



OMEGA

ENGINEERING, INC.

An OMEGA Group Company



MODEL 873

**Hand Held Digital
Thermometer**



Operator's Manual



WARRANTY

OMEGA warrants this unit to be free of defects in materials and workmanship and to give satisfactory service for a period of one (1) year from date of purchase. If the unit should malfunction, it must be returned to the factory for evaluation. Our Customer Service Department will issue an Authorized Return (AR) number immediately upon phone or written request. Upon examination by OMEGA, if the unit is found to be defective it will be repaired or replaced at no charge. However, this WARRANTY is VOID if the unit shows evidence of having been tampered with or shows evidence of being damaged as a result of excessive current, heat, moisture, vibration, or misuse. Components which wear or which are damaged by misuse are not warranted. These include contact points, fuses, and triacs.

THERE ARE NO WARRANTIES EXCEPT AS STATED HEREIN. THERE ARE NO OTHER WARRANTIES, EXPRESSED OR IMPLIED, INCLUDING BUT NOT LIMITED TO THE IMPLIED WARRANTIES OF MERCHANTABILITY AND OF FITNESS FOR A PARTICULAR PURPOSE. IN NO EVENT SHALL OMEGA ENGINEERING, INC. BE LIABLE FOR CONSEQUENTIAL, INCIDENTAL OR SPECIAL DAMAGES. THE BUYER'S SOLE REMEDY FOR ANY BREACH OF THIS AGREEMENT BY OMEGA ENGINEERING, INC. OR ANY BREACH OF ANY WARRANTY BY OMEGA ENGINEERING, INC. SHALL NOT EXCEED THE PURCHASE PRICE PAID BY THE PURCHASER TO OMEGA ENGINEERING, INC. FOR THE UNIT OR UNITS OR EQUIPMENT DIRECTLY AFFECTED BY SUCH BREACH.

Return Requests/Inquiries

Direct all warranty and repair requests/inquiries to OMEGA Customer Service Department, telephone number (203) 359-1660. Before returning any instrument, please contact the OMEGA Customer Service Department to obtain an authorized return (AR) number. The designated AR number should then be marked on the outside of the return package.

To avoid processing delays, also please be sure to include:

1. Returnee's name, address, and phone number.
2. Model and Serial numbers.
3. Repair instructions.



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FAX: (203) 359-7700

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GENERAL INFORMATION

The OMEGA® Models 873C and 873F are Hand Held Digital Thermometers. Both instruments have large easy to read liquid crystal displays (LCD). The input connection consists of a subminiature, type K thermocouple, female connector (SMP-K-F). This input accommodates any OMEGA type K thermocouple probe fitted with an SMP-K-M connector. Cold junction electronic circuitry in the 873F/873C automatically compensates for ambient temperature changes. These instruments also provide piece-wise linearization conformity for thermocouple non-linearity. The instruments are powered by a 9V battery. Continuous operation of 350 hours is typical with an alkaline battery or 200 hours typical with a carbon-zinc battery.

The Model 873C measures temperature from -55°C to 1000°C on two ranges. The 200°C range measures temperature from -55.0°C to 199.9°C with a resolution of 0.1°C . The 1000°C range measures temperature from -55°C to 1000°C with a resolution of 1°C . The accuracy is $\pm (0.25\% \text{ rdg} + 1.0^{\circ}\text{C})$ from -40°C to 1000°C and $\pm (0.25\% \text{ of rdg} + 2^{\circ}\text{C})$ for -40°C to -55°C .

The Model 873F measures temperature from -60°F to 200°F on two ranges. The 200°F range measures temperature from -60.0°F to 199.9°F with a resolution of 0.1°F . The 2000°F range measures temperature from -60°F to 1999°F with a resolution of 1°F . The accuracy of the Model 873F is $\pm (0.25\% \text{ of rdg} + 2.0^{\circ}\text{F})$.

UNPACKING AND INSPECTION

Remove the Packing List and verify that all equipment has been received. If there are any questions about the shipment, please call OMEGA Customer Service Department at (203) 359-1660.

Upon receipt of shipment, inspect the container and equipment for any signs of damage. Take particular note of any evidence of rough handling in transit. Immediately report any damage to the shipping agent.

NOTE

The carrier will not honor any claims unless all shipping material is saved for their examination. After examining and removing contents, save packing material and carton in the event reshipment is necessary.

OPTIONAL ACCESSORIES

The following optional accessories can be used with the Models 873C and 873F to enhance the performance of the instrument. These accessories are available:

Part Number	Description
KS871	Tilt Stand/Belt Clip/Probe Holder; can be used as a tilt stand or clipped to your belt. It will hold one compact probe.
SC800	Soft Carrying Case
880A2	Deluxe Carrying Case
MN1604	9V Replacement Battery
SMP-K-M	Subminiature Thermocouple Connector, Male
SMP-K-F	Subminiature Thermocouple Connector, Female
OT-201-1	1 oz jar of High Thermal Conductivity Paste for fast surface measurements.

PREPARATION FOR USE

The Models 873F and 873C are supplied ready for use with battery installed. Connect the appropriate probe to the miniature TC connector located on the top of the instrument (just above the display).

SAFETY SYMBOLS AND TERMS

The symbol  on the instrument denotes that the user should refer to the operating instructions.

The **WARNING** used in this manual explains dangers that could result in personal injury or death.

The **CAUTION** used in this manual explains hazards that could damage the instrument.

ENVIRONMENTAL CONDITIONS

Operation of the Models 873C and 873F should take place at an ambient temperature of -10°C to 50°C (14°F to 122°F), less than 80% relative humidity up to 35°C , linearly derate 3% R.H./C from 35°C to 60°C .

OPERATION

The 873C and 873F Hand Held Digital Thermometers are easy to use. There is only one control (located on the side of the instrument) that turns the instrument on/off and selects the range. (See Figures 1 and 2). Use the following procedure to operate the instrument:

1. Turn on the power to the instrument by selecting the desired range.

Model 873C:

- A. 200°C range is the center position of the ON/OFF range switch.
- B. 1000°C range is the upper position of the ON/OFF range switch.

Model 873F:

- A. 200°F range is the center position of the ON/OFF range switch.
 - B. 2000°F range is the upper position of the ON/OFF range switch.
2. Select the appropriate temperature probe and insert it into the input jack.
 3. Make the measurement:
 - A. Touch the probe tip to the material to be measured.
 - B. Read the display. The reading is in Celsius for the Model 873C. The reading is in Fahrenheit for the Model 873F.

NOTE

An open sensor or overrange condition is indicated by:



CAUTION

Do not attempt to measure temperatures beyond the range of the probe being used. Probe damage may occur.

WARNING

A shock hazard exists on the Models 873C and 873F input jacks when probes or sensors are exposed to voltage levels greater than 42V peak to earth ground.

SAFETY PRECAUTIONS

1. Do not touch the probe tip when measuring excessively high or low temperature.
2. Do not exceed 42V peak from the probe tip or input jack to earth ground.

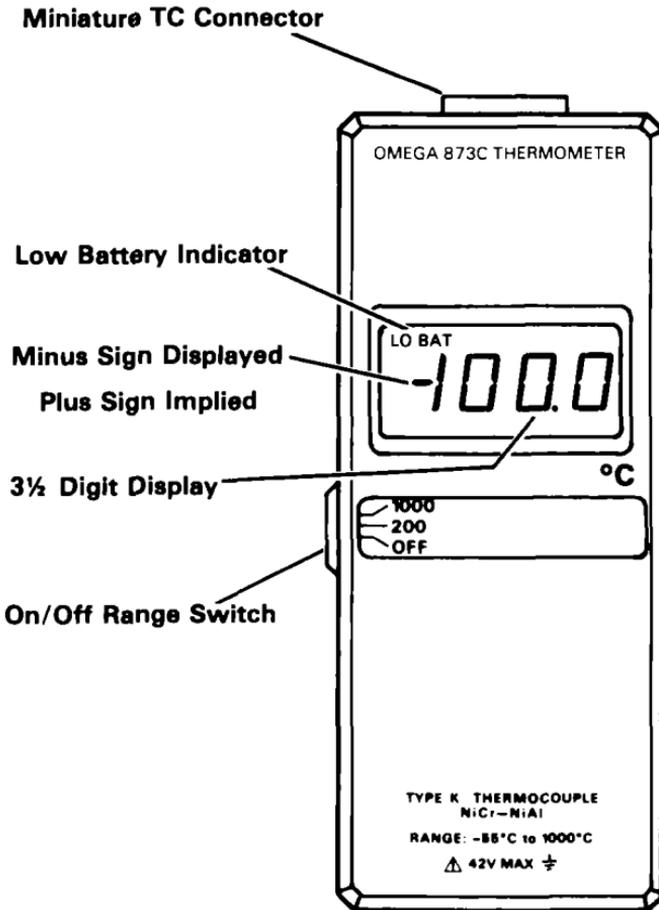


Figure 1. Model 873C Control Layout

Miniature TC Connector

Low Battery Indicator

Minus Sign Displayed
Plus Sign Implied

3½ Digit Display

On/Off Range Switch

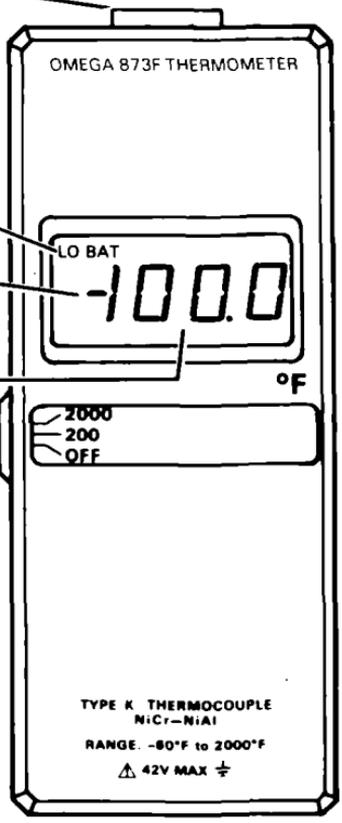


Figure 2. Model 873F Control Layout

SERVICING INFORMATION

This section contains information needed to maintain the Models 873C and 873F. The following information is included: functional check, performance verification, disassembly instructions, battery installation/replacement, calibration, probe matching, troubleshooting, parts list, schematic diagram and component layout.

WARNING

The information presented in this section is intended for use by qualified personnel only. Turn off the power and remove all probes from the instrument before replacing the battery.

FUNCTIONALITY CHECK

At room temperature hold the tip of a probe sensor between your thumb and index finger. A reading between 25°C and 40°C (77°F and 104°F) should be observed to confirm functionality of the instrument.

PERFORMANCE VERIFICATION

Accuracy Check

1. Prepare a distilled water ice bath or use an OMEGA[®] TRC III Ice Point Reference Chamber.
2. Connect a TC probe to the input jack of the instrument.
3. Immerse the TC probe into the TRC III or distilled water ice bath and allow 10 minutes for thermal stabilization.
4. Turn on the instrument and use Table 1 to verify that the readings on each range are within specifications.

Table 1. Performance Verification

Range	873°C	873°F
200	0.0 ± 1°C	32.0 ± 2°F
1000	0 ± 1°C	—
2000	—	32 ± 2°F

ENVIRONMENTAL CONDITIONS

The Models 873C and 873F should be at an ambient temperature of $23^{\circ}\text{C} \pm 1^{\circ}\text{C}$ and a relative humidity of less than 80%.

DISASSEMBLY INSTRUCTIONS

WARNING

Turn off the instrument and disconnect the temperature probe before removing the bottom cover.

NOTE

When disassembling the instrument, handle the PC board by the edges. Body oil, dirt, etc can degrade circuit performance. Keep the PC board clean and free of contaminants.

1. Place the unit face down on a bench or other similar surface and remove the screws from the bottom cover.
2. Separate the bottom cover from the rest of the instrument by grasping the top of the case (just above the display) and carefully lifting it away from the display.
3. Remove the battery.
4. Remove the standoff (ST-166-1) that secures the PC board to the case. The standoff is located in the center of the PC board.
5. Remove the switch cap.
6. Lift the PC board out of the top cover (front panel)
7. Remove the shield.
8. The LCD is held in place on the PC board by a shock resistant mounting and is assembled as shown in Figure 3.
9. To reassemble the unit, reverse the above procedure.

CAUTION

When removing the LCD from the PC board be careful not to spread the four retaining hooks on the clear plastic bezel out too far. The plastic bezel hooks may fracture.

WARNING

When reassembling the instrument, be sure to reinstall the switch cover. Common mode voltage may be present on the switch creating a possible hazard if the cover is not installed.

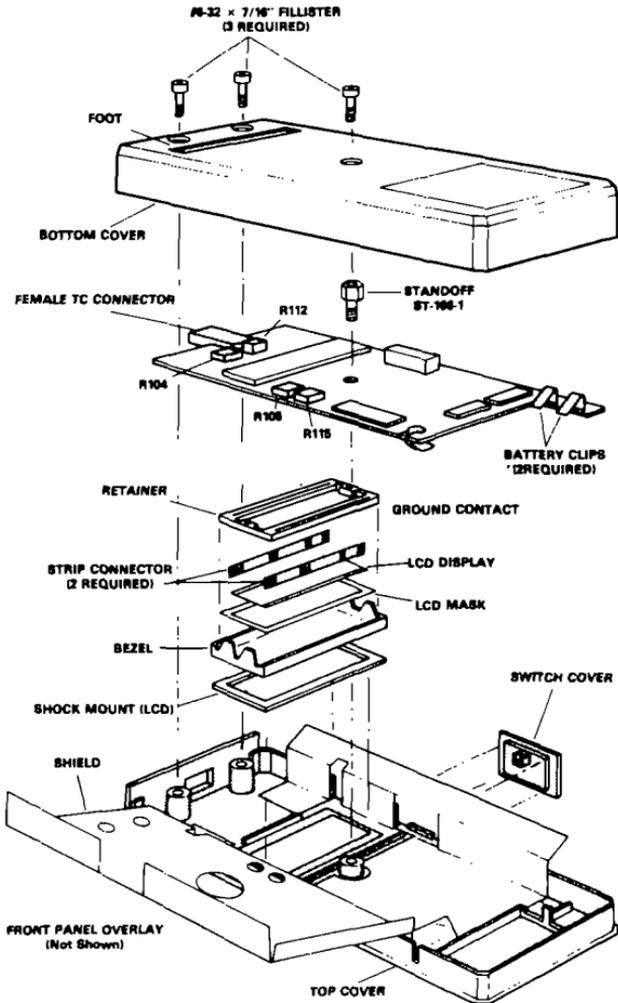


Figure 3. Model 873 Exploded View

BATTERY INSTALLATION/REPLACEMENT

To install or replace the battery:

1. Remove the bottom cover of the instrument (refer to the disassembly instructions).

WARNING

Turn the instrument off and disconnect the input probe before removing the bottom cover. Reinstall the cover before resuming use of the instrument.

2. Remove the old battery.
3. Place the new battery in the battery compartment. Be sure to observe the proper polarity. Refer to Figure 4.
4. Reinstall the bottom cover before resuming use of the instrument.

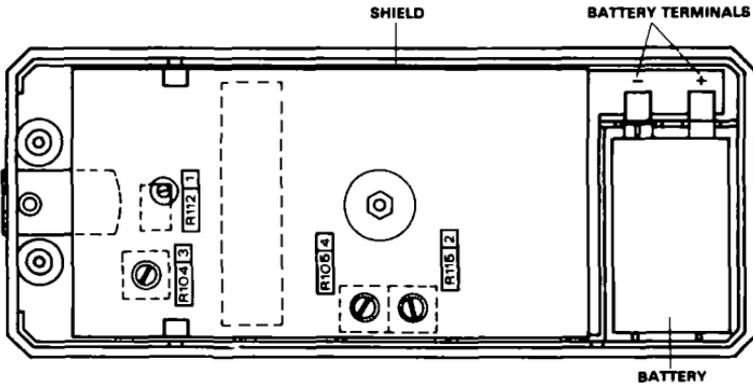


Figure 4. Battery Installation

CALIBRATION

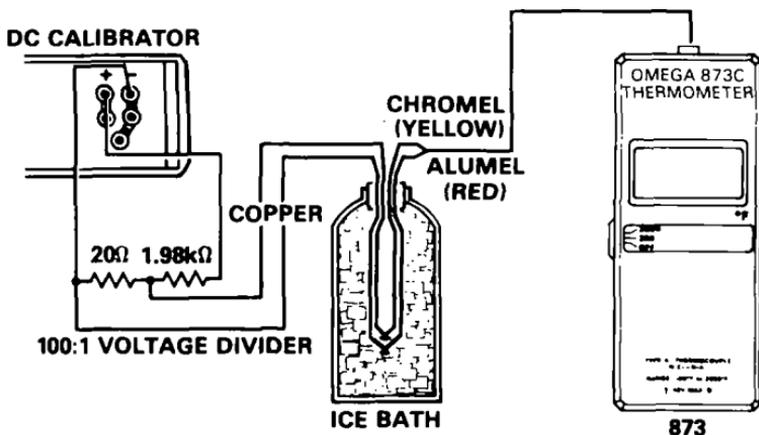
Required Test Equipment

1. DC voltage calibrator with $\pm 0.01\%$ of setting $\pm 20\mu\text{V}$ accuracy.
2. 100: 1 divider—1.98k and 20Ω wirewound resistors, 0.02% ratio accuracy or better.
3. OMEGA TRC III Ice Point Reference Chamber or distilled water ice bath.
4. OMEGA type K TRP Reference Probe or make a thermocouple transition junction (see Calibration Set-Up).

Calibration Set-Up

1. To make a thermocouple transition junction, silver solder a piece of copper wire to each (type K) thermocouple wire and insulate the junction with a waterproof jacket.
2. Connect the thermocouple wires from the type K transition junction to an OMEGA Miniature Thermocouple Connector SMP-K-M.
3. Turn on the voltage calibrator.
4. Plug in the miniature connector (see steps 1 and 2) into the 873 input.
5. Connect the copper wires to the 100:1 divider as shown in Figure 5. Connect the copper/chromel wire to the positive side.
6. Connect the 100:1 divider to the DC voltage calibrator as shown.
7. Use an OMEGA TRC III or prepare the distilled water ice bath as follows:
 - A. Drill a hole in the cap of a Dewar flask or Thermos™ to accommodate the thermocouple.
 - B. Firmly pack the flask with pea-size ice cubes made from distilled water and then fill the flask with distilled water.

- C. Replace the melted ice with more ice while removing the excess water.
- D. Place the cap on the flask. Immerse the thermocouples into the flask and allow 20 minutes for temperature stabilization.



*The 20 Ω resistor must be at a uniform temperature during calibration.

Figure 5. Set-Up Procedure

Calibration Procedure

1. Remove the bottom cover as described in the disassembly instructions.

WARNING

To prevent a shock hazard, turn the instrument off and remove the input probe from the instrument before removing the bottom cover.

2. Turn on the Model 873 and perform the calibration adjustments listed in Table 2 (873C) or Table 3 (873F). For access to calibration adjustments refer to Figure 4.

Table 2. Model 873C Calibration Adjustments

Step	Adjustment	Range	Calibrator Setting	Trimmer Adjust	Desired Reading
1	Zero	200°C	0.00000	R112	00.0°C
2	+ Gain (× 1)	1000°C	+ 41.269mV	R115	1000°C
3	+ Gain(× 10)	200°C	+ 7.139mV	R104	175.0°C
4	- Gain	200°C	-1.527mV	R105	-40.0°C

Table 3. Model 873F Calibration Adjustment

Step	Adjustment	Range	Calibrator Setting	Trimmer Adjust	Desired Reading
1	Zero	200°F	-0.692mV	R112	00.0°F
2	+ Gain(× 1)	2000°F	+ 44.645mV	R115	1990°F
3	+ Gain(× 10)	200°F	3.589mV	R104	190.0°F
4	- Gain	200°F	-1.929mV	R105	-60.0°F

PROBE MATCHING

To improve the accuracy of the Model 873 while using a particular probe, calibration can be adjusted so that probe errors in the region of zero (0.0°C or 32°F) are compensated. Place the probe in an ice bath and allow the reading to stabilize. Then reset the zero adjustment (R112) to a 0.0°C or 32°F reading.

TROUBLESHOOTING

The following troubleshooting information is intended to be used by qualified electronic maintenance personnel who are familiar with the proper use of standard electronic test equipment.

To gain access to the PC board, refer to the disassembly instructions. Use the parts list, schematic diagram and component layout to identify parts and check point locations.

DC Voltage Checks

1. Battery: $V_{BAT} > 7.5V$
2. +V to (Analog Ground) = $+2.9 \pm 0.3V$
3. +V to (Digital Ground) = $+5V \pm 1V$
4. Reference Diode
CR101 (Anode) to (Analog Ground) = $-1.23V \pm 0.03V$.
5. Negative reference divider (R114) referenced to analog ground. *

873C	873F
Pin 12 = -1.23 V	Pin 12 = -1.23 V
Pin 10 = -0.209V	Pin 11 = -0.209V
Pin 11 = -0.209V	Pin 10 = -0.208V
Pin 7 = -0.206V	Pin 9 = -0.205V
Pin 9 = -0.204V	Pin 8 = -0.204V
Pin 8 = -0.204V	Pin 7 = -0.203V
Pin 6 = -0.201V	Pin 6 = -0.198V
Pin 4 = -0.200V	Pin 5 = -0.197V
Pin 5 = -0.197V	Pin 4 = -0.196V
Pin 3 = -0.195V	Pin 3 = -0.191V
Pin 2 = -0.193V	Pin 2 = -0.188V

*The setting of R115 and the tolerances of the resistors within the network (R114) can affect these levels by $\pm 5\%$.

6. Cold Junction Voltage

(Ambient Temperature = $25^{\circ}C \pm 3^{\circ}C$)

Across R102A approximately equal to 1mV.

7. Waveform Checks (see Figure 6)

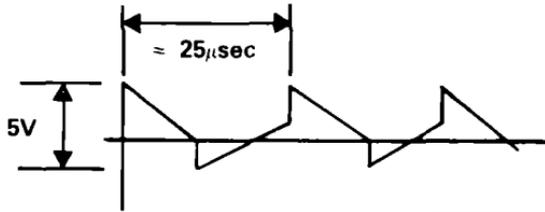
U104 pin 40 (OSC 1)

U104 pin 39 (OSC 2)

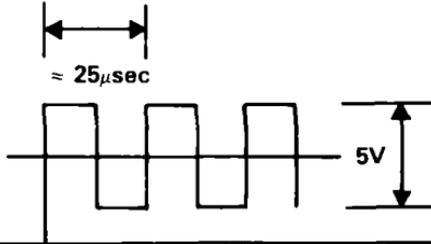
U104 pin 38 (OSC 3)

U104 pin 21 (Backplane)

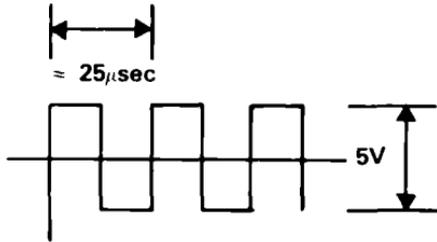
U104 PIN 40 (OSC 1)



U104 PIN 39 (OSC 2)



U104 PIN 38



U104 PIN 21

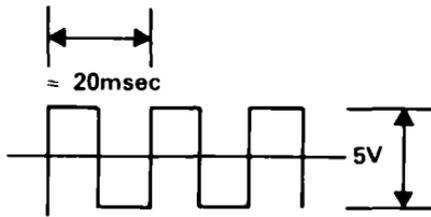


Figure 6. Waveform Checks

SPECIAL HANDLING OF STATIC SENSITIVE DEVICES

CMOS devices are designed to function at high impedance levels. Normal static charge can destroy these devices. Table 4 lists all the static sensitive devices for the Models 873C and 873F. Steps 1 through 7 provide instructions on how to avoid damaging these devices.

Table 4. Static Sensitive Devices

Schematic Designation
U104
U105
U107
U108
U109

1. Devices should be handled and transported in protective containers, antistatic tubes or conductive foam.
2. Use a properly grounded work bench and a grounding wriststrap.
3. Handle devices by the body only.
4. Printed circuit boards must be grounded to bench while inserting devices.
5. Use antistatic solder removers.
6. Use grounded tip soldering irons.
7. After devices are soldered or inserted into sockets they are protected and normal handling can resume.

SPECIFICATIONS

MODEL 873F SPECIFICATIONS

TEMPERATURE SENSOR: Type K (NiCr-NiAl) Thermocouple.

RANGE	TEMPERATURE SPAN	RESOLUTION	ACCURACY* (65 to 82°F; 2 years)
200°F	-60.0° to 199.9°	0.1°	±(0.25% rdg + 2.0°F)
2000°F	-60° to 1999°	1°	±(0.25% rdg + 2°F)

*Includes NBS conformity, cold junction compensation, temperature coefficient (65° to 82°F) and repeatability errors. Excludes thermocouple errors; however thermocouple errors around 32°F may be compensated for by an internal zero adjustment.

REPEATABILITY: 0.3°F typical for 1 week at constant ambient temperature.

TEMPERATURE COEFFICIENT: 65° to 82°F; included in accuracy specification. From 14° to 65° and 82° to 122°F: less than ±(0.025% of rdg + 0.2°F)/°F.

INPUT CURRENT: 25nA typical, 50nA maximum.

MODEL 873C SPECIFICATIONS

TEMPERATURE SENSOR: Type K (NiCr-NiAl) Thermocouple.

RANGE	TEMPERATURE SPAN	RESOLUTION	ACCURACY* (18 to 28°C; 2 years)
200°C	-40.0° to 199.9°	0.1°	±(0.25% rdg + 1.0°C)
	-55.0° to -40.0°	0.1°	±(0.25% rdg + 2.0°C)
1000°C	-40° to 1000°	1°	±(0.25% rdg + 1°C)
	-55° to -40°	1°	±(0.25% rdg + 2°C)

*Includes NBS conformity, cold junction compensation, temperature coefficient (18° to 28°C) and repeatability errors. Excludes thermocouple errors; however thermocouple errors around 0°C may be compensated for by an internal zero adjustment.

REPEATABILITY: 0.2°C typical for 1 week at constant ambient temperature.

TEMPERATURE COEFFICIENT: 18° to 28°C; included in accuracy specification. From -10° to 18° and 28° to 50°C: less than ±(0.025% of rdg + 0.1°C)/°C.

INPUT CURRENT: 25nA typical, 50nA maximum.

Specifications subject to change without notice.

MODEL 873F and 873C GENERAL SPECIFICATIONS
(unless specified):

DISPLAY: 3½ digit LCD, 13mm (0.5") height. Polarity and decimal point indication.

CONVERSION RATE: 2.5 readings per second.

OVERRANGE AND OPEN SENSOR INDICATION: 3 least significant digits blanked.

MAXIMUM COMMON MODE VOLTAGE: 42V peak to earth.

NORMAL MODE REJECTION RATIO: Greater than 40dB at 50 & 60Hz.

COMMON MODE REJECTION RATIO: Greater than 120dB at DC, 50 & 60Hz.

ENVIRONMENTAL LIMITS FOR OPERATING (Model 873F): 14° to 122°F, less than 80% relative humidity up to 95°F; linearly derate 1.5% R.H./°F from 95° to 122°F.

ENVIRONMENTAL LIMITS FOR OPERATING (Model 873C): -10° to 50°C, less than 80% relative humidity up to 35°C; linearly derate 3% R.H./°C from 35° to 50°C.

ENVIRONMENTAL LIMITS FOR STORAGE (Model 873F): -30° to 140°F, less than 90% relative humidity up to 95°F; linearly derate 1.5% R.H./°F from 95° to 140°F.

ENVIRONMENTAL LIMITS FOR STORAGE (Model 873C): -35° to 60°C, less than 90% relative humidity up to 35°C, linearly derate 3% R.H./°C from 35° to 60°C.

THERMOCOUPLE LINEARIZATION: Multislope A/D with 11 piecewise linear segments.

THERMOCOUPLE INPUT: Miniature TC connector.

POWER: 9V alkaline or carbon-zinc (NEDA 1604) battery.

BATTERY LIFE, CONTINUOUS: 350 hours typical with alkaline; 200 hours typical with carbon-zinc.

BATTERY INDICATOR: Display indicates "LO BAT" when less than 10% of life remains.

DIMENSIONS: 160mm long × 69mm wide × 31mm thick (6.3" × 2.7" × 1.2"). Net weight 210gm (7.5 oz.).

CONSTRUCTION: Heavy duty ABS plastic housing.

ACCESSORIES SUPPLIED: Battery, Instruction Manual and Model

TC-GG-K-24-36-SMP-M Thermocouple Sensor

Model 873C and 873F, Parts List

Sch Desig.	Description	Sch Location
BT101	9V Alkaline Battery, NEDA 1604	F1
C101	Capacitor, .1 μ F, 50V, Ceramic	B1
C102	Capacitor, .1 μ F, 50V, Ceramic	C2
C103	Capacitor, 33pF, 1000V, Ceramic	B2
C104	Capacitor, .1 μ F, 50V, Ceramic	G1
C105	Capacitor, .1 μ F, 50V, Ceramic	G1
C106	Capacitor, 47pF, 500V, Silver Mica or Ceramic	E2
C107	Capacitor, .33 μ F, 63V, Metalized Polyester	F2
C108	Capacitor, .047 μ F, 50V, Metalized Polypropylene	E2
C109	Capacitor, 4.7 μ F, 25V, Aluminum Electrolytic	G5
C110	Capacitor, .33 μ F, 63V, Metalized Polyester	D1
CR101	Silicon Diode, 1N914	E3
J1001	Miniature TC Connector, Female	A2
J1002	Battery Clip	F1
J1003	Battery Clip	F1
Q101	Transistor, NPN, 2N3904	B2
Q102	Transistor, NPN, 2N3904	B2
Q103	Transistor, PNP, 2N3906	E3
R101	Resistor, 10k, 5%, 1/4W, Composition	A2
R102*	Thick Film Resistor Network	Sev
R102**	Thick Film Resistor Network	Sev
R103	Resistor, 10M, 5%, 1/4W, Composition	D1
R104*	Potentiometer, 1k	D1
R104**	Potentiometer, 500 Ω	D1
R105	Potentiometer, 2k	D2
R106	Thick Film Resistor Network	Sev
R107	Resistor, 191k, 1%, 1/8W, Metal Film	F2
R108	Resistor, 390k, 5%, 1/4W, Composition	F2
R109	Thick Film Resistor Network	Sev
R110	Factory Selected Resistor (Part of A31419)	B3
R111	Factory Selected Resistor (Part of A31410)	B3
R112	Potentiometer, 2k	B3
R113	Factory Selected Resistor (part of A31419)	C3

Model 873C and 873F, Parts List (Cont.)

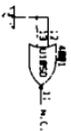
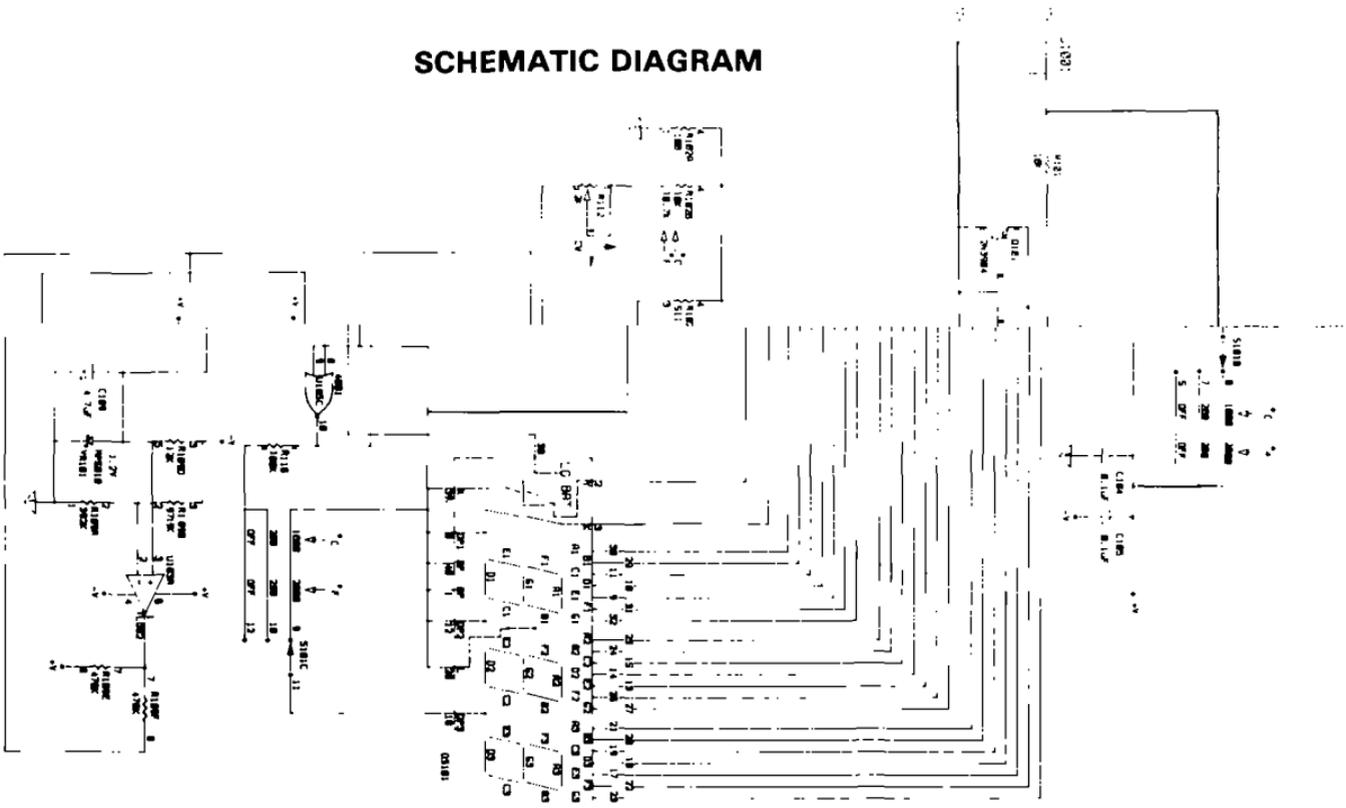
Sch Desig.	Description	Sch Location
R114*	Thick Film Resistor Network	Sev
R114**	Thick Film Resistor Network	Sev
R115	Potentiometer, 2k	F4
R116	Resistor, 100k, 5%, 1/4W, Composition	G4
R117	Resistor, 100k, 5%, 1/4W, Composition	B6
R118	Resistor, 121k, 1%, 1/8W, Metal Film	D1
S101	Switch, 4P3T, On/Off Range Switch	Sev
U101	Op Amp, LM308 (Factory selected; part of A31419)	C2
U102	Current Source, LM334 (Factory selected; part of A31410)	C3
U103	Low Power JFET Op Amp, TL062Cp	D2/G5
U104	3-1/2 Digit A/D Converter, ICL7136	F2
U105	Quad 2 Input NOR Gate, 4001	Sev
U106	Dual Synchronous Up Counter, 4518	C5
U107	12 Stage Binary Counter, 4020	C5
U108	Analog Multiplexer, 4051	D5
U109	Analog Multiplexer, 4053	
VR101	Reference Diode, 1.23V	G5
W101	Jumper Wire	B5

*Model 873F

**Model 873C

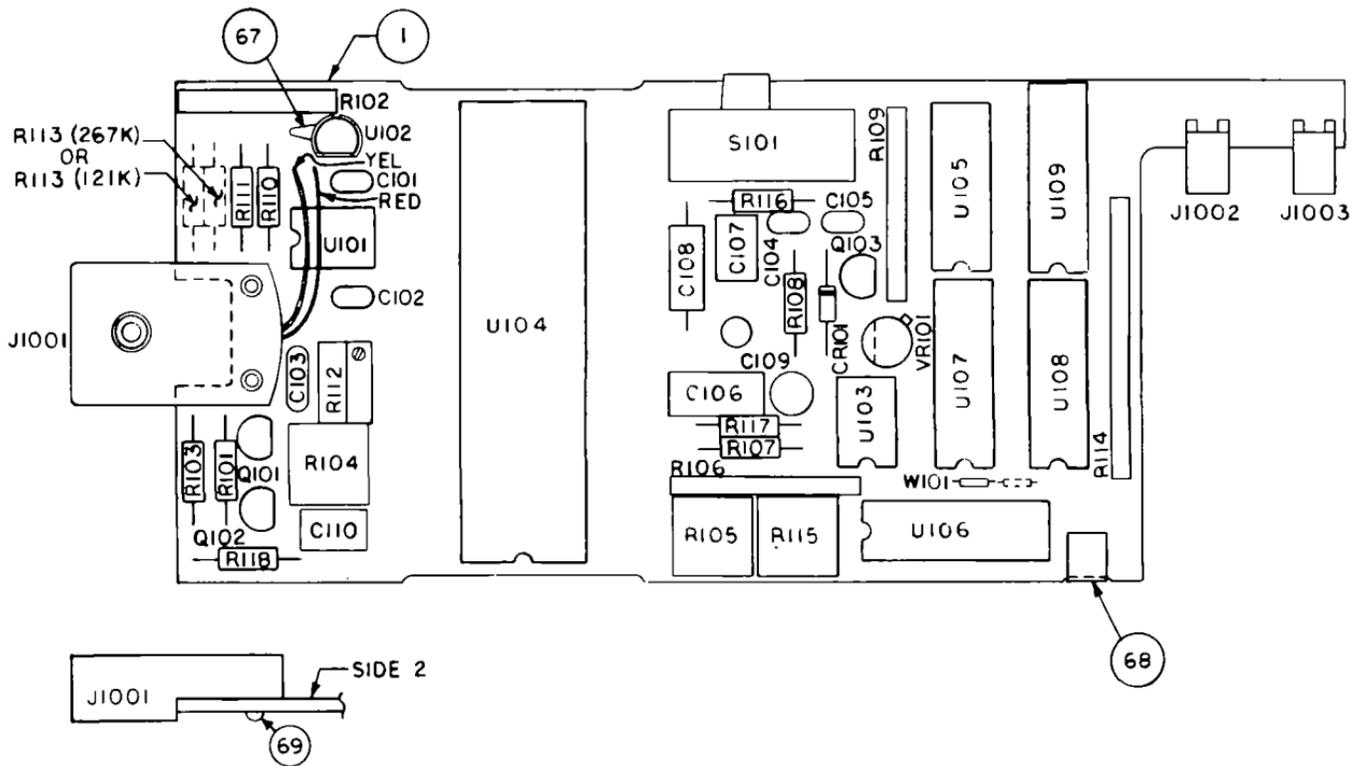
NOTE: Mechanical Parts can be found in the exploded view (Figure 3).

SCHEMATIC DIAGRAM



NOTE: REFER TO DRAWING S-1010 FOR
 ALL DIMENSIONS AND CONNECTIONS.

1131. SEE OR. PROCEEDING.
 SEE OR. PROCEEDING.

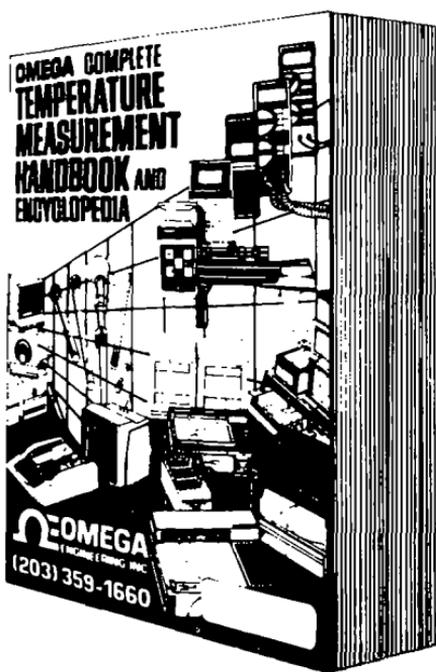


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