

When a signal exceeds the Detection Level, the readings and output signals are held for a specified Hold Time. The Hold Time should be long enough for air bubbles and dust to move away from the sample surface. Normally, air bubbles and dust will run off the sample surface or disappear within a short time (in a few seconds). In practice, first set the Hold Time to a shorter time, and then increase it if the function does not work satisfactorily.

c. Sampling Time

After the Hold Time has elapsed, the turbidimeter gives readings without any processing for a specified Sampling Time to verify that no fluctuation occurs in turbidity readings.

The time count begins after the Hold Time. It is unlikely that air bubbles or dust occur consecutively. Therefore, the Sampling Time may not need to be too short. If the Sampling Time is set too short, the response is delayed when a sudden change in turbidity actually occurs. First set the Sampling Time slightly longer. If something is wrong with the behavior of the function, shorten the time. For the procedure for settings in <PROGRAM1> mode, refer to Section 6.6.

Instructions for Use

Be careful when using the function as the following restrictions apply.

- The function works only in <MEAS.> mode. As soon as the mode is changed, the Hold or Sampling timer is reset and the function stops working.
- The function does not work during automatic zero calibration or automatic cleaning.
If automatic zero calibration or automatic cleaning begins when the function is active (i.e., during a Hold Time or Sampling Time period), the function immediately stops running and the timer is reset.
- During a Hold Time period, both turbidity readings (including communication data) and analog outputs are held.
- The function does not run for approximately 5 seconds right after the turbidimeter is turned on.
- If the turbidimeter is turned off then on again while the function is running, the timer is reset.
- Since the reference clock runs at a period of approximately 1.07 seconds, the actual time are slightly greater than their setpoints, respectively. For example, if the time is set to 10 seconds, the actual time will be: $10 \times 1.07 =$ approximately 11 seconds.

6. PROCEDURES FOR CONVERTER OPERATION

The converter incorporates a microprocessor and has automatic cleaning, automatic zero calibration, and self-diagnostic functions as well as turbidity measuring functions.

The operator may use the control panel to enable display of various data, manual operation of solenoid valves, etc., or entry of operation parameters.

This chapter describes key operation procedures, details of indications on the display, etc.

6.1 Components of Control Panel and Their Functions and Actions

Access to all function in obtained through keys on the control panel. The panel includes display areas for data, modes, function codes, etc. in which measured values and operating statuses are displayed.

Figure 6.1 and Table 6.1 show the control panel components and their functions.

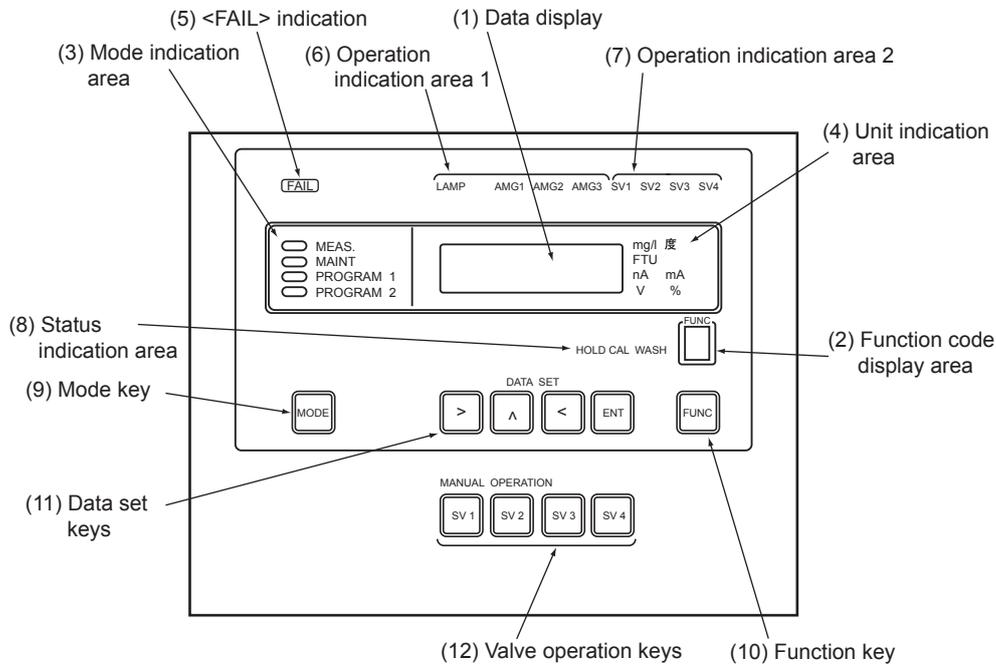


Figure 6.1 Control Panel

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Table 6.1 Operation Keys/Display Indications and Functions

No. in Fig. 6.1	Name	Function
(1)	Data display (in red LED)	Displays measured values, set data, messages, etc.
(2)	Function code area (in red)	Displays the function code selected.
(3)	Mode indication area (active mode is indicated by the green lamp)	Indicates the operation mode. The lamp relevant to the current operation mode is lit.
(4)	Unit indication area (green LED of active unit is lit)	Indicates the unit of the data. The unit of the data item currently displayed in the data display.
(5)	<FAIL> indication (in red: characters in relief)	Turns on when the processor fails or other failures are detected.
(6)	Operation indication area 1 (green LED of active operation is lit)	Turns on or off in response to the lamp turning on or off or the selected range of the analog output.
(7)	Operation indication area 2 (green LED of active operation is lit)	Turns on or off in response to the solenoid valve being on or off.
(8)	Status indication area (green LED of active status is lit)	Lights up, goes out, or flashes corresponding to the "output hold", "calibration" and "cleaning" statuses.
(9)	Mode key	Used when selecting an operation mode.
(10)	Function key	Used when selecting the function code.
(11)	Data set keys	Used when changing data settings or implementing calibration.
(12)	Valve operation keys	Used when turning solenoid valves on or off. Every time a key is pressed, the solenoid valve relevant to the key is turned on or off.

6.2 Operation Modes and Functions

Operation of the turbidimeter is divided principally into three operation modes (modes are classified into four types).

- (1) Measurement mode (<MEAS.> mode) (subsections 6.2.1)
- (2) Maintenance mode (<MAINT.> mode) (subsections 6.2.2)
- (3) Setting modes
 - Data setting/operation setting mode (<PROGRAM1> mode) (subsections 6.2.3)
 - Automatic cleaning and zero-calibration setting/failure detection function selection mode (<PROGRAM2> mode) (subsections 6.2.4)

Display or setting items for data and command items, such as for calibration, are determined by functions in each mode. Accordingly, various operations require designation of a mode and a function code.

Table 6.2 outlines the modes and the function codes in each mode. For details on function codes, see subsections 6.2.1 to 6.2.4.

Table 6.2 Outline of Modes and Function Codes

Mode	Function code (FUNCTION)	Description
MEAS.	1 to 8	This is the mode for steady operation in which turbidity is measured. If execution of automatic cleaning and zero calibration is selected, a sequence operation is carried out. (Suffix code: A2 or A3)
MAINT.	1 to F	This is the mode for performing maintenance in which calibration can be done (implemented items are selected using the [FUNC] key). The data set key and valve operation keys can be operated.
PROGRAM.1	1 to F	Data can be set such as output range setting. (The setting items are selected using the [FUNC] key). The data set key and valve operation keys can be operated.
	1. to F.	Operating functions such as range switching (automatic, remote/local) and execution/stopping of automatic cleaning can be selected (setting items are selected using the [FUNC] key). The data set key and valve setting keys can be operated.
PROGRAM.2	1 to F	The cleaning and calibration sequence time can be set (setting items are selected using the [FUNC] key). The data set key and valve operation keys can be operated.
	1. to 9.	Execution/stopping of failure detection can be selected (setting items are selected using the [FUNC] key). The data set key and valve operation keys can be operated.

6.2.1 Functions in <MEAS.> Mode

Table 6.3 gives details on the functions in the <MEAS.> mode.

Table 6.3 Function in <MEAS.> Mode

F	Indication	Display range	Example of indication	Initial (default) value	Unit	Remarks
1	Turbidity	-10.00 to 2200	150.0		mg/L	Degree/FTU is also possible. *3
2	Lamp voltage	-0.100 to 6.000	3.600		V	
3	Turbidity element detection current	-99.99 to 5600 *1	1000		nA	
4	Reference element detection current	-0.2000 to 2.4000 *2	1.6000		V	
5	Analog output in %	-10.0 to 110.0	50.0		%	
6	Analog output in mA	2.40 to 21.60	12.00		mA	
7	Zero-point error	-30.00 to 30.00	0.02	0.00	mg/L	Degree/FTU is also possible. *3
8	Slope	-50.0 to 400.0	150.0	100.0	%	
9 | F.	(Not to be selected)					

*1, *2: These are indicated by reversing the sign (+ or -) for the voltage values obtained by placing the AG terminal of the detector to the negative side (-).

*3: "FTU" unit, a turbidity unit when formazin standard is used, is also available. Since the instrument uses kaolin standard, reference sensitivity calibration using formazin standard is required for the FTU display.

Note 1: The values in the column for the initial value are those shown when the memory storing the data is initialized. These are partially different from the values set upon shipment from the factory.

6.2.2 Functions in <MAINT.> Mode

Table 6.4 gives details on the functions in the <MAINT.> mode.

Table 6.4 Function in <MAINT.> Mode

F	Operation	Permissible calibration range	Initial indication	Remarks
1	Zero calibration (zero water)	-10 to 10 mV	Measured turbidity value	Uses zero water.
2	Zero calibration (lamp is off)	-10 to 10 mV	Measured turbidity value	Automatic turning off of light source
3	Zero-shift calibration (zero-point correction)	-9 to 9 mg/L (deg.)	Measured turbidity value	Zero-shift calibration (zero correction)
4	Span calibration (standard solution or calibration plate)	50 to 400%	Measured turbidity value	Selection of calibration plate/ standard solution
5	Span calibration (sensitivity correction)	0.25 to 4	Measured turbidity value	Sensitivity correction for the standard solution (calibration plate) reference
6	Manual start of automatic cleaning	—	JEt	Effective for the model with automatic cleaning (Suffix code: -A2 or -A3)
7	Manual start of automatic calibration	—	A_CAL	Effective for the model with automatic zero calibration (Suffix code: -A3)
8	Reference sensitivity calibration *1	—	Measured turbidity value	Criteria for slope failure
9	Converter check operation	—	C.CHEC	Checked by switching to dummy input. Display --> 50.0 mg/L (deg.) Output --> 12 mA
A	Error code indication	—	E.CHEC	
B	Error reset	—	CL_Er	
C	Calibration of lamp control reference value	0.2000 to 2.3000 V	L_CAL	The lamp voltage is set at 3.6 V and the reference signal is stored as the reference value.
D	—			
E	Version number indication	—	—	Example: 1.08
F	Password setting for changing the adjustment mode	—	___00	
1. | F.	(Not to be selected)			

*1: Set the sensitivity after the reference sensitivity performed upon shipment from the factory to 100% and check the slope in normal span calibration taking value as a reference.

Note 1: The values in the column for the initial value are those shown when the memory storing the data is initialized. These are partially different from the values set upon shipment from the factory.

Note 2: If a function code which is not used is selected, "_____" is displayed.

6.2.3 Functions in <PROGRAM1> Mode

Table 6.5 gives details on the functions in the <PROGRAM1> mode.

Table 6.5 Functions in <PROGRAM1> Mode

F	Operation	Setting range/ selection	Initial indication	Remarks
1	Output range 1 setting	0.00 to 2000 mg/L (deg.)	L00.00 H02.00	
2	Output range 2 setting	0.00 to 2000 mg/L (deg.)	L00.00 H020.0	
3	Output range 3 setting	0.00 to 2000 mg/L (deg.)	L00.00 H0200	
4	Average coefficient setting (time constant setting)	1 to 255	00030	The 30 to 90% response time is about 22 seconds.
5	Setting of output value in a failed condition	-10 to 110%	00000	
6	Output setting of line-segment approximation	0 to 100%	00050	
7	Auto-range changeover point setting	70 to 100%	00080	
8	High alarm setting	-010.0 to 2200.0 mg/L (deg.)	2200.0	
9	Low alarm setting	-010.0 to 2200.0 mg/L (deg.)	-010.0	
A	Setting of turbidity value by calibration plate	0000.0 to 2000.0 mg/L (deg.)	0090.0	This varies with the calibration plates.
B	Setting of zero-correction factor	-9.000 to 09.000 mg/L (deg.)	00.000	
C	Setting of sensitivity correction factor	0.2500 to 4.0000	1.0000	
D				
E				
F				
1.	Auto-range selection *1	ON/OFF	OFF	ON: Execution OFF: Stop
2.	Remote range selection *1	ON/OFF	OFF	ON: Execution OFF: Stop
3.	Local range selection *1	__ 1/ __ 2/ __ 3	__ 1	1: Output range 1 2: Output range 2 3: Output range 3
4.	Output hold setting in the <MAINT.>, <PROGRAM 1>, or <PROGRAM 2> mode	ON/OFF	ON	ON: Hold OFF: No-hold
5.	Output mode setting in failure occurrence	__ 1/ __ 2/ __ 3	__ 1	1: No-hold 2: Hold 3: Preset
6.	Setting to output hold for 4 mA or less	ON/OFF	OFF	ON: Execution OFF: Stop
7.	Setting to hold negative turbidity display	ON/OFF	OFF	ON: Execution OFF: Stop
8.	Setting to display hold in automatic cleaning or automatic calibration	ON/OFF	OFF	ON: Execution OFF: Stop
9.	Basic code (sampling specifications) setting	__ 1/ __ 2/ __ 3	__ 3	1: -NN, -KC, -A1 2: -A2 3: -A3
A.	Automatic cleaning function execution/stop	ON/OFF	ON	ON: Execution OFF: Stop
B.	Automatic calibration function execution/stop	ON/OFF	ON	ON: Execution OFF: Stop
C.	Selection of unit to indicate	__ 1/ __ 2/ __ 3	__ 1	1: mg/L 2: Degree 3: FTU *2
D.	Selection of calibration plate/standard solution	ON/OFF	ON	ON: Calibration plate OFF: Standard solution
E.	Selection of AUX contact output	ON/OFF	ON	ON: Upper and lower limit alarm OFF: In automatic cleaning or automatic calibration
F.	Selecting execution/stop of spike detection function	ON/OFF	OFF	ON: Execution OFF: Stop

*1: The priority of these items are as follows (see subsection 5.2.1):

Auto-range > Remote range > Local range

*2: "FTU" unit, a turbidity unit when formazin standard is used, is also available. Since the instrument uses kaolin standard, reference sensitivity calibration using formazin standard is required for the FTU display.

Note 1: The values in the initial value column are those given when the memory storing the data is initialized. These may be partially different from the values set upon shipment from the factory.

Note 2: If an unused function code which is selected, "_____" is displayed.

Note 3: If a value out of the set range is entered, "not" is displayed. Pressing the [>] key restores this indication to the data display.

6.2.4 Functions in <PROGRAM2> Mode

Table 6.6 gives details on the functions in the <PROGRAM2> mode.

Table 6.6 Functions in <PROGRAM2> Mode

F	Operation	Setting range/ selection	Initial indication	Remarks
1	Setting of time range for automatic cleaning	0.1 to 24.0 hours	0002.0	
2	Setting of cleaning calibration ratio	1 to 20 times	00001	
3	Setting of number of cleaning	1 to 20 times	00005	
4	Setting of cleaning time 1 *1	10 to 120 seconds	00030	
5	Setting of cleaning time 2 *2	10 to 120 seconds	00030	
6	Setting of drain time 1 *1	10 to 120 seconds	00010	
7	Setting of drain time 2 *2	10 to 120 seconds	00010	
8	Setting of filling time 1 *1	10 to 120 seconds	00100	
9	Setting of filling time 2 *2	10 to 120 seconds	00100	
A	Setting of relaxation time	30 to 600 seconds	00150	
B				
C	Setting of maintenance contact output operation	__ 1/ __ 2	__ 2/Closed	1: Open in operation 2: Closed in operation
D	Setting of FAIL contact output operation	__ 1/ __ 2	__ 1/Open	1: Open in operation 2: Closed in operation
E	Setting of high and low alarm contact output operation	__ 1/ __ 2	__ 1/Open	1: Open in operation 2: Closed in operation
F	Setting of operation of contact output during automatic cleaning and zero-calibration	__ 1/ __ 2	__ 2/Closed	1: Open in operation 2: Closed in operation
1.	Selection of execution/stopping of turbidity rangeover detection function	ON/OFF	ON	ON: Execution OFF: Stop
2.	Selection of execution/stopping of disconnected-lamp detection function	ON/OFF	ON	ON: Execution OFF: Stop
3.	Selection of execution/stopping of lamp failure detection function	ON/OFF	ON	ON: Execution OFF: Stop
4.	Selection of execution/stopping of A/D circuit failure detection function	ON/OFF	ON	ON: Execution OFF: Stop
5.	Selection of execution/stopping of failure-inmemory-comparison detection function	ON/OFF	ON	ON: Execution OFF: Stop
6.	Selection of execution/stopping of reference voltage failure detection function	ON/OFF	ON	ON: Execution OFF: Stop
7.	Selection of execution/stopping of end-of-lamp-life detection function	ON/OFF	ON	ON: Execution OFF: Stop
8.	Selection of execution/stopping of automatic calibration failure detection function	ON/OFF	ON	ON: Execution OFF: Stop
9.	Selection of execution/stopping of high and low alarm detection function	ON/OFF	ON	ON: Execution OFF: Stop
A.				
B.				
C.				
D.				
E.				
F.				

*1: Effective with Suffix code "-A2" (with automatic cleaning)

*2: Effective with Suffix code "-A3" (with automatic cleaning and calibration)

Note 1: The values in the initial value column are those given when the memory storing the data is initialized. These may be partially different from the values set upon shipment from the factory.

Note 2: If an unused function code which is selected, "_____" is displayed.

Note 3: If a value out of the set range is entered, "not" is displayed. Pressing the [>] key restores this indication to the data display.

6.3 Key Operation

6.3.1 Mode Switching

The current operation mode is indicated by the lit mode indicator lamp.

The operation modes are switched in turn as shown in Figure 6.2 every time [MODE] key is pressed. However, if a function code other than "1" is selected in each mode, that made is not changed by the first key operation but the function code only returns to "1".



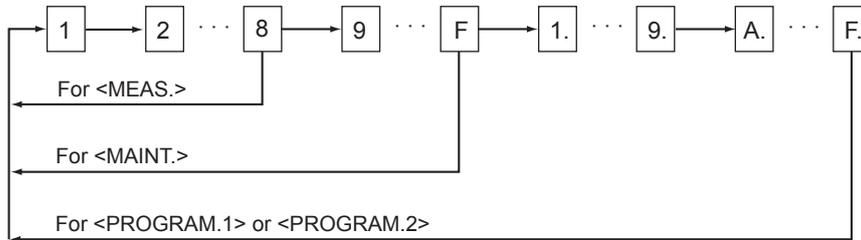
F0602.ai

Figure 6.2 Mode Switching by [MODE] Key Operation

6.3.2 Function Switching

Pressing the [FUNC] key switches the function codes. The switched function code is displayed in the function code display area. In addition, the function code contents are different in each mode (see Section 6.2). The selectable number of the function codes also changes.

Figure 6.3 shows the switching sequence of function codes by the [FUNC] key operation.



Note: If the [MODE] key is pressed with the function code set to a code other than "1", the function code returns to "1".

F0603.ai

Figure 6.3 Function Code Switching by [FUNC] Key Operation

6.3.3 Numerical Input

Numerical input is made with the data set keys. Operation of the data set keys becomes effective in the modes other than the <MEAS.> mode. The data set keys include the following four keys.

(a) [>] Key (Digit selection key):

This is used select the digits of a value of displayed data in the data display that are to be changed. Digits are selected in such a manner that a digit to be changed moves one place to the right from the most significant digit on the left every time this key is pressed and returns to the left end from the right end.

When the display is on or off in each mode, pressing the [>] key indicates them alternately. Also, when the display comprises __1, __2, and __3, pressing the [>] key indicates one of them in this order.

(b) [^] Key (Numeral-up Key):

Every time this key is pressed, the numeric value of the selected digit increases in turn; when it reaches 9, it returns to 0. In the most significant digit, a "-" (minus sign) is inserted next to 9. However, if the displayed data do not include negative values, the negative sign is not inserted.

(c) [v] Key (Numeral-down key):

Every time this key is pressed, the numeric value in the selected digit decreases in turn; when it reaches 0, it returns to 9. In the most significant digit, a "-" (minus sign) is inserted next to 0. However, if the displayed data do not include negative values, the negative sign is not inserted.

(d) [ENT] Key (Entry key):

This key is used to enter displayed data. When data are entered, the entire displayed data flash only once.

6.3.4 Opening/Closing Valves

The opening or closing of a solenoid valve is performed with the valve operation key in the maintenance mode. When a solenoid valve operates, the relevant lamp is lit.

Regardless of a solenoid valve's open/close status in the maintenance mode, if the mode is changed to the <MEAS.> mode, e.g., for the specification "with automatic cleaning and automatic calibration", the predetermined sequential operation is performed and the solenoid valves automatically open or close.

Table 6.7 shows the use of solenoid valves based on the sampling specifications (Suffix code).

Table 6.7 Sampling Specifications (Suffix Code) and Use of Solenoid Valves

Suffix code	SV1	SV2	SV3	SV4
-NN, -KC	X	X	X	X
-A1	X	X	X	X
-A2	○	○	X	X
-A3	○	○	○	○

X: Used ○: Not used

Note: SV1 is a pinch valve, SV3 is a motor-operated valves and SV2 and SV4 are solenoid valves.

6.4 Operation in <Meas.> Mode

Each data item in Table 6.3 is displayed by [FUNC] key operation. In this section, the functions are described in the following order.

- (1) Turbidity
- (2) Lamp voltage
- (3) Turbidity element detection current
- (4) Reference element
- (5) Analog output in %
- (6) Analog output in mA
- (7) Zero-point error
- (8) Slope

(1) Turbidity (FUNCTION "1")

Turbidity is displayed in the range of -10.00 to 2200 mg/L.

The unit that is displayed can be selected from "mg/L", "degree", or "FTU" in the <PROGRAM1> mode and with FUNCTION "C".

(2) Lamp voltage indication (FUNCTION "2")

The output voltage of the converter to the lamp (across terminals P1 and P2) is displayed.

(3) Turbidity element detection current (FUNCTION "3")

The signal detected by the turbidity detecting light-receiving element in the detector is displayed as the current value (converted value).

(4) Reference element detection voltage (FUNCTION "4")

The signal detected by the light-receiving element for the amount of light from the lamp is displayed as the voltage.

(5) Analog output in % (FUNCTION "5")

The current output signal is displayed in a % of the selected output range span.

(Example) In the case of output range: 0 to 2 mg/L, and

Turbidity indication: 1.20 mg/L

$$\% \text{ Indication} = \frac{1.20}{2 - 0} \times 100 = 60.0 \% \quad \text{F6401.ai}$$

The analog output is sent out in the range of -10 to 110% of the output range span.

(6) Analog output in mA (FUNCTION "6")

The current analog output value is displayed in a value converted to mA. The value is directly displayed for a 4 to 20 mA output, but for a 1 to 5 V output, it is displayed by converting it into a 4 to 20 mA output.

(7) Zero-point error (FUNCTION "7")

The measuring voltage signal for zero water or with the light source turned off at zero calibration is displayed in a value converted to turbidity. If the measuring signal at zero calibration exceeds the range of -10 to 10 mV, "Err21" is displayed.

(8) Slope (FUNCTION "8")

When the sensitivity at the reference sensitivity calibration is taken as 100%, this indication displays the ratio as a percentage of the sensitivity obtained at usual span calibration to 100%. If the sensitivity exceeds the range of 50 to 400% at span calibration, "Err22" is displayed.

6.5 Operation in <MAINT.> Mode

This section describes key operations by specifying the functions in the <MAINT.> mode and describes the operations in the following order.

- (1) Zero calibration (with zero water)
- (2) Zero calibration (with lamp turned off)
- (3) Zero-shift calibration (Zero-point correction)
- (4) Span calibration (with standard solution or calibration plate)
- (5) Span calibration (sensitivity correction)
- (6) Manual start of automatic cleaning
- (7) Manual start of automatic calibration
- (8) Reference sensitivity calibration
- (9) Converter check operation
- (10) Error code display
- (11) Error resetting
- (12) Reference lamp control value calibration
- (13) Version number display
- (14) Password entry to switch to the adjustment mode

(1) Zero Calibration (with "zero water") [FUNCTION "1"]

The zero-calibration operation using "zero water". For the value operating procedures, see Section 7.6.

The following is a description of the key operations.

(Example of display)

- | | |
|---|------------------------------------|
| (1) Select FUNCTION "1" in the <MAINT.> mode. | => 000.04 mg/L |
| (2) Press the [ENT] key after the display becomes stable. | => The "CAL" lamp begins to flash. |
| (3) Press the [>] key. | => 000.00 mg/L is displayed. |
| (4) Press the [ENT] key to terminate calibration. | => 000.00 mg/L |

The entire display flashes once and the "CAL" lamp goes out.

In addition, at operation 4, the measured signal at the zero point is checked and if the permissible range (-10 to 10 mV) is exceeded, Err21 (zero calibration overrange) is displayed (see Section 5.3 *3). In this case, the "FAIL" lamp is not lit and a FAIL contact is not output.

An error message can be reset by pressing the [ENT] key and the display returns to the turbidity indication. Wait until the display becomes stable and then begin from step 2 again.

At any stage of zero-calibration operation, pressing the [MODE] key or [FUNC] key allows switching to another mode or function. Calibration computation is not performed unless the operation of 4 is carried out.

Note: At this calibration, the turbidity not multiplied by the correction factor from the zero-shift calibration (zero correction) in (3) or span calibration (sensitivity correction) in (5) is displayed.

(2) Zero Calibration (with lamp turned off) (FUNCTION "2")

The zero-calibration operation is done by automatically turning off the lamp. Only in a measured turbidity exceeding 200 mg/L, can zero calibration be performed simply in the following operations. A turbidity reading with the lamp turned off reads a value 1 mg/L smaller than a reading using "zero water".

(Example of display)

- | | |
|--|---|
| (1) Select FUNCTION "2" in the <MAINT.> mode.
At this time, the lamp is still lit. | => 002.00 mg/L |
| (2) Press the [ENT] key.
The lamp goes out and the displayed value becomes smaller. | => 000.50 mg/L
The CAL lamp flashes. |
| (3) Wait one minute or more and after the display becomes stable, and press the [>] key. | => 000.00 mg/L is displayed. |
| (4) Press the [ENT] key to calibrate. | => 000.00 mg/L
The entire display flashes once and then the CAL lamp goes out. |

In addition, at operation 4, the zero-calibration range is checked and the permissible range (-10 to 10 mV) is exceeded, Err21 (zero-calibration overrange) is displayed (see Section 5.3 *3). In this case, the "FAIL" lamp is not lit and a FAIL contact is not output.

The error message can be reset by pressing the [ENT] key and the display returns to the turbidity indication. Wait until the display becomes stable and then begin from step 2 again.

In any stage of zero-calibration operation, pressing the [MODE] key or [FUNC] key allows switching to another mode or function. Calibration computation is not performed unless operation of 4 is carried out. Also, since the lamp voltage returns to the control voltage when the turbidimeter resets from the function for calibration with the lamp turned off, a little time is necessary until the turbidity reading becomes stable. When the mode is to be changed to the <MEAS.> mode, change the mode after waiting for five minutes or more.

Note: At this calibration, the turbidity not multiplied by the correction factor from the zero-shift calibration (zero correction) in (3) or span calibration (sensitivity correction) in (5) is displayed.

(3) Zero-shift Calibration (FUNCTION "3")

At any turbidity value, this is an operation to zero-shift a turbidity reading within the permissible range (± 9 mg/L).

For details on the function, see Section 5.3 (*3). The zero-correction factor obtained in this calibration can be displayed and directly changed in FUNCTION "B" in the <PROGRAM1> mode.

The operation procedures are as follows.

(Example of display)

- | | |
|---|---|
| (1) Select FUNCTION "3" in the <MAINT.> mode. | => 000.13 mg/L |
| (2) Wait until the display becomes stable, and then press the [ENT] key. | => 000.13 mg/L
The CAL lamp flashes. |
| (3) Press the [>] key. | => 00000. mg/L
The display is now ready for determination of the decimal point position. |
| (4) Press the [>] key to determine the position of decimal point.
Every time the key is pressed, the decimal point moves to the right and when the least significant digit is reached, the decimal point then moves to the second digit from the left. | => 000.00 mg/L |

- (5) Press the [ENT] key. => 000.00 mg/L
The second digit from the left flashes and waits for the turbidity setting.
- (6) Select a digit with the [>] key and set the turbidity value using the [^] or [v] key. => 000.22 mg/L
Every time [>] key is pressed, the flashing digit moves to the right and when the least significant digit is reached, it moves to the second digit from the left.
- (7) Press the [ENT] key to terminate calibration. => 000.22 mg/L
The entire display flashes once and the CAL lamp goes out.

In addition, if the turbidity value set in operation 7 exceeds the permissible setting range (0 to 2200 mg/L), "not" is displayed. As this setpoint is out of range, reset the error message by pressing the [>] key and continue the operation from step 2.

Also, check the zero-correction factor; if it exceeds the permissible range (± 9 mg/L), "Err23" is displayed. In this case, the "FAIL" lamp is not lit and a FAIL contact is not output. Reset the error message by pressing the [ENT] key and continue operations from step 2.

At any stage of zero-shift calibration operation, pressing the [MODE] key or [FUNC] key allows switching to another mode or function. Calibration computation is not performed unless operation 7 is carried out.

(4) Span Calibration (by standard solution or calibration plate) (FUNCTION "4")

This is the operation for normal span calibration (by the calibration plate or standard solution). For details on value operation and others, see Sections 7.6 and 7.7. Select whether the calibration plate or standard solution is used in span calibration in FUNCTION "D" in the <PROGRAM1> mode.

The following is the key operation procedure.

(a) Span calibration with calibration plate

- | | |
|--|---|
| | (Example of display) |
| (1) Select FUNCTION "4" in the <MAINT.> mode. | => 0090.5 mg/L |
| (2) Wait until the display becomes stable, and then press the [ENT] key. | => 0090.5 mg/L
The CAL lamp flashes. |
| (3) Press the [>] key. | => 0090.0 mg/L
The preset turbidity value of the calibration plate is displayed. |
| (4) Press the [ENT] key to terminate calibration. | => 0090.0 mg/L
The display flashes once and the CAL lamp goes out. |

In operation 4 check the difference between the current turbidity value and the calibration plate turbidity value. If it exceeds the permissible range ($\pm 50\%$ of the preset calibration plate turbidity value), "Err24" is displayed. In this case, the "FAIL" lamp is not lit and a FAIL contact is not output. Reset the error message by pressing the [ENT] key, check that the calibration plate is set in place and continue operation from step 2.

Also, check the ratio of the current sensitivity (slope) to the reference sensitivity. If the exceeds the permissible range (50 to 400%), "Err22" is displayed (see Section 5.3 *3).

The error message is reset by pressing the [ENT] key. Perform operation from step 2 again.

At any stage of zero-shift calibration operation, pressing the [MODE] key or [FUNC] key allows switching to another mode or function. Calibration computation is not performed unless operation 4 is carried out.

Note: At this calibration, the turbidity not multiplied by the correction factor from the zero-shift calibration (zero correction) in (3) or span calibration (sensitivity correction) in (5) is displayed.

(b) Span calibration with standard solution

(Example of display)

- (1) Select FUNCTION "4" in the <MAINT.> mode. => 0105.0 mg/L
- (2) Wait until the display becomes stable, and then press the [ENT] key. => 0105.0 mg/L
The CAL lamp flashes.
- (3) Press the [>] key. => 00000. mg/L
The display is now ready for determination of the decimal point position.
- (4) Press the [>] key to determine the position of the decimal point. => 000.00 mg/L
Every time the key is pressed, the decimal point moves to the right and when the least significant digit is reached, it moves to the second digit from the left.
- (5) Press the [ENT] key. => 0000.0 mg/L
The second digit from the left flashes and waits for the turbidity setting.
- (6) Select a digit with the [>] key and set the turbidity value of the standard solution using the [^] or [v] key. Every time the [>] key is pressed, the flashing digit moves to the right and when the least significant digit is reached, it moves to the second digit from the left. => 0100.0 mg/L
- (7) Press the [ENT] key to terminate calibration. => 0100.0 mg/L
The entire display flashes once and the CAL lamp goes out.

If the turbidity value set in operation 7 exceeds the permissible setting range (0 to 2200 mg/L), "not" is displayed. In this case, the "FAIL" lamp is not lit and a FAIL contact is not output. Reset the error message by pressing the [ENT] key and continue operation from step 2.

Also, check the ratio of the current sensitivity (slope) to the reference sensitivity. If it exceeds the permissible range (50 to 400%), "Err22" is displayed (see Section 5.3 *3).

The error message is reset by pressing the [ENT] key. Perform operation from step 2 again.

At any stage of zero-shift calibration operation, pressing the [MODE] key or [FUNC] key allows switching to another mode or function. Calibration computation is not performed unless operation 7 is carried out.

Note: At this calibration, the turbidity not multiplied by the correction factor from the zero-shift calibration (zero correction) in (3) or span calibration (sensitivity correction) in (5) is displayed.

(5) Span Calibration (sensitivity correction) (FUNCTION "5")

A part from the sensitivity based on the calibration plate (or standard solution), another corrective sensitivity can be provided. For details on this function, see Section 5.3 (*3).

The sensitivity correction factor can be displayed and directly changed using FUNCTION "C" in the <PROGRAM1> mode. Valve statuses in the operation of this function are the same as those in the measurement status.

- | | |
|--|---|
| | (Example of display) |
| (1) Select FUNCTION "5" in the <MAINT.> mode. | => 0105.0 mg/L |
| (2) Wait until the display becomes stable, and then press the [ENT] key. | => 0105.0 mg/L
The CAL lamp flashes. |
| (3) Press the [>] key. | => 00000. mg/L
The display is now ready for determination of the decimal point position. |
| (4) Press the [>] key to determine the position of decimal point.
Every time the key is pressed, the decimal point moves to the right and when the least significant digit is reached, it moves to be second digit from the left. | => 000.00 mg/L |
| (5) Press the [ENT] key. | => 0000.0 mg/L
The second digit from the left flashes and waits for the turbidity setting. |
| (6) Select a digit with the [>] key and set the desired turbidity value using the [^] or [v] key.
Every time the [>] key is pressed, the flashing digit moves to the right and when the least significant digit is reached, it moves to the second digit from the left. | => 0100.0 mg/L |
| (7) Press the [ENT] key to terminate calibration. | => 0100.0 mg/L
The entire display flashes once and the CAL lamp goes out. |

If the turbidity value set in step 7 exceeds the permissible setting range (0 to 2200 mg/L), "not" is displayed. In this case, the "FAIL" lamp is not lit and a FAIL contact is not output. Reset the error message by pressing the [ENT] key and continue operation from step 2.

Also, check the ratio of the sensitivity correction to the current sensitivity. If it exceeds the permissible range (0.25 to 4), "Err22" is displayed. The error message is reset by pressing the [ENT] key. Perform operation from step 2 again.

(6) Manual Start of Automatic Cleaning (FUNCTION "6")

This is the operation to manually start the automatic cleaning operation.

For specification of automatic cleaning (Suffix code: -A2 or -A3), this function can be used. For details on automatic cleaning, see Subsection 4.2.2.

The following is the procedure for this function.

- | | |
|--|---|
| | (Example of display) |
| (1) Select FUNCTION "6" in the <MAINT.> mode. | => "JEt" is displayed. |
| (2) Press the [ENT] key. | => The WASH lamp flashes and automatic cleaning starts. |
| (3) The predetermined cleaning operation is carried out. | => A turbidity value is displayed during cleaning. |

- (4) Termination
If cleaning is to be repeated, operate from step 2 again. => "End" is displayed. The WASH lamp goes out.

Even if "contact output during automatic cleaning and calibration" is selected as an auxiliary contact output, the contact is not actuated in a manual start of the automatic cleaning operation. A digital output is also not sent out.

During cleaning, the cleaning operation can be stopped if the mode of the function is switched to another mode or function using the [MODE] key or [FUNC] key. In this case, the solenoid valve automatically returns to the status at the start of measurement.

(7) Manual Start of Automatic Calibration (FUNCTION "7")

This is the operation to manually start the automatic calibration operation.

For specification of automatic calibration (Suffix code: -A3), this function can be used.

For details on automatic calibration, see Subsection 4.2.3.

The following is the procedure for this function.

(Example of display)

- (1) Select FUNCTION "7" in the <MAINT.> mode. => "A_CAL" is displayed.
- (2) Press the [ENT] key. => The CAL lamp flashes and automatic calibration starts.
- (3) The predetermined calibration operation is carried out. => A turbidity value is displayed during calibration.
- (4) Termination
If cleaning is to be repeated, operate from step 2 again. => "End" is displayed. The CAL lamp goes out.

Even if "contact output during automatic cleaning and calibration" is selected as an auxiliary contact output, the contact is not actuated in a manual start of the automatic calibration operation. A digital output is also not sent out.

During calibration, the calibration operation can be stopped if the mode of the function is moved to another mode or function using the [MODE] key or [FUNC] key. In this case, the solenoid valve automatically returns to the statuses at the start of measurement.

If a similar operation is performed after completing the calibration computation, that calibration becomes effective.

(8) Reference Sensitivity Calibration (FUNCTION "8")

The reference sensitivity is determined in this operation using the standard solution upon the shipment from the factory. The sensitivity obtained at that time is the basis for an abnormal sensitivity check at normal span calibration and for the sensitivity (slope) display. Usually, this function is not used except upon shipment from the factory. The valve operations and supply procedure for the standard solution are the same as those at span calibration. For details, see Section 7.7.

The following is the procedure for this function.

(Example of display)

- (1) Select FUNCTION "8" in the <MAINT.> mode. => 0105.0 mg/L
- (2) Wait until the display becomes stable, and then press the [ENT] key. => 0105.0 mg/L
The CAL lamp flashes.
- (3) Press the [>] key. => 00000. mg/L
The display is now ready for determination of the decimal point

- position.
- (4) Press the [>] key to determine the position of the decimal point. Every time the key is pressed, the decimal point moves to the right and when the least significant digit is reached, it moves to the second digit from the left. => 000.00 mg/L
- (5) Press the [ENT] key. => 0000.0 mg/L
The second digit from the left flashes and waits for the turbidity setting.
- (6) Select a digit with the [>] key and set the turbidity value of the standard solution using the [^] or [v] key. Every time the [>] key is pressed, the flashing digit moves to the right and when the least significant digit is reached, it moves to the second digit from the left. => 0100.0 mg/L
- (7) Press the [ENT] key to terminate calibration. => 0100.0 mg/L
The entire display flashes once and the CAL lamp goes out.

If the turbidity value set in operation (7) exceeds the permissible setting range (0 to 2200 mg/L), "not" is displayed. In this case, the "FAIL" lamp is not lit and a FAIL contact is not output. Reset the error message by pressing the [ENT] key and continue operation from step 2.

Also in reference sensitivity calibration, the permissible sensitivity range is not specifically determined in calibration. If calibration of this function is performed, the slope display in the <MEAS.> mode becomes 100.0%. In any stage of reference sensitivity calibration operation, pressing the [MODE] key or [FUNC] key allows switching to another mode or function. The calibration computation is not performed unless operation 7 is carried out.

Note: At this calibration, the turbidity not multiplied by the correction factor from the zero-shift calibration (zero correction) in (3) or span calibration (sensitivity correction) in (5) is displayed.

(9) Converter Check Operation (FUNCTION "9")

This operation checks the operation of the converter by switching the converter input signal from a measured signal to a simulated signal.

The following is the procedure for this function.

(Example of display)

- (1) Select FUNCTION "9" in the <MAINT.> mode. => "C.CHEC" is displayed.
- (2) Press the [ENT] key. => 0050.0 mg/L

The converter is normal if the turbidity reading and analog output satisfy the following conditions:

Turbidity reading: 50.0 ±0.5 mg/L
 Analog output: 12.00 ± 0.16 mA (or 4 to 20 mA output)
 3.00 ±0.05 V (for 1 to 5 V output)

If the analog output in the maintenance mode is set to "hold", the analog output is held at 12 mA (or 3 V) in this operation. When the mode or function is switched to <MEAS.> mode using the [MODE] key, the converter input returns to a measured signal from the simulated input. In this case, a little time is needed until the reading becomes stable (1 minute or more).

Note: The time required for the reading to stabilize in returning to a measured signal from the simulated input depends on the averaging coefficient preset in FUNCTION "4" in the <PROGRAM1> mode. If the data (30) set on shipment from the factory are changed, the extra time is needed.

Turbidity value is affected by the value of "MEAS.7". There is no error when the value of "MEAS.9 + MEAS.7" is within "50±0.5 mg/L", even though the value of "MEAS.9" is out of "50±0.5 mg/L". E.g: There is no error when MAINT.9=48 and MEAS.7=2, because "48+2=50" and 50 is within "50±0.5 mg/L".

(10) Error Code Display (FUNCTION "A")

If the FAIL lamp is lit, an error code is not displayed at the time of an error occurrence.

This function is used to confirm an error code. Table 6.8 shows error codes displayed with this function and their contents.

Table 6.8 Error Codes and Their Contents

Error code	Contents	Mode for detection
Err11	Turbidity overrange	MEAS.
Err12	Lamp voltage error	MEAS.
Err13	Lamp disconnection	MEAS.
Err14	A/D circuit error	Any mode
Err15	Memory comparison error	Any mode
Err18	Reference signal voltage error	MEAS.
Err25	Service life of lamp	MEAS.
Err26	Automatic zero-calibration error	MEAS.

The following is the procedure for this function.

(Example of display)

- (1) Select FUNCTION "A" in the <MAINT.> mode. => "E.CHEC" is displayed.
- (2) Press the [ENT] key. => "Err11"
"Err11" flashes. If there is more than one error, they appear in turn.
- (3) Press the [ENT] key. => "E.CHEC" is displayed.

If this function is operated when there is no error, "Good" is displayed. For troubleshooting when errors occur, see Chapter 8.

(11) Error Resetting (FUNCTION "B")

This function can reset error statues (FAIL lamp and FAIL contact output). An error status is automatically reset at an instance when the causes of an error are removed but this function can reset the error even if the causes are not removed. However, if the causes of the error still remain when the mode is changed after resetting and moved to each error detection mode, that error is again detected.

The following is the procedure for this function.

(Example of display)

- (1) Select FUNCTION "B" in the <MAINT.> mode. => "CL_Er" is displayed.
- (2) Press the [ENT] key. => "CL_Er" display flashes once and the error is reset.

For troubleshooting when errors occur, see Chapter 8.

(12) Reference Lamp Control Valve Calibration (FUNCTION "C")

This function determines the reference signal of the reference light-receiving element when the amount of light from the lamp is controlled. Be sure to carry out this calibration after replacing the lamp and then do a span calibration (calibration plate). For the lamp replacement procedure, see Section 7.5.

The following is the procedure for this function.

(Example of display)

- | | |
|---|---|
| (1) Select FUNCTION "C" in the <MAINT.> mode. | => "L_CAL" is displayed. |
| (2) Press the [ENT] key. The lamp voltage is fixed at 4.3 V. | => 1.4203 V
The reference signal is displayed. |
| (3) Wait for about 5 minutes or more until the display becomes stable and then press the [ENT] key. | => 1.4203 V
The entire display flashes once and the reference value is stored. |
| (4) Terminated. | |

When step 3 is operated, if the displayed reference signal exceeds the permissible range (0.2 to 2.3 V), "Error" is displayed. The error message can be reset by pressing the [ENT] key. Repeat the procedure from the adjustment of the lamp's position.

If the mode is switched to another mode using the [MODE] or [FUNC] key after step 2 or after calibration is terminated by operating step 3, lamp-voltage control restarts. As it takes a little time until the lamp voltage stabilizes, allow 30 minutes or more before starting measurement. Since the lamp voltage does not change unless step 2 is operated, a waiting time is not necessary.

(13) Version Number Display (FUNCTION "E")

This function displays the converter program version number.

(Example of display)

- | | |
|--|-----------|
| 1. Select FUNCTION "E" in the <MAINT.> mode. | => "1.08" |
|--|-----------|

(14) Password Entry to Switch to the Adjustment Mode (FUNCTION "F")

This function is for only utilization of the service mode by service personnel of Yokogawa. Thus, this function is not usually operated.

6.6 Operation in <PROGRAM1> Mode

In the <PROGRAM1> mode, data setting operations, such as output range, and operating status setting operations, such as auto range selection, are carried out.

Function "1" to "F": Data settings

Function "1." to "F.": Operating status settings

Section 6.6 describes key operations which specify each function in the <PROGRAM1> mode and the displays accompanying those key operations in the following order.

- (1) Setting output ranges 1, 2, and 3
- (2) Setting averaging coefficient (time constant)
- (3) Setting output value if an error occurs
- (4) Setting line-segment function output
- (5) Setting change-over point in auto-ranging
- (6) Setting high alarm value
- (7) Setting low alarm value
- (8) Setting turbidity value of calibration plate
- (9) Setting zero-correction factor
- (10) Setting sensitivity correction factor
- (11) Setting detection level for spike detection function
- (12) Setting hold time for spike detection function
- (13) Setting sampling time for spike detection function
- (14) Auto-range selection
- (15) Remote range selection
- (16) Local range setting
- (17) Setting output hold in maintenance
- (18) Setting output mode if a failure occurs
- (19) Setting output hold for 4 mA or less
- (20) Setting negative turbidity display hold
- (21) Setting display-hold in automatic cleaning and calibration
- (22) Selecting Suffix codes (sampling specifications)
- (23) Selecting execution/stop of automatic cleaning function
- (24) Selecting execution/stop of automatic calibration function
- (25) Selecting designation of unit
- (26) Selecting calibration plate or standard solution
- (27) Selecting AUX (C1, C2) contact outputs
- (28) Selecting execution/stop of spike detection function

(1) Setting Output Ranges 1, 2, and 3 (Functions "1", "2", and "3")

The analog output is sent out by being selected for one of the output ranges, 1, 2, or 3.

These are three output range selections as shown below.

- Auto-range selection
- Remote range selection
- Local range selection

For details on selection, see (11), (12), and (13) in Section 6.6. In this item, the setting of upper and lower limit values in output ranges 1, 2, and 3 is described taking output range 1 as an example.

(Example of display)

- | | |
|--|--|
| (1) Select FUNCTION "1" in the <PROGRAM1> mode. If the lower limit is not to be changed, start operation from step 6. | => L00.00 mg/L |
| (2) Press the [>] key. | => L0000. mg/L
This display is now ready for determination of the decimal point position. |
| (3) Determine the decimal point position with the [>] key.
Every time the [>] key is pressed, the decimal point moves to the right one digit and when the least significant digit is reached, it returns to the most significant digit. | => L00.00 mg/L |
| (4) Press the [ENT] key. | => <u>L</u> 00.00 mg/L
The most significant digit flashes and wits for the numerical value entry. |
| (5) Select a digit with the [>] key and set the desired lower limit using the [^] or [v] key.
Every time the [>] key is pressed, the flashing digit moves to the right one digit and when the least significant digit is reached, it returns to the most significant digit. | => L0 <u>5</u> .00 mg/L |
| (6) When press [ENT] key, current upper limit is indicated. | => H10.00 mg/L |
| (7) Press the [>] key. | => H0000. mg/L
The display is now ready for determination of the decimal point position. |
| (8) Determine the position of the decimal point using the [>] key.
Every time the [>] key is pressed, the decimal point moves to the right one digit and when it reaches the least significant digit, it returns to the most significant digit. | => H000.0 mg/L |
| (9) Press the [ENT] key. | => H <u>0</u> 00.0 mg/L
The most significant digit flashes and waits for the numerical value entry. |
| (10) Select a digit and set the desired upper limit using the [^] or [v] key.
Every time the [>] key is pressed, the decimal point moves to the right one digit and when it reaches the least significant digit, it returns to the most significant digit. | => H0 <u>2</u> 0.0 mg/L |

- (11) By pressing the [ENT] key, the upper and lower limits are entered. => H020.0 mg/L
The entire display flashes once.
- (12) When the [ENT] key is pressed, the procedure returns to 1. => L05.00 mg/L

In operation of step 6 or 11, if the upper and lower limits are beyond the permissible range (0 to 2000 mg/L), "not" is displayed. In this case, reset the message by pressing the [>] key and repeat the operations from step 2.

Also in step 11, if the span between the upper and lower limits does not meet the following conditions when checked, "not" is displayed. Reset the message by pressing the [>] key in a similar manner and repeat the operations from step 2.

Range span (Upper limit - lower limit) ≥ 20% of the upper limit ≥ 2.00 mg/L

If the upper and lower limits are only to be confirmed, pressing the [ENT] key alternately displays L and H.

If the auto-range switching function is to be used, set the ranges as shown below.

- Set 0.00 mg/L for all lower limits (L).
- Set the upper limits (H) in the following manner.
Range 1 ≤ Rang 2 ≤ Range 3
- If two-range operation is required, set Range 2 = Range 3.
- If one-range operation is required, set Range 1 = Range 2 = Range 3.

(2) Setting Averaging Coefficient (time constant) (FUNCTION "4")

The converter display and analog output are computed for average by the program. In this setting, the extent of averaging (signal time constant) can be changed. Table 6.9 shows an approximate correspondence between the averaging coefficient and a 90% response time.

The 90% response time is about the averaging coefficient x 0.75 seconds. This coefficient is set at 30 (about 22 seconds for a 90% response time) upon shipment from the factory. If the fluctuation of measured readings is large, e.g., due to suspended matter in the measurement object, change the averaging coefficient as necessary.

Table 6.9 Averaging Coefficient and 90% Response Time

Averaging coefficient	Standard for 90% response time
10	Approx. 8 sec.
20	Approx. 22 sec.
30	Approx. 15 sec.
40	Approx. 30 sec.
50	Approx. 38 sec.
100	Approx. 75 sec.

The following is the procedure for the setting operation.

(Example of display)

- (1) Select FUNCTION "4" in the <PROGRAM1> mode. => 00030
- (2) Press the [>] key. => 00030
The most significant digit flashes.
- (3) Select a digit using the [>] key and set it to the desired value using the [^] or [v] key. => 00040
The flashing digit moves to the right and when the least significant digit is reached, it returns to the most significant digit.

- (4) Press the [ENT] key to enter the value. => 00040
The entire display flashes once.

In addition, in step 4, if the set value is beyond the permissible range (1 to 255), "not" is displayed, Reset the message by pressing the [>] key and repeat operations from step 2.

Note: If calibration is performed using the calibration plate in FUNCTION "4" in the <MAINT.> mode, the averaging coefficient automatically changes to 10 regardless of this setting.

(3) Setting Output Value If an Error Occurs (FUNCTION "5")

If "preset" (_ _3) is selected in the output mode setting (FUNCTION "5" in the <PROGRAM1> mode) when an error occurs, the analog output when the error occurs is fixed at this setting value. Display and set the setpoint in the ratio (%) to the analog output span. The following is an example.

- (Example) For a setpoint at "50%",
When 4 to 20 mA output: The output value holds at 12 mA when an error occurs.
When 1 to 5 V output: The output value holds at 3 V when an error occurs.

The following is the setting key operation.

(Example of display)

- (1) Select FUNCTION "5" in the <PROGRAM1> mode. => 00000%
- (2) Press the [>] key. The most significant digit flashes. => 00000%
- (3) Select a digit with the [>] key and set it to the desired value using the [^] or [v] key. => 00050%
The flashing digit moves to the right and when the least significant digit is reached, it returns to the most significant digit.
- (4) Press the [ENT] key to enter the set value. The entire display flashes once. => 00050%

In step 4, if the set value is beyond the permissible range (-10 to 110), "not" is displayed. Reset the message by pressing the [>] key and repeat the operations from step 2.

(4) Setting Line-segment Function Output (FUNCTION "6")

Analog output can be provided in the form of a line segment. Set the break point for such a line segment in this function. A line segment is output, being the set value (percentage of the output range span) as the break point at 50% of the output signal span (4 to 20 mA or 1 to 5 V). For details on the function, see Subsection 5.2.2 (1). The following is the procedure for the setting operations:

(Example of display)

- (1) Select FUNCTION "6" in the <PROGRAM1> mode. => 00050%
- (2) Press the [>] key. The most significant digit flashes. => 00050%
- (3) Select a digit with the [>] key and set it to the desired value using the [^] or [v] key. => 00060%
The flashing digit moves to the right and when the least significant digit is reached, it returns to the most significant digit.
- (4) Press the [ENT] key to enter the set value. The entire display flashes once. => 00060%

In step 4, if the set value is beyond the permissible range (0 to 100%), "not" is displayed. Reset the message by pressing the [>] key and repeat the operations from step 2.

(5) Setting Change-over Point in Auto-ranging (FUNCTION "7")

If auto-range is used, the range is changed over at the point set here. The change-over point is displayed and set at a ratio (%) to the upper limit setpoint of the range. The following shows the operating manner.

- The time to change over from the lower range to the higher range is the point where measured values become large than the change-over point in the lower range.
- The timing to change over from the higher range to the lower range is a point where measured values become 10% smaller than the change-over point in the lower range.

The following describes the setting operations.

	(Example of display)
(1) Select FUNCTION "7" in the <PROGRAM1> mode.	=> 00080%
(2) Press the [>] key. The most significant digit flashes.	=> <u>0</u> 0080%
(3) Select a digit with the [>] key and set it to the desired value using the [^] or [v] key.	=> 00090% The flashing digit moves to the right and when the least significant digit is reached, it returns to the most significant digit.
(4) Press the [ENT] key to enter the set value.	=> 000 <u>9</u> 0% The entire display flashes once.

In step 4, if the set value is beyond the permissible range (70 to 100%), "not" is displayed. Reset the message by pressing the [>] key and repeat the operations from step 2.

(6) Setting High Alarm Value (FUNCTION "8")

In the high and low alarm detection function is set to "execution" (FUNCTION "9." in <PROGRAM2> mode), when a measured value exceeds this setpoint, the MEAS lamp flashes and if AUX (C1, C2) contacts are set for high and low alarms (FUNCTION "E." in <PROGRAM1> mode), the contact output is actuated. Alarm hysteresis is 2% of the setpoint.

The following shows the setting key operations.

	(Example of display)
(1) Select FUNCTION "8" in the <PROGRAM1> mode.	=> 2200.0 mg/L
(2) Press the [>] key.	=> <u>2</u> 200.0 mg/L The most significant digit flashes.
(3) Select a digit with the [>] key and set it to the desired value using the [^] or [v] key.	=> 1 <u>0</u> 00.0 mg/L The flashing digit moves to the right and when the least significant digit is reached, it returns to the most significant digit.
(4) Press the [ENT] key to enter the set value. The entire display flashes once.	=> 1000.0 mg/L

In step 4, if the set value is beyond the permissible range (-10 to 2200 mg/L), "not" is displayed. Reset the message by pressing the [>] key and repeat the operations from step 2.

(7) Setting Low Alarm Value (FUNCTION "9")

In the high and low alarm detection function is set to "execution" (FUNCTION "9." in <PROGRAM2> mode), when a measured value is below this setpoint, the MEAS lamp flashes and if AUX (C1, C2) contacts are set for high and low alarms (FUNCTION "E." in <PROGRAM1> mode), the contact output is actuated. Alarm hysteresis is 2% of the setpoint.

The following shows the setting key operations.

(Example of display)

- | | |
|---|---|
| (1) Select FUNCTION "9" in the <PROGRAM1> mode. | => -010.0 mg/L |
| (2) Press the [>] key.
The most significant digit flashes. | => <u>-</u> 010.0 mg/L |
| (3) Select a digit with the [>] key and set it to the desired value using the [^] or [v] key. | => 00 <u>0</u> 0.0 mg/L
The flashing digit moves to the right and when the least significant digit is reached, it returns to the most significant digit. |
| (4) Press the [ENT] key to enter the set value. | => 0000.0 mg/L
The entire display flashes once. |

In step 4, if the set value is beyond the permissible range (-10 to 2200 mg/L), "not" is displayed. Reset the message by pressing the [>] key and repeat the operations from step 2.

(8) Setting Turbidity Value of Calibration Plate (FUNCTION "A")

Upon shipment from the factory, the value of the attached calibration plate has been set.

The following shows the setting key operations.

(Example of display)

- | | |
|---|---|
| (1) Select FUNCTION "A" in the <PROGRAM1> mode. | => 0090.0 mg/L |
| (2) Press the [>] key. | => 00 <u>9</u> 0.0 mg/L
The most significant digit flashes. |
| (3) Select a digit with the [>] key and set it to the desired value using the [^] or [v] key. | => 00 <u>9</u> 5.0 mg/L
The flashing digit moves to the right and when the least significant digit is reached, it returns to the most significant digit. |
| (4) Press the [ENT] key to enter the set value. | => 0095.0 mg/L
The entire display flashes once. |

In step 4, if the set value is beyond the permissible range (0 to 2000 mg/L), "not" is displayed. Reset the message by pressing the [>] key and repeat the operations from step 2.

(9) Setting Zero-Correction Factor (FUNCTION "B")

The zero-correction factor obtained in zero-shift calibration (zero correction) (FUNCTION "3" in <MAINT.> mode) can be displayed or directly changed. For details on the zero-shift calibration function, see Section 5.3 (*3).

The following shows the setting key operations.

(Example of display)

- | | |
|---|---|
| (1) Select FUNCTION "B" in the <PROGRAM1> mode.
If the display is only to be confirmed, operations of 2, 3, and 4 are not necessary. | => 00.000 mg/L |
| (2) Press the [>] key. | => 00.000 mg/L
The most significant digit flashes. |
| (3) Select a digit with the [>] key and set it to the desired value using the [^] or [v] key. | => 00.0 <u>5</u> 0 mg/L
The flashing digit moves to the right and when the least significant digit is reached, it returns to the most significant digit. |
| (4) Press the [ENT] key to enter the set value. | => 00.050 mg/L
The entire display flashes once. |

In step 4, if the set value is beyond the permissible range (± 9 mg/L), "not" is displayed.

Reset the message by pressing the [>] key and repeat the operations from step 2.

(10) Setting Sensitivity Correction Factor (FUNCTION "C")

The sensitivity correction factor obtained in span calibration with sensitivity correction (FUNCTION "5" in <MAINT.> mode) can be displayed or directly changed. For details on the span calibration function, see Section 5.3 (*3).

The following shows the setting key operations.

(Example of display)

- | | |
|---|--|
| (1) Select FUNCTION "C" in the <PROGRAM1> mode.
If the display is only to be confirmed, operations of 2, 3, and 4 are not necessary. | => 1.0000 |
| (2) Press the [>] key.
The most significant digit flashes. | => <u>1</u> .0000 |
| (3) Select a digit with the [>] key and set it to the desired value using the [^] or [v] key. | => 1. <u>2</u> 000
The flashing digit moves to the right and when the least significant digit is reached, it returns to the most significant digit. |
| (4) Press the [ENT] key to enter the set value. | => 1.2000
The entire display flashes once. |

In step 4, if the set value is beyond the permissible range (0.25 to 4), "not" is displayed.

Reset the message by pressing the [>] key and repeat the operations from step 2.

(11) Setting Detection Level for Spike Detection Function (FUNCTION “D”)

(Example of display)

- (1) Select FUNCTION “D” in <PROGRAM1> mode. => 00005%
- (2) Press the [>] key. => 00005%
The most significant digit flashes.
- (3) Select a digit with the [>] key and set it to the desired value using the [^] or [v] key. => 00010%
The flashing digit moves to the right and when the least significant digit is reached, it returns to the most significant digit.
- (4) Press the [ENT] key to enter the set value. => 00010%
The entire display flashes once.

In step 4, if the set value is beyond the permissible range (1 to 100), "not" is displayed. Reset the message by pressing the [>] key and repeat the operations from step 2.

(12) Setting Hold Time for Spike Detection Function (FUNCTION “E”)

(Example of display)

- (1) Select FUNCTION “D” in <PROGRAM1> mode. => 00030
- (2) Press the [>] key. => 00030
The most significant digit flashes.
- (3) Select a digit with the [>] key and set it to the desired value using the [^] or [v] key. => 00050
The flashing digit moves to the right and when the least significant digit is reached, it returns to the most significant digit.
- (4) Press the [ENT] key to enter the set value. => 00050
The entire display flashes once.

In step 4, if the set value is beyond the permissible range (1 to 600), "not" is displayed. Reset the message by pressing the [>] key and repeat the operations from step 2.

(13) Setting Sampling Time for Spike Detection Function (FUNCTION “F”)

(Example of display)

- (1) Select FUNCTION “D” in <PROGRAM1> mode. => 00030
- (2) Press the [>] key. => 00030
The most significant digit flashes.
- (3) Select a digit with the [>] key and set it to the desired value using the [^] or [v] key. => 00030
The flashing digit moves to the right and when the least significant digit is reached, it returns to the most significant digit.
- (4) Press the [ENT] key to enter the set value. => 00030
The entire display flashes once.

In step 4, if the set value is beyond the permissible range (1 to 600), "not" is displayed. Reset the message by pressing the [>] key and repeat the operations from step 2.

(14) Auto-range Selection (FUNCTION "1.")

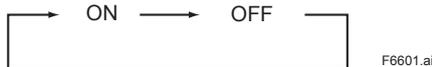
This function selects execution/stop of the auto-range switching function. The auto-range function automatically selects either output range 1, output range 2, or output range 3 depending on the measured values. For details on the function, see Subsection 5.2.1. In addition, the contact outputs (A1, A2, A3, A4) operate corresponding to the selected output range.

Note: Confirm that the range 1, 2, or 3 setting satisfies the conditions in Section 6.6 (1). If the conditions are not satisfied, auto-range switching does not take place.

The following describes the setting key operations.

(Example of display)

- (1) Select FUNCTION "1." in the <PROGRAM1> mode. The current set status is displayed. => OFF (stop)
- (2) Press the [>] key to select on/off. => ON (execution)



- (3) Press the [ENT] key to enter the setting. => ON
The display flashes once.

(15) Remote Range Selection (FUNCTION "2.")

This function sets execution/stop remote range switching function. However, if the auto range switching function, item (11) above, is selected (execution), this setting is invalid.

If execution of function is set, either output range 1, output range 2, or output range 3 is selected by a contact input (R1, R2, or R3). Contact outputs (A1, A2, A3, A4) operate by the selected output range. Table 6.10 shows the remote range switching operation.

The following is the procedure for this function.

Table 6.10 Remote Range Switching Operation

Contact input		Selected range	Range contact output
R1-R2	R1-R3		
Open	Open	Output range 1	A1 to A2 : Closed
Closed	Open	Output range 2	A1 to A3 : Closed
Open	Closed	Output range 3	A1 to A4 : Closed

The following is the setting key operations.

(Example of display)

- (1) Select FUNCTION "2." in the <PROGRAM1> mode. The current set status is displayed. => OFF (stop)
- (2) Press the [>] key to select on/off. => ON (execution)



- (3) Press the [ENT] key to enter the setting. => ON
The display flashes once.

(16) Local Range Setting (FUNCTION "3.")

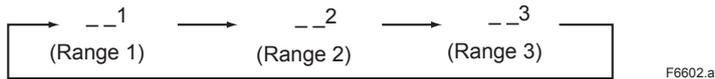
If automatic range switching and remote range switching are not selected, this function selects the output range. Contact outputs (A1, A2, A3, A4) operate by the selected output range.

For the relationship between output ranges and contact outputs, see Table 6.10.

The following shows the setting key operations.

(Example of display)

- (1) Select FUNCTION "3." in the <PROGRAM1> mode. The current set range is displayed with a code. => __1 (Range 1)
- (2) Press the [>] key to select the code. => __2 (Range 2)



- (3) Press the [ENT] key to enter the setting. => 2
The display flashes once.

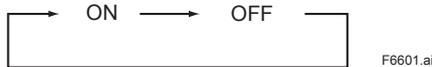
(17) Setting Output Hold in Maintenance (FUNCTION "4.")

This function sets execution/stop of output hold in maintenance (<MAINT.> or <PROGRAM1, 2> mode). If "execution" is selected, the output value immediately before operation holds when the maintenance mode is selected.

The following shows the setting key operations.

(Example of display)

- (1) Select FUNCTION "4." in the <PROGRAM1> mode. The current set status is displayed. => ON (execution)
- (2) Press the [>] key to select on/off. => OFF (stop)



- (3) Press the [ENT] key to enter the setting. => OFF
The display flashes once.

Immediately after setting, the setting status of the analog output becomes effective.

When on (hold) is selected, the HOLD lamp is lit while the output is held.

In addition, even if off (no-hold) is selected, FUNCTION "5." setting has priority provided that " __2 " (hold) or " __3 " (preset) is selected in the operation of FUNCTION "5." (the next item).

(18) Setting Output Mode If a Failure Occurs (FUNCTION "5.")

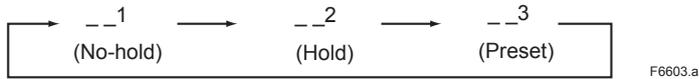
This function sets the analog output mode (no-hold, hold, or preset) if a failure occurs (the FAIL lamp is lit). The operation details are as follows:

- No-hold: Even if a failure occurs, the analog output does not hold.
- Hold: When a failure occurs, the analog output immediately before the occurrence holds until the failure returns to normal.
- Preset: When a failure occurs, the analog output is held at a preset output value.
The preset value is set with FUNCTION "5" described in this section (3).

The following describes the setting key operations.

(Example of display)

- (1) Select FUNCTION "5." in the <PROGRAM1> mode. The current set code is displayed. => __1 (Non-hold)
- (2) Press the [>] key to select the setting code. => __2 (Hold)



- (3) Press the [ENT] key to enter the set code. => 2
The display flashes once.

In this function, if " __2" (hold) or " __3" (preset) is selected, this setting has priority over the setting in FUNCTION "4."

(19) Setting Output Hold for 4 mA or Less (FUNCTION "6.")

By setting "on" (execution) in this function, the analog output does not fall below 4 mA (or 1 V).

The following describes the setting key operations.

(Example of display)

- (1) Select FUNCTION "6." in the <PROGRAM1> mode. The current set status is displayed. => OFF (stop)
- (2) Press the [>] key to select on or off. => ON (execution)



- (3) Press the [ENT] key to enter the setting. => ON
The display flashes once.

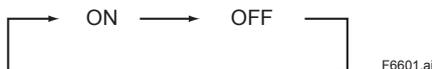
(20) Setting Negative Turbidity Display Hold (FUNCTION "7.")

When on (execution) is set in this function, the turbidity indication does not fall below 0.00 mg/L even if the turbidity value becomes negative in the computation. However, this setting is effective only in the <MEAS.> mode.

The following describes the setting key operations.

(Example of display)

- (1) Select FUNCTION "7." in the <PROGRAM1> mode. The current set status is displayed. => OFF (stop)
- (2) Press the [>] key to select on or off. => ON (execution)



- (3) Press the [ENT] key to enter the setting. => ON
The display flashes once.

(21) Setting Display-hold in Automatic Cleaning and Calibration (FUNCTION "8.")

When "ON(execution)" is selected in this function, a turbidity value immediately before the operation holds and displays during automatic cleaning and calibration in <MEAS.> mode.

The following shows the setting key operations.

(Example of display)

- (1) Select FUNCTION "8." in the <PROGRAM1> mode. The current set status is displayed. => OFF (stop)
- (2) Press the [>] key to select on or off. => ON (execution)



- (3) Press the [ENT] key to enter the setting. => ON
The display flashes once.

(22) Selecting Suffix Codes (sampling specifications) (FUNCTION "9.")

Select sampling specifications (Suffix codes). Usually, this is set upon shipment from the factory. Thus, no setting is necessary before use. Table 6.11 shows the relationship between sampling specifications and Suffix code.

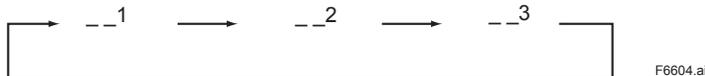
Table 6.11 ME Codes and Settings

Suffix code	Sampling specification	Setting code
-NN, -KC	Without sampling system	__1
-A1	With sampling system and automatic cleaning	__1
-A2	With sampling system	__2
-A3	With sampling system and automatic cleaning and calibration	__3

If a change is necessary, perform the key operations in the following procedure.

(Example of display)

- (1) Select FUNCTION "9." in the <PROGRAM1> mode. The current set code is displayed. => __3
- (2) Press the [>] key to select the setting code.=> __2



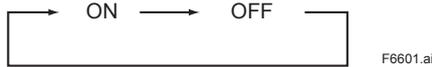
- (3) Press the [ENT] key to enter the setting. => __2
The display flashes once.

(23) Selecting Execution/Stop of Automatic Cleaning Function (FUNCTION "A.")

This function selects execution/stop of the automatic cleaning function (started with the internal timer) when the Suffix code (sampling specifications) is "-A2" or "-A3". If off (stop) is selected in the automatic cleaning function, the manual start operation in FUNCTION "6" in the <MAINT.> mode can be exceeded. As this function is set to on (execution) upon shipment from the factory, if it becomes necessary to select off (stop), perform the key operations in the following procedure.

(Example of display)

- (1) Select FUNCTION "A." in the <PROGRAM1> mode. The current set status is displayed. => ON (execution)
- (2) Press the [>] key to select on/off. => OFF (stop)



- (3) Press the [ENT] key to enter the setting. => OFF
The display flashes once.

(24) Selecting Execution/Stop of Automatic Calibration Function (FUNCTION "B.")

This function selects execution/stop of the automatic calibration function (started with the internal timer) when the Suffix code (sampling specifications) is "-A3". If off (stop) is selected in the automatic calibration function, the manual start operation in FUNCTION "7" in the <MAINT.> mode can be exceeded. As this function is set to on (execution) upon shipment from the factory, if it becomes necessary to select off (stop), perform the key operations in the following procedure.

(Example of display)

- (1) Select FUNCTION "B." in the <PROGRAM1> mode. The current set status is displayed. => ON (execution)
- (2) Press the [>] key to select on/off. => OFF (stop)



- (3) Press the [ENT] key to enter the setting. => OFF
The display flashes once.

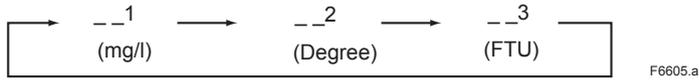
(25) Selecting Designation of Units (FUNCTION "C.")

This function can set the unit of turbidity to be displayed on the converter at either "mg/L", "degree", or "FTU".

If the unit designation is to be changes, perform it using the following key operations.

(Example of display)

- (1) Select FUNCTION "C." in the <PROGRAM1> mode. The current set code is displayed. => __1 (mg/L)
- (2) Press the [>] key to select the setting code. => __2 (Degree)



- (3) Press the [ENT] key to enter the setting. => 2
The display flashes once.

The unit selected in step 3 is lit in the unit display area on the right of the data display when the turbidity is displayed (Figure 6.4).

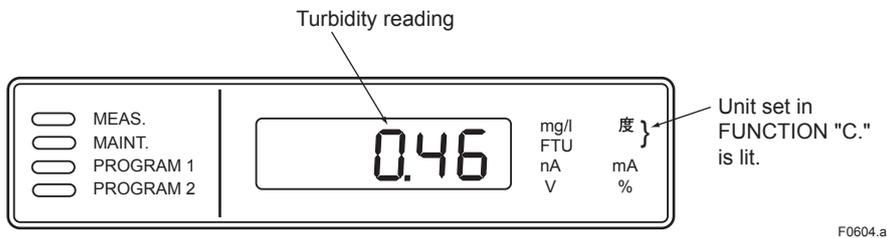


Figure 6.4 Unit Designation

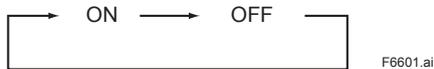
(26) Selecting Calibration Plate/Standard solution (FUNCTION "D.")

In the span calibration operation for FUNCTION "4" in the <MAINT.> mode, this function sets either the calibration plate or the standard solution for span calibration.

Upon shipment from the factory, on (calibration plate) is set. If off (standard solution) is to be selected, perform the key operations in the following procedure.

(Example of display)

- (1) Select FUNCTION "D." in the <PROGRAM1> mode. The current set status is displayed. => ON (calibration plate)
- (2) Press the [>] key to select on/off. => OFF (standard solution)



- (3) Press the [ENT] key to enter the setting. => OFF
The display flashes once.

(27) Selecting AUX (C1, C2) Contact Output (FUNCTION "E.")

The operating conditions for AUX contact output (C1, C2) are selected from the following two.

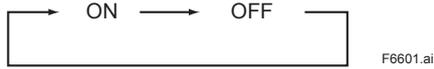
- High and low alarm contact output (setting: on)
- Contact output during automatic cleaning and automatic zero-calibration operations (setting: off)

The following shows the setting key operations.

(Example of display)

(1) Select FUNCTION "E." in the <PROGRAM1> mode. The current set status is displayed. => ON

(2) Press the [>] key to select on/off. => OFF



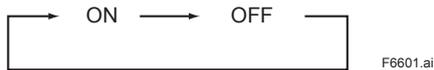
(3) Press the [ENT] key to enter the setting. => OFF
The display flashes once.

(28) Selecting Execution/Stop of Spike Detection Function (FUNCTION "F.")

(Example of display)

(1) Select FUNCTION "F." in the <PROGRAM1> mode. The current set status is displayed. => OFF (stop)

(2) Press the [>] key to select on/off. => ON (execution)



(3) Press the [ENT] key to enter the setting. => ON
The display flashes once.

6.7 Operation in <PROGRAM2> Mode

In this mode, the time setting operations for automatic cleaning and automatic zero calibration, the operation settings for contact output and the selection operations for part of execution/stop of the failure detection function are carried out.

- FUNCTION "1" to FUNCTION "F": Time settings, contact output operation settings
- FUNCTION "1." to FUNCTION "F.": Selection for part of execution/stop of the failure detection functions

Key operations made by specifying a function in the <PROGRAM2> mode and the displays following those key operations are described in the following order.

- (1) Time setting for automatic cleaning and automatic zero calibration
- (2) Selection of contact output operation (open/close)
- (3) Selection of execution/stop of the failure detection functions

(1) Time Setting for Automatic Cleaning and Automatic Zero Calibration (FUNCTION "1" to FUNCTION "A")

Table 6.12 shows a list of setting times and operation functions. For details on automatic cleaning and automatic zero-calibration operations, see subsections 4.2.2 and 4.2.3. For specification without automatic cleaning or automatic zero calibration (Suffix codes: -NN, -KC, -A1), this setting is non-operative.

Table 6.12 Time Settings for Automatic Cleaning and Automatic Zero Calibration

Setting	FUNCTION	Setting range	Factory setting
Automatic cleaning period	1	0.1 to 24.0 hours	0002.0
Cleaning calibration ratio *3	2	1 to 10 times	00001
Repeated cleaning	3	1 to 20 times	00005
Cleaning time 1 *1	4	10 to 120 seconds	00030
Cleaning time 2 *2	5	10 to 120 seconds	00030
Draining time 1 *1	6	10 to 120 seconds	00010
Draining time 2 *2	7	10 to 120 seconds	00010
Filling time 1 *1	8	10 to 120 seconds	00100
Filling time 2 *2	9	10 to 120 seconds	00100
Relaxation time	A	30 to 600 seconds	00150

*1: For models with Suffix code -A2 (without automatic zero calibration), use this time setting.

*2: For the models with Suffix code -A3 (with automatic zero calibration), use this time setting.

*3: The time is set for the automatic cleaning period, while for the automatic zero-calibration period, the cleaning calibration ratio, which means the number of the automatic cleaning is performed for one automatic zero calibration, is set.

The following shows an example of the setting operations for the automatic cleaning period. Similar operations apply to the other settings.

(Example of display)

- (1) Select FUNCTION "1" in the <PROGRAM2> mode. The current setpoint is displayed. => 0002.0 (time)
- (2) Press the [>] key. => 0002.0 (time)
The most significant digit flashes.
- (3) Select a digit with the [>] key and set the digit to the desired value using the [^] or [v] key. => 0004.0 (time)
The flashing digit moves to the right and when the least significant digit is reached, it returns to the most significant digit.
- (4) Press the [ENT] key. => 0004.0 (time)
The entire display flashes once.

If the setpoint in step 4 is beyond the permissible range, "not" is displayed. Reset the message using the [>] key and repeat the operation from step 2.

(2) Selection of Contact Output Operation (open/closed) (FUNCTION "C" to FUNCTION "F")

Select open or closed for the contact output when operated. Table 6.13 shows the types of contact outputs and corresponding functions.

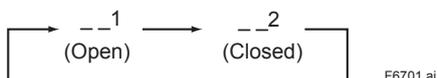
Table 6.13 Contact Outputs and Operating Functions

Contact output	FUNCTION	Output terminal	Factory setting
Maintenance contact output	C	M1, M2	Closed
FAIL contact output	D	F1, F2	Open
High and low alarm contact output	E	C1, C2	Open
Contact output during automatic cleaning and automatic zero calibration	F	C1, C2	Closed

The following shows an example of the setting operations for the maintenance contact output. Similar operations apply to the other settings.

(Example of display)

- (1) Select FUNCTION "C" in the <PROGRAM2> mode. The current set status is displayed. => __1 (Open)
- (2) Press the [>] key to select the setting codes. => __2 (Closed)



- (3) Press the [ENT] key to enter the setting. => __2
The display flashes once.

(3) Selection of Execution/Stop of the Failure Detection Functions (FUNCTION "1." to FUNCTION "9.")

These functions can select execution/stop of part of the failure detection functions. Table 6.14 shows the detected failures and their operation functions.

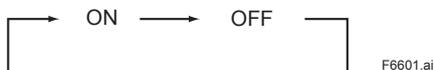
Table 6.14 Detected Failures and Their Operation Functions

Detected failure	FUNCTION	Error code	Factory setting
Turbidity overrange	1.	Err11	ON
Lamp disconnection	2.	Err12	ON
Lamp voltage failure	3.	Err13	ON
A/D circuit failure	4.	Err14	ON
Memory comparison failure	5.	Err15	ON
Reference voltage failure	6.	Err18	ON
Lamp service life	7.	Err25	ON
Automatic calibration failure	8.	Err26	ON
High or low alarm	9.	MEAS lamp flashes.	ON

For details on each failure detection function, see Section 5.1. The following are the setting key operations for an example of turbidity overranging. The same procedure applies to the other settings.

(Example of display)

- (1) Select FUNCTION "1." to FUNCTION "9." in the <PROGRAM2> mode. => ON (execution)
- (2) Press the [>] key to select on/off. => OFF (stop)



- (3) Press the [ENT] key to enter the setting. => ON
The display flashes once.

Note: Normally, it is not necessary to operate these.

6.8 Valve Operation

Table 6.15 shows the valve on/off statuses in measurement, draining, or zero calibration for each sampling specification. However, for operations in automatic cleaning or automatic zero calibration, see Section 4.2.

Table 6.15 Valve Statuses in Each Operation

Operation	Sampling specification (Suffix code)	V1	V2	V3	V4	V5	SV1	SV2	SV3	SV4
Measurement	-A1	Open	Open	Closed	Closed	Closed	—	—	—	—
	-A2	Open	Open	Closed	Open	—	Closed	Closed	—	—
	-A3	Open	Open	Open	Open	—	Closed	Closed	Open	Closed
Drain	-A1	Closed	Open	Closed	Closed	Open	—	—	—	—
	-A2	Closed	Open	Closed	Open	—	Open	Closed	—	—
	-A3	Closed	Open	Open	Open	—	Open	Closed	Closed	Closed
Zero calibration (with "zero water")	-A1	Closed	Open	Open	Closed	Closed	—	—	—	—
	-A2	Closed	Open	Open	Open	—	Closed	Closed	—	—
	-A3	Open	Open	Open	Open	—	Closed	Closed	Closed	Open
Manual cleaning (Sample)	-A1	Open	Open	Closed	Open	Closed	—	—	—	—
	-A2	Open	Open	Closed	Open	—	Closed	Open	—	—
	-A3	Open	Open	Open	Open	—	Closed	Open	Open	Closed
Manual cleaning ("zero water")	-A1	Closed	Open	Open	Open	Closed	—	—	—	—
	-A2	Closed	Open	Open	Open	—	Closed	Open	—	—
	-A3	Open	Open	Open	Open	—	Closed	Open	Closed	Open

Note: Valves SV1 to SV4 are opened or closed with each [SV1] to [SV4] key in the <MAINT.> mode.

7. MAINTENANCE

This chapter describes the inspection and maintenance implemented to maintain the instrument in good operating condition.

7.1 Inspection and Maintenance Intervals

Table 7.1 shows the main inspection and maintenance items to keep the instrument in good operating condition and their recommended periods before inspection or maintenance. As these periods vary with each operating condition, use Table 7.1 only as a guide.

Table 7.1 Guide for Inspection and Maintenance Periods

Inspection or maintenance item	Recommended Interval
Washing with cleaning water	As needed
Cleaning of measuring cell	Weekly
Cleaning of head tank	Monthly
Lamp replacement	Yearly
Zero calibration	Monthly
Span calibration	Monthly
Cleaning of lenses	6 months
Replacement of zero turbidity filter element	Yearly*1
Fuse replacement	Yearly
Cleaning of piping	6 months
Checking of flowrate and water level	Monthly
Silicone tube (for Suffix Code "-A2" or "-A3")	Yearly

*1: This is a guide for the replacement period if the meter is operated at a flow rate of 2 L/min using tap water having an average turbidity of 0.4 mg/L.

7.2 Washing with Cleaning Water

For the specification without automatic cleaning (Suffix code: -A1), washing is carried out by opening and closing the valves manually.

For the specification with automatic cleaning (Suffix code: -A2 or -A3), automatic cleaning (washing) is performed periodically.

For the automatic cleaning operation, see Subsection 4.2.2.

Here washing of the instrument with the specification without automatic cleaning (Suffix code: -A1) is described.

In this case, washing is carried out by manually operating valve V4 for cleaning.

- (1) Select the <MAINT.> mode.
- (2) Open valve V4 and wash for about 30 seconds (for the statuses of each valve during washing, see Table 6.15).

In order to prevent cleaning water from splashing, wash by passing measuring water or "zero water" through the valve.

- (3) Close valve V4 and open valve V5 for about 19 seconds to drain water.
- (4) Repeat steps 2 and 3 several times depending on the degree of contamination.
- (5) Close valve V5.
- (6) Finished.

7.3 Cleaning of Measuring Cell

Clean the inside of the detector directly with a brush or the like.

- (1) Select the <MAINT.> mode.
- (2) Select the draining status (for the statuses of each value during draining, see Table 6.15).
- (3) Loosen screw A under the detector cover and open the cover (see Figure 7.1).
- (4) After the water in the detector is drained off, wipe the inside of the detector with a soft brush, sponge, or the like. Be careful not to mar or scratch the inside and not to splash the lenses in the light source and light-receiving part with water.
- (5) Open valves V4 and SV2 to supply cleaning water and discharge the dirt with the water. Also in this case, gradually open valve V4 so as not to splash the lenses in the light source and light-receiving part with water.
- (6) Tighten screw A after cleaning is completed and execute zero and span calibrations.
- (7) Finished.

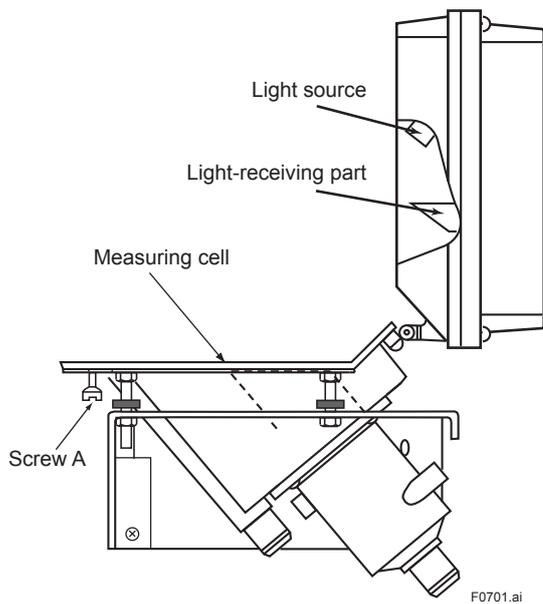
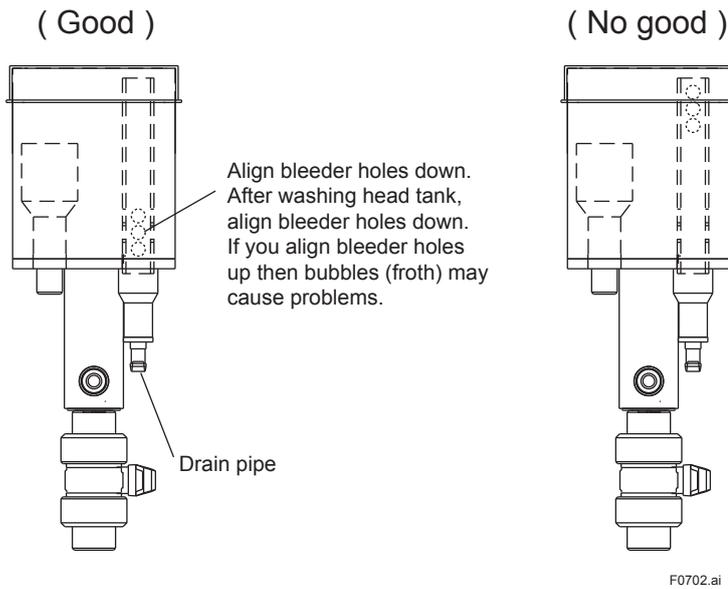


Figure 7.1 Detector

7.4 Cleaning of Head Tank

This section describes the cleaning of the head tank.

- (1) Select the <MAINT.> mode.
- (2) Open the valves so they are set to drain the tank. For the statuses of each valve in draining, see Table 6.15.
- (3) After the water in the head tank is drained off, open the upper cover and wipe the inside of the tank with a soft brush, sponge, or the like.
- (4) After cleaning is completed, discharge any remaining dirt by supplying tap water or repeat filling the tank two or three times with "zero water" and then draining it until all of the dirt in the head tank is discharged with the water.
- (5) Finished.



NOTE

After washing head tank, be sure to align holes down. If you align bleeder holes up then bubbles (froth) may cause problems.

7.5 Lamp Replacement

The lamp's service life is more than year. However, it is recommended that it be replaced with a new one after a period of one year as preventive maintenance.

This section describes replacement of the lamp.

- (1) Turn off the power switch.
- (2) Remove the four C screws in the upper part of the detector and remove the cover (see Figure 7.2).
- (3) Disconnect terminals P1 and P2 by removing them from the terminal board and remove the two B screws, then remove the lamp holder.
- (4) Loosen the clamp that locks the lamp.
- (5) Replace the lamp. In doing this, confirm that the boss of the new lamp is placed in the position shown in Figure 7.2.

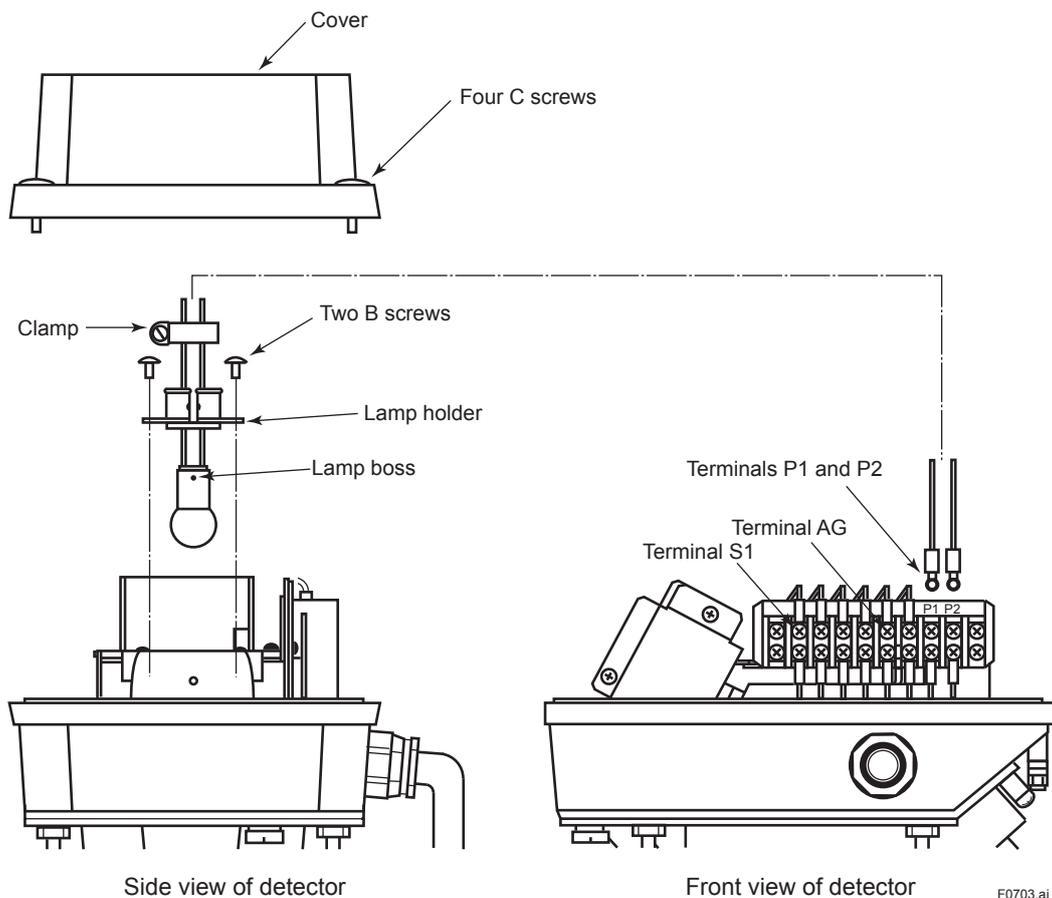


Figure 7.2 Lamp replacement

- (6) Temporarily set the clamp lightly in place for later adjustment.
- (7) Using a cotton swab soaked in alcohol or relevant cleaning solution, clean the backside of the lens in the detector.
- (8) Tighten terminals P1 and P2 to the terminal board and also the two B screws.
- (9) Turn on the power. Wait about 5 minutes or more until the brightness of the lamp has stabilized.
- (10) Carry out lamp control reference value calibration.
Select FUNCTION "C" in the <MAINT.> mode.

-
- (11) Press the [ENT] key and the reference signal voltage is displayed and the lamp voltage is fixed at about 3.6 V.
 - (12) Set the calibration plate to the detector.
 - (13) Connect a tester or relevant device between terminals S1 (-) and AG (+) to measure DC voltage. While checking the voltage, slowly move the lamp up and down to determine the position where the maximum absolute value of the measured voltage occurs. Depending on the lot of the calibration plate, the maximum occurs generally in a range of 30 to 100 mV. The higher the value of the calibration plate, the greater the output. At the optimum position (a slight displacement does not matter), tighten the clamp to 0.7 N·m torque. This can be done by fully tightening with a flat head screwdriver. Make sure that the torque is sufficient, otherwise the lamp may move when the detector is opened/closed.
 - (14) Connect a tester or relevant device between terminals S2 (-) and AG (+) to measure the voltage of reference element. It should be in a range of 0.2 to 2.3 V. If the voltage is outside the range, readjust the position of the lamp. Position the lamp so that the lamp beam passes through the center of the pinhole on the reference element box. This increases the amount of light, thereby raising the voltage. Tighten the clamp firmly.
 - (15) Tighten the four C screws and attach the cover.
 - (16) Allow the meter to warm up for at least one hour. After the reading has stabilized, press the [ENT] key to update the lamp control reference value.

If the mode is changed by pressing the [FUNC] or other key during the warm-up, the calibration is not successfully completed. Before changing the mode, press the [ENT] key. To resume updating the lamp control reference value, repeat steps 10 and 11. Wait for the turbidity meter to stabilize for at least 30 minutes (at least one hour in total), then press the [ENT] key.

- (17) Finished.

Wait about 10 minutes or more until the lamp voltage stabilizes, and then carry out span calibration (with the calibration plate) described in Section 7.7. If the measuring range is 200 mg/L (degrees) or less, perform a zero calibration (see Section 7.6) before the span calibration.

7.6 Zero Calibration

7.6.1 Zero Calibration with "Zero Water"

Zero calibration using "zero water" is described in this subsection.

(1) For specification with automatic cleaning and automatic zero calibration (Suffix code: -A3).

Carry out zero calibration using the manual start function of automatic zero calibration.

- (1) Select FUNCTION "7" in the <MAINT.> mode. => "A.CAL" is displayed.
- (2) Press the [ENT] key. => Automatic zero calibration starts and the "CAL" lamp flashes.
- (3) Predetermined calibration operations are performed and terminated.

(2) For specification with automatic cleaning but without automatic zero calibration (Suffix code: -A2).

Carry out zero calibration by allowing "zero water" to flow for about 30 minutes after performing cleaning with the manual start function of the automatic cleaning.

- (1) Select FUNCTION "6" in the <MAINT.> mode. => "JEt" is displayed.
- (2) Press the [ENT] key. => Automatic cleaning starts.
- (3) After cleaning is completed, allow "zero water" to flow for about 30 minutes to run-in the filter. (For valve statuses, see Table 6.15).
- (4) Select FUNCTION "1" in the <MAINT.> mode. => "Turbidity valve" is displayed.
- (5) Wait until the reading becomes stable and then press the [ENT], [>], and [ENT] keys in this order to calibrate the meter.
- (6) Finished.

(3) For specification without automatic cleaning or automatic zero calibration (Suffix code: -A1).

After performing manual cleaning, allow "zero water" to flow for about 30 minutes to perform zero calibration.

- (1) Select the <MAINT.> mode and open the valves so they are set to drain (for valve statuses, see Table 6.15).
- (2) After draining off the measuring water, allow "zero water" to flow (for valve statuses, see Table 6.15).
- (3) Open valve V4 with "zero water" flowing and let cleaning water flow for about 30 seconds.
- (4) Close valve V4 and open valve V5 to drain off the water.
- (5) Close valve V5 after about 10 seconds.
- (6) Repeat operation steps 3 to 5 several times depending on the degree of contamination.
- (7) Let "zero water" flow for about 30 minutes to run-in the filter.
- (8) Select FUNCTION "1" in the <MAINT.> mode.
- (9) "Turbidity valve" is displayed.
- (10) Wait until the reading becomes stable and then press the [ENT], [>], and [ENT] keys in this order to calibrate the meter.
- (11) Finished.

7.6.2 Zero Calibration by Turning Off Light Source

If the turbidity to be measured is 200 mg/L or more, zero calibration can be performed by turning OFF the light source.

The zero-point difference between this method and the "zero water" method is about 1 mg/L.

- (1) Select FUNCTION "2" in the <MAINT.> mode. => "Turbidity value" is displayed.
- (2) The lamp goes out when the [ENT] key is pressed once.
- (3) Wait one minute or more until the reading becomes stable, and then press the [>] and [ENT] keys in this order, Now calibration is over.
- (4) Finished.

7.7 Span Calibration

7.7.1 Span Calibration Using Calibration Plate

In normal maintenance, carry out span calibration using the attached calibration plate.

The calibration plate is calibrated by the standard solution.

- (1) Select FUNCTION "D." in the <PROGRAM1> mode and confirm that "ON" is displayed. "ON" means calibration using the calibration plate ("ON" is set up upon shipment from the factory).
- (2) Select FUNCTION "4" in the <MAINT.> mode. => "Turbidity value" is displayed.
- (3) Drain the measuring water in the detector (for the valve statuses when draining, see Table 6.15).
- (4) Loosen screw A under the detector cover and open the detector (see Figure 7.3).
- (5) Set the calibration plate housed in the upper inside part of the converter as shown in Figure 7.3. If the calibration plate is dirty, wipe the part its surface used for light scattering (the glossy part in the center of the plate) with the attached silicone cloth. In doing this, take care not to scratch the surface. Also, do not clean it with a solvent such as alcohol (but clean it with a detergent).
- (6) Shut the detector and tighten screw A.
- (7) Wait until the reading becomes stable and press the [ENT], [>], and [ENT] keys in this order. Now calibration is over.
- (8) Open the detector again and remove the calibration plate and then shut the detector and tighten screw A.
- (9) Take care not to let the calibration plate dirty, house it in the converter.
- (10) Finished.

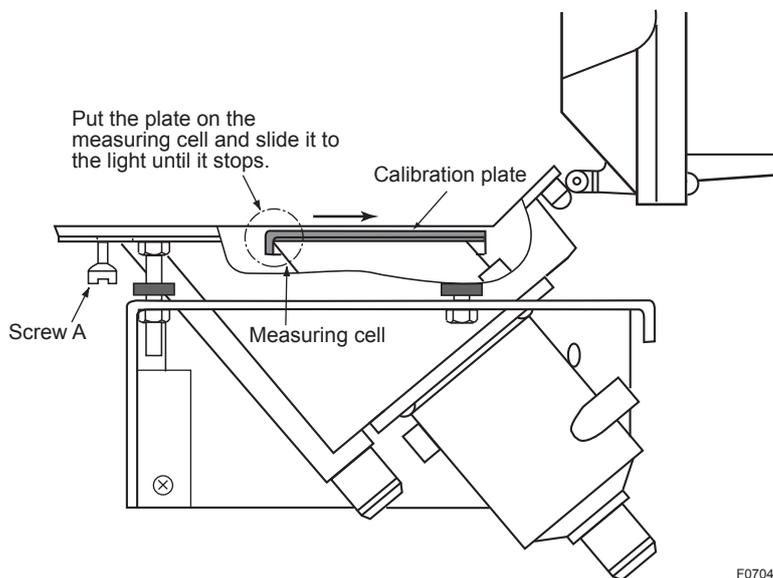


Figure 7.3 Setting Calibration Plate

<Cleaning Procedure for the Calibration Plate>

Dust and dirt on the surface of the calibration plate should be cleaned in the following procedure:

(1) Wiping with the Silicone cloth of accessories or cleaning by washing

If there is dust on the surface, remove it in a manner of lightly wiping with the Silicone cloth. Do not, in this case, rub hard on the surface.

If dust or dirt is not removed merely by wiping, wash the surface letting tap water flow on the surface. After cleaning, drain off the water, and wipe up the remaining water with the Silicone cloth or tissue. In doing this, do not rub the surface.

(2) Cleaning with detergent

If dirt is stuck on the surface through contact with your hand, or dirt cannot be removed even with wiping as described in (1), clean the plate with a detergent. Cleaning should be done in the following procedure:

- (1) Dissolve a suitable quantity of detergent in a certain amount of tap water and immerse the calibration plate in the solution.
- (2) Swirl the calibration plate around in the solution to remove the dirt from the surface.
- (3) If the dirt cannot be removed only by swirling the plate around, wipe the surface lightly with tissue that has been dampened in the solution to remove dirt.
- (4) After dirt has been removed, thoroughly rinse off the solution using tap water and drain off well the water droplets remaining on the surface.
- (5) Wipe up the remaining water with the Silicone cloth or tissue. In doing this, do not rub the surface.

NOTE

- Avoid rubbing the surface with any material.
 - For cleaning, do not use agents other than a detergent (e.g., a solvent such as ethanol, acetone, etc.).
 - For cleaning, also avoid touching the surface with your fingers.
 - If the surface gets scratched, a correct turbidity reading cannot be obtained. Be sure to exercise care in handling.
-

7.7.2 Span Calibration Using Standard Solution

Span calibration is carried out normally with the calibration plate. However, if the standard solution is to be used, do it in the following procedure.

- (1) Prepare 10 liters or more of the standard solution (see Subsection 7.15.2).
- (2) Select FUNCTION "D." in the <PROGRAM1> mode and change the setting to "OFF".
"OFF" means calibration with the standard solution ("ON" is set upon shipment from the factory).
- (3) Select FUNCTION "4" in the <MAINT.> mode. => "Turbidity value" is displayed.
- (4) Stop supplying the measuring water and once drain the measuring water into the detector.
- (5) Drain several times using "zero water" and remove the dirt on the detector and header tank. Finally, stop the "zero water" and drain off the detector and the header tank so that no water remains in them.

- (6) Connect the standard solution tank to the measuring water feed inlet and supply the standard solution at 2 L/min using a pump. Supply the standard solution agitating it with a magnetic stirrer.
- (7) When the standard solution begins to overflow the measuring cell, stop supplying the standard solution by turning off the pump, and drain it off by opening the drain value. Then close the drain valve and again supply the standard solution.
- (8) Allow the standard solution to flow for 4 minutes or more and after the reading stabilizes, carry out span calibration. For the operating procedure, see Section 6.5 (4).
- (9) After calibration is completed, stop supplying the standard solution and drain it.
Reconnect the measuring water piping and restart the supply of measuring water. It takes a certain time until the detector, heater tank, and piping are completely filled new measuring water.
- (10) Select FUNCTION "D." in the <PROGRAM1> mode and return the setting to "ON".
- (11) Finished.

7.8 Cleaning of Lenses

- (1) Select the <MAINT.> mode and turn off the power switch.
- (2) Loosen screw A under the detector cover and open the detector (see Figure 7.4).
- (3) Check whether or not the lenses in the detector (see Figure 7.4) are dirty. If they are, wipe them using, e.g., an applicator. In this case, it is better to soak the applicator in alcohol.
- (4) After cleaning the lenses, carry out zero and span calibrations.
- (5) Finished.

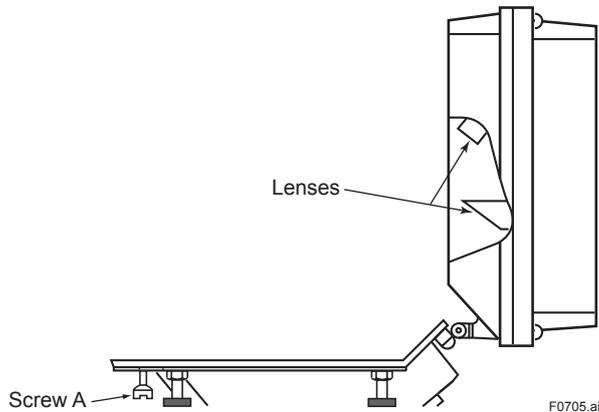


Figure 7.4 Lens Positions

7.9 Replacement of Filter (for "zero water")

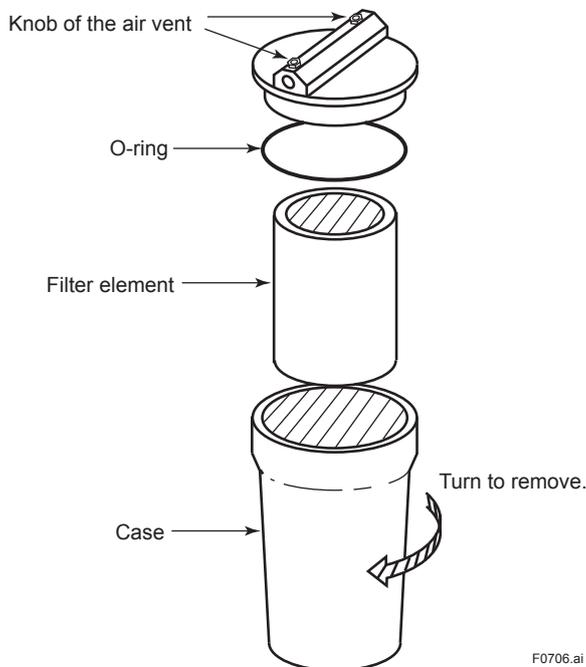
If the filter employs an element for "zero water", replace it periodically.

- (1) Select the <MAINT.> mode.
- (2) Shut valves V2 and V3.
- (3) Turn the filter case to remove it. (Exercise care because water inside the case may spill out).
- (4) Wipe the inside wall of the case with a brush or the like if it is dirty.
- (5) Replace the filter element with a new one.
- (6) Reassemble the filter in the reverse order of disassembly.

In this case, be sure that the O-ring for preventing water leakage is not damaged.

- (7) Open valves V2 and V3, let "zero water" flow and check whether or not any water leaks out.
- (8) Loosen the knob of the air vent at the top of the filter and vent the air until tap water begins to leak out. After the air venting is completed, tighten the knob.
- (9) Allow water the flow for 20 minutes or more run-in the filter.
- (10) Finished.

Note: If the zero filter is not to be used for a prolonged time, remove the filter and dry and store it in a dry place.



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Figure 7.5 Replacement of Zero Filter

7.10 Replacement of Fuses

For preventive maintenance, it is recommended that the fuses be replaced each with a new one after a period of one year.

As there are both 1A and 3A fuses, do not mix them up.

- (1) Turn off the power switch.
- (2) Remove the caps of the fuse holders on the front panel of the converter (turn counterclockwise) (see Figure 7.6).
- (3) Replace the fuses.
- (4) Close the caps; now the procedure is completed.
- (5) Finished.

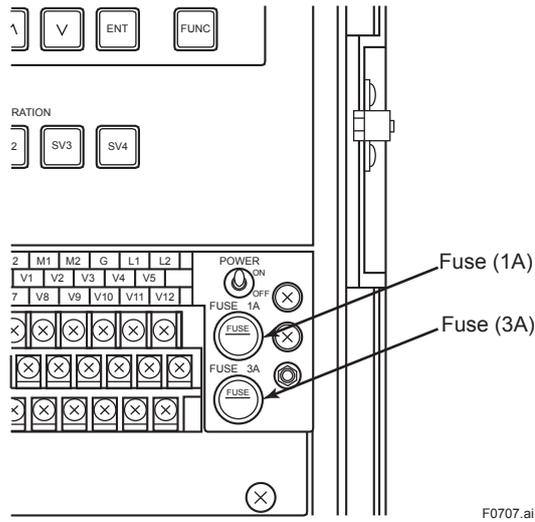


Figure 7.6 Replacement of Fuses

7.11 Cleaning of Piping

Remove the piping between the detector and the heater tank and clean it.

- (1) Select the <MAINT.> mode.
- (2) Set the meter to drain (for the valve statuses in draining, see Table 6.15).
- (3) After confirming that the water in the header tank is dirt on the inside wall of the piping with a slender brush or the like, and last wash out the inside of the piping with tap water.
- (4) When the spike detection function is specified, also clean the pipe assembly for the spike detection function. Disconnect the PVC pipe by loosening the clamps at the detector side.
- (5) Attach the piping again in the reverse order of removal.
- (6) Finished.

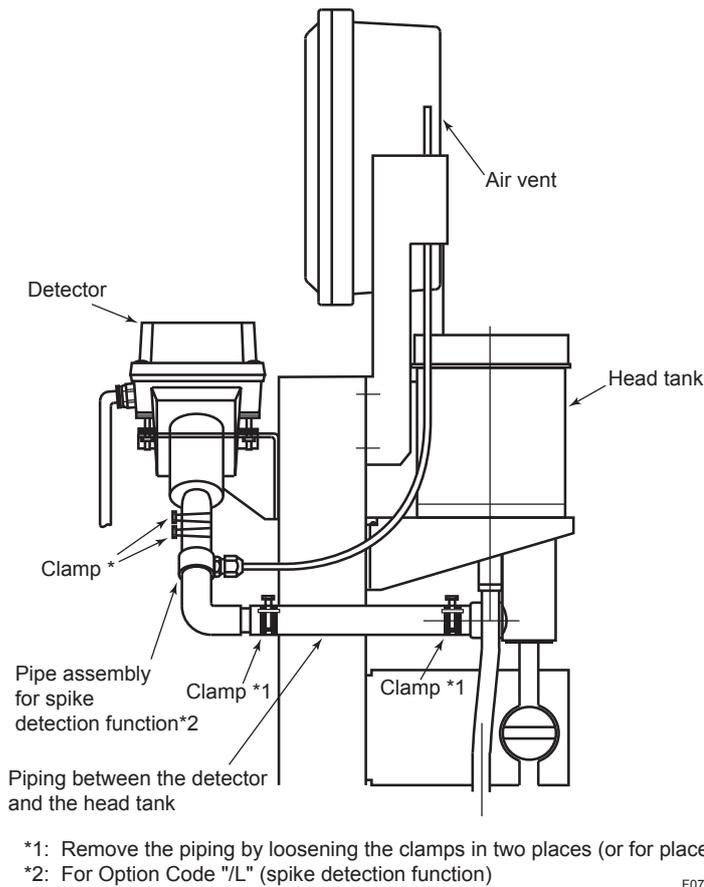
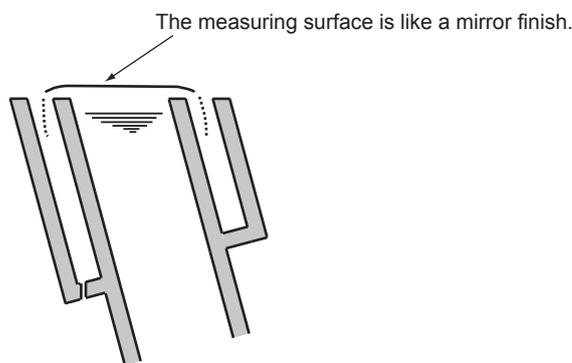


Figure 7.7 Removal of Piping

7.12 Checking Flowrate (Water Level)

Checking the water level of the measuring cell by letting measuring water or "zero water" flow.

- (1) Select the <MAINT.> mode. Remove screw A under the detector cover to open the detector (see Figure 7.1). Let each valve be set in the measuring status or the zero calibration status (see Table 6.15).
- (2) Confirm that the measuring surface is like a mirror finish and, if the surface is rippled, adjust the flowrate of the measuring water or "zero water".
- (3) Check whether or not the overflowing measuring water is approximately uniform at all parts of the periphery of the cell. If there is a large deviation, make a horizontal adjustment for the detector described in Subsection 4.1.4.
- (4) Check for dirt inside the detector and if necessary, clean it. If cleaning is performed, be sure to calibrate zero and span.
- (5) Checking is finished by closing the detector.
- (6) Finished



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Figure 7.8 Measuring Water Surface

As shown in Figure 7.1, lift the detector cover and check whether the cleaning water flowrate is sufficient.

7.13 Operation If Water Supply is Suspended

If the supply of measuring water and tap water (cleaning water and "zero water") is suspended, normal measurements cannot be carried out. The instrument cannot detect a suspension of Sample and tap water (cleaning water and "zero water"). The water supply status should, therefore, be checked regularly.

An automatic calibration failure (Err26) or an upper or lower limit alarm may be detected during an interruption in the supply of measuring water and tap water (cleaning water and "zero water"). If such a failure is detected, check the supply of measuring water and/or tap water.

7.14 Operation During Power Failure and at Power Recovery

Setting data, the current operation mode and function number are stored in the EEPROM (non-volatile memory). Accordingly, data are not lost in a power failure. The operation mode and function number status immediately before the power is turned off are retained unchanged as long as the re-supply of current is performed. However, operations in the way of execution cannot be recovered and the initial status is restored in that function number.

If the power fails in the <MEAS.> mode, the internal time is reset upon power recovery.

Thus, automatic cleaning and automatic zero calibration operations start to operate at the measurement start point in Figure 7.9.

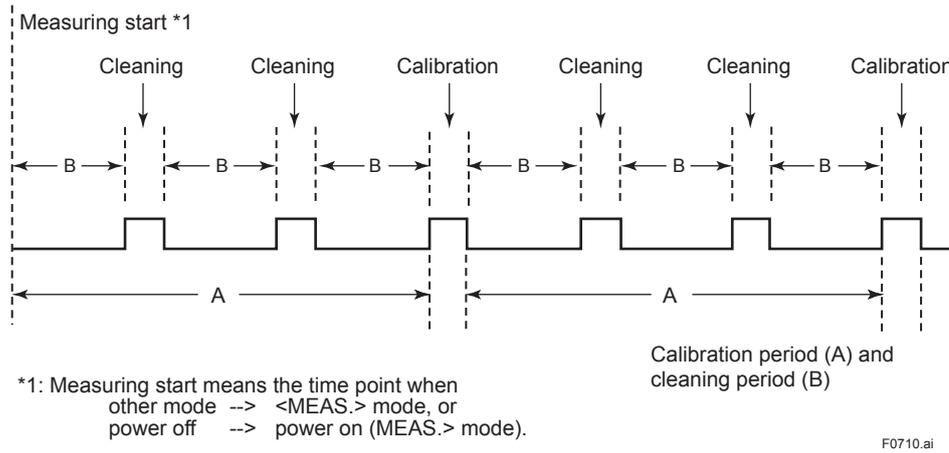


Figure 7.9 Automatic Cleaning and Automatic Zero Calibration Periods

IF the power fails, SV3 (motor valve) retain the status before the power was turned off (open or closed). Note that, even if the power fails, they may not necessarily be closed.

Valves SV1 (pinch valve) and SV2 and SV4 (solenoid valves) are shut.

The contact statuses are as shown in Table 7.2.

Table 7.2 Contact Operation in Power Failure

Contact output	Terminals	Operation
Maintenance output	M1, M2	Closed
FAIL output	F1, F2	Open
AUX output	C1, C2	Closed
Range output	A1, A2	Closed
	A1, A3	Open
	A1, A4	Open

7.15 Zero and Span Standards

7.15.1 Zero Turbidity Standard

For a low turbidity range (200 mg/L (degrees) or less), distilled water (0.03 mg/L (degrees) or less) or tap water filtered with a zero-turbidity filter (0.02 mg/L (degree) or less) will be adopted as the standard solution.

For a high turbidity range (more than 200 mg/L (degrees) or more), plain tap water (2 mg/L (degrees) or less) will be adopted as the standard solution.

7.15.2 Span Standards

(1) Turbidity Calibration Plate

The calibration plate attached to this instrument is calibrated making the standard solution described in (2) below as the reference.

(2) Turbidity Standard Solution

The turbidity indication (mg/L) of the TB400G turbidimeter adopts and indicates kaolin concentrations defined in the JIS K0101 standard. However, kaolin differs in viscosity distribution, particle shape, and colour depending on its place of production, quality, and production batches leading to an error.

Therefore, Yokogawa employs a method to define formazin (FTU) as the standard solution and to convert it to kaolin concentration.

The turbidity indication of degree is based on the polystyrene latex (PSL) concentration defined in the Water Quality Standards. When using the PSL standard, observe the following instructions.

NOTE

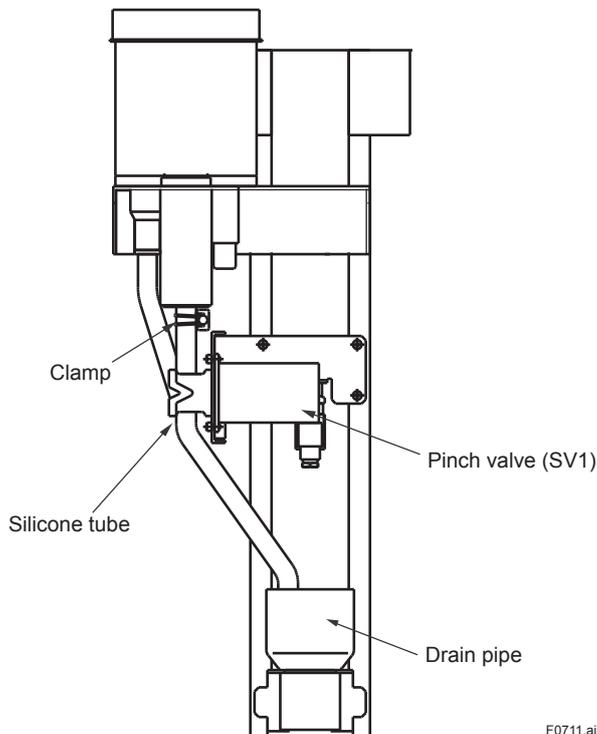
-
- Do not shake the container when stirring the standard solution. Shaking can cause the formation of a large amount of bubbles and thus the solution cannot be used for a while.
 - Slowly rotate the container for stirring, taking care not to allow suspended matter to collect in the bottom corners of the container.
 - When diluting the solution, gently and slowly pour zero water into the container, otherwise, air bubbles will occur, interfering with accurate calibration.
-

7.16 Replacement of Silicone Tube

1. Remove the clamp and open the SV1 valve.
2. Remove the existing silicone tube and then thread a new silicone tube into the hole of the SV1 valve.
3. Engage the clamps with the head and tail of the silicone tube. Insert the tube head into the downside of the head tank and the tube tail into the topside of the drainpipe.
Wet these connections to make insertion easier.
4. Make sure the drain-pipe is visible at the top of the head tank.
5. Fasten the clamp.
6. Place the lower end of the tube into the drain pipe.

NOTE

The valve becomes extremely hot when left electrified for about 10 minutes. Be careful not to burn yourself on it. The valve may not open if the tube is not threaded properly or the tube adheres. If this occurred, use manual force to help open the valve.



F0711.ai

Figure 7.10 Replacement of Silicone Tube for Pinch Valve

8. TROUBLESHOOTING

If a failure occurs in the converter or the detector, the self-diagnostic function detectors the failure and lights up FAIL lamp to notify of the occurrence of the failure. When the FAIL lamp is lit, first check the error code and then do the checks for each item described in Section 8.1.

Incorrect indications that cannot be checked by the self-diagnostic function may also be considered. If an indication failure occurs but the FAIL lamp is not lit, do the checks referring to each item in Section 8.2. For checking, a multimeter, or the like, that can measure DC/AC voltage, DC currents, and resistances, will be needed.

As a result, if component replacement or repair is required, or if the location of the failure cannot be determined, contact Yokogawa.

8.1 Events in Which FAIL Lamp Is Lit

If the FAIL lamp is lit during measurement, check the error code in the following procedure and carry out making checks corresponding to each number.

<Error Code Confirmation Procedure>

- (1) Select FUNCTION "A" in the <MAINT> mode and press the [ENT] key.
- (2) A display appears, such as "Err11". Check the points according to the listed procedure for each error number.

Note 1: When a failure occurs, the FAIL contact operates. If the FAIL status presents an inconvenience, perform an "error reset operation" (FUNCTION "B" in the <MAINT.> mode) to reset the failure. If resetting, be sure to first check the details by the "error code checking operation" before resetting.

(1)Err11 (turbidity overrange)

Carry out checking in the following order.

Operation and checking procedure	Failure Mode and Corrective Action
1 Measure the DC voltage across the converter connection terminals [S1(+) and AG(-)] to make sure of it, and confirm that it is smaller than -2.45 V or larger than +0.5 V.	
2 Check whether or not the turbidity of measuring water exceeds the measurable range (2200 mg/L (deg.)).	"Err11" is detected when the turbidity of the measuring water increases and the detector signal exceeds -2.45 V.
3 Measure the DC voltage across the converter connection terminals [V+(+) and AG(-)] and confirm that it is +5 ±0.5 V.	If the measured voltage is out of the range, a failure of the +5 V power circuit on the converter analog board is assumed. => Request inspection and/or repair of the analog board.
4 Measure the DC voltage across the converter connection terminals [V-(+) and AG(-)] and confirm that it is -5 ±0.5 V.	If the measured voltage is out of the range, a failure of the -5 V power circuit on the converter analog board is assumed. => Request inspection and/or repair of the analog board.
5 Introduce the external light onto the scattered light-receiving element by opening the detector and check whether the DC voltage across the converter connection terminals [S1(+) and AG(-)] changes.	If the measured voltage does not change, a failure of the detector preamplifier is assumed. => Request inspection and/or repair of the measuring preamplifier.

(2)Err12 (lamp disconnection)

Carry out checking in the following order.

	Operation and checking procedure	Failure Mode and Corrective Action
1	Open the upper cover of the detector and confirm whether the lamp is lit.	If it is not lit, a loosening of the P1 and P2 converter and detector connection terminal screws is assumed. => Tighten them again securely.
2	If there is no problem with the terminal screws being loose, disconnect the wiring to converter connection terminals P1 and P2, and measure the resistance between detector connection terminals P1 and P2.	If the resistance goes to infinity, it shows the lamp filament has burned through. => Replace the lamp with the spare lamp as an necessary. => After replacing the lamp, perform "lamp control reference value calibration" and "span calibration".
3	If the lamp is lit, measure the DC voltage across the converter connection terminals [S2 (+) and AG(-)].	If the measured voltage is within ± 0.5 V, a failure of the lamp light quantity control receiving element is assumed. => Request checking and/or repair of the control preamplifier.

(3)Err13 (lamp voltage failure)

Carry out checking in the following order.

	Operation and checking procedure	Failure Mode and Corrective Action
1	Measure the DC voltage across the converter connection terminals [P1(+) and P2(-)] and confirm that it exceeds the range of +3 to +6 V.	
2	Check for short-circuiting between the converter and detector connection terminals P1 and P2.	As the lamp power supply circuit has the function of overcurrent protection, if shortcircuiting is eliminated, the lamp voltage is restored by itself.
3	Check for loosening of the primary and secondary connectors (CN7 and CN8) of the lamp power transformer in the converter.	If there is loosening due to poor contact, the lamp voltage is restored by itself by re-inserting the connectors. If there are no problems in checking listed above, a failure of the lamp power supply circuit on the converter analog board is assumed. => Request checking and/or repair of the analog board.

(4)Err14 (A/D circuit failure)

A failure of the A/D conversion IC or the measurement and comparison input circuits is assumed.
Request checking and/or repair of the converter CPU board.

(5)Err15 (memory comparison failure)

A data memory IC (EEPROM) failure is assumed.
Request checking and/or repair of the converter CPU board.

NOTE

If the power is turned off with a memory-comparison failure generated, the stored data are initialized when the power is turned on again. If initialization is performed, re-setting of necessary data, zero and span calibration for the input circuit, lamp control reference value calibration, and turbidity zero and span calibration are required. If data cannot be properly written into the memory, "Err17" is displayed to notify of a failure occurrence.

(6)Err16 (RAM failure)

A failure of the IC (RAM) used for the computation buffer is assumed.

Request checking and/or repair of the converter CPU board.

Note: Err16 is detected only when the power is turned on. All functions of the converter are suspended when a failure occurs.

(7)Err17 (EEPROM failure)

A failure of the data memory IC (EEPROM) is assumed.

Request checking and/or repair of the converter CPU board.

Note: Err17 is detected only when the power is turned on. All functions of the converter are suspended when a failure occurs.

(8)Err18 (reference signal voltage failure)

Operation and checking procedure	Failure Mode and Corrective Action
Measure the DC voltage across the converter connection terminals [S2(+) and AG(-)]. Confirm that it is lower than about -2.45 V or it is higher than +0.5 V.	A failure of the control preamplifier in the converter is assumed. => Request checking and/or repair of the control preamplifier.

(9)Err25 (lamp service life ended)

Operation and checking procedure	Failure Mode and Corrective Action
Measure the DC voltage across the converter connection terminals [P1(+) and P2(-)]. Confirm that it is about 4.8 V *1.	The lamp brightness decreases and the lamp voltage shows the upper control limit (about 4.8 V *1). => Replace the lamp with the spare lamp.

*1: If the program version number is 1.08, the upper limit is set to 4.1 V. (The version number can be confirmed in FUNCTION "E" in <MAINT.> mode. Refer to Subsection 6.5 (13)).

Note: If the lamp life alarm occurs, turbidity measurement does not immediately become impossible.
If the lamp life alarm occurs, since the lamp voltage is fixed at about 4.1 V, turbidity measurement can be contained in this state. However, since the lamp voltage is not controlled, measurement error gradually increases. Thus, replace the lamp as soon as possible.

NOTE

After replacing the lamp, perform running-in for an hour or more and then perform lamp control reference value calibration and turbidity span calibration.

(10) Err26 (automatic calibration failure)

In automatic zero calibration, the zero-calibration permissible range is exceeded. The cause is assumed to be a failure in the operation of the motor-operated drain valve (SV1) or motor-operated measuring water valve (SV3), clogging of the piping between the detector and the head tank, etc.

Operation and checking procedure	Failure Mode and Corrective Action
1 Select the <MAINT.> mode and check the open/shut operations by turning valves SV1 and SV3 on and off.	
2 If the valve(s) does(do) not operate properly, turn off the power to the converter one time and remove the motor-operated valve wiring from the converter connection terminal board (Table 8.1).	
3 Turn on the power again and check whether the valve driving voltage (power voltage) appears across the terminals by doing an on/off operation using the SV key (Table 8.1).	(a) If the normal driving voltage is not output, a failure of the valve driving circuit on the converter analog board is assumed. => Request checking and/or repair of the analog board. (b) If the normal driving voltage is output, a failure of the motor-operated valve(s) is assumed. => Replace the motor-operated valve(s) with good one(s).

Table 8.1 Motor-operated Valve Connection Terminals

Terminal	Valve	Function
V1 V2 V3	SV1 (Pinch valve)	Open, Closed — COM
V4 V5 V6	SV3 (Motor valve)	Open Closed COM

<Example of operation>

SV1 open => Across V1 and V3: Power supply voltage output
SV1 closed Across V1 and V3: 0 V output
SV3 open => Across V4 and V6: Power supply voltage output
Across V5 and V6: 0 V output
SV3 closed => Across V4 and V6: 0 V output
Across V5 and V6: Power supply voltage output

(11) FAIL Lamp Is Lit and Other Lamps and Displays Are All Off

This shows a CPU failure occurrence. For confirmation, turn off the power one time and then turn it on again. If the CPU fails, the FAIL lamp immediately lights up. After confirmation, request checking and/or repair of the CPU board.

8.2 Events in Which FAIL Lamp Is Not Lit

If an indication failure occurs that the self-diagnostic function cannot detect, check it by referring to Table 8.2.

Table 8.2 Phenomena for Failures and their Causes and Countermeasures

Phenomenon for failure	Possible cause	Check and corrective action
Turbidity reading does not change.	a Failure of the measuring light receiving element in the detector	Confirm the reading using the calibration plate. If there is no change, a failure of the measuring preamplifier in the detector is assumed. Request checking and/or repair.
	b Clogging in the piping between the detector and the header tank.	Open the detector and, if measuring water does not flow through the measuring cell, check the piping and clean it if there is clogging.
	c If the turbidity reading is fixed to 0.00 mg/L and thus does not change, it is assumed that 0.00 mg/L was entered in reference sensitivity calibration.	Carry out reference sensitivity calibration using the calibration plate.
Fluctuation of turbidity reading is large.	a Unsuitable measuring water flowrate	Open the detector and if the water surface is not like a mirror finish, adjust the flowrate.
	b Shift of level adjustment for the measuring cell water surface	Check the level adjustment
	c Turbidimeter not securely fixed	Confirm the tightness of the anchor bolts or the like.
	d Large vibrations in surroundings	Change the signal averaging coefficient greatly. If the vibrations are violent, change the installation location.
	e The reading may fluctuate due to suspended substances in the sample water.	Greatly change the signal averaging coefficient.
Abrupt change in turbidity reading	a Poor contact in wiring between the converter and detector	Re-tighten the connection terminal screws of the converter and detector.
	b Influence from air bubbles	Increase the signal averaging coefficient.
No change in turbidity reading	a Check the range setting and range operation mode.	Auto-range setting (on/off) Remote range setting (on/off) Local range setting (1/2/3) Upper and lower range limit setpoints
Turbidity value drift	a Contamination of the measuring cell	Clean the measuring cell. For the model with automatic cleaning, shorten the cleaning interval.
	b For the model with automatic calibration, a dirty zero filter	Clean the filter element or for use over a prolonged period, replace it with a new one.
	c Dim light-receiving lens	Adjust the temperature so that the difference between the measuring-water temperature and the ambient temperature is within the predetermined value (30 °C). If the lens is dirty, clean it.
No converter display	a Blown converter fuse	Replace it with the attached fuse required.
The "MEAS" lamp flashes.	a A high or low alarm is detected.	Select FUNCTION "8" and/or FUNCTION "9" in the <PROGRAM1> mode and change the setpoint (s), or select FUNTION "9." in the <PROGRAM2> mode and reset the function. The lamp stops flashing.

9. SPARE PARTS

Table 9.1 shows the spare parts and their recommended replacement intervals. The recommended replacement intervals in the table are set for preventive purposes and no guarantee is given against accidental failures. It is subject to change depending on field experiences and others.

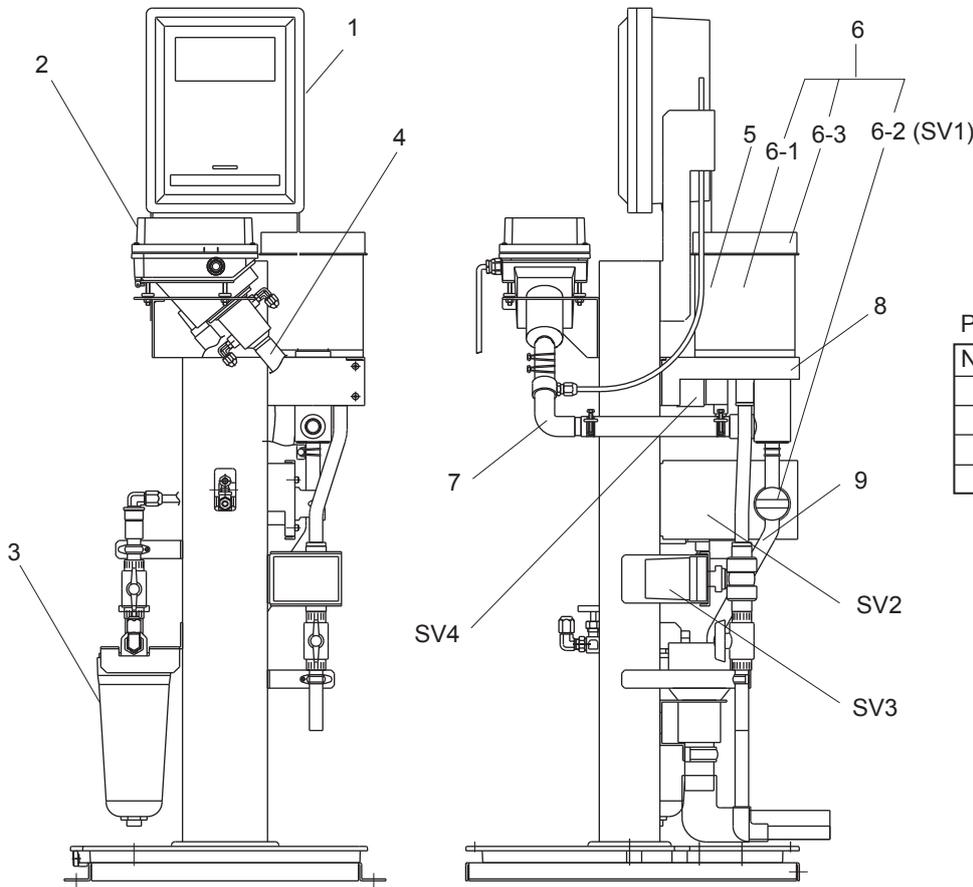
Table 9.1 Spare Parts List

Item	Part Number	Recommended Replacement Interval *1
Lamp	K9410DA	Yearly
Filter, 1 µm	K9008ZD	Yearly
Filter, 0.2 µm (When /PSL option is specified)	K9726EH	Yearly
Fuse, 1A	A1109EF	Yearly
Fuse, 3A	A1113EF	Yearly
Drain tube (When -A2 or -A3 is specified)	K9411JM	Yearly

*1: Replacement intervals vary depending on the application.

Customer Maintenance Parts List

Model TB400G [Style: S3] Surface Scattering Light Turbidity Meter

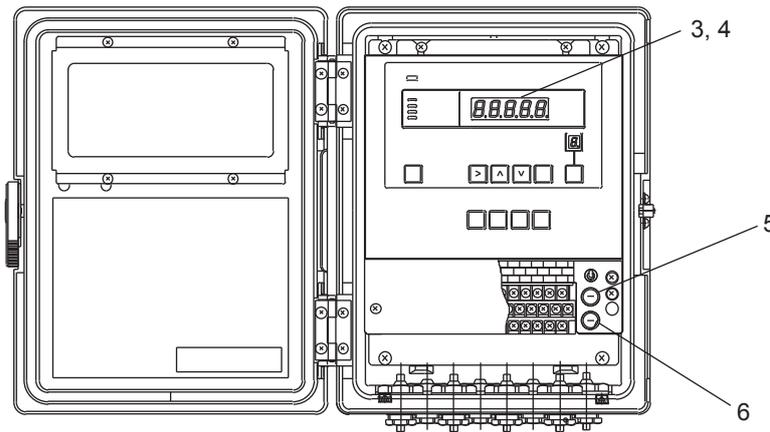
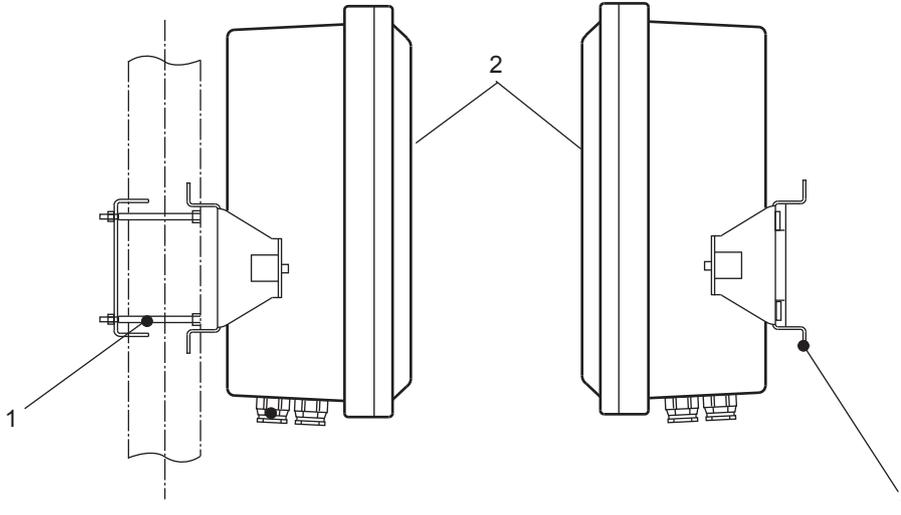


Part No. for each label

Name Plate	Parts No.
SV1	K9411TE
SV2	K9411TF
SV3	K9411TG
SV4	K9411TH

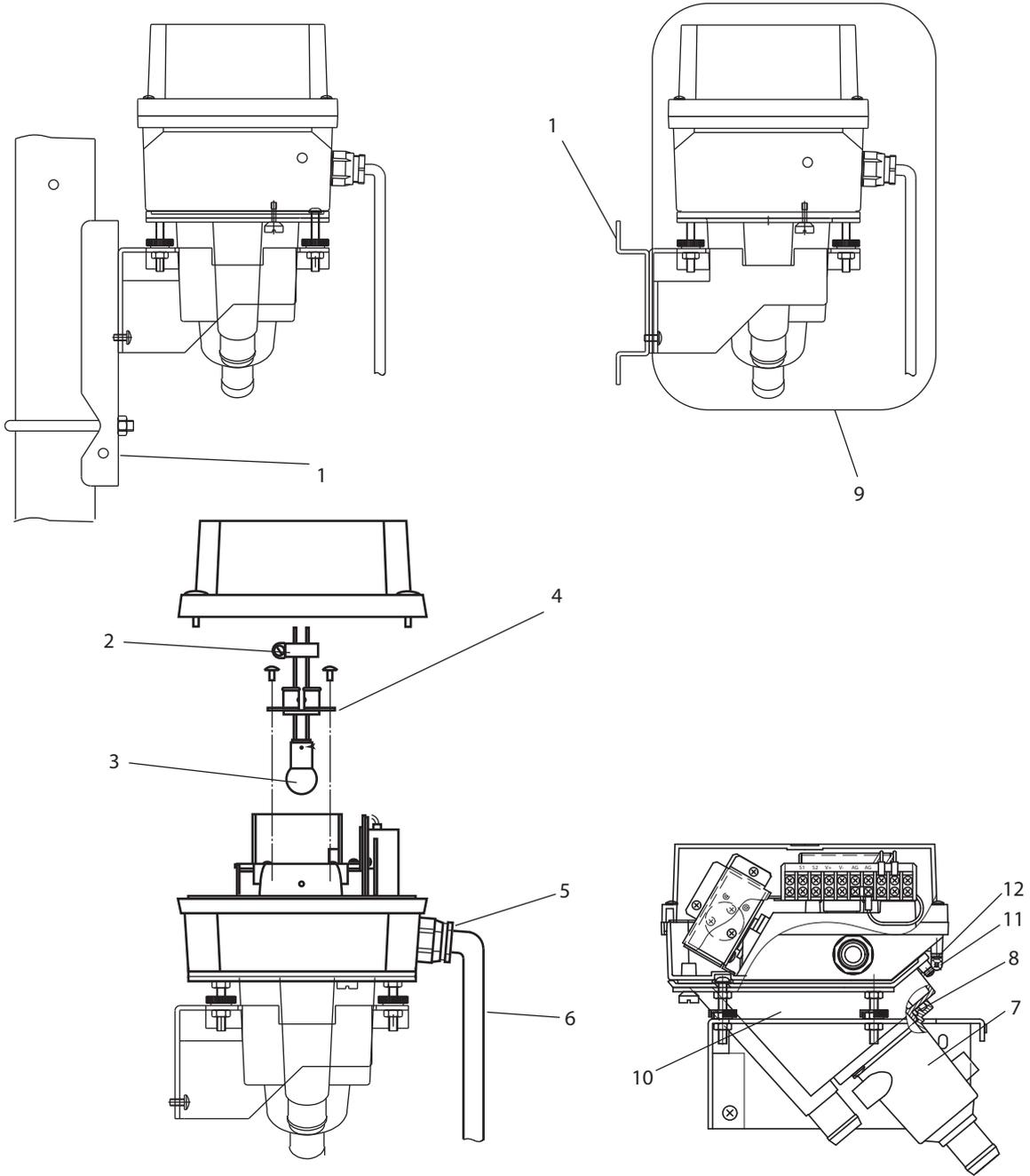
Item	Part No.	Qty	Description	Item	Part No.	Qty	Description
1	—	1	Converter (see page 2)	6-3	L9810MP	1	Head Tank Cover
2	—	1	Detector (see page 3)	7	K9411YA	1	Pipe Assembly
3	—	1	Zero Filter (see page 4)	8	K9411BB	1	Bracket
	K9411UA		(for 1 micron filter)	9	K9411JM	1	Tube
	K9726EF		(for 0.2 micron filter)				
4	K9411ZF	1	Tube (2m)	SV2,SV4	—	1	Solenoid Valve
5	K9411GC	1	Tank Assembly without Pinch Valve		A1014MZ		(for 100 V AC)
	K9411JS	1	(Option Code, in case of / L)		A1015MZ		(for 200 V AC)
6	—	1	Tank Assembly with Pinch Valve		A1016MZ		(for 110 V AC)
	K9411JA		(for 100,110 V AC)		A1017MZ		(for 220 V AC)
	K9411JB		(for 200, 220 V AC)	SV3	—	1	Motor Valve
	K9411JQ		(Option Code, in case of / L, for 100,110 V AC)		K9411DP		(for 100,110 V AC, Manufactured before Feb. 2009)
	K9411JR	1	(Option Code, in case of / L, for 200,220 V AC)		K9411DT		(for 100,110 V AC, Manufactured after Feb. 2009)
					K9411DQ		(for 200,220 V AC, Manufactured before Feb. 2009)
					K9411DU		(for 200,220 V AC, Manufactured after Feb. 2009)
6-1	K9411JC	1	Head Tank				
	K9411JP	1	(Option Code, in case of / L)				
6-2 (SV1)	—	1	Pinch Valve				
	K9411JG		(for 100,110 V AC)				
	K9411JH		(for 200, 220 V AC)				

Converter



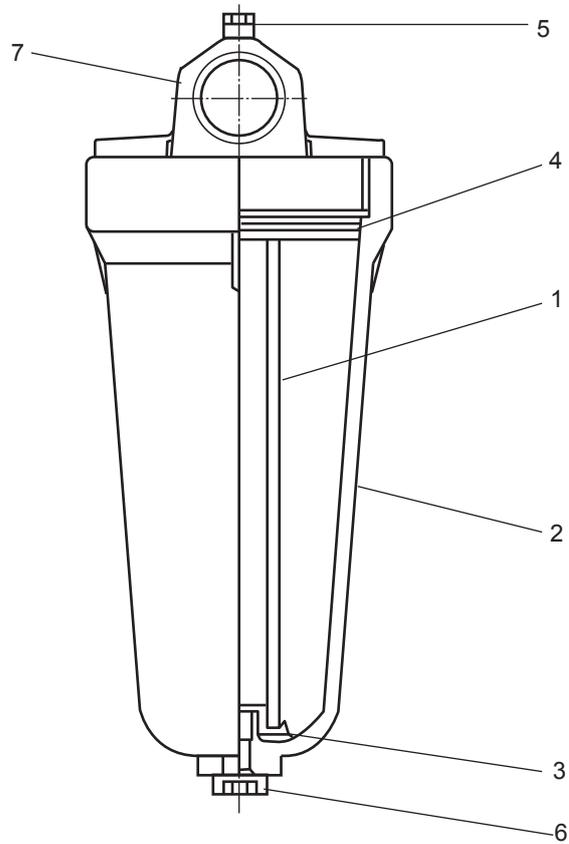
Item	Part No.	Qty	Description	Item	Part No.	Qty	Description
1	—	1	Mounting hardware	5	A1109EF	1	Fuse (1A)
	K9411ZG		(Option Code, in case of / P)	6	A1113EF	1	Fuse (3A)
	K9411ZH		(Option Code, in case of / R)				
2	—	1	Converter				
3	K9410XA	1	CPU Assembly				
4	—	1	Analog Assembly				
	K9410WA		(for 100 / 110 VAC, 4 to 20 mA DC output)				
	K9410WB		(for 100 / 110 VAC, 1 to 5V DC output)				
	K9410WC		(for 200 / 220 VAC, 4 to 20 mA DC output)				
	K9410WD		(for 200 / 220 VAC, 1 to 5V DC output)				

Detector



Item	Part No.	Qty	Description	Item	Part No.	Qty	Description
1	—	1	Mounting hardware (Option Code, in case of / P) (Option Code, in case of / R)	7	K9410CA	1	Cell
2	L9813WE	1	Clamp	8	Y9208XB	1	O-ring
3	K9410DA	1	Lamp Assembly	9	K9410AA	1	Cell Assembly
4	K9410BK	1	Holder	K9410AB	1	(Option Code, in case of / S)	
5	L9811CV	1	Cable Gland	10	K9410BB	1	Cell
6	K9410CQ	1	Cable Assembly	11	L9814CS	2	Hinge
				12	Y9306LU	8	Screw

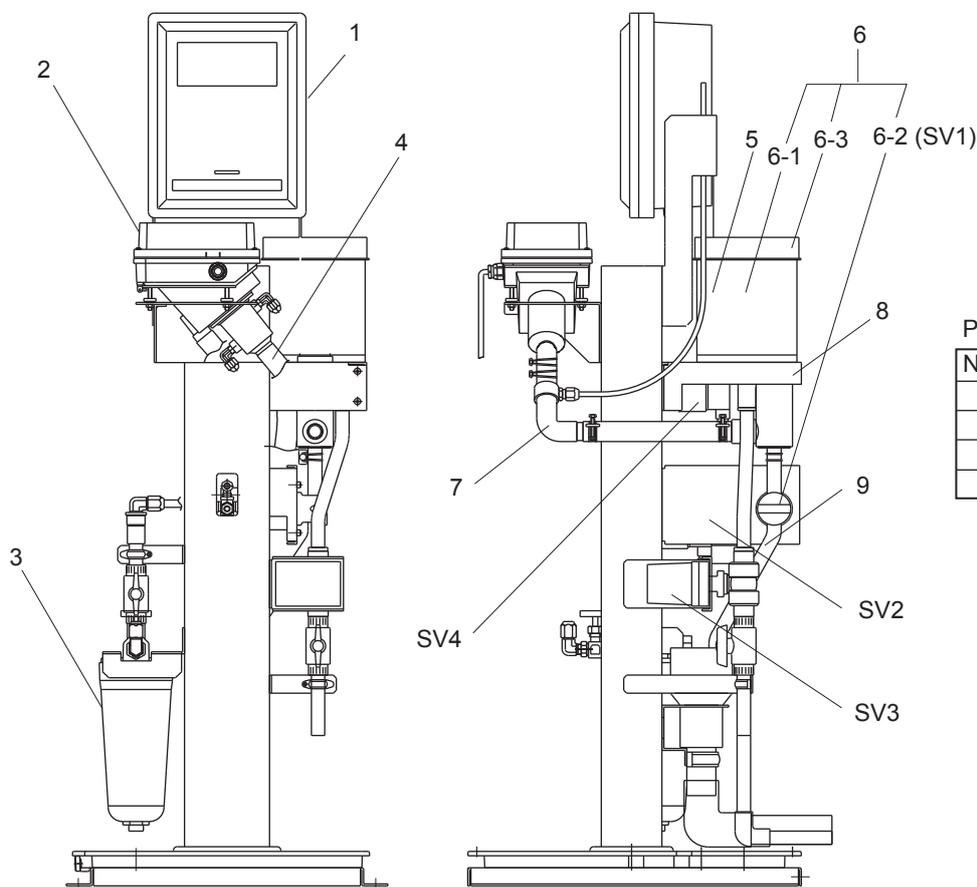
K9411UA ZERO FILTER (1 micron filter)
K9726EF ZERO FILTER (0.2 micron filter)



Item	Part No.	Qty	Description
1	—	1	Filter element
	K9008ZD		(1 micron)
	K9726EH		(0.2 micron)
2	K9411UB	1	Case
3	K9008ZE	1	Plate
4	K9411UD	1	O-Ring
5	K9411UC	1	O-Ring
6	K9411UE	1	O-Ring
7	K9411UF	1	Head

Customer Maintenance Parts List

Model TB400G [Style: S3] Surface Scattering Light Turbidity Meter

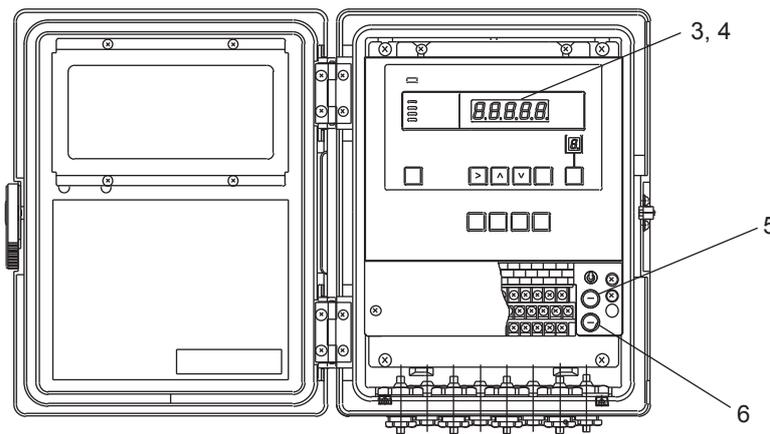
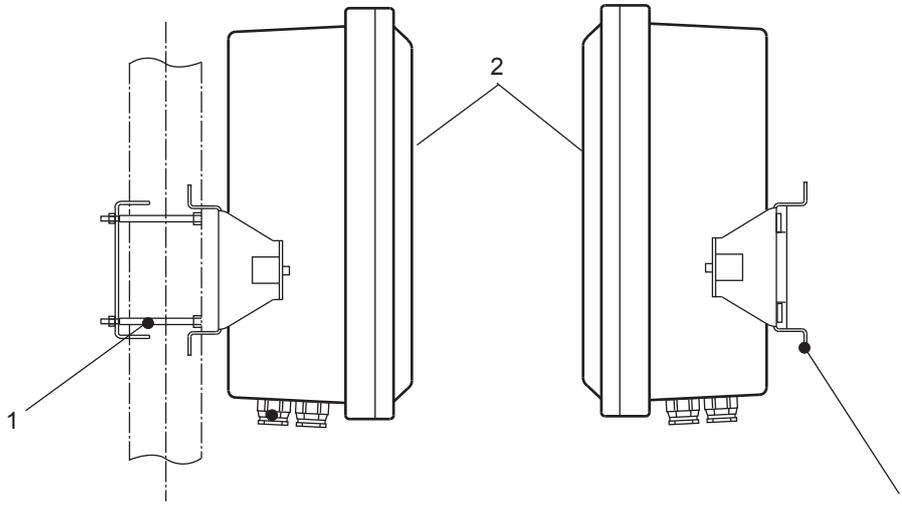


Part No. for each label

Name Plate	Parts No.
SV1	K9411TE
SV2	K9411TF
SV3	K9411TG
SV4	K9411TH

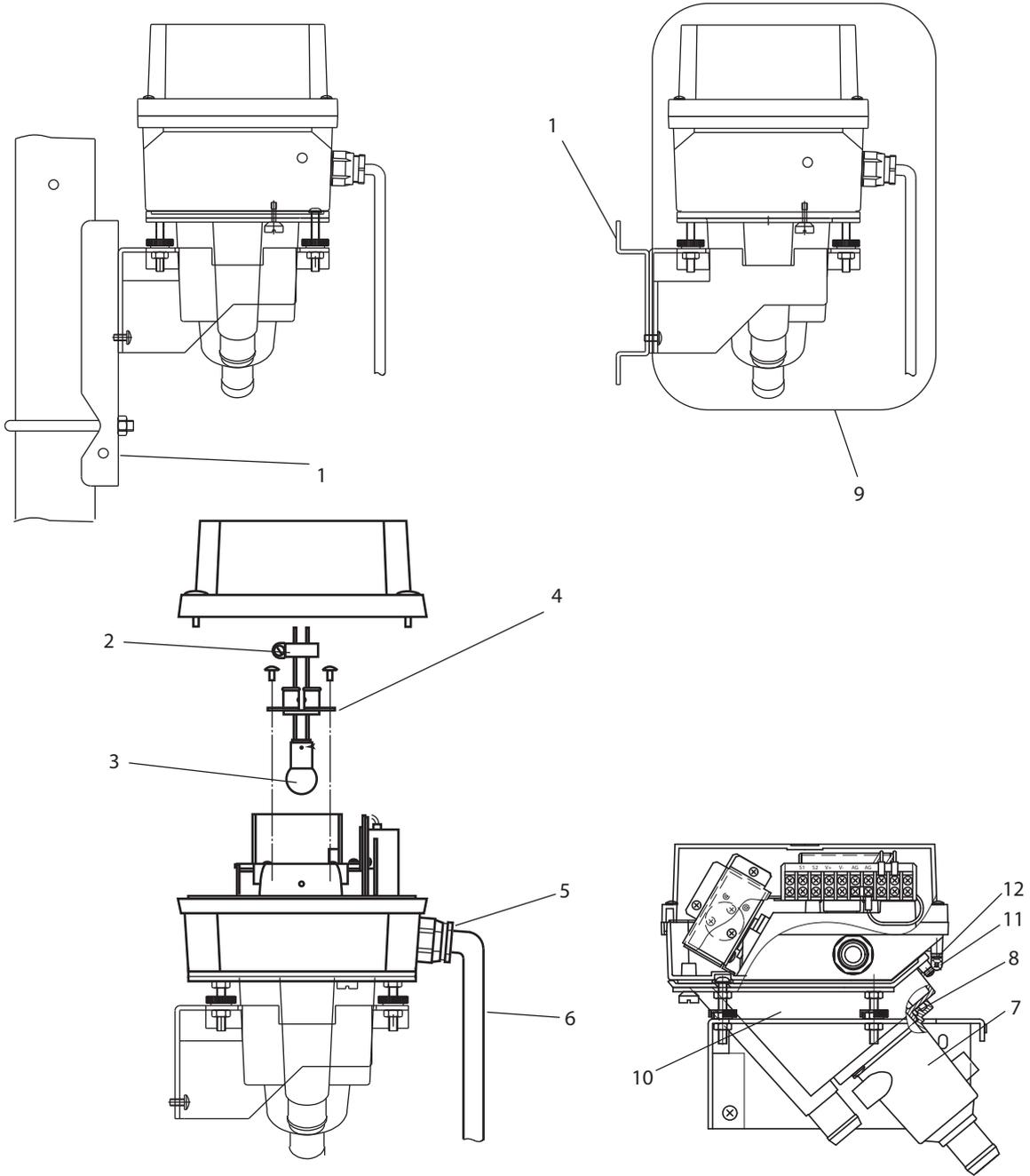
Item	Part No.	Qty	Description	Item	Part No.	Qty	Description
1	—	1	Converter (see page 2)	6-3	L9810MP	1	Head Tank Cover
2	—	1	Detector (see page 3)	7	K9411YA	1	Pipe Assembly
3	—	1	Zero Filter (see page 4)	8	K9411BB	1	Bracket
	K9411UA		(for 1 micron filter)	9	K9411JM	1	Tube
	K9726EF		(for 0.2 micron filter)	SV2,SV4	—	1	Solenoid Valve
4	K9411ZF	1	Tube (2m)		A1014MZ		(for 100 V AC)
5	K9411GC	1	Tank Assembly without Pinch Valve		A1015MZ		(for 200 V AC)
	K9411JS	1	(Option Code, in case of / L)		A1016MZ		(for 110 V AC)
6	—	1	Tank Assembly with Pinch Valve		A1017MZ		(for 220 V AC)
	K9411JA		(for 100,110 V AC)	SV3	—	1	Motor Valve
	K9411JB		(for 200, 220 V AC)		K9411DP		(for 100,110 V AC, Manufactured
	K9411JQ		(Option Code, in case of / L, for		K9411DT		before Feb. 2009)
			100,110 V AC)		K9411DQ		(for 100,110 V AC, Manufactured
	K9411JR	1	(Option Code, in case of / L, for		K9411DU		after Feb. 2009)
			200,220 V AC)				(for 200,220 V AC, Manufactured
6-1	K9411JC	1	Head Tank				before Feb. 2009)
	K9411JP	1	(Option Code, in case of / L)				(for 200,220 V AC, Manufactured
6-2 (SV1)	—	1	Pinch Valve				after Feb. 2009)
	K9411JG		(for 100,110 V AC)				
	K9411JH		(for 200, 220 V AC)				

Converter



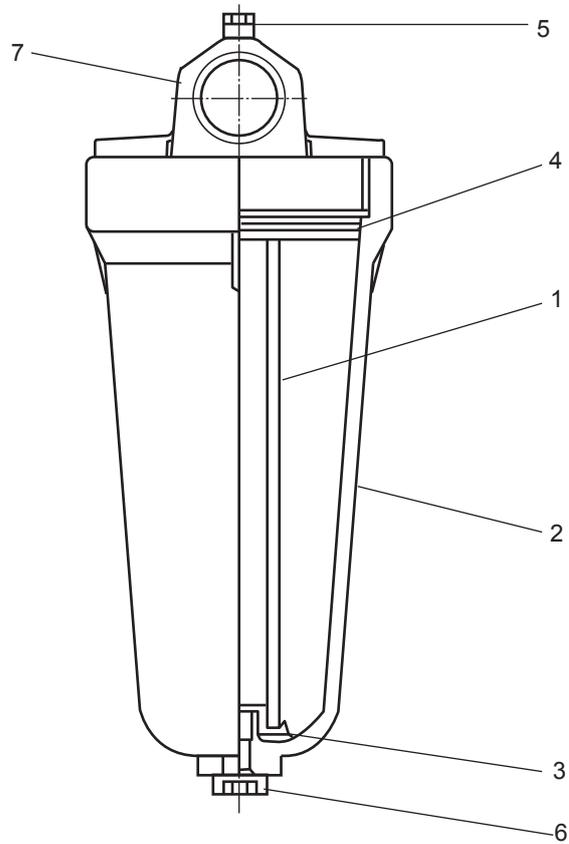
Item	Part No.	Qty	Description	Item	Part No.	Qty	Description
1	—	1	Mounting hardware	5	A1109EF	1	Fuse (1A)
	K9411ZG		(Option Code, in case of / P)	6	A1113EF	1	Fuse (3A)
	K9411ZH		(Option Code, in case of / R)				
2	—	1	Converter				
3	K9410XA	1	CPU Assembly				
4	—	1	Analog Assembly				
	K9410WA		(for 100 / 110 VAC, 4 to 20 mA DC output)				
	K9410WB		(for 100 / 110 VAC, 1 to 5V DC output)				
	K9410WC		(for 200 / 220 VAC, 4 to 20 mA DC output)				
	K9410WD		(for 200 / 220 VAC, 1 to 5V DC output)				

Detector



Item	Part No.	Qty	Description	Item	Part No.	Qty	Description
1	—	1	Mounting hardware (Option Code, in case of / P) (Option Code, in case of / R)	7	K9410CA	1	Cell
2	L9813WE	1	Clamp	8	Y9208XB	1	O-ring
3	K9410DA	1	Lamp Assembly	9	K9410AA	1	Cell Assembly
4	K9410BK	1	Holder	K9410AB	1	(Option Code, in case of / S)	
5	L9811CV	1	Cable Gland	10	K9410BB	1	Cell
6	K9410CQ	1	Cable Assembly	11	L9814CS	2	Hinge
				12	Y9306LU	8	Screw

K9411UA ZERO FILTER (1 micron filter)
K9726EF ZERO FILTER (0.2 micron filter)



Item	Part No.	Qty	Description
1	—	1	Filter element
	K9008ZD		(1 micron)
	K9726EH		(0.2 micron)
2	K9411UB	1	Case
3	K9008ZE	1	Plate
4	K9411UD	1	O-Ring
5	K9411UC	1	O-Ring
6	K9411UE	1	O-Ring
7	K9411UF	1	Head

Revision Information

- Title : Model TB400G Surface Scattering Light Turbidity Meter [Style: S3]
- Manual No. : IM 12E04A02-02E

Nov. 2019/10th Edition

Added -PHN6, -PHU6 (Pages v, Chapter 2, 4-10)

Mar. 2018/9th Edition

Corrections (Pages 4-6, 4-8)

Dec. 2017/8th Edition

Addition of option code "/TT3" (Pages 2-5, 2-15 to 2-26)

Corrections (Pages i, 1-2, 2-3, 2-4, 2-9 to 2-14, 2-27 to 2-32, 3-3, 3-4, 4-8, 4-9)

Dec. 2016/7th Edition

Chapter 2, Chapter 7 were partially revised.

Jan. 2015/6th Edition

Deletion of descriptions concerning PH400G

Deletion of external dimensions using PH400G (section 2.5.5 to 2.5.10 of 5th edition)

P.i, "INTRODUCTION": Addition of note about symbol of unit "liter"

P.2-5, "2.3 Model and Suffix Codes": Deletion of suffix codes concerning PH400G

P.2-6, "2.5 External Dimensions": Deletion of models using PH400G on Table 2.1

P.2-33 to 2-37, "2.6 Piping System Diagrams": Addition of note about prevention of reverse flow

P.2-40, "Figure 2.25": Deletion of PH400G wiring

Mar. 2014/5th Edition

Addition of "For Korea (-KC)"

(Pages 1-2, 2-3 to 2-8, 2-50, 3-1, 3-3, 3-5, 3-6, 4-1, 4-2, 4-4, 6-5, 6-8, 6-29, 6-32)

Aug. 2013/4th Edition Addition for PH450G pH meter installed option, title of IM changed.

P 2-2 Some revision of Standard Specifications (equalized to description of GS);

P 2-5 Some revision of Model and Suffix Codes with note (equalized to description of GS);

P 2-6 to P 2-52 Some revision of subsection 2.5 to 2.7 (external dimensions, piping, wiring diagrams);

P 6-16 Some revision of note in (9) Converter Check Operation (FUNCTION "9");

P 9-1 P/N change of Fuse (3 A) for spare parts;

Customer Maintenance Parts Lists CMPL 12E04A02-03E, some P/N added for item 4, and item 6-3 of page 1,

P/N change for item 6, and P/N deletion for item 2 of page 2.

May. 2010/3rd Edition

Style of TB400G has been changed to "S3"; P2-5, Style code of TB400G MS-code changed to "S3";

P4-2, Some change of step "1" on Sec. 4.1.4; P4-3, Some change of step "3" on Sec. 4.1.8;

P6-4, Some error correction of item "7", "B", "C", and "F" on Table 6.4; P6-15, Some error correction of step "1" on item (7); P6-16, Some error correction of step "2" on item (9);

P6-25 to 6-26, Some footnote addition on end of item (11) to (13);

P7-13 Some changes of Sec. 7.1.4 Operation During Power Failure and at Power Recovery.

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Section 2.7 Fig. 2.23 and 2.27 Chart of internal connecting wires correction (SV1);

Section 3.2.2 (2) Note is added; Section 7.16 NOTE is corrected.

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