KEMPION

CE

Digital DO Controller

MESTAR+ Series

Instruction Manual

전세산업 (주)

Thank you very much for purchasing cheonsei DO controller.

Before beginning operation, please read this instruction manual carefully.

Correct handling, repair & maintenance are described easily.

Please keep this instruction manual at the place where you can see it easily.

※The specification of products can be changed for improvement without prior notice.

※Please refer to the website (www.cheonsei.co.kr) as we always register the latest instruction manual.

CONTENTS

1 Notice for Safety

1-1 Introduction

- To use the products safely, the signs are showed on the manual like below.
- As it is a matter of safety, please be sure to keep the directions in manual
- The signs and indication are as follows.

⚠ Warning

Person death or serious injury will be occurred, if warning is not kept by wrong handling.

⚠ Caution

Person injury or property damage will be occurred, if caution is not kept by wrong handling.

1-2 Cautions for operation condition

⚠ Caution

- Do not use this controller and its components for other purposes.
  Otherwise it may cause trouble.
- Please keep the followings, otherwise it may cause trouble.
  Ambient temperature : -5 ~ 45℃ / Relative humidity : below 80%
  Install location : Indoor and inside of electrical panel
  Temperature of the handling liquid
  : below the working temperature described in the electrode specification
- Gas or moisture, which occur in jobsite, can lead to the internal corrosion of the controller and it may cause reduction of service life and trouble.

1-3 Warning for handling condition

⚠ Warning

- Install this controller beyond the reach of children and/or unauthorized person.
- Turn off the power and stop the controller & other equipments when repairing or disassembling the controller. If power is on during work, it may cause electric shock.
- Controller should be properly grounded and install ELCB(Earth Leakage Circuit Breaker) in order to prevent electric shock.
- In case of installation in the electric panel, install the controller after securing sufficient space in order not to contact with the components inside electric panel.
- Do not touch with wet hands. Electric shock may occur.
- Use only designated parts. If undesignated parts are used to the controller, it may cause accident & trouble.
- Do not arbitrarily reconstruct the controller. If the controller is arbitrarily reconstructed, it may cause accident & trouble.

⚠ Caution

- Do not use the controller of which case was damaged.
  If the controller is used, it may cause trouble to equipment connected with the controller.
- Do not install controller in the heavy moist or dusty place.
  Electric shock and trouble may occur.
- Do not use power other than that specified in controller. Otherwise, it may cause malfunction or fire.
- Refrain from voltage withstand test in order to prevent damage of internal parts.
- Dispose of waste controller in accordance with related national law.

2 Product Confirmation

2-1 Check point when unpacking

Please check following points immediately after receiving the product.
If the defect is found from the product, please request it to local agent or CHEONSEI.

① Is specification correct as ordered?
② Is there any missing parts ?
③ Is there any visible damage caused by vibration or shock during transport?
④ Is there any loosened bolt or nut?

2-2 Components

① Controller
- Digital DO controller : 1Set
- Bracket(SPC-1 M4 x 52) : 2EA
- User manual : 1 Copy

② SET Components
- Refer to section 6.

3 General

This controller is a digital controller built-in micro processor. It can be used by composing circuit with the external devices through dry contact of analog input & output and, as option, it can be composed according to wanted using condition by installing communication card.
This controller is designed only for a high insulation shielded cable.
If you need to extend the electrode cable, refrain from using the general cable in market and use our high insulation shielded cable.

4 Model Code

MESTAR+ D □□ – □

① ② ③ ④

① Controller	② Controller Option	③ Output	④ Electrode
D : DO (Dissolved Oxygen)	B : Standard (Temp. Compensation) C : Communication(RS-485)	0 : Standard 1 : Temp.(4~20mA)	0 : None 1 : CPD11

5 Specification

5-1 Controller

Specification		Performance	
Measuring range & Display range	mg/L	0.00 ~ 20.00mg/L	
	Temp	-10.0℃ ~ 100℃	
Resolution & Accuracy	mg/L	0.01mg/L / ±1% of Full Scale	
	Temp	0.1℃ / 0.5℃	
Ambient Temp. & Humidity		-5℃ ~ 45℃ / Relative humidity: Below 80% (Muse be free from condensation and dew)	
Range of temp. compensation		0~100℃ Auto/Manual	
Calibration method		2Point (Zero: Zero Solution, Span: Saturation Solution or Air)	
Display		3" LCD Segment Display (LED Back Light: White)	
Alarm output	Setting	High, Low	
	Output	Dry Contact 1a1b, Contact capacity: 3A 250VAC / 3A 28VDC	
	Deadband	Setting Range: 0.00 ~ 1.00mg/L	
Analog output	DO	0.00 ~ 20.00mg/L	4~20mA isolated output (Load resistance 1,000Ω)
	Temp	-10.0 ~ 100℃(Option)	
Memory		EEPROM	
Communication		RS-485 2Wire Half-Duplex(Option)	
Power		AC85 ~ 245V, 50/60Hz (Power consumption: 3W)	
Case		Anti-Static ABS	
Size & Weight		96mm * 96mm * 115mm / Approx.450g	
Installation place		Indoor, inside electric panel	

5-2 Electrode

	Specification
Model	CPD11
Use	Dissolved oxygen measurement
Electrode type	Galvanic
Measuring range	0.00 ~ 20.00mg/L
Flow condition for measurement	More than 0.35m/s
Temp. Compensation element	Pt 1,000Ω
Workable temp.	0 ~ 50℃
Workable pressure	Max. 1bar
Response time	90% in 2minutes (Base on 25℃)
Cable length	Approx. 5m
Meterial	ABS

6 SET Components

6-1 Standard SET Components

SET Model	Components	Specification	Quantity
MESETAR+ DB0-1	Controller	Digital DO Controller	1SET
	Panel Bracket	SPC-1 M4 x 52mm	2EA
	User manual	44Page	1Copy
	Electrode	CPD11	1SET
	Electrode Holder	Size : Φ34 x 1m, Meterial : P.P	1SET
	Bracket for Holder	Meterial : PVC	1SET
	Connection Box	Coated with Anti-Static film	1SET
	Connection Cable	High isolated special shield cable(5P)	20m
	Buffer Powder	Sodium Sulfite(Na_2SO_3) 15g	1EA
	Buffer Powder Bottle	500cc, Meterial : P.P	1EA

6-2 Option Item

① Connection kit and connection cable (Up to 100m) ※non-extendable

② Sampling holder

7 Name & Function of Each Part

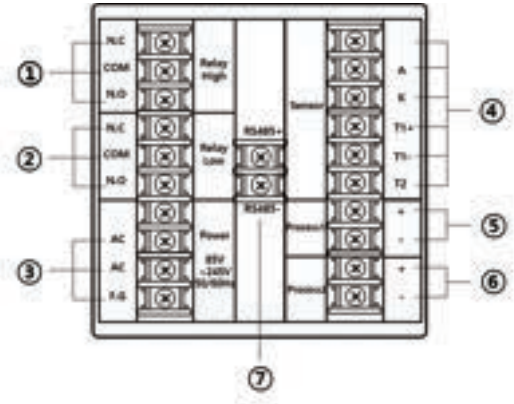
7-1 Screen Layout

① Setup mode
② Measurement mode
③ Calibration mode
④ Zero calibration
⑤ Span calibration
⑥ Main display
⑦ Main display unit
⑧ Sub display unit
⑨ Temp. compensation setting status
⑩ Sub display
⑪ Low alarm status
⑫ High alarm status
⑬ Hold setting status

7-2 Key Fuction

Key	Setup mode	Measurement mode	Calibration mode
CAL	-	Enter calibration mode (5seconds)	Exit
MENU	Return	Enter setup mode	-
▲	Increase	High alarm set value display (3seconds)	Increase
▼	Decrease	Low alarm set value display (3seconds)	Decrease
ENTER	Select	Select	Select

7-3 Rear



① Relay High : High alarm output
② Relay Low : Low alarm output
③ Power : Power Supply
④ Sensor : Electrode connection
⑤ Process1 : 4~20mA Analog output for 0.00~20.00mg/L
⑥ Process2 : 4~20mA Analog output for -10 ~ 100℃(Option)
⑦ Communication
: RS-485 Communication output (Option)

8 Calibration

8-1 Calibration

The correction method of this controller is a two-point correction method and supports air correction, solution correction, and slope correction. Air correction only supports span correction, and zero correction is set automatically. When calibrating using a solution, the Zero standard solution is anhydrous sodium sulfite. Mix 15g of (Na2SO3) with 500mL of distilled water to prepare 0.2mol/L anhydrous sodium sulfite solution. For the concentration of saturated water during span correction, refer to the saturated oxygen amount table according to temperature below. Slope correction is a function that corrects the measured value by measuring the error due to the temperature change of the saturated water when the temperature change of the measured water is large.

(1atm, Salinity 0ppt)

Temp.	Saturated oxygen(mg/L)	Temp.	Saturated oxygen(mg/L)
0℃	14.62	25℃	8.26
5℃	12.77	30℃	7.56
10℃	11.29	35℃	6.59
15℃	10.08	40℃	6.41
20℃	9.09	45℃	5.93

<Saturated oxygen according to temperature>

8-2 Cautions for calibration

① In compensation mode, it does not switch to measurement mode even after several minutes have passed. To exit calibration mode, you must cancel calibration with the CAL key or complete calibration with the ENTER key.

② If the calibration mode is terminated in an abnormal way, such as turning off the power during calibration, the value being calibrated will not be saved.

③ For accurate calibration, stir the standard solution sufficiently before use.

④ Before submerging the electrode or when transferring it to a different standard solution, wash it thoroughly with fresh water or distilled water.

⑤ When calibrating using correction fluid, perform zero calibration first and then perform span calibration.

⑥ Since the measurement of dissolved oxygen is greatly affected by temperature and flow rate, accuracy can be improved only when calibration is performed under the same temperature and flow rate conditions as the flow rate at the time of measurement. If there is a large change in the temperature and flow rate of the measured water after correction, the accuracy of the measurement may decrease.

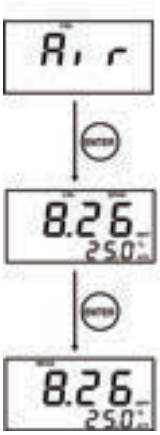
⑦ Perform Span correction using air correction and correction solution at a higher concentration than the concentration to be measured, at least 8 mg/L.
If the span correction concentration is too low, measurement accuracy may decrease.

⑧ Slope correction can only be performed with saturated water that has a difference of at least ±5.0℃ from the temperature when Span correction was performed using air correction and correction fluid.

Warning

- Do not handle calibration powder or solution used for product calibration by children or the elderly & the infirm, since it may be harmful to the human body.
  Be sure to follow the doctor's prescription when drinking it.
- When the glass electrode is broken, it may cause serious damage to the human body.
  Be careful in handling the glass electrode an check the surface of electrode by naked eye and, if there is a crack or an damage in the electrode, do not use it an discard it.
- Be sure to wear protective gear, if the measuring liquid is harmful to the human body.

8-3 Air Calibration



① Clean the electrode thoroughly with distilled water.

② Face the sensor part of the electrode downward and expose it to the air.

③ In measurement mode, press the CAL key for 5 seconds to enter compensation mode.

④ Select air calibration(Air).

※Air calibration only supports span calibration.

⑤ The current DO concentration is displayed on the main display and the current temperature is displayed on the sub display.

Refer to the 'Saturated oxygen according to temperature in 8-1' table and check whether the oxygen concentration measured by the controller matches the current temperature.

※If the current temperature and the temperature display on the controller do not match, change the temperature setting value. (Refer to 9-10 Temperature measurement value correction)

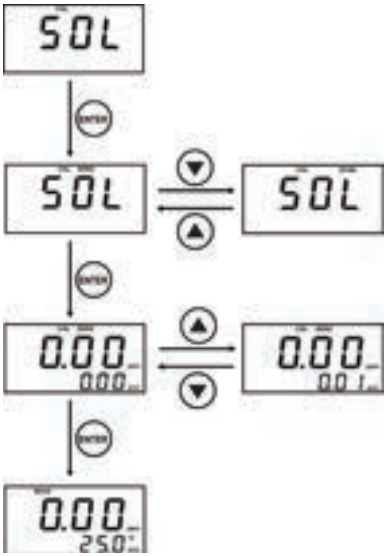
※If the oxygen level in the controller is measured too low, perform correction after cleaning and inspecting the electrode.

⑥ When the concentration of the controller becomes stable, press the ENTER key to complete the calibration.

※It may take up to 5 minutes for the concentration of the controller to stabilize.

8-4 Zero Solution Calibration

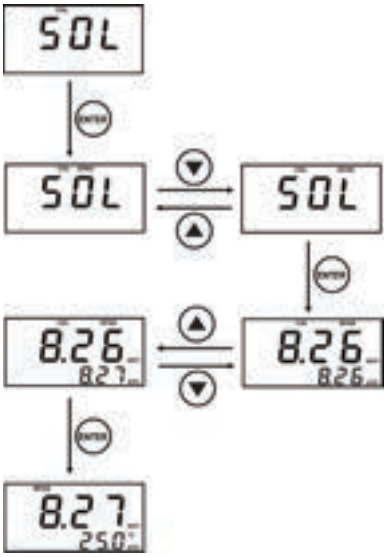
When performing zero correction using zero water, use 0.2 mol/L anhydrous sodium sulfite solution as the zero standard solution. It can be manufactured by mixing 15g of anhydrous sodium sulfite (Na2SO3) included in the set with 500mL of distilled water. When calibrating with any solution other than zero water, refer to the characteristics of that solution.



① Clean the electrode with distilled water.
② Immerse the electrode in the zero solution
③ Wait until the controller has stabilized.(It may take up to 5 minutes)
④ Check that the set temperature matches the temperature of the zero solution.
※If it is not matched, change the setting temperature.
(Refer to 9-9 Automatic temperature compensation setting, 9-10 Temperature measurement calibration)
⑤ In the measurement mode, press the CAL key for 5 seconds to enter the calibration mode.
⑥ Select solution calibration(SOL).
⑦ Select the compensation type(ZERO).
⑧ The measured DO concentration is displayed on the main display. (When using zero solution : 0.00mg/L)
⑨ The concentration to be corrected is displayed on the sub screen.
⑩ Press ENTER to complete the calibration.

8-5 Saturation Solution Calibration

When calibrating span using saturated water, prepare saturated water by injecting sufficient oxygen into distilled water. When calibrating with any solution other than saturated water, refer to the characteristics of the solution.



① Clean the electrode with distilled water.

② Immerse the electrode in the span solution(Saturation solution).

③ Wait until the controller has stabilized.(It may take up to 5 minutes)

④ Check that the set temperature matches the temperature of the span solution.

※If it is not matched, change the setting temperature.

(Refer to 9-9 Automatic temperature compensation setting, 9-10 Temperature measurement calibration)

⑤ In the measurement mode, press the CAL key for 5 seconds to enter the calibration mode.

⑥ Select solution calibration(SOL).

⑦ Select the compensation type(SPAN).

⑧ The measured DO concentration is displayed on the main display.

⑨ The concentration to be corrected is displayed on the sub display.

You can use the keys(▲,▼) to change the compensation concentration.

※When calibrating with any solution other than saturated solution,

refer to the characteristics of that solution.

⑩ Press ENTER to complete the calibration.

8-6 Slope Calibration

Please perform air correction or saturation water correction first, and then perform slope correction with saturation concentration at different temperatures.

If the error in measured values due to temperature changes in the measured water is large, accuracy can be improved through slope correction.

※ Slope correction is not required as the product is shipped with correction completed.
Proceed only if you determine that calibration is necessary.

① Clean the electrode with distilled water.

② With the sensor part facing down, expose the electrode to the air or infiltrate it into Span correction solution.

③ In the measurement mode, press the CAL key for 5 seconds to enter the calibration mode.

④ Select slop calibration(SLOP)

※Slop calibration only supports span calibration for saturated .

⑤ The current DO concentration is displayed on the main display and the current temperature is displayed on the sub display.

Refer to the 'Saturated oxygen according to temperature in 8-1' table and check whether the oxygen concentration measured by the controller matches the current temperature.

※If the current temperature and the temperature display on the controller do not match, change the temperature setting value. (Refer to 9-10 Temperature measurement value correction)

※If the oxygen level in the controller is measured too low, perform correction after cleaning and inspecting the electrode.

⑥ When the concentration of the controller becomes stable, press the ENTER key to complete the calibration.

※It may take up to 5 minutes for the concentration of the regulator to stabilize.

※Slope correction is only possible if there is a temperature difference of ±5.0℃ or more compared to the temperature when air correction or saturated water correction was completed.

If the temperature conditions are not met, error 'E.04' occurs.

9 Setting & Function

9-1 Menu setting

You can enter setup mode by pressing the MENU key in measurement mode, and can cancel the setting or return to measurement mode by pressing MENU key in setup mode. In setup mode, if there is no an keystroke for 20 seconds, return to measurement mode without any storage of the value that is being set. ENTER key must be pressed to save the setting value. The controller supports the following 10 setting functions.

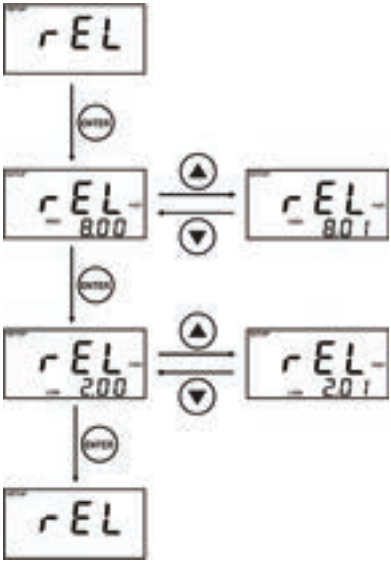
※Some functions are not supported depending on the specifications or settings of the controller.

9-2 Menu components

	9-3 Alarm setting(Relay) It sets the operation value of High, Low alarm. After setting the high alarm, you can set the low alarm. Default: High 8.00mg/L / Low 2.00mg/L
	9-4 Deadband setting It sets the range when alarm output turns OFF when ON. System errors caused by frequent ON/OFF operation of alarm output can be pevented. Default: 0.00mg/L
	9-5 Unit setting You can set the temperature unit for your convenience. Main Display: mg/L, ppm, % Sub Display: ℃, ℉, % Default : mg/L, ℃
	9-6 Damping setting Ignores small changes in the controller readings. If there is a problem in the output signal of the electrode under certain circumstances, only the amount of change over Default: 0.01mg/L
	9-7 Offset setting Increases or decreases the measured value by the set value. It is used temporarily when the measured values show a certain difference or when it is difficult to immediately proceed with the calibration. Default: 0.00mg/L
	9-8 Measurement value fixed setting(hold) The measured value is fixed at the set value. System errors can be prevented by fixing the measured values when cleaning or replacing electrodes. Default : Off

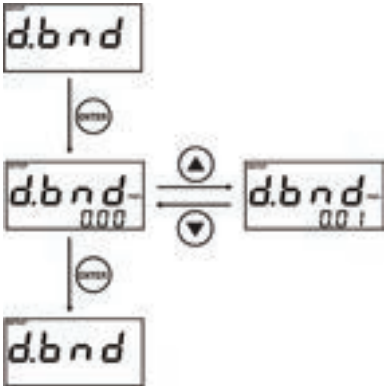
	9-9 Automatic temperature compansation(ATC) Compensates the measured value for the temperature measured by the temp sensor. Default : On
	9-10 Temperature measurement calibration If the temperature measured through the temperature compensation electrode is different from the actual temperature, it is compensated. ※It is not supported when automatic temperature compensation(ATC) is not used.
	9-11 Communication address setting Set the address of the controller for RS-485 communication. Default : 01 ※A controller without communication specification is not supported.
	9-12 Baudrate setting Set the communication Baudrate. Default : 9.6(9600bps) ※A controller without communication specification is not supported.

9-3 Alarm setting(Relay)



① rEL in setup mode is the alarm setting menu.
② When entering the setting screen, the currently set alarm value is displayed.
③ You can change the alarm setting value with the ▲,▼ keys.
(Unit: 0.01mg/L, Range: 0.00 ~ 20.00mg/L)
④ After setting the high alarm, you can set the lo alarm.
⑤ The high alarm value cannot be set lower than the low alarm value.
⑥ The low alarm value cannot be set higher than the high alarm value.
⑦ The deadband setting value is reflected in the alarm setting value. (Refer to 9-4 Deadband setting)
ex) When the deadband is set at 0.30mg/L and high alarm is set at 2.00mg/L,
low alarm cannot be set above 1.70mg/L.
⑧ Alarm ON condition
• High alarm : High alarm setting value ≤ Measured value
• Low alarm : Low alarm setting value ≥ Measured value
⑨ Alarm OFF condition
• High alarm : High alarm setting value > Measured value
• Low alarm : Low alarm setting value < Measured value
※For Deadband setting and its operation, please refer to “9-4 Deadband setting”.

9-4 Deadband setting



① d.bnd in setup mode is the deadband setting menu.

② When entering the setting screen, the currently set alarm value is displayed.

③ You can change the deadband setting value with the ▲,▼ keys.
(Unit: 0.01mg/L, Max: 1.00mg/L)

④ Finish the setting by pressing ENTER key.

⑤ The alarm will occur as shown below example.

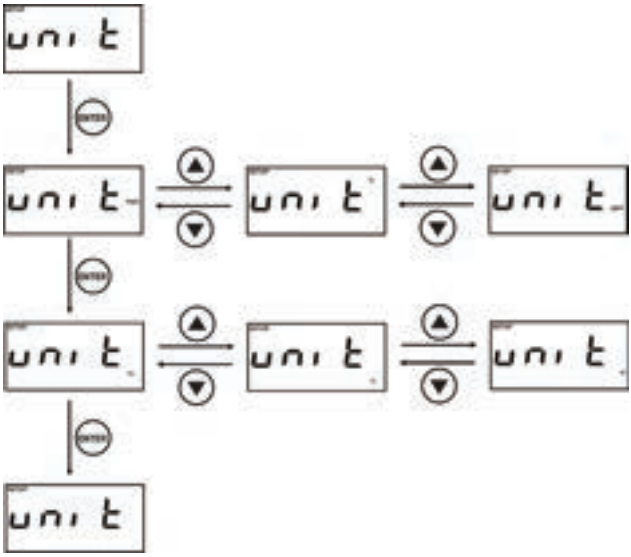
ex) When setting of 0.10mg/L

- When setting value of high alarm is 8.00mg/L
  : If measured value is 8.00mg/L or over, High alarm will occur,
  and if measured value become less than 7.90mg/L, High alarm will be off.
- When setting value of low alarm is 6.00mg/L
  : If measured value is less than 6.00mg/L, Low alarm will occur,
  and if measured value become 6.10mg/L or over, Low alarm will be off.

※Deadband setting value can not be set within the difference range of high alarm and low alarm.
(Refer to "9-3 Alarm setting")

ex) When 7.00mg/L of high alarm and 6.80mg/L of low alarm are set,
0.20mg/L or higher can not be set as deadband.

9-5 Unit setting



① unit in setup mode is the unit setting menu.

② When entering the setting screen,
the currently set unit is displayed.

③ You can change the unit setting with the ▲,▼ keys.

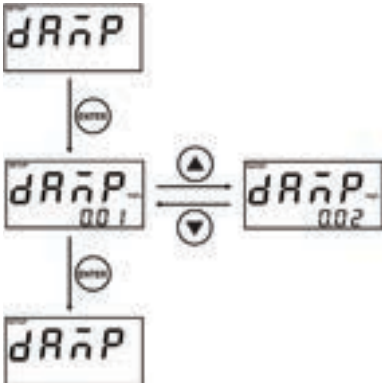
④ After setting the main dispaly unit, you can set the sub display unit setting.

- Main Display : mg/L, ppm, %
- Sub Display : ℃, ℉, %v

※If the main Display unit is set to %, the sub display unit cannot be set to %.

⑤ Finish the setting by pressing ENTER key.

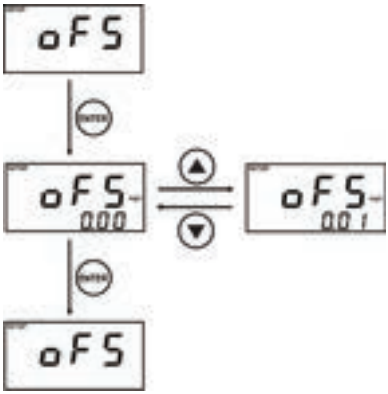
9-6 Damping setting



① dAnp in setup mode is the damping setting menu.
② When entering the setting screen, the currently set damping value is displayed.
③ You can change the damping setting value with the ▲,▼ keys.
(Unit: 0.01mg/L, Max: 1.00mg/L)
④ Finish the setting by pressing ENTER key.

ex) When setting of 0.50mg/L
A change of ±0.05mg/L or more from the value currently displayed on the display must be detected to be reflected on the display.

9-7 Offset setting



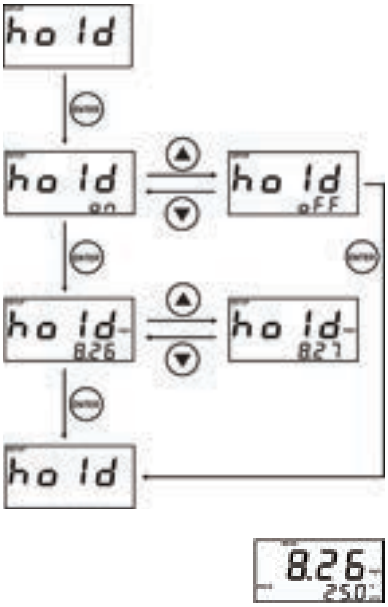
① oFS in setup mode is the offset setting menu.

② When entering the setting screen, the currently set offset value is displayed.

③ You can change the offset setting value with the ▲,▼ keys.
(Unit: 0.01mg/L, Range: -1.00 ~ 1.00mg/L)

④ Finish the setting by pressing ENTER key.

9-8 Measured value fixed setting



① Hold in setup mode is the measurement value fixed setting menu.

② Enter the setting screen and select whether to set the measurement value fixed.

③ You can change ON/OFF with ▲,▼ keys

④ When selecting off, the setting is immediately completed.

⑤ When selecting on, the value to set is displayed.

⑥ You can change the hold setting value with the ▲,▼ keys.
(Unit: 0.10mg/L, Range: 0.00~20.00mg/L)

⑦ Finish the setting by pressing ENTER key.

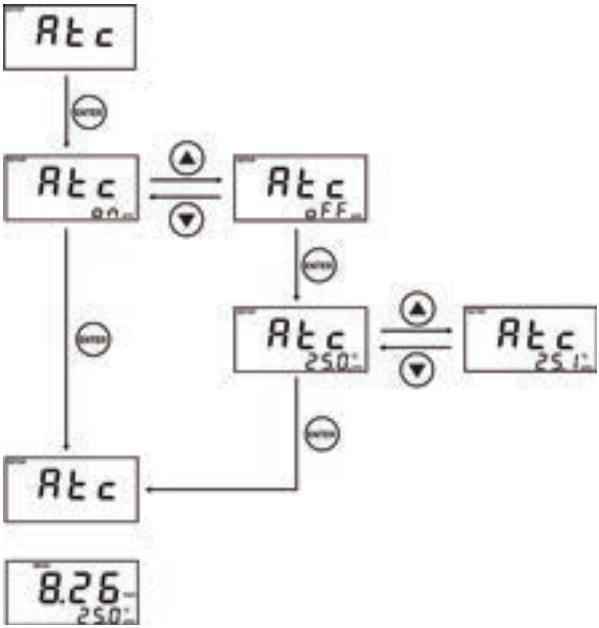
⑧ The measured value is displayed as the setting value and HOLD status is displayed.

※If the hold setting value is higher than the setting value of HIGH Alarm
or lower than the setting value of LOW Alarm, alarm will occur, but it will be not effected by Dead band.

※It is impossible to enter the calibration mode, when the measured value is hold state.

9-9 Automatic temperature compensation(ATC)

/ Manual temperature setting



① ATC in setup mode is the Automatic temperature compensation(ATC) setting menu.

② Enter the setting screen and select whether to set the ATC.

③ You can change ON/OFF with ▲,▼ keys

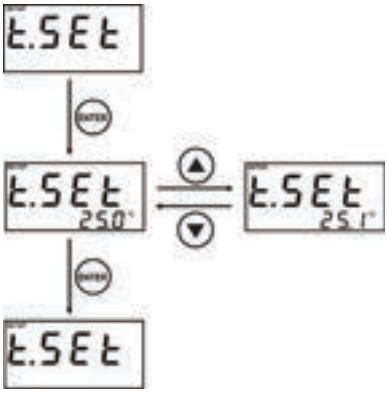
④ When selecting on, the setting is immediately completed and ATC status is displayed in measurement mode.

⑤ When selecting off, set the temperature by manual.

⑥ You can change the temperature value with the ▲,▼ keys.
(Unit: 0.1℃, Range: 0.0 ~ 100.0℃)

⑦ Finish the setting by pressing ENTER key.

9-10 Temperatuer measurement calibration



① t.SEt in setup mode is the temperature measurement calibration menu.

② When entering the setting screen, the currently measured temperature is displayed.

③ Change the measured temperature to the actual temperature with the ▲,▼ keys.

④ Finish the setting by pressing ENTER key.

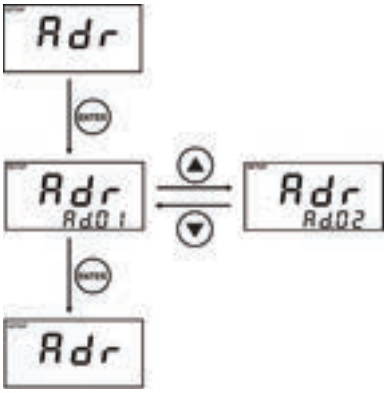
※It works only when automatic temperature compensation setting is on.

※If the temperature sensor is not connected, it will not work.

※The temperature sensor built into the electrode is a heat conduction type, so it may take up to 30 minutes for the temperature measurement to stabilize.

Also, perform temperature measurement value correction when the temperature measurement value of the controller is stable.

9-11 Communication address setting



① Adr in setup mode is the communication(RS-485) address setting menu.

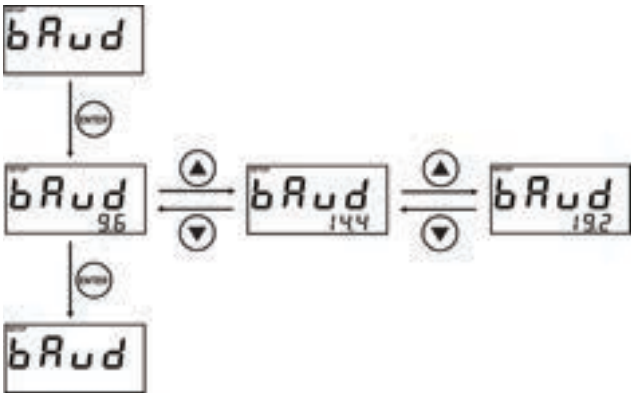
② When entering the setting screen, the currently set address is displayed.

③ You can change the address with the ▲,▼ keys.
(Range: 1 ~ 32)

④ Finish the setting by pressing ENTER key.

※A controller without communication specification is not supported.

9-12 Baud Rate Setting



① bAud in setup mode is the communcation(RS-485) baudrate setting menu.

② When entering the setting screen, the currently set baudrate is displayed.

③ You can change the baudrate with the ▲,▼ keys.
(9.6: 9600bps, 14.4: 14400bps, 19.2: 19200bps)

④ Finish the setting by pressing ENTER key.

※A controller without communication specification is not supported.

10 Communication Protocol

10-1 Communication Type

1)Channel : RS-485(Multi Drop)
2)Baudrate : 9,600bps(Default), 14,400bps, 19,200bps
3)Transmission : Half-Duplex
4)Protocol : Modbus RTU

10-2 Character Form

1)Character composition
- 0 Start bit
- 8 Data bit (LSB First)
- No Parity bit
- 1 Stop bit

2)Bit Sequence

Start	Data (8bit)								Stop
Bit	D0	D1	D2	D3	D4	D5	D6	D7	Bit
0	x	x	x	x	x	x	x	x	1

10-3 Frame

1)Frame construction
- Each area of the message is called a Field and consists of four fields.

①Address field : 8bit
②Function Code field : 8bit
③Data field : N x 8bit
④CRC(Error Check)field : 16bit

Message				
Slave Address	Function Code	Data	CRC Low	CRC High
8bit	8bit	N x 8bit	8bit	8bit

2)Frame division

- Frames are classified by a waiting time of at least 3.5 character time after transmission of the last character of the frame, and if a new character is received within 3.5 character time, it is judged as a continuation of the frame being transmitted.
- The frame string must be transmitted continuously, and if a waiting time of 1.5 Character time or more occurs between each character, it is judged as an incomplete message and the receive buffer is initialized.

3)Character time (Baud Rate : 9600bps)

- 1Character : 1.04ms
- 3.5Character : 3.64ms

10-4 Field

1)Address field

- In the frame sent by the Master (PC), it is the address of the Slave (controller) to communicate with, The frame sent by the Slave is its own address.
- The address setting of the controller can be set in the Adr item of the menu function. When entering the menu, Ad.01 (initial value) is displayed on the controller screen, and addresses 1 to 31 can be changed with the ▲ and ▼ keys.
  ※It must be saved with the ENTER key, and if there is no key operation for 20 seconds, the setting is terminated without saving.
- The address cannot be changed by any method other than controller operation.

2)Functioin Code field

- Select the type of function to request from the Slave. (Only two functions are supported.)
  ①Register read : 0x03
  ②Register write : 0x06
- If the Master's request is normal, the same function code as the requested function code is returned.
- If the master's request is abnormal, an error response is made by setting the first bit of the requested function code to 1.
  ex) Error respond to 0x03 : 0x83
  Error respond to 0x06 : 0x86

3)Data field

- It consists of the address, number, and data of the register, and the composition of the data field varies depending on the requested function code and response type.
  ①Register read request : Register address to start reading, number of registers to read
  ②Register read respond : Number of byte, data
  ③Register write request, respond : Register address to write, data value to write
  ④Error respond : Exception Code
- All data is composed of 2Byte (16bit) signed Integer type and has a value of '-32768 ~ 32767'.

• In case of negative number, it is treated as a complement and displayed.
(Refer to “7.Data Conversion”.)
• All data are processed as integers without distinction of decimal point and transmitted.
For information on decimal point, refer to “10-7. Data conversion” to convert data.
(Data of 50 and 5.0 are treated as 50 and transmitted in the form of 0x0032.)

• Example of data construction

① 14.00(Decimal)

Data (High)	Data (Low)
0x05	0x78

② -20(Decimal)

Data (High)	Data (Low)
0xFF	0xEC

4)CRC(Error Check) field

- The CRC field consists of 2 bytes, and the transmission order is the lower 1 byte and the upper 1 byte.
- CRC check method is CRC16 (Modbus).
- For how to create CRC16, refer to “10-10.CRC16 creation method”.

10-5 Register Map

Register Address	Contents	Write / Read	Value		Report
0x0001	Controller Status	Read	0x0101		pH measurement mode
			0x0102		ORP measurement mode
			0x0103		RC measurement mode
			0x0104		DO measurement mode
			0x0105		EC measurement mode
			0x0110		Calibration mode entry state
			0x0120		Setup mode entry state
			0x0191		ERROR1 occur
			0x0192		ERROR2 occur
			0x0193		ERROR3 occur
0x0002	Alarm Status	Read	0x0200		No alarms occurred
			0x0201		High alarm occur
			0x0202		Low alarm occur
0x0003	Meas Data	Read			Measured concentration value
0x0004	Temp Meas Data	Read			Measured temp. value
0x0005	High Alarm Data	Write / Read			High alarm set value
0x0006	Low Alarm Data	Write / Read			Low alarm set value
0x0007	Unit	Read	High Byte	0x80	Main unit mV
				0x40	Main unit pH
				0x20	Main unit %
				0x10	Main unit mg/L
				0x08	Main unit ppm
				0x04	Main unit mS
			Low Byte	0x80	Sub unit ℃
				0x40	Sub unit ℉
				0x20	Sub unit %
0x0008	Dead Band	Write / Read			Dead Band set value
0x0009	Offset	Write / Read			Offset set value
0x000A	Damping	Write / Read			Damping set value

10-6 Write data input range

1)pH

High Alarm (0x0005)	Low Alarm (0x0006)	Dead Band (0x0008)	Offset (0x0009)	Damping (0x000A)
0 ~ 14.00	0 ~ 14.00	0 ~ 1.00	-1.00 ~ 1.00	1 ~ 1.00
0x0000 ~ 0x0578	0x0000 ~ 0x0578	0x0000 ~ 0x0064	0xFF9C ~ 0x0064	0x0001 ~ 0x0064

2)ORP

High Alarm (0x0005)	Low Alarm (0x0006)	Dead Band (0x0008)	Offset (0x0009)	Damping (0x000A)
-1999 ~ 1999	-1999 ~ 1999	0 ~ 100	-100 ~ 100	1 ~ 100
0xF831 ~ 0x07CF	0xF831 ~ 0x07CF	0x0000 ~ 0x0064	0xFF9C ~ 0x0064	0x0001 ~ 0x0064

3)RC

High Alarm (0x0005)	Low Alarm (0x0006)	Dead Band (0x0008)	Offset (0x0009)	Damping (0x000A)
0 ~ 4.00	0 ~ 4.00	0 ~ 1.00	-1.00 ~ 1.00	0 ~ 1.00
0x0000 ~ 0x0190	0x0000 ~ 0x0190	0x0000 ~ 0x0064	0xFF9C ~ 0x0064	0x0000 ~ 0x0064

4)DO

High Alarm (0x0005)	Low Alarm (0x0006)	Dead Band (0x0008)	Offset (0x0009)	Damping (0x000A)
0 ~ 20.00	0 ~ 20.00	0 ~ 1.00	-1.00 ~ 1.00	0 ~ 1.00
0x0000 ~ 0x07D0	0x0000 ~ 0x07D0	0x0000 ~ 0x0064	0xFF9C ~ 0x0064	0x0000 ~ 0x0064

5)EC

High Alarm (0x0005)	Low Alarm (0x0006)	Dead Band (0x0008)	Offset (0x0009)	Damping (0x000A)
0 ~ 20.00	0 ~ 20.00	0 ~ 1.00	-1.00 ~ 1.00	0 ~ 1.00
0x0000 ~ 0x07D0	0x0000 ~ 0x07D0	0x0000 ~ 0x0064	0xFF9C ~ 0x0064	0x0000 ~ 0x0064

10-7 Data transfomation

1) Dot Position

	pH	ORP	RC	DO		EC
				ppm	%	
Meas Data (0x0003)	2	0	2	2	1	2
Temp Meas Data (0x0004)	1	None	None	1		1
High Alarm Data (0x0005)	2	0	2	2	1	2
Low Alarm Data (0x0006)	2	0	2	2	1	2
Dead Band (0x0007)	1	0	1	1		1
Offset (0x0008)	1	0	1	1		1
Damping (0x0009)	1	0	1	1		1
Temp Offset (0x000A)	1	0	None	1		1

2) Negative Number

- 65536 + Negative Number = Data

ex) -50

65536 + (-50) = 65486 (0xFFCE)

10-8 Request and response format

1)Read request

- Read consecutive registers of the requested quantity
- Fuction code 0x03
- Start address of register to read -1
- The number of registers to read
- Ex) Request the register value of 0x0003 ~ 0x0007 of Controller 1

Slave Address	Function Code	Starting Address (High)	Starting Address (Low)	No. Of Register (High)	No. Of Register (Low)	CRC (Low)	CRC (High)
0x01	0x03	0x00	0x02	0x00	0x05	0x24	0x09

2)Read response (normal response)

- Number of data bytes
- Data in the requested register
- Ex) Response to the above read request example
  pH: 11.40, Temp:25.0, High Alarm: 9.00, Low Alarm: 4.00, Main unit: pH, Sub unit: ℃

Slave Address	Function Code	Byte Count	Value (High)	Value (Low)	Value (High)	Value (Low)	Value (High)
0x01	0x03	0x0A	0x04	0x74	0x00	0xFA	0x03

Value (Low)	Value (High)	Value (Low)	Value (High)	Value (Low)	CRC (Low)	CRC (High)
0x84	0x01	0x90	0x40	0x80	0xA9	0xF2

3)Write request

- Write a value to one register
- Function code 0x06
- Address of register to be written -1
- Ex) Write the value of 0x0320 (Relay High: 8.00) to the register of 0x0005 of controller address 1.

Slave Address	Function Code	Starting Address (High)	Starting Address (Low)	Value (High)	Value (Low)	CRC (Low)	CRC (High)
0x01	0x06	0x00	0x06	0x03	0x20	0x68	0xE3

4)Write respond

- Respond with the same data as the write request

10-9 Error respond

1)Function Code

- Response by setting the first bit of the requested function code to 1
- Read error 0x83
- Write error 0x86

2)Exception Code

- Information on what kind of error occurred
- 0x01 : Use of unsupported function code
- 0x02 : Register address is invalid
- 0x03 : Invalid data entry

10-10 How to create CRC16

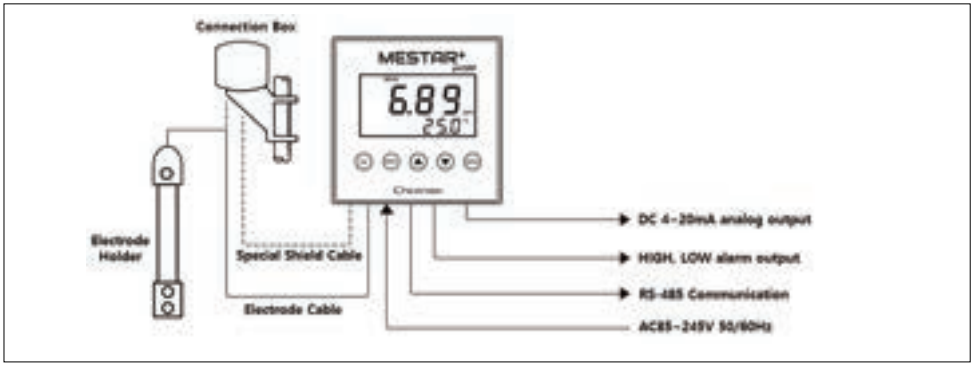
1)Load 0xFFFF into 16Bit register (CRC register).
2)XOR the lower byte and data (8Bit) of CRC register and save the result in CRC register.
3)Shift the CRC register to the right (LSB direction) by 1 bit and check the LSB.
4)If LSB is 0, repeat step 3.
If LSB is 1, XOR the CRC register and 0xA001 and store the result in the CRC register.
5)Repeat steps 3 and 4 8 times.
6)Repeat items 1 to 5 as many as the number of bytes in the frame except for CRC 2Byte.

10-11 CRC16 Program example

```
crc16_check(num)
{
    int I, j;
    uint crc_sum=0xffff, carry=0;
    for(i=0; i<num; i++)
    {
        crc_sum = plc_rbuffer[i] ^ crc_sum;
        for( j=0; j<8; j++)
        {
            carry = crc_sum & 0x01;
            crc_sum = crc_sum >> 1;
            if(carry == 1) crc_sum = crc_sum ^ 0xA001;
        }
    }
    sum[0] = crc_sum & 0xff;
    sum[1] = crc_sum >> 8;
    if(sum[0] == plc_rbuffer[num]) return(true);
    else return(false);
}
```

11 System Diagram

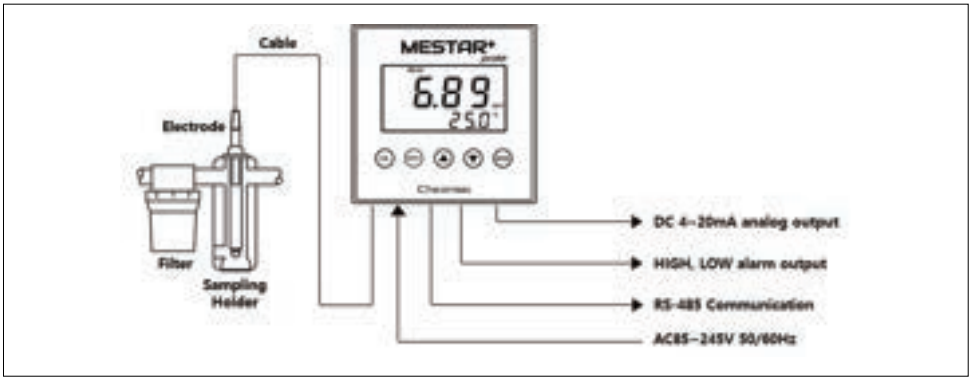
11-1 Electrode holder type



※The electrode holder is provided as components when purchasing a standard set.

※As the number of connections using the connection box increases, the signal sensitivity of the electrode may decrease. Use the connection box to a minimum and install the special shield cable within a maximum length of 100m.

11-2 Sampling holder type



※The sampling holder is sold separatly.

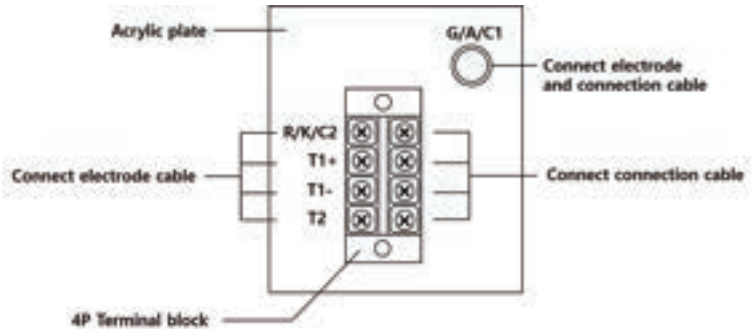
※※When purchasing the sampling holder, please refer to the separate sampling holder instruction manual.

12 Handling of Components

※※This manual describes only the handling for the standard set components.

12-1 Wiring of connection box

Be careful not to change the wiring, since the connection of the electrode and the connecting cable must match each other at the terminals inside the connection box.



<Temp. Compensation Type 5P>

Caution

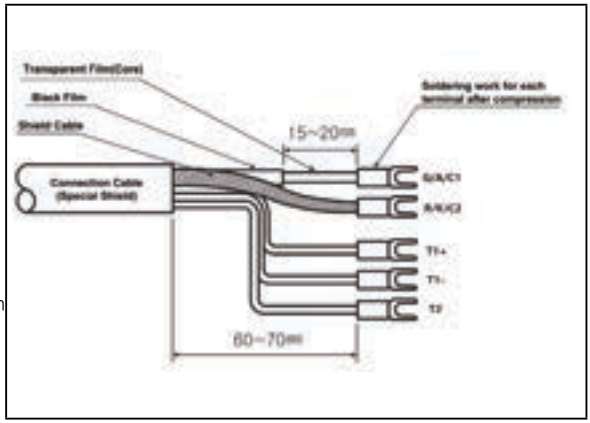
- Do not install controller in the heavy moist, dust or vibration place. The connection may be poor.
- Do not install this connection box at the place where corrosive gas is generated.
- Turn off power before repair & maintenance.
  It may cause a damage of controller by static electricity.

12-2 Termination method of connection cable(for Temp. compensation)

①Remove the external film & the internal black film as beside figure and solder the Y terminal after compressing the Y terminal(1.5-3Y) to the cable.

②Wrap it with tube or tape after soldering. Specially, wrap shield cable of R terminal with shrink tube(Φ2.0) or tape in order to prevent its exposure.

③When moving external film & internal black film, be careful that transparent film (G/A/C1) don't be damaged and, if the transparent film is damaged, rework after cutting the damaged part.



Terminal name	G/A/C1	R/K/C2	T2	T1	T1
Cable color	Transparent	Shield	Whtie	Red	Yellow

⚠ Caution

- Remove black film as above figure certainly.
  If not removed, G/A/C1 terminal and R/K/C2 terminal will be short state, can not measure.

12-3 Electrode component

①Membrane ②DO Electrode ③injection port Stopper ④Membrane(Spare) ⑤Internal Liquid 30mL(0.5M NaOH)

12-4 Electrode internal liquid injection method

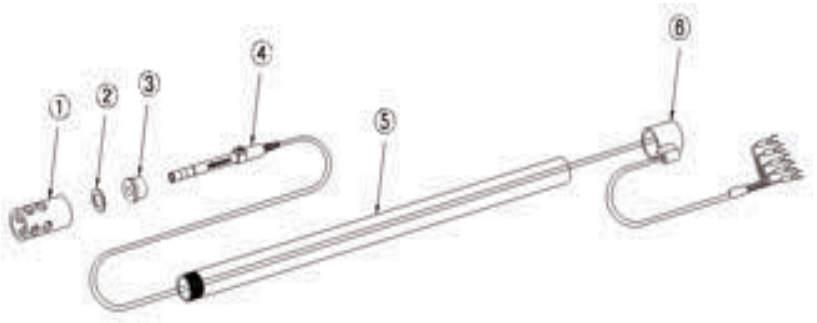
	• Remove the membrane of the electrode. • Because it is threaded, it can be removed by turning it by hand.
	• Fill the membrane with about 2/3 of the internal liquid (0.5M NaOH).
	• Assemble the membrane to the electrode. • Do not completely tighten the membrane, but allow the internal liquid to flow out through the assembly gap.
	• Open the internal fluid injection port using a minus (-) screwdriver. ※Be careful not to lose the O-ring of the inlet stopper.
	• Put the internal liquid through the internal liquid injection port until it flows out through the gap in the membrane assembly. • When internal fluid injection is complete, completely close the membrane and internal fluid injection port.

⚠ Caution

- Be careful not to apply excessive force when handling as the product may be damaged and the handler may be injured.
- If you have sensitive skin or have a wound on your hand, wear chemical gloves when injecting internally before handling.
- If skin contact with the internal fluid causes skin rash, itchiness, pain, etc., immediately rinse with clean water.
- The liquid inside the electrode may be harmful to the human body, so do not drink it and do not allow the elderly or children to handle it.

※ If symptoms such as skin rash persist after drinking or handling the internal liquid, be sure to seek medical advice.

11-5 Electrode holder SET components



①Protection tube ②Washer(P.E) ③Rubber packing ④DO Electrode ⑤Electrode holder ⑥Rubber stopper

11-6 Installation method of electrode & electrode holder

	• Turn the electrode protection tube at the bottom of the electrode to open it.
	• Insert the electrode from the top of the electrode pipe and pull it out from the bottom.
	• Separate the membrane of the electrode.
	• Insert the electrode into the hole of the rubber packing. At this time, watch the direction of the rubber packing carefully and be careful not to insert it in the opposite direction.

	• Fill the electrode with internal liquid (0.5M NaOH). ※Refer to "12-4 Electrode internal liquid injection method"
	• Assemble the electrode on which the internal fluid injection has been completed. • Insert the rubber packing combined with the electrode onto the electrode.
	• Put a washer (P.P) on the rubber packing.
	• Assemble the protective tube to fix it.
	• The top of the electrode is covered with a rubber stopper to prevent foreign substances from penetrating into the electrode. ※It is convenient when replacing electrodes to loosen the electrode cable inside the electrode rod rather than tighten it.

⚠ Caution

• Be careful not to apply excessive force when handling the electrode. if the glass electrode is broken by excessive force, it may cause injury.

13 Cause & Solution of Problem

Item	Problem	Number of Cause & Solution
A	E.01 on screen (Electronic circuit board is not connected)	1, 2
B	E.02 on screen (Electrode is not calibrated)	3, 4
C	E.03 on screen (Electrode signal error)	3, 4, 5
D	Reading on screen is not changed	3, 4, 5, 6, 7
E	Measuring is difficult reading is not steady	3, 5, 6, 7
F	There is a big difference from the temperature indication	8,9

No.	Cause	Solution
1	Faulty circuit board connection	Repair the controller
2	Damaged circuit board	Repair the controller
3	Damaged electrodes & Electrode's aging	Exchange electorde
4	Shortage of electrode solution	Supplement of internal liquid
5	Fault of liquid to be measured	Connecting terminal after removing obstacle
6	Poor quality of the measuring liquid	Exchange the measuring liquid
7	The fluid velocity of liquid to be measured is not steady	Makes the fluid velocity steady
8	Temperature sensor calibration required	Performs temperature measurement value correction function of set item
9	Faulty or bad temperature compensation circuit	Temperature compensation PCB replacement

14 Warranty

Caution

- If the product is reconstructed arbitrarily or the undesignated parts are used into the product, CHEONSEI will not warrant and CHEONSEI is not responsible for any expense caused by accident or trouble

① The warranty period of the product is 1 year from the date of sale.

② During the warranty period, we can repair or replace free of charge in case of failure or damage due to problems in our design and manufacturing.

③Repair or replacement in the event of failure or damage due to the following causes will be charged regardless of the warranty period.

1)Failure and damage after the warranty period has expired

2)Problems in use due to careless handling

3)Failure and damage caused by using parts other than those specified by our company or by arbitrarily remodeling

4)Failure and damage caused by repairs or remodeling other than our company or our designated contractor

5)Failure and damage due to force majeure such as fire or natural disaster

15 Repair Service

Caution

- When the product is sent to factory for repair service, do not damage during transport. Also, please make sure that bolts and other components are securely fastened in order not to loss it.

① Contact to CHEONSEI or local agent as shown on back of the manual, if you have any problem or questions.

② If you want to repair, please inform the following.

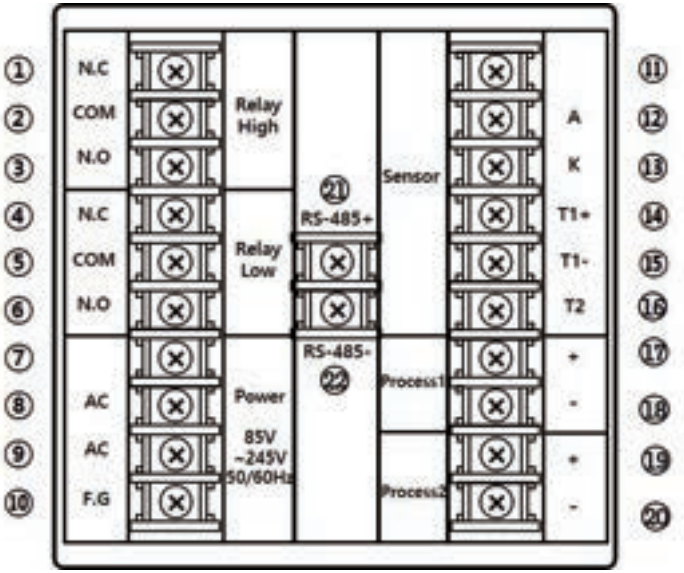
1) Model Name & manufacture number written in name plate

2) Used period, using condition & state

③ If warranty period is over, it may charge according to repair part.
Please contact with sales agent for more information.

④ Minimum retention period of parts for repair is 5 years from the date of production.

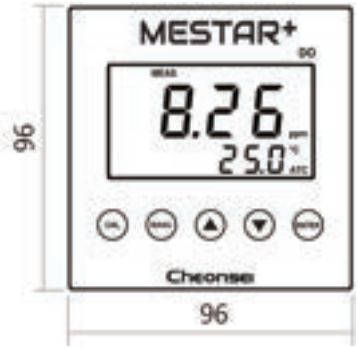
16 Repair Service



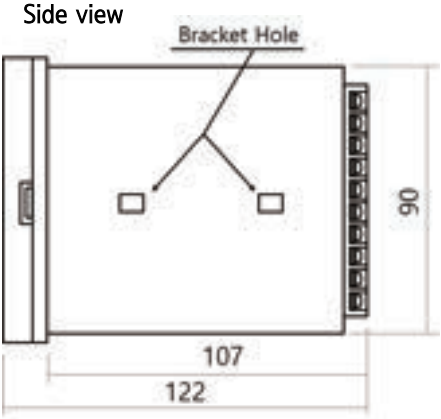
1)HIGH Alarm N.C
2)HIGH Alarm COM
3)HIGH Alarm N.O
4)LOW Alarm N.C
5)LOW Alarm COM
6)LOW Alarm N.O
7)None
8)AC Power input
9)AC Power input
10)F.G(Frame Ground)
11)None
12)Electrode A
13)Electrode K
14)Electrode T1+
15)Electrode T1-
16)Electrode T2
17)DO Analog Output +
18)DO Analog Output -
19)Temp Analog Output +
20)Temp Analog Output -
21)RS-485 +
22)RS-485 -

17 Controller Dimension

Front view

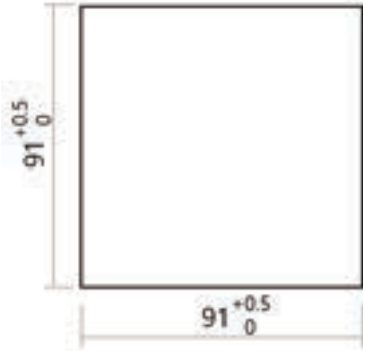


Side view



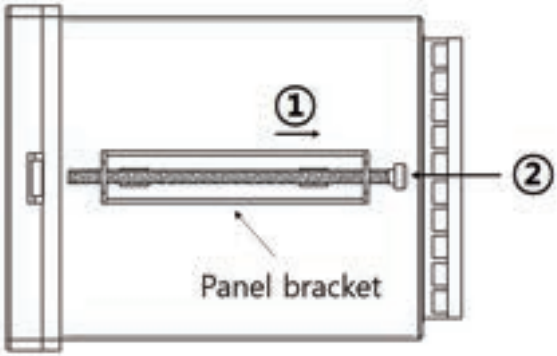
Rear view

Panel Cutout



18 Controller Installation

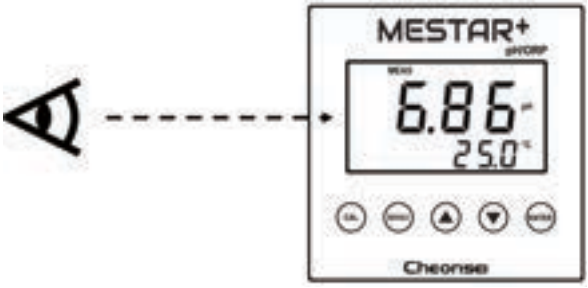
18-1 Panel bracket fixed



1)Insert the panel bracket into the panel bracket mounting holes on both sides of the controller and insert in the direction of ①.

2)Tighten the support bolt in the direction of ② to fix it.

18-2 Installation height



Caution

- Install the controller screen so that it is level with the eye level.
- The controller screen is an LCD type, so if you do not look directly at the screen, visibility is reduced.

Cheonsei
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