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

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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 MRC 5000 microbased chart recorder.

**NOTE:**

It is strongly recommended that Partlow Brand 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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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 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.

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

1.4 POWER INPUT
The standard recorder will operate on input power over the range of 100-240 VAC, 47-63 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
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 Partlow MRC 7000 and ARC 4100 recorders. Figure 2-1C shows the adapter plate relative to the MRC 7000/ARC 4100 cutout. The Adapter Plate includes ears that attach to the sides of the recorder.

FIGURE 2-1C

Use #10 screws
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.

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:

\[ \text{Terr} = \text{TCe} \times L \]

where:
\[ \text{TCe} = \text{temperature error in } ^\circ\text{F} \text{ or } ^\circ\text{C per 1000 feet} \]
\[ L = \text{length of lead wire in thousands of feet} \]
TABLE 1

<table>
<thead>
<tr>
<th>AWG</th>
<th>Thermocouple Type:</th>
<th>J</th>
<th>K</th>
<th>T</th>
<th>R</th>
<th>S</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td></td>
<td>0.03</td>
<td>0.09</td>
<td>0.04</td>
<td>0.10</td>
<td>0.11</td>
</tr>
<tr>
<td>12</td>
<td></td>
<td>0.05</td>
<td>0.13</td>
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<td>0.16</td>
</tr>
<tr>
<td>14</td>
<td></td>
<td>0.09</td>
<td>0.21</td>
<td>0.10</td>
<td>0.27</td>
<td>0.26</td>
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<tr>
<td>16</td>
<td></td>
<td>0.14</td>
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<td>0.41</td>
<td>0.42</td>
</tr>
<tr>
<td>18</td>
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<td>0.25</td>
<td>0.68</td>
<td>0.68</td>
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<tr>
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<td>0.86</td>
<td>0.39</td>
<td>1.08</td>
<td>1.09</td>
</tr>
<tr>
<td>24</td>
<td></td>
<td>0.88</td>
<td>2.19</td>
<td>0.99</td>
<td>2.72</td>
<td>2.73</td>
</tr>
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</table>

TABLE 2

<table>
<thead>
<tr>
<th>AWG</th>
<th>Thermocouple Type:</th>
<th>J</th>
<th>K</th>
<th>T</th>
<th>R</th>
<th>S</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td></td>
<td>0.06</td>
<td>0.15</td>
<td>0.07</td>
<td>0.18</td>
<td>0.19</td>
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<tr>
<td>12</td>
<td></td>
<td>0.10</td>
<td>0.24</td>
<td>0.11</td>
<td>0.30</td>
<td>0.30</td>
</tr>
<tr>
<td>14</td>
<td></td>
<td>0.16</td>
<td>0.39</td>
<td>0.18</td>
<td>0.48</td>
<td>0.48</td>
</tr>
<tr>
<td>16</td>
<td></td>
<td>0.25</td>
<td>0.61</td>
<td>0.28</td>
<td>0.75</td>
<td>0.75</td>
</tr>
<tr>
<td>18</td>
<td></td>
<td>0.40</td>
<td>0.99</td>
<td>0.45</td>
<td>1.22</td>
<td>1.23</td>
</tr>
<tr>
<td>20</td>
<td></td>
<td>0.64</td>
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<td>0.71</td>
<td>1.94</td>
<td>1.96</td>
</tr>
<tr>
<td>24</td>
<td></td>
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<td>3.94</td>
<td>1.78</td>
<td>4.89</td>
<td>4.91</td>
</tr>
</tbody>
</table>

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:

\[
T_{err} = T_{Re} \times L \quad \text{where; } \quad T_{Re} = \text{temperature error in } ^\circ \text{C or } ^\circ \text{F per 1000 feet} \\
L = \text{length of lead wire in thousands of feet}
\]

TABLE 3 2 Wire RTD

<table>
<thead>
<tr>
<th>AWG No.</th>
<th>Error °C</th>
<th>Error °F</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>+/-5.32</td>
<td>+/-9.31</td>
</tr>
<tr>
<td>12</td>
<td>+/-9.31</td>
<td>+/-14.6</td>
</tr>
<tr>
<td>14</td>
<td>+/-13.3</td>
<td>+/-23.9</td>
</tr>
<tr>
<td>16</td>
<td>+/-21.3</td>
<td>+/-38.6</td>
</tr>
<tr>
<td>18</td>
<td>+/-34.6</td>
<td>+/-61.2</td>
</tr>
<tr>
<td>20</td>
<td>+/-54.5</td>
<td>+/-97.1</td>
</tr>
<tr>
<td>24</td>
<td>+/-86.5</td>
<td>+/-155.6</td>
</tr>
</tbody>
</table>
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 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 25A.

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.25A

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.
### 2.4.4 ALARM OUTPUT WIRING

Alarm 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 alarm as shown in Figure 2-7.

#### FIGURE 2-7

![Diagram of alarm output wiring](image)

### 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

![Diagram of communication wiring](image)
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 alarm is active, the appropriate alarm 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, alarm LED, and pens will react normally when in a Hi or Lo condition, as if the value was high or low, relative to the alarm setpoint. In a SnSr condition, relays will be de-energized, alarm 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 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.

- ALRM 1/1 LED flashes Display shows Pen 1/Alarm 1 setpoint value
- ALRM 1/2 LED flashes Display shows Pen 1/Alarm 2 setpoint value
- ALRM 2/1 LED flashes Display shows Pen 2/Alarm 1 setpoint value
- ALRM 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.

3.3 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.

<table>
<thead>
<tr>
<th>RTD and Millivolt</th>
<th>5 VDC</th>
<th>Milliamp</th>
<th>Thermocouple</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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 alarm 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 alarm 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.

<table>
<thead>
<tr>
<th>PARAMETER CODE</th>
<th>PARAMETER DESCRIPTION</th>
<th>SETTINGS OR RANGE</th>
<th>DEFAULT SETTING</th>
</tr>
</thead>
<tbody>
<tr>
<td>InPS</td>
<td>Input Selection</td>
<td>0 - 18</td>
<td>1</td>
</tr>
<tr>
<td>ICor</td>
<td>Input Correction</td>
<td>-999 to 999*</td>
<td>0</td>
</tr>
<tr>
<td>A1</td>
<td>Alarm Type</td>
<td>OFF = none</td>
<td>OFF</td>
</tr>
<tr>
<td>A2</td>
<td>Alarm Type</td>
<td>OFF = none</td>
<td>OFF</td>
</tr>
<tr>
<td>dISP</td>
<td>Display Input/Pen Value during normal operation, RUN mode</td>
<td>On = Display value</td>
<td>On</td>
</tr>
<tr>
<td>dPOS</td>
<td>Decimal Point Position</td>
<td>0 = nnnn</td>
<td>0</td>
</tr>
<tr>
<td>EUU</td>
<td>Engineering Units that equate to upper transducer input (will show only for Volt)</td>
<td>-9999 to 9999*</td>
<td>5000</td>
</tr>
</tbody>
</table>
or Milliamp Input types)
Engineering Units that equate to lower transducer input (will show only for Volt or Milliamp Input types)

-9999 to 9999* 0

Value that equates to upper chart division

Value that equates to Lower chart division

-9999 to 9999 0

Hysteresis or Switch differential for alarms in units, not percent (will show only if alarms present)

0 to 200* 3

Display Filter Factor Filters display for input noise. Higher number means more filtering.

1 to 10 1

Alarm Changes Determines if alarm 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.

**COMMUNICATION PARAMETER - CP
(There is only one parameter in this section) Only seen if optional communications is ordered.

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 tESst 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 alarm relay will be energized in sequence for about 4 seconds while its status LED (ALRM 1/1, ALRM 1/2, ALRM 2/1, or ALRM 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:

<table>
<thead>
<tr>
<th>Input Type</th>
<th>JU1</th>
<th>JU2</th>
<th>InPS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thermocouple</td>
<td>DOWN</td>
<td>DOWN</td>
<td>&quot;1&quot;</td>
</tr>
<tr>
<td>RTD</td>
<td>PARK</td>
<td>PARK</td>
<td>&quot;11&quot;</td>
</tr>
<tr>
<td>mV</td>
<td>PARK</td>
<td>PARK</td>
<td>&quot;14&quot;</td>
</tr>
<tr>
<td>mA</td>
<td>MIDDLE UP</td>
<td>MIDDLE UP</td>
<td>&quot;12&quot;</td>
</tr>
<tr>
<td>V</td>
<td>UP</td>
<td>UP</td>
<td>&quot;17&quot;</td>
</tr>
</tbody>
</table>

5.1 INPUT CALIBRATION - InP

EQUIPMENT REQUIRED:
Input source with accuracy better than ±0.05% of reading.

- Thermocouple: 1 J type
  1 mercury thermometer ±.25°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 \texttt{rEF} should be displayed.

With \texttt{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 \texttt{SCAN} should be displayed. When \texttt{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 \texttt{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 \texttt{PEn}.

With \texttt{PEn} displayed, depress the SCROLL key to select another pen, or UP to return to \texttt{inP}.

If something fails in the process, \texttt{FAIL} will be displayed. Depress any key to return to the \texttt{inP} display.

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

\begin{tabular}{|l|l|}
\hline
\textbf{CODE} & \textbf{REFERENCE VALUE} \\
\hline
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 \\
\hline
\end{tabular}

\section*{5.2 CHART/PEN CALIBRATION - Chrt}
This Cal section calibrates the pens to the chart, and is divided into two additional sections: \texttt{PEn} and \texttt{ArC}. \texttt{PEn} calibrates the pen spans to the chart. \texttt{ArC} provides a capability to make the pens sweep the chart to facilitate mechanical adjustments of pen arms.

\texttt{PEN SPAN CALIBRATION - PEn}
With \texttt{Chrt} in the display, press DOWN to enter the Chart calibration section and \texttt{PEn} will be displayed. Depressing the SCROLL key will toggle between \texttt{PEn} and \texttt{ArC}. With \texttt{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 \texttt{P1Lo}.

With \texttt{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 \texttt{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 \texttt{P2Hi} is completed, depressing SCROLL will return to \texttt{PEn}.

If Pen 2 is not included, press SCROLL twice to skip \texttt{P2Lo} and \texttt{P2Hi} calibration, and return to \texttt{PEn}.

\texttt{PEN ARC MECHANICAL ADJUSTMENTS - ArC}
\textbf{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 \texttt{Chrt} in the display, press DOWN to enter the Chart calibration section and \texttt{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 - Model Number Matrix

FIRST PEN OPTION
1  Recorder Only
4  High/Low Limit*

SECOND PEN OPTION
0  None
1  Recorder Only
4  High/Low Limit*

PEN 1 OUTPUTS
0  None
1  One Alarm Relay
2  Two Alarm Relays

PEN 2 OUTPUTS
0  None
1  One Alarm Relay
2  Two Alarm Relays

COMMUNICATIONS
0  None
1  Configurator Port
2  RS-485 Coms
3  Configurator Port & RS-485 Coms

CASE
1  Standard - NEMA 3
2  Door Lock
3  NEMA 4X

SUFFIX
Blank  None
AA  Alarms And Communications Connectivity Option (Allows for later field installation of both options)

VOLTAGE
1  Standard (100-240 VAC)
2  Low Voltage**
3  Standard Voltage Operation and Transmitter Power Supply
4  Low Voltage Operation and Transmitter Power Supply
5  CE
6  CE and Low Voltage
7  CE and Standard Voltage and Transmitter Power Supply
8  CE and Low Voltage and Transmitter Power Supply

*  Does not include a relay. Order relays in output options.
**  Low Voltage is 20-50 VAC or 22-65 VDC
## Appendix B - Specifications

### INPUTS

<table>
<thead>
<tr>
<th>Input Types/Range</th>
<th>Type</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thermocouple</td>
<td>J</td>
<td>0°C to 760°C, 0°F to 1400°F</td>
</tr>
<tr>
<td></td>
<td>K</td>
<td>0°C to 1360°C, 0°F to 2500°F</td>
</tr>
<tr>
<td></td>
<td>T</td>
<td>-200°C to 400°C, -330°F to 750°F</td>
</tr>
<tr>
<td></td>
<td>R</td>
<td>200°C to 1650°C, 400°F to 3000°F</td>
</tr>
<tr>
<td></td>
<td>S</td>
<td>200°C to 1650°C, 400°F to 3000°F</td>
</tr>
<tr>
<td>RTD</td>
<td>100 ohm Platinum</td>
<td>-140°C to 400°C, -220°F to 750°F, 0.00385 ohms/°C</td>
</tr>
<tr>
<td>Current DC</td>
<td></td>
<td>0 to 20mA, 4 to 20mA, Internal 4.7 ohm Shunt Resistor</td>
</tr>
<tr>
<td>Voltage DC</td>
<td></td>
<td>0 to 25mV, 0 to 50mV, 10 to 50mV, 0 to 5 V, 1 to 5 V</td>
</tr>
<tr>
<td>Impedance</td>
<td></td>
<td>&gt; 100M ohm for TC and mV inputs, &gt; 100K ohm for 5V inputs, 4.7 ohms for mA inputs</td>
</tr>
<tr>
<td>RTD Excitation Current</td>
<td></td>
<td>150 microamps, typical</td>
</tr>
<tr>
<td>Input Scan Rate</td>
<td></td>
<td>1 scan per second for non-RTD inputs, 1 scan per 1.2 seconds for RTD inputs</td>
</tr>
<tr>
<td>Input Correction</td>
<td></td>
<td>Offset Adjustment, -999 to 999 units</td>
</tr>
<tr>
<td>Sensor Fault Detection</td>
<td></td>
<td>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</td>
</tr>
</tbody>
</table>

### INPUT PERFORMANCE

**Performance Under Reference Condition:**

- **Measurement Error**: Type J, K, T, R, S, and RTD: ±0.25% of span ±1 degree
- **mA, mV, and VDC**: ±0.25% of scaled span plus 1 least significant digit
- **Cold Junction Compensation Error**: ±0.2°C @ 25°C
- **Cold Junction Compensation Rejection**: 0.04°C/°C deviation from 25°C
- **Linearization Error**: TCs: ±0.25°C typical, ±0.5°C worst case with exceptions, RTDs: ±0.1°C typical, ±0.3°C worst case
- **Ambient Temperature Error**: ±0.01% of span per°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**

<table>
<thead>
<tr>
<th>Feature</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pen Type</td>
<td>Disposable fiber tip</td>
</tr>
<tr>
<td>Pen Color</td>
<td>Pen 1 - Red, Pen 2 - Green</td>
</tr>
<tr>
<td>Chart Size</td>
<td>10 inch</td>
</tr>
<tr>
<td>Chart Drive</td>
<td>Stepper motor</td>
</tr>
<tr>
<td>Chart Rotation</td>
<td>User configurable: 8 hours, 12 hours, 24 hours, 48 hours, or 7 days</td>
</tr>
<tr>
<td>Chart Span</td>
<td>Bottom and top of span, -9999 to 9999 units</td>
</tr>
</tbody>
</table>

**RECORDING PERFORMANCE**

<table>
<thead>
<tr>
<th>Feature</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chart Recording Accuracy</td>
<td>0.5% of chart span reference accuracy</td>
</tr>
<tr>
<td>Chart Rotation Accuracy</td>
<td>± 0.5% of rotation time, assuming all backlash removed</td>
</tr>
</tbody>
</table>

**OPERATOR INTERFACE**

<table>
<thead>
<tr>
<th>Feature</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Display</td>
<td>Four digit, 0.56&quot; high, red, seven segment, LED display</td>
</tr>
<tr>
<td>Status Indicators</td>
<td>Four red LED alarm status indicators, One green LED Pen 2 indicator</td>
</tr>
<tr>
<td>Keypad</td>
<td>Three keys for programming and unit operation</td>
</tr>
<tr>
<td>Display Modes</td>
<td>Normal: Process value(s) or blank</td>
</tr>
</tbody>
</table>

**ALARMS**

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

**RELAY OUTPUTS**

<table>
<thead>
<tr>
<th>Feature</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Relays</td>
<td>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</td>
</tr>
</tbody>
</table>

**POWER REQUIREMENTS**

<table>
<thead>
<tr>
<th>Feature</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Line Voltage</td>
<td>100-240 VAC, 47-63 Hz</td>
</tr>
<tr>
<td></td>
<td>Optional: 20-50 VAC, 50/60 Hz or 22-65 VDC</td>
</tr>
<tr>
<td>Power Consumption</td>
<td>18 VA Maximum</td>
</tr>
</tbody>
</table>

**TRANSMITTER POWER SUPPLY**

<table>
<thead>
<tr>
<th>Feature</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transmitter Power Supply</td>
<td>Provides up to 40mA of current at 24VDC</td>
</tr>
</tbody>
</table>
**CONSTRUCTION**

Enclosure: Injection molded Noryl case and cover with acrylic window  
NEMA Rating: NEMA 3 standard, NEMA 4X optional  
Conduit Openings: Three openings on the right side  
Mounting: Panel or wall  
Overall Dimensions: 14" wide X 14" high X 3.8" deep.  
Panel Cutout: 12.7" wide X 12.7" high  
Panel Depth: 2.5" (63.5mm)  
Panel Protrusion: 1.3" (33.0mm)  
Weight: 7 lbs maximum  
Retrofit: With adaptor plate, will fit Partlow MRC 7000/ARC 4100 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  
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: A2-1995  
CE - Complies with EN50082-2  
Limit Device: FM: Approved
NOTES

1. Linearization accuracy is based on conformance to NIST Monograph 175 (based on the ITS-90) for letter-designated thermocouple types, or other industry standards for RTDs.

2. Factory Calibration is defined by limits of repeatability in a manufacturing environment and ± 0.15°C for thermocouple
Warranty and Return Statement

These products are sold by West Control Solutions 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 West Control Solutions or from a Partlow Brand 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 West Control Solutions factory and to conform at that time to the specifications set forth in the relevant Partlow Brand instruction manual or manuals, sheet or sheets, for such products for a period of two years.

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

Limitations

West Control Solutions 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 West Control Solutions 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 West Control Solutions.

Returns

West Control Solutions sole and exclusive obligation and buyer’s sole and exclusive remedy under the above warranty is limited to repairing or replacing, free of charge, the products which are reported to West Control Solutions at its main office indicated below.

West Control Solutions is to be advised of return requests during normal business hours and such returns are to include a statement of the observed deficiency. Shipments MUST be marked with a RMA number obtained from West Control Solutions. The buyer shall pre-pay shipping charges for products returned and West Control Solutions or its representative shall pay for the return of the products to the buyer.