
Instruction Manual

CA11 HANDY CAL Voltage/Current Calibrator Model 710 10

Thank you for purchasing the CA11 HANDY CAL.
To fully utilize all of the features of this instrument,
read this Instruction Manual carefully and use the
instrument accordingly.

1st Edition: Nov. 1997

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IM CA11-E
1st Edition

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1. Safety Use

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



Indicates that there is a danger to personnel and/or the instrument and that it is necessary for the user to refer to the Instruction Manual.



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.

- 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.

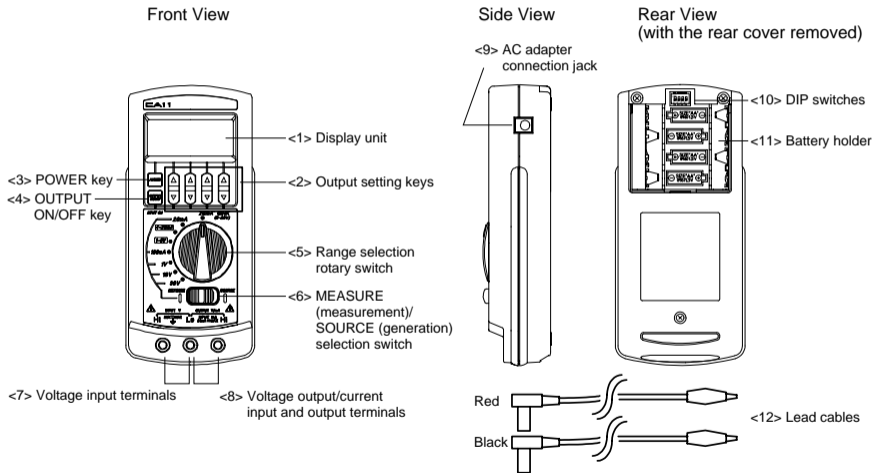
- **External connection**

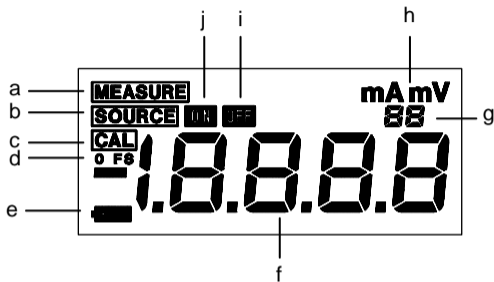
If you need to touch a circuit for external connection, cut off the power from that circuit and make sure that there is no voltage. Then carry out the connection. When replacing the batteries, always disconnect lead cables.

- **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 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 an output value.

g "SP" appears here when the sweep function (see Section 7, "Other Features") is selected in signal generation. It also displays the lower two digits of a measured or an output value in the calibration mode.

h Shows the unit of the range selected.

i OFF

Lights when output is turned off in signal generation or the protective circuit is activated.

j ON

Lights when output is turned on in 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 values one by one. Carry and borrow of the digits is applied respectively according to the incrementing of “9” and the decrementing of “0”

For 4-20 mA and 1-5 V ranges, see Subsection 5.2, “Generating DC Current or DC Voltage.”

<3> POWER key

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

<4> OUTPUT ON/OFF key

Turns on/off an output signal in signal generation. For measurement, it returns measurement operation to normal status after the protective circuit has activated.

<5> Range selection rotary switch

Selects a range for generation or measurement. Note that the 4-20 mA and 1-5 V ranges are step output ranges in signal generation and are the same as the 20 mA and 10 V ranges in measurement respectively.

For invalid ranges, terminal-to-terminal connection becomes open, causing “-nC-” and “OFF” to appear on the display unit.

<6> Measurement/generation selection switch

Selects SOURCE (generation) or MEASURE (measurement).

<7> Voltage input terminals

Used to measure a voltage range.

<8> Voltage output/current input and output terminals

Used for “signal generation” in the voltage range and for “measurement” and “signal generation” in the current range.

<9> AC adapter connection jack

Used to connect an AC adapter (optional).

<10> DIP switches

See Section 7, “Other Features.”


<11> Battery holder

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

<12> 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**

- 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.
- Do not use any AC adapter other than the dedicated AC adapter of Yokogawa.

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 for more than 1 second causes the power to be turned on. Pressing the key again causes it to be turned off.

When the power is turned on, the instrument starts a self-test and displays "CA11." The features selected by the range selection rotary switch and measurement/generation 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.

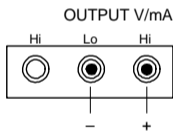
To disable this automatic power off feature, refer to Section 7, “Other Features.”

If you wish to keep the instrument turned on after 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 generation.





CAUTION

- Do not apply any voltage to the output terminals except for the 20 mA SINK range. If voltage is applied inadvertently, the internal circuit may be damaged.
- As this instrument is calibrated without the voltage drop of the lead cables, error due to the resistance of the lead cables (approx. 0.1 Ω for go and return) must be considered.

5.2 Generating DC Current or DC Voltage

The instrument generates voltage or current at a specified value through the output terminals. In invalid ranges, terminal-to-terminal connection becomes open, and the display unit indicates “-nC-” and “OFF.”

■ Normal setting:

<1> Switch the MEASURE/SOURCE selection switch to “SOURCE” (generation).

This causes the display unit to light “SOURCE” and “OFF.”

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

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

<4> Press the [OUTPUT ON/OFF] key to output a signal.

The display unit shows “ON.”

To stop the output, press the [OUTPUT ON/OFF] key again. This causes “OFF” to appear on the display unit and opens the terminals.

■ Allowable load

The instrument should be used according to the maximum output and maximum load range specified in Section 8, “Specifications.”

■ 4-20 mA/1-5 V step output range

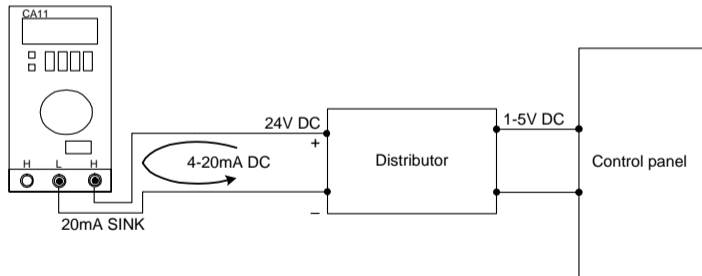
In the 4-20 mA range, any of the [▲]/[▼] keys for the upper two digits can be used to step up or down in 4 mA such as $4 \leftrightarrow 8 \leftrightarrow 12 \leftrightarrow 16 \leftrightarrow 20$ mA. The use of the [▲]/[▼] keys of the lower two digits is the same as their normal setting.

In the 1-5 V range, the [▲]/[▼] keys for the upper one digit can be used to step up or down in 1 V. For the lower three digits, the use of keys is the same as for normal setting.

■ Current SINK range

The instrument can absorb a 0.1-24 mA signal with the external power supplied from the same signal wires and function as a two-wire transmitter. This feature is used for loop tests. The loop power supply should be used in the range of 5 V to 28 V.

The polarity of application voltage should be as shown below.



■ Output limiter

If a load current in the voltage range or a load voltage in the current range reaches a value exceeding the maximum value specified in the specifications, the protective limiter is activated, turning off the output signal.

To recover from this condition, correct the load to a normal status and press the [OUTPUT ON/OFF] key to turn on output.

■ Sweep function

Increases or decreases the output level to the preset level at a constant rate by setting a DIP switch. For more information, see Section 7, “Other Features.”

6. Measurement



- When connecting the device under measurement, turn off the power of 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 voltage input terminals or a voltage circuit to the current 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.
- Always use the lead cables supplied with the instrument.
- Maximum allowable voltage between all input/output terminals and ground is 30 V DC. Any voltage exceeding this level may not only damage the instrument but also cause injury to personnel. Never attempt to apply such voltage.

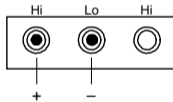


- Do not apply voltage exceeding the maximum allowable input voltage to the voltage input terminals. This may damage the instrument.
Maximum input voltage: 30 V DC
- Do not apply current exceeding the maximum allowable input current to the current input terminals. If current exceeding this level is applied, built-in fuses for protecting the current input circuit will burn. If a fuse burns, contact us for repair.
Maximum input current: 24 mA

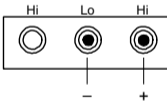
6.1 Connecting Procedure

- <1> Insert the plugs of the supplied lead cables into the terminals of the CA11 as shown in figure “a” below for voltage or in figure “b” below for current.
- <2> Connect the clips on the other ends to the input terminals of the device under measurement.

a Connection of the voltage
input terminals
INPUT V



b Connection of the current
input terminals
INPUT mA



6.2 Measuring DC Voltage and DC Current

- <1> Switch the measurement/generation 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. Indication of the measurement results will be updated approximately every second.
 - If input signal is over-ranged, the display unit shows “----”.
 - For invalid ranges, terminal-to-terminal connection becomes open, causing the display unit to show “-nC-” and “OFF.”

■ Input limiter

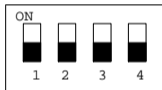
If voltage is applied to the current input terminals or excessive current is applied to them, the internal protective circuit is activated, opening the terminal-to-terminal connection. This causes the display unit to show “OFF.”

In this case, check that the connection is correct and press the [INPUT ON] key (= [OUTPUT ON/OFF] key). This causes the OFF indication to disappear and resume measurement.

7. Other Features

The following features are available depending on setting of the DIP switches, which are accessed by removing the rear cover from the back of the instrument.

DIP switches

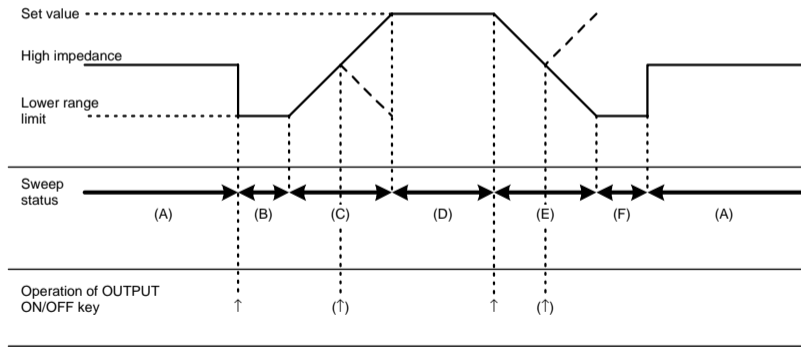


- 1: Sweep function
- 2: Sweep time (ON: 32 sec., OFF: 16 sec.)
- 3: Not used
- 4: Disable automatic power-off

7.1 Sweep Function

Setting the DIP switch 1 on, increases or decreases the output level to the preset level at a constant rate.

Output status transition diagram



Operation procedure

- <1> Turn on DIP switch 1.
- <2> Use DIP switch 2 to select sweeping time (16 or 32 seconds).
- <3> Set the measurement/generation selection switch to SOURCE. The display unit shows “SOURCE,” “OFF,” “SP,” and lower limit (initial value).
- <4> Use the [▲]/[▼] keys to preset the upper limit for output as the same way as normal signal generation. (Status A above)
- <5> Press the [OUTPUT ON/OFF] key.
 - (B) The display unit shows “ON” and a lower limit (initial value) of 2 seconds and the instrument outputs that value.
 - (C) Then the reading on the display unit and the output level automatically increase to the upper limit set in step <4> at the constant sweep time rate set in step <2>. The display unit shows “ON” blinking. In this case, if you press the [OUTPUT ON/OFF] key again, the reading and the output level start decreasing from that value at a constant rate. The output status changes to status E (dotted-line part in the figure).

(D) When the reading and the output level reach the set values, they remain at this level until the [OUTPUT ON/OFF] key is pressed. The display unit lights “ON.”

In this case, if you press the [OUTPUT ON/OFF] key, the reading and the output level start decreasing from that value at a constant rate. The output status changes to status E.

(E) Then the reading and the output level automatically decrease to the set lower limit at the constant sweep time rate set in step <1>.

The display unit shows “OFF” blinking.

In this case, if you press the [OUTPUT ON/OFF] key again, the reading and the output level start increasing from that value at a constant rate.

The output status changes to status C (dotted-line part in the figure).

(F) Then the reading and the output level reach the lower limit and remain at this level for 3 seconds. The display unit lights “ON.”

<6> Return to step <4>.

Canceling the sweep feature:

<7> Open the rear cover at the back of the instrument and set DIP switch 1 to off.

7.2 Disabling Automatic Power off

At the factory shipment, the instrument is initialized so that it will turn off automatically if not operated for a period of 10 minutes or more. If you set DIP switch 4 to on, the instrument can be used continuously without automatic power off.

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 Functions

Accuracy: \pm (% of set value + mV, μ V or μ A), at $23 \pm 5^\circ\text{C}$ for one year

Range Selection	Range of Generated Signal	Accuracy	Setting Resolution	Remarks
30V	0 to 30.00V	0.05%+20mV	10mV	Maximum output current: 1 mA
10V	0 to 11.000V	0.05%+2mV	1mV	Maximum output current: 10 mA *1 When the load is 1 k Ω or greater, and the error of the lead cables is also excluded.
<1-5V>	1/2/3/4/5V		1Vstep	
1V	0 to 1.1000V	0.05%+0.2mV *1	0.1mV	
100mV	0 to 110.00mV	0.05%+50 μ V *1	0.01mV	
20mA	0 to 24.00mA	0.05%+4 μ A	0.01mA	Maximum load: 12 V
<4-20mA>	4/8/12/16/20mA		4mAstep	
20mA SINK	0.1 to 24.00mA	0.1% +4 μ A	0.01mA	External power supply: 5 to 28 V

Temperature effect: 1/10 of accuracy / $^\circ\text{C}$.

■ Measurement Functions

Accuracy: \pm (% of reading + least significant digits), at $23 \pm 5^\circ\text{C}$ for a year

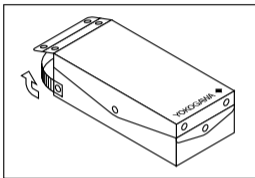
Range Selection	Indication	Accuracy	Resolution	Remarks
30V	0 to \pm 30.00V	0.05%+2 digits	10mV	Input impedance: Approximately 1 M Ω
10V	0 to \pm 11.000V	0.05%+2 digits	1mV	
1V	0 to \pm 1.1000V	0.05%+2 digits	0.1mV	
100mV	0 to \pm 110.00mV	0.05%+7 digits	0.01mV	
20mA	0 to \pm 24.00mA	0.05%+1 digit	0.01mA	Input impedance: Approximately 45 Ω

- Power supply : Four 1.5-V alkaline batteries (ANSI AA-size) or dedicated AC adapter (sold separately)
- Battery life : Approximately 50 hours for 5 V DC output with a load of 10 k Ω or greater
 Approximately 25 hours for 20 mA output with a load of 5 V
 When running on alkaline 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 1 sec.
- Loading conditions : Less than 100 μH for 20 mA, 0.1 μF for other ranges
- Measured-value indication updating intervals : Every second (approx.)
- Display : 7-segment-by-5-digit LCD
- Maximum allowable applied voltage : 30 V DC between each terminal and ground

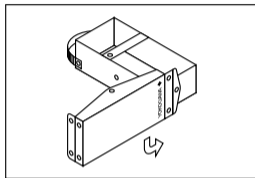
Operating temperature and humidity range	: 0 to 50°C, 20 to 80% R.H (no condensation allowed)
Storage temperature and humidity range	: -20 to 50°C, 90% R.H or less (no condensation allowed)
Dimension	: Approximately 192 (H) × 92 (W) × 42 (D) mm (excluding protrusions)
Weight	: Approximately 440 g
Safety	: 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	: Lead cables (one pair) Carry case (B9108NK)
Optional accessories	: Dedicated AC adaptor (A1020UP AC 100 V • A1022UP AC 120 V • B9108WB AC 220-240 V) Terminal adapter (B9108KF)

9. How to Use the Carry Case

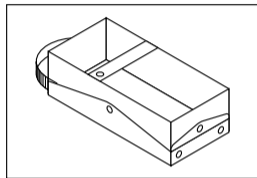
The carry case may be used as described below:



(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 inside 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 CA11 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 1000mV 10V 30V	Max.110mV Max.1.1V Max.11V Max.33V	$\pm (0.005\%+5\mu\text{V})$ $\pm (0.005\%+20\mu\text{V})$ $\pm (0.005\%+200\mu\text{V})$ $\pm (0.005\%+2\text{mV})$	Model 1271/7561 (Yokogawa) or equivalent
20mA	Digital multimeter	20mA(4-20mA)	Max.24mA	$\pm (0.01\%+0.8\mu\text{A})$	Model 1281/1271 (Yokogawa) or equivalent
20mASINK	Digital multimeter, Standard DC voltage generator	20mASINK	0.01 to 24mA 5V to 28V		

■ Measurement feature

Items to be calibrated	Names of standards	Range	Generated value	Accuracy	Remarks
DCV	Standard DC voltage generator	100mV 1000mV 10V (1-5V) 30V	100mV 1V 10V 30V	\pm (0.01%/100mV) \pm (0.01%/1V) \pm (0.01%/10V) \pm (0.02%/30 V)	Model 9100/2552 (Yokogawa) or equivalent
20mA	Standard DC current generator	20mA(4-20mA)	20mA	\pm 0.02%/20mA	Model 9100 (Yokogawa) or equivalent

10.2 Environmental Conditions for Calibration

Ambient temperature : $23 \pm 1^{\circ}\text{C}$

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 following tables.
- It is possible to select the necessary range to be calibrated independently.
- Always calibrate the zero (0) point and full scale (FS) in pair for generation.

Generation:

Calibration points		Standard value*1
100mV	0	0mV
	FS	100mV
1V	0	0mV
	FS	1000mV
10V	0	0V
	FS	10V
30V	0	0V
	FS	30V
20mA	0	0V
	FS	20mA
20mA SINK	0.1	0.1mA
	FS	20mA

*1 Make adjustments to CA11 according to the reading of the standard (CA11 output value), as specified in the table.

Measurement:

Calibration points		Standard value*2
100mV	FS	100mV
1V	FS	1V
10V	FS	10V
30V	FS	30V
20mA	FS	20mA

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

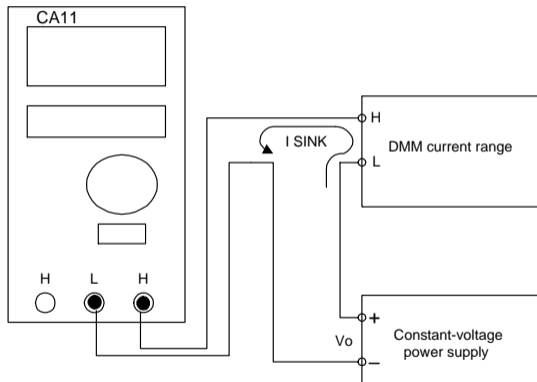
10.4 Precautions for Calibration



- 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.

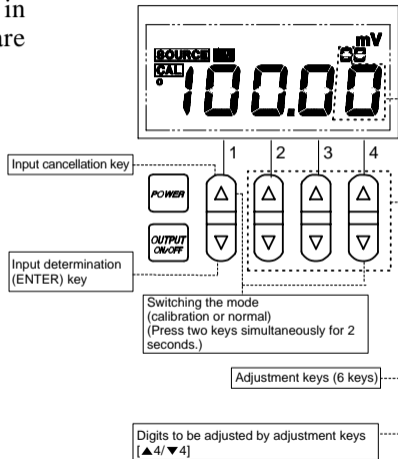
■ Connection for 20 mA SINK calibration

Connect the CA11 calibrator to the standard as shown below:



10.5 Assignment of Keys for Calibration

When the CA11 calibrator is in the calibration mode, keys are assigned as specified here.



10.6 Calibrating the Generation feature

■ Operation procedure:

- <1> Warm up the standard.
- <2> Before turning on the power of the CA11 calibrator, connect it to the standard.
- <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 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 CA11 using the standard (digital multimeter) and adjust the CA11 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 of the range.

<7> Read the output value of the CA11 using the standard (digital multimeter) and adjust the CA11 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 previously 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 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.

10.7 Calibrating the Measurement Feature

■ Operation procedure:

<1> Warm up the standard.

<2> Before turning on the power of the CA11 calibrator, connect it to the standard.

<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 measurement/generation 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 value to the instrument. Wait until the reading stabilizes, then press the [▼1] input determination (ENTER) key to fix the setting.
- <7> After fixing the setting, “0” and “FS” indications on the display unit starts 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 previously 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 comments come to your attention, please 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.

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