

Operation Instruction for Thermocouple Calibrator

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1. Safety Information

To ensure the safety operation, the following signs are used only as specified in this operation instruction.

Warning

A warning shows that if the operation does not comply with the following correct instruction, it is possible to bring hazards to the user or cause damage to the calibrator in use. The warning also points out how to avoid the accidents.

Caution

A caution shows that if the operation does not comply with the following correct instruction, it is possible to cause damage to the calibrator in use. The caution also points out how to avoid maloperation.

Note

A note serves as a sign to remind the user that he must understand the correct operation of the calibrator and its characteristics.

To prevent the user and the calibrator from any electric shock and other hazards, it is necessary to observe the following regulation:

Warning

- It is not allowed to operate the calibrator at the working field where there exists flammable gas or explosive gas or vapor. It is very dangerous to operate the calibrator in such a surrounding.
- Never apply more than 30V between any two terminals, or between any terminal and earth ground.

Caution

- **Disassembly:** No one is allowed to remove the split case (top & bottom) of the calibrator except professionals.
- **In use:** The calibrator can't perform both input and output simultaneously. No direct connection

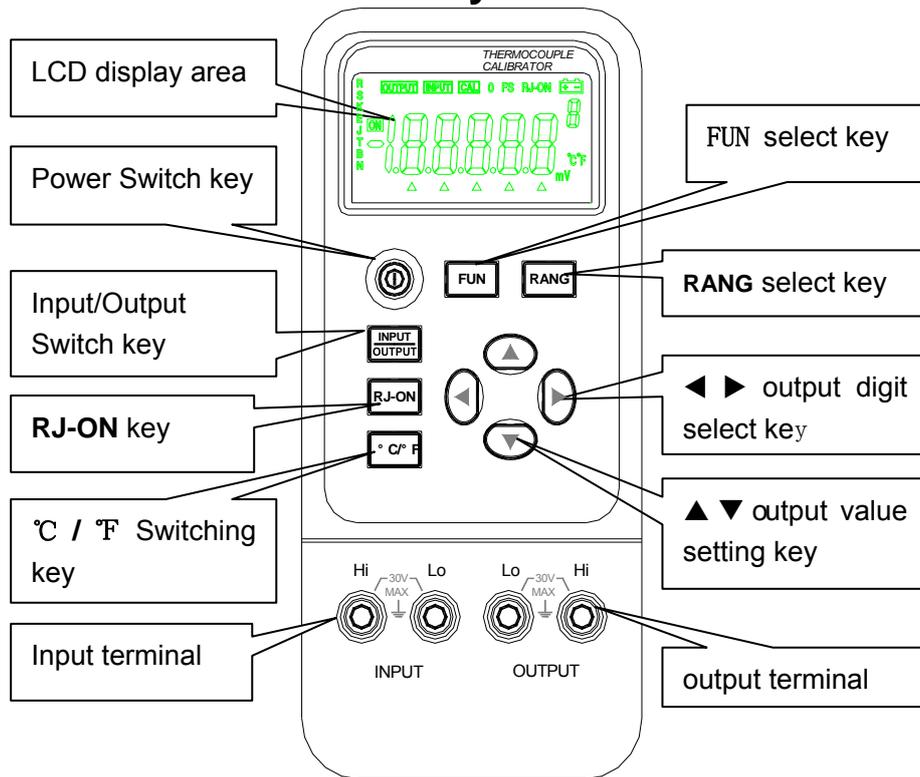
can be made between both input and output.

- **Maintenance:** Periodically wipe the case with a damp cloth and detergent; do not use any corrosive solvents.

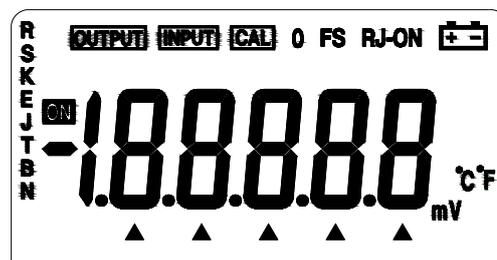
Note

- To keep the calibrator in a designed accuracy, it needs warming up 5 minutes before it is put into operation.
- If any user requires a higher accuracy of the calibrator, the user should make contact with the manufacturer.
- If the automatic reference-junction temperature compensation of the calibrator deviates from its designed accuracy, the user should make contact with our manufacturer.

2. Instrument Panel Layout and Function



Explanation of LCD Display Area



- a) : Press the key (**INPUT/OUTPUT**) when the symbol 'output' appears in the display, denoting that the calibrator is in an output state.
- b) : Press the key (**INPUT/OUTPUT**) when the symbol 'input' appears in the display, denoting that the calibrator is in an input state.
- c) : When this symbol appears in the display, the calibrator is in a calibration state.
- d) 0 FS: This symbol appears with the calibrator getting into a calibration state, denoting that the zero point or the full scale point is in calibration.
- e) RJ- ON: When this symbol appears in the display, it denotes that the calibrator performs the operation of its reference junction compensation. (See subsection 5.2)
- f) : This symbol appears to show that the battery is nearly used up and needs replacing now. (See subsection 3.1)
- g)  : This symbol appears to show that the output digits need setting now.
- h) mV, °C, °F: These symbols appear to show that the unit of a present input value or output value.
- i) : This symbol appears to show that the signal of input or output is in a turn-on state.
- j) R, S, K, E, J, T, B, N: Each of these individual symbols show the type of a thermocouple.

3. Replacing the battery

Warning

- The test leads need removing and the power supply of the calibrator must be shut off prior to replacing the battery.

3.1 When the symbol  appears in the display, it denotes that the battery is nearly used up and needs replacing according to

the following steps:

- 1) Remove the test leads and turn off the power supply of the calibrator.
- 2) Remove the holster from the calibrator. Open the battery cover at the back of the calibrator by unlocking it in the indicated direction.
- 3) Replace the used-up battery with a new one. Put the battery cover back and lock it in the indicated direction.
- 4) Put the holster back onto the calibrator.

4. Power-On/Off of Calibrator

4.1 Power-key operation

Press the power key to turn on the power supply of the calibrator. Then press it again to hold it in one second and the power supply will be off. When the power supply is turned on, the calibrator will start to make self-diagnosis internally and the full screen is in display. After this, appropriate operation should be carried out.

Note

- **Power-on:** To ensure the correct operation of the calibrator with power on, it is good practice to turn off the power supply pausing 5 seconds, and then restart the calibration.

4.2 Automatic power-off

By the shipping time, the calibrator is set for automatic power-off function in the factory like this: In case there is no operation of the calibrator within 10 minutes after power-on, it will cut off the power supply automatically. However, users can decide whether they want to use the function of the automatic power-off or not. The setting can be done by themselves. (See section 7)

5. Output from calibrator

The output terminal of the calibrator produces a DC voltage set by the user or produces an analog temperature signal from a thermocouple.

! Caution

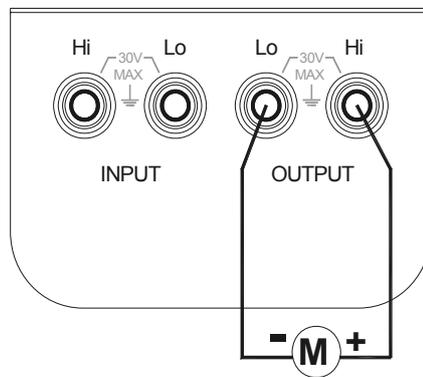
Do not apply any voltage to the output terminal during the operation. If any improper voltage is applied to the output terminal, it will cause damage to the circuit.

Output Operation Procedure

Func.Operation	Range Operation	Display	Set Range
DCV 1 V	1 V ←	0.0000V	-0.1000 to 1.1000V
	↓ 100 mV ┘	000.00mV	-10.00 to 110.00mV
TC R	R ←	0000°C	-40 to 1760°C
	↓		
	S	0000°C	-20 to 1760°C
	↓		
	K	0000.0°C	-200 to 1370°C
	↓		
	E	0000.0°C	-200 to 1000°C
	↓		
	J	0000.0°C	-200 to 1200°C
	↓		
T	0000.0°C	-200 to 400°C	
↓			
B	400°C	400 to 1800°C	
↓			
N	0000.0°C	-200 to 1300°C	

5.1 DC voltage output

- 1) Insert one end of the test lead into the output jack of the calibrator and connect the other end to the input of the user's instrument as shown in the following diagram.



- 2) Press the key (**INPUT/OUTPUT**) when the symbol **OUTPUT** appears in the display, denoting that the calibrator is in an output state.
- 3) Press the key (**FUN**) to select the V function when the unit 'V' appears in the display.
- 4) Press the key (**RANG**) to select the V or mV function when the unit 'V' or 'mV' appears in the display.
- 5) Press the key (**◀**) / (**▶**) to select the set digits for output.
- 6) Press the key (**▲**) / (**▼**) to change the numerical value of the set digits. The value can do carry or number decrement automatically. Hold the pressed key in one second and the value will keep varying.

5.2 Simulating output from thermocouple

- 1) Insert one end of the test lead into the output jack of the calibrator and connect the other end with the input of the user's instrument as shown in the above-illustrated diagram.
- 2) Press the key (**INPUT/OUTPUT**) when the symbol **OUTPUT** appears in the display, denoting that the calibrator is in an output state.
- 3) Press the key (**FUN**) to select the thermocouple function when the unit '°C' and the type 'R' appear in the display.
- 4) Press the key (**RANG**) to select an appropriate type of a thermocouple.
- 5) Press the key (**◀**) / (**▶**) to select the set digits for output.

- 6) Press the key (▲) / (▼) to change the numerical value of the set digits. The value can do carry or number decrement automatically. Hold the pressed key in one second and the numerical value will keep varying.
- 7) Automatic Compensation for Reference-Junction Temperature:
During the direct calibration of an instrument with reference-junction temperature compensation, it is common practice to press the key (RJ-ON) so that the calibrator can start the function of automatic reference-junction compensation, thus providing the required thermo-electromotive force for output followed by displaying the symbol 'RJ-ON'.(Refer to section 8 concerning the reference-junction compensation accuracy of the calibrator.)
Where: output emf = emf corresponding to the set temperature –emf corresponding to the room temperature.
 - ◇ It takes two seconds for the calibrator to start its internal reference junction compensation. After this, each automatic compensation takes place at intervals of 10 seconds.
 - ◇ If there is a change in the operating ambient temperature, do not start the operation until the built-in compensating sensor had become stable (ca.10 minutes).
 - ◇ If there is no need for the calibrator to use the function of automatic reference-junction compensation, the symbol 'RJ-ON' will no longer appear in the display by pressing the key (RJ-ON) .
- 8) Press the key (°C/°F) to select the unit '°C' or '°F'.

6. Calibrator Measurement

Warning

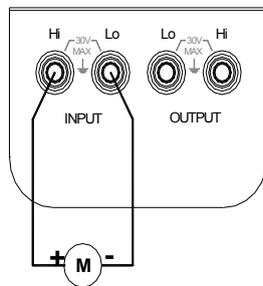
- During the operation, never apply more than 30V between any two terminals, or between any terminal and earth ground. Any voltage more than 30V will not only cause damage to the calibrator, but also lead to possible personal injury.

! Caution

- During the operation, do not apply a voltage exceeding the measuring range to the input terminal, which will cause possible damage to the calibrator.
- Connect the calibrator to the instrument to be measured only after the power supply of the instrument has been cut off. The electric connection without cutting off the power supply will lead to possible damage to the calibrator.
- During the operation, special care should be taken not to apply current signals to the input terminal. Any improper electric connection will cause damage to the calibrator and the instrument to be measured.

6.1 Measuring DC voltage

- 1) Insert one end of the test lead into the input jack of the calibrator and connect the other end to the output of the user's instrument as shown in the following diagram:



- 2) Press the key (**INPUT/OUTPUT**) when the symbol **INPUT**, **ON**, 'mV' appears in the display, denoting that the calibrator is in an input state.
- 3) The calibrator starts measurements and display followed by indicating '000.00', denoting a wait. Then the display indicates the measured result.

result.

- 4) The refreshing rate of displaying the measurement is about twice per second. If the measured value exceeds the measuring range, the display will indicate the symbol '-OL-'.

6.2 Measuring thermocouple (TC)

- 1) Insert one end of the test lead into the input jack of the calibrator and connect the other end to the output of the user's instrument as shown in the above-illustrated diagram.

- 2) Press the key (**INPUT/OUTPUT**) when the symbol 'INPUT' appears in the display, denoting that the calibrator is in an input state.
- 3) Press the key (**FUN**) to select the function of measuring TC when the display indicates the unit '°C' and the type 'R'.
- 4) Press the key (**RANG**) to select an appropriate type of TC.
- 5) When the display indicates the symbol '0000' first, it denotes a wait followed by displaying the measured result. The refreshing rate of displaying the measurement is ca. once per second. If the measured value exceeds the measuring range, the display will indicate the symbol '-OL-'.
- 6) Automatic Compensation for Reference-Junction: press the key (**RJ-ON**) to start the function of automatic reference junction compensation. The measurement value is regarded as a temperature value through the reference junction compensation.
Where: temperature indication = temperature of TC type corresponding to input emf + room temperature
- 7) Press the key (°C/°F) to select the unit '°C' or '°F'.

7. Other Features

The following operation makes it possible for the calibrator to change its automatic power-off function.

- 1) Cut off the power supply of the calibrator.
- 2) Press the key (**POWER**) to make a full screen display. Then release the (**POWER**) key immediately followed by pressing the key (**RANG**) when the calibrator gets into a maintenance state. The display indicates the symbol 'AP-XX'.
- 3) Press the key (▼) when the symbol 'AP-OF' appears in the display, denoting that there is no automatic power-off function available to the calibrator, and when the symbol 'AP-ON' appears, denoting that the calibrator has recovered its automatic power-off function.
- 4) Cut off the power supply again to exit the maintenance state.

8. Performance Capabilities

Output Function & Specification (applicable to temperature range from 18 to 28 °C ,within one year after calibration).

Output	Range	Output Range	Resolution	Accuracy	Remark
DCV	100mV	-10.00 to 110.00mV	0.01 mV	±0.05% of set value ±30µV	Max. output current ±2mA
	1V	-0.10000 to 1.1000V	0.1 mV	±0.05% of set value ±0.3mV	
TC	R	-40 to 1760°C	1°C	±0.05% of set value	By using ITS-90 temperature scale Note 1 Note 2
	S	-20 to 1760°C	1°C	±3°C(≤100°C) ±0.05% of set value ±2°C(>100°C)	
	B	400 to 1800 °C	1°C	±0.05% of set value ±3°C(400°C to 600°C) ±0.05% of set value ±2°C(> 600°C)	
	E	-200.0 to 1000.0 °C	0.1°C	±0.05% of set value	
	K	-200.0 to 1370.0 °C	0.1°C	±2°C(≤ -100°C) ±0.05% of set value	
	J	-200.0 to 1200.0 °C	0.1°C	±1°C(> -100°C)	
	T	-200 to 400.0°C	0.1°C		

	N	-200.0 to 1300.0°C	0.1°C		
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Input function & Specification (applicable to temperature range from 18 to 28 °C, within one year after calibration).

Input	Range	Input Range	Resolution	Accuracy	Remark
DCV	100mV	-10.00 to 110.00mV	10μV	± 0.05% of meas. value ± 30μV	Input resis. 1M Ω
TC	R	-40 to 1760°C	1°C	± 0.05% of meas. value ± 3°C (≤100°C) ± 0.05% of meas. value ± 2°C (>100°C)	By using ITS-90 temperature scale Input resis. 1MW Note 1 Note 2
	S	-20 to 1760°C	1°C		
	B	400 to 1800°C	1°C	± 0.05% of meas. value ± 3°C (400°C to 600°C) ± 0.05% of meas. value ± 2°C (>600°C)	
	E	-200.0 to 1000.0°C	0.1°C	±0.05% of meas. value ± 2°C (≤-100°C) ±0.05% of meas. value ± 1°C (>-100°C)	
	K	-200.0 to 1370.0°C	0.1°C		
	J	-200.0 to 1200.0°C	0.1°C		
	T	-200.0 to 400.0°C	0.1°C		
	N	-200.0 to 1300.0°C	0.1°C		

Note 1: The accuracy does not include the error of internal temperature

compensation caused by a sensor. The range of the internal temperature compensation sensor is from -10 to 50 °C with its compensating error up to 0.5°C.

Note 2: temperature coefficient: $\pm 0.005\%$ of range per °C for the temperature ranges from 0 to 18°C and from 28 to 50°C.

General Specifications

- Power supply: 9V battery (ANSI / NFDA 1604A or IEC6LR619V alkaline)
- Battery life: ca.25 hours
- Max. permitted voltage: 30v (between any two terminals or between any terminal and earth ground)
- Operating temperature: 0°C to 50°C
- Operating relative humidity: $\leq 80\%$ RH
- Storage temperature: $\leq -10^{\circ}\text{C}$ to 55°C
- Storage humidity: $\leq 90\%$ RH
- Size: 200×100×40 mm(with holster)
- Weight: 550g (with holster)
- Accessory: operation instruction, a set of CF-36 industrial test lead (with alligator clips)
- Option: AC power-supply adapter (VCPS) and a set of CF-31-A industrial test lead (with probe clips)
- Safety: Certified as compliant to IEC1010 provisions (Safety Standard issued by International Electrotechnical Commission)

9. Calibration

Note

To ensure the designed accuracy of the calibrator, it is recommendable to calibrate your calibrator once a year. The following recommended standard equipment is used to perform the calibration,

which serves as an example.

! Caution

- During the operation, never apply more than max. permitted voltage to the input of the calibrator, otherwise the overvoltage will lead to possible damage to the input section.
- During the operation, avoid any short circuit and never apply more than the max. permitted voltage to the output of the calibrator and the coworking standard device, otherwise any maloperation will cause possible damage to their internal circuits.

**9.1 Selecting Standard Equipment
Calibrating Output Characteristics**

Calib.Item	Standard Equipment	Input Range	Accuracy	Recommend
DCV 100mV 1V	Digital meter	Max.110mV Max.1.1V	$\pm (10\text{ppm}+1\mu\text{V})$ $\pm (10\text{ppm}+5\mu\text{V})$	1281(FLUKE) 5520A(FLUKE) or equivalent

Calibrating Input characteristics

Calib.Item	Standard Equipment	Output Range	Accuracy	Recommen d
DCV 100mV	standard source	Max.110mV	$\pm (11\text{ppm}+2\mu\text{V})$	5520A(FLUKE) or equivalent

9.2 Ambient Condition for Calibration

Ambient temperature: $23^{\circ}\text{C} \pm 1^{\circ}\text{C}$
 Relative humidity: 45 to 75% RH
 Warming-up:

- The standard equipment must be warmed up to the given time.
- Do not connect the calibrator to the power supply until it has been exposed to the ambient condition for 24 hours. Then set

the calibrator to a state of non-automatic shutdown followed by warming up to 0.5 hour.

Note

Power supply for calibration: During the calibration, the battery needs replacing with a new alkaline one.

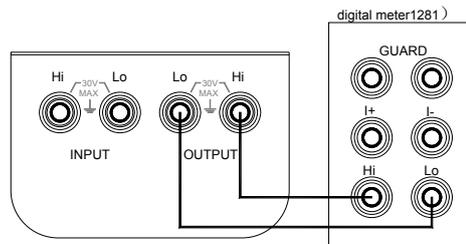
9.3 Operation Output Calibration

Operating calibration in order of items and calibration points in the following table:

Item No.	Output Range	Calib.Point
1	DCV/1V	0
		FS
		0 FS
2	DCV/100mV	0
		FS

9.3.1 1V Range Calibration

- 1) The calibration writing is shown in the following diagram:



- 2) Press the key (FUN) & (RANGE) first, and then press the key (POWER) to enter the calibrator in a state of calibrating the 1V output when the display indicates the symbols 'OUTPUT', 'CAL 0', 'ON' and the unit 'V'.
- 3) Set the digital meter to an appropriate range.
- 4) With the output stabilized, operate the keys (◀) / (▶) and (▲)

/ (▼) to set the indication of the calibrator in identity with the reading of the digital meter.

- 5) Press the key (°C/°F) and the display will flash, denoting that the calibrated point has been stored.
- 6) Press the key (RANG) to display the symbol 'CAL FS'. With the output stabilized, repeat the operation of steps 4 and 5.
- 7) Press the key (RANG) to display the symbol 'CAL 0 FS'. With the output stabilized, repeat the operation of steps 4 and 5.

Note

- **Calibration storage:** Press the key (°C/°F) to store the calibrated point when the display does not flash, denoting that the calibration storage is invalid.

9.3.2 100mV Range Calibration

- 1) The calibration wiring is shown in the above-illustrated diagram.
- 2) Press the key (FUN) to enter the calibrator in a state of 100mV output calibration when the display indicates the symbols 'OUTPUT', 'CAL 0', 'ON' and the unit 'mV'.
- 3) Repeat the operation of steps 3 to 6 in subsection 9.3.1

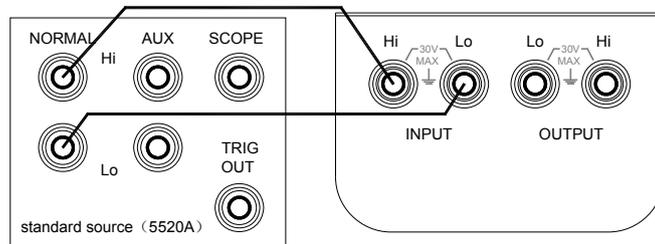
9.4 Operating Input Calibration

Operating the calibration in order of items and calibration points in the following table:

Item .No	Input Range	Calib .Point
1	DCV/100mV	FS:100mV

9.4.1 100mV Range calibration

- 1) The calibration wiring is shown in the following diagram:



- 2) Press the key (**INPUT/OUTPUT**) to enter the calibrator in a state of 100mV input calibration when the display indicates the symbols **INPUT**, **CAL 0**, **ON**, and '100.00mV'.
- 3) Set the standard source to a corresponding range.
- 4) Set the output of standard source to the indication of the calibrator. With the output stabilized, press the key (°C/°F) and the display will flash, denoting that the calibrated point has been stored.

10. Points for Attention to Use of Operation

Instruction

- The present operation instruction is subject to change without notice.
- The content of the operation instruction is regarded as correct. Whenever any user finds its mistakes, omission, etc., he or she is requested to make contact with the manufacturer.
- The manufacturer is not liable for any accident and hazard arising from any maloperation.
- The functions described in this operation instruction should not be used as grounds to apply this product to a particular purpose.