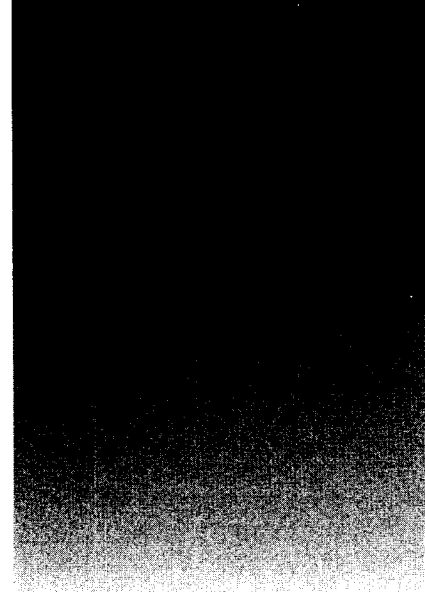
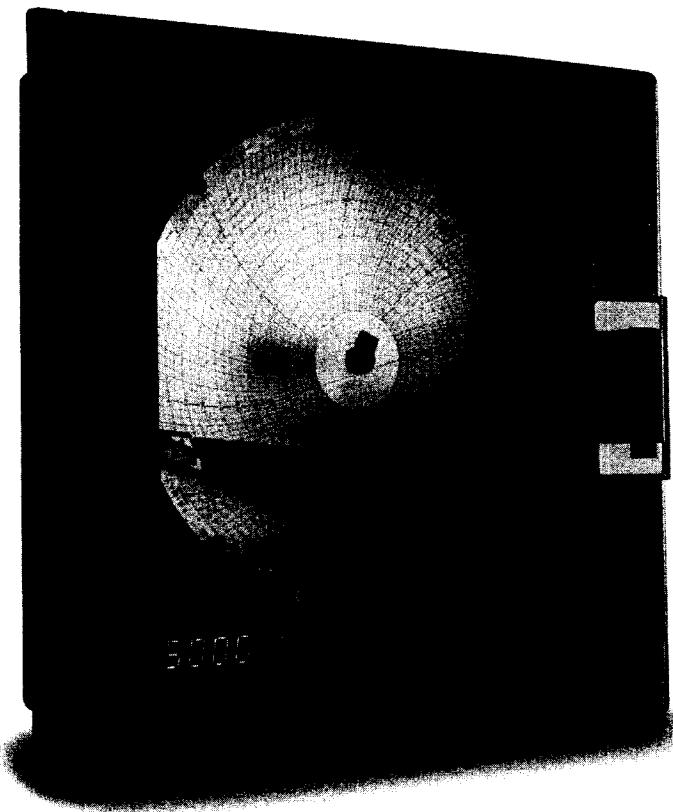


User's Guide



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CT5000 Circular Recorder



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It is the policy of OMEGA to comply with all worldwide safety and EMC/EMI regulations that apply. OMEGA is constantly pursuing certification of its products to the European New Approach Directives. OMEGA will add the CE mark to every appropriate device upon certification.

The information contained in this document is believed to be correct but OMEGA Engineering, Inc. accepts no liability for any errors it contains, and reserves the right to alter specifications without notice.

WARNING: These products are not designed for use in, and should not be used for, patient connected applications.

TABLE OF CONTENTS

	PAGE NUMBER
SECTION 1 - OVERVIEW	5
1.1 Display	5
1.2 Control	5
1.3 Alarms	5
1.4 Digital Communications	5
1.5 Power Input	5
SECTION 2 - INSTALLATION & WIRING	6
2.1 Unpacking	6
2.2 Location / Mounting	6
2.3 Preparation for Wiring	8
2.4 Wiring Connections	11
SECTION 3 - NORMAL OPERATION	15
3.1 Changing The Chart	15
3.2 Control Output Settings	15
3.3 Alarm Settings	16
3.4 High/Low Limits	16
SECTION 4 - RECORDER SETUP, TEST, AND CALIBRATION	16
4.1 Hardware Selections - Input Jumper Positions	17
4.2 Recorder Programming	17
4.3 Test Mode	20
SECTION 5 - RECORDER CALIBRATION MODE	21
5.1 Input Calibration	21
5.2 Chart/Pen Calibration	22
SECTION 6 - MODEL NUMBER CHANGES	23
APPENDICES	
A - Specifications	24
Warranty	31

FIGURES

Figure 2-1A	Panel Mounting	6
Figure 2-1B	Surface Mounting	7
Figure 2-1C	Adaptor Plate	7
Figure 2-2	Noise Suppression	9
Figure 2-3	Noise Suppression	9
Figure 2-4	Board and Terminal Locations	11
Figure 2-5A	AC Power Input Wiring-Standard Voltage	12
Figure 2-5B	Power Wiring-Low Voltage	12
Figure 2-6	Input Signal Wiring	12
Figure 2-7	Relay Output Wiring	13
Figure 2-8	Communications Wiring	13
Figure 2-9A	Transmitter Power Supply (One Transmitter)	14
Figure 2-9B	Transmitter Power Supply (Two Transmitters)	14

Section 1 Overview

This instrument records process trend lines, one or two pens, on a 10 inch circular chart. As an option, up to two alarm points are provided for each of the two pens.

This recorder will accept J, K, T, R, and S Thermocouples and RTD inputs, as well as typical Millivolt, Milliamp (4-20mA) and Volt inputs, (up to 5 volts).

1.1 DISPLAY

Process values for each pen can be displayed on the .56" LED display, or the display can be blanked. In the latter case, the display is used only for programming and setting alarm points.

1.2 CONTROL

The instrument can be provided with relay control outputs which can be programmed for on-off control capability.

1.3 ALARMS

Two optional alarm output relays, with SPDT contacts, are available for each pen. Each alarm is also configurable as a latching, limit device. In this case, a manual reset button is required and included when the High/Low Limit option is ordered.

1.4 DIGITAL COMMUNICATIONS

An optional, RS-485 digital communications port is available that utilizes the standard MODBUS RTU protocol.

1.5 POWER INPUT

The standard recorder will operate on input power over the range of 90-264 VAC, 50-60 Hz, without any modifications. A low power voltage option (20-50 VAC or 22-65 VDC) is also available. All Low Voltage option recorders are clearly identified as such by a label near the power wiring terminal block.

Section 2 Installation and Wiring

Read these instructions completely and carefully before proceeding with the installation and operation of this recorder. Electrical code requirements and safety standards should be observed. Installation should be performed by qualified personnel only.

Caution: The standard recorder will accept a power input over the range of 90-264 VAC. There is a special low power voltage option that is available. Please verify the AC input power required by the recorder before proceeding with the installation. The power required is listed in the Model/Serial number label affixed to the platen in the upper left hand corner.

2.1 UNPACKING

Remove the recorder from the carton and inspect for any damage due to shipment. If any damage is noted, report and file a claim with the carrier. Write the model number and serial number of the instrument on the inside front cover of this operation manual for future reference.

2.2 LOCATION / MOUNTING

Locate the instrument away from excessive moisture, oil, dust and vibration. Do not subject the instrument to operating temperatures outside of the 0 to 55°C (32 to 131°F) range.

The panel where the instrument will be mounted must provide rigid support for the approximate 7 lb. weight of the instrument. Adjacent instruments may be mounted within a minimum of 2 inches horizontally and 3 inches vertically, providing that proper panel support is provided.

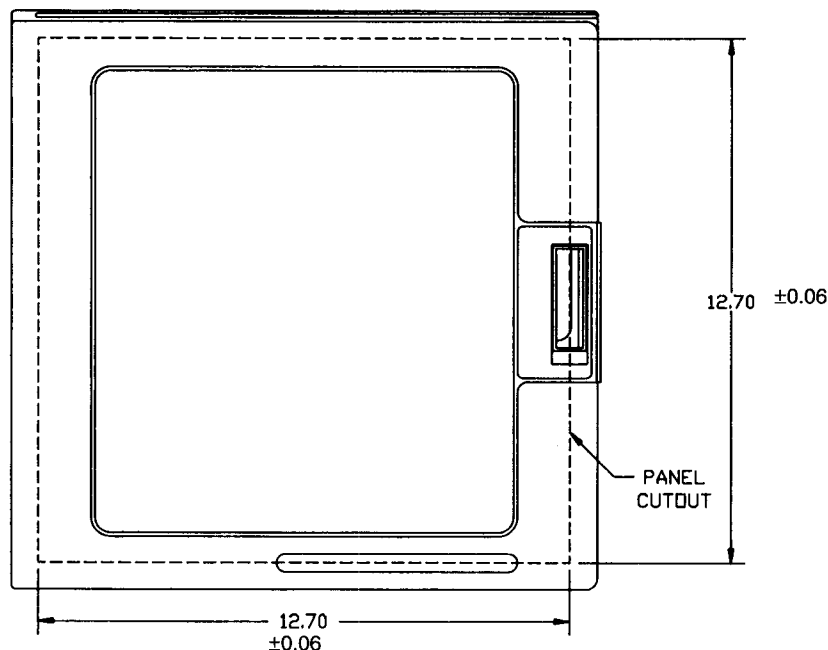
PANEL MOUNTING:

1. Remove the mounting brackets attached to the recorder upon receipt.
2. Cut panel opening to the dimensions illustrated in Figure 2-1A.
3. Insert the recorder in the panel opening. Reattach the mounting brackets to the side of the recorder with the mounting ears facing the back of the panel. Adjust the mounting brackets so they fit snugly against the panel, and then tighten.

PANEL MOUNTING HARDWARE REQUIRED: (provided with instrument)

- (1) set mounting brackets - mounted to the recorder
- (1) set mounting screws - mounted to the recorder

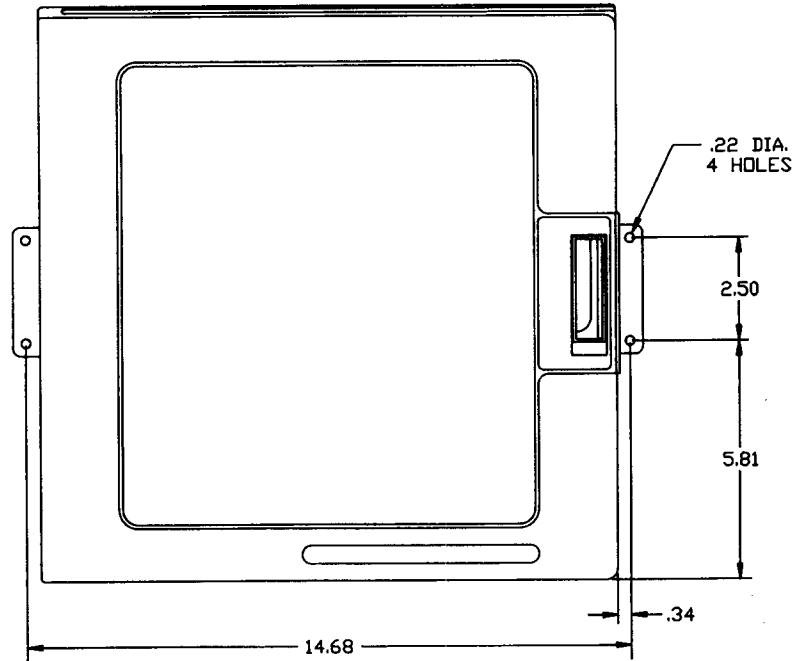
FIGURE 2-1A



SURFACE MOUNTING:

1. Loosen the mounting brackets attached to the recorder and flip their position so the ears are flush with the back of the recorder. Fasten the recorder to the surface using the appropriate fasteners (#10 screws or nuts and bolts) depending on the surface material.
2. As an alternative, remove the brackets, attach them to the surface, and then attach the recorder to the brackets.

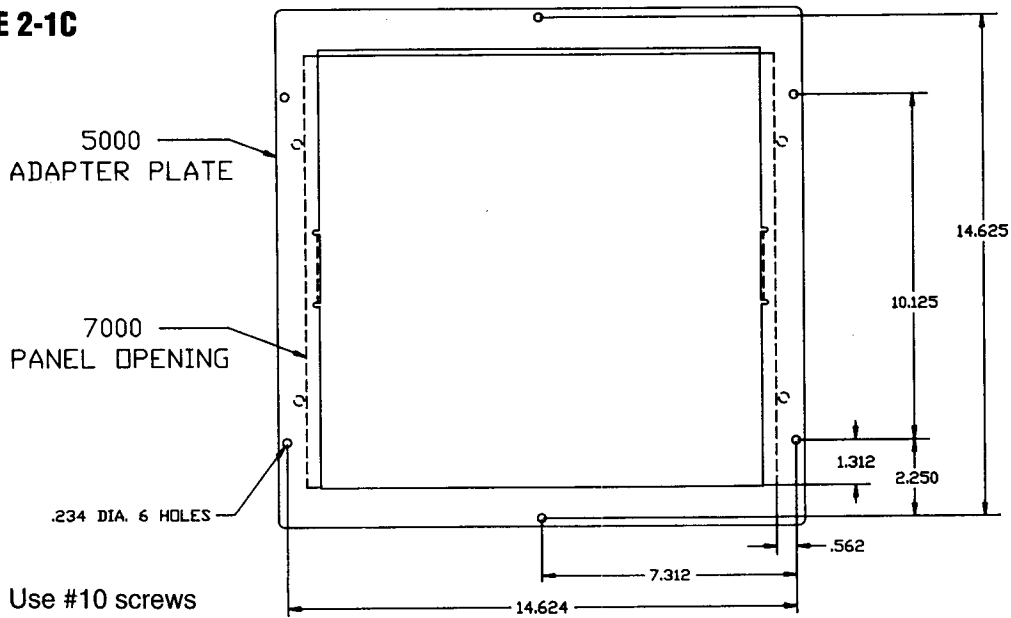
FIGURE 2-1B



RETROFIT:

Note: An Adapter Plate is available (P/N 50033301) that allows the recorder to retrofit with the CT7000 recorders. Figure 2-1C shows the adapter plate relative to the CT7000 cutout. The Adapter Plate includes ears that attach to the sides of the recorder.

FIGURE 2-1C



2.3 PREPARATION FOR WIRING

Electrical noise interference is a phenomenon typical of industrial environments. Use the following guidelines which are generally used to minimize the effect of electrical noise on instrumentation in general.

2.3.1 WIRING GUIDELINES

Listed below are some of the common sources of electrical noise in the industrial environment:

- Ignition Transformers
- Arc Welders
- Mechanical contact relay(s)
- Solenoids

Before using any instrument near the devices listed, the instructions below should be followed:

1. If the recorder is to be mounted in the same panel as any of the listed devices, separate them by the largest distance possible.
2. If possible, replace electromechanical relay(s) with solid state relays.
3. Consider using a separate isolation transformer to power the recorder and any other instrumentation in the panel. The transformer will serve to isolate the recorder from noise found on the AC power lines.
4. If the recorder is being installed on existing equipment, existing wiring should be inspected to insure that good wiring practices have been followed.
5. Connect a good earth ground to the recorder chassis ground connection. To verify this, take a resistive measurement from the instrument chassis to the nearest metal water pipe or proven earth ground. The reading should not exceed 100 ohms. Each instrument should have a dedicated earth ground. Do not chain link multiple instrument ground wires.
6. AC neutral should be at or near ground potential. To verify this, measure the AC voltage between neutral and ground. The reading should be no more than 50 millivolts. If greater, the secondary of the transformer feeding the recorder should be checked out by an electrician.
7. Wire Isolation/Segregation - this recorder is designed to promote proper separation of the wiring groups that connect to it. The AC power terminals are located near the top of the instrument. The input signal terminals are located in the middle section of the main board and the output alarm relay connections are on a separate board in the lower right hand corner of the instrument.
8. Input Signal Wiring - Shielded cable helps eliminate electrical noise being induced on the wires. All input wires should be run with shielded cable. Connection lead length should be kept as short as possible. The shield should be grounded at one end only. The preferred grounding location is at the sensor, transmitter or transducer.
9. For severe levels of electrical noise, it may be necessary to suppress the noise at its source. Many manufacturers of relays, contractors, etc. supply "surge suppressors" which mount on the noise source. For those devices that do not have surge suppressors supplied, RC (resistance-capacitance) networks and/or MOVs (metal oxide varistors) may be added.

Inductive Loads - MOVs are recommended for transient suppression for inductive loads, and should be connected in parallel and as close as possible to the load. See Figure 2-2. Additional protection may be provided by adding an RC network across the load.

Contacts - Arcing may occur across contacts (relays or switches) when they open and close. This results in electrical noise as well as damage to the contacts. Connecting an RC network, properly sized, in parallel, can eliminate this problem. See Figure 2-3.

For circuits up to 3 amps, a combination of a 220 ohm resistor and 0.5 microfarad capacitor (1000 volts) is recommended. For circuits from 3 to 5 amps, connect two of these in parallel. The resistor should be 1/4 watt or 1 watt for 115 VAC or 230VAC circuits, respectively.

FIGURE 2-2

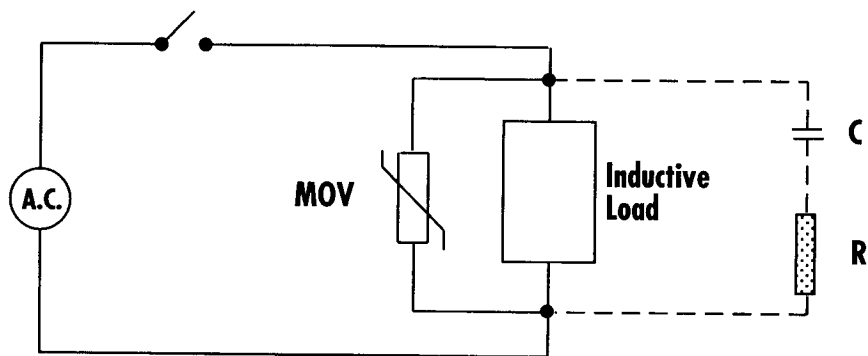
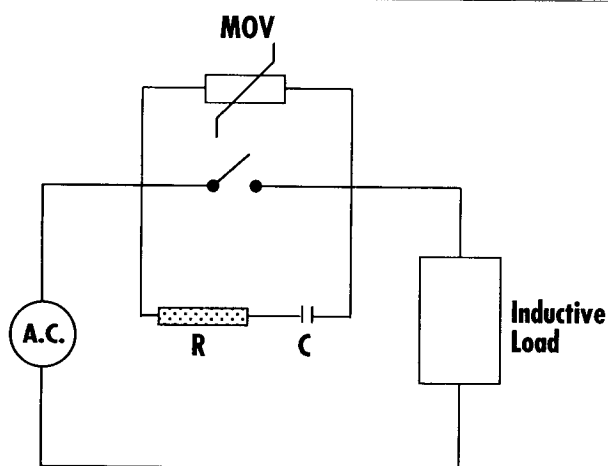


FIGURE 2-3



2.3.1 SENSOR PLACEMENT

If the input probe will be subjected to corrosive or abrasive conditions, it should be protected by the appropriate thermowell. The probe should be positioned to reflect the true process temperature:

In liquid media - the most agitated area

In air - the best circulated area

For thermocouple sensors, the lead resistance should not exceed 300 ohms. If this is exceeded, recorder accuracy could be affected. To determine the temperature error caused by lead length resistance, use the following equation:

$T_{err} = TCe \times L$ where; TCe = temperature error in °F or °C per 100 feet
 L = length of lead wire in thousands of feet

TABLE 1

Temperature error in °C per 1000 feet of Lead wire					
AWG No.	Thermocouple Type:				
	J	K	T	R	S
10	0.03	0.09	0.04	0.10	0.11
12	0.05	0.13	0.06	0.16	0.16
14	0.09	0.21	0.10	0.27	0.26
16	0.14	0.34	0.15	0.41	0.42
18	0.22	0.55	0.25	0.68	0.68
20	0.36	0.86	0.39	1.08	1.09
24	0.88	2.19	0.99	2.72	2.73

TABLE 2

Temperature Error in °F per 1000 feet of Lead wire					
AWG No.	Thermocouple Type:				
	J	K	T	R	S
10	0.06	0.15	0.07	0.18	0.19
12	0.10	0.24	0.11	0.30	0.30
14	0.16	0.39	0.18	0.48	0.48
16	0.25	0.61	0.28	0.75	0.75
18	0.40	0.99	0.45	1.22	1.23
20	0.64	1.55	0.71	1.94	1.96
24	1.58	3.94	1.78	4.89	4.91

For 3 wire RTDs, the instrument can virtually eliminate all lead wire resistance error.

Two wire RTDs should be used only with lead lengths less than 10 feet, unless special input calibration is performed using the **iCor** (Input Correction) capability. (See Section 4 for setting **iCor**.) To determine the temperature error resulting from the lead length resistance, use the following equation:

$$T_{err} = TRe \times L \quad \text{where; } TRe = \text{temperature error in } ^\circ\text{C or } ^\circ\text{F per 1000 feet}$$

$$L = \text{length of lead wire in thousands of feet}$$

TABLE 3 **2 Wire RTD**

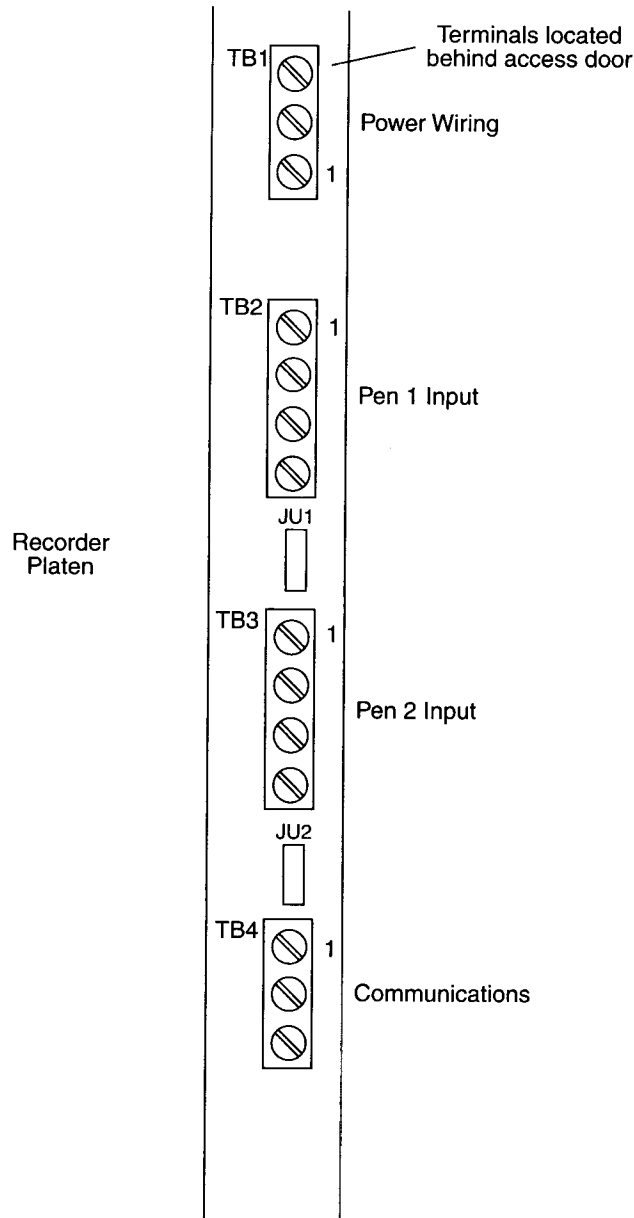
AWG No.	Error °C	Error °F
10	+/-5.32	+/-9.31
12	+/-9.31	+/-14.6
14	+/-13.3	+/-23.9
16	+/-21.3	+/-38.6
18	+/-34.6	+/-61.2
20	+/-54.5	+/-97.1
24	+/-86.5	+/-155.6

2.4 WIRING CONNECTIONS

WARNING: Avoid electrical shock. AC power wiring must not be connected at the source distribution panel until all wiring connections are completed.

All wiring connections are typically made to the instrument at the time of installation. All connections are made behind the access door on the recorder right side. Loosen the two thumbscrews and open the access door to complete all wiring. Connections should be made at the terminal blocks, two 14 gauge wires maximum, copper conductors only, except thermocouple inputs. Terminal blocks are designated TB1 through TB4. See Figure 2-4 for the terminal block locations. The number of terminal blocks present on the instrument depends on the model/hardware configuration.

FIGURE 2-4



2.4.1 ELECTRICAL CONDUIT OPENINGS

The instrument case has 3 conduit openings, all on the right hand side of the case. To minimize the effect of electrical noise, the following wire groups should be routed through the conduit openings as shown below.

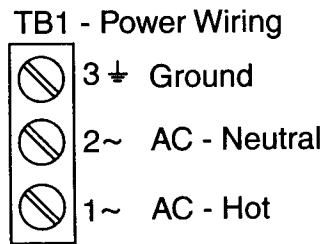
- Top Conduit Opening - Power Input - TB1
- Middle Conduit Opening - Input Signal Wiring & Communications - TB2, TB3, and TB4
- Bottom Conduit Opening - Optional Control/Alarm Outputs - Option Board TB5-TB8

Note: Unused conduit openings should be sealed.

2.4.2.1 AC POWER WIRING - STANDARD VOLTAGE

Connect the AC hot line to terminal 1 of TB1 and the neutral to terminal 2 of TB1.
Connect the AC ground to terminal 3 of TB1. See Figure 2-5A

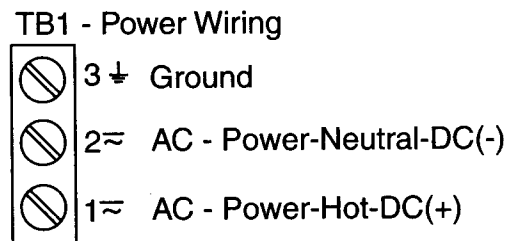
FIGURE 2-5A



2.4.2.2 POWER WIRING - LOW VOLTAGE

Connect the AC hot line to terminal 1 of TB1 and the neutral to terminal 2 of TB1.
Connect the AC ground to terminal 3 of TB1. Connect the DC positive (+) to terminal 1 of TB1 and the negative (-) to terminal 2 of TB2. Connect the ground to terminal 3 of TB1. See Figure 2-5B.

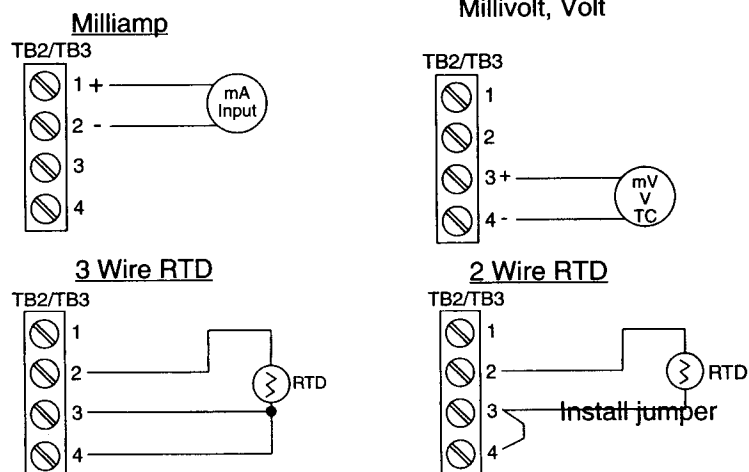
FIGURE 2-25B



2.4.3 INPUT SIGNAL WIRING

Pen 1 inputs are connected to TB2 and Pen 2 inputs are connected to TB3. The input wiring for each pen is identical. See Figure 2-6 for details on wiring various types of inputs to the recorder.

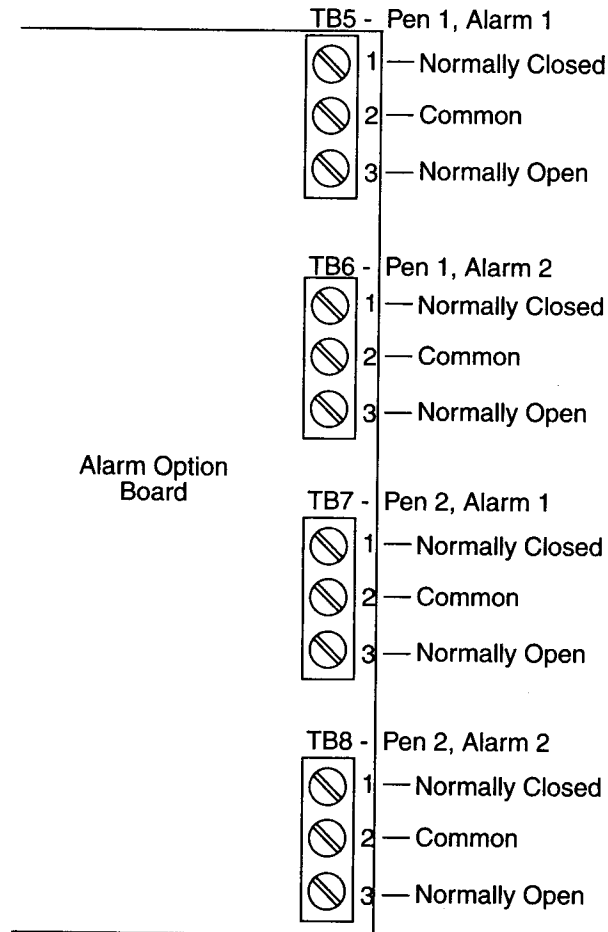
FIGURE 2-6



2.4.4 RELAY OUTPUT WIRING

Relay outputs, up to 2 for each pen, are provided as an option on this instrument with a separate circuit board that is mounted in the lower right hand corner of the instrument, near the lower electrical conduit hole. Wire up each relay as shown in Figure 2-7.

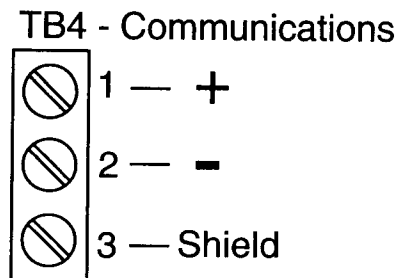
FIGURE 2-7



2.4.5 COMMUNICATIONS WIRING

Connections for the Communications option are made to the Main board via the TB4 connections. See Figure 2-8 for wiring.

FIGURE 2-8



2.4.6 TRANSMITTER POWER SUPPLY WIRING

Connections are made as shown using TB10, terminal 2 as positive (+) and terminal 1 as negative (-). See Figure 2-9A for one transmitter and Figure 2-9B for two transmitters (40mA DC maximum).

FIGURE 2-9A

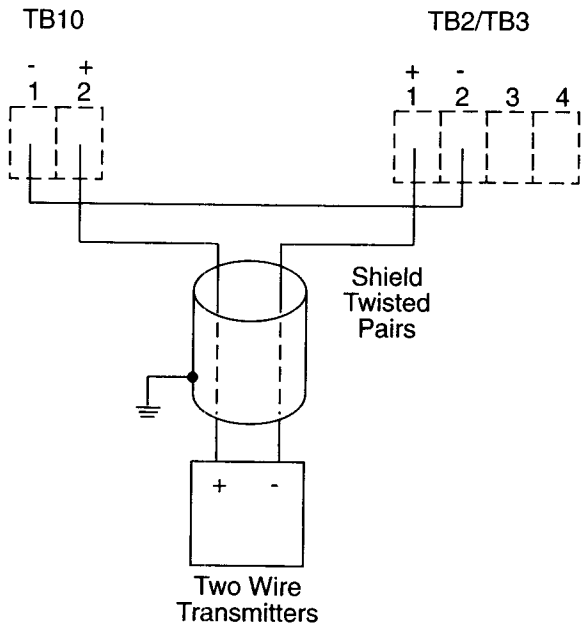
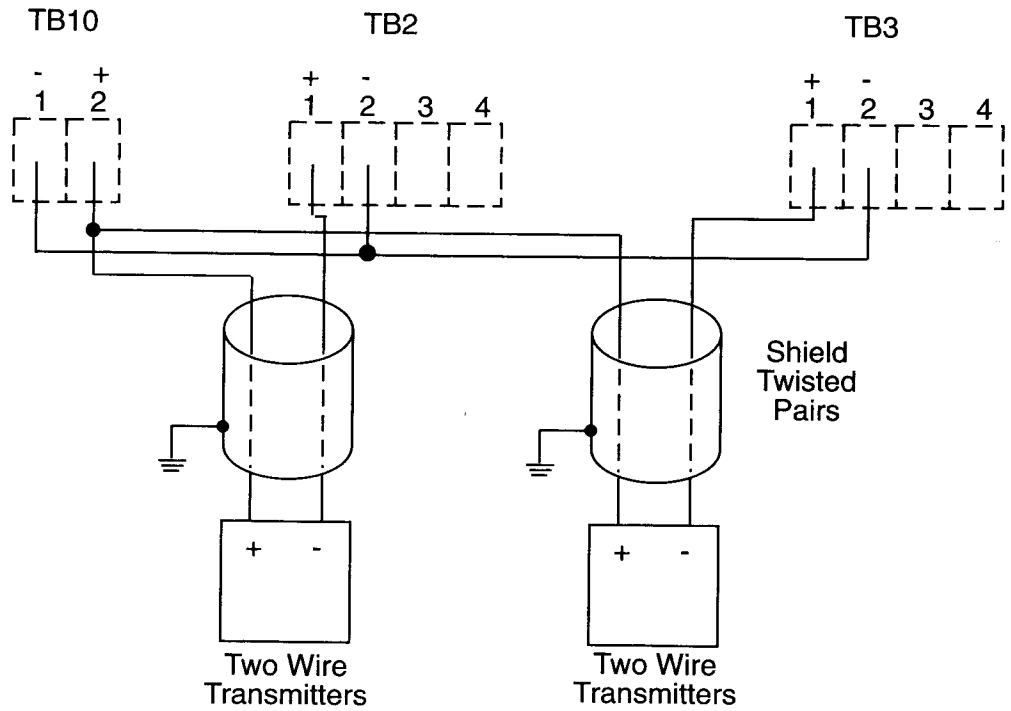


FIGURE 2-9B



Section 3 Normal Operation

Assuming that the MODE switch (discussed later) is in the RUN position, on power up, the recorder will display the software revision, in the format rX.XX, while the pens move to the home position (toward the center of the chart). Then the instrument will display the model number. Only the first 8 digits will be displayed, 4 digits at a time, for two seconds each. Then the display will blank while the recorder is measuring the input(s).

Then the pen(s) will go to their proper positions on the chart and the display will show the process value for pen 1 (if configured to display it) and will alternately show the pen 2 value (if it is present and if configured to display it), indicated by the green, PEN 2 LED. If any output is active, the appropriate LED will be lit.

Note: Each time power is applied, the pen(s) will move to the home position (toward the center of the chart) and then position themselves at the proper place on the chart.

The recorder will operate using the Program Parameters that were last stored in memory. The recorder is shipped from the factory set up for a Type J thermocouple input, range code 1 (0-1400°F) on all pens. To modify the input types and ranges, see Section 4 for detailed instructions.

Located on the backside of the access door (inside the recorder) is a Short Form Programming Card that summarizes the Run and Program mode information.

See Appendix A for a complete description of the model number and options. See Section 6 for modifying the recorder model number.

SENSOR FAULT DETECTION

The recorder will display, record, and act upon normal measured values. If an input is above or below the advertised span, the display will indicate a **Hi** or **Lo** condition, respectively. If the input is disconnected (sensor break) or excessively out of range, **SnSr** will be displayed.

Relays, output LED, and pens will react normally when in a **Hi** or **Lo** condition, as if the value was high or low, relative to the setpoint. In a **SnSr** condition, relays will be de-energized, output LEDs will not be lit, and pens will go upscale.

NOTE: A sensor break can not be detected on zero based Volt and Milliamp inputs (0-5 volts and 0-20mA), as the divider or shunt resistor, coupled with no input connection, produce a valid input signal of zero.

NOTE: A "Lo" condition can not be detected on zero based Volt, Milliamp, and Millivolt inputs, due to the nature of the hardware. The instrument will handle slightly negative signals, but more negative inputs will result in the display indicating a "Hi" condition. Refer to the Specifications section for more details.

3.1 CHANGING THE CHART

To make chart changing easier, the recorder can move the pens to the outside edge of the chart. It is not necessary to use this capability. Do so only if you find it more convenient.

DO NOT PUSH THE PENS MANUALLY. This could affect mechanical adjustments or bend the pen arms, adversely affecting accurate operation.

POSITIONING THE PENS FOR CHART CHANGING

While the MODE switch is in the RUN position, press the SCROLL key. **CC** will appear in the display, designating chart changing. Press the DOWN arrow key. The recorder will move the pens fully upscale. The display will flash **CC**. Change the chart per the instructions that follow and then press the DOWN arrow key again. The recorder will resume normal trend recording.

CHANGING THE CHART PAPER

To change the chart, pull up on the chart clip located in the center of the chart. Remove the old chart and place the new chart on the chart hub. **DO NOT** press down firmly. The UP arrow key can be used to advance the chart. Every time the UP arrow key is pressed, the chart will advance one step. Line up the current time on the chart with the chart time arrow located to the right of the display. Then press the chart down on the chart hub and flip the chart clip to the down position.

3.2 CONTROL OUTPUT SETTINGS

3.2.1 SINGLE OUTPUT

When Single Output On/Off control is configured as CH (Control Heat), the relay will turn OFF when the process value is greater than the setpoint by one-half the hysteresis value and turn ON when the process value is less than the setpoint by one-half the hysteresis value.

When Single Output On/Off control is configured as CC (Control Cool), the relay will turn ON when the process value is greater than the setpoint by one-half the hysteresis value and turn OFF when the process value is less than the setpoint by one-half the hysteresis value.

3.2.2 DUAL OUTPUT - HEAT/COOL

When Dual Output On/Off control is configured as CH (Control Heat) for Output 1 and CC (Control Cool) for Output 2, Output 1 relay will turn OFF when the process value is greater than the setpoint plus one-half the hysteresis value and turn ON when the process value is less than the setpoint minus one-half the hysteresis value. Output 2 relay will turn ON when the process value is greater than the setpoint plus one and one-half the hysteresis value and turn OFF when the process value is less than the setpoint plus one-half the hysteresis value.

3.2.3 DUAL OUTPUT - HEAT/HEAT

When Dual Output On/Off control is configured as CH (Control Heat) for Output 1 and CH for Output 2, Output 1 relay will turn OFF when the process value is greater than the setpoint plus one-half the hysteresis and turn ON when the process value is less than the setpoint minus one-half the hysteresis value. Output 2 relay will turn OFF when the process value is equal to the setpoint minus one-half the hysteresis and turn ON when the process value is equal to the setpoint minus one and one-half the hysteresis value.

3.2.4 DUAL OUTPUT - COOL/COOL

When Dual Output On/Off control is configured as CC (Control Cool) for Output 1 and CC for Output 2, Output 1 relay will turn OFF when the process value is equal to the setpoint minus one-half the hysteresis and turn ON when the process value is equal to the setpoint plus one-half the hysteresis value. Output 2 relay will turn OFF when the process value is equal to the setpoint plus one-half the hysteresis value and turn ON when the process value is equal to the setpoint plus one and one-half the hysteresis value.

3.2.5 TO REVIEW/MODIFY CONTROL SETTINGS

Repeatedly depress the SCROLL key. If any control outputs exist, the OUT LED (OUT 1/1, OUT2/1, etc.) for the first existing control will flash along with its current control setpoint in the order shown below. Note that CC (for chart changing) will also appear in the sequence when the SCROLL key is repeatedly depressed.

OUT 1/1 LED flashes Display shows Pen 1/Control setpoint
 value

OUT 2/1 LED flashes Display shows Pen 2/Control setpoint
 value

If Control Changes are allowed/enabled, use the UP/DOWN keys to change the setting. All control settings are defaulted to 0 and are adjustable from -9999 to 9999 (assuming no decimal positions).

If Control Changes are disabled, the settings cannot be changed, only viewed.

3.3 ALARM SETTINGS

There are two possible alarm set point values for each of the two possible inputs/pens. They will be displayed only if the alarm options are present and configured. The types of alarms and the ability to make alarm set point changes, is defined during configuration. See Section 4 to select the types of alarms and to allow/disable alarm changes.

TO REVIEW/MODIFY ALARM SETTINGS

Repeatedly depress the SCROLL key. If any alarms exist, the alarm LED (ALRM 1/1, ALRM 1/2, etc.) for the first existing alarm will flash along with its current alarm set point in the order shown below. Note that CC (for chart changing) will also appear in the sequence when the SCROLL key is repeatedly depressed.

OUT 1/1 LED flashes	Display shows Pen 1/Alarm 1 setpoint value
OUT 1/2 LED flashes	Display shows Pen 1/Alarm 2 setpoint value
OUT 2/1 LED flashes	Display shows Pen 2/Alarm 1 setpoint value
OUT 2/2 LED flashes	Display shows Pen 2/Alarm 2 setpoint value

If Alarm Changes are allowed/enabled, use the UP/DOWN keys to change the setting. All alarm settings are defaulted to 0 and are adjustable from -9999 to 9999 (assuming no decimal positions).

If Alarm Changes are disabled, the settings cannot be changed, only viewed.

3.4 HIGH/LOW LIMITS

High or Low Limits are latching alarms. Once an alarm is engaged, it will remain active until BOTH of the following occur:

- 1) The alarm condition no longer exists (i.e. for a high limit the process value has fallen below the alarm setpoint), and,
- 2) The alarm condition is acknowledged by depressing the red reset button to right of the display, on the platen.

The button will reset any limit alarms that can be reset.

If power is cycled and the alarm condition no longer exists, the corresponding limit will be reset.

Section 4 - Recorder Setup, Test, and Calibration

Because the MODE switch protects the configuration as well as the calibration of the recorder, "calibration seal" labels are provided to cover up the switch, if desired, to secure the configuration and calibration, as well as record the date of the calibration. The label looks like this:



If necessary, remove the label or "seal" to access the MODE switch.

The instrument has two basic "modes" of operation. The Run mode (as addressed in Section 3) is the normal operating mode. The other basic mode is the Program/Test/Calibration mode, which is used only for setup, troubleshooting, and calibration. The Program/Test/Calibration mode, accessed by having the MODE switch in the PROG/TEST/CAL position, is further divided into the three respective modes of Program, Test, and Calibration. Each of these modes is divided into sections corresponding to a portion of the programming parameters, or individual test or calibration functions.

The availability of various options (i.e. alarms, communications, etc.), as defined by the model number shown by the recorder on power-up, will determine the selections offered in the Program, Test, and Cal mode. For example, if no alarm options exist, then the alarm types do not need to be configured.

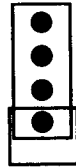
Located on the back of the access panel (inside the recorder) is a Short Form Programming Card that can be used as a reference for selecting all program parameters.

4.1 HARDWARE SELECTIONS - INPUT JUMPER POSITIONS

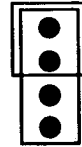
Hardware jumpers JU1 and JU2 are used to select the input type for Pen 1 and Pen 2 respectively. The jumper positions are shown on the main wiring label on the recorder as well as on the Short Form Programming Card. See below:

JU1 and JU2 Positions - JU1 is located between wiring terminals TB2 and TB3 on the edge of the main board. JU2 is located between wiring terminals TB3 and TB4 on the same board.

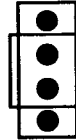
RTD and Millivolt



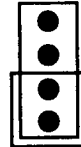
5 VDC



Milliamp



Thermocouple



4.2 RECORDER PROGRAMMING

The recorder setup programming can only be accomplished when the MODE slide switch is placed in the PROG/TEST/CAL position. This switch is located to the left of the display. The Program mode is used to select: chart rotation speed, input types/ranges, display scaling, and display options, chart scaling, and relay operation.

In the Program/Test/Calibration mode, the keys will function as follows:

SCROLL



When a mode or section designation is displayed, SCROLL steps to the next mode or section.
When a parameter code is displayed, SCROLL will display the corresponding parameter value.
When a parameter value setting is displayed, SCROLL will display the next parameter code.

DOWN ARROW



When a mode or section designation is displayed, DOWN will enter that mode or section.
When a parameter code is displayed, DOWN will display the next parameter code.
When a parameter setting is displayed, the setting will be decremented or changed, unless it is at its limit.

UP ARROW



When a mode designation is displayed, the UP key will have no effect, as the instrument is at the initial level. Use the MODE switch to return to normal operation.
When a section designation is displayed, the UP key will revert to the mode designation.
When a parameter code is displayed, UP will revert back to the section designation.
When a parameter setting is displayed, the setting will be incremented or changed, unless it is at its limit.

To enter the Program/Test/Cal mode, position the MODE switch accordingly. The unit will display **Prog**. Subsequent depressions of the SCROLL key will cause the unit to display **tEst**, and then **CAL**, and back to **Prog**.

NOTE: When the MODE switch is placed in the PROG/TEST/CAL position, all output LEDs will be turned off and all relays will be deenergized.

To enter the Program mode, press the DOWN arrow key when **Prog** is displayed.

The display will show **Pen1** (Pen 1 parameters). Subsequent depressions of the SCROLL key will show **Pen2** (Pen 2 parameters, if Pen 2 exists), **CHAR** (Chart operation), **CP** (Comms parameters, if optional communications is installed) and then back to **Pen1**.

To enter the desired section of the Program mode, press the DOWN arrow key when the desired section is displayed. Use the keys as defined previously to enter modes and sections, move around, and modify parameter settings. The parameters, their definitions, and range of adjustment, are as follows:

PEN 1 AND PEN 2 SECTIONS OF PROGRAM MODE - Pen1 and Pen2

(Pen 2 will appear only if present in the recorder.)

These parameters apply to each pen, assuming pen 2 is present, and are configured in each respective section.

PARAMETER CODE	PARAMETER DESCRIPTION	SETTINGS OR RANGE	DEFAULT SETTING
InPS	Input Selection	0 - 18 0 = J T/C 0 to 760°C 1 = J T/C 0 to 1400°F 2 = K T/C 0 to 1360°C 3 = K T/C 0 to 2500°F 4 = T T/C -200 to 400°C 5 = T T/C -330 to 750°F 6 = R T/C 200 to 1650°C 7 = R T/C 400 to 3000°F 8 = S T/C 200 to 1650°C 9 = S T/C 400 to 3000°F 10 = RTD 100 ohm -140 to 400°C 11 = RTD 100 ohm -200 to 750°F 12 = 0-20mA 13 = 4-20mA 14 = 0-50mV 15 = 10-50mV 16 = 0-25mV 17 = 0-5VDC 18 = 1-5VDC	1
ICor	Input Correction (calibrates sensor to recorder)	-999 to 999*	0
A1	Output Type (will show only if present)	OFF = none Hi = High Alarm Lo = Low Alarm HL = High Limit LL = Low Limit CH= Control Heat CC= Control Cool	OFF
A2	Output Type (will show only if present)	OFF = none Hi = High Alarm Lo = Low Alarm HL = High Limit LL = Low Limit CH= Control Heat CC= Control Cool	OFF
dISP	Display Input/Pen Value during normal operation, RUN mode	On = Display value OFF = Do not display value	On
dPOS	Decimal Point Position	0 = nnnn 1 = nnn.n 2 = nn.nn	0
EUU	Engineering Units that equate to upper transducer input (will show only for Volt or Milliamp Input types)	-9999 to 9999*	5000
EUL	Engineering Units that equate to lower transducer input (will show only for Volt or Milliamp Input types)	-9999 to 9999*	0

ChUP	Value that equates to upper chart division	-9999 to 9999*	100
ChLO	Value that equates to Lower chart division	-9999 to 9999	0
HySt	Hysteresis or Switch differential for outputs in units, not percent (will show only if outputs present)	0 to 200*	3
dFF	Display Filter Factor Filters display for input noise. Higher number means more filtering.	1 to 10	1
ALC	Alarm Changes Determines if output setpoints can be changed in the RUN mode	On = Allowed/Enable OFF = Disable	On

* The range shown corresponds to no decimal position. If **dPOS** is 1, 9999 becomes 999.9, 200 becomes 20.0, etc.

CHART SECTION OF PROGRAM MODE - CHAR
(There is only one parameter in this section)

<u>PARAMETER CODE</u>	<u>PARAMETER DESCRIPTION</u>	<u>SETTINGS OR RANGE</u>	<u>DEFAULT SETTING</u>
ChSP	Chart Speed	OFF = off - don't rotate 8Hr = 8 hours 12Hr = 12 hours 24Hr = 24 hours 48Hr = 48 hours 7dAy = 7 days	24Hr

****COMMUNICATION PARAMETER - CP**

(There is only one parameter in this section) Only seen if optional communications is ordered.

<u>PARAMETER CODE</u>	<u>PARAMETER DESCRIPTION</u>	<u>SETTINGS OR RANGE</u>	<u>DEFAULT SETTING</u>
CAd	Communication Address	0 to 247	0

NOTE: Communications Bit Rate is fixed at 9600 baud.

4.3 TEST MODE - TEST

To enter the Test mode, press SCROLL until **tESt** shows on the display. Press DOWN to enter the Test mode. Press SCROLL to display the various tests (**diSP** and **Chrt**). Press DOWN to enter a test section.

4.3.1 Display, Keypad, and Relay Test - **diSP**

Once you enter the Display/Keypad/Relay test by depressing DOWN, the display should first show all 8s with decimal points and all status LEDs lit for about 5 seconds. Then the display will go blank for 5 seconds.

Then the display will show **SCrL**. Depress the SCROLL key to proceed with the keypad test.

The display will show **UAro**. Depress the UP arrow key to proceed with the keypad test.

The display will show **dAro**. Depress the DOWN arrow key to complete the keypad test.

The display will show **rLy** while the instrument does the relay test. Each output relay will be energized in sequence for about 4 seconds while its status LED (OUT 1/1, OUT 1/2, OUT 2/1, or OUT 2/2) is lit. When complete, **rLy** will be displayed for 4 seconds and then **diSP** will be displayed.

4.3.2 Chart Test - **Chrt**

Running the Chart Test will produce a test pattern drawn by the pens on the chart with the chart advancing.

After entering the test by pressing DOWN, the green pen will go toward the home position and the red pen will go toward the outside of the chart. The chart will rotate at roughly 1 revolution every 1.5 minutes. Both pens will travel about 80% of the chart in about 15 seconds, and then reverse their travel, and return to their initial position. This process will continue to be repeated.

Depress any key to terminate the Chart test. The pen(s) will go to the home position and then **Chrt** will be displayed.

Section 5 Recorder Calibration Mode - CAL

As covered in Section 4, the "calibration seal" may need to be removed to access the MODE switch to gain access to the calibration section. The MODE switch must be positioned to the **PROG/TEST/CAL** position.

CAUTION: DO NOT ATTEMPT ANY CALIBRATIONS WITHOUT THE PROPER TEST EQUIPMENT THAT MEETS OR EXCEEDS THE SPECIFICATIONS LISTED.

The Calibration mode provides for the calibration of all the input types for each input as well as the calibration of each pen to the chart.

The Input Calibration can be performed for ONLY the Input Type selected by the hardware jumpers JU1 and/or JU2 AND ONLY the Input Type selected in the Program Mode Input Selection code **InPS**. See below:

<u>Input Type</u>	<u>JU1</u>	<u>JU2</u>	<u>InPS</u>
Thermocouple	DOWN	DOWN	"1"
RTD	PARK	PARK	"11"
mV	PARK	PARK	"14"
mA	MIDDLE	MIDDLE	"12"
V	UP	UP	"17"

5.1 INPUT CALIBRATION - inP

EQUIPMENT REQUIRED:

Input source with accuracy better than $\pm 0.05\%$ of reading.

Thermocouple: 1 J type
1 mercury thermometer $\pm .25^\circ\text{F}$ or equivalent
Allow 30 minutes of warm up time for the instrument with the T/C connected before proceeding with calibration

DC: 0 to 50mV or
0 to 5V or
0 to 20mA

RTD: Decade resistance box with .01% resolution or equivalent.

PROCEDURE:

Position the input conditioning jumpers (JU1 for Pen 1 and JU2 for Pen 2) for the proper input (T/C, RTD, mV, mA or V). Be sure that the Input Selection parameter **InPS** in Program Mode has been set correctly.

To enter the Calibration mode, depress SCROLL until **CAL** appears on the display. Press DOWN to enter the Calibration mode. Depressing SCROLL will display the following Calibration sections: **inP** and **Chrt**. **inP** is the input calibration section and **Chrt** is the Chart calibration section. Press DOWN to enter the desired section when it is displayed.

The Input Calibration section is divided into four sections: **PEn**, **rAng**, **rEF**, and **SCAn**. **PEn** selects the pen/input to be calibrated, **rAng** selects the input type (T/C, RTD, etc.) to be calibrated, **rEF** defines the source value to be applied, and **SCAn** performs the actual calibration.

A 50mV Input calibration must be performed before the Cold Junction Compensation Calibration can be performed.

With **PEn** displayed, depress the SCROLL key to display the pen/input selected. Use the UP or DOWN keys to select 1 or 2, then depress the SCROLL key and **rAng** should be displayed.

With **rAng** displayed, depress the SCROLL key to show the range code of the input type to be calibrated. The range codes are shown below. Use the UP or DOWN keys to select the range to be calibrated:

0=None, means no calibration will be performed.
1=50 millivolts for all millivolt and thermocouple ranges.
2=5 volts for all volt ranges.

- 3=Milliamp for all milliamp ranges.
- 4=RTD for all RTD ranges.
- 5=Cold Junction Compensation for all T/C ranges.

After selecting the proper range code, depress the SCROLL key and **rEF** should be displayed.

With **rEF** displayed, depress the SCROLL key to display the value for the source to be connected. Connect the input source set for this value to the selected input terminals. After connecting the source, depress the SCROLL key and **SCAn** should be displayed. When **rAng** selected is 5, connect the J type thermocouple to the input terminals. Position the "HOT" junction outside the enclosure with the mercury thermometer position along side. Using the UP or DOWN keys, make the display match the reading seen on the mercury thermometer.

With **SCAn** displayed, depress the SCROLL key. The display will count up in seconds, denoting that it is proceeding with the calibration. When the calibration is complete, the display will show **PEn**.

With **PEn** displayed, depress the SCROLL key to select another pen, or UP to return to **inP**.

If something fails in the process, **FAIL** will be displayed. Depress any key to return to the **inP** display.

The reference values needed to calibrate each input type are as follows:

CODE	REFERENCE VALUE
1-millivolt/TC	50.00mV ±0.01mV
2-volt	5.00 Volts ±0.01V
3-milliamp	20.00mA ±0.01mA
4-RTD	200.0ohms ±0.01%
5-T/C	AMBIENT

5.2 CHART/PEN CALIBRATION - Chrt

This Cal section calibrates the pens to the chart, and is divided into two additional sections: **PEn** and **ArC**. **PEn** calibrates the pen spans to the chart. **ArC** provides a capability to make the pens sweep the chart to facilitate mechanical adjustments of pen arms.

PEN SPAN CALIBRATION - PEn

With **Chrt** in the display, press DOWN to enter the Chart calibration section and **PEn** will be displayed. Depressing the SCROLL key will toggle between **PEn** and **ArC**. With **PEn** in the display, press DOWN to enter the Pen Span calibration section. Each pen will home (move downscale), and the display will blank (this could take as long as 20 seconds). The display will show **P1Lo**.

With **P1Lo** displayed, Pen 1 will be positioned at the low end of the chart. Use UP or DOWN to position Pen 1, the red pen, on the inner ring of the chart. Press SCROLL when done.

The display will now show **P1Hi** and the red pen will go to the outer ring of the chart. Again, use UP or DOWN to adjust the pen. Press SCROLL when done.

If Pen 2 is included, the same process must be repeated for Pen 2, the green pen. After **P2Hi** is completed, depressing SCROLL will return to **PEn**.

If Pen 2 is not included, press SCROLL twice to skip **P2Lo** and **P2Hi** calibration, and return to **PEn**.

PEN ARC MECHANICAL ADJUSTMENTS - ArC

Important Note:

Pen arc adjustments have been done at the factory and should not need to be done in the field, unless the pen arm adjustments (mechanical) have been compromised. (This can happen if the pens are forcibly moved.)

Adjustments can be made at the bottom or top of span. In either position, the arm "length" can be adjusted by moving the pen blade toward or away from the pivot point, but the pen tip should also line up with the inner or outer ring of the chart. The latter is referred to as "position". Only the red pen can be adjusted to draw the correct arc. It is not mechanically possible for the green pen to draw the correct arc if the red pen is adjusted to do so.

With **Chrt** in the display, press **DOWN** to enter the Chart calibration section and **PEn** will be displayed.

With **PEn** displayed, depressing the **SCROLL** key will toggle between **PEn** and **ArC**. With **ArC** in the display, press **DOWN** to enter the Pen Arc adjustment section. During arc calibration/adjustment, **ArC** will remain in the display. The pens will move to the home position and the red pen will then draw an arc upscale.

If the pen is upscale, pressing the **DOWN** key will cause the selected pen to move downscale. If it is already downscale, the **DOWN** key will cause the chart to advance. If the pen is downscale, pressing the **UP** key will cause it to move upscale. If it is already upscale, the **UP** key will cause the chart to advance. Adjust the red pen's "length" and "position" on the inner/outer ring as needed. Repeat this sequence until the red pen is properly adjusted.

When finished with the red pen, press **SCROLL** to adjust the green pen. For the green pen, the "length" should be adjusted so that it almost touches the red pen when they pass each other. Adjust the "position" to align with the inner/outer ring. When finished with the green pen, press **SCROLL** to exit. **P1Lo** will be displayed, as the Pen Span calibration must now be done.

Section 6 Model Number Changes

When adding options to the recorder in the field, it is necessary to change the model number contained within the memory of the recorder.

The model number is displayed during the power up sequence. The first 8 digits of the model number are displayed in two 4 digit steps. The first displayed value will be the prefix 5, the first pen option, second pen option, and pen 1 output (the first 4 digits of the model number). The next display will show the pen 2 output, communications, case, and voltage options present on the recorder.

To change the model number, set the **MODE** switch to the **PROG/TEST/CAL** position, and power down and power up the recorder. After the software revision is displayed while the pen(s) go to the home position, the first 4 digits of the model number will be displayed. Use **UP** or **DOWN** to change the number. Press **SCROLL** and the next 4 digits of the model number will be shown. Again use **UP** or **DOWN** to change the number. Make sure the model number is correct for the hardware options present.

When complete, depress **SCROLL**. Refer to section 4.2 to make any programming changes required by the change in hardware options.

Appendix A - Specifications

INPUTS

Input Types/Range	Type	Range	Range
Thermocouple	J	0°C to 760°C	0°F to 1400°F
	K	0°C to 1360°C	0°F to 2500°F
	T	-200°C to 400°C	-330°F to 750°F
	R	200°C to 1650°C	400°F to 3000°F
	S	200°C to 1650°C	400°F to 3000°F
RTD	100 ohm Platinum	-140°C to 400°C	-220°F to 750°F
	.00385 ohms/ohm/°C		
Current DC	0 to 20mA, 4 to 20mA		
Voltage DC	Internal 4.7 ohm Shunt Resistor		
	0 to 25mV, 0 to 50mV, 10 to 50mV, 0 to 5 V, 1 to 5 V		
Impedance	> 100M ohm for TC and mV inputs		
	100K ohms for 5V inputs		
RTD Excitation Current	4.7 ohms for mA inputs		
	150 microamps, typical		
Input Scan Rate	1 scan per second for non-RTD inputs		
	1 scan per 1.2 seconds for RTD inputs		
Input Correction	Offset Adjustment, -999 to 999 units		
Sensor Fault Detection	Display goes to "SnSr" and pen goes upscale if a sensor break is detected		
	No sensor break can be detected for zero based Volt and Milliamp ranges		
	Display goes to "Hi" 10% above span. Display goes "Lo" 10% below span or zero, whichever is higher.		

INPUT PERFORMANCE

Performance Under Reference Condition:

Measurement Error	Type J, K, T, R, S, and RTD: $\pm 0.25\%$ of span ± 1 degree mA, mV, and VDC: $\pm 0.25\%$ of scaled span plus 1 least significant digit
Cold Junction Compensation Error	$\pm 0.2^\circ\text{C}$ @ 25°C
Cold Junction Compensation Rejection	0.04°C deviation from 25°C
Linearization Error	TCs: $\pm 0.25^\circ\text{C}$ typical, $\pm 0.5^\circ\text{C}$ worst case with expectations RTDs: $\pm 0.1^\circ\text{C}$ typical, $\pm 0.3^\circ\text{C}$ worst case
Ambient Temperature Error	$\pm 0.01\%$ of span per $^\circ\text{C}$ deviation from 25°C
Common Mode Rejection	> 120 dB at 50/60 Hz, 260 VAC max.
Normal Mode Rejection	85 dB minimum @ 60Hz or greater
Isolation	Universal input isolated from all outputs at 240VAC Inputs share a common signal ground

Reference Conditions

Ambient Temperature	25°C
Relative Humidity	60 - 70%
Supply Voltage	115 VAC, 60 Hz
Source Resistance	< 10 ohms for TC input
Lead Resistance	< 0.1 ohm/lead balanced (Pt100)

RECORDING

Pen Type	Disposable fiber tip
Pen Color	Pen 1 - Red Pen 2 - Green
Chart Size	10 inch
Chart Drive	Stepper motor
Chart Rotation	User configurable: 8 hours, 12 hours, 24 hours, 48 hours, or 7 days
Chart Span	Bottom and top of span, -9999 to 9999 units

RECORDING PERFORMANCE

Chart Recording Accuracy	0.5% of chart span reference accuracy
Chart Rotation Accuracy	± 0.5% of rotation time, assuming all backlash removed

OPERATOR INTERFACE

Display	Four digit, 0.56" high, red, seven segment, LED display
Status Indicators	Four red LED alarm status indicators, One green LED Pen 2 indicator
Keypad	Three keys for programming and unit operation
Display Modes	Normal: Process value(s) or blank

CONTROL OUTPUTS

Number	Up to two control outputs for each of two inputs
Type	On/Off, Reverse or Direct Acting
Hysteresis	Fully adjustable, 0 to 200 units, First output straddles setpoint, second output setpoint plus or minus 1/2 hysteresis and setpoint plus or minus 1 1/2 hysteresis

ALARMS

Number	Up to two process alarms for each of two inputs
Type	Process high or low
Limit Device	Optional high/low limits for each input with latching output Normally open output latches open Red reset button included to the right of the display
Hysteresis	Fully adjustable, 0 to 200 units, single sided
Security	Alarm setpoint changes can be prohibited
Sensor Fault Action	Alarms work normally in "Hi" and "Lo" conditions Alarm relays are deenergized in a "SnSr" sensor break condition

RELAY OUTPUTS

Relays	SPDT, contacts rated 5 amps resistive at 115 VAC, 2.5 amps resistive at 230 VAC, 1/8 HP at 230 VAC (single phase), 250 VA at 115/230
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POWER REQUIREMENTS

Line Voltage	90-264 VAC, 50/60 Hz Optional: 20-50 VAC, 50/60 Hz or 22-65 VDC
Power Consumption:	18 VA Maximum

TRANSMITTER POWER SUPPLY

Transmitter Power Supply

Provides up to 40mA of current at 24VDC

CONSTRUCTION

Enclosure	Injection molded Noryl case and cover with acrylic window
NEMA Rating	NEMA 3 standard, NEMA 4X future option
Conduit Openings	Three openings on the right side
Mounting	Panel or wall
Overall Dimensions	14" wide X 14" high X 3.8" deep. (355.6mm X 355.6mm X 96.5mm)
Panel Cutout	12.7" wide X 12.7" high (322.58mm X 322.58mm)
Panel Depth	2.5" (63.5mm)
Panel Protrusion	1.3" (33.0mm)
Weight	7 lbs maximum
Retrofit	With adaptor plate, will fit CT 7000 cutout

ENVIRONMENTAL AND OPERATING CONDITIONS

Operating Temperature	0°C to 55°C (32°F to 122°F)
Storage Temperature	-40°C to 65°C (-4°F to 149°F)
Humidity	10 to 90% RH, non-condensing
Vibration	0.3 to 100 Hz @ 0.2g
Mounting Position	Up to 30° forward or backward tilt from vertical Up to 10° side tilt from vertical

DIGITAL COMMUNICATIONS

Configuration Port	TTL levels
Communications Port	RS-485 serial communications, Half-duplex
Protocol	MODBUS RTU
Bit Rate	9600 bits per second
Parity	Odd
Address	User configurable - 0 to 247

GENERAL REFERENCE DATA

Data Backup	EEPROM for configuration parameters and calibration data EEPROM for alarm setpoints
Warranty	Two years

APPROVALS AND COMPLIANCE

Safety	UL Approved for USA - UL 1092, UL 916, and QUXY - File E67237 UL Certified for Canada - CSA Spec 142 - File E67237 CE - Complies with EN 61010-1:1993: Pending
Immunity/Susceptability	CE - Complies with EN50082-1992: Pending
Emissions	CE - Complies with EN50081-1: 1992 and EN50081-2:1994: Pending
Limit Device	FM: Pending



WARRANTY/DISCLAIMER

OMEGA ENGINEERING, INC. warrants this unit to be free of defects in materials and workmanship 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 OMEGA's customers receive maximum coverage on each product.

If the unit should malfunction, it must be returned to the factory for evaluation. OMEGA's 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. OMEGA's WARRANTY does not apply to defects resulting from any action of the purchaser, including but not limited to mishandling, improper interfacing, operation outside of design limits, improper repair, or unauthorized modification. 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 corrosion; or current, heat, moisture or vibration; improper specification; misapplication; misuse or other operating conditions outside of OMEGA's control. Components which wear are not warranted, including but not limited to contact points, fuses, and triacs.

OMEGA is pleased to offer suggestions on the use of its various products. However, OMEGA neither assumes responsibility for any omissions or errors nor assumes liability for any damages that result from the use of its products in accordance with information provided by OMEGA, either verbal or written. OMEGA warrants only that the parts manufactured by it will be as specified and free of defects. OMEGA MAKES NO OTHER WARRANTIES OR REPRESENTATIONS OF ANY KIND WHATSOEVER, EXPRESSED OR IMPLIED, EXCEPT THAT OF TITLE, AND ALL IMPLIED WARRANTIES INCLUDING ANY WARRANTY OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE ARE HEREBY DISCLAIMED. LIMITATION OF LIABILITY: The remedies of purchaser set forth herein are exclusive and the total liability of OMEGA with respect to this order, whether based on contract, warranty, negligence, indemnification, strict liability or otherwise, shall not exceed the purchase price of the component upon which liability is based. In no event shall OMEGA be liable for consequential, incidental or special damages.

CONDITIONS: Equipment sold by OMEGA is not intended to be used, nor shall it be used: (1) as a "Basic Component" under 10 CFR 21 (NRC), used in or with any nuclear installation or activity; or (2) in medical applications or used on humans. Should any Product(s) be used in or with any nuclear installation or activity, medical application, used on humans, or misused in any way, OMEGA assumes no responsibility as set forth in our basic WARRANTY / DISCLAIMER language, and additionally, purchaser will indemnify OMEGA and hold OMEGA harmless from any liability or damage whatsoever arising out of the use of the Product(s) in such a manner.

RETURN REQUESTS / INQUIRIES

Direct all warranty and repair requests/inquiries to the OMEGA Customer Service Department. BEFORE RETURNING ANY PRODUCT(S) TO OMEGA, PURCHASER MUST OBTAIN AN AUTHORIZED RETURN (AR) NUMBER FROM OMEGA'S CUSTOMER SERVICE DEPARTMENT (IN ORDER TO AVOID PROCESSING DELAYS). The assigned AR number should then be marked on the outside of the return package and on any correspondence.

The purchaser is responsible for shipping charges, freight, insurance and proper packaging to prevent breakage in transit.

FOR **WARRANTY** RETURNS, please have the following information available BEFORE contacting OMEGA:

1. P.O. number under which the product was PURCHASED,
2. Model and serial number of the product under warranty, and
3. Repair instructions and/or specific problems relative to the product.

FOR **NON-WARRANTY** REPAIRS, consult OMEGA for current repair charges. Have the following information available BEFORE contacting OMEGA:

1. P.O. number to cover the COST of the repair,
2. Model and serial number of product, and
3. Repair instructions and/or specific problems relative to the product.

OMEGA's policy is to make running changes, not model changes, whenever an improvement is possible. This affords our customers the latest in technology and engineering.

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Where Do I Find Everything I Need for Process Measurement and Control? **OMEGA...Of Course!**

TEMPERATURE

- Thermocouple, RTD & Thermistor Probes, Connectors, Panels & Assemblies
- Wire: Thermocouple, RTD & Thermistor
- Calibrators & Ice Point References
- Recorders, Controllers & Process Monitors
- Infrared Pyrometers

PRESSURE, STRAIN AND FORCE

- Transducers & Strain Gauges
- Load Cells & Pressure Gauges
- Displacement Transducers
- Instrumentation & Accessories

FLOW/LEVEL

- Rotameters, Gas Mass Flowmeters & Flow Computers
- Air Velocity Indicators
- Turbine/Paddlewheel Systems
- Totalizers & Batch Controllers

pH/CONDUCTIVITY

- pH Electrodes, Testers & Accessories
- Benchtop/Laboratory Meters
- Controllers, Calibrators, Simulators & Pumps
- Industrial pH & Conductivity Equipment

DATA ACQUISITION

- Data Acquisition & Engineering Software
- Communications-Based Acquisition Systems
- Plug-in Cards for Apple, IBM & Compatibles
- Datalogging Systems
- Recorders, Printers & Plotters

HEATERS

- Heating Cable
- Cartridge & Strip Heaters
- Immersion & Band Heaters
- Flexible Heaters
- Laboratory Heaters

ENVIRONMENTAL MONITORING AND CONTROL

- Metering & Control Instrumentation
- Refractometers
- Pumps & Tubing
- Air, Soil & Water Monitors
- Industrial Water & Wastewater Treatment
- pH, Conductivity & Dissolved Oxygen Instruments