# SPECIFICATION SHEET

## Lift-up immersion type · water sampling Type MA pH METER WITH AUTOMATIC CALIBRATION FUNCTION

MAC-1600

The MAC-1600 is a field-installation pH meter that automates electrode cleaning and two-point calibration using JIS standard solutions.

In addition to reducing troublesome maintenance work, it is possible to measure pH with high reliability over a long period of time.

In addition to the 2-channel measurement function, which controls two detectors with a single converter, it can be used for pH control or monitoring in various plant facilities

## Features

## 1. Labor saving in maintenance work

Clean the electrodes and calibrate the standard solution periodically. This helps to save labor for maintenance work. It also greatly reduces the burden of maintenance work in hazardous locations and locations with poor environments.

### 2. Reliable pH measurement

Automatically performs two-point calibration with JIS-standard solution pH7 and pH4 or pH9. Since it is performed with high accuracy, stable and reliable pH monitoring and pH control can be continued for a long period of time.

#### 3. Supports 2-channel measurement (optional)

By simultaneous measurement of two channels connecting two detectors (including the liquid feed control unit) measurement without missing is possible even during calibration and cleaning. The automatic transmission output switching function is effective for the same sample measurement.

- Fixed ch1 preferred (automatically switched to ch2 during cleaning and auto calibration.)
- (2) Fixed ch2 preferred (automatically switched to



ch1 during cleaning and auto calibration.)

- (3) Alternate switching (priority output of the channel that was last cleaned and calibrated)
- (4) Electrode performance priority (Electrode soundness is compared every calibration, and good channel is given priority output)

### 4. Three types of electrode variations

In addition to the 5600 series electrodes, which have been proven in the past, tip replaceable electrodes and digital electrodes (CALMEMO-pH), has been included to the lineup. The optimum pH electrode can be selected according to maintainability and site conditions.

## 5. Lift-up type aerial jet cleaning with high cleaning efficiency

The electrode holder is pulled up from the sample water by an air cylinder. The water is released and high-pressure wash water is injected into the electrode sensitive part in the air. It is a cleaning method with low pressure loss and high jet effect. In addition, since the chemical solution does not come into contact with the sample water in the same way, there is no concern of a decrease in the effect due to dilution.



### **Configuration Diagram**

#### 6. Simple and reliable lift-up airborne calibration

Following automatic cleaning, in the same manner in the air, two types of pH standard solutions are sequentially washed. Feed liquid to the electrode sensitive part and contact it with the number. Since there is no risk of contamination with sample water or washing water (chemical liquid), stable and reliable automatic calibration can be performed in a short time (about 10 minutes). In addition, the time required for interchangeable-tip electrodes and CALMEMOpH electrodes can be reduced by approximately three minutes.

#### 7. Appropriate and practical self-diagnosis message

If calibration is impossible or an electrode is damaged, it outputs collective signal as "instrument failure." At this time, 18 types of error messages on the instrument can be corrected properly. In addition, three types of alarm signals are output as "maintenance required" when electrode fouling, standard solution shortage, or cleaning chemical shortage occurs, so appropriate maintenance can be performed when necessary.

#### 8. Remote functions for plant automation

Automatic cleaning and calibration can be started with the calendar timer in the instrument. It can be performed with a start signal from the control room and outputs an answer signal during cleaning or calibration. In addition, it is possible to issue a directive for the standby operation to lift up the electrode so that it will not get dirty when the plant stops, and it outputs an answer signal during standby.

## 9. Holder washing function

Holder cleaning function allows chemical cleaning of electrode holder as well as the electrode.

## **Standard Specification**

Product Name	: pH meter type with automatic calibration function		Non-voltage "Closed" contact is output when alarm message A4 occurs.
Model	: MAC-1600		Cleaning solution shortage signal;
Measurement object	t: pH of solution (hydrogen ion concentration)		no-voltage "Close" contact is output
Measurement metho	d: Glass electrode method		when alarm message A5 occurs
Measuring range	: pH -1.00 to 15.00		Contact capacity; AC 250V 1A, DC 30V
0 0	(mV; -800.0 to 800.0 temperature; -5.0		1A resistive load
	to 105.0°C)	Control contact	: Automatic calibration start signal;
Display	: Liquid crystal digital (with backlight)	input	Calibration starts with "Closed" contact
	Minimum display 0.01pH		input of 100 mS or more
	(Temperature; 0.1 mV;0.1)		Automatic cleaning start signal;
Analogue output	: DC 4 ~ 20mA I/O isolation type,		Cleaning starts with "Closed" contact
	2-output load resistor $650\Omega$ or less		input of 100 mS or more
	Output width arbitrarily set;		Standby command signal; standby
	pHAt least 5pH wide in 0.01pH units		operation with no voltage status
	(Set to 0.00 to 14.00 at shipment)		"Closed" contact input
	TemperatureAt least 40°C wide in	Control contact	: Calibration in progress signal;
	0.1°C unit	output	no-voltage "Close" contact is output
	(Set to 0.0 to 100.0°C at shipment)		during automatic calibration
	Output hold setting; Transmission		Cleaning in progress signal; outputs
	output of last value or arbitrarily value		no-voltage "Close" contact during
	is set to hold at automatic cleaning,		automatic cleaning.
	automatic calibration, or maintenance		Standby (maintenance in progress)
	(standby) mode (set to hold		signal; no-voltage "close" contact is
	immediately before at shipment)		output during standby mode
Digital-output	: RS-485 (insulation type), Modbu(s		(maintenance mode in progress)
	RTU)		Contact capacity; AC 250V 1A, DC 30V
Alarm contact	: Instrument failure signal; error		1A resistive load
output	messages E1 to E42	Electric power	: AC 100 to 240V±10% 50/60Hz
	Outputs no-voltage "Closed" contact	Source	Power consumption; 1 channel
	when it occurs		AC 100V approx. 10VA, approx. 30VA
	Power-off signal; no-voltage "Close"		at auto calibration
	contact at detection output.		AC 240V approx. 15VA, approx. 35VA
	Electrode alarm signal; no-voltage		at auto calibration
	"Close" contact is output when alarm	Features	: Linearity; ±0.03pH (at equivalent input)
	message A1, A2, A3, A6 occurs.		Repeatability; ±0.02pH (at equivalent
	Standard solution shortage signal;		input)

Temperature compensation range	: 0 to 100°C (temperature characteristics of the glass electrode are automatically compensated in combination with the temperature compensation electrode)
Automatic calibration method	<ul> <li>temperature compensation electrone)</li> <li>Lift-up type standard liquid drip calibration</li> <li>Calibration point; 2 points (JIS standard solution used for pH7 and pH4 or pH9)</li> <li>Calibration cycle; 0 to 240 hours (set to 48 hours when shipped).</li> <li>Set the Year/Month/Day of calibration</li> <li>Calibration time; Approximately 7 to 10 minutes (when the pH electrode characteristics are normal) Calibration solution tank capacity; 2 pieces of 5 L tank</li> <li>(Supply cycle; Approximately every other day per month of automatic calibration)</li> </ul>
Automatic cleaning method	: Lift-up type water / chemical jet intermittent cleaning Cycle; 0 to 24.0 hours (installed at 6.0 hours when shipped) Set the Year/Month/Day of cleaning Cleaning time; Approx. 4 minutes Chemical solution for cleaning; 5% hydrochloric acid Tank capacity; 20 L Consumption; Approx. 100mL/1 time
Standby action	: Lift-up type intermittent water injection (Prevents electrode fouling and dryness) Command method; manual (field) or remote Water injection cycle; 1 to 180 minutes (set to 10 minutes when shipped)
Combination pH electrode	5600 type (standard) or 5601 type with 5m lead wire
(Specified at shipment)	GSS-314B type (tip replaceable) with 5m lead wire ELP-103 type (CALMEMO-pH) Digital ample cable with ELW-072 type lead wire of 5m
Sample Water pH Temperature	Compensate pH values for sample water with a known pH temperature
Compensation	coefficient Temperature compensation range; 0 to 100°C Converted temperature 25°C Temperature coefficient setting range; -0.100 to +0.100 pH/°C
Structure Production	: IP54 (JIS C 0902 dust-proof type) In the case of outdoor installation, rain- proof and sun-proof measures (roof) are
Mounting	: Operating display/liquid feed control; 50A pole or wall/rack mounting Detector; 50A pole or flange-mounted immersion type, flange-connected water sampling type

Material Quality	: Operation display; Aluminum casting Liquid feed control unit; SPCC Detector; SUS304_PVC_polypropylepe
Painting Color	<ul> <li>Operation display; Metallic silver Liquid feed control unit; Munsell 5Y7/1</li> </ul>
Supply air	: Instrument air
	Pressure; 0.2 to 0.7MPa
	Consumed; Approximately 20L/
	cleaning and calibration
	Port; Rc 1/4 (with air filter)
Supply washing	: Tap water (industrial water is allowed)
water	Pressure; 0.2 to 0.5MPa
	Consumed; 10 to 20L/ wash and calibration
	Connecting port; Rc 1/2 (provided with
	Y type strainer 40 mesh)
Cable connection	Cable gland for O.D. 6 to 12mm 5 pcs.
port	(Wire conduit connecting screw G 1/2
	when cable gland is removed)
Sample water	: Temperature; 0 to 60°C (up to 80°C for
conditions	high temperature specifications)
	Pressure; Atmospheric pressure
	Flow velocity; 1 m/sec or less
	Electrical conductivity; 10 mS/m
	(100µS/cm) or more Ambient
Temperature/	: 0 to 50°C 95%RH or less (no
humidity	condensation)
Mass	: Operation display; Approx. 2.6kg
	Liquid feed control unit; Approx. 23kg

Operation display; Approx. 2.6kg
 Liquid feed control unit; Approx. 23kg
 Cleaning unit; Approx. 3.8kg
 Detector (Type A); approx. 6kg

Option	
Sunshade	: Prevents overheating inside the
	transducer and liquid feed section due
	to direct sunlight in the case of outdoor open-air installation
Chemical tank cover	: Prevents deterioration of polyethlene
	tank caused by ultraviolet rays.
	The liquid feed tube is also a PFA tube
	with excellent weatherability.
Soda lime unit	: When using pH9 reference solution for
	span calibration it prevents oxidization
	due to airborne CO <sub>2</sub> .
Standard Solution	: Warms the standard solution in the
Heating Unit	liquid feed section in winter to
	maintain high calibration accuracy.
Mounting bracket	: Mounting bracket for use with special
for deep tank	specifications is available for
	immersion type detection for deep tank
	of 1m or more to the water surface
	of 1m or more to the water surface

<example (tip="" gss-314b="" of="" replaceab<="" th=""><th>ble)&gt;</th><th></th></example>	ble)>	
Electrode holder rising water jet clea	aning Transmissio	on output hold
	20Seconds	
<chemical cleaning="" jet=""></chemical>		
	50Seconds	
<water cleaning="" jet=""></water>	60Seconds	
<ph7 feed="" liquid="" standard=""></ph7>	objectinus	
	60Seconds	
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stop response>	0Seconds	
ا Discrimination of stable		
of liquid feed restart>	10 to 200 constants	
<zara calibration=""></zara>	10 to 20seconds	
	About	7 minutes
<water cleaning="" jet=""></water>		1
	10Seconds	
<pre><ph4 (9)="" foods<="" liquid="" pre="" standard=""></ph4></pre>	coc	
	buseconds	
Stop response>		
	OSeconds	
<discrimination of="" stability<="" td=""><td></td><td></td></discrimination>		
	10 to 20Seconds	
<span calibration=""></span>		
<water cleaning="" jet=""></water>		
	10Seconds	
<electrode holder="" lowering=""></electrode>		
↓	60Seconds	↓
Start of measurement	Transmission o	utput hold release

## Content of alarm and error messages

Alarm message (sub display)

A1	Calibration zero value is close to the normal limit. Corrective action: Clean the electrode and replace the internal solution (KCl).
A2	Calibration slope value is near the normal limit. Corrective action: Clean the electrode.
A3	Calibration Zero and Slope Values Near Normal Limit. Corrective action: Clean or replace electrode with new one.
A4	Standard solution is low. Corrective action: Corrective action: Replenish the standard solution.
A5	Cleaning liquid (chemical liquid) is low. Corrective action: Replenish the cleaning liquid (chemical liquid).
(A6)	pH indication difference monitoring function is enabled and indication difference between 2 channels is large. Corrective action: Refer to "Electrode alarm (A1, A2, A3)".

## Error Message

E1	Zero calibration value error
E2	Span calibration value error
E3	Zero/span calibration value error
E4	Abnormal standard liquid temperature
E5	Stable discrimination error
(E6)	(Failure during cleaning)
(E10)	(Glass electrode failure)
(E11)	(Comparison electrode failure)
E12	Electrode temperature-compensation failure
E20	Memory error "Operation display: MC"
E21	Memory error "Liquid feed control unit: FC"
E22	Setting data error "Operation display: MC"
E23	Setting data error "Liquid feed control unit: FC"
E30	Liquid feed control section failure
E31	Liquid feed control section communication error
(E40)	(CALMEMO not connected or abnormal)
(E41)	(Digital amplifier cable failure)
(E42)	(Digital amplifier cable disconnected)

## Names of parts

**Calibration operation** 







#### Installation

#### Main unit



\*1. Time of adoption of chemical cleaning option

Installation conditions

Install the product in a place that conforms to the following conditions.

- 1. The distance between the main body and the detector shall be within 5m maximum. (5m tube supplied as standard)
  - (Install the main unit and detector as close as possible.)
- The ambient temperature should be in the range of 0 to 50°C. (If the ambient temperature becomes 0°C or less, anti-freezing measures are required.)
- 3. No corrosive gas or vibrate.
- 4. Separate from motors and other electrical equipment that may cause inductive interference.
- 5. Maintenance space shall be available in the front/left/ right direction of the main unit.
- 6. Space shall be available to allow removal of the upper electrode holder of the detector.
- 7. FL shall not be higher than GL by 2m or more.
- 8. Pipe the supplied Y-strainer to the washing water supply line.
- 9. If the wash feed water pressure exceeds 0.5MPa, install a pressure reduction valve so that it is less than or equal to 0.5MPa.
- 10. If there is a possibility of water hammering (water hammer) on the wash water supply line, installation of a water hammer preventer is recommended.
- 11. Condensation prevention measures are required in places exposed to direct sunlight.







#### **Product code**



- \*1. A connection cable of 3m between the transmitter and the second liquid feed control unit is included. Please contact us if more than 4 m is required. (Max. 10m)
- \*2. A connection cable of 3m to the transmitter of the master unit is included. Please contact us if more than 4 m is required. (Max. 10m)
- \*3. The immersion type A detector has a holder material: transparent PVC or PP/length: 1.6m/lift stroke: 600mm with mounting bracket (for 50A poles).

The immersion type B detector has a holder material: transparent PVC or PP/length: 1.0 m/lift stroke: 250 mm 50A JIS10K flanged mating.

Sampling type detector: Holder and measuring vessel material: transparent PVC or PP/Holder length: 1.0 m/lift stroke: 250 mm/

Measurement tank sample IN: 25A JIS10K/ sample OUT: 50A JIS10K flange (atmospheric release) mating.

Note that the material of the water sampling type case (chamber) is the material selected in the "Combination holder material".

\*4. Water jet cleaning uses a lift-up type aerial cleaning method to inject 0.2 to 0.5MPa of high-pressure wash water into the contacts. Chemical cleaning uses 0.05MPa air pressure to spray chemicals (e.g., 5%HCl) onto the contacts.

Due to intense contamination caused by the Chemical feed pH control line from the washing plants' smoke processing and waste water treatment facility, 1 complex washing method is supported.

If the cleaning effect is confirmed to be sufficient only with water jet cleaning, such as final effluent, it can be dealt without the need for 2 chemical cleaning.

- \*5. For outdoor installation, the holder made by PVC is recommended because the holder made by PP deteriorates due to ultraviolet rays.
- \*6. In terms of pH9 standard solution, since the carbon dioxide gas in the air penetrates and the pH value decreases, soda lime unit is equipped in the tank.

\*7. Sunshades of the transmitter and liquid feed control and chemical tank covers / Teflon tubes are required for performance maintenance, instrument protection and safety in outdoor installation. The sunshade cover prevents internal heating of the instrument in direct sunlight and prevents deterioration of the polyethylene chemical tank caused by ultraviolet rays. The coupling (chemical tank and cleaning calibration tank) and the polyethylene tube (5m for chemical liquid feed) are replaced with Teflon tubes.

\*8. For outdoor installation, we recommend that the product is equipped with a heating unit.

If the outside temperature is  $5^{\circ}$ C or less (0°C or higher) in winter regardless of whether the installation location is indoors or outdoors, it is necessary for the purpose of maintaining the performance and protecting the instrument.

Increase the temperature within the standard solution tank to  $15^{\circ}$ C or more, and maintain good liquid feed performance of the pump and response performance of the electrode.

\*9. The operating temperature range varies depending on the electrode and holder material used.

- 5600 and PVC holder... 0 to 60°C 5600 and PP holder... 0 to 70°C 5601 and PP holder... 0 to 80°C GSS-314B and PVC Holder... 0 to 60°C GSS-314B and PP Holder... 0 to 80°C ELP-103 and PVC Holder... 0 to 60°C
- ELP-103 and PP Holder... 0 to 80°C
- \*10. Please inquire for combinations of electrodes other than those listed above.

The KCl-free type for GSS electrodes and the ceramic junction fixed type for CALMEMO-pH electrodes cannot be specified.

#### Note

- 1. The specifications of the detector, electrode (lead wire length), standard liquid used, etc. are the same for both the master and slave units in the 2ch specification.
- 2. In case of the specification without converter (for extension of detector), please inform us of the serial number of the already designed instrument to be combined.
- 3. The measurement range (transmission output range) is-1.00 to 15.00pH. (pH0: 00 to 14.00 when shipped)
- 4. Power supply is AC100 to 240V 50/60Hz.
- 5. The integrated installation type is standard. The transmitter and liquid feed control section are assembled on a stainless steel (SUS304 unpainted) pole stand (L1600).

[Other options and special specifications]

Please inquire regarding requirements for special specifications such as detectors for deep vessels, heavy corrosion and salt-resistant coatings, wall or rack mounting, anti-freezing measures in the tubes of the liquid feed section to the detector, anti-condensation air purge measures in the liquid feed section, and compressed air supply (combine) units.

#### **Related equipment**

#### Junction box

A junction box is required when the transmitter and electrode are installed away from each other and the standard electrode lead length is too short.

Model	: FC-4
Construction	: Outdoor installation
Weight	: Approx. 0.9kg
Case material	: ABS resin
Base material	: ABS resin
Finish	: Pearskin finish chromium plating
Mounting	$\div 25$ - 50A pipe, wall or panel mount

## • Extension cable

The extension cable is a special cable specifically manufactured for a pH/ORP analyzer. It connects the controller and junction box.

Model	: EC-10
Outside diameter	: φ8
Insulation	: Polyethylene and PVC
Sheath	: PVC
Insulation resistance be	etween core conductors
	$: 10^{5} M\Omega$ or greater/100m.
Maximum cable length	÷100m, no cable splicing.
Standard length	: 5m - 100m (5m unit step)
Weight	: Approx. 0.5kg/5m
*The CALMEMO	pH electrode cannot be extended with

dedicated cable.



FC-4 dimensions



Cross section of EC-10

a



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Please read the operation manual carefully before using producuts.

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