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E-91
P.N. 136109

MIC 1462 1/4 DIN SETPOINT PROGRAMMER

REFERENCE MANUAL

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SECTION 1: PRODUCT DESCRIPTION

1.1 General

This instrument is a powerful, easy-to-use 1/4 DIN setpoint programmer with full PID control capability (complete with Self-Tune and Pre-Tune facilities).

Control functions, alarm settings and other parameters are easily entered through the front keypad. E² 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.

Standard features include:

- Up to eight programs of up to 16 free-format (i.e., dwell, ramp, join, or end) segments each.
- Facility to join programs to one another in any sequence (maximum program length 121 segments)
- User can change currently-running program segment.
- Delayed Start of Program facility
- End of Program relay output
- Universal input-thermocouple, RTD (PT100) or DC linear user-selectable.
- Universal power supply (90 -264V AC 50/60 Hz)
- Configurable from front panel
- Comprehensive front panel displays
- Front panel sealing to NEMA 4 standard
- Behind-panel depth only 100mm (3.94 inches)
- Power failure recovery

Optional features include:

- Remote control and selection of program (plug-in option)
- Up to four Event relay outputs (plug-in option)
- Second control output
- Alarm outputs
- Recorder output (setpoint or process variable)
- RS-485 serial communications
- User-definable program tag names
- Support software (Off-line Configurator, On-line Graphic Program Editor) - operates via RS-485 communications link.
- Real-time clock

1.2 Displays

Each instrument is provided with two main displays, a message display, and status indicators as shown in Figure 1 -1. The upper main display shows the value of the process variable. The lower main display shows the setpoint value. The message display shows parameter tag names and mode list items during various modes of operation.

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. In addition, setpoint programming is available to step the controller through ramp and soak segments.

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.

1.5 Re-Transmission (Analog) Output

If the instrument is specified with this option, the process variable or setpoint value can be scaled over any desired range and re-transmitted

1.6 Remote Inputs

The optional remote inputs allow for external selection of a profile; profile start; hold; or reset; and for selection of profile timebase.

1.7 Event Outputs

The optional event outputs may be used to control external components during either single setpoint control (Base Mode) operation or during a profile (Program Run Mode). The events can be configured as timed or process value events.

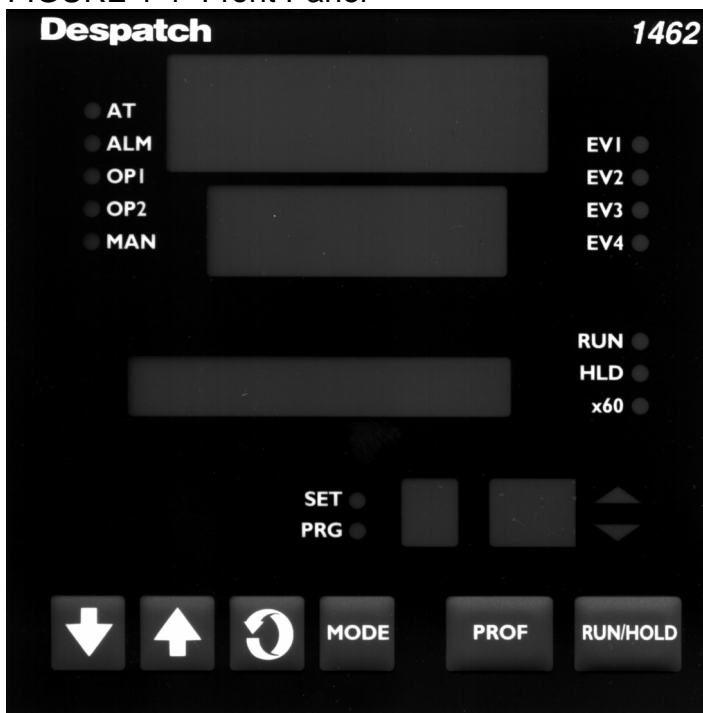
1.8 Real-Time Clock

The instrument may be fitted with a real-time clock which allows starting a profile at a specific time and day. The clock may also be used by the controller to determine whether to restart a profile or return to Base Mode when a power loss occurs.

1.9 Communications

The optional communications feature allows the instrument to be controlled from an external source or to supply digital information. This feature provides for uploading/downloading of profiles and configuration information.

FIGURE 1-1 Front Panel



SECTION 2: INSTALLATION & WIRING

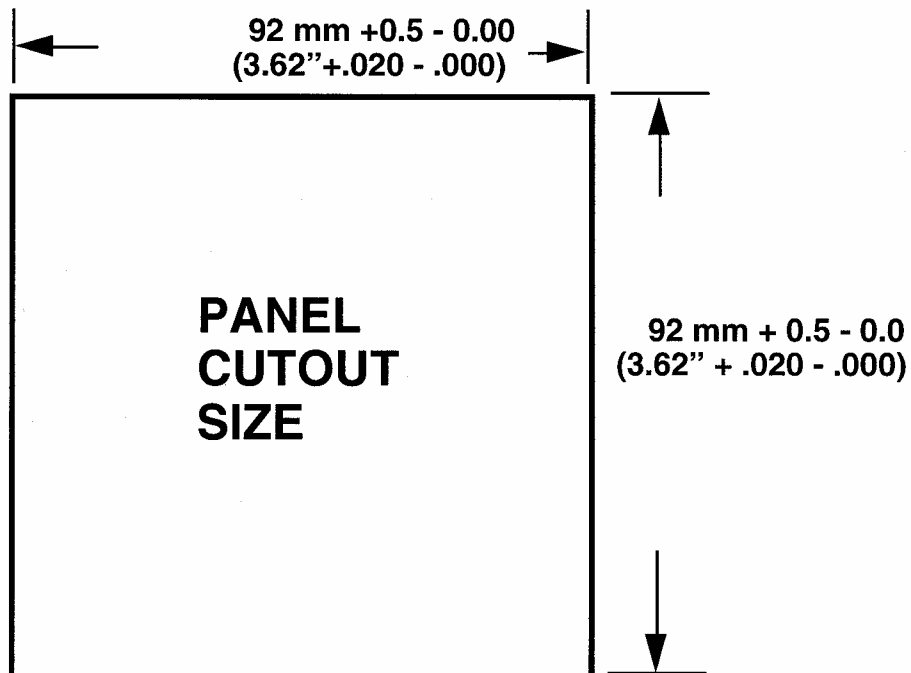
2.1 Unpacking Procedure

1. Remove the instrument from its packing. The instrument is supplied with a panel gasket and push-fit strap. Retain the packing for future use, should it be necessary to transport the instrument to a different site or return it to the factory for repair/testing.
2. Examine the delivered items for damage or deficiencies. If any is found, notify the carrier immediately. Check that the model number shown on the label affixed to the instrument housing corresponds to that ordered (see Appendix D).

2.2 Panel-Mounting The Setpoint Programmer

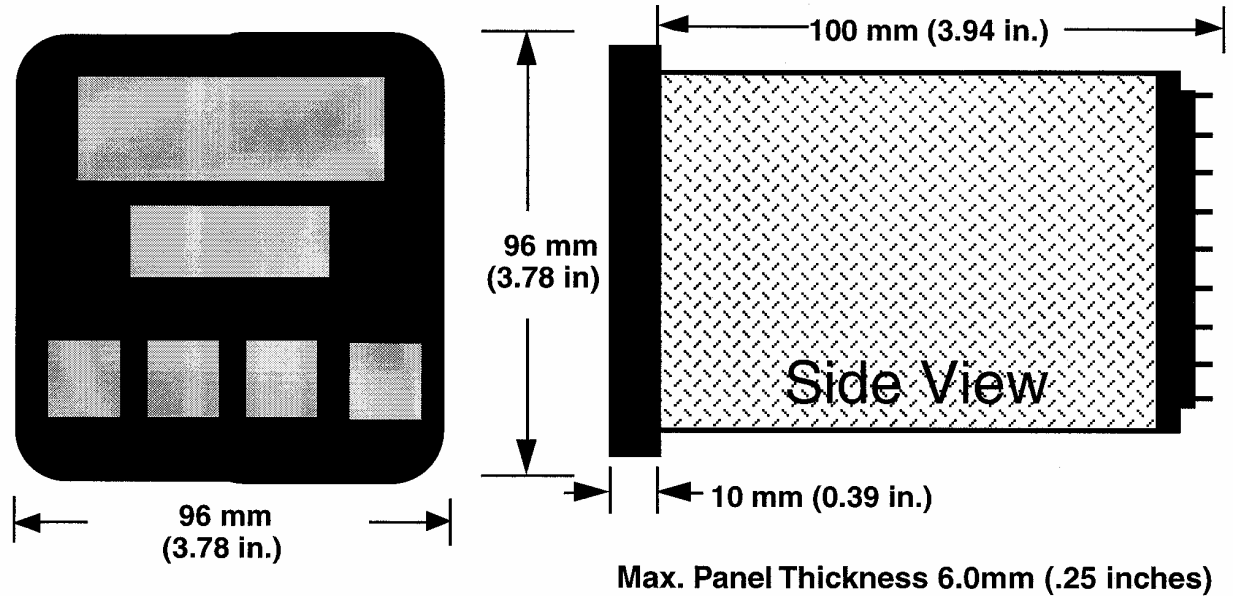
The panel on which the instrument is to be mounted must be rigid and may be up to 6.0 mm (.25 inches) thick. The cutout required for a single instrument is shown in Figure 2-1.

FIGURE 2-1
Cut-Out Dimensions



The main dimensions of the instrument are shown below.

FIGURE 2-2
Main Dimensions



To panel-mount the instrument:

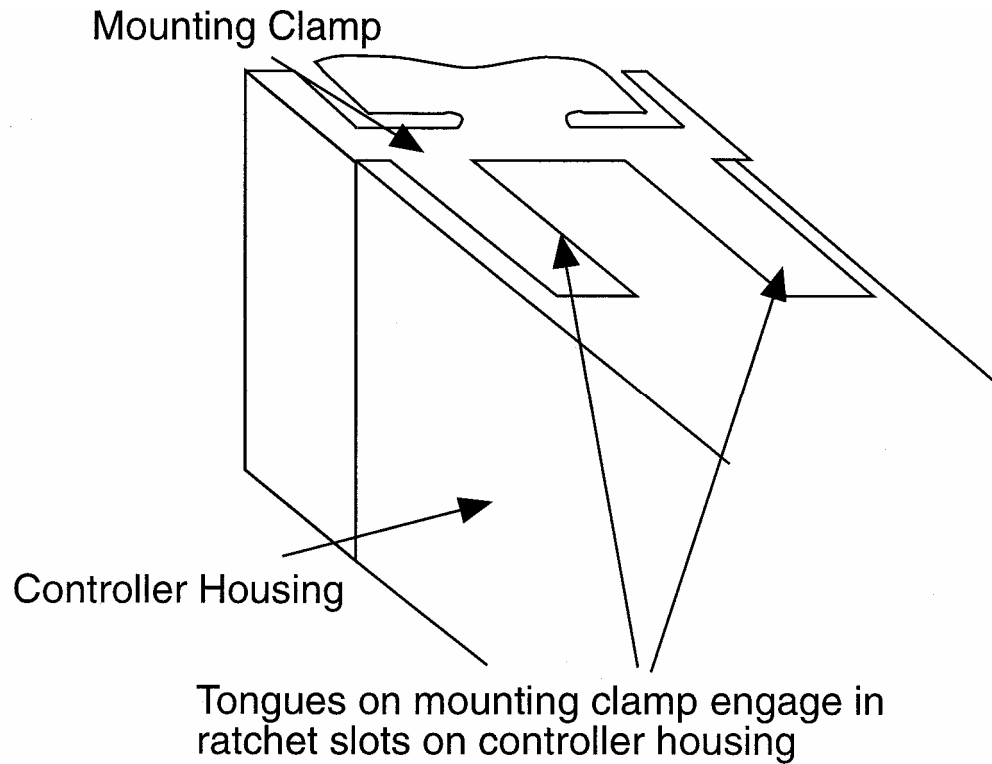
1. Insert the rear of the instrument housing through the cutout (from the front of the mounting panel) and hold the instrument lightly in position against the panel. Ensure that the panel gasket is not distorted and that the instrument is positioned squarely against the mounting panel. Apply pressure to the front panel bezel only.

Caution: Do not remove the panel gasket, as this may result in inadequate clamping of the instrument in the panel.

2. Slide the fixing strap in place (Figure 2-3) and push it forward until it is firmly in contact with the rear face of the mounting panel (the tongues on the strap should have engaged in matching ratchet positions on the instrument housing and the fixing strap springs should be pushing firmly against the mounting panel rear face).

Once the instrument is installed in its mounting panel, it may be subsequently removed from its housing, if necessary, as described in Appendix B.

FIGURE 2-3
Panel-Mounting the Instrument



2.3 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.

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.

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.

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 mADC)
- 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 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 the source.

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.

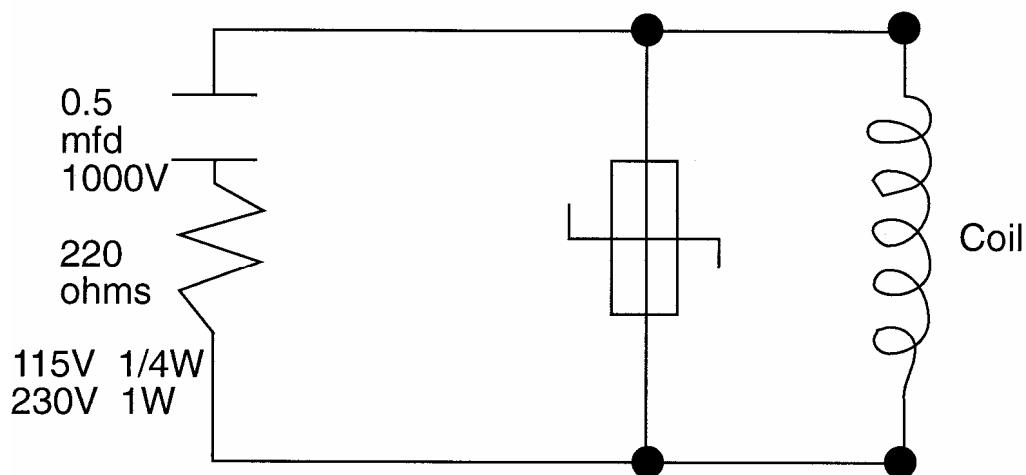
NOISE SUPPRESSION AT THE SOURCE

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.

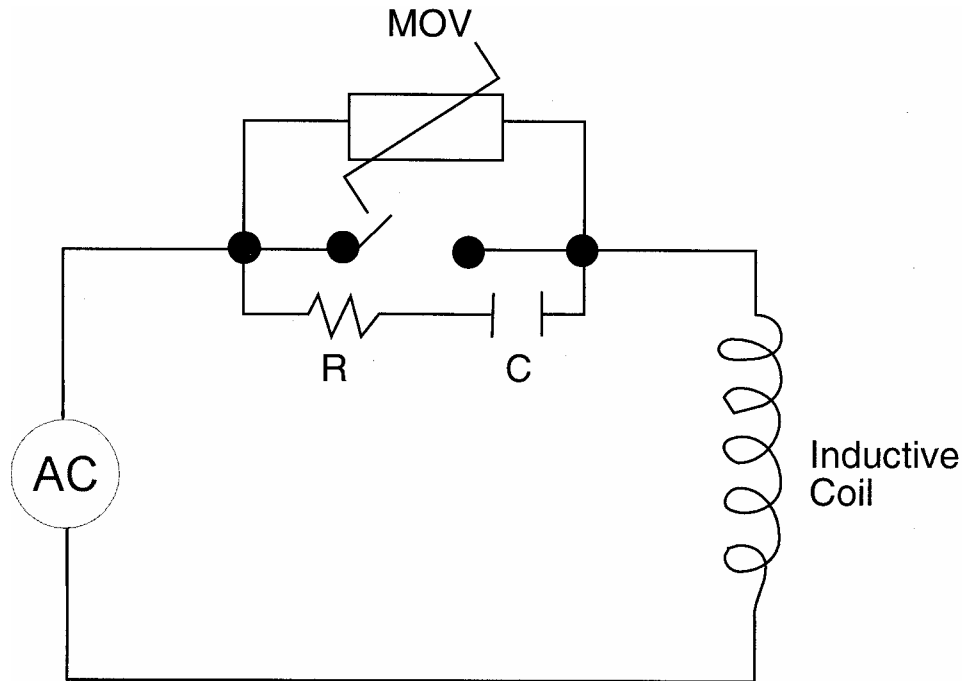
FIGURE 2-4



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.

FIGURE 2-5



2.4 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
Rear Terminal Connections

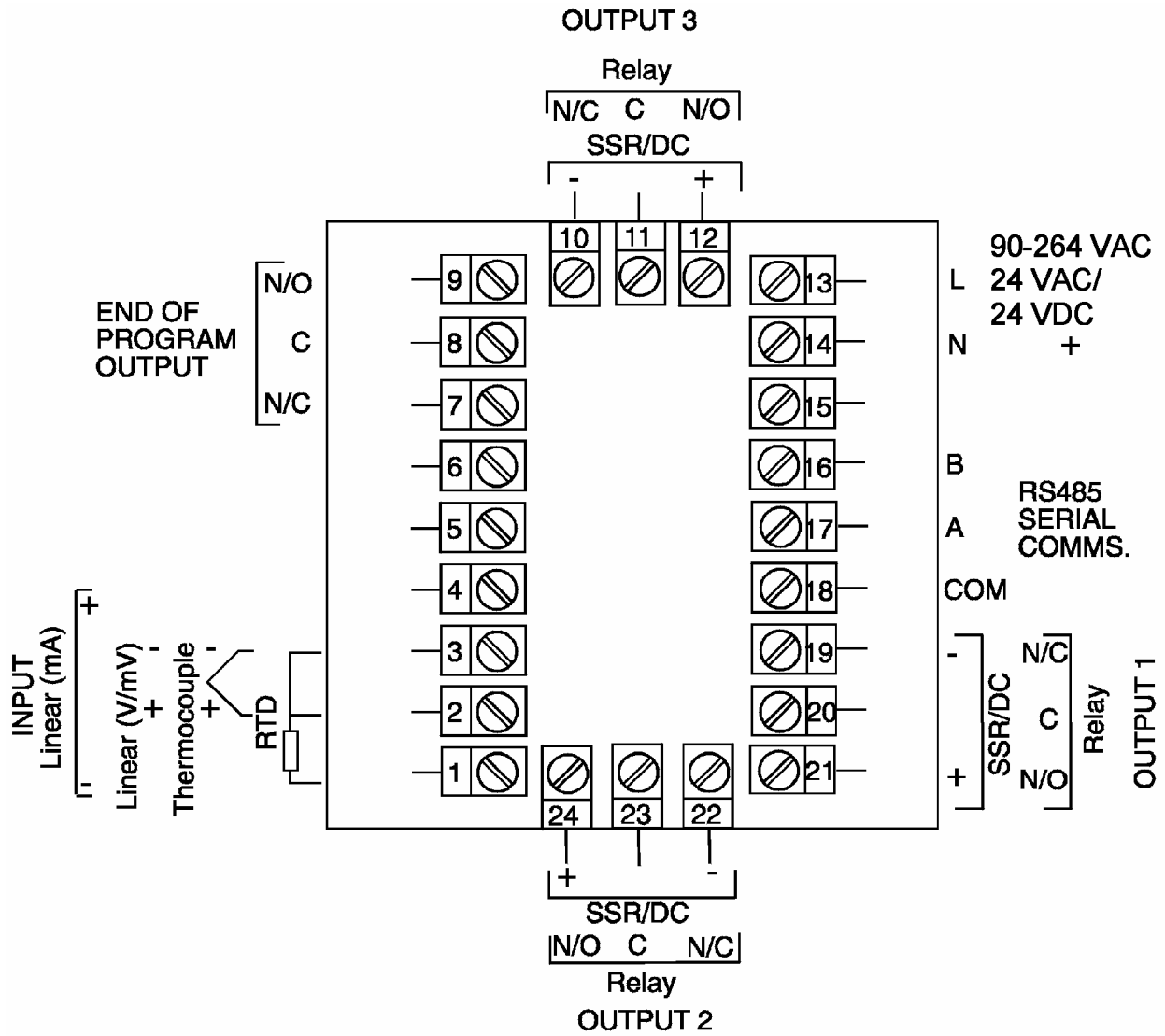
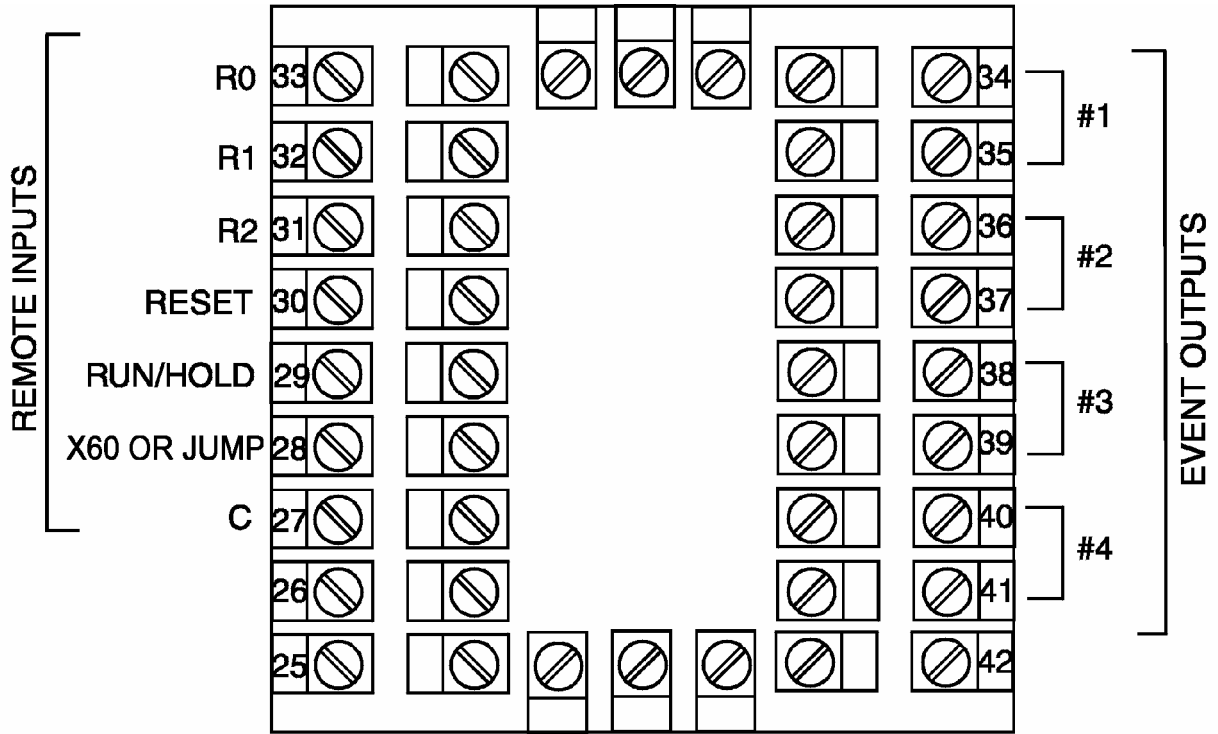


FIGURE 2-6A



2.5 Input Connections

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 personnel. Power should be connected via a two pole isolating switch (preferably situated near the equipment) and a 1A fuse, as shown in Figure 2-7.

FIGURE 2-7
Line Supply

The instrument will operate on 90-264V AC 50/60 Hz electrical line supply. The power consumption is approximately 4 VA. If the instrument has relay outputs in which the contacts are to carry line voltage, it is recommended that the relay contact line supply should be switched and fused in a similar manner but should be separate from the instrument line supply.

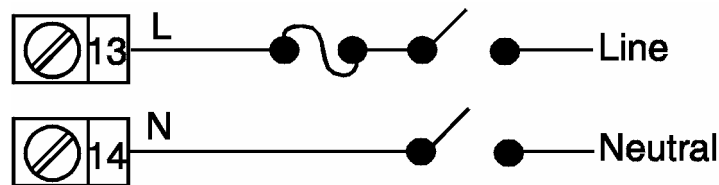


FIGURE 2-7A
24V Nominal AC/DC Supply

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

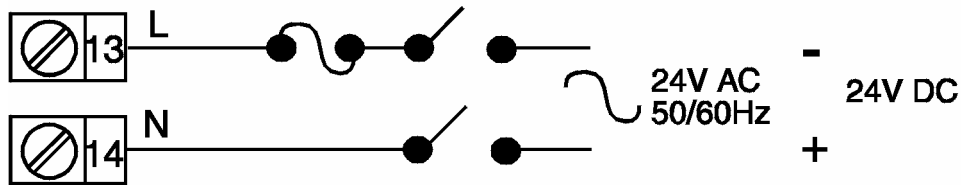


FIGURE 2-8
Thermocouple (T/C) Input

Make the thermocouple connections as illustrated below. Connect the positive leg of the thermocouple to terminal 2 and the negative leg to terminal 3.

Note: Thermocouple must not be grounded! Damage to the cold junction in the control will result!

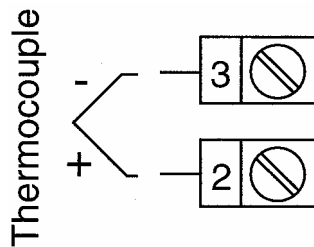


FIGURE 2-9
RTD Input

Make RTD connections as illustrated below. For a three wire RTD, connect the resistive leg of the 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 Section 10).

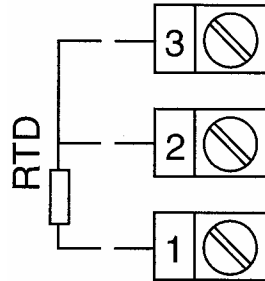


FIGURE 2-10
Volt, mV Input

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 Section 10).

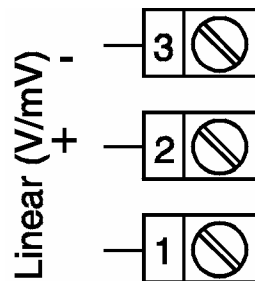


FIGURE 2-11
mADC Input

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 Section 10).

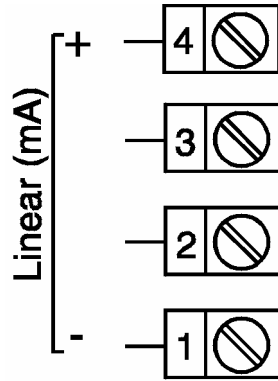


FIGURE 2-12
Remote Digital Communications - RS485

Make digital communication connections as illustrated below.

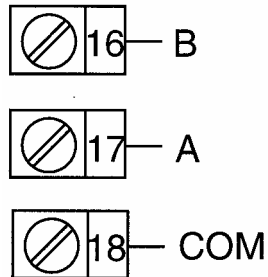


FIGURE 2-13
Relay Output 1 (Control Output 1)

Connections are made to Output 1 relay as illustrated below. The contacts are rated at 2 amp resistive, 120/240 VAC .

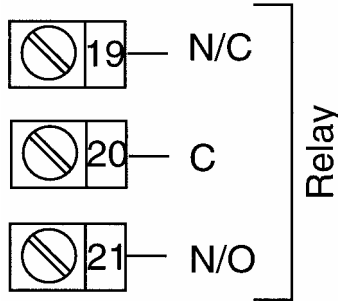


FIGURE 2-14
SSR Driver Output 1 (Control Output 1)

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.

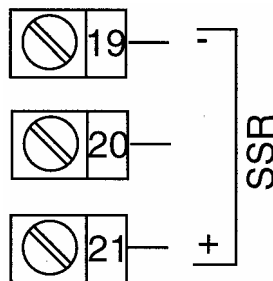


FIGURE 2-15
mADC Output 1 (Control Output 1)

Make connections for DC Output 1 as illustrated below.

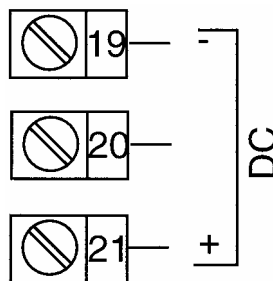


FIGURE 2-16
Relay Output 2 (Control Output 2 OR Alarm 2)

Connections are made to Output 2 relay as illustrated below. The contacts are rated at 2 amp resistive, 120/240 VAC.

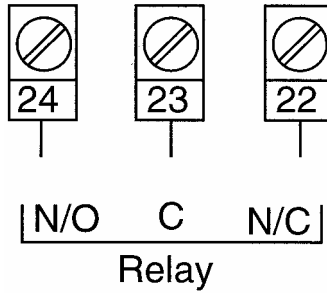


FIGURE 2-17
SSR Driver Output 2 (Control Output 2 OR Alarm 2)

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.

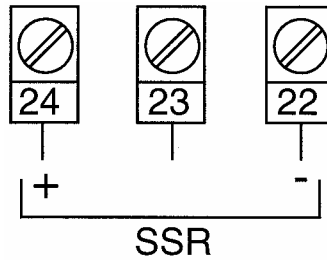


FIGURE 2-18
mADC Output 2 (Control Output 2)

Make connections for DC Output 2 as illustrated below.

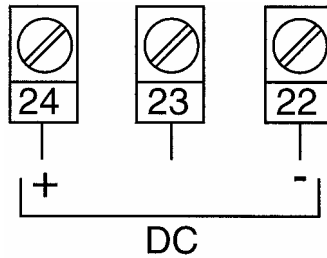


FIGURE 2-19
Relay Output 3 (Alarm 1)

Connections are made to Output 3 relay as illustrated below. The contacts are rated at 2 amp resistive, 120/240 VAC.

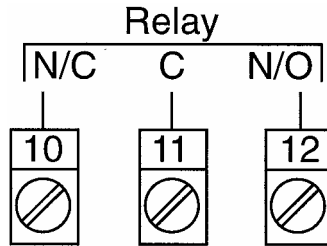


FIGURE 2-20
SSR Driver Output 3 (Alarm 1)

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.

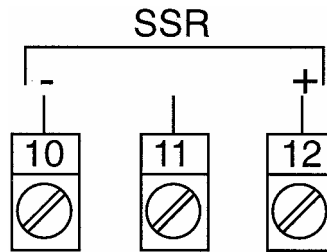


FIGURE 2-21
mADC Output 3 (Recorder Output Only)

Make connections for DC output 3 as illustrated below.

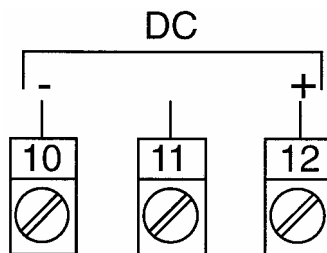


FIGURE 2-22
End of Program Output

Connections are made to End of Program Output as shown below. The contacts are rated at 5 amp resistive, 120/240 VAC.

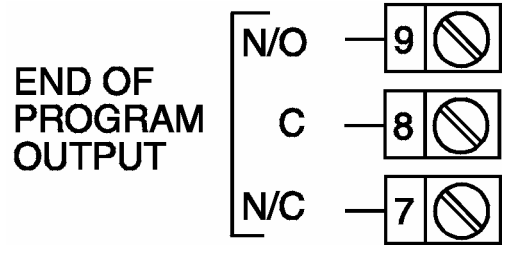


FIGURE 2-23
Event Outputs (optional)

If the Event Outputs have been specified, make connections as shown below. The contacts are rated at 5 amps, 120/240 VAC.

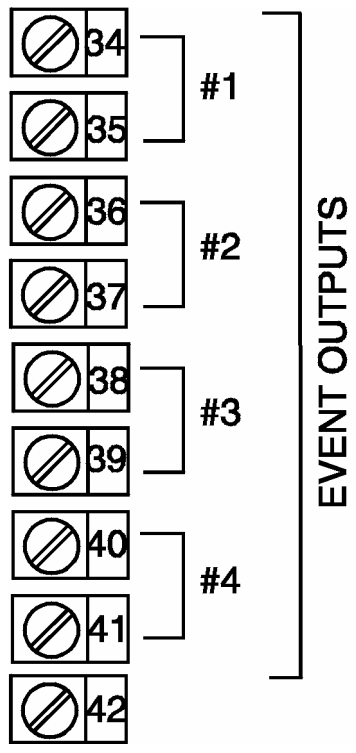
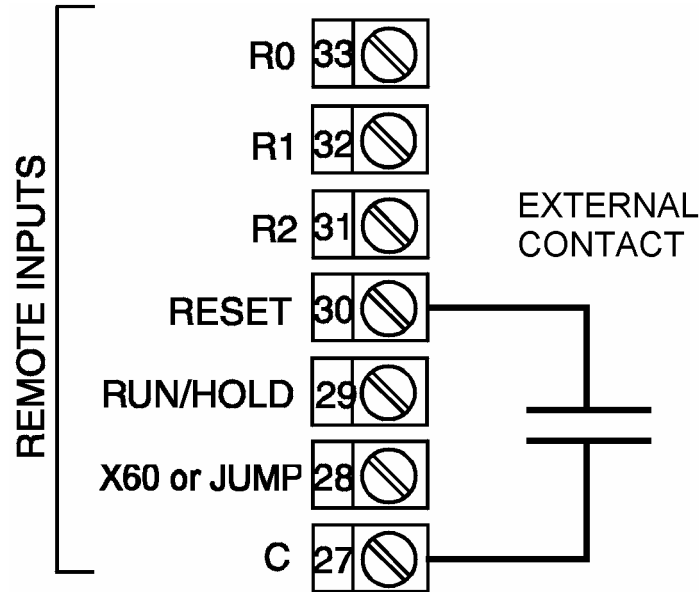


FIGURE 2-24
Remote Program Inputs (optional)

If the Remote Program Control Inputs has been specified, make connections as shown.



Note: Only one remote connection shown for clarity.

Remote inputs may be used to control parameters normally operated via the keypad. Remote inputs are operated by closing an external relay. R0, R1 and R2 form a three-bit digital representation of the desired profile, with R0 being the least significant bit. Closing the RESET input will cause a running profile to abort. Closing the RUN/HOLD relay will start a profile. Subsequently opening this contact will hold the profile at its current setting and closing it again will continue the profile. The X60 or JUMP input is configurable to cause either a change to the profile timebase (X60) or jump to the next segment (JUMP).

SECTION 3: OPERATION

3.1 Control Responses

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

		Out 1	Out2
P (Proportional)	Proportional Band	Pb1	Pb2
I (integration)	Automatic Reset	ArSt	ArSt
D (Derivative)	Rate	rAtE	rAtE

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.

3.2 Direct/Reverse Operation of Outputs

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.

3.3 On-Off Control

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, "HySl " 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.

3.4 Time Proportioning Control

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 = $.4 \times 32 = 12.8$ seconds
 Output off time = $.6 \times 32 = 19.2$ seconds

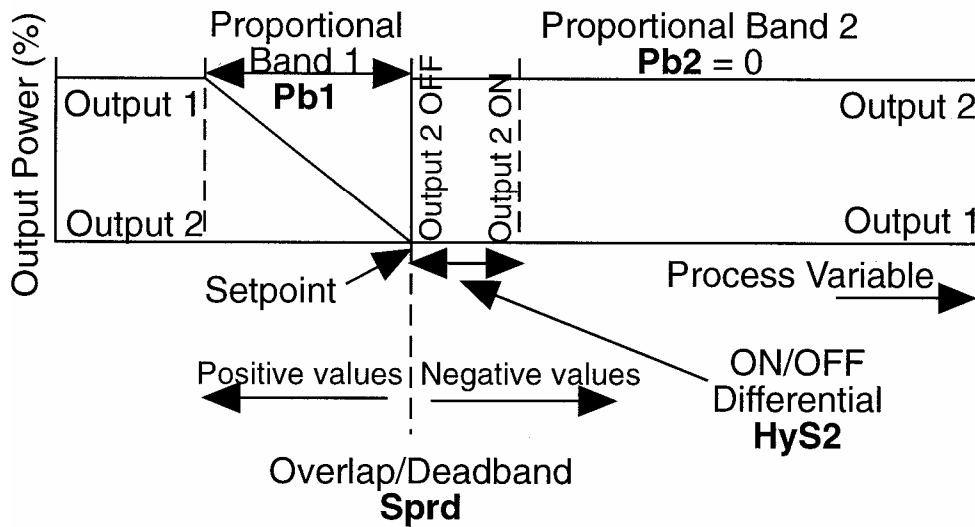
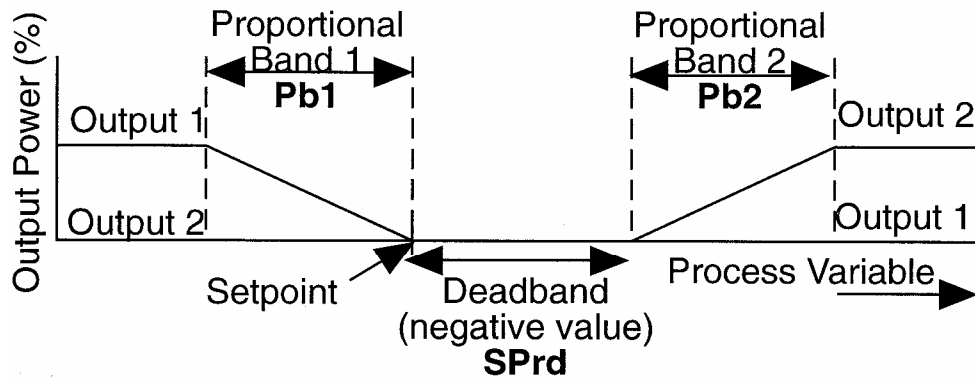
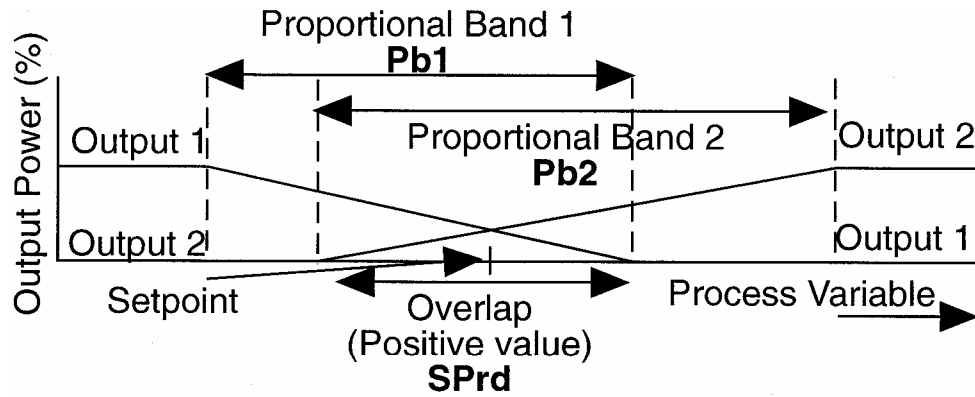
When the unit is operating in the Control Mode, the control algorithm determines the output % required to correct for any difference between the process value and the setpoint. The output calculation is affected by Tune Mode parameter adjustments. See Figure 3-1 for proportional bandwidth effect on the output.

3.5 Current Proportioning Control

Current Proportioning control can be implemented on units provided with mADC current output(s). Current Proportioning control provides a 4 to 20 mADC or 0-20 mADC 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 3-1 (below) for proportional bandwidth effect on the output.

FIGURE 3-1
Proportional Band 1



3.6 Power Up Procedure

Verify all electrical connections have been properly made before applying power to the instrument.

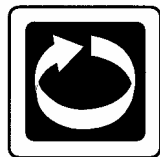
If the instrument is being powered for the first time, it may be desirable to disconnect the controller output connections. The instrument will be into control following the power up sequence and the output(s) may turn on. During Power up, a self-test procedure is initiated during which all LED segments 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: When power is first applied, a delay of approximately 3 seconds will be seen before the displays light up.

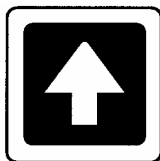
3.7 Keypad Operation



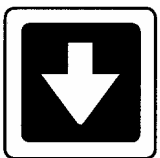
MODE Key - Cycles through modes available in the instrument.



SCROLL Key - Displays the next parameter in sequence (indicated by Message display).



UP Key
Increments displayed parameter value/cycles through options.



DOWN Key
Decrements displayed parameter value/cycles through options.



PROF Key
Cycles through Program (profile) numbers.



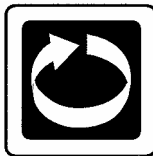
RUN/HOLD Key
Runs, holds or aborts current program (profile).



+



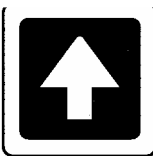
Jumps to next segment, when program is running.



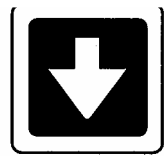
+



Selects/de-selects Manual Control



+



Sets a segment to Dwell when defining a program.

3.8 Indicators

Control Status Indicators

● AT	AT - On when Self-Tune is active; flashes when PreTune is active.
● ALM	ALM - Flashes when any alarm is active.
● OP1	OP1 - On when primary control output is active.
● OP2	OP2 - On when secondary control output (if fitted) is active.
● MAN	MAN - On when Manual Control is selected.

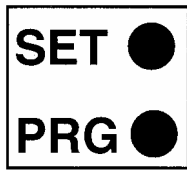
Run Status Indicators

RUN ●	RUN -	On - Program running or (if HLD On also) held Flashing - Program in Delayed state
HLD ●	HLD -	On - Program held Flashing - Program in Auto-Hold
x60 ●	X60 -	Off - timebase = hours/minutes On - timebase = minutes/seconds

Event Indicators

EV1 ●	Each indicates the status (active or inactive) of a user-defined event (Off = inactive, On = active)
EV2 ●	
EV3 ●	
EV4 ●	

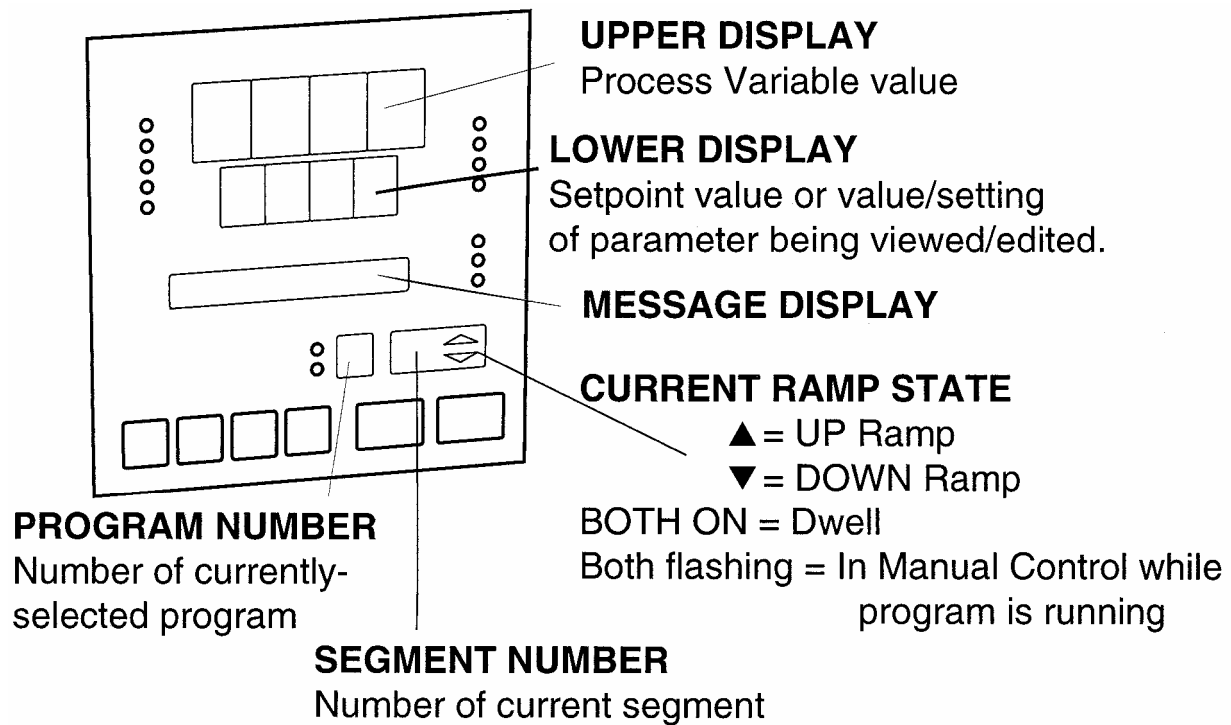
Mode Indicators



SET - On when Profile Set Mode is entered; flashes when viewing parameters in Configuration Mode after entry from Base Mode.

PRG - On when Profile Set Mode is entered.

3.9 Displays



3.10 Viewing Setpoint And Control Status

In Base Mode (with no program running), repeatedly pressing the SCROLL key will cause the control to display various control information. The operator may view and change the setpoint. The operator may also view the units the control is using, whether the outputs are on or off, the alarm status, the present time and day (if the real time clock is fitted), and the percent output of the control instrument (if operating in Manual Mode).

NOTE: If the SCROLL key is held for more than two seconds, the instrument will automatically scroll through the displays.

3.11 Viewing And Adjusting The Controller Setpoint

With the Setpoint Programmer in Base Mode (i.e. with the RUN, HLD, SET, and PRG indicators off), the two main displays will show the process variable value (upper display) and the setpoint value (lower display - Read Only). To change the setpoint value:

1. Press the SCROLL key until the Message Area displays **Setpoint**.
2. If Setpoint has been enabled in the Enable Mode, the UP and DOWN keys may be used to change the setpoint value (in the lower display) as required.
3. When the setpoint value is set as desired, press the SCROLL key again to view other Base Mode parameters.

3.12 Viewing The Input Units

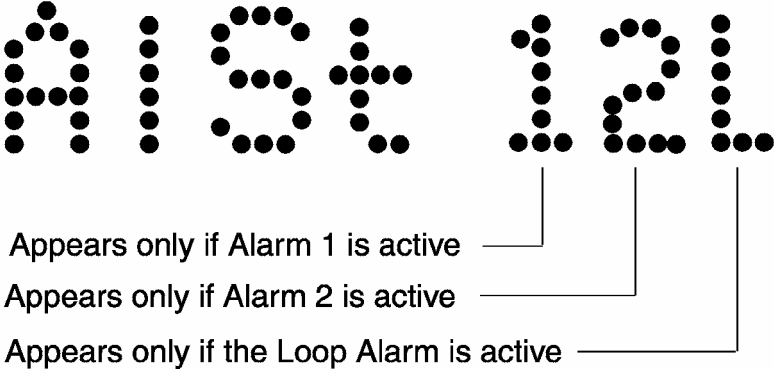
To see what type of input the control is using press the SCROLL key until the Units display is shown. The Units display shows the temperature scale for thermocouple and RTD inputs <DEGF> or <DEGC> or unspecified engineering **UNITS** for other input types. This display can be deactivated, if desired.

3.13 Base Mode And Off Mode Outputs

The Base Mode allows for the process and event outputs to be turned on or off. When all outputs are off, the Base Mode becomes Off Mode. In Base Mode the process output is adjusted by the controller based on the process input and setpoint. The event outputs for the Base Mode are set in the Configuration Mode. To view the present status of the outputs, press the SCROLL key until **OUTPUTS** is displayed in the message display. Use the UP and DOWN keys to turn the outputs **ON** or **OFF** (toggle between Base Mode and Off Mode).

3.14 Alarm Status Indication

When any alarm is active, the ALM indicator will flash. To view the main status in the Message Display, press the SCROLL key until a display appears in the form:



3.15 Manual Control

In any mode except Configuration Mode, the operator may select manual control of the process by simultaneously pressing the SCROLL and MODE keys, provided Manual Mode is enabled in Enable Mode. The instrument will then enter Base Mode or (if a program is currently running) Program Run Mode with the program held. The Message Display will read **Manual**, the MAN indicator will be lit, and the lower Main Display will show the power output value, in format PXXX, which may then be adjusted using the UP and DOWN keys.

While manual control is being used, the power output display is included in the displays available in Base Mode and Program Run Mode. To view the percent output setting when the Manual Mode is active, press the SCROLL key until **Manual** is displayed. This display is not available if Manual Mode is not active.

To cancel manual control, press the SCROLL and MODE keys simultaneously, whereupon the power output value display and the **Manual** message display will disappear. The Setpoint Controller will remain in whatever mode prevailed when manual control was implemented (if this is Program Run Mode, the currently-running program will be resumed from the point at which it was held).

3.16 Viewing The Time And Day

If the real time clock option is fitted, the operator may view the present time and day. Press the SCROLL key until **HH:MM Tim** is displayed. This is the present time of day in hours and minutes. Press the SCROLL key again and **Day: XXX** is displayed with **XXX** being an abbreviation for the present day of the week. If **TIME BAD** is displayed, the time and day must be set in the Profile Mode (see Section 6).

3.17 Selecting And Running A Program

When no program is running, the instrument is in Base Mode and the RUN and HLD indicators are off. In this mode, select a program as follows:

1. Hold down the PROF key until the required program number is displayed.
2. Press the RUN/HOLD key once to start the program. The RUN indicator will then go ON, or flash if a delayed start has been programmed. The instrument is now in Program Run Mode. In Program Run Mode, the process setpoint and event outputs are controlled by the program selected.

3.18 Changing The Program Timebase

While a program is running, the normal timebase is hours/minutes. To change to a timebase of minutes/seconds (i.e. select the x60 facility) press the UP key for more than five seconds, whereupon the x60 indicator will go on. To cancel operation on the x60 timebase, press the DOWN key for more than five seconds, whereupon the x60 indicator will go off.

3.19 Holding A Program Manually

The operator may hold or freeze a program by momentarily pressing the RUN/HOLD key. The HLD indicator will then go on (the RUN indicator staying on) and the program will stop execution. The program may subsequently be restarted by momentarily pressing the RUN/HOLD key again.

HLD INDICATOR FLASHING: Before the operator holds the program manually, the HLD indicator may start flashing. This indicates that the program is currently subject to a Deviation-Hold. If the RUN/HOLD key is pressed (for a manual Hold), the HLD indicator will go on continuously. When the operator removes the manual Hold (by pressing the RUN/HOLD key again), the HLD indicator will either flash (indicating that the Deviation-Hold conditions still prevail) or go off (indicating that the Deviation-Hold conditions no longer prevail).

RUN INDICATOR FLASHING: This indicates that the program is in a Delay state (i.e. is timed to start after a user-defined delay has elapsed). When the delay period has elapsed, the program will run and the RUN indicator will come on continuously.

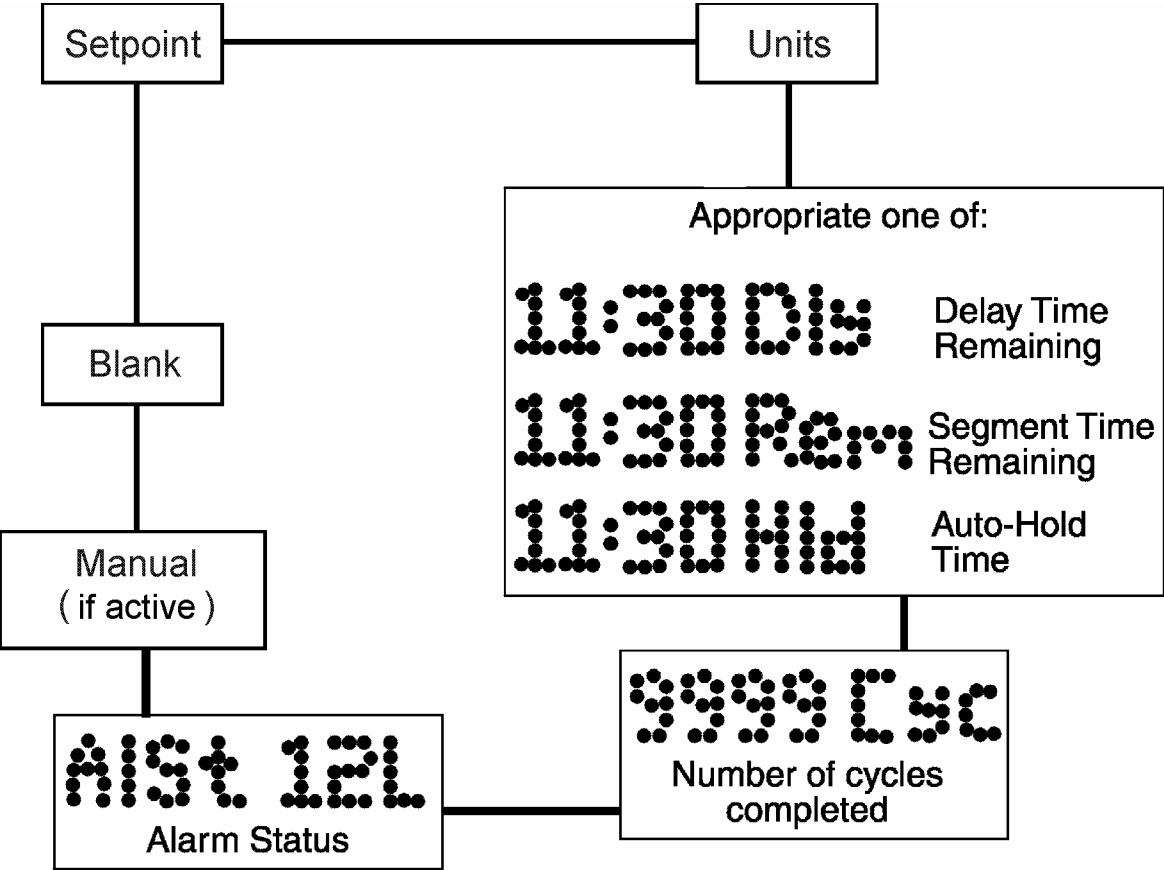
3.20 Jumping To The Next Segment

At any time during a program's execution, the operator may jump forward to the next segment by simultaneously pressing the PROF and UP keys.

Note that, since programs may be joined or set to cycle, jumping past the last segment in a program may result in changes in the Program Number and Cycle Count.

3.21 Viewing Program Progress/Status

In Program Run Mode, a number of displays are made available to the operator (in the Message Display area) which indicate program progress/ status. While the current program is running, held or delayed, press the SCROLL key to cycle through a sequence of program status displays with the following legends in the Message Display:



In the case of Segment Time Remaining or Deviation-Hold Time display, the time is in hours/minutes (if the x60 indicator is OFF) or minutes/seconds (if the x60 indicator is ON). The Delay Time display is always in hours/minutes.

Note: If the SCROLL key is held for two seconds or longer the instrument will auto-scroll through the above display cycle (with the exception of the Self-Tune and Pre-Tune displays). The auto-scroll can be stopped by pressing any key other than the SCROLL key.

3.22 Aborting A Program

The operator may abort (i.e. terminate) the current program by holding down the RUN/HOLD key for more than five seconds. When the program is aborted, a return is made to the Base Mode and the Message area will read **Aborted**.

This message will be removed by the next key press.

3.23 "End Of Program" Indication

When the program has completed its End Segment (i.e. the last segment to be performed), the message display will read **At End**, and a return is made to the Base Mode. Press any key to clear the Message Display.

SECTION 4: ACCESSING MODES OF THE CONTROLLER

The control has various modes in which the control parameters can be viewed or changed. A list of available modes is shown along with a brief description of their purpose.

To access a mode, press the MODE key until the desired mode appears in the message display. Press the SCROLL key to enter the mode. Refer to other sections of this manual for detailed information on each mode. Any mode which has been disabled in the Enable Mode will not be displayed, and may not be accessed.

Table 4-1 Controller Modes

MODE	USAGE
PreTune	Preset the PID control parameters to provide a base for the SelfTune facility
AutoTune	Activate/Deactivate AutoTune
ProfPar	Create or edit a program profile
TunePar	Adjust the instrument PID parameters
Alarm	Set up the instrument alarm parameters
Enable	Allow access to various modes of the control
ConfPar	Adjust the control input, output and communications parameters
Test	Test the instrument outputs
Calib	Calibrate the control instrument
BaseMode	Return to Base Mode

SECTION 5: USING THE PRETUNE AND AUTOTUNE FEATURES

5.1 Using The Pre-Tune Facility

The Pre-Tune facility is used to set the instrument's PID control parameters to values which are approximately correct in order to provide a base from which the Auto-Tune facility may subsequently optimize tuning. Pre-Tune may be activated as follows:

1. With the instrument in Base mode (with the RUN and HLD indicators off), press the MODE key until the Message Display reads **PreTune** and the lower Main Display shows reads **OFF**.
2. Press the UP key to change the lower Main Display to **ON**, indicating that the Pre-Tune facility is now activated. The AT indicator will flash.

NOTES:

1. *If the process variable is within 5% of the input span from the setpoint, the Pre-Tune facility cannot be activated and any attempt to do so will have no effect.*
2. *Since the Pre-Tune facility is a single-shot operation., it will automatically deactivate itself once the operation is complete.*

To de-activate the Pre-Tune facility manually (with the instrument in Base Mode), access the Pre-Tune mode using the instructions above; then press the DOWN key to change the lower Main display from **ON** to **OFF**.

5.2 Using The Auto-Tune Facility

The Self-Tune facility is used to optimize tuning while the Controller part of the instrument is operating. Auto-Tune may be activated as follows:

1. With the instrument in Base Mode (with RUN and HLD indicators OFF), press the MODE key until the Message Display reads **AutoTune** and the lower Main Display reads **OFF**.
2. Press the UP key to change the lower Main Display to **ON**, indicating that the Auto-Tune facility is now activated. The AT indicator is on continuously.

To de-activate the Auto-Tune facility, access the Auto-Tune mode using the instructions above, then press the DOWN key to change the lower Main Display from **ON** to **OFF**.

SECTION 6: PROFILE SET MODE

The instrument may be put into Profile Set Mode from either Base Mode or Program Run Mode (i.e. with a program currently running). This mode allows editing or viewing of a program profile.

6.1 Entry Into Profile Set Mode

To enter the Profile Set Mode from Base Mode:

1. Press the MODE key until **PROF PAR** appears in the message display
2. Press the SCROLL key to enter the Profile Set Mode.

To return to Base Mode:

1. Press the MODE key until **Basemode** appears in the message display.
2. Press the SCROLL key to return to Base Mode.

In Profile Set mode, the operator will be presented with the first of a sequence of parameter displays. The operator may then step through the sequence, using the SCROLL key. The parameter setting (in the lower Main Display) may be changed using the UP/DOWN keys. The displayed Program Number may be changed using the PROF key and the displayed Segment Number may be changed using the RUN/HOLD key.

The instrument may be fitted with an optional internal 24 hour clock. This clock provides the time period information for the power fail recovery feature (see section 6) and permits a program profile to be started at a specific time of day.

Profile Set Mode parameters are divided into three categories:

- a) GLOBAL - Those common to all programs

To view the parameters in the Global category, press the PROF key until the Program Number shown is "A". Press the RUN/HOLD key until the Segment Number shown is blank.

b) PROGRAM - Those which apply to a specific program as a whole

To view parameters in the Program category, press the PROF key until the desired Program Number is displayed. Press the RUN/HOLD key until the Segment Number shown is blank.

c) SEGMENT - Those relevant to a specific segment in a specific program

To view parameters in the Segment category, press the PROF key until the desired Program Number is displayed. Press the RUN/HOLD key until the desired Segment Number is displayed.

6.2 Parameters Common To All Programs

(Program Number = A, Segment Number = Blank)

The parameters common to all programs (global parameters) are presented for editing/viewing in the following sequence:

Table 6-1 Global Profile Parameters

STEP	DESCRIPTION	MESSAGE DISPLAY	FUNCTION	AVAILABLE SETTING
1	Start On	Start On	Defines setpoint value at start of each program	SEtP - Current Controller setpoint value Proc - Current Process variable value
2	Go To	Go To	Defines Base Mode Status and end of each program	On - Outputs are active Off - Outputs are inactive
3	End On	End on	Defines setpoint value at end of each program	F_SP-End on Final SP value* SEtP-End on Controller SP value
4	Delay Time	Delay	Defines delay (in hours/min) between initiating the program and actually starting	Numerical value, with the decimal point separating the hours and minutes.
5	Program Lock	LockProg	Defines whether the operator is permitted to change program definitions while a program is running/held	On - No changes permitted Off - changes permitted
6	Power Fail Recovery Period	Recovery	Defines length of power loss before automatic return to Base Mode after restoration of power, regardless of Recovery Type.	1:00 - 24:59 NOTE: If the real time clock option has not been provided, changing this value to 0.01 will allow selection of Recovery Type. Setting this to 00:00 will force a return to Base Mode.
7	Power Fail Recovery Type	Rec Type	Defines response to restoration of power after a power loss. This parameter does not appear if Recovery is set to 0.00. These settings can be overridden by the Recovery parameter.	cont - Continue with mode of operation at time of power failure. rESt - Restart program running at time of power failure. If one was not running, return to Base Mode. PFH - Setpoint and event outputs are held at values at time of power loss. P.F. Hold is displayed until a key other than RUN/HOLD is pressed. Pressing the RUN/HOLD key will continue the profile if one was running. Holding this key for more than five seconds will abort the profile.

STEP	DESCRIPTION	MESSAGE DISPLAY	FUNCTION	AVAILABLE SETTING
8	Time of day	RTC Time**	Sets clock time of real-time clock option	1:00 - 24:59
9	Day of week	RTC Day**	Sets day of real-time clock option	Sun through SA
10	External Selection	Ext. Sel ***	Defines functions which may be controlled externally	nonE = No external selection SEL = Program selection only run = Only Run, Hold, Abort and x60 functions both = All program selection and run control functions

* The Final Setpoint value for the End Segment of each program.

** Only if real-time clock is fitted.

*** Only if external options are fitted.

6.3 Parameters Which Apply To A Specific Program As A Whole

(Program Number = 1 to 8, Segment = Blank)

Only the parameters relevant to the displayed program number (which can be changed using the PROG key) are presented. The parameter sequence is as follows:

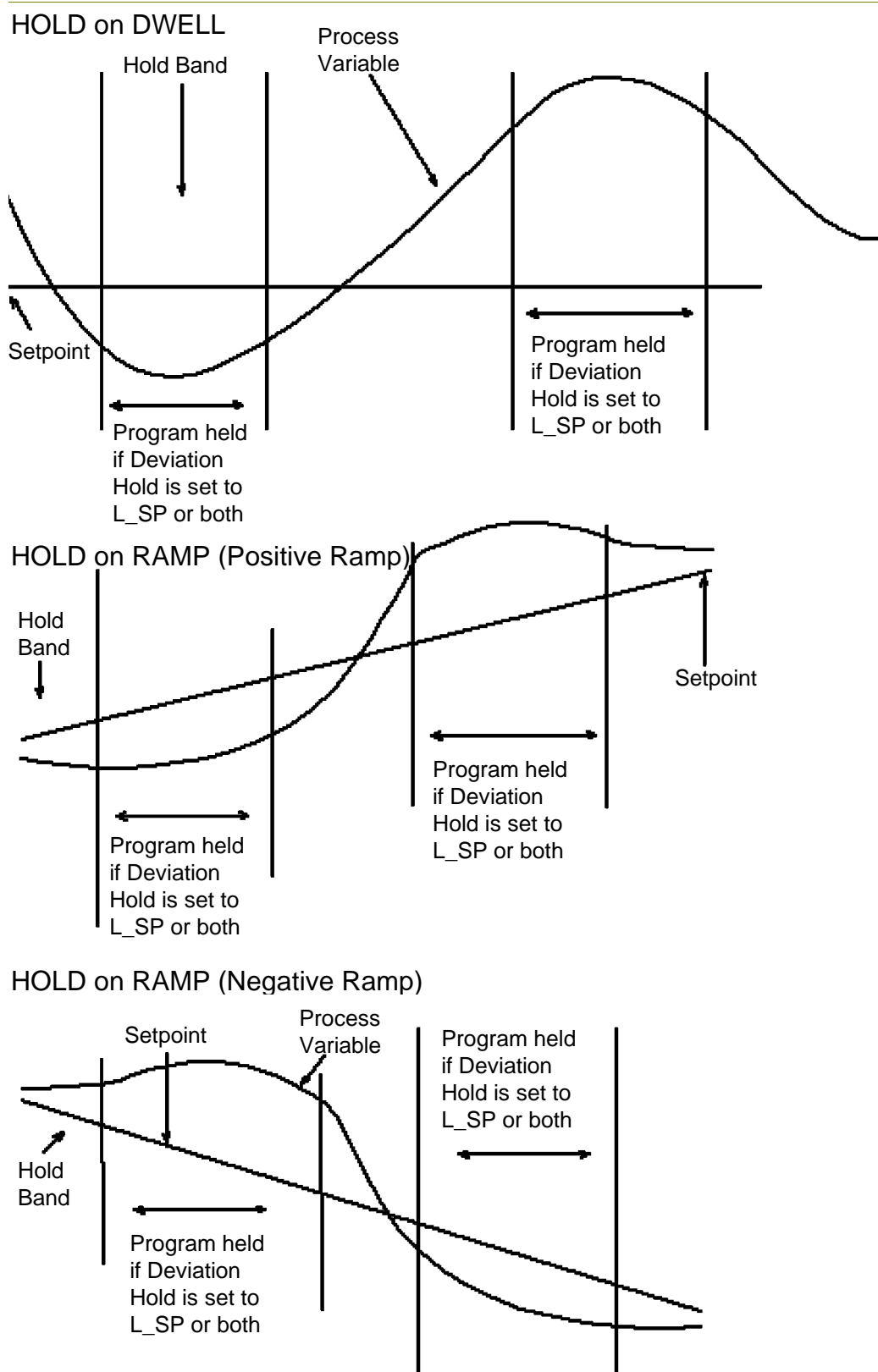
Table 6-2 Program Profile Parameters

STEP	DESCRIPTION	MESSAGE DISPLAY	FUNCTION	AVAILABLE SETTING
1	Cycle Count	Cycles	Defines the number of times the program will be repeated	1-9999 Program will repeat the set number of times inF = Program will repeat indefinitely
2	Deviation Hold	Dev.Hold	Selects operation of Deviation Hold facility (relative to setpoint)	OFF = No Deviation Hold H_SP = Deviation Hold above setpoint only L_SP = Deviation Hold below setpoint only both = Deviation Hold above and below setpoint
3*	Hold Band	HoldBand	Defines the width of the Hold Band	Numerical value (0.0 to span)
4*	Hold On	Hold on	Defines whether the Deviation Hold facility is used on ramps only, dwells only or both	d_r = Deviation Hold on ramps and dwells d = Deviation Hold on dwells only r = Deviation Hold on ramps only
5	Pre-x60	Pre-x60	Determines whether the timebase for the program is pre-selected to be hours/minutes or minutes/seconds	nonE = No pre-selection On = Operates MINS/SECS OFF = Operates HRS/MINS
6	Autostart time Enable	Timer	Selects whether autostart is active for this profile	On OFF
7	Start Time**	Strt-ti	Determines the automatic start time for the profile	1:00 - 24:59 OFF = manual start only
8	Start Day**	Strtday	Determines the day of the week when start time applies	ALL = 7 days a week Mon = Monday tuE = Tuesday Wed = Wednesday thu = Thursday Fri = Friday SAt = Saturday Sun = Sunday 5 dy = Mon - Fri 6 dy = Mon - Sat

* Not displayed if deviation hold is off.

** Only displayed when real-time clock is fitted, or if timer is set to On.

FIGURE 6-1



6.4 Editing/Viewing Parameters In Any/Each Segment In A Specific Program

(Program Number = 1 to 8, Segment Number = 1-16)

Adjust the Program Number (using the PROF key) and the Segment Number (using the RUN/HOLD key) as required. The parameters presented will be those relevant to the program and segment whose numbers are displayed. The parameters sequence for each segment is as follows. Press the SCROLL key to step through each parameter.

Table 6-3 Segment Profile Parameters

STEP	DESCRIPTION	MESSAGE DISPLAY	FUNCTION	AVAILABLE SETTING
1	Final Setpoint Value	Final SP	Defines the final value of the setpoint for this segment, selects a dwell segment or indicates a Join, Repeat, or End Program segment	Numeric value (limited by SPHi and SPLo) or (by pressing the UP/DOWN keys simultaneously) indicates a dwell with: “_ _ _ _” or, if the segment is already a Join, Repeat, or End Program segment, as shown below
2	Segment Time or Ramp Rate as selected by Segment Mode parameter in Configuration Mode	Time or RampRate	Defines the duration/ramp rate of the segment or whether this is a Join, Repeat or End Program segment*	Four-digit number in the form nn.nn (hours-minutes or minutes-seconds) or negative values as follows (press DOWN key): JO1 - Join to Program 1 JO2 - Join to Program 2 JO3 - Join to Program 3 JO4 - Join to Program 4 JO5 - Join to Program 5 JO6 - Join to Program 6 JO7 - Join to Program 7 JO8 - Join to Program 8 rEP - Repeat Segment End - End Program
3	Event †	Event	Defines the states of the four event outputs for this segment	Four-bit binary number (0=inactive, 1=active) (0010 = only event 2 active)

* If a segment is set to be a Join segment, a repeat segment or an End Program segment, the next depression of the SCROLL key will set the Segment Number to 1. Otherwise, the next depression of the SCROLL key will display the next segment final SP, or Event for the current segment if the Event Output hardware is fitted.

† This parameter appears in the sequence only if the Event Output hardware is fitted, in which case this parameter will be followed by the Final Setpoint Value parameter for the next segment. If this hardware is not fitted, this parameter will be omitted from the sequence and the segment number will be advanced, causing the Final Setpoint Value parameter for the next segment to appear immediately.

CANCELLING JOIN, REPEAT OR END PROGRAM SEGMENTS

This can be achieved:

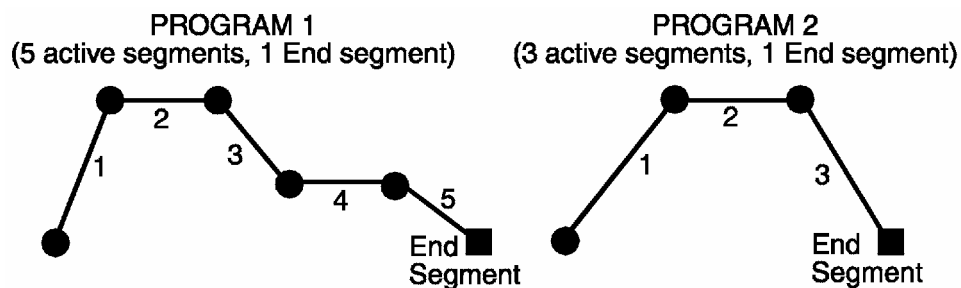
- (a) at the Final Setpoint Value parameter, by simultaneously pressing the UP/DOWN keys to produce a Dwell segment, or
- (b) at the Segment Time/Ramp Rate parameter, by incrementing the value to 0 or a positive value.

6.5 Using Join, Repeat And End Segments And Cycling Programs

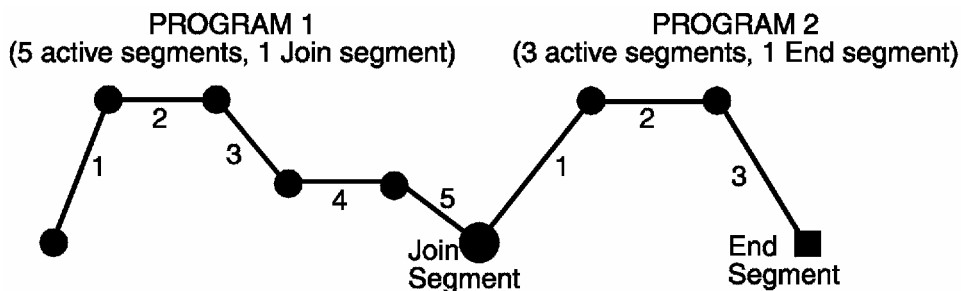
By default, the instrument has eight programs, each 16 segments long (all 16 segments are active and, at the end of Segment 16 is an implicit End Segment). These programs can be made shorter (using End segments) or longer (by creating program sequences with Join, Repeat and End segments). The only limit to the size of a program sequence is a maximum length of 121 active segments plus seven Join segments plus one End segment (i.e. all eight programs joined to make one program sequence).

Segments follow a free format in that ramp or dwell can be followed by dwell or ramp, completely as desired.

Consider two example programs:

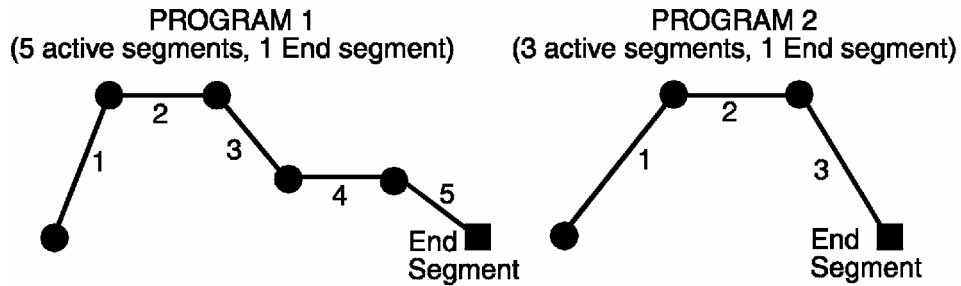


To join the two programs to form a program sequence, change the End segment of Program 1 to a Join segment (Segment Time or Ramp Rate set to J02 - Join Program 2):

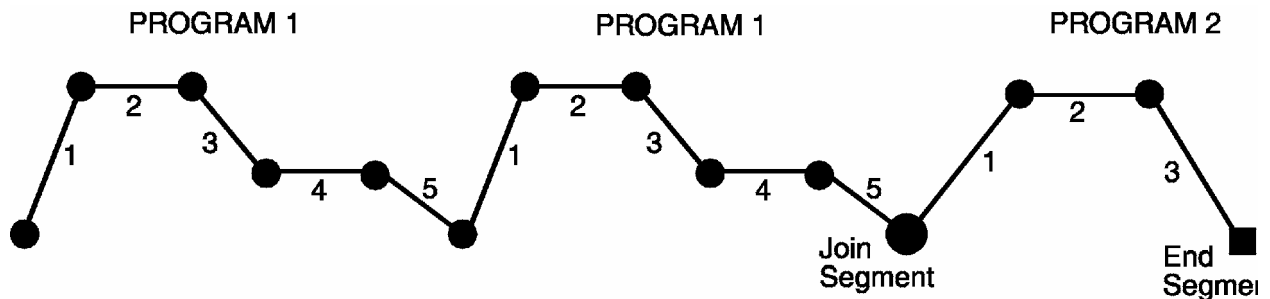


There are no restrictions on joining programs; several programs can be joined to one program (i.e. to prove user-selectable warm-up programs, depending upon which program is run first).

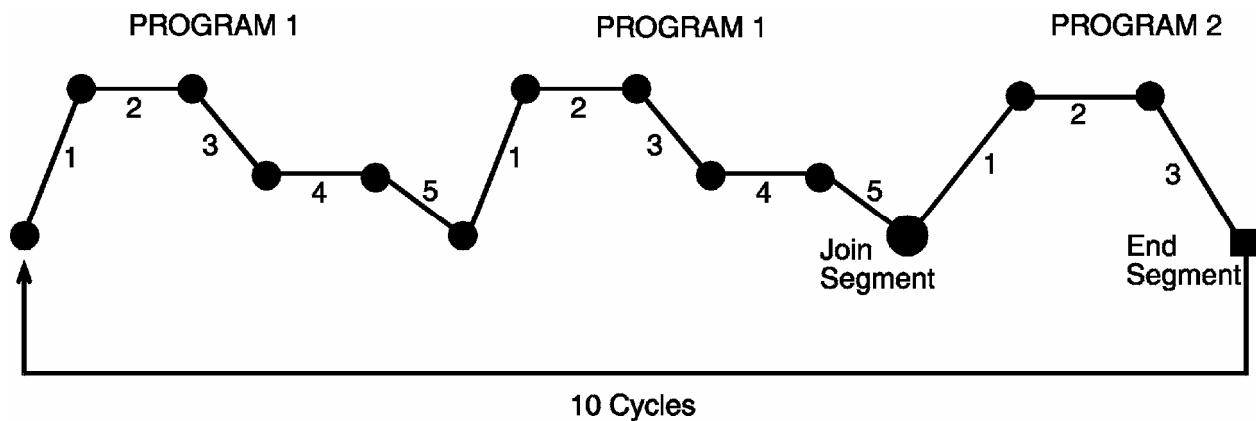
The Cycle feature can be used to make more complex program sequences. Consider the two simple example programs previously described:



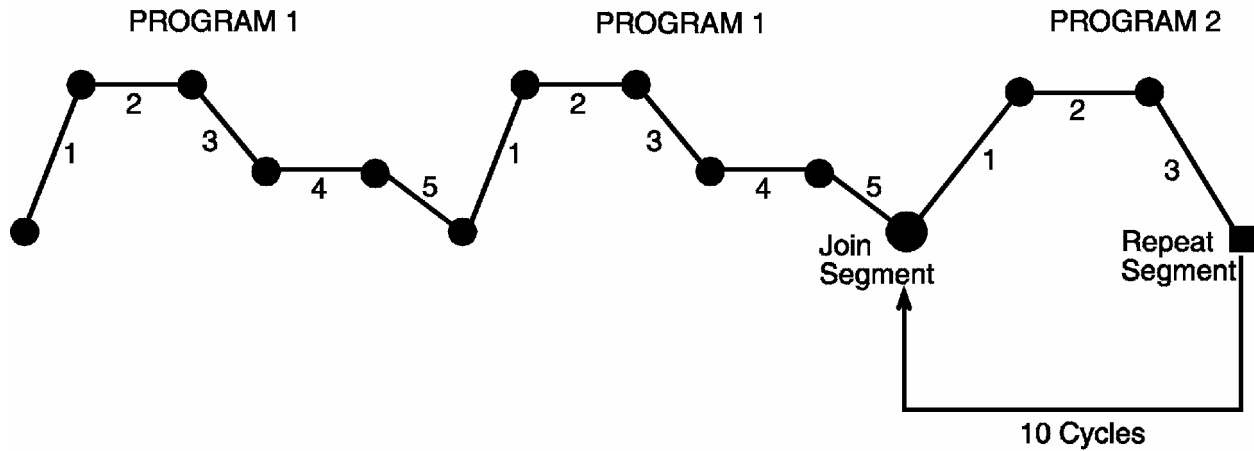
Also consider the case where Program 1 is set to perform two cycles and Program 1 is joined to Program 2. When Program 1 is run, the result would be:



If Program 2 were now set to perform ten cycles, the result would be:



Now, with Program 2 set to perform 10 cycles, change its last segment to a Repeat segment (Segment Time or Ramp Rate set to REP); the result would be:



At the end of the tenth cycle of Program 2, the program sequence would end.

6.6 Basic Rules To Remember

In any program sequence:

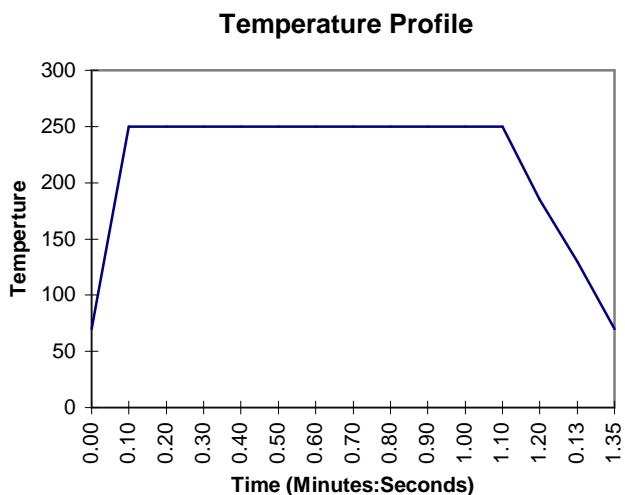
- A program ending in a Join segment will perform the required number of cycles of itself before joining the new program.
- A program ending in a Repeat segment (hence, by definition, the last program in the sequence) will perform the required number of cycles of itself before ending the sequence.
- A program ending in an End segment (hence, by definition, the last program in the sequence) will perform its cycle on the entire program sequence before ending that sequence.

6.7 Exiting Profile Set Mode

The operator may exit from Profile Set Mode by pressing the MODE key. To return to Base Mode, press the MODE key until the Base Mode prompt appears in the Message Display, then press the SCROLL key.

6.8 Sample Profile

The Control is capable of storing eight (8) profiles with up to sixteen (16) segments depending on memory. Each segment consists of a final setpoint, time, and event(s) status.



Entering Global Parameters for the Profile

1. Press the **MODE** key until **Prof Par** is displayed in the Message Display.
2. Press the **SCROLL** key and **Cycles** will be displayed with **1** displayed in the Program display. Make changes with the **UP** and **DOWN** arrow keys. Press the **SCROLL** key to move to the next display.

*Note: the segment display must be blank. If not, press **RUN/HOLD** key until the segment display is blank.*

Description	Message Display	Setting In Lower Display
Cycle Count	Cycles	1
Deviation Hold	Dev. Hold	OFF
Time Base	Pre-x60	ON
Autostart Time Enable	Timer	OFF

Entering Parameters Common to All Profiles

1. With **Cycles** displayed in the Message Display, Press the **PROF** key until **A** is displayed in the Program Display. . Make changes with the **UP** and **DOWN** arrow keys. Press the **SCROLL** key to move to the next display.

Description	Message Display	Setting In Lower Display
Start On	Start On	Proc
Go To	Go To	OFF
Delay Time	Delay	0.00
Program Lock	Lock Prog	ON
Power Fail Recovery Period	Recovery	0.01
Power Fail Recovery Type	Rec Type	Cont
Time of Day *	RTC Time	Enter time
Day of Week *	RTC Day	Enter Day

* Only used if Real Time Clock is installed in the Control.

Entering the Profile

1. Press the **PROF** key until **1** is displayed in the Program Display. Press the **RUN/HOLD** key until **1** is displayed in the Segment Display and **Final SP** is displayed in the message display. Make changes with the **UP** and **DOWN** arrow keys. Press the **SCROLL** key to move to the next display.

Segment	Description	Message Display	Setting In Lower Display
#1	Setpoint	Final SP	250
	Ramp Time	Time	0.10
	Event Status	Event	0001
#2	Setpoint	Final SP	250 (or “- - - -”)
	Soak Time	Time	1.00
	Event Status	Event	0001
#3	Setpoint	Final SP	70
	Ramp Time	Time	0.25
	Event Status	Event	0000
#4	Setpoint	Final SP	70 (or “- - - -”)*
	Time	Time	End
	Event Status	Event	0000

* To change an **END** segment to a ramp, soak, or jump segment press the **RUN/HOLD** key until the **END** segment appears (segment 4 in the sample). Press the **SCROLL** key until **TIME** is displayed in the message display. Use the **UP** and **DOWN** arrow keys to change the segment time. If a different final setpoint is desired on the **END** segment, press the **RUN/HOLD** key until the **END** segment number appears with the **FINAL SP** in the message display. Press the **UP** and **DOWN** arrow keys simultaneously. You then can change the setpoint.

Running the Profile

1. Press the **MODE** key to return to the BASEMODE. Press the **PROF** key until **1** is displayed in the segment display. Press the **RUN/HOLD** key to start the profile.

SECTION 7: TUNE MODE

The Tune Mode parameters control the PID functions of the instrument.
To enter the Tune Parameter Mode from Base Mode:

1. Press the MODE key until TunePar appears in the message display
2. Press the SCROLL key to enter the Tune Parameter Mode.

To return to Base Mode:

1. Press the MODE key until Basemode appears in the message display.
2. Press the SCROLL key to return to Base Mode.

Press the SCROLL key to step through the parameters. Press the UP and DOWN keys to change the parameter value.

Table 7-1 Tune Mode Parameters

STEP	DESCRIPTION	MESSAGE DISPLAY	FUNCTION	AVAILABLE SETTING
1	Input Correction Offset ¹	InpCor	Modifies actual PV value: Offset PV + Actual PV = PV value used	For linear input, limited by Scale Range Max. and Scale Range Min. Default = 0.
2	Output 1 Power	Po1	Indicates current Output1 power level	Not adjustable "Read Only"
3	Output 2 Power ²	Po2	Indicates current Output2 power level	Not adjustable "Read Only"
4	Recorder Output Scale Maximum ⁶	POutHI	The value of the process variable or setpoint (as applicable) for which the recorder output is a maximum.	-1999 to 9999 (decimal point as for the process variable input range). Default = Input Range Max.
5	Recorder Output Scale Minimum ⁶	POutLo	The value of the process variable or setpoint (as applicable) for which the recorder output is a minimum.	-1999 to 9999 (decimal point as for the process variable input range). Default = Input Range Min.

STEP	DESCRIPTION	MESSAGE DISPLAY	FUNCTION	AVAILABLE SETTING
6	Proportional Band1 (PB1)	P. Band 1	Defines portion of input span in which the Output 1 power level is proportional to the (offset) process variable value	0.0% (ON/OFF control) to 999.9% of input span. Default 10.0%
7	Proportional Band 2 (PB2) ²	P. Band2	Defines portion of input span in which the Output 2 power level is proportional to the (offset) process variable value	0.0% (ON/OFF control) to 999.9% of input span. Default 10.0%
8	Auto Reset ³	AutoRset	Integral Time Constant	1 second to 99 minutes 59 seconds per repeat Default 5.00 minutes
9	Rate ³	Rate	Derivative Time Constant	00 seconds to 99 minutes 59 seconds Default 1.00 minute
10	Spread ⁴	Spread	Defines the portion of the proportional band (PB1 + PB2) over which both outputs are active (overlap) or neither output is active (deadband)	-20% to +20% (negative value = deadband, positive value = overlap) Default = 0%
11	Manual Reset ³	ManRset	Bias applied to output power, expressed as a percentage of output power	0% to 100% (Output1 only) -100% to +100% (Output 1 & Output 2) Default = 25%
12	Hysteresis1 ⁸	Hyst1	Defines band below setpoint where output 1 will not transition	0.1 to 10% of input span Default 0.5% (= 7°F for input type 1420)
13	Hysteresis2 ^{8,2}	Hyst2	Defines band above setpoint where output 2 will not transition	0.1 to 10% of input span Default 0.5% (= 7° for input type 1420)

STEP	DESCRIPTION	MESSAGE DISPLAY	FUNCTION	AVAILABLE SETTING
14	Setpoint Rate	SPRate	Determines maximum rate of change for setpoint in units per hour	1 to 9999, INF Default = INF (infinite)
15	Output 1 Cycle Time ⁷	CycTime1	Limits frequency of operation of output relay to maximize relay life.	0.5, 1, 2, 4, 8, 16, 32, 64, 128, 256 or 512 seconds. Default = 1 second
16	Output 2 Cycle Time ^{7,2}	CycTime2	Limits frequency of operation of output relay to maximize relay life.	0.5, 1, 2, 4, 8, 16, 32, 64, 128, 256 or 512 seconds. Default = 1 second

Notes on Tune Parameters Mode

1. The Input Correction value should be chosen with care. Any adjustment to this parameter is, in effect, a calibration adjustment. Injudicious application of values to this parameter could lead to the displayed process variable value bearing no meaningful relationship to the actual process variable value. There is no front panel indication when this parameter is in effect (i.e. has been set to a non-zero value).
2. These parameters are applicable only if the secondary control (COOL) output is fitted.
3. These parameters are not applicable if Proportional Band 1 is set to 0 (i.e. ON/OFF control).
4. This parameter is not applicable if Proportional Band 1 is set to 0 or if Output 2 (COOL) is not fitted.
5. The message Display will show Diff 1 for ON/OFF control on Output 1 only, Diff 2 for ON/OFF control on Output 2 only or Diff for ON/OFF control on both Output 1 and Output 2.
6. These parameters are not applicable if the Recorder Output option is not fitted.
7. Output 1 cycle Time is not applicable if Proportional Band 1 is set to 0 or if Output 1 is a DC linear output. Output 2 cycle Time is not applicable if Proportional Band 1 is set to 0, if Output 2 is not fitted or if Output 2 is a DC linear output.
8. These parameters only apply if the proportional band has been set to 0.

SECTION 8: ALARM MODE

The Alarm Mode parameters control the type of alarms used and their settings.

To enter the Alarm Setting Mode from Base Mode:

1. Press the MODE key until **Alarm** appears in the message display
2. Press the SCROLL key to enter the Alarm Setting Mode.

To return to Base Mode:

1. Press the MODE key until **Basemode** appears in the message display.
2. Press the SCROLL key to return to Base Mode.

Press the SCROLL key to step through the parameters. Press the UP and DOWN keys to change the parameter setting.

Table 8-1 Alarm Mode Parameters

STEP	DESCRIPTION	MESSAGE DISPLAY	FUNCTION	AVAILABLE SETTING
1	Alarm 1 Type	Alarm 1	Specifies Alarm 1 Operation	P_hi - Process High P_Lo - Process Low dE - Deviation bAnd - Band nonE - None
2	Alarm 2 Type	Alarm 2	Specifies Alarm 2 Operation	P_hi - Process High P_Lo - Process Low dE - Deviation bAnd - Band nonE - None
3	Alarm Inhibit	Inhibit	Specifies which alarms are inhibited	nonE - No inhibit ALA1 - Alarm 1 ALA2 - Alarm 2 both - Both Alarms
4a	Process High Alarm 1 value	HiAlarm 1	If Alarm 1 is a Process High alarm, the value of process variable at or above which Alarm 1 will be active	Input Range Max. to Input Range Min. Default = Input Range Max.
4b	Process Low Alarm 1 value	LoAlarm 1	If Alarm 1 is Process Low Alarm, the value of process variable at or below which Alarm 1 will be active	Input Range Max. to Input Range Min. Default = Input Range Min.
4c	Band Alarm 1 value	BaAlarm 1	If Alarm 1 is a Band Alarm, the band of process variable values (centered on the setpoint) outside which the process variable will cause this alarm to be active.	± (input span) from setpoint. Default = five input units.

STEP	DESCRIPTION	MESSAGE DISPLAY	FUNCTION	AVAILABLE SETTING
4d	Deviation (High/Low) Alarm 1 value	DeAlarm 1	If Alarm 1 is a Deviation High/Low alarm, gives a value above (positive value) or below (negative value) the setpoint. If the process variable deviates from the setpoint by a margin greater than this value, the alarm becomes active	± (input range) from setpoint. Default = five input range units.
5	Alarm 1 Hysteresis value	Al1 Hyst	Value defines a hysteresis band on the "safe" side of the alarm 1 value	1 unit to X units, where X = 10% of input span
6a	Process High Alarm 2 value	HiAlarm 2	If Alarm 2 is a Process High alarm, the value of process variable at or above which Alarm 2 will be active	Input Range Max. to Input Range Min. Default = Input Range Max.
6b	Process Low Alarm 2 value	LoAlarm2	If Alarm 2 is Process Low Alarm, the value of process variable at or below which Alarm 2 will be active	Input Range Max. to Input Range Min. Default = Input Range Min.
6c	Band Alarm 2 value	BaAlarm2	If Alarm 2 is a Band Alarm, the band of process variable values (centered on the setpoint) outside which the process variable will cause this alarm to be active.	± (input span) from setpoint. Default = five input units.
6d	Deviation (High/Low) Alarm 2 value	DeAlarm 2	If Alarm 2 is a Deviation High/Low Alarm, gives a value above (positive value) or below (negative value) the setpoint. If the process variable deviates from the setpoint by a margin greater than this value, the alarm becomes active.	± (input range) from setpoint. Default = five input range units
7	Alarm2 Hysteresis Value	Al2 Hyst	A non-zero value defines a hysteresis band on the "safe" side of the Alarm 2 value	1 unit to X units, where X = 10% of input span
8	Loop Alarm Enable	Loop Alm	Enables/disables Loop Alarm	EnAb disA Default = disA
9	Loop Alarm Time	LpAtime	If ON/OFF control is selected (i.e. PB1=0) and Loop Alarm is enabled, this defines the duration of the saturation condition after which the Loop Alarm is activated.	1 second to 99 minutes 59 seconds. Default = 99 minutes 59 seconds

8.1 Alarm Inhibit Facility

On power-up, an "alarm" condition may occur, based on the alarm value, the process value and, if appropriate to the alarm type, the setpoint value. This would normally activate an alarm; however, if the pertinent alarm is inhibited, the alarm indication is suppressed and the alarm will remain inactive. This will prevail until the "alarm" condition returns to the "inactive" state, whereafter the alarm will operate normally.

8.2 Loop Alarm And Loop Alarm Time

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 facility, when enabled, repeatedly checks the control output(s) for saturation i.e. either or both outputs being at the maximum or minimum limit. If an output is found to be in saturation, the Loop Alarm facility starts a timer; thereafter, if the saturated output has not caused the process variable to be corrected by a pre-determined amount V after a time T has elapsed, the Loop Alarm goes active. Subsequently, the Loop Alarm facility 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 saturated output comes out of saturation, the Loop Alarm is deactivated.

For PID control, the Loop Alarm Time T is always set to twice the value of the Reset (Integral Time Constant) parameter. For On/Off control, the user defined value of the Loop Alarm Time parameter is used.

The value of V is dependent upon the input type:

°C ranges:	2°C or 2.0°C
°F ranges:	3°F or 3.0°F
Linear ranges:	10 least significant display units

For single output controllers, the saturation limits are 0% and Output Power Limit. For dual output controllers, the saturation limits are -100% and Output Power Limit.

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 facility. Upon exit from Manual Control Mode or after completion of the Pre-Tune routine, the Loop Alarm is automatically re-enabled.

When full ON/OFF control is selected (i.e. Proportional Band 1 is set to 0) and Loop Alarm is enabled, the Loop Alarm Time parameter determines the duration of the saturation condition after which the Loop alarm will be activated. It may be adjusted within the range 1 second to 99 minutes 59 seconds. This parameter is omitted from the display sequence if ON/OFF control is not selected or Loop Alarm is disabled. The default setting is 99:59.

SECTION 9: ENABLE MODE

The Enable mode controls which modes are readily available to the operator. If a mode is disabled or off, it will not be displayed when the MODE key is pressed in Base Mode. If a mode is set to Read Only, that mode is not available to be changed by the operator, such as the Setpoint Change and AutoTune settings.

To enter the Enable Mode from Base Mode:

1. Press the MODE key until **Enable** appears in the message display.
2. Press and hold the SCROLL key for five seconds to access the Enable Mode.
3. With **PassCode** displayed in the message display, use the UP and DOWN keys to set the pass code in the numerical display.
4. With the proper pass code displayed, press the SCROLL key.

If a proper pass code has been entered, the control will enter the Enable Mode, with **EnAb** shown in the lower display. If an improper pass code has been entered, the control will revert back to the **Enable** prompt.

Once the Enable Mode has been accessed, if no key is pressed for more than one minute, the instrument will automatically revert to Base Mode.

Press the SCROLL key to step through the parameters. Press the UP and DOWN keys to change the parameter setting.

Table 9-1 Enable Mode Parameters

STEP	MODE	DISPLAY	AVAILABLE SETTINGS
1	Profile Parameters	Prof Par	Enable Disable
2	Setpoint Change (Change setpoint in Base Mode)	Setpoint	Enable Read Only (R/O)
3	Pre-Tune Facility	PreTune	Enable Read Only (R/O) Off
4	Auto-Tune Facility	AutoTune	Enable Read Only (R/O) Off
5	Alarm Parameters	Alarm	Enable Disable
6	Tuning Parameters	TunePar	Enable Disable
7	Configuration Parameters	ConfPar	Enable Disable

STEP	MODE	DISPLAY	AVAILABLE SETTINGS
8	Test	Test	Enable Disable
9	Calibration	Calib.	Enable Disable
10	Manual control of output (Base Mode)	Manual	Enable Disable
11	Setpoint ramp rate (determines whether ramp rate control is active/enabled or inactive/disabled)	SPRate	Enable Disable
12	Communications Write (writing of parameters via RS485 comm. Link)	ComWrite	Enable Disable
13	Auto Pre-Tune*	AutoPT	Enable Disable
14	Units (display units in Base Mode)	Units	Enable Disable
15	Password Change	PassCh	0 - 9999

*This setting does not determine access. It determines whether the Pre-Tune facility is automatically activated when power is applied to the instrument.

To return to Base Mode:

1. Press the MODE key until **Basemode** appears in the message display.
2. Press the SCROLL key to return to Base Mode.

SECTION 10: CONFIGURATION MODE

10.1 Entering The Configuration Mode

To enter the Configuration Mode from Base Mode:

1. Press the MODE key until **ConfPar** appears in the message display.
2. Press the SCROLL key to enter the Configuration Mode.

To return to Base Mode:

1. Press and hold the MODE key for 5 seconds. The instrument will cycle through its power-up sequence and return to BASE mode.

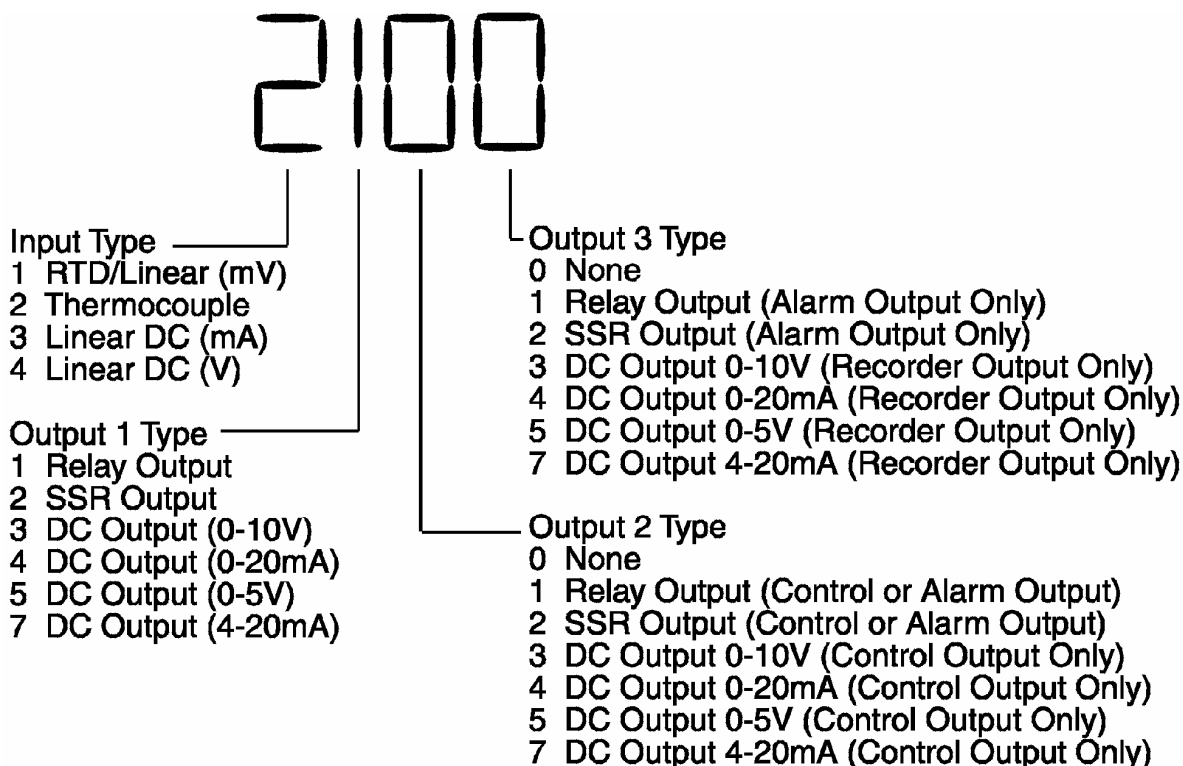
The user may step through the Configuration Mode parameters using the SCROLL key. For each parameter, the Message Display will show a legend identifying that parameter and the lower main display will show the current setting of that parameter. The setting may be adjusted using the UP/DOWN keys. As soon as the setting is changed, the lower main display will flash, indicating that the new setting has yet to be confirmed. When the setting is as required, it may be confirmed by pressing the PROF key, whereupon the upper display will stop flashing.

NOTE: Changes to certain Configuration Mode parameters (i.e. input range, output use and type) will cause other mode parameters to be automatically set to their default values. Items affected include Tune Mode, and Pretune and Auto Tune Facilities. Until the Tune Mode settings have been verified by changing at least one parameter, the upper main display will show decimal points to indicate that the values are in their default condition.

Changes to Configuration Mode parameters will not be accepted until they have been verified with the PROF key.

10.2 Hardware Definition Code

This parameter is a special facility in Configuration Mode, which is used to specify the hardware fitted (input type, output types, etc.); this must be compatible with the hardware actually fitted. It can be accessed, with the instrument in Configuration Mode, by simultaneously pressing the DOWN and SCROLL keys. The Message Display will then read **HwDefine**, and the lower main display will be of the form:



The displayed code may be incremented/decremented using the UP/ DOWN keys as required. The maximum setting available for this code is 4777. For example, the code for a thermocouple input, 4-20mA DC primary output (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 PROF key.

NOTE: It is essential that this code is changed promptly whenever there is a change to the instrument's hardware configuration (change of input/output type, alarm/recorder output added/removed etc.). The instrument software depends upon this code to operate correctly. To save any changes made in Hardware Define Mode, the PROF key must be pressed when the desired setting is flashing.

Hardware Definitions also may be viewed as Read Only displays in Base Mode by pressing the SCROLL and DOWN keys simultaneously.

While the Hardware Definition Code is displayed, pressing the SCROLL key will cause the Message Display to read **ExtOptn**, and the lower main display to change to one of:

none

No option PCB fitted

1 in

Digital Input
Option PCB fitted

out

Event Output
Option PCB fitted

both

Both Option PCBs fitted

The desired setting can be achieved using the UP/DOWN keys.

Press the SCROLL key to change the Message Display to Comms, and the lower main display to one of:

none

RS485
Communications
Option PCB not fitted

SLA

RS485
Communications
Option PCB fitted -
Programmer acting as
slave device

MA5

RS485
Communications
Option PCB fitted -
Programmer acting as
master device

The desired setting can be achieved using the UP/DOWN keys.

Pressing the SCROLL key again will display Inputs in the Message Display. Press the UP and DOWN keys to select from contact (cont) and low voltage (ttl) type of inputs.

Pressing the SCROLL key again will display the desired function of the remote input wired to terminal 28 (see Section 2). Press the UP and DOWN keys to select from X60

timebase (60) or jump to next segment (SEGJ) This input can be used to remotely control the appropriate function in the Program Run Mode.

To exit from the Hardware Definition Code facility, press the DOWN and SCROLL keys simultaneously (which will cause a return to the normal Configuration Mode).

10.3 Configuration Mode Parameters

The Configuration Mode parameters are presented for view/edit in the following sequence:

STEP	DESCRIPTION	MESSAGE DISPLAY	FUNCTION	AVAILABLE SETTING
1	Primary Input Range ⁵	Input	Code displayed defines input type/range (see App. A)	See App. A Default = 1420 (Type J T/C in °F)
2	Control Action	Control	Specifies control action of Output 1 ¹	dir - Direct Acting rEv - Reverse Acting (default) Mdr = Motor drive reverse Mdd = Motor drive direct
3	Output 2 Usage ¹⁰	Out2 Use	Specifies use of Output 2 ²	out2 - Control Output A2_d - Alarm 2 (direct) A2_r - Alarm 2 (reverse) Or_d - Alarm 1 OR 2 (direct) Or_r - Alarm 1 OR 2 (reverse) Ad_d - Alarm 1 AND 2 (direct) Ad_r - Alarm 1 AND 2 (reverse) LP_d - Loop Alarm (direct) LP_r - Loop Alarm (reverse)
4	Output 3 Usage ¹⁰	Out3 Use	Specifies use of Output 3 ³	Al_d - Alarm 1 (direct) Al_r - Alarm 1 (reverse) Or_d - Alarm 1 OR 2 (direct) Or_r - Alarm 1 OR 2 (reverse) Ad_d - Alarm 1 AND 2 (direct) Ad_r - Alarm 1 AND 2 (reverse) LP_d - Loop Alarm (direct) LP_r - Loop Alarm (reverse) rEcS - Rcdr Output (SP) rEcP - Rcdr Output (PV)
5	Segment Mode	Seg Mode	Defines parameter used to specify duration of each segment (along with final SP value)	ti - Time rA - Ramp Rate Default = ti
6	Baud Rate ⁶	Baud Rate	Selects Baud Rate for RS485 Comms.	Numeric value: 1200, 2400, 4800 or 9600 Default = 4800
7	Protocol ⁶	Protocol	Select protocol and parity for RS485 comms.	Mbn = Modbus, no parity Mbo = Modbus, odd parity MbE = Modbus, even parity WES = ASCII Default = Mbn
8	Address ^{6,7}	Address	Selects RS485 comm. address	Numeric value = 1 - 255 (Modbus), 1 - 99 (ASCII)
9	CJC ⁴ Enable/Disabled	CJC	Enables/disables cold junction comp.	EnAb-enabled diSA - disabled
10	Events ¹⁰	Events	Set event status in Base Mode	(Binary with LSD = Event 1 0100 = Event #3 on, all other events off)

10.4 Controller Parameters

The Controller parameters appear in the following sequence:

STEP	DESCRIPTION	MESSAGE DISPLAY	FUNCTION	AVAILABLE SETTING
11	Scale Range Decimal Point ⁹	DecPos	For linear inputs, defines the decimal point position	0 XXXX 1 XXX.X (default) 2 XX.XX 3 X.XXX
12	Scale Range Maximum ⁹	EngU UP	For linear inputs, defines the scaled input value when the process variable input is at its maximum value.	-1999 to 9999 (decimal point as defined by Scale Range Decimal Point parameter) Default = 0.0
13	Scale Range Minimum ⁹	EngU LO	For linear inputs, defines the scaled input value when the process variable input is at its minimum value.	-1999 to 9999 (decimal point as defined by Scale Range Decimal Point parameter) Default = 0.0
14	Setpoint High Limit ⁸	SP High	The maximum limit for setpoint adjustment. Should be set to a value which prevents setpoint values causing damage to the process.	Current setpoint value to input Range Mx. Default = Input Range Max.
15	Setpoint Low Limit ⁸	SP Low	The minimum limit for setpoint adjustment. Should be set to a value which prevents setpoint values causing damage to the process.	Input Range Min. to current setpoint value. Default = Input Range Minimum.
16	Input Filter Time Constant	Filter	Defines time constant for input filter (removes extraneous impulse from the process variable input).	0.0 seconds (filter OFF) to 100.0 seconds in 0.5 increments. Default = 2.0 seconds.
17	Output Power Limit	Out PL	Determines maximum output setting instrument will provide.	0 to 100 (%)
18	Engineering Units ⁹	Units	Sets units to be displayed in base mode.	Unit CEnt FAHr
19	End of program output relay	EOPrelay	Sets action of relay	End = relay active at end of profile run = relay active during profile Default = End

Notes on Configuration Mode Parameters

1. If the secondary output is chosen as Output 2 (COOL) control output, its action is always the compliment of the action of Output 1.
2. The default setting for Output 2 Usage is Alarm 2 hardware output, direct-acting (if relay/SSR output) or Output 2 - COOL (if DC output).
3. The default setting for Output 3 Usage is Alarm 1 hardware output, direct-acting (if relay/SSR output) or Process Variable Recorder Output (if DC output)
4. This parameter does not appear in the sequence if the input type selected is not thermocouple. If the CJC is disabled, the initial display in Operator Mode will show horizontal bars flashing in the lower display.
5. The primary input default setting is dependent upon the hardware fitted, as indicated in the Hardware Definition Code.
6. These parameters do not appear if the Hardware Definition Comms parameters is set to none.
7. This parameter does not appear if the Programmer communications option is set to operate in Master mode.
8. Internal software prevents (a) the Setpoint High Limit being given a value less than any setpoint value contained in currently-resident programs, and (b) the Setpoint Low Limit being given a value greater than any setpoint value contained in currently-resident programs.
9. These parameters are applicable only if a linear input is fitted.
10. These parameters do not appear if features are not fitted.

SECTION 11: TEST MODE

The Test Mode permits turning on and off the instrument outputs in order to determine proper operation.

To enter the Test Mode from Base Mode:

1. Press the MODE key until **Test** appears in the message display.
2. Press the SCROLL key to enter the Test Mode.

To return to Base Mode:

1. Press the MODE key until **Basemode** appears in the message display.
2. Press the SCROLL key to return to Base Mode.

Exiting the Test Mode will turn all outputs off and terminate communications. Control of outputs and communications will be returned to the mode from which access to the Test Mode was gained.

Press the SCROLL key to step through the parameters. Use the UP and DOWN keys to change the parameter setting.

Table 11-1 Test Mode Parameters

Step	Display	Setting
1	Output1 ²	On/Off
2	Output2 ^{1,2}	On/Off
3	Output3 ^{1,2}	On/Off
4	EOPrelay	On/Off
5	Event1 ¹	On/Off
6	Event2 ¹	On/Off
7	Event3 ¹	On/Off
8	Event4 ¹	On/Off
9	Comms	Send/Stop

NOTES:

1. Only appears if presence has been registered in Hardware Define (Configuration Mode)
2. Driven to 100% when turned on.

SECTION 12: CALIBRATION MODE

To enter the Calibration Mode from Base Mode:

1. Press the MODE key until **Calib** appears in the message display.
2. Press the SCROLL key to enter the Calibration Mode.

To return to Base Mode, cycle power to the control.

12.1 Calibration Procedure

NOTE: Calibration should be attempted only on Controllers on which calibration errors have been encountered (see CALIBRATION CHECK).

CALIBRATING THE UNIVERSAL INPUT

Equipment Required

1. Input source with an accuracy better than +/- 0.05 of reading:
 - a) Thermocouple inputs: Thermocouple simulator, "K" type with compensated leads
 - b) DC linear inputs: 0 - 50 mV, 0 - 10 V or 0 - 20 mA
 - c) RTD inputs: decade resistance box with connections for three-wire input (or equivalent)
2. Case assembly, wired for appropriate input supply (90 - 264 VAC 50/60 Hz, 20 - 50 VAC 50/60 Hz or 22 - 65 VDC)

Calibration Procedure

1. Ensure that the Controller is powered-off and that the mains (line) lead is disconnected. On the CPU PCB, fit the appropriate link jumpers (see Figure B-3, Appendix B). Connect the appropriate input lead (see Table 12-1).
2. Connect the mains (line) lead to the Controller. Power-up the Controller and leave switched on for five minutes (for RTD and DC Linear inputs) or 30 minutes (for thermocouple inputs).

3. Enter Calibration Mode. The lower main display will then show Input Type Number, in the form:

iP_I

and the message display will show:

Calib

Using the UP/DOWN keys, change the input type number as required (see Table 12-1).

NOTE: If required, only one input type may be calibrated. Exception: If it is required to calibrate the thermocouple input (Input Type 5), it is necessary first to calibrate the DC 0 - 50 mV input (Input Type 1).

4. Press the PROF key to change the lower main display to show: _ _ _ _

After a few seconds, the lower main display will either (a) return to the initial Input Type Number display if calibration was successful, or (b) display:

FAIL

In the latter case, the link jumpers and wiring should be checked.

5. To calibrate all inputs, repeat Steps 1 to 4 for each of the other input types (see Table 12-1) until all five input types have been successfully calibrated.

The universal input calibration procedure is now complete.

Table 12-1 Universal Input Type Selection

Input Type No.	Input Type	Calibration Input	Link Jumper 1	Link Jumper 2	Link Jumper 3
1	0 - 50 mVDC	50 mVDC	Parked	Parked	Parked
2	0 - 10 VDC	10 VDC	Fitted	Parked	Parked
3	0 - 20 mADC	20 mADC	Parked	Fitted	Parked
4	3-wire RTD	200 ohm	Parked	Parked	Parked
5	Thermocouple	0°C ("K"-type)	Parked	Parked	Fitted

EXIT FROM CALIBRATION MODE

To exit from Calibration Mode, cycle power to the instrument.

NOTE: An automatic exit is made from Calibration Mode if there is no key activity for two minutes.

CALIBRATION CHECK

1. Set the Controller to the required configuration (using link jumpers and front panel entry) as described in the appropriate Site Manual.
2. Power-up the Controller and leave it powered-up for at least five minutes (for RTD and DC linear inputs) or at least 30 minutes (for thermocouple inputs).
3. After the appropriate delay for stabilization has elapsed, check the calibration by connecting the appropriate input source and checking a number of cardinal points.

APPENDIX A: RANGE CODES

The input ranges available (selectable via the front panel) are:

For Thermocouple Inputs

TYPE	INPUT RANGE	DISPLAYED CODE
R	0 - 1650°C	1127
R	32 - 3002°F	1128
S	0 - 1649°C	1227
S	32 - 3000°F	1228
J	0.0 - 205.4°C	1415
J	32.0 - 401.7°F	1416
J	0 - 450°C	1417
J	32-842°F	1418
J	0 - 761°C	1419
J	32 - 1401 °F	1420
T	-200 - 262°C	1525
T	-328 - 503°F	1526
T	0.0 - 260.0°C	1541
T	32.0 - 501.0°F	1542
K	-200 - 760°C	6726

TYPE	INPUT RANGE	DISPLAYED CODE
K	-328 -1399°F	6727
K	-200 - 1373°C	6709
K	-328 - 2503°F	6710
L	0.0 - 205.7°C	1815
L	32.0 - 402.2°F	1816
L	0 - 450°C	1817
L	32 - 841°F	1818
L	0 - 762°C	1819
L	32 - 1403°F	1820
B	211 - 3315°F	1934
B	100 - 1824°C	1938
N	0 - 1399°C	5371
N	32 - 2550°F	5324

For RTD Inputs

Note: Input conditioning jumper LJ1, LJ2, or LJ3 needs to be changed, see Appendix B.

INPUT RANGE	DISPLAYED CODE
0 - 800°C	7220
32 - 1471 °F	7221
32 - 571 °F	2229
-100.9 - 100.0 °C	2230
- 149.7 - 211.9°F	2231
0 - 300°C	2251

INPUT RANGE	DISPLAYED CODE
0.0 - 100.9°C	2295
32.0 - 213.6°F	2296
-200 - 206°C	2297
-328 - 402°F	2298
- 100.9 - 537.3°C	7222
- 149.7 - 999.1 °F	7223

For DC Inputs

Note: Input conditioning jumper LJ1, LJ2. or LJ3 needs to be changed, see Appendix B.

INPUT RANGE	DISPLAYED CODE
0-20mA	3413
4-20mA	3414
0-50mV	4443
10-50mV	4499
0-5V	4445
1-5V	4434
0-10V	4446
2-10V	4450

APPENDIX B: BOARD LAYOUT, JUMPER POSITIONING

FIGURE B-1 PCB POSITIONS

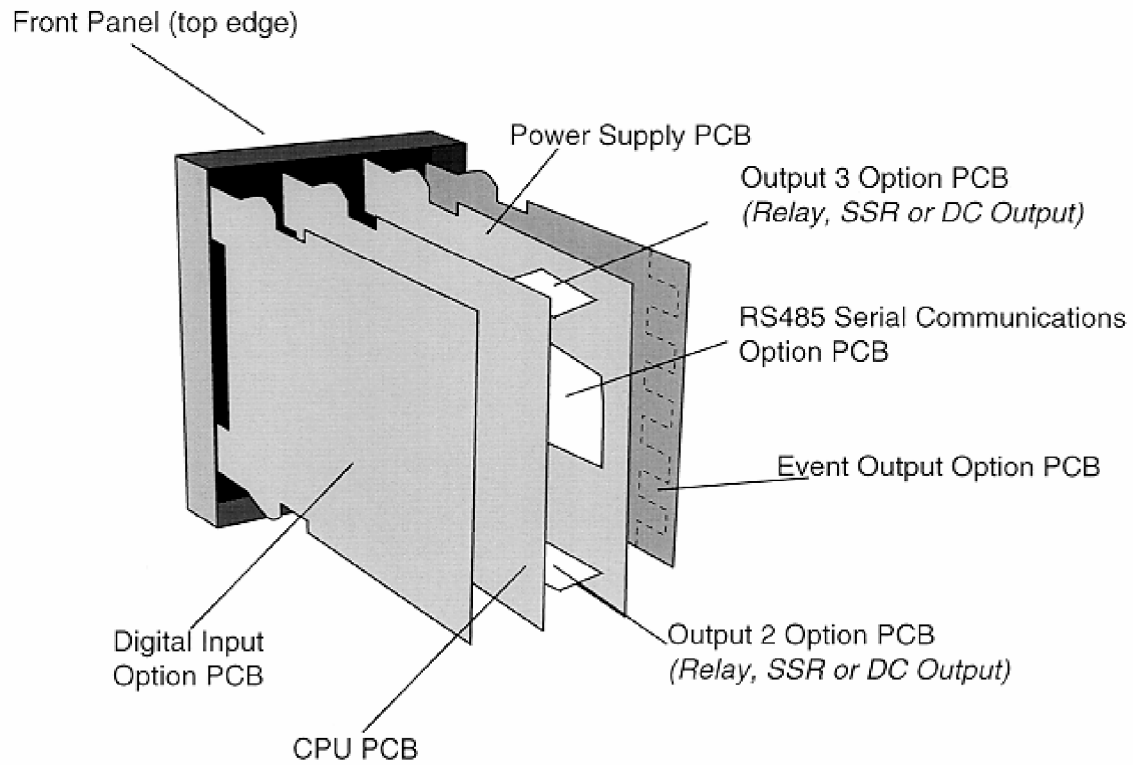


FIGURE B-2 OUTPUT 2, OUTPUT 3 REMOVAL

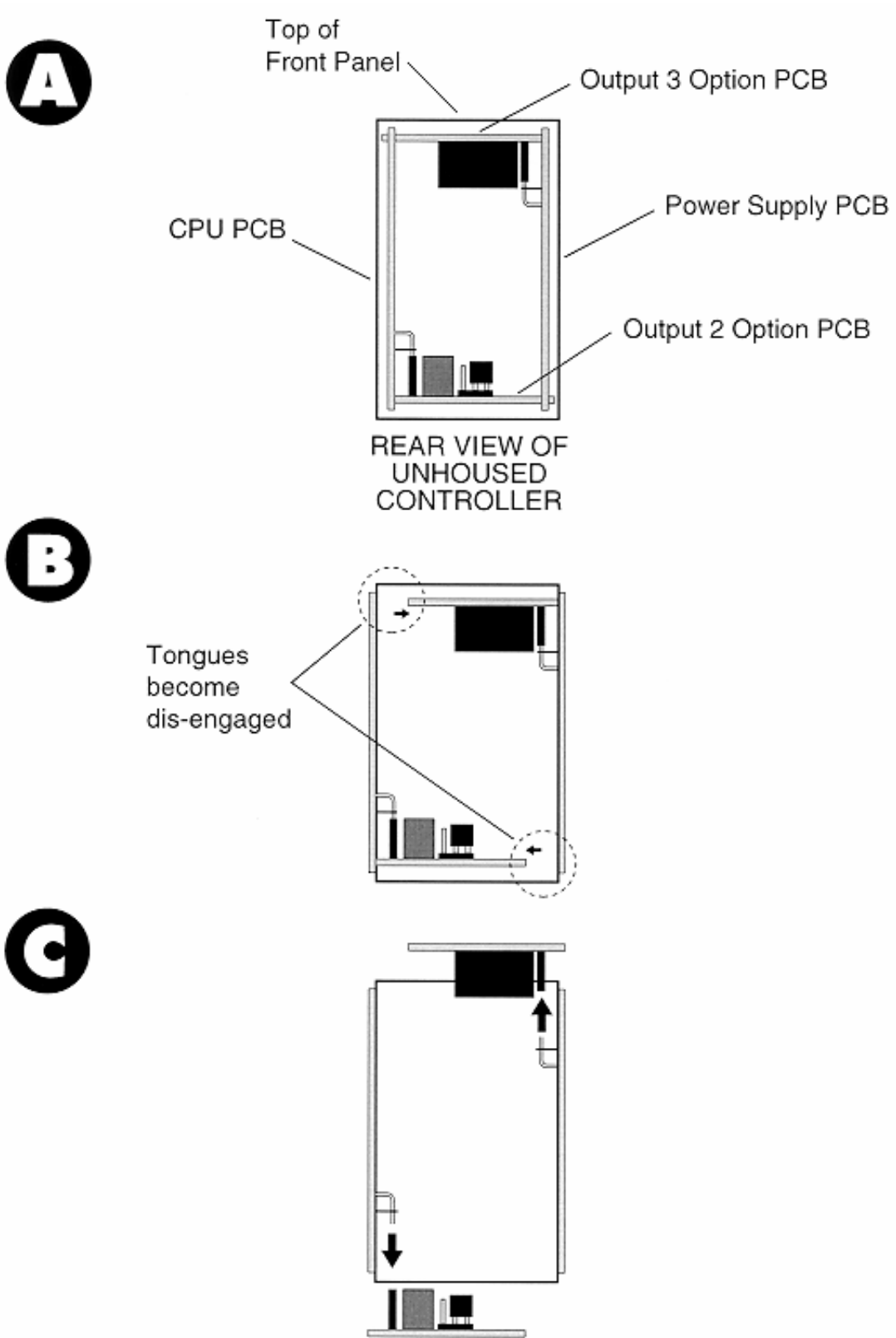
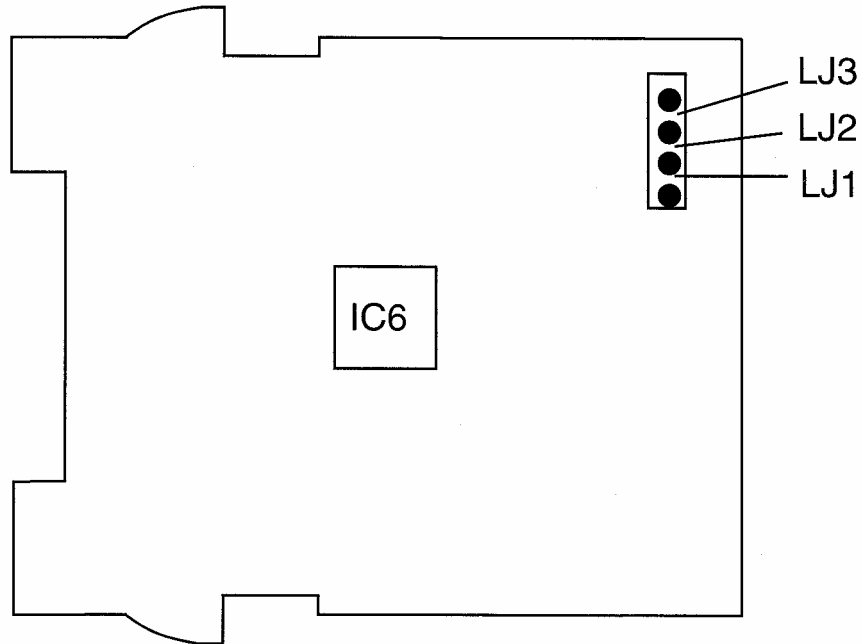
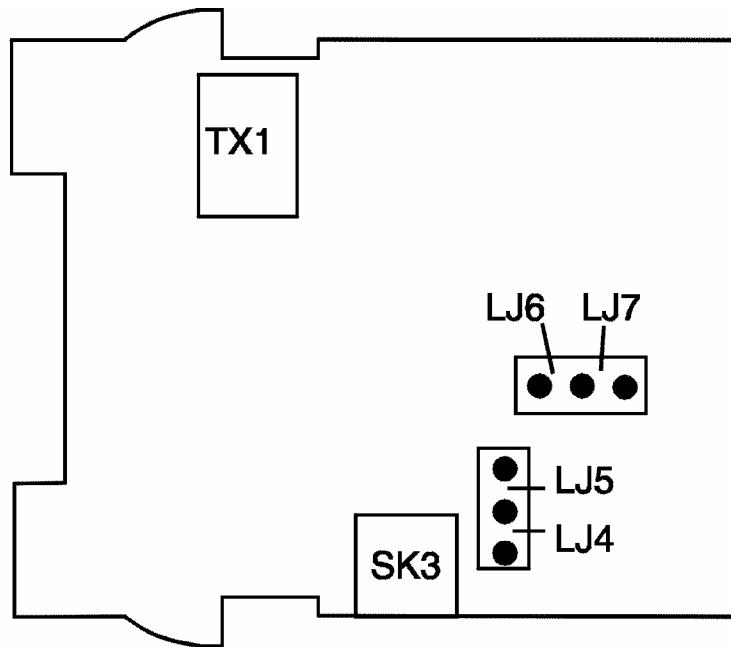


FIGURE B-3 CPU PWA



<u>Input Type</u>	<u>LJ1, LJ2, LJ3 Jumper Position</u>
RTD, DC (mV)	None (parked)
T/C	LJ3
DC (mA)	LJ2
DC (V)	LJ1

FIGURE B-4 PS PWA WITH RELAY OR SSR OUTPUT 1







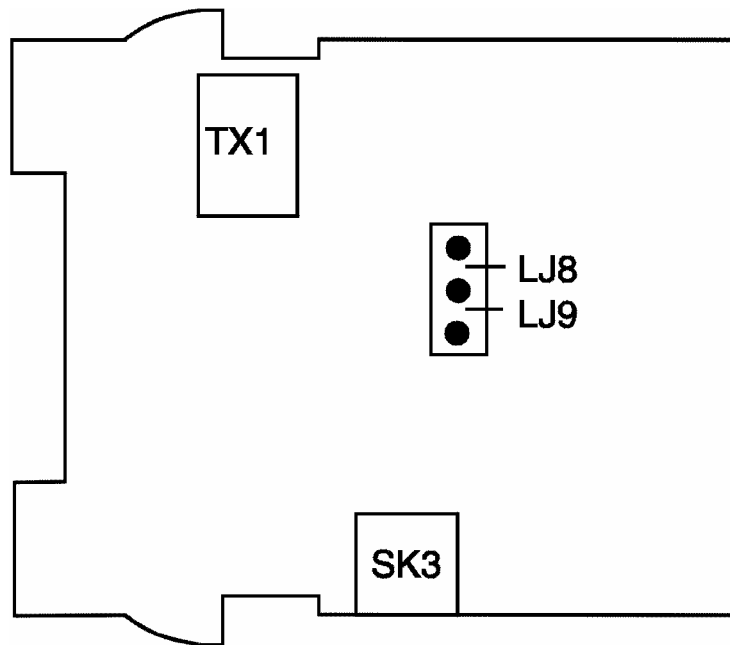
<u>Output Type</u>	<u>LJ4, LJ5 Jumper Position</u>	<u>LJ6, LJ7 Jumper Position</u>
Relay	 LJ5	 LJ6
SSR	 LJ4	 LJ7

FIGURE B-5 PWA WITH DC OUTPUT 1



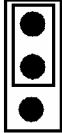
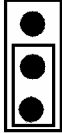


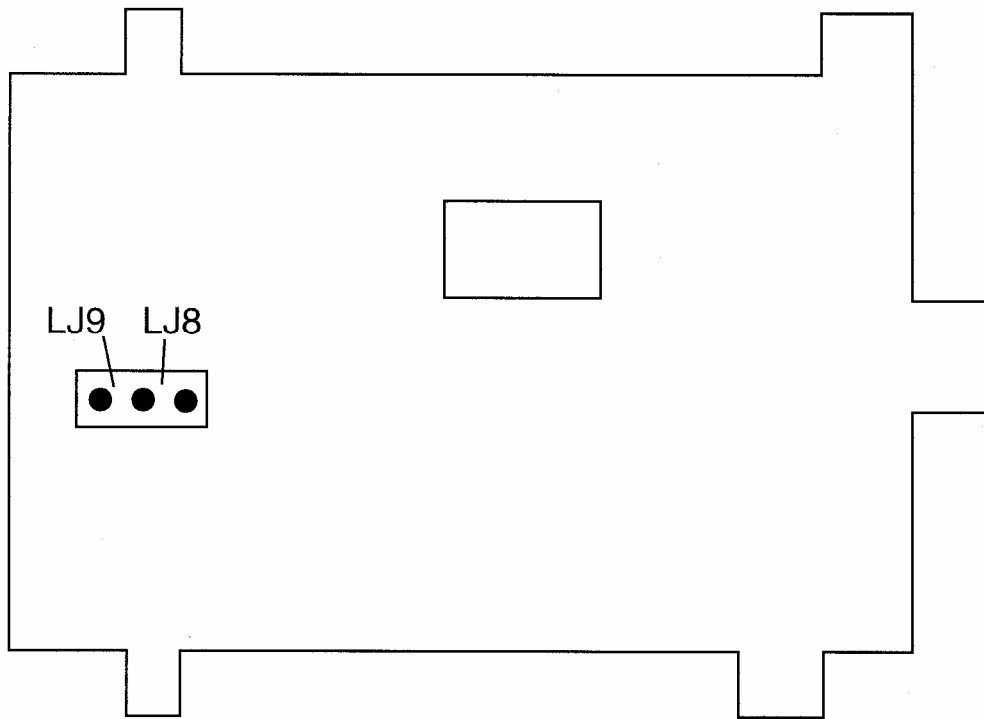




<u>Output Type</u>	<u>LJ8, LJ9 Jumper Position</u>
DC (0-10V)	 LJ8
DC (0-20mA)	 LJ9
DC (0-5V)	 LJ8
DC (4-20mA)	 LJ9

FIGURE B-6 OPTION PWA DC OUTPUT 2/OUTPUT 3



<u>Output Type</u>	<u>LJ8, LJ9 Jumper Position</u>
DC (0-10V)	 LJ8
DC (0-20mA)	 LJ9
DC (0-5V)	 LJ8
DC (4-20mA)	 LJ9

APPENDIX C: SPECIFICATIONS

Input Specifications

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 Inputs Types:	R, S, J, T, K, L, B, and N Note: Thermocouple must not be grounded! Damage to the cold junction in the control will result!
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 Inputs Type and Connection:	Three-wire Pt100
Calibration:	Complies with BS1904 and DIN43760.
Lead Compensation:	Automatic
RTD Current:	I50 μ A (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 Inputs 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.

Output Specifications

General

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

Relay

Contact Type: SPDT

Rating: 2A resistive at 120/240V AC

Lifetime: > 500,000 operations at rated voltage/current

Isolation: Inherent

SSR Driver/TTL

Drive Capability: SSRD>4.3V DC into 250 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 jumper movement.

Output 2

General

Types Available: Relay, SSR Driver and DC

Relay

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

SSR Driver/TTL

Drive Capability: SSRD>4.3V DC into 250 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

Transmitter Power Supply Rating: 24 VDC, 20 mA maximum

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

Output 3

General

Types Available: Relay, SSR Driver and DC linear (retransmit only)

Relay

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

SSR Driver/TTL

Drive Capability: SSRD>4.3V DC into 250 ohm minimum
Isolation: Not isolated from input or other SSR outputs

DC

Resolution: Eight bits in 250 mS (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.
Transmitter Power Supply Rating: 24 VDC, 20 mA maximum
*Changes between V and mA ranges also require jumper movement.

Control Specifications

Control Types:	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:	1 s-99min 59sec/repeat and OFF
Rate:	0 (OFF) - 99min 59sec
Manual Reset (Bias):	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
Auto/Manual Control:	User-selectable with "bumpless" transfer into and out of Manual control.
Cycle Times:	Selectable from 0.5sec to 512sec in binary steps
Setpoint Range:	Limited by Setpoint Maximum and Setpoint Minimum.
Setpoint Maximum:	Limited by Setpoint and Range Maximum.
Setpoint Minimum:	Limited by Range Minimum and Setpoint.

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 1.0% of span.
Loop Alarm:	Detects faults in the control feedback loop by continuously monitoring process variable response to the control output(s).

Program Specifications

Programs:	Eight, each with free-form segments
Length of Programs:	Adjustable in the range 1 to 16 segments; programs cascable - maximum length 121 segments.
Segment Types:	Ramp, Dwell, Join, Repeat, or End.
Program Cycling:	Range 1 to 9999, infinite.
Delayed Start:	May be set in the range 0 to 99:59 (hours:minutes). One setting applies to all programs.
Control:	Run, Hold, Abort, Time Base x60 (local or remote); Select Program (local or remote); Jump to next Segment.
Start From:	Either current process variable value or controller setpoint value.
Go To:	Base Mode or Off Mode
End On:	Final Value or controller setpoint.
Deviation/Hold:	Off, below setpoint only, above setpoint only or above and below setpoint. On ramps only, on dwells only, or on both ramps and dwells. Auto/Hold band may be set from 0 to input span.
Time Base:	Either hours:minutes or minutes:secs (x60) preprogrammable or may be set during Program Run.
Segment Time:	May be set in the range 0 to 99:59 (hours:minutes or minutes:seconds).
Ramp Rate:	0 to 9999 least significant digits per hour or minute.

End of Program Output

Type:	Relay
Contact Type:	SPDT
Rating:	5A resistive @ 120/240V AC
Lifetime:	>100,000 operations @ rated voltage/current
Isolation:	Inherent

Event Outputs - Option

Type:	Relay (4)
Contact Type:	SPST
Rating:	5A resistive @ 120/240V AC
Lifetime:	>100,000 operations @ rated voltage/current.
Isolation:	Inherent

Programmability:	Each event is programmable to either OFF or ON for each segment.
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Digital (Remote Program Control) Inputs, Outputs

Type:	Voltage-free contact compatible
Number Available:	Six: Run/Hold, Time Base x60, Abort Three (binary-coded) Program Select.
Active State:	Max. Contact Resistance (closed) = 50 ohms
Non-Active State:	Min. Contact Resistance (open) = 5,000 ohms Max. Voltage for "1" = 24.0V
Max. Input Delay (OFF-ON):	0.25 seconds
Min. Input Delay (ON-OFF):	0.25 seconds

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
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Thermocouple Inputs

Measurement Accuracy:	± 0.25% of span ± 1 LSD (Note: Reduced performance with Type B T/C between 100-600°C (212 - 1112°F))
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Note: Thermocouple must not be grounded! Damage to the cold junction in the control will result!

Linearization Accuracy:	Better than ± 0.20°C any point, any 0.1°C range (± 0.05°C typical). Better than ± 0.50°C any point, any 1°C range.
Cold Junction Comp:	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: 0-10 ± 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 (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 3 Accuracy: mA: 0-20mA \pm 0.25% of span (20mA) @ 250 ohm
(Recorder Accuracy) 4-20mA \pm 0.25% of span (16mA) @ 250 ohm
V: 0-10V \pm 0.25% of span (10V) @ 2K ohm
0-5V \pm 0.25% of span (5V) @ 2K ohm

Operating Conditions

Ambient Operating Temperature: 0° C to 55° C
Ambient Storage Temperature: -20° C to 80° C
Relative Humidity: 20% - 95% non-condensing
Supply Voltage: 90 - 264VAC 50/60 Hz (standard)
20 - 50V AC 50/60Hz or 22-65V DC (optional)
Source Resistance: 1000 ohm maximum (thermocouple)
Lead Resistance: 50 ohm per lead maximum balanced (Pt100)

Performance Under Operating Conditions

Temperature Stability: 0.01 % of span/^o C change in ambient temperature
Cold Junction Compensation: Better than $\pm 1^{\circ}$ C (thermocouple only)
Note: Thermocouple must not be grounded! Damage to the cold junction in the control will result!
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 Pt 100 50ohm/lead: < 0.5% of span error
Radiated RF Field Influence: Degradation of Output 1 accuracy to 3% at spot frequencies in the range 80-350MHz at field strength of 10V/m.

Environmental

EMI Susceptibility:	Designed to meet EN50082-1:1992 and EN50082-2: 1995
EMI Emissions:	Designed to meet EN50081-1:1992 and EN50081-2:1994
Safety Considerations:	Designed to comply with EN61010-1:1993
Supply Voltage:	90-264 AC 50/60Hz (standard) 20-50V AC 50/60Hz or 22-65V DC (optional)
Power Consumption:	4 watts approximately
Front Panel Sealing:	NEMA4
Agency Approvals:	UL listing pending cUL certified for use in Canada pending

Physical

Dimensions:	1/4 DIN front panel 96mm x 96mm (3.78" x 3.78") 100mm deep (3.94")
Mounting:	Plug-in with panel mounting fixing strap. Panel cutout 92mm x 92mm (3.62" x 3.62")
Terminals:	Screw type (combination head)
Weight:	16 ounces maximum
Display Character:	Top : .4" Bottom: .36" Message: .19" Profile/Segment No.: .25"

APPENDIX D: SOFTWARE REFERENCE SHEET

Tune Parameter	Setting
Inp Cor	
Po1	
Po2	
P Out HI	
P Out LO	
P Band 1	
P Band 2	
AutoRset	
Rate	
Spread	
Man Rset	
Hyst 1	
Hyst 2	
Hyst	
SP Rate	
CycTime1	
CycTime2	

Alarm Parameter	Setting
Alarm1	
Alarm2	
Inhibit	
Alarm1SP	
AI1 Hyst	
Alarm2SP	
AI2 Hyst	
Loop Alm	
LpATime	

Enable Parameter	Setting
Prof Par	
Setpoint	
Pre Tune	
AutoTune	
Alarm	
Tune Par	
Conf Par	
Test	
Calib.	
Manual	
SPRate	
ComWrite	
AutoPT	
Units	
PassCh	

Configuration Parameter	Setting
Input	
Control	
Out2Use	
Out3Use	
Seg. Mode	
BaudRate	
Protocol	
Address	
CJC	
Events	
Dec Pos	
EngU UP	
EngU LO	
SP High	
SP Low	
Filter	
Out PL	
Units	
EOPrelay	

Hardware Definition	Setting
HwDefine	
ExtOptn	
Comms	

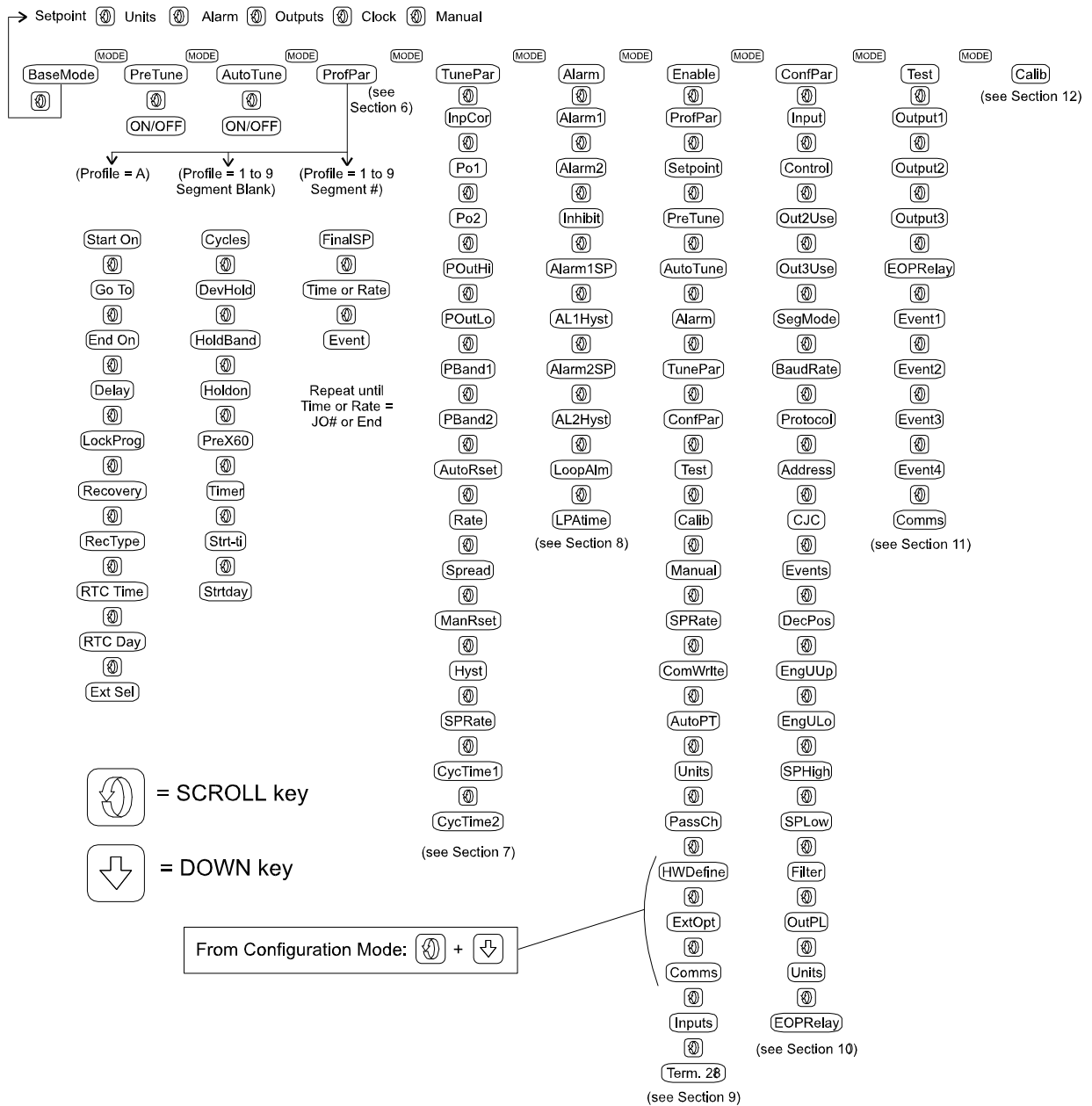
Global Parameter	Setting
Start On	
GoTo	
EndOn	
Delay	
LockProg	
Recovery	
Rec Type	
RTC Time	
RTC Day	
Ext Sel	

Program Parameter	Setting
Cycles	
DevHold	
Hold Band	
Hold On	
Pre-x60	
Timer	
Strt-ti	
Strtday	

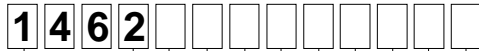
Segment Programming		
Step	Parameter	Setting
1	Final SP	
	Time/Rate	
	Event	
2	Final SP	
	Time/Rate	
	Event	
3	Final SP	
	Time/Rate	
	Event	
4	Final SP	
	Time/Rate	
	Event	
5	Final SP	
	Time/Rate	
	Event	
6	Final SP	
	Time/Rate	
	Event	
7	Final SP	
	Time/Rate	
	Event	
8	Final SP	
	Time/Rate	
	Event	

Segment Programming		
Step	Parameter	Setting
9	Final SP	
	Time/Rate	
	Event	
10	Final SP	
	Time/Rate	
	Event	
11	Final SP	
	Time/Rate	
	Event	
12	Final SP	
	Time/Rate	
	Event	
13	Final SP	
	Time/Rate	
	Event	
14	Final SP	
	Time/Rate	
	Event	
15	Final SP	
	Time/Rate	
	Event	
16	Final SP	
	Time/Rate	
	Event	

APPENDIX E: FLOW CHART OF OPERATION



APPENDIX F: MODEL NUMBER HARDWARE MATRIX



MODEL _____

OUTPUT 1 _____

- 1 Relay
- 2 SSRD
- 3 4-20 mA*

OUTPUT 2 _____

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

OUTPUT 3 _____

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

OPTION 1 _____

- 00 None
- 01 RS-485 Communications

OPTION 2 _____

- 00 None
- 10 Event Outputs (4)
- 20 Remote Profile Control Inputs (6)***
- 30 Both Event Outputs & Remote Profile Control Inputs
- 40 Real Time Clock
- 50 Real Time Clock and Event Outputs
- 60 Real Time Clock and Remote Inputs
- 70 Real Time Clock, Event Outputs and Remote Inputs

SUFFIX _____

- 00 Line Voltage 120 VAC
- 02 Line Voltage 24 V AC/DC

*For control output only

** For retransmission only

*** Remote Control available - Run/Hold, Abort, Time Base Change (x60), and three (binary coded) Program Select.

Product Warranty
See separate warranty for Standard Products (Form BB7)

Parts, Materials and Labor

Seller warrants the equipment manufactured by Seller and not by others, to be free from defects in workmanship and material under normal use and service for a period of (1) year from the date of delivery or the period of two thousand (2,000) accumulated hours of use, whichever period is shorter. Use or service with corrosive or abrasive chemicals or materials is not deemed normal. The period of the forgoing warranty, in the case of furnaces, shall be ninety (90) days or five hundred twenty-five (525) accumulated hours of use, whichever period is shorter. Components manufactured by others including expendable items, are warranted only in accordance with the warranty, if any, issued by such other manufacturer.

Buyer shall give Seller written notice of any defects with 14 days after discovery thereof, specifying each particular defect discovered. If such notice is properly given, Seller will correct without charge any workmanship that is demonstrated to Seller's satisfaction to have been defective at the time of installation, and will repair or replace, at Seller's option, without charge, f.o.b. Seller's factory, parts covered by this warranty that upon inspection are found defective under normal use within the warranty period above stated. All work of removal and reinstallation, whether or not found defective, and shipping charges for defective or replacement parts shall be at the sole expense of Buyer.

The foregoing warranty shall not apply to (i) work done or materials furnished by others in connection with installation work performed without supervision by Seller's installation supervisors, or (ii) equipment repaired or altered by others unless such repairs or alterations were specifically agreed to in writing by an Officer of Seller. Seller shall not be liable for consequential damages of any kind which occur during the course of installation of equipment, or which result from the use or misuse by Buyer, its employees or others of the equipment supplied hereunder, and Buyer's sole and exclusive remedy against Seller for any breach of the foregoing warranty or otherwise shall be for the repair or replacement of the equipment of parts thereof affected by such breach.

The foregoing warranty shall be valid and binding upon Seller if and only if Buyer loads, operates and maintains the equipment supplied hereunder in accordance with the instruction manual to be provided upon delivery of the equipment. Seller does not guarantee the process of manufacture by Buyer or the quality of product to be produced by the equipment supplied hereunder, and Seller shall not be liable for prospective profits.

Despatch will repair or replace, at Despatch's option, FOB Despatch's factory, parts and materials covered by this warranty. Despatch is not responsible for parts or material failures resulting from misuse, abuse, inadequate preventative maintenance, acts of nature, or non-conforming utilities, including electrical, fuel supply, environmental and intake/exhaust provisions. This warranty also does not cover normal wear or routine maintenance parts and materials expressly designed as expendable/consumable and replaceable. (Note: Laboratory oven electric heaters are warranted for a period of five (5) years from date of shipment; three (3) years from date of shipment for Protocol Plus and DES 2000 temperature controllers).

Labor services for parts and materials replacement and repair to support this warranty are available at Despatch's normal service fees. This service is provided worldwide by a network of factory trained professionals.

Transportation Costs

All transportation costs to transport defective parts or materials to Despatch and to transport repaired or replacement parts or materials to Customer shall be the responsibility of the Customer.

Terms and Conditions

This Warranty shall be deemed valid and binding upon Despatch if and only if the Customer:

1. Installs, loads, operates and maintains the covered product supplied hereunder in accordance with the instruction manual provided upon delivery and product labeling affixed to the subject equipment;
2. If applicable, follows the Emergency Procedure set forth in this Warranty; and
3. Contacts Despatch's Helpline at 1-800-473-7373 for assistance in diagnosing and troubleshooting the problem immediately upon discovering any damage or malfunction. Despatch's reasonable determination as to whether a repair, replacement, or service is covered by this Warranty shall be final and binding.

Exclusions

This Warranty DOES NOT cover:

1. Damage or malfunctions, or expenses incurred in the process of diagnosing and/or repairing damage or malfunctions, resulting from any of the following: operator error, misuse, abuse, inadequate preventative maintenance, normal wear and tear, service or modifications by other than Despatch authorized technicians, use of the covered product that is inconsistent with the operation manual or labeling, acts of nature (including, without limitation, floods, fire, earthquake, or acts of war or civil emergency) internal or external corrosion, or non-conforming utilities (including, without limitation, electrical, fuel supply, environmental and intake/exhaust installations);
2. Repair or replacement of parts or materials designed and intended to be expendable or consumable; refrigerants, filters, lamps;
3. Routine maintenance; or
4. Labor costs incurred for troubleshooting, diagnostics or testing (except for testing required to verify that a covered defective part or material has been repaired).

Limitations of Liability

Despatch, shall not, in any event, be liable for indirect, special, consequential, incidental, or punitive damages or penalties of any kind, including, without limitation loss of revenue, profits or business opportunities resulting from interruption of process or production. In no event shall Despatch be liable for damages in excess of the amounts paid by Customer to Despatch with respect to the applicable product(s). This Warranty does not cover, and Despatch shall not be liable for any losses, costs, damages or expenses resulting from delays in diagnosing or repairing the products, supplying or obtaining replacement parts or materials, strikes, labor stoppages or shortages, fires, accidents, government acts or regulations, or any other causes beyond the control of Despatch.

Non-Compliance By Customer

Despatch reserves the right to suspend and withhold service under this Warranty in the event of non-compliance by the Customer to any terms and conditions of this Warranty or the applicable purchase order or invoice. Further, Despatch shall not be liable for any loss of production, expenses, and inconveniences incurred due to such suspension.

Customer Furnished Equipment Warranty Limitation

This Warranty does not cover diagnosis or repairs of defects in or caused by, lack of performance of, or fitness for purpose of customer-supplied parts or equipment unless specifically noted in the Despatch written order acceptance confirmation.

Performance Commitment

Despatch provides no guarantee of process performance or fitness for purpose, unless specifically noted otherwise in Despatch written order acceptance confirmation. Despatch is providing equipment with design parameters specific only to its equipment.

Procedure Upon Discovery of Defects and Emergencies

In the event Customer becomes aware of any defect in the applicable products, Customer must immediately: (a) shut off fuel or energy supply (gas and electricity), (b) call for emergency assistance, if needed, and (c) notify Despatch Service.

THE REPRESENTATION AND WARRANTIES SET FORTH HEREIN ARE EXCLUSIVE AND IN LIEU OF AND CUSTOMER HEREBY WAIVES AND DISCLAIMS RELIANCE UPON, ALL OTHER REPRESENTATIONS AND WARRANTIES OF EVERY KIND WHATSOEVER, WHETHER EXPRESS OR IMPLIED, OR ARISING BY OPERATION OF LAW OR IN EQUITY, OR BY COURSE OF PERFORMANCE OR DEALING OR USAGE OF TRADE, INCLUDING, WITHOUT LIMITATION, ANY IMPLIED WARRANTIES OF MERCHANTABILITY OR OF FITNESS FOR A PARTICULAR PURPOSE.

THIS WARRANTY IS PERSONAL TO THE CUSTOMER AND MAY NOT BE TRANSFERRED OR ASSIGNED. ALL LIMITATIONS HEREUNDER, HOWEVER, SHALL BE BINDING ON ALL SUCCESSORS AND ASSIGNS OF CUSTOMER.

Service
Worldwide Phone 952-469-8230; Worldwide Fax 952-469-8193; North American Phone 800-473-4373
e-mail service@despatch.com; www.despatch.com

Please see reverse side for other service offerings

Despatch Industries

Advantage Service Assurance Program (ASAP)

CONTACT: DESPATCH SERVICE AGREEMENTS SPECIALIST at 800-473-7373 or 952-469-8230
or e-mail: service@despatch.com

Despatch continues to deliver exceptional products backed by a strong sense of responsibility and drive for long term customer satisfaction. Your partnership with Despatch can offer even higher value through your subscription to one of Despatch's Advantage Service Assurance Program(ASAP).

Warranty

Despatch's exclusive, comprehensive service programs start with the 1 year parts only warranty which is described on the other side of this document. This warranty can be expanded immediately to meet your most stringent service needs. Despatch Service Products Group will be able to answer your service questions and provide a quotation for the immediate expansion of your product warranty. Call 800-473-7373 or 952-469-8230; or e-mail service@despatch.com.

Immediate Service Response

The key to an effective service program is response. Wherever your location, Despatch is only a phone call away. Our U.S. and Canadian customers can reach Despatch at 1-800-473-7373. Worldwide customers can call 1-952-469-8230 or FAX 1-952-469-8193. Our Customer Service Technicians have over 150 years combined experience and access to detailed design and manufacturing documentation specific to your Despatch unit(s). This exacting level of service is a benefit only Despatch can provide and means that you can expect speedy, accurate and the most cost effective response.

Field Service Network

A worldwide network of factory trained Service Professionals is available to support your Despatch equipment. From routine repair to certified instrument calibration, the Despatch service network is positioned to respond to your needs. As a manufacturer of custom equipment, our service programs are customized to meet your specific needs regarding:

1. Service scope
2. Response time
3. Preventive maintenance frequency and content
4. Payment method

Sustained Service Support

At Despatch, long term customer satisfaction means more than just responding quickly and effectively to our customers' service needs. It means offering comprehensive customer support well beyond the scope and duration of our initial warranty. Despatch offers two basic service packages which are customized to each individual customer's need. These service packages are titled Full Service and Preventive Maintenance Plus+ service agreement products. Each is unique in the industry and offer the following benefits:

1. Priority response for minimum production interruption
2. Preventive maintenance for longer product life
3. Discounts on parts and services
4. Various payment plans to ease budgeting and recording expenses
5. Reduce purchase ordering costs

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