The Sixth Sense AI-100

1/32 DIN Fuzzy Logic controller

User's Manual

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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.
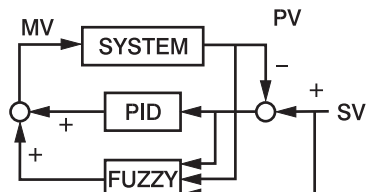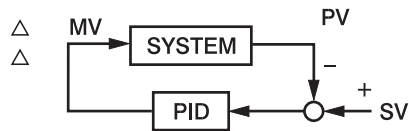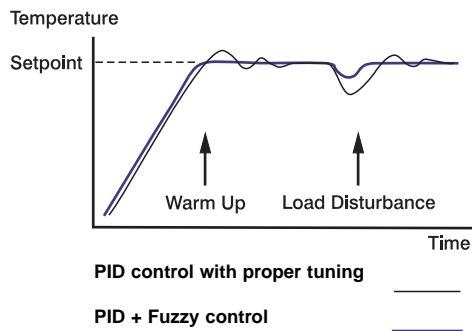

Figure 2. *PID with fuzzy logic*

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

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

LINEAR INPUTS (All scalable)

Input type	Range	Accuracy
4-20 mA, 0-20 mA, 0-1V, 0-5V, 1-5V, 0-10V	-1400 to 9400	±0.05% FS

MODEL CONFIGURATION

A	I	1	0	0	-	☐	☐	☐	☐	☐

POWER INPUT

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

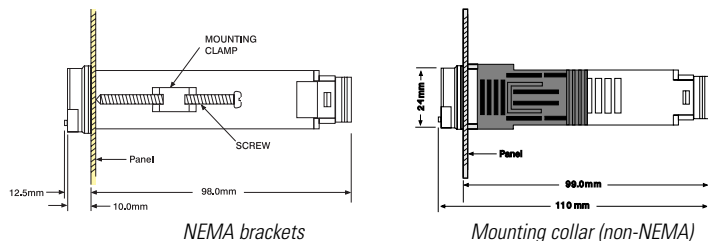|	
0	None
1	Relay
2	SSR Drive
3	4-20mA
4	0-20mA
5	0-10V

AUXILIARY OPTIONS

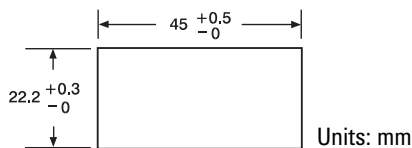|	
0	None
1	RS-485 Communications
2	Retransmission 4-20mA/0-20mA

INSTALLATION

MOUNTING

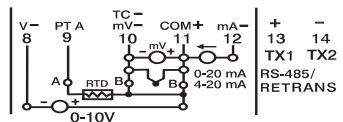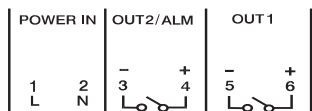Install mounting clamp(s). Gently tighten clamp until the controller fits snugly against the front panel.

NEMA brackets   *Mounting collar (non-NEMA)*

Make panel cutout as shown in figure

1.772"(W) X 0.874"(H)

Units: mm

WIRING

The following connections for outputs and inputs are provided on the wiring diagram located at the rear of the housing:

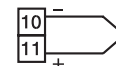*Rear Terminal Connections*

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.

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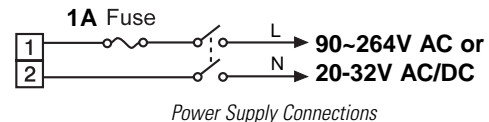
This equipment is designed for installation in an enclosure which provides adequate protection against electric shock. The enclosure must be connected to earth ground.

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.

Thermocouple Input Connections
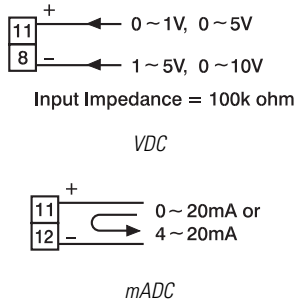
Pt100 Ohm RTD INPUT

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.
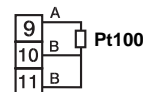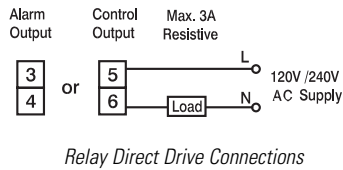

RTD input Connections

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

VDC

mADC

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 Direct Drive Connections

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


Relay Contactor Drive Connections
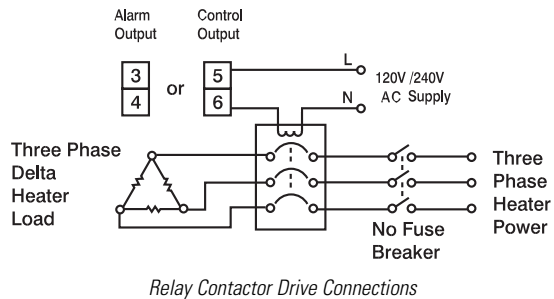
DC PULSE (SOLID-STATE RELAY DRIVE) OUTPUT
Controllers fitted with the DC pulse output produce a time-proportional non-isolated pulse voltage (0-24V nominal, output impedance 660Ω). The connections are shown in the illustration below.



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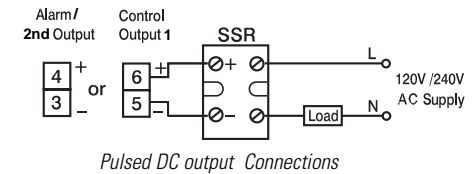
DC LINEAR OUTPUT
There are three types of linear output modules that can be selected for the output. The connections are shown in the illustration below.

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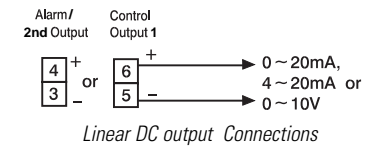
RS-485 COMMUNICATIONS/ANALOG RETRANSMISSION
RS-485 serial communications or Analog retransmission of process variable, setpoint, or manipulated variable can be selected as an optional feature. The connections are shown in the illustration below.

RS-485 Communications

Analog retransmission
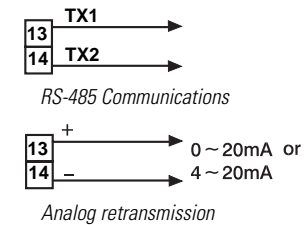
NEGOTIATING THE MENU

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 ⏶ or ⏷ key momentarily to view set-point.
or
Press the ⟳ key momentarily to enter the Primary Program Menu.
or
Press the ⟳ key and the ⏷ key simultaneously to enter the Tool Program Menu.

TOUCH KEYS	FUNCTION	DESCRIPTION
⏶	Up key	Press to select digit to change. Press and hold to increase value for parameter
⏷	Down key	Press to select digit to change. Press and hold to decrease value for parameter
⟳	Scroll key	Press to select parameter in direct sequence or to select tool program parameters
⟳ press for 3.2 seconds	Long scroll/ Enter key	Use to select protected parameters in higher security level or to actuate selected tool program
⟳ & ⏶	Reverse scroll/ Calibration Verification	Use to select parameter in reverse sequence or to verify display accuracy for input types during calibration
⟳ & ⏶ press for 3.2 seconds	Lock key	Use to disable keypad operation to protect parameters
⟳ & ⏷	Tool program key	Press to select tool program in sequence
⏶ & ⏷	Reset/Exit key	Press to unlock keypad operation, to reset display, to exit tool program, or to end autotune and manual control execution.
⏶ & ⏷ press for 3.2 seconds	Autotune key	Hold both keys for 3.2 seconds then release to start autotune.

LEARNING THE PARAMETERS

5∪ **SV - Setpoint**
This parameter is the target value for the process. It can be adjusted throughout the range defined by the Low Scale Value *LoSC* and High Scale Value *hi.SC* . Set in degrees/engineering units.

ASP.1 **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 - Ramp Rate**
This determines the rate at which your process will approach set-point. Setting this parameter to 0 will cause your system to approach setpoint at maximum speed. Set in degrees/minute.

oFSt **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.

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

hYSt **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.

| t_l | **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.

| t_d | **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 | **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).

Code for "Addr"	Retransmission
192	4~20mA, PV
193	4~20mA, SV
194	4~20mA, MV1 (Output 1)
195	4~20mA, MV2 (Output 2)
196	0~20mA, PV
197	0~20mA, SV
198	0~20mA, MV1 (Output 1)
199	0~20mA, MV2 (Output 2)

| Lo.SC |
| hi.SC | **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.

| PL.1 |
| PL.2 | **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 | **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 | **UNIT - Process Unit**
Used to select the correct engineering units for the process. (PU for Analog inputs, C or F for temperature applications).

| rESo | **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.)

| Con.A | **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.

| A1.md | **A1MD - Alarm Mode Selection for Alarm #1**
Refer to page 22 for the various alarm types available.

A1SF | **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 **C.CYC** | **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.

C.Pb **d-b** | **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.

Normal Display

Parameter	Description
Process value / setpoint value	Low scale to high scale value **212.0°F
ASP1 — Alarm 1 Set Point Value or Dwell Time (A1SF = toon or tooF)	Low scale–high scale value (for Full Scale Alarm), -111.0~111.0°C or -199.9~199.9°F (for Deviation and Deviation Band Alarm), 0-9999 minutes (for Dwell Time) **18.0°F
rAnP — Ramp Rate	0-55.55°C/minute or 0 ~ 99.99°F/minute **0.00
oFSt — Offset Value for Manual Reset (Integral Time TI=0)	0~100.0% **0.0
Sh.F — Shift Process Value	-111.0~111.0°C or -199.9~199.9°F **0.0°F
Pb — Proportional Band of Output 1	0~200.0°C or 0~360.0°F, 0:For ON-OFF control **18.0°F
ti — Integral (Reset) Time of Output 1	0~3600 seconds**120
td — Derivative (Reset) Time of Output 1	0~1000 seconds**40
AhY1 — Hysteresis of Alarm 1	0~11.0°C or 0.1~ 19.9°F **00.1°F
hYSt — Hysteresis of ON-OFF control	0~11.0°C or 0.1~ 19.9°F **00.1°F
Addr — Address of the unit for the communication	0~40 **00
LoSC — Low Scale of Range Adjust for your process	Minimum value for the selected input (INPUT) to High Scale (HISC) **000.0°F
hiSC — High Scale of Range Adjust for your process	Low Scale (LOSC) to maximum value for the selected input (INPUT) **999.9°F
PL1 — Power Limit of Output 1	0~100% **100
PL2 — Power Limit of Output 2	0~100% **100
inPt — Input Type Selection	
unit — Select Unit	
rESo — Resolution Selection	
ConA — Control Action of Output 1	
A1nd — Alarm 1 Mode	
A1SF — Alarm 1 Special Function	
CYC — Proportional Cycle Time of Output 1	0~99 Seconds, 0 for Linear current/Voltage output. **20
CCYC — Cooling Cycle Time	0~99 Seconds, 0 for Linear current/Voltage output. **20
CPb — Cooling P Band	0.0~200.0°C or 0.1~360.0°F **18.0°F
d-b — Dead Band for PB and CPB	-111.0~111.0°C or -199.9~199.9°F, **000.0°F

Input Type Selection (inPt):

J-tC	:J TYPE T/C
**K-tC	:K TYPE T/C
t-tC	:T TYPE T/C
E-tC	:E TYPE T/C
b-tC	:B TYPE T/C
r-tC	:R TYPE T/C
S-tC	:S TYPE T/C
n-tC	:N TYPE T/C
Ptdn	:PT100 DIN
Pt.JS	:PT100 JIS
4-20	:4-20MA
0-20	:0-20MA
0-1v	:0-1V
0-5v	:0-5V
1-5v	:1-5V
0-10	:0-10V

Select Unit (unit):

oC	:degree C
** oF	:degree F
P.u	:process unit (Voltage or Current Input)

Resolution Selection (rESo):

** nodP	:No Decimal Point Used
1dP	:1 Digit Decimal
2.dP	:2 Digit Decimal (only for Linear Voltage or Current Input)

Control Action of Output 1 (ConA):

di.rt	:Direct (Cooling) Action.
** rEur	:Reverse (Heating) Action.

Alarm 1 Special Function (A1SF):

** nonE	:No Special Function
LtCh	:Alarm with Latch Function
hold	:Alarm with Hold Function
Ltho	:Alarm with Latch & Hold Function
toon	:Dwell Timer ON as Time Out.
tooF	:Dwell Timer OFF as Time Out.
CooL	:Proportional cooling

Alarm 1 Mode (A1nd):

dvhi	:Deviation High Alarm.
dvLo	:Deviation Low Alarm.
dbhi	:Deviation Band High Alarm.
dbLo	:Deviation Band Low Alarm.
FShi	:Full Scale High Alarm.
FSLo	Full Scale Low Alarm.

Level 0 | Level 1 | Level 2

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.
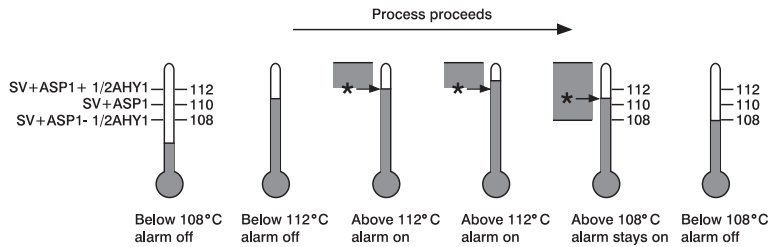
**: Denotes the default setting

Long (symbol): Press and hold (symbol) for at least 3.2 seconds
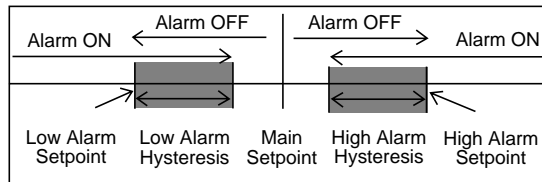
19   20

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;

$\boxed{RSP.1}$ **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

Process proceeds →

SV+ASP1+ 1/2AHY1 — 112 SV+ASP1 — 110 SV+ASP1- 1/2AHY1 — 108				112 110 108	112 110 108
Below 108°C alarm off	Below 112°C alarm off	Above 112°C alarm on	Above 112°C alarm on	Above 108°C alarm stays on	Below 108°C alarm off

$\boxed{RhY.1}$ **Alarm 1 Hysteresis** - This parameter establishes an area around Alarm 1 setpoint where the alarm relay will not change states.

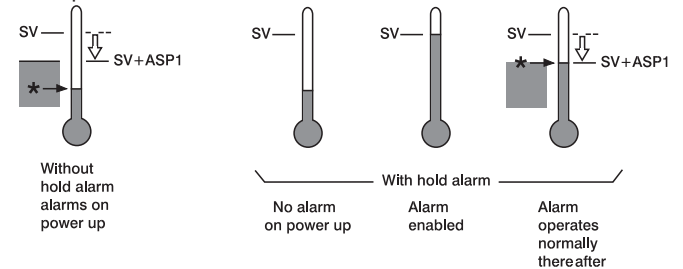| Alarm ON ← Alarm OFF →	Alarm OFF → Alarm ON
Low Alarm Setpoint Low Alarm Hysteresis Main Setpoint	High Alarm Hysteresis High Alarm Setpoint

$\boxed{R\ l\bar{n}d}$ **Alarm 1 mode** - This parameter determines the alarm type that is to be used, such as a deviation alarm, a band alarm, or an absolute alarm.

Code	Type		
1	Full scale high	$\boxed{FSh\ i}$	Alarm Set point → PV
2	Full scale low	$\boxed{FSLo}$	Alarm Set point → PV
3	Deviation high	$\boxed{d\underline{y}h_i}$	Alarm Set point / Set point → PV
4	Deviation low	$\boxed{d\underline{y}Lo}$	Alarm Set point / Set point → PV
7	Deviation band high	$\boxed{dbh\ i}$	Alarm Set point / Set point → PV
8	Deviation band low	$\boxed{dbLo}$	Set point → PV

$\boxed{R\ lSF}$ **Alarm 1 Spec. Func.-** This parameter assigns special functions to Alarm 1 such as a **holding** feature $\boxed{hoLd}$ that prevents an alarm during start up or a **latch** function $\boxed{LtCh}$ that prevents the alarm from clearing unless power is interrupted.

Example: Deviation low alarm with Hold function.

SV — ⇓ SV+ASP1	SV —	SV —	SV — ⇓ SV+ASP1
Without hold alarm alarms on power up	No alarm on power up	Alarm enabled	Alarm operates normally thereafter
	With hold alarm		

SETTING ALARMS

To set an alarm:

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 ⟦ $A~Ind$ ⟧ .

Pause momentarily. After 3.2 sec the display will begin to toggle between ⟦ $A~Ind$ ⟧ and its current setting.

Press and hold either the ⟰ or ⟱ key to select the desired alarm type.

Press the ⟳ key momentarily to continue scrolling through the Primary Program Menu until you come to ⟦ $A~1.SF$ ⟧ .

Pause momentarily. After 3.2 sec the display will begin to toggle between ⟦ $A~1.SF$ ⟧ and its current setting.

Press and hold either the ⟰ or ⟱ key to select the desired alarm special function.

Press the ⟳ key momentarily to continue scrolling through the Primary Program Menu until you come to ⟦ $ASP.1$ ⟧ .

Pause momentarily. After 3.2 sec the display will begin to toggle between ⟦ $ASP.1$ ⟧ 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 select the desired alarm set point.

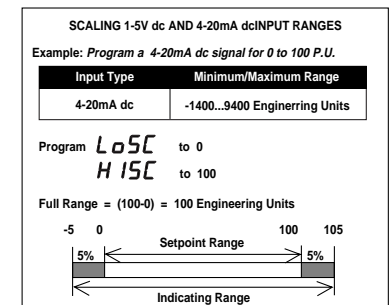Press the ⟳ key momentarily to continue scrolling through the Primary Program Menu until you come to ⟦ $Ahy.1$ ⟧ .

Pause momentarily. After 3.2 sec the display will begin to toggle between ⟦ $Ahy.1$ ⟧ 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 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.

SCALING 1-5V dc AND 4-20mA dcINPUT RANGES

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

Input Type	Minimum/Maximum Range
4-20mA dc	-1400...9400 Enginerring Units

Program $LoSC$ to 0
        $H~1SC$ to 100

Full Range = (100-0) = 100 Engineering Units

-5   0   100   105
         Setpoint Range
5%   5%

Indicating Range

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.

SCALING THERMOCOUPLE AND RTD(Pt100) INPUT RANGES

Example: *Program a J thermocouple for 50 to 500 F*

Input Type	Minimum/Maximum Range
J Thermocouple	32 . . . . .1832 F

Program $LoSC$ to 50
$HISC$ to 500

Full Range = (500-50) = 450 F

27.5 50   500 522.5
5%   Setpoint Range   5%
Indicating Range

Parameters $\boxed{LoSC}$ (zero point/lower setpoint limit) and $\boxed{hi.SC}$ (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 $\boxed{LoSC}$ / $\boxed{hi.SC}$.

Pause momentarily. After 3.2 sec the display will begin to toggle between $\boxed{LoSC}$ / $\boxed{hi.SC}$ 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.

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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 $\boxed{rAnP}$ which can be adjusted in units/minute. This function will be disabled when $\boxed{rAnP}$ is set to zero.

TO SET A RAMP RATE;

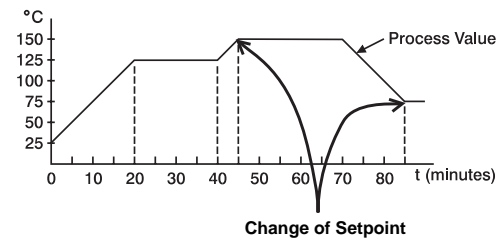Press the ⟳ key momentarily to enter the Primary Program Menu.

Press the ⟳ key momentarily to scroll through the Primary Program Menu until you come to $\boxed{rAnP}$.

Pause momentarily. After 3.2 sec the display will begin to toggle between $\boxed{rAnP}$ 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.

°C
150
125
100
75
50
25

0 10 20 30 40 50 60 70 80   t (minutes)

Process Value

Change of Setpoint

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RAMP & SOAK/DWELL FUNCTION

A dwell timer has been incorporated into this controller. Alarm #1 can be configured by setting $\boxed{\text{A 1.5F}}$ = $\boxed{\text{t.o.on}}$ or $\boxed{\text{t.o.oF}}$ 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
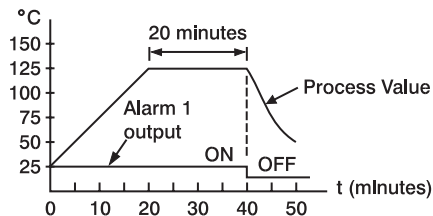
Follow the procedure outlined in Ramp Function to set a ramp rate.

While in the Primary Program Menu continue to scroll until you come to parameter $\boxed{\text{A 1.5F}}$.

Pause momentarily. After 3.2 sec the display will begin to toggle between $\boxed{\text{A 1.5F}}$ and its current value.

Press and hold either the ⏶ or ⏷ key to increment or decrement to the desired position, $\boxed{\text{t.o.on}}$ to turn the relay on after the amount of time defined by $\boxed{\text{A5P.1}}$ or $\boxed{\text{t.o.oF}}$ to turn the relay off after the amount of time defined by $\boxed{\text{A5P.1}}$.

Press the ↻ key momentarily to continue scrolling through the Primary Program Menu until you come to parameter $\boxed{\text{A5P.1}}$.

Pause momentarily. After 3.2 sec the display will begin to toggle between $\boxed{\text{A5P.1}}$ 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 time setting.

TOOL 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 main headings of the Tool Program Menu.

Press the ⟳ 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 ⌃ 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 parameters within that heading,

or

Press the ⟳ key and the ⌄ 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 ⟳ and the ⌄ key simultaneously.

The display will toggle between $\boxed{hAnd}$ and $\boxed{Cont}$.

Press the ⟳ key momentarily.

The display will toggle between the process variable and the current output percentage $\boxed{h\_\_\_}$.

To change output #1 skip this step, to change output #2 press the ⟳ key momentarily to display the output percentage for the cooling output $\boxed{C\_\_\_}$.
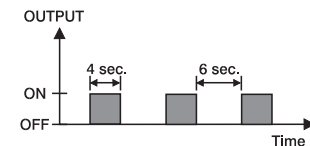
Press and hold the ⟳ key for 3.2 seconds.

The display will begin flashing as it toggles between the process variable and $\boxed{h\_\_\_}$.

Use the ⌃ and ⌄ keys to highlight and change the display $\boxed{h\_\_\_}$ to the desired output percentage.

Example:
$\boxed{H\ 40}$ is viewed with cycle time $\boxed{CYC}$ =10 sec.
The output 1 will act as shown:

Flow Chart of Tool Programs

Hand (manual) control.

hAnd / Cont

- View the percentage power of Heating output. — Long C — Enter the manual control mode. Allow to adjust the percentage value of Heating output by using ≪ or ≫ . 000~100%

h _ _ _

- View the percentage power of Cooling output (Alarm). — Long C — Enter the manual control mode. Allow to adjust the percentage value of Cooling output (Alarm) by using ≪ or ≫ . 000~100%

C _ _ _

Read peak process value.

rEAd / PEAH

- View the maximum (peak) process value. — Long C — Reset the maximum and minimum process values.

h.Pu

- View the minimum (peak) process value. — Long C — Reset the maximum and minimum process values.

Lo.Pu

Calibrate A-D converter*.

CAL, / A-d

- Adjust the cold-junction compensation code. (-19.9~42.7 count) ≪ or ≫ — Long C — Calibrate the A-D and enter the cold-junction compensation

t _ _ _

- ≪ or ≫ — Long C — Calibrate the 0~20mA and enter it.

A _ _ _

- Adjust the drift compensation code. (-6.6~6.6 count) ≪ or ≫ — Long C — Enter the drift compensation code.

d _ _ _

Define protection mode for the status of control and alarm outputs 1 & 2 to ensure a safe condition while the control fails.

FA, L / SAFE

- Select a proper status for Output . on:Output ON ** oFF: Output OFF ≪ or ≫ — Long C — Enter the status.

out.1

- Select a proper status for Alarm . ** on:Alarm ON oFF: Alarm OFF ≪ or ≫ — Long C — Enter the status.

ALr2

Lock parameters.

LoCH / PArA

- Select Lock or Free for the Security Level 0. LoCH: Protect (Lock) all the Level 0 parameters. **FrEE : Allow all the Level 0 parameters to be adjustable. ≪ or ≫ — Long C — Enter the selection

LEu0

- Select Lock or Free for the Security Level 1. LoCH: Protect (Lock) all the Level 1 parameters. **FrEE : Allow all the Level 1 parameters to be adjustable. ≪ or ≫ — Long C — Enter the selection

LEu1

- Select Lock or Free for the Security Level 2. LoCH: Protect (Lock) all the Level 2 parameters. **FrEE : Allow all the Level 2 parameters to be adjustable. ≪ or ≫ — Long C — Enter the selection

LEu2

Configure security levels for all parameters.

ConF / LEuL

- Change the value of security level for the selected parameter. ≪ or ≫ — Long C — Enter the updated security level of ASP1.

ASP.1

- Change the value of security level for the selected parameter. ≪ or ≫ — Long C — Enter the updated security level of RAMP.

rAmP

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

- Change the value of security level for the selected parameter. ≪ or ≫ — Long C — Enter the updated security level of DB.

d - b

LEuL
: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

* 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 $\boxed{\text{ConA}}$.

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 $\boxed{\text{ConA}}$.

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

Press and hold either the 🔼 or 🔽 key to select the desired control action ($\boxed{\text{dirt}}$ = direct / $\boxed{\text{rEyr}}$ = reverse).

Reverse Action **Direct Action**
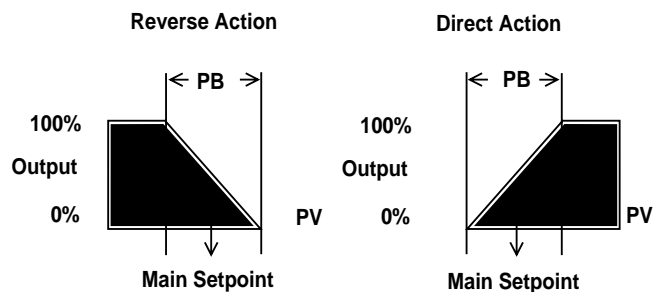
Note: PB = Proportional Band

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 $\boxed{\text{A1SF}}$ in the Primary Program Menu to $\boxed{\text{Cool}}$. 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
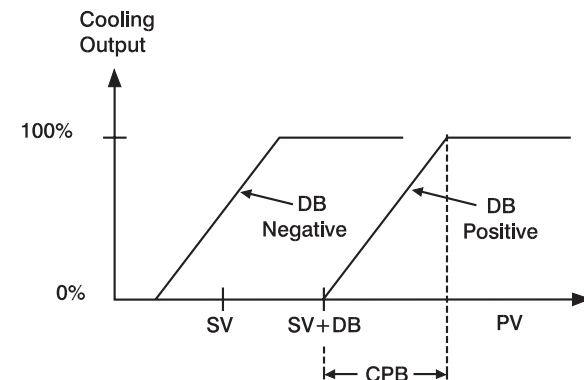
CONFIGURABLE MENUS

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.

$\boxed{LE\text{Y}O}$ - 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.

$\boxed{LE\text{Y} I}$ - This is the second group of parameters within the Primary Program Menu. Locate parameters here that need to be accessed but not frequently.

$\boxed{LE\text{Y}2}$ - 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.

$\boxed{LE\text{Y}3}$ - 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 $\boxed{COnF}$.

Pause momentarily. After 3.2 sec the display will begin to toggle between $\boxed{COnF}$ and $\boxed{LE\text{Y}L}$.
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.

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 $\boxed{LoCt}$.

Pause momentarily. After 3.2 sec the display will begin to toggle between $\boxed{LoCt}$ and $\boxed{PArA}$.

Press the ⟳ key to access the parameters $\boxed{LEy0}$ - $\boxed{LEy2}$.

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 ($\boxed{LoCt}$ = locked, $\boxed{FrEE}$ = accessible).

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

ERROR MESSAGES

Symptom	Probable Cause(s)	Solution
Process display shows: $\boxed{SbEr}$	- Sensor break	- Replace RTD or sensor - Use manual mode operation
Process display shows: $\boxed{LLEr}$	- Input signal beyond the low range, sensor fails	- Replace sensor - Check sensor or thermocouple type, correct input selection
Process display shows: $\boxed{HHEr}$	- Input signal beyond the high range, sensor fails	- Replace sensor - Check sensor or thermocouple type, correct input selection
Process display shows: $\boxed{AdEr}$	- A to D module damage	- Replace module - Check for outside source of damage such as transient voltage spikes
Process display shows: $\boxed{oPEr}$	- Incorrect operation of auto tune procedure - Manual mode is not allowed for an ON-OFF control system	- Repeat procedure. Increase Prop. band to a number larger than 0.
Process display shows: $\boxed{CSEr}$	- Check-sum error, values in memory may have changed accidentally.	- Check and reconfigure control parameters
Process display shows: $\boxed{ntEr}$	- Fail to enter data into EEPROM	- Replace EEPROM
Process display shows: $\boxed{OyEr}$	- Overflow error, data out of range during execution of program	- Check if there is noise coming in. - Replace EEPROM.
Process Display shows: $\boxed{LoCt}$	- Attempt to change a locked parameter	- UNLOCK procedure stated in the flow chart of tool programs.