



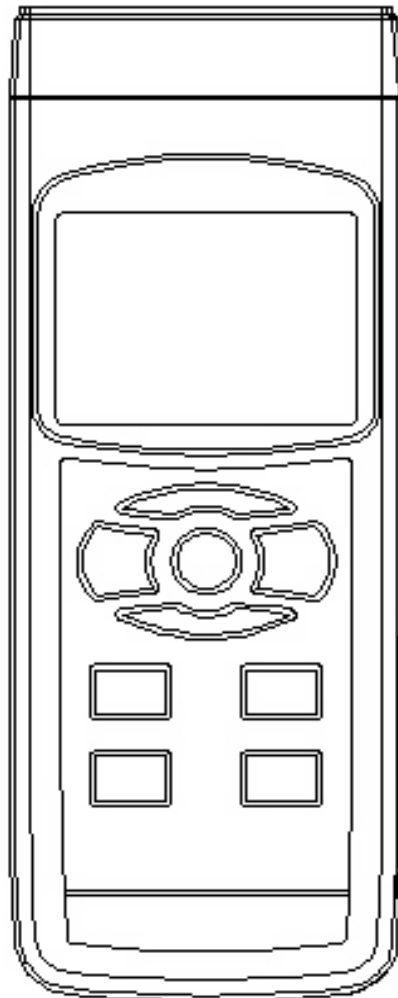
Laboratory Equipment Manufacturer
www.mrclab.com



T1, T2, T3, T4, T1-T2, Type J/K, Pt 100 ohm

4 CHANNEL THERMOMETER

Model : TM-946



PLEASE READ THIS MANUAL CAREFULLY BEFORE OPERATION

3, Hagavish st. Israel 58817 Tel: 972 3 5595252, Fax: 972 3 5594529
mrc@mrclab.com

MRC. 7.19

TABLE OF CONTENTS

1. FEATURES.....	1
2. SPECIFICATIONS.....	1
3. FRONT PANEL DESCRIPTION.....	5
4. GENERAL MEASURING PROCEDURE.....	6
4-1 Type K measurement.....	6
4-2 Type J measurement.....	7
4-3 Pt 100 ohm measurement.....	7
4-4 T1-T2 measurement.....	8
4-5 Data Hold.....	8
4-6 Data Record (Max, Min reading).....	8
4-7 Data Logger.....	9
5. ADVANCED MEASURING PROCEDURE.....	11
5-1 Change the data logger sampling time.....	11
5-2 Clear the existing saving data from the memory.....	13
6. SEND THE DATA OUT FROM THE METER.....	14
7. OFFSET ADJUSTMENT.....	16
7-1 Type K, Type J offset adjustment.....	16
7-2 Pt 100 ohm offset adjustment.....	17
8. AUTO POWER OFF DISABLE.....	18
9. RS232 PC SERIAL INTERFACE.....	19
10. BATTERY REPLACEMENT.....	21
11. OPTIONAL ACCESSORIES.....	21

1. FEATURES

- * Type K/J, Pt 100 ohm, measurement with 4 display.
- * Show 4 channels display on the LCD at the same time.
- * Type K : -199.9 to 1370 °C.
- * Type J : -199.9 to 1210 °C.
- * Pt 100 ohm : -199.9 to 850.0 °C.
- * °C/°F, 0.1 degree/1 degree.
- * 4 channels (T1, T2, T3, T4), T1-T2.
- * Microcomputer circuit provides intelligent function and high accuracy.
- * Manual and auto data logger, with flexible sampling time selection, can save max. 16,000 reading data.
- * Records Maximum and Minimum readings with recall.
- * Data hold function for freezing the desired value.
- * Offset adjustment for the Type K and Type J measurement.
- * Offset adjustment for the Pt 100 measurement.
- * Measuring unit can select to °C or °F.
- * DC 1.5V (UM-4, AAA) battery x 6 PCs.
- * Build in the input socket for DC 9V power adapter.
- * RS232 PC serial interface.
- * Few panel buttons, easy operation.
- * Built-in low battery indicator.
- * Heavy duty & compact housing case.

2. SPECIFICATIONS

2-1 General Specifications

Circuit	Custom one-chip of microprocessor LSI circuit.
---------	--

Display	LCD size : 52 mm x 38 mm * <i>Show 4 channels display on the display at the same time.</i>	
Display Unit	°C, °F.	
Resolution	0.1°C/1°C, 0.1°F/1 °F.	
Channels	T1, T2, T3, T4, T1-T2.	
Sensor type	Type K thermocouple probe.	
	Type J thermocouple probe.	
	PT 100 ohm probe * <i>Cooperate with an 0.00385 alpha coefficient, meet DIN IEC 751.</i>	
Sampling Time of Data Logger	Manual	Push the data logger button once will save data one time. * <i>Set the sampling to 0 second.</i>
	Auto	1 second to 59 minutes and 59 seconds.
Data Logger number	Max. 16,000-point Data logger	
	Type K, Type J, 4 channels (T1, T2, T3, T4) * <i>Memory occupy 4 data point space.</i>	
	Pt 100 ohm, 2 channels (T1,T2) * <i>Memory occupy 2 data point space.</i>	
Temperature Compensation	Automatic temp. compensation for the cold junction both type K/J thermometer	
Linear Compensation	Linear Compensation for the full range.	
Offset, Span Adjustment	Available for advanced calibration procedure.	
Probe Input Socket	Type K, Type J : 2 pin thermocouple socket.	
	Pt 100 ohm : Ear phone socket.	

Over Indication	Show " - - - - - ".
Data Hold	Freeze the display reading.
Memory Recall	Maximum & Minimum value.
Sampling Time of display	Approx. 1 second.
Power off	Auto shut off saves battery life or manual off by push button.
Data Output	RS 232 PC serial interface.
Operating Temperature	0 to 50 °C.
Operating Humidity	Less than 80% R.H.
Power Supply	DC 1.5 V battery (UM4, AAA) x 6 PCs, or equivalent.
	DC 9V adapter input. <i>* AC/DC power adapter is optional.</i>
Power Current	Approx. DC 9 mA.
Weight	310 g/0.68 lb.
Dimension	174 x 68 x 42 mm (6.9 x 2.7 x 1.7 inch).
Accessories Included	Instruction manual..... 1 PC
Optional Accessories	<ul style="list-style-type: none"> * Type K thermocouple probe. TP-01, TP-02A. TP-03, TP-04 * Pt 100 ohm probe, TP-101. * AC to DC 9V adapter. * RS232 cable, UPCB-02. * USB cable, USB-01 * Data Acquisition software, SW-U801 * Data Logger software, SW-DL2005. * Soft carrying case, CA-05A. * Hard carrying case, CA-06.

2-2 Electrical Specifications (23± 5 °C)

Type K, Type J thermocouple

Sensor Type	Resolution	Range	Accuracy
Type K	1 °C	1000 to 1370 °C	± (0.5 % + 1 °C)
	0.1 °C	-199.9 to 999.9 °C	
	1 °F	1000 to 2498 °F	± (0.5 % + 1.8 °F)
	0.1 °F	-199.9 to 999.9 °F	
Type J	1 °C	1000 to 1210 °C	± (0.5 % + 1 °C)
	0.1 °C	-199.9 to 999.9 °C	
	1 °F	1000 to 2210 °F	± (0.5 % + 1.8 °F)
	0.1 °F	-199.9 to 999.9 °F	

* Accuracy value is specified for the meter only.
 * Type K probe TP-01 TP-02A, TP-03. TP-04 are the optional accessories.

PT 100 ohm

Resolution	Range	Accuracy
0.1 °C	-199.9 to 850.0 °C	± (0.4 % + 1 °C) ± (0.4 % + 1.8 °F)
1 °F	1000 to 1562 °F	
0.1 °F	-199.9 to 999.9 °F	
1 °F	-200 to -327 °F	

* Pt 100 ohm probe TP-101 is the optional accessory.
 * Above specification tests under the environment RF Field Strength less than 3 V/M & frequency less than 30 MHz only.

3. FRONT PANEL DESCRIPTION

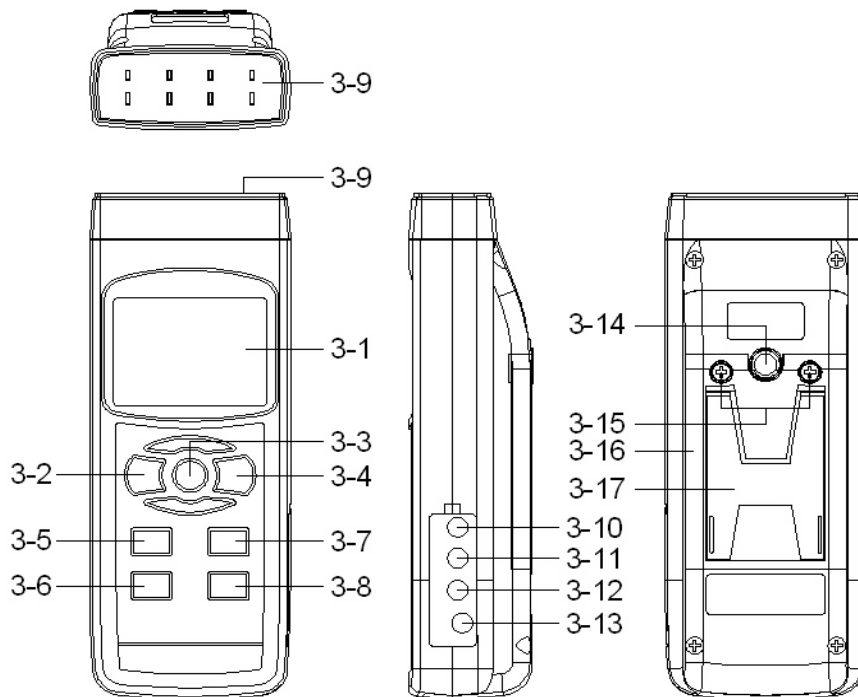


Fig. 1

- 3-1 Display
- 3-2 Power button
- 3-3 Hold/ESC button
- 3-4 REC/Enter button
- 3-5 Function button (▲ button, L button)
- 3-6 °C/°F button (Send, CLR button)
- 3-7 T1-T2 button (▼ button, R button)
- 3-8 Logger button (Sample time, Offset button)
- 3-9 T1,T2,T3,T4 input socket (Type K, Type J)
- 3-10 PT1 input socket (Pt 100 ohm)
- 3-11 PT2 input socket (Pt 100 ohm)
- 3-12 RS-232 output terminal
- 3-13 DC 9V adapter socket
- 3-14 Tripod Fix Nut
- 3-15 Battery Cover Screws
- 3-16 Battery compartment/Cover
- 3-17 Stand

4. GENERAL MEASURING PROCEDURE

4-1 Type K measurement

1) Power on the meter by pressing the " Power button " (3-2, Fig. 1) once (> 1 sec).

** After already power on the meter, pressing the " Power button " once (> 1 sec) will turn off the meter.*

2) Meter default measurement function is Type K, the display will not show any indicator.

** For the Type J measurement, the LCD will show " J " indicator.*

** For the Pt 100 ohm measurement, the LCD will show " Pt " indicator.*

3) Select the temperature unit to °C, °F by pressing the " °C/°F button " (3-6, Fig. 1)

** The LCD will show " °C " (°F) unit.*

** The selecting unit will be saved into the memory permanently. If meter power off and on again, the original selecting unit will present automatically.*

4) Insert the Type K probes into the " T1, T2, T3, T4 input socket " (3-9, Fig. 1).

The LCD will show the 4 channels (T1, T2, T3, T4) temperature value at the same time.

** If the certain channels do not insert the temperature probes, the relative channel display will show over range " - - - - - ".*

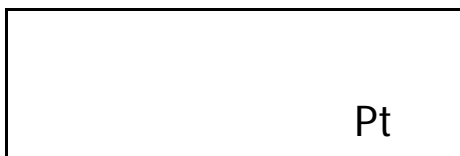
4-2 Type J measurement

All the measuring procedures are same as the Type K (section 4-1) except to select the function to " Type J " by pressing the " Function button " (3-5, Fig. 1) once until the up LCD display show " J " indicator.

4-3 Pt 100 ohm measurement

All the measuring procedures are same as the Type K (section 4-1) except :

1) Pressing the " Function button " (3-5, Fig. 1) until the right down LCD display show " Pt "



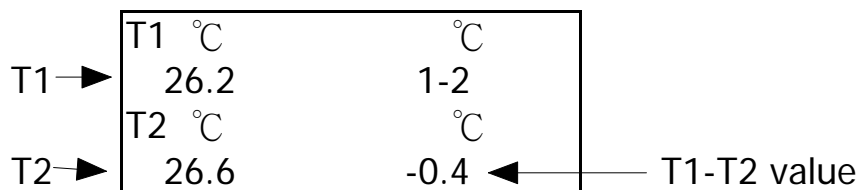
2) Insert the Pt 100 ohm probe to
PT1 input socket (3-10, Fig. 1)
PT2 input socket (3-11, Fig. 1)

* The Pt 100 ohm measurement only allow max. two channels (two probes) input.

4-4 T1-T2 measurement

If the meter already insert two probes :
Type K, Type J : T1, T2 input socket
Pt 100 ohm : PT1, PT2 input socket

Pressing the " T1-T2 button " (3-7, Fig. 1), display will show the difference temperature value between T1, T2 (PT1, PT2) as :



4-5 Data Hold

During the measurement, press the " Hold Button " (3-3, Fig. 1) once will hold the measured value & the LCD will show " D.H. " symbol.

Press the " Hold Button " once again will release the data hold function.

4-6 Data Record (Max., Min. reading)

* The data record function records the maximum and minimum readings. Press the " REC Button " (3-4, Fig. 1) once to start the Data Record function and there will be a " REC " symbol on the display.

- * When the " REC " symbol on the display :
 - a) Press the " REC Button " (3-4, Fig. 1) once, the " REC MAX " symbol along with the maximum value will appear on the display.
If intend to delete the maximum value, just press the " Hold button " (3-3, Fig. 1) once, the display will show the " REC " symbol only & execute the memory function continuously.
 - b) Press the " REC button " (3-4, Fig. 1) again, the " REC. MIN. " symbol along with the minimum value will appear on the display.
If intend to delete the minimum value, just press the " Hold button " (3-3, Fig. 1) once, then the display will show the " REC " symbol only & execute the memory function continuously.
 - c) To exit the memory record function, just press the " REC " button over seconds at least. The display will revert to the current reading.

4-7 Data Logger

- * The data logger function can save 16,000 measuring data.
- * The default sampling time is 2 seconds.

The data logger procedures are as following :

- a) Press the " REC Button " (3-4, Fig. 1) once to start the Data Record function and there will be a " REC " symbol on the display.

b) Auto Data Logger (Sampling time should select to 1 second to 59 minutes and 59 seconds)

Press the " Logger button " (3-8, Fig. 1) once to start the Data Logger function. The REC symbol will flash per 2 second and the beeper will sound when save the data into the memory. Now the Date Logger function is executed.

Manual Data Logger (Sampling time should set to 0 second)

Press the " Logger Button " (3-8, Fig. 1) once will save the data one time into the memory, at the same time the symbol " REC " will flash once and the beeper will sound.

Memory full

When execute the data logger function, if the upper left display show " FULL ", it indicate the memory data already over 16,000 no. and the memory is full.

c) During the Data Logger function is executed, press the " Logger Button " (3-8, Fig. 1) once will stop the data logger function, the " REC " symbol will stop to flash.

If press the " Logger Button " (3-8, Fig. 1) once again will continuous the Data Logger function.

Note :

- 1) If intend to change the data logger sampling time, please refer section 5-1, page 11.*
- 2) If intend to know the space of balance data numbers into the memory IC, please refer section 6, page 14.*
- 3) If intend to clear the saving data from the memory please refer section 5-2, page 13.*

5. ADVANCED SETTING PROCEDURE

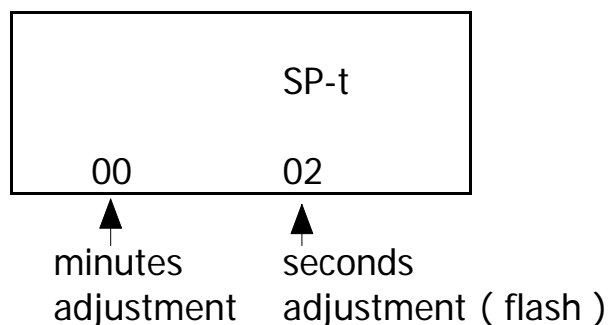
Before executing advanced adjustment procedures, exit the " Hold function " and the Record " function.

5-1 Change the data logger sampling time

- 1) Pressing " Sample time button " (3-8, Fig. 1) continuously at least two seconds then release, the display will show :

oFS	SP-t
-----	------

1) Pressing " R button " (3-7, Fig. 1) once, the display will show as example :

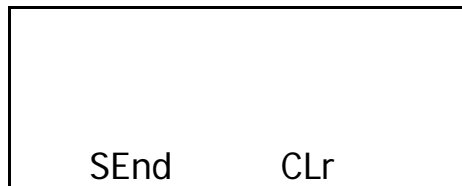


- * The " seconds digits " will be flashed, use the " ▲ button " (3-5, Fig. 1) " ▼ button " (3-7, Fig. 1) to adjust the desiring seconds value (0 to 59).
- * Pressing " Sampling time button " (3-8, Fig. 1) once again, the " minutes digits " will be flashed, use the " ▲ button " (3-5, Fig. 1) " ▼ button " (3-7, Fig. 1) to adjust the desiring minutes value.
- * Pressing " Enter button " (3-4, Fig. 1) once, both the " seconds digits " and " minutes digits " will flashing 4 times then return to normal measuring screen, the sampling time will save into the memory.

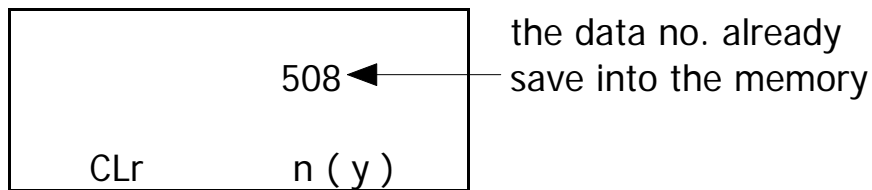
During the display flashing, if pressing the " ESC button " (3-3, Fig. 1) will exit the sampling time setting function, the setting value will not be saved into the memory.

5-2 Clear the existing saving data from the memory

1) Pressing " CLR button " (3-6, Fig. 1) continuously at least two seconds then release, the display will show :



2) Pressing " R button " (3-7, Fig. 1) once, the display will show as example :

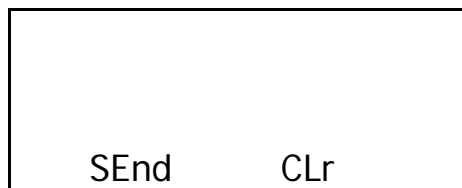


- * Use the " ▲ button " (3-5, Fig. 1) " ▼ button " (3-7, Fig. 1) to change the right bottom text from " n " to " y ".
- * Pressing " Enter button " (3-4, Fig. 1) once, the data no. will show zero value and flashing 4 times then return to normal measuring screen, the data no. will be erased from the memory.

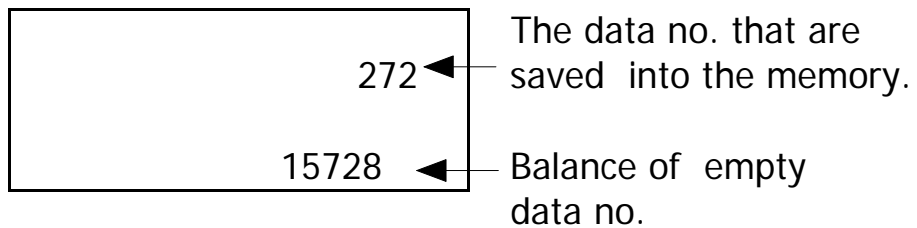
During the display flashing, if pressing the " ESC button " (3-3, Fig. 1) will exit the memory clear function.

6. SEND THE DATA OUT

- 1) To send the data out from the meter, should exit the " Hold function " and the " Record function " at first.
- 2) Pressing " Send button " (3-6, Fig. 1) continuously at least two seconds then release, the display will show :



- 3) Pressing " L button " (3-5, Fig. 1) once, the display will show as example :

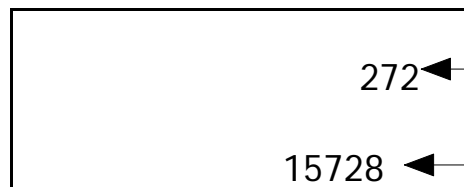


- 4) Pressing " Send button " (3-6, Fig. 1) once, the display will show as following screen and send the data out.



Value will increase up from zero until reach to the existing save data no.

Then LCD will change to the following screen.



The data no. that are saved into the memory.

Balance of empty data no.

- * During send the data out, if pressing the " Send button " (3-6, Fig. 1) once will stop the data send out temporarily.
- * Pressing " Send button " (3-6, Fig. 1) once again will send the data continuously.
- * After data send out, pressing the " ESC button " (3-3, Fig. 1) will return to normal screen.

5) If intend up load the data to the computer, then should connect the optional RS232 cable/UPCB-02 or USB cable/USB-01 and cooperate the Data Logger software (optional, Model : SW-DL2005).

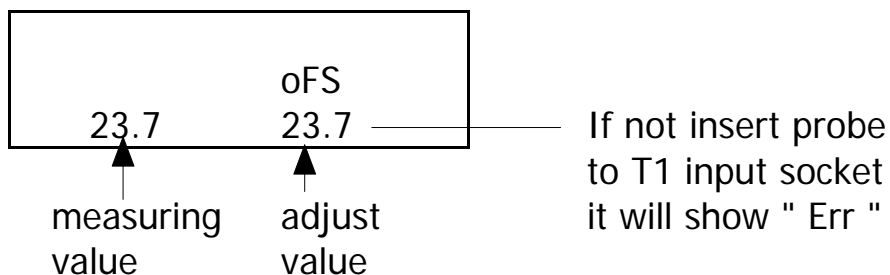
7. OFFSET ADJUSTMENT

7-1 Type K, Type J offset adjustment

- 1) Set the function to Type K (Type J).
- 2) Insert the probe to the T1 input socket.
- 3) Pressing " Offset button " (3-8, Fig. 1) continuously at least two seconds then release, the display will show :



- 4) Pressing " L button " (3-5, Fig. 1) once, the display will show as example



- * Use the " ▲ button " (3-5, Fig. 1) " ▼ button " (3-7, Fig. 1) to adjust the desiring value on right bottom display.
- * Pressing " Enter button " (3-4, Fig. 1) once, both bottom display will flashing 4 times then return to normal measuring screen and finish the offset adjustment procedures.
- * *The above offset adjustment for Type K (Type J) is valid for T1, T2, T3, T4 at the same time.*

7-2 Pt 100 ohm offset adjustment

- 1) Set the function to Pt 100 ohm.
- 2) Insert the Pt 100 ohm probe to the PT1 (PT2) input socket.
- 3) Pressing " Offset button " (3-8, Fig. 1) continuously at least two seconds then release, the display will show :

oFS	SP-t
-----	------

- 4) Pressing " L button " (3-5, Fig. 1) once, the display will show :

Pt 1	oFS Pt 2
------	-------------

- 5) If intend to make the offset adjustment for Pt 1, it should insert the probe to PT1 input socket. Pressing " L button " (3-5, Fig. 1) once, the display will show example as following.
- 6) If intend to make the offset adjustment for Pt 2, it should insert the probe to PT2 input socket. Pressing " R button " (3-7, Fig. 1) once, the display will show example as following.

23.7	oFS 23.7
------	-------------

↑ measuring value ↑ adjust value

If not insert probe to PT1, PT2 input socket, it will show " Err "

- * Use the " ▲ button "(3-5, Fig. 1) " ▼ button " (3-7, Fig. 1) to adjust the desiring value on right bottom display.
- * Pressing " Enter button " (3-4, Fig. 1) once, both bottom display will flashing 4 times then return to normal measuring screen and finish the offset adjustment procedure.
- * *The above offset adjustment for Pt 100 ohm is valid for PT1, PT2 individually.*

8. AUTO POWER OFF DISABLE

The meter is built the " Auto power shut off " to saves battery life. If any buttons not be pushed within 10 minutes, then the power will be off automatically.

If the user is not intend to execute the " Auto Power off " function, it should take the following procedures :

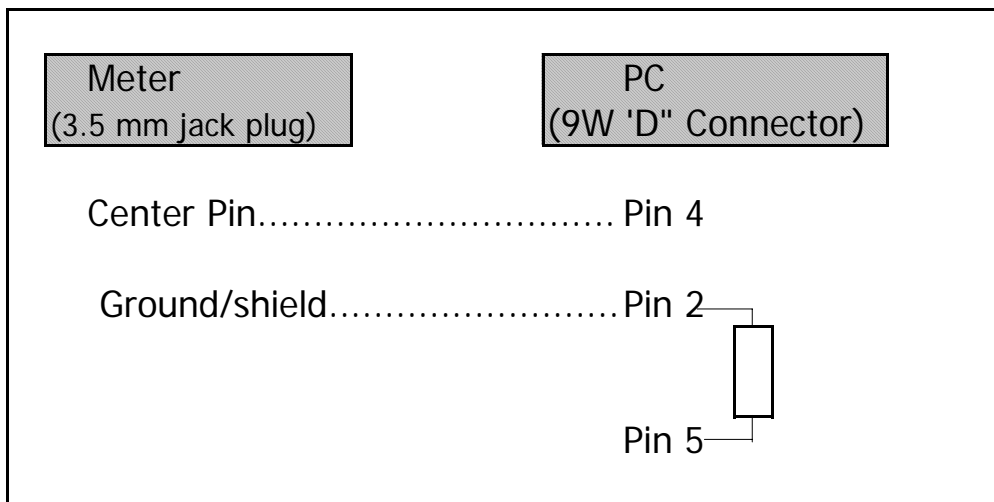
During the measurement, push the " Record Button" (3-4, Fig. 1) to execute the memory record function, the auto power function will disable.

9. RS232 PC SERIAL INTERFACE

The instrument has RS232 PC serial interface via " RS 232 out terminal " 3.5 mm terminal (3-12, Fig. 1).

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

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



The 16 digits 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 indicates the following status :

D15	Start Word = 02
D14	4
D13	Function : T1, T2, T3, T4 When send the T1 value, D13 = 1 When send the T2 value, D13 = 2 When send the T3 value, D13 = 3 When send the T4 value, D13 = 4
	Function : T1, T2, T1-T2 When send the T1 value, D13 = 1 When send the T2 value, D13 = 2 When send the T1-T2 value, D13 = 3
D12 & D11	Annunciator for Display
	°C = 01 °F = 02
D10	Polarity 0 = Positive 1 = Negative
D9	Decimal Point(DP), position from right to the left 0 = No DP, 1 = 1 DP, 2 = 2 DP, 3 = 3 DP
D8 to D1	Display reading, D8 = MSD, D1 = LSD. For example : If the display reading is 1234, then D8 to D1 is : 00001234
D0	End Word = 0D

RS232 setting

Baud rate	9600
Parity	No parity
Data bit no.	8 Data bits
Stop bit	1 Stop bit

10. BATTERY REPLACEMENT

- 1) When the left corner of LCD display show " , it is necessary to replace the battery. However, in-spec. measurement may still be made for several hours after low battery indicator appears before the instrument become inaccurate.
- 2) Open the " Battery Cover " (3-16, Fig. 1) away from the instrument by loosening the " Battery Cover Screws " (3-15, Fig. 1) and remove the batteries.
- 3) Replace the batteries (DC 1.5V, UM4/AAA type, 6 PCs) and reinstate the cover.
** Please make attention the polarity of the battery.*
- 4) Make sure the battery cover is secured after changing the batteries.

9. OPTIONAL ACCESSORIES

RS232 cable UPCB-02	* Isolated RS232 cable. * Used to connect the meter to the computer (COM port).
USB cable USB-01	* USB Computer interface cable. * Used to connect the meter to the computer (USB port).
Data Logger software SW-DL2005	* Software the used to download the data logger (data recorder) from the meter to computer.
Carrying case CA-06	* Hard carrying case. * 280 x 195 x 65 mm.
Carrying case CA-05A	* Soft carrying case with saah. * 260 x 110 x 55 mm.

Data Acquisition software SW-U801-WIN	* The SW-U801-WIN is a multi displays (1/2/4/6/8 displays) powerful application software, provides the functions of data logging system, text display, angular display, chart display, data recorder high/low limit, data query, text report, chart report.. .xxx.mdb data file can be retrieved for EXCEL, ACCESS..., wide intelligent applications.
--	--

(Type K) TP-01	* Max. short-tern operating Temperature: 300 °C (572 °F). * It is an ultra fast response naked-bead thermocouple suitable for many general purpose application.
Thermocouple Probe (Type K), TP-02A	* Measure Range: -50 °C to 900 °C , -50 °F to 1650 °F. * Dimension:10cm tube, 3.2mm Dia.
Thermocouple Probe (Type K), TP-03	* Measure Range: -50 °C to 1200 °C , -50 °F to 2200 °F. * Dimension: 10cm tube, 8mm Dia.
Surface Probe (Type K), TP-04	* Measure Range: -50 °C to 400 °C , -50 °F to 752 °F. * Size : Temp. sensing head - 15 mm Dia. Probe length - 120 mm.

Pt 100 ohm probe TP-101	* -50 C to 400 C., Class A. * Cooperate with an 0.00385 alpha.
----------------------------	---