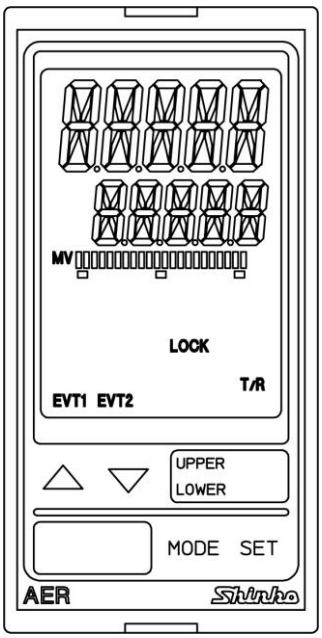
Digital Indicating Turbidity/SS Meter

AER-101-TU

Instruction Manual



Shinko

Preface

Thank you for purchasing our AER-101-TU, Digital Indicating Turbidity/SS (Suspended Solids) Meter.

This manual contains instructions for the mounting, functions, operations and notes when operating the AER-101-TU. To ensure safe and correct use, thoroughly read and understand this manual before using this instrument.

To prevent accidents arising from the misuse of this instrument, please ensure the operator receives this manual.

Characters Used in This Manual

Indication	-1	0	1	2	3	4	5	6	7	8	9	℃	℉
Number, ℃/℉	-1	0	1	2	3	4	5	6	7	8	9	℃	℉
Indication	A	b	c	d	E	F	G	H	I	J	K	L	M
Alphabet	A	B	C	D	E	F	G	H	I	J	K	L	M
Indication	N	o	P	Q	R	S	T	U	V	W	X	Y	Z
Alphabet	N	O	P	Q	R	S	T	U	V	W	X	Y	Z

⚠ Caution

- This instrument should be used in accordance with the specifications described in the manual. If it is not used according to the specifications, it may malfunction or cause a fire.
- Be sure to follow all of the warnings, cautions and notices. If they are not observed, serious injury or malfunction may occur.
- The contents of this instruction manual are subject to change without notice.
- Care has been taken to ensure that the contents of this instruction manual are correct, but if there are any doubts, mistakes or questions, please inform our sales department.
- This instrument is designed to be installed within a control panel. If it is not, measures must be taken to ensure that the operator cannot touch power terminals or other high voltage sections.
- Any unauthorized transfer or copying of this document, in part or in whole, is prohibited.
- Shinko Technos Co., Ltd. is not liable for any damage or secondary damage(s) incurred as a result of using this product, including any indirect damage.

Safety Precautions (Be sure to read these precautions before using our products.)

The safety precautions are classified into 2 categories: “Warning” and “Caution”.
Depending on the circumstances, procedures indicated by ⚠ Caution may result in serious consequences, so be sure to follow the directions for usage.

⚠ Warning Procedures which may lead to dangerous conditions and cause death or serious injury, if not carried out properly.

⚠ Caution Procedures which may lead to dangerous conditions and cause superficial to medium injury or physical damage or may degrade or damage the product, if not carried out properly.

⚠ Warning

- To prevent an electrical shock or fire, only Shinko or other qualified service personnel may handle the inner assembly.
- To prevent an electrical shock, fire or damage to the instrument, parts replacement may only be undertaken by Shinko or other qualified service personnel.

⚠ SAFETY PRECAUTIONS

- To ensure safe and correct use, thoroughly read and understand this manual before using this instrument.
- This instrument is intended to be used for measuring equipment. Verify correct usage after purpose-of-use consultation with our agency or main office. (Never use this instrument for medical purposes with which human lives are involved.)
- Proper periodic maintenance is also required.
- This instrument must be used under the conditions and environment described in this manual. Shinko Technos Co., Ltd. does not accept liability for any injury, loss of life or damage occurring due to the instrument being used under conditions not otherwise stated in this manual.

⚠ Caution with Respect to Export Trade Control Ordinance

To avoid this instrument from being used as a component in, or as being utilized in the manufacture of weapons of mass destruction (i.e. military applications, military equipment, etc.), please investigate the end users and the final use of this instrument. In the case of resale, ensure that this instrument is not illegally exported.

1. Installation Precautions

⚠ Caution

This instrument is intended to be used under the following environmental conditions (IEC61010-1): Overvoltage category Ⅱ, Pollution degree 2

Ensure the mounting location corresponds to the following conditions:

- A minimum of dust, and an absence of corrosive gases
- No flammable, explosive gases
- No mechanical vibrations or shocks
- No exposure to direct sunlight, an ambient temperature of 0 to 50℃ (32 to 122℉) that does not change rapidly, and no icing
- An ambient non-condensing humidity of 35 to 85%RH
- No large capacity electromagnetic switches or cables through which large current is flowing.
- No water, oil or chemicals or where the vapors of these substances can come into direct contact with the unit.
- If the AER-101-TU is mounted through the face of a control panel, the ambient temperature of the unit – not the ambient temperature of the control panel – must be kept under 50℃. Otherwise the life of electronic parts (especially electrolytic capacitors) of the unit will be shortened.

Note: Do not install this instrument on or near flammable material even though the case of this instrument is made of flame-resistant resin.

2. Wiring Precautions

⚠ Caution

- Do not leave wire remnants in the instrument, as they could cause a fire or a malfunction.
- Use a solderless terminal with an insulation sleeve in which the M3 screw fits when wiring the AER-101-TU.
- The terminal block of this instrument is designed to be wired from the left side. The lead wire must be inserted from the left side of the terminal, and fastened with the terminal screw.
- Tighten the terminal screw using the specified torque. If excessive force is applied to the screw when tightening, the terminal screw or case may be damaged.
- This instrument does not have a built-in power switch, circuit breaker or fuse. It is necessary to install a power switch, circuit breaker or fuse near the instrument. (Recommended fuse: Time-lag fuse, rated voltage 250 V AC, rated current 2 A)
- For a 24 V AC/DC power source, do not confuse polarity when using direct current (DC).
- Be sure to connect the ground terminal to earth for safety (D-class grounding). Keep the grounding of this unit separate from other electrical devices, such as motors.
- Do not apply a commercial power source to the Turbidity/SS sensor which is connected to the input terminal nor allow the power source to come into contact with the sensor.
- Use the Turbidity/SS sensor made by OPTEX Co., Ltd.
- Keep the input wires and power lines separate.

3. Operation and Maintenance Precautions

⚠ Caution

- Do not touch live terminals. This may cause an electrical shock or problems in operation.
- Turn the power supply to the instrument OFF when retightening the terminal or cleaning.
  Working on or touching the terminal with the power switched ON may result in severe injury or death due to electrical shock.
- Use a soft, dry cloth when cleaning the instrument.
  (Alcohol based substances may tarnish or deface the unit.)
- As the display section is vulnerable, be careful not to put pressure on, scratch or strike it with a hard object.

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1. Model

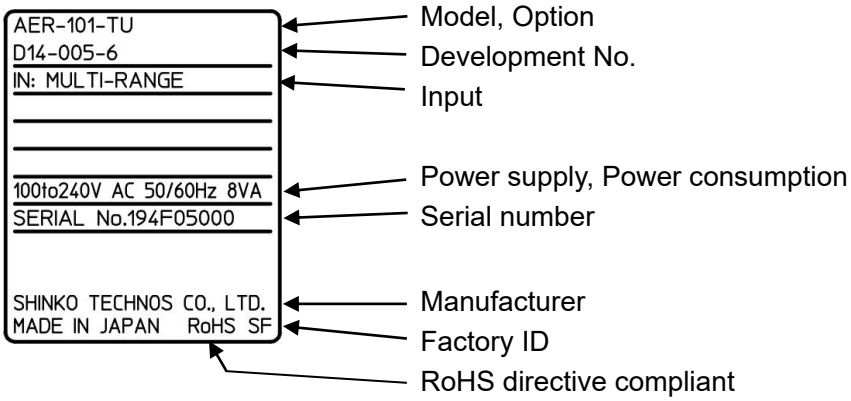
1.1 Model

AER-10	1-	TU		,□□	
Input Points	1				1 point
Input		TU			Turbidity sensor (made by OPTEX): TC-100, TC-500, TC-3000 SS (Suspended Solids) sensor (made by OPTEX): TCS-1000 (E), TS-MxS-A
Power Supply Voltage					100 to 240 V AC (standard)
			1		24 V AC/DC (*)
Option				C5	Serial communication RS-485

(*) Power supply voltage 100 to 240 V AC is standard.
When ordering 24 V AC/DC, enter “1” in Power supply voltage, after ‘TU’.

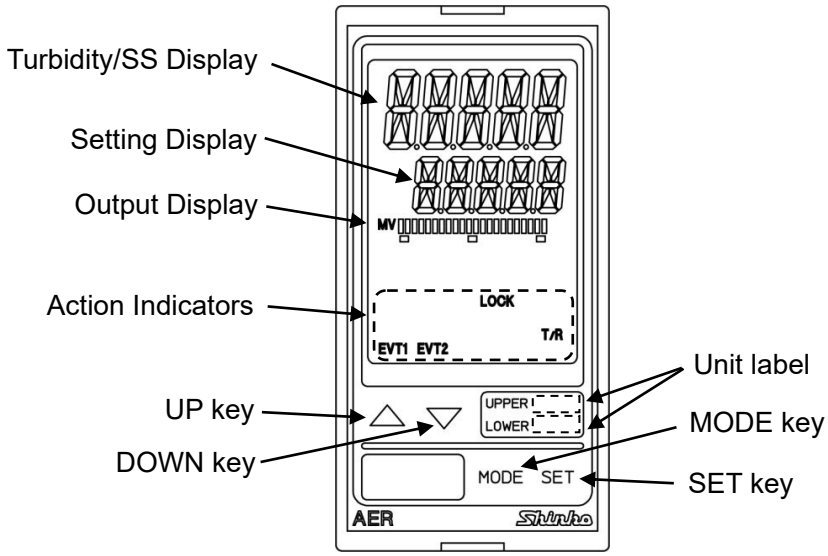
1.2 How to Read the Model Label

The model label is attached to the left side of the case.



(Fig. 1.2-1)

2. Names and Functions of Instrument



(Fig. 2-1)

Displays

Turbidity/ SS Display	In Turbidity/SS Display Mode, Turbidity/SS input value is indicated in red/green/ orange. In setting mode, setting characters are indicated in red/green/ orange. Indications differ depending on the selections in [Backlight selection (p.32)] and [Turbidity/SS color (p.33)].
Setting Display	In Turbidity/SS Display Mode, the EVT value is indicated in green. In setting mode, the set value is indicated in green. Indications differ depending on the selections in [Backlight selection (p.32)].
Output Display	Backlight Green The bar graph is lit corresponding to the transmission output. Indications differ depending on the selections in [Bar graph indication (p.34)].

Action Indicators: Backlight Orange

EVT1	Lights up when EVT output (Contact output) is ON.
EVT2	Lights up when Self-check output (Contact output) is ON.
T/R	Lights up during Serial communication (C5 option) TX output (transmitting).
LOCK	Lights up when Lock 1, 2 or 3 is selected.

Unit Label

UPPER	Attach the user's unit of Turbidity/SS Display from the included unit labels if necessary.
LOWER	Attach the user's unit of Setting Display from the included unit labels if necessary.

Keys

△	**UP key**	Increases the numeric value.
▽	**DOWN key**	Decreases the numeric value.
MODE	**MODE key**	Selects a setting group.
SET	**SET key**	Switches the setting modes, and registers the set value.

3. Mounting to the Control Panel

3.1 Site Selection

⚠ Caution

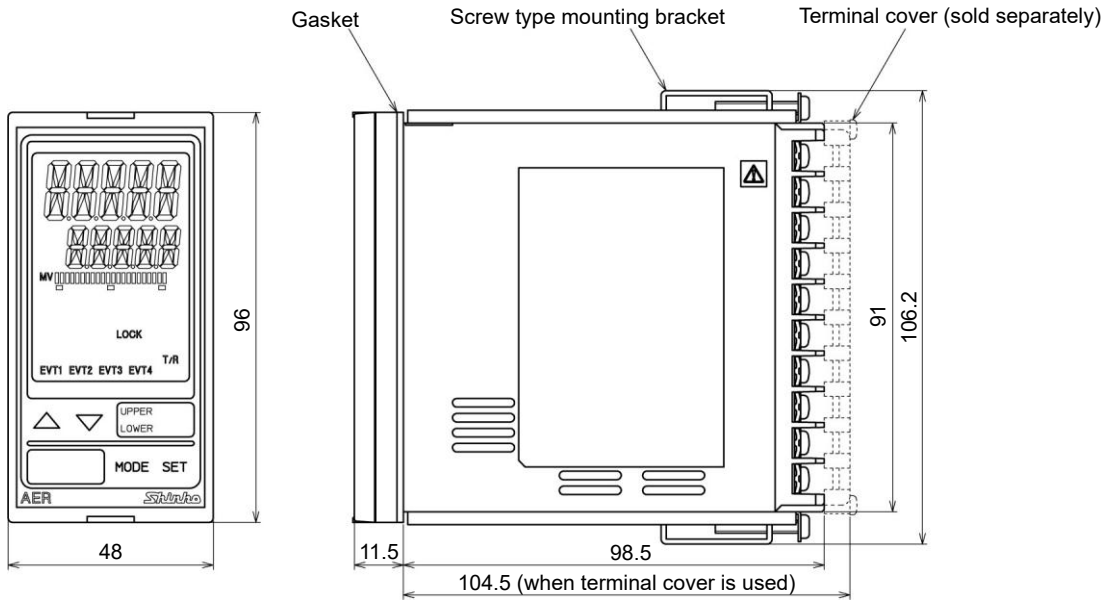
Use within the following temperature and humidity ranges.
Temperature: 0 to 50℃ (32 to 122℉) (No icing), Humidity: 35 to 85 %RH (Non-condensing)
Take note that the ambient temperature of this unit – not the ambient temperature of the control panel – must not exceed 50℃ if mounted through the face of a control panel, otherwise the life of electronic components (especially electrolytic capacitors) may be shortened.

This instrument is intended to be used under the following environmental conditions (IEC61010-1): Overvoltage category Ⅱ, Pollution degree 2

Ensure the mounting location corresponds to the following conditions:

- A minimum of dust, and an absence of corrosive gases
- No flammable, explosive gases
- No mechanical vibrations or shocks
- No exposure to direct sunlight, an ambient temperature of 0 to 50℃ (32 to 122℉) that does not change rapidly, and no icing.
- An ambient non-condensing humidity of 35 to 85%RH
- No large capacity electromagnetic switches or cables through which large current is flowing
- No water, oil, chemicals or the vapors of these substances can come into direct contact with the unit.

3.2 External Dimensions (Scale: mm)

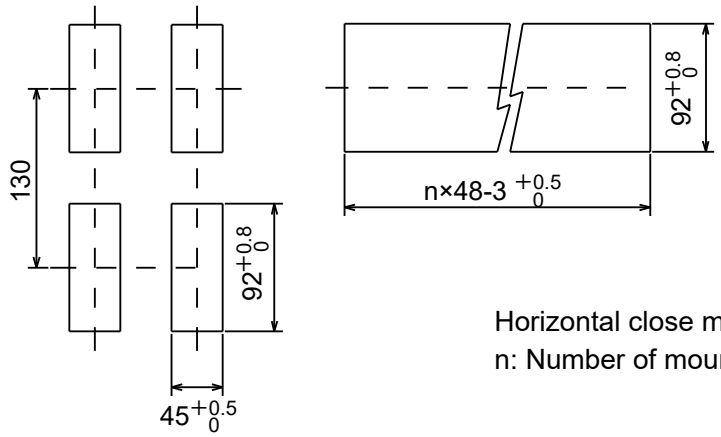


(Fig. 3.2-1)

3.3 Panel Cutout (Scale: mm)

⚠ Caution

If horizontal close mounting is used for the unit, IP66 specification (Drip-proof/ Dust-proof) may be compromised, and all warranties will be invalidated.



Horizontal close mounting
n: Number of mounted units

(Fig. 3.3-1)

3.4 Mounting and Removal

> **⚠ Caution**
>
> **As the case is made of resin, do not use excessive force while screwing in the mounting bracket, or the case or mounting brackets could be damaged. The tightening torque should be 0.12 N•m.**

How to mount the unit

Mount the unit vertically to the flat, rigid panel to ensure it adheres to the Drip-proof/Dust-proof specification (IP66).

Mountable panel thickness: 1 to 8 mm

(1) Insert the unit from the front side of the panel.

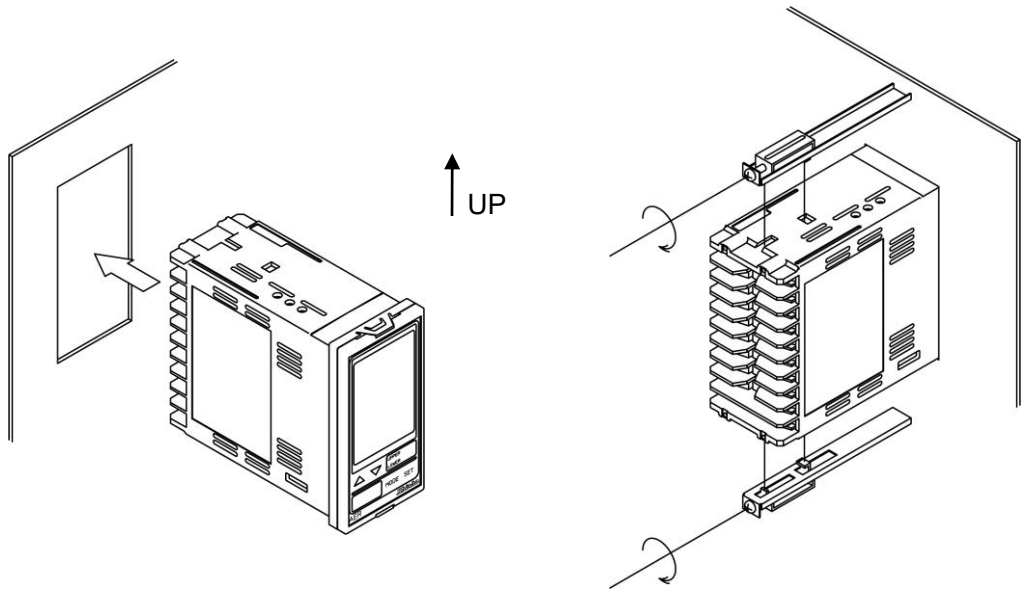
(2) Attach the mounting brackets by the holes at the top and bottom of the case, and secure the unit in place with the screws.

How to remove the unit

(1) Turn the power to the unit OFF, and disconnect all wires before removing the unit.

(2) Loosen the screws of the mounting brackets, and remove the mounting brackets.

(3) Pull the unit out from the front of the panel.



(Fig. 3.4-1)

4. Wiring

⚠ Warning

Turn the power supply to the instrument off before wiring or checking. Working on or touching the terminal with the power switched on may result in severe injury or death due to electrical shock.

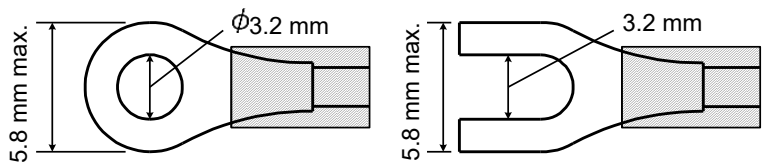
⚠ Caution

- Do not leave wire remnants in the instrument, as they could cause a fire or a malfunction.
- Use a solderless terminal with an insulation sleeve in which the M3 screw fits when wiring the AER-101-TU.
- The terminal block of this instrument is designed to be wired from the left side. The lead wire must be inserted from the left side of the terminal, and fastened with the terminal screw.
- Tighten the terminal screw using the specified torque. If excessive force is applied to the screw when tightening, the terminal screw may be damaged.
- This instrument does not have a built-in power switch, circuit breaker and fuse. It is necessary to install a power switch, circuit breaker and fuse near the instrument. (Recommended fuse: Time-lag fuse, rated voltage 250 V AC, rated current 2 A)
- For a 24 V AC/DC power source, do not confuse polarity when using direct current (DC).
- Be sure to connect the ground terminal to earth for safety (D-class grounding). Keep the grounding of this unit separate from other electrical devices, such as motors.
- Do not apply a commercial power source to the Turbidity/SS sensor which is connected to the input terminals nor allow the power source to come into contact with the sensor.
- Use the Turbidity sensor or SS sensor made by OPTEX Co., Ltd.
- Keep the input wires and power lines separate.

4.1 Lead Wire Solderless Terminal

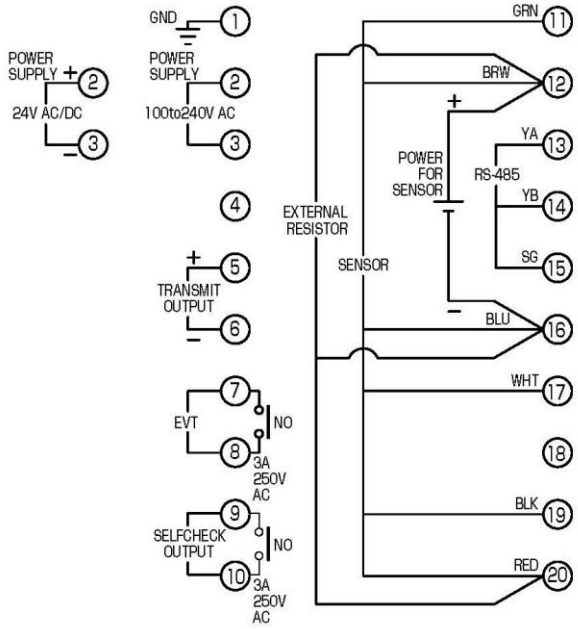
Use a solderless terminal with an insulation sleeve in which an M3 screw fits as follows. The tightening torque should be 0.63 N•m.

Solderless Terminal	Manufacturer	Model	Tightening Torque
Y-type	NICHIFU TERMINAL INDUSTRIES CO., LTD.	TMEX1.25Y-3	0.63 N•m
	J.S.T.MFG.CO.,LTD.	VD1.25-B3A	
Ring-type	NICHIFU TERMINAL INDUSTRIES CO., LTD.	TMEX1.25-3	
	J.S.T.MFG.CO.,LTD.	V1.25-3	



(Fig. 4.1-1)

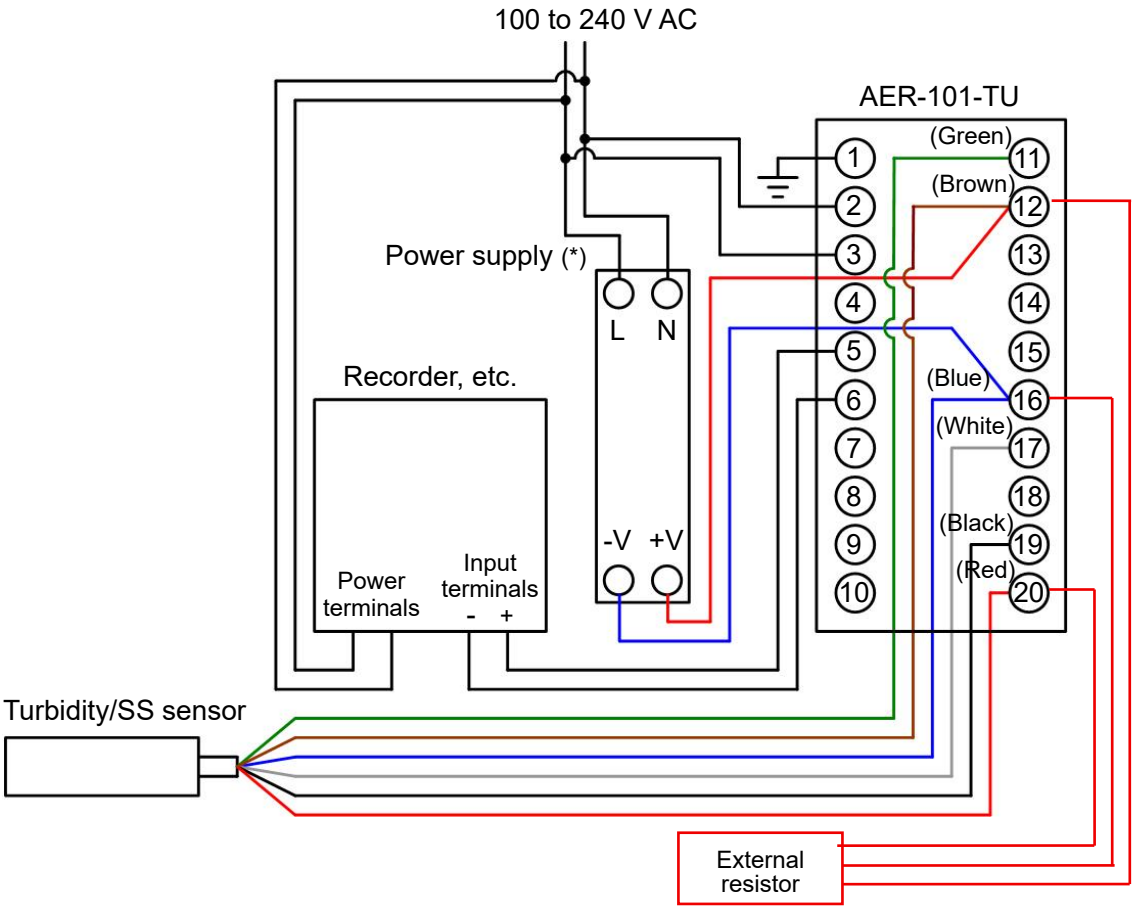
4.2 Terminal Arrangement



(Fig. 4.2-1)

Code, Terminal No.			Description
GND		①	Ground
POWER SUPPLY		② ③	100 to 240 V AC or 24 V AC/DC (When 1 is added after 'TU') For 24 V DC, ensure polarity is correct.
TRANSMIT OUTPUT		⑤ ⑥	Transmission output
EVT		⑦ ⑧	EVT output (Contact output)
SELFCHECK OUTPUT		⑨ ⑩	Self-check output (Contact output)
SENSOR	GRN	⑪	Self-check input terminal for Turbidity/SS sensor (Green)
	BRW	⑫	Power (+) terminal for Turbidity/SS sensor (Brown) BRW terminal for External resistor
	BLU	⑯	Power (–) terminal for Turbidity/SS sensor (Blue) BLU terminal for External resistor
	WHT	⑰	Analog signal (+) input terminal for Turbidity/SS sensor (White)
	BLK	⑲	Analog signal (–) input terminal for Turbidity/SS sensor (Black)
	RED	⑳	Calibration signal output terminal for Turbidity/SS sensor (Red) RED terminal for External resistor
POWER FOR SENSOR	+	⑫	External power (+) terminal
	–	⑯	External power (–) terminal
RS-485	YA	⑬	Serial communication RS-485 (C5 option)
	YB	⑭	
	SG	⑮	

4.3 Wiring Example



(Fig. 4.3-1)

(*) **Power Supply** (OMRON products recommended)

Turbidity Sensor, SS Sensor	Power Supply Model
Turbidity sensor: TC-100, TC-500, TC-3000 SS sensor: TCS-1000 (E)	S8VS-01512 (12 V DC)
SS sensor: TS-MxS-A	S8VS-01524 (24 V DC)

5. Outline of Key Operation and Setting Groups

5.1 Outline of Key Operation

There are 2 setting modes: Simple Setting mode, and Group Selection mode in which setting items are divided into groups.

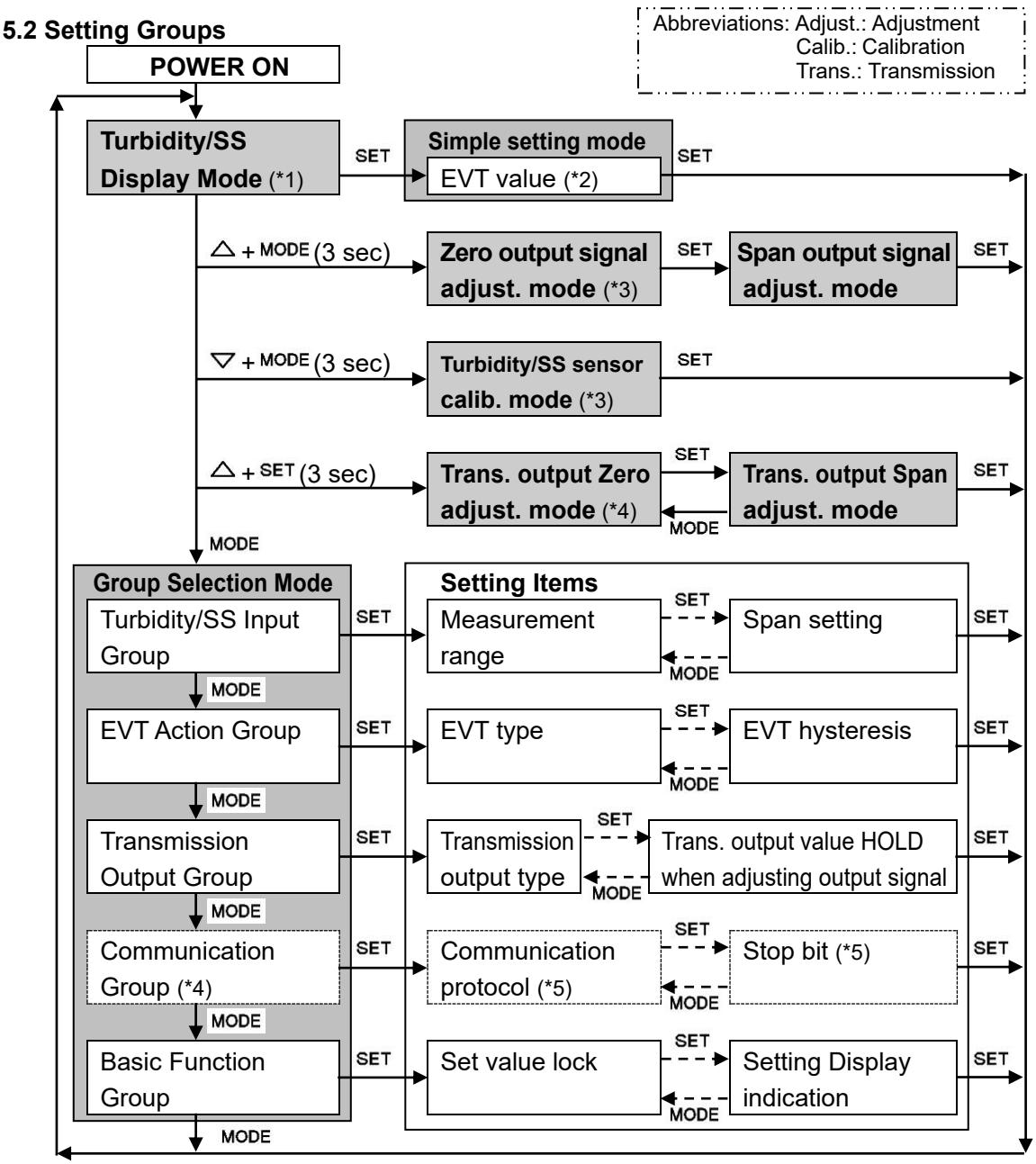
If the SET key is pressed in Turbidity/SS Display Mode, the unit enters Simple Setting mode.

If the MODE key is pressed in Turbidity/SS Display Mode, the unit enters Group Selection mode.

If a group is selected with the MODE key, and the SET key is pressed, the unit enters each setting item.

To set each setting item, use the △ or ▽ key, and register the value with the SET key.

5.2 Setting Groups



(Fig. 5.2-1)

(*1) In Turbidity/SS Display Mode, measurement starts, indicating an item selected in [Backlight selection (p.32)] in Basic Function Group.

(*2) If ----- (No action), ERoUT (Error output) or FAIL (Fail output) is selected in [EVT type (p.24)] in EVT Action Group, the unit cannot enter Simple Setting Mode.

(*3) If Lock1 (Lock 1), Lock2 (Lock 2) or Lock3 (Lock 3) is selected in [Set value lock (p.32)] in Basic Function Group, the unit cannot enter Zero output signal adjustment mode or Turbidity/SS sensor calibration mode.

(*4) If Lock1 (Lock 1), Lock2 (Lock 2) or Lock3 (Lock 3) is selected in [Set value lock (p.32)] in Basic Function Group, the unit cannot enter Transmission output Zero adjustment mode while adjusting Zero or Span output signal, or while calibrating the Turbidity/SS sensor.

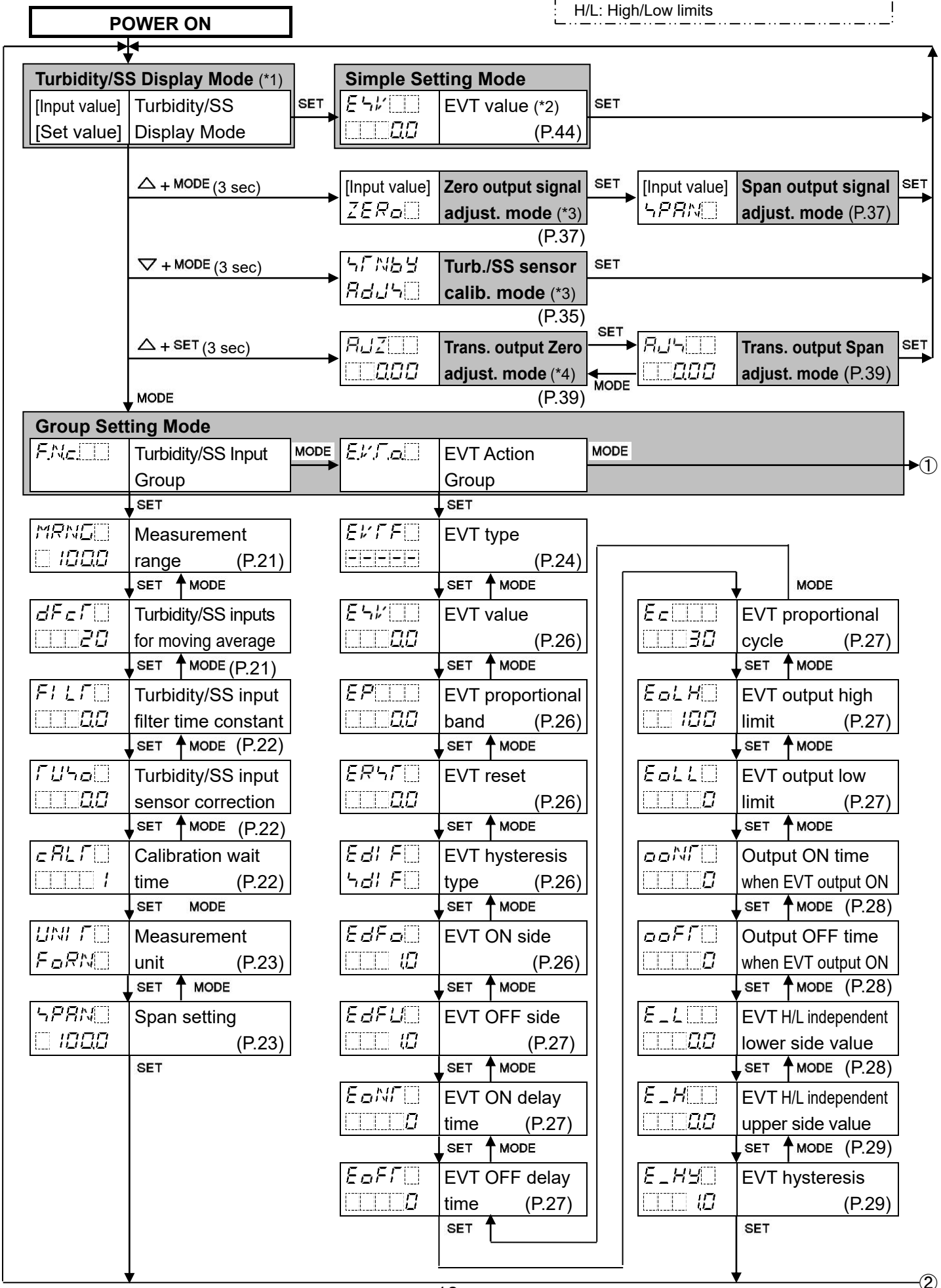
(*5) Setting items and group with dotted lines are optional, and they appear only when the C5 option is ordered.

[About Key Operation]

- △ + MODE (3 sec): Press and hold the △ key and MODE key (in that order) together for 3 seconds. The unit will proceed to Zero Output Signal Adjustment mode.
- ▽ + MODE (3 sec): Press and hold the ▽ key and MODE key (in that order) together for 3 seconds. The unit will proceed to Turbidity/SS sensor Calibration mode.
- △ + SET (3 sec): Press and hold the △ key and SET key (in that order) together for 3 seconds. The unit will proceed to Transmission Output Zero Adjustment mode.
- MODE, SET: Press the MODE or SET key. The unit will proceed to the next setting item, illustrted by an arrow.
- SET → or ← MODE: Press the SET or MODE key until the desired setting mode appears.
- To revert to Turbidity/SS Display Mode, press and hold the MODE key for 3 seconds while in any mode.

6. Key Operation Flowchart

Abbreviations:
Adjust.: Adjustment Turb.: Turbidity,
Calib.: Calibration Trans.: Transmission
H/L: High/Low limits



[**About Setting Items**]

EMV 0.0	Measurement range (P.21)

- **Upper left**: Turbidity/SS Display: Indicates the setting item characters.
- **Lower left**: Setting Display: Indicates the factory default.
- **Right side**: Indicates the setting item and reference page.

[**About Each Mode and Setting Items]]**

(*1) In Turbidity/SS Display Mode, measurement starts, indicating the item selected in [Backlight selection (P.32).

(*2) If ------ (No action), ERoUT (Error output) or FAIL (Fail output) is selected in [EVT type (P.24)], the unit cannot enter Simple Setting Mode.

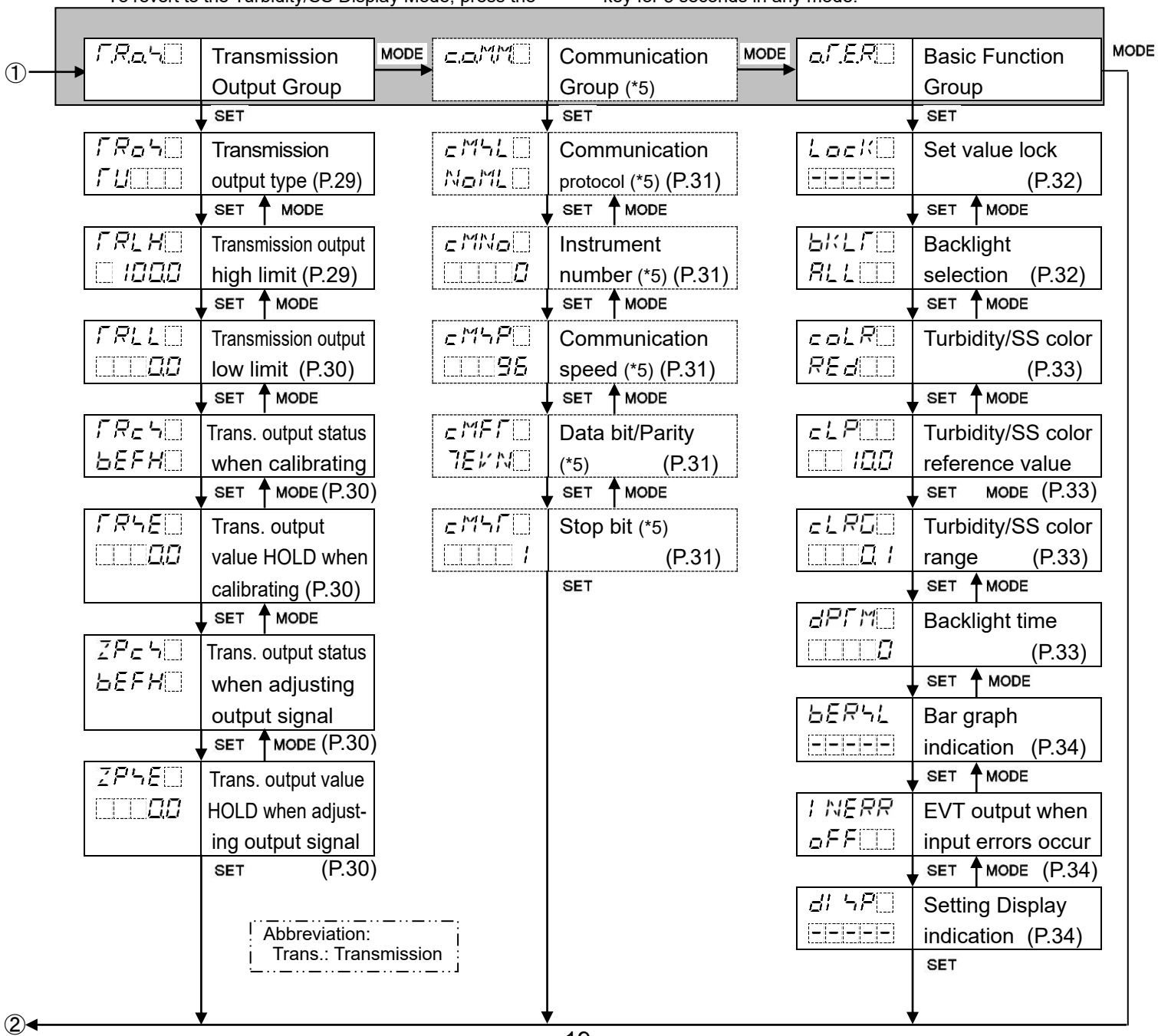
(*3) If Lock1 (Lock 1), Lock2 (Lock 2) or Lock3 (Lock 3) is selected in [Set value lock (P.32)], the unit cannot enter Zero output signal adjustment mode or Turbidity/SS sensor calibration mode.

(*4) If Lock1 (Lock 1), Lock2 (Lock 2) or Lock3 (Lock 3) is selected in [Set value lock (P.32)], and when the unit is adjusting Zero or Span output signal or calibrating Turbidity/SS sensor, the unit cannot enter Transmission output Zero adjustment mode.

(*5) Setting items and group with dotted lines are optional, and they appear only when the C5 option is ordered.

[About Key Operation]

- △ + MODE (3 sec): Press and hold the △ and MODE keys (in that order) together for 3 sec. The unit enters the next mode.
- ▽ + MODE (3 sec): Press and hold the ▽ and MODE keys (in that order) together for 3 sec. The unit enters the next mode.
- △ + SET (3 sec): Press and hold the △ and SET keys (in that order) together for 3 sec. The unit enters the next mode.
- MODE, SET: Press the MODE or SET key. The unit will proceed to the next setting item, illustrated by an arrow.
- To revert to the Turbidity/SS Display Mode, press the MODE key for 3 seconds in any mode.



7. Setup

Setup should be done before using this instrument according to the user's conditions Setting Turbidity/SS input, EVT type, Transmission output, Communication (C5 option), and Indication settings (Backlight selection, Turbidity/SS color, etc.)]

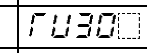
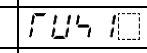
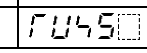
Setup can be conducted in the Turbidity/SS Input Group, EVT Action Group, Transmission Output Group, Communication Group (C5 option) and Basic Function Group.

If the user's specification is the same as the factory default of the AER-101-TU, or if setup has already been complete, it is not necessary to set up the instrument. Proceed to Section "8. Calibration (p.35)".

7.1 Turn the Power Supply to the AER-101-TU ON.

For approx. 4 seconds after the power is switched ON, the following characters are indicated on the Turbidity/SS Display. (Table 7.1-1)

(Table 7.1-1)

Measurement Range	Turbidity/SS Display
0.0 to 100.0 (Formazin)	
0 to 500 (Formazin)	
0 to 3000 (Formazin)	
0 to 1000 mg/L (Kaolin)	
0 to 50000 mg/L (Kaolin)	

During this time, all outputs are in OFF status, and action indicators are turned off. After that, measurement starts, indicating the item selected in [Backlight selection (p.32)].
This status is called Turbidity/SS Display Mode.

7.2 Turbidity/SS Input Group

To enter the Turbidity/SS Input Group, follow the procedure below.

① FNc Press the MODE key in Turbidity/SS Display Mode.

② MRNG Press the SET key.

The unit proceeds to the Turbidity/SS Input Group, and “Measurement range” is indicated.

<table>
<tr><th>Character</th><th>Setting Item, Function, Setting Range</th><th>Factory Default</th></tr>
<tr><td>MRNG
100.0</td><td>Measurement range
• Selects measurement range corresponding to the Turbidity or SS sensor model.
If measurement range is changed, setting data (EVT value, EVT proportional band, EVT reset, EVT ON side, EVT OFF side, EVT High/Low limits independent lower side value, and EVT High/Low limits independent upper side value) will be cleared. Set them again.
• Selection item
<table>
<tr><th>Selection</th><th>Measurement Range</th><th>Model</th></tr>
<tr><td>100.0</td><td>0.0 to 100.0 (Formazin)</td><td>Turbidity sensor TC-100</td></tr>
<tr><td>500</td><td>0 to 500 (Formazin)</td><td>Turbidity sensor TC-500</td></tr>
<tr><td>3000</td><td>0 to 3000 (Formazin)</td><td>Turbidity sensor TC-3000</td></tr>
<tr><td>1000</td><td>0 to 1000 mg/L (Kaolin)</td><td>SS sensor TCS-1000(E)</td></tr>
<tr><td>5000</td><td>0 to 50000 mg/L (Kaolin) (*)</td><td>SS sensor TS-MxS-A</td></tr>
</table>
(*) The measurement range of the SS sensor TS-MxS-A is 0 to 50000 mg/L (Kaolin).
The ones digit of the current Turbidity/SS value is rounded off, and is divided by 10. This value is indicated as an input value.
(e.g.) 25004 mg/L (Kaolin) is indicated as 2500.
25005 mg/L (Kaolin) is indicated as 2501.</td><td>0.0 to 100.0 (Formazin)</td></tr>
<tr><td>dFcT
20</td><td>Turbidity/SS inputs for moving average
• Sets the number of Turbidity/SS inputs used to obtain a moving average.
• Setting range: 1 to 120</td><td>20</td></tr>
</table>

Character	Setting Item, Function, Setting Range	Factory Default
FILT 00.0	**Turbidity/SS input filter time constant** • Sets filter time constant for Turbidity/SS input. Even when Turbidity/SS input value before filter process changes as shown in (Fig. 7.2-1), if the filter time constant "T" is set, the Turbidity/SS input value changes as shown in (Fig. 7.2-2) so that Turbidity/SS input value after finishing filter process can reach 63% (of the desired value) after T seconds have passed. If the filter time constant is set too large, it affects EVT action due to the delay of response. (e.g.) In case the LSD (least significant digit) of the Turbidity/SS input value prior to filter process is fluctuating, it can be suppressed by using the filter time constant. Turbidity/SS input value Time (sec) (Fig. 7.2-1) Turbidity/SS input value 100% 63% T Time (sec) (Fig. 7.2-2) • Setting range: 0.0 to 10.0 seconds	0.0 seconds
SUbo 00.0	**Turbidity/SS input sensor correction** • Sets Turbidity/SS input sensor correction value. This corrects the input value from the Turbidity/SS sensor. When a Turbidity/SS sensor cannot be installed at the exact location where measurement is desired, Turbidity/SS input value by the sensor may deviate from the input value in the measured location. In this case, desired Turbidity/SS input value can be obtained by adding a sensor correction value. However, it is effective within the measurement range regardless of the sensor correction value. Turbidity/SS input value after sensor correction = Current Turbidity/SS input value + (Sensor correction value) • Setting range: ±10% of measurement span (*1) (*2)	0
cALT 1	**Calibration wait time** • Sets the waiting time until calibration signal output turns from OFF to ON after the unit has entered Turbidity/SS Sensor Calibration mode. • Setting range: 0 to 10 minutes	1 minute

(*1) The measurement unit and decimal point place follow the selection in [Measurement range (p.21)].

(*2) If KAoN [Kaolin (mg/L)] is selected in [Measurement unit (p.23)], measurement span will become the value set in [Span setting (p.23)].

Character	Setting Item, Function, Setting Range	Factory Default
UNIT FoRN	**Measurement unit** (*1) • Selects the measurement range unit. Not available if 1000 [0 to 1000 mg/L (Kaolin)] or 5000 [0 to 50000 mg/L (Kaolin) is selected in [Measurement range (p.21)]. **If measurement unit is changed, setting data (EVT value, EVT proportional band, EVT reset, EVT ON side and EVT OFF side, EVT High/Low independent lower side value, and EVT High/Low independent upper side value) will be cleared. Set them again**. • FoRN: Formazin KAoN: Kaolin (mg/L)	Formazin
SPAN 100.0	**Span setting** (*2) • Set span in order to change Formazin to Kaolin. Not available if FoRN (Formazin) is selected in [Measurement unit]. • Setting range: (Table 7.2-1)(P.23)	100.0 (Formazin)

(*1) The measurement unit and decimal point place follow the selection in [Measurement range (p.21)].
(*2) In [Measurement unit] and [Span setting], Formazin turbidity input value can be changed to the equivalent Kaolin value.

(e.g.) When changing Formazin turbidity input value to Kaolin value by using the Turbidity sensor.

Order	Description
①	Take several examples of Formazin turbidity input value and Kaolin value in order to examine the correlation between them. This must be done in the desired measurement location.
②	Confirm that both Formazin turbidity input value and Kaolin value are linearly related, and calculate span setting value using the value from each measurement unit closest to the span setting value. The following shows the calculating formula. Span setting value = Current span value x Kaolin value / Formazin Turbidity input value (e.g.) Current span value (Formazin): 100.0 Turbidity input value (Formazin): 80.0 Kaolin value: 60.0 mg/L Span setting value = 100.0 x 60.0 / 80.0 = 75.0
③	Select KAoN [Kaolin (mg/L)] in [Measurement unit].
④	For the Span setting, set the value calculated at step ② (e.g. 75.0).
⑤	Attach the user's unit of Turbidity/SS Display from the included unit labels if necessary. (See p.9.)

(Table 7.2-1)

Measurement Range	Measurement Unit	Setting Range	Factory Default
0.0 to 100.0 (Formazin)	Kaolin (mg/L)	0.0 to 900.0 (Formazin)	100.0 (Formazin)
0 to 500 (Formazin)		0 to 9000 (Formazin)	500 (Formazin)
0 to 3000 (Formazin)		0 to 9000 (Formazin)	3000 (Formazin)

7.3 EVT Action Group

To enter the EVT Action Group, follow the procedure below.

① EVT□ Press the MODE key twice in Turbidity/SS Display Mode.

② EVTF Press the SET key.

The unit enters the EVT Action Group, and "EVT type" will appear.

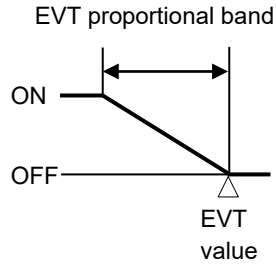
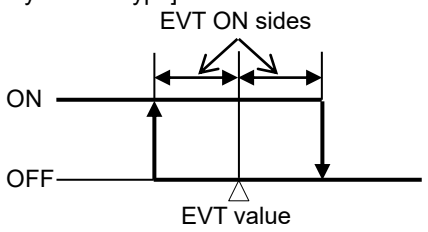
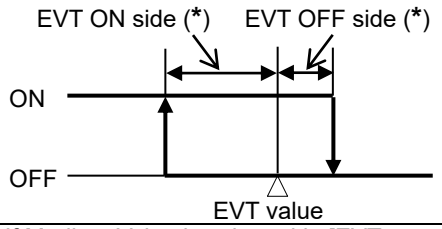
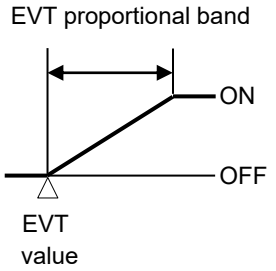
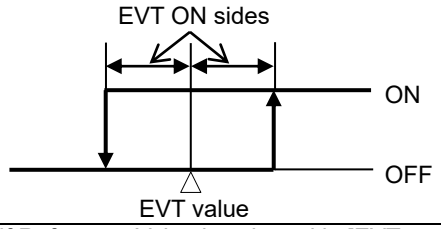
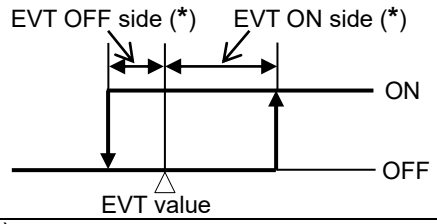
Character	Setting Item, Function, Setting Range	Factory Default
EVTF -----	**EVT type** • Selects an EVT output (Contact output) type. **Note: If EVT type is changed, EVT value defaults to 0.0 or 0.** • ----- : No action TU_L□ : Turbidity/SS input low limit action (Fig. 7.3-1)(p.25) TU_H□ : Turbidity/SS input high limit action (Fig. 7.3-1)(p.25) ERoUT : Error output [When the error type is "Error" (Table 7.3-1), the output is turned ON.] FAIL□ : Fail output [When the error type is "Fail" (Table 7.3-1), the output is turned ON.] TU_HL : Turbidity/SS input High/Low limits independent action (Fig.7.3-2)(p.25)	No action

• **Error output, Fail output**

(Table 7.3-1)

Error Type	Error Contents	Occurrence
Fail	When receiving Self-check output from Turbidity/SS sensor	When measuring
Fail	Analog signal (+, White) (–, Black) cable of Turbidity/SS sensor is disconnected or short-circuited.	
Error	Turbidity/SS input value has exceeded the value equivalent to 20.5 mA DC.	
Error	Turbidity/SS input value has dropped below the value equivalent to 3.5 mA DC.	
Fail	During calibration, the output signal from the Turbidity/SS sensor has not reached approx. 2 mA DC. (Before the calibration signal output switches from ON to OFF, if the output signal from the Turbidity/SS sensor is between 1 and 3 mA DC, it is regarded as normal. If the output signal is outside of this range, it is regarded as a Fail.)	When calibrating
Fail	After calibration is finished, the output signal from the Turbidity/SS sensor has not returned to 4 mA DC. (Approximately 5 seconds after the calibration signal output switches from ON to OFF, if the output signal from the Turbidity/SS sensor is between 3.5 and 4.5 mA DC, it is regarded as normal. If the output signal is outside of this range, it is regarded as a Fail.)	
Error	During span output signal adjustment, Turbidity/SS input value has exceeded the value equivalent to 20.5 mA DC.	When adjusting
Error	During zero output signal adjustment, Turbidity/SS input value has dropped below the value equivalent to 3.5 mA DC.	

• **EVT Action**

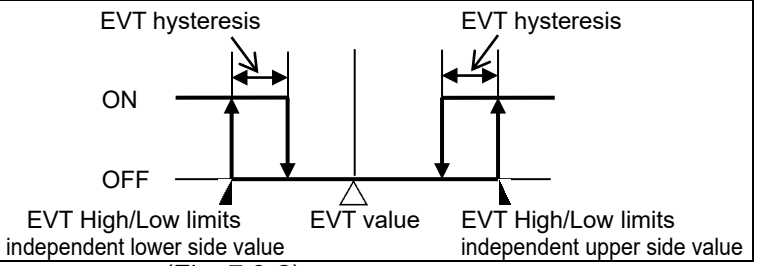
EVT Type	P Control Action	ON/OFF Control Action
Turbidity/SS input low limit action, (Activated based on indication value)		If Medium Value is selected in [EVT hysteresis type]:  If Reference Value is selected in [EVT hysteresis type]: 
Turbidity/SS input high limit action, (Activated based on indication value)		If Medium Value is selected in [EVT hysteresis type]:  If Reference Value is selected in [EVT hysteresis type]: 

(Fig. 7.3-1)

*** Setting Example:**

If [EVT1 ON side (E 1dFo)] is set to 0.0, EVT1 output can be turned ON at the value set in [EVT1 value (Ev1 1)].

If [EVT1 OFF side (E 1dFU)] is set to 0.0, EVT1 output can be turned OFF at the value set in [EVT1 value (Ev1 1)].

EVT Type	ON/OFF Control Action
Turbidity/SS input High/Low limits independent action (Activated based on indication value)	

(Fig. 7.3-2)

Character	Setting Item, Function, Setting Range	Factory Default
EVV□ □□□0.0	**EVT value** • Sets EVT value. (Fig. 7.3-1, p.25) • Not available for this setting item and all following items if ----- (No action), EROUT (Error output) or FAIL□ (Fail output) is selected in [EVT type]. • Setting range: Measurement range low limit to Measurement range high limit (*1) (*2)	0.0 (Formazin)
EP□□□ □□□0.0	**EVT proportional band** • Sets EVT proportional band. (Fig. 7.3-1, p.25) ON/OFF control action when set to 0.0 or 0. • Not available if TU_HL (Turbidity/SS input High/Low limits independent action) is selected in [EVT type]. • Setting range: Measurement range low limit to Measurement range high limit (*1) (*2)	0.0 (Formazin)
ERSF□ □□□0.0	**EVT reset** • Sets EVT reset value. • Not available for the ON/OFF control action. • Not available if TU_HL (Turbidity/SS input High/Low limits independent action) is selected in [EVT type]. • Setting range: ±10% of measurement span (*1) (*3)	0.0 (Formazin)
Edi F□ Sdi F□	**EVT hysteresis type** • Selects EVT output hysteresis type (Medium or Reference Value). (Fig. 7.3-1, p.25) • Not available for the P control action. • Not available if TU_HL (Turbidity/SS input High/Low limits independent action) is selected in [EVT type]. • cdi F□: Medium Value Sets the same value for both ON and OFF sides in relation to EVT value. Only ON side needs to be set. Sdi F□: Reference Value Sets individual values for ON and OFF sides in relation to EVT value. Both ON and OFF sides need to be set individually.	Reference Value
EdFo□ □□□ 1.0	**EVT ON side** • Sets the span of EVT ON side. (Fig. 7.3-1, p.25) If cdi F□ (Medium Value) is selected in [EVT hysteresis type], the span of ON/OFF side will be the same value. • Not available for the P control action. • Not available if TU_HL (Turbidity/SS input High/Low limits independent action) is selected in [EVT type]. • Setting range: 0 to 20% of measurement span (*1) (*3)	1.0 (Formazin)

(*1) The measurement unit and decimal point place follow the selection in [Measurement range (p.21)].

(*2) If KAoN□ [Kaolin (mg/L)] is selected in [Measurement unit (p.23)], measurement range high limit value will become the value set in [Span setting (p.23)].

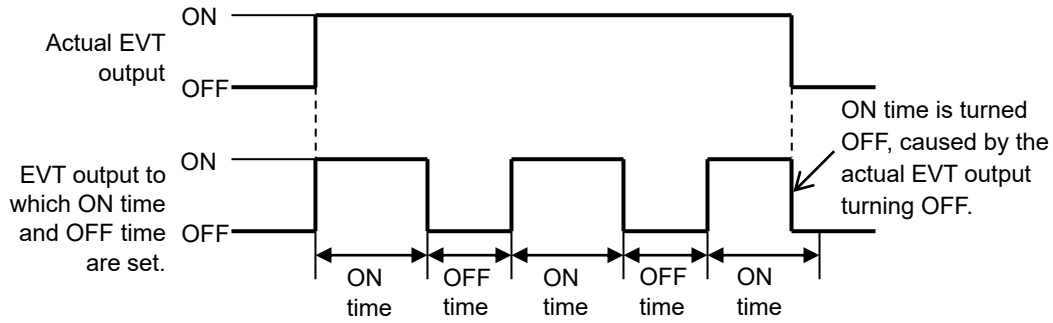
(*3) If KAoN□ [Kaolin (mg/L)] is selected in [Measurement unit (p.23)], measurement span will become the value set in [Span setting (p.23)].

Character	Setting Item, Function, Setting Range	Factory Default
EdFU 10	**EVT OFF side** • Sets the span of EVT OFF side. (Fig. 7.3-1, p.25) • Not available for the P control action, or if cdI F (Medium Value) is selected in [EVT hysteresis type]. • Not available if FU_HL (Turbidity/SS input High/Low limits independent action) is selected in [EVT type]. • Setting range: 0 to 20% of Measurement span (*1) (*2)	1.0 (Formazin)
EoNF 0	**EVT ON delay time** • Sets EVT action ON delay time. The EVT output does not turn ON (under the conditions of turning ON) until the time set in [EVT ON delay time] elapses. • Not available for the P control action. • Setting range: 0 to 10000 seconds	0 seconds
EoFF 0	**EVT OFF delay time** • Sets EVT action OFF delay time. The EVT output does not turn OFF (under the conditions of turning OFF) until the time set in [EVT OFF delay time] elapses. • Not available for the P control action. • Setting range: 0 to 10000 seconds	0 seconds
Ec 30	**EVT proportional cycle** • Sets EVT proportional cycle. • Not available for the ON/OFF control action. • Not available if FU_HL (Turbidity/SS input High/Low limits independent action) is selected in [EVT type]. • Setting range: 1 to 300 seconds	30 seconds
EoLH 100	**EVT output high limit** • Sets EVT output high limit value. • Not available for the ON/OFF control action. • Not available if FU_HL (Turbidity/SS input High/Low limits independent action [EVT type]. • Setting range: EVT output low limit to 100%	100%
EoLL 0	**EVT output low limit** • Sets EVT output low limit value. • Not available for the ON/OFF control action. • Not available if FU_HL (Turbidity/SS input High/Low limits independent action) is selected in [EVT type]. • Setting range: 0% to EVT output high limit	0%

(*1) The measurement unit and decimal point place follow the selection in [Measurement range (p.21)].
(*2) If KAoN [Kaolin (mg/L)] is selected in [Measurement unit (p.23)], measurement span will become the value set in [Span setting (p.23)].

Character	Setting Item, Function, Setting Range	Factory Default
oonT 0	**Output ON Time when EVT output ON** • Sets Output ON time when EVT output is ON. If ON time and OFF time are set, EVT output can be turned ON/OFF in a configured cycle when EVT output is ON. (Fig. 7.3-3) • Not available for P control action • Not available if TU_HL (Turbidity/SS input High/Low limits independent action) is selected in [EVT type]. • Setting range: 0 to 10000 seconds	0 seconds
ooFT 0	**Output OFF Time when EVT output ON** • Sets Output OFF time when EVT output is ON. If ON time and OFF time are set, EVT output can be turned ON/OFF in a configured cycle when EVT output is ON. (Fig. 7.3-3) • Not available for P control action • Not available if TU_HL (Turbidity/SS input High/Low limits independent action) is selected in [EVT type]. • Setting range: 0 to 10000 seconds	0 seconds

Timing chart (Output ON time and OFF time when EVT output is ON)



(Fig. 7.3-3)

E_L 0.0	**EVT High/Low limits independent lower side value** • Sets EVT High/Low limits independent lower side value. (Fig. 7.3-2)(P.25) • Disabled when set to 0 or 0.0. • Available when TU_HL (Turbidity/SS input High/Low limits independent action is selected in [EVT type]. • Setting range: Measurement range low limit to Measurement range high limit (*1) (*2)	0.0 (Formazin)

(*1) The measurement unit and decimal point place follow the selection in [Measurement range (p.21)].

(*2) If KAoN [Kaolin (mg/L)] is selected in [Measurement unit (p.23)], measurement range high limit value will become the value set in [Span setting (p.23)].

Character	Setting Item, Function, Setting Range	Factory Default
E_H 0.0	**EVT High/Low limits independent upper side value** • Sets EVT High/Low limits independent lower side value. (Fig. 7.3-2)(p.25) • Disabled when set to 0 or 0.0. • Available when TU_HL (Turbidity/SS input High/Low limits independent action) is selected in [EVT type]. • Setting range: Measurement range low limit to Measurement range high limit (*1) (*2)	0.0 (Formazin)
E_HY 10	**EVT hysteresis** • Sets hysteresis of EVT High/Low limits independent action (Fig. 7.3-2)(p.25) • Available when TU_HL (Turbidity/SS input High/Low limits independent action) is selected in [EVT type]. • Setting range: 0.1 to 20% of measurement span (*1)(*3)	1.0 (Formazin)

(*1) The measurement unit and decimal point place follow the selection in [Measurement range (p.21)].

(*2) If KAoN [Kaolin (mg/L)] is selected in [Measurement unit (p.23)], measurement range high limit will become the value set in [Span setting (p.23)].

(*3) If KAoN [Kaolin (mg/L)] is selected in [Measurement unit (p.23)], measurement span will become the value set in [Span setting (p.23)].

7.4 Transmission Output Group

To enter the Transmission Output Group, follow the procedure below.

① TRo4 Press the MODE key 3 times in Turbidity/SS Display Mode.

② TRLH Press the SET key.

The unit enters the Transmission Output Group, and “Transmission output type” will appear.

Character	Setting Item, Function, Setting Range	Factory Default
TRo4 TU	**Transmission output type** • Selects Transmission output type. • TU : Turbidity/SS transmission MV : EVT MV transmission	Turbidity/SS transmission
TRLH 100.0	**Transmission output high limit** • Sets Transmission output high limit value. (This value correponds to 20 mA DC output.). If Transmission output high limit and low limit are set to the same value, Transmission output will be fixed at 4 mA DC. • Setting range: Turbidity/SS transmission: Transmission output low limit to Measurement range high limit (*1) (*2) MV transmission: Transmission output low limit to 100.0%	Turbidity/SS transmission: 100.0 (Formazin) MV transmission: 100.0%

(*1) The measurement unit and decimal point place follow the selection in [Measurement range (p.21)].

(*2) If KAoN [Kaolin (mg/L)] is selected in [Measurement unit (p.23)], measurement range high limit value will become the value set in [Span setting (p.23)].

Character	Setting Item, Function, Setting Range	Factory Default
TRLL 0.0	**Transmission output low limit**	Turbidity/SS transmission: 0.0 (Formazin) MV transmission: 0.0%
	• Sets Transmission output low limit value. (This value correponds to 4 mA DC output.). If Transmission output high limit and low limit are set to the same value, Transmission output will be fixed at 4 mA DC. • Setting range: Turbidity/SS transmission: Measurement range low limit to Transmission output high limit (*1) MV transmission: 0.0% to Transmission output high limit	
TRcS bEFH	**Transmission output status when calibrating**	Last value HOLD
	• Selects Transmission output status when calibrating. • bEFH: Last value HOLD (Retains the last value before calibration, and outputs it.) SEtH: Set value HOLD (Outputs the value set in [Transmission output value HOLD when calibrating].) PVtH: Measured value (Outputs the measured value when calibrating.)	
TRSE 0.0	**Transmission output value HOLD when calibrating**	Turbidity/SS transmission: 0.0 (Formazin) MV transmission: 0.0%
	• Sets Transmission output value HOLD. • Available only when SEtH (Set value HOLD) is selected in [Transmission output status when calibrating]. • Setting range: Turbidity/SS transmission: Measurement range low limit to Measurement range high limit (*1)(*2) MV transmission: 0.0 to 100.0%	
ZPcS bEFH	**Transmission output status when adjusting output signal**	Last value HOLD
	• Selects Transmission output status when adjusting Zero or Span output signal. • bEFH: Last value HOLD (Retains the last value before the output signal adjustment, and outputs it.) SEtH: Set value HOLD (Outputs the value set in [Transmission output value HOLD when adjusting output signal].) PVtH: Measured value (Outputs the measured value when adjusting output signal.)	
ZPSE 0.0	**Transmission output value HOLD when adjusting output signal**	Turbidity/SS transmission: 0.0 (Formazin) MV transmission: 0.0%
	• Sets Transmission output value HOLD. • Available only when SEtH (Set value HOLD) is selected in [Transmission output status when adjusting output signal]. • Setting range: Turbidity/SS transmission: Measurement range low limit to Measurement range high limit (*1)(*2) MV transmission: 0.0 to 100.0%	

(*1) The measurement unit and decimal point place follow the selection in [Measurement range (p.21)].
(*2) If KAoN [Kaolin (mg/L)] is selected in [Measurement unit (p.23)], measurement range high limit value will become the value set in [Span setting (p.23)].

7.5 Communication Group

To enter the Communication Group, follow the procedure below.

This group is available only when Serial communication (C5 option) is ordered.

① c.aMM Press the MODE key 4 times in Turbidity/SS Display Mode.

② cMSL Press the SET key.

The unit enters the Communication Group, and the 'Communication protocol' will appear.

Character	Setting Item, Function, Setting Range	Factory Default
cMSL NoML	**Communication protocol** • Selects communication protocol. • NoML : Shinko protocol ModA : MODBUS ASCII mode ModR : MODBUS RTU mode	Shinko protocol
cMNo 0	**Instrument number** • Sets the instrument number of this unit. (The instrument numbers should be set one by one when multiple instruments are connected, otherwise communication is impossible.) • Setting range: 0 to 95	0
cMSP 96	**Communication speed** • Selects a communication speed equal to that of the host computer. • 96 : 9600 bps 192 : 19200 bps 384 : 38400 bps	9600 bps
cMFT 7EVN	**Data bit/Parity** • Selects data bit and parity. • 8NoN : 8 bits/No parity 7NoN : 7 bits/No parity 8EVN : 8 bits/Even 7EVN : 7 bits/Even 8odd : 8 bits/Odd 7odd : 7 bits/Odd	7 bits/Even
cMST 1	**Stop bit** • Selects the stop bit. • 1 : 1 bit 2 : 2 bits	1 bit

7.6 Basic Function Group

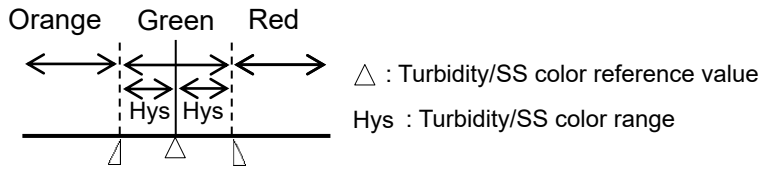
To enter the Basic Function Group, follow the procedure below.

① aT.E.R Press the MODE key 4 times in Turbidity/SS Display Mode.
If Serial communication (C5 option) is ordered, press the MODE key 5 times in Turbidity/SS Display Mode.

② LocK Press the SET key.

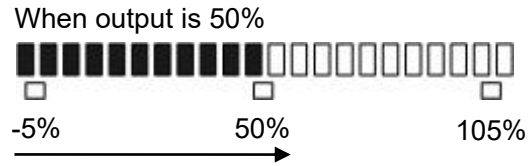
The unit enters the Basic Function Group, and the “Set value lock” will appear.

Character	Setting Item, Function, Setting Range	Factory Default
LocK -----	**Set value lock** • Locks the set values to prevent setting errors. If LocK 1 (Lock 1), LocK2 (Lock 2) or LocK3 (Lock 3) is selected, the unit cannot enter Zero output signal adjustment mode or Turbidity/SS sensor calibration mode. • ----- (Unlock): All set values can be changed. LocK 1 (Lock 1) : None of the set values can be changed. LocK2 (Lock 2) : Only EVT value can be changed. LocK3 (Lock 3): All set values – except Measurement range, Measurement unit, Span setting, Zero and Span output signals, Turbidity/SS sensor calibration, Transmission output Zero and Span adjustments – can be temporarily changed. However, they revert to their previous value after the power is turned off because they are not saved in the non-volatile IC memory. If EVT type is changed, it will affect other setting items, so do not change the EVT type. Be sure to select Lock 3 when changing the set value frequently via software communication. (If a value set via software communication is the same as the value before the setting, the value will not be written in non-volatile IC memory.)	Unlock
bKLT ALL	**Backlight selection** • Selects the display to backlight. • ALL : All are backlit. TU : Turbidity/SS Display SET : Setting Display Ac : Action indicator TUST : Turbidity/SS Display + Setting Display TUAc : Turbidity/SS Display + Action indicator SETAc : Setting Display + Action indicator	All are backlit

Character	Setting Item, Function, Setting Range	Factory Default
coLR REd	**Turbidity/SS color** • Selects a color for the Turbidity/SS Display. • GRN: Green REd: Red oRG: Orange FUCR: Turbidity/SS color changes continuously. (Fig. 7.8-1) The Turbidity/SS Display color changes according to settings in [Turbidity/SS color reference value] and [Turbidity/SS color range]. • When Turbidity/SS input value is lower than [Turbidity/SS color reference value] – [Turbidity/SS color range]: Orange • When Turbidity/SS input value is within [Turbidity/SS color reference value] ± [Turbidity/SS color range]: Green • When Turbidity/SS input value is higher than [Turbidity/SS color reference value] + [Turbidity/SS color range]: Red  (Fig. 7.8-1)	Red
cLP 10.0	**Turbidity/SS color reference value** • Sets a reference value for Turbidity/SS color to be green when FUCR (Turbidity/SS color changes continuously.) is selected in [Turbidity/SS color]. • Setting range: 0.0 to Measurement range high limit (*1) (*2)	10.0 (Formazin)
cLRG 0.1	**Turbidity/SS color range** • Sets a range for Turbidity/SS color to be green when FUCR (Turbidity/SS color changes continuously.) is selected in [Turbidity/SS color]. • Setting range: 0.1 to Measurement range high limit (*1) (*2)	0.1 (Formazin)
dPTM 0	**Backlight time** • Sets time to backlight from no operation status until backlight is switched off. When set to 0, the backlight remains ON. Backlight relights by pressing any key while backlight is OFF. • Setting range: 0 to 99 minutes	0 minutes

(*1) The measurement unit and decimal point place follow the selection in [Measurement range (p.21)].

(*2) If KAoN [Kaolin (mg/L)] is selected in [Measurement unit (p.23)], measurement range high limit value will become the value set in [Span setting (p.23)].

Character	Setting Item, Function, Setting Range	Factory Default
bER5L -----	**Bar graph indication** • Selects bar graph indication. • -----: No indication rAnG□: Transmission output Segments will light in accordance with the output. Scale is -5 to 105%. Segments will light from left to right in accordance with the output.  (Fig. 7.8-2)	No indication
INERR oFF□□	**EVT output when input errors occur** • If input errors occur, such as Turbidity/SS sensor is disconnected or short-circuited, EVT output Enabled/Disabled can be selected. If "Disabled" is selected, EVT output will be turned OFF when input errors occur. If "Enabled" is selected, EVT output will be maintained when input errors occur. • Available when rU_L (Turbidity/SS input low limit) or rU_H□ (Turbidity/SS input high limit) is selected in [EVT type]. • oFF□□ : Disabled oN□□□ : Enabled	Disabled
dI SP□ -----	**Setting Display indication** • Selects an item to be indicated on the Setting Display in Turbidity/SS Display Mode. • -----: No indication EVV□□: EVT value	No indication

8. Calibration

Turbidity/SS Sensor Calibration mode, Zero and Span Output Signal Adjustment modes and Transmission Output Adjustment mode are described below.

8.1 Turbidity/SS Sensor Calibration Mode

8.1.1 Turbidity/SS Sensor Calibration

Be sure to calibrate the Turbidity sensor or SS sensor before using it.
If Lock 1 (Lock 1), Lock2 (Lock 2) or Lock3 (Lock 3) is selected in [Set value lock (p.32)], the unit cannot enter Turbidity/SS Sensor Calibration mode.

Step	Displays	Operation
①	[Input value] [Set value]	Clean the body of Turbidity/SS sensor, particularly its lens(es).
②	[Input value] [Set value]	Immerse the Turbidity/SS sensor in the distilled water or ion-exchanged water.
③	[STNBY] [Adj□] ◄►[Calibration wait time]	Press and hold the ▽ and MODE key (in that order) together for 3 seconds in Turbidity/SS Display Mode. The unit will proceed to Turbidity/SS Sensor Calibration mode. STNBY is indicated on the Turbidity/SS Display until the time set in [Calibration wait time] has elapsed. Adj□/Calibration wait time are alternately indicated on the Setting Display.(*1) During the time set in [Calibration wait time], the Turbidity/SS sensor will adjust to the ambient water temperature.
④	[cAL□□] [Adj□]	After the time set in [Calibration wait time] has elapsed, calibration automatically starts.(*2) During calibration, calibration signal output is turned ON for 3 seconds, indicating cAL□□ on the Turbidity/SS Display and Adj□ on the Setting Display. (*3) When the calibration signal output switches from OFF to ON, the Turbidity/SS sensor will output approx. 2 mA DC of analog signal.

(*1): Calibration wait time is set to 0 minutes, the Turbidity/SS Display indicates STNBY, and he Setting Display flashes Adj□.
pproximately 5 minutes after the Turbidity/SS sensor has adjusted to the ambient water emperature, start calibration by pressing the MODE key.
fter that, refer to Step ④ and all following steps.

(*2): If the MODE key is pressed before the time set in [Calibration wait time (p.22)] has elapsed, calibration will start.
After that, refer to Step ④ and all following steps.

(*3): If □5000 [0 to 50000 mg/L (Kaolin)] is selected in [Measurement range (p.21)], the calibration signal output is turned ON for 5 seconds.

Step	Displays	Operation
⑤	[cAL □□] [Good□]	After Calibration is complete, the calibration signal output is turned OFF, indicating cAL □□ on the Turbidity/SS Display, and Good□ on the Setting Display. When the calibration signal output switches from ON to OFF, the Turbidity/SS sensor will return to 4 mA DC of analog signal.
⑥	[Input value] [Set value]	Press the SET key. The unit will revert to Turbidity/SS Display Mode.

8.1.2 Errors when Calibrating Turbidity/SS Sensor

Errors when calibrating Turbidity/SS sensor are shown below.

To release the error, press the SET key. The unit will revert to Turbidity/SS Display Mode.

Displays	Error Contents
[cAL □□] [E-2 1□]	The Turbidity/SS sensor has an output error monitoring function. During calibration, if the output signal from the Turbidity/SS sensor does not reach approx. 2 mA DC (*), the Turbidity/SS Display indicates cAL □□, and the Setting Display indicates E-2 1□. Before the calibration signal output switches from ON to OFF, if the output signal from the Turbidity/SS sensor is between 1 and 3 mA DC, it is regarded as normal. If the output signal is outside of this range, it is regarded as a Fail, and the error code is indicated.
[cAL □□] [E-22□]	The Turbidity/SS sensor has an output error monitoring function. After calibration is completed, if the output signal from the Turbidity/SS sensor does not return to 4 mA DC (*), the Turbidity/SS Display indicates cAL □□, and the Setting Display indicates E-22□. Approximately 5 seconds after (*) the calibration signal output switches from ON to OFF, if the output signal from the Turbidity/SS sensor is between 3.5 and 4.5 mA DC, it is regarded as normal. If the output signal is outside of this range, it is regarded as a Fail, and the error code is indicated.

(*): If □5000 [0 to 50000 mg/L (Kaolin)] is selected in [Measurement range (p.21)], approximately 35 seconds after.

8.2 Zero and Span Output Signal Adjustment Modes

8.2.1 Adjusting Zero and Span Output Signals

⚠ Caution

- Be sure to perform turbidity/SS sensor calibration before adjusting Zero and Span Output signals.
- Be sure to adjust Span Output signal after Zero Output signal is adjusted.

Before using this instrument, perform Zero and Span Output signal adjustments as follows.

If LocK 1 (Lock 1), LocK2 (Lock 2) or LocK3 (Lock 3) is selected in [Set value lock (p.32)], the unit cannot move to Zero Output Signal Adjustment mode.

Step	Displays	Operation
①	[Input value] [Set value]	Clean the body of Turbidity/SS sensor, particularly its lens(es).
②	[Input value] [Set value]	Immerse the Turbidity/SS sensor in the distilled water or ion-exchanged water.
③	[Input value] [ZERo□]◄►[Zero output signal adjustment value]	Press and hold the △ and MODE key (in that order) together for 3 seconds in Turbidity/SS Display Mode. The unit proceeds to Zero Output Signal Adjustment mode, indicating a turbidity/SS input value on the Turbidity/SS Display, and ZERo□/Zero output signal adjustment value alternately on the Setting Display.
④	[Input value] [ZERo□]◄►[Zero output signal adjustment value]	Approximately 5 minutes after the Turbidity/SS sensor adjusts to the ambient water temperature, check the turbidity/SS input value. If the turbidity/SS input value does not show 0 (zero), set the Zero output signal adjustment value with the △ or ▽ key so that the turbidity/SS input value becomes 0 (zero). Setting range of Zero output signal adjustment value: ±5% of measurement span Zero output signal adjustment is now completed.
⑤	[Input value] [SPAN□]◄►[Span output signal adjustment value]	Press the SET key in Zero Output Signal Adjustment mode. The unit proceeds to Span Output Signal Adjustment mode, indicating the turbidity/SS input value on the Turbidity/SS Display, and SPAN□/Span output signal adjustment value alternately on the Setting Display.

Step	Displays	Operation
⑥	[Input value] [SPAN]◄►[Span output signal adjustment value	Block the light beam between the lenses of the sensor for more than 30 seconds. **[Be careful not to touch the lens(es).]** If the turbidity/SS input value (*) does not show measurement range high limit, set the Span output signal adjustment value with the △ or ▽ key so that the input value becomes measurement range high limit value. Setting range of Span output signal adjustment value: ±5% of measurement span Span output signal adjustment is now completed.
⑦	[Input value] [Set value]	Press the SET key. The unit reverts to Turbidity/SS Display Mode.

(*) When the SS sensor TS-MxS-A is used, set the Span output signal adjustment value so that the turbidity/SS input value becomes 5000.
The measurement range of the SS sensor TS-MxS-A is 0 to 50000 mg/L (Kaolin).
The ones digit of the current Turbidity/SS input value is rounded off, and is divided by 10. This value is indicated.
As the measurement range high limit is 50000 mg/L, set the Span output signal adjustment value so that the Turbidity/SS input value becomes 5000.

8.2.2 Errors when Adjusting Zero and Span Output Signals

Errors when adjusting Zero and Span output signals are shown below.
To release the error, press the SET key. The unit will revert to Turbidity/SS Display Mode.

Displays	Error Contents
[E-24] ◄►[Input value] [ZERo] ◄►[Zero output signal adjustment value]	While adjusting Zero output signal, if the turbidity/SS input value has become lower than the value equivalent to 3.5 mA DC, the Turbidity/SS Display will indicate E-24 / Turbidity/SS input value alternately, and the Setting Display will indicate ZERo /Zero output signal adjustment value alternately.
[E-23] ◄►[Input value] [SPAN] ◄►[Span output signal adjustment value]	While adjusting Span output signal, if the turbidity/SS input value has exceeded the value equivalent to 20.5 mA DC, the Turbidity/SS Display will indicate E-23 / Turbidity/SS input value alternately, and the Setting Display will indicate SPAN /Span output signal adjustment value alternately.

8.3 Transmission Output Adjustment Mode

Fine adjustment of Transmission output is performed.
The AER-101-TU is adjusted at the factory, however, differences may occur between the indication value of the connected equipment (recorders, etc.) and output value of this instrument.
In this case, perform Transmission output Zero adjustment and Span adjustment.

The unit cannot enter Transmission output Zero adjustment mode in the following cases:

- During Zero or Span output signal adjustment, or Turbidity/SS sensor Calibration
- When Lock 1 (Lock 1), Lock2 (Lock 2) or Lock3 (Lock 3) is selected in [Set value lock (p.32)].

Step	Displays	Operation
①	[Input value] [Set value]	Turbidity/SS Display Mode
②	[AJZ□□] [Transmission output Zero adjustment value]	Press and hold the △ key and SET key (in that order) together for 3 seconds in Turbidity/SS Display Mode. The unit enters Transmission output Zero adjustment mode, indicating AJZ□□ on the Turbidity/SS Display, and Transmission output Zero adjustment value on the Setting Display.
③	[AJZ□□] [Transmission output Zero adjustment value]	Set a Transmission output Zero adjustment value with the △ or ▽ key, while viewing the value indicated on the connected equipment recorders, etc.). Setting range: ±5.00% of Transmission output span
④	[AJ4□□] [Transmission output Span adjustment value]	Press the SET key. The unit enters Transmission output Span adjustment mode, indicating AJ4□□ on the Turbidity/SS Display, and Transmission output Span adjustment value on the Setting Display.
⑤	[AJ4□□] [Transmission output Span adjustment value]	Set a Transmission output Span adjustment value with the △ or ▽ key, while viewing the value indicated on the connected equipment (recorders, etc.). Setting range: ±5.00% of Transmission output span
⑥	[AJZ□□] [Transmission output Zero adjustment value]	Press the MODE key. The unit reverts to Transmission output Zero adjustment mode. Repeat steps ③ to ⑥ if necessary.
⑦	[Input value] [Set value]	To finish Transmission output adjustment, press the SET key in Transmission output Span adjustment mode. The unit reverts to the Turbidity/SS Display Mode.

9. Measurement

9.1 Starting Measurement

After mounting to the control panel, wiring, setup and calibration are complete, turn the power to the instrument ON.

For approx. 4 seconds after the power is switched ON, the following characters are indicated on the Turbidity/SS Display.

During this time, all outputs are in OFF status, and all action indicators are turned off.

After that, measurement starts, indicating the item selected in [Backlight selection (p.32)].

(Table 9.1-1)

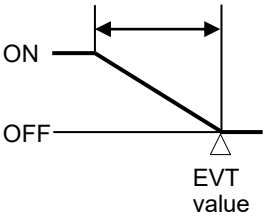
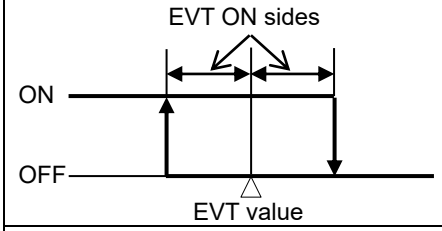
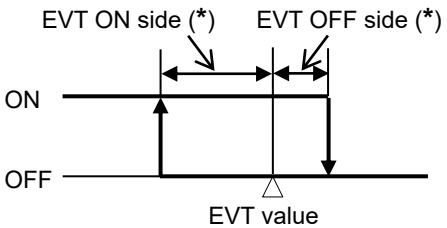
Measurement Range	Turbidity/SS Display
0.0 to 100.0 (Formazin)	TU 1
0 to 500 (Formazin)	TU 5
0 to 3000 (Formazin)	TU30
0 to 1000 mg/L (Kaolin)	TU 1
0 to 50000 mg/L (Kaolin) (*)	TU 5

(*) The measurement range of the SS sensor TS-MxS-A is 0 to 50000 mg/L (Kaolin).
The ones digit of the current Turbidity/SS input value is rounded off, and is divided by 10. This value is indicated.
(e.g.) 25004 mg/L (Kaolin) is indicated as 2500.
25005 mg/L (Kaolin) is indicated as 2501.

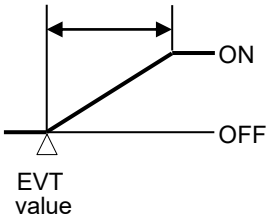
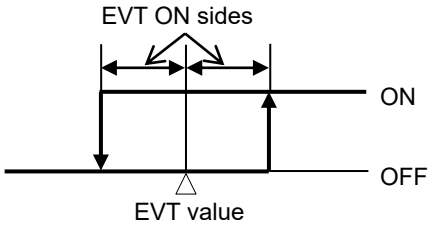
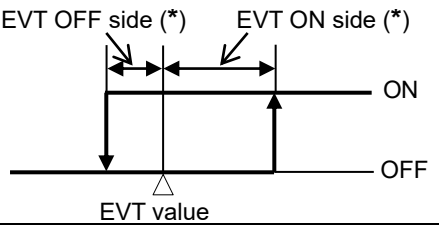
9.2 EVT Output

If TU_L (Turbidity/SS input low limit action), TU_H (Turbidity/SS input high limit action) or TU_HL (Turbidity/SS input High/Low limits independent action) is selected in [EVT type (p.24)], the following action is activated.

- **EVT Action**

EVT Type	P Control Action	ON/OFF Control Action
Turbidity/SS input low limit action (Activated based on indication value)	EVT proportional band 	If Medium Value is selected in [EVT hysteresis type]:  If Reference Value is selected in [EVT hysteresis type]: 

(Fig. 9.2-1)

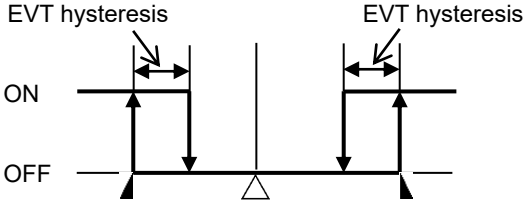
EVT Type	P Control Action	ON/OFF Control Action
Turbidity/SS input high limit action (Activated based on indication value)	EVT proportional band  	If Medium Value is selected in [EVT hysteresis type]:  If Reference Value is selected in [EVT hysteresis type]: 

(Fig. 9.2-2)

*** Setting Example:**

If [EVT1 ON side (E 1dFo)] is set to 0.0, EVT1 output can be turned ON at the value set in [EVT1 value (EVA 1)].

If [EVT1 OFF side (E 1dFU)] is set to 0.0, EVT1 output can be turned OFF at the value set in [EVT1 value (EVA 1)].

EVT Type	ON/OFF Control Action
Turbidity/SS input High/Low limits independent action (Activated based on indication value)	

(Fig. 9.2-3)

• **P Control Action**

Within the proportional band, the manipulated variable is output in proportion to the deviation between the EVT value and turbidity/SS input value.

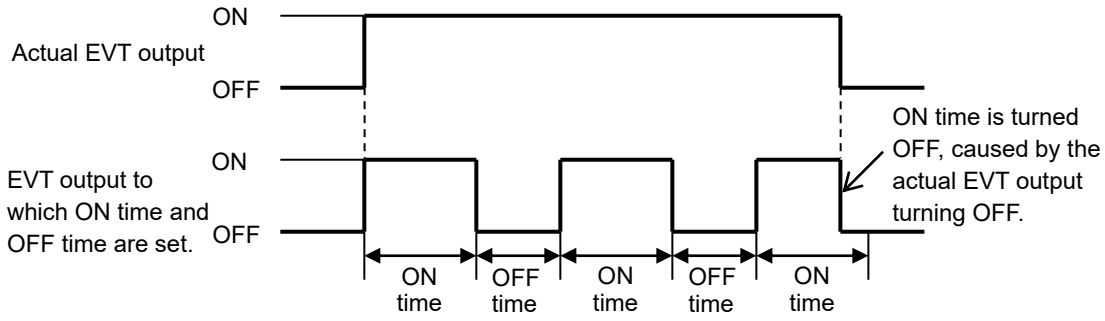
EVT Type	Description
Turbidity/SS input low limit action	If turbidity/SS input value is lower than [EVT value – EVT proportional band], EVT output is turned ON. If turbidity/SS input value enters within the proportional band, EVT output is turned ON/OFF in EVT proportional cycles. If turbidity/SS input value exceeds the EVT value, EVT output is turned OFF.
Turbidity/SS input high limit action	If turbidity/SS input value is higher than [EVT value + EVT proportional band], EVT output is turned ON. If turbidity/SS input value enters within the proportional band, EVT output is turned ON/OFF in EVT proportional cycles. If turbidity/SS input value drops below the EVT value, EVT output is turned OFF.

• **ON/OFF Control Action**

EVT Type	Description
Turbidity/SS input low limit action	If turbidity/SS input value is lower than EVT value, EVT output is turned ON. If turbidity/SS input value exceeds the EVT value, EVT output is turned OFF.
Turbidity/SS input high limit action	If turbidity/SS input value is higher than EVT value, EVT output is turned ON. If turbidity/SS input value drops below the EVT value, EVT output is turned OFF.

If ON time and OFF time are set in [Output ON time/OFF time when EVT output ON (p.28)], EVT output can be turned ON/OFF in a configured cycle when EVT output is ON.

Timing chart (Output ON time and OFF time when EVT output is ON)



(Fig. 9.2-4)

EVT output status can be read by Status flag 1 (EVT output flag bit) in Serial communication (C5 option).

EVT output status, when input errors occur, differs depending on the selection in [EVT output when input errors occur (p.34)].

- If oFF (Disabled) is selected, EVT output will be turned OFF when input errors occur.
- If oN (Enabled) is selected, EVT output will be maintained when input errors occur.

9.3 Error Output

If ERoUT (Error output) is selected in [EVT type (p.24)], and when the error type is "Error" in (Table 9.6-1) (p.43), the EVT output is turned ON.

9.4 Fail Output

If FAIL□ (Fail output) is selected in [EVT type (p.24)], and when the error type is "Fail" in (Table 9.6-1) (p.43), the EVT output is turned ON.

9.5 Self-check Output

If the instrument receives Self-check output from the Turbidity/SS sensor, an error code E-11□ is indicated on the Setting Display, and Self-check output is turned ON.

If the instrument receives Self-check output while calibrating, or while adjusting zero output signal or span output signal, the Self-check output will not be turned ON. After the unit reverts to Turbidity/SS Display Mode, Self-check output will be turned ON.

9.6 Error Code during Measurement

If Turbidity/SS sensor error occurs or the sensor is disconnected or short-circuited, their corresponding error codes flash on the Setting Display as shown below in (Table 9.6-1).

(Table 9.6-1)

Error Code	Error Type	Error Contents	Occurrence
E-11□	Fail	When receiving Self-check output from Turbidity/SS sensor [See Section 9.5 Self-check output (p.43).]	When measuring
E-12□	Fail	Analog signal (+, White) (–, Black) cable of Turbidity/SS sensor is disconnected or short-circuited.	
E-13□	Error	Turbidity/SS input value has exceeded the value equivalent to 20.5 mA DC.	
E-14□	Error	Turbidity/SS input value has dropped below the value equivalent to 3.5 mA DC.	

9.7 Setting EVT

EVT value can be set in Simple Setting mode.
This setting item corresponds to [EVT value (p.26)] in EVT Action Group.
To enter Simple Setting mode, follow the procedure below.

① EVT□□ Press the SET key in Turbidity/SS Display Mode.
"EVT value" will appear.

② Set EVT value using the △ or ▽ key, and register the value with the SET key.

Character	Setting Item, Function, Setting Range	Factory Default
EVT□□ □□□0.0	**EVT value** • Sets EVT value. (Fig. 9.2-1, 9.2-2, 9.2-3) (pp.40, 41) • Not available if -----(No action), ERoUT (Error output) or FAIL□ (Fail output) is selected in [EVT type (p.24)]. • Setting range: Measurement range low limit to Measurement range high limit (*1) (*2)	0.0 (Formazin)

(*1) The measurement unit and decimal point place follow the selection in [Measurement range (p.21)].
(*2) If KAoN□[Kaolin (mg/L)] is selected in [Measurement unit (p.23)], measurement range high limit will become the value set in [Span setting (p.23)].

③ Press the SET key. The unit reverts to Turbidity/SS Display Mode.

9.8 Transmission Output

Converting Turbidity/SS input value or MV to analog signal every input sampling period, outputs in current.
If Transmission output high limit and low limit are set to the same value, Transmission output will be fixed at 4 mA DC.

Resolution	12000
Current	4 to 20 mA DC (Load resistance: Max. 550 Ω)
Output accuracy	Within ±0.3% of Transmission output span

10. Specifications

10.1 Standard Specifications

Rating

<table>
<tr><td rowspan="6">Rated scale</td><th>Input</th><th>Input Range</th><th>Resolution</th></tr>
<tr><td rowspan="3">Turbidity (*1)</td><td>0.0 to 100.0 (Formazin)</td><td>0.1 (Formazin)</td></tr>
<tr><td>0 to 500 (Formazin)</td><td rowspan="2">1 (Formazin)</td></tr>
<tr><td>0 to 3000 (Formazin)</td></tr>
<tr><td rowspan="2">SS</td><td>0 to 1000 mg/L (Kaolin)</td><td>1 mg/L (Kaolin)</td></tr>
<tr><td>0 to 50000 mg/L (Kaolin) (*2)</td><td>10 mg/L (Kaolin)</td></tr>
<tr><td colspan="3">(*1) Formazin can be changed to Kaolin in [Measurement unit].
(*2) The ones digit of the current Turbidity/SS input value is rounded off, and is divided by 10. This value is indicated as an input value.</td></tr>
<tr><td rowspan="3">Input</td><th>Name</th><th>Manufacturer</th><th>Model</th></tr>
<tr><td>Turbidity sensor</td><td>OPTEX Co., Ltd.</td><td>TC-100, TC-500, TC-3000</td></tr>
<tr><td>SS sensor</td><td>OPTEX Co., Ltd.</td><td>TCS-1000(E), TS-MxS-A</td></tr>
<tr><td rowspan="3">Power supply voltage</td><td>Model</td><th>AER-101-TU</th><th>AER-101-TU 1</th></tr>
<tr><td>Power supply voltage</td><td>100 to 240 V AC 50/60 Hz</td><td>24 V AC/DC 50/60 Hz</td></tr>
<tr><td>Allowable voltage fluctuation range</td><td>85 to 264 V AC</td><td>20 to 28 V AC/DC</td></tr>
</table>

General Structure

External dimensions	48 x 96 x 98.5 mm (W x H x D)	
Mounting	Flush (Applicable panel thickness: 1 to 8 mm)	
Case	Material: Flame-resistant resin, Color: Black	
Front panel	Membrane sheet	
Drip-proof/Dust-proof	IP66 (for front panel only)	
Indication structure	Display	
	Turbidity/SS Display	11-segment LCD display 5-digits Backlight: Red/Green/Orange Character size: 14.0 x 5.4 mm (H x W)
	Setting Display	11-segment LCD display 5-digits Backlight: Green Character size: 10.0 x 4.6 mm (H x W)
	Output Display	22-segment LCD display Bar graph Backlight: Green
	Action indicators: Backlight: Orange color	
	EVT	EVT output (Contact output) ON: Lit
	T/R	Serial communication TX output (transmitting): Lit
	LOCK	Set Value Lock 1, 2, 3 selected: Lit
Setting structure	Input system using membrane sheet key	

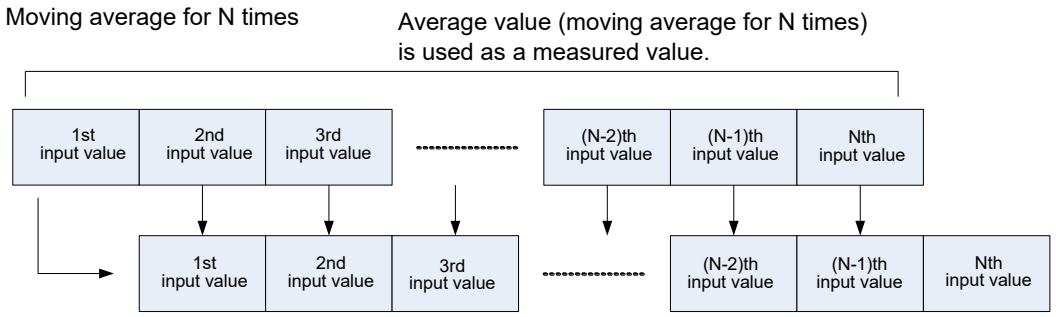
Indication Performance

Repeatability	±0.2% of measurement span±1 digit (However, sensor accuracy is excluded.)
Linearity	±0.2% of measurement span±1 digit (However, sensor accuracy is excluded.)
Input sampling period	500 ms
Time accuracy	Within ±1% of setting time

Standard Functions

Turbidity/SS sensor calibration	Immerse the Turbidity/SS sensor in the distilled water or ion-exchanged water, then calibration is automatically performed after the time set in [Calibration wait time] has elapsed.
Zero output signal adjustment	Immerse the Turbidity/SS sensor in the distilled water or ion-exchanged water. Approximately 5 minutes after the Turbidity/SS sensor has adjusted to the ambient water temperature, adjust the turbidity/SS input value by setting Zero output signal adjustment value so that the turbidity/SS input value becomes 0 (zero).
Span output signal adjustment	Block the light beam between the lenses of the sensor for more than 30 seconds. Adjust the turbidity/SS input value by setting Span output signal adjustment value so that the turbidity/SS input value becomes Measurement range high limit value.

Turbidity/SS inputs for moving average	Sets the number of turbidity/SS input values for calculating the moving average. The average value will be obtained every time sampling occurs. (Fig. 10.1-1) This function is disabled in Turbidity/SS Sensor Calibration mode, Zero Output Signal Adjustment mode and Span Output Signal Adjustment mode.



For the next sampling, the 1st input value from the last previous sampling is discarded, and a new input value is added, from which an average value is calculated. This is used as an input value.

(Fig 10.1-1)

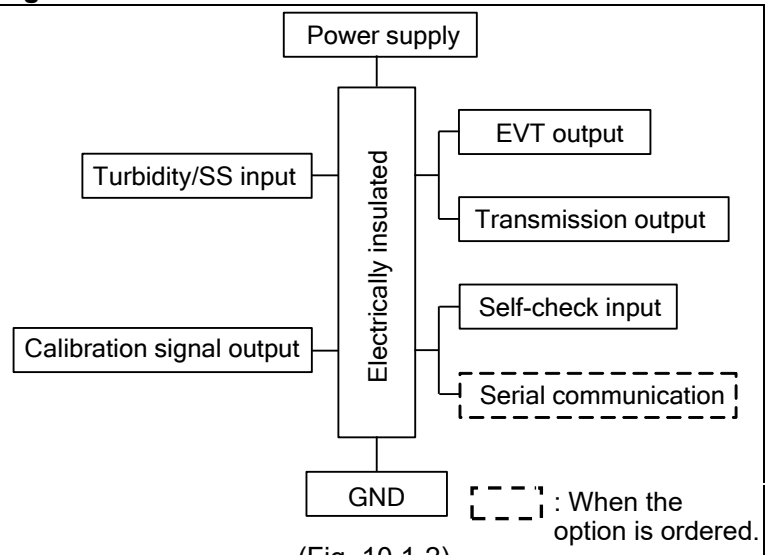
Self-check Output (Contact output)		If the instrument receives Self-check output from the Turbidity/SS sensor, an error code E-11 flashes on the Setting Display, and Self-check output is turned ON. If the instrument receives Self-check output while calibrating, or adjusting Zero output signal or Span output signal, the Self-check output will not be turned ON. After the unit reverts to Turbidity/SS Display Mode, the Self-check output will be turned ON.	
	Output	Relay contact 1a	
		Control capacity	3 A 250 V AC (resistive load) 1 A 250 V AC (inductive load cosϕ=0.4)
		Electrical life	100,000 cycles

<table>
<tr><td colspan="2">EVT Output</td><td colspan="2"></td></tr>
<tr><td></td><td>Output action</td><td colspan="2">P control action: When setting the proportional band to any value except 0.0 or 0.
ON/OFF control action: When setting the proportional band to 0.0 or 0.</td></tr>
<tr><td></td><td></td><td>EVT proportional band</td><td>0 to Measurement span (*1)(*2)</td></tr>
<tr><td></td><td></td><td>EVT proportional cycle</td><td>1 to 300 seconds</td></tr>
<tr><td></td><td></td><td>EVT ON side, OFF side</td><td>0 to 20% of Measurement span (*1)(*2)</td></tr>
<tr><td></td><td></td><td>Output high limit, low limit</td><td>0 to 100%</td></tr>
<tr><td></td><td></td><td>EVT H/L limits independent upper side value,
EVT H/L limits independent lower side value</td><td>Measurement range low limit to Measurement range high limit (*1)(*3)
Disabled when set to 0 or 0.0.</td></tr>
<tr><td></td><td></td><td>EVT hysteresis</td><td>0.1 to 20% of Measurement span (*1)(*2)</td></tr>
<tr><td></td><td></td><td colspan="2">(*1) The measurement unit and decimal point place follow the selection in [Measurement range (p.21)].
(*2) If KAoN [Kaolin (mg/L)] is selected in [Measurement unit (p.23)], measurement span will become the value set in [Span setting (p.23)].
(*3) If KAoN [Kaolin (mg/L)] is selected in [Measurement unit (p.23)], measurement range high limit will become the value set in [Span setting (p.23)].</td></tr>
<tr><td></td><td>Type</td><td colspan="2">Selectable by the keypad from the following.
• No action
• Turbidity/SS input low limit action (Fig. 9.2-1)(p.40)
• Turbidity/SS input high limit action (Fig. 9.2-2)(p.41)
• Error output
• Fail output
• Turbidity/SS input High/Low limits independent action (Fig. 9.2-3)(p.41)</td></tr>
<tr><td></td><td>Output</td><td colspan="2">Relay contact 1a</td></tr>
<tr><td></td><td></td><td>Control capacity</td><td>3 A 250 V AC (resistive load)
1 A 250 V AC (inductive load, cosϕ=0.4)</td></tr>
<tr><td></td><td></td><td>Electrical life</td><td>100,000 cycles</td></tr>
<tr><td></td><td>EVT ON delay time</td><td colspan="2">0 to 10000 seconds</td></tr>
<tr><td></td><td>EVT OFF delay time</td><td colspan="2">0 to 10000 seconds</td></tr>
<tr><td></td><td>Output ON time/ OFF time when EVT output ON</td><td colspan="2">If Output ON time and OFF time are set, the output can be turned ON/OFF in a configured cycle when EVT output is ON. (Fig. 9.2-4)(p.42)
See [Timing chart (Output ON time and OFF time when EVT output is ON]. (Fig. 9.2-4, p.42)</td></tr>
</table>

Transmission Output Function

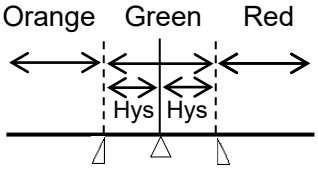
Transmission output		Converting Turbidity/SS input value or MV to analog signal every input sampling period, and outputs the value in current. If Transmission output high limit and low limit are set to the same value, Transmission output will be fixed at 4 mA DC.	
		Resolution	12000
		Current	4 to 20 mA DC (Load resistance: Max. 550 Ω)
		Output accuracy	Within ±0.3% of Transmission output Span
	Transmission output adjustment	Fine adjustment of Transmission output can be performed via Transmission output Zero and Span adjustments.	
	Transmission output status when calibrating	Transmission output status can be selected when calibrating. Last value HOLD: Retains the last value before calibration, and outputs it. Set value HOLD: Outputs the value set in [Transmission output value HOLD when calibrating]. Measured value: Outputs the measured value when calibrating conductivity.	
	Transmission output status when adjusting output signal	Transmission output status can be selected when adjusting output signal. Last value HOLD: Retains the last value before the output signal adjustment, and outputs it. Set value HOLD: Outputs the value set in [Transmission output value HOLD when adjusting output signal]. Measured value: Outputs the measured value when adjusting output signal.	

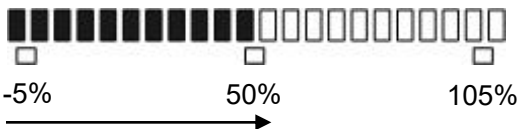
Insulation, Dielectric Strength

Circuit Insulation Configuration	 (Fig. 10.1-2)
Insulation Resistance	10 MΩ minimum, at 500 V DC
Dielectric Strength	Power terminal - ground (GND): 1.5 kV AC for 1 minute Input terminal - ground (GND): 1.5 kV AC for 1 minute Input terminal - power terminal: 1.5 kV AC for 1 minute

Attached Functions

<table>
<tr><td>Set Value Lock</td><td>Lock 1: None of the set values can be changed.
Lock 2: Only EVT value can be changed.
Lock 3: All set values – except Measurement range, Measurement unit, Span setting, Zero and Span output signals, Turbidity/SS sensor calibration, Transmission output Zero and Span adjustments – can be temporarily changed.
However, they revert to their previous value after the power is turned off because they are not saved in the non-volatile IC memory.</td></tr>
<tr><td>Turbidity/SS Input Sensor Correction</td><td>This corrects the input value from the Turbidity/SS sensor. When turbidity/SS input value measured by the sensor may deviate from the value in the measured location, desired Turbidity/SS input value can be obtained by adding a sensor correction value.
However, it is effective within the measurement range regardless of the sensor correction value.
Setting range: ±10% of measurement span</td></tr>
<tr><td>Outside Measurement Range</td><td>• When turbidity/SS input value is outside the measurement range, the following will be indicated.
<table>
<tr><th>Turbidity/SS Display</th><th>Setting Display</th></tr>
<tr><td>If turbidity/SS input value has exceeded the value equivalent to 20.5 mA DC, the input value equivalent to 20.5 mA DC will flash.</td><td>Flashes E- 13</td></tr>
<tr><td>If turbidity/SS input value has dropped below the value equivalent to 3.5 mA DC, the input value equivalent to 3.5 mA DC will flash.</td><td>Flashes E- 14</td></tr>
</table></td></tr>
<tr><td>Power Failure Countermeasure</td><td>The setting data is backed up in the non-volatile IC memory.</td></tr>
<tr><td>Self-diagnosis</td><td>The CPU is monitored by a watchdog timer, and if an abnormal status occurs, the AER-101-TU is switched to warm-up status.</td></tr>
<tr><td>Warm-up Indication</td><td>For 4 seconds after power is turned on, the following characters are indicated on the Turbidity/SS Display.
<table>
<tr><th>Measurement Range</th><th>Turbidity/SS Display</th></tr>
<tr><td>0.0 to 100.0 (Formazin)</td><td>TU 1</td></tr>
<tr><td>0 to 500 (Formazin)</td><td>TU 5</td></tr>
<tr><td>0 to 3000 (Formazin)</td><td>TU30</td></tr>
<tr><td>0 to 1000 mg/L (Kaolin)</td><td>TU 1</td></tr>
<tr><td>0 to 50000 mg/L (Kaolin)</td><td>TU 5</td></tr>
</table></td></tr>
</table>

<table>
<tr><td>Turbidity/SS Color Selection</td><td>Selects Turbidity/SS Display color.
<table>
<tr><th>Selection Item in [Turbidity/SS Color (p.33)]</th><th>Turbidity/SS Display Color</th></tr>
<tr><td>GRN</td><td>Green</td></tr>
<tr><td>REd</td><td>Red</td></tr>
<tr><td>oRG</td><td>Orange</td></tr>
<tr><td>CUCR</td><td>Turbidity/SS color changes continuously.</td></tr>
</table>
Turbidity/SS color changes continuously:
Turbidity/SS Display color changes according to [Turbidity/SS color reference value (p.33)] and [Turbidity/SS color range (p.33)] settings.
• When Turbidity/SS input value is lower than [Turbidity/SS color reference value] – [Turbidity/SS color range]: Orange
• When Turbidity/SS input value is within [Turbidity/SS color reference value] ± [Turbidity/SS color range]: Green
• When Turbidity/SS input value is higher than [Turbidity/SS color reference value] + [Turbidity/SS color range]: Red


(Fig. 10.1-3)</td></tr>
<tr><td>Bar Graph Indication</td><td>When TRnT (Transmission output) is selected in [Bar graph indication (p.34)], segments light in accordance with the output.
Scale is -5 to 105%. Segments light increasingly to the right in accordance with the output.
(e.g.) When output is 50%


(Fig. 10.1-4)</td></tr>
</table>

Other

Power Consumption	Approx. 8 VA
Ambient Temperature	0 to 50℃
Ambient Humidity	35 to 85%RH (Non-condensing)
Weight	Approx. 280 g
Accessories Included	Unit label: 1 sheet, Mounting brackets: 1 set Instruction manual: 1 copy, Inspection report: 1 sheet External resistor 1 set
Accessories Sold Separately	Power Supply (Recommended products) 12 V DC: S8VS-01512 (Made by OMRON Corp.) 24 V DC: S8VS-01524 (Made by OMRON Corp.)

10.2 Optional Specifications

Serial Communication (Option code: C5)

<table>
<tr><td rowspan="12">Serial Communication</td><td colspan="2">The following operations can be carried out from an external computer.
(1) Reading and setting of various set values
(2) Reading of the turbidity/SS input value and status
(3) Function change, adjustment
(4) Reading and setting of user save area</td></tr>
<tr><td>Cable Length</td><td>1.2 km (Max), Cable resistance value: Within 50 Ω
(Terminators are not necessary, but if used, use 120 Ω minimum on both side.)</td></tr>
<tr><td>Communication Line</td><td>EIA RS-485</td></tr>
<tr><td>Communication Method</td><td>Half-duplex communication</td></tr>
<tr><td>Communication Speed</td><td>9600, 19200, 38400 bps (Selectable by keypad)</td></tr>
<tr><td>Synchronization Method</td><td>Start-stop synchronization</td></tr>
<tr><td>Code Form</td><td>ASCII, Binary</td></tr>
<tr><td>Communication Protocol</td><td>Shinko protocol, MODBUS ASCII, MODBUS RTU
(Selectable by keypad)</td></tr>
<tr><td>Data Bit/Parity</td><td>8 bits/No parity, 7 bits/No parity, 8 bits/Even, 7 bits/Even,
8 bits/Odd, 7 bits/Odd (Selectable by keypad)</td></tr>
<tr><td>Stop Bit</td><td>1, 2 (Selectable by keypad)</td></tr>
<tr><td>Error Correction</td><td>Command request repeat system</td></tr>
<tr><td>Error Detection</td><td>Parity check, Checksum (Shinko protocol),
LRC (MODBUS protocol ASCII),
CRC-16 (MODBUS protocol RTU)</td></tr>
<tr><td>Data Format</td><td>
<table>
<tr><th>Communication Protocol</th><th>Shinko Protocol</th><th>MODBUS ASCII</th><th>MODBUS RTU</th></tr>
<tr><td>Start bit</td><td>1</td><td>1</td><td>1</td></tr>
<tr><td>Data bit</td><td>7</td><td>7 (8) Selectable</td><td>8</td></tr>
<tr><td>Parity</td><td>Even</td><td>Even (No parity, Odd) Selectable</td><td>No parity (Even, Odd) Selectable</td></tr>
<tr><td>Stop bit</td><td>1</td><td>1 (2) Selectable</td><td>1 (2) Selectable</td></tr>
</table>
</td></tr>
</table>

11. Troubleshooting

If any malfunction occurs, refer to the following items after checking that power is being supplied to the AER-101-TU.

11.1 Indication

Problem	Possible Cause	Solution
The Turbidity/SS Display and Setting Display are unlit.	The time set in [Backlight time (p.33)] has passed.	If any key is pressed while displays are unlit, it will re-light. Set the backlight time to a suitable time-frame.
The Setting Display is unlit.	----- (No indication) is selected in [Setting Display indication (p.34)].	Select EVT (EVT value).
[E 11] is flashing on the Setting Display.	The Turbidity sensor or SS sensor is malfunctioning.	It is necessary to repair the Turbidity sensor or SS sensor. Contact our agency or us.
	Incorrect wiring of the Turbidity sensor or SS sensor cable	Wire the Turbidity sensor or SS sensor correctly.
[E 12] is flashing on the Setting Display.	Analog signal (+, white) (–, black) cable of the Turbidity/SS sensor is disconnected or short-circuited.	Check the Turbidity sensor or SS sensor cable.
[E 13] is flashing on the Setting Display.	The Turbidity sensor or SS sensor is malfunctioning.	It is necessary to repair the Turbidity sensor or SS sensor. Contact our agency or us.
	Incorrect wiring of the Turbidity sensor or SS sensor cable.	Wire the Turbidity sensor or SS sensor correctly.
[E 14] is flashing on the Setting Display.	The Turbidity sensor or SS sensor is malfunctioning.	It is necessary to repair the Turbidity sensor or SS sensor. Contact our agency or us.
	Incorrect wiring of the Turbidity sensor or SS sensor cable.	Wire the Turbidity sensor or SS sensor correctly.
	Is the signal from the Turbidity sensor or SS sensor being affected by noise?	Add the accessory resistor as shown in “4.3 Wiring Example” (p. 15).

Problem	Possible Cause	Solution
[E-21] is flashing on the Setting Display.	The Turbidity sensor or SS sensor is malfunctioning.	It is necessary to repair the Turbidity sensor or SS sensor. Contact our agency or us.
	Incorrect wiring of the Turbidity sensor or SS sensor cable.	Wire the Turbidity sensor or SS sensor correctly.
[E-22] is flashing on the Setting Display.	The Turbidity sensor or SS sensor is malfunctioning.	It is necessary to repair the Turbidity sensor or SS sensor. Contact our agency or us.
	Incorrect wiring of the Turbidity sensor or SS sensor cable.	Wire the Turbidity sensor or SS sensor correctly.
[E-23] and Turbidity/SS input value are alternately indicated on the Turbidity/SS Display.	The light beam between the lenses has not been completely blocked.	Make sure the light beam is completely blocked for more than 30 seconds, then perform Span output signal adjustment again.
	The Turbidity sensor or SS sensor is malfunctioning.	It is necessary to repair the Turbidity sensor or SS sensor. Contact our agency or us.
	Incorrect wiring of the Turbidity sensor or SS sensor cable	Wire the Turbidity sensor or SS sensor correctly.
[E-24] and Turbidity/SS input value are alternately indicated on the Turbidity/SS Display.	The lens(es) of the Turbidity sensor or SS sensor is not clean.	Clean the lens(es) of Turbidity sensor or SS sensor, then perform Zero output signal adjustment again.
	The Turbidity sensor or SS sensor is malfunctioning.	It is necessary to repair the Turbidity sensor or SS sensor. Contact our agency or us.
	Incorrect wiring of the Turbidity sensor or SS sensor cable	Wire the Turbidity sensor or SS sensor correctly.
[Err 1] is indicated on the Turbidity/SS Display	Internal memory is defective.	Contact our agency or us.

11.2 Key Operation

Problem	Possible Cause	Solution
• None of the values can be changed. • The values do not change by △ or ▽ key.	"Lock 1 (Lock 1)" is selected in [Set value lock (p.32)]	Select ----- (Unlock).
• Only EVT value can be set. Other settings are impossible. • The values do not change by △ or ▽ key.	"Lock2 (Lock 2)" is selected in [Set value lock (p.32)].	Select ----- (Unlock).
Unable to enter Zero Output Signal Adjustment mode or Turbidity/SS Sensor Calibration mode.	Lock 1 (Lock 1), Lock2 (Lock 2) or Lock3 (Lock 3) is selected in [Set value lock (p.32)].	Select ----- (Unlock).
Unable to enter Transmission output Zero adjustment mode.	Lock 1 (Lock 1), Lock2 (Lock 2) or Lock3 (Lock 3) is selected in [Set value lock (p.32)].	Select ----- (Unlock).
	The unit is in Zero or Span output signal adjustment mode or in Turbidity/SS sensor calibration mode.	After Zero/Span Output Signal adjustment or Turbidity/SS Sensor Calibration is finished, return to the Turbidity/SS Display Mode, and then perform Transmission output calibration.

12. Character Tables

The following shows our character tables. Use data column for your reference.

12.1 Setting Group List

Character	Setting Group	Reference Section
FNc.	Turbidity/SS Input Group	Section 12.5 (pp. 57, 58)
EVTa	EVT Action Group	Section 12.6 (pp. 58, 59)
TRA4	Transmission Output Group	Section 12.7 (pp. 59, 60)
coMM	Communication Group	Section 12.8 (p.60)
aTER	Basic Function Group	Section 12.9 (p.61)

12.2 Turbidity/SS Sensor Calibration Mode

Character	Setting Item, Setting Range	Factory Default	Data
SENSY AdJ4(*)	**Turbidity/SS Sensor Calibration** After the time set in [Calibration wait time] has elapsed, calibration automatically starts. During calibration, calibration signal output is turned ON for 3 seconds, indicating CAL on the Turbidity/SS Display and AdJ4 on the Setting Display. After Calibration is complete, the calibration signal output is turned OFF, indicating CAL on the Turbidity/SS Display, and Good on the Setting Display.		

(*) AdJ4 and Calibration wait time are alternately displayed.

12.3 Zero and Span Output Signal Adjustment Modes

Character	Setting Item, Setting Range	Factory Default	Data
[Input value] ZERo(*1)	**Zero output signal adjustment value** Setting range: ±5% of measurement span	0.0	
[Input value] SPAN(*2)	**Span output signal adjustment value** Setting range: ±5% of measurement span	0.0	

(*1) ZERo and Zero output signal adjustment value are alternately indicated.

(*2) SPAN and Span output signal adjustment value are alternately indicated.

12.4 Transmission Output Adjustment Mode

Character	Setting Item, Setting Range	Factory Default	Data
AJZ 0.00	**Transmission output Zero adjustment value** Setting range: ±5.00% of transmission output span	0.00%	
AJ4 0.00	**Transmission output Span adjustment value** Setting range: ±5.00% of transmission output span	0.00%	

12.5 Simple Setting Mode

Character	Setting Item, Setting Range	Factory Default	Data
EVT 0.0	**EVT value** Setting range: Measurement range low limit to Measurement range high limit (*1) (*2)	0.0 (Formazin)	

(*1) The measurement unit and decimal point place follow the selection in [Measurement range (p.21)].
(*2) If KAoN [Kaolin (mg/L)] is selected in [Measurement unit (p.23)], measurement range high limit value will become the value set in [Span setting (p.23)].

12.6 Turbidity/SS Input Group

Character	Setting Item, Setting Range	Factory Default	Data
MRNG 100.0	**Measurement range**	0.0 to 100.0 (Formazin)	

Selection	Measurement Range	Model
100.0	0.0 to 100.0 (Formazin)	Turbidity sensor TC-100
500	0 to 500 (Formazin)	Turbidity sensor TC-500
3000	0 to 3000 (Formazin)	Turbidity sensor TC-3000
1000	0 to 1000 mg/L (Kaolin)	SS sensor TCS-1000(E)
5000	0 to 50000 mg/L (Kaolin) (*1)	SS sensor TS-MxS-A

dFcT 20	**Turbidity/SS inputs for moving average** Setting range: 1 to 120	20	
FILT 0.0	**Turbidity/SS input filter time constant** Setting range: 0.0 to 10.0 seconds	0.0 seconds	
rUSo 0.0	**Turbidity/SS input sensor correction** Setting range: ±10% of measurement span (*2)(*3)	0	
cALT 1	**Calibration wait time** Setting range: 0 to 10 minutes	1 minute	
UNIT FoRN	**Measurement unit** FoRN: Formazin KAoN: Kaolin (mg/L)	Formazin	
SPAN 100.0	**Span setting** See (Table 12.6-1). (p.58)	100.0 (Formazin)	

(*1) The measurement range of the SS sensor TS-MxS-A is 0 to 50000 mg/L (Kaolin).
The ones digit of the current Turbidity/SS input value is rounded off, and is divided by 10. This value is indicated.
(e.g.) 25004 mg/L (Kaolin) is indicated as 2500.
25005 mg/L (Kaolin) is indicated as 2501.
(*2) The measurement unit and decimal point place follow the selection in [Measurement range (p.21)].
(*3) If KAoN [Kaolin (mg/L)] is selected in [Measurement unit (p.23)], measurement span will become the value set in [Span setting (p.23)].

(Table 12.6-1)

Measurement Range	Measurement Unit	Setting Range	Factory Default
0.0 to 100.0 (Formazin)	Kaolin (mg/L)	0.0 to 900.0 (Formazin)	100.0 (Formazin)
0 to 500 (Formazin)		0 to 9000 (Formazin)	500 (Formazin)
0 to 3000 (Formazin)		0 to 9000 (Formazin)	3000 (Formazin)

12.7 EVT Action Group

Character	Setting Item, Setting Range	Factory Default	Data
EVTF -----	**EVT type** ----- : No action TU_L : Turbidity/SS input low limit action TU_H : Turbidity/SS input high limit action ERROR : Error output FAIL : Fail output TU_HL : Turbidity/SS input High/Low limits independent action	No action	
EVV 0.0	**EVT value** Setting range: Measurement range low limit to Measurement range high limit (*1)(*2)	0.0 (Formazin)	
EP 0.0	**EVT proportional band** Setting range: Measurement range low limit to Measurement range high limit (*1)(*2)	0.0 (Formazin)	
ERST 0.0	**EVT reset** Setting range: ±10% of measurement span (*1)(*3)	0.0 (Formazin)	
EdIF HdIF	**EVT hysteresis type** cdIF : Medium Value HdIF : Reference Value	Reference Value	
EdFo 1.0	**EVT ON side** Setting range: 0 to 20% of measurement span (*1)(*3)	1.0 (Formazin)	
EdFU 1.0	**EVT OFF side** Setting range: 0 to 20% of measurement span (*1)(*3)	1.0 (Formazin)	
EoNT 0	**EVT ON delay time** Setting range: 0 to 10000 seconds	0 seconds	
EoFT 0	**EVT OFF delay time** Setting range: 0 to 10000 seconds	0 seconds	
Ec 30	**EVT proportional cycle** Setting range: 1 to 300 seconds	30 seconds	

(*1) The measurement unit and decimal point place follow the selection in [Measurement range (p.21)].

(*2) If KAoN [Kaolin (mg/L)] is selected in [Measurement unit (p.23)], measurement range high limit value will become the value set in [Span setting (p.23)].

(*3) If KAoN [Kaolin (mg/L)] is selected in [Measurement unit (p.23)], measurement span will become the value set in [Span setting (p.23)].

Character	Setting Item, Setting Range	Factory Default	Data
EoLH 100	**EVT output high limit** Setting range: EVT output low limit to 100%	100%	
EoLL 0	**EVT output low limit** Setting range: 0% to EVT output high limit	0%	
ooNT 0	**Output ON time when EVT output ON** Setting range: 0 to 10000 seconds	0 seconds	
ooFT 0	**Output OFF time when EVT output ON** Setting range: 0 to 10000 seconds	0 seconds	
E_L 0.0	**EVT High/Low limits independent lower side value** Setting range: Measurement range low limit to Measurement range high limit (*1)(*2)	0.0 (Formazin)	
E_H 0.0	**EVT High/Low limits independent upper side value** Setting range: Measurement range low limit to Measurement range high limit (*1)(*2)	0.0 (Formazin)	
E_HY 1.0	**EVT hysteresis** 0.1 to 20% of measurement span (*1)(*3)	1.0 (Formazin)	

(*1) The measurement unit and decimal point place follow the selection in [Measurement range (p.21)].

(*2) If KAoN [Kaolin (mg/L)] is selected in [Measurement unit (p.23)], measurement range high limit value will become the value set in [Span setting (p.23)].

(*3) If KAoN [Kaolin (mg/L)] is selected in [Measurement unit (p.23)], measurement span will become the value set in [Span setting (p.23)].

12.8 Transmission Output Group

Character	Setting Item, Setting Range	Factory Default	Data
TRo4 TU	**Transmission output type** TU: Turbidity/SS transmission MV: EVT MV transmission	Turbidity/SS transmission	
TRLH 100.0	**Transmission output high limit** Turbidity/SS transmission: Transmission output low limit to Measurement range high limit (*1) (*2) MV transmission: Transmission output low limit to 100.0%	Turbidity/SS transmission: 100.0 (Formazin) MV transmission: 100.0%	
TRLL 0.0	**Transmission output low limit** Turbidity/SS transmission: Measurement range low limit to Transmission output high limit (*1) MV transmission: 0.0% to Transmission output high limit	Turbidity/SS transmission: 0.0 (Formazin) MV transmission: 0.0%	
TRc4 bEFH	**Transmission output status when calibrating** bEFH: Last value HOLD (Retains the last value before calibration, and outputs it.) 4ETH: Set value HOLD (Outputs the value set in [Transmission output value HOLD when calibrating].) PVH: Measured value (Outputs the measured value when calibrating.)	Last value HOLD	
TR4E 0.0	**Transmission output value HOLD when calibrating** Turbidity/SS transmission: Measurement range low limit to Measurement range high limit (*1)(*2) MV transmission: 0.0 to 100.0%	Turbidity/SS transmission: 0.0 (Formazin) MV transmission: 0.0%	
ZPc4 bEFH	**Transmission output status when adjusting output signal** bEFH: Last value HOLD (Retains the last value before the output signal adjustment, and outputs it.) 4ETH: Set value HOLD (Outputs the value set in [Transmission output value HOLD when adjusting output signal].) PVH: Measured value (Outputs the measured value when adjusting output signal.)	Last value HOLD	
ZP4E 0.0	**Transmission output value HOLD when adjusting output signal** Turbidity/SS transmission: Measurement range low limit to Measurement range high limit (*1)(*2) MV transmission: 0.0 to 100.0%	Turbidity/SS transmission: 0.0 (Formazin) MV transmission: 0.0%	

(*1) The measurement unit and decimal point place follow the selection in [Measurement range (p.21)].

(*2) If KAoN [Kaolin (mg/L)] is selected in [Measurement unit (p.23)], measurement range high limit value will become the value set in [Span setting (p.23)].

12.9 Communication Group

Available when Serial communication (C5 option) is ordered.

Character	Setting Item, Setting Range	Factory Default	Data
cMtL NoML	**Communication protocol** NoML : Shinko protocol ModA : MODBUS ASCII mode ModR : MODBUS RTU mode	Shinko protocol	
cMNo 0	**Instrument number** Setting range: 0 to 95	0	
cMtP 96	**Communication speed** 96 : 9600 bps 192 : 19200 bps 384 : 38400 bps	9600 bps	
cMFt 7EvN	**Data bit/Parity** 8NoN : 8 bits/No parity 7NoN : 7 bits/No parity 8EvN : 8 bits/Even 7EvN : 7 bits/Even 8odd : 8 bits/Odd 7odd : 7 bits/Odd	7 bits/Even	
cMtr 1	**Stop bit** 1 : Stop bit 1 2 : Stop bit 2	Stop bit 1	

12.10 Basic Function Group

Character	Setting Item, Setting Range	Factory Default	Data
LocK -----	**Set value lock** ----- : Unlock LocK 1 : Lock 1 LocK2 : Lock 2 LocK3 : Lock 3	Unlock	
bKLT ALL	**Backlight selection** ALL : All are backlit. TU : Turbidity/SS Display SET : Setting Display Ac : Action indicator TUST : Turbidity/SS Display + Setting Display TUAc : Turbidity/SS Display + Action indicator SETAc : Setting Display + Action indicator	All are backlit.	
coLR REd	**Turbidity/SS color** GRN : Green REd : Red oRG : Orange EcGR : Turbidity/SS color changes continuously	Red	
cLP 10.0	**Turbidity/SS color reference value** Setting range: 0.0 to Measurement range high limit (*1)(*2)	10.0 (Formazin)	
cLRG 0.1	**Turbidity/SS color range** Setting range: 0.1 to Measurement range high limit (*1)(*2)	0.1 (Formazin)	
dPTM 0	**Backlight time** Setting range: 0 to 99 minutes	0 minutes	
bERGL -----	**Bar graph indication** ----- : No indication TRoT : Transmission output	No indication	
INERR oFF	**EVT output when input errors occur** oFF : Disabled oN : Enabled	Disabled	
dISP -----	**Setting Display indication** ----- : No indication EVT : EVT value	No indication	

(*1) The measurement unit and decimal point place follow the selection in [Measurement range (p.21)].
(*2) If kAoN [Kaolin (mg/L)] is selected in [Measurement unit (p.23)], measurement range high limit value will become the value set in [Span setting (p.23)].

12.11 Error Codes

When errors occur, the following error code will flash on the Turbidity/SS Display or Setting Display.

Display	Error Code	Error Type	Error Contents	Occurrence
Setting Display	E- 11	Fail	When receiving Self-check output from Turbidity/SS sensor	When measuring
	E- 12	Fail	Analog signal (+, White) (–, Black) cable of Turbidity/SS sensor is disconnected or short-circuited.	
	E- 13	Error	Turbidity/SS input value has exceeded the value equivalent to 20.5 mA DC.	
	E- 14	Error	Turbidity/SS input value has dropped below the value equivalent to 3.5 mA DC.	
	E-21	Fail	During calibration, the output signal from the Turbidity/SS sensor has not reached approx. 2 mA DC. (Before the calibration signal output switches from ON to OFF, if the output signal from the Turbidity/SS sensor is between 1 and 3 mA DC, it is regarded as normal. If the output signal is outside of this range, it is regarded as a Fail, and the error code is indicated.)	When calibrating
	E-22	Fail	After calibration is finished, the output signal from the Turbidity/SS sensor has not returned to 4 mA DC. (Approximately 5 seconds after calibration signal output switches from ON to OFF, if the output signal from the Turbidity/SS sensor is between 3.5 and 4.5 mA DC, it is regarded as normal. If the output signal is outside of this range, it is regarded as a Fail, and the error code is indicated.)	
Turbidity/SS Display	E-23	Error	During Span output signal adjustment, Turbidity/SS input value has exceeded the value equivalent to 20.5 mA DC.	When adjusting
	E-24	Error	During Zero output signal adjustment, Turbidity/SS input value has dropped below the value equivalent to 3.5 mA DC.	

***** Inquiries *****

For any inquiries about this unit, please contact our agency or the vendor where you purchased the unit after checking the following.

[Example]

- Model ---------- AER-101-TU
- Serial number ---------- No. 194F05000

In addition to the above, please let us know the details of the malfunction, or discrepancy, and the operating conditions.

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