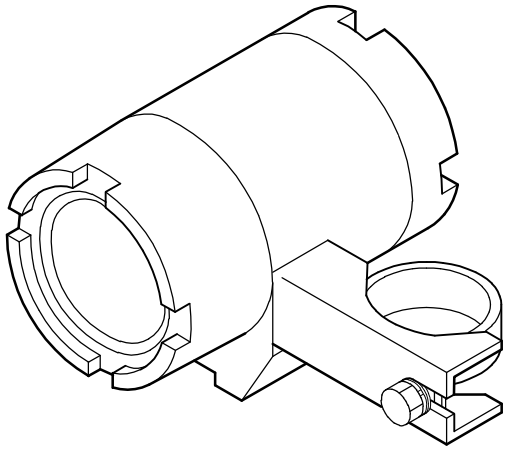
INSTRUCTION MANUAL

DISSOLVED OXYGEN ANALYZER/TRANSMITTER

MODEL ODM-135A

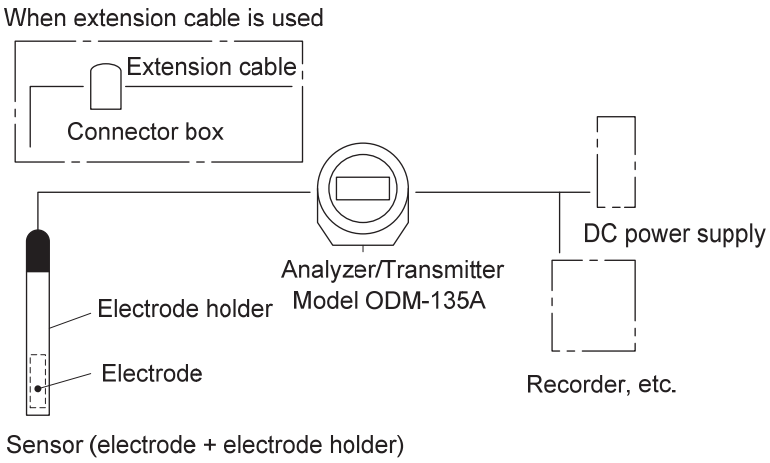


- Please keep this instruction manual close at hand of the persons who are in charge of the operation of this product.
- Before operating this product, please read this instruction manual carefully for its correct handling.

No. ODM-IB38210E

Introduction

(a) Thank you for your purchase of our product. The Model ODM-135A Dissolved Oxygen Analyzer/Transmitter (hereafter called the transmitter or the product) is a two-wire isolated type indicating transmitter used in a measurement system for various processes to measure dissolved Oxygen in liquid solutions.



Example of Measurement System

(b) Though the maximum available measuring range of DO is 0 to 50mg/L, one of nine (9) measuring ranges is selectable according to your requirements. Usually, the measuring range is pre-set by DKK-TOA before shipping in accordance with the specifications fixed when receiving your order. The power supply must be 24VDC±10%. For other specifications, see 6.1 “Specifications”.

(c) Following displays are available though the output signal is delivered only with the DO measured value.

・DO measured value display (unit: mg/L) ···· Concentration of dissolved oxygen in water

・O2 measured value display (unit: %) ····· Concentration of oxygen in the air

・SAT measured value display (unit: %) ····· Saturation ratio of dissolved oxygen in water

・Solution temperature display (unit: °C) ····· Temperature of in water

(d) The resistance value of the temperature compensation circuit to “compensate electrode temperature characteristic” is 10kΩ/25°C (thermistor). Combine DO electrode whose temperature compensation element is 10kΩ type.

(e) Since this manual mainly describes the transmitter, refer to the instruction manual attached to the electrode or sensor for the sensor combined with the transmitter.

(f) An abnormal measured value may be indicated or output by the following causes. Build a system such that related facilities are not damaged.

- Any problem of the product such as deterioration or damage of the detecting section or inappropriate insulation of cables.
- Improper setting of operating conditions or calibration operation.
- Electrical interference such as noise in the vicinity or improper grounding.
- Other unpredictable phenomena

(g) Since important items are described in “Safety Information”, read the contents carefully.

(h) The product should be handled by persons who have received proper training. In addition, for technical services such as repairs, ask a specialist to do who is qualified for the technical certification system in our company or a person who has technical skills equivalent to that certification system.

Safety Information

(1) Meaning of markings

Meaning of signal terms and symbols used in notations of warning in the instruction manual is described below. In addition, the alert symbol (⚠: General caution symbol) used on a product label, etc. is meant to notify the existence of hazard/loss and it also means “Refer to the Instruction Manual”.

⚠WARNING:

Indicates the degree of hazard which can lead to death or serious injury if you fail to operate the product properly.
Serious injury means an injury such as loss of sight, burns (high temperature or low temperature), electric shock, bone fracture and poisoning, and the aftereffects of the injury remains or the injury requires hospitalization or long periods of outpatient treatment.

⚠CAUTION:

Indicates the degree of hazard/loss which can result in injury or property damage if you fail to operate the product properly.
Injury means an injury not requiring hospitalization or long periods of outpatient treatment and refers to burns or electric shock. Property damage refers to widespread damage to the home, household goods and livestock, pets, equipment, materials, etc. (damage to other than the product itself).

【IMPORTANT】	Indicates important matters other than ⚠WARNING and ⚠CAUTION. They are the matters such as preventing damage to the product main body, preventing data destruction, preventing wasting time, maintaining performance, and observing regulations.
〔NOTE〕	Indicates comments, reasons, background information, a case example and other items to help the reader understand the meaning.
＞＞	Indicates reference items.
①, ②, ③	Indicates item numbers such as the ones used in operations.

(2) Safety compliance items

⚠WARNING

Hazardous Gasses

- Do not use the product in an area where explosive gas or flammable gas exists. Using the product in any of these areas can cause explosion or fire.

Electric Shock

- Do not touch the terminals inside the transmitter while power is applied. Touching the terminals may cause electric shock.
- The ground terminal must be grounded. If the terminal is not grounded and a problem occurs in the power supply system, electric shock may result.

⚠ CAUTION

Disassembly and Modification

- Do not disassemble or modify the sections of the product that are not described in the instruction manual. The product can be damaged.

Warning Label Lost

- If any warning label affixed to this product becomes too difficult to read or lost, please order a new one through your local sales agent or our sales office and affix it to its original position.

(3) Notes on use of the instruction manual

Important items such as “Safety compliance items” are described in this manual. Handle the manual as follows:

(a) The instruction manual is required not only at the start of operation but also required when maintenance is performed or in case a failure occurs. Please keep the manual at hand all the time so that the operator who actually operates the product can read the manual at any time.

(b) If the manual is lost or too smeared to read, please order a new copy through your local sales agent or directly from our sales office.

(c) Some of the diagrams used in the manual or on product labels may be modified with part of their shapes or displays omitted or they may be described in abstract form. In addition, numbers etc. shown on the screen example are just examples for such cases.

(d) The contents of the manual may be changed without prior notice for reasons such as to improve performance.

(e) Intellectual property right of the manual belongs to DKK-TOA. All or part of the manual must not be reproduced without permission.

Warranty

(1) Warranty Coverage

DKK-TOA Corporation (DKK-TOA) warrants its products against defective material or workmanship for the warranty period.

(a) The warranty period is one year from the date of delivery to the original user. If the date of delivery cannot be specified, the warranty period is 24 months from the month following the date of manufacture shown on the product nameplate.

(b) Specific written agreements with DKK-TOA, if any, shall take precedence over this warranty.

(c) The limitation of warranty described herein may not apply where applicable laws do not allow such limitation.

(2) Limited Warranty

This warranty does not cover the cases listed below.

(a) Direct or indirect failure or damage caused by the use of the product for a purpose or in a manner not prescribed by the specifications or the instruction manual for the product.

(b) Direct or indirect failure or damage caused by force majeure, including but not limited to an act of God, natural disaster such as earthquake, storm and flood damage, and lightning, fire, accident, abnormal voltage, salt damage, gas damage, labor unrest, acts of war (declared or undeclared), terrorism, .civil strife, or acts of any governmental jurisdiction.

(c) Failure or damage caused by any repair or modification not authorized by DKK-TOA.

(d) Failure or damage caused by the transport, moving, or dropping of the product after the purchase that is not attributable to DKK-TOA.

(e) Electrodes and consumables (The warranty period for each part has priority when the period is shorter than that for the main unit of the product. If the customer requires any part after more than six months from the date of manufacture, consult DKK-TOA or its distributor.)

(f) Failure or damage caused by the use of consumables, parts, or software not supplied by DKK-TOA.

(g) Malfunctions or damage caused by the use of connecting equipment not supplied by DKK-TOA.

(h) Loss of data, settings, programs, or software stored on the product not attributable to DKK-TOA.

(i) Any product other than DKK-TOA's, if specified by the purchaser or user, that incorporates, or is incorporated into or combined with DKK-TOA's products (*1). In such cases, this warranty covers DKK-TOA's products only.

(j) Any product not under proper maintenance in accordance with the instruction manual furnished by DKK-TOA.

(k) Products without a nameplate (excluding products proved to have been delivered by DKK-TOA).

EXCEPT AS EXPRESSLY SET FORTH IN THE PRECEDING SENTENCES, DKK-TOA MAKES NO WARRANTY OF ANY KIND WHATSOEVER WITH RESPECT TO ANY PRODUCT. DKK-TOA EXPRESSLY DISCLAIMS ANY WARANTY IMPLIED BY LAW, INCLUDING BUT NOT LIMITED TO ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE.

LIMITATION OF REMEDIES: In the event that a defect is discovered within the warranty period, DKK-TOA or its authorized distributor will, at its option, repair or replace the defective product or its part, or will refund the purchase price of the product. **THIS IS THE EXCLUSIVE REMEDY FOR ANY BREACH OF WARRANTY.**

LIMITATION OF DAMAGES: IN NO EVENT SHALL DKK-TOA BE LIABLE FOR ANY INCIDENTAL OR CONSEQUENTIAL DAMAGES OF ANY KIND FOR BREACH OF ANY WARRANTY, NEGLIGENCE, ON THE BASIS OF STRICT LIABILITY, OR OTHERWISE.

(3) Others

(a) Product parts for maintenance (*2) will normally be supplied for five years (*3) from the date manufacturing and sales are discontinued.

(b) The cause of any malfunction or damage shall be determined by a DKK-TOA technician.

(c) For repairs, contact a local distributor in your country or state.

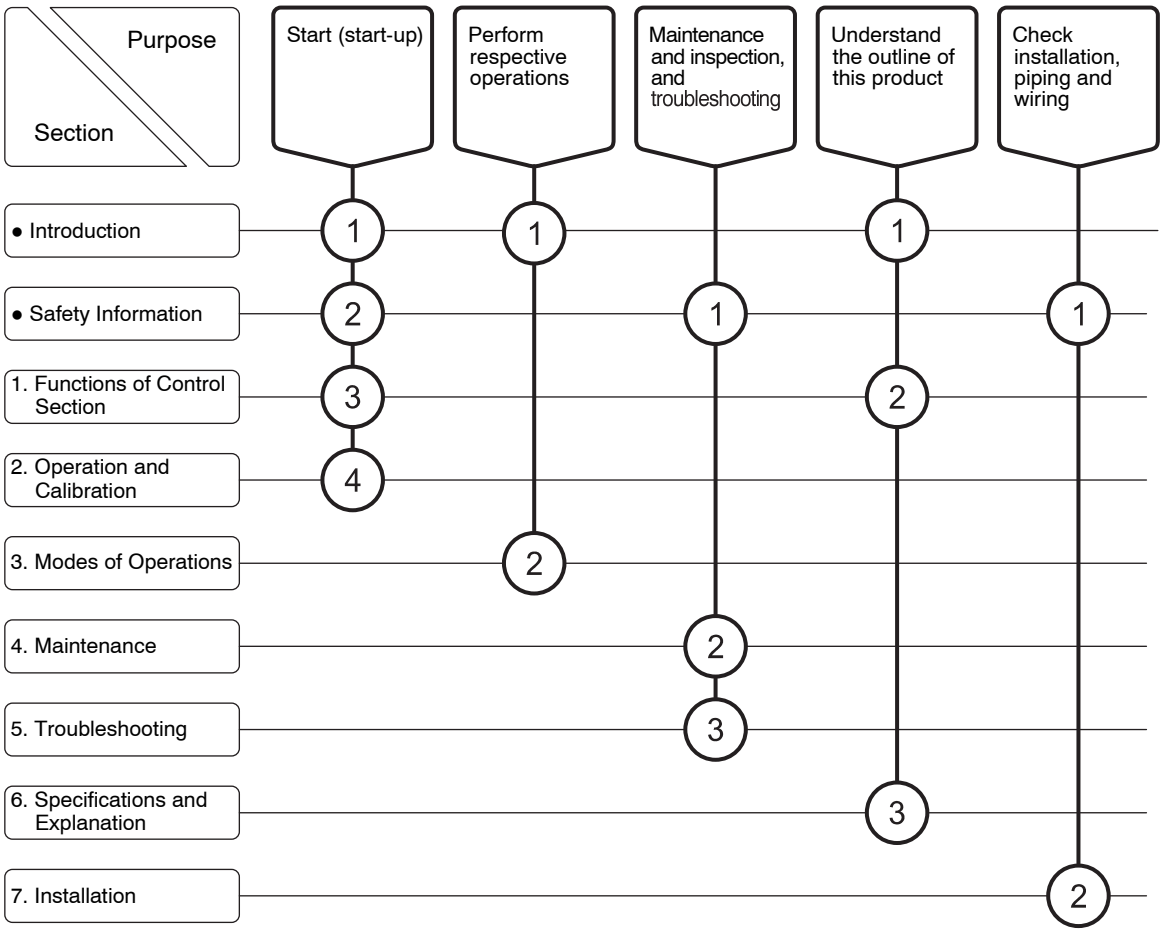
*1: Warranties for products from other companies must be maintained by the user.

*2: Maintenance parts refers to parts that are required to maintain operation of the product.

*3: This five-year period is subject to availability of parts or their replacement.

Reading Guide

Refer to the necessary sections of this instruction manual depending on your purposes such as understanding the outline of this product or starting the product as shown below. The numbers in circles indicate sections to be referred to in sequential order.



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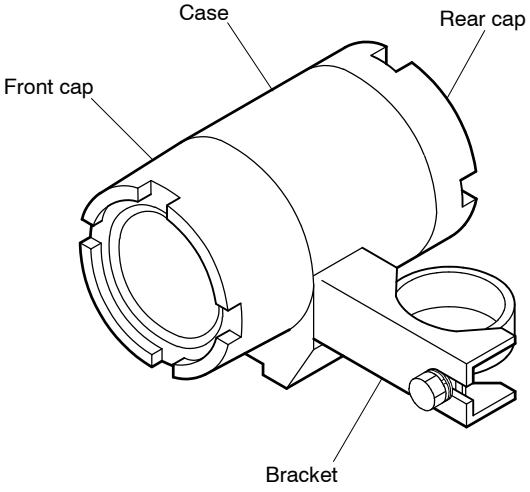
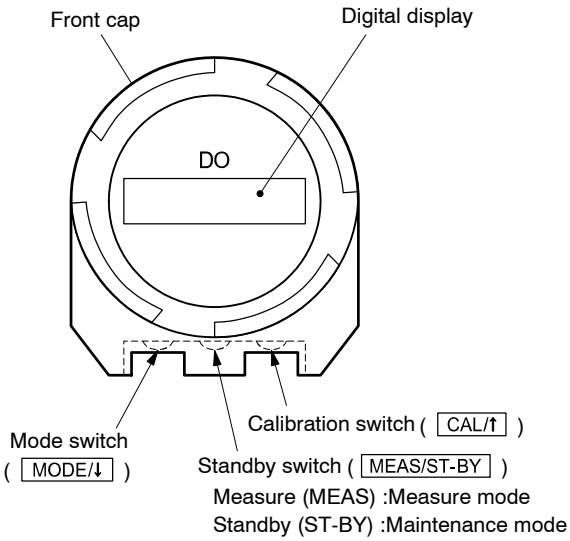
1. Functions of Control Section

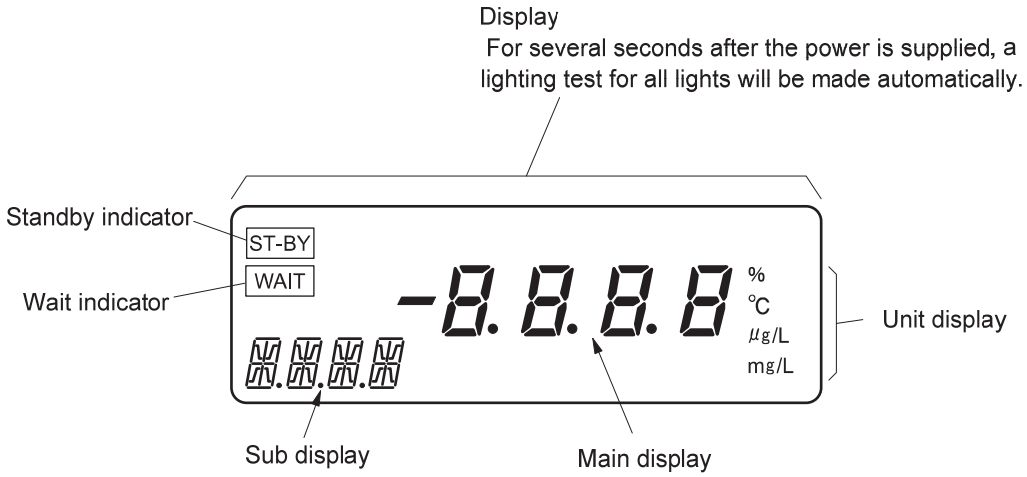
(1) Names of main components



Appearance of Transmitter



Front View



Digital Display

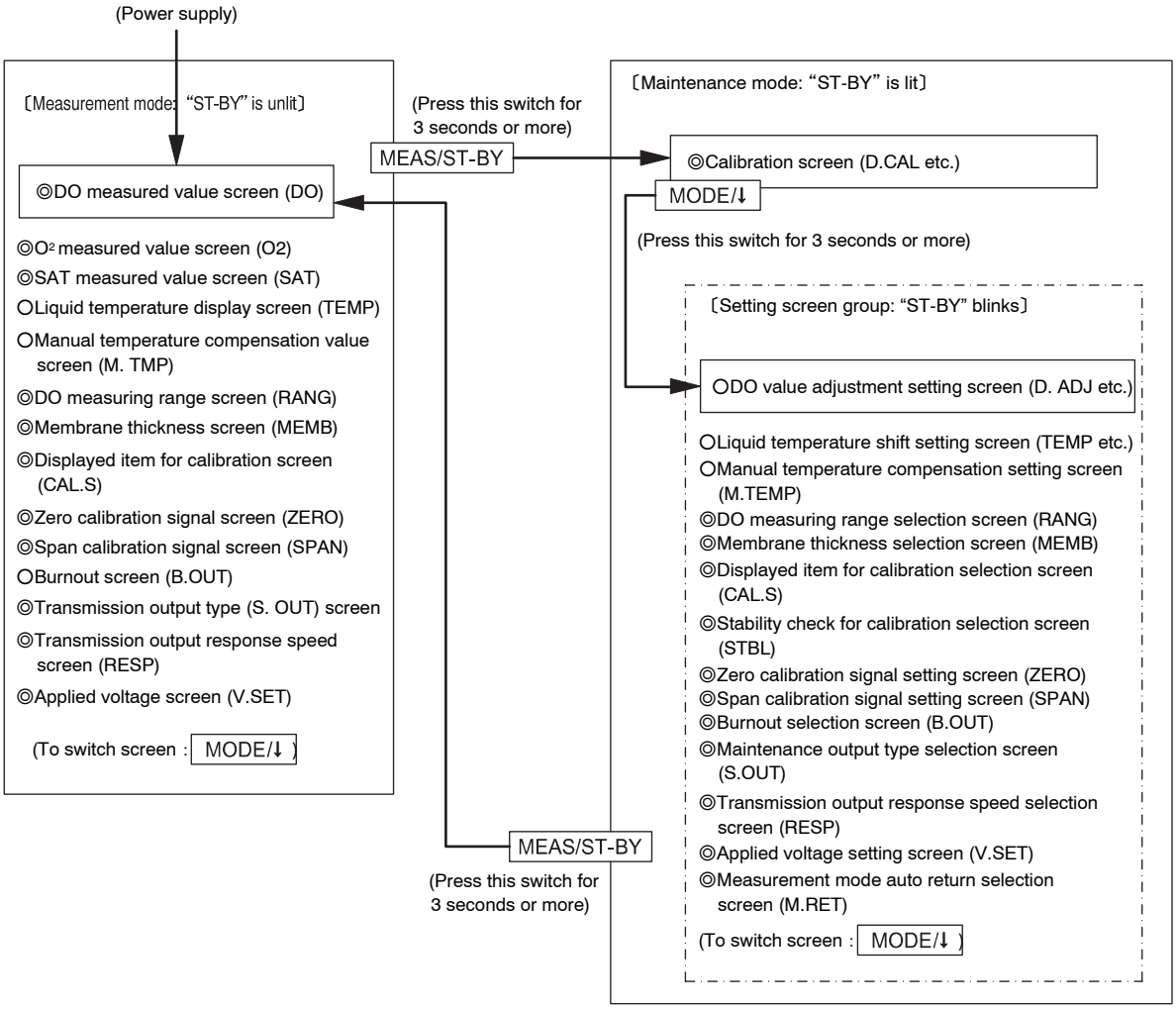
(2) Switch functions

Names and Functions of Switches

Name (used in text)	Measurement mode	Maintenance mode	Function
Standby switch (MEAS/ST-BY)	○	○	• When pressed for 3 seconds or more in the measurement mode (Standby indicator "ST-BY" is unlit), the mode changes to the maintenance mode ("ST-BY" is lit). • When pressed for 3 seconds or more in the maintenance mode, the mode returns to the measurement mode. • When pressed once (less than 3 seconds) while the transmitter is ready to select (or set) in the maintenance mode, the set values will be confirmed.
Mode switch (MODE/↓)	○	○	• Each time this switch is pressed once (less than 3 seconds) in the measurement mode or maintenance mode, the screen switches from one to another. • When the transmitter is ready to change settings in the maintenance mode, you can select the desired setting item or decrease the setting value.
Calibration switch (CAL/↑)	–	○	• Perform calibration in the maintenance mode (Standby indicator "ST-BY" is lit). • Pressing this switch for 3 seconds or more in the maintenance mode makes each item ready for setting changes. • When the transmitter is ready to change settings in the maintenance mode, you can select the desired setting item or increase the setting value.

○: Enabled –: Disabled

(3) Operation screen map



◎ : Screens that appears always
○ : Screens that may not appear depending on the settings or by specifications

[Note] For "Transmission output adjustment" screen not included here, refer to 4.4 "Transmission Output Adjustment".

Operation Screen Map

2. Operation and Calibration

2.1 Operation Start Procedure

The transmitter can be put into normal operating state by following each operation below.

①Check the installation condition. ····· Check that the necessary installation work is completed, which is described in 7. "Installation" (mounting, piping and wiring) and the installation related items described in the instruction manual provided for the electrode or sensor.

②Prepare for the sensor. ····· Perform the following preparation work for the sensor.
>> Instruction manual provided for the electrode or sensor

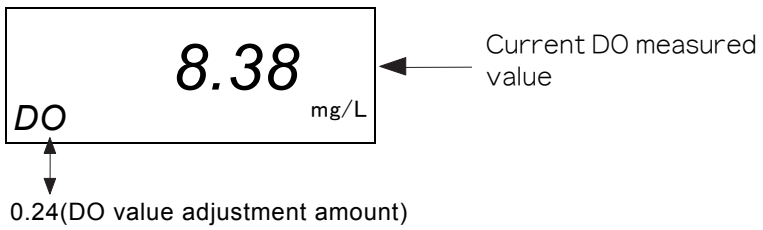
- In the case of an immersion type ····· Install the electrode to the sensor, remove the rubber cover, and immerse the tip end of the electrode and so on.
- In the case of a liquid flow-through type ····· Install the electrode to the sensor, introduce sample into the case of the sensor and so on.
- In the case of a sensor with cleaner ····· Other than above items, check the power supply of the cleaner, etc.

【IMPORTANT】
- Combine DO electrode whose temperature element is 10kΩ / 25ºC (thermistor).

③Make sure of the power and turn it on. ····· Make sure that the power to be supplied to the transmitter is 24VAC ± 10% and then turn on the power.

【IMPORTANT】
- If the transmitter does not start normally when power is applied, turn off power and wait for 10 seconds or more and then turn on power again.
- Do not turn on power at least 10 seconds after power is turned off.

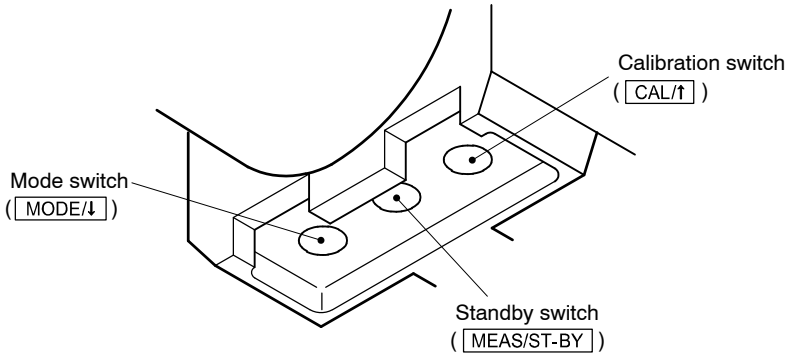
- As soon as the power is supplied to the transmitter, the "DO measured value" screen, which is the initial screen of the measurement mode ("ST-BY" is unlit), appears. The DO measured value is displayed on the main display and the DO value adjustment amount is displayed on the sub display. However, the DO value adjustment amount is not displayed when the value is zero. (>> 3.3(2) "DO value adjustment setting")



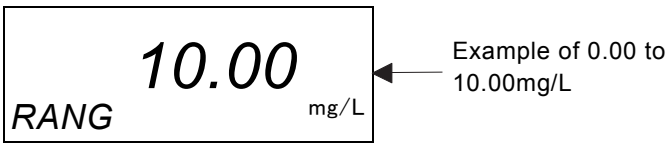
DO Measured Value Screen (DO)

- Transmission output (4 to 20mA) is output 2 minutes after the power is turned on.

④Check the DO measuring range. ····· Press MODE/↓ several times until the "DO measuring range" (RANG) screen appears and check the main display DO measuring range value.



Switches on the Underside of the Transmitter



DO Measuring Range Screen

- Normally, the setting is made according to the ordered specification.
- How to change the measuring range: >> 3.3(5) “DO measuring range selection”

⑤Set other items if necessary. ····· If you find items specifically necessary among setting items in the table below, set those values. However, “DO measuring range selection” in the table is already checked in Step ④.

Factory Setting Values of Setting Items

Setting item	Factory setting	Reference item
• DO value adjustment setting	DO not adjusted (“oFF”)	3.3(2) “DO value adjustment setting”
• Liquid temperature shift setting	Liquid temperature not shifted (“oFF”)	3.3(3) “Liquid temperature shift setting”
• Manual temperature compensation setting	Manual temperature compensation not performed (“oFF”)	3.3(4) “Manual temperature compensation setting”
• DO measuring range selection	Depends on the ordered specifications	3.3(5) “DO measuring range selection”
• Displayed item for calibration selection	do	3.3(7) “Displayed item for calibration selection”
• Stability check for calibration selection	Stability check (“on”)	3.3(8) “Stability check for calibration selection”
• Burnout selection	Burnout function not executed (“oFF”)	3.3(10) “Burnout selection”
• Maintenance output type selection	Hold (“HoLd”)	3.3(11) “Maintenance output type selection”
• Transmission output response speed selection	2 (standard)	3.3(12) “Transmission output response speed selection”
• Measurement mode auto return selection	Automatically returns (“on”)	3.3(14) “Measurement mode auto return selection”

⑥Perform the calibration. ····· >> 2.2 “Calibration”

⑦Select the measurement mode screen. ····· >> 3.1 “Measurement Mode Screen Selection”

The DO measurement system is now in normal operating state.

2.2 Calibration

(a) Before measurement, this transmitter must always be calibrated and the characteristics of the electrode and transmitter adjusted using standard solution.

(b) When measurements are continuous, the electrode characteristics are changed by contamination, etc. of the sample water, but calibration prevents this effect. Periodically perform calibration even after the start of operation.

(c) The calibration of the transmitter can start with either one of "Zero" or "Span" calibration first

(d) When "Calibration" (D.CAL etc.) screen is displayed, the transmitter automatically judges which calibration is to be executed, "Zero" or "Span", in response to the signal from the electrode. For example, if the electrode is immersed in "Zero" reference solution, the transmitter automatically goes into the state for zero calibration. And if the electrode is left in the air, the transmitter goes into the state for span calibration.

(e) For the "Displayed Item for Calibration Selection" (CAL.S) screen in the setting mode, one of "DO", "O_2" or "SAT" displayed item can be set for calibration. Factory setting is "DO", but it can be changed for calibration with "O_2" or "SAT" according to the procedure.

(f) Calibration with air which is simple and accurate is also applicable for "Span" calibration.

(g) Execute "Zero" and "Span" calibration first before adjusting the indication of the transmitter to the analysis data of the sample ＞＞ 3.3(2) "DO value adjustment setting"

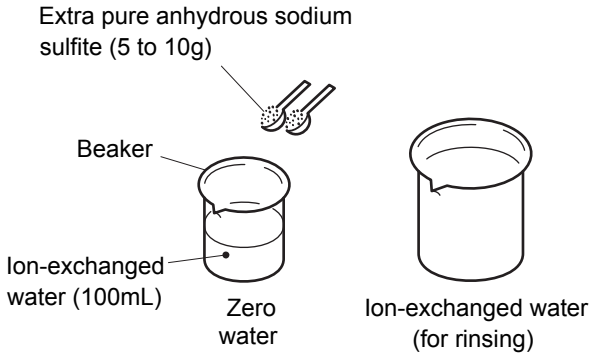
(1) Zero calibration with zero solution

5 to 10% sodium sulfite solution is employed as "Zero" solution. ＞＞ "2.2(2) Zero calibration with input off"

①Make preparations.

- Extra pure anhydrous sodium sulfite (Na_2SO_3) ····· 5 to 10g
- Ion-exchanged water ····· 1 to 2L
- Beaker ····· 1 (for zero calibration solution)
- Beaker (large) ····· 1 (for ion-exchanged water)

②Prepare zero solution. ····· Fill one of the 2 beakers with 100mL of ion-exchanged water (to a level sufficient for immersion of the electrode tip) and add 5 to 10g of anhydrous sodium sulfite (approx. 2 spoonfuls) into it. Then, fill the other beaker with ion-exchanged water for rinsing the electrode.

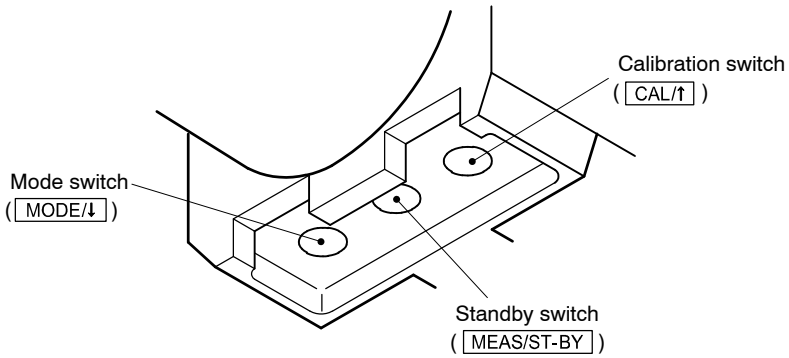


Zero Solution Preparations

③Prepare the electrode. ····· Prepare the electrode tip so that it can be immersed in the zero solution prepared in the beaker. If the tip of the electrode is found dirty, thoroughly clean and rinse it with ion-exchanged water.

④Set to maintenance mode. ····· If the measurement mode ("ST-BY" unlit) is set, press [MEAS/ST-BY] for 3 seconds or more.

- The transmitter enters the maintenance mode (ST-BY). The "calibration" (D.CAL etc.) screen, which is the initial screen of the maintenance mode, is displayed.



Switches on the Underside of the Transmitter

⑤Confirm the displayed item for calibration. ····· Confirm that the sub display of "Calibration" (D.CAL etc.) screen shows the displayed item with which the calibration is intended.

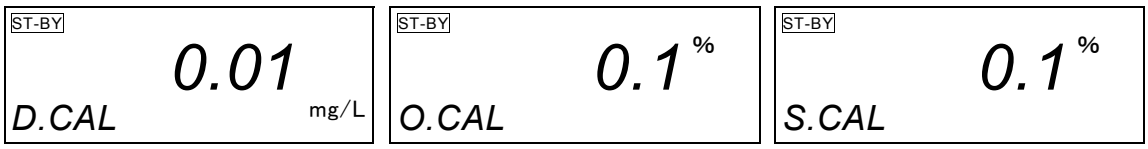
- Sub display

  D.CAL (DO displayed calibration) ····· Calibration per concentration of dissolved oxygen in water (mg/L)

  O.CAL (O_2 displayed calibration) ····· Calibration per concentration of oxygen (%)

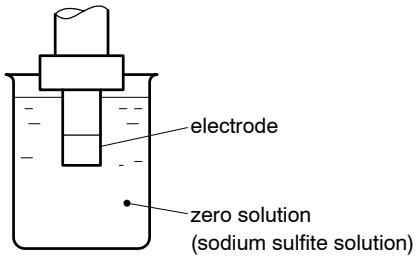
  S.CAL (SAT displayed calibration) ····· Calibration per saturation ratio of dissolved oxygen in water

- Usually set the displayed item to D.CAL (DO displayed calibration) and change it if necessary. >> 3.3(7) "Displayed item for calibration selection"



Calibration Screen (D.CAL etc.)

⑥Immerse the electrode into the zero solution. ····· Rinse the electrode with ion-exchanged water and immerse it into the prepared zero solution (sodium sulfite solution).



Immersing Electrode into Zero Solution

⑦Start the zero calibration. ····· Wait for about 30 to 60 minutes (1 to 2 hours for DO electrode Model 7536L, 7546L) until the indication decreases and stabilizes. Then, press CAL/↑.

- When wait display "WAIT" starts blinking, the zero calibration starts. When the zero calibration is finished, "WAIT" goes out.
- If "oFF" is set on "Stability check for calibration selection" (STBL) screen, the zero calibration immediately starts without blinking "WAIT". >> 3.3(8) "Stability check for calibration selection"
- Finally, "0.00mg/L" appears on the main display (in case of D.CAL) and the zero calibration finishes.
- If the zero calibration is required again, repeat the procedure from step ⑥. As for the span calibration, refer to the related section described later.

⑧Set the sensor at the measuring point. ····· Rinse the electrode with ion-exchanged water and set the sensor at the measuring point.

【IMPORTANT】 • After the end of calibration, do not press CAL/↑ in the calibration mode. If it is pressed, calibration will become necessary.

⑨ Set to measurement mode. ····· Press MEAS/ST-BY for 3 seconds or more.

- Return to the measurement mode ("ST-BY" unlit) and release transmission output hold.
- Even if DO value adjustment is set to on, during calibration execution, DO value adjustment is temporarily released and calibration is performed using the standard solution value. In addition, when the transmitter is returned to the measurement mode after calibration is complete, the DO value adjustment amount of the last time is displayed on the sub display and the measured value contains that value.

(2) Zero calibration with input off

This is a simplified method of zero calibration to be executed by disconnecting the electrode lead wire from the terminal "1" of the transmitter, namely, by setting the input signal from the electrode side to off (oFF) without using the zero solution.

Compared to the method mentioned in 2.2(1) "Zero calibration with zero solution", although the measured value tends to be higher by 0.02 to 0.04mg/L, this method may be convenient for the zero calibration or zero point checking in a short time.

⚠ WARNING

Electric Shock

- If a "wash in progress" contact signal cable of sensor with cleaner (option) is connected to the transmitter, do not touch the terminals in the product while power is applied. An electric shock may result.

①Disconnect the electrode lead wire "1". ····· Remove the insulation cover in the transmitter and disconnect the electrode lead wire from terminal "1".

②Set to maintenance mode. ····· If the measurement mode ("ST-BY" unlit) is set, press MEAS/ST-BY for 3 seconds or more.

- The transmitter enters the maintenance mode (ST-BY). The "calibration" (D.CAL etc.) screen, which is the initial screen of the maintenance mode, is displayed.

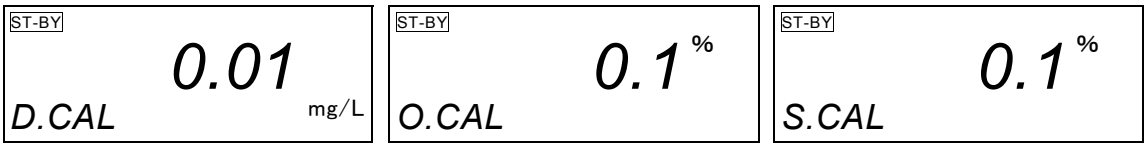
③Confirm the displayed item for calibration. ····· Confirm that the sub display of "Calibration" (D.CAL etc.) screen shows the displayed item with which the calibration is intended.

- Sub display

D.CAL (DO displayed calibration) ····· Calibration per concentration of dissolved oxygen in water (mg/L)

O.CAL (O_2 displayed calibration) ····· Calibration per concentration of oxygen (%)

S.CAL (SAT displayed calibration) ····· Calibration per saturation ratio of dissolved oxygen in water



<DO displayed calibration> <O_2 displayed calibration> <SAT displayed calibration>

Calibration Screen (D.CAL etc.)

- Usually set the displayed item to D.CAL (DO displayed calibration) and change it if necessary. >> 3.3(7) "Displayed item for calibration selection"

④ Start the zero calibration. ····· Wait for about 1 to 2 minutes until the indication decreases and stabilizes. Then, press CAL/↑.

- When wait display "WAIT" starts blinking, the zero calibration starts. When the zero calibration is finished, "WAIT" goes out.
- If "oFF" is set on "Stability check for calibration selection" (STBL) screen, the zero calibration immediately starts without blinking "WAIT". >> 3.3(8) "Stability check for calibration selection"

- Finally, “0.00mg/L” appears on the main display (in case of D.CAL) and the zero calibration finishes.
- If the zero calibration is required again, repeat the procedure of step ④. As for the span calibration, refer to the related section described later.

⑤Return to the original state. ····· Connect the disconnected electrode lead wire to terminal “1” like before.

⑥Set to measurement mode. ····· Press MEAS/ST-BY for 3 seconds or more to end the calibration.

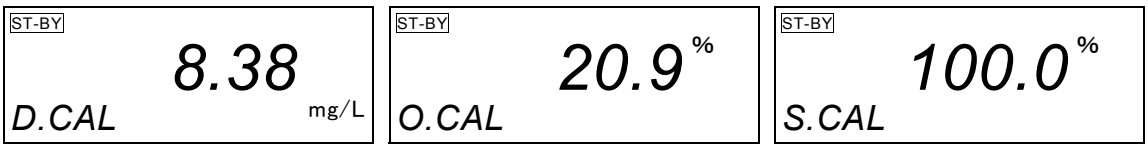
- Return to the measurement mode (“ST-BY” unlit) and release transmission output hold.
- Even if DO value adjustment is set to on, during calibration execution, DO value adjustment is temporarily released. In addition, when the transmitter is returned to the measurement mode after calibration is complete, the DO value adjustment amount of the last time is displayed on the sub display and the measured value contains that value.

(3) Span calibration with air

Generally, the span calibration is executed with air or with air saturated water since the oxygen concentration in them is clear and accurate. Therefore, this transmitter is prepared for the span calibration with air in principle. However, adopt the method of the span calibration with air saturated water in case the measuring point is positioned very close to heat sources or exposed to the direct sunlight since the measurement may become unstable under such conditions. >> 2.2(4) “Span calibration with air saturated water”

①Set to maintenance mode. ····· If the measurement mode (“ST-BY” unlit) is set, press MEAS/ST-BY for 3 seconds or more.

- The transmitter enters the maintenance mode (ST-BY). The “calibration” (D.CAL etc.) screen, which is the initial screen of the maintenance mode, is displayed.



<DO displayed calibration> <O_2 displayed calibration> <SAT displayed calibration>

Calibration Screen (D.CAL etc.)

- Usually set to D.CAL (DO displayed calibration) and change it if necessary.
  >> 3.3(7) “Displayed item for calibration selection”

②Leave the electrode in the air. ····· Rinse the electrode with ion-exchanged water first and then leave it in the air.

③ Start the span calibration. ····· Wait for about a few minutes until the indication stabilizes. Then, press CAL/↑.

- When wait display “WAIT” starts blinking, the span calibration starts. When the span calibration is finished, “WAIT” goes out.
- If “oFF” is set on “Stability check for calibration selection” (STBL) screen, the span calibration immediately starts without blinking “WAIT”. >> 3.3(8) “Stability check for calibration selection”
- The calibration value is displayed and the span calibration finishes.

- If the span calibration is required again, repeat the procedure of step ③. For returning to the setting screen group, press [MODE/↓] for 3 seconds or more.

④Set to measurement mode. ····· Leave the electrode to the measuring point and press [MEAS/ST-BY] for 3 seconds or more. The transmitter returns to the measurement mode.

- Return to the measurement mode ("ST-BY" unlit) and release transmission output hold.
- Even if DO value adjustment is set to on, during calibration execution, DO value adjustment is temporarily released. In addition, when the transmitter is returned to the measurement mode after calibration is complete, the DO value adjustment amount of the last time is displayed and the measured value contains that value.

(4) Span calibration with air saturated water

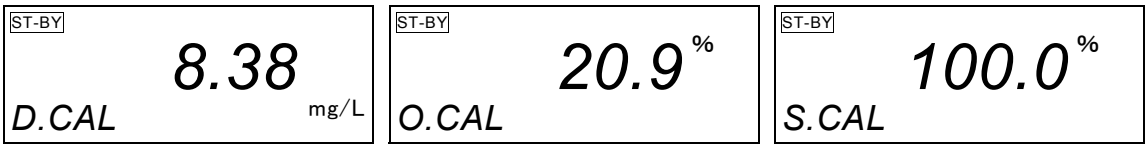
①Preparation

- 500mL PE beaker
- Stirrer for agitation
- Ion-exchanged water or city water ····· 1 to 2L

②Stir the ion-exchanged water. ····· Fill the beaker with the ion-exchanged water to the level of 1/2 to 2/3 of the beaker and stir it with the stirrer for 10 to 15 minutes.

③Set to maintenance mode. ····· If the measurement mode ("ST-BY" unlit) is set, press [MEAS/ST-BY] for 3 seconds or more.

- The transmitter enters the maintenance mode (ST-BY). The "calibration" (D.CAL etc.) screen, which is the initial screen of the maintenance mode, is displayed.



<DO displayed calibration> <O_2 displayed calibration> <SAT displayed calibration>

Calibration Screen (D.CAL. etc.)

- Usually set to D.CAL (DO displayed calibration) and change it if necessary.
  >> 3.3(7) "Displayed item for calibration selection"

④Immerse the electrode. ····· Rinse the electrode with the ion-exchanged water first, and then immerse the electrode tip in the air saturated water in the PE beaker so that the metallic part of the electrode tip is completely dipped under the water maintaining the agitation running.

⑤Start the span calibration. ····· Wait for about 5 to 10 minutes until the indication stabilizes. Then, press [CAL/↑].

- When wait display "WAIT" starts blinking, the span calibration starts. When the span calibration is finished, "WAIT" goes out.
- If "oFF" is set on "Stability check for calibration selection" (STBL) screen, the span calibration immediately starts without blinking "WAIT". >> 3.3(8) "Stability check for calibration selection"
- The concentration of the dissolved oxygen in the air saturated water appears on the main display and the span calibration finishes. (Example: 8.11mg/L at 25℃)
- If the span calibration is required again, repeat the procedure of step ④, ⑤. For returning to the setting screen group, press [MODE/↓] for 3 seconds or more.

⑥Set to measurement mode. ····· Leave the electrode to the measuring point and press MEAS/ST-BY for 3 seconds or more. The transmitter returns to the measurement mode.

- Return to the measurement mode ("ST-BY" unlit) and release transmission output hold.
- Even if DO value adjustment is set to on, during calibration execution, DO value adjustment is temporarily released. In addition, when the transmitter is returned to the measurement mode after calibration is complete, the DO value adjustment amount of the last time is displayed and the measured value contains that value.

(5) Indication value in span calibration

The output signal from the DO electrode is proportional to the partial pressure of the oxygen.

Partial pressure of the oxygen in the air saturated water

≒ Partial pressure of oxygen in the air

= 100kPa x 20.9% = 20.9kPa

Atmospheric pressure; Oxygen (O_2) concentration

〔NOTE〕 • Air Saturated Water ····· Fill ion-exchanged water (Sample water or city water is also allowed.) in a 300 to 500mL beaker to the level of 70 to 80% of the beaker and stir it with a stirrer for about 10 minutes. Then, the water turns to air saturated water. Immerse the electrode for measurement maintaining the stirrer running since the movement of the water at the electrode is necessary for accurate measurement.

The above equation can be confirmed by the fact that the output from the electrode immersed in air saturated water is nearly equal to that placed in the air of the same temperature. Namely, if the electrode calibrated to 8.11mg/L or 100% in air saturated water at 25℃ is placed in the air, the indication of the transmitter does not change. (Strictly speaking, however, a slight difference between them may be recognized because of the difference in the temperature of them.)

The span calibration with air is a method based on the theory mentioned above. Since the air saturated state is "100%", the span calibration can be executed regardless of the amount of the saturated DO depending on its temperature.

〔NOTE〕 • SAT (SAT. RATIO: Saturation ratio) ····· The saturation ratio is defined as a unit to express the extent of saturation with air supposing the saturation ratio of a solution saturated with air is 100% and is used, for instance, when saturated DO of pure water cannot be applied because of the composition of the sample.

The following table shows span calibration values in each mode.

Span Calibration Values in each mode

t℃	DO (mg/L)	O_2 (%)	SAT (%)
0	14.16	20.9	100.0
:	:	:	:
:	:	:	:
25	8.11	20.9	100.0
:	:	:	:
:	:	:	:
40	6.60	20.9	100.0

↑

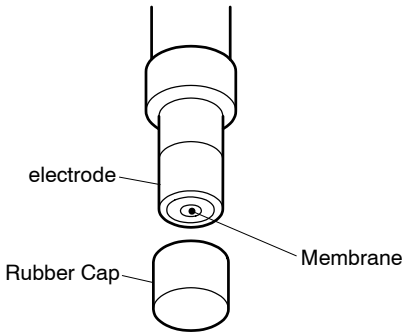
Since the gas solubility varies with the temperature, the DO value changes accordingly. But the oxygen partial pressure remains constant without any change regardless of temperature.

2.3 Stopping Operation

When operation will be stopped for several weeks or more, as a rule, proceed as follows:

①**Turn off the power source.** ····· Turn off the power source to the transmitter at the supply side of the power transmission cable.

②**Store the sensor.** ····· Pull up the sensor from the sample water and clean it thoroughly, then put on the rubber cap to the tip of the electrode.



Putting on the Rubber Cap

- If the electrode will not be contaminated, the sensor can also be immersed in the sample water.

③**Protect the transmitter.** ····· When the cable was disconnected from the transmitter, prevent the entry of outside air into the transmitter by installing a dustproof plate (cardboard, etc. can also be used) to the watertight gland.

To restart operation, refer to 2.1 “Operation Start Procedure”.

3. Modes of Operations

3.1 Measurement Mode Screen Selection

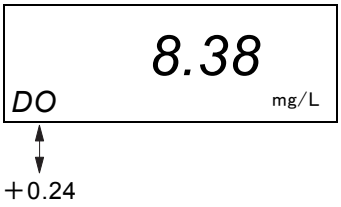
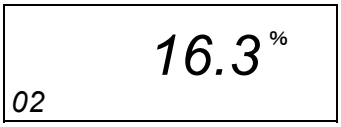
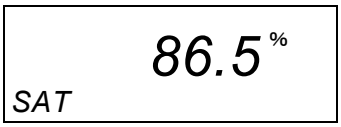
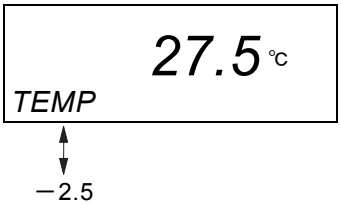
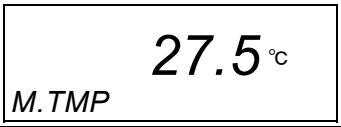
(a) The measurement mode contains screens such as the "DO measured value" screen shown in the table below and every time MODE/↓ is pressed (less than 3 seconds), the screen switches from one to another.

(b) The transmission output conforms to the DO measured value regardless of the screen displayed.

(c) Each screen other than the "DO measured value" (DO) screen, "O_2 measured value" (O_2) screen, or "SAT measured value" (SAT) screen automatically returns to the "DO measured value" screen after they have been displayed for about 20 seconds.

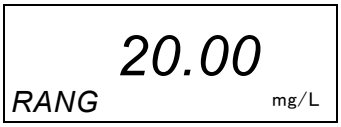
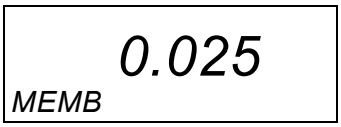
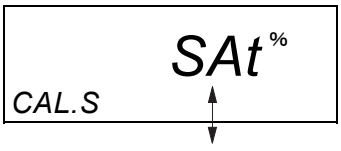
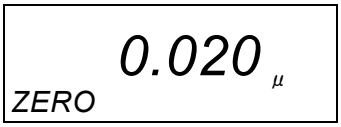
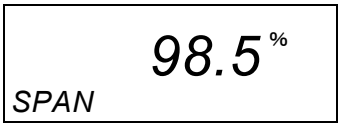
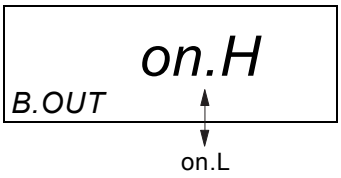
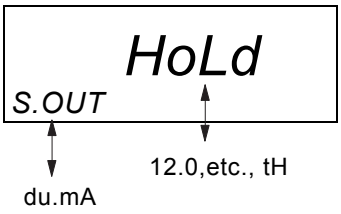
(d) When the screen is switched to "O_2 measured value" (O_2) screen, or "SAT measured value" (SAT) screen, the transmission output is held while the screen is displayed. In addition, the transmission output is also held in the same way for the first 30 seconds after the screen is switched from "SAT measured value" (SAT) screen to "Liquid Temperature Display" (TEMP) screen or "Manual Temperature" (M.TMP) screen.

Screen Sequence of Measurement Mode

No.	Screen name	Screen display example	Contents
			(To switch screen: MODE/↓)
①	DO measured value screen		• Main display ···· Present DO measured value • Sub display ···· DO value adjustment amount If "oFF" (off) is set for DO value adjustment, "DO" is displayed.
②	O_2 measured value screen		• Main display ···· Present O_2 measured value • Transmission output is held.
③	SAT measured value screen		• Main display ···· Present SAT measured value • Transmission output is held.
④	[When manual temperature compensation switch is off (OFF).]		
	Liquid temperature display screen*		• Main display ···· Present sample water temperature measured by the electrode. • Sub display ···· Liquid temperature shift value. If liquid temperature shift is zero, "TEMP" is displayed.
	[When manual temperature compensation switch is on (ON).]		
	Manual temperature compensation value screen*		• Main display ···· Set compensation temperature.

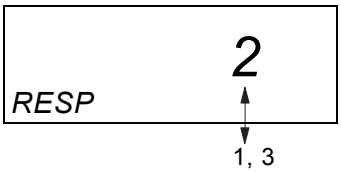
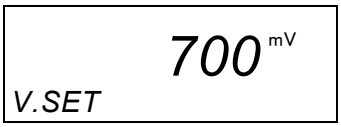
(To be continued)

(Continued from previous page)

No.	Screen name	Screen display example	Contents
⑤	DO measuring range screen		• Main display ···· DO measuring range set presently is displayed.
⑥	Membrane thickness screen		• Main display ···· Membrane thickness currently set (mm)
⑦	Displayed item for calibration screen.		• Main display ···· One of the following three "do" (DO displayed calibration) ···· During calibration, DO concentration is displayed. (unit: mg/L) "o2" (O_2 displayed calibration) ···· During calibration, O_2 concentration is displayed. (unit: %) "SAt" (SAT displayed calibration) ···· During calibration, SAT concentration is displayed. (unit: %)
⑧	Zero calibration signal screen		• Main display ···· The last zero calibration signal is displayed. (μA)
⑨	Span calibration signal screen		• Main display ···· The ratio of the last span calibration signal to the designed standard value (%) is displayed.
⑩	Burnout screen*		• Main display ···· "on.H" or "on.L" "on.H" (on high) ···· Transmission goes off scale at the plus side when abnormal. "on.L" (on low) ···· Transmission goes off scale at the minus side when abnormal. • When "oFF" (off), this screen is not displayed.(Factory setting)
⑪	Transmission output type screen		• Main display ···· One of the following three "HoLd" (Hold) ···· Outputs the last transmission output value (fixed) before the mode is switched to the maintenance mode. "12.0" etc. (Dummy) ···· Outputs an arbitrarily set transmission output value (fixed). (Sub display ···· du, mA) "tH" (Through) ···· DO measured value is output in the same way as in the measurement mode.

(To be continued)

(Continued from previous page)

No.	Screen name	Screen display example	Contents
⑫	Transmission output response speed screen		• Main display ···· One of the following three 1 ···· Fast 2 ···· Standard 3 ···· Slow
⑬	Applied voltage screen		• Main display ···· Current applied voltage on the electrode
	(Returns to Step ①.)		

∗ ···· Screen is not displayed depending on the setting screen group setting.

3.2 Maintenance Mode Calibration Screen Operation

(a) The maintenance mode contains the "Calibration" (D.CAL etc.) screen and the "Setting screen group" screens. (>> 3.3 "Operations of Setting Screen Group in Maintenance Mode") The "calibration" (D.CAL, others) screen is explained here.

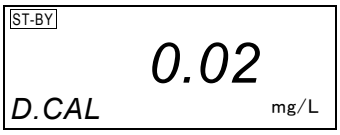
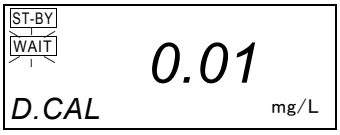
(b) On the "calibration" (D.CAL etc.) screen, "Zero" and "Span" calibration can be performed.

(c) Since the transmitter automatically judges which calibration is to be performed, "Zero" or "Span", in response to the signal from the DO electrode, it is not required to assign which calibration is to be performed. In addition, the zero and span calibration can be performed regardless of its order and can be repeated at any number of times if necessary.

(d) As for preparation of zero solution and others, refer to "2.2 Calibration" for details since this section describes mainly about operation of switches.

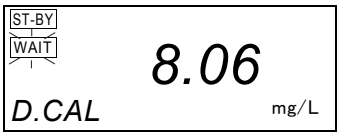
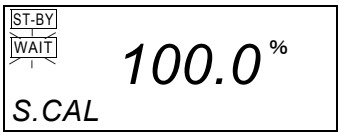
(e) During calibration, one of screens of "D.CAL" (DO displayed calibration), "O.CAL" (O_2 displayed calibration) or "S.CAL" (SAT displayed calibration) appears in accordance with the selection of "Displayed item for calibration selecting" (CAL.S) screen. If the displayed item needs to be changed, refer to 3.3(7) "Displayed item for calibration selection" and perform it before calibration.

Procedure of DO calibration

Procedure and display example	Contents
① Select the maintenance mode. ·····  Calibration screen	Press MEAS/ST-BY for 3 seconds or more in the measurement mode ("ST-BY" is unlit). • "ST-BY" lights and the "calibration" (D.CAL, others) screen, the initial screen of the maintenance mode, appears.
② Start zero calibration. ·····  Zero calibration in progress screen	Immerse the electrode in the zero solution for about 30 to 60 minutes (1 to 2 hours for model DO electrode 7536L, 7546L), or set to input off (disconnect the electrode lead wire "1"), and press CAL/↑. • "WAIT" blinks. (Does not blink when the "stability check for calibration" (STBL) screen was set to "oFF".)
③ Confirm the end of zero calibration. ·····	Confirm that "WAIT" is off. When set to input off, connect the electrode lead wire. • When the electrode was immersed in the zero solution, rinse the electrode with ion-exchanged water and wipe the water from the electrode tip.
④ Start span calibration. ·····	Leave the DO electrode in the air or immerse it in the air saturated water. After 5 to 10 minutes in either case, confirming that the value on the main display is stabilized, press CAL/↑. ・"WAIT" blinks. (Does not blink when the "stability check for calibration" (STBL) screen was set to "oFF".)

(To be continued)

(Continued from previous page)

Procedure and display example	Contents
 <DO displayed calibration>	
 <O_2 displayed calibration>	
 <SAT displayed calibration>	
Span calibration in progress screen	
⑤ Confirm the end of span calibration.	Confirm that "WAIT" is off. • If the calibration needs to be performed again, repeat steps from ②.
⑥ Return the electrode to its original state.	Return the electrode to the measuring point. • If MODE/↓ is pressed here for 3 seconds and more, the screen goes to the next screen of the setting screen group.
⑦ Select the measurement mode.	Press MEAS/ST-BY for 3 seconds or more.

3.3 Operations of Setting Screen Group in Maintenance Mode

For operation of the "calibration" (D.CAL, others) screen, refer to 3.2 "Maintenance Mode Calibration Screen Operation".

(1) Screen sequence of setting screen group

(a) The setting screen group contains the screens shown below and each screen can be used for different purpose.

(b) If you press [MEAS/ST-BY] for 3 seconds or more in the measurement mode, the "calibration" (D.CAL, others) screen, the initial screen of the maintenance mode, appears. Then if you press [MODE/↓] for 3 seconds or more, you can go to the "DO value adjustment setting" screen, the initial screen of the setting screen group.

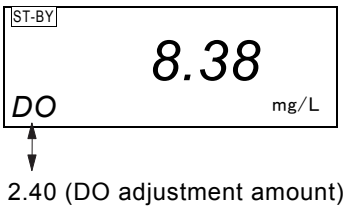
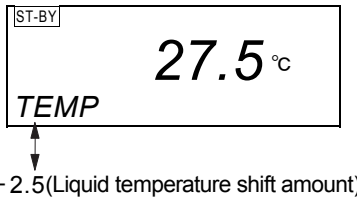
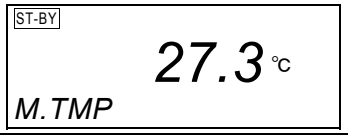
(c) Of the setting screen group, every time you press [MODE/↓], the screen switches from one to another. If you press [MEAS/ST-BY] for 3 seconds or more in the setting screen group, the mode returns to the measurement mode.

(d) When you press [CAL/↑] for 3 seconds or more in each screen, the screen turns to the entry state and the entered values can be changed using [MODE/↓] or [CAL/↑] and it can be confirmed by pressing [MEAS/ST-BY] (less than 3 minutes).

【IMPORTANT】 • When you press [MEAS/ST-BY] to confirm the set values in each screen operation, press it for less than 3 seconds. If you press [MEAS/ST-BY] for 3 seconds or more, the setting operation will be interrupted and the mode returns to the measurement mode.

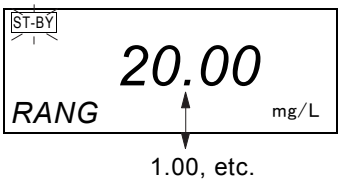
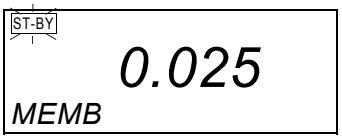
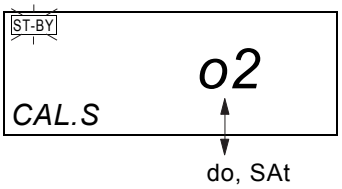
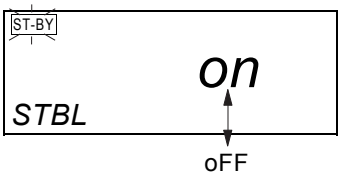
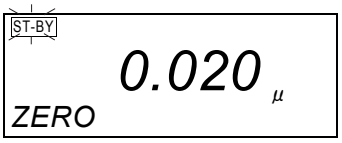
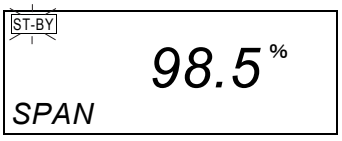
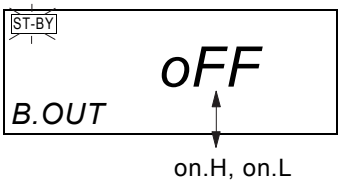
(e) For operation of each screen, refer to 3.3(2) "DO value adjustment setting" and subsequent items.

Screen Sequence of Setting Screen Group

No.	Screen name	Screen display example	Contents
			(Screen switching: [MODE/↓])
①	DO value adjustment setting screen		• Main display ···· Do measured value including adjustment amount • Sub display ···· Do adjustment amount. (Only when "on" is set) (Factory setting: "oFF") • Setting range ····+100 to – 70% (main display is incremented and decremented.)
②	When manual temperature compensation switch is off ("OFF").		
	Liquid temperature shift setting screen		• Main display ···· Liquid temperature measured value containing the shift amount. • Sub display ···· Liquid temperature shift amount (only when "on" is set). (Factory setting: "oFF") • Setting range ···· ±5.0°C
	When manual temperature compensation switch is on ("ON").		
	Manual temperature compensation setting screen		• Main display ···· Temperature set value (°C) • Setting range ···· 0 to 100°C

(To be continued)

(Continued from previous page)

No.	Screen name	Screen display example	Contents
③	DO measuring range selection screen		• Main display ···· Upper limit value of the currently set DO measuring range • Setting range ···· 1.00, 2.00, 5.00, 10.00, 15.00, 20.00, 25.00, 30.00, 50.00mg/L (Factory setting: depends on the ordered specification)
④	Membrane thickness selection screen		• Main display ···· Membrane thickness currently selected (mm) • Setting range ···· 0.025(mm), 0.050(mm) • Does not have to be changed unless especially necessary.
⑤	Displayed item for calibration selection screen.		• Main display ···· One of the following three "do" (DO displayed calibration) ···· During calibration, DO concentration is displayed. (unit: mg/L) "o2" (O_2 displayed calibration) ···· During calibration, O_2 concentration is displayed. (unit: %) "SAt" (SAT displayed calibration) ···· During calibration, SAT concentration is displayed. (unit: %)
⑥	Stability check for calibration selection screen		• Main display ···· One of the following two "on" (on) ···· Executes stability check for calibration. (Factory setting) "oFF" (off) ···· Cancels stability check for calibration.
⑦	Zero calibration signal amount setting screen		• Main display ···· The zero calibration signal in the last zero calibration (μA) • Automatically rewritten according to the calibrated result. • Does not have to be changed unless especially necessary.
⑧	Span calibration signal amount setting screen		• Main display ···· The ratio of the last span calibration signal to the designed standard value (%) is displayed. • Automatically rewritten according to the calibrated result. • Does not have to be changed unless especially necessary.
⑨	Burnout selection screen		• Main display ···· Selected burnout mode "on.H" (on high) ···· Swings the transmission output value off scale to (+) side if an error occurs. "on.L" (on low) ···· Swings the transmission output value off scale to (–) side if an error occurs. "oFF" (off) ···· Fixes the transmission output value to 4mA if an error occurs.. (Factory setting)

(To be continued)

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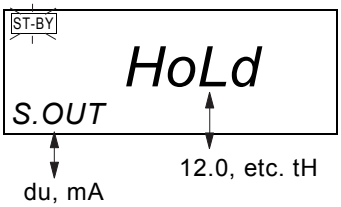
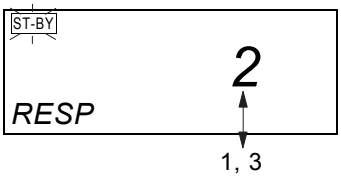
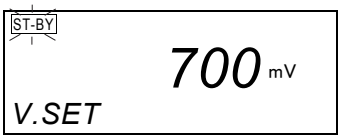
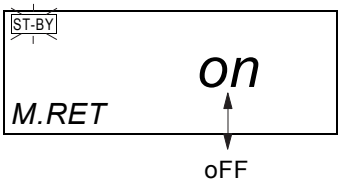
No.	Screen name	Screen display example	Contents
⑩	Maintenance output type selection screen		• Main display ···· Selected output type in the maintenance mode "HoLd" (Hold) ···· Hold output "12.0" etc. ···· Dummy output (Sub display ···· du, mA) "tH" (Through) ···· Through output.
⑪	Transmission output response speed selection screen		• Main display ···· Selected transmission output response speed 1 ···· Fast 2 ···· Standard 3 ···· Slow
⑫	Applied voltage setting screen		• Main display ···· Current applied voltage on the electrode • Does not have to be changed unless especially necessary.
⑬	Measurement mode auto return selection screen		• Main display ···· Selected auto return to measurement mode on/off "on" (on) ···· Executes auto return from maintenance mode to measurement mode from now on (Factory setting). "oFF" (off) ···· Does not execute auto return from maintenance mode to measurement mode from now on.
	(Returns to Step ①.)		

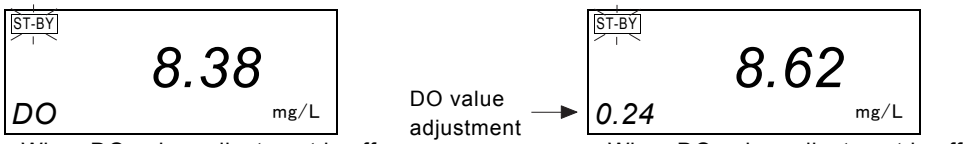
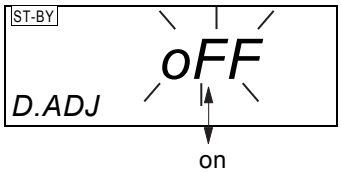
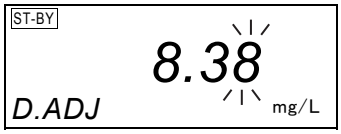
(2) DO value adjustment setting

(a) How to select on/off for DO value adjustment (sensitivity change) setting and how to set the DO value adjustment amount when "on" is selected are described in the table below. By this operation, the indication and the output signal of the transmitter can be adjusted to the DO measured value by another method (with a desk-top DO meter, etc.).

- Operation screen ····· "DO value adjustment setting" (±□.□□) screen

(b) Though "on" (on) is set to "DO value adjustment setting" screen, while the "calibration" (D.CAL) screen of the maintenance mode is selected, the DO value adjustment is temporarily turned off (oFF). As soon as the screen exits from the "calibration" (D.CAL) screen, it returns the "on" state of the DO value adjustment.

Procedure for DO Value Adjustment Setting

Procedure and display example	Contents
① Select the maintenance mode. ·····	Press MEAS/ST-BY for 3 seconds or more in the measurement mode. • The "calibration" (D.CAL etc.) screen appears ("ST-BY" lights).
② Select "DO value adjustment setting" screen. ·····	Press MODE/↓ for 3 seconds or more. • Main display ···· DO measured value containing DO value adjustment amount. • Sub display ···· DO value adjustment amount (if DO value adjustment is off, "DO" is displayed).
	
③ Set to selection enabled state. ·····	Press CAL/↑ for 3 seconds or more. • Selection for on/off setting is enabled.
	
④ Select "on" or "oFF". ·····	Press MODE/↓ or CAL/↑ to select either one of the following on the main display. • "on" (on) ···· Executes DO value adjustment. "oFF" (off) ···· Cancels DO value adjustment. (Factory setting)
⑤ Confirm the "on"/"oFF" setting. ·····	Press MEAS/ST-BY. • If "oFF" (off) is selected ···· The screen changes to the state after the operation of Step ⑦ is ended. Go to Step ⑧.
	

(To be continued)

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Procedure and display example	Contents
⑥ Enter DO value adjustment amount. ·····	Press [MODE/↓] or [CAL/↑] to show DO measured value containing the adjustment amount on the main display. • Setting range ···· +100 to – 70% (to DO measured value)
⑦ Confirm DO value adjustment amount. ·····	Press [MEAS/ST-BY]. • The value is confirmed and the screen returns to the state after the operation of Step ② is ended. • Sub display ···· Adjustment amount • If [MODE/↓] is pressed here, the screen goes to the next screen.
⑧ Select the measurement mode. ·····	Press [MEAS/ST-BY] for 3 seconds or more.

(3) Liquid temperature shift setting

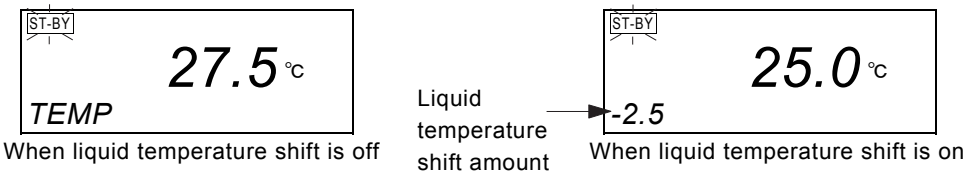
(a) How to select on/off for liquid temperature measured value shift (parallel shift) setting and how to set the liquid temperature shift amount when "on" is selected are described in the table below. By this operation, the liquid temperature measured value of the transmitter can be adjusted to the liquid temperature measured value by another method (with precise thermometer, etc.).

• Operation screen ····· "Liquid temperature shift setting" (TEMP or ±□.□) screen

(b) When liquid temperature shift is set to "on" (on), the liquid temperature measured value, of course, and the DO measured value by automatic temperature compensation and the DO measured value by manual value temperature compensation depend on the shifted liquid temperature measured value.

Procedure for Liquid Temperature Shift Setting

Procedure and display example	Contents
① Select the setting screen group. ·····	Press [MEAS/ST-BY] for 3 seconds or more in the measurement mode and then press [MODE/↓] for 3 seconds or more. • The "DO value adjustment setting" screen appears ("ST-BY" blinks).
② Select "Liquid temperature shift setting" screen. ····	Press [MODE/↓] once. • Main display ···· Liquid temperature measured value containing temperature shift amount. • Sub display ···· "TEMP" or "±□.□ (numeric value)" appears. "TEMP" ···· When liquid temperature shift is Off. Numeric value ···· When liquid temperature shift is On.



When liquid temperature shift is off — When liquid temperature shift is on

(To be continued)

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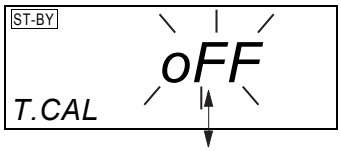
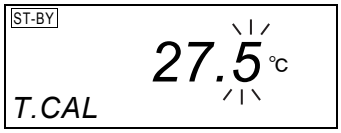
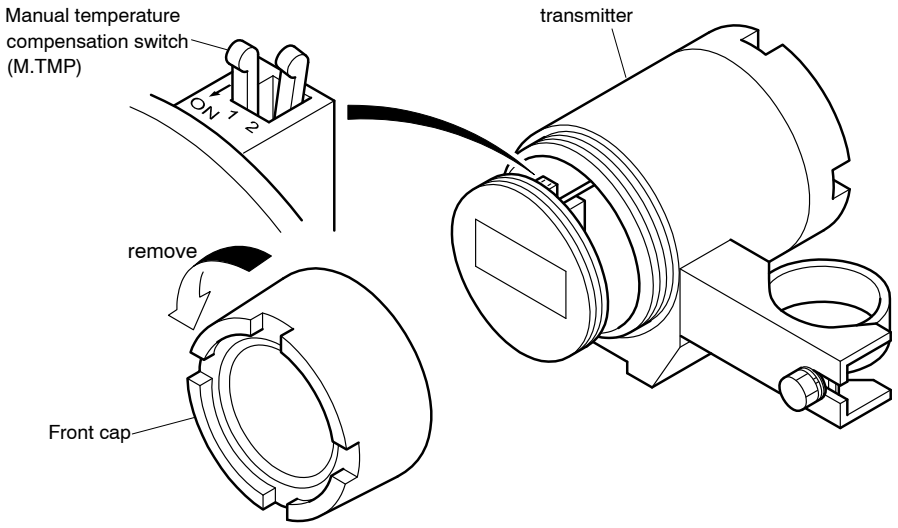
Procedure and display example	Contents
③ Set to selection enabled state. ····· 	Press CAL/↑ for 3 seconds or more. • Selection for on/off setting is enabled.
④ Select "on" or "oFF". ·····	Press MODE/↓ or CAL/↑ to select either one of the following on the main display. • "on" (on) ···· Executes the liquid temperature shift. "oFF" (off) ···· Cancels the liquid temperature shift. (Factory setting)
⑤ Confirm the "on"/"oFF" setting. ····· 	Press MEAS/ST-BY. • If "on" (on) is selected ···· The screen changes to liquid temperature shift amount input enabled state. • If "oFF" (off) is selected ···· The screen changes to the state after the operation of Step ⑦ is ended. Go to Step ⑧.
⑥ Enter the temperature after the liquid temperature shift. ·····	Press MODE/↓ or CAL/↑ to show the liquid temperature containing the shift amount on the main display. • Amount setting range ···· Measured value ±5.0°C
⑦ Confirm the liquid temperature shift amount. ·····	Press MEAS/ST-BY. • The value is confirmed and the screen returns to the state after the operation of Step ② is ended. • Sub display ···· Shift amount • If MODE/↓ is pressed here, the screen goes to the next screen.
⑧ Select the measurement mode. ·····	Press MEAS/ST-BY for 3 seconds or more.

(4) Manual temperature compensation setting

(a) The procedure for performing manual temperature compensation (compensates the temperature characteristic) when an electrode without temperature compensation element or an electrode of other than 10kΩ/25°C (thermistor) temperature compensation is shown in the table below.

- Operation screen ····· "Manual temperature compensation setting" (M.TMP) screen

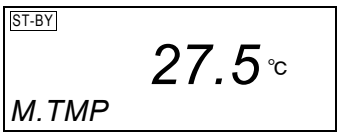
(b) When performing manual temperature compensation, perform the operations shown in the following table after removing the front cap of the transmitter and setting the manual temperature compensation switch (M.TMP) on the PC board to the on ("ON") side in advance.



Manual temperature compensation switch (M.TMP)

(c) When making measurements by automatic temperature compensation, return the manual temperature switch (M.TMP) to the off ("OFF") side. (Factory setting: "OFF")

Procedure for manual temperature compensation setting

Procedure and display example	Contents
① Select the setting screen group. ·····	Press [MEAS/ST-BY] for 3 seconds or more in the measurement mode and then press [MODE/↓] for 3 seconds or more. • The "DO value adjustment setting" screen appears ("ST-BY" blinks).
② Select "manual temperature compensation setting" screen ····· 	Press [MODE/↓] several times until "M.TMP" is displayed on the sub display. • Main display ···· Temperature compensation set value
③ Set to input state ·····	Press [CAL/↑] for 3 seconds or more. • Main display blinks and the transmitter enters the input enabled state.
④ Enter the temperature compensation set value. ·····	Press [MODE/↓] or [CAL/↑] to show the compensation temperature. • Setting range ···· 0.0 to 100.0°C
⑤ Confirm the temperature set value. ·····	Press [MEAS/ST-BY]. • The value is confirmed and the screen returns to the state after the operation of Step ② is ended. • If [MODE/↓] is pressed here, the screen goes to the next screen.
⑥ Select the measurement mode. ·····	Press [MEAS/ST-BY] for 3 seconds or more.

(5) DO measuring range selection

(a) The DO value measuring range can be selected.

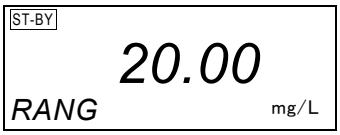
- Operation screen ····· "DO measuring range selection" (RANG) screen

(b) The following table shows the set value on the main display and the DO measuring range.

Values on the main display and DO measuring range

Value on the main display of "DO measuring range selection" (RANG) screen	DO measuring range (mg/L)
1.00	0.00 to 1.00
2.00	0.00 to 2.00
5.00	0.00 to 5.00
10.00	0.00 to 10.00
15.00	0.00 to 15.00
20.00	0.00 to 20.00
25.00	0.00 to 25.00
30.00	0.00 to 30.00
50.00	0.00 to50.00

Procedure for DO measuring range selection

Procedure and display example	Contents
① Select the setting screen group. ·····	Press [MEAS/ST-BY] for 3 seconds or more in the measurement mode and then press [MODE/↓] for 3 seconds or more. • The "DO value adjustment setting" screen appears ("ST-BY" blinks).
② Select "DO measuring range selection" screen ····· 	Press [MODE/↓] several times until "RANG" is displayed on the sub display. • Main display … the currently set DO measuring range
③ Set to selection state ·····	Press [CAL/↑] for 3 seconds or more. • The figures of the main display blink and the transmitter enters the selection state.
④ Select the DO measuring range. ·····	Press [MODE/↓] or [CAL/↑] and select the DO measuring range. • Setting range ···· 1.00, 2.00, 5.00, 10.00, 15.00, 20.00, 25.00, 30.00, 50.00mg/L (Factory setting: depends on the ordered specification)
⑤ Confirm. ·····	Press [MEAS/ST-BY]. • The value is confirmed and the screen returns to the state after the operation of Step ② is ended. • If [MODE/↓] is pressed here, the screen goes to the next screen.
⑥ Select the measurement mode. ·····	Press [MEAS/ST-BY] for 3 seconds or more.

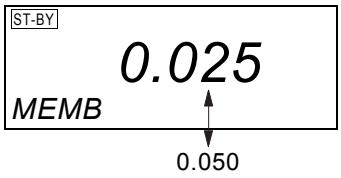
(6) Membrane thickness selection

(a) The membrane thickness can be selected for the thickness change of membrane which is incorporated with electrode to be used.

- Operation screen ····· "Membrane thickness selection" (MEMB) screen

(b) This screen is provided mainly for technical service person. Do not change the set value unless especially necessary.

Procedure for membrane thickness selection

Procedure and display example	Contents
① Select the setting screen group. ·····	Press [MEAS/ST-BY] for 3 seconds or more in the measurement mode and then press [MODE/↓] for 3 seconds or more. • The "DO value adjustment setting" screen appears ("ST-BY" blinks).
② Select the "membrane thickness selection" screen. ··  	Press [MODE/↓] several times until "MEMB" appears on the sub display. • Main display ···· Current membrane thickness (mm)
③ Set to selection state ·····	Press [CAL/↑] for 3 seconds or more. • The figures of the main display blink and the transmitter enters the on/off selection state.
④ Select the membrane thickness. ·····	Press [MODE/↓] or [CAL/↑] to show either one of the following according to the combined electrode type. • "0.025" ···· Select 0.025mm membrane for Model 7536L, Model ELD-023, or Model 7546L. • "0.050" ···· Select 0.050mm membrane for Model 7533L, Model ELD-024, Model 765*L, or Model 766*L.
⑤ Confirm. ·····	Press [MEAS/ST-BY]. • The value is confirmed and the screen returns to the state after the operation of Step ② is ended. • If [MODE/↓] is pressed here, the screen goes to the next screen.
⑥ Select the measurement mode.·····	Press [MEAS/ST-BY] for 3 seconds or more.

(7) Displayed item for calibration selection

(a) One of the three displayed items which is used for calibration can be selected.

- Operation screen ····· "Displayed item for calibration selection" (CAL.S) screen

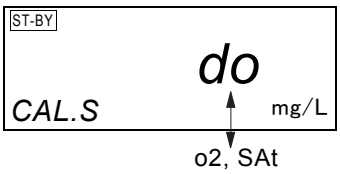
(b) Usually set to "DO displayed calibration" (do) and change it if necessary.

"DO displayed calibration" (do) Calibration with dissolved oxygen concentration (mg/L)

"O_2 displayed calibration" (o2) Calibration with oxygen concentration (%)

"SAT displayed calibration" (SAt) Calibration with saturation ratio of dissolved oxygen

Procedure for displayed items for calibration selection

Procedure and display example	Contents
① Select the setting screen group. ·····	Press [MEAS/ST-BY] for 3 seconds or more in the measurement mode and then press [MODE/↓] for 3 seconds or more. • The "DO value adjustment setting" screen appears ("ST-BY" blinks).
② Select "Displayed item for calibration selection" screen. ····· 	Press [MODE/↓] several times until "CAL.S" appears on the sub display. • Main display … Selected displayed item
③ Set to selection enabled state. ·····	Press [CAL/↑] for 3 seconds or more. • The figures of the main display blink and the transmitter enters the selection state.
④ Select "Displayed item for calibration" ·····	Press [MODE/↓] or [CAL/↑] to display either one of the following. "do" ···· DO displayed calibration (Factory setting) "o2" ···· O_2 displayed calibration "SAt" ···· SAT displayed calibration
⑤ Confirm. ·····	Press [MEAS/ST-BY]. • The value is confirmed and the screen returns to the state after the operation of Step ② is ended. • If [MODE/↓] is pressed here, the screen goes to the next screen.
⑥ Select the measurement mode. ·····	Press [MEAS/ST-BY] for 3 seconds or more.

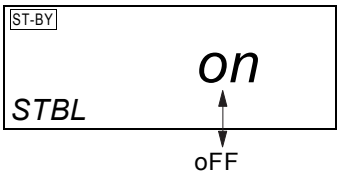
(8) Stability check for calibration selection

(a) The on/off procedure for the automatic stability check function, which performs calibration by checking that the electrode potential is stable at calibration, is shown in the table below.

- Operation screen ····· "Stability check for calibration selection" (STBL) screen

(b) When the automatic stability check function was set to on (on), press CAL/↑ at calibration execution. If the indication stabilizes within 5 minutes, calibration is performed. If this stability check function is not used, set to "oFF" (off) in this screen and perform calibration by visual stability check by the operator.

Procedure for stability check for calibration selection

Procedure and display example	Contents
① Select the setting screen group. ·····	Press MEAS/ST-BY for 3 seconds or more in the measurement mode and then press MODE/↓ for 3 seconds or more. • The "DO value adjustment setting" screen appears ("ST-BY" blinks).
② Select "Stability check for calibration selection" screen. ····· 	Press MODE/↓ several times until "STBL" appears on the sub display.
③ Set to selection enabled state. ·····	Press CAL/↑ for 3 seconds or more. • The figures of the main display blink and the transmitter enters the on/off selection state.
④ Select "Stability check for calibration selection" ····	Press MODE/↓ or CAL/↑ to display either one of the following. • "on" (On) ···· Executes the stability check for calibration selection. (Factory setting) "oFF" (Off) ···· Cancels the stability check for calibration selection.
⑤ Confirm. ·····	Press MEAS/ST-BY. • The value is confirmed and the screen returns to the state after the operation of Step ② is ended. • If MODE/↓ is pressed here, the screen goes to the next screen.
⑥ Select the measurement mode. ·····	Press MEAS/ST-BY for 3 seconds or more.

(9) Signal amount for zero calibration and signal amount for span calibration setting

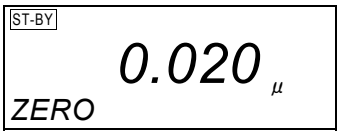
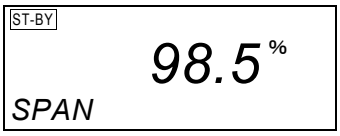
(a) The signal amount for zero calibration or the signal amount for span calibration can be changed intentionally. However, this value is automatically rewritten to the signal amount from electrode each time calibration is performed.

- Operation screen ····· "Signal amount for zero calibration setting" (ZERO) screen
  "Signal amount for span calibration setting" (SPAN) screen

(b) This screen is provided mainly for technical service person. Do not change the set value unless especially necessary.

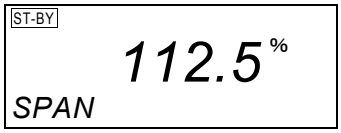
【IMPORTANT】 • If measurements are made with the set value changed by mistake, the correct measured value will not be obtained. In this case, perform standard solution calibration. Return to the original value is possible.

Procedure for signal amount for zero calibration and signal amount for span calibration setting

Procedure and display example	Contents
① Select the setting screen group. ·····	Press [MEAS/ST-BY] for 3 seconds or more in the measurement mode and then press [MODE/↓] for 3 seconds or more. • The "DO value adjustment setting" screen appears ("ST-BY" blinks).
② Select "Signal amount for zero calibration setting" screen. ····· 	Press [MODE/↓] several times until "ZERO" appears on the sub display. • Main display ···· Current signal amount for zero calibration
③ Set to entry state. ·····	Press [CAL/↑] for 3 seconds or more. • The figures of the main display blink and the transmitter enters the entry state.
④ Enter the signal amount for zero calibration. ·····	Press [MODE/↓] or [CAL/↑] to enter the signal amount for zero calibration. • Setting range ···· ±0.050 (μA)
⑤ Confirm the signal amount for zero calibration. ·····	Press [MEAS/ST-BY]. • The value is confirmed and the screen returns to the state after the operation of Step ② is ended.
⑥ Select "Signal amount for span calibration setting" screen. ····· 	Press [MODE/↓] once. Then "SPAN" appears on the sub display. • Main display ···· Current signal amount for span calibration

(To be continued)

(Continued from previous page)

Procedure and display example	Contents
⑦ Set to entry state. ·····	Press [CAL/↑] for 3 seconds or more. • The figures of the main display blink and the transmitter enters the entry state.
⑧ Enter the signal amount for span calibration. ·····	Press [MODE/↓] or [CAL/↑] to enter the signal amount for span calibration. • Setting range ···· 60.0 to 140.0%
⑨ Confirm the signal amount for span calibration. ··· 	Press [MEAS/ST-BY]. • The value is confirmed and the screen returns to the state after the operation of Step ⑥ is ended. • If [MODE/↓] is pressed here, the screen goes to the next screen.
⑩ Select the measurement mode. ·····	Press [MEAS/ST-BY] for 3 seconds or more.

(10) Burnout selection

(a) If an error occurs, the burnout function notifies the error by swinging the transmission output value off the scale. The procedure to select on/off setting for this burnout function and how to select the direction of the output swing off are described in the table below.

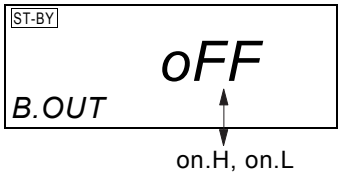
- Operation screen ····· "Burnout selection" (B.OUT) screen

(b) Burnout can be selected from one of the three types: "on.H" (on High), "on.L" (on Low), and "oFF" (off).

(c) The burnout function is activated when any of the following messages is displayed.

- Memory element error (E-20)
- Setting data error (E-21)
- Temperature measured value error (E-3: when the 0°C to 50°C range was exceeded for 30 seconds or more)

Procedure for Burnout Selection

Procedure and display example	Contents
① Select the setting screen group. ·····	Press [MEAS/ST-BY] for 3 seconds or more in the measurement mode and then press [MODE/↓] for 3 seconds or more. • The "DO value adjustment setting" screen appears ("ST-BY" blinks).
② Select the "Burnout selection" screen. ····· 	Press [MODE/↓] several times until "B.OUT" appears on the sub display. • Main display ···· Either one of "on.H", "on.L" or "oFF"
③ Set to selection enabled state. ·····	Press [CAL/↑] for 3 seconds or more. • The figures of the main display blink and the transmitter enters the burnout type selection state.
④ Select the burnout type. ·····	Press [MODE/↓] or [CAL/↑] to select either one of the following on the display. • "on.H" (on High) ···· The transmission output swings off scale to (+) side (21mA fixed value) if an error occurs. "on.L" (on Low) ···· The transmission output swings off scale to (–) side (3.8mA fixed value) if an error occurs. "oFF" (off) ···· The transmission output is 4mA fixed value if an error occurs. (Factory setting)
⑤ Confirm the burnout setting. ·····	Press [MEAS/ST-BY]. • The set item is confirmed and the screen returns to the state after the operation of Step ② is ended. • If [MODE/↓] is pressed here, the next screen appears.
⑥ Select the measurement mode. ·····	Press [MEAS/ST-BY] for 3 seconds or more.

(11) Maintenance output type selection

(a) The procedure to set the transmission output type used during maintenance mode is described in the table below.

- Operation screen ····· "Maintenance output type selection" (S.OUT) screen

(b) For maintenance output type, you can select one of the three types: Hold (HoLd), Dummy ("12.0" etc) and Through (tH). If you select Dummy (dummy value), you have to set an arbitrary transmission output value (dummy value) after the selection.

(c) When the transmitter is equipped with the external hold function (option) and a "wash in progress" contact signal is inputted to the terminals 90 and 11, the same operation as the transmission output type set at this screen is executed. ＞＞ 7.3(6) "Wire connection of 'wash in progress' contact signal input cable (option)"

Procedure for maintenance output type selection

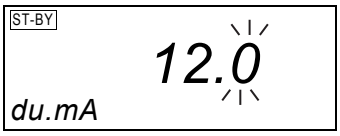
Procedure and display example	Contents
① Select the setting screen group. ·····	Press MEAS/ST-BY for 3 seconds or more in the measurement mode and then press MODE/↓ for 3 seconds or more. • The "DO value adjustment setting" screen appears ("ST-BY" blinks).
② Select the "Maintenance output type selection" screen. ·····	Press MODE/↓ several times until "S.OUT" appears on the sub display. • Either one of Hold mode, Through mode, or Dummy mode appears.

Hold mode Through mode Dummy mode

③ Set to selection enabled state. ·····	Press CAL/↑ for 3 seconds or more. • The figures of the main display blink and the transmitter enters the maintenance output mode selection state.
④ Select the output type. ·····	Press MODE/↓ or CAL/↑ to select either one of the following on the display. • "HoLd" (Hold) ···· Fixes and outputs the last transmission output value before the mode is switched to the maintenance mode. (Factory setting) "tH" (Through) ···· Outputs the pH measured value in the same way as in the measurement mode. On the sub display, "du.mA" (Dummy) ···· Fixes and outputs an arbitrary set transmission output value.

(To be continued)

(Continued from previous page)

Procedure and display example	Contents
⑤ Confirm the output mode.	Press MEAS/ST-BY. • If "HoLd" or "tH" is selected, go to Step ⑧. If MODE/↓ is pressed here, the screen goes to the next screen. • If dummy mode is selected, the dummy value blinks on the main display and the screen is ready for dummy value input.
⑥ Enter the dummy value. 	Press MODE/↓ or CAL/↑ to enter the dummy value. • Setting range ···· 4.0 to 20.0mA (Factory setting: 12.0mA)
⑦ Confirm the dummy value.	Press MEAS/ST-BY. • The screen returns to the state after the operation of Step ② is ended. • If MODE/↓ is pressed here, the screen goes to the next screen.
⑧ Select the measurement mode.	Press MEAS/ST-BY for 3 seconds or more.

(12) Transmission output response speed selection

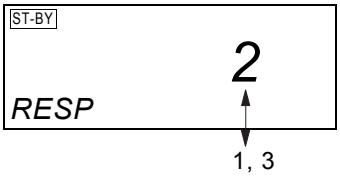
(a) The transmission output response speed can be selected.

- Operation screen ····· "Transmission output response speed selection" (RESP) screen

(b) For transmission output response speed, you can select one of the three selection items below:

- "1" ····· Fast (approx. 10 seconds / 90% with equivalent input)
- "2" ····· Standard (approx. 30 seconds / 90% with equivalent input)
- "3" ····· Slow (approx. 60 seconds / 90% with equivalent input)

Procedure for transmission output response speed selection

Procedure and display example	Contents
① Select the setting screen group. ·····	Press [MEAS/ST-BY] for 3 seconds or more in the measurement mode and then press [MODE/↓] for 3 seconds or more. • The "DO value adjustment setting" screen appears ("ST-BY" blinks).
② Select the "Transmission output response selection" screen. ····· 	Press [MODE/↓] several times until "RESP" appears on the sub display. • Main display ···· Either "1", "2", or "3"
③ Set to selection enabled state. ·····	Press [CAL/↑] for 3 seconds or more. • The figures of the main display blink and the transmitter enters the transmission output response speed selection state.
④ Select the transmission output response speed. ·····	Press [MODE/↓] or [CAL/↑] to display either one of the following. • "1" ···· Fast • "2" ···· Standard (Factory setting) • "3" ···· Slow
⑤ Confirm the transmission output response speed. ····	Press [MEAS/ST-BY]. • The setting is confirmed and the screen returns to the state after the operation of Step ② is ended. • If [MODE/↓] is pressed here, the next screen appears.
⑥ Select the measurement mode. ·····	Press [MEAS/ST-BY] for 3 seconds or more.

(13) Applied voltage setting

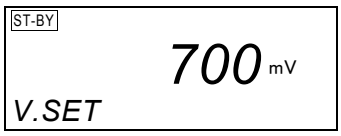
(a) The applied voltage to present electrode can be checked or set in the following screen.

- Operation screen ····· "Applied voltage setting" (V.SET) screen

(b) This screen is provided mainly for technical service person. Do not change the set value unless especially necessary.

【IMPORTANT】 • If measurements are made with the set value changed by mistake, the correct measured value will not be obtained.

Procedure for applied voltage setting

Procedure and display example	Contents
① Select the setting screen group. ·····	Press [MEAS/ST-BY] for 3 seconds or more in the measurement mode and then press [MODE/↓] for 3 seconds or more. • The "DO value adjustment setting" screen appears ("ST-BY" blinks).
② Select "Applied voltage setting" screen ····· 	Press [MODE/↓] several times until "V.SET" appears on the sub display. • Main display ···· Current applied voltage
③ Set to selection enabled state. ·····	Press [CAL/↑] for 3 seconds or more. • The figures of the main display blink and the transmitter enters the entry state.
④ Enter the applied voltage. ·····	Press [MODE/↓] or [CAL/↑] to enter the applied voltage value. • Setting range ···· 0 to 999mV (Factory setting: 700mV)
⑤ Confirm the applied voltage. ·····	Press [MEAS/ST-BY]. • The screen returns to the state after the operation of Step ② is ended. • If [MODE/↓] is pressed here, the next screen appears.
⑥ Select the measurement mode. ·····	Press [MEAS/ST-BY] for 3 seconds or more.

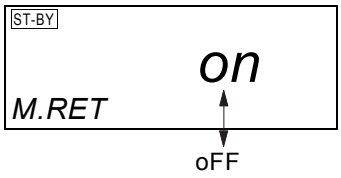
(14) Measurement mode auto return selection

(a) If Off (oFF) is selected in this screen, the auto return from maintenance mode to measurement mode function can be canceled. When On (on) is selected, the mode can return to the auto return.

- Operation screen ····· "Measurement mode auto return selection" (M.RET) screen

(b) If On (on) is selected in this screen, the mode automatically returns to the measurement mode approximately two hours after the maintenance mode is selected.

Procedure for measurement mode auto return selection

Procedure and display example	Contents
① Select the setting screen group. ·····	Press [MEAS/ST-BY] for 3 seconds or more in the measurement mode and then press [MODE/↓] for 3 seconds or more. • The "DO value adjustment setting" screen appears ("ST-BY" blinks).
② Select the "Measurement mode auto return selection" screen. ····· 	Press [MODE/↓] several times until "M.RET" appears on the sub display.
③ Set to selection enabled state. ·····	Press [CAL/↑] for 3 seconds or more. • The figures of the main display blink and the transmitter enters the entry state.
④ Select the auto return "on"/"off" setting. ·····	Press [MODE/↓] or [CAL/↑] to display either one of the following. • "on" (on) ···· Executes the auto return function to the measurement mode. (Factory setting) • "oFF" (off) ···· Cancels the auto return function to the measurement mode.
⑤ Confirm the auto return "on"/"off" setting. ·····	Press [MEAS/ST-BY]. • The setting is confirmed and the screen returns to the state after the operation of Step ② is ended. • If [MODE/↓] is pressed here, the screen returns to the "DO value adjustment setting" screen, the initial screen of the setting screen group.
⑥ Select the measurement mode. ·····	Press [MEAS/ST-BY] for 3 seconds or more.

4. Maintenance

4.1 Maintenance List

(a) To operate the product normally on a continuous basis and maintain its specified performance, understand its function, etc. thoroughly and perform maintenance work periodically.

【IMPORTANT】 • Operating the product without performing maintenance periodically can result in a failure.

(b) The “Maintenance cycle” described in the following table is based on the standard condition (conditional states to satisfy items such as the ones in 7.1(1) “Installation location of transmitter”, 7.2 “Sensor Mounting”). Since the maintenance cycle differs depending on the installation condition, modify the maintenance cycle according to the operating condition after operating the sensor more than several months.

(c) For the measurement system, the maintenance and inspection for sensor is important. Refer to the Instruction Manual provided for the sensor.

(d) For technical services such as repairs, please call our sales office or your sales representative. A specialist who is qualified for the technical certification system in our company or a person who has technical skills equivalent to that certification system must perform technical services such as repairs.

Standard Maintenance List

No.	Subject	Contents	Start up	Maintenance cycle						Execution method, etc.
				1 week	2 weeks	1 month	6 months	1 year	When needed	
1	Entire measurement system	Calibration			○					>> 2.2 “Calibration”
2	Transmitter	Check and adjustment of displayed value and transmission output by equivalent input						○		>> 4.3 “Operation Check Using Equivalent Input”, 4.4 “Transmission Output Adjustment”

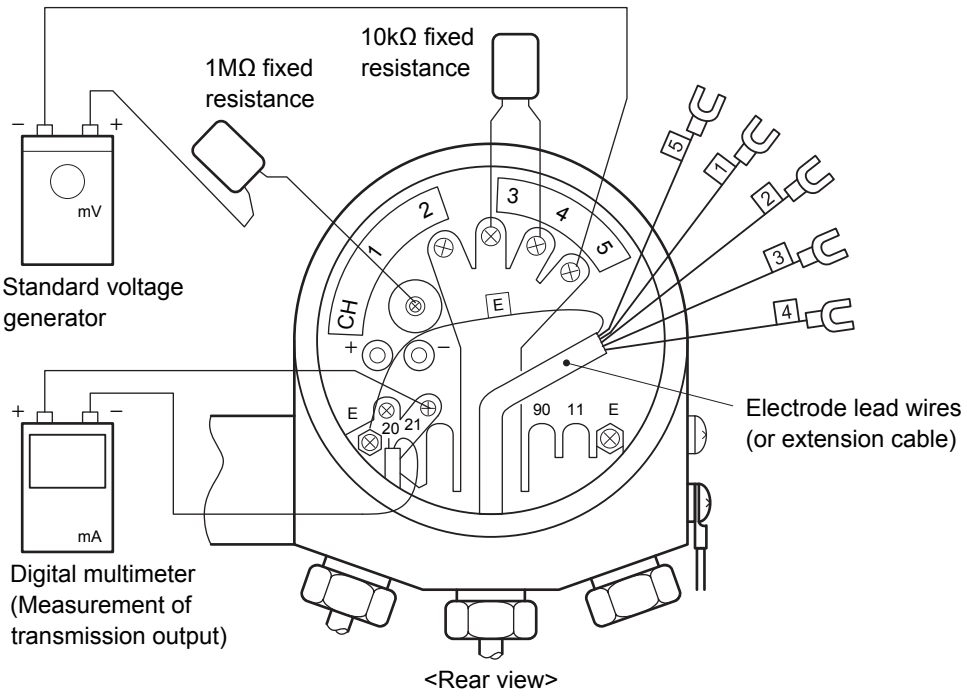
4.2 Spare Parts

- Main DO electrode (temperature compensation resistor of 10kΩ)

  Model: 7533L (aeration tank for general)

  Model: 7536L (aeration tank for general or a night soil tank)
- JIS special grade anhydrous sodium sulfite (sulfite soda) ····· “Zero” calibration by solution
- Membrane for electrode (Refer to the separately prepared instruction manual for the electrode.)
- Internal solution for electrode (Refer to the separately prepared instruction manual for the electrode.)

4.3 Operation Check Using Equivalent Input



Operation Check Using Equivalent Input

①Preparation

- Standard voltage generator (0 to 5V available)
- Digital multimeter (internal resistance 10Ω max., using the current measuring range)
- 10kΩ fixed resistance
- 1MΩ fixed resistance

⚠ WARNING

Electric Shock

- If a “wash in progress” contact signal cable of sensor with cleaner (option) is connected to the transmitter, do not touch the terminals in the product while power is applied. An electric shock may result.

②Turn off the power and disconnect the electrode lead wire. ····· Turn off power at the power source side and remove the transmitter cap and insulation cover. Then remove the electrode lead wires (or extension cable) connected to the terminals 1 to 5, E.

③Connect the prepared devices. ····· Connect the following devices to their respective terminals.

- Standard voltage generator ····· the output signal on (-) side to terminal 5

  Connects 1MΩ fixed resistance to the output signal on (+) side
- 10kΩ fixed resistance ····· Between terminals 3 and 4

- 1MΩ fixed resistance ····· Between terminal 1 and the output terminal on (+) side of standard voltage generator
- Digital multimeter ····· Between terminal 21 and its lead wire

④Calibrate ····· Perform the zero and span calibration as follows.

ⓐ Turn on the power. ····· Turn on the power to the Transmitter on the power supply side and supply the power of 24VDC to the Transmitter.

ⓑ Select the maintenance mode. ····· Press MEAS/ST-BY for 3 seconds or more and the mode changes to maintenance mode. ("ST-BY" is lit.)

ⓒ Perform the necessary setting. ····· Set the "DO value adjustment setting" (D.ADJ) screen to "oFF". Set the "Transmission output signal response setting" (RESP) screen to "1". ＞＞ 3.3(2) "DO value adjustment setting", 3.3(12) "Transmission output response speed selection"

ⓓ Set to "calibration" screen. ····· Press MEAS/ST-BY for 3 seconds or more to return to the measurement mode first and then press MEAS/ST-BY for 3 seconds or more again to set to the "Calibration" (D.CAL, etc.) screen, initial screen of maintenance mode.
＞＞ 3.2 "Maintenance Mode Calibration Screen Operation"

ⓔ Stop the output of standard voltage generator. ····· Disconnect the lead wire from terminal (+) of the standard voltage generator.

ⓕ Start zero calibration. ····· Press CAL/↑ once on "Calibration" (D.CAL, etc.) screen and "WAIT" begins to blink, the zero calibration starts. When "WAIT" goes out, zero calibration is finished,

ⓖ Set the output of standard voltage generator to 0.811V. (When the membrane thickness selection (MEMB) is 0.050)……Connect back the lead wire to terminal (+) of the standard voltage generator and supply 0.811V to the transmitter.

ⓗ Start span calibration. ····· Press CAL/↑ once on "Calibration" (D.CAL, etc.) screen and "WAIT" begins to blink, the span calibration starts. When "WAIT" goes out, spa calibration is finished.

ⓘ Return to measurement mode.·····Turn off the output from the standard voltage generator. Then, press MEAS/ST-BY for 3 seconds or more and the mode returns to measurement mode. ("ST-BY" goes out.)

⑤Confirm the characteristic. ····· In measurement mode, press MODE/↓ repeatedly until "DO Measuring Range Setting" (RANG) screen appears. Then, supply equivalent input which corresponds to the current measuring range to the transmitter, referring to the tables of "Input and Output Standard Value for Measuring Range" shown below and confirm the characteristic of the transmitter.
In case the measured value shows a measurement error over the allowable error indicated below, check the accuracy and function of the instruments employed first. If they are found normal, contact DKK-TOA's sales agent or office.

<Allowable Error>

・Displayed value·····0.05mg/L or within ±1%FS (whichever larger one)

・Transmission output value·····within ±0.4%FS against the displayed value

⑥Return to the original state. ····· If the characteristic is confirmed and found normal, turn off the power to the transmitter and disconnect all the wiring of digital multimeter, etc. Then, connect the lead wires to the its original position like before.

⑦Put the transmitter in the measurement state. ····· After supplying the power to the transmitter and calibrating, set to the measurement mode.
＞＞ 3.2 "Maintenance Mode Calibration Screen Operation"

Input and Output Standard Value for Measuring Range (Model ODM-135A)

DO 0-1mg/L range

Equivalent input (V)	Displayed value (mg/L)	Transmission output (mA)
0.000	0.00	4.00
0.020	0.20	7.20
0.040	0.40	10.40
0.060	0.60	13.60
0.080	0.80	16.80
0.100	1.00	20.00

DO 0-2mg/L range

Equivalent input (V)	Displayed value (mg/L)	Transmission output (mA)
0.000	0.00	4.00
0.040	0.40	7.20
0.080	0.80	10.40
0.120	1.20	13.60
0.160	1.60	16.80
0.200	2.00	20.00

DO 0-5mg/L range

Equivalent input (V)	Displayed value (mg/L)	Transmission output (mA)
0.00	0.00	4.00
0.100	1.00	7.20
0.200	2.00	10.40
0.300	3.00	13.60
0.400	4.00	16.80
0.500	5.00	20.00

DO 0-10mg/L range

Equivalent input (V)	Displayed value (mg/L)	Transmission output (mA)
0.000	0.00	4.00
0.200	2.00	7.20
0.400	4.00	10.40
0.600	6.00	13.60
0.800	8.00	16.80
1.000	10.00	20.00

DO 0-15mg/L range

Equivalent input (V)	Displayed value (mg/L)	Transmission output (mA)
0.000	0.00	4.00
0.300	3.00	7.20
0.600	6.00	10.40
0.900	9.0	13.60
1.200	12.00	16.80
1.500	15.00	20.00

DO 0-20mg/L range

Equivalent input (V)	Displayed value (mg/L)	Transmission output (mA)
0.000	0.00	4.00
0.400	4.00	7.20
0.800	8.00	10.40
1.200	12.00	13.60
1.600	16.00	16.80
2.000	20.00	20.00

DO 0-25mg/L range

Equivalent input (V)	Displayed value (mg/L)	Transmission output (mA)
0.000	0.00	4.00
0.500	5.00	7.20
1.000	10.00	10.40
1.500	15.00	13.60
2.000	20.00	16.80
2.500	25.00	20.00

DO 0-30mg/L range

Equivalent input (V)	Displayed value (mg/L)	Transmission output (mA)
0.000	0.00	4.00
0.600	6.00	7.20
1.200	12.00	10.40
1.800	18.00	13.60
2.400	24.00	16.80
3.000	30.00	20.00

DO 0-50mg/L range

Equivalent input (V)	Displayed value (mg/L)	Transmission output (mA)
0.000	0.00	4.00
1.000	10.00	7.20
2.000	20.00	10.40
3.000	30.00	13.60
4.000	40.00	16.80
5.000	50.00	20.00

O2 0-25% range

Equivalent input (V)	Displayed value (%)	Transmission output (mA)
0.000	0.0	- - -
0.194	5.0	- - -
0.388	10.0	- - -
0.582	15.0	- - -
0.776	20.0	- - -
0.970	25.0	- - -

SAT 0-100% range

Equivalent input (V)	Displayed value (%)	Transmission output (mA)
0.000	0	- - -
0.162	20	- - -
0.324	40	- - -
0.487	60	- - -
0.649	80	- - -
0.811	100	- - -

〔NOTE〕 • Always connect the standard voltage generator through the fixed resistor of 1MΩs. The equivalent input shown in the table “Input and Output Standard Value for Measuring Range” are based on that condition.

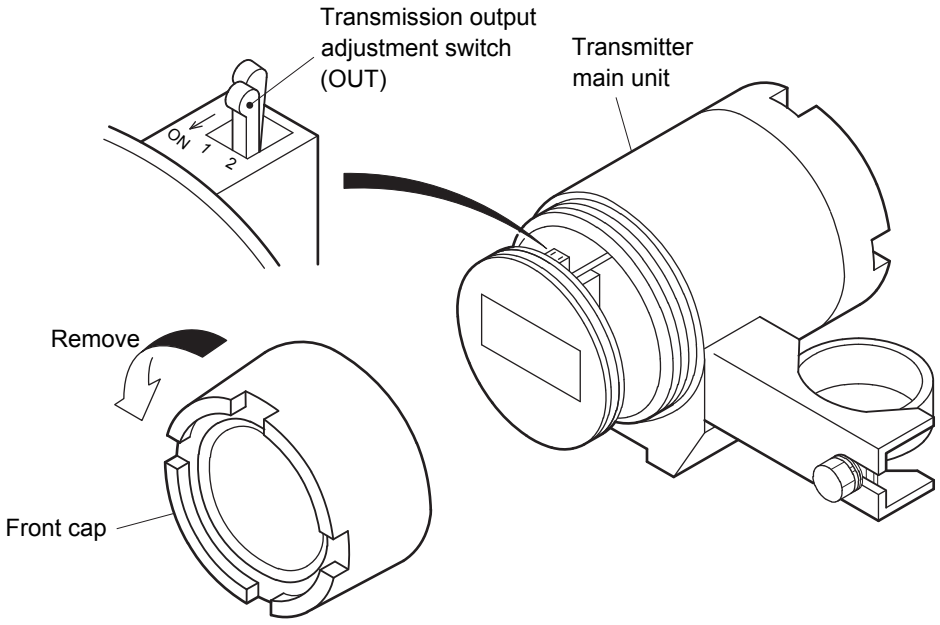
• For the operation check of transmitter, micro-current signal equivalent input is required. However, by supplying voltage from the standard voltage generator through the fixed resistor of 1MΩ, the required, current signal can be fed to the transmitter as a practical method.

4.4 Transmission Output Adjustment

(a) If the transmission output value does not agree with the indication of a receiving instrument (such as a recorder), you can adjust the transmission output of the transmitter.

- Operation screens ····· "Transmission output adjustment 4mA" (4mA) screen
  "Transmission output adjustment 20mA" (20mA) screen

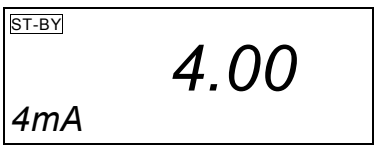
(b) These screens appear when the transmission output adjustment switch inside the front cap is switched to "ON". When this operation is ended, be sure to set this switch back to "OFF" (opposite side of "ON") position.



Transmission Output Adjustment

①Set the transmission output adjustment switch to ON position. ····· Remove the front cap of the transmitter and set the transmission output adjustment switch (OUT) to "ON" position. "4mA" is displayed on the sub display and the "Transmission output adjustment 4mA" (4mA) screen appears.

〔NOTE〕 • At this time, the transmission output changes suddenly and thus it is necessary to take measures to protect the control system.

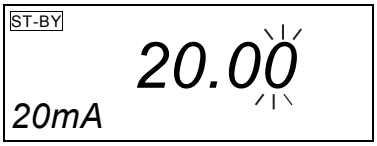


Transmission Output Adjustment 4mA Screen

②Adjust the 4mA side. ····· Press MODE/↓ or CAL/↑ to increase or decrease the transmission output value of 4mA on the main display until the zero point of the receiving instrument is adjusted correctly.

③Confirm the 4mA side. ····· Press MEAS/ST-BY once.

- The transmission output value of 4mA entered in Step ② is confirmed and the "Transmission output adjustment 20mA" (20mA) screen appears.



Transmission Output Adjustment 20mA Screen

④Adjust the 20mA side. ····· Press MODE/↓ or CAL/↑ to increase or decrease the transmission output value of 20mA on the main display until the span value of the receiving instrument is adjusted correctly.

⑤Confirm the 20mA side. ····· Press MEAS/ST-BY once. The transmission output value of 20mA entered in Step ④ is confirmed and the screen returns to the "Transmission output adjustment 4mA" (4mA) screen.

⑥Return to the original state. ····· Set the transmission output adjustment switch (OUT) to OFF position and reinstall the front cap of the transmitter in the same way as before.

5. Troubleshooting

5.1 Error Message

(1) Error messages for calibration and necessary actions

(a) When measurement is continued, the characteristic of the DO electrode changes gradually by contaminants and chemical reactions. By performing the calibration, correct measurement can be maintained. However, if the characteristic change goes too far, correct measurement cannot be maintained. This transmitter indicates error messages during calibration and temperature measurement meaning "You cannot use this transmitter under this condition."

(b) An error message can be reset by pressing MEAS/ST-BY or CAL/↑.

(c) When returned to the measurement mode after an error message was displayed, the transmitter is returned to the measurement state by calibration value of the previous time.

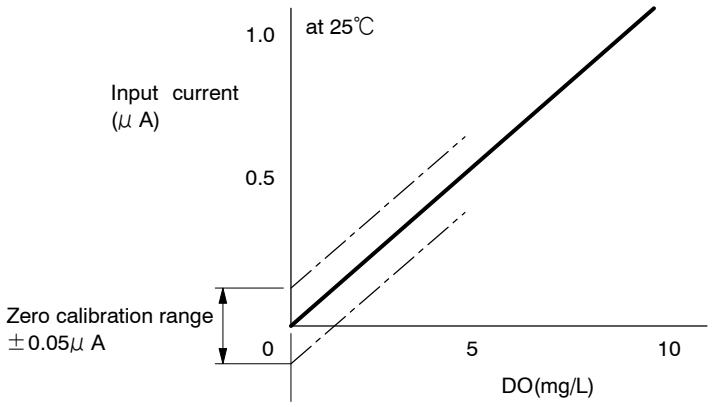
Error messages for calibration and necessary actions

Item	Indication	Message name and contents	Actions, etc.
1	ST-BY E−−0 D.CAL mg/L	[Zero calibration cannot be performed.] • Indicates that the value was outside the ±0.05μA range for design standard as a result of zero calibration.	• Replace the internal solution and replace the electrode membrane.. • Clean the sensing pole of electrode. • Prepare the zero calibration solution again.
2	ST-BY E−−1 D.CAL mg/L	[Span calibration cannot be performed.] • Indicates that the value was outside the ±40% range for design standard as a result of span calibration.	• Replace the internal solution of the electrode membrane.
3	ST-BY E−−2 D.CAL mg/L	[Stability check cannot be performed.] • Indicates that the signal from the electrode continues to change even after stability check starts and 5 minutes elapse at zero and span calibration.	• Same as "1"and "2" • Replace the electrode membrane internal solution. • The characteristic of the electrode may become poor if the temperature falls. Therefore, when the temperature is low like in winter, take time for the intended calibration or execute the calibration at 15 to 20℃. • While the measurement is kept over a long period, substances like silver may accumulate on the sensing pole in the electrode which causes the deterioration of the DO electrode. In such a case, remove the deposit on the sensing pole with a knife or equal to clean it paying attention not to harm its surface.

〔NOTE〕 • The relationship between DO electrode electromotive force and error message is shown in the figure.

(a) Zero calibration cannot be performed. (E--0)

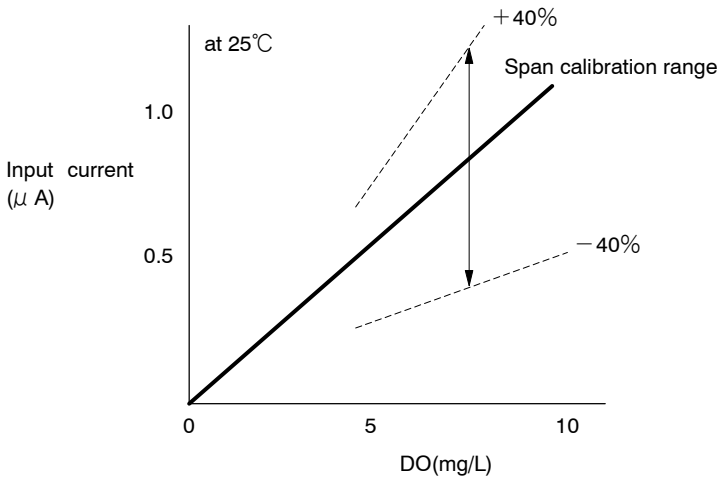
When zero calibration is performed outside the ±0.05μA range for the design standard, error message “E--0” is displayed.



Zero calibration mismatching range

(b) Span calibration cannot be performed. (E--1)

When span calibration is performed outside the ±40% range for the design standard, error message “E--1” is displayed.



Span calibration mismatching range

(c) Stability check cannot be performed. (E--2)

The signal from the electrode continues to change even after stability check starts and 5 minutes elapse at zero and span calibration, error message “E--2” is displayed.

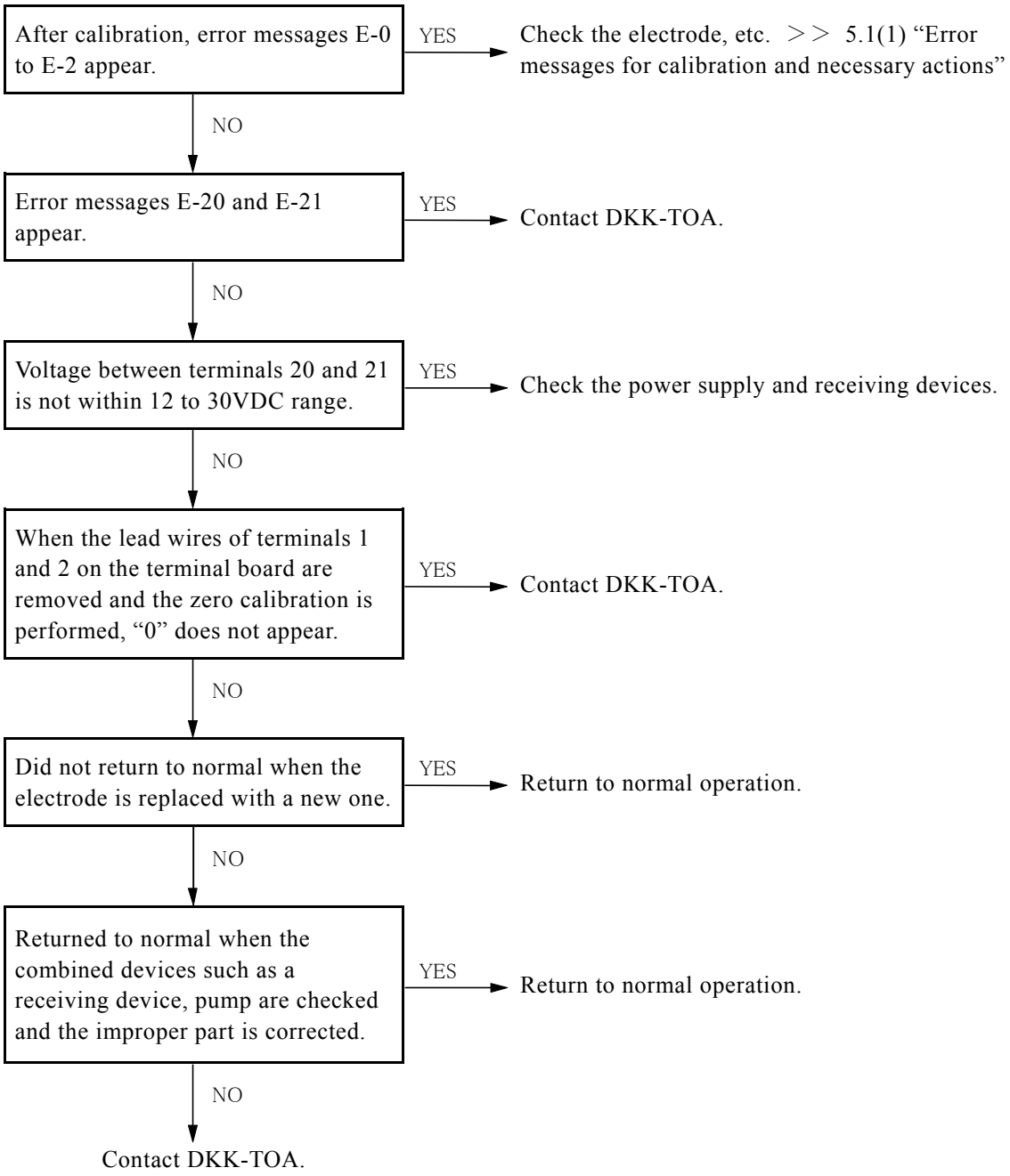
(2) Other error messages and necessary actions

Storage element error (E-20), Setting data error (E-21), and temperature error (E--3) are for burnout function.

Other Error Messages and Necessary Actions

Item	Indication	Message name and contents	Actions, etc.
1	DO E--3 mg/L O2 E--3 % SAT E--3 %	[Temperature error] • When the measured temperature (T) becomes T>50°C or T<0°C for 30 seconds or more • At this time, transmission output is as follows by the setting of burnout function. (B.OUT) • "oFF"…Constant output of 4mA • "on.H"…Constant output of 21mA • "on.L"…Constant output of 3.8mA	• The error message is canceled when the temperature is more than 0°C and less than 50°C.
2	ROM E-20	[Storage element error] • When power is on, setting data could not be read. The data was found erroneous.	• When not returned to normal even if the power is turned on again, contact DKK-TOA.
3	DATA E-21	[Setting data error] • When power is on and setting data is read, the data was found erroneous.	• Turn on the power again. • When not returned to normal even if the power is turned on again, repair is necessary.
4	DO 11.00 mg/L At overflow DO – mg/L At underflow The figure disappears and 3 decimal points blink.	[Overflow] or [Underflow] • Indicates that 10% or more figure of DO measuring range full scale is entered or the figure less than -0.20mg/L is entered.	• Set the DO measuring range again. • Check the insulation of the extension cable. • Perform zero calibration again.

5.2 Troubleshooting Flowchart



●Repair contact

If a repair is required, please contact your sales representative, our sales office, or our service department. In this case, let us know the following information:

Model name (MODEL)

Serial number (SER. No.)

Manufacturing date (DATE)

6. Specifications and Explanation

6.1 Specifications

(a) Basic Items

Product name	:	Dissolved Oxygen Analyzer/Transmitter
Model	:	ODM-135A
Measuring object	:	Dissolved oxygen in water (DO), Oxygen in air (O_2), Saturation ratio of Dissolved oxygen in water (SAT) and temperature (TEMP)
Measurement method	:	Polarography with membrane type
Measured value display	:	4-digit digital LCD display with sub display and unit indicators
Measuring range (display)	:	(1) DO measurement ····· 0 to 50mg/L (minimum display: 0.01mg/L)
		(2) O_2 measurement ····· 0 to 30% (minimum display: 0.1%)
		(3) SAT measurement ····· 0 to 150% (minimum display: 0.1%)
		(4) Measurement temperature ··· 0 to 100°C (minimum display: 0.1°C)
Measuring range (transmission output)	:	Any range is available out of the following ones:
		0 to1/0 to 2 /0 to 5/0 to 10/0 to 15/0 to 20/0 to 25/0 to 30/0 to 50mg/L
Transmission output signal	:	Analog output, corresponds to DO measured value
		Type ····· Input/output isolated from ground
		Class····· 4 to 20mADC
		Load resistance····· 650Ω maximum (When power supply is 24V)
		Ripple ····· Peak value 0.5%FS maximum
Temperature compensation resistance	:	10kΩ (at 25°C)
Temperature compensation range	:	0 to 45°C
DO electrode temperature compensation	:	(1) Automatic temperature compensation ····· When measurement is performed by combining the transmitter with electrode with temperature compensation resistance, temperature compensation of DO electrode is performed at the measured temperature.
		(2) Manual temperature compensation ····· Temperature compensation of DO electrode is performed at the set temperature corresponding to an electrode with a temperature compensation resistance different from the specifications and an electrode with no temperature compensation resistance.
Power voltage and max. load resistance	:	24VDC ± 10%, max. load resistance: 650Ω (When power supply is 24V)
		Max. load resistance (Ω) = 50 × Power voltage −550

(b) Performance

Linearity (indication)	:	DO measurement ····· within ±1%FS (equivalent input) However, for 0 to 1mg/L range, 0 to 2 mg/L range, within ±0.05mg/L
Conversion difference between indication and transmission output	:	Within ±0.4%FS (0.06mA) with respect to indicated value (equivalent input)
Repeatability (indication)	:	Within ±0.8%FS (equivalent input) However, for 0 to 1mg/L range, 0 to 2 mg/L range, within ±0.04mg/L
Temperature compensation accuracy		Within ±3%FS for 0 to 45°C
Stability (indication)	:	Within ±1%FS / 24h (equivalent input) However, for 0 to 1mg/L range, 0 to 2 mg/L range, within ±0.05mg/L
Response time (indication)	:	"1": 10s (90% response), "2": 30s (90% response), "3": 60s (90% response)
Allowable ambient temperature/humidity	:	(1) Operation guaranteed range ····· –30 to 65°C, 0 to 99%RH (2) Performance guaranteed range ····· –20 to 55°C, 0 to 99%RH (3) Transport/storage guaranteed range ····· –30 to 70°C, 0 to 99%RH

(c) Structure, etc.

Sensor	:	Model OC-711, NOC-814, OC-950C, etc.
Connector box	:	Model FC-4 (Option)
Extension cable	:	Model EC-22 (Option)
Connection terminals	:	M4
Cable ports	:	G3/4, 3 places
Structure	:	Outdoor installation, IP55
External dimensions and mounting method	:	118mm × 129mm × 178mm (main unit), 50A pipe mounting
Material	:	Main unit ·····Aluminum Window ·····Resin
Surface color	:	Blue, metallic silver
Mass	:	Approx. 3kg

(d) Functions

Calibration method	Zero calibration ····· Calibration by opening the electrode terminal of the transmitter or by immersing the electrode into the solution of 5 to 10% sodium sulfite Span calibration···Calibration of electrode by air or air saturated water.
Display (function) mode	O_2 value, SAT value, liquid temperature, measuring range, membrane thickness, calibration method, stability check, electrode zero current, electrode slope, transmission method for error, transmission output type, response speed, applied voltage
Calibration (adjustment) function	• DO value adjustment. (slope adjustment) • Electrode zero current value adjustment. (parallel transmission) • Electrode slope coefficient setting. (slope adjustment) • Liquid temperature shift (parallel shift within ±5°C) • Transmission output (4mA and 20mA adjustable using dedicated switch)
External hold function	(Option) Wash in progress contact signal input terminal for output hold. When received a signal (100VAC) from a various type of cleaner, the transmission output type is switched.
Manual temperature compensation	Liquid temperature can be input by dedicated switch.
Self-diagnosis	Burnout function works. That is, when temperature compensation resistance breaking or short circuit, storage element error (E-20), setting data error (E-21), or other error is generated, the transmission output is set to 3.8mA or 21mA.

6.2 Key Point of DO Measurement

The key point of DO measurement, especially, as for the characteristic of the dissolved oxygen analyzer, the nature of dissolved oxygen, etc. is described here.

(1) Important factors affecting the measurement

There are 4 factors which affect the DO measurement: temperature, pressure, flow rate and composition of the sample being measured.

(a) Temperature

Since the output of electrode has a thermal coefficient of about +3%/°C and the thermal coefficient of the amount of saturated dissolved oxygen is about -3%/°C, the deviation of those two coefficients will be about 6%/°C. This is corrected on the transmitter side by the output of thermistor incorporated in the electrode, but a large error in temperature compensation may occur in case the difference between the temperature of calibration and that of measurement becomes too large. An error can be minimized by adjusting the temperature of calibration as close to that of the sample to be measured as possible.

(b) Pressure

Since the output of electrode varies proportionally to the partial pressure of oxygen, the output of electrode becomes double if the pressure is doubled or gauge pressure is 0.1MPa.
When the sample is in contact with the air, the saturated dissolved oxygen is doubled, however, the saturated dissolved oxygen is not changed when the sample is not in contact with the air.

Therefore, when the sample is under positive or negative pressure, careful attention is required. This cannot be corrected by the electrode.

(c) Flow Rate

On the membrane surface, precisely speaking, on the cathode surface, an oxygen deficient layer produced by oxygen consumption within the electrode is gradually spreading toward outside and the output of electrode gradually drops because of the said spreading layer. To displace the oxygen deficient layer with the fresh sample, the flow speed of the sample is necessary. This is one of disadvantages of the membrane type electrode. Generally speaking, the flow speed is 10 to 20cm/sec, but 5cm/sec is sufficient in actual measurement.

The accumulation of fouling substances on the membrane is a problem because it stops the movement of sample on the membrane. But it does not disturb the oxygen permeation. For example, DO in oil that used to be regarded as one of fouling substances can be measured without problem in the same manner as in water.

(d) Composition of Sample

Since the DO concentration falls by adding water-soluble component such as NaCl to the sample even if the oxygen partial pressure remains unchanged, correction of the DO concentration is necessary in such a case.
This is the reason why the table of oxygen solubility in pure water contains the salt correction data. Generally, for the sample of high salt or sugar concentration, the oxygen solubility is low. On the contrary, for the samples containing alcohol or other organic solvent the oxygen solubility is high. These are also difficult to correct by the electrode.

〔NOTE〕 • As a unit to express the concentration of dissolved oxygen, “mg/L” is usually used. Besides, “Saturation Ratio” is also used assuming that the concentration saturated with air is 100%. In case of a sample of complicated composition whose DO concentration measured with the DO electrode often does not agree with the laboratory analysis, “Saturation Ratio” (expressed as SAT in this instruction manual) is quite convenient since the DO concentration of the sample can be obtained later by converting from the amount of saturated dissolved oxygen if the temperature and the saturation ratio (SAT) of the sample are taken notes of.

(2) Amount of saturated dissolved oxygen in water

[Atmosphere 0.1MPa (absolute pressure) (760mmHg), Oxygen 20.9% in the moisture saturation air]

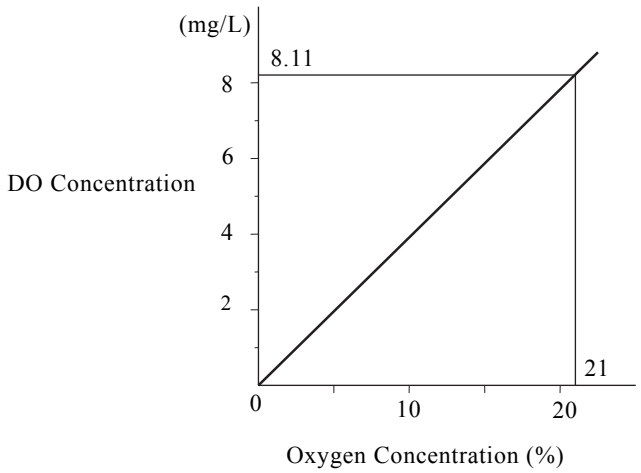
Temp. (°C)	Chloric-ion in water (mg/L)						DO to be subtracted per 100mg/L of Chloric-ion
	0	5000	10000	15000	20000	25000	
	Amount of Dissolved Oxygen (mg/L)						
0	14.16	13.40	12.63	11.87	11.10	10.33	0.0153
	13.77	13.03	12.29	11.55	10.80	10.06	0.0148
	13.40	12.68	11.97	11.25	10.52	9.80	0.0144
	13.04	12.35	11.65	10.95	10.25	9.55	0.0140
	12.70	12.03	11.35	10.67	9.99	9.31	0.0135
5	12.37	11.72	11.06	10.40	9.74	9.08	0.0131
	12.06	11.42	10.79	10.15	9.51	8.87	0.0128
	11.75	11.15	10.52	9.90	9.28	8.66	0.0124
	11.47	10.87	10.27	9.67	9.06	8.46	0.0120
	11.19	10.61	10.03	9.44	8.85	8.27	0.0117
10	10.92	10.36	9.79	9.23	8.66	8.09	0.0113
	10.67	10.12	9.57	9.02	8.47	7.92	0.0110
	10.43	9.90	9.36	8.82	8.29	7.75	0.0107
	10.20	9.68	9.16	8.64	8.11	7.59	0.0104
	9.97	9.47	8.97	8.46	7.95	7.44	0.0101
15	9.76	9.27	8.78	8.29	7.79	7.29	0.0099
	9.56	9.06	8.60	8.12	7.63	7.15	0.0096
	9.37	8.90	8.44	7.97	7.49	7.02	0.0094
	9.18	8.73	8.27	7.82	7.36	6.89	0.0091
	9.01	8.57	8.12	7.67	7.22	6.77	0.0089
20	8.84	8.41	7.97	7.54	7.10	6.65	0.0087
	8.68	8.26	7.83	7.40	6.97	6.54	0.0086
	8.53	8.11	7.70	7.26	6.85	6.43	0.0084
	8.39	7.98	7.57	7.16	6.74	6.33	0.0082
	8.25	7.85	7.44	7.04	6.65	6.23	0.0081
25	8.11	7.72	7.32	6.95	6.52	6.13	0.0079
	7.99	7.60	7.21	6.82	6.42	6.03	0.0078
	7.87	7.48	7.10	6.71	6.32	5.93	0.0077
	7.75	7.37	6.99	6.61	6.22	5.84	0.0076
	7.64	7.26	6.88	6.51	6.12	5.74	0.0076
30	7.53	7.16	6.78	6.41	6.03	5.65	0.0075
	7.43	7.06	6.66	6.31	5.93	5.56	0.0075
	7.32	6.96	6.59	6.21	5.84	5.47	0.0074
	7.23	6.86	6.49	6.12	8.75	5.38	0.0074
	7.13	6.77	6.40	6.03	5.65	5.28	0.0074
35	7.04	6.67	6.30	5.93	5.56	5.19	0.0074
	6.95	6.58	6.21	5.84	5.46	5.10	0.0074
	6.86	6.49	6.12	5.75	5.37	5.00	0.0074
	6.77	6.40	6.03	5.65	5.27	4.90	0.0075
	6.68	6.31	5.94	5.55	5.17	4.80	0.0075
40	6.60	6.22	5.84	5.46	5.07	4.69	0.0076
	6.51	6.13	5.75	5.36	4.97	4.58	0.0077
	6.42	6.04	5.65	5.25	4.86	4.47	0.0078
	6.33	5.94	5.55	5.15	4.75	4.35	0.0079
	6.24	5.84	5.45	5.04	4.64	4.23	0.0080
45	6.15	5.75	5.34	4.93	4.52	4.11	0.0082
	6.06	5.65	5.23	4.81	4.39	3.98	0.0084
	5.96	5.54	5.12	4.69	4.26	3.84	0.0085
	5.86	5.43	5.00	4.56	4.13	3.69	0.0087
	5.76	5.32	4.88	4.43	3.99	3.54	0.0089
50	5.66	5.21	4.75	4.30	3.84	3.39	0.0091

〔NOTE〕 • However, figures of Temperature ≧40°C and dissolved oxygen at 25000mg/L of chloric-ion shown above are calculated based on Truesdale's equation. <G.A.Truesdale, et, al.: J. appl.Chem., 5, 53(1955)>

(3) Measurement for samples containing salts

(a) Concentration of chloric-ion and indication of DO analyzer

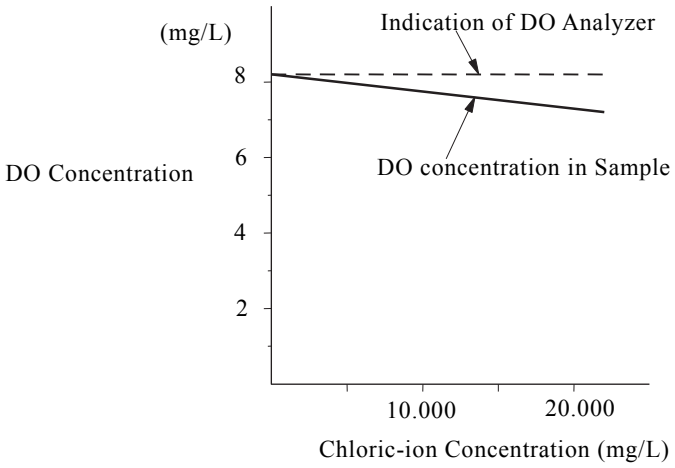
Generally, if a sample contains a large amount of salts in it, its oxygen solubility drops lower than that of the pure water. Therefore, a correction of DO is required for the measurement of a sample containing a lot of salts (for example, seawater).



Relation between Chloric-ion concentration and DO concentration (25°C) (not including salt)

The above graph indicates the relation between the oxygen concentration in a gas at 25°C when the gas containing oxygen is blown into water which is close to pure water (like city water or desalted water) and the dissolved oxygen in the water under the equilibrium condition. Now, take the water in a beaker and introduce air (Oxygen concentration: 21%) into it. Then, insert a DO electrode in it and calibrate the DO analyzer so that its indication shows 8.11mg/L. After that, reduce the oxygen concentration in the gas to 14% which is 2/3 level. If so, the DO concentration in the water falls to 8.11 x 2/3 = 5.41mg/L and the DO analyzer indicates 5.41mg/L accordingly. This is because the oxygen partial pressure corresponding to DO concentration of 5.41mg/L is 14%, the indication of the DO analyzer drops to 2/3.

Now, introducing air into the same water (with the DO indication of 8.11mg/L), if some amount of table salt is added into the water being bubbled with air, the actual DO concentration begins to decrease.
(Refer to the graph "Relation between Chloric-ion Concentration and DO Concentration" shown in the following page.)



Relation between Chloric-ion Concentration and DO Concentration (25°C)

For example, if the chloric-ion concentration increases to 20,000mg/L, the actual DO at 25°C falls to 6.52mg/L. But the indication of the DO analyzer shows 8.11mg/L remaining unchanged. This is because the oxygen partial pressure corresponding to the DO of 6.52mg/L in the water which contains 20,000mg/L of chloric-ion is still 21% and the membrane type DO electrode employed for DO analyzer responds to the oxygen partial pressure. And when the DO concentration in the water which contains 20,000mg/L of chloric-ion changes to 6.52 x 2/3 = 4.35mg/L, the indication of the DO analyzer shows 8.11 x 2/3 = 5.41mg/L and it drops to 2/3 since the new equilibrium oxygen partial pressure of 4.35mg/L is 14%.

In case DO measurement is intended, therefore, with water which contains chloric-ion like sea water or others, take the following procedure keeping these points in mind.

(b) Direct indication of DO concentration

In this case, calibrate the transmitter as follows.

①Obtain the chloric-ion concentration. ····· First of all, obtain the chloric-ion concentration in the sample by some conceivable means. Assume that the chloric-ion concentration obtained is about 20,000mg/L.

②Introduce air into the sample ····· Take some city water in a beaker and introduce air into it for bubbling. Maintain its temperature nearly equal to that of the sample. (For example, 25°C)

③Immerse the electrode in the water. ····· Immerse the electrode in the water provided at step ②.

④Perform span calibration. ·····＞＞ 2.2(4) “Span calibration with air saturated water”

⑤Check the saturated DO concentration. ····· Check the amount of saturated DO at 25°C with 20,000mg/L of chloric-ion concentration in 6.2(2) “Amount of Saturated Dissolved Oxygen in Water”, the saturated DO will be obtained as 6.52mg/L.

⑥Correct the indication. ····· Adjust the concentration indication of the transmitter to 6.52mg/L in accordance with the DO value adjustment function. ＞＞3.3(2) “DO value adjustment setting”

⑦Immerse the electrode in the sample. ····· Immerse the DO electrode for measurement. Now, the indication of the transmitter directly shows the DO of the sample.

(c) Method to obtain DO concentration with correction factor

This method is suitable for DO measurement of various kinds of samples.
For the purpose of explanation, assume that the chloric-ion concentration is 20,000mg/L at 25°C and the saturated DO concentration under this condition is 6.52mg/L from the table of 6.2(2) “Amount of saturated dissolved oxygen in water”.

①Calibrate the DO analyzer. ····· Immerse a DO electrode into city water of 25°C which is being bubbled with air and adjust the indication of the DO analyzer to 8.11mg/L. (in the same way of calibration for DO measurement of normal water.)

②Immerse the DO electrode in sample. ····· Immerse the DO electrode in the sample and take the reading of the DO analyzer.
Assume the reading is 4.00mg/L.

③Calculate the DO concentration. ····· Multiply the reading obtained at the previous step ② by [6.52/8.11] to obtain the DO concentration of the sample as follows.

$$4.00\times\frac{6.52}{8.11}=3.22(\mathrm{mg/L})$$

〔NOTE〕 • When the indication of DO is stable, the DO concentration of the sample may be directly obtained by adjusting the reading of the DO analyzer to the value calculated at step ③ >> Step ⑥ in “6.2(3) (b) Direct indication of DO concentration”

• Supersaturation of Oxygen···In some cases of measurement of DO in water where algae are growing, the DO measured might be higher than the air saturated DO. This occurs when algae produce oxygen by carbon assimilation and the water is in the state of supersaturation of oxygen.
Especially, under clear sky in daytime this phenomenon occurs sometimes, but this is not a malfunction of the analyzer. Take this sample in a beaker to aerate it for a while and the supersaturated oxygen is driven out of the sample. As a result, the DO indication begins to gradually decrease and eventually drops to the saturated DO concentration.

7. Installation

7.1 Transmitter Mounting

(1) Installation location of transmitter

Install the transmitter in a location which conforms to the specification and satisfies the following conditions:

(a) A location where the lead wires of the sensor and extension cable reach.

(b) A location where installation and maintenance work can be performed safely.

(c) A location where ambient temperature and humidity are within the specification limits and direct sunlight does not strike and a sudden change of temperature does not occur, and temperature does not change locally.

(d) A location where equipment that generates electrical noise is not found nearby.

(e) A location where sea water, chemicals, etc. are not splashed.

(f) A location where vibration does not exist.

(g) A location where corrosive gas does not exist.

(h) A location where any other factors that may affect with the operation do not exist.

⚠ WARNING

Gases

- Do not use the transmitter in a location where explosive gas or flammable gas exits. An explosion or fire may occur.

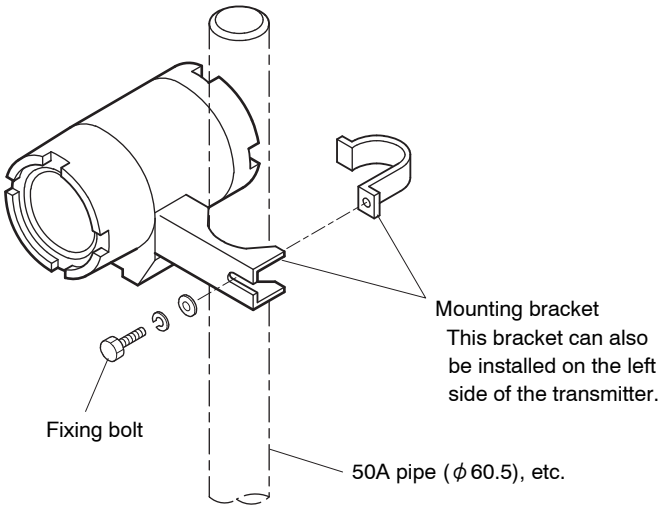
(2) How to mount the transmitter

Loosen the fixing bolt and install a mounting bracket to the 50A pipe, etc. and then fix the transmitter by tightening the fixing bolt. Follow the procedure below:

(a) Make the transmitter installation height 1.3 to 1.5m from the floor, it makes the reading and other works easy.

(b) Reserve a space of at least 10cm between the rear of the transmitter and the surrounding object. This makes maintenance work easy to perform.

(c) Mount the transmitter so that the top surface of the mounting bracket will be level.



How to Mount the Transmitter

7.2 Sensor Mounting

The installation conditions of sensor are such as, it is easy to perform maintenance and no strong vibration exits. Install the sensor referring to the instruction manual of the electrode or sensor provided separately.

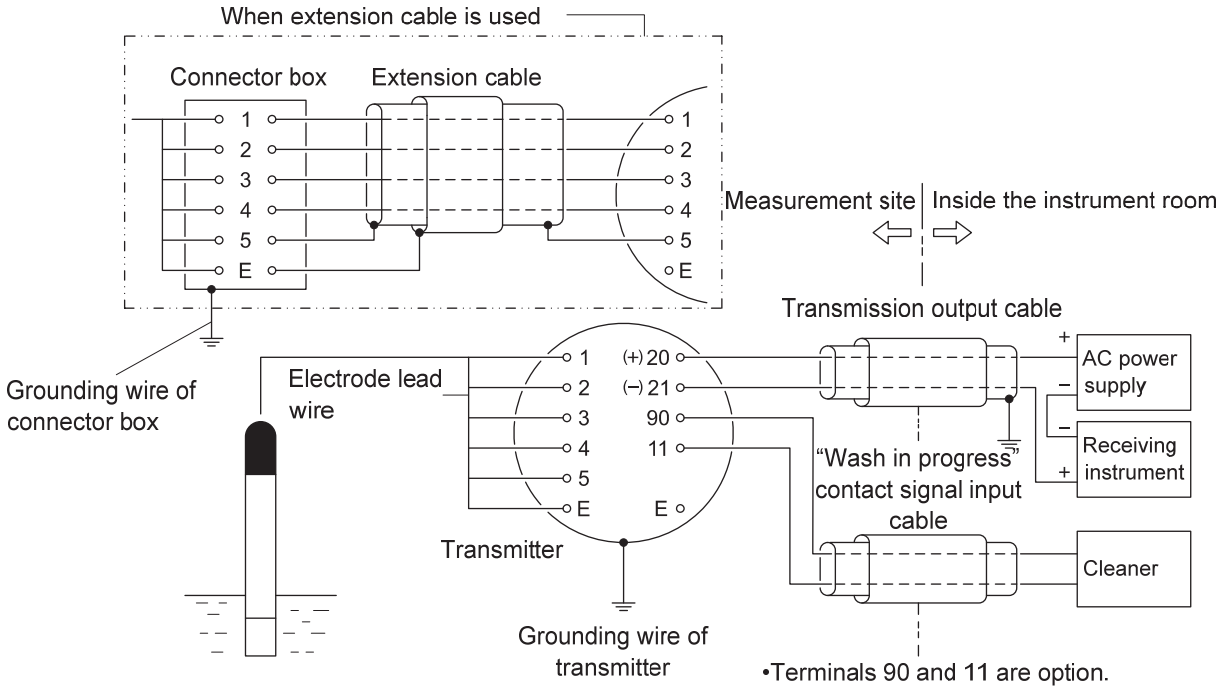
7.3 Wire Connection

⚠ WARNING

Electric Shock

- If a “wash in progress” contact signal cable of sensor with cleaner (option) is connected to the transmitter, do not touch the terminals in the product while power is applied. An electric shock may result.

(1) Wire connection diagram



Wire Connection Diagram

(2) Electrode lead wires

(a) Connect the terminals of electrode lead wires to the transmitter.

【IMPORTANT】
- Since the sensor may be lifted at the time of maintenance work, do not fix the electrode lead wires tightly using conduit pipe, etc.
- If a “wash in progress” contact signal cable of sensor with cleaner (option) is connected to the transmitter, for safety here, do not supply the power to the transmitter. Supply the power based on 2.1 “Operation Start Procedure”.

(b) If the electrode and transmitter must be installed away from each other, connect the terminals of electrode lead wires to a connector box. >> 7.4 “Extension by Cable (Option)”

(c) The resistance value of the temperature compensation circuit of this transmitter is 10kΩ/25°C (thermistor). Use a DO electrode with a temperature compensation element of 10kΩ for this transmitter.

(3) Power / transmission cable

(a) Use a 2-core shielded cable to connect between the terminals 20(+), 21(−) of the transmitter terminal board, DC power supply and a receiving instrument (such as a recorder).

(b) Provide a switch outside of this transmitter so that power supply can be turned off at the power source side.

【IMPORTANT】 • Power voltage is 24VDC±10%. Do not apply a high voltage exceeding this range. Applying a high voltage may damage the transmitter.

(4) Grounding wire of transmitter

(a) The ground terminal on the side of the transmitter or the ground terminal (E) inside the transmitter must be grounded with Class D grounding method (ground resistance 100Ω max.) and avoid sharing the ground with power equipment.

(b) If the transmitter cannot be grounded near the installation site, the transmitter can be grounded at the power source side. Use a 3-core instrumentation cable for power / transmission cable and connect the grounding core wire of the cable to the ground terminal E of the transmitter terminal board.

⚠ WARNING

Electric Shock

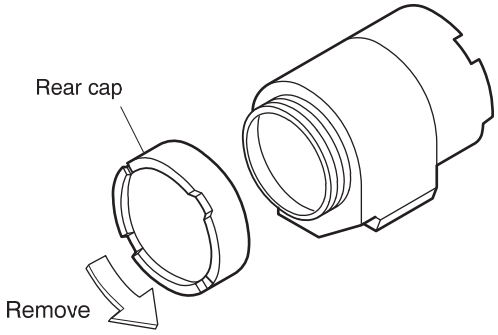
- If a “wash in progress” contact signal cable of sensor with cleaner (option) is connected to the transmitter, install a grounding wire. If not, an electric shock may result when power supply system trouble occurs.

(5) Wire connection to transmitter

【IMPORTANT】 • If a “wash in progress” contact signal cable of sensor with cleaner (option) is connected to the transmitter, for safety here, do not supply the power to the transmitter. Supply the power based on 2.1 “Operation Start Procedure”.

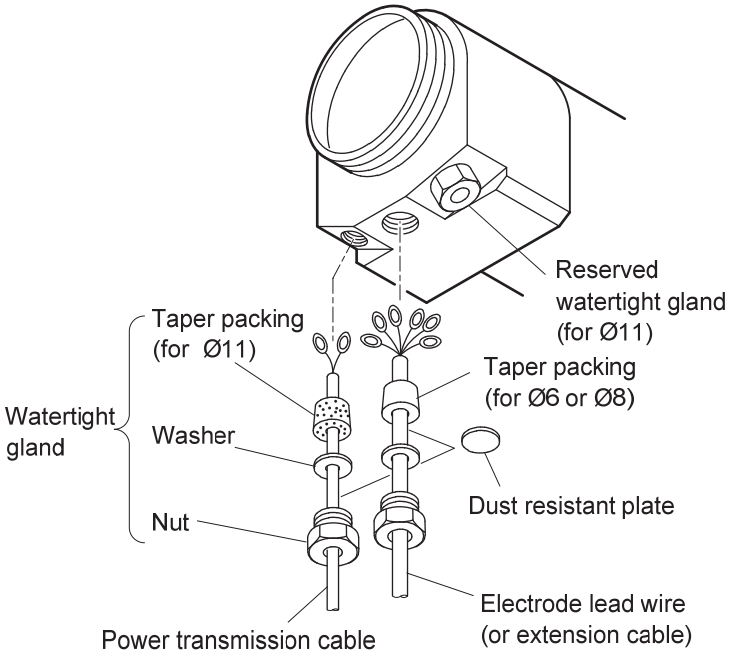
①Check that power is turned off. ····· Check that power is not supplied to the transmitter or the cleaner.

②Remove the rear cap. ····· Rotate the rear cap of the transmitter counterclockwise to remove it. Also remove the insulation cover.



Removing the Rear Cap

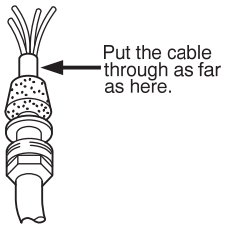
③Assemble watertight glands. ····· Among 3 sets of watertight glands, remove the glands on the left and in the center and put a corresponding cable through each gland as shown below.



Assembling the Watertight Glands

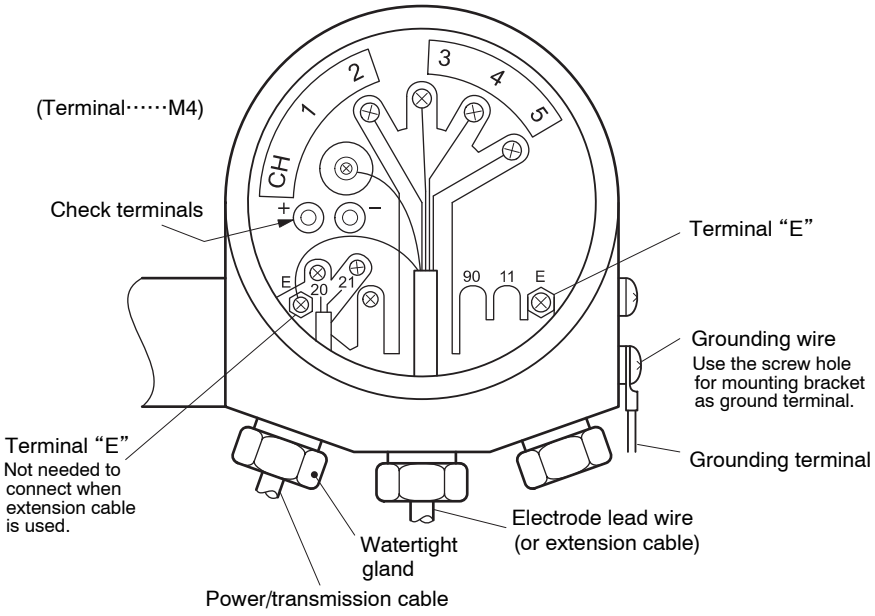
Watertight gland on the left (for ϕ11 cable)	: Put a power transmission cable through the gland.
Watertight gland in the center (for ϕ6 or ϕ8 cable)	: A taper packing for ϕ6 or ϕ8 is provided with the transmitter in accordance with the diameter of electrode lead wire or extension cable to be assembled.
Watertight gland on the right (for ϕ11 cable)	: Reserved.

【IMPORTANT】



- To maintain airtight condition, use a taper packing appropriate for the cable diameter. If a taper packing is not appropriate for the cable diameter, airtight condition cannot be maintained and it will cause insulation deterioration.
- Do not connect wires when it is rainy. It will cause insulation deterioration. If rainwater gets into the cable, the humidity inside the transmitter becomes high.
- Never moisten or soil the terminal end of electrode lead wires and extension cable.

④Connect wires to the transmitter. ····· Connect wires to the terminal board of the transmitter as shown below.



Wire Connection of Transmitter

【IMPORTANT】

- Do not allow the terminal 1 of the electrode lead wires in contact with other terminals. If they contact each other, insulation deterioration may occur.
- Do not connect the power / transmission cable with polarity in reverse.
  Terminal 20 ····· (+) Terminal 21 ····· (–)

〔NOTE〕 • Description for terminal numbers

1, 2	:	Electrode
3, 4	:	Temperature compensation (these terminals are not provided for electrode without temperature compensation)
5	:	Shield
E	:	Ground
20(+), 21(–)	:	Power supply, transmission output

- Check terminals ····· These terminals are provided to simply check the current signal of power/ transmission cable. When you check the current, use a digital multimeter with internal resistance of 10Ω maximum.

⑤**Tighten the watertight glands.** ····· Tighten the watertight glands to keep airtight for the transmitter.

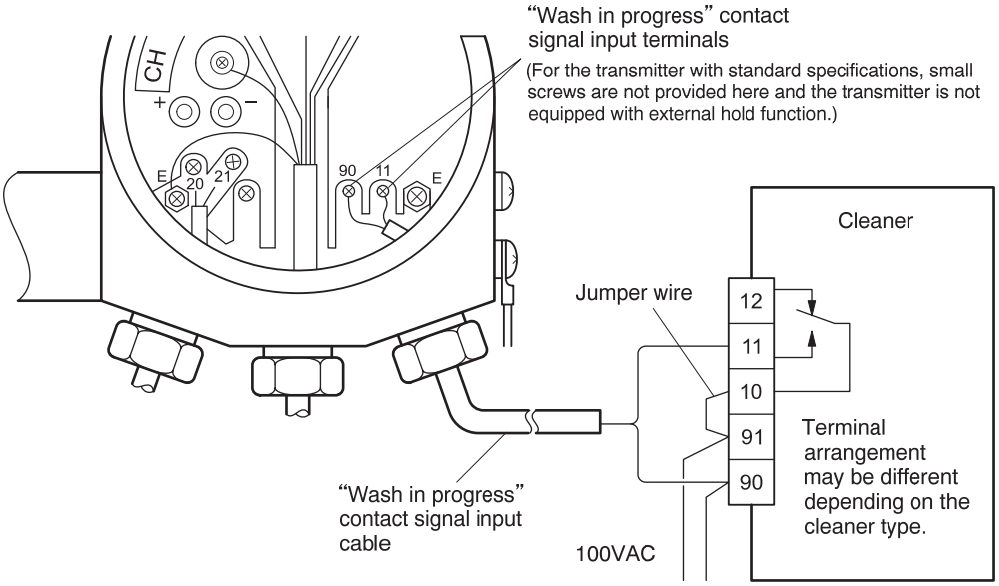
⑥**Put on the cap, etc.** ····· Check the wiring of the terminal board again and install the insulation cover and put on the cap.

⑦**Connect the grounding wire.** ····· Connect a grounding wire to the ground terminal on the side of the case or to the terminal E of the terminal board inside the transmitter.

(6) Wire connection of "wash in progress" contact signal input cable

(option)

If the transmitter is equipped with external hold function (option), the transmission output can be changed to the maintenance output mode (hold, dummy, through) by connecting a sensor with cleaner to the "wash in progress" contact signal input terminals to avoid the fluctuation of indicated value during wash operation. In this case, connect between the transmitter and the cleaner in the procedure below. Immediately before the cleaner starts washing, a "wash in progress" contact signal (100V) will be sent from the cleaner to the transmitter.



Wire Connection of "Wash in progress" Contact Signal Input Terminals

①**Check that power is off.** ····· Check that the power supply to the cleaner and the transmitter is off.

【IMPORTANT】 • If a "wash in progress" contact signal cable of sensor with cleaner (option) is connected to the transmitter, for safety here, do not supply the power to the transmitter. Supply the power based on 2.1 "Operation Start Procedure".

②**Connect a cleaner.** ····· Connect a jumper wire, which is provided for the transmitter, between the terminals 91 and 10 of the cleaner.

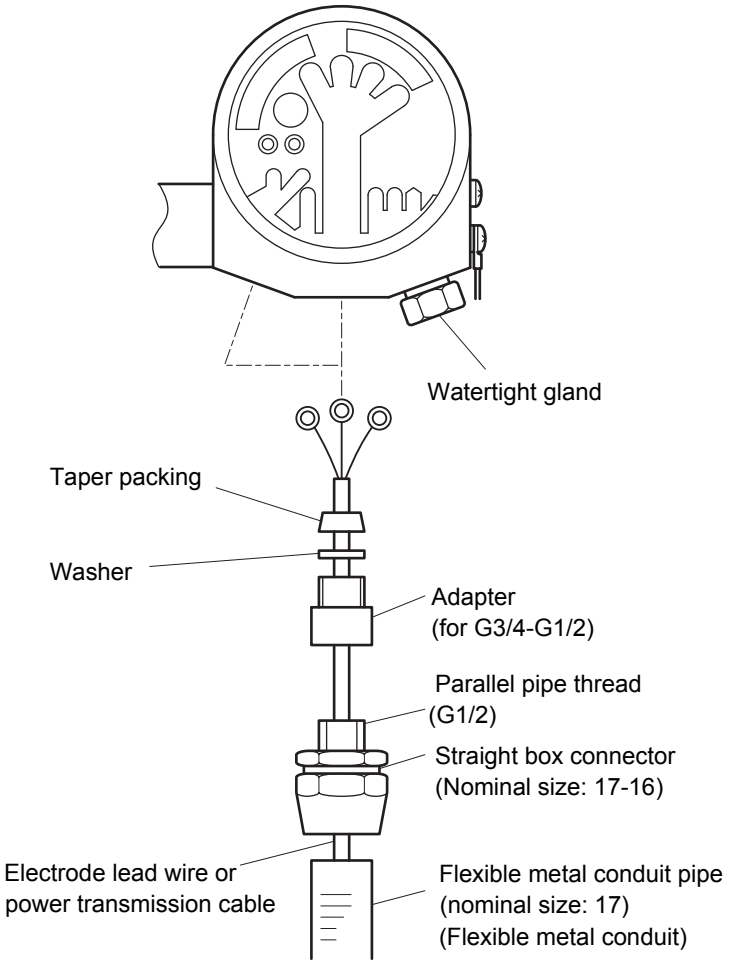
③**Connect a cable.** ····· Prepare a "wash in progress" contact signal input cable and connect it between the transmitter and the cleaner while checking the terminal numbers for the cleaner and those for the transmitter match.

〔NOTE〕 • Immediately before the washing operation begins, a “wash in progress” contact signal is output from the cleaner and the transmission output value becomes the transmission output type for maintenance mode.

(7) Wiring using conduit

(a) It is recommended that you use conduit for wiring. When using conduit, use a flexible metal conduit pipe near the transmitter, approx. 1m from the transmitter.

(b) When removing watertight gland, the cable ports of the power transmission cable and electrode lead wire are provided with parallel pipe thread (G3/4). Therefore, when using a box connector for flexible metal conduit pipe (nominal size 17 or 16) (G1/2), use an adapter between them.

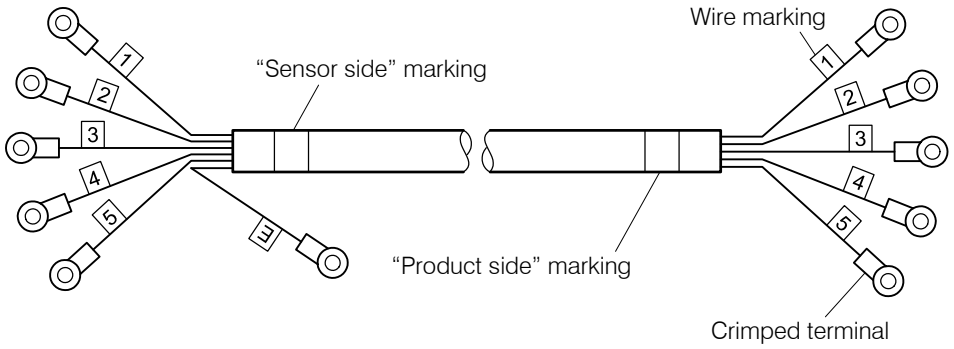


Wiring Using Flexible Conduit (Flexible Metal Conduit)

7.4 Extension by Cable (Option)

When the product (transmitter, controller, meter etc.) must be installed at a place the electrode lead wire (standard: 5m) cannot reach, extend the lead wire by using the attached cable and connector box according to the order specifications.

(1) Extension cable (Option)



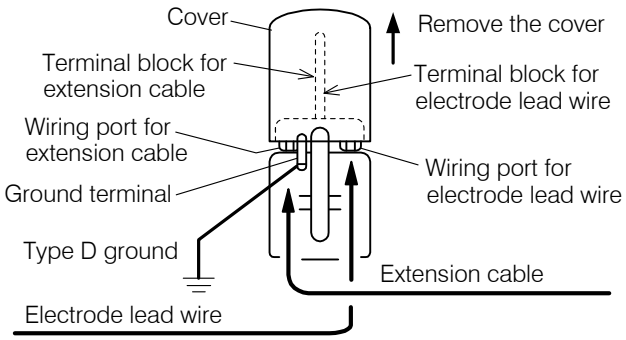
Extension cable

(a) Connect the sensor side (marking: "TO DETECTOR" etc.) of the extension cable to the extension cable use terminal block of the connector box and connect the product side (marking: "TO METER" etc.) to the input terminals (1 to 5, E) of the product (transmitter, controller, meter etc.).

(b) Keep the terminals of the extension cable clean and wire the cable so that it is separated from power cables and other noise sources and does not sway.

【IMPORTANT】
- When the extension cable gets wet or dirty, dry it after wiping with alcohol, etc.
- When there is a noise source near the extension cable or the extension cable vibrates or sways, the indication will fluctuate.
- The extension cable cannot be spliced. Always use 1 cable (up to 100m).
- For terminal processing of the extension cable, request that the work be done by a technical services company. If terminal processing is incorrect, normal measurement cannot be made.

(2) Connector box (Option)



Connector Box Wiring

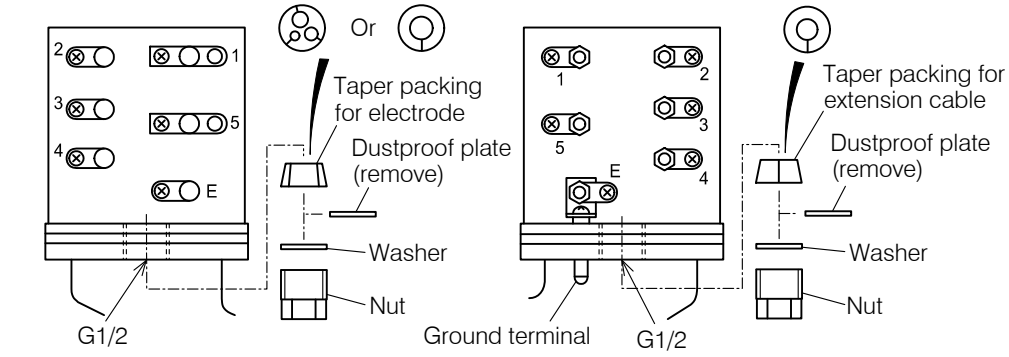
(a) Pass the following cables, etc. through each wiring port and wire them by matching the wire mark numbers and the terminal block numbers.

- Electrode lead wire ····· Pass through the wiring port (right side) for electrode lead wire and wire to the terminal block for electrode lead wire.
- Extension cable ····· Pass through the wiring port (left side) for extension cable and wire to the terminal block for extension cable.

(b) Ground the connector box ground terminal by Type D grounding work (ground resistance value 100Ω or less).

(c) When the connector box cover is pulled upward it is separated from the connector box. At this time, if the nut of one of the wiring ports is loosened, air will enter the connector box and the cover will be easy to remove.

(d) The connector box terminal blocks conform to the following figure. As the dustproof plates are for shipping and storage, remove them.

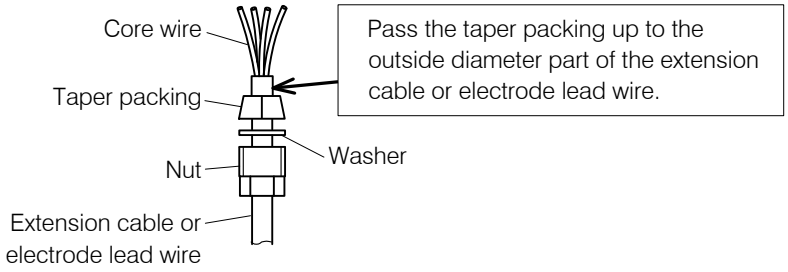


Connector Box Terminal Blocks

(e) When the taper packing for electrode has three holes, remove the rubber film of the hole matched to the thickness of the electrode lead wire and pass the lead wire through that hole.

【IMPORTANT】 • If a hole not matched to the outside diameter of the electrode lead wire is used, air tightness will not be maintained. In addition, do not remove the rubber film of unused holes.

(f) Pass the taper packing through the hole up to the outside diameter part of the extension cable or electrode lead wire. If the taper packing is placed at the core wires part and the nut is tightened, air tightness inside the connector box may not be maintained.

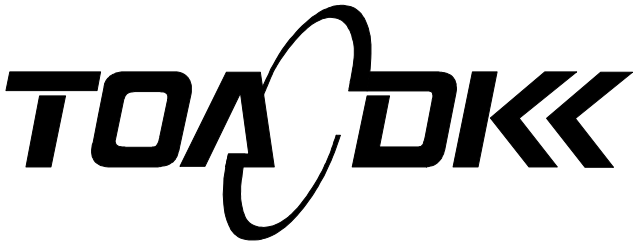


Position of Taper Packing

(g) When using conduit at the extension cable wiring, we recommend the method by which the nut, etc. are removed from the connector box wiring ports, a straight box connector (size: 17-16), etc. is screwed onto the parallel pipe thread (G1/2) at the bottom, and a flexible pipe (size: 17) is connected.

Revision History

Instruction Manual No.ODM-IB38210E	30/ 3/2015 (JJ)	New Version in English (RS2 M.Furuya, DEC S.Shimura)



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