INTRODUCTION

General Description

The AI-100 is a fully programmable, microprocessor-based temperature/process controller. It offers superior control with 200 msec sampling rate and by using fuzzy logic to enhance its P, I and D parameters. The 4-digit 0.4” red LED display offers excellent visibility on a unit that is 1/32 DIN in size.

The AI-100 is available with either 20-32V AC/DC or 90-264V AC power supply. This is a single universal input unit that will accept 8 different thermocouple types, Pt100 RTDs, and a variety of linear mA and VDC signals. The wide range of options for the two available outputs include relays, SSR drives, 4-20mA, 0-20mA, or 0-10VDC. Output #1 can be used in either a direct or reverse action control situation with a programmable ramp rate. Output #2 can be used as a control output, as an alarm, or as a dwell timer.

Optional features include 2-wire RS-485 serial communications with Windows 95™-based software, and Analog Retransmission of process variable, setpoint variable or the percentage of control output, as a 0-20 mA/4-20 mA DC signal.

The communications software package, COMM 4851, offers excellent graphics, bar and trend displays, and supports easy-to-use database control and back-up capability.

FUZZY LOGIC

The function of Fuzzy Logic is to adjust the PID parameters internally in order to make the control output more flexible and adaptive to the process. One of the best analogies would compare Fuzzy Logic to the abilities of a good driver. The driver is
able to control a car well at a variety of speeds and under varying circumstances by using knowledge gained through previous experience. Fuzzy Logic combined with PID control has been proven to be an efficient method to improve control stability. This is illustrated in figure 3.

**Figure 2. PID with fuzzy logic**

**Figure 3. PID vs. PID and fuzzy logic**

### SPECIFICATIONS

**INPUT**
- Thermocouple(T/C): Type J,K,T,E,B,R,S,N RTD: Pt100 ohm RTD (DIN or JIS)
- Linear: Scalable. Refer to table on p.5
- Accuracy: Refer to table on p.5
- External Resistance: 100 ohm max. (for thermocouple)
- Normal Mode Rejection: 60dB
- Common Mode Rejection: 120dB
- Sample Rate: 5 times/sec

**CONTROL**
- Proportional Band: 0-360°F, 0-200°C, 0-3600 Process Units
- Reset (Integral): 0-3600 seconds
- Rate (derivative): 0-1000 seconds
- Ramp rate: 0-55.55°C/min, 0-99.99°F/min, 0-99.99 Process Units (P.U.)/min
- Dwell: 0-9999 minutes
- Hysteresis: 0.1-11.0°C, 0.1-19.9°F, 0.1-199 P.U.
- Cycle Time: 0-99 seconds
- Control Action: Direct (cooling) and reverse (heating)

**OUTPUT**
- Relay: SPST, 3A/240 VAC (resistive)
- DC pulse: 24 VDC/20 mA max.
- 4 to 20 mA: Linear, max. load 500 ohms
- 0 to 20 mA: Linear, max. load 500 ohms
- 0 to 10 V: Linear, min. input impedance 500K ohms

**ALARM**
- Relay: SPST, 3A/240 VAC (resistive)

**INDICATION**
- Process Display: 0.4” red LED, 4 digits
- Status Indicator: Control output and alarm
POWER
Rating: 90-264VAC, 50/60Hz or 20-32V AC/DC
Consumption: Less than 5VA

ENVIRONMENTAL & PHYSICAL
Safety: CE, UL & CSA Approved
Protection: NEMA 4X, IP66 (front panel)
Operating Temperature: -10 to 50°C (14 to 122°F)
Humidity: 0 to 90%RH (non-condensing)
Insulation: 20 Mohm min. (500 VDC)
Breakdown: AC2000V, 50/60Hz, 1 minute
Vibration: 10-55Hz, amplitude 1mm
Shock: 200 m/s² (20G)
Weight: 110 grams (3.87 oz.)
Dimension: 24(H) x 48(W) x 99mm (depth behind panel)
Panel cutout: 22.2mm(H) (+.3/-0) 45 mm(W) (+.5/-0)
Warranty: 2 years

RANGE AND ACCURACY OF INPUTS

<table>
<thead>
<tr>
<th>SENSOR</th>
<th>INPUT TYPE</th>
<th>RANGE (°F)</th>
<th>RANGE (°C)</th>
<th>ACCURACY</th>
</tr>
</thead>
<tbody>
<tr>
<td>J</td>
<td>Iron-Constantan</td>
<td>-58 to 1830</td>
<td>-50 to 999</td>
<td>±3.6°F/±2°C</td>
</tr>
<tr>
<td>K</td>
<td>Chromel-Alumel</td>
<td>-58 to 2500</td>
<td>-50 to 1370</td>
<td>±3.6°F/±2°C</td>
</tr>
<tr>
<td>T</td>
<td>Copper-Constantan</td>
<td>-454 to 752</td>
<td>-270 to 400</td>
<td>±3.6°F/±2°C</td>
</tr>
<tr>
<td>E</td>
<td>Chromel-Constantan</td>
<td>-58 to 1382</td>
<td>-50 to 750</td>
<td>±3.6°F/±2°C</td>
</tr>
<tr>
<td>B</td>
<td>Pt30%Rh/Pt6%Rh</td>
<td>572 to 3272</td>
<td>300 to 1800</td>
<td>±3.6°F/±2°C</td>
</tr>
<tr>
<td>R</td>
<td>Pt13%Rh/Pt</td>
<td>32 to 3182</td>
<td>0 to 1750</td>
<td>±3.6°F/±2°C</td>
</tr>
<tr>
<td>S</td>
<td>Pt10%Rh/Pt</td>
<td>32 to 3182</td>
<td>0 to 1750</td>
<td>±3.6°F/±2°C</td>
</tr>
<tr>
<td>N</td>
<td>Nicrosil-Nisil</td>
<td>-58 to 2372</td>
<td>-328 to 1300</td>
<td>±3.6°F/±2°C</td>
</tr>
<tr>
<td>RTD</td>
<td>Pt100 ohm (DIN)</td>
<td>-328 to 842</td>
<td>-200 to 450</td>
<td>±0.72°F/±0.4°C</td>
</tr>
<tr>
<td>RTD</td>
<td>Pt100ohm (JIS)</td>
<td>-328 to 842</td>
<td>-200 to 450</td>
<td>±0.72°F/±0.4°C</td>
</tr>
</tbody>
</table>

LINEAR INPUTS (All scalable)

<table>
<thead>
<tr>
<th>Input type</th>
<th>Range</th>
<th>Accuracy</th>
</tr>
</thead>
<tbody>
<tr>
<td>4-20 mA, 0-20 mA, 0-1V, 0-5V, 1-5V, 0-10V</td>
<td>-1400 to 9400</td>
<td>±0.05% FS</td>
</tr>
</tbody>
</table>

MODEL CONFIGURATION

POWER INPUT
1 A1100
2
3
4 90-264VAC
5 20-32V AC/DC

INPUT SIGNAL
0 J - Iron-Constantan
1 K - Chromel-Alumel
2 T - Copper-Constantan
3 E - Chromel-Constantan
4 B - Pt30%Rh/Pt6%Rh
5 R - Pt13%Rh/Pt
6 S - Pt10%Rh/Pt
7 N - Nicrosil-Nisil
8 RTD - Pt100 (DIN)
9 RTD - Pt100 (JIS)
A 4-20mA
B 0-20mA
C 0-10V
D 1-5V
E 0-5V
F 0-1V

OUTPUT #1 OPTIONS
0 None
1 Relay
2 SSR Drive
3 4-20mA
4 0-20mA
5 0-10V

ALARM/OUTPUT #2 OPTIONS
0 None
1 Relay
2 SSR Drive
3 4-20mA
4 0-20mA
5 0-10V

AUXILIARY OPTIONS
0 None
1 RS-485 Communications
2 Retransmission 4-20mA/0-20mA
POWER SUPPLY
The controller is supplied to operate on either 90-264V AC or 20-32V AC/DC. Check that the supply voltage corresponds to that indicated on the product label before connecting power to the controllers.

This equipment is designed for installation in an enclosure which provides adequate protection against electric shock. The enclosure must be connected to earth ground.

THERMOCOUPLE INPUT
Thermocouple input connections are shown in the illustration below. The thermocouple extension wire must be of proper type and gauge, and should be run in a conduit, separate from any power wiring. The resistance of the entire run should not exceed 100Ω.

Pt100 Ohm RTD INPUT
RTD connections are shown in the illustration below with the compensating lead connected to terminal 11. For two-wire RTD inputs, terminals 10 and 11 should be linked.
**DC PULSE (SOLID-STATE RELAY DRIVE) OUTPUT**
Controllers fitted with the DC pulse output produce a time-proportional non-isolated pulse voltage (0-24V nominal, output impedance 660Ω). The connections are shown in the illustration below.

**DC LINEAR OUTPUT**
There are three types of linear output modules that can be selected for the output. The connections are shown in the illustration below.

**RS-485 COMMUNICATIONS/ANALOG RETRANSMISSION**
RS-485 serial communications or Analog retransmission of process variable, setpoint, or manipulated variable can be selected as an optional feature. The connections are shown in the illustration below.

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**DC LINEAR INPUT**
DC linear voltage and current input connections are shown below.

**RELAY OUTPUT DIRECT DRIVE**
The illustration below shows connections for using the internal relay to drive a small load. The current should not exceed 3 amps.

**RELAY OUTPUT CONTACTOR DRIVE**
The illustration below shows connections for using an external relay to drive heavier loads.
LEARNING THE PARAMETERS

SV - Setpoint
This parameter is the target value for the process. It can be adjusted throughout the range defined by the Low Scale Value \( L_{SC} \) and High Scale Value \( H_{SC} \). Set in degrees/engineering units.

ASP1 - Alarm 1 Setpoint or Dwell Time
If output #2 is configured as an alarm this parameter sets the point that the alarm will be activated. If output #2 is configured as a Dwell Timer this parameter sets the amount of time to be counted. Set in degrees/engineering units for alarms or minutes for timer.

Ramp - Ramp Rate
This determines the rate at which your process will approach setpoint. Setting this parameter to 0 will cause your system to approach setpoint at maximum speed. Set in degrees/minute.

OFST - Offset Value for Manual Reset
For systems using proportional control only (Ti set to 0) this parameter will be adjusted to compensate for any deviation between setpoint and process. Set 0-100% of Pb.

SHIF - Shift Process Value
This value will be added to the process value to correct for errors or to synchronize a number of different units. Set in degrees/engineering units.

PB - Proportional Band
The proportional band is that area around main setpoint where the control output is neither full on nor full off.

HYST - Hysteresis for ON/OFF Control
The hysteresis for output #1 is the area around the main setpoint where the output does not change condition. It is intended to eliminate relay chatter at setpoint for ON/OFF control applications.

NEGOTIATING THE MENU

When the controller is powered up, it automatically displays the Process Variable (PV).

From the Process Variable (PV) display you can easily:
Press either the Up or Down key momentarily to view set-point. or Press the Scroll key momentarily to enter the Primary Program Menu. or Press the long scroll key press for 3.2 seconds and the key simultaneously to enter the Tool Program Menu.

<table>
<thead>
<tr>
<th>TOUCH KEYS</th>
<th>FUNCTION</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Up key</td>
<td>Press to select digit to change. Press and hold to increase value for parameter</td>
<td></td>
</tr>
<tr>
<td>Down key</td>
<td>Press to select digit to change. Press and hold to decrease value for parameter</td>
<td></td>
</tr>
<tr>
<td>Scroll key</td>
<td>Press to select parameter in direct sequence or to select tool program parameters</td>
<td></td>
</tr>
<tr>
<td>Long scroll/Enter key press for 3.2 seconds</td>
<td>Use to select protected parameters in higher security level or to actuate selected tool program</td>
<td></td>
</tr>
<tr>
<td>Reverse scroll/Calibration Verification &amp; press for 3.2 seconds</td>
<td>Use to select parameter in reverse sequence or to verify display accuracy for input types during calibration</td>
<td></td>
</tr>
<tr>
<td>Lock key &amp; press for 3.2 seconds</td>
<td>Use to disable keypad operation to protect parameters</td>
<td></td>
</tr>
<tr>
<td>Tool program key &amp;</td>
<td>Press to select tool program in sequence</td>
<td></td>
</tr>
<tr>
<td>Reset/Exit key &amp; &amp;</td>
<td>Press to unlock keypad operation, to reset display, to exit tool program, or to end autotune and manual control execution.</td>
<td></td>
</tr>
<tr>
<td>Autotune key &amp; &amp; press for 3.2 seconds</td>
<td>Hold both keys for 3.2 seconds then release to start autotune.</td>
<td></td>
</tr>
</tbody>
</table>
**TI - Integral Time**
The integral time is the speed at which a corrective increase or decrease in output is made to compensate for offset which usually accompanies proportional only processes. The more the integral time entered, the slower the action. The less the integral time entered, the faster the action. Enter a value that would eliminate offset without overcompensation, resulting in process oscillation.

**TD - Derivative Time**
The derivative time is that time used in calculating rate of change and thermal lag in helping eliminate overshoot which results in response to process upsets. This overshoot usually accompanies proportional only and proportional integral processes. The derivative action dampens proportional and integral action as it anticipates where the process should be. The more the derivative time entered, the more the damping action. The less the derivative time entered, the less damping action. Enter as much derivative time as necessary to eliminate overshoot without overdamping the process resulting in process oscillation.

**ADDR - Address of unit for serial communications/ Retransmission**
This unit can be assigned a numerical address to identify it as one of 191 stations on an RS-485 serial communications loop (set from 1-191) or for 4-20mA/0-20mA retransmission (set from 192-199).

<table>
<thead>
<tr>
<th>Code for “Addr”</th>
<th>Retransmission</th>
</tr>
</thead>
<tbody>
<tr>
<td>192</td>
<td>4-20mA, PV</td>
</tr>
<tr>
<td>193</td>
<td>4-20mA, SV</td>
</tr>
<tr>
<td>194</td>
<td>4-20mA, MV1 (Output 1)</td>
</tr>
<tr>
<td>195</td>
<td>4-20mA, MV2 (Output 2)</td>
</tr>
<tr>
<td>196</td>
<td>0-20mA, PV</td>
</tr>
<tr>
<td>197</td>
<td>0-20mA, SV</td>
</tr>
<tr>
<td>198</td>
<td>0-20mA, MV1 (Output 1)</td>
</tr>
<tr>
<td>199</td>
<td>0-20mA, MV2 (Output 2)</td>
</tr>
</tbody>
</table>

**LOSC/HISC - Low/High Scale Range**
If a thermocouple or RTD is being used these parameters will establish the allowable range for the setpoint. If an analog input is being used these parameters will establish the scaling range for the process signal and the allowable range for the setpoint. Set in temperature/engineering units.

**PL1/PL2 - Power Limit for Heating and Cooling Outputs**
These parameters limit the maximum percentage of power for the control outputs. These are used on systems that cannot tolerate 100% power. Set from 0-100%.

**INPT - Input Type Selection**
Used to indicate what type of sensor input will be connected. See Range and Accuracy of Inputs on page 5 for available input types.

**UNIT - Process Unit**
Used to select the correct engineering units for the process. (PU for Analog inputs, C or F for temperature applications).

**RESO - Decimal Point Resolution**
This parameter defines the position of the decimal point for the process value and setpoint value. Set to 0, 1 or 2 positions right of the decimal point. (2 positions is reserved for linear inputs only.)

**CONA - Control Action of Output #1**
Determines whether the output will be reverse acting, as in a heating application, or direct, as in a cooling application. See programmable control action on page 33.

**A1MD - Alarm Mode Selection for Alarm #1**
Refer to page 22 for the various alarm types available.
A1SF - Alarm #1 Special Function
Selects a hold function or latch function for alarm #1. Also, used to reconfigure alarm #1 as a dwell timer. Refer to page 22 for more information. Set to Cool for cooling action on output #2.

CYC/CCYC - Proportional Cycle Time for Outputs #1 & #2
These parameters determine the duration of the duty cycle for time proportioned outputs. Set from 0-99 seconds. Set to 0 for linear outputs.

CPB/DB - Cooling Proportional Band/Dead Band
Used only when output #2 is configured for cooling applications. Refer to page 34 for a more detailed explanation.

PRIMARY PROGRAM MENU

Press the key momentarily to enter the Primary Program Menu.

Press the key momentarily to scroll through the Primary Program Menu.

Pause momentarily on a parameter to be changed. After 3.2 sec the display will begin to toggle between the parameter and its current value.

Press either the or key momentarily to highlight the numerical position to be changed.

Press and hold either the or key to increment or decrement the desired position.

Press the key momentarily to continue scrolling through the Primary Program Menu.

When you’ve reached the last parameter in a given level, press and hold the key until that parameter stops flashing. This will advance you to the next level of the Primary Program Menu.
**CHANGING SETPOINT (SV)**

Press either the or key momentarily to view set-point

Press either the or key momentarily to highlight the numerical position to be changed.

Press and hold either the or key to increment or decrement the desired position.

After approximately 10 seconds the unit will automatically return to reading the Process Variable (PV).

**BEGIN CONTROLLING**

1. Insure that the controller is properly wired for your application. As soon as the unit is powered up it will begin trying to control at the current setpoint.

2. Check the display of the controller. Make sure that it is reading the actual temperature/engineering units.

3. If everything looks correct set the desired setpoint, go to the auto-tune procedure (page 20) and initiate it. When autotune is complete your system will be ready.

4. If you experience problems go to the troubleshooting section (p.38).

**AUTO-TUNING**

Auto-tune is a procedure that will oscillate your process around setpoint twice, testing the dynamics of your system and automatically setting the P, I, and D parameters.

You should auto-tune your system:
- during initial set-up.
- if setpoint is changed by a large amount.
- if sensor or output is changed.

**TO COMPLETE THE AUTO-TUNE PROCEDURE;**

1. Make sure all parameters are configured correctly.
2. Have system under normal load conditions.
3. Make sure Pb(Proportional band) is not 0.
4. Set the setpoint to the normal operating temperature.
   **Note:** If system overshoot is likely to cause damage, reduce the setpoint during autotune.
5. Press and hold the and keys for 3.2 seconds and then release. The display will begin flashing and will continue to flash throughout the auto-tune process.

**Note:** To abort the autotune process, press and release the and keys during the first oscillation of the process.
FLOW CHART OF PARAMETERS

The following chart shows a typical (default) access sequence of parameters.

Note: Using the Tool Program the display sequence and the security level for any parameter are configurable. Also, any unused parameter can be removed from the display sequence to simplify the operation.

**: Denotes the default setting

Long : Press and hold for at least 3.2 seconds
ALARMS

This controller is available with a second output that can be configured for a variety of alarm types. The following parameters in the Primary Program Menu are used to configure the alarms:

**Alarm 1 setpoint** - This parameter determines the point that alarm 1 will be activated.

Example: Deviation high alarm with no special function
SV= 100°C, ASP1= 10°C, AHY1= 4°C

**Alarm 1 Hysteresis** - This parameter establishes an area around Alarm 1 setpoint where the alarm relay will not change states.

<table>
<thead>
<tr>
<th>Code</th>
<th>Type</th>
<th>PV</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Full scale high</td>
<td>PV</td>
</tr>
<tr>
<td>2</td>
<td>Full scale low</td>
<td>PV</td>
</tr>
<tr>
<td>3</td>
<td>Deviation high</td>
<td>PV</td>
</tr>
<tr>
<td>4</td>
<td>Deviation low</td>
<td>PV</td>
</tr>
<tr>
<td>5</td>
<td>Deviation band high</td>
<td>PV</td>
</tr>
<tr>
<td>6</td>
<td>Deviation band low</td>
<td>PV</td>
</tr>
</tbody>
</table>

**Alarm 1 Spec. Func.** - This parameter assigns special functions to Alarm 1 such as a holding feature that prevents an alarm during start up or a latch function that prevents the alarm from clearing unless power is interrupted.

Example: Deviation low alarm with Hold function.
SETTING ALARMS

To set an alarm:

Press the \( \Rightarrow \) key momentarily to enter the Primary Program Menu.

Press the \( \Rightarrow \) key momentarily to scroll through the Primary Program Menu until you come to \( \Rightarrow \) \( \Rightarrow \).

Pause momentarily. After 3.2 sec the display will begin to toggle between \( \Rightarrow \) \( \Rightarrow \) and its current setting.

Press and hold either the \( \Rightarrow \) or \( \Rightarrow \) key to select the desired alarm set point.

Press the \( \Rightarrow \) key momentarily to continue scrolling through the Primary Program Menu until you come to \( \Rightarrow \) \( \Rightarrow \).

Pause momentarily. After 3.2 sec the display will begin to toggle between \( \Rightarrow \) \( \Rightarrow \) and its current setting.

Press and hold either the \( \Rightarrow \) or \( \Rightarrow \) key to select the desired amount of alarm hysteresis.

SCALING ANALOG INPUTS / SETTING SETPOINT LIMITS

When an analog input such as 4-20 mA signal is applied to this unit it is necessary to tell the unit how this signal is to be scaled.

<table>
<thead>
<tr>
<th>Input Type</th>
<th>Minimum/Maximum Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>4-20mA dc</td>
<td>-1400...9400 Engineering Units</td>
</tr>
</tbody>
</table>

Example: Program a 4-20mA dc signal for 0 to 100 P.U.

Setpoint Range

Indicating Range

Pause momentarily. After 3.2 sec the display will begin to toggle between \( \Rightarrow \) \( \Rightarrow \) and its current setting.

Press either the \( \Rightarrow \) or \( \Rightarrow \) key momentarily to highlight the numerical position to be changed.

Press and hold either the \( \Rightarrow \) or \( \Rightarrow \) key to select the desired alarm set point.

Press the \( \Rightarrow \) key momentarily to continue scrolling through the Primary Program Menu until you come to \( \Rightarrow \) \( \Rightarrow \).

Pause momentarily. After 3.2 sec the display will begin to toggle between \( \Rightarrow \) \( \Rightarrow \) and its current setting.

Press either the \( \Rightarrow \) or \( \Rightarrow \) key momentarily to highlight the numerical position to be changed.

Press and hold either the \( \Rightarrow \) or \( \Rightarrow \) key to select the desired amount of alarm hysteresis.
When a thermocouple or RTD is applied to this controller it may be necessary to establish limits that the setpoint can be set within in order to protect the system from over/under-temperature situations.

### RAMP FUNCTION

If the ramp function is enabled the process will increase or decrease, during initial power up and setpoint changes, at a rate determined by the parameter $\text{Ramp}$ which can be adjusted in units/minute. This function will be disabled when $\text{Ramp}$ is set to zero.

#### TO SET A RAMP RATE;

Press the key momentarily to enter the Primary Program Menu.

Press the key momentarily to scroll through the Primary Program Menu until you come to $\text{Ramp}$.

Pause momentarily. After 3.2 sec the display will begin to toggle between $\text{Ramp}$ and its current value.

Press either the or key momentarily to highlight the numerical position to be changed.

Press and hold either the or key to increment or decrement the desired position.

Press the key momentarily to continue scrolling through the Primary Program Menu.

### SCALING THERMOCOUPLE AND RTD(Pt100) INPUT RANGES

Example: Program a J thermocouple for 50 to 500 F

<table>
<thead>
<tr>
<th>Input Type</th>
<th>Minimum/Maximum Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>J Thermocouple</td>
<td>32 F to 1832 F</td>
</tr>
<tr>
<td>H1SC</td>
<td>0 to 500</td>
</tr>
<tr>
<td>Full Range</td>
<td>(500-50) = 450 F</td>
</tr>
</tbody>
</table>

#### Change of Setpoint

When a thermocouple or RTD is applied to this controller it may be necessary to establish limits that the setpoint can be set within in order to protect the system from over/under-temperature situations.

Parameters $\text{LoSet}$ (zero point/lower setpoint limit) and $\text{HiSet}$ (span point/upper setpoint limit) are used to scale analog inputs or to establish setpoint limits.

#### TO SET THESE PARAMETERS;

Press the key momentarily to enter the Primary Program Menu.

Press the key momentarily to scroll through the Primary Program Menu until you come to $\text{LoSet}$ / $\text{HiSet}$.

Pause momentarily. After 3.2 sec the display will begin to toggle between $\text{LoSet}$ / $\text{HiSet}$ and its current setting.

Press either the or key momentarily to highlight the numerical position to be changed.

Press and hold either the or key to enter the desired value.

---

**Change of Setpoint**

![Change of Setpoint Diagram]

**Ramp Function**

If the ramp function is enabled the process will increase or decrease, during initial power up and setpoint changes, at a rate determined by the parameter $\text{Ramp}$ which can be adjusted in units/minute. This function will be disabled when $\text{Ramp}$ is set to zero.

#### TO SET A RAMP RATE;

Press the key momentarily to enter the Primary Program Menu.

Press the key momentarily to scroll through the Primary Program Menu until you come to $\text{Ramp}$.

Pause momentarily. After 3.2 sec the display will begin to toggle between $\text{Ramp}$ and its current value.

Press either the or key momentarily to highlight the numerical position to be changed.

Press and hold either the or key to increment or decrement the desired position.

Press the key momentarily to continue scrolling through the Primary Program Menu.

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**Change of Setpoint**

![Change of Setpoint Diagram]
RAMP & SOAK/DWELL FUNCTION

A dwell timer has been incorporated into this controller. Alarm #1 can be configured by setting \( R_{15}F = t_{on} \) or \( t_{off} \) to provide either a dwell function or a soak function to be used in conjunction with the ramp function.

The ramp and soak function will allow the system to be programmed to approach setpoint at a specific ramp rate, hold the setpoint temperature for a set amount of time and then shut off the alarm relay. When the output is wired in series with the alarm relay, the output will turn off when the alarm relay shuts off. This will end the soak cycle and return the process to ambient conditions until the controller is reset.

TO SET A SOAK/DWELL TIME

Press and hold either the \( \uparrow \) or \( \downarrow \) key to increment or decrement to the desired position, \( t_{on} \) to turn the relay on after the amount of time defined by \( R_{15}F \) or \( t_{off} \) to turn the relay off after the amount of time defined by \( R_{15}F \).

Press the \( \Rightarrow \) key momentarily to continue scrolling through the Primary Program Menu until you come to parameter \( R_{15}F \).

Pause momentarily. After 3.2 sec the display will begin to toggle between \( R_{15}F \) and its current value.

Press either the \( \uparrow \) or \( \downarrow \) key momentarily to highlight the numerical position to be changed.

Press and hold either the \( \uparrow \) or \( \downarrow \) key to increment or decrement the desired time setting.

Follow the procedure outlined in Ramp Function to set a ramp rate.

While in the Primary Program Menu continue to scroll until you come to parameter \( R_{15}F \).

Pause momentarily. After 3.2 sec the display will begin to toggle between \( R_{15}F \) and its current value.

continued on page 28
TOOL PROGRAM MENU

Press the \( \text{key} \) and the \( \text{key} \) simultaneously to enter the Tool Program Menu.

Press the \( \text{key} \) and the \( \text{key} \) simultaneously to scroll through the main headings of the Tool Program Menu.

Press the \( \text{key} \) to access the parameters under each main heading within the Tool Program Menu.

Pause momentarily on a parameter to be changed. After 3.2 sec the display will begin to toggle between the parameter and its current value.

Press either the \( \text{key} \) or \( \text{key} \) momentarily to highlight the numerical position to be changed.

Press and hold either the \( \text{key} \) or \( \text{key} \) to increment or decrement the desired position.

Press the \( \text{key} \) momentarily to continue scrolling through the parameters within that heading,

or

Press the \( \text{key} \) and the \( \text{key} \) simultaneously to continue scrolling through the main headings of the Tool Program Menu.

MANUAL CONTROL

The outputs of this controller can be used in a manual mode. This enables the operator to apply a specific percentage of power to the system.

To use this unit in manual mode:

Enter the Tool Program Menu by pressing the \( \text{key} \) and the \( \text{key} \) simultaneously.

The display will toggle between \( \text{Hand} \) and \( \text{Cont} \).

Press the \( \text{key} \) momentarily.

The display will toggle between the process variable and the current output percentage \( \text{Hand} \).

To change output \#1 skip this step, to change output \#2 press the \( \text{key} \) momentarily to display the output percentage for the cooling output \( \text{Clic} \).

Press and hold the \( \text{key} \) for 3.2 seconds.

The display will begin flashing as it toggles between the process variable and \( \text{Hand} \).

Use the \( \text{key} \) and \( \text{key} \) keys to highlight and change the display \( \text{Hand} \) to the desired output percentage.

Example:
\( \text{Hand} \) is viewed with cycle time \( \text{Cyc} \) = 10 sec.

The output 1 will act as shown:
Enter the manual control mode. Allow to adjust the percentage value of Heating output by using (3) or (5) 000~100%.

View the percentage power of Heating output.

View the maximum (peak) process value.

View the minimum (peak) process value.

Adjust the cold-junction compensation code. (-19.9~42.7 count)

Adjust the drift compensation code. (-6.6~6.6 count)

Select a proper status for Output:
- Output ON
- Output OFF

Select a proper status for Alarm:
- Alarm ON
- Alarm OFF

Select Lock or Free for the Security Level 0:
- Protect (Lock) all the Level 0 parameters.
- Allow all the Level 0 parameters to be adjustable.

Select Lock or Free for the Security Level 1:
- Protect (Lock) all the Level 1 parameters.
- Allow all the Level 1 parameters to be adjustable.

Select Lock or Free for the Security Level 2:
- Protect (Lock) all the Level 2 parameters.
- Allow all the Level 2 parameters to be adjustable.

Configure security levels for all parameters.

Security LEVEL:
- 0: Put the parameter in LEVEL 0.
- 1: Put the parameter in LEVEL 1.
- 2: Put the parameter in LEVEL 2.
- 3: Mask parameter

Display the rest of parameters according to the standard access sequence.

* Do not proceed through this section unless there is a definite need to re-calibrate the controller. All previous calibration data will be lost.
**PROGRAMMABLE CONTROL ACTION**

Output #1 can be used in a reverse action configuration (heating applications) or in a direct action configuration (cooling applications) by adjusting parameter \( \text{ConR} \).

To adjust the control action of output #1:

Press the \( \) key momentarily to enter the Primary Program Menu.

Press the \( \) key momentarily to scroll through the Primary Program Menu until you come to \( \text{ConR} \).

Pause momentarily. After 3.2 sec the display will begin to toggle between \( \text{ConR} \) and its current setting.

Press and hold either the \( \) or \( \) key to select the desired control action (\( \text{dir} \) = direct / \( \text{rev} \) = reverse).

**COOLING CONTROL**

This controller has the option of being configured as a single or a dual output controller.

The alarm output can be used as a control output by setting parameter \( \text{AFSF} \) in the Primary Program Menu to \( \text{Cool} \). Once this is done the following parameters are used as output #2 control parameters:

- **CPB**: Cooling Proportional Band
- **DB**: Dead Band
- **CCYC**: Cooling Cycle Time

![Diagram showing control actions](image)

Note: PB = Proportional Band
**CONFIGURABLE MENUS**

This controller gives you the flexibility to configure the menus in a way that is most convenient for your application. There are four menu levels that parameters in the primary program menu can be assigned to.

- **LEV0** - This is the first group of parameters within the Primary Program Menu. Locate parameters here that need to be changed frequently or that need to be accessed easily.

- **LEV1** - This is the second group of parameters within the Primary Program Menu. Locate parameters here that need to be accessed but not frequently.

- **LEV2** - This is the third group of parameters within the Primary Program Menu. Locate parameters here that are specific to your application but are not going to be changed.

- **LEV3** - This is a level used to mask parameters that are not used for your application or parameters that are not to be accessed by the operator.

**TO ASSIGN PARAMETERS TO A SPECIFIC LEVEL**

Press the key and the key simultaneously to enter the Tool Program Menu.

Press the key and the key simultaneously to scroll through the Tool Program Menu until you come to .

Pause momentarily. After 3.2 sec the display will begin to toggle between and .

Press the key to access the parameters under this, contained within the primary program menu and their current menu level.

Pause momentarily on a parameter to be changed. After 3.2 sec the display will begin to toggle between the parameter and the level it is currently assigned to.

Press and hold either the or key to increment or decrement to the menu level desired.

Press and hold the key for 3.2 sec to register the selection.

*continued on page 36*
LOCKING MENUS

The various menu levels within the Primary Program menu can be left free so that information can be viewed as well as changed, or any of the levels can be locked so that the information can only be viewed but not changed.

TO LOCK A MENU LEVEL WITHIN THE PRIMARY PROGRAM MENU

Press the  key and the  key simultaneously to enter the Tool Program Menu.

Press the  key and the  key simultaneously to scroll through the Tool Program Menu until you come to  .

Pause momentarily. After 3.2 sec the display will begin to toggle between  and  .

Press the  key to access the parameters  .

Pause momentarily on a menu level to be changed. After 3.2 sec the display will begin to toggle between the parameter and the lock setting it is currently set to.

Press and hold either the  or  key to increment or decrement to the lock level desired (  = locked,  = accessible).

Press and hold the  key for 3.2 sec to register the selection.

ERROR MESSAGES

<table>
<thead>
<tr>
<th>Symptom</th>
<th>Probable Cause(s)</th>
<th>Solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Process display shows: $s^e$</td>
<td>- Sensor break</td>
<td>- Replace RTD or sensor - Use manual mode operation</td>
</tr>
<tr>
<td>Process display shows: $l^d$</td>
<td>- Input signal beyond the low range, sensor fails</td>
<td>- Replace sensor - Check sensor or thermocouple type, correct input selection</td>
</tr>
<tr>
<td>Process display shows: $h^d$</td>
<td>- Input signal beyond the high range, sensor fails</td>
<td>- Replace sensor - Check sensor or thermocouple type, correct input selection</td>
</tr>
<tr>
<td>Process display shows: $a^d$</td>
<td>- A to D module damage</td>
<td>- Replace module - Check for outside source of damage such as transient voltage spikes</td>
</tr>
<tr>
<td>Process display shows: $p^e$</td>
<td>- Incorrect operation of auto tune procedure - Manual mode is not allowed for an ON-OFF control system</td>
<td>- Repeat procedure. Increase Prop. band to a number larger than 0.</td>
</tr>
<tr>
<td>Process display shows: $c^e$</td>
<td>- Check-sum error, values in memory may have changed accidentally.</td>
<td>- Check and reconfigure control parameters</td>
</tr>
<tr>
<td>Process display shows: $n^e$</td>
<td>- Fail to enter data into EEPROM</td>
<td>- Replace EEPROM</td>
</tr>
<tr>
<td>Process display shows: $o^e$</td>
<td>- Overflow error, data out of range during execution of program</td>
<td>- Check if there is noise coming in. - Replace EEPROM.</td>
</tr>
<tr>
<td>Process display shows: $l^c$</td>
<td>- Attempt to change a locked parameter</td>
<td>- UNLOCK procedure stated in the flow chart of tool programs.</td>
</tr>
</tbody>
</table>