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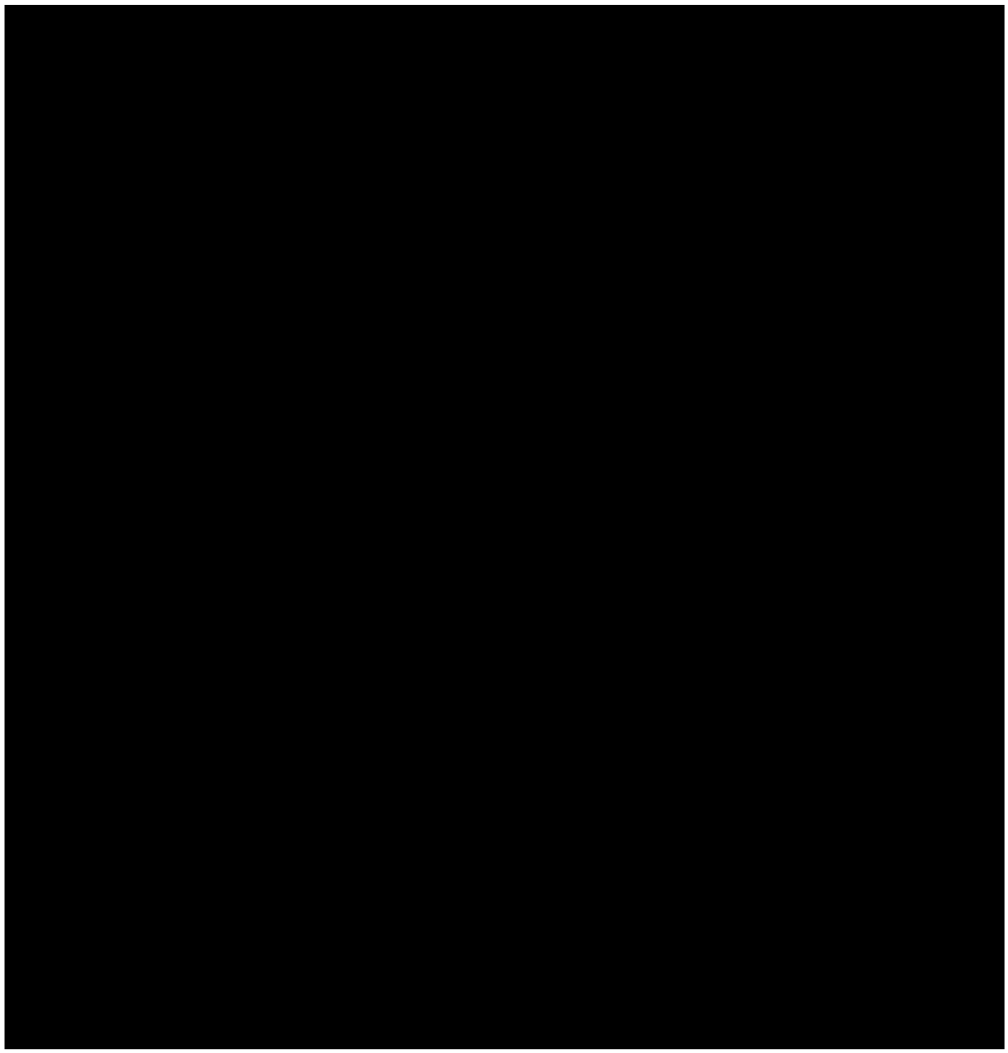
ARC 4100

Installation, Wiring, Operation Manual



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QUALITY INSTRUMENTATION DESIGNED & MANUFACTURED IN THE USA

Information in this installation, wiring, and operation manual is subject to change without notice. One manual is providedwith each instrument at the time of shipment. Extra copies are available at the price published on the front cover.

This the the Eighth Edition of the ARC 4100 Recording Controller Manual. It was written and produced entirely on a desk-top-publishing system. Disk versions are available by written request to the Partlow Advertising and Publications Department.

We are glad you decided to open this manual. It is written so that you can take full advantage of the features of your new ARC 4100 analog chart recording controller.

NOTE

It is strongly recommended that Partlow equipped applications incorporate a high or low limit protective device which will shut down the equipment at a preset process condition in order to preclude possible damage to property or products.

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FIGURES & TABLES

Product Description 1.1

1.1.1 GENERAL

The unit is a circular chart recording instrument capable of measuring, recording, and controlling up to two process variables from a variety of inputs. Applications include temperature (degrees F and C), pressure, relative humidity, pH level, electrical measurement, flow and others.

Instrument capabilities such as recording, controlling functions, alarm settings, and other parameters are selected from the order matrix and are factory implemented.

The process input for each pen is configured, at the factory, per order matrix model selection and directly connects to either thermocouple, RTD, mVDC, VDC, or mADC inputs. Most changes to input type are easily accomplished in the field. However, an input change from thermocouple to RTD on units with Recorder PWA's at revisions before Rev D should be done only after consulting with factory. Inputs are factory calibrated and will require re-calibration if changed in any way. Thermocouple cold junction compensation is performed automatically by the instrument.

The instrument can operate with either 115VAC or 230VAC line voltage at 50 or 60Hz. The voltage and frequency are selected when ordering. The 230VAC line voltage option includes soldered jumpers to allow the electronics to be configured to 115VAC line voltage when necessary. **The chart drive is not switchable**, and must be changed whenever the line voltage or frequency is changed.

The instrument is housed in a durable enclosure suitable for panel or surface mounting.

1.1.2 RECORDING

The unit incorporates a 10 inch circular chart. One box of standard charts is provided with each instrument. Charts are available in a wide selection of zero based, non-zero based, reverse, and dual scale ranges. The instrument can be provided with one or two pens. Pen 1 is red and Pen 2 is green. Pens are of the disposable fiber-tip type. Changes in pens, as well as charts, are quickly and easily accomplished.

Displays & Status Indicators

Setpoint is selected/observed using a 3 or 4 - digit pushbutton thumbwheel potentiometer. Two LED indicators are provided :

INDICATOR	COLOR	DESCRIPTION
OUT1	Red	Output 1 status
OUT2	Yellow	Output 2 status

1.1.3 SETPOINT/STATUS INDICATORS

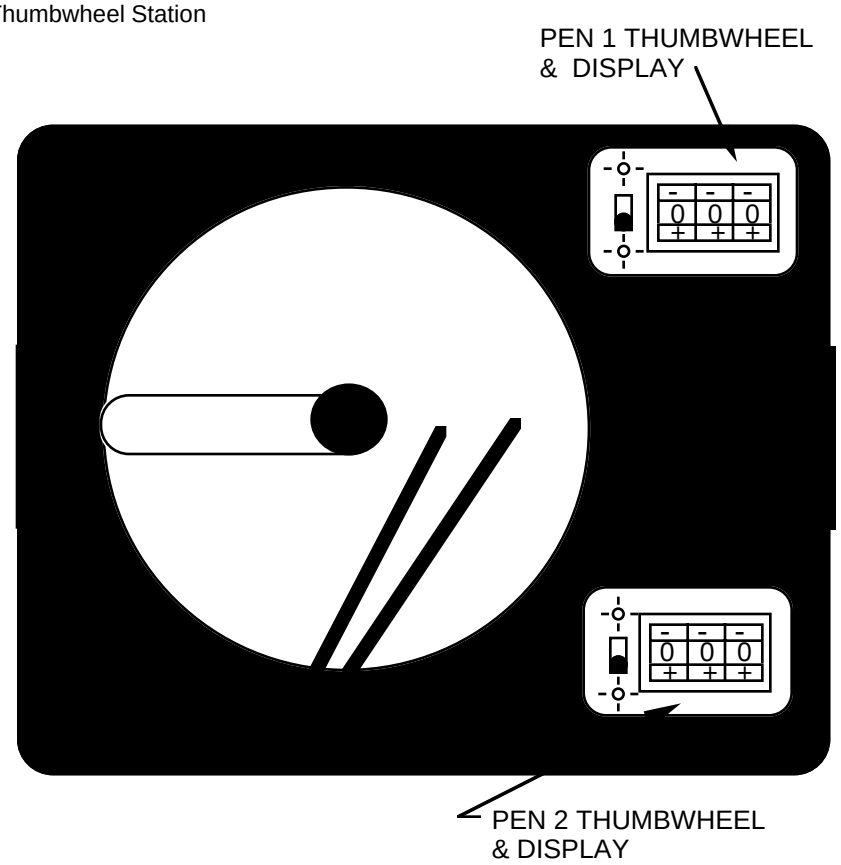
Each recording controller is provided with either a remote or local setpoint capability. If a local setpoint is desired, the following selections are available:

- Three digit positive only thumbwheel
- Three digit positive and negative thumbwheel
- Four digit positive only thumbwheel

The thumbwheel provided in the upper right corner is for Pen 1 and the thumbwheel provided in the lower right corner is for Pen 2. The status indicators provided depend upon the specific pen function, e.g. alarm only, high limit, on-off controller relay, on-off controller SSR driver, time proportioning relay, time proportioning SSR driver or 4 to 20mA. A detail of the status indicators is shown in Figure 1-2. Status indication is provided for Pen 1 Output 1, Pen 1 Output 2, Pen 2 Output 1, Pen 2 Output 2.

Pen 1 and Pen 2 Output status indicators are Red LED's.
Pen 1 and Pen 2 Second output orAlarm indicators are Yellow LED's.

FIGURE 1-1
Front Panel Display
& Thumbwheel Station



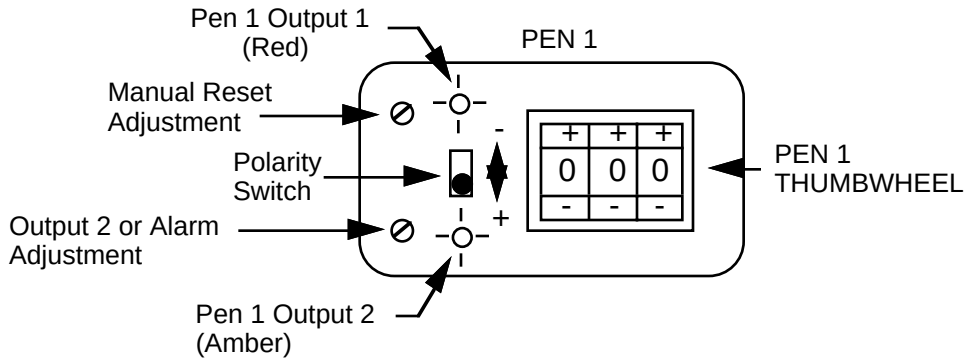
1.1.4 CONTROL

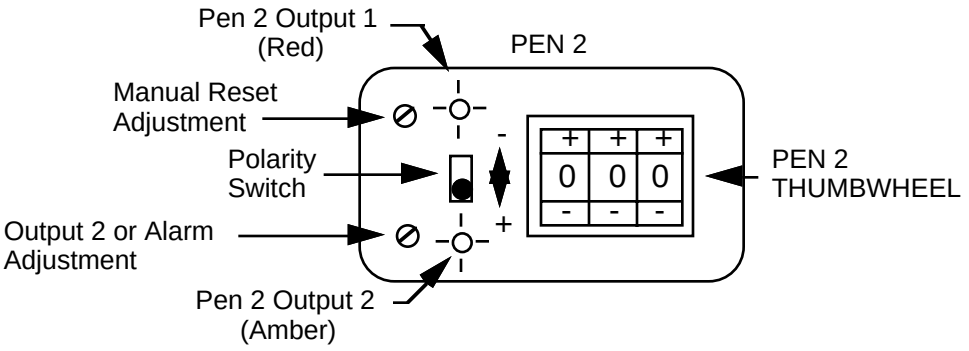
The Recording Controller is available with single and dual pen capability. Each pen is specified independently and can be provided with one of several control outputs as well as a second output for control or alarm conditions.

The instruments can be ordered as either high limit, on-off, time proportioning, or current proportioning. Proportioning units include full PID (Proportional, Integral, and Derivative) capability.

Remote setpoint capability can be provided for either Pen 1 or Pen 2 setpoint in lieu of local setpoint. The remote setpoint may be either 4 to 20mA, 1 to 5 volts or a potentiometer.

FIGURE 1-2
Recording Controller
Display and Thumbwheel
Adjustment





Installation & Wiring 2.1

At shipment from the factory the instrument has been configured to accept input(s) as specified. AC power input is as specified in the model number; 115VAC or 230VAC. Verify the AC power input provided with the instrument prior to proceeding with installation.

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

Installation of the Instrument includes:
* Unpacking
* Location
* Mounting
* Preparation for Wiring
* Wiring Connections

Unpacking 2.2

Remove the instrument from the carton and inspect it for any damage due to shipment. If any damage is noticed due to transit, report and file a claim with the carrier. Write the model number and serial number of the instrument on the front cover of this Operation Manual for future reference when corresponding with the factory.

Location 2.3

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

Mounting 2.4

Figure 2-1 shows installation view and physical dimensions for the panel mounted instrument.

The panel that the instrument will be mounted in must provide rigid support for the approximately 20 pound Instrument. Adjacent Recorders or Recording Controllers may be mounted within a minimum of 2 inches horizontally and 3 inches vertically, providing that proper panel support is supplied.

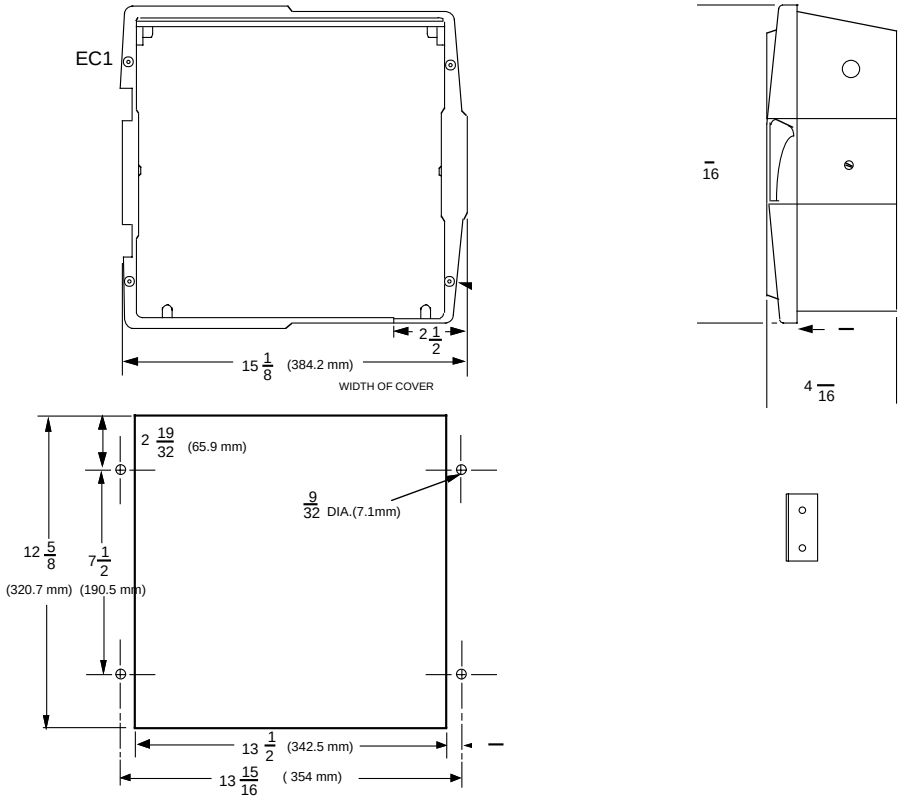
PANEL MOUNTING HARDWARE REQUIRED: (Not provided with instrument)
(4) 9/32" x 2" bolts w/nuts
(4) appropriate lockwashers

The location of the instrument is important and should be located in an area void of excessive moisture, vibration, oil, and dust. The instrument should also be located in an ambient temperature of 0 to 55° C (32 to 131° F).

For panel mounting, cut the panel hole to the dimensions shown in Figure 2-1 (page 9). If the rear of the panel is accessible for wiring after installation, mount the instrument in the panel by opening the hinged cover and fastening the instrument to the panel through the mounting holes located in the case flange. If the rear of the panel is not accessible, the instrument must be wired first. In this case, see wiring instructions.

For surface mounting, install the brackets ordered separately to the sides of the instrument case and mount to the surface.

FIGURE 2-1



Panel cut-out for flush mounting

2.5"
63.5mm

Preparation for Wiring 2.5

This section is divided into two parts: Wiring Guidelines, and Sensor Placement. Please review this completely before proceeding with wiring of instrument.

The wiring guidelines contained in the following paragraphs must be followed to ensure the best possible performance of the instrument. Please review this section carefully before proceeding.

2.5.1 WIRING GUIDELINES

2.5.1.1 AC POWER WIRING

Clean AC power is required to ensure a proper installation. To be classified "clean" the following must be met:

Earth Ground

Earth ground must be attached to the instrument's chassis. To verify that it is earth ground being attached, make a resistance check from instrument chassis to the nearest metal water pipe or proven earth ground. This reading should not exceed 1000 ohms.

2.5.1.2 WIRE ISOLATION

3 conduit openings, EC1, EC2, and EC3 are provided so wiring can be divided into separated catagories.

* Analog input or output (i.e. thermocouple, RTD, VDC, mVDC or mADC)
* SPDT Relay or SSR driver outputs
* AC power

The only wires that should be run together are those of the same category. Each of these must be isolated from each other .

2.5.2 SENSOR PLACEMENT (Thermocouple or RTD)

Thermocouple lead resistance should not exceed 300 ohms.
If this is exceeded, instrument accuracy could be affected.

Two wire RTD's should be used only for lead lengths less than 10 feet.

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

In liquid media - the most agitated area.
In air - the best circulated area.

Wiring Connections 2.6

All wiring connections are typically made to the instrument with it installed. Terminal connections should be made via terminal blocks with captive wire clamps, two 12 gauge wires maximum.

Use the wiring connections, Figure 2-3 (page 12), for planning all wiring installation. The layout in Figure 2-3 shows the general location and orientation of all terminal blocks. Terminal blocks are designated TB1 thru TB6. Figure 2-3 shows details for the various possible input connections. Paragraph 2.6.2 provides descriptive detail for AC power connections. Paragraph 2.6.3 details all input connections, and paragraph 2.6.4 provides wiring connection details for all outputs.

2.6.1 ELECTRICAL CONDUIT OPENINGS

Figure 2-1 shows the location of all electrical conduit openings that are provided on the instruments. These openings are labeled EC1 thru EC3. It is recommended that wiring enter the instrument through the conduit openings provided as follows:

EC1 - AC power
EC2 - Analog input and mAdc outputs
EC3 - SPDT relay or SSR driver outputs

Following these recommendations will help ensure proper operation .
Unused conduit openings should be sealed if exposed to the environment.

2.6.2 AC POWER WIRING CONNECTIONS

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

Consult the model code and the wiring label for the appropriate line voltage for the unit.

Instruments specified with 230VAC power input, as specified in model number, are provided with a soldered jumper which allows configuration back to 115VAC. Verify soldered jumper configuration before proceeding with AC power wiring (see Fig. 4-4). Also ensure correct AC chart drive motor is installed (line voltage is stamped on motor.

CONNECT AC WIRING AS FOLLOWS:

1. Run AC power cable through the EC1 conduit opening as shown in Figure 2-1 (page 9).

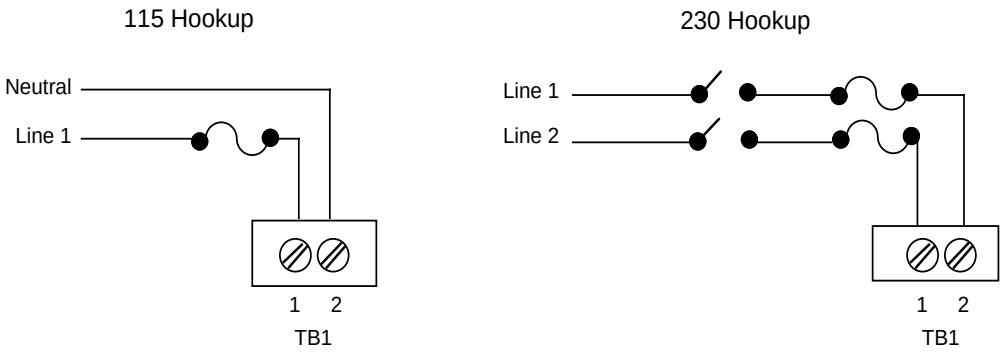
2. Connect AC hot and neutral to terminals 1 and 2 respectively of TB1 as shown in Figure 2-2 (below).

3. Connect Earth Ground to the instrument ground screw as shown in Figure 2-3 (page 12).

4. If Event Pen option is present, connect the 115VAC power through the EC1 conduit opening as shown in Figure 2-1 (page 9) and as labeled in Figure 2-3A (page 12). ***Note: regardless of which line voltage supply used for instrument supply, event pen operating voltage is 115 VAC only.***

   The event pen marks the circular chart on the outside edge of the paper. The pen movement is short but a distinct difference can be seen between the On and Off cycles of the pen. Typical event pen usage is for indication of an alarm condition.

FIGURE 2-2



Note: Customer supplied disconnect and fuse (3 amps)

FIGURE 2-3A

Installation Instructions for 115VAC Actuating Signal Wiring
to Rectifier/100VDC Event Pen

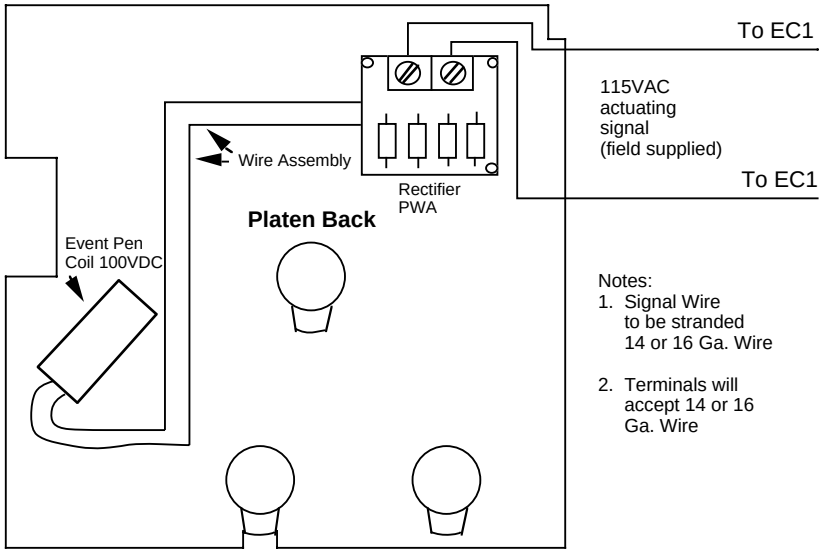
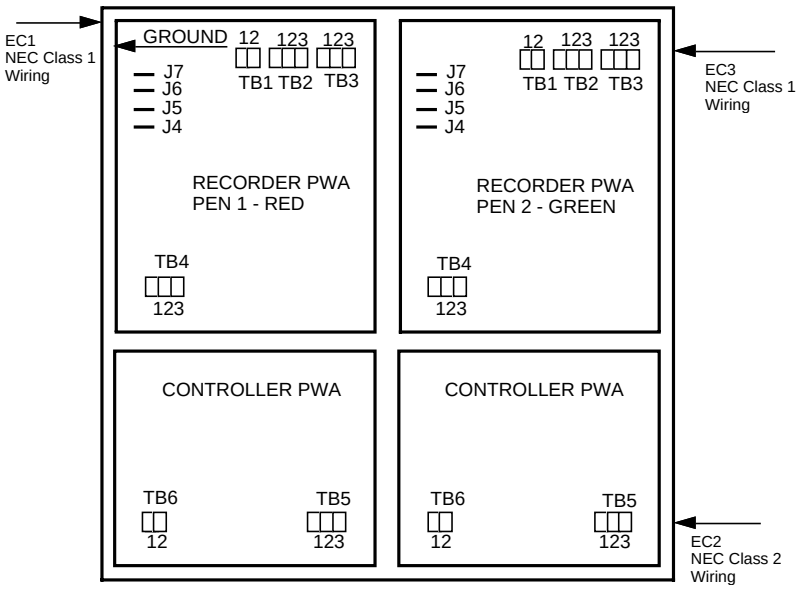


FIGURE 2-3



BLOCK	TERMINAL	DESCRIPTION
TB1	1 & 2	AC Hot/Neutral
TB2	1,2,3	2nd Output Relay N.O./Common/N.C.
TB3	1,2,3	1st Output Relay N.O./Common/N.C.
TB4	1,2,3	Input Signal +/- / RTD Common
TB5	1,2,3	Remote Setpoint] +V Out / +/-
TB6	1 & 2	4 to20mA Output +/-

Recorder PWA - Pen 1
J7, J6 - AC Power to chart drive motor
J5, J4 - AC Ground for chassis and chart drive

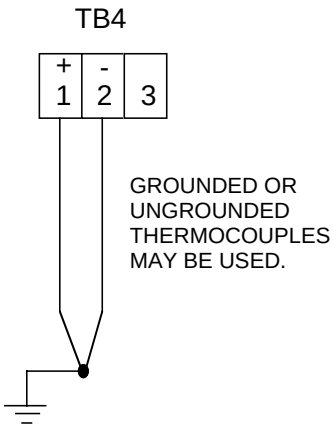
Recorder PWA - Pen 2
J7, J6 - AC Line Voltage (not used)
J5, J4 - AC Ground

2.6.3 INPUT CONNECTIONS

Wiring connection for instrument inputs are by input type as described in the following paragraphs. Each instrument is factory shipped ready to accept input(s) specified.

Process input type for each pen can be changed. For Rev. D printed circuit boards and above refer to Appendix A for jumper selection. For printed circuit boards below Rev D. consult the factory before making changes to input types.

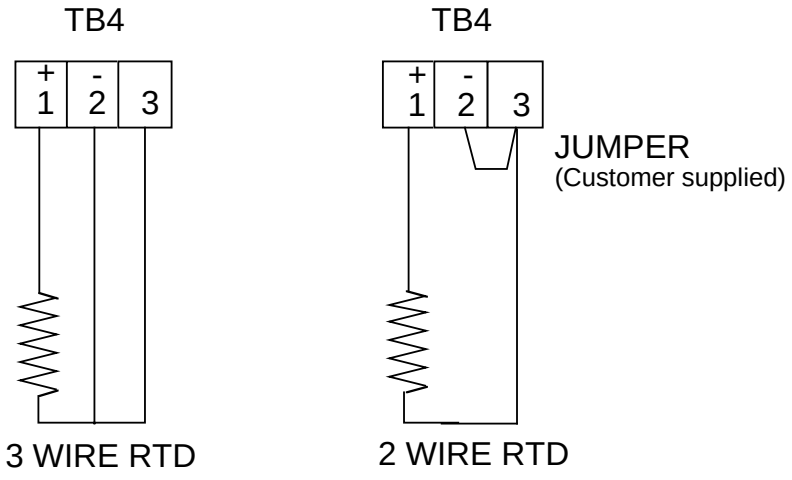
FIGURE 2-4



2.6.3.1 THERMOCOUPLE PROCESS INPUT

Make thermocouple connections as shown in Figure 2-4. Use TB4 of the respective recorder board for Pen 1 or Pen 2. Connect the positive leg of the thermocouple to terminal 1, and the negative to terminal 2. For industrial environments with comparitively high electrical noise levels, shielded thermocouples and extension wire is recommended. The shield thermocouple should be grounded at one, preferably at the source end.

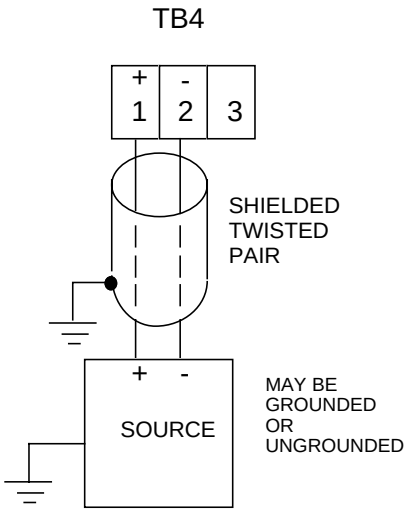
FIGURE 2-5



2.6.3.2 RTD PROCESS INPUT

Make RTD connections as shown in Figure 2-5. Use TB4 of the respective recorder board for Pen 1 or Pen 2. Connections are shown for 3 wire and 2 wire RTD's. If a three wire device is used, install the common wires to terminals 2 and 3. If a two wire device is used, install a jumper between terminals 2 and 3.

FIGURE 2-6



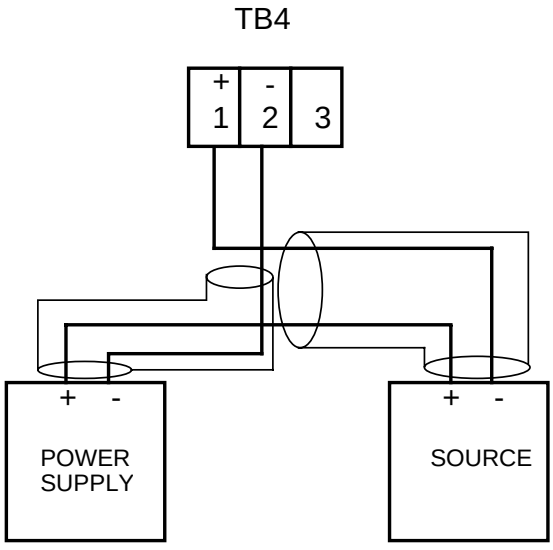
2.6.3.3 VOLT/MILLIVOLT PROCESS INPUT

Make volt or millivolt connections as shown in Figure 2-6. Use TB4 of respective recorder board for Pen 1 or Pen 2.Terminal 1 is positive and terminal 2 is negative.

2.6.3.4 MILLIAMP PROCESS INPUT

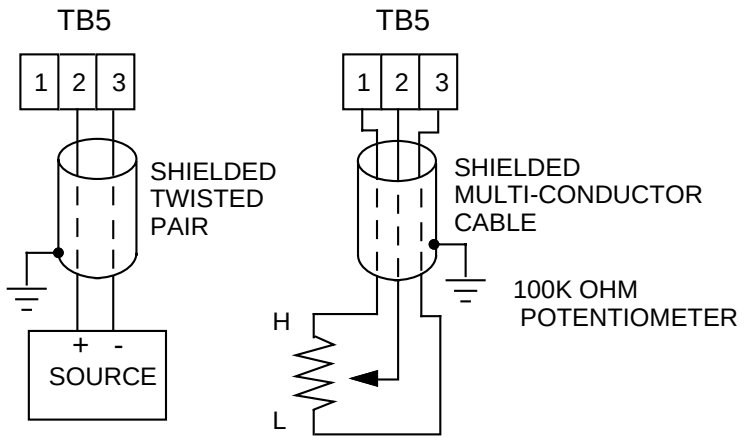
Make milliamp connections as shown in Figure 2-6. Use TB4 of respective recorder board for Pen 1 or Pen 2. Milliamp input will have an internal 249 ohm shunt resistor jumper selected at the factory . Milliamp input is configured for 1 to 5VDC input. Terminal 1 is positive and terminal 2 is negative.

FIGURE 2-6A



Make connections as shown when a transmitter power supply is used.

FIGURE 2-7



Terminal 1 is 5VDC, Terminal 2 is the input, and Terminal 3 is ground.

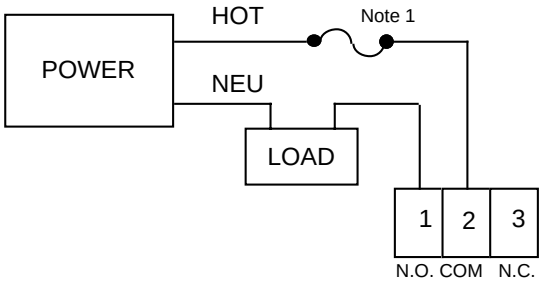
2.6.3.5 REMOTE SETPOINT INPUT

If Remote Setpoint capability has been specified, make connections as shown in Figure 2-7. The remote setpoint input is setup as 1 to 5VDC input. Use TB5 of the respective controller board for Pen 1 or Pen 2. Connect the positive lead to terminal 2 and the negative lead to terminal 3.

2.6.4 OUTPUT CONNECTIONS

Output connections may be either of the following or a combination there of: SPDT relays, SSR drivers, or 4 to 20mADC. Either of these output configurations may be selected independently for each pen.

FIGURE 2-8



Note 1
Customer selected fuse should be sized for controlled load. Maximum fused ratings 5 amp 115VAC resistive load or 2.5 amp 250VAC.

FIGURE 2-9

2.6.4.1 SPDT RELAY AND SSR DRIVER OUTPUTS
Connections are made to relays as shown in Figure 2-8.
Connections are made to SSR drivers as shown in Figure 2-9.

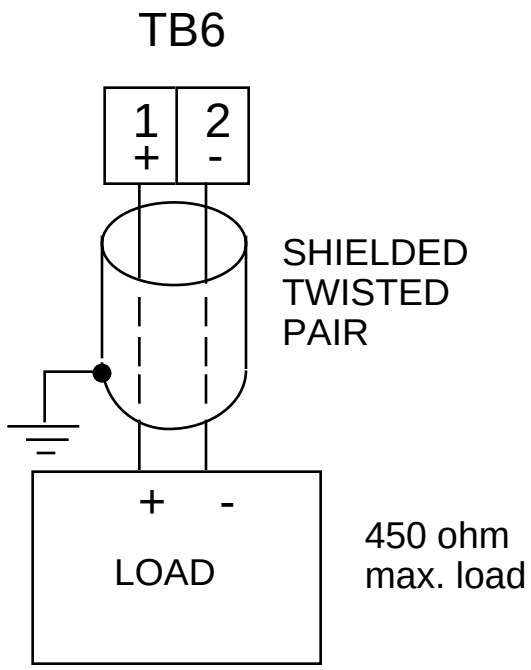
Terminal connections are made using TB3 of the respective recorder board for the First Output Relay or SSR Driver and TB2 of the respective recorder board for the Second Output Relay or SSR Driver. Terminal 1 is N.O., terminal 2 is Common, and terminal 3 is N.C. for both TB2 and TB3 for Relay Outputs.

The Normally Open (N.O.) contacts of the relays should be used for control outputs to ensure that the outputs are OFF when power is removed from the instrument. Control outputs are jumper configurable for reverse or direct action for heating and cooling applications respectively.

Terminal 1 is positive and terminal 2 is negative for both TB2 and TB3 for SSR Driver Outputs. Terminal 3 of TB2 and TB3 is not used with SSR Driver Outputs. (ie. loads that are smaller than 5 watts in power consumption).

For high impedence loads (i.e. Neon lamp) it may be necessary to remove snubber network (R68 thru R72 on PWA 046-155-XX) otherwise output will be continuously activated even though relay is off and LED is extinguished. See Page 22 for resistor location.

FIGURE 2-10



2.6.4.2 CURRENT OUTPUTS

Connections are made to current outputs as shown in Figure 2-10. Current output is 4 to 20mADC.

Terminal connections are made using TB6 of the respective controller board for one or two Pen instruments.

Connect positive lead (+) to terminal 1 and the negative lead (-) to terminal 2. Current outputs will drive into 450 ohms maximum load.

Tuning and Alarm Adjustments 3.1

The Recording Controller can be ordered providing proportional control. This type of control is provided with Proportional (P), Integral (I, auto reset), and Derivative (D, rate) control responses. Partlow defines the PID parameters as follows:

P(Proportional)	Proportional Band
I(Intergral)	Automatic Reset
D(Derivative)	Rate

The above PID parameters are jumper selectable.

Manual Reset is provided for use in lieu of, or in conjuction with Automatic Reset, and a Cycle Time selection is provided for use in Time Proportioning control applications. All are jumper selectable. These parameters are discussed in the following paragraphs.

3.1.1 PROPORTIONAL BAND

The Proportional Band adjustment is made in terms of percentage. This parameter defines the band over which the control output will function. Proportional Band Adjustment is jumper selectable and is factory set at 5%. Refer to Appendix A-2 (page 31).

This control response defines the controller Gain. The Gain is defined as the amount of change in output for a given change in input. The higher the controller gain, the larger the control output will be. The proportional Band in % is the mathematical inverse of the Gain, i.e. Gain = 1/Proportional Band %. The larger the proportional band is, the smaller the Gain. The smaller the proportional band the larger the Gain. For proper control of the process, the controller gain must be set to match the gain of the process, i.e. High Process Gain requires Low Controller Gain (Wide Proportional Band), and Low Process Gain requires High Controller Gain (Narrow Proportional Band).

3.1.2 AUTOMATIC RESET

Automatic Reset or Integral action response adjustments are made in terms of repeats per minute. This can be defined as the number of times a change in the control output, due to the proportional action, will be repeated in one minute. Automatic Reset is jumper selectable and is factory set at 0 repeats per minute. Refer to Appendix A-2 (page 31). Before using Automatic Reset it is advisable to first zero Manual Reset.

3.1.3 MANUAL RESET

The Manual Reset parameter is adjusted in terms of span (%). This adjustment will shift the proportional band by ± the Manual Reset value. This allows for compensation of the offset between the process value and the setpoint, after the process has settled out. Manual Reset will provide ± 50% of the span and is factory set near midpoint (0%). This is adjustable at the setstation.

3.1.4 RATE

Rate or Derivative action is adjusted in terms of minutes. The Rate time is defined as the time the output from a PD (proportional band + derivative) controller will lead the output from a P (proportional band) only controller when both experience the same input change. Rate action is applied to the process input, not the setpoint. Rate is a dynamic parameter and is adjusted to the time constants and lags in the process. Rate should affect the control output only when the process itself changes. Rate is jumper selectable and is factory set at 0 minutes. Refer to Appendix A-2 (page 31).

3.1.5 CYCLE TIME

Controllers used in Time Proportioning applications require a Cycle Time adjustment in addition to the PID responses. Cycle Time can be defined as the time duration or period of oscillation of the relay or SSR driver output. Cycle Time is selectable in terms of seconds and is factory set at 10 seconds. Refer to Appendix A-2 (page 31).

3.1.6 DIRECT/REVERSE CONTROL ACTION

Each control output is jumper selectable for direct or reverse action. Direct acting proportional control provides an increasing output as the process value increases. Reverse acting control provides a decreasing output as the process value increases. In On/Off control, Reverse action turns the output "ON" when the process goes below setpoint. Direct action turns the output "OFF" when the process goes below setpoint. The current output, first relay output, and LED output are jumper selectable and are factory selected for reverse action. The second output is jumper selectable and must be configured in the field. Refer to Appendix A-2 (page 31).

3.1.7 ON - OFF CONTROL

On - Off operation can be field "jumper configured" for either or both Output 1 or Ouput 2. Instruments with 1st and 2nd output configuration can be field "jumper configured" for Direct/Direct, Direct/Reverse, Reverse/Direct, or Reverse/Reverse control applications. Refer to Appendix A-2 (Page 31) for jumper selection.

Alarm Adjustments 3.2

THE ALARM OUTPUT MUST BE CONFIGURED IN THE FIELD. Refer to Figure A-2 (page 31) and Table on botton of page 32.

3.2.1 PROCESS ALARM

The Process Alarm is adjustable from 0 to 100% of span. This type of alarm remains fixed and does not track the process control setpoint. Clockwise adjustment of pot on front platen (see Fig 1-2) increases the actuation point. There are two ways to adjust the Process Alarm Actuation point. One method is via a simulator input (ie. millivolt source, decade box or current generator), a second method is via the Process Input.

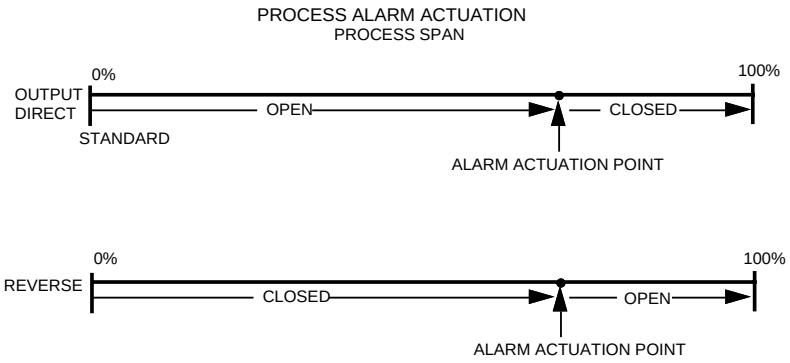
Simulator Input Source (Use decade box for RTD controllers)

1. Remove power if applied to instrument being adjusted for alarm actuation.
2. Disconnect input from board being set up for alarm functions.
3. connect up appropriate input signal to terminal block 4 (TB4).
4. Apply power to instrument.
5. Adjust input source to align pen with the desired alarm actuation point.
6. Turn the front panel second output adjustment until alarm is actuated. Clockwise rotation will increase the actuation point.
7. Once alarm setting is set, return instrument to normal operation, ie remove power, re-connect original source, etc.
8. Re-supply power and test if possible process alarm in actual operation.

Process Input

1. Supply the process temperature to the recorder controller equal to the desired alarm actuation point.
2. Adjust the alarm setting for actuation at this point. Clockwise rotation increases the actuation point.

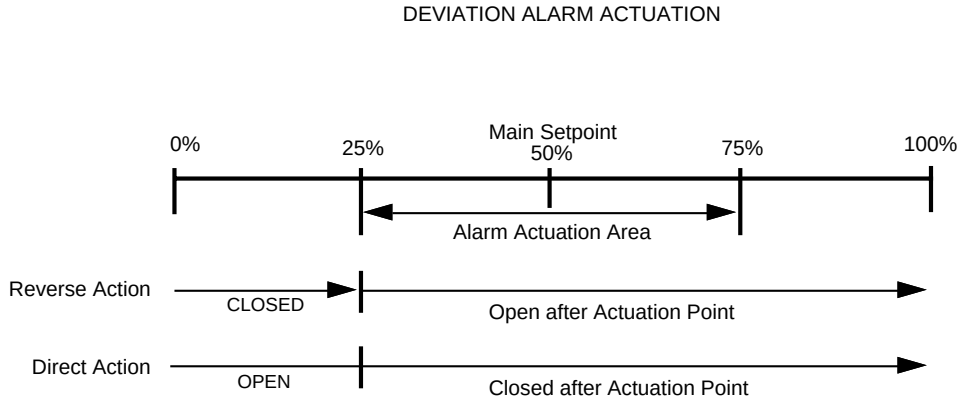
FIGURE 3-1



3.2.2 DEVIATION ALARM

The Deviation Alarm is adjustable ± 25% of span of setpoint and tracks the primary setpoint (retains relationship with the setpoint regardless of the latter's position). The second output must be configured in the field. Refer to Appendix A-2 (Page 31). Counterclockwise adjustment increases the actuation point, with the potentiometer midpoint actuating the alarm at setpoint.

FIGURE 3-2

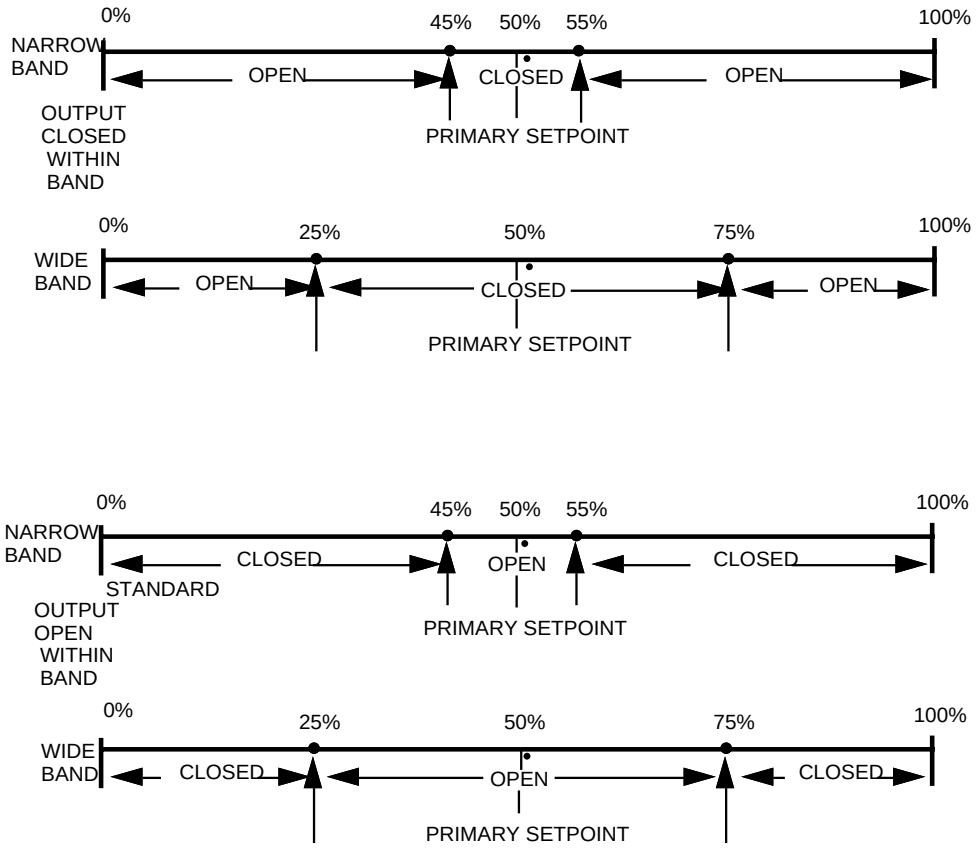


3.2.3 DEVIATION BAND ALARM

The Deviation Band Alarm is adjustable ± 25% of span from setpoint and tracks the primary setpoint similar to the Deviation Alarm. The second output must be configured in the field. Refer to Appendix A-2 (Page 31). Counterclockwise adjustment of Output 2 or Alarm potentiometer narrows the band width. Clockwise adjustment of Output 2 or Alarm potentiometer widens the band width.

FIGURE 3-3

EXAMPLES OF DEVIATION BAND ALARM ACTUATION



Service 4.1

4.1.1 CHANGING CHARTS

Chart changes may be done while in the normal operating mode.

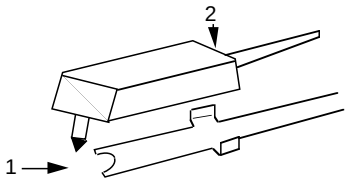
1. Pens will be active and the chart will continue rotating.
2. Open the instrument door, unscrew the chart center hub, and swing the namestrip arm out of the way.
3. Gently lift the pens up and carefully remove the old chart. Do not apply too much upward force on the pen arms or they may bend out of shape or be damaged.
4. Install new chart. Lift pens up out of the way. Do not bend pen arms. Make sure that the current time on chart is lined up at the "current time setting" mark on the chart platen.
5. Place namestrip arm over chart and tighten chart center hub.
6. Close the instrument door and place the instrument in the desired mode.

CAUTION: Chart hub pin (Optional) is sharp to perforate chart. Use caution in installing chart so fingers are not injured.

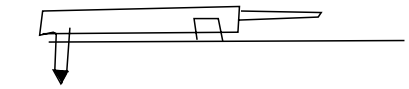
4.1.2 CHANGING PENS

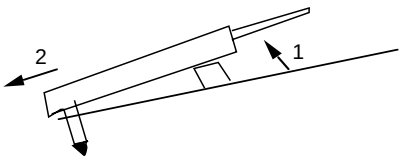
Open the instrument door. Refer to Figure 4-1 for pen changing procedure. This procedure is provided on a label on the instrument chart platen.

FIGURE 4-1



To install pen, slide pen into holder (1) and push down (2) as shown by arrows.





To remove pen for replacement, pull up at back end (1) and push out.

For five replacement pens order:

Green #60500401
Red #60500402

Calibration 4.2

Do not attempt any of these calibrations without the proper test equipment with specifications equal to or better than those listed.

4.2.1 The following pertains to thermocouple inputs only.

When simulating thermocouple inputs for calibration, the millivolt values must be compensated for the temperature of the cold junction, that is, the temperature at the terminal block on the Recorder board. The simplest and most accurate method of doing this is to use a compensated millivolt source or thermocouple simulator which does this automatically. In this case, no special or additional steps are required and the Calibration Check and Calibration Procedures can be followed as stated.

If a compensated source or thermocouple simulator is not available, a simple millivolt source can be used, but the millivolt values must be corrected to compensate for the ambient temperature at the terminal block.

Due to the sensitivity of the cold junction compensation sensor, you may experience problems performing calibration and obtaining repeatability when a millivolt source is used rather than a thermocouple simulator or compensated millivolt source. The unit's compensation sensor can be eliminated to facilitate calibration and provide repeatibility when a simple millivolt source is used. This may induce error, due to possible error in the compensation sensor (1 degree C max.), but this is probably no more than that due to the thermocouple used.

Refer to Figure 4-2 (page 27) for the location of the revision level of the Recorder bare boards, which is etched on the board.

Rev C and newer Recorder boards include a two-position jumper JU11, which selects normal compensation or a fixed cold junction temperature of 32°F (0°C). With this feature, the unit can be calibrated using the millivolt values directly form the thermocouple tables. After the calibration or check is complete, move JU11 back to the "normal" position.

On older boards, Rev A or Rev B, the compensation sensor can be eliminated, but not as easily, and the millivolt values must be adjusted. The following procedure simulates a cold junction temperature of 0° F (-17.8°C), which is not the assumption used in the tables, and corrects the table value accordingly.

1. Temporarily connect a jumper (wire with eze-hooks on each end) from R38 to R48, as shown in Figure 4-2 (page 27).

2. Connect the millivolt source to the unit and calibrate per standard instructions using corrected millivolt values.

The corrected values are obtained by subtracting the millivolt value, for 0° F to the table value for the desired temperature for the proper thermocouple. In equation form:

CORRMV = TBLMV - (TBLZF)

Where: CORRMV is the corrected millivolt value.
TBLMV is the millivolt value from the table.
TBLZF is the millivolt value from the table for 0° F (-17.8° C).

(Continued on next page)

(Continued from page 23)

Example: For range 0 to 300F Type J

From the tables: 0 F = -0.885 mV

300 F = 7.947 mV

For 0 F: CORRMV = -0.885 - (-0.885) = 0.000 mV
For 300 F: CORRMV = 7.947 - (-0.885) = 8.832 mV

Example: For range 0 to 300C Type K

From the tables: 0 F = -0.692 mV
0 C = 0.000 mV
300 C = 12.207 mV

For 0 C: CORRMV = 0.000 - (-0.692) = 0.692 mV
For 300 C: CORRMV = 12.207 - (-0.692) = 12.899 mV

3. After the calibration or check is complete, disconnect the jumper that was connected to R38 and R48.

4.2.2 CALIBRATION CHECK

To check the accuracy of the recorder:

1. With the process value known, clip the black lead of a digital voltmeter to testpoint TPC on the Recorder PWA board (top board) and the red lead of the digital voltmeter to testpoint TP7 on the Recorder PWA board.

2. The voltage measured should be about equal to the process value divided by the span, multiplied by 10.
   TP7 = (Process Value ÷ Span) x 10

3. Set the setpoint to 50% of span. (Only required if instrument is not a recorder only, no outputs)

4. Clip the red lead of the voltmeter to TP1 on the Controller PWA board (bottom board).

5. The voltage measured should equal negative 2.500 VDC, ± 0.003 VDC.

6. If any of the above volt readings are incorrect, recalibration is necessary.

4.2.3 CALIBRATION PROCEDURES

The following procedure provides complete calibration of input, pen and setpoint.
THE FOLLOWING ADJUSTMENTS APPLY TO THE RECORDER PWA.

1. Clip black lead of digital voltmeter to TPC.

2. Clip red lead to TP6.

3. Locate R102 and adjust for -5.000 ± 0.001VDC.

4. Move red lead to TP4.

5. Adjust input device for minimum of span, making sure to compensate for ambient temperature if required for thermocouple inputs.

6. Locate R103 and adjust for 0.000 ± 0.003 VDC.

7. Move red lead to TP7.

8. Locate R104 or R103 depending on the range. Adjusting R104 may not affect some ranges such as RTD or Linear. If this is the case, R103 must be adjusted. The process value is limited by circuitry to a range of 0 to 10.25 volts. Zero adjustment must be accomplished as follows : Turn the adjustment screw on R104 or R103 (whichever applies) clockwise until the voltage observed increases. After the observed voltage increase, turn the adjustment screw counter-clockwise until the voltage observed is 0.000 ± 0.001VDC.

9. Locate R100 and adjust so that the pen is at minimum of span.

10. Adjust input device for maximum of span, making sure to compensate for ambient temperature if required for thermocouple inputs.

11. With red lead on TP7, locate R101 and adjust for 10.000 ± 0.001 VDC.

12. Locate R105 (red lead still on TP7) and adjust so that the pen is at maximum of span.

13. Adjust the input device for 10% of span, making sure to compensate for ambient temperature if required for thermocouple inputs.

14. Referring to step 8, adjust the appropriate potentiometer, R104 or R103, for 1.000 ± 0.001VDC.

15. Locate R100 and adjust so that the pen is 10% of span.

16. Adjust input device for maximum of span, making sure to compensate for ambient temperature if required for thermocouple inputs.

17. With red lead on TP7, locate R101 and adjust for 10.000 ± 0.001VDC.

18. Locate R105 and adjust so that the pen is at maximum of span.

19. Repeat steps 14 through 19 until no further adjustments are required.

20. It may be necessary to go through the procedure again, starting at step 7, to make sure zero and span do not shift.

21. Remove the jumper if it was added or restore JU11 to the "normal" position if it was moved for checking or calibration.

(Continued on next page)

(Continued from page 25)

IF THE INSTRUMENT HAS A CONTROL PWA, THE FOLLOWING ADJUSTMENTS ARE MADE ON THE CONTROL PWA.

1. Set the thumbwheel station to minimum of span.

2. Move red lead to TP1.

3. Locate R100. The setpoint signal is limited by circuitry to a range of -5.000VDC to 0.000VDC. Zero and span adjustments must be accomplished as follows : Turn the adjustment screw on R100 clockwise until the magnitude of the voltage observed increases. After the observed voltage increases, turn the adjustment on screw R100 counter-clockwise until the voltage observed is 0.000 ± 0.001 VDC.

4. Set the thumbwheel station for maximum of span.

5. Locate R101 and turn the adjustment screw counterclockwise until the voltage observed decreases. After the observed voltage decreases, turn the adjustment screw clockwise until the voltage observed is -5.000 ± 0.001VDC.

6. Set the thumbwheel station to 10% of span.

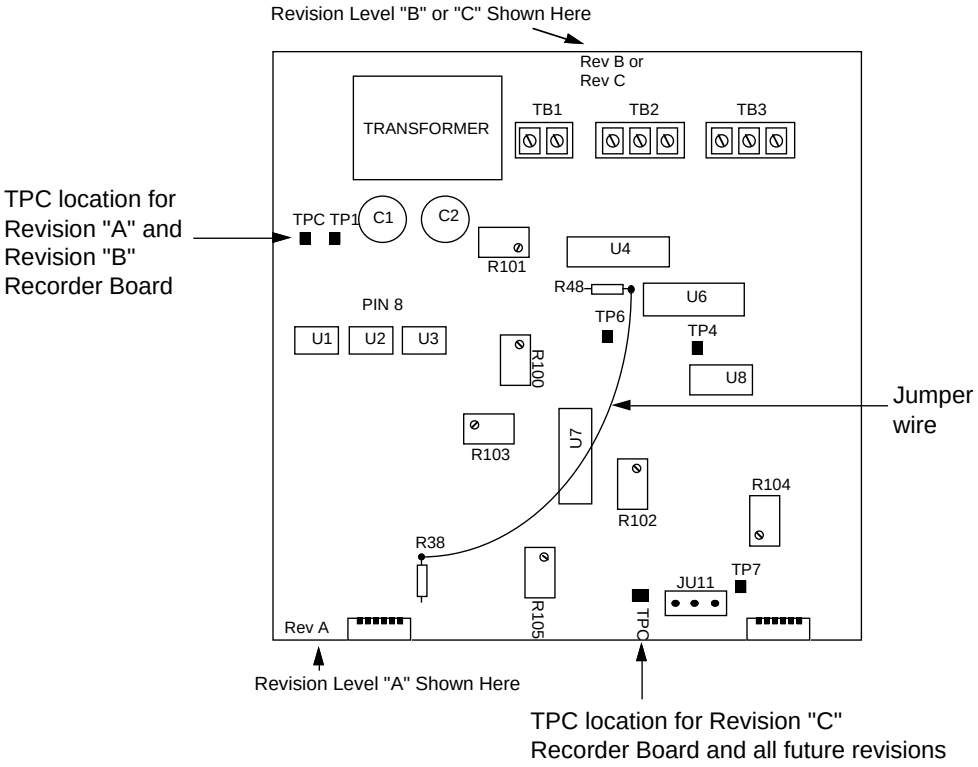
7. Adjust R100, if necessary, for -0.500 ± 0.001VDC.

8. Set the thumbwheel station to 90% of span.

9. Adjust R101, if necessary, for -4.500 ± 0.001VDC.

10. Repeat steps 6 through 9 until satisfactory results are obtained.

FIGURE 4-2
Calibration Board Layout
Recorder PWA



THERMOCOUPLE

*NORMAL **CALIBRATION

JU11 JU11

For Revision C and future Recorder Board revision levels only

* Place in this position for "normal" operation or calibration
** Place in this position when thermocouple ranges are calibrated without a compensated source.

FIGURE 4-3
Calibration Board
Layout Controller
PWA

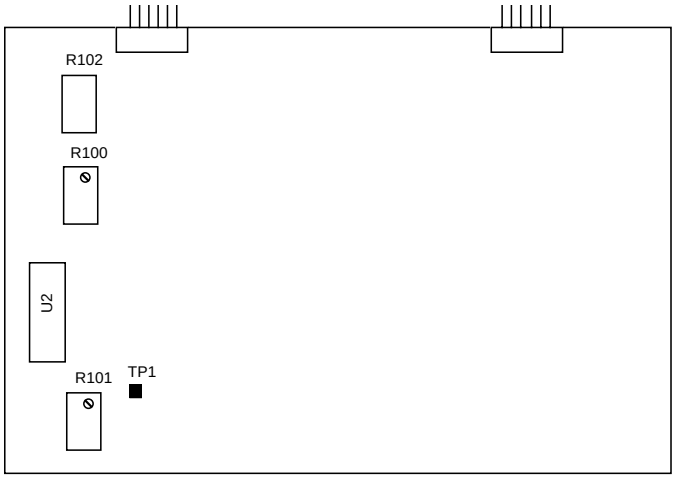


TABLE 4-1 Troubleshooting Guide

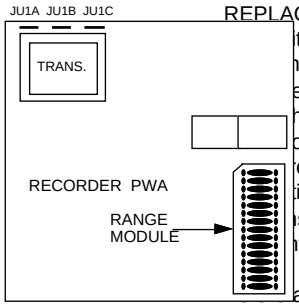
Symptom	Corrective Action
1. No pen movement or indicator lights	Check all power wiring
2. Pen reads full upscale or downscale	Check sensor leads for breaks or sensor polarity
3. Incorrect indication or control	1. Check for correct thermocouple polarity 2. Check thermocouple extension wire for correct type and polarity 3. Check for resistance build-up on terminals
4. No output, but indicator light functions properly	Check output wiring, correct contacts
5. Pen reads ambient temperature	Thermocouple short at input terminals

Note : If the instrument does not respond to the above corrective actions, contact the factory or your local representative.

Field Range Change 4.3

When ordering a replacement module, for either a damaged module or field range change, order as Part Number 41902XXX. Enter the proper three digit range code in place of XXX. A resistor, R23, may need replacing and will be included in the range change kit.

FIGURE 4-4

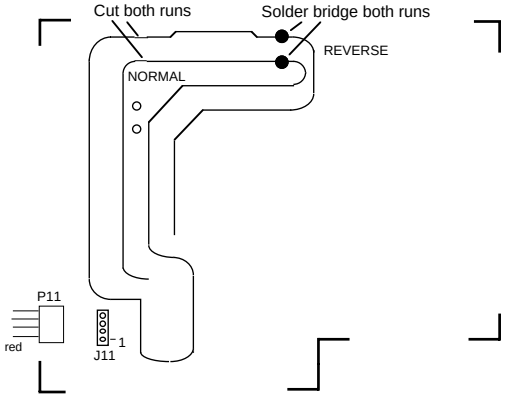


INSTALLATION INSTRUCTIONS

1. DISCONNECT ALL POWER BEFORE REMOVING OR REPLACING ANY PARTS.
   t-static safety precautions due to static electricity sensitive nents.
   e the range module on the Recorder PWA.
   he new range module on the Recorder PWA ensuring orientation.
   ed, move the approproate jumpers corresponding with the ion of the new range. See Appendix A for proper jumper s.
   troller PWA is present, replace R23 with the replacement in the replacement kit.
   applying power to the isntrument, R100 of the Recorder PWA must be adjusted fully clockwise and R105 of the Recorder ust be adjusted fully counter-clockwise. Failure to do so use damage to the unit.
   ration of the instrument is necessary. Refer to calibration ures found on pages 32,22 and 34.

For units ordered as 230VAC and operating at 230VAC, only jumper JU1B should be present.

For units ordered as 230VAC but converted to 115VAC, only jumper JU1A and JU1C should be present.



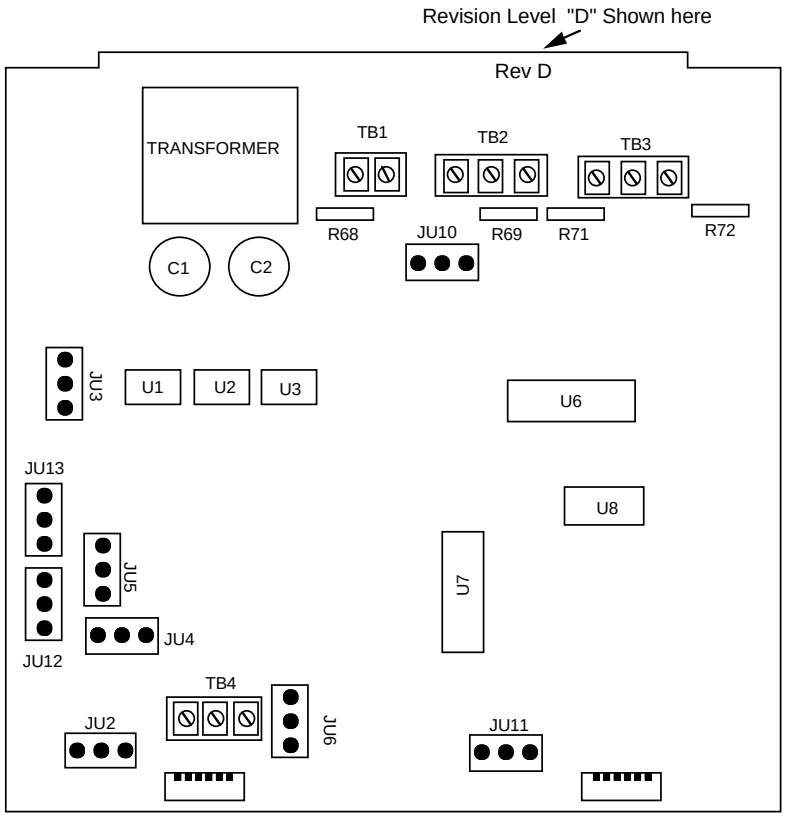
FOR REVERSE RANGES

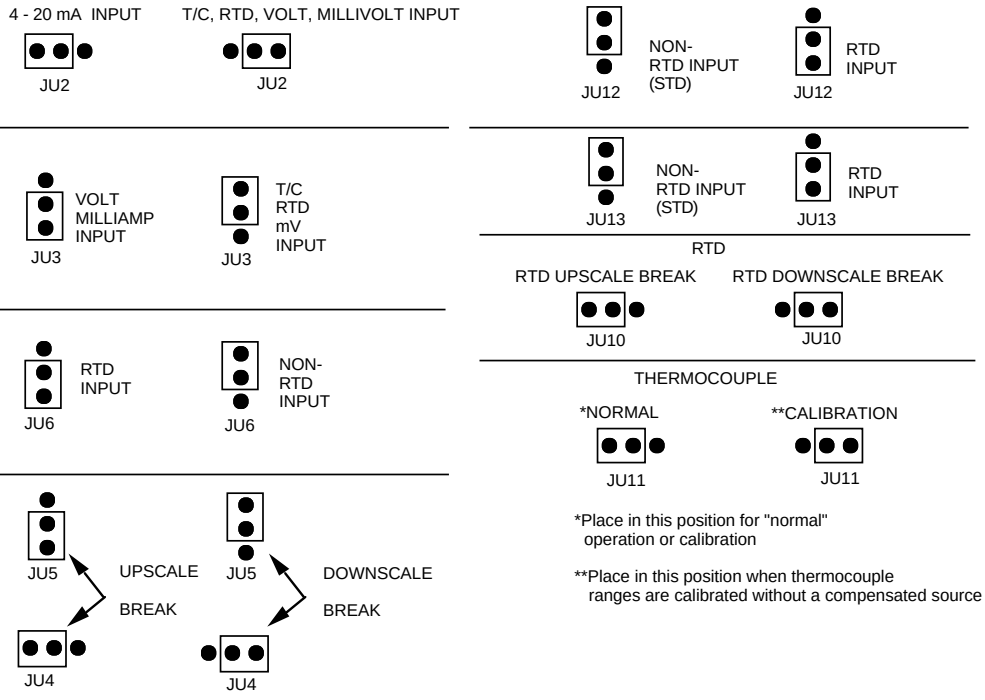
(150 to 25, 180 to 30, etc) proceed as follows:

1. Locate Pen Drive Assembly and Circuit Board.
2. See figure to the left.
3. Cut both runs marked "normal" as shown.
4. Solder bridge both runs marked "reverse" as shown.
5. Reverse Plug P11 that is coming from motor to circuit board so that the red wire is on pin 1 of J11.

Appendix A
Board Layouts

FIGURE A-1 - Recorder PWA Board - Revision D

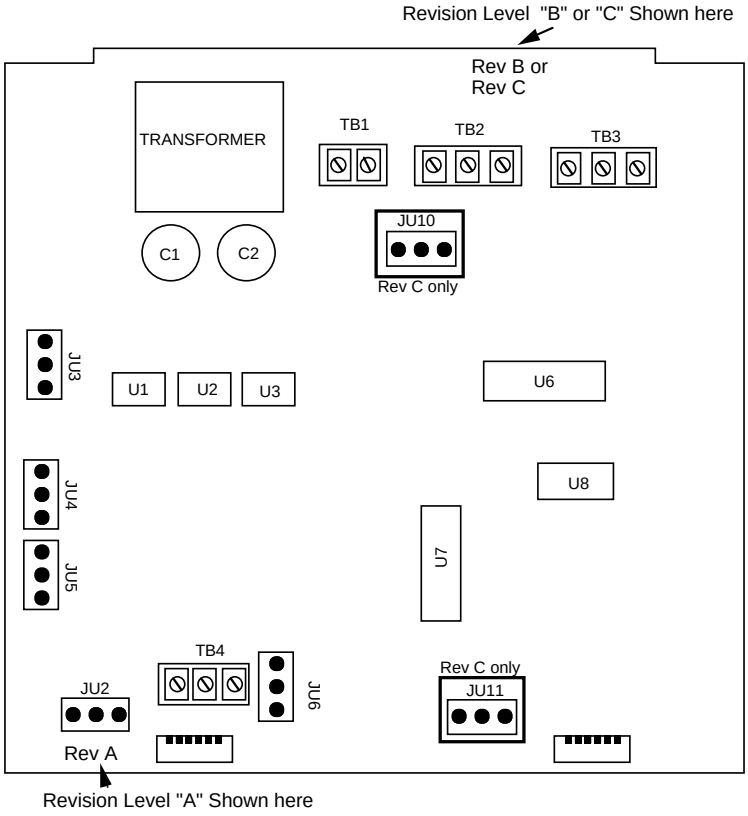




*Place in this position for "normal" operation or calibration

**Place in this position when thermocouple ranges are calibrated without a compensated source

FIGURE A-1 - Recorder PWA Board - Revision C and below



4 - 20 mA INPUT

JU2

T/C, RTD, VOLT, MILLIVOLT INPUT

JU2

JU10 and JU11 apply to REV C only

VOLT
MILLIAMP
INPUT

JU3

T/C
RTD
mV
INPUT

JU3

RTD

RTD UPSCALE BREAK

JU10

RTD DOWNSCALE BREAK

JU10

THERMOCOUPLE

*NORMAL

JU11

**CALIBRATION

JU11

RTD
INPUT

JU6

NON-
RTD
INPUT

JU6

*Place in this position for "normal" operation or calibration

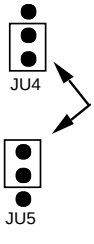
**Place in this position when thermocouple ranges are calibrated without a compensated source

JU4

UPSCALE

BREAK

JU5



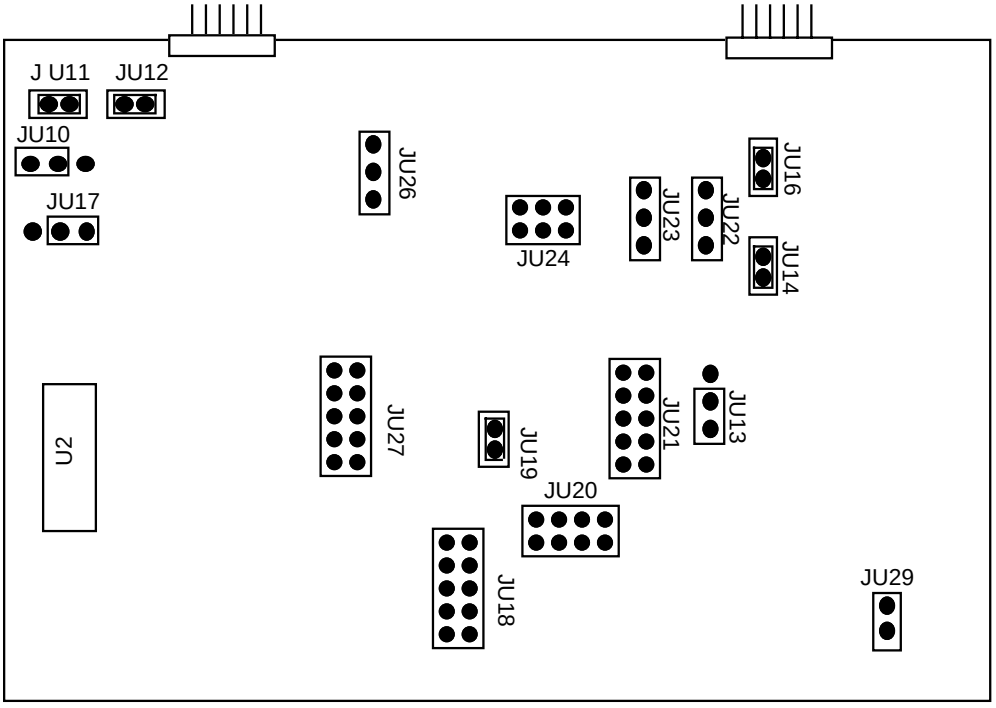
JU4

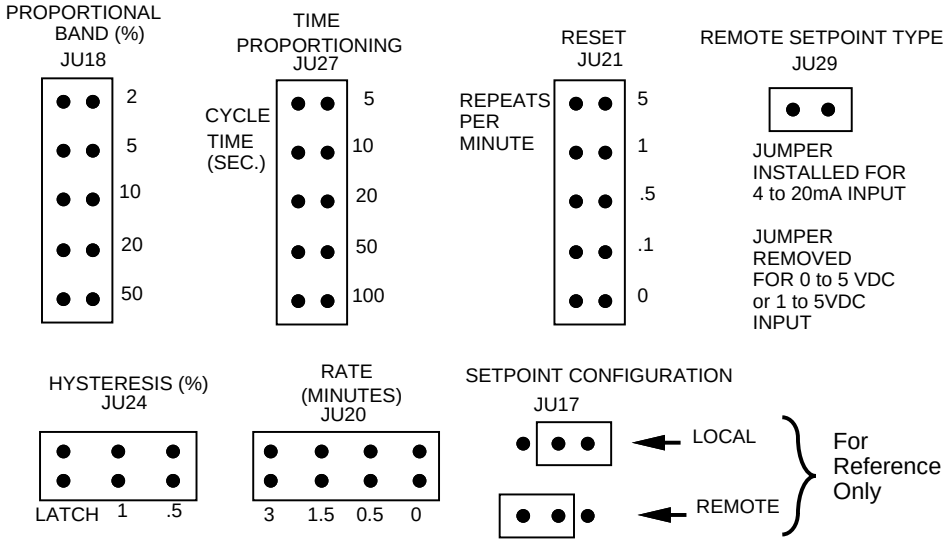
DOWNSCALE

BREAK

JU5

FIGURE A-2 - Controller PWA Board





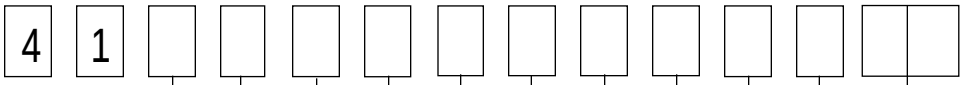
(Continued on next page)

FIRST OUTPUT	JU19	JU22	JU23	JU26
ON/OFF REVERSE	OUT			
ON/OFF DIRECT	OUT			
HIGH LIMIT **SEE NOTE**	OUT			
LOW LIMIT **SEE NOTE**	OUT			
TIME PROPOR-TIONING REVERSE	OUT			
TIME PROPOR-TIONING DIRECT	OUT			
CURRENT PROPOR-TIONING DIRECT	OUT			
CURRENT PROPOR-TIONING REVERSE	IN			

NOTE : CONSULT FACTORY FOR HIGH to LOW or LOW to HIGH BOARD LIMIT CHANGE

SECOND OUTPUT	OUTPUT DIRECTION	JU10	JU11	JU12	JU13	JU14	JU16
PROCESS ALARM	DIRECT		IN	IN		OUT	IN
PROCESS ALARM	REVERSE		IN	IN		OUT	OUT
DEVIATION ALARM	DIRECT		OUT	IN		OUT	OUT
DEVIATION ALARM	REVERSE		OUT	IN		OUT	IN
DEVIATION BAND ALARM	OPEN WITHIN BAND		OUT	OUT		IN	IN
DEVIATION BAND ALARM	CLOSED WITHIN BAND		OUT	OUT		IN	OUT
ON/OFF	DIRECT		OUT	IN		OUT	OUT
ON/OFF	REVERSE		OUT	IN		OUT	IN
JUMPER POSITIONS AS SHIPPED FROM THE FACTORY			IN	IN		IN	IN

Appendix B - Order Matrix



Pen 1 Type / Output
1 Recorder Only
2 High Limit
3 On-Off Controller Relay
4 On-Off Controller SSR Driver
5 Time Prop. Relay
6 Time Prop. SSR Driver
7 4-20 MA

Pen 1 Setpoint
0 Recorder Only
1 * Local 3 Digit Positive Only*
2 Local 3 Digit Pos./Neg.(See Note1)*
3 Local 4 Digit Positive Only*
4 Remote Setpoint**

Pen 1 Second Output
0 None
1 On-Off/Alarm Relay
2 On-Off/Alarm SSR Driver

Pen 2 Type / Output
0 None
1 Recorder Only
2 High Limit
3 On-Off Controller Relay
4 On-Off Controller SSR Driver
5 Time Prop. Relay
6 Time Prop. SSR Driver
7 4-20 MA

Pen 2 Setpoint
0 None or Recorder Only
1 *Local 3 Digit Positive Only
2 * Local 3 Digit Pos./Neg.(See Note 1)
3 * Local 4 Digit Positive Only
4 **Remote Setpoint

Pen 2 Second Output
0 None
1 On-Off/Alarm Relay
2 On-Off/Alarm SSR Driver

Option Suffix
(Blank) None
N3 NEMA3†
AV Remote Thumbwheel only
AW RTD Depression on Pen 2
HA Reverse Range Pen 1
HB Reverse Range Pen 2
HC Reverse Range Pen 1 & 2
NA N3 plus Reverse Pen 1
NB N3 plus Reverse Pen 2
NC N3 plus Reverse Pen 1 & 2

Line Voltage
1 115VAC 60Hz
2 230VAC 60Hz
3 115VAC 50Hz
4 230VAC 50Hz
CSA Approved
5 115VAC 60Hz
6 230VAC 60Hz
7 115VAC 50Hz
8 230VAC 50Hz

Chart Rotation
1 24 Hour
2 7 Day
3 12 Hour
4 48 Hour
5 72 Hour

Enclosure Option***
2 Std. Cover (Plastic Windows)
4 Door Lock
6 Sealed Conduit Conn.
7 Combination of 4 & 6

Internal Options
0 None
1 Chart Pin in Chart Flange
2 Event Pen-115VAC Only
3 Tamperproof Platen
4 Combination 1&2
5 Combination 1&3
6 Combination 2&3
7 Combination 1,2,3

* Ranges with top of span of 1000 are three digit ranges with the setpoint maximum of 999.
** If Remote Setpoint is selected, Local Setpoint is not available. This is a 1-5VDC or 4/20mADC Remote Setpoint input type.
*** Options 4 & 6 shouldn't be ordered without N3 suffix.
† N3 NEMA 3 Equivalent Spray Resistant Enclosure.

NOTE 1: Must be ordered with Positive/Negative Ranges only.

For Range Codes, see next page

Range Codes

DEG.	RANGE	RTD	J T/C	K T/C	T T/C	R T/C	S T/C
F	-150 to 350				301		
F	-100 to 100	001					
F	-100 to 200	061					
F	-50 to 50	041					
F	0 to 100	002					
F	0 to 200	003					
F	0 to 300	004	111				
F	0 to 400	023	103		304		
F	0 to 600	006	104				
F	0 to 800	024	106				
F	0 to 1000		107	213			
F	0 to 1200		112	203			
F	0 to 2000			205			
F	0 to 2500			206			
F	0 to 3000					501	
F	20 to 100	056					
F	20 to 120	057					
F	30 to 180	038					
F	30 to 230	028					
F	50 to 200	036					
F	60 to 180	027					
F	80 to 180	026	116				
F	100 to 250	042					
F	120 to 220	037					
F	130 to 190	060					
F	135 to 195	065					
F	150 to 350	040					
F	200 to 300	045					
F	1000 to 3000						554
F	150 to 25	050					
F	180 to 30	039					
F	230 to 30	029					
C	-100 to 100	022					
C	-100 to 200	046					
C	-50 to 50	043					
C	-50 to 75	055					
C	-35 to 70	059					
C	-30 to 70	058					
C	0 to 100	011					
C	0 to 110	030					
C	0 to 200	009	101		303		
C	0 to 300	010	115				
C	0 to 400	012	102				
C	0 to 600		114	201			
C	0 to 1000			202			
C	0 to 1200			208			
C	0 to 1500					503	553
C	110 to 0	031					

Unit	Input Range	Setpoint Range	Linear
mVDC	0 to 50	0 to 100	909
	0 to 100	0 to 100	803
	0 to150	0 to 150	914
mADC	4 to 20	0 to 100	907
	4 to 20	0 to 200	924
	4 to 20	30 to 230	926
	0 to 20	0 to 100	925
	4 to 20	0 to 300	927
VDC	0 to 0.2	0 to 100	999
	0 to 0.5	0 to 100	922
	0 to 1.0	0 to 100	920
	0 to 4.0	0 to 100	923
	0 to 5.0	0 to 100	919
	0 to 10.0	0 to 100	921
	1 to 5.0	0 to 100	902

Appendix C - Specifications

Input

*THERMOCOUPLE
Type

J

K

T

R

S

Cold junction compensated with thermocouple break protection.
8.5 mV minimum span
100mV maximum span

*RTD
100 ohm, 2 or 3-wire
20 ohm minimum span
200 ohm maximum span
Standard ranges are for
0.00385 ohms/ohm/degree C

*DC VOLTAGE
0 VDC minimum
10 VDC Maximum
1 VDC Minimum span

*DC MILLIVOLTS
0 mV minimum
100 mV maximum
10 mV minimum span

*MILLIAMPS
4 to 20 mA accomodated
with a 249 ohm shunt
resistor, jumper selectable

REMOTE SETPOINT
Optional
1 to 5 VDC (on board 249
ohm shunt resistor to convert
4 to 20 mA input to 1 to 5 VDC).
Three-position terminal block
available to provide +5 VDC
output for potentiometric remote
setpoint.

Outputs

CONTROL OUTPUT 1 AND 2 (each pen)

Relay	SPDT 115VAC: 5.0A Resistive, 1/8HP, 250VA 230VAC: 2.5A Resistive, 1/8HP, 250VA
SSR Driver	Open collector output Short circuit protected @ 40mA maximum. Provides 5VDC at 23mA or 3VDC at30mA
Current	4 to 20 mA - 0 to 450 ohm grounded load maximum. Output span may exceed the stated span, but shall cover the minimum span of 4 to 20 mA.

ALARM OUTPUT

Relay	SPDT 115VAC: 5.0A Resistive, 1/8HP, 250VA 230VAC: 2.5A Resistive, 1/8HP, 250VA
SSR Driver	Open collector output Short circuit protected @ 40mA maximum Provides 5VDC @ 23mA or 3VDC @ 30mA

CONTROL / ALARM FUNCTION

Output 1	On/Off, Time Proportioning, 4 to 20 mA - all either Direct or Reverse acting. Also available as a High Limit.
Output 2	On/Off - Direct or Reverse acting as Control or as an Alarm (Process, Deviation, or Deviation Band)

NOTE : Up to two outputs provided for each pen (Pen1 or Pen2)

Performance

Measurement Error Limit	All input types : 1.0% of span
Ambient Temperature Error	0.04% of span per degree C deviation from 25° C
Hysteresis	Jumper selectable .5%, 1%, (factory set at .5%) or latch for limit.
Noise Rejection	Normal mode, 65dB minimum at 60 Hz or greater. Common mode, 85dB minimum. 24VAC maximum. 33VDC maximum.
Line Voltage	Standard : 115VAC ± 10% 50 or 60 Hz Optional : 230VAC ± 10% 50 or 60 Hz
Power Consumption	25VA maximum
Operating Temperature	32° to 131°F 0° to 55°C (ambient)
Storage Temperature	-40° to 149°F -40° to 65° C
Humidity	0 to 70% RH noncondensing
Dimensions	13.19"H X 15.13" W X 3.63" Deep
Weight	20 pounds maximum
Vibration	0.5 to 100 Hz @ 0.2g
Sensor Fault Detection	Jumper selectable for upscale or downscale sensor break. Only downscale break is available for milliamp inputs due to the use of a low ohm shunt resistor.
Agency Approvals	UL CSA - Only if ordered

Record

Chart	10 inch circular chart; 100 charts furnished with each instrument. Unless otherwise specified, charts shipped with instrument are 0-100 linear range.
Chart Drive	AC synchronous motor
Chart Rotation	Factory set per order matrix
Pen Type	Disposable Fiber-tip
Pen Color	Pen 1 - Red Pen 2 - Green

Warranty and Return Statement

These products are sold by The Partlow Corporation (Partlow) under the warranties set forth in the following paragraphs. Such warranties are extended only with respect to a purchase of these products, as new merchandise, directly from Partlow or from a Partlow distributor, representative or reseller, and are extended only to the first buyer thereof who purchases them other than for the purpose of resale.

Warranty

These products are warranted to be free from functional defects in materials and workmanship at the time the products leave the Partlow factory and to conform at that time to the specifications set forth in the relevant Partlow instruction manual or manuals, sheet or sheets, for such products for a period of one year.

THERE ARE NO EXPRESSED OR IMPLIED WARRANTIES WHICH EXTEND BEYOND THE WARRANTIES HEREIN AND ABOVE SET FORTH. PARTLOW MAKES NO WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE WITH RESPECT TO THE PRODUCTS.

Limitations

Partlow shall not be liable for any incidental damages, consequential damages, special damages, or any other damages, costs or expenses excepting only the cost or expense of repair or replacement as described above.

Products must be installed and maintained in accordance with Partlow instructions. Users are responsible for the suitability of the products to their application. There is no warranty against damage resulting from corrosion, misapplication, improper specifications or other operating condition beyond our control. Claims against carriers for damage in transit must be filed by the buyer.

This warranty is void if the purchaser uses non-factory approved replacement parts and supplies or if the purchaser attempts to repair the product themselves or through a third party without Partlow authorization.

Returns

Partlow's sole and exclusive obligation and buyer's sole and exclusive remedy under the above warranty is limited to repairing or replacing (at Partlow's option), free of charge, the products which are reported in writing to Partlow at its main office indicated below.

Partlow is to be advised of return requests during normal business hours and such returns are to include a statement of the observed deficiency. The buyer shall pre-pay shipping charges for products returned and Partlow or its representative shall pay for the return of the products to the buyer.

Approved returns should be sent to:

PARTLOW CORPORATION
2 CAMPION ROAD
NEW HARTFORD, NY 13413 USA