Instruction Manual

CA12 HANDY CAL
Temperature Calibrator
Model 710 21

Thank you for purchasing the CA12 HANDY CAL.
To fully utilize all of the features of this instrument, read this Instruction Manual carefully and use the instrument accordingly.

2nd Edition: Aug. 1998

YOKOGAWA ◆
Yokogawa M&C Corporation

IM CA12-E
2nd Edition

Contents

1. Safety Use

■ The following symbols are used on the instrument and in the Instruction Manual to ensure safe use.

WARNING Indicates that there is a possibility of serious personal injury or death if the operating procedure is not followed correctly and describes the precautions for avoiding such injury or death.

CAUTION Indicates that there is a possibility of personnel injury or damage to the instrument if the operating procedure is not followed correctly and describes the precautions for avoiding such injury or damage.

NOTE Draws attention to information essential for understanding the operation and features.

■ Damage to the instrument or personal injury or even death may result from electrical shock or other factors. To avoid this, follow the precautions below.

⚠ WARNING

● **Use in gases**

Do not operate this instrument in areas where inflammable or explosive gases or vapor exists. It is extremely hazardous to use the instrument under such environments.

● **External connection**

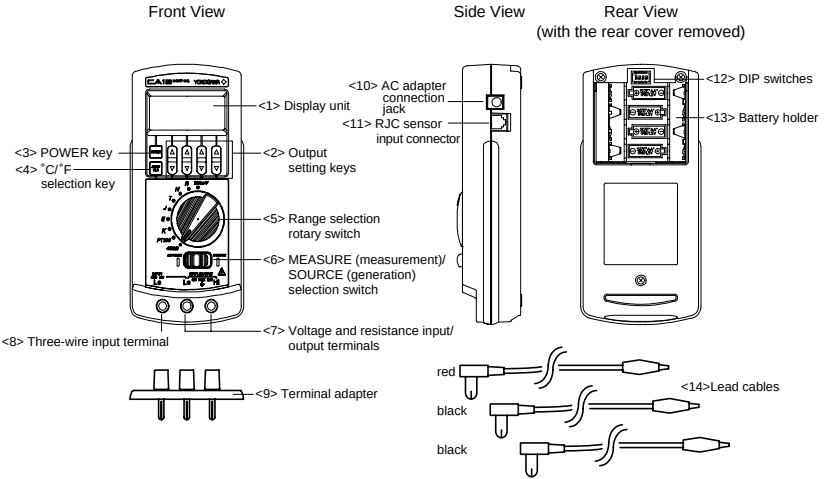
If you need to touch a circuit for external connection, cut off the power from that circuit and make sure that no voltage is being supplied. Then carry out the connection. When replacing the batteries, always disconnect lead cables.

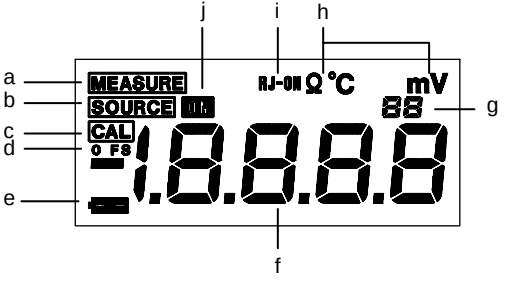
⚠ CAUTION

● **Disassembly**

No person other than our service personnel should open the cover.

2. Names and Functions of Parts





<1> Display unit

a MEASURE

Lights when MEASURE (measurement) is selected using the selection switch <6>.

b SOURCE

Lights when SOURCE (generation) is selected using the selection switch <6>.

c CAL

Lights in the calibration mode.

d 0 FS

Lights or blinks when the offset or full scale is calibrated in the calibration mode.

e 

This mark informs the battery's status. When lit, it indicates that the batteries will soon need replacing and when blinking, it indicates that they must be replaced. (see Section 3, "Replacing the Batteries.")

f Displays a measured value or generated value.

g “°F” appears when “°C/°F” selection key is selected to “°F” at temperature range. It also displays the lower two digits of a measured or generated value in the adjustment mode.

h Shows the unit of the range selected.

i RJ-ON
Lights when the reference junction compensation is being calculated in signal generation.

j ON
Lights during signal generation.

<2> Output value setting keys

Sets an output value for signal generation. The [▲]/[▼] keys are provided for each digit, which increase or decrease the value one by one. Carry and borrow of the digits is applied respectively according to the incrementing of “9” and decrementing of “0”.

<3> POWER key

Turns on/off the power supply. For more information, see Section 4, “Turning the Power On/Off.”

<4> ˚C/˚F selection key

Selects “˚C” or “˚F” unit.

<5> Range selection rotary switch

Selects a range for generation or measurement.

<6> MEASURE/SOURCE selection switch

Selects SOURCE (generation) or MEASURE (measurement).

<7> I/O terminals

Used for generation and measurement in each range.

<8> Three-wire input terminal

Used for “measurement” in three-wire connection in the resistance or RTD range.

<9> Terminal adapter

Attached to the instrument’s terminals for use when a thermocouple signal is measured or when lead wires are to be connected directly to the terminals.

<10> AC adapter connection jack

Used to connect an AC adapter (optional).

<11> RJC sensor input connector

When using an external RJC sensor (optional), connect it here.

<12> DIP switches

See Section 7, “Other Features.”

<13> Battery holder

Contains four AA-size batteries. See Section 3, “Replacing the Batteries.”

<14> Lead cables for measurement or generation

Used to connect the instrument to the device under measurement/ generation.

3. Replacing the Batteries

If the  mark on the display unit starts blinking, the batteries have been used up. Follow the procedure below to replace the batteries.

<1> Check that the power is off.

<2> Slide the rear cover at the back of the instrument to remove it.

<3> Replace all four batteries with new ones. Place them in their holder according to the polarity directions shown inside the holder.

<4> After replacing the batteries, put the rear cover back on the instrument.

■Connecting the AC Power (optional)

Before connecting the AC power

Perform the following precautions to avoid electrical shock or damage to the instrument.

WARNING

- Do not use any AC adapter other than the dedicated AC adapter (See Page 34)
- Before connecting the power cord, check that the voltage of the supply side matches the rated voltage of the instrument.
- Before connecting the power cord, check that the power of the instrument is off.

Connecting procedure:

<1> Check that the POWER key of the instrument is off.

<2> Connect the AC adapter (optional) to the AC adapter connection jack in the instrument. (Note that unless the AC adapter is connected to the power outlet, the power cannot be turned on.)

4. Turning the Power On/Off

■ Operating the POWER Key

When the instrument's power is off, pressing the POWER key on the front panel for more than 1 second causes the power to be turned on. Pressing this key again causes it to be turned off.

When the power is turned on, the instrument starts a self-test and displays "CA12." The features selected by the range selection rotary switch and MEASURE/SOURCE selection switch starts functioning.

- For battery-driven operations, disconnect the AC adapter from the instrument.

■Automatic Power off

In the factory-shipped setting, all indications start blinking if the instrument has not been operated for about 9.5 minutes. Then, if the instrument is not operated for another 30 seconds, it automatically turns off.

To disable this automatic Power off feature, refer to Section 7, “Other Features.”

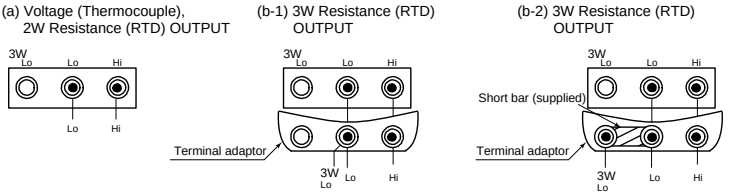
If you wish to keep the instrument turned on when the indications start blinking, press the [POWER] key. This causes blinking to normal lighting, without changing the previous status.

5. Generation

5.1 Connecting the Output Terminals

<1> Insert the plugs of the lead cables supplied into the output terminals of the instrument.

<2> Connect the clips on the other ends of the cables to the input terminals of the device under measurement/generation.



· When carrying out calibration on a resistance temperature detector or a resistance measurement unit in three-wire connection, the supplied terminal adapter can be used to achieve a three-wire configuration (Fig.b-1). 3W Lo and Lo terminals can be shorted (Fig.b-2). Otherwise connect as Fig.a.

CAUTION

- Do not apply any voltage to the output terminals during the generation operation. If voltage is applied inadvertently, the internal circuit may be damaged.

NOTE

- As this instrument is calibrated without the voltage drop of the lead cables, error due to the resistance of the lead cables (about 0.1 Ω for go and return) must be considered.

5.2 Generating DC Voltage

The instrument generates a voltage or resistance of a specified value from the output terminals.

■Normal procedure:

<1> Switch the MEASURE/SOURCE selection switch to “SOURCE” (generation).
This causes the display unit to light “SOURCE” and “ON.”

<2> Select the range to be generated using the range selection rotary switch. The display unit shows an initial value and the unit for each range.

<3> Press the [▲]/[▼] keys for each digit to set an output value.

5.3 Generating Resistance or RTD Signal

The instrument generates a required value of simulated resistance output at the 400 Ω resistance range and at PT100 RTD (resistance temperature detector) range which corresponds to the required temperature value of the PT100.

NOTE

- The method of simulating resistance output is by generating voltage according to the excitation current 'I' received from the device under calibration, due to the equation:
  R (required resistance) =
  V (generated voltage) / I (current received from device)
  Therefore the device to be calibrated must have the excitation current for resistance measurement.
- For correct simulation output, the excitation current should be within a range of 0.5 mA to 2 mA (please refer Section 8 for more information).

NOTE

- On initial calibration conditions from the factory, the generated resistance value is calibrated without considering the voltage drop due to the lead cables (approx 0.1 Ω for the supplied), so the increase of error rate should be considered at the opposite end of the lead cables.
- If capacitance between the terminals of the resistance-measuring device under calibration becomes 0.1 μF or more, the CA12 may not be able to generate the correct resistance value.

5.4 Generating a Thermocouple (TC) Signal

The instrument generates thermo-electromotive force from the output terminals, corresponding to the required temperature of a specified thermocouple (TC).

■ Reference junction compensation

When you directly calibrate a thermometer with a function of a built-in reference junction compensation, use an RJC sensor (optional) as follows. (You can also use the built-in RJC sensor to carry out calibration (see Section 7, “Other Features”).)

<1> Connect the RJC sensor to the RJC sensor input connector of the instrument. Insert the sensor such that the claw at the bottom of the connector is locked in. To release the connector, gently press the locking claw to unlock the connector and then remove it.

<2> When the sensor is connected, the instrument automatically enters RJ-ON status and outputs a thermo-electromotive force based on the output value settings and compensation of the temperature detected by the RJC sensor. The instrument displays “RJ-ON.” (For the accuracy of the reference temperature measurement using the RJC sensor, see Section 8, “Specifications.”)

- The thermo-electromotive force is obtained by subtracting calculated value of the RJC sensor from the calculated thermo-electromotive force without RJC sensor.
- Compensation of output voltage by the RJC sensor is achieved by a sampling approximately every 4 seconds. Thus, there is a maximum delay of 4 seconds between the connection of the connector and the start of compensation.
- For accurate compensation, a certain amount of time (about 5 minutes) must be reserved.

NOTE

- If reference junction compensation is not required, the RJC sensor should always be disconnected from the connector of the instrument.

6. Measurement

WARNING

- When connecting the device under measurement, turn off the power for the device. Connecting/disconnecting the lead cables for measurement without turning off the power of the device under measurement may be extremely dangerous.
- Special care should be taken to avoid connecting a current circuit to the input terminals. Inadvertent connection may not only cause damage to the circuit or device under measurement and this instrument, but may also be hazardous to personnel.
- The maximum allowable voltage between all input/output terminals and ground is 42 V. Any voltage exceeding this level may not only damage the instrument but also cause injury to personnel. Never attempt to apply such voltage.

CAUTION

- Do not apply voltage exceeding the measuring range to the input terminals. This may damage the instrument.

6.1 Connecting Procedure

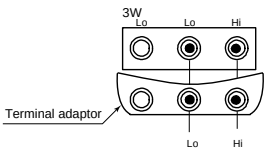
<1> When connecting a thermocouple or the lead wires, attach them to the terminal adapter supplied with the instrument.

<2> For measurements of the voltage or the resistance or RTD in a two-wire connection, connect the supplied lead cables to the terminals of the instrument or the lead wires to the terminal adapter (see following figure “a”).

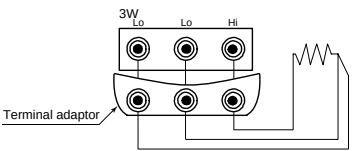
For measurements of the resistance or RTD in a three-wire connection, connect the lead cables to the terminals of the instrument or connect the lead wires to the terminal adapter (see following figure “b”).

- Remove the shortbar (supplied) when measuring with a three-wire commection.
- For the measurements of the resistance or the RTD in a two-wire connection, do not connect any point to the 3W Lo terminal except the Lo terminal (middle terminal).

a Connection of the input terminals for measuring voltage, a thermocouple signal, the resistance in a two-wire connection, or an RTD signal in a two-wire connection



b Connection of the input terminals for measuring the resistance in a three-wire connection and an RTD signal in a three-wire connection



6.2 Measuring DC Voltage, Resistance, or an RTD Signal

<1> Switch the MEASURE/SOURCE selection switch to MEASURE (measurement).
MEASURE lights up on the display unit.

<2> Select the range to be measured using the range selection rotary switch.

- The display unit shows the measurement results (such as the corresponding temperature for the RTD). The measurement results display is updated approximately every second.
- If the measurement data is over range, the display unit shows “- - - -”.

6.3 Measuring a Thermocouple (TC) Signal

<1> Switch the MEASURE/SOURCE selection switch to MEASURE (measurement).
MEASURE lights up on the display unit.

<2> Select the thermocouple to be measured using the range selection rotary switch.

- The display unit shows the results of the corresponding temperature, on which the internal RJC sensor-measured temperature compensation was based.
- If the input terminals are open, the display unit shows “-bo-” (burn-out).
- If the measurement data is over range, the display unit shows “- - - -”.
- If the temperature in the operating environment of the instrument changes rapidly, wait until RJ compensation stabilizes and then use the instrument.

7. Other Features

The following features are available depending on the setting of the DIP switches above the battery holder. These switches are accessed by removing the rear cover from the back of the instrument.

DIP switches

1: When generating: Internal RJC
2: Unused
3: Unused
4: Disabling automatic power off

7.1 Internal Reference Junction Compensation

When generating a thermocouple signal, setting the DIP switch 1 on enables the instrument’s internal RJC sensor to generate a temperature compensated output.

7.2 Disabling Automatic Power off

At the factory shipment, the instrument is initialized to turn off automatically if not operated for a period of 10 minutes or more. If you wish to use it continuously without automatic power off, set the DIP switch 4 to on. This disables the automatic power off feature.

However, when the instrument is battery-driven, it is recommended that this switch be generally set to off in order to prevent the batteries from being used up.

8. Specifications

■ Source/Measurement Functions

Accuracy: ±(% of set value or reading + °C, μV, or Ω), at 23 ± 5°C for one year

Range Selection		Range of Source/measure		Accuracy		Resolution	Remarks
				Source	Measurement		
TC	K	-200.0 to 1370.0ºC	-328 to 2498ºF	0.05%+1ºC *1 (at -100ºC or greater) 0.05%+2ºC (at less than -100ºC)	0.07%+1.5ºC (at -100ºC or greater) 0.07%+2ºC (at less than -100ºC)	0.1ºC/1ºF	*1 Accuracy of RJC is excluded.
	E	-200.0 to 1000.0ºC	-328 to 1832ºF				
	J	-200.0 to 1200.0ºC	-328 to 2192ºF				
	T	-200.0 to 400.0ºC	-328 to 752ºF				
	N	-200.0 to 1300.0ºC	-328 to 2372ºF				
	R	0 to 100ºC	32 to 212ºF	0.05%+3ºC *1	0.07%+3ºC	1ºC/1ºF	
		100 to 1768ºC	212 to 3214ºF	0.05%+2ºC *1	0.07%+2ºC		
100mV		-10.00 to 110.00mV		0.05%+30μV	0.05%+30μV	10μV	
RTD Pt100		-200.0 to 850.0ºC	-328 to 1562ºF	0.05%+0.6ºC *2	0.05%+0.6ºC	0.1ºC/1ºF	*2: External exitation current 0.5 to 2 mA; Add 0.05% +1ºC (0.4Ω) when it is 0.1 mA.
400Ω		0 to 400.0Ω		0.05%+0.2Ω *2	0.05%+0.2Ω	0.1Ω	

Temperature effect: 1/10 of accuracy / ºC.

Power supply	: Four 1.5-V alkaline batteries (ANSI AA-size) or dedicated AC adapter (sold separately)
Battery life	: Approximately 80 hours (when running on alkaline dry batteries)
Automatic Power off	: After a period of approx. 10 minutes with no operations
Generation Signal Level Setting	: By four sets of up and down keys
Response of Generator	: Approximately 20 milliseconds
Loading conditions	: Less than 0.1 μF
Measured-value indication updating intervals	: Every second (approx.)
Display	: 7-segment-by-5-digit LCD
Maximum allowable applied voltage	: 42 V between each terminal and ground
Operating temperature and humidity range	: 0 to 50°C, 20 to 80% R.H (no condensation allowed)
Storage temperature and humidity range	: -20 to 50°C, 90% R.H or less (no condensation allowed)
Dimension	: Approximately 192 (H) × 92 (W) × 42 (D) mm (excluding protrusions)
Weight	: About 440 g
Safety	: EN61010-1:1993 When using with AC adaptor (optional), only B9108WB conforms to the safety regulation (A1020UP/A1022UP are excluded).
EMC	: EN55011:1991 Group 1 Class B EN50082-1:1992 Influence under RF field : ±1% of range

Accessories : Measurement/generation lead cables (B9108MT), a set of red and 2black wires
Carry case (B9108NK)
Terminal adapter (B9108KF)

Optional accessories : Dedicated AC adapter
(A1020UP AC 100 V • A1022UP AC 120 V • B9108WB AC 220-240 V)
RJC (reference junction compensation) sensor (B9638CR)

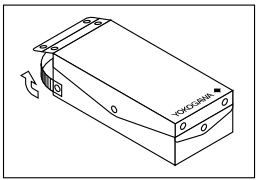
■ Specifications of the RJC Sensor (for Reference Junction Compensation of TC Signal Generation)

Measuring range	Accuracy (when combined with the instrument)
-10 to 50°C	23± 5°C :± 0.5°C -10 to +50°C :± 1°C

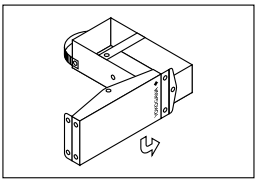
Length of cord Approximately 1.5 m
Compensation by the built-in sensor is also possible by adjusting the setting of the internal DIP switch on the instrument.

9. How to Use the Carry Case

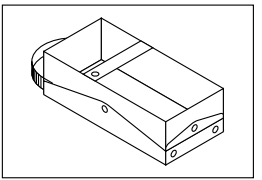
The carry case may be used as described below:



(1) Release the strap-side snap fasteners and the other side snap fasteners of the case cover to open it.



(2) Turn the case cover over by using the logo-side snap fastener as the center.



(3) Re-fasten the strap-side snap fasteners and side snap fasteners of the cover.

Other features and notes of the carry case

* The instrument can be placed into the housing of the back side of the case cover, with the lead cables connected to the terminals of the instrument.
* The strap allows the instrument to be used or stored by suspending it on a hook, rod, and others.
* Note that the logo-side fastener of the case cover cannot be released.

10. Calibration Procedure

To maintain a high level of accuracy, it is recommended that the CA12 HANDY CAL be calibrated annually. Requests for calibration work can also be made to our service representatives.

The following is examples of calibrations that use the standards recommended in “Selecting the Standards.”

10.1 Selecting the Standards

■ Generation feature

Items to be calibrated	Names of standards	Range	Measuring range	Accuracy	Remarks
DCV	Digital multimeter	100mV	110 mV max.	± (0.005%+5µV)	Model 1271/7561 (Yokogawa) or equivalent
Ω	Digital multimeter	400Ω	440 Ω max., Measuring current: 1 mA	± (0.005%+0.02Ω)	Model 1271/7561 (Yokogawa) or equivalent

■Measurement feature

Items to be calibrated	Names of standards	Range	Generated value	Accuracy	Remarks
DCV	Standard DC voltage generator	100mV	100mV	± 0.01%	Model 9100/2552 (Yokogawa) or equivalent
Ω	Decade resistance box	400Ω	400Ω	± 0.01%	Model 279301 (Yokogawa) or equivalent

10.2 Environmental Conditions for Calibration

Ambient temperature : 23 ± 1°C
Relative humidity : 45 to 75% R.H
Warm-up : Warm-up time specified for the standard

10.3 Calibration Points

- The calibration points are as specified in the tables below.
- It is possible to select the necessary range to be calibrated independently.
- Always calibrate the zero (0) point and full scale (FS) point in pair for generation.

Generation:

Calibration points		Standard value*1
100mV	0	0mV
	FS	100mV
400Ω	0	0Ω
	FS	400Ω

*1 Make adjustments to CA12 according to the reading of the standard (CA12 output value), as specified in the table.

Measurement:

Calibration points		Standard value*2
100mV	FS	100mV
400Ω	FS	400Ω

*2 Set the value to the standard as specified in the table.

10.4 Precautions for Calibration

CAUTION

- Do not apply a voltage exceeding the maximum input voltage; otherwise, the input part may be damaged.
- Do not short-circuit or apply an external voltage to output terminals of the instrument or standard equipment, or else their internal circuitry may be damaged.

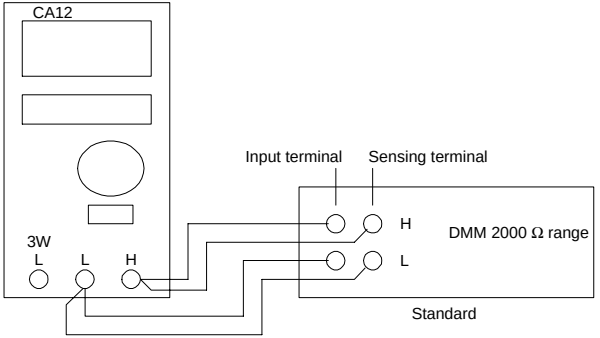
(1) Calibrating 400 Ω generation

· Set resistance-measuring current to 1 mA (*).

(*) Check the specifications of the digital multimeter (DMM) to be used as the standard.
Example: Resistance-measuring current is 1 mA for the 1 kΩ range of 1271 (Yokogawa) or the 2000 Ω range of 7561 (Yokogawa).

· Connection method

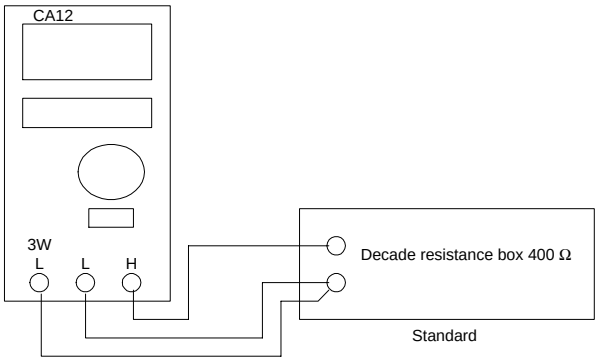
Connect the CA12 calibrator to the standard in four-wire connection for calibration as shown below:



(2) Calibrating 400 Ω measurement

- Connection method

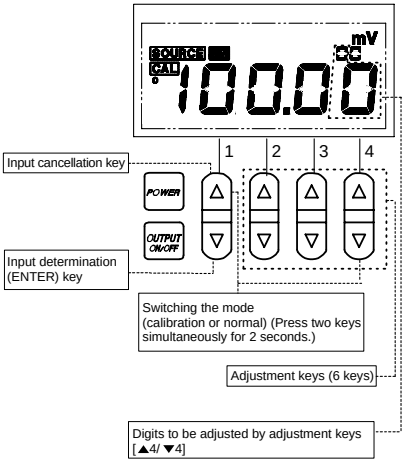
  Connect the CA12 calibrator to the standard in three-wire connection for calibration as shown below:



(3) Calibrating the internal reference junction compensation feature

Because this calibration requires special equipment (a K-type thermocouple and 0°C reference temperature chamber), contact our service representatives for calibration.

10.5 Assignment of Keys for Calibration



10.6 Calibrating the Generation feature

■ Operation procedure:

<1> Warm up the standard.

<2> Before turning on the power of the CA12 calibrator, connect it to the standard. Make sure that the external RJC sensor is disconnected.

<3> Turn on the [POWER] key of CA12, and warm up the instrument.

<4> Press the [▲1] and [▼4] keys shown in the previous figure simultaneously for about 2 seconds to enter the calibration mode.

<5> Select the generation range to calibrate, using the MEASURE/SOURCE selection switch and range selection rotary switch.

The display unit shows “CAL,” “SOURCE,” “ON,” “0,” and a lower limit.

<6> Read the output value of the CA12 using the standard (digital multimeter) and adjust the CA12 so that the output value is set to the offset value using the [▲] and [▼] adjustment keys. Then, press the [▼1] input determination (ENTER) key to fix the setting.
After fixing the setting, the display unit changes its contents to "CAL," "SOURCE," "ON," "FS," and a full scale value of the range.

<7> Read the output value of the CA12 using the standard (digital multimeter) and adjust the CA12 so that the output value is set to the full scale value using the [▲] and [▼] adjustment keys. Then, press the [▼1] input determination (ENTER) key for about 1 second to fix the setting.
After fixing the setting, the display unit shows "0 FS" blinking. Re-press the [▼1] input determination (ENTER) key for about 1 second to write the calibration coefficients into the EEPROM of the instrument. (This overwrites the previous calibration coefficients.)
When this is complete, the instrument returns to the status in step 5.

<8> Repeat steps 5 to 7 for each range to calibrate.

■ To return to the previous step:

<9> To return to the previous step without fixing the setting, press the [▲1] input cancellation key. Note that this is possible only before writing into EEPROM.

■ To return to the normal operation mode:

<10> Press the [▲1] and [▼4] keys shown in the previous figure simultaneously for about 2 seconds, or press the [POWER] key to turn off the power once and then press again to turn back on.

10.7 Calibrating the Measurement Feature

■Operation procedure:

<1> Warm up the standard.

<2> Before turning on the power of the CA12 calibrator, connect it to the standard. Make sure that the external RJC sensor is disconnected.

<3> Turn on the POWER key of the instrument, and warm up the instrument.

<4> Press the [▲1] and [▼4] keys shown in the previous figure simultaneously for about 2 seconds to enter the calibration mode.

<5> Select the measurement range to calibrate, using the MEASURE/SOURCE selection switch and range selection rotary switch.
"CAL" and "MEASURE" appear and "FS" blinks on the display unit.
(If a value nearly equivalent to full scale has been input, a measured value and "FS" appear.)

<6> Set up the standard in order to input the full scale to the CA12. Wait until the reading stabilizes, then press the [▼1] input determination (ENTER) key for about 1 second to fix the setting.

<7> After fixing the setting, “0” and “FS” indications on the display unit start blinking. Re-press the [▼1] input determination (ENTER) key for about 1 second to write the calibration coefficients into the EEPROM of the instrument. (This overwrites the previous calibration coefficients.)

<8> Repeat steps 5 to 7 for each range to calibrate.

■ To return to the previous step:

<9> To return to the previous step without fixing the setting, press the [▲1] input cancellation key. Note that this is possible only before writing into the EEPROM.

■ To return to the normal operation mode:

<10>Press the [▲1] and [▼4] keys shown in the previous figure simultaneously for about 2 seconds, or press the [POWER] key to turn off the power once and then press again to turn back on.

11. Notice of the Instruction Manual

<1> The information contained in this Instruction Manual is subject to change without notice.

<2> The information contained herein is assumed to be accurate. However, should any doubt, errors, omission, or come to your attention, please let inform us.

<3> Yokogawa M&C assumes no responsibility or liability for damages resulting from the customer’s misuse or inadvertent operations.

<4> This Instruction Manual describes the details of the functions of the product and does not warrant the product for any particular purposes.

YOKOGAWA

Yokogawa M&C Corporation

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