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.

Copyright © April 1996, The Partlow Corporation, all rights reserved. No part of this publication may be reproduced, transmitted, transcribed or stored in a retrieval system, or translated into any language in any form by any means without the written permission of the Partlow Corporation.

This is the First Edition of the MIC 1820/1420 manual. It was written and produced entirely on a desk-top-publishing system. Disk versions are available by written request to the Partlow 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 MIC 1820/1420 process 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.*
# Table of Contents

## Section 1 - General

1.1 Product Description ........................................ 5

## Section 2 - Installation & Wiring

2.1 Installation & Wiring ........................................ 7
2.2 Preparations for Wiring ..................................... 9
2.3 Input Connections ........................................... 16
2.4 Output Connections .......................................... 20

## Section 3 - Configuration & Operation

3.1 Operation ................................................... 24
3.2 Configuration ............................................... 31
3.3 Pre-Tune Mode ............................................. 39
3.4 Auto-Tune Mode ............................................ 39
3.5 RaPID Feature ............................................... 42
3.6 Manual Tuning Method ..................................... 42

## Section 4 - Control Capability

4.1 Control Capability .......................................... 44
4.2 Control Responses .......................................... 44
4.3 Direct/Reverse Operation of Control Outputs .......... 45
4.4 On-Off Control ............................................ 45
4.5 Time Proportioning Control ............................... 46
4.6 Current Proportioning Control ............................ 47
4.7 Setpoint Adjustments ..................................... 48

## Appendices

A - Glossary of Terms ........................................... 49
   Figure A-1 Alarm Actuation ................................ 55
   Figure A-2 Alarm Hysteresis ................................ 57
   Figure A-3 Asymmetrical Band Alarm ..................... 60
   Figure A-4 Proportional Band & Deadband/Overlap .... 62
B - Board Layout - Jumper positioning ..................... 63
   Figure B-1 PCB Positions (MIC 1820) ................... 63
   Figure B-2 PCB Positions (MIC 1420) ................... 64
   Figure B-3 Output 2/Output 3 Removal (MIC 1820) .... 65
   Figure B-4 Output 2/Output 3 Removal (MIC 1420) .... 66
Appendices cont.

- Figure B-5 CPU PWA 67
- Figure B-6 PSU PWA with Relay or SSR Out.1 68
- Figure B-7 PSU PWA with DC Output 1 69
- Figure B-8 Option PWA 70
- Figure B-9 CPU PWA with Remote Input Type 71

C - Hardware Definition Code 72
D - Input Range Codes/Remote Setpoint Input Codes 75
E - RaPID Control Feature/Alarm Hysteresis 77
F - Specifications 80
G - Model Number Hardware Matrix 89
H - Software Reference Sheet 90

Figures & Tables

- Figure 1-1 Controller Display Illustration 6
- Figure 2-1 Panel Cut-Out Dimensions 7
- Figure 2-2 Main Dimensions 8
- Figure 2-3 Panel Mounting the controller 9
- Figure 2-4 Noise Suppression 12
- Figure 2-5 Noise Suppression 12
- Figure 2-6A 1/4 Din Wiring Label 14
- Figure 2-6B 1/8 Din Wiring Label 15
- Figure 2-7 AC Power 16
- Figure 2-7A Nominal AC/DC Supply 17
- Figure 2-8 Thermocouple Input 17
- Figure 2-9 RTD Input 18
- Figure 2-10 Volt, mV mAADC Input 18
- Figure 2-11 Remote Digital Connections 19
- Figure 2-12 Remote Setpoint Input - V/mA/mV and Potentiometer 19
- Figure 2-13 Remote Setpoint Selection 19
- Figure 2-14 Dual Setpoint Selection 20
- Figure 2-15 Relay Output 1 20
- Figure 2-16 SSR Driver Output 1 20
- Figure 2-17 mAADC Output 1 21
- Figure 2-18 Relay Output 2 21
- Figure 2-19 SSR Driver Output 2 21
- Figure 2-20 mAADC Output 2 22
- Figure 2-21 Relay Output 3 22
- Figure 2-22 SSR Driver Output 3 22
- Figure 2-23 mAADC Output 3 23
- Figure 4-1 Proportional Bandwidth Effect on Output 47
- Table 3-1 Enable Mode Configuration Procedures 32
- Table 3-2 Program Mode Configuration Procedures 32
- Table 3-3 Tune Mode Configuration Procedures 35
Product Description 1.1

1.1.1 GENERAL
This instrument is a microprocessor based single loop controller capable of measuring, displaying and controlling temperature, pressure, flow, and level from a variety of inputs. Most outputs are easily tuned using the instrument Pre-Tune and Auto-Tune, or RaPID (Response assisted PID) functions.

Control functions, alarm settings and other parameters are easily entered through the front keypad. E\textsuperscript{2} Technology (100 year life) protects against data loss during AC power outages.

The input is user configurable to directly connect to either thermocouple, RTD, mVDC, VDC or mADC inputs. The instrument can operate from either a 90-264 VAC, 50/60 HZ power supply, or optional 24V AC/DC power supply.

1.1.2 DISPLAYS
Each instrument is provided with dual displays and status indicators as shown in Figure 1-1. The upper display (RED) displays the value of the process variable. The lower display (GREEN) displays the setpoint value. Status indication is as shown, see Figure 1-1, page 6.

1.1.3 CONTROL
The instrument can be programmed for on-off, time proportioning, or current proportioning control implementations depending on the model number. A second control output is an available option. Proportional control implementations are provided with fully programmable PID parameters.

1.1.4 ALARMS
Alarm indication is standard on all instruments. Up to two alarm outputs are possible. Alarm type may be set as Process Direct or Reverse (high or low), Deviation Direct or Reverse (above or below setpoint), Deviation Band Type (closed or open within band), or Loop Reverse or Direct. Alarm status is indicated by LED. An Alarm Inhibit is provided to prevent, when activated, unwanted alarms during power-up.
1.1.5 PROCESS VARIABLE/SETPOINT VALUE RE-TRANSMISSION OUTPUT
If the instrument is specified with this option, this output may be scaled over any desired range and re-transmitted.
**Installation and Wiring 2.1**

Electrical code requirements and safety standards should be observed and installation performed by qualified personnel.

The electronic components of the instrument may be removed from the housing during installation. To remove the components, grip the side edges of the front panel and pull the instrument forward. During re-installation, the vertically mounted circuit boards should be properly aligned in the housing.

Ensure that the instrument is correctly orientated. A stop will operate if an attempt is made to insert the instrument incorrectly.

Recommended panel opening sizes are illustrated in Figure 2-1. After the opening is properly cut, insert the instrument into the panel opening. Ensure that the panel gasket is not distorted and that the instrument is positioned squarely against the panel. Slide the mounting clamp into place on the instrument (see Figure 2-3, page 8) and push it forward until it is firmly in contact with the rear face of the mounting panel.

*Note: The mounting clamp tongues may engage either on the sides or the top/bottom of the instrument housing. Therefore, when installing several instruments side-by-side in one cut out, use the ratchets on the top/bottom faces.*

**FIGURE 2-1**

Panel Cut-Out Dimensions

<table>
<thead>
<tr>
<th>PANEL CUTOUT SIZE</th>
<th>92 mm +0.5 - 0.00 (3.62” + .020 - .000)</th>
<th>PANEL CUTOUT SIZE</th>
<th>92 mm + 0.5 - 0.0 (3.62” + 0.20 - 0.00)</th>
</tr>
</thead>
<tbody>
<tr>
<td>45 mm +0.5 - 0.0 (1.77” + .020 - .000)</td>
<td>92 mm +0.05 - 0.0 (3.62”+.020 -.000)</td>
<td>45 mm +0.5 - 0.0 (1.77” + .020 - .000)</td>
<td>92 mm +0.05 - 0.0 (3.62”+.020 -.000)</td>
</tr>
</tbody>
</table>
FIGURE 2-2
Main Dimensions

MIC 1820

MIC 1420

Max. Panel thickness 6.0mm (0.25 in)

Max. Panel Thickness 6.0mm (0.25 in)
Preparation for Wiring 2.2

2.2.1 WIRING GUIDELINES
Electrical noise is a phenomenon typical of industrial environments. The following are guidelines that must be followed to minimize the effect of noise upon any instrumentation.

2.2.1.1 INSTALLATION CONSIDERATIONS
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 device listed, the instructions below should be followed:
1. If the instrument is to be mounted in the same panel as any of the listed devices, separate them by the largest distance possible. For maximum electrical noise reduction, the noise generating devices should be mounted in a separate enclosure.

2. If possible, eliminate mechanical contact relay(s) and replace with solid state relays. If a mechanical relay being powered by an instrument output device cannot be replaced, a solid state relay can be used to isolate the instrument.

3. A separate isolation transformer to feed only instrumentation should be considered. The transformer can isolate the instrument from noise found on the AC power input.

4. If the instrument is being installed on existing equipment, the wiring in the area should be checked to insure that good wiring practices have been followed.

2.2.1.2 AC POWER WIRING
Neutral (For 115 VAC)
It is good practice to assure that the AC neutral is at or near ground potential. To verify this, a voltmeter check between neutral and ground should be done. On the AC range, the reading should not be more than 50 millivolts. If it is greater than this amount, the secondary of this AC transformer supplying the instrument should be checked by an electrician. A proper neutral will help ensure maximum performance from the instrument.

2.2.1.3 WIRE ISOLATION
Four voltage levels of input and output wiring may be used with the unit:
• Analog input or output (i.e. thermocouple, RTD, VDC, mVDC, or mA DC)
• SPDT Relays
• SSR driver outputs
• AC power

The only wires that should run together are those of the same category. If they need to be run parallel with any of the other lines, maintain a minimum 6 inch space between the wires. If wires must cross each other, do so at 90 degrees. This will minimize the contact with each other and reduces “cross talk”. “Cross Talk” is due to the EMF (Electro Magnetic Flux) emitted by a wire as current passes through it. This EMF can be picked up by other wires running in the same bundle or conduit.
In applications where a High Voltage Transformer is used (i.e. ignition systems) the secondary of the transformer should be isolated from all other cables.

This instrument has been designed to operate in noisy environments, however, in some cases even with proper wiring it may be necessary to suppress the noise at its source.

**2.2.1.4 USE OF SHIELDED CABLE**
Shielded cable helps eliminate electrical noise being induced on the wires. All analog signals should be run with shielded cable. Connection lead length should be kept as short as possible, keeping the wires protected by the shielding. The shield should be grounded at one end only. The preferred grounding location is the sensor, transmitter or transducer.

**2.2.1.5 NOISE SUPPRESSION AT THE SOURCE**
Usually when good wiring practices are followed no further noise protection is necessary. Sometimes in severe electrical environments, the amount of noise is so great that it has to be suppressed at the source. Many manufacturers of relays, contactors, 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 MOV (metal oxide varistors) may be added.

Inductive Coils - MOV’s are recommended for transient suppression in inductive coils connected in parallel and as close as possible to the coil. See Figure 2-4. Additional protection may be provided by adding an RC network across the MOV.
Contacts - Arcing may occur across contacts when the contact opens and closes. This results in electrical noise as well as damage to the contacts. Connecting a RC network properly sized can eliminate this arc.

For circuits up to 3 amps, a combination of a 47 ohm resistor and 0.1 microfarad capacitor (1000 volts) is recommended. For circuits from 3 to 5 amps, connect 2 of these in parallel. See Figure 2-5, below.
2.2.2 SENSOR PLACEMENT (Thermocouple or RTD)
Two wire RTD’s should be used only with 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
FIGURE 2-6
Wiring Label

1/4 DIN
Input Connections 2.3
In general, all wiring connections are made to the instrument after it is installed. Avoid Electrical Shock. AC power wiring must not be connected to the source distribution panel until all wiring connection procedures are completed.

Caution: This equipment is designed for installation in an enclosure which provide adequate protection against electric shock. Local regulations regarding electrical installation should be rigidly observed. Consideration should be given to prevention of access to the power terminations by unauthorized authorized personnel. Power should be connected via a two pole isolating switch (preferably situated neat the equipment) and a 1 A fuse, as shown in Figure 2-7.

FIGURE 2-7
Main Supply
The instrument will operate on 90-264V AC 50/60 Hz mains (line) supply. The power consumption is approximately 4 VA. If the instrument has relay outputs in which the contacts are to carry mains (line) voltage, it is recommended that the relay contact mains (line) supply should be switched and fused in a similar manner but should be separate from the instrument mains (line) supply.
FIGURE 2-7A
24V Nominal AC/DC Supply
The supply connection for the 24V AC/DC option of the instrument are as shown below. Power should be connected via a two pole isolating switch and a 315 mA slow-blow (anti-surge type T) fuse. With the 24V AC/DC supply option fitted, these terminals will accept the following supply voltage ranges:

- 24V (nominal) AC 50/60Hz - 20-50V
- 24V (nominal) DC - 22-65V

FIGURE 2-8
Thermocouple (T/C) Input
Make thermocouple connections as illustrated below. Connect the positive leg of the thermocouple to terminal 2 and the negative leg to terminal 3.
FIGURE 2-9
RTD Input
Make RTD connections as illustrated below. For a three wire RTD, connect the resistive leg of RTD to terminal 1 and the common legs to terminals 2 and 3. For a two wire RTD, connect one leg to terminal 2 and the other leg to terminal 3 as shown below. A jumper wire supplied by the customer must be installed between terminals 2 and 3. Input conditioning jumper must be positioned correctly (see Appendix B) and Hardware Definition Code must be correct (See Appendix C).

FIGURE 2-10
Volt, mV Input
Make volt and millivolt connections as shown below. Terminal 2 is positive and terminal 3 is negative. Input conditioning jumper must be positioned correctly (see Appendix B) and Hardware Definition Code must be correct (see Appendix C).

mADC Input
Make mADC connections as shown below. Terminal 4 is positive and terminal 1 is negative. Input conditioning jumper must be positioned correctly (see Appendix B) and Hardware Definition Code must be correct (see Appendix C).
FIGURE 2-11
Remote Digital Communications - RS485
Make digital communication connections as illustrated below.

FIGURE 2-12
Remote Setpoint Input - V/mA/mV and Potentiometer
Connections are illustrated below. Terminal 6 is positive and terminal 7 is negative. The remote setpoint input can be configured for linear DC mv, linear DC mA, linear DC Volt or potentiometer. Make sure that the input selected matches the Second Input Usage selected in the Hardware Definition Mode and the Secondary Analog Input conditioning jumper is positioned correctly (see Appendix B.)

FIGURE 2-13
Remote Setpoint Selection
Connections are made as shown.
**FIGURE 2-14**
Dual Setpoint Selection

![Diagram of Dual Setpoint Selection](image)

**Output Connections 2.4**

**FIGURE 2-15**
Relay Output 1 (Control Output 1)
Connections are made to Output 1 relay as illustrated below. The contacts are rated at 2 amp resistive, 120/240 VAC.

![Diagram of Relay Output 1](image)

**FIGURE 2-16**
SSR Driver Output 1 (Control Output 1)
Connections are made to Output 1 SSR Driver as illustrated below. The solid state relay driver is a non-isolated 0-4 VDC nominal signal. Output impedance is 250 ohms.

![Diagram of SSR Driver Output 1](image)
FIGURE 2-17
mADC Output 1 (Control Output 1)
Make connections for DC Output 1 as illustrated below.

FIGURE 2-18
Relay Output 2 (Control Output 2 OR Alarm 2)
Connections are made to Output 2 relay as illustrated below. The contacts are rated at 2 amp resistive, 120/240 VAC.

FIGURE 2-19
SSR Driver Output 2 (Control Output 2 OR Alarm 2)
Connections are made to Output 2 SSR Driver as illustrated below. The solid state relay driver is a non-isolated 0-4 VDC nominal signal. Output impedance is 250 ohms.
FIGURE 2-20
mADC Output 2 (Control Output 2)
Make connections for DC Output 2 as illustrated below.

FIGURE 2-21
Relay Output 3 (Alarm 1)
Connections are made to Output 3 relay as illustrated below. The contacts are rated at 2 amp resistive, 120/240 VAC.

FIGURE 2-22
SSR Driver Output 3 (Alarm 1)
Connections are made to Output 3 SSR Driver as illustrated below. The solid state relay driver is a non-isolated 0-4 VDC nominal signal. Output impedance is 250 ohms.
FIGURE 2-23
mADC Output 3 (Recorder Output Only)
Make connections for DC output 3 as illustrated below.
Operation 3.1

3.1.1 POWER UP PROCEDURE
Verify all electrical connections have been properly made before applying power to the instrument.

If the instrument is being powered for the first time, it may be desirable to disconnect the controller output connections. The instrument will be into control following the power up sequence and the output(s) may turn ON. During power up, a self-test procedure is initiated during which all LED segments in the two front panel displays appear and all LED indicators are ON. When the self-test procedure is complete, the instrument reverts to normal operation.

Note: A delay of about 3 seconds, when power is first applied, will be seen before the displays light up.

3.1.2 KEYPAD OPERATION

AUTO/MANUAL KEY
This key is used to:
1. Enter the Auto/Manual mode and vice versa.
2. Used to activate the Auto Tune mode.
3. Used to confirm a change in the Program mode.

SCROLL KEY
This key is used to:
1. Select adjustment of the ramping setpoint, if enabled.
2. Select a parameter to be viewed or adjusted.
3. Display enabled modes of operation.
4. Display a mode parameter value.
5. Advance display from a parameter value to the next parameter code.
6. Activate the Pre-tune mode.
7. With the DOWN key to view the current Hardware Definition Code setting.
UP KEY
This key is used to:
1. Increase the displayed parameter value.
2. Increase setpoint.
3. With the DOWN key to enter Pre and Auto Tune mode, and to engage the RaPID function.

DOWN KEY
This key is used to:
1. Decrease the displayed parameter value.
2. Decrease setpoint.
3. With the UP key to enter the Pre and Auto Tune mode, and to engage the RaPID function.
4. With the SCROLL key to view the current Hardware Definition Code setting.

3.1.3 INITIAL DISPLAYS
After the instrument has performed its power up self test (during which, if the SCROLL key is held down during power up, the current instrument firmware revision is displayed), the initial Operator Mode displays appear. These are dependent upon whether the instrument is configured for single setpoint operation, dual setpoint operation or remote/local setpoint operation.

3.1.3.1 SINGLE SETPOINT OPERATION
Normally the initial displays are:
   Upper Display = Process Variable value
   Lower Display = Setpoint value adjustable
The setpoint may be adjusted by using the UP/DOWN keys.

Press the SCROLL key again, if setpoint ramping is not disabled and if the ramp rate is not switched OFF, to change the displays to:
   Upper Display - Ramping Setpoint value ("Read Only")
   Lower Display = the legend SPrP
3.1.3.2 DUAL SETPOINT OPERATION
If dual setpoint operation has been selected, the normal Operator Mode displays will be as follows:
  - Upper Display = Process Variable value
  - Lower Display = Active Setpoint value (adjustable)
Press the SCROLL key to change displays to:
  - Upper Display = Setpoint 1 value (adjustable)
  - Lower Display = the legend SP1
Press the SCROLL key again to obtain the equivalent display for Setpoint 2 (with legend SP2).
NOTE: The lower display uses the left-most character to distinguish between the active and inactive setpoints in the following manner:

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>_ SP2</td>
<td>= SP2</td>
<td>SP2</td>
</tr>
<tr>
<td>Active Setpoint</td>
<td>Active Setpoint</td>
<td>Inactive Setpoint</td>
</tr>
<tr>
<td>(selected via digital input)</td>
<td>(selected via keypad override)</td>
<td></td>
</tr>
</tbody>
</table>

Press the SCROLL key again, if setpoint ramping is not disabled and if the ramp rate is not switched OFF, to change the displays to:

3.1.3.3 REMOTE SETPOINT OPERATION
If remote setpoint operation has been selected the normal Operator Mode displays will be as follows:
  - Upper Display = Process Variable value
  - Lower Display = Active setpoint value (Adjustable)
Press the SCROLL key to change the displays to:
  - Upper Display = Ramping Setpoint value
  - Lower Display = the legend SP\text{rP} 
Press the SCROLL key again to obtain the equivalent display for Remote Setpoint (with the legend rSP).

NOTE: The lower display uses the left-most character to distinguish between the active and inactive setpoints in the following manner:

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>_ SP</td>
<td>= SP</td>
<td>rSP</td>
</tr>
</tbody>
</table>
3.1.3.4 OVERRIDE FEATURE
While the instrument is being used with either Dual Setpoint operation or Remote Setpoint operation, the Override feature is available. This enables the active setpoint selected by the digital input to be manually overridden from the keypad. To engage the Override feature, with the instrument displaying the desired setpoint (legend in lower display), press the UP and DOWN keys simultaneously. This will cause the left-most character of the lower display to show a flashing "". This indicates that the display setpoint is now the active setpoint, regardless of the state of the digital input. To cancel an override condition, simply press the UP and DOWN keys again with this display shown.

3.1.3.5 VIEWING/ADJUSTING THE SETPOINT RAMP RATE
If setpoint ramping is enabled, the ramp rate display may be selected using the SCROLL key. The ramp rate may be adjusted (using the UP/DOWN keys) within the range 1 to 999. Any attempt to increase the value beyond 999 will cause the upper display to go blank and setpoint ramping to be switched OFF (default).

3.1.3.6 ALARM STATUS DISPLAY*
The user may view the status of the instrument's alarm(s) by depressing the SCROLL key until the lower display shows the legend "ALSt" and the upper display shows the alarm status in the following format:

*This display is available only if one or more of the alarms is/are energized.

When "ALSt" is seen in the lower display, to enter the Program or Tune modes, press the UP key with "ALSt" displayed, then the SCROLL key to Program or Tune.
3.1.3.7 OVER-RANGE/UNDER-RANGE DISPLAY
If the process variable attains a value higher than the input scale maximum limit, the upper display will show:

![CHH]

If the process variable attains a value lower than the input scale minimum, the upper display will show:

![CLL]

If a break is detected in the sensor circuit, the upper display will show:

![SnSr]

3.1.4 FRONT PANEL INDICATORS

**OP1** Indicates the state of the Output 1 relay or SSR driver. When the indicator is ON the relay is energized or the SSR driver is ON.

**OP2** Indicates the state of the Output 2 relay or SSR driver. When the indicator is ON the relay is energized or the SSR driver is ON.

**ALM** When flashing, indicates an Alarm condition.

**MAN** Flashes when the Manual mode has been entered.

**AT** Indicates when the Pre-Tune, Auto-Tune or RaPID mode has been selected; flashing RED for Pre-Tune, continuously ON RED for Auto-Tune or flashing GREEN for RaPID activated.
3.1.5 SETPOINT ADJUSTMENT

3.1.5.1 LOCAL SETPOINT
To adjust the instrument setpoint, proceed as follows:

To adjust the Setpoint, press the UP or DOWN key as applicable. Momentary depression will increment or decrement (as appropriate) the setpoint by one unit in the least significant digit. If the key is held for longer than 1 second, the least significant digit will change at the rate of 25 units per second. If the key is held for longer than 10 seconds, the second least significant digit will change at the rate of 25 units per second. If the key is held for more than 10 seconds, the third least significant digit will change at the rate of 25 units per second.

3.1.5.2 RAMPING SETPOINT
A selectable Ramp Rate function in the range of 1 to 9999 units per hour can be used to limit the rate at which the setpoint used by the control algorithm will change. This feature will also establish a soft start up. Upon power up, the instrument will take the initial process value as the setpoint. A setpoint ramp rate will be calculated to increase the setpoint from the initial process value to the setpoint selected. The setpoint ramp feature disables the Pre-Tune facility. The Auto-Tune facility, if selected, will commence only after the setpoint has completed the ramp.

Sudden changes in the setpoint value entered via the keypad can be inhibited from effecting the control outputs by use of this feature. The internal setpoint used to control the process will ramp to the setpoint value entered at the rate of change selected.

To view the Ramping Setpoint value while in the Control mode and "ESPr" in the Tune mode is disabled, press the SCROLL key until "SPrP" is displayed in the lower display. This is the code for the ramping setpoint value. Press the SCROLL key one more time and the lower display shows "SPrP" and the upper display will show the current ramping setpoint.
SPRr not OFF and ESPr equal to 0

If ESPr is enabled, the display sequence changes to:

*Adjustable

To enter the Program or Tune mode when setpoint ramping is selected, press the SCROLL key until the lower display shows "SPrP" or "SPrr" and the upper display is blank. With "SPrP" or "SPrr" display in the lower display, press the UP key once and "CtrL" should be displayed in the lower display. With "CtrL" displayed, press the SCROLL key until "Prog" or "tunE" is displayed in the lower display.

3.1.6 MANUAL CONTROL

Manual Control is not applicable if the Auto/Manual selection in Tune mode is disabled.

To enter the Manual mode, press the AUTO/MANUAL key. The Manual mode status LED will begin to flash indicating that the Manual mode is in use. Shifting from the Control to the Manual mode is bumpless. The proportional output(s) will stay at the last value(s) calculated by the control.
algorithm. The upper display will show the current process value. The lower display will show the current value output power in the form PXXX where X is equal to the percentage of output power. The value of output power may be adjusted using the UP and DOWN keys, as required.

The output power value can be varied in the range 0% of 100% for instruments using Output 1 only, and -100% to +100% for instruments with both Output 1 and Output 2.

To exit from the Manual mode, press the Auto/Manual key. Shifting to the Control mode is bumpless.

---

**Configuration 3.2**

All configurable parameters are provided in Tables 3-1 through 3-3 on the following pages. These tables illustrate the display sequence, parameter adjustment and factory setting for each step.

Depression of the SCROLL key will cycle the display if Setpoint Ramp Rate is not enabled (top display is blank, lower display shows the parameter code) through all enabled modes as follows:

CONTROL ---- PROGRAM ---- TUNE
(Ctrl) (Prog) (tunE)

If a mode is not enabled it will be skipped over by the routine.

**3.2.1 ENABLE MODE**
The Enable mode provides a means of enabling or disabling access to the Program and Tune modes. If a mode has been disabled, then that mode will not be displayed or available to the user in the Control mode. See Table 3-1 (page 29-30) for the Enable Mode procedure.

**3.2.2 PROGRAM MODE**
The Program mode is used to configure or re-configure the instrument. The input and output selections are made in the Program mode. All possible parameters are illustrated in Table 3-2 (page 31). Only those parameters that are applicable to the hardware options chosen will be displayed.
3.2.3 TUNE MODE
The Tune mode is used to adjust the tuning parameters, alarm settings, setpoint limits, and retransmit scaling needed for proper operation of the instrument. See Table 3-3 (page 33) for Tune mode. Only those parameters that are applicable will be displayed.

TABLE 3-1 ENABLE MODE
To enter the Enable mode, press and hold the UP and DOWN keys. After 5 seconds (the AT LED should have flashed once), the display returns to normal. After 5 more seconds, "EnAb" will be displayed. Release the keys, the display should show "EPro". Pressing the DOWN key will display the Enable mode codes in the following sequence:

EPro - - Etun - - ESPC

Pressing the SCROLL key will display the Enable mode codes with the upper display blank. The next depression of the SCROLL key will add the Enable code status (ON or OFF) to the upper display. With the Enable code status displayed, use the UP key to change the status to ON and the DOWN key to change the status to OFF.

To exit the Enable mode, press the UP key with the Enable code displayed in the lower display and the upper display blank.

<table>
<thead>
<tr>
<th>STEP</th>
<th>DESCRIPTION</th>
<th>DISPLAY CODE</th>
<th>AVAILABLE SETTINGS</th>
<th>FACTORY SETTING</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Program Mode</td>
<td>EPro</td>
<td>ON/OFF</td>
<td>ON</td>
</tr>
<tr>
<td>2</td>
<td>Tune Mode</td>
<td>Etun</td>
<td>ON/OFF</td>
<td>ON</td>
</tr>
<tr>
<td>3</td>
<td>Setpoint</td>
<td>ESPC</td>
<td>ON/OFF</td>
<td>ON</td>
</tr>
</tbody>
</table>

TABLE 3-2 PROGRAM MODE
To enter the Program mode, press and release the SCROLL key until "Prog" is displayed. Use the DOWN key to enter the Program mode. Depress and release the SCROLL key to sequence through the parameters and their values, alternately showing the parameter code in the lower display with the upper display blank, then the parameter code with the parameter value displayed. Use the UP and DOWN keys to adjust the parameter values. After adjusting a parameter, the upper display will flash, indicating that the new setting has yet to be confirmed. When the setting is as re-
quired, it may be confirmed by pressing the AUTO/MANUAL key and the upper display stops flashing. After confirming a change, press the SCROLL key to proceed to the next parameter. Use the DOWN key to advance to the next parameter when a parameter code is showing in the lower display and the upper display is blank.

To exit the Program mode, press the UP key whenever a parameter code is displayed in the lower display and the upper display is blank.

DEFAULT PARAMETER INDICATION
If a parameter value, such as Input Select, was changed while in the Program mode, when returning to the Control mode, a decimal point after each digit will be lit. This display indicates all Tune mode parameters have been set to their default condition. To clear this condition, enter the Tune mode and make a parameter value change and review each parameter for its proper setting.

<table>
<thead>
<tr>
<th>STEP</th>
<th>DESCRIPTION</th>
<th>DISPLAY CODE</th>
<th>AVAILABLE SETTINGS</th>
<th>FACTORY SETTING</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Input Select</td>
<td>inPS</td>
<td>See App. D*</td>
<td>1420</td>
</tr>
<tr>
<td>2 **</td>
<td>Remote Setpoint</td>
<td>rinP</td>
<td>See App. D</td>
<td>**</td>
</tr>
<tr>
<td>3</td>
<td>Output 1 Action</td>
<td>Out1</td>
<td>Reverse Direct</td>
<td>REV</td>
</tr>
<tr>
<td>4</td>
<td>Alarm 1 Type</td>
<td>ALA1</td>
<td>P_hi=Proc High</td>
<td>P_hi</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>nonE=No Alarm</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>bAnd=Band</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>dE=Deviation</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>P_Lo=Proc Low</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Alarm 2 Type</td>
<td>ALA2</td>
<td>Same selection</td>
<td>nonE</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>as ALA1</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Alarm Inhibit</td>
<td>Inhi</td>
<td>nonE=No Inhibit</td>
<td>P_hi</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>ALA1=Alarm1 Inhibited</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>ALA2=Alarm2 Inhibited</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>both=Both Inhibited</td>
<td></td>
</tr>
<tr>
<td>STEP</td>
<td>DESCRIPTION</td>
<td>DISPLAY CODE</td>
<td>AVAILABLE SETTINGS</td>
<td>FACTORY SETTING</td>
</tr>
<tr>
<td>------</td>
<td>-------------------</td>
<td>--------------</td>
<td>--------------------</td>
<td>----------------</td>
</tr>
<tr>
<td>7</td>
<td>Output 2 Usage</td>
<td>USE2</td>
<td>Out2=Control (opposite of Out1 action)</td>
<td>Out2=Control</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>LP_r=Loop Reverse</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>LP_d=Loop Direct</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Ad_r=Rev Logic AND</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Ad_d=Dir Logic AND</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Or_r=Rev Logic OR</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Or_d=Dir Logic OR</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>A2_r=Alm 2 Rev</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>A2_d=Alm 2 Dir</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Hy_d=Alm Hyst Dir Act***</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Hy_r=Alm Hyst Rev Act**</td>
<td></td>
</tr>
<tr>
<td>(Continued on the next page)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Output 3 Usage</td>
<td>USE3</td>
<td>Al_d=Alm 1 Dir</td>
<td>A1_d</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>rEcP=Rcdr Out P.V.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>rEcS=Rcdt Out S.P.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>LP_r=Loop Reverse</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>LP_d=Loop Direct</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Ad_r=Rev Logic AND</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Ad_d=Dir Logic AND</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Or_r=Rev Logic OR</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Or_d=Dir Logic OR</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Al_r=Alm 2 Rev</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Hy_d=Alm Hyst Dir Act***</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Hy_r=Alm Hyst Rev Act***</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Com Bit Rate</td>
<td>CbS</td>
<td>1200, 2400, 4800, 9600</td>
<td>4800</td>
</tr>
<tr>
<td>10</td>
<td>Com Address</td>
<td>CAd</td>
<td>1-32</td>
<td>1</td>
</tr>
<tr>
<td>11</td>
<td>CJC Enable</td>
<td>CJC</td>
<td>EnAb disA</td>
<td>EnAb</td>
</tr>
</tbody>
</table>

* The Hardware Definition Code and input jumper configuration may need to be changes. See Appendix B and C.
** If Remote Setpoint Input has been selected in the Hardware Definition.
Code, this parameter will appear in the normal Program Mode parameter sequence. The upper display shows a product code which defines the input range. The factory setting depends on code selected, see Appendix D.

*** An Alarm Hysteresis output is made active only when both alarms become active; it subsequently becomes inactive only when both alarms are inactive. Thus, the status of an Alarm Hysteresis output only when one alarm is active depends upon the alarm status immediately prior to that alarm being activated. See Appendix E.

**TABLE 3-3 TUNE MODE**

To enter the Tune mode, press and release the SCROLL key until tune is displayed. Use the DOWN key to enter the Tune mode. Depress and release the SCROLL key to sequence through the parameters and their values, alternately showing the parameter code in the lower display with the upper display blank, then the parameter code with the parameter value displayed. Use the UP and DOWN keys to adjust the parameter values. After adjusting a parameter, depress the SCROLL key to proceed to the next parameter. Use the DOWN key to advance to the next parameter when a parameter code is showing in the lower display and the upper display is blank.

To exit the Tune mode, press the UP key whenever a parameter code is displayed in the lower display and the upper display is blank.

<table>
<thead>
<tr>
<th></th>
<th>Parameter</th>
<th>Value Range</th>
<th>Setting</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Ramping Setpoint Value</td>
<td>SPPrP ± Setpoint Limits Read Only</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Setpoint Ramp Rate</td>
<td>SPrr 1 to 9999 units/hour OFF</td>
<td>OFF</td>
</tr>
<tr>
<td>3*</td>
<td>Input Filter</td>
<td>Filt 0.0 to 100.0 seconds in .5 sec. increments</td>
<td>2.0</td>
</tr>
<tr>
<td>4</td>
<td>Input Correct</td>
<td>iCor ± Span</td>
<td>0</td>
</tr>
<tr>
<td>5</td>
<td>Output 1%</td>
<td>Po1 0 to 100% Read Only</td>
<td></td>
</tr>
</tbody>
</table>

(Continued on next page)
<table>
<thead>
<tr>
<th>STEP</th>
<th>DESCRIPTION</th>
<th>DISPLAY CODE</th>
<th>AVAILABLE SETTINGS</th>
<th>FACTORY SETTING</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>Output 2%</td>
<td>Po2</td>
<td>0 to 100%</td>
<td>Read Only</td>
</tr>
<tr>
<td>7</td>
<td>1st Output</td>
<td>Pb1</td>
<td>0 to 999.9%</td>
<td>5.0</td>
</tr>
<tr>
<td></td>
<td>Prop. Band</td>
<td></td>
<td>of Input Span 0%</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>=On/OFF</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>2nd Output</td>
<td>Pb2</td>
<td>0 to 999.9%</td>
<td>5.0</td>
</tr>
<tr>
<td></td>
<td>Prop. Band</td>
<td></td>
<td>of Input Span 0%</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>=ON/OFF</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Automatic</td>
<td>ArSt</td>
<td>OFF to 99 mins.</td>
<td>OFF</td>
</tr>
<tr>
<td></td>
<td>Reset</td>
<td></td>
<td>59 secs/Repeat</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Rate</td>
<td>rAtE</td>
<td>0 sec to 99 mins.</td>
<td>0 secs.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>59 secs.</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>Overlap/</td>
<td>SPrd</td>
<td>-20 to 20%</td>
<td>0%</td>
</tr>
<tr>
<td></td>
<td>Deadband</td>
<td></td>
<td>of Pb1 and Pb2</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>Manual Reset</td>
<td>rSEt</td>
<td>0 to 100% Output 1</td>
<td>25%</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>-100 to 100% Out 2</td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>Hysteresis</td>
<td>HyS1</td>
<td>0.1 to 10.0%</td>
<td>0.5</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>of span</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>HyS2</td>
<td>0.1 to 10.0%</td>
<td>0.5</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>of span</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>HySt</td>
<td>0.1 to 10.0%</td>
<td>0.5</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>of span</td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>Setpoint</td>
<td>SPuL</td>
<td>Span Max.</td>
<td>Span Max.</td>
</tr>
<tr>
<td></td>
<td>Upper Limit</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>Setpoint</td>
<td>SPLL</td>
<td>Span Min.</td>
<td>Span Min.</td>
</tr>
<tr>
<td></td>
<td>Lower Limit</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>Remote</td>
<td>rSPu</td>
<td>-1999 to 9999</td>
<td>PV Range</td>
</tr>
<tr>
<td></td>
<td>Setpoint</td>
<td></td>
<td>Maximum</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Maximum</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>17</td>
<td>Remote</td>
<td>rSPL</td>
<td>-1999 to 9999</td>
<td>PV Range</td>
</tr>
<tr>
<td></td>
<td>Setpoint</td>
<td></td>
<td>Minimum</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Minimum</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>STEP</td>
<td>DESCRIPTION</td>
<td>DISPLAY</td>
<td>AVAILABLE SETTINGS</td>
<td>FACTORY SETTING</td>
</tr>
<tr>
<td>------</td>
<td>----------------------------------</td>
<td>---------</td>
<td>--------------------</td>
<td>-----------------</td>
</tr>
<tr>
<td>18</td>
<td>Remote Setpoint Offset</td>
<td>rSPo</td>
<td>-1999 to 9999</td>
<td>0</td>
</tr>
<tr>
<td>19</td>
<td>Process Output Upper</td>
<td>Pou</td>
<td>-1999 to 9999</td>
<td>Span Max.</td>
</tr>
<tr>
<td>20</td>
<td>Process Output Lower</td>
<td>PoL</td>
<td>-1999 to 9999</td>
<td>Span. Min.</td>
</tr>
<tr>
<td>21</td>
<td>Output 1 % Limit</td>
<td>o1PL</td>
<td>0 to 100%</td>
<td>100</td>
</tr>
<tr>
<td>22</td>
<td>Output 1 Cycle Time</td>
<td>Ct1</td>
<td>.5, 1, 2, 4, 8, 16, 32, 64, 128, 256, 512 secs</td>
<td>32</td>
</tr>
<tr>
<td>23</td>
<td>Output 2 Cycle Time</td>
<td>Ct2</td>
<td>.5, 1, 2, 4, 8, 16, 32, 64, 128, 256, 512 secs</td>
<td>32</td>
</tr>
<tr>
<td>24</td>
<td>Process High Alarm 1</td>
<td>PHA1</td>
<td>± Span</td>
<td>Span Max.</td>
</tr>
<tr>
<td>25</td>
<td>Process Low Alarm 1</td>
<td>PLA1</td>
<td>± Span</td>
<td>Span Min.</td>
</tr>
<tr>
<td>26</td>
<td>Band Alarm 1</td>
<td>bAL1</td>
<td>0 to Span</td>
<td>5</td>
</tr>
<tr>
<td>27</td>
<td>Deviation Alarm 1</td>
<td>dAL1</td>
<td>± Span</td>
<td>5</td>
</tr>
<tr>
<td>28</td>
<td>Alarm Hysteresis</td>
<td>AHy1</td>
<td>1 LSD to 10% of span</td>
<td>1 LSD</td>
</tr>
<tr>
<td>29</td>
<td>Process High Alarm 2</td>
<td>PHA2</td>
<td>± Span</td>
<td>Span Max.</td>
</tr>
<tr>
<td>STEP</td>
<td>DESCRIPTION</td>
<td>DISPLAY CODE</td>
<td>AVAILABLE SETTINGS</td>
<td>FACTORY SETTING</td>
</tr>
<tr>
<td>------</td>
<td>------------------------------</td>
<td>--------------</td>
<td>--------------------</td>
<td>-----------------</td>
</tr>
<tr>
<td>30</td>
<td>Process Low Alarm 2</td>
<td>PLA2</td>
<td>± Span</td>
<td>Span Min.</td>
</tr>
<tr>
<td>31</td>
<td>Band Alarm 2</td>
<td>bAL2</td>
<td>0 to Span</td>
<td>5</td>
</tr>
<tr>
<td>32</td>
<td>Deviation Alarm 2</td>
<td>dAL2</td>
<td>± Span</td>
<td>5</td>
</tr>
<tr>
<td>33</td>
<td>Alarm 2 Hysteresis</td>
<td>AHy2</td>
<td>1 LSD to 10% of span</td>
<td>1 LSD</td>
</tr>
<tr>
<td>34</td>
<td>Loop Alarm Enable</td>
<td>LAEn</td>
<td>0=Disable 1=Enable</td>
<td>0</td>
</tr>
<tr>
<td>35</td>
<td>Loop Alarm Time</td>
<td>LAti</td>
<td>1 sec to 99 mins. 99 mins. 59 secs.</td>
<td>59 secs.</td>
</tr>
<tr>
<td>36</td>
<td>Decimal Position</td>
<td>dPoS</td>
<td>0, 1, 2, 3 (Linear Input Only)</td>
<td>1</td>
</tr>
<tr>
<td>37</td>
<td>Engineering Units Upper</td>
<td>Euu</td>
<td>-1999 to 9999</td>
<td>1000</td>
</tr>
<tr>
<td>38</td>
<td>Engineering Units Lower</td>
<td>EuL</td>
<td>-1999 to 9999</td>
<td>0</td>
</tr>
<tr>
<td>39</td>
<td>*Enable Pre Tune</td>
<td>EPtn</td>
<td>0=Disable 1=Enable</td>
<td>0</td>
</tr>
<tr>
<td>40</td>
<td>Enable Manual Control</td>
<td>ESby</td>
<td>0=Disable 1=Enable</td>
<td>0</td>
</tr>
<tr>
<td>41</td>
<td>**Setpoint Ramp Rate Enable</td>
<td>ESPr</td>
<td>0=Disable 1=Enable</td>
<td>0</td>
</tr>
<tr>
<td>42</td>
<td>Comm. Enable</td>
<td>CCon</td>
<td>0=Disable 1=Enable</td>
<td>1</td>
</tr>
</tbody>
</table>
* Activates Pre-Tune on power-up when enabled.
** When enabled, allows user to change ramp rate without having to enter Tune mode.

NOTE: Pre-tune and Auto-TUne Modes will not function if OUTPUT 2 has been configured ON/OFF.

**Pre-Tune Mode 3.3**
The Pre-Tune mode may be used to set the instrument's PID parameters to values which are approximately correct, in order to provide a base from which the Auto Tune mode may optimize tuning.

To engage the Pre-Tune mode, with the instrument in Control mode, press and hold the UP and DOWN keys for approximately 5 seconds (the display will flash during this period) until the AT LED flashes once. Release the UP and DOWN keys. Press and hold the SCROLL key for approximately 3 seconds until the AT LED flashes.

To disengage the Pre-Tune mode, press and hold the UP and DOWN keys until the AT LED flashes once. Release the UP and DOWN keys. Press and hold the SCROLL key for approximately 3 seconds until the AT LED is continuously OFF.

**Note:** Since the Pre-Tune mode is a single-shot operation, it will automatically disengage itself once the operation is complete. If the Enable Pre-Tune parameter in the Tune mode is enabled, then upon power interruption, the unit will first engage the Pre-Tune mode prior to engaging the Auto-Tune mode when power is restored.

Also note: The Pre-Tune mode will not engage during setpoint ramping. Additionally, if the process variable is within 5% of input span from the setpoint, or if an incorrect key sequence is used, the Pre-Tune mode will not be engaged.

**Auto-Tune Mode 3.4**
The Auto-Tune mode is used to optimize tuning while the instrument is operating.
To engage the Auto-Tune mode, with the instrument in Control mode, press and hold the UP and DOWN keys for approximately 5 seconds (the display will flash during this period) until the AT LED flashes once. Release the UP and DOWN keys. Press and hold the AUTO/MAN key for approximately 3 seconds until the AT LED lights continuously.

**Note:** If the Enable Pre-Tune parameter in the Tune mode is enabled, then on power-up, the unit will automatically engage the Pre-Tune mode prior to engaging the Auto-Tune mode when power is restored.

To disengage the Auto-Tune mode, press and hold the UP and DOWN keys until the AT LED flashes once. Release the UP and DOWN keys. Press and hold the AUTO/MAN key for approximately 3 seconds until the AT LED is continuously OFF.

**How Auto-Tune Works**
This instrument uses a pattern recognition algorithm, which monitors the process error (deviation signal). Figure 3-1 shows a typical temperature application involving process start up, a setpoint change and a load disturbance. The deviance signal is shown shaded and overshoots have been exaggerated for clarity.

The auto-tuning algorithm observes one complete deviation oscillation before calculating a set of PID values. Successive deviation oscillations cause values to be recalculated so that the controller rapidly coverages on optimal control.

When auto-tuning controllers are switched off, the final PID terms remain stored in the controller's nonvolatile memory, and are used as starting values at the next switch on.

The stored values are not always valid, if for instance, the controller is brand new or the application has changed. In these cases the user can utilize an extra facility on the auto-tuning controllers called "Pre-Tune". Figure 3-2 shows how the "Pre-Tune" facility artificially disturbs the start up pattern so that a first approximation of the PID values can be made prior to the setpoint being reached.
New instruments supplied by the factory contain PID terms set at "DE-FAULT" values which have been found to give adequate and safe control over a wide range of applications. In the "Pre-Tune" mode of operation, the "default" PID terms are loaded and the controller demands 100% power until the process value has moved approximately halfway to the setpoint. At that point, power is removed thereby introducing a deviation oscillation. Once the oscillation peak has passed, the Pre-Tune algorithm can calculate its first approximation to the optimum PID values. The power is reapplied using new values. This technique limits possibility of setpoint overshoot when the instrument is new or the application has been changed.

**FIGURE 3-1**

![Diagram of temperature over time showing setpoint change and load disturbance](image)

**FIGURE 3-2**

![Diagram of temperature over time showing 100% power period](image)
RaPID Feature 3.5

The RaPID (Response assisted PID) range of controllers have been designed with a unique "fuzzy" logic algorithm which dramatically reduces overshoot and improves settling times on start-up, setpoint changes and disturbances by 70%, without complicating set-up and usage.

The fuzzy logic based algorithm enhances the traditional PID function, continuously reblanding the P, I and D control building blocks on line. Instead of learning from an event and reacting after it has happened (which is how all self-tuning PID controllers work, ) the RaPID controllers can react as an event occurs, thereby improving the quality of control and speed of response in any application.

To engage the RaPID feature, press the UP and DOWN keys simultaneously twice in quick succession. The same key action is used to disengage the RaPID feature.

To engage the RaPID feature and the Pre-Tune together, press the UP and DOWN keys twice in quick succession, then immediately press SCROLL key. The Pre-Tune feature then performs its single shot operation (AT LED will flash green), after which the RaPID feature automatically starts to operate (AT LED will be ON green).

For a detailed description of the RaPID feature, refer to Appendix E.

NOTE: If either Pb1 to Pb2 is zero, the RaPID feature cannot be engaged.

Manual Tuning Method 3.6

1. Cycle Time - Time Proportioning Outputs
   A. Adjusting the cycle time affects instrument operation
      1. Shorter Cycle Time
         a. More accurate control
         b. Shorter life span of electromechanical components
2. Proportional Bandwidth
   A. Proportional Bandwidth is the inverse of gain.
      Increased Bandwidth = Decreased Gain
   B. Increase the Proportional Bandwidth if:
      1. The process overshoots excessively
      2. The process oscillates excessively
   C. Decrease the Proportional Bandwidth if:
      1. The process responds slowly
      2. The process fails to reach setpoint

3. Add Automatic Reset
   A. Increase the Automatic Reset (decrease the time) until the process becomes unstable, then decrease (increase the time) until stability is restored.
   B. Be sure to allow sufficient time for the process and the instrument to react.

4. Rate Adjustment
   A. Rate can cause process instability. Typically add Rate as 1/10 th of the automatic reset value.
   B. Decrease Rate if:
      1. The process overshoots/undershoots
      2. If the process oscillates excessively

5. Manual Reset
   A. After making all other adjustments, use if an offset exists between the setpoint and the process variable.
   B. If the process is:
      1. Below setpoint use a positive Manual Reset value
      2. Above the setpoint use a negative Manual Reset value
Control Capability 4.1
A variety of user programmable control features and capabilities are available including:

- Auto Tune
- Alarm Functions
- Auto/Manual Switching
- Process Retransmission
- Setpoint Retransmission
- Setpoint Ramp Rate
- Proportioning (Time or Current)/On-Off Control
- Single On-Off Control
- Single Time Proportioning Control
- Single Current Proportioning
- Dual On-Off Control
- Dual Time Proportioning
- Dual Current Proportioning

The capabilities available in a specific unit are dependent upon the hardware options specified when the instrument is ordered. Refer to Appendix F for the decoding of the instrument model number. Current proportioning control cannot be implemented if a current output was not ordered. The available output types and quantity of each are as follows:

<table>
<thead>
<tr>
<th>Type of Output</th>
<th>Quantity Available</th>
</tr>
</thead>
<tbody>
<tr>
<td>SPDT mechanical relay output</td>
<td>Up to three</td>
</tr>
<tr>
<td>SSR Driver</td>
<td>Up to three</td>
</tr>
<tr>
<td>mADC current output</td>
<td>Up to two</td>
</tr>
</tbody>
</table>

Control Responses 4.2
Each instrument may be configured to provide 3 mode proportional control. Proportional control is provided with Proportional Band, Integration, and Derivative responses. The PID parameters are defined as follows:

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Out 1</th>
<th>Out 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>P (Proportional)</td>
<td>Pb1</td>
<td>Pb2</td>
</tr>
<tr>
<td>I (Integration)</td>
<td>ArSt</td>
<td>ArSt</td>
</tr>
<tr>
<td>D (Derivative)</td>
<td>rAtE</td>
<td>rAtE</td>
</tr>
</tbody>
</table>

Manual Reset is provided for use in lieu of, or in conjunction with automatic reset. A cycle time adjustment parameter is provided for use with each time proportioning control output.
Direct/Reverse Operation of Outputs  4.3

Direct operation is typically used with cooling applications. On-Off direct output(s) will turn on when the process variable exceeds setpoint. Proportional direct output(s) will increase the percentage of output as the process value increases within the proportional band.

Reverse operation is typically used with heating applications. On-Off reverse output(s) will turn off when the process variable exceeds setpoint. Proportional reverse output(s) will decrease the percentage of output as the process value increases within the proportional band.

Output 2 will be Direct when Output 1 is selected as Reverse and Reverse when Output 1 is selected as Direct.

On-Off Control  4.4

On-Off control can be implemented with SPDT relay or SSR driver output(s) by setting the corresponding proportional band (Pb) to 0.0. On-Off operation can be assigned to Output 1 only (Output 2 not present), Output 1 AND Output 2, or Output 2 only (Output 1 is time proportional or current proportional). A hysteresis adjustment is provided for On-Off outputs, "HyS1" for Output 1 only, "HySt" for Output 1 AND Output 2, or "HyS2" for Output 2 only. This adjustment is in % of input span and defines the bandwidth of the hysteresis. Relay chatter can be eliminated by proper adjustment of this parameter. When operating in On-Off control, the output(s) will turn on or off depending upon the setpoint, the process value, and the hysteresis adjustment.
Time Proportioning Control  4.5
Time Proportioning control can be implemented with a SPDT relay or SSR driver. Time proportioning control can be selected for either Output 1 or Output 1 and Output 2, depending on hardware configuration. Time proportioning control is accomplished by cycling the output on and off during a prescribed period of time when the process variable is within the proportional band.

Ex:  Calculated output % = 40%; Cycle time adjustment = 32 seconds
     Output on time = .4 x 32 = 12.8 seconds
     Output off time = .6 x 32 = 19.2 seconds

When the unit is operating in the Control mode, the control algorithm determines the output % required to correct for any difference between the process value and the setpoint. The output calculation is affected by Tune mode parameter adjustments. See Figure 4-1 (page 37) for proportional bandwidth effect on the output.
Current Proportioning Control  4.6

Current Proportioning control can be implemented on units provided with mADC current output(s). Current Proportioning control provides a 4 to 20mADC or 0-20mADC output in response to process value and setpoint. As with Time proportioning, the calculated output % for Current proportioning is affected by the Tune mode parameter adjustments.

See Figure 4-1 (below) for proportional bandwidth effect on the output.

FIGURE 4-1
Setpoint Adjustment  4.7
To adjust the setpoint with the instrument in the Control mode, press the UP key to raise the setpoint and the DOWN key to lower the setpoint.

Depressing the SCROLL key, if setpoint ramping is enabled and if ramp rate is not OFF will change the displays to:
- Upper Display = Ramping Setpoint Value (Read Only)
- Lower Display = SPrP
Appendix A
Glossary of Terms

Input Filter Time Constant
This parameter is used to filter out any extraneous impulses on the process variable. This filtered PV is used for all PV-dependent functions (control, alarm, etc). The time constant is adjustable from 0.0 seconds (off) to 100.0 seconds, in 0.5 second increments. Default value is 2.0 seconds. Display code is FiLt.

Input Correction
This parameter is used to modify the actual process variable and is adjustable in the range ± input span. Default value is 0. Display code is iCor.

Proportional Band 1
This parameter is the portion of the input span over which the Output 1 power level is proportional to the displayed process variable value. It may be adjusted in the range 0.0% (ON/OFF) to 999.9%. Default value is 5.0%. Display code is Pb1. The function is illustrated in Figure A-1, page 49.

Proportional Band 2
This parameter is the portion of the input span over which the Output 2 power level is proportional to the displayed process variable value. It may be adjusted in the range 0.0% (ON/OFF) to 999.9%. Default value is 5.0%.* Display code is Pb2. In Figure A-1 (page 49), Proportional Band 2 is shown (a) with a nonzero value (Case 1 and Case 2) - PID Control, and (b) with a zero value (Case 3) - ON-OFF control.

Automatic Reset (Integral)
This parameter is used to bias the proportional output(s) to compensate for process load variations. It is adjustable in the range 1 second to 99 minutes 59 seconds per repeat and OFF (value greater than 99 minutes 59 seconds). Decreasing the time increases the Reset. This parameter is not available if Pb1 is set to 0. Default value is OFF. Display code is ArSt.

*This parameter is applicable only if Output 2 is present.
**Rate (Derivative)**
This parameter is adjustable in the range 00 seconds to 99 minutes 59 seconds and specifies how the control action responds to the rate of change in the process variable. This parameter is not available if Pb1 is set to 0. Default value is 0.0. Display code is rAtE.

**Overlap/Deadband**
This parameter defines the portion of the proportional band (Pb1 + Pb2) over which both outputs are active (or, in the case of a deadband, neither output is active). It is adjustable in the range -20% to +20% (negative value = deadband). The function is illustrated in Figure A-1, page 49. This parameter is not applicable if Pb1 = 0 or if there is no Output 2. Default value is 0%. Display code is SPrd.

Note: With Output 2 set on ON/OFF (Figure A-1, page 50, Case 3) the Overlap/Deadband parameter has the effect of moving the ON hysteresis band of Output 2 to create an overlap (positive values) or a deadband (negative values). When Overlap/Deadband = 0, the Output 2 OFF edge of the Output 2 ON/OFF hysteresis band coincides with the point at which Output 1 = 0%.

**Manual Reset**
This parameter is expressed as a percentage of output power and is adjustable in the range 0% to 100% (if only Output 1) or -100% to +100% (if both Output 1 and Output 2). This parameter is not applicable if Pb1 = 0. Default value is 25%. Display code is rSEt.

**Hysteresis**
This parameter is a switching differential used when one or both outputs have been set to ON/OFF. This parameter is adjustable within the range 0.1% to 10.0% of input span. Default value is 0.5%. Display code is HyS1, HyS2, HySt. Note: Alarm output hysteresis is fixed at 2°C/F.

**Setpoint Upper Limit**
This parameter is the maximum limit for setpoint adjustment. It should be set to a value which prevents the setpoint being given a value which will cause damage to the process. The range of adjustment is to Maximum Input Range. Default value is Range Maximum. Display code is SPuL.
Setpoint Lower Limit
This parameter is the minimum limit for setpoint adjustment. It should be set to a value which prevents the setpoint being given a value which will cause damage to the process. The range of adjustment is to Minimum Input Range. Default value is Range Minimum. Display code is SPLL.

Process Output Upper Value
This parameter defines the value of the retransmitted output (process variable or setpoint, whichever is applicable) at its maximum value; for example, for a 0-5V output, this value corresponds to 5V. It may be adjusted within the range -1999 to 9999. The decimal position is always the same as that for the process variable input. Default value is Input Range Maximum. Display code is Pou.

Note: If this parameter is set to a value less than that for the Process Output Lower Value, the relationship between the process variable/setpoint value and the retransmission output is reversed.

Remote Setpoint Maximum
This, and the Remote Setpoint Minimum parameter define the scaling of the RSP input (which is a linear input). This parameter may be adjusted between -1999 and +9999, with the decimal point position as for the primary input. After scaling, the RSP value range is limited by the Setpoint Upper and Lower Limits. Thus, if the scaled RSP value is greater than the Setpoint Upper limit, the RSP value will be clamped to the Setpoint Upper Limit. The default value is Input Range Maximum. Display code is rSPh.

Remote Setpoint Minimum
This, and the Remote Setpoint Maximum parameter define the scaling of the RSP input (which is a linear input). This parameter may be adjusted between -1999 and +9999, with the decimal point position as for the primary input. After scaling, the RSP value range is limited by the Setpoint Upper and Lower Limits. Thus, if the scaled RSP value is less than the Setpoint Lower Limit, the RSP value will be clamped to the Setpoint Lower Limit. The default value is Input Range Minimum. Display code is rSPL.
Remote Setpoint Offset
This parameter is used to modify the remote setpoint value in the following manner:

Offset remote setpoint value = setpoint value + remote setpoint offset value

Default value is 0. Display code is rSPo.

Process Output Lower Value
This parameter defines the value of the retransmitted output (process variable or setpoint, whichever is applicable) at its minimum value; for example, for a 0-5V output, this value corresponds to 0 V. It may be adjusted within the range -1999 to 9999. The decimal position is always the same as that for the process variable input. Default value is Input Range Minimum. Display code is PoL.

Note: If this parameter is set to a value greater than that for the Process Output Upper Value, the relationship between the process variable/setpoint value and the retransmission output is reversed.

Output 1 Percent Limit
This parameter is used to limit the power level of Output 1 and may be used to protect the process being controlled. It may be adjusted between 0 % and 100%. This parameter is not applicable if Pb1 = 0. Display code is o1PL.

Cycle Time
This parameter is used to select the on/off cycle time for time proportioning outputs (Ct1 for Output 1 and Ct2 for Output 2). The permitted range of value is 0.5, 1, 2, 4, 8, 16, 32, 64, 128, 256, or 512 seconds. Default value is 32. Display codes Ct1 & Ct2.

Process High Alarm 1 Value
This parameter, applicable only when Alarm 1 is selected to be a Process High alarm, defines the process variable value at or above which Alarm 1 will be active. Its value may be adjusted between Input Range Maximum and Input Range Minimum. Its default value is Input Range Maximum. Display code is PHA1.
**Process Low Alarm 1 Value**  
This parameter, applicable only when Alarm 1 is selected to be a Process Low alarm, defines the process variable value at or below which Alarm 1 will be active. Its value may be adjusted between Input Range Maximum and Input Range Minimum. Its default value is Input Range Minimum. Display code is PLA1.

**Band Alarm 1 Value**  
This parameter, applicable only if Alarm 1 is selected to be a Band Alarm, defines a band of process variable values, centered on the setpoint value. If the process variable value is outside this band, the alarm will be active. This parameter may be adjusted from 0 to span from the setpoint. The default value is 5. The display code is bAL1.

**Deviation Alarm 1 Value**  
This parameter, applicable only if Alarm 1 is selected to be a Deviation High/Low Alarm, defines a value above (positive value - Deviation High Alarm) or below (negative value - Deviation Low Alarm) the setpoint; if the process variable deviates from the setpoint by a margin greater than that defined by this parameter, Alarm 1 goes active. This parameter may be adjusted in the range ± span from setpoint. The default value is 5. Display code is dAL1.

**Alarm 1 Hysteresis**  
This parameter applies a hysteresis band on the "safe" side of the Alarm 1 value. Thus, Alarm 1 will become active when the Alarm 1 value is exceeded; Alarm 1 will become inactive when the process variable value is outside the hysteresis band on the "safe" side of the Alarm 1 value. Alarm 1 Hysteresis may be set to a value in the range 1 (least significant digit) to 10% of input span (expressed as display units). The default value is 1. Display code is AHy1. The effects of the hysteresis value on the operation of the different types of alarms is illustrated in Figure A-2.

**Process High Alarm 2 Value**  
This parameter, applicable only when Alarm 2 is selected to be a Process High Alarm, defines the process variable value at or above which Alarm 2 will be active. Its value may be adjusted between Input Range Maximum and Input Range Minimum. Its default value is Input Range Maximum. Display code is PHA2.
**Process Low Alarm 2 Value**  
This parameter, applicable only when Alarm 2 is selected to be a Process Low Alarm, defines the process variable value at or below which Alarm 2 will be active. Its value may be adjusted between Input Range Maximum and Input Range Minimum. Its default value is Input Range Minimum. Display code is PLA2.

**Band Alarm 2 Value**  
This parameter, applicable only if Alarm 2 is selected to be a Band Alarm, defines a band of process variable values, centered on the setpoint value. If the process variable is outside this band, the alarm will be active. This parameter may be adjusted from 0 to span from the setpoint. The default value is 5. Display code is bAL2.

**Deviation Alarm 2 Value**  
This parameter, applicable only if Alarm 2 is selected to be a Deviation High/Low Alarm, defines a value above (positive value - Deviation High Alarm) or below (negative value - Deviation Low Alarm) the setpoint; if the process variable deviates from the setpoint by a margin greater than that defined by this parameter, Alarm 2 goes active. This parameter may be adjusted in the range ± span from setpoint. The default value is 5. Display code is dAL2.

**Alarm 2 Hysteresis**  
This parameter applies a hysteresis band on the "safe" side of the Alarm 2 value. Thus, Alarm 2 will become active when the Alarm 2 value is exceeded; Alarm 2 will become inactive when the process variable value is outside the hysteresis band on the "safe" side of the Alarm 2 value. Alarm 2 Hysteresis may be set to a value in the range 1 (least significant digit) to 10% of input span (expressed as display units). The default value is 1. Display code is AHy2. The effects of the hysteresis value on the operation of the different types of alarms is illustrated in Figure A-2.
FIGURE A-1
Alarm Actuation

Process High Alarm
direct-acting
"ALM" Off
Relay Off
"ALM" flashes
Relay On

Process High Alarm
reverse-acting
"ALM" Off
Relay On
"ALM" flashes
Relay Off

Process Low Alarm
direct-acting
"ALM" flashes
Relay On
"ALM" Off
Relay Off

Process Low Alarm
reverse-acting
"ALM" flashes
Relay Off
"ALM" Off
Relay On

ALARM POINT

FIGURE A-1
Alarm Actuation

PV

PV

PV

PV

Edition 1
55
MIC 1820/MIC 1420 Manual
Band Alarm
direct-acting
open within band

- "ALM" flashes Relay On
- "ALM" flashes Relay On

PV

Band Alarm
reverse-acting
closed within band

- "ALM" Off Relay Off
- "ALM" Off Relay Off

PV

Deviation High Alarm
direct-acting
(positive value)

- "ALM" Off Relay Off
- "ALM" Off Relay Off

PV

Deviation Low Alarm
direct-acting
(negative value)

- "ALM" flashes Relay On
- "ALM" Off Relay Off

PV

Deviation High Alarm
reverse-acting
(positive value)

- "ALM" Off Relay Off
- "ALM" Off Relay Off

PV

Deviation Low Alarm
reverse-acting
(negative value)

- "ALM" flashes Relay Off
- "ALM" Off Relay On

PV
FIGURE A-2
Alarm Hysteresis
**Loop Alarm Enable**

This parameter is the means by which the user can enable or disable the Loop Alarm. The Loop Alarm is a special alarm which detects faults in the control feedback loop by continuously monitoring process variable response to the control output(s).

The Loop Alarm, when enabled, repeatedly checks the control output(s) for being at the maximum or minimum limit. If an output is found to be at the limit, the Loop Alarm mode starts a timer; thereafter, if the high output has not caused the process variable to be corrected by a predetermined amount V after a time T has elapsed, the Loop Alarm goes active. Subsequently, the Loop Alarm mode repeatedly checks the process variable and the control output(s). When the process variable starts to change value in the correct sense or when the output comes below the limit, the Loop Alarm is deactivated.

For PID control, the Loop Alarm Time T is always set to twice the value of the Auto Reset parameter. For ON/OFF control, the user defined value of the Loop Alarm Time Set Up parameter is used.

The value of V is dependent upon the input type:

- **Deg C:** 2°C or 2.0°C
- **Deg F:** 3°F or 3.0°F
- **Linear Range:** 10 least significant display units

For single output instruments, the limits are 0% and Out 1 Max %. For dual output instruments, the limits are -100% and Out 1 Max %.

**Notes:**

1. Correct operation of the Loop Alarm depends upon reasonably accurate PID tuning.

2. The Loop Alarm is automatically disabled during Manual Control mode and during execution of the Pre-Tune mode. Upon exit from Manual mode or after completion of the Pre-Tune routine, the Loop Alarm is automatically re-enabled.
Loop Alarm Time
When full ON/OFF control is selected and Loop Alarm is enabled, this parameter determines the duration of the limit condition after which the Loop Alarm will be activated. It may be adjusted within the range of 1 second to 99 minutes 59 seconds. This parameter is omitted from the Tune mode display sequence if ON/OFF control is not selected or Loop Alarm is disabled. The default setting 99:59. Display code is LAti.

Logical Combination of Alarms
Two alarms may be combined logically to create an AND/OR situation. They may be configured for Reverse-acting or Direct-acting. Either Output 2 or Output 3 may be assigned as Logical Outputs.

Example:
Logical OR of Alarm 1 with Alarm 2

<table>
<thead>
<tr>
<th>Direct-Acting</th>
<th>Reverse-Acting</th>
</tr>
</thead>
<tbody>
<tr>
<td>AL1 OFF, Al2 OFF: Relay OFF</td>
<td>AL1 OFF, Al2 OFF: Relay ON</td>
</tr>
<tr>
<td>AL1 ON, Al2 OFF: Relay ON</td>
<td>AL1 ON, Al2 OFF: Relay OFF</td>
</tr>
<tr>
<td>AL1 OFF, Al2 ON: Relay ON</td>
<td>AL1 OFF, Al2 ON: Relay OFF</td>
</tr>
<tr>
<td>AL1 ON, Al2 ON: Relay ON</td>
<td>AL1 ON, Al2 ON: Relay OFF</td>
</tr>
</tbody>
</table>

Logical AND of Alarm 1 with Alarm 2

<table>
<thead>
<tr>
<th>Direct-Acting</th>
<th>Reverse-Acting</th>
</tr>
</thead>
<tbody>
<tr>
<td>AL1 OFF, Al2 OFF: Relay OFF</td>
<td>AL1 OFF, Al2 OFF: Relay ON</td>
</tr>
<tr>
<td>AL1 ON, Al2 OFF: Relay OFF</td>
<td>AL1 ON, Al2 OFF: Relay ON</td>
</tr>
<tr>
<td>AL1 OFF, Al2 ON: Relay OFF</td>
<td>AL1 OFF, Al2 ON: Relay ON</td>
</tr>
<tr>
<td>AL1 ON, Al2 ON: Relay ON</td>
<td>AL1 ON, Al2 ON: Relay OFF</td>
</tr>
</tbody>
</table>
**Decimal Point**

This parameter, applicable only if a linear input is specified, defines the position of the decimal point in values for the process variable, setpoint, alarm levels and retransmission outputs as follows:

<table>
<thead>
<tr>
<th>Value</th>
<th>Decimal Point Position</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>XXXX</td>
</tr>
<tr>
<td>1</td>
<td>XXX.X</td>
</tr>
<tr>
<td>2</td>
<td>XX.XX</td>
</tr>
<tr>
<td>3</td>
<td>X.XXX</td>
</tr>
</tbody>
</table>

The default value is 0. Display code is dPoS.
**Engineering Units Upper**
This parameter, applicable only if a linear input is specified, defines the scaled input value when the process variable input is at its maximum value. It is adjustable between -1999 to 9999. The default value is 1000. This parameter can be set to a value less than (but not equal to) Engineering Units Lower, in which case the sense of the input is reversed. Display code is Euu.

**Engineering Units Lower**
This parameter, applicable only if a linear input is specified, defines the scaled input value when the process variable input is at its minimum value. It is adjustable between -1999 and 9999. The default value is 0. This parameter can be set to a value greater than (but not equal to) Engineering Units Upper, in which case the sense of the input is reversed. Display code is EuL.

**Pre-Tune Enable/Disable**
This parameter determines whether or not the instrument Pre-Tune mode is activated on power up or not (0=disabled, 1=enabled). Default is 0. Display code is EPtn.

**Manual Mode Enable/Disable**
This parameter determines whether operator selection of manual control is enabled or disabled (0=disabled, 1=enabled). The default setting is 0. Display code is ESby.

**Setpoint Ramp Enable/Disable**
This parameter enables/disables use of the Setpoint Ramp feature (0=disabled, 1=enabled). The default setting is 0. Display code is ESPr.

**Communications Enable**
This parameter enables/disables the changing of parameter values via the RS485 communications link, if the Communications option is specified. Settings are 0=disabled and 1=enabled. Default setting is 0. Display code is CCon.
**FIGURE A-4**
Proportional Band & Deadband/Overlap

**Case 1**

Output Power (%)

Output 1  \[\text{Proportional Band 1} \ (Pb1)\]

Output 2

Setpoint

Overlap (Positive value) \[\text{SPrd}\]

Process Variable

**Case 2**

Output Power (%)

Output 1  \[\text{Proportional Band 1} \ (Pb1)\]

Output 2  \[\text{Proportional Band 2} \ (Pb2)\]

Setpoint

Deadband (negative value) \[\text{SPrd}\]

Process Variable

**Case 3**

Output Power (%)

Output 1

Output 2

Setpoint

Overlap/Deadband \[\text{SPrd}\]

Process Variable

Proportional Band 1 \[\text{Pb1}\]

Proportional Band 2 \[\text{Pb2} = 0\]

ON/OFF Differential \[\text{HyS2}\]

Positive values

Negative values
Appendix B
Board Layout - Jumper Positioning

FIGURE B-1 PCB POSITIONS (MIC 1820)
FIGURE B-2 PCB POSITIONS (MIC 1420)
FIGURE B-3 OUTPUT 2, OUTPUT 3 REMOVAL (MIC 1820)

CPU PCB

Output 2 Option PCB

Output 3 Option PCB

Power Supply PCB

Top of Front Panel

REAR VIEW OF UNHOUSED CONTROLLER

Tongues become dis-engaged
FIGURE B-4 OUTPUT 2, OUTPUT 3 REMOVAL (MIC 1420)

A

Top of Front Panel
Output 3 Option PCB
CPU PCB
Power Supply PCB
Output 2 Option PCB
REAR VIEW OF UNHOUSED CONTROLLER

B

Tongues become dis-engaged

C
**Figure B-5 CPU PWA**

<table>
<thead>
<tr>
<th>Input Type</th>
<th>LJ1, LJ2, LJ3 Jumper Position</th>
</tr>
</thead>
<tbody>
<tr>
<td>RTD, DC (mV)</td>
<td>None (parked)</td>
</tr>
<tr>
<td>T/C</td>
<td>LJ3</td>
</tr>
<tr>
<td>DC (mA)</td>
<td>LJ2</td>
</tr>
<tr>
<td>DC (V)</td>
<td>LJ1</td>
</tr>
</tbody>
</table>
FIGURE B-6 PSU PWA WITH RELAY OR SSR OUTPUT 1

Output Type | LJ4, LJ5 Jumper Position | LJ6, LJ7 Jumper Position
-------------|--------------------------|--------------------------
Relay       | LJ5                      | LJ6                      
SSR         | LJ4                      | LJ7                      

Jumper Position

TX1
SK3
LJ4, LJ5
LJ6, LJ7
FIGURE B-7 PSU PWA WITH DC OUTPUT 1

<table>
<thead>
<tr>
<th>Output Type</th>
<th>LJ8, LJ9 Jumper Position</th>
</tr>
</thead>
<tbody>
<tr>
<td>DC (0-10V)</td>
<td>LJ8</td>
</tr>
<tr>
<td>DC (0-20mA)</td>
<td>LJ9</td>
</tr>
<tr>
<td>DC (0-5V)</td>
<td>LJ8</td>
</tr>
<tr>
<td>DC (4-20mA)</td>
<td>LJ9</td>
</tr>
</tbody>
</table>
FIGURE B-8  OPTION PWA DC OUTPUT 2/OUTPUT 3

<table>
<thead>
<tr>
<th>Output Type</th>
<th>LJ8, LJ9 Jumper Position</th>
</tr>
</thead>
<tbody>
<tr>
<td>DC (0-10V)</td>
<td>LJ8</td>
</tr>
<tr>
<td>DC (0-20mA)</td>
<td>LJ9</td>
</tr>
<tr>
<td>DC (0-5V)</td>
<td>LJ8</td>
</tr>
<tr>
<td>DC (4-20mA)</td>
<td>LJ9</td>
</tr>
</tbody>
</table>
FIGURE B-9 JUMPER PLACEMENT FOR REMOTE INPUT TYPE

Output Type | LJ8, LJ9 Jumper Position
---|---
DC (0-10V) | [Diagram showing placement]
DC (0-20mA) | [Diagram showing placement]
DC (0-5V) | [Diagram showing placement]
DC (4-20mA) | [Diagram showing placement]
Appendix C

Hardware Definition Code

The Hardware Definition Code is used to represent the hardware installed (input type, Output 1 type, Output 2 type and Output 3 type); this must be compatible with the hardware actually installed. It can be accessed, with the instrument in Program mode (with a prompt inPS, etc. displayed), by simultaneously depressing the DOWN and SCROLL keys. The displays will show "XXXX" (where X represents any number) in the upper display and "dEFn" in the lower display, where:

the first (left-most) digit is input type:
1=RTD/Linear mV
2=Thermocouple
3=Linear DC mA
4=Linear DC V

the second digit is Output 1 type:
1=Relay
2=SSR
3=DC 0-10V
4=DC 0-20mA
5=DC 0-5V
7=DC 4-20mA

the third digit is Output 2 type:
0=Output 2 not installed
1=Relay (control or alarm 2)
2=SSR (control or alarm 2)
3=DC 0-10V (control only)
4=DC 0-20mA (control only)
5=DC 0-5V (control only)
7=DC 4-20mA (control only)

the fourth digit is Output 3 type:
0=Output 3 not installed
1=Relay (alarm 1 only)
2=SSR (alarm 1 only)
3=DC 0-10V (retransmit only)
4=DC 0-20mA (retransmit only)
5=DC 0-5V (retransmit only)
7=DC 4-20mA (retransmit only)

The displayed code may be incremented/decremented using the UP/DOWN keys as required. The maximum setting available is 4777. For example, the code for a thermocouple input, DC 4-20mA Output 1 and relay Output 3 would be 2701. When the code is first altered, the code display will flash, until the desired value is displayed and confirmed by pressing the Auto/Manual key.

While the Hardware Definition Code is displayed, depressing the SCROLL key will cause the display to change to:

```
nonE  or  r485  or  duAL
OPtn  OPtn  OPtn
```

Where nonE indicates the absence of any option, r485 indicates the presence of the communications option, and duAL indicates the presence of the dual setpoint option. If selected, the plug-in digital input board used for selection of setpoint must be installed.

NOTE: The RS485 Serial Communications option and the plug-in Dual Setpoint option are mutually exclusive.

Another depression of the SCROLL key will cause the appearance of the Second Input Usage menu display, which may be one of the following:

```
nonE  or  rSP1  or  rSP3
2InP  2InP    2InP
OR
rSP4  or  rSP9    duAL
2InP  2InP    2InP
```
Where nonE indicates Second Input not used, rSP1 indicates the use of the Second Input as a linear DC mV Remote Setpoint, rSP3 indicates the use of the second input as a linear DC mA Remote Setpoint, rSP4 indicates the use of the Second Input as linear DC Volt, rSP9 indicates the use of the Second Input as Potentiometer (up to 2K ohm) type Remote Setpoint, and duAL indicates Dual Setpoint switching capabilities.

Selection of Dual Setpoint switching allows the digital input part of the Remote Setpoint option to be used for dual setpoint switching, thus permitting the instrument to have Dual Setpoint operation and RS485 Serial Communications (the normal setpoint switching input and the RS485 Communications option are mutually exclusive.

NOTE: It is essential that this code is changed whenever there is a change to the instrument’s hardware configuration (change of input/output type, alarm/retransmit output added/removed etc.). The instrument’s software depends upon this code to ensure that the instrument operates correctly.

To exit from the Hardware Definition Code display, depress the DOWN and SCROLL keys simultaneously.
## Appendix D
### Input Range Codes
The input ranges available (selectable via the front panel) are:

#### For Thermocouple Inputs

<table>
<thead>
<tr>
<th>TYPE</th>
<th>INPUT RANGE</th>
<th>DISPLAYED CODE</th>
<th>TYPE</th>
<th>INPUT RANGE</th>
<th>DISPLAYED CODE</th>
</tr>
</thead>
<tbody>
<tr>
<td>R</td>
<td>0 - 1650°C</td>
<td>1127</td>
<td>K</td>
<td>-200 - 760°C</td>
<td>6726</td>
</tr>
<tr>
<td>R</td>
<td>32 - 3002°F</td>
<td>1128</td>
<td>K</td>
<td>-328 - 1399°C</td>
<td>6727</td>
</tr>
<tr>
<td>S</td>
<td>0 - 1649°C</td>
<td>1227</td>
<td>K</td>
<td>-200 - 1373°C</td>
<td>6709</td>
</tr>
<tr>
<td>S</td>
<td>32 - 3000°F</td>
<td>1228</td>
<td>K</td>
<td>-328 - 2503°C</td>
<td>6710</td>
</tr>
<tr>
<td>J</td>
<td>0.0 - 205.4°C</td>
<td>1415</td>
<td>L</td>
<td>0.0 - 205.7°C</td>
<td>1815</td>
</tr>
<tr>
<td>J</td>
<td>32.0 - 401.7°F</td>
<td>1416</td>
<td>L</td>
<td>32.0 - 402.2°F</td>
<td>1816</td>
</tr>
<tr>
<td>J</td>
<td>0 - 450°C</td>
<td>1417</td>
<td>L</td>
<td>0 - 450°C</td>
<td>1817</td>
</tr>
<tr>
<td>J</td>
<td>32 - 842°F</td>
<td>1418</td>
<td>L</td>
<td>32 - 841°F</td>
<td>1818</td>
</tr>
<tr>
<td>J</td>
<td>0 - 761°C</td>
<td>1419</td>
<td>L</td>
<td>0 - 762°C</td>
<td>1819</td>
</tr>
<tr>
<td>J</td>
<td>32 - 1401°F</td>
<td>1420</td>
<td>L</td>
<td>32 - 1403°F</td>
<td>1820</td>
</tr>
<tr>
<td>T</td>
<td>-200 - 262°C</td>
<td>1525</td>
<td>B</td>
<td>212 - 3315°F</td>
<td>1934</td>
</tr>
<tr>
<td>T</td>
<td>-328 - 503°F</td>
<td>1526</td>
<td>B</td>
<td>100 - 1824°C</td>
<td>1938</td>
</tr>
<tr>
<td>T</td>
<td>0.0 - 260.6°C</td>
<td>1541</td>
<td>N</td>
<td>0 - 1399°C</td>
<td>5371</td>
</tr>
<tr>
<td>T</td>
<td>32.0 - 501.0°F</td>
<td>1542</td>
<td>N</td>
<td>32 - 2550°F</td>
<td>5324</td>
</tr>
</tbody>
</table>

#### For RTD Inputs

Note: Input conditioning jumper JU1 needs to be changed, see Appendix B.

<table>
<thead>
<tr>
<th>INPUT RANGE</th>
<th>DISPLAYED CODE</th>
<th>INPUT RANGE</th>
<th>DISPLAYED CODE</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 - 800°C</td>
<td>7220</td>
<td>0.0 - 100.9°C</td>
<td>2295</td>
</tr>
<tr>
<td>32 - 1471°F</td>
<td>7221</td>
<td>32.0 - 213.6°F</td>
<td>2296</td>
</tr>
<tr>
<td>32 - 571°F</td>
<td>2229</td>
<td>-200 - 206°C</td>
<td>2297</td>
</tr>
<tr>
<td>-100.9 - 100.0°C</td>
<td>2230</td>
<td>-328 - 402°F</td>
<td>2298</td>
</tr>
<tr>
<td>-149.7 - 211.9°F</td>
<td>2231</td>
<td>-100.9 - 537.3°C</td>
<td>7222</td>
</tr>
<tr>
<td>0 - 300°C</td>
<td>2251</td>
<td>-149.7 - 999.1°F</td>
<td>7223</td>
</tr>
</tbody>
</table>
For DC Inputs
Note: Input conditioning jumper JU1 needs to be changed, see Appendix B.
Also, the Hardware Definition Code for the input type must also be changed, see Appendix C.

<table>
<thead>
<tr>
<th>INPUT RANGE</th>
<th>DISPLAYED RANGE</th>
<th>DISPLAYED CODE</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 - 20mA</td>
<td>0 - 5V</td>
<td>3413 4445</td>
</tr>
<tr>
<td>4-20mA</td>
<td>1 - 5V</td>
<td>3414 4434</td>
</tr>
<tr>
<td>0 - 50mV</td>
<td>0 - 10V</td>
<td>4443 4446</td>
</tr>
<tr>
<td>10 - 50mV</td>
<td>2 - 10V</td>
<td>4499 4450</td>
</tr>
<tr>
<td>0 - 100mV</td>
<td></td>
<td>4412</td>
</tr>
</tbody>
</table>

Remote Setpoint Input Ranges

<table>
<thead>
<tr>
<th>SECOND INPUT RANGE</th>
<th>INPUT RANGE</th>
<th>DISPLAYED CODE</th>
</tr>
</thead>
<tbody>
<tr>
<td>rSP1</td>
<td>0 - 50mV</td>
<td>4443</td>
</tr>
<tr>
<td></td>
<td>10 - 50mV</td>
<td>4499</td>
</tr>
<tr>
<td></td>
<td>0 - 100mV</td>
<td>4412</td>
</tr>
<tr>
<td>rSP3</td>
<td>0 - 20mA</td>
<td>3413</td>
</tr>
<tr>
<td></td>
<td>4 - 20mA</td>
<td>3414</td>
</tr>
<tr>
<td>rSP4</td>
<td>0 - 5V</td>
<td>4445</td>
</tr>
<tr>
<td></td>
<td>1 - 5V</td>
<td>4434</td>
</tr>
<tr>
<td></td>
<td>0 - 10V</td>
<td>4446</td>
</tr>
<tr>
<td></td>
<td>2 - 10V</td>
<td>4450</td>
</tr>
</tbody>
</table>

If the Second Input Usage is set to rSP9, the upper display will show the fixed legend Pot.
**Appendix E**

**RaPID Control Feature**

The RaPID (Response - assisted PID) feature offers dramatic improvements in control quality compared with conventional PID techniques. It responds much more effectively than PID techniques to load conditions. With this feature, the instrument's response at start-up, during setpoint changes and during disturbances shows considerably reduced overshoot and much more shorter settling times (see below).

![Graphs showing start-up, disturbance, and setpoint changes comparison between PID and RaPID control.](image-url)
RaPID works best with well-tuned terms. It is therefore recommended, on newly installed instruments, that the Pre-Tune facility is run before RaPID is engaged.

Note: If Pre-Tune and RaPID are both engaged, Pre-Tune will run first. Once Pre-Tune (a single shot process) is automatically disengaged, RaPID will operate automatically.

In conditions of frequent change in load characteristics, it is recommended that the Auto-Tune facility is used.

Note: With Auto-Tune and RaPID engaged together, Auto-Tune is suspended until RaPID is disengaged, whereupon Auto-Tune will operate automatically.

The responses to RaPID being engaged are:

<table>
<thead>
<tr>
<th>Pre-Tune</th>
<th>Auto-Tune</th>
<th>Response</th>
<th>Indication</th>
</tr>
</thead>
<tbody>
<tr>
<td>Not operational</td>
<td>Not selected</td>
<td>RaPID activated</td>
<td>AT static green</td>
</tr>
<tr>
<td>Not operational</td>
<td>Selected</td>
<td>Auto-Tune suspended</td>
<td>AT flash green then static green</td>
</tr>
<tr>
<td>Operational</td>
<td>Not Selected</td>
<td>Pre-Tune completes operation, then Auto-Tune suspended and RaPID activated</td>
<td>AT flash green then static green</td>
</tr>
<tr>
<td>Operational</td>
<td>Selected</td>
<td>Pre-Tune completes operation, then Auto-Tune suspended and RaPID activated</td>
<td>AT flash green then static green</td>
</tr>
</tbody>
</table>

The responses to RaPID being disengaged are:

<table>
<thead>
<tr>
<th>Pre-Tune</th>
<th>Auto-Tune</th>
<th>Response</th>
<th>Indication</th>
</tr>
</thead>
<tbody>
<tr>
<td>Not Operational</td>
<td>Not Selected</td>
<td>RaPID deactivated</td>
<td>AT OFF</td>
</tr>
<tr>
<td>Not Operational</td>
<td>Selected</td>
<td>RaPID deactivated, Auto-Tune comes out of suspension</td>
<td>AT static red</td>
</tr>
</tbody>
</table>

(Continued on next page)
Operational

Not selected

Pre-Tune completes operation, then RaPID deactivated and return made to normal control

AT flash red, then off

Operational

Selected

Pre-Tune completes operation, then RaPID deactivated and Auto-Tune comes into effect

AT flash red, then static red

Alarm Hysteresis Output

An Alarm Hysteresis output is made active only when both alarms become active; it subsequently becomes inactive only when both alarms are inactive. Thus, the status of an Alarm Hysteresis output when only one alarm is active depends upon the status immediately prior to that alarm being activated; thus
## Appendix F
### Specifications

#### INPUT SPECIFICATIONS

**General**
- **Input Sample Rate:** Four per second
- **Input Resolution:** 14 bits approximately
- **Input Impedance:** Greater than 100M ohm resistive (except for DC mA and V inputs)
- **Isolation:** Universal input isolated from all outputs except SSR at 240 VAC.

**Thermocouple**
- **Types:** R, S, J, T, K, L, B and N
- **Calibration:** Complies with BS4937, NBS125 and IEC584.
- **Sensor Break Protection:** Break detected within 2 seconds. Control outputs set to OFF (0% power); alarms operate as if the process variable has gone over-range.

**RTD and DC mV**
- **Type and Connection:** Three-wire Pt100
- **Calibration:** Complies with BS1904 and DIN43760.
- **Lead Compensation:** Automatic
- **RTD Sensor Current:** 200mA (approximately)
- **Sensor Break Protection:** Break detected within 2 seconds. Control outputs set to OFF (0% power); alarms operate as if the process variable has gone under-range.

**DC mA and DC V**
- **Scale Range Maximum:** -1999 to 9999
- **Scale Range Minimum:** -1999 to 9999
- **Minimum Span:** 1 display LSD
- **Sensor Break Protection:** Applicable to 4-20mA, 1-5V, and 2-10V ranges only. Break detected within 2 seconds. Control outputs set to OFF (0% power); alarms operate as if the process variable has gone under-range.
DUAL SETPOINT SELECTION INPUT
Type: Voltage free or TTL compatible
Voltage Free Operations: Connections to contacts of external switch or relay; contacts open equal Setpoint 1 selected (minimum contact resistance = 5K ohms), contacts closed equal setpoint 2 selected (maximum contact resistance = 50 ohms)
TTL Levels: To select Setpoint 1: -0.6V to 0.8V
To select Setpoint 2: 2.0V to 24V

REMOTE SETPOINT/POTENTIOMETER INPUT
Types available: 4 - 20mA, 0 -20 mA
0 - 10V, 2 - 10V, 0 - 5V, 1 -5V
0 - 100mV, 0 - 50mV, 10 - 50mV
Potentiometer (up to 2K ohms)
Measurement accuracy under reference conditions: +/- 0.25% of input span +/- 1 LSD
Input sample rate: Four per second
Input resolution: 13 bits
Isolation: 240V ac isolation from all other outputs and inputs except Remote Setpoint Select
Sensor Break protection: For 4 - 20 mA and 1 - 5 ranges only
Remote Setpoint Scale Max.: -1999 to 9999, decimal point as for universal input
Remote Setpoint Scale Min.: -1999 to 9999, decimal point as for universal input
Remote Setpoint Offset: -1999 to 9999, decimal point as for universal input

REMOTE SETPOINT SELECT INPUT
Type: Voltage free contact and TTL compatible. Selects Local/Remote Setpoint (or Setpoint 1/Setpoint 2, if Dual Setpoint operation is selected)
To Select Remote Setpoint/
Setpoint 2:
  Maximum resistance (closure): 50 ohms
  Maximum voltage (TTL) for "0": 0.8 (1mA sink)
  Minimum voltage for "0": -0.6V
To Select Remote Setpoint/
Setpoint 1:
  Minimum contact resistance (open): 5K ohms
  Minimum voltage for (TTL) for "1": 2.0V
  Maximum voltage for "1": 24.0V
  Maximum input delay (OFF-ON): 0.5 second
  Minimum input delay (ON-OFF): 0.5 second
  Isolation: 240V ac isolation from all outputs and inputs except Remote Setpoint

variable has gone under-range.

Output Specifications

Output 1

General
Types Available: Relay (as standard), SSR Driver and DC as options.

Relay
Contact Type: Single pole double throw SPDT
Rating: 2A resistive at 120/240V AC
Lifetime: > 500,000 operations at rated voltage/current
Isolation: Inherent

SSR Driver/TTL
Drive Capability: SSRD>4.2V DC into 1K ohm minimum
Isolation: Not isolated from input or other SSR outputs.

DC
Resolution: Eight bits in 250mS (10 bits in 1 second typical, >10 bits in >1 second typical).
Update Rate: Every control algorithm execution
Ranges: 0-20mA, 4-20mA, 0-10V, and 0-5V*
Load Impedance: 0-20mA: 500 ohm maximum
4-20mA: 500 ohm maximum
0-10V: 500 ohm minimum
0-5V: 500 ohm minimum
Isolation: Isolated from all other inputs and outputs.

*Changes between V and mA ranges also require JU movement.

OUTPUT 2

General
Types Available: Relay, SSR and DC

Relay
Contact Type: Single pole double throw (SPDT)
Rating: 2A resistive at 120/240V AC
Lifetime: > 500,000 operations at rated voltage/current
Isolation: Inherent

SSR Driver/TTL
Drive Capability: SSRD>4.2V DC into 1K ohm minimum
Isolation: Not isolated from input or other SSR outputs

DC
Resolution: Eight bits in 250mS (10 bits in 1 second typical, >10 bits in >1 second typical)
Update Rate: Every control algorithm execution
Ranges: * 0-20mA, 4-20mA, 0-10V, and 0-5V*
Load Impedance: 0-20mA: 500 ohm maximum
4-20mA: 500 ohm maximum
0-10V: 500 ohm minimum
0-5V: 500 ohm minimum
Isolation: Isolated from all other inputs and outputs

*Changes between V and mA ranges also require JU movement.

OUTPUT 3

General
Types Available: Relay, SSR Driver and DC linear (retransmit only)
Relay
Contact Type: Single Pole Double Throw (SPDT)
Rating: 2A resistive at 120/240V AC
Lifetime: > 500,000 operations at rated voltage/current
Isolation: Inherent

SSR Driver/TTL
Drive Capability: SSRD>4.2V DC into 1K ohm minimum
Isolation: Not isolated from input or other SSR outputs

DC
Resolution: Eight bits in 250mS (10 bits in 1 second typical, >10 bits in >1 second typical).
Update Rate: Four times per second
Ranges: 0-20mA, 4-20mA, 0-10V, and 0-5V*
Load Impedance: 0-20mA: 500 ohm maximum
4-20mA: 500 ohm maximum
0-10V: 500 ohm minimum
0-5V: 500 ohm minimum
Isolation: Isolated from all other inputs and outputs.

* Changes between V and mA ranges also require JU movement.

CONTROL SPECIFICATIONS
Control Types: RaPID, PID, PID/On-OFF2, ON-OFF
Automatic Tuning Types: Pre-Tune and Auto-Tune
Proportional Bands: 0 (OFF), 0.5% - 999.9% of input span @ 0.1% increments
Auto Reset: 1s-99min 59s/repeat and OFF
Rate: 0 (OFF) - 99min 59s
Manual Reset: Adjustable in the range 0-100% of output power (single output) or -100% to +100% of output power (dual output)
Deadband/Overlap: -20% to +20% of proportional band 1 + proportional band 2
ON/OFF Hysteresis: 0.1% to 10.0% of input span
Cycle Times: Selectable for 0.5s to 512s in binary steps
Setpoint Range: Limited by Setpoint Upper and Setpoint Lower limits
Setpoint Maximum: Limited by Setpoint and Range Upper Limits
Setpoint Minimum: Limited by Range and Setpoint Lower Limits
Setpoint Ramp: Ramp rate selectable 1-9999 LSDs per hour and infinite. Number displayed is decimal point aligned with selected range.

Alarms
Maximum Number: Two "soft" alarms plus Loop Alarm*
Maximum # Outputs: Up to 2 outputs can be used for alarm purposes
Combination Alarms: Logical OR or AND of alarms to an individual hardware output is available.
Hysteresis: 1 LSD to 10% of span
* Loop Alarm: Detects faults in the control feedback loop by continuously monitoring process variable response to the control output(s)

PERFORMANCE
Reference Conditions
Ambient Temperature: 20°C ± 2°C
Relative Humidity: 60-70%
Supply Voltage: 90-264V AC 50Hz ±1%
Source Resistance: <10 ohm for T/C input
Lead Resistance: <0.1 ohm/lead balanced (Pt100)

Performance Under Reference Conditions
Common Mode
Rejection: >120dB at 50/60Hz giving negligible effect at up to 264V 50/60Hz
Series Mode
Rejection: >500% of span (at 50/60Hz) causes negligible effect

DC Linear Inputs
Measurement
Accuracy: ± 0.25% of span ± 1 LSD

Thermocouple Inputs
Measurement
Accuracy: ± 0.25% of span ± 1LSD

Note: Reduced performance with Type B T/C between 100-600 °C (212 - 1112 °F)
Linearization Accuracy: Better than ± 0.2°C any point, any 0.1°C range (± 0.05°C typical). Better than ± 0.5°C any point, any 1°C range.

Cold Junction Compensation: Better than ± 0.7°C

RTD Inputs Measurement Accuracy: ± 0.25% of span ± 1 LSD

Linearization Accuracy: Better than ± 0.2°C any point, any 0.1°C range (± 0.05°C typical). Better than ± 0.5°C any point, any 1°C range.

DC Outputs
Output 1 Accuracy: mA: 0-20mA ± 0.5% of span (20mA) @250 ohm 4-20mA ± 0.5% of span (16mA) @ 250 ohm V: 0-10V ± 0.5% of span (10V) @ 2K ohm 0-5V ± 0.5% of span (5V) @ 2K ohm

Output 2 Accuracy: mA: 0-20mA ± 0.5% of span (16mA) @ 250 ohm 4-20mA ± 0.5% of span (16mA) @ 250 ohm V: 0-10V ± 0.5% of span (10V) @ 2K ohm 0-5V ± 0.5% of span (5V) @ 2K ohm

Output 3 Accuracy: mA: 0-20mA ± 0.25% of span (20mA) @ 250 ohm 4-20mA ± 0.25% of span (16mA) @ 250 ohm V: 0-10V ± 0.25% of span (10V) @ 2K ohm 0-5V ± 0.25% of span (5V) @ 2K ohm

OPERATING CONDITIONS
Ambient Operating Temperature: 0° to 55°C

Ambient Storage Temperature: -20° to 80°C
Relative Humidity: 20% - 95% non-condensing
Supply Voltage: 90 - 264VAC 50/60Hz (standard)
20-50V AC 50/60Hz or 22-65 V DC (option)
Source Resistance: 1000Ω maximum (thermocouple)
Lead Resistance: 50Ω per lead maximum balanced (Pt100)

PERFORMANCE UNDER OPERATING CONDITIONS
Temperature Stability: 0.01% of span /degree C change in ambient temperature
Cold Junction Compensation: (thermocouple only): Better than ±1°C
Supply Voltage Influence: Negligible
Relative Humidity Influence: Negligible
Sensor Resistance Influence:
Thermocouple 100 ohm: <0.1% of span error
Thermocouple 1000 ohm: <0.5% of span error
RTD Pt100 50 ohm/lead: 0.5% of span error

ENVIRONMENTAL
EMI Susceptibility: Designed to meet EN50082 Part 2
EMI Emissions: Designed to meet EN50081 Part 2
Safety Considerations: Designed to comply with IEC 1010-1 in as far as it is applicable
Supply Voltage: 90 - 264V AC 50/60 Hz (standard)
20 - 50V AC 50/60 Hz or 22-65V DC (option)
Power Consumption: 4 watts approximately
Front Panel Sealing: NEMA4
Agency Approvals: UL Pending
cUL certified for use in Canada pending

PHYSICAL
Dimensions: 1/8 DIN front panel: 48 mm x 96mm
(1.89 " x 3.78")
3.94 inches deep (100mm)
1/4 DIN front panel: 96mm x 96mm (3.78" x 3.78")
3.94 inches deep 100mm

Mounting: Plug-in with panel mounting fixing strap.
Panel cut-out:
1/8 DIN: 45mm x 92mm (1.77" x 3.62")
1/4 DIN: 92mm x 92mm. (3.62" x 3.62")

Terminals: Screw type (combination head)
Weight:
1/8 DIN:  8 ounces maximum
1/4 DIN:16 ounces maximum

Display Character Height:
1/8 DIN:  Top - .39", Bottom - .28"
1/4 DIN:  Top - .53", Bottom - .39"
Appendix G
Order Matrix

MODEL
8  1/8 DIN
4  1/4 DIN

OUTPUT1
1  Relay
2  SSRD
3  4-20 mA*

OUTPUT2
0  None
1  Relay
2  SSRD
3  4-20 mA*

OUTPUT3
0  None
1  Relay
2  SSRD
3  4-20 mA**

OPTIONS
00  None
01  RS-485 Communications
03  Dual Setpoint

SECOND ANALOG INPUT TYPE
Blank  None
02  Line Voltage 24V AC/DC
03  Remote Setpoint - 0 -20mA†

*For control output only
** For retransmission only
† Field changeable to 0/100 mV, 0/10V, or Potentiometer (up to 2K ohm)
## Appendix H
### Software Reference Sheet

<table>
<thead>
<tr>
<th>HDW DEF</th>
<th>OPTION</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Program</th>
<th>Mode</th>
</tr>
</thead>
<tbody>
<tr>
<td>inPS</td>
<td></td>
</tr>
<tr>
<td>inP</td>
<td></td>
</tr>
<tr>
<td>Out1</td>
<td></td>
</tr>
<tr>
<td>ALA1</td>
<td></td>
</tr>
<tr>
<td>ALA2</td>
<td></td>
</tr>
<tr>
<td>Inhi</td>
<td></td>
</tr>
<tr>
<td>USE2</td>
<td></td>
</tr>
<tr>
<td>USE3</td>
<td></td>
</tr>
<tr>
<td>CbS</td>
<td></td>
</tr>
<tr>
<td>CA1</td>
<td></td>
</tr>
<tr>
<td>CJC</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Enable</th>
<th>Mode</th>
</tr>
</thead>
<tbody>
<tr>
<td>ENAB</td>
<td>ON</td>
</tr>
<tr>
<td>EPro</td>
<td></td>
</tr>
<tr>
<td>EtuN</td>
<td></td>
</tr>
<tr>
<td>ESPC</td>
<td></td>
</tr>
<tr>
<td>Tune</td>
<td>Mode</td>
</tr>
<tr>
<td>-------</td>
<td>------</td>
</tr>
<tr>
<td>SPrP</td>
<td></td>
</tr>
<tr>
<td>SPrr</td>
<td></td>
</tr>
<tr>
<td>Filt</td>
<td></td>
</tr>
<tr>
<td>iCor</td>
<td></td>
</tr>
<tr>
<td>Po1</td>
<td></td>
</tr>
<tr>
<td>Po2</td>
<td></td>
</tr>
<tr>
<td>Pb1</td>
<td></td>
</tr>
<tr>
<td>Pb2</td>
<td></td>
</tr>
<tr>
<td>ArSt</td>
<td></td>
</tr>
<tr>
<td>rAtE</td>
<td></td>
</tr>
<tr>
<td>SPrd</td>
<td></td>
</tr>
<tr>
<td>rSEt</td>
<td></td>
</tr>
<tr>
<td>HyS1</td>
<td></td>
</tr>
<tr>
<td>HyS2</td>
<td></td>
</tr>
<tr>
<td>HySt</td>
<td></td>
</tr>
<tr>
<td>SPuL</td>
<td></td>
</tr>
<tr>
<td>SPLL</td>
<td></td>
</tr>
<tr>
<td>rSPh</td>
<td></td>
</tr>
<tr>
<td>rSPL</td>
<td></td>
</tr>
<tr>
<td>rSPO</td>
<td></td>
</tr>
<tr>
<td>Pou</td>
<td></td>
</tr>
<tr>
<td>PoL</td>
<td></td>
</tr>
</tbody>
</table>

(continued on next page)
<table>
<thead>
<tr>
<th>Tune</th>
<th>Mode</th>
</tr>
</thead>
<tbody>
<tr>
<td>o1PL</td>
<td></td>
</tr>
<tr>
<td>Ct1</td>
<td></td>
</tr>
<tr>
<td>Ct2</td>
<td></td>
</tr>
<tr>
<td>PHA1</td>
<td></td>
</tr>
<tr>
<td>PLA1</td>
<td></td>
</tr>
<tr>
<td>bAL1</td>
<td></td>
</tr>
<tr>
<td>dAL1</td>
<td></td>
</tr>
<tr>
<td>AHy1</td>
<td></td>
</tr>
<tr>
<td>PHA2</td>
<td></td>
</tr>
<tr>
<td>PLA2</td>
<td></td>
</tr>
<tr>
<td>bAL2</td>
<td></td>
</tr>
<tr>
<td>dAL2</td>
<td></td>
</tr>
<tr>
<td>AHy2</td>
<td></td>
</tr>
<tr>
<td>LAEn</td>
<td></td>
</tr>
<tr>
<td>LAti</td>
<td></td>
</tr>
<tr>
<td>dPoS</td>
<td></td>
</tr>
<tr>
<td>Euu</td>
<td></td>
</tr>
<tr>
<td>EuL</td>
<td></td>
</tr>
<tr>
<td>EuL</td>
<td></td>
</tr>
<tr>
<td>EPtn</td>
<td></td>
</tr>
<tr>
<td>ESby</td>
<td></td>
</tr>
<tr>
<td>ESPr</td>
<td></td>
</tr>
<tr>
<td>ESCpr</td>
<td></td>
</tr>
<tr>
<td>CCon</td>
<td></td>
</tr>
</tbody>
</table>
Warranty and Return Statement

These products are sold by The Partlow Corporation (Partlow) under the warranties set forth in the following para-
graphs. 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 two years.

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, misappli-
cation, 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