3 in 1, IR, Type K/J/R/E/T, Pt 100 ohm **THERMONETER** Model : TM-2000



purchase of this Your THERMOMETER marks a step forward for you into field of precision the Although measurement. this THERMOMETER is a complex and delicate instrument, its durable structure will allow many years of use if proper operating techniques are developed. Please read the following instructions carefully and always keep this manual within easy reach.



OPERATION MANUAL

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1. FEATURES

- * 3 in 1, Infrared thermometer + Pt 100 ohm thermometer + Thermocouple (Type K/J/R/E/T) thermometer.
- * The best professional thermometer in the world.
- * Microcomputer circuit with high performance.
- * Wide temperature measuring range.
- * Build in $^{\circ}C$ & $^{\circ}F$ select button on the front panel.
- * 0.1 degree resolution for Pt 100 ohm & type K/J/T/E.
- * Data hold function for storing the desired value on display.
- * Memory function to record the maximum & minimum reading.
- * Build in a REL button, useful for relative measurement.
- * LCD display with back light.
- * Sensor select button on the front panel, easy to change different type probe.
- * Infrared thermometer, non-contact temperature measurement, -20 $^\circ\!C$ to 400 $^\circ\!C$ (-4 $^\circ\!F$ to 752 $^\circ\!F$), precise non contact temperature measurement.
- * Emissivity adjustment for IR thermometer.
- * Laser guide for IR temperature measurement.
- * 4 wires PT 100 probe input, cooperate with an 0.00385 alpha coefficient, meet DIN IEC 751, high precision.
- * Thermocouple probe accept 5 different types : type K, type J, type R, type T, type E.
- * RS 232 data output, easily cooperate with computer.
- * Optional data acquisition software for data record.
- * Auto power off saves battery life.
- * Built-in low battery indicator.
- * Heavy duty & compact housing case with stand.
- * Operate from 006P DC 9V battery.
- * Patent pending in TAIWAN, CHINA, USA, GERMANY......
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2. SPECIFICATIONS

2-1 General Specifications

Display	51 mm x 32 mm supper large LCD display,
	15 mm (0.6") digit size.
Sensor	1. Infrared thermometer
Туре	(Non contact temperature measurement)
	2. Platinum Pt 100 ohm
	(0.00385 alpha coefficient, meet DIN IEC 751)
	3. Thermocouple probe
	@ Thermocouple type K
	@ Thermocouple type J
	@ Thermocouple type T
	@ Thermocouple type E
	@ Thermocouple type R
Functions	$^\circ\mathrm{C}$, $^\circ\mathrm{F}$, Data hold, Memory (Max., Min.),
	Relative measurement,
	LCD back light,
	Emissivity adjustment (IR thermometer).
Resolution	0.1 degree or 1 degree.
Circuit	Exclusive microcomputer circuit, the
	software build in linearity correction function
	instead of the traditional hardware circuit.
Emissivity	Range : 0.20 to 1.00.
Adjustment	Adjustment by pushing button on front panel.
Laser Guide	Red laser light, less than 1 mW,
	Meet EN60825
Probe Input	Pt 100 ohm probe :
Socket	DIN 4 pin socket.
	Thermocouple couple probe :
	Standard 2 pin thermocouple socket.

Sampling Time	Approx. 1 second.
Hold Function	To freeze the display reading value.
Memory Recall	Memorize the Maximum, Minimum
	reading.
Offset	Available for IR thermometer,
Adjustment	Pt 100 ohm & Thermocouple thermometer
	Adjustment by pushing button on front panel.
Over Indication	Show " ".
Data Output	RS232 PC serial interface.
Power Supply	Alkaline or heavy duty type,
	DC 9V battery, 006P, MN1604 (PP3)
	or equivalent.
Power	Approx. DC 11 mA (w/o laser light on).
Consumption	Approx. DC 16 mA (with laser light on). * Above consumption value is caculated under the function of IR thermometer & without LCD back light
Operating	$0 \text{ to } 50 \degree (32 \text{ to } 122 \degree \text{F})$
Temperature	
Operating	Less than 80% RH
Humidity	
Size	HWD 200 x 68 x 30 mm (7 9 x 2 7 x 1 2 inch)
Weight	220 g/0 48 LB
Standard	Operational manual 1 PC
Accessory	
Optional	Thermocouple couple (Type K) probe :
& accessories	Model : TP-01, TP-02A, TP-03, TP-04.
Temp. Probe	Pt 100 ohm probe :
	Model : TP-100
(Refer page 18,	RS232 cable
page 19)	Model : UPCB-02
, , ,	Application software, windows version.

2-2 Electrical Specifications

A. Infrared Thermometer

Resolution/	1°C - 20 °C to 400 °C
ranges	1°F -4 °F to 752 °F
Accuracy	 3 % of reading or 3°C (5°F), which ever is greater. * Accuracy test under the measurement range less than 300 °C (572 °F). * <i>Meter operating temp. within 23 5 °C</i> & the emissivity value of measurement
T	 target set to 0.95. * Spec. tested under the 20 cm dia. black body, the measuring distance from the probe sensing Head is 30 cm. * Spec. tested under the environment RF Field Strength less than 3 V/M & frequency less than the 30 MHz only.
Temp. Sensor	
Setting	 By push button. Setting range : 0.20 to 1.00. * Factory preset emissivity value to 0.95, which will cover 90% of a typical application.
Measurement	6 to 12 micro meter.
Wave length Region	
Distance Factor	D/S : Approx. 7:1. D - Distance, S - Spot.

B. Thermocouple (type K/J/R/E/T) Thermometer

Sensor	Reso-	Range	Accuracy
Туре	lution		
Туре К	0.1 °C	-50.0 to 1300.0 °C	(0.2 % + 0.5 °C)
		-50.1 to -100.0 °C	(0.2 % + 1 °C)
	0.1 °F	-58.0 to 2372.0 °F	(0.2 % + 1 °F)
		-58.1 to -148.0 °F	(0.2 % + 1.8 °F)
Туре Ј	0.1 °C	-100.0 to 1150.0 °C	(0.2 % + 0.5 °C)
		-50.1 to -100.0 °C	(0.2 % + 1 °C)
	0.1 °F	-58.0 to 2102.0 °F	(0.2 % + 1 °F)
		-58.1 to -148.0 °F	(0.2 % + 1.8 °F)
Туре Т	0.1 °C	-50.0 to 400.0 °C	(0.2 % + 0.5 °C)
		-50.1 to -100.0 °C	(0.2 % + 1 °C)
	0.1 °F	-58.0 to 752.0 °F	(0.2 % + 1 °F)
		-58.1 to -148.0 °F	(0.2 % + 1.8 °F)
Туре Е	0.1 °C	-50.0 to 900.0 °C	(0.2 % + 0.8 °C)
		-50.1 to -100.0 °C	(0.2 % + 1 °C)
	0.1 °F	-58.0 to 1652.0 °F	(0.2 % + 1.5 °F)
		-58.1 to -148.0 °F	(0.2 % + 1.8 °F)
Type R	1 °C	0 to 600 °C	(1% + 5°C)
		601 to 1700 °C	(1.5 % + 5 ℃)
	1 °F	32 to 1112 °F	(1% + 10°F)
		1113 to 3092 °F	(1.5 % + 10 °F)

Remark :

a. Accuracy value is specified for the meter only.

b. Accuracy is tested under the meter's environment temperature within 23 5 $^\circ$ C.

c. Linearity Correction : Memorize the thermocouple's curve into the intelligent CPU circuit,

C. Platinum PT 100 ohm Thermometer

Resolution	Range	Accuracy
0.1 ℃	-200.0 to 850.0 °C	(0.2 % + 0.5 °C)
0.1 °F	-328.0 to 1562.0 °F	(0.2 % + 1.0 °F)

Remark :

a. Accuracy value is specified for the meter only.

- b. Accuracy is tested under the meter's ambient temperature within 23 5℃.
- *c. Linearity Correction : Memorize the Pt 100 ohm's curve into the intelligent CPU circuit.*
- d. Pt 100 probe input, cooperate with an 0.00385 alpha coefficient, meet DIN IEC 751.
- e. Input socket : DIN 4 pin socket.
- f. 4 wires Pt 100 ohm probe (model : PT-100) is optional, refer to page 18.



4. IR MEASURING PROCEDURE

4-1 General IR Measurement

Measuring consideration of the "Emissivity "

All objects emit invisible energy. The amount of energy is emitted proportional to the object's temperature & its ability to emit energy. This ability is called emissvity based upon the material that object is made of and its surface roughness. Emissivity values range from 0.1 for a very reflective object to 1.00 for a black body.

The probe of this IR THERMOMETER senses energy and calculates the temperature based on the amount of IR energy it receives and a factory set emissivity value is 0.95, which will cover 90% of the typical applications. However if the emissivity value of the measured material is not 0.95, then should adjust the "Emissivity Value ".

The procedure of the emissivity adjustment, please refer to " 4-5 How to Calculate & Adjust the Emissivity, page 11 "

1) Power On :

Power on the meter by pressing the "Power Off/On Button " (3-2, Fig. 1).

The display will count down from "99999", ""88888" to " "00000", then show the IR temperature value (approx. room temperature value) & the emissivity value on the right bottom corner of the LCD.



4-3 Measurement Field Distance/Spot (D/S) value

The object must large than spot size calculated by the measurement Distance/Spot ratio (Distance Factor, refer to page 4). For accurate measurement, a 1.5 times distance/spot size is recommended.

Careful collimating is required when the object is not large enough, if the temperature of the object or a part of it is higher (or lower) than the ambient temperature. After the direction of the probe (little move the probe), the ideal collimating is obtained the display registers the maximum (or minimum) reading. However the emissivity of the object and its ambient must be roughly the same.

4-4 Disturbance

Objects with low emissivity or objects with a low temperature but high emissivity, emit little infrared energy.

Fig. 2

For this reason, measurement of these objects is effected by powerful infrared energy radiated from nearby objects with high emissivity or high temperature.

For example, when such objects are measured in sunlight, erratic measurement happened because of powerful radiated energy from the sun and reflected by the surface of the object and received by the sensor.

4-5 Emissivity Adjustment

A factory set emissivity value of 0.95, which will cover 90% of the typical applications. However to match the correct emissivity with the specific value of the object is important in order to obtain the true temperature. When the emissivity of the object is known & its value is not 0.95. It is necessary to adjust the emissivity value again. The adjustment procedures are listed as following :

- a) Press the "Emissivity Button "(3-8, Fig. 1) continuously for at least 2 seconds. The emissivity value will flash, then release the button.
- b) Use the "Down Button " (3-4, Fig. 1), " Up Button " (3-7, Fig. 1) or the "Left Button " (3-3, Fig. 1) to adjust the required emissivity value.
 Press the "Emissivity Button " continuously for at least 2 seconds again. The emissivity value will stop flashing.
 Release the button, the adjustment procedures are completely finished.

4-6 Offset Value adjustment

Caused by the environment temperature change or other reasons.... Then the measuring value may drift few degrees (1, 2 or 3 degrees).

If found that the measuring values exist little deviation especially when measuring the low temperature, then adjust the offset value will make the compensation & let the measured value precisely.

The offset value adjustment procedures are as following :

a) Use two fingers to press the "Hold Button " (3-5, Fig. 1) & "REC Button " (3-6, Fig. 1) together & not release. The small digit (right bottom corner of LCD) will show the same value of main LCD (big digit).



b) Still hold on the "Hold Button " & the "REC Button ", use the "Down Button " (3-4, Fig. 1), "Up Button " (3-7, Fig. 1) to adjust the big display until the required exact environment temp. value appeared.



Then release all buttons, the small digit display (right bottom corner of LCD) will disappear, the offset adjustment procedures are completely finished.



4-7 Others

- a) If the meter seems to be giving incorrect reading. Then the object may exist the not correct emissivity value (0.95), then it is necessary to make the right emissivity correction. procedures (refer 4-5).
- b) If the surface for measuring is covered by frost or other material, clean it expose the surface.
- c) If the surface for measuring is highly reflective, apply masking tape or apply the known " block body paint " (such as emissivity 0.95).

5. THERMOCOUPLE (Type K/J/T/E/R) MEASURING PROCEDURE

- 1) After power on the meter, select the sensor type (Type K/J/T/E/R) by pressing "Sensor Button "(3-3, Fig. 1). The display will show the symbol of K, J, R, E, T.
- 2) Insert the temp. probe plug into the "Thermocouple Input Socket " (3-11, Fig. 1).



- Select the " °C " " °F " display unit by pressing " °C /°F Button " (3-7, Fig. 1).
- 4) Display will show the temperature reading that measured from the probe.
- 5) **Offset Value adjustment :** Same as 4-6, refer to page 12.

Consideration :

- * When insert the probe plug into the temp. input socket, please take care to observe the correct polarity.
- * When the probe plug is first inserted into the thermometer socket, or if the probe is changed, the plug must be allowed to stabilize at temperature of the socket, which is in thermal contact with cold junction compensation device, for greatest accuracy is to be achieved. This will take a couple of minutes and only apply if the probe plug has previously been exposed to an ambient temperature different to that thermometer.

6. PT 100 ohm MEASURING PROCEDURE

- 1) After power on the meter, press
 - the " Sensor Button " (3-3, Fig. 1) until the LCD show the mark of " $\ensuremath{\mathsf{Pt3850}}$ "
- 2) During the power on, Plug the Pt 100 temp. probe
 (TP-100, optional) into the "Pt 100 ohm Input Socket"
 (3-13, Fig. 1)
- 3) Select the " $^\circ\!C$ " " $^\circ\!F$ " display unit by pressing " $^\circ\!C/^\circ\!F$ Button " (3- 7, Fig. 1).
- 4) Display will show the temperature reading that measured from the probe.
- 5) **Offset Value adjustment :** Same as 4-6, refer to page 12.

7. DATA HOLD, RECORD, RELATIVE, LCD BACK LIGHT and AUTO POWER OFF DISABLE

7-1 Data Hold

- During the measurement, pressing the "Hold Button " (3-5, Fig. 1) will freeze the measured value & the LCD will show "HOLD " symbol.
- 2) Press the "Hold Button " again to cancel the data hold function

7-2 Data Record (Maximum, Minimum reading)

- The DATA RECORD function displays the maximum and minimum readings. To start the DATA RECORD function, press the "REC Button " (3-6, Fig. 1) once. "REC " symbol will appear on the LCD display.
- 2) With the "REC " symbol on the display :
 - (a) Press the "REC Button " (3-6, Fig. 1) once, the "Max " symbol along with the maximum value will appear on the display.
 - (b) Press the "REC Button " again, the "Min " symbol along with the minimum value will appear on the display.
 - (c) To exit the memory record function, press the "REC Button " continuously for at least 2 seconds. The display will revert to the current reading.

7-3 Relative measurement

 During the measurement, the circuit will memorize the last measured value if press the "REL Button " (3-4, Fig. 1) once, display will show zero value & a "REL " symbol appear on the LCD.

- 2) The new measured frequency values will deduct above memorized " Last measured values " automatically.
- 3) It will cancel the relative measurement function if press the " REL Button " once again, at same time the " REL " marker will disappear.

Considering :

When making the "Data Hold "& "Data Record " measurement, the Relative function is prohibited.

7-4 LCD Back-light

Press the "Back Light Button " (3-5, Fig. 1) continuously for at least 2 seconds. The "Back-light " of LCD will light 10 seconds approximately then off automatically.

7-5 Auto Power Off disable

The instrument build-in " Auto Power Shut-off " in order to prolong battery life. The meter will switch off automatically if none of the buttons are pressed within approx. 10 minutes.

To disable this feature, Select the memory record function during measurement, by pressing the "REC Button" (3-6, Fig. 1).

8. BATTERY REPLACEMENT

- When the left top corner of LCD display show " " it is necessary to replace the battery. However within specification measurement may still be made for several hours after low battery indicator appears before the instrument become inaccurate.
- 2) Open the "Battery Cover" (3-10, Fig. 1) away from the instrument and remove the battery.
- 3) Install a 9 V battery (Alkaline or Heavy duty type) and replace the cover.

9. RS232 PC SERIAL INTERFACE

The instrument features an RS232 output via 3.5 mm Terminal (3-9, Fig. 1).

The connector output is a 16 digit data stream which can be utilized to the user's specific application.

A RS232 lead with the following connection will be required to link the instrument with the PC serial input.



The 16 digit data stream will be displayed in the following format :

D15 D14 D13 D12 D11 D10 D9 D8 D7 D6 D5 D4 D3 D2 D1 D0

Each digit indicate the following status :

D0	End Word
D1 & D8	Display reading, $D1 = LSD$, $D8 = MSD$
	For example :
	If the display reading is 1234, then D8 to D1 is :
	00001234
D9	Decimal Point(DP), position from right to the left
	0 = No DP, 1= 1 DP, 2 = 2 DP, 3 = 3 DP
D10	Polarity
	0 = Positive 1 = Negative
D11 & D12	Annunciator for Display
	°C = 01 °F = 02
D13	1
D14	4
D15	Start Word

RS232 FORMAT : 9600, N, 8, 1

10. OPTIONAL ACCESSORIES & PROBES

PT-100 ohm	Model : TP-100
Probe	* -50 $^\circ\!\mathrm{C}$ to 400 $^\circ\!\mathrm{C}$ (-58 $^\circ\!\mathrm{F}$ to 752 $^\circ\!\mathrm{F}$), DIN
	plug, 4 pins/4 wires, Class A, Cooperate
	with an 0.00385 alpha coefficient,
	* Meet DIN IEC 751.
	* Accuracy : (0.15 + (0.002 x T))°C
	* Dimension Sensing head - 152 mm tube
	Probe length : 245 mm.

Thermocouple	Model : TP-01
Probe	* Measure Rage : -40 $^\circ C$ to 250 $^\circ C$, -40 $^\circ F$
(ТуреК)	to 482 °F.
	* Ultra fast response naked-bead
	thermocouple, general purpose
	application.
Thermocouple	Model : TP-02A
Probe	* Measure Range : -50 $^\circ \!\! C$ to 900 $^\circ \!\! C$, -50 $^\circ \!\! F$
(ТуреК)	to 1650 °F.
	* Dimension: 10 cm tube, 3.2 mm Dia.
Thermocouple	Model : TP-04
Probe	* Measure Range : -50 $^\circ \!\! \mathbb{C}$ to 400 $^\circ \!\! \mathbb{C}$, -50 $^\circ \!\! \mathbb{F}$
(ТуреК)	to 752 °F.
Surface Probe	* Dimension: 10 cm tube, 8 mm Dia.
Thermocouple	Model : TP-03
Probe	* Measure Range : -50 $^\circ\!\!\mathbb{C}$ to 1200 $^\circ\!\!\mathbb{C}$,
	-50°F to 2200 °F.
(ТуреК)	* Size : Temp. sensing head - 15 mm Dia.
	Probe length : 120 mm.
RS232 cable	Model : UPCB-02
	* RS232 cable for connecting between the
	meter & the computer.
Software	Model : SW-U101-WIN, Windows version.
	* Software apply as the performance of data
	logging system & data recorder
Carrying Case	Model : CA-03, Vinyl soft carrying case.
Carrying Case	Model : CA-06, Hard carrying case.

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