

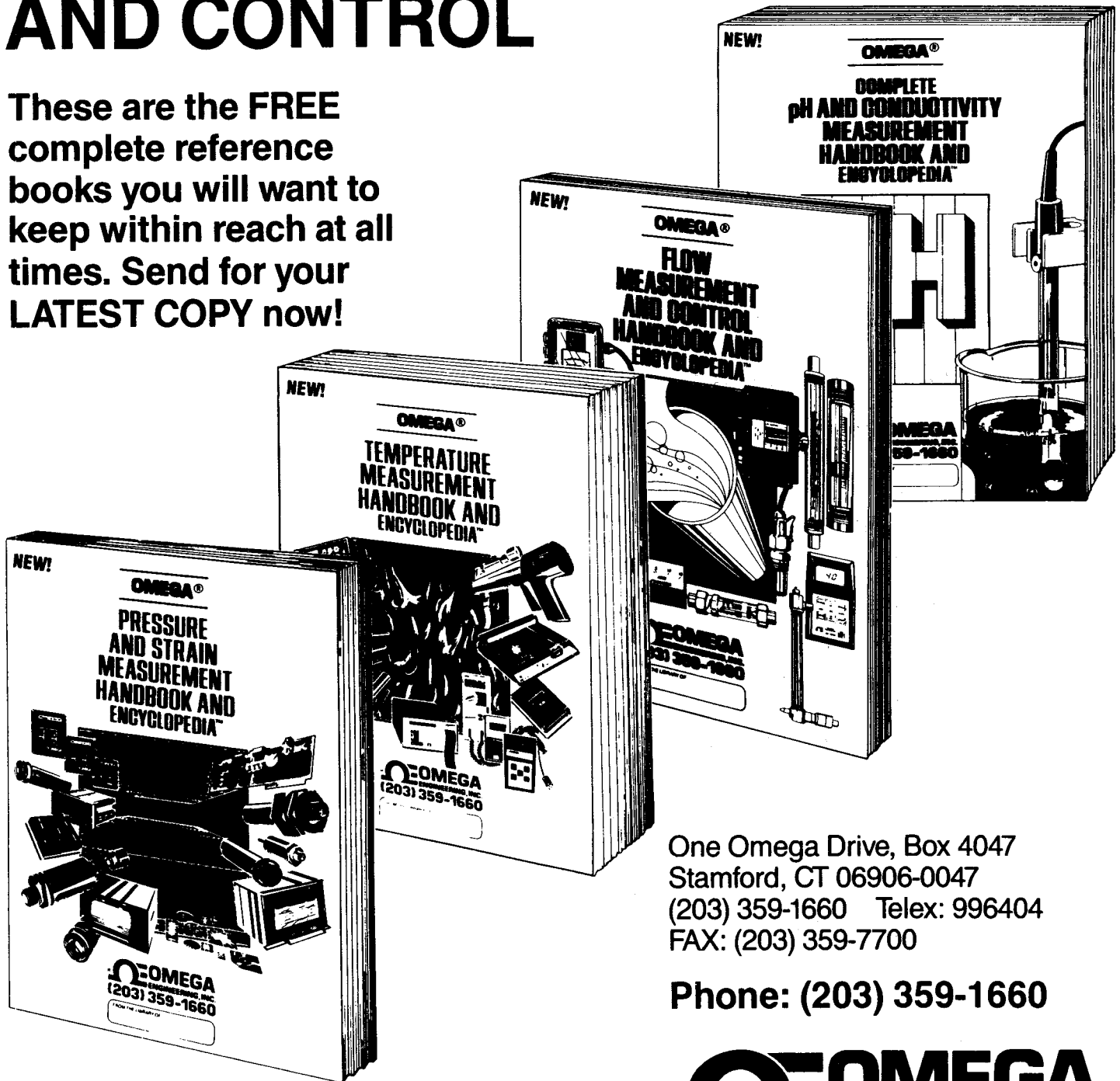
# **Model CL-505A Precision Calibrator**

## **Operator's Manual**



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TABLE OF CONTENTS  
CL-505A PRECISION CALIBRATOR

SECTION	PAGE
SECTION 1 INTRODUCTION	1
1.1 General Description	1
1.2 Features	1
1.3 Superimposed Noise Level on the Generated Signal	1
SECTION 2 INSTALLATION	2
2.1 Unpacking	2
2.2 Battery Installation	3
SECTION 3 OPERATION	3
3.1 Controls and Indicators	3
3.2 Pre-operating Procedure	11
3.3 Operation	11
3.3.1 mV Measurement	12
3.3.2 mA Measurement	13
3.3.3 Thermocouple Measurement Using External Cold Junction Compensation	14
3.3.4 Thermocouple Measurement Using Internal Cold Junction Compensation	15
3.3.5 RTD Measurement	16
3.3.6 Resistance Measurement	17
3.3.7 mV Simulation	17
3.3.8 mA Simulation	20
3.3.9 Thermocouple Simulation With External Cold Junction Compensation	21
3.3.10 Thermocouple Simulation With Internal Cold Junction Compensation	22
3.3.11 Signal Function Storage	24
3.3.12 Signal Function Simulation Recall	26
3.4 Error Messages	26
3.4.1 Overrange of a Measured Signal	27

TABLE OF CONTENTS (continued)  
CL-505A PRECISION CALIBRATOR

SECTION	PAGE
3.4.2	27
3.4.3	27
3.4.4	27
3.4.5	28
3.4.6	28
3.4.7	28
3.4.8	28
SECTION 4 SERVICE INFORMATION	29
4.1	29
4.2	29
4.2.1	30
4.2.2	30
4.2.3	31
4.2.4	35
4.2.5	35
4.2.6	36
SECTION 5 SPECIFICATIONS	36

## SECTION 1 INTRODUCTION

### 1.1 GENERAL DESCRIPTION

The OMEGA CL-505A Precision Calibrator provides thermocouple, RTD, mA, mV and ohm measurements and simulations to calibrate a variety of instruments and systems.

Thermocouple types covered are J, K, E, T, R, S, and B (in values of °C or °F). Values measured or generated for system calibration are displayed on a high-visibility digital display window (LCD). The CL-505A has built-in memory stores, and recalls on command as many as 10 test signals.

This portable unit can be operated directly from ac power lines, or from a self-contained, rechargeable battery.

### 1.2 FEATURES

- o Fast, key-entry operation
- o AC or battery operation
- o Simulates or tests thermocouples
- o Calibrates 100 ohm RTD's
- o Measures or produces test voltages or currents
- o Accommodates thermocouple types J, K, E, T, R, S, and B
- o Recalls 10 points at the touch of a button

### 1.3 SUPERIMPOSED NOISE LEVEL ON THE GENERATED SIGNAL

One of the most significant features of the CL-505A, is the capability to generate an output signal continuously adjusted with a special feed-back system, controlled by the microprocessor, in order to keep the pre-set value. The system controls and checks that the generated signal corresponds exactly to the pre-set value.

The CL-505A generates a signal with a value equal to the one displayed and programmed via the keyboard, and the display shows the real value on the output terminals. Consequently, the generated value is not modified by the load impedance value, connected to the CL-505A. To obtain this result, an automatic control of the output value is employed, which gives a superimposed noise level to the signal.

In case of repeated calibrations where the load impedance is constant and a minimum superimposed noise level or  $\pm 1\mu\text{V}$  is required, the following procedure can be used:  
Push: [OUT] - the value - the engineering unit - [OUT] keys again when output signal become stable

## SECTION 2 INSTALLATION

### 2.1 UNPACKING

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.

## 2.2 BATTERY INSTALLATION

The battery is completely charged before shipment. To avoid accidental discharge of the battery due to a long period of storage, the CL-505A is delivered with the battery disconnected.

Install the battery as follows:

1. Remove the instrument from the carrying case.
2. Unscrew the back cover and connect the battery cables to the battery as illustrated in Figure 2-1.

### NOTE

The instrument must be fed by the battery.

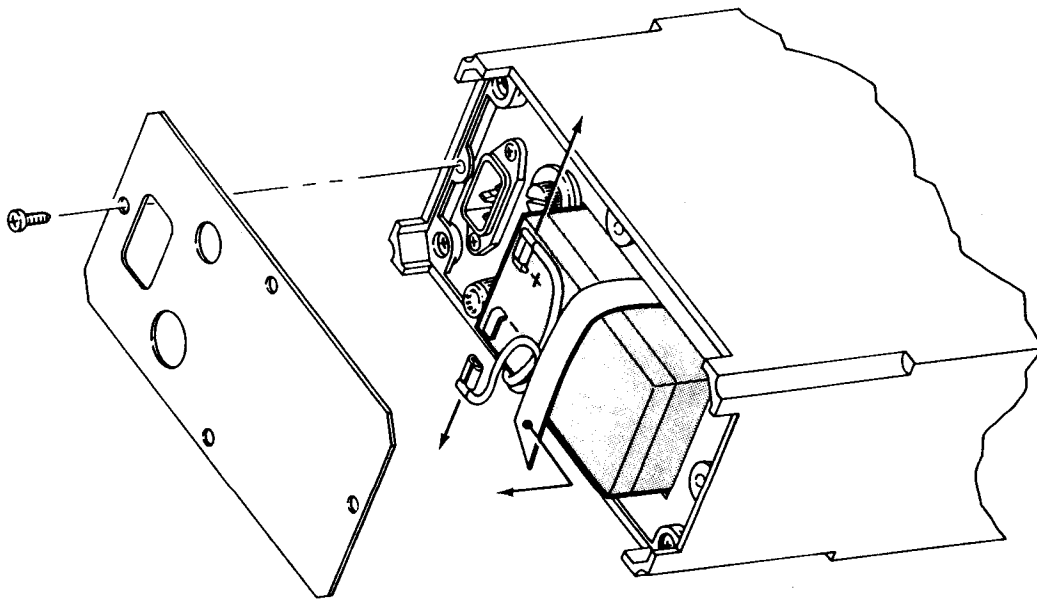


Figure 2-1. Battery Installation

## SECTION 3 OPERATION

### 3.1 CONTROLS AND INDICATORS

Figure 3-1 and Table 3-1 illustrate and describe the controls and indicators that are used for operation of the CL-505A Calibrator.

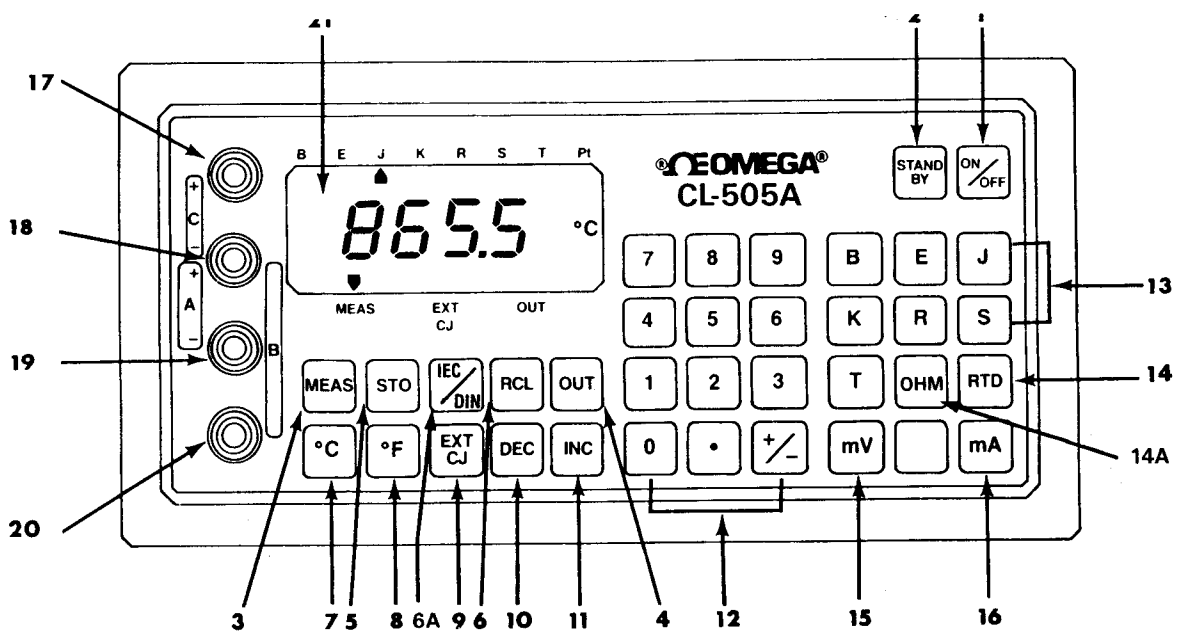


Figure 3-1. CL-505A Controls and Indicators

TABLE 3-1

CONTROLS AND INDICATORS

ITEM NO.	CONTROL OR INDICATOR	FUNCTION
1	[ON/OFF] key	Turns instrument ON and OFF. When power is ON, decimal points appear on the LCD display to indicate that power has been applied to the unit. The CL-505A automatically energizes at the lowest current consumption rate (mV and mA simulations are off).  The input is shorted, and between the input terminals there is an impedance of 2 megohms.



ITEM NO.	CONTROL OR INDICATOR	FUNCTION
2	[STAND-BY] key	<p>deactivates the unit at the lowest current consumption rate. In STANDBY mode, mV and mA simulations are deactivated.</p> <p>Prior to operating the instrument, one of the following keys must be pressed: [MEAS], [OUT], [STO], or [RCL].</p> <p>The input is shorted, and between the input terminals there is an impedance of 2 megohms</p>
3	[MEAS] key	Used to program the CL-505A for signal measurement.
4	[OUT] key	Used to program the CL-505A as a simulator (signal generator).
5	[STO] key	In the simulation mode (only), can be pressed to store a fixed value and a function.

TABLE 3-1 (Continued)

ITEM NO.	CONTROL OR INDICATOR	FUNCTION
(5 continued)		The information is stored in an addressable memory and is restricted to 10 test signals, labeled with digits 0 through 9.
6	[RCL] key	Used to recall any one of the 10 test signals that were stored in memory.  The test signal, which consists of a fixed value and a function, is only operative in the simulation mode.
6A	ANSI C96/IEC 584 or DIN 43710 key	Alternating function key used to select ANSI/IEC or DIN Linearization Tables during thermocouple measurement or simulation  ANSI/IEC selection is indicated by a fixed arrow appearing on the LCD, adjacent to MEAS/OUT label.  DIN selection is indicated by a blinking arrow appearing on the LCD, adjacent to MEAS/OUT label.

TABLE 3-1 (Continued)

ITEM NO.	CONTROL OR INDICATOR	FUNCTION
7	[°C] key	Used to display, in °C, measured or simulated signals (thermocouple or RTD).
8	[°F] key	Used to display, in °F, measured or simulated signals (thermocouple or RTD).
9	[EXT CJ] key	used to select internal or external cold junction compensation during thermocouple measurement or simulation.  External mode selection is identified by an arrow (opposite EXT CJ) on the LCD display.
10	[DEC] key	Used to decrease the simulated signal.
11	[INC] key	Used to increase the simulated signal.
12	Numerical keyboard	Also contains decimal point and polarity controls. The (+/-) key is used in the simulation mode to change the polarity from the one displayed.

TABLE 3-1 (Continued)

ITEM NO.	CONTROL OR INDICATOR	FUNCTION
13	[J, K, E, T, R, S, B,] keys	Selects the appropriate thermocouple type for measurement or simulation.
14	[RTD] key	Used to select RTD measurement (resistance is 100 ohms at 0°C).
14A	[OHM] key	Used to select ohm measurement.
15	[mV] key	Used to program the CL-505A for millivolts in measurement or simulation modes.
16	[mA] key	Used to program the CL-505A for milliamps in measurement or simulation modes.
17	Top terminal post, marked + in the "C" area	Positive terminal during mA simulation.

TABLE 3-1 (Continued)

ITEM NO.	CONTROL OR INDICATOR	FUNCTION
18	Second terminal post from top, marked - in the "C" area, + in the "A" area	<p>Functions as:</p> <ul style="list-style-type: none"> <li>o Negative terminal during mA simulation.</li> <li>o Positive terminal during mV simulation.</li> <li>o Positive terminal during mA or mV measurement.</li> <li>o Positive terminal during thermocouple measurement or simulation.</li> <li>o Positive terminal during RTD and ohm measurement.</li> </ul>
19	Third terminal post from top, marked - in the "A" area	<p>Terminal functions as:</p> <ul style="list-style-type: none"> <li>o Negative terminal during mV simulation.</li> <li>o Negative terminal during mV or mA measurement.</li> <li>o Negative terminal during thermocouple measurement or simulation. Attach the thermocouple lead with red insulation.</li> <li>o Negative terminal during RTD and ohm measurement.</li> </ul>

TABLE 3-1 (Continued)

ITEM NO.	CONTROL OR INDICATOR	FUNCTION
20	Bottom terminal post	Terminal is to accommodate the third wire during RTD and ohm measurement.
21	Liquid Crystal Display (4 1/2 digit)	<p>Shows results in °C, °F, mV, mA, and ohm, as appropriate.</p> <p>Upper arrow indicates selected function (thermocouple or RTD).</p> <p>Lower arrows indicate:</p> <ul style="list-style-type: none"> <li>o Selected function type (measurement or simulation).</li> <li>o Internal or external cold junction compensation.</li> </ul> <p>LO BAT indicates battery needs recharging. (Recharging time - 12 hours.)</p>

## 3.2 PRE-OPERATING PROCEDURE

Begin operation as follows:

1. To turn the CL-505A ON, press the [ON/OFF] key. The Calibrator is now in STAND-BY mode. All decimal points should be displayed on the LCD.
2. Before selecting any function, check the battery status by means of the LO BAT indicator on the LCD.

### CAUTION

If the battery is discharged, the LO BAT indicator will automatically appear on the LCD. Switch the Calibrator OFF, and confirm that the voltage selector switch has been set to the correct position; then plug the CL-505A into the ac power supply (using the power supply cable). This will recharge the battery (recharging time is 12 hours).

## 3.3 OPERATION

Four modes of operation are provided by the CL-505A:

- o SIGNAL MEASUREMENT (T/C, RTD, ohm, mV, and mA)
- o SIGNAL SIMULATION (T/C, mV, and mA)
- o SIMULATION SIGNAL FUNCTION STORAGE
- o RECALL AND SIMULATION OF STORED FUNCTIONS

### CAUTION

Before selecting any functions, place the CL-505A into STAND-BY status, and complete the appropriate external circuit connections illustrated in Figures 3-2 through 3-10.

### 3.3.1. mV Measurement

Connect the external circuit as shown in Figure 3-2.

#### CAUTION

Be sure that the input signal does not exceed 50 V or damage to the input circuit could result.

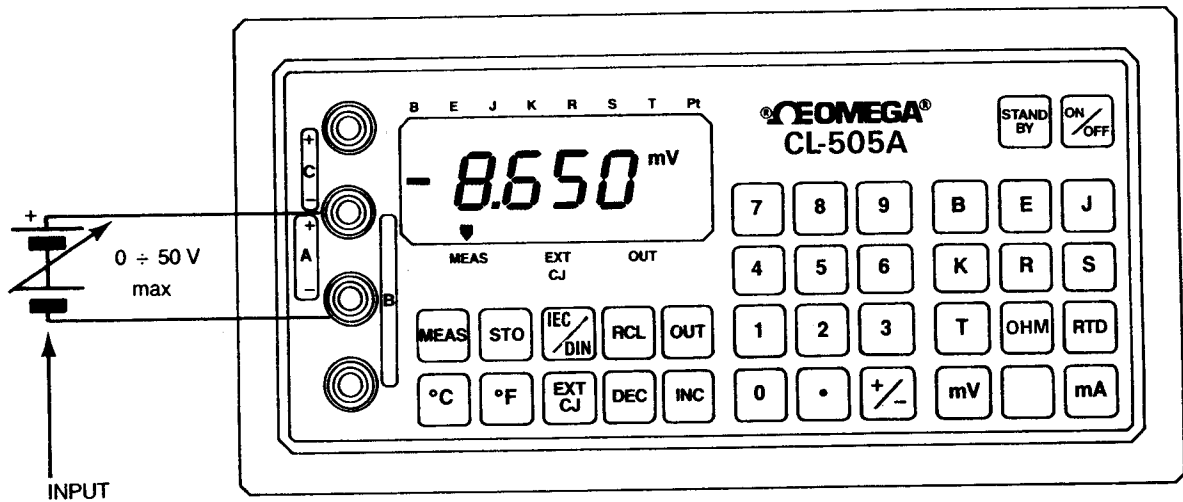


Figure 3-2. Connections for mV Measurement

1. Turn the Calibrator ON.
2. To obtain a mV measurement, press the [MEAS] and [mV] keys in sequence.
3. The LCD display will show the mV value produced by the external circuit. The automatic range values will extend from 0 to 9995:
  - From 0.000 to 9.995 mV; resolution 5  $\mu$ V
  - From 10.00 to 99.95 mV; resolution 50  $\mu$ V
  - From 100.0 to 999.5 mV; resolution 500  $\mu$ V
  - From 1000 to 9995 mV; resolution 5 mV

#### NOTE

The above ranges are valid for either positive or negative values.



### 3.3.2 mA MEASUREMENT

Connect the external circuit as illustrated by Figure 3-3.

#### CAUTION

Be sure that the input signal does not exceed 130 mA, or the CL-505A will automatically disconnect the input circuit and return to STAND-BY condition.

1. Turn the Calibrator ON.
2. To obtain a mA measurement, press the [MEAS] and [mA] keys in sequence.

The LCD display will now show the mA value produced by the external circuit. The automatic range values will extend from 0 to 99.95:

From 0.0000 to 0.9995 mA; resolution 0.5  $\mu$ A

From 1.000 to 9.995 mA; resolution 5  $\mu$ A

From 10.00 to 99.95 mA; resolution 50  $\mu$ A

From 100.0 to 130.0 mA; resolution 0.5 mA

#### NOTE

The above ranges are valid for either positive or negative values.



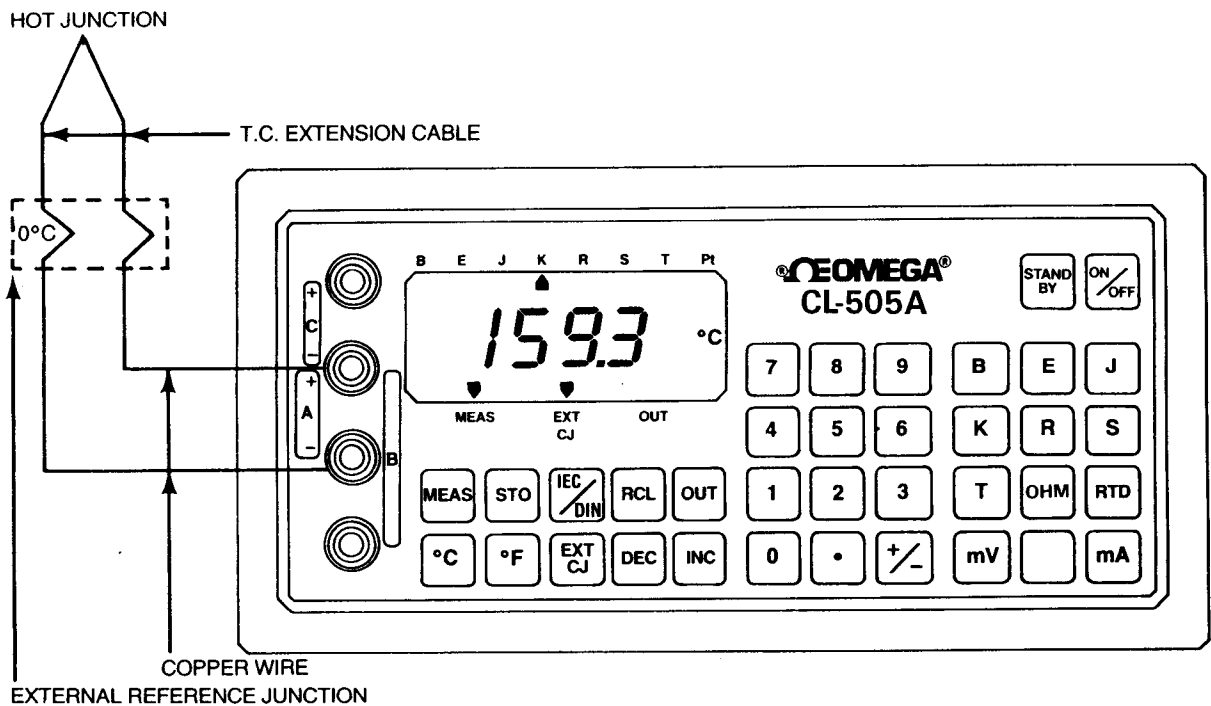


Figure 3-4. Connections For Thermocouple Measurement Using External CJ Compensation

3. By using the [°C] and the [°F] keys, the operator can preset the readout temperature for either °C or °F.
4. IEC/DIN key allows the operator to choose ANSI/IEC or DIN linearization.

NOTE

Selection of °C/°F and/or ANSI/IEC or DIN can be made at any time during measurement.

3.3.4 Thermocouple Measurement Using Internal Cold Junction Compensation

Connect the external circuit as illustrated by Figure 3-5.

NOTE

To obtain an accurate measurement using the internal cold junction compensation, thermocouple extension cable of the correct type must be used and it must be correctly connected by polarity and color code.

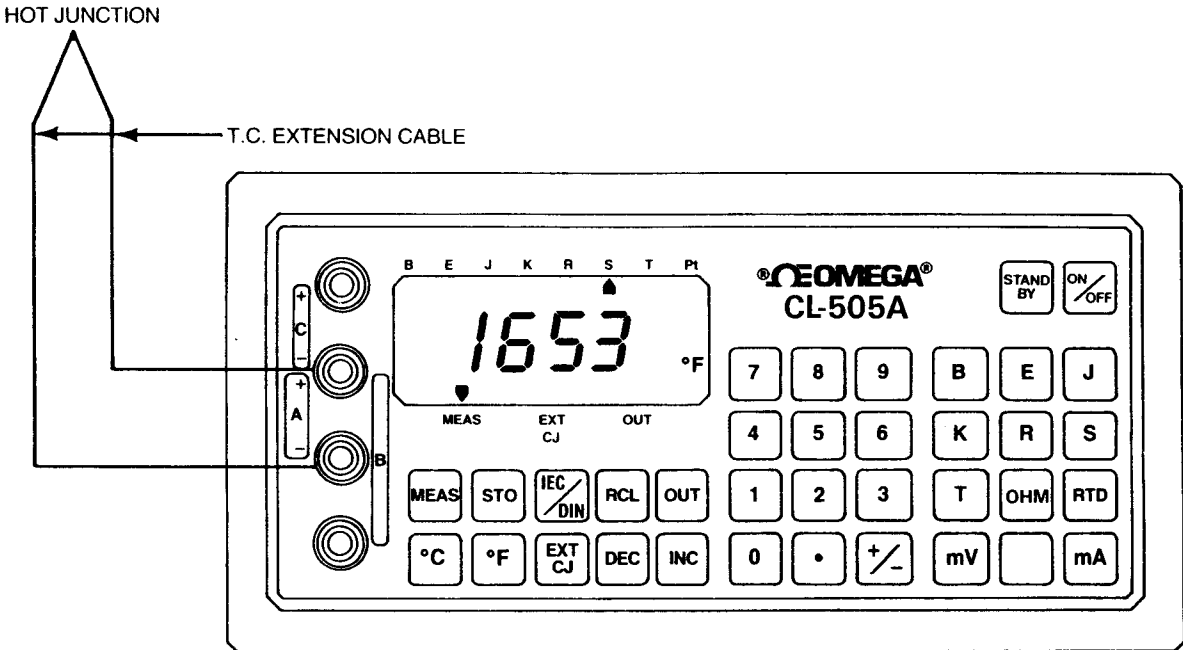


Figure 3-5. Connections For Thermocouple Measurement Using Internal Cold Junction Compensation

1. Turn the Calibrator ON.
2. To obtain a temperature measurement, press the [MEAS] key followed by the key for the appropriate thermocouple type ([J] or [K], for example) in that sequence.  
The display will show the temperature measured by the thermocouple in °C.
3. By using the [°C] and the [°F] keys, the operator can set the readout temperature for either °C or °F.

NOTE

Selection °C/°F and/or ANSI/IEC or DIN can be made any time during measurement.

3.3.5 RTD Measurement

Connect the 100 ohm platinum RTD ( $\alpha = 0.00385$ ) as illustrated by Figure 3-6.

NOTE

Use three lead copper wire to make this connection.

1. Turn the Calibrator ON.
2. To obtain a temperature measurement, press the [MEAS] and [RTD] keys in sequence. The display will show the temperature being detected by the RTD in °C.
3. By using the [°C] and [°F] keys, the operator can preset the readout temperature for either °C or °F.

NOTE

Selection °C or °F can be made at any time during measurement.

### 3.3.6 Resistance Measurement (ohms)

Connect the external circuit as per Figure 3.7.

NOTE

Use three-lead copper wire to make connection.

1. Turn the Calibrator on.
2. To obtain a resistance measurement, press the [MEAS] and [UHM] keys in sequence. The display will now show ohm measurement.

### 3.3.7 mV Simulation

Connect the CL-505A to the device or system being calibrated as illustrated by Figure 3-8.

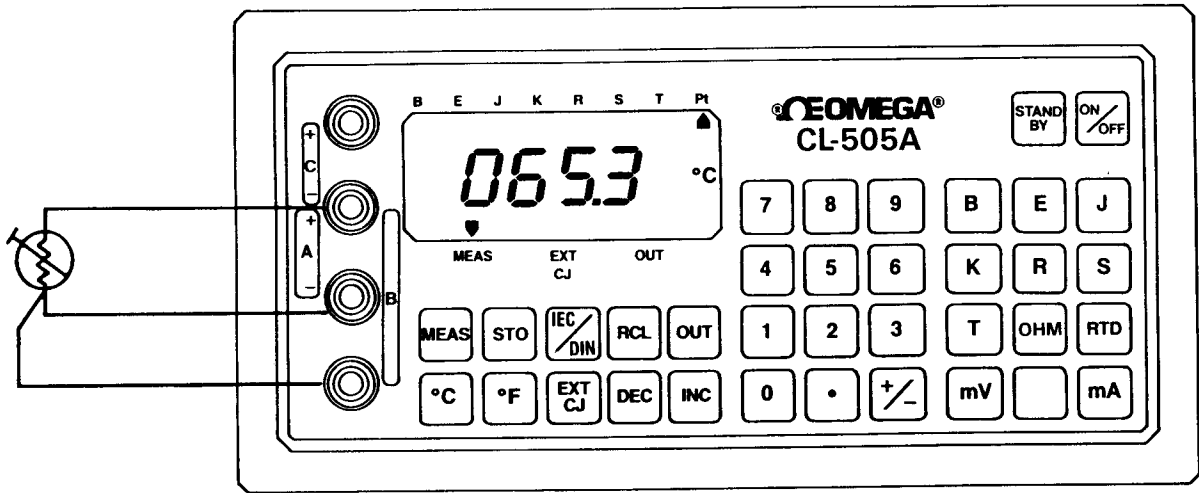


Figure 3-6. Connections For RTD Measurement

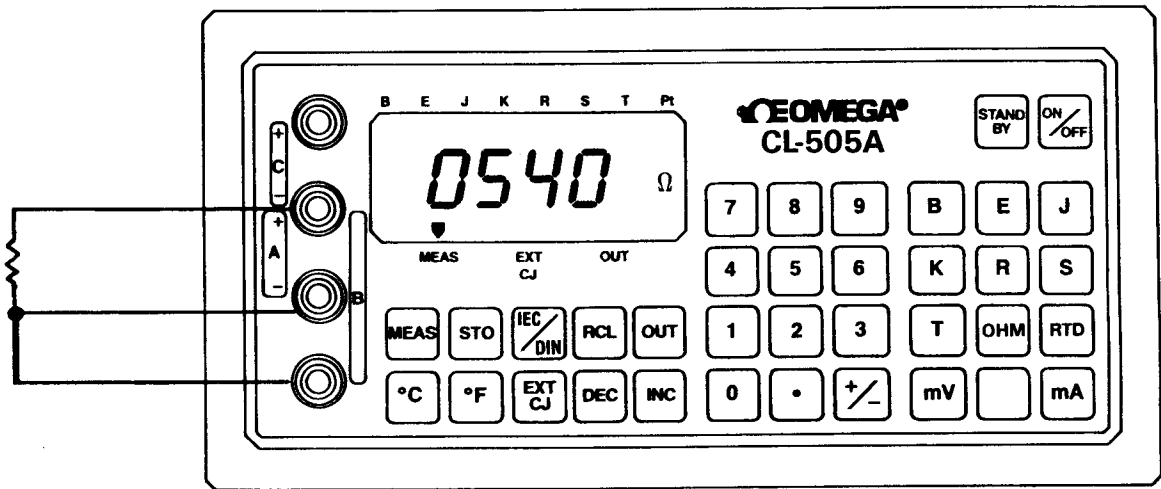


Figure 3-7. Connections for Ohm Measurement

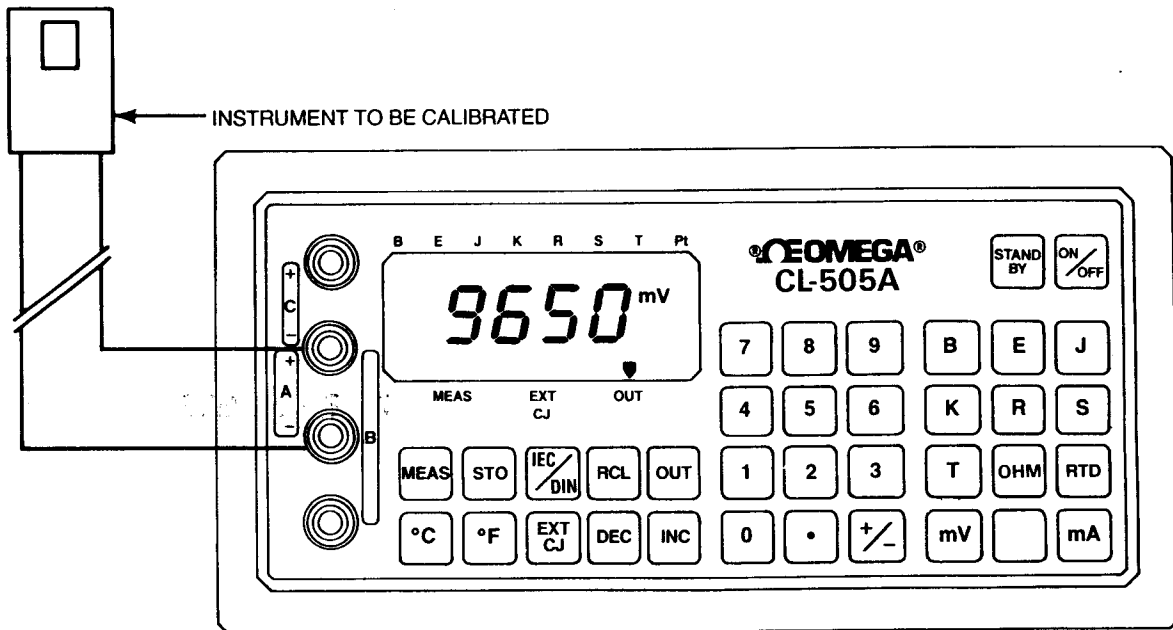


Figure 3-8. Connections For mV Simulation

1. Turn the CL-505A ON.  
The CL-505A can automatically generate signal levels between - 9995 mV and + 9995 mV with a maximum current drain of 5 mA, over the following ranges:

From 0.000 to 9.995 mV; resolution 5 uV  
From 10.00 to 99.95 mV; resolution 50 uV  
From 100.0 to 999.5 mV; resolution 500 uV  
From 1000 to 9995 mV; resolution 5 mV

#### NOTE

The above ranges are valid for either positive or negative values.

2. To start simulation, press the [OUT] key, and then enter the numerical value via the keyboard. Then enter the command by pressing the [mV] key, using the [.] key as required. If the value is negative depress the [+/-] key.

#### NOTES

If an error is made when entering the command, repeat the numerical, decimal, and sign keys only.

The CL-505A will not be programmed with the displayed value until the function key ([mV]) has been pressed.

Executing the command will cause the CL-505A to generate the value displayed on the LCD.

3. To increase or decrease the output value, press the respective [INC] or [DEC] key, and hold it until the required value has been reached.

### 3.3.8 mA Simulation

Connect the CL-505A to the device being calibrated as illustrated by Figure 3-9.

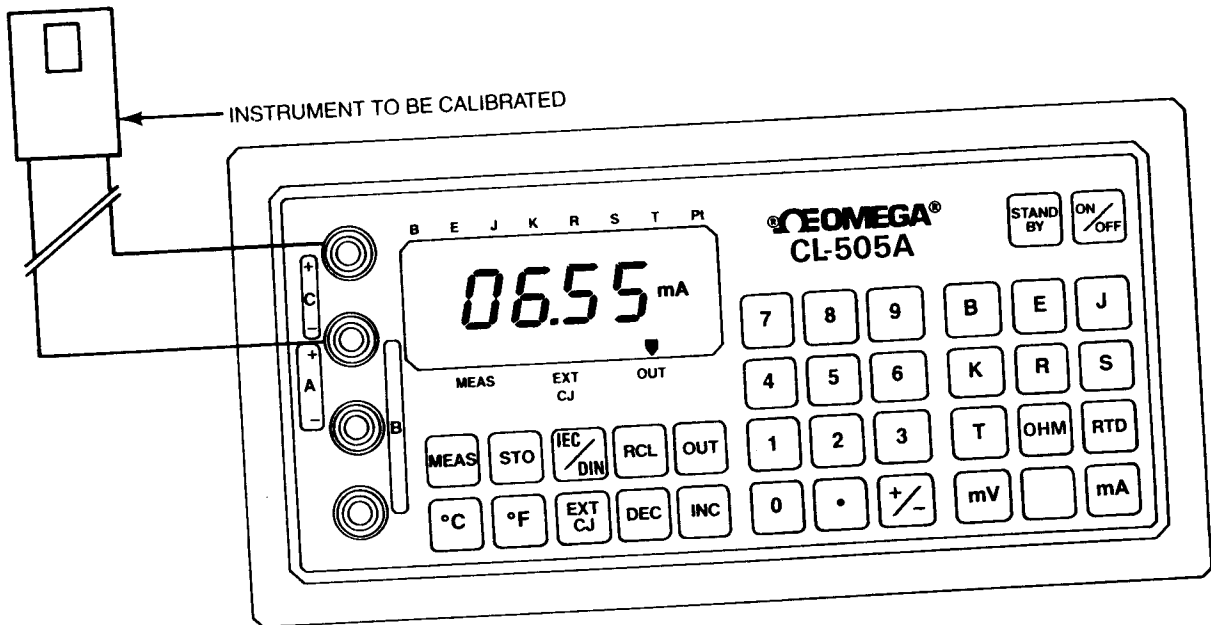


Figure 3-9. Connections for mA Simulation

1. Turn the CL-505A UN.  
The CL-505A can generate any signal between 0 and 50 mA (accuracy 10  $\mu$ A up to 20 mA; 20  $\mu$ A from 20 to 50 mA) with a maximum load of 500 ohms up to 20 mA and 200 ohms up to 50 mA. Maximum drop voltage across the load 10.0V.
2. To start simulation, press the [OUT] key, and then enter the numerical value via the keyboard, using the [.] key as required. Then enter the command by pressing the [mA] key. The required value will be displayed on the LCD.
3. To correct an error or to increase or decrease the values displayed on the LCD, refer to Steps 2 and 3 of paragraph 3.3.7.



NOTE

Only positive signals are generated.  
Reverse leads to change polarity.

### 3.3.9 Thermocouple Simulation With External Cold Junction Compensation

Connect the CL-505A to the device being calibrated, via a 0°C cold junction as illustrated by Figure 3-10.

1. Turn the CL-505A ON.  
The CL-505A can generate a mV signal corresponding to the set temperature value, within the ranges listed in Table 5-1. These values relate to a cold junction temperature of 0°C (32°F) at a maximum load of 5 mA.
2. To begin simulation, press the [OUT] and [EXT CJ] keys in sequence.
3. Enter the temperature value via the keyboard, using the [.] key as required. If the temperature is negative depress the [+/-] key. Press the [°C] or [°F] keys depending on the units used. (If neither is pressed the CL-505A will default to °C).
4. Execute the command by pushing the required thermocouple type key. The required value will be displayed on the LCD in °C or °F.

NOTE

Selection of °C/°F and/or ANSI/IEC or DIN can be changed at any time during simulation, by pressing the appropriate key.

5. To correct an error or to increase or decrease the value displayed on the LCD, refer to Steps 2 and 3 of paragraph 3.3.7.

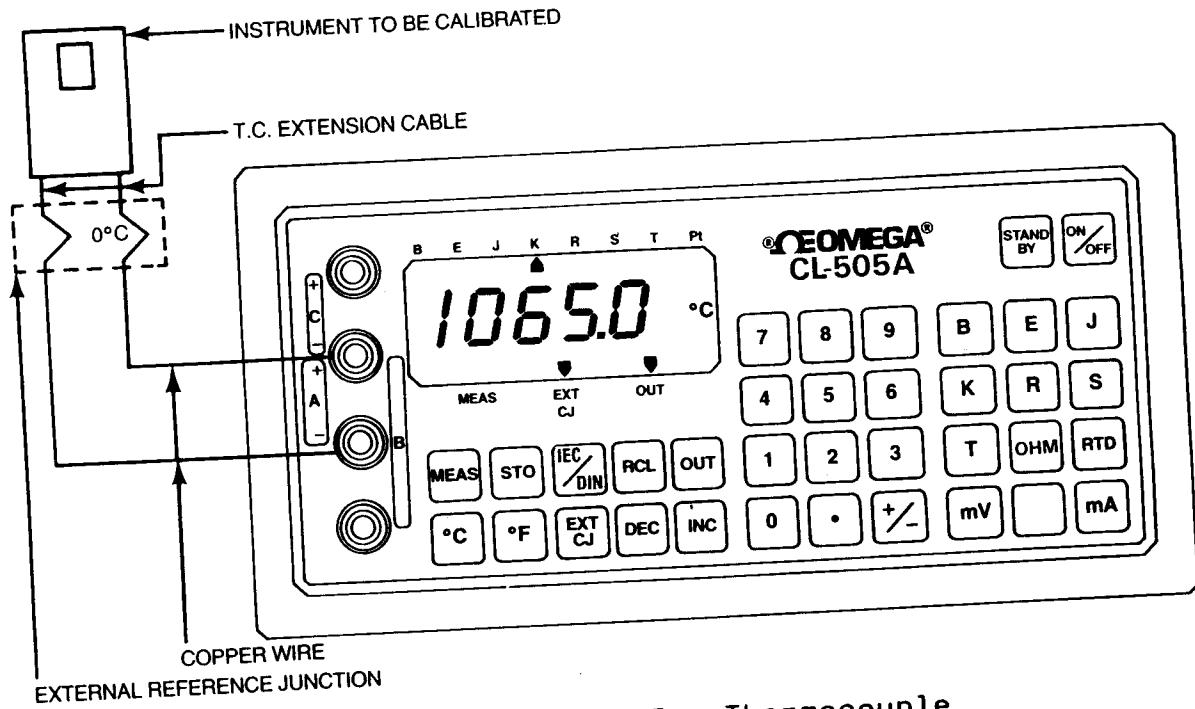


Figure 3-10. Connections For Thermocouple Simulation With External CJ Compensation

### 3.3.10 Thermocouple Simulation With Internal Cold Junction Compensation

Connect the CL-505A to the device being calibrated as illustrated by Figure 3-11.

#### NOTES

To obtain accurate simulation, using the internal cold junction compensation, thermocouple extension cable of the correct type must be used, and it must be connected according to polarity and color code. The negative lead is standardized with red insulation.

For all kinds of simulation, if the value entered is outside the programmed range (see Table 5-1), the CL-505A will automatically load and simulate the maximum range value.

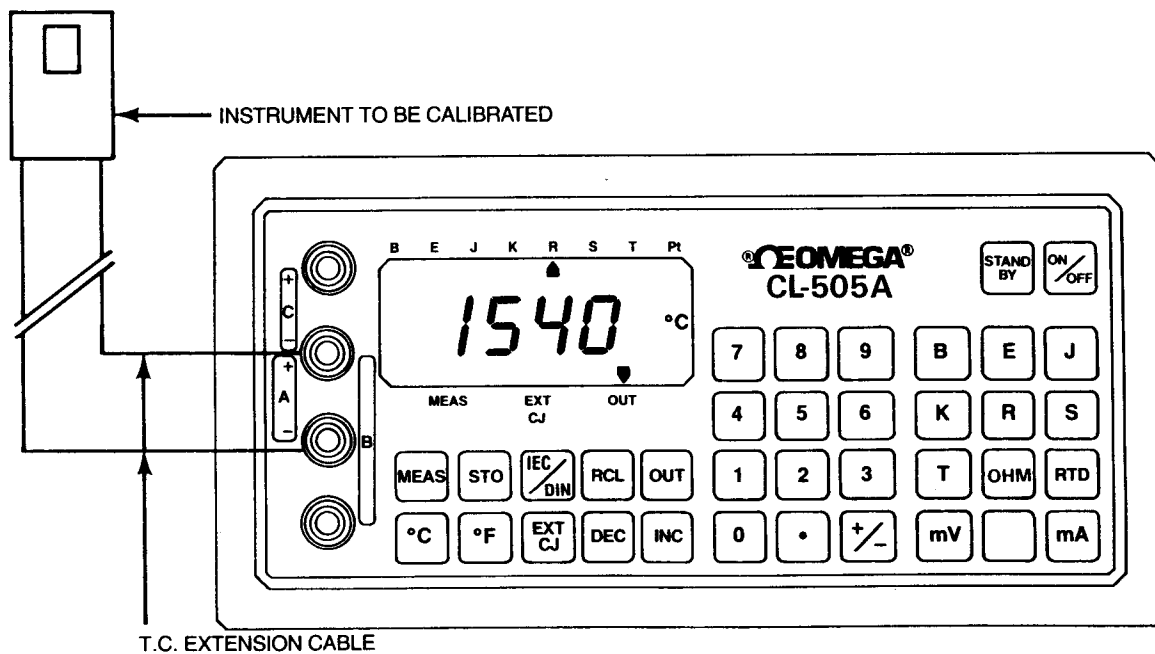


Figure 3-11. Connections For Thermocouple Simulation With Internal CJ Compensation

Connect the CL-505A to the device begin calibrated, as per Figure 3-11.

1. Turn the CL-505A ON.  
The CL-505A can generate a mV signal corresponding to the set temperature value within the ranges listed in Table 5-1. This mV signal will automatically be adjusted to the ambient temperature at the CL-505A terminals. Maximum load is 5 mA.
2. To begin simulation, press the [OUT] key.
3. Then enter the temperature value via the keyboard.  
Enter the numerical value, using the [.] key as required. Press the [+/-] key if the temperature is negative. Enter the [°F] or [°C] units. (If neither is depressed the CL-505A will default to °C).
4. Execute the command by pressing the required thermocouple type key. The required value will be displayed on the LCD in °C.

#### NOTE

Selection of °C/°F and/or ANSI/IEC or DIN can be changed at any time during simulation, by pressing the appropriate key.

5. To correct an error or to increase or decrease the value displayed on the LCD, refer to Steps 2 and 3 in paragraph 3.3.7.

### 3.3.11 Single Function Storage

In the Simulation mode (only), the CL-505A can store up to ten signal functions. These may be a combination of thermocouple, millivolt, or millirange signals. RTD and ohm values may not be stored.

Proceed as follows:

1. Turn the CL-505A ON.
2. Push [STU] key to select the storage functions.
3. Enter the numerical value via the keyboard as noted above for signal simulation. If the value refers to temperature, the appropriate °C or °F configuration must also be specified as well as any internal or external compensation values.

NOTE

If not previously programmed, the instrument will automatically program itself for °C and internal cold junction compensation.

4. When the numerical value has been set, select the function type, and at the keyboard, execute the command by entering the memory number (0 to 9) in which the function is to be stored.

NOTE

If a particular memory number has been previously used to store another signal value, addressing a new command to that memory will delete the previous value and load the new function in its place.

CAUTION

All simulated values stored in memory will be lost when the instrument is turned OFF.

### 3.3.12 Signal Function Simulation Recall

To recall and simulate a previously stored signal, proceed as follows:

#### NOTE

Before recalling the signal, it will be necessary to connect the appropriate external circuit in Figures 3-8 through 3-11.

Press the [RCL] key, and at the keyboard, enter the number (0 to 9) in which the function was previously stored.

This will execute the command and the CL-505A will display values, units, and the mode of operation on the LCD. The CL-505A will then generate whatever function was programmed into that particular memory.

#### NOTES

It is not possible to display a stored function without simulation.

If two or more consecutive simulations are required (without calling STAND-BY condition), the previous simulated value will not be removed from the terminal until the new simulated value is output.

### 3.4 ERROR MESSAGES

The OMEGA CL-505A will automatically display an error message to alert the operator to the existence of an abnormal condition.

#### 3.4.1 Overrange of a Measured Signal

If the input signal exceeds the maximum value listed in Range Table 5-1, the LCD will display the following:

1.....

#### 3.4.2 Underrange of a Measured Signal

If the input signal is below the minimum value listed in Range Table 5-1, the LCD will display the following:

-1.....

#### 3.4.3 Open Circuit

Prior to measurement of the thermocouple, the CL-505A will check the input line. If the input line is open, or presents an impedance of more than 10 kilohm, the LCD will display the following:

EE.OC

#### 3.4.4 Overrange Room Temperature

If the room (ambient) temperature, as measured at the internal cold junction, is higher than 60°C, the LCD will display the following:

CCCC

#### 3.4.5 Underrange Room Temperature

If the room (or ambient) temperature, as measured at the internal cold junction, is lower than -20°C, the LCD will display the following:

-CCCC

#### NOTE

Errors covered in paragraphs 3.4.4 and 3.4.5 can be identified only during thermocouple measurement or simulation when the internal cold junction compensation is used.

#### 3.4.6 Overload of a Negative Signal Simulation

If the external load, during a negative signal simulation, exceeds the maximum load, the LCD will display the following:

-1.....

The output value present on terminal will be function on the applied load.

#### 3.4.7 Overload of Positive Signal Simulation

If the external load, during a positive signal simulation, exceeds the maximum load, the LCD will display the following:

+1.....

The output value present on terminal will be function on the applied load.

#### 3.4.8 Miscellaneous Errors

If errors are made during the entry of OUTPUT, STORAGE, or RECALL functions, the LCD will display the following:

EEEE

All functions and entered values will be cancelled, and the CL-505A will automatically return to the STAND-BY mode of operation.



The LCD can display the following key-entry errors:

- Set value with too many decimal places (in °C)
- Set value with three decimal places (in mA)
- Attempt to simulate RTD or Ohm. — *keep in?*
- Recall of a function from an empty address file

## SECTION 4 SERVICE INFORMATION

### 4.1 REPLACING THE BATTERY

Replace the battery as follows:

1. Remove the CL-505A from carrying case.
2. Unscrew the cover (see Figure 2-1).
3. Detach the battery strap.
4. Disconnect the cables from the battery terminals.
5. Pull the battery out of the case.
6. Install the new battery by reversing the above steps.

### 4.2 CALIBRATION PROCEDURE

#### 4.2.1. Equipment Required

1. Precision mV meter
2. 10 kilohm resistor
3. 100 ohm resistor
4. Copper wire
5. Jumper wire
6. Thermocouple and RTD Reference Tables in Section T of the OMEGA Temperature Measurement Handbook and Encyclopedia

#### 4.2.2 Offset Adjustment

Connect a 10 kilohm  $\pm 10\%$  resistor between terminals + and - mV. Press in sequence [MEAS] [MV]. Display must show 0.000  $\pm 0.005$  mV (see Figure 4-1), otherwise, adjust P3 pot on the IN/OUT Board (upper card, see figures 4-2 and 4-3) in order to obtain the required value.

Remove the 10 kilohm resistor and replace it with a copper wire. The display must always show the measured value. If not, it is necessary to replace the IN/OUT Board.

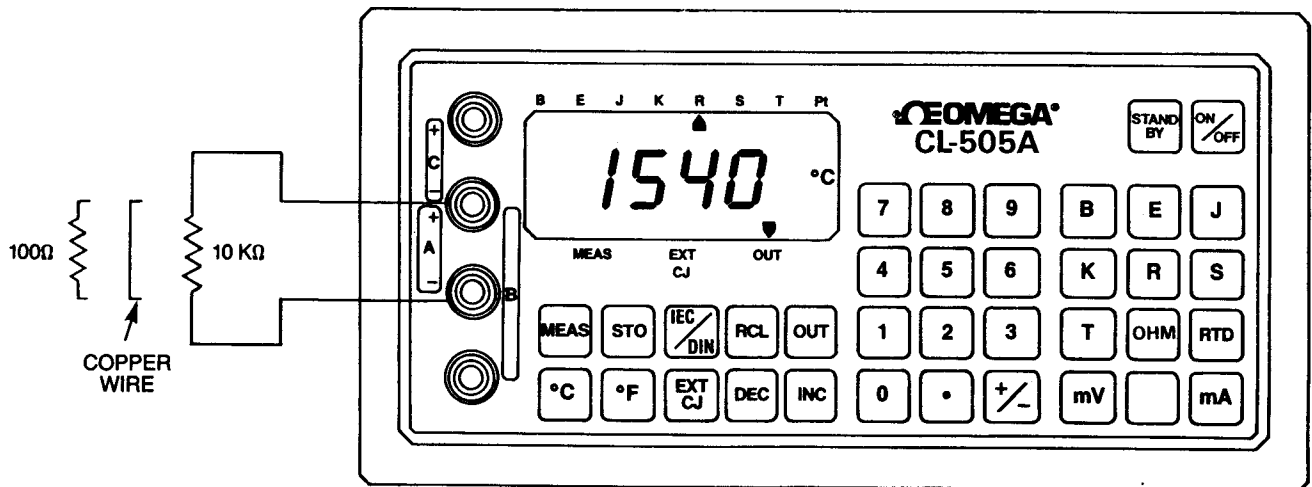


Figure 4-1. Connections for Calibration

#### 4.2.3 100 uA Current Adjustment

Press [MEAS] key and disconnect the copper wire between the input terminals. Connect a 100 ohm resistor between terminals + and - mV and press [RTD] key. See Figure 4-1.

Connect a precision mV meter between the + and - mV terminals. Adjust P1 pot on the IN/OUT board (lower card see Figure 4-2) until a voltage drop corresponding to a 9.995 mV  $\pm 0.003$  mV appears on the precision mV meter.

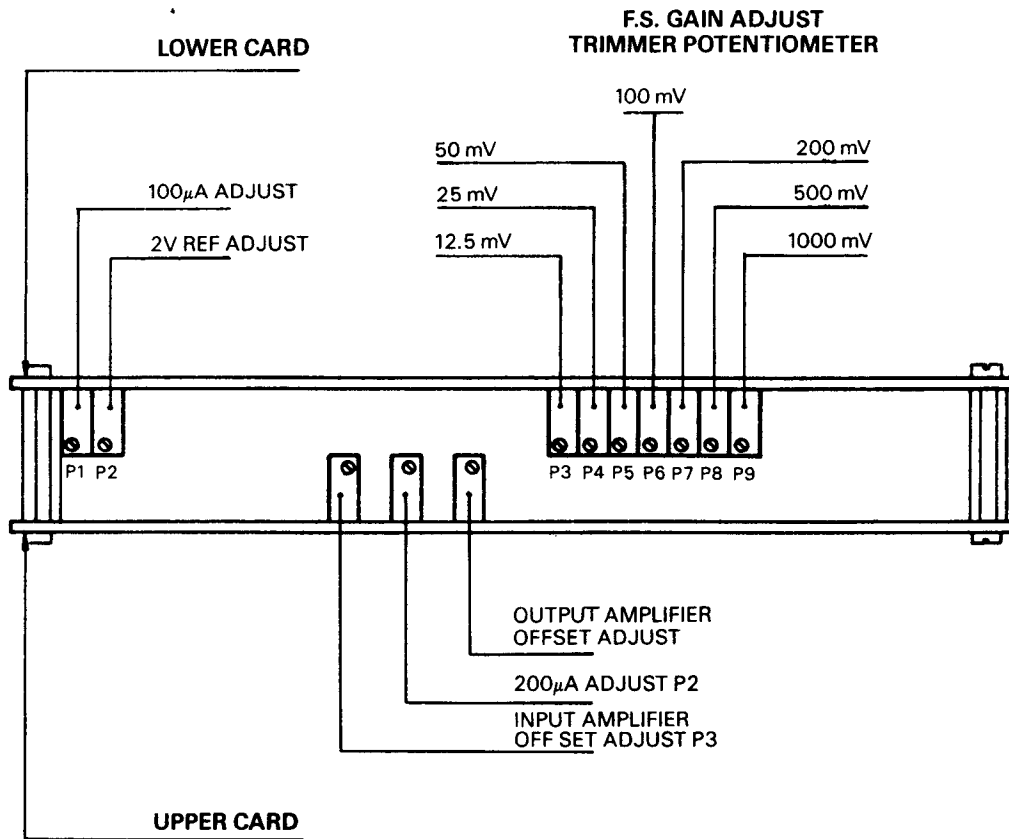
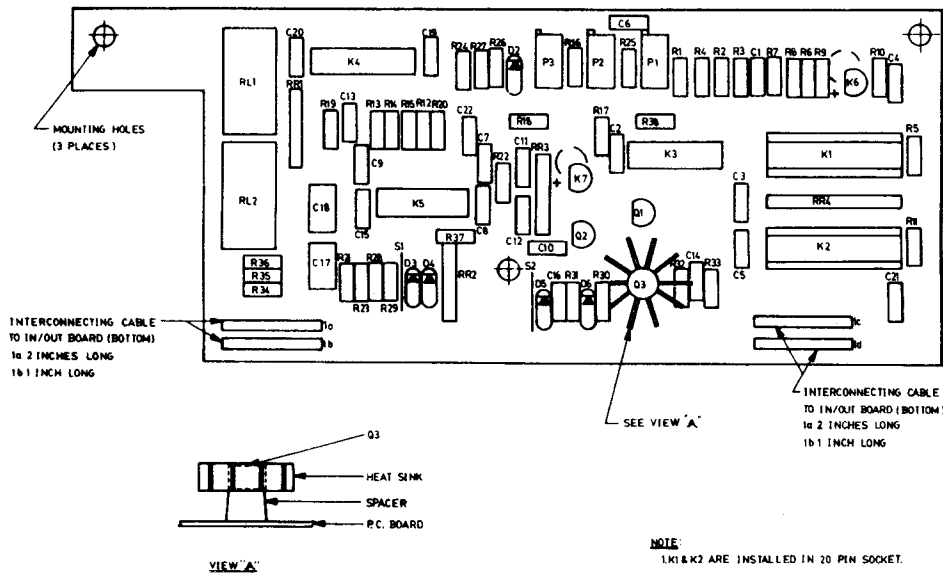


Figure 4-2. IN/OUT Board Upper and Lower Card Adjustments

#### 4.2.4 Span Converter Adjustment

- A. Disconnect the 100 ohm resistor between the input terminals. Turn off the CL-505A.
- B. By means of a jumper, short circuit S1 of the CPU Board as illustrated in Figure 4-4. Turn on the CL-505A.
- C. Adjust P2 (lower card see Figure 4-2) on the IN/OUT Board until there is a reading of 2.000V between pins 39 and 36 on the AD converter (K1 on the I/O Board, see Figure 4-3).
- D. Apply the calibration voltages in Table 4-1 at the input terminals + and - mV.



NOTE:  
K1 & K2 ARE INSTALLED IN 20 PIN SOCKET.

(Top)

REF. DES.	QTY	DESCRIPTION	PART NO./VALUE
RR1,RR2,RR3,RR4	4	RESISTOR PACK	100 K
Q3	1	TRANSISTOR	VN67AB
Q1, Q2	2	TRANSISTOR	VN100M
RL1, RL2	2	RELAY	DR12-12V
D3, D4, D5, D6	4	DIODE	FDH 333
D2	1	DIODE	1N623A
P2	1	POTENTIOMETER	5 K
PI, P3	2	POTENTIOMETER	50 K
K6, K7	2	I.C.	LM 336 BZ
K4	1		CD4051
K3, K5	2		1F 347
K1, K2	2	I.C.	DAC 0832
C11, C13, C15	3	CAPACITOR	100 PICOFARAD 50V
C13, C17, C14, C16	5		33 PICOFARAD 50V
C17, C18	2		1 MICROFARAD 50V
C7	1		10 NANOFARAD 50V
C22, C10, C19, C20, C21, C12, C4, C6, C8, C9	11	CAPACITOR	47 NANOFARAD 50V
R12	1		910 K 1/2W
R26	1	RESISTOR	49.9 OHM 1/4W
R35	1		2.74 K 1/4W
R34	1		2.2 K 1/4W
R23	1		10 K 1/4W
R22	1		6.8 K 1/4W
R21	1		20 K 1/4W
R29	1		1 K 1/4W
R28	1		181 K 1/4W
R24	1		5.6 K 1/4W
R25	1		200 K 1/4W
R24	1		75 K 1/4W
R23, R27	2		102 K 1/4W
R21	1		100 OHM 1/4W
R20	1		301 K 1/4W
R19, R22, R30	3		22 OHM 1/4W
R18	1		2.2 K 1/4W
R16, R17	2		4.99 K 1/4W
R14	1		330 K 1/4W
R13	1		110 K 1/4W
R10	1		1.2 K 1/4W
R8	1		825 K 1/4W
R7, R9	2		13 K 1/4W
R6, R36	2		6.49 K 1/4W
R5, R1, R37	3		100 K 1/4W
R3, R4, R5	3		1 M 1/4W
R1, R2	2	RESISTOR	499 K 1/4W

REF. DES.	QTY	DESCRIPTION	PART NO./VALUE
P1, P4, P5, P6, P7, P8, P9	7	POTENTIOMETER	280 OHM
P2	1		5 K
P3	1	POTENTIOMETER	2K
K6	1	I.C.	LM 336 BZ
K5	1		ICL 7650
K4	1		HI 6108
K3	1		HI 200-5
K2	1		CD 4051
K1	1	I.C.	ICL 7109
RL1, RL2, RL3, RL4	4	RELAY	S2-L2-12V
C13, C14, C15	3	CAPACITOR	1 MICROFARAD 63V
C10	1		1 MICROFARAD 160V
C9	1		10 NANOFARAD 63V
C7	1		22 MICROFARAD 160V
C4, C18	2		15 NANOFARAD 100V
C3	1		1 MICROFARAD 50V
C12, C3, C8, C11, C16, C17	8	CAPACITOR	47 NANOFARAD 25V
R21	1	RESISTOR	99 OHM 1/4W
R19, R20	2		10 OHM 1/4W
R18	1		10 K 1/4W
R17	1		4.7 K 1/4W
R15	1		200 K 1/4W
R13, R14	2		24.9 K 1/4W
R8	1		100 OHM 1/4W
R20	1		10 K 1/4W
R9	1		56 K 1/4W
R6	1		866 K 1/4W
R7	1		220 K 1/4W
R4, R5, R6	3		480 K 1/4W
R3	1		24.3 K 1/4W
R2, R12, R15	3		100 K 1/4W
R1	1	RESISTOR	1.2 K 1/4W

REF. DES.	QTY	DESCRIPTION	PART NO./VALUE
<b>OMEGA</b> Distributor Cann. 0507			
DESIGNED BY: <b>ROGERS</b>			
CHECKED BY: <b>RDGERS</b>			
PROJ. NO.	DATE	REV.	
IN/OUT BOARD (BOTTOM) MODEL CL-505A	4/9/85	C050-0249	REV.

(Bottom)

REF. DES.	QTY	DESCRIPTION	PART NO./VALUE
P1, P4, P5, P6, P7, P8, P9	7	POTENTIOMETER	280 OHM
P2	1		5 K
P3	1	POTENTIOMETER	2K
K6	1	I.C.	LM 336 BZ
K5	1		ICL 7650
K4	1		HI 6108
K3	1		HI 200-5
K2	1		CD 4051
K1	1	I.C.	ICL 7109
RL1, RL2, RL3, RL4	4	RELAY	S2-L2-12V
C13, C14, C15	3	CAPACITOR	1 MICROFARAD 63V
C10	1		1 MICROFARAD 160V
C9	1		10 NANOFARAD 63V
C7	1		22 MICROFARAD 160V
C4, C18	2		15 NANOFARAD 100V
C3	1		1 MICROFARAD 50V
C12, C3, C8, C11, C16, C17	8	CAPACITOR	47 NANOFARAD 25V
R21	1	RESISTOR	99 OHM 1/4W
R19, R20	2		10 OHM 1/4W
R18	1		10 K 1/4W
R17	1		4.7 K 1/4W
R15	1		200 K 1/4W
R13, R14	2		24.9 K 1/4W
R8	1		100 OHM 1/4W
R20	1		10 K 1/4W
R9	1		56 K 1/4W
R6	1		866 K 1/4W
R7	1		220 K 1/4W
R4, R5, R6	3		480 K 1/4W
R3	1		24.3 K 1/4W
R2, R12, R15	3		100 K 1/4W
R1	1	RESISTOR	1.2 K 1/4W

REF. DES.	QTY	DESCRIPTION	PART NO./VALUE
<b>OMEGA</b> Distributor Cann. 0507			
DESIGNED BY: <b>ROGERS</b>			
CHECKED BY: <b>RDGERS</b>			
PROJ. NO.	DATE	REV.	
IN/OUT BOARD (BOTTOM) MODEL CL-505A	4/9/85	C050-0249	REV.

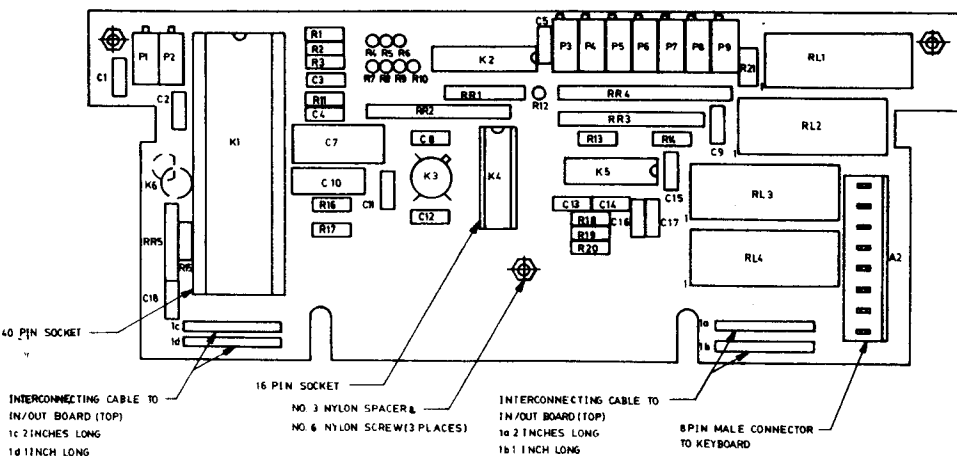


Figure 4-3. Component Layout (IN/OUT Board)

TABLE 4-1

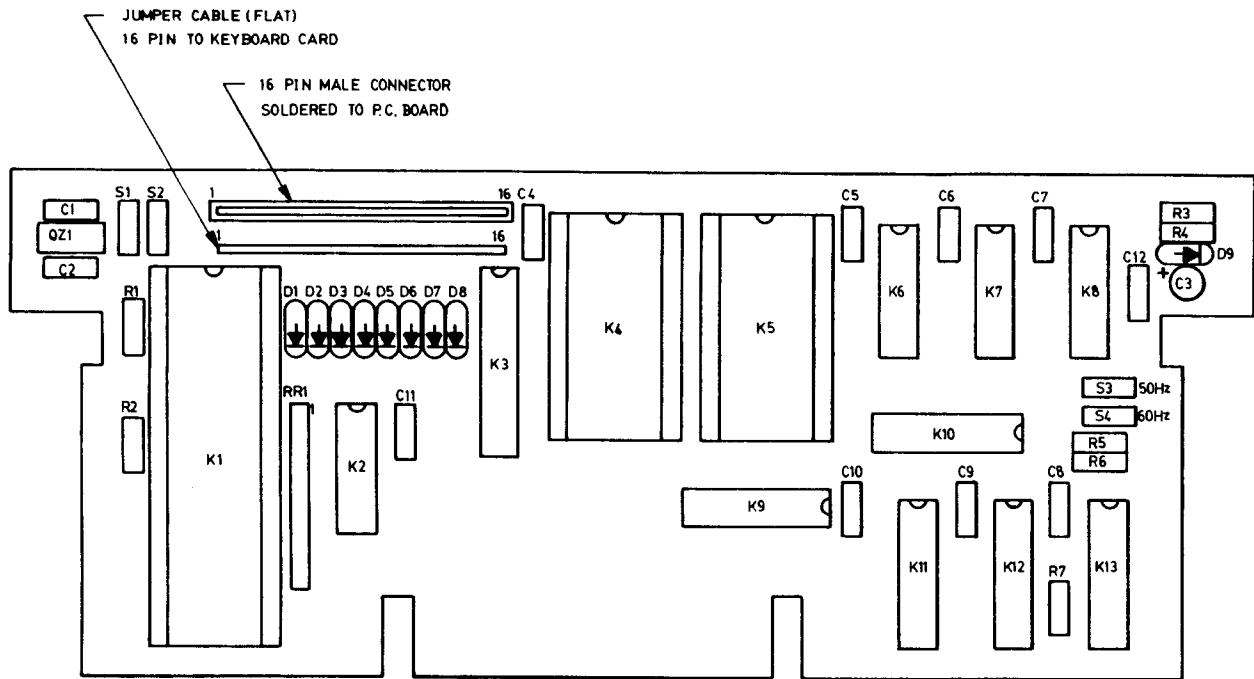
## Span Adjustment

## Calibration Voltages

	Voltage Input (mV)	Full Scale Input Voltage (mV)	*Adjust Trimmer PX for 4000 Bits	**Jumper S1
1.	12.21	12.5	P3	ON
2.	24.42	25	P4	OFF
3.	48.84	50	P5	ON
4.	97.68	100	P6	OFF
5.	195.36	200	P7	ON
6.	488.4	500	P8	OFF
7.	976.8	1000	P9	ON

\*Note the PX Trimmers are on IN/OUT Board (lower card see Figure 4-2).

\*\* Jumper S1 on the CPU Board (see paragraph 4.2.4, step B) is alternated on and off for these settings.



RR1	1	RESISTOR PACK	100 K
QZ	1		4.608 MHz
R4,R5,R6,R7	4	RESISTOR	100 K 1/4 W
R3	1	"	1 M 1/4 W
R1,R2	2	RESISTOR	10 K 1/4 W
C10,C11,C12		CAPACITOR	47 NANOFARAD 100V
C4,C5,C6,C7,C8,C9	9	↑	47 NANOFARAD 100V
C3	1	↓	10 MICROFARAD 16V
C1,C2	2	CAPACITOR	10 PICOFARAD 50V
K13	1	I.C.	74C163
K11,K12	2	↑	4042
K9,K10	2		MC14556B
K8	1		74C04
K7	1		74C00
K6	1		74C02
K5	1		2716
K4	1		2732
K3	1		74C373
K2	1	↓	74C164
K1	1	I.C.	8039
REF DES	QTY	DESCRIPTION	PART NO/VALUE
TOLERANCES EXCEPT AS NOTED		STANDARD	
DECIMAL		CONV. 08807	
±		DRAWN BY L. ROGERS	
±		APPROVED BY	
±		TITLE	
±		CPU CARD (COMPONENT LAYOUT) MODEL 505A	
±		DATE 4/9/85	
±		DRAWING NUMBER C050-0251	
±		REV.	

**NOTE:**  
1. CANCEL I.C. PART NUMBERS  
AFTER BEING MOUNTED ON CARD.

Figure 4-4. Component Layout (CPU Board)

#### 4.2.5 200 $\mu$ A Current Adjustment

Press the [STAND BY] key. Connect a 100 ohm resistor as shown in Figure 4-5. Press in sequence [MEAS] and [RTD] key. Adjust P2 pot on the IN/OUT board (upper card see Figure 4-2) until a reading of  $0.000^{\circ}\text{C} \pm 0.1$  appears on the LCD display.

#### 4.2.6 Final Check

Compare thermocouple and RTD values using the tables in the technical Section of the OMEGA Temperature Measurement Handbook and Encyclopedia. Keep in mind that thermocouple measurements must be done with the [EXT RC] key pressed.

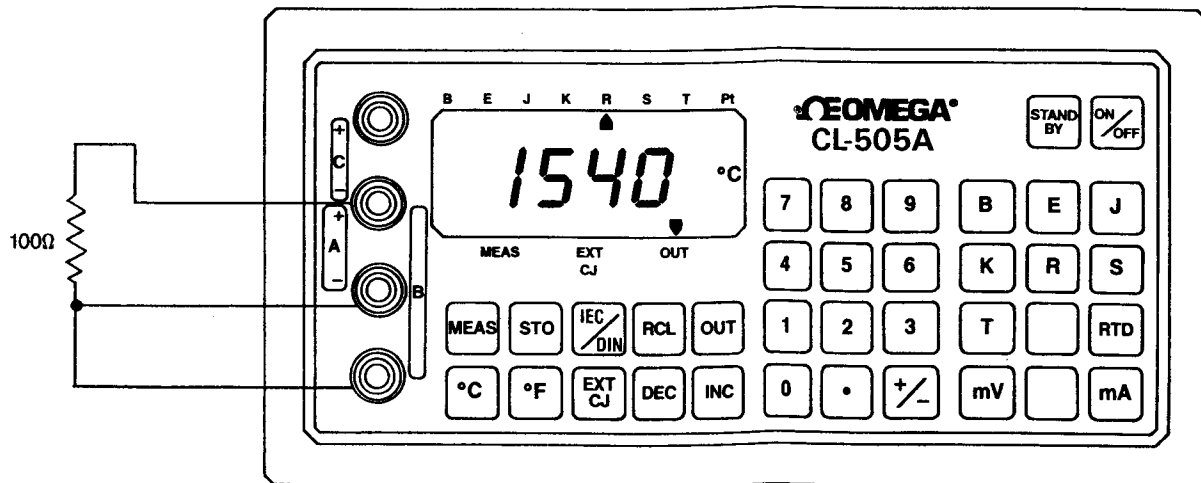


Figure 4-5. Connection of 100 Ohm Resistor

SECTION 5 SPECIFICATIONS

MOUNTING: Bench, panel or portable with vinyl (leather optional) case. Straps on the case can be configured to allow unit to be slung from user's shoulder, or neck.

POWER SUPPLY: 117 V/125 V/160 V/220 V/240 V ac ( $\pm 10\%$ ), 50 to 60 Hz; Voltages selectable via rear switch.

DC OPERATION: Rechargeable lead acid (jellied) battery (12 V, 1.5 AH) for eight hours of operation in calibration mode, and six hours in single generator mode at 70°F operating temperature.

RANGES: SEE TABLE 5-1

THERMOCOUPLE INPUT IMPEDANCE

MEASUREMENT MODE: 100 Megohm

CALIBRATE MODE: Less than 10 ohm at less than 150 nanoamps

CHARGING SYSTEM: Internal rectifier supplied from ac line through power supply.



SPECIFICATIONS (continued)

DISPLAY(S):

- 1) Liquid crystal display (LCD)  
for 4 1/2 digits of information
- 2) LCD indicator on display for:
  - o Thermocouple types, 100 ohm
  - o RTD, milliamp (mA), millivolt (mV) mode, and ohm selected
  - o -Degrees C or F mode selected
  - o -Measurement [MEAS] and output [OUT] mode selected
  - o -External cold junction reference [EXT CJ] mode selected

ZERO DRIFT:

Automatically compensated for in the range of 0° to 50°C (32° to 120°F)

SPAN DRIFT:

0.002% per °C over the range of 0° to 50°C (32° to 120°F)

AUTO COLD JUNCTION  
COMPENSATION:

From -20° to +60°C (-4° to +150°F) automatically selected with thermocouple and cal mode selection.

EXTERNAL COLD JUNCTION  
COMPENSATION:

Auto cold junction compensation can be bypassed with mode selection, if external cold junction compensation is desired by operator.

SPECIFICATIONS (continued)

DIMENSIONS:

H: 3.8" (96 mm) x W: 7.56" (192 mm) x D: 7.87" (200 mm). [Does not include carrying case.]  
Weight: 8 lbs.

PANEL CUTOUT:

3.62" x 7.32" + 0.04 - 0.00.  
Panel mounting adaptors furnished with each unit.

CARRYING CASE:

Vinyl standard with each unit - (leather optional).

**TABLE 5-1  
RANGES**

**Measured/Simulated Thermocouples (Thermocouple Calibrator or Generator Mode Load 2000 Ohm)**

**IEC 584**

Thermocouple	Type of Input	Range	Accuracy*(±)	Resolution
<b>J</b>	Iron-Constantan	-150° to 1200°C	0.3° ≤ 430°C > 0.5°	0.1° ≤ 430°C > 0.5°
		-238° to 2190°F	0.6° ≤ 806°F > 1°	0.5° ≤ 1600°F > 1°
<b>K</b>	Chromel-Alumel	-150° to 1370°C	0.3° ≤ 290°C > 0.5°	0.1° ≤ 290°C > 0.5°
		-238° to 2284°F	1230°C > 1° 0.6° ≤ 1999.5°F > 1.0° 2250°F > 2°	1230°C > 1° 0.5° ≤ 1999.5°F > 1° 2250°F > 2°
<b>T</b>	Copper-Constantan	-160° to 400°C	0.5° ≤ 0°C > 0.3°	0.2° ≤ -100°C > 0.1°
		-258° to 750°F	1° ≤ 0°F ≤ 0.6°	0.5°F
<b>E</b>	Chromel-Constantan	-200° to 1000°C	0.4° ≤ 0°C > 0.3°	0.2° ≤ -150°C > 0.1°
		-330° to 1830°F	330°C > 0.5° 0.8° ≤ 0°F > 0.6° 630°F > 1°	330°C > 0.5° 0.5° ≤ 1210°F > 1°
<b>R</b>	Platinum/ Platinum 13% Rhodium	-50° to 1770°C	1.0°C	1° ≤ 100°C ≥ 0.5°
		-58° to 3218°F	2°F	2° ≤ 200°F ≥ 1°
<b>S</b>	Platinum/ Platinum 10% Rhodium	-50° to 1770°C	1.0°C	1° ≤ 100°C ≥ 0.5°
		-58° to 3218°F	2°F	2° ≤ 200°F ≥ 1°
<b>B</b>	Platinum 30% Rhodium/ Platinum 6% Rhodium	0° to 1820°C	1.0°C	300°C > 1°
		32° to 3300°F	2°F	580°F > 2°F ≤ 1100°F > 1°F

**Measured/Simulated Thermocouples (Thermocouple Calibrator or Generator Mode Load 2000 Ohm)**

**DIN 43710/1961**

Thermocouple	Type of Input	Range	Accuracy*(±)	Resolution
<b>J</b>	Iron-Constantan	-150° to 900°C	0.3° ≤ 430°C > 0.5°	0.1° ≤ 430°C > 0.5°
		-240° to 1650°F	0.6° ≤ 806°F > 1°	0.5° ≤ 1560°F > 1°
<b>K</b>	Chromel-Alumel	0° to 1300°C	0.3° ≤ 290°C > 0.5°	0.1° ≤ 290°C > 0.5°
		32° to 2272°F	1230°C > 1° 0.6° ≤ 1999.5°F > 1.0° 2250°F > 2°	1230°C > 1° 0.5° ≤ 1999.5°F > 1° 2250°F > 2°
<b>T</b>	Copper-Constantan	-160° to 600°C	0.5° ≤ 0°C > 0.3°	0.2° ≤ -150°C
		-255° to 1110°F	1° ≤ 0°F > 0.6°	0.1° ≤ 440°C > 0.5° 0.5°F
<b>E</b>	Chromel-Constantan	-200° to 1000°C	0.4° ≤ 0°C > 0.3°	0.2° ≤ -150°C > 0.1°
		-330° to 1830°F	330°C > 0.5° 0.8° ≤ 0°F > 0.6° 630°F > 1°	330°C > 0.5° 0.5° ≤ 1210°F > 1°
<b>R</b>	Platinum/ Platinum 13% Rhodium	0° to 1700°C	1.0°C	1° ≤ 100°C > 0.5°
		32° to 2910°F	2°F	2° ≤ 200°F > 1°
<b>S</b>	Platinum/ Platinum 10% Rhodium	0° to 1600°C	1.0°C	1° ≤ 100°C > 0.5°
		32° to 2910°F	2°F	2° ≤ 200°F > 1°
<b>B</b>	Platinum 30% Rhodium/ Platinum 6% Rhodium	0° to 1800°C	1.0°C	300°C > 1°
		32° to 3270°F	2°F	580°F > 2°F ≤ 1100°F > 1°F

**Measured RTD (Calibrator Mode)**

Designation	Input	Range	Accuracy*(±)	Resolution
<b>RTD</b>	Platinum-100 Ohm RTD	-200° to 850°C	0.3° ≤ 315°C > 0.5°	0.1° ≤ 315°C > 0.5°
		-330° to 1560°F	0.6° ≤ 600°F > 1°	0.5°F
<b>Ohm</b>	Resistor	0.0 to 600.0 Ohm	0.1 Ohm ≤ 350 > 0.2 Ohm	0.1 Ohm ≤ 350 > 0.2 Ohm

Table 5-1 (continued)

**Simulated mV (Voltage Generator Mode) Accuracy\*  $\pm 0.05\%$  of Full Scale Value up to 1000 mV,  $\pm 0.1\%$  over 1000 mV.**

Range	Resolution	Maximum Allowed Load
$\pm 10$ mV	5 $\mu$ V	200 Ohm/mV Load Resistor
$\pm 100$ mV	50 $\mu$ V	
$\pm 1$ V	0.5 mV	Maximum Current 5 mA
$\pm 10$ V	5 mV	

**Simulated mA (Current Generator Mode) Accuracy\*  $\pm 0.05\%$  of Full Scale Value**

Range	Resolution
0 to 50 mA	10 $\mu$ A $\leq$ 20 mA > 20 $\mu$ A

**Measured mA (Current Calibrator Mode) Accuracy\*  $\pm 0.05\%$  of Full Scale Value**

Range	Resolution	Impedance
-10 to +10 mA	5 $\mu$ A	10 Ohm
-130 to +130 mA	50 $\mu$ A $\leq$ $\pm 100$ mA $\geq$ 0.5 mA	

**Measured mV and V (Voltage Calibrator Mode) Accuracy\*  $\pm 0.05\%$  of Full Scale Value up to 1000 mV,  $\pm 0.1\%$  over 1000 mV**

Range	Resolution	Impedance
-10 to +10 mV	5 $\mu$ V	100 M $\Omega$
-100 to +100 mV	50 $\mu$ V	100 M $\Omega$
-1 to +1 V	0.5 mV	100 M $\Omega$
-10 to +10 V	5 mV	2 M $\Omega$

\* Accuracy includes max. linearization error, A/D conversion, internal instrument noise, and cold-junction compensation for 24 hours without zero or scale adjustment. All contributing errors are added together to produce worst case instrument accuracy.

NOTES

NOTES

APPENDIX

# OMEGA® ... Your Source for Process Measurement and Control

## TEMPERATURE

- Thermocouple, RTD & Thermistor  
Probes & Assemblies
- Connector Systems and Panels
- Wire: Thermocouple, RTD and Thermistor
- Calibrators and Ice Point References
- Recorders, Controllers and Process Monitors
- Data Acquisition Modules and Data Loggers
- Computer Sensor Interface

## PRESSURE/STRAIN

- Transducers
- Strain Gauges
- Load Cells
- Pressure Gauges
- Instrumentation

## FLOW

- Rotameters
- Flowmeter Systems
- Air Velocity Indicators
- Turbine/Paddlewheel Systems
- Vortex Meters and Flow Computers

## pH

- Electrodes
- Benchtop/Laboratory Meters
- Controllers
- Calibrators/Simulators
- Transmitters



One Omega Drive, Box 4047  
Stamford, CT 06907-0047  
(203) 359-1660 Telex: 996404 Cable: OMEGA FAX: (203) 359-7700

## WARRANTY

OMEGA warrants this unit to be free of defects in materials and workmanship and to give satisfactory service for a period of 13 months from date of purchase. OMEGA Warranty adds an additional one (1) month grace period to the normal one (1) year product warranty to cover handling and shipping time. This ensures that our customers receive maximum coverage on each product. 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.



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Stamford, Connecticut 06907-0047  
(203) 359-1660 Telex: 996404 Cable: OMEGA FAX: (203) 359-7700

### 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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