MODCELL 2050R
Indicating Process Controller

User's Guide

2050R Model B Version 2.8
2051R Model B Version 2.8



MicroMod
AUTOMATION

MicroMod Automation, Inc.

The Company

MicroMod Automation is dedicated to improving customer efficiency by providing the most cost-effective, application-specific process solutions available. We are a highly responsive, application-focused company with years of expertise in control systems design and implementation.

We are committed to teamwork, high quality manufacturing, advanced technology and unrivaled service and support.

The quality, accuracy and performance of the Company's products result from over 100 years experience, combined with a continuous program of innovative design and development to incorporate the latest technology.

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△ **Warning.** An instruction that draws attention to the risk of injury or death.	✎ **Note.** Clarification of an instruction or additional information.
⧗ **Caution.** An instruction that draws attention to the risk of the product, process or surroundings.	i **Information.** Further reference for more detailed information or technical details.

Although **Warning** hazards are related to personal injury, and **Caution** hazards are associated with equipment or property damage, it
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1. Warning Labels on containers and packages must be observed.
2. Installation, operation, maintenance and servicing must only be carried out by suitably trained personnel and in accordance with the information given or injury or death could result.
3. Normal safety procedures must be taken to avoid the possibility of an accident occurring when operating in conditions of high
4. pressure and/or temperature.
5. Chemicals must be stored away from heat, protected from temperature extremes and powders kept dry. Normal safe handling procedures must be used.
6. When disposing of chemicals, ensure that no two chemicals are mixed.

Safety advice concerning the use of the equipment described in this manual may be obtained from the Company address on the back
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INTRODUCTION

FEATURES

- Isolated universal process and remote set-point input
- Four internal set-points
- No jumpers required to define instrument parameters
- Ratio/bias on process and remote set-point
- Totalizer
- Ramp/soak profile
- On-demand auto-tuning
- Retransmission of process, set-point, or input number 2
- Output tracking of electrical input number 2
- Linearization with sq. rt.
- RS-485 Extended MODBUS Communications
- Replacement for Foxboro 62H and SPEC 200 (2051R only)
- Less than 8 inches (203.2 mm) behind the panel depth
- Two-year warranty

DESCRIPTION

The MODCELL 2050R and 2051R indicating controllers are microprocessor-based 3x6 instruments that can display and control process variables such as temperature, pressure, liquid level, or flow. Control capabilities include: current and time proportioning control, on/off control, heat/cool control, position feedback control, ramp/soak profiling of the control set-point, and P, PI, or full PID control responses. A second set of P and I tuning constants is provided when dual output control (heat/cool) is selected.

The functional capabilities of the 2050R and 2051R are identical. The bezel width of the 2051R is slightly smaller than the 2050R bezel width permitting the 2051R to be used as a replacement controller for the Foxboro 62H and SPEC 200 controllers.

Instrument setup is accomplished via easy-to-read English prompts and operator push buttons located on the front display. The process input is user selectable for direct connection of either Thermocouple, RTD, slide wire, mV dc, V dc, or mA dc input. Linearization is user selectable to both process and remote set-point input and may be square root or none. A nonvolatile RAM memory stores configuration data and has a typical data retention of 10 years.

INTRODUCTION

Ranging of the RTD and Thermocouple is automatic. The process input is isolated from the rest of the instrument. A 24V dc transmitter power supply is provided for use with a two-wire mA dc input on both process and remote set-point inputs.

When the controller is equipped with an option card, RS-485 communication capability is provided via either a 2-wire or 4-wire bus. This feature supports communication with a host device such as a personal computer or MODCELL Multiloop Processor using the Extended Modbus Protocol. All information pertaining to Modbus communication is provided in the **MODBUS Communications Supplement IB-23C650M**.

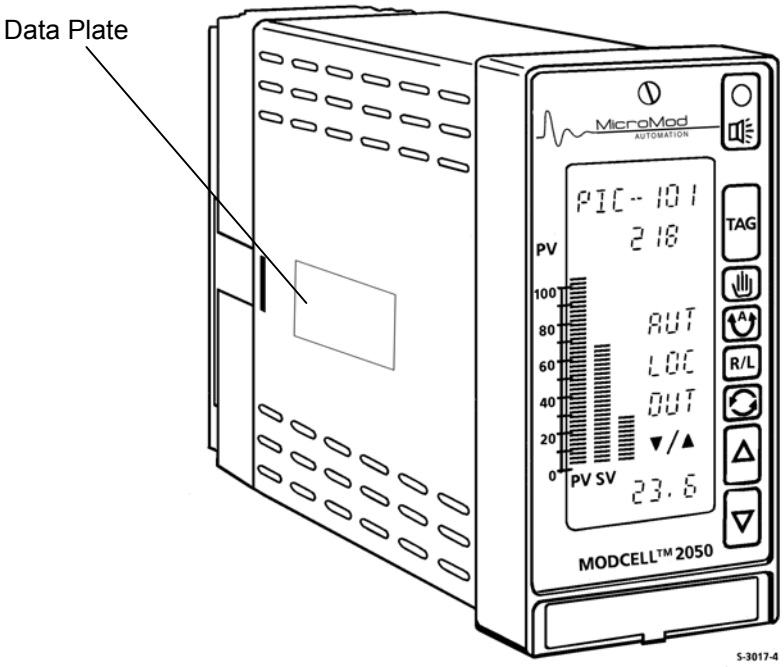
IDENTIFICATION INFORMATION

BASE NUMBER	**2050R**	MODCELL 2050 Single Loop Controller
	2051R	MODCELL 2051R Single Loop Controller for Replacement of Foxboro 62H and SPEC 200
INSTRUMENT POWER	**Z**	85-250 V ac, 47-440 Hz
	A	20-50 V dc, 20-35 V ac
ELECTRICAL CODE	**23**	FM Approved Class 1, Division 2, Groups A, B, C, D and CSA Certified Class 1, Division 2, Groups A, B, C, D and UL Listed (Non-Hazardous Location)
	12	General Purpose, EU EMC Compliant (see notes on pages 10 and 20).
OPTIONS	**0**	None
	1	2nd Isolated universal analog input, 2nd non-isolated analog output, and RS-485 Communications Hardware
FIRMWARE VERSION	**02**	Version 2
MODEL	**A**	1st design level
	B	2nd design level (EU EMC Compliant)

Sample Number: **2050RZ23102B**

See the product Data Plate as shown on the next page for specific identification of your controller.

INTRODUCTION



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INSTALLATION

GENERAL

Read these instructions thoroughly before starting installation. Installation personnel should be qualified technicians. Observe all electrical code requirements and safety standards during installation. Installing the controller involves:

- Unpacking
- Mounting
- Wiring Connections

Displays and Cleaning

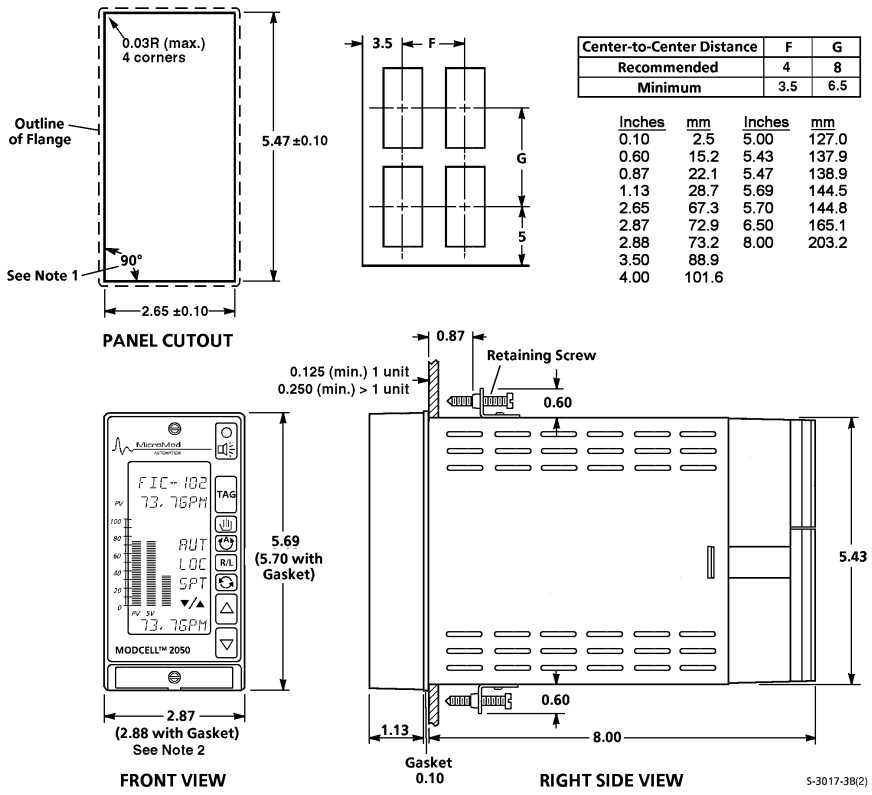
The display is protected by an overlay that can be removed after installation. The face of the display, while made of scratch-resistant plastic, can be abraded by harsh materials such as paper towels and industrial wipes. Lens cleaning tissues and soft cloths are suitable for cleaning displays. Remove dust from the rear of the instrument by removing it from the instrument housing and spraying exposed surfaces with non-corrosive, non-toxic, non-flammable inert dusting gas.

Environmental Specifications

Operating Tempearture:	0 to +50°C (32 to 122°F)
Storage Temperature:	–40 and+75°C (–40 and 167°F)
Humidity	5 to 95 % RH, non condensing
Altitude:	2000 meters max
Ingress Protection:	(NEMA 4x) Front: IP56 Rear: IP20
Pollution degree:	2

UNPACKING

Visually inspect the controller after unpacking for any damage. A cold junction compensating thermistor is included in the information package (an additional one is included if the additional input option is ordered). Save packing materials for any reshipment, or to support any claim of shipment damage. All damage claims are made against the carrier and are the responsibility of the customer.



Center-to-Center Distance	F	G
Recommended	4	8
Minimum	3.5	6.5

Inches	mm	Inches	mm
0.10	2.5	5.00	127.0
0.60	15.2	5.43	137.9
0.87	22.1	5.47	138.9
1.13	28.7	5.69	144.5
2.65	67.3	5.70	144.8
2.87	72.9	6.50	165.1
2.88	73.2	8.00	203.2
3.50	88.9		
4.00	101.6		

Notes:

1. When mounting housing in panel cutout or rack and panel mounting bezel, turn retaining screws until point of screw touches rear of panel or bezel. Overtightening of retaining screws will distort housing. Housing must be square after retaining screws are tightened.

2. MODCELL 2051R does not use the gasket and has a bezel width of 2.735” (69.47 mm). The panel cutout may be for the 2050R

Figure 1. Mounting Dimensions. 2050R and 2051R

MOUNTING

The controller must be installed in an approved enclosure or installed in a means acceptable to the authority having jurisdiction for electrical installations.

Select a mounting location where there is minimum vibration. The ambient temperature must be between 32 and 131°F (0 and 55°C) with a relative humidity of 25-95% RH (noncondensing). The panel must provide rigid support for the 3.2-pound (1.45 kg) controller and any other panel devices. Assure that electrical wiring routing and support are planned. The front face of the controller is designed to NEMA 4 environment.

Mount the controller as follows:

1. Prepare the panel as indicated in Figure 1.
2. Draw a 1/4" boundry around cutout for reference when caulking. Apply a 1/4“ bead of silicon caulking (Loctite # 59530 or equivalent) on the panel around the cutout.

   NOTE: If NEMA 4 is not required, the controller can be installed without the gasket or the caulking.
3. Slide instrument housing only into panel cutout.
4. Insert brackets into slots in top and bottom of instrument housing. Be sure the housing gasket is not pinched or twisted between the instrument housing and the front of the panel.
5. Tighten retaining screws to a torque of 5 inch-pounds (0.6 Nm) or 1-1/2 turns after contact is made with the back of the panel.
6. Wipe the excess silicon caulking to form a smooth fill and allow it to dry for 24 hours.
7. After the caulking has dried, insert the instrument into the housing and tighten the two jack screws to 7 to 10 inch-pounds (0.8 to 1.1 Nm) or 1-1/2 turns after the front face draws into the gasket.

PURGING

When necessary, the controller can be air purged to control its ambient environment. It must be mounted in a sealed container with suitable air purge connections and purge pressure regulating equipment. For rapid air volume exchange during startup, the controller can withstand a purge pressure of 5 inches of water for 10 minutes. For normal operation, the controller can withstand a sustained purge pressure of 2 inches of water indefinitely.

WIRING GUIDELINES

The power wiring connections and input/output (I/O) connections are made with the controller installed in its operating location and with the power off. The rear view of the controller housing in Figure 2 shows the terminals available for inputs and outputs (rear cover removed).

CAUTION

Do not connect any wires to terminals 36, 37, 38, 39, and 40. Connections to these terminals can cause an instrument malfunction.

The recommended wiring procedure is as follows:

1. The power wire size must be from 14 AWG (1.6 mm) to 18 AWG (1.0 mm) with a 600V, -20°C +105°C UL, CSA approved rating. The signal wire size can be as small as 22 AWG (0.65 mm).
2. Route signal wiring less than 30 V rms, 42.4 V peak or 60 V dc from top left. Route signal wiring greater than 30 V rms, 42.4 V peak or 60 V dc from bottom right. Distribute to appropriate terminals.
3. Use a small, flat-head screwdriver to loosen appropriate connection screws and clamps on terminal blocks.
4. Strip approximately 5/16 inch (8 mm) of insulation from end of each wire, insert wires at assigned terminals, and secure terminal screws and clamps.
5. MODCELL 2050R controllers require a cold junction compensating thermistor for thermocouple inputs. If a thermocouple input is planned, contact the factory and purchase one 500P1269 thermistor for each planned thermocouple input. Install the thermistor across terminals 12 and 13 for the process input (5 and 6 for the second input option).
6. Connect green ground wire to panel ground to dampen out noise spikes on the ac line.
7. After all connections are completed and checked, proceed to **Setup**.

NOTE: Input 2, Output 2, and RS-485 Communications require that the option card be installed. See **MODBUS Communications Supplement IB-23C650M** for RS-485 connection information.

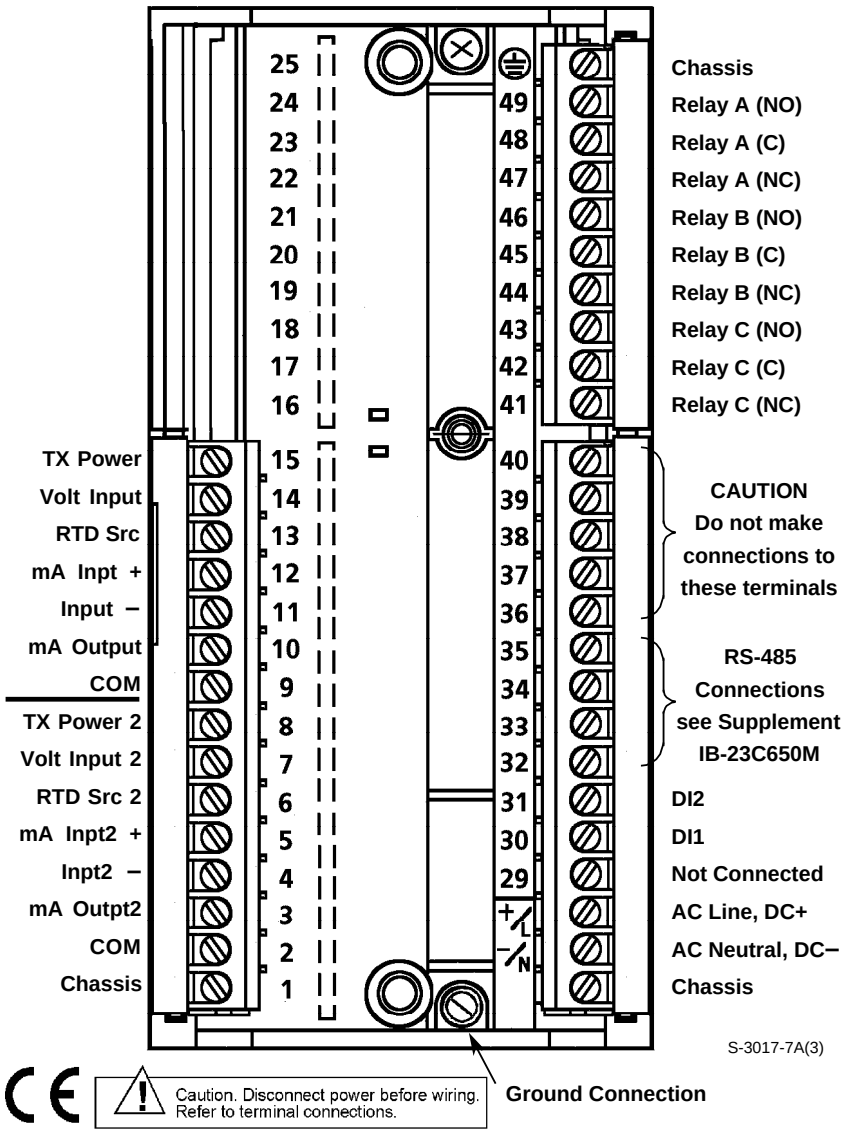


Figure 2. Controller Power and Signal Terminations

NOTE

Terminal blocks plug into the back of the controller housing. They can be removed to facilitate making wiring connections.

POWER CONNECTIONS

WARNING

*Avoid electrical shock. AC power wiring must **not** be connected at the **distribution panel** (ac source) until all wiring procedures are completed.*

All power wiring must be in compliance with the requirements of the National Electrical Code or Canadian Electrical Code. In any installation where the power source does not have one side of the line connected as a neutral conductor, both sides of the line must be overcurrent protected.

The controller does not contain a power disconnect switch. Install a disconnect switch or circuit breaker between the controller and its power source. Choose an accessible location as near to the controller as practical, and identify the switch or breaker as the disconnecting device for the controller.

The ac power connections are made to the terminal block, Figure 2. Route power cable from the bottom right of housing.

NOTE: A ferrite sleeve is included with instruments built for EU EMC compliance (electrical code 12). Pass all power conductors through this 1-1/8" sleeve and secure the sleeve as close as possible to the instrument using a tie wrap or other means. This provides proper attenuation of electromagnetic interference (EMI) in conformance with EU requirements.

Power specifications for the controller are:

Switcher Power Supply Input:
Instrument Power Code Z: 85-250 V rms, 47-440 Hz
Instrument Power Code A: 20-50 V dc, 20-35 V ac

Power Consumption (120V rms, 60 Hz): 20 W (45 VA) maximum

Supply Voltage Influence: ±0.1% for ±15% variations typical

Transient Overvoltages: Classified as Installation (Overvoltage) Catagory II per IEC 664 (specifies a maximum impulse withstand voltage of 1500 V for phase to earth voltage of 150 Vrms)

Interruption: No effect from 2 cycle dropout at 120V rms, 60 Hz.

Interference: No permanent effect from exposure to IEC 801-4 fast transients level 3, or IEC 801-5 surges level 3.

Internal Fuse: 4 amps, 250 V Slow Blow (DC version), soldered in
2.5 amps, 250 V Slow Blow (AC version), soldered in

External switch or circuit breaker rating: DC: 3 amps 28 VDC;
AC: 1 amps, 250 VAC

GROUND CONNECTIONS

The primary power ground system consists of the plant electrical ground (equipment grounding conductors). AC ground and chassis ground are connected when the termination housing is connected to the control module. If this path is insufficient to dampen out noise spikes on the ac line, the chassis ground may be connected directly to panel ground. The circuit common for all signals is negative.

Electrical Noise

Electrical disturbances can be caused by lightning, motors and motor driven devices, relays, solenoids, and communication equipment. These disturbances often introduce electrical noise in power lines, transmission lines, and site grounds. The successful operation of any microprocessor-based device depends, in part, on the precautions taken to minimize the effect of these disturbances. Often called "transients" or "voltage spikes", this form of noise is infinitely variable in terms of amplitude, frequency, and duration.

Common sources of this type of noise are:

- loose or poor quality connections (especially power connections)
- arc welding equipment
- switches operating inductive loads
- relays, solenoids and other coil operated devices
- high current conductors – electric heater circuits
- fluorescent or neon lamps
- motors and motor driven devices
- switch mode devices – SCRs, thyristors
- lightning
- electrostatic discharges

Suggested Preventative Measures

Primary power circuit distribution system:

- Ideally, each microprocessor-based device should be provided with an independent dedicated power source. Where this approach is not feasible due to space availability or cost per device, an acceptable alternative is to install constant voltage, isolation transformers in the branch circuit where the microprocessor-based device is installed.

- In addition to the above, install a combination transient surge suppressor and noise filter in the instrument side of the power distribution system.

The combination device suppresses transients and effectively reduces other noise forms such as electromagnetic (EMI) and radio frequency (RFI) interferences. These devices can be connected to multiple units to reduce overall cost.

Input signals

- Twisted wire pairs are essential. The wire type should be stranded, not solid. The largest wire gauge allowed is best and the more twists per foot the better. A 2-inch lay (6 twists per foot) should be the minimum used.
- In addition to the above, signal wires should be physically isolated from all power conductors (separate conduit, cable race, etc.)
- Shielded wire is also essential. Shields should be terminated at the instrument or in the field in accordance with local regulations.

  CAUTION:
  1. Never terminate a shield at both ends. One end should always be left "floating" or ground currents may be introduced.
  2. Thermocouple shields should be terminated at the process measurement end. Most thermocouples are constructed where the sensor is electrically equivalent to the process connection (grounded junction).

Equipment grounding:

- Grounding practices defined by the National Fire Protection Agency (NFPA) in their National Electrical Code (NEC) handbook or State agency amendments to this code should be strictly observed.
- Existing ground conductors and ground paths should be periodically inspected and tested to insure continuity and compliance with current code requirements.
- For best noise reduction performance, the microprocessor-based device's ground terminal should be connected to a nearby grounded large metal structure, using the shortest length wire possible. If a three-wire cordset is used to power the microprocessor-based device through a receptacle, the ground wire is generally too long and too noisy to be a good ground.

REMOTE SET-POINT CONNECTIONS

When a remote set-point is required, connections are made to the Input 2 terminals, Figure 2. This is an isolated universal input which accepts the same signals as the process input. Make remote set point connections to the terminals identified as I/O2 in Figures 3 through 10.

PROCESS INPUT SIGNAL CONNECTIONS

Process input connections are shown as follows:

- Thermocouple Inputs - see Figure 3
- RTD Inputs - see Figure 4
- mA Inputs from 2-Wire Transmitters - see Figure 5
- mA Inputs from Non 2-Wire Transmitters - see Figure 6
- Volt Inputs - see Figure 7
- mV Inputs - see Figure 8
- Digital Inputs - see Figure 9
- Motorized Valve Inputs - see Figure 10
- Slidewire Inputs - see Figure 10

NOTE: Input 2 is available when an option card is installed. Input 2 is an isolated universal analog input which accepts mV dc, mA dc (2-wire & non 2-wire), RTD, Thermocouple, and slidewire inputs. Input 2 connections are made as shown in Figures 3 through 10, using the terminals identified as I/O 2

: General process input signal specifications are:

Open Input Fault Detection: Recover option is user configurable
Input Isolation: Galvanic isolation using transformers and optical isolators. The process input circuit is isolated; however, if a field input is completely floating, it may pick up electrical noise. Field inputs should be grounded in the field or at the instrument.
Input Resistance: 10M ohms minimum
Input Common Mode Rating: 45V dc
Common Mode Rejection: 120 dB @ 50/60 Hz
Normal Mode Noise Filter: 20 dB minimum @ 60 Hz
Maximum Normal Mode Voltage: 30V dc (except current input)
Display Accuracy: Input accuracy±one least significant display digit

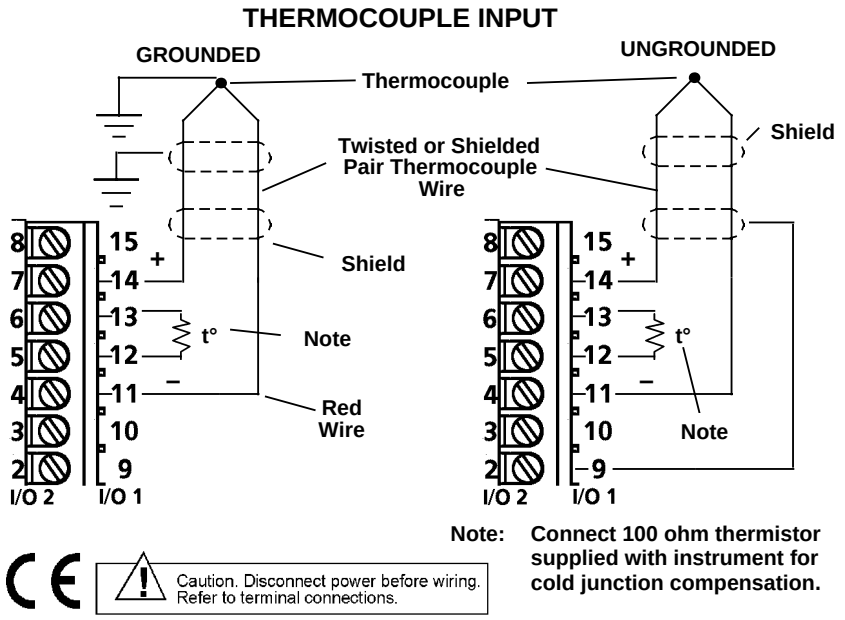


Figure 3. Thermocouple Input Connections

Thermocouple input specifications are:

Thermocouple: Automatic ranging and linearization
- Type B*: 752 to 3002°F (400 to 1650°C)
  *Performance accuracy is not guaranteed below 752°F.
- Type E: –328 to 1832°F (–200 to 1000°C)
- Type J: –328 to 2192°F (–200 to 1200°C)
- Type K: –328 to 2498°F (–200 to 1370°C)
- Type N: 32 to 2372°F (0 to 1300°C)
- Type R & S: 32 to 3002°F (0 to 1650°C)
- Type T: –328 to 752°F (–200 to 400°C)

Thermocouple resistance: 1000 ohms maximum

Sample Time: 0.25 seconds

Standards: Per NBS125 and IEC584

Resolution: 3 microvolts or one least significant digit

Accuracy:
- Type J, K, E, T, N: ±2.7°F (1.5°C) of input
- Type R, S, B: ±3.6°F (2.0°C) of input

Cold junction compensation: 100 ohm RTD

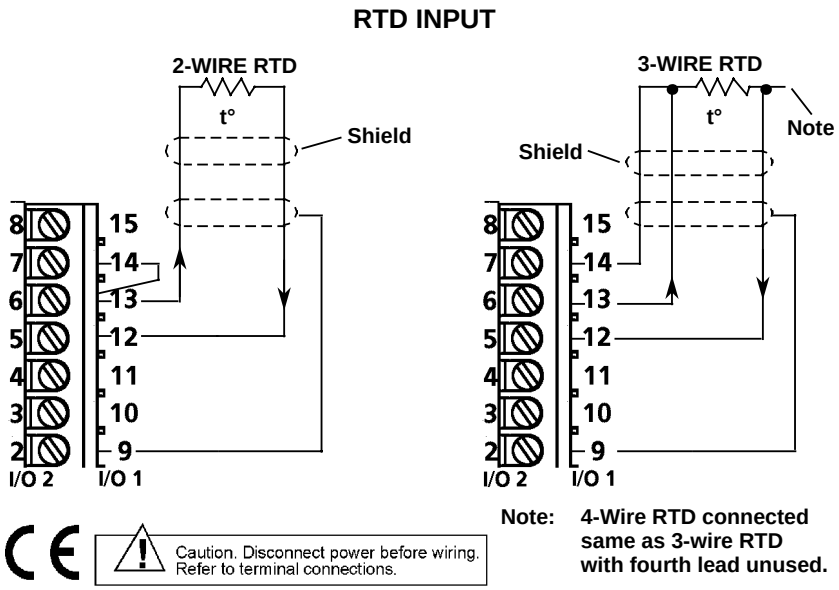


Figure 4. RTD Input Connections

RTD input specifications are:

RTD Type: 3-Wire Platinum, 100 ohm,
RTD Ranging and Linearization: Automatic over range of 0 to 400 ohms, –328 to 1562°F (–200 to 850°C)
Standards: Per IEC751 and DIN43760
Total Circuit Resistance (including leadwires): 430 ohms
Sample Time: 0.25 seconds
Resolution: 0.012 ohms or 0.03°C for a 100 ohm platinum RTD
Accuracy: ±1.8°F (1.0°C) of input
RTD Current: 250 microamps typical
Burnout Detection: Upscale, all leads

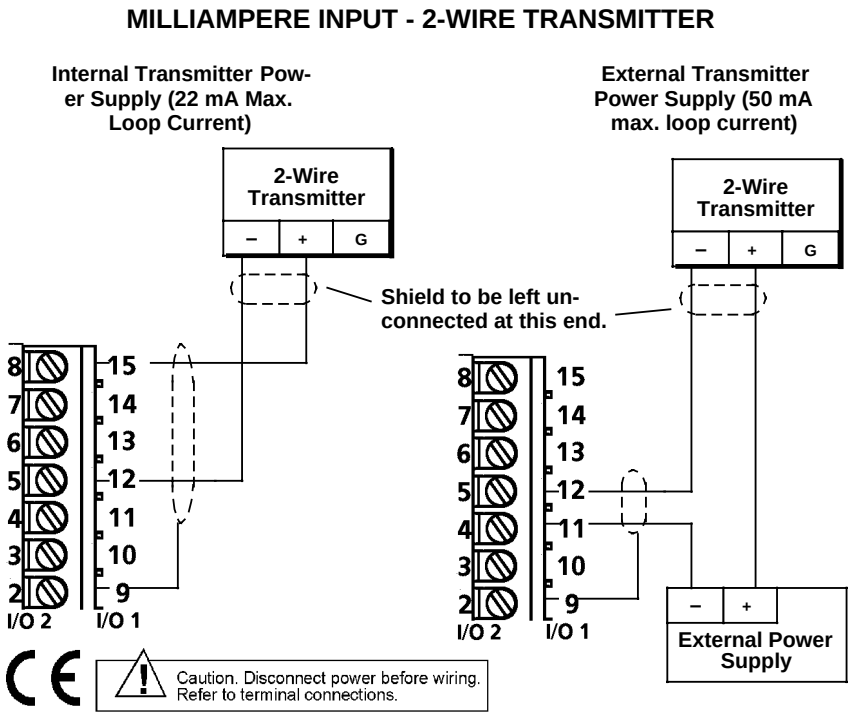
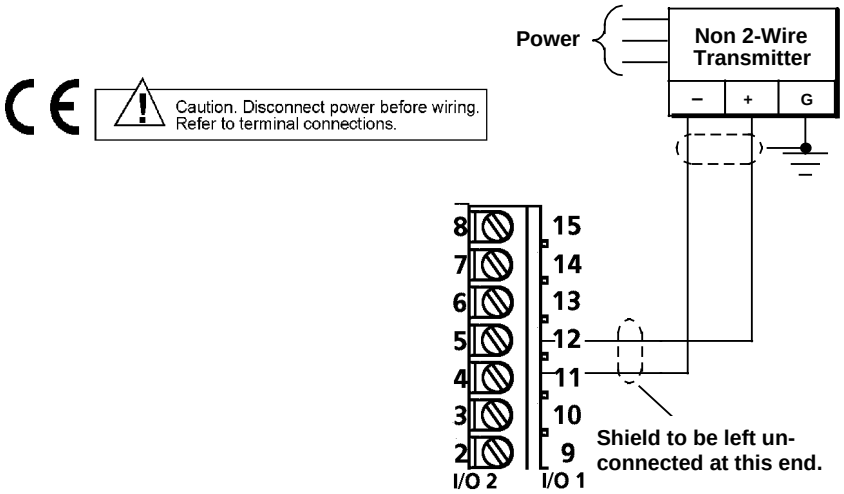


Figure 5. 2- Wire Milliampere Input Connections

Milliamp input specifications are:

Input Range: 0 to 54 mA dc, Limited to below 70 mA
Input Span: Operator settable from 1mA to 50 mA
Input Impedance: 50 ohms nominal
Resolution: 2.5 microamps maximum, 0.016% of a typical milliamp span
Accuracy: ±0.1% of input
Temperature Effect: 0.01% per degree C.
Sample Time: 0.25 seconds
Transmitter Power Supply: Isolated 24V dc, 20 mA transmitter power supply. For current inputs above 20 mA, a separate power supply must be used.
Linearizations:Square law

MILLIAMPERE INPUT - NON 2-WIRE TRANSMITTER



Note: Non 2-Wire Transmitter may also be ungrounded.

Figure 6. Non 2-Wire Milliampere Input Connections

Milliamp input specifications are:

Input Range: 0 to 54 mA dc, Limited to below 70 mA
Input Span: Operator settable from 1mA to 50 mA
Input Impedance: 50 ohms nominal
Resolution: 2.5 microamps maximum, 0.016% of a typical milliamp span
Accuracy: ±0.1% of input
Temperature Effect: 0.01% per degree C.
Sample Time: 0.25 seconds
Linearizations: Square law

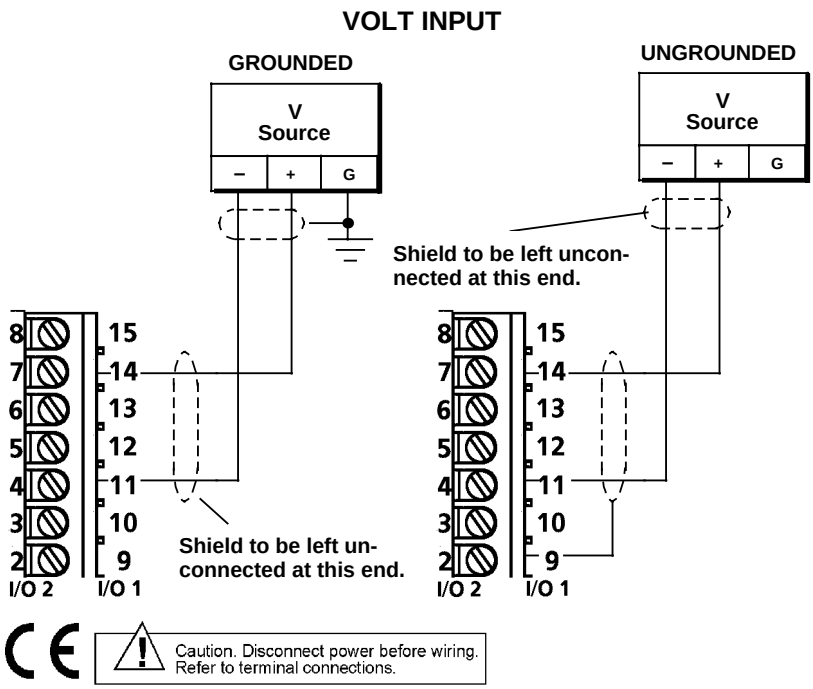


Figure 7. Voltage Input Connections

Volt input specifications are:

Input Range: –10 mV to +6 V dc
Input Impedance: 10M ohms minimum
Resolution: 120 microvolts maximum, 0.003% of a typical 4 volt span
Accuracy: 0.05% of input
Temperature Effect: 0.01% per degree C
Linearizations: Square law
Sample Time: 0.25 seconds

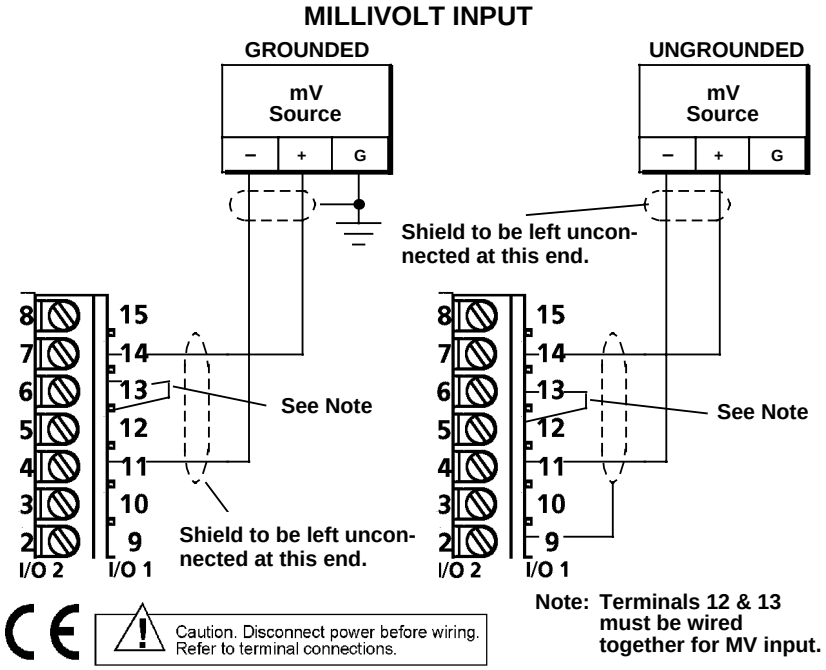


Figure 8. Millivolt Input Connections

Millivolt input specifications are:

Input Range: –10 to 120 mV dc
Input Impedance: 10M ohms minimum
Resolution: 3 microvolts maximum, 0.003% of a typical 100 mV span
Accuracy: 0.08% of input or 20 microvolts, whichever is greater
Temperature Effect: 0.01% per degree C
Linearizations: Square law
Sample Time: 0.25 seconds

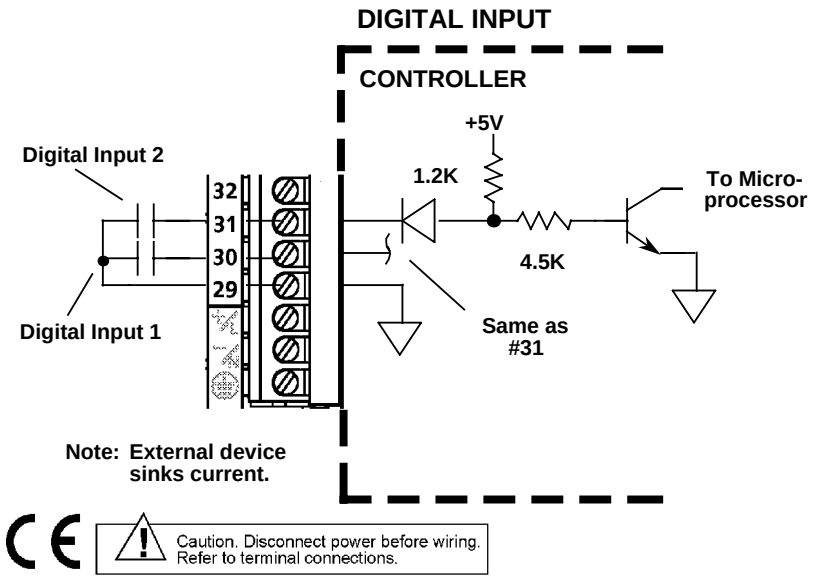


Figure 9. Digital Input Connections

NOTE: Circuit common is disconnected from terminal #29 on instruments built for EU EMC compliance (electrical code 12). The common return for these instruments must be connected to one of the other common terminals, #2 or #9.

Digital input specifications are:

Input Type: Dry contact or dc voltage inputs
Open: 50K ohms minimum or 4-24V dc
Closed: 50 ohms maximum or <1.5V dc
Sample Time: 0.25 Seconds
Contact Source: 3.7 mA @ 0 Volts, Typical

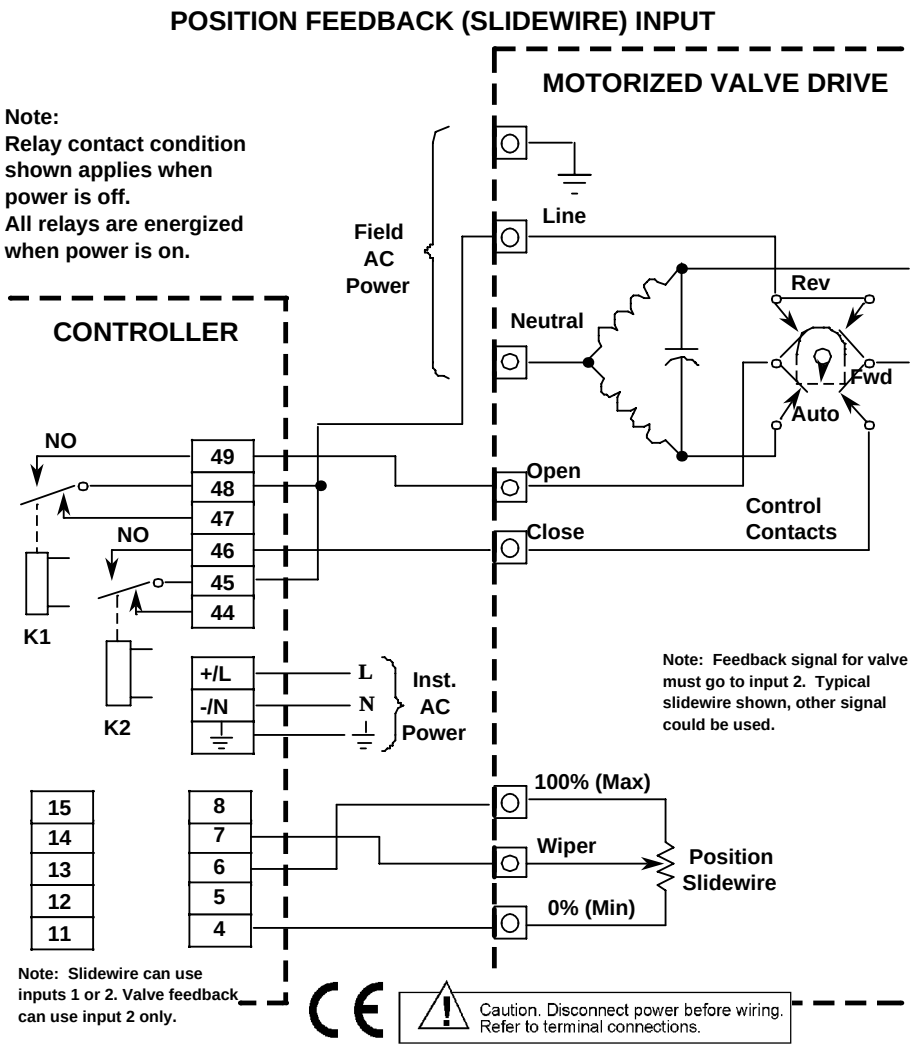


Figure 10. Motorized Valve and Slidewire Connections

Slidewire input specifications are:

Minimum Resistance: No External Parts: 500 ohms With 3.9K 1/2W Resistor added from terminal 15 to 13 (Input 1) or from terminal 8 to 6 (Input 2): 20 ohms

OUTPUT SIGNAL CONNECTIONS

Output connections are shown as follows:

- mA Outputs - see Figure 11
- Voltage Outputs - see Figure 12
- Relay Outputs - see Figure 13

The analog control output is always a milliamp signal as shown in Figure 11. When an application requires a voltage signal, a precision dropping resistor must be connected across the output terminals to generate the required voltage as shown in Figure 12.

Output 2 is available when an option card is installed. Output 2 is a non isolated 0 to 54 mA output with the same specifications as the standard analog control output. Connections to Output 2 are made as shown in Figures 11 and 12, using the terminals identified as I/O 2.

Digital outputs are provided by 3 relays. Either one or two of the relays can be configured as control outputs (see *Table 1, Base Configuration*). Relays which are not used for control can be used for alarms or various other functions (see *Table 5, Output Relays Setup Menu*).

NOTE: If any relay output circuit voltage is greater than 30 Volts, see the **Warning** under **Wiring Guidelines**.

MILLIAMPERE OUTPUT

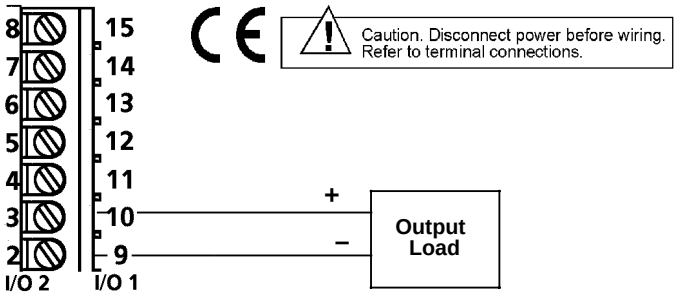


Figure 11. Milliampere Output Connections

Milliampere Output specifications are:

Range: 0 to 54 mA maximum, non-isolated

Resolution: 14 microamps, 0.09% of a typical 16 milliamp span

Accuracy: ±0.2% of of setting

Temperature Effect: 0.01% per degree C

Load Resistance:
at 22 mA: 1000 ohms maximum
at 54 mA: 400 ohms maximum

Open Circuit Voltage: 25.5 volts typical

Ripple: 20 millivolts peak to peak at 100K Hz typical

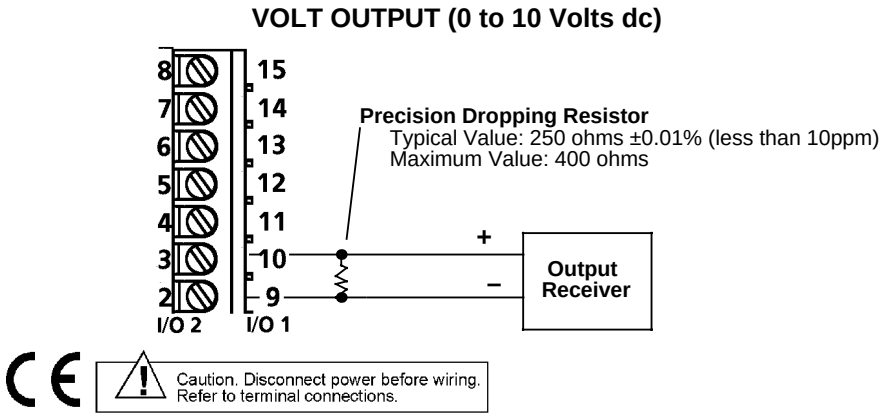


Figure 12. Voltage Output Connections

Note: For 0 to 10 Vdc signal to receiver, controller output current range must be set at 0 to 40.0 mA dc when using 250 ohm resistor.

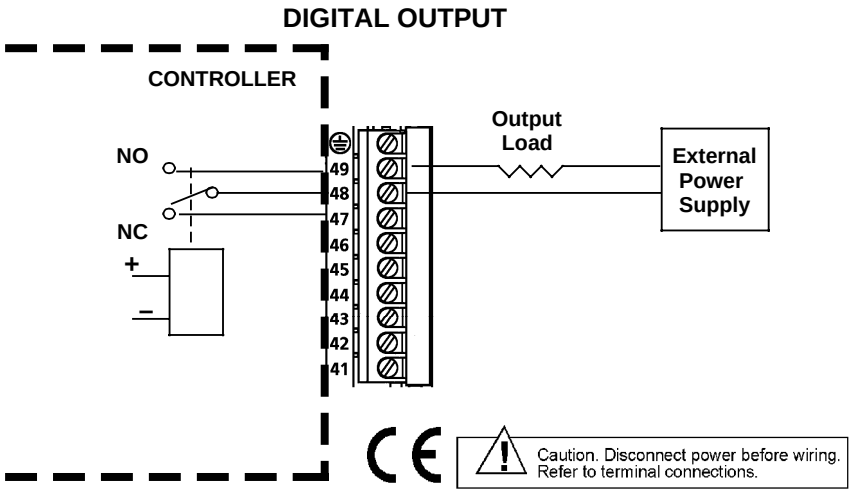


Figure 13. Digital Output Connections

Note: Connections shown are for Relay A. See Figure 2 for identification of terminals for relays B and C.

Wire rating: 600V, -20°C +105°C UL, CSA approved

Digital Output specifications are:

Relay Type: SPDT (NO, NC, C)
Number of Relays: 3 (up to 2 can be used for control)
Contact Rating: 150 V ac maximum at 120V ac, resistive: 5A at 30V dc, resistive: 5A
Response time: 0.25 Seconds

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SETUP

CAUTION

Be sure the process can be maintained in safe conditions before turning on controller power. The controller may not be properly configured to meet the specific requirements of the process until setup has been performed.

GENERAL PREPARATIONS

After installation is complete, begin setup by preparing the controller as follows:

1. At ac power source, connect power to controller. When power is turned on, the front panel character displays illuminate. The display may hold or flash a [POWER] [FAILED] message showing that power has been off.



2. If the controller is not in manual, press and release manual key to enter manual mode. The MAN indicator will light.



3. Scroll to the next display (press and release scroll key). Other power up diagnostic messages may appear as described in **Diagnostics**. Scroll again to obtain process input value on the middle display and percent controller output on the lower display. The OUT indicator will light when output is displayed.

4. Press the UP or DN key to adjust output to a safe value for setup if necessary.



5. Press tag key to move to Displays Menu. The configuration menus, Figure 14, can be reached by pressing the UP or DN key. Use the configuration menus as described in the data base reference tables to set the instrument up for operation.

SETUP FUNCTIONS

For ease of use, the firmware has been divided into functional groups. The first group is for daily continuing operation, and the remaining groups are for setup and tuning. The method of moving from one group to another and the operational loop associated with each group are shown in Figure 14. Data entries are made by scrolling through the steps in each setup group, and making an appropriate response to each step.

SETUP METHOD

Initial setup begins with the base hardware configuration, Table 1, and can continue with the remaining setup tables in order. This resolves basic factors first, those which affect settings in other areas and which are not likely to change.

SETUP CONTROLS

The setup control keys are:



Scroll: Use the scroll key to move through the basic setup steps. Holding the scroll key down when in a lower step advances to step 1.



Up: Press to move up through setup menus. Used to increase setup values. Used to enter a YES response.



Down: Press to move down through setup menus. Used to decrease setup values. Used to enter a NO response.

Use UP (with DN) to vary rate of increase of values:

- For slow rate, press and hold UP (*UP*)
- For intermediate rate, hold UP and press DN (*DN*) once
- For fast rate, hold UP and press and press DN twice
- For fastest rate, hold UP and press and press DN three times

In a similar manner as described above, use DN (with UP) to vary rate of decrease of values.

DATA BASE REFERENCE TABLES

The data base reference tables are put in the order needed for initial setup. All data base items are listed for this instrument. As you go through the data base, certain items will not appear. This is because of the instrument configuration and selections made in other areas.

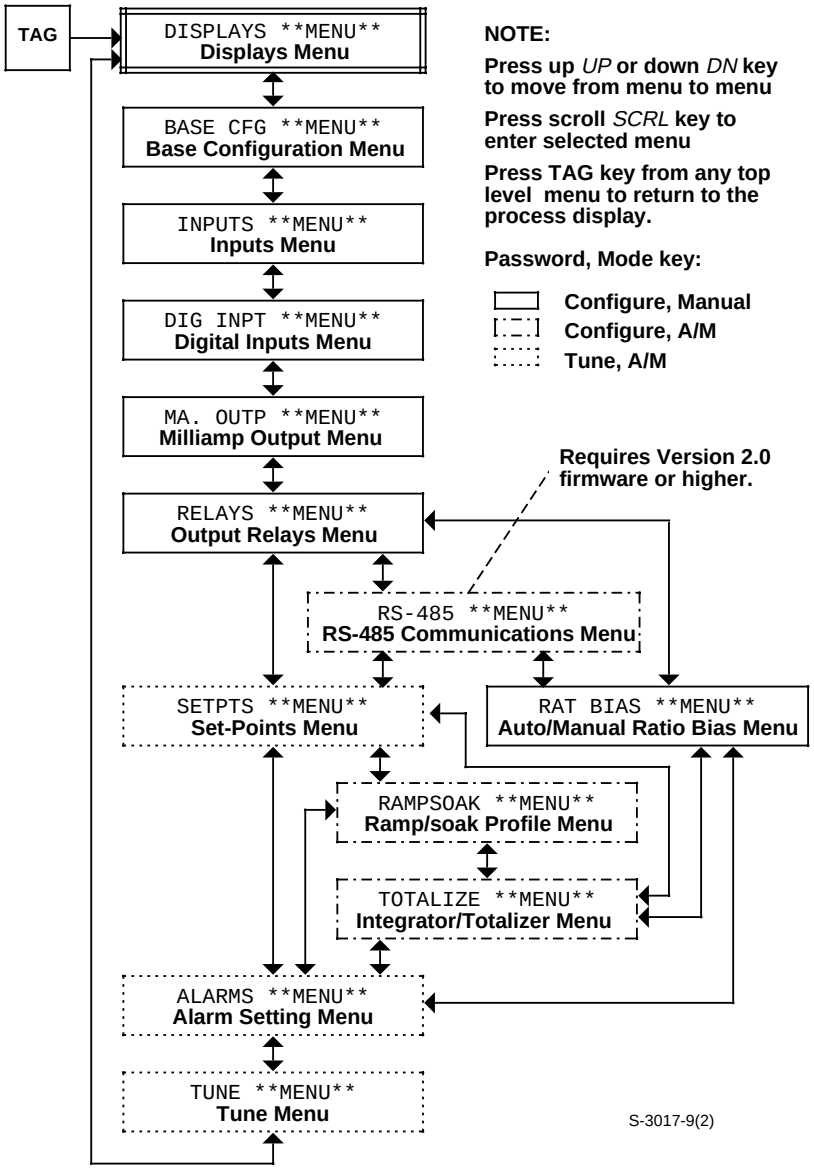


Figure 14. Relationship of Setup Functions

Table 1. Base Configuration

Step	Step Description	Top Display
1	**Base Configuration Menu.** *UP* moves to DISPLAYS **MENU**. *DN* moves to INPUTS **MENU**. *SCRL* advances to Step 2 (read only in auto).	BASE CFG
2	**Main Power Frequency.** *UP* or *DN* selects 50 or 60 HERTZ. *SCRL* advances to Step 3.	MAIN PWR
3	**Process Input Type.** *UP* or *DN* selects process input type. *SCRL* advances to: Step 3.1 if input type is THERMCPL, Step 3.2 if input type is RTD, Step 4 if Input 2 is present, or Step 5 (Output type) otherwise.	PROC INP
3.1	**Process Input Thermocouple Type.** *UP* or *DN* selects thermocouple type. *SCRL* advances to Step 3.2.	PROC INP
3.2	**Process Temperature Calibration.** *UP* moves to Step 3.2.1. *SCRL* advances to: Step 4 if Input 2 is present, or Step 5 (Output type) otherwise.	PROCESS
3.2.1	**Process Calibration Correction.** *UP* or *DN* sets correction temperature. *SCRL* advances to: Step 4 if Input 2 is present, or Step 5 (Output type) otherwise.	PR TEMP=

Table 1. Base Configuration

Middle Display	Bottom Display	Entry Description
MENU		None.
FREQ	60 HERTZ 50 HERTZ	Optimize input line frequency rejection by correctly identifying the power line frequency.
TYPE		Process input types are: MILLIAMP = 0 to 54 mA dc input VOLT = 0 to 6 V dc input THERMCPL = Thermocouple input RTD = RTD input MILLIVLT = –10 to 120 mV dc input SLIDEWIR = 0 to 100% slidewire (potentiometer) wiper position
TC TYPE	TYPE *	Where * = J, K, E, R, S, T, B, or N. The type of thermocouple selected must match the type connected to the process input terminals.
TEMP CAL		This procedure is provided to compensate for variations in individual RTDs or thermocouples.
xxx.x	xx.x	Where xxx.x = process temperature and xx.x = temperature correction (+15 to –15 degrees). The correction should be adjusted to eliminate any measurement error in the process temperature. Notes: 1. Use reference standard thermometer or ice bath for reference temperature. 2. Allow controller with thermocouple to warm up for at least 1/2 hour to ensure that the cold junction compensator has reached a stable temperature.

Table 1. Base Configuration

Step	Step Description	Top Display
3.2.1 (cont'd)	**Process Calibration Correction.**	
4	**Input 2 Enable.** (Requires Option Board) *UP* selects YES or *DN* selects NO. *SCRL* advances to: Step 4.1 (Input 2 Type) from YES, or Step 5 (Output type) from NO.	INPUT 2
4.1	**Input 2 Type.** *UP* or *DN* selects input 2 type. *SCRL* advances to: Step 4.1.1 if input type is THERMCPL, Step 4.1.2 if input type is RTD, or Step 5 (Output type) otherwise.	INPUT 2
4.1.1	**Input 2 Thermocouple Type.** *UP* or *DN* selects thermocouple type. *SCRL* advances to Step 4.1.2.	INPUT 2
4.1.2	**Input 2 Temperature Calibration.** *UP* moves to Step 4.1.2.1. *SCRL* advances to Step 5.	INPUT 2

Table 1. Base Configuration

Middle Display	Bottom Display	Entry Description
		3. Be sure that any length of thermocouple extension wire or RTD lead wire used in the installation is connected for this procedure. If it is not possible to use the extension or lead wire, an equivalent resistor should be used. 4. When using a melting ice bath as a temperature standard, put melting ice and water mixture in a thermos to establish a precise 32°F (0°C) temperature which is within the range of most thermocouples and RTDs used with the controller. 5. An alternate method for an RTD is to connect a 100-ohm 0.1% resistor to the RTD lead wires in place of the actual RTD. The Primary display should read 32°F (0°C) because a standard RTD (DIN Std 43760) has a resistance of 100 ohms at 32°F.
ENABLE	NO	= Don't allow INPUT 2 SETUP in INPUTS **MENU** or **REM** (remote setpoint) select display.
	YES	= Allow input 2 setup and remote setpoint select display.
TYPE		Input types are:
	MILLIAMP	= 0 to 54 mA dc input
	VOLT	= 0 to 6 V dc input
	THERMCPL	= Thermocouple input
	RTD	= RTD input
	MILLIVLT	= –10 to 120 mV dc input
	SLIDEWIR	= 0 to 100% slidewire (potentiometer) wiper position
TC TYPE	TYPE *	Where * = J, K, E, R, S, T, B, or N. The type of thermocouple selected must match the type connected to the Input 2 terminals.
TEMP CAL		This procedure is provided to compensate for variations in individual RTDs or thermocouples.

Table 1. Base Configuration

Step	Step Description	Top Display
4.1.2.1	**Input 2 Calibration Correction.** *UP* or *DN* sets correction temperature. *SCRL* advances to Step 5.	I2 TEMP=
5	**Output Type.** *UP* or *DN* selects output type. *SCRL* advances to Step 5.1.	OUTPUT
5.1	**Control Action.** *UP* or *DN* selects control action. *SCRL* advances to: Step 5.2 if output type is CUR PROP, Step 5.3 if output type is HC/CR or HC/CC, Step 5.4 if output type is HC/RR, Step 5.5 if output type is POS PROP, or Step 6 (Hold Pwr Up Msg) otherwise.	CONTROL
5.2	**Milliamp Output Action.** *UP* or *DN* selects mA output action. *SCRL* advances to Step 6 (Hold Pwr Up Msg).	MA. OUTP
5.3	**Heat Band Output Action.** *UP* or *DN* selects heat band output action. *SCRL* advances to Step 5.4.	HEAT OUT

Table 1. Base Configuration

Middle Display	Bottom Display	Entry Description
xxx.x	xx.x	Where xxx.x = input 2 temperature and xx.x = temperature correction (+15 to -15 degrees). See Step 3.2.1. for additional information.
TYPE	CUR PROP	= Current Proportioning
	POS PROP	= Position Proportioning (Input 2 must be electrical type: mA, mV, V, or slidewire)
	HC/RR	= Heat/Cool (dual relay)
	HC/CR	= Heat/Cool (mA/relay)
	HC/CC	= Heat/Cool (dual mA)
	ON/OFF	= On/Off
	TIM PROP	= Time Proportioning
ACTION	DIRECT	= increasing process input produces increasing controller calculated output.
	REVERSE	= increasing process input produces decreasing controller calculated output. When dual output (heat/ cool) control is used, the calculated output is converted to separate heat and cool outputs. Action in the heat band (above crossover for reverse 'control action') is 'control action', while action in the cooling band (below cross-over) is the opposite of 'control action'. See the section **Dual Output (Heat/Cool) Control** for details.
ACTION	DIRECT	= output (MA.LOW to MA.HIGH) corresponds to a direct acting valve.
	REVERSE	= output (MA.HIGH to MA.LOW) corresponds to a reverse acting valve.
ACTION	DIRECT	= output is MA.LOW at 0% displayed heat output and is MA.HIGH at 100% displayed heat output.
	REVERSE	= output is MA.HIGH at 0% displayed heat output and is MA.LOW at 100% displayed heat output. **Note**: Relay heat output is direct action only.

Table 1. Base Configuration

Step	Step Description	Top Display
5.4	**Cool Band Output Action.** *UP* or *DN* selects cool band output action. *SCRL* advances to Step 6.	COOL OUT
5.5	**Valve Calibration.** *UP* begins valve calibration at Step 5.5.1. *SCRL* advances to Step 6. In Steps 5.5.1 and 5.5.2, use of the *UP* and *DN* keys run the valve motor. The open (high) setting is obtained by using the keys to drive the valve to its full open position, and the closed (low) setting is obtained by driving the valve to the full closed position. As the valve motor runs, the numbers on the bottom display change to provide indication of valve stem movement. The position proportioning deadband and preact values in the Tune menu should also be set appropriately.	VALVE
5.5.1	**Calibrate Open Position.** *UP* or *DN* is used to drive valve fully open. *SCRL* to continue with Step 5.5.2.	CALIBRAT
5.5.2	**Calibrate Closed Position.** *UP* or *DN* is used to drive valve fully closed. *SCRL* advances to: Step 6 if calibration is valid, or Step 5.5.3 (invalid calibration) if it is bad.	CALIBRAT
5.5.3	**Invalid Calibration.** *SCRL* to continue with Step 5.5.4.	BAD
5.5.4	**Closed Feedback Value was Greater than the Open Feedback Value.** *SCRL* to continue with Step 5.5.5.	CLOSED

Table 1. Base Configuration

Middle Display	Bottom Display	Entry Description
ACTION	DIRECT =	relay output is open or mA output #2 is MA.LOW at 0% displayed cool output and relay is closed or mA output #2 is MA.HIGH at 100% displayed cool output.
	REVERSE =	relay output is closed at 0% displayed cool output and open at 100%, or mA output #2 is MA.HIGH at 0% and is MA.LOW at 100% displayed cool output.
CALIB		Valve position feedback (input 2) must be calibrated prior to startup to use the controller for position proportioning control. The feedback signal always uses input 2 (option board required) and may be a slidewire feedback, as shown in Figure 9, or other electrical input.
OPEN POS	xxxxx =	Valve Stem Position Feedback. When this reaches a maximum value (i.e. stops changing) the valve is fully open. Scrolling will record this as the 100% open feedback value.
CLSD POS	xxxxx =	Valve Stem Position Feedback. When this reaches a minimum value (i.e. stops changing) the valve is fully closed. Scrolling will record this as the 0% open (100% closed) feedback value.
CALIBRAT		
> OPEN		

Table 1. Base Configuration

Step	Step Description	Top Display
5.5.5	**Repeat Calibration.** *UP* selects YES or *DN* selects NO. *SCRL* advances to: Step 6 from NO, or Step 5.5.1 from YES. **Note**: Valve operation should be checked by returning to the operation Displays and controlling the valve in manual.	REPEAT
6	**Hold Power-Up Message.** *UP* selects YES or *DN* selects NO. *SCRL* advances to Step 7.	HOLD PWR
7	**Power-Up Mode.** *UP* or *DN* selects power-up mode value. *SCRL* advances to: Step 10 if output type is on/off, or Step 8 otherwise.	POWER UP
8	**Auto/Manual Ratio Bias Station Enable.** *UP* selects YES or *DN* selects NO. *SCRL* advances to: Step 11 from YES, or Step 10 if output type is heat/cool, or Step 9 otherwise.	RAT BIAS
9	**Auto Tune Enable.** *UP* selects YES or *DN* selects NO. *SCRL* advances to Step 10.	AUTOTUNE
10	**Ramp-Soak Enable.** *UP* selects YES or *DN* selects NO. *SCRL* advances to Step 11.	RAMPSOAK

Table 1. Base Configuration

Middle Display	Bottom Display	Entry Description
CALIBRAT	NO	= Don't repeat the procedure.
	YES	= Repeat the calibration procedure.
		Note: If NO is selected, the calibration will remain bad.
UP MSG	NO	= Don't hold 'POWER FAILED' message at power-up.
	YES	= Hold 'POWER FAILED' message at power-up until scroll key is pressed.
MODE	LAST	= Power up in the same mode (Auto/Manual) as at power down.
	AUTO	= Power up in auto mode.
	MANUAL	= Power up in manual mode.
ENABLE	NO	= Don't allow RAT BIAS **MENU** setup or **RAT** variable select display.
	YES	= Allow Ratio Bias setup and display. With this option enabled, ratio and bias values (local or remote) are applied to the process variable to directly affect output without using the PID algorithm (no set-point used). The output calculation is: Output = Process Variable x Ratio + Bias
ENABLE	NO	= Don't allow AUTOTUNE setup and **ATN** variable select display.
	YES	= Allow auto tune setup and display. See Automatic Tuning in **Operation** section for setup and operation procedure.
ENABLE	NO	= Don't allow RAMPSOAK **MENU** setup or **RSK** variable select display.
	YES	= Allow ramp-soak setup and display.

Table 1. Base Configuration

Step	Step Description	Top Display
11	**Totalizer Enable.** *UP* selects YES or *DN* selects NO. *SCRL* advances to Step 12.	TOTALIZE
12	**RS-485 Communications Enable.** (Requires Option Board) *UP* selects YES or *DN* selects NO. *SCRL* advances to Step 13.	RS-485
13	**Tune Password.** *UP* or *DN* sets tune password value (value must be other than zero to lock configuration menus in Step 19). *SCRL* advances to Step 14.	TUNE
14	**Configure Password.** *UP* or *DN* sets configure password value (value must be other than zero to lock configuration menus in Step 19). *SCRL* advances to: Step 20 if you don't have configuration access with a non-zero password, or Step 15 if you have config. access with a non-zero password and a bad check sum was found at most recent power up or check summing is currently off, or Step 16 otherwise.	CONFIG
15	**Checksum the database.** *UP* selects YES or *DN* selects NO. *SCRL* advances to: Step 16 from NO, or Step 15.1 from YES.	CHK SUM
15.1	**Are You Sure You Want to Stop Check-summing the Database?** *UP* selects YES or *DN* selects NO. *SCRL* advances to Step 16.	ARE YOU

Table 1. Base Configuration

Middle Display	Bottom Display	Entry Description
ENABLE	NO =	Don't allow TOTALIZE **MENU** setup or **TOT** variable select display.
	YES =	Allow totalizer setup and display.
ENABLE	NO =	Don't allow RS-485 **MENU** setup and display.
	YES =	Allow RS-485 **MENU** setup and display.
PASSWORD	xxxx	Use this value (1 to 30000) at CFG/TUNE PASSWORD in 'Displays' menu to allow read access to all menus and tune access to 'Tune' through 'Setpts' menus (a configuration password must also be configured). **Note**: value can only be viewed and changed if you have read/write access with configuration password. Otherwise it is shown as 0.
PASSWORD	xxxx	Use this value (1 to 30000) at CFG/TUNE PASSWORD in 'Displays' menu to allow complete access to all menus. **Note**: value can only be viewed and changed if you have read/write access with configuration password. Otherwise it is shown as 0.
DATABASE	YES =	Checksum the data base.
	NO =	Don't checksum the data base.
		You can turn off the checksum if directed by a service representative. A bad checksum should not occur. If it does, some part of the code may be corrupt.
SURE?	YES	This step is present only to guard against
	NO	accidentally turning off the database checksumming.

Table 1. Base Configuration

Step	Step Description	Top Display
16	**Main Board Calibration Data.** *UP* begins calibration. See **Calibration Data** section and Table 15. *SCRL* advances to Step 17.	MAIN BRD
• • •	• • •	• • •
17	**Option Board Calibration Data.** *UP* begins calibration. See **Calibration Data** section and Table 15. *SCRL* advances to Step 18.	OPTN BRD
• • •	• • •	• • •
18	**Default Database.** *UP* selects request to default the database (Are You Sure), Step 18.1. *SCRL* advances to Step 19 when both tune and configure passwords are other than zero. *SCRL* advances to Step 20 otherwise.	DEFAULT
18.1	**Are You Sure You Want to Default the Database?** *UP* selects YES or *DN* selects NO. *SCRL* advances to: Step 19 from NO, or Step 18.2 from YES.	ARE YOU

Table 1. Base Configuration

Middle Display	Bottom Display	Entry Description
CALIBRAT		Entry point for main board calibration. See **Calibration Data** section for details on these steps. **Caution**: These are factory calibration values and should be altered only on the advice of authorized service personnel. Changing any or all of the 4 calibration values will cause the instrument to mark the main instrument calibration valid.
•	•	•
•	•	•
•	•	•
CALIBRAT		Entry point for option board calibration. See **Calibration Data** section for details on these steps. **Note:** Factory calibration values are shipped with the option board and need to be entered as part of installing a new board.
•	•	•
•	•	•
•	•	•
DATABASE		The *UP* key will be ignored unless the configuration password is non-zero. If FACTORY1 DATABASE is the prompt for this step, a test data base will be loaded in place of the default.
SURE?	YES NO	This step is present only to guard against accidentally defaulting the database. When the database is defaulted, all configuration data is written over with the factory default values. The unit must then be reconfigured for the desired control functions.

Table 1. Base Configuration

Step	Step Description	Top Display
18.2	**Configuration has Changed.** *SCRL* advances to Step 19.	CONFIG
19	**Lock configuration menus** *UP* or *DN* selects YES or NO *SCRL* advances to Step 20.	LOCK CFG
20	**Software Revision Number.** *SCRL* advances to Step 21.	SOFTWARE
21	**Display Revision Number.** *SCRL* advances to Step 1.	DISPLAY

Table 1. Base Configuration

Middle Display	Bottom Display	Entry Description
CHANGED		This is just a reminder that the instrument needs to be re-configured now that the database has been defaulted.
MENUS	YES	**=** When both tune and configure passwords are other than zero, don't allow operator to leave Displays Menu unless either tune or configure password is entered at CFT/TUNE PASSWORD.
	NO	= Read access to all menus is available. Tune or configuration access requires entry of a valid password as described in Steps 13 and 14
VERSION		Main board software revision number. This display is for information only.
VERSION		Display board software revision number. This display is for information only.

Table 2. Input Setup Menu

Step	Step Description	Top Display
1	**Inputs Menu.** *UP* moves to BASE CFG **MENU**. *DN* moves to DIG INPT **MENU**. *SCRL* to begin setup at Step 2.	INPUTS
2	**Decimal Point.** *UP* or *DN* positions decimal point. *SCRL* to advance to Step 3.	DECIMAL
3	**Process Input Setup.** *UP* begins setup at: Step 3.1 if input type is RTD or thermocouple, or Step 3.2 if input type is mA, mV, V, or slidewire. *SCRL* to advance to: Step 4 if input 2 is enabled, or Step 5 otherwise.	PROC INP
3.1	**Process Temperature Units.** *UP* or *DN* selects units. *SCRL* to advance to Step 3.5.	PRC TEMP
3.2	**Process Input High Value.** *UP* or *DN* sets high value of electrical process input. *SCRL* to advance to Step 3.3.	PROC INP PROC INP PROC INP PROC HI
3.3	**Process Input Low Value.** *UP* or *DN* sets low value of electrical process input. *SCRL* to advance to Step 3.4.	PROC INP PROC INP PROC INP PROC LO

Table 2. Input Setup Menu

Middle Display	Bottom Display	Entry Description
MENU		None.
POINT	0.	= Display units
	0.0	= Display tenths
	0.00	= Display hundredths (electrical inputs only)
	0.000	= Display thousandths (electrical inputs only)
		Positioning of the decimal point in this menu sets the decimal location for 'engineering unit' entries in all menus. If values have already been set up, they may have to be changed depending on decimal positioning in this menu.
SETUP		None.
UNITS	CELSIUS	= Celsius
	FAHRENHT	= Fahrenheit
MA. HI *or*	xx.xx	1.00 to 54.00 mA dc
MV. HI *or*	xx.x	–8.0 to 120 mV dc
VOLTS HI *or*	x.xx	0.10 to 6.00 V dc
POSITION	x.xxx	0.100 to 1.000 (wiper position relative to the high and low ends of the element)
MA. LO *or*	xx.xx	0.00 to 53.00 mA dc (minimum span = 1.00)
MV. LO *or*	xx.x	-10.0 to 118 mV dc (minimum span = 2.0)
VOLTS LO *or*	x.xx	0.00 to 5.90 V dc (minimum span = .10)
POSITION	x.xxx	0.000 to 0.900 (wiper position) (minimum span = .100) NOTE: input low must be less than input high.

Table 2. Input Setup Menu

Step	Step Description	Top Display
3.4	**Process Input Linearization Type.** *UP* or *DN* selects type. *SCRL* to advance to Step 3.5	PROCESS
3.5	**Process Input Engineering Units, High.** *UP* or *DN* sets engineering units. *SCRL* to advance to: Step 3.7 if process input linearization type is SQR ROOT, or Step 3.6 otherwise.	PROC ENG

Table 2. Input Setup Menu

Middle Display	Bottom Display	Entry Description
LIN TYPE	NONE SQR ROOT	
UNITS HI	xxxx	–3000 to 30000 for mV, V, mA, and slidewire (minimum span = 2) For thermocouple range limits, see thermocouple input specification on page 12. (minimum span for: types B, R, and S = 300°C, 540°F types E, J, K, N, and T = 100°C, 180°F) For RTD range limits, see RTD input specifications on page 13. (minimum span = 20°C, 36°F) Settings for high and low engineering unit values are determined by the specific process measurement requirement. For example, if the process input signal is 4 to 20 mA dc, and this signal represents a flow measurement range of 0 to 580 gallons/sec., then the engineering unit low setting would be 0 and the high setting would be 580. If the process input signal is degrees Celsius and the range of interest is 140 to 270 degrees, then the engineering unit low setting would be 140 and the high setting would be 270. Engineering units determine the 0 and 100% points for the process and set-point bar displays, the input span for the control algorithm, and for electrical inputs, the scaling of the numeric process and set-point displays. (Temperature inputs are always displayed in degrees F or degrees C, regardless of the engineering units entered.) Engineering units can be used as a linear multiplier. By setting the values at 0 and 58, for example, a scale factor of 10 is achieved. With proper use of the decimal, the units could be set at 0 and 0.58 for a scale factor of 1000.

Table 2. Input Setup Menu

Step	Step Description	Top Display
3.6	**Process Input Engineering Units, Low.** *UP* or *DN* sets engineering units. *SCRL* to advance to Step 3.7.	PROC ENG
3.7	**Process Fault Output.** *UP* or *DN* sets value. *SCRL* to advance to Step 3.8 if FIXED, Step 3.9 if LAST.	PR FAULT
3.8	**Fixed Fault Output** *UP* or *DN* sets value. *SCRL* to advance to Step 3.9.	FIXED
3.9	**Process Fault Detection Level Percentage.** *UP* or *DN* sets percent. *SCRL* to advance to Step 3.10.	PR FAULT

Table 2. Input Setup Menu

Middle Display	Bottom Display	Entry Description
UNITS LO	xxxx	–3000 to 30000 Note: Fixed at 0 when process input linearization type is SQR ROOT.
OUTPUT	LAST FIXED	This is the output required during an input fault. When an input failure is detected, controller is put in manual and calculated output switches to the fault output value.
FAULT OP	xx	0 to 100% If heat/cool is used, the output value (OV) can be determined from heat output (HO) or cool output (CO) and crossover value (CV) as follows: OV (Heat) = (((100-CV) × HO)/100) + CV OV (Cool) = CV - ((CV × CO)/100)
LEVL PCT	xx	0 to 100% This is the percentage of input level used to generate a fault condition and is calculated using the configured input span. For example, at the 10% level a fault in a 0 to 5 volt input (span is 5 volts) would trigger at –0.01 (lower limit) and 5.5V and at the 20% level it would trigger at –0.01 and 6.0V. At the 100% level, a 4 to 5V input with a span of 1V would trigger a fault at 3 and 6V. Limits on detection levels are: Volt = –0.01 to 6.0V millivolt = –10.00 to 130 mV milliampere = –.20 to 55.00 mA slidewire = –.1 to 1.200 RTD = –202 to 852°C, –332 to 1566°F Thermocouple Type: B = 370 to 1680°C, 698 to 3056°F E = –210 to 1009°C, –346 to 1848°F J = –210 to 1208°C, –346 to 2206°F K = –210 to 1375°C, –346 to 2507°F N = –10 to 1314°C, 14 to 2397°F R = –30 to 1680°C, –22 to 3056°F S = –30 to 1680°C, –22 to 3056°F T = –210 to 410°C, –346 to 770°F

Table 2. Input Setup Menu

Step	Step Description	Top Display
3.10	**Recovery Option.** *UP* or *DN* selects option. *SCRL* to advance to: Step 4 if input 2 is enabled, or Step 5 otherwise.	RECOVERY
4	**Input 2 Setup.** (Requires Option Board) *UP* begins setup at: Step 4.7 if output type is POS PROP, or Step 4.1 if input 2 type is thermocouple or RTD, or Step 4.2 if input type 2 is mA, mV, V, or slidewire *SCRL* to advance to Step 5.	INPUT 2
4.1	**Input 2 Temperature Units.** *UP* or *DN* selects units. *SCRL* to advance to Step 4.5.	IN2 TEMP
4.2	**Input 2 High Value.** *UP* or *DN* sets high value of input 2. *SCRL* to advance to Step 4.3.	INPUT 2 INPUT 2 INPUT 2 INP2 HI
4.3	**Input 2 Low Value.** *UP* or *DN* sets low value of input 2. *SCRL* to advance to Step 4.7 if either digital input function is OUTP TRK, go to Step 4.4 otherwise.	INPUT 2 INPUT 2 INPUT 2 INP2 LO
4.4	**Input 2 Linearization Type.** *UP* or *DN* selects type. *SCRL* to advance to Step 4.5.	INPUT 2

Table 2. Input Setup Menu

Middle Display	Bottom Display	Entry Description
OPTION	MANUAL	= Makes instrument return to the manual mode after the input failure is corrected.
	LAST	= Makes instrument return to the mode it was in when the input failure occurred.
SETUP		If input 2 is being used as a remote bias or ratio value input, the value will be displayed as follows: xxx.xx.
UNITS	CELSIUS	= Celsius
	FAHRENHT	= Fahrenheit
MA. HI *or* MV. HI *or* VOLTS HI *or* POSITION	xx.xx	1.00 to 54.00 mA dc
	xx.x	–8.0 to 120 mV dc
	x.xx	0.1 to 6.00 V dc
	x.xxx	0.100 to 1.000 (wiper position)
MA. LO *or* MV. LO *or* VOLTS LO *or* POSITION	xx.xx	0.00 to 53.00 mA dc (minimum span = 1.00)
	xx.x	–10.0 to 118 mV dc (minimum span = 2.0)
	x.xx	0.00 to 5.90 V dc (minimum span = .10)
	x.xxx	0.000 to 0.900 (wiper position) (minimum span = .100)
LIN TYPE	NONE SQR ROOT	When SQR ROOT linearization is selected, the engineering units low value defaults to zero and will not appear in this menu.

Table 2. Input Setup Menu

Step	Step Description	Top Display
4.5	**Input 2 Engineering Units, High.** *UP* or *DN* sets engineering units. *SCRL* to advance to: Step 4.7 if input 2 linearization type is SQR ROOT, or Step 4.6 otherwise.	IN2 ENG
4.6	**Input 2 Engineering Units, Low.** *UP* or *DN* sets engineering units. *SCRL* to advance to Step 4.7.	IN2 ENG

Table 2. Input Setup Menu

Middle Display	Bottom Display	Entry Description
UNITS HI	xxxx	–3000 to 30000 for mV, V, mA, and slidewire (minimum span = 2) For thermocouple range limits, see thermocouple input specification on page 12. (minimum span for: types B, R, and S = 300°C, 540°F; types E, J, K, N, and T = 100°C, 180°F) For RTD range limits, see RTD input specifications on page 13. (minimum span = 20°C, 36°F) See description on Process Input Engineering Units High, Step 3.5.
UNITS LO	xxxx	–3000 to 30000 Notes: Low value fixed at 0 when input 2 linearization type is SQR ROOT. Hi and Lo units decimal points are positioned at xxx.xx when a remote ratio is configured.

Table 2. Input Setup Menu

Step	Step Description	Top Display
4.7	**Input 2 Fault Action.** *UP* or *DN* selects action. *SCRL* to advance to: Step 4.8 for LOCAL, or Step 4.9 otherwise.	I2 FAULT
4.8	**Input 2 Fault Value.** *UP* or *DN* sets value. *SCRL* to advance to Step 4.9.	I2 FAULT
4.9	**Input 2 Fault Detection Level Percentage.** *UP* or *DN* sets percent. *SCRL* to advance to Step 5.	I2 FAULT

Table 2. Input Setup Menu

Middle Display	Bottom Display	Entry Description
ACTION		Output type is NOT Position Proportioning:
	NONE	= No action taken on input 2 failure.
	LOCAL	= On input 2 failure, make the setpoint mode (or amrb ratio or bias source) local, and set it to the fault value below.
		Output type is Position Proportioning:
	NONE	= No action taken on input 2 failure.
	HOLD POS	= On input 2 failure, hold the current valve position.
	CLSD POS	= On input 2 failure, drive the valve closed.
	OPEN POS	= On input 2 failure, drive the valve open.
		NOTE: On input 2 failure, control mode is set to manual and output to Process Fault Output. If recovery option is LAST and controller was in auto, it will return to auto when the fault clears.
VALUE	xxxx	–3000 to 30000 This value is limited by local set-point or ratio/bias limits. This is the value which the local set-point takes at a fault condition.
LEVL PCT	xx	0 to 100% See entry description with Step 3.8.

Table 2. Input Setup Menu

Step	Step Description	Top Display
5	**Engineering Units Label.** *UP* to begin label entry. *SCRL* to advance to Step 6. 1. When *UP* is pressed to begin entry, the first label character will begin to flash (if not a space). 2. Use *UP* or *DN* to select the desired character. (Selecting *UP* first begins at 'A'; selecting *DN* first begins at '9'.) 3. *SCRL* to the next character and use *UP* or *DN* to set it. 4. Repeat through the last character. 5. *SCRL* back to the non-flashing label display. 6. Use *UP* to repeat label entry or *SCRL* to the next step.	ENG UNIT
6	**Right Bar Displayed Variable.** *UP* or *DN* selects type. *SCRL* to advance to: Step 6.1 for DEVIATN, or Step 1 for OUTPUT.	RIGHT
6.1	**Right Bar Displayed Variable.** *UP* or *DN* sets percent. *SCRL* to return to Step 1.	DEV BAR

Table 2. Input Setup Menu

Middle Display	Bottom Display	Entry Description
LABEL	XXX	Where x = any of the characters listed under Tag Name in the Tune Menu (Table 11). This is the label appended to the numeric process and set-point displays. When possible, a space will appear between the numeric value and the label. However, if 5 characters are required for the value, the space will be lost. If 6 are required, the third label character will be lost. For this reason, a 1 or 2 character label would be preferable. e.g. 23.2 GPM 37.58GPM 103.47GP
BAR	OUTPUT	= Display the control output in the right bar display.
	DEVIATN	= Display deviation (process - setpoint) in the right bar display. Allows deviation to be viewed in the Displays menu.
FULL SCL	XX	1 to 100% of span This is the positive or negative deviation that will give a full scale indication on the deviation bar. For example, if span is 200 and Full Scale is set to 25%, then a deviation of ±50 would give a full scale indication on the deviation bar. If span is 50 and Full Scale is set to 50%, then a deviation of ±25 would give a full scale indication on the deviation bar.

Table 3. Digital Input Setup Menu

Step	Step Description	Top Display
1	**Digital Input Menu.** *UP* moves to INPUTS **MENU**. *DN* moves to MA. OUTP **MENU**. *SCRL* to begin setup at Step 2.	DIG INPT
2	**Digital Input 1.** *UP* begins digital input 1 configuration at Step 2.1. *SCRL* to advance to Step 3.	DIGITAL
2.1	**Digital Input 1 Function.** *UP* or *DN* selects function. *SCRL* to advance to: Step 3 from NONE, or Step 2.1.1 from AUTO/MAN, or Step 2.1.10 from ALRM ACK or OUTP TRK, or Step 2.1.6 from TOTALIZE, or Step 2.1.4 from RAMPSOAK, or Step 2.1.8 from SETP SEL.	DIG IN 1
2.1.1	**Digital Auto to Manual Fixed Output Enable.** *UP* or *DN* selects YES or NO. *SCRL* to advance to: Step 2.1.2 from NO, or Step 2.1.1.1 from YES.	DIG A-M
2.1.1.1	**Digital Auto to Manual Fixed Output Value.** *UP* or *DN* sets value. *SCRL* to advance to Step 2.1.2.	DIG A-M
2.1.2	**Auto/Manual Key Lockout.** *UP* or *DN* selects YES or NO. *SCRL* to advance to Step 2.1.3.	A/M KEY

Table 3. Digital Input Setup Menu

Middle Display	Bottom Display	Entry Description
MENU		None.
INPUT 1		None.
FUNCTION	NONE	= Not used
	AUTO/MAN	= Switch control mode
	ALRM ACK	= Global alarm acknowledge
	TOTALIZE	= Issue command(s) to totalizer algorithm
	RAMPSOAK	= Issue command(s) to ramp/soak algorithm
	SETP SEL	= Select active set-point
	OUTP TRK	= Cause output to track input 2 (only available when input 2 is electrical and output is current proportioning)
OUT ENAB	NO	= Leave output at current value when switching control mode to manual with digital input
	YES	= Set output to value below when switching control mode to manual with digital input
OUT VAL	xx.x	x to xxx% Limited by output mA high and low limits above. Output generated when switching to manual with digital input.
LOCKOUT	YES	= Lockout front panel changes from auto to manual control mode
	NO	= Allow front panel changes from auto to manual control mode
		Note: NO allows changes from front panel, which may conflict with digital input state. Digital input actions take place only at 'transitions' so that a subsequent front panel override can take place if allowed.

Table 3. Digital Input Setup Menu

Step	Step Description	Top Display
2.1.3	**Manual to Auto Transition Allowed.** *UP* or *DN* selects YES or NO. *SCRL* to advance to Step 2.1.10.	MAN-AUTO
2.1.4	**Ramp/Soak Digital Input 1 Function.** *UP* or *DN* selects function. *SCRL* to advance to Step 2.1.5.	RAMPSOAK
2.1.5	**Ramp/Soak Command Lockout.** *UP* or *DN* selects YES or NO. *SCRL* to advance to Step 2.1.10.	R/H,RSET *or* RUN/HOLD *or* SKIP
2.1.6	**Totalizer Digital Input 1 Function.** *UP* or *DN* selects function. *SCRL* to advance to Step 2.1.7.	TOTALIZE

Table 3. Digital Input Setup Menu

Middle Display	Bottom Display	Entry Description
ALLOWED	NO	= Allows digital input to switch control mode only on closed transition (auto to manual)
	YES	= Allows digital input to switch control mode from manual to auto, or auto to manual
DI1 FUNC	RUN/STOP	= If DI closed: start profile at step 1 If DI open: reset and stop on step 1
	RUN/HOLD	= If DI closed: continue from current step If DI open: stop and hold current step
	RUN/SKIP	= If DI closed: continue profile If DI open: skip current step, continue
LOCKOUT	YES	= Locks out the front panel ramp/soak commands indicated R/H,RSET = Run/hold, reset commands locked if run/stop selected RUN/HOLD = Run/hold commands locked if run/hold selected SKIP = Skip commands locked if run/skip selected
	NO	= Allows all front panel commands to the ramp/soak algorithm Also see note in 2.1.2 above.
DI1 FUNC	RUN/STOP	= If DI closed: start counting at preset value If DI open: reset and stop at preset value
	RUN/RSET	= If DI closed: continue from current count If DI open: reset and begin counting from preset value
	RUN/HOLD	= If DI closed: continue from current count If DI open: stop and hold current count

Table 3. Digital Input Setup Menu

Step	Step Description	Top Display
2.1.7	**Totalizer Command Lockout.** *UP* or *DN* selects YES or NO. *SCRL* to advance to Step 2.1.10.	R/H,RSET *or* RESET *or* RUN/HOLD
2.1.8	**Remote/Local Key Lockout.** *UP* or *DN* selects YES or NO. *SCRL* to advance to: Step 2.1.9 if input 2 is present and available for for use as remote set-point, or Step 2.1.10 otherwise.	R/L KEY
2.1.9	**Local to Remote Transition Allowed.** *UP* or *DN* selects YES or NO. *SCRL* to advance to Step 2.1.10.	LOC-REM
2.1.10	**Digital Input 1 Action.** *UP* or *DN* selects REVERSE or DIRECT. *SCRL* to advance to Step 3.	DIG IN 1
3	**Digital Input 2.** *UP* begins digital input 2 configuration Step 3.1. *SCRL* to advance to: Step 4 if one or both digital inputs are used for set-point switching, or Step 1 otherwise.	DIGITAL

Table 3. Digital Input Setup Menu

Middle Display	Bottom Display	Entry Description
LOCKOUT	YES	= Locks out the front panel totalizer commands indicated R/H,RSET = Run/hold, reset commands locked if run/stop selected RESET = Reset commands locked if run/reset selected RUN/HOLD = Run/hold commands locked if run/hold selected
	NO	= Allows all front panel commands to the totalizer algorithm Also see note in 2.1.2 above.
LOCKOUT	YES	= Locks out the front panel selection of active set-point
	NO	= Allows front selection of active set-point When both digital inputs are used for set-point selection, this choice applies to both. They are not independent. Also see note in 2.1.2 above.
ALLOWED	NO	= Digital input transition selects any set-point for which it is configured, except remote
	YES	= Digital input transition selects any set-point for which it is configured When both digital inputs are used for set-point selection, this choice applies to both. They are not independent.
ACTION	REVERSE DIRECT	Causes a closed contact to be treated as an open contact and vice versa
INPUT 2		None.

Table 3. Digital Input Setup Menu

Step	Step Description	Top Display
3.1	**Digital Input 2 Function.** *UP* or *DN* selects function. *SCRL* to advance to: Step 4 from NONE, or Step 3.1.1 from AUTO/MAN, or Step 3.1.10 from ALRM ACK or OUTP TRK, or Step 3.1.6 from TOTALIZE, or Step 3.1.4 from RAMPSOAK, or Step 3.1.8 from SETP SEL.	DIG IN 2
3.1.1	**Digital Auto to Manual Fixed Output Enable.** *UP* or *DN* selects YES or NO. *SCRL* to advance to: Step 3.1.2 from NO, or Step 3.1.1.1 from YES.	DIG A-M
3.1.1.1	**Digital Auto to Manual Fixed Output Value.** *UP* or *DN* sets value. *SCRL* to advance to Step 3.1.2.	DIG A-M
3.1.2	**Auto/Manual Key Lockout.** *UP* or *DN* selects YES or NO. *SCRL* to advance to Step 3.1.3.	A/M KEY
3.1.3	**Manual to Auto Transition Allowed.** *UP* or *DN* selects YES or NO. *SCRL* to advance to Step 3.1.10.	MAN-AUTO
3.1.4	**Ramp/Soak Digital Input 2 Function.** *UP* or *DN* selects function. *SCRL* to advance to Step 3.1.5.	RAMPSOAK

Table 3. Digital Input Setup Menu

Middle Display	Bottom Display	Entry Description
FUNCTION	NONE	= Not used
	AUTO/MAN	= Switch control mode
	ALRM ACK	= Global alarm acknowledge
	TOTALIZE	= Issue command(s) to totalizer algorithm
	RAMPSOAK	= Issue command(s) to ramp/soak algorithm
	SETP SEL	= Select active set-point
	OUTP TRK	= Cause output to track input 2 (only available when input 2 is electrical and output is current proportioning)
OUT ENAB	NO	= Leave output at current value when switching control mode to manual with digital input
	YES	= Set output to value below when switching control mode with digital input
OUT VAL	xx.x	x to xxx% Limited by output mA high and low limits above. Output generated when switching to manual with digital input.
LOCKOUT	YES	= Lockout front panel changes from auto to manual control mode
	NO	= Allow front panel changes from auto to manual control mode See note above in 2.1.2.
ALLOWED	NO	= Allows digital input to switch control mode only on closed transition (auto to manual)
	YES	= Allows digital input to switch control mode from manual to auto, or auto to manual
DI2 FUNC	RUN/STOP	= If DI closed: start profile at step 1 If DI open: reset and stop on step 1
	RUN/HOLD	= If DI closed: continue from current step If DI open: stop and hold current step
	RUN/SKIP	= If DI closed: continue profile If DI open: skip current step, continue

Table 3. Digital Input Setup Menu

Step	Step Description	Top Display
3.1.5	**Ramp/Soak Digital Input 2 Command Lockout.** *UP* or *DN* selects YES or NO. *SCRL* to advance to Step 3.1.10.	R/H,RSET *or* RUN/HOLD *or* SKIP
3.1.6	**Totalizer Digital Input 2 Function.** *UP* or *DN* selects function. *SCRL* to advance to Step 3.1.7.	TOTALIZE
3.1.7	**Totalizer Digital Input 2 Command Lockout.** *UP* or *DN* selects YES or NO. *SCRL* to advance to Step 3.1.10.	R/H,RSET *or* RESET *or* RUN/HOLD
3.1.8	**Remote/Local Key Lockout.** *UP* or *DN* selects YES or NO. *SCRL* to advance to: Step 3.1.9 if input 2 is present and available for use as remote set-point, or Step 3.1.10 otherwise.	R/L KEY

Table 3. Digital Input Setup Menu

Middle Display	Bottom Display	Entry Description
LOCKOUT	YES	= Locks out the front panel ramp/soak commands indicated R/H,RSET = Run/hold, reset commands locked if run/stop selected RUN/HOLD = Run/hold commands locked if run/hold selected SKIP = Skip commands locked if run/skip selected
	NO	= Allows all front panel commands to the ramp/soak algorithm
		Also see note in 2.1.2 above.
DI2 FUNC	RUN/STOP	= If DI closed: start counting at preset value If DI open: reset and stop at preset value
	RUN/RSET	= If DI closed: continue from current count If DI open: reset and begin counting from preset value
	RUN/HOLD	= If DI closed: continue from current count If DI open: stop and hold current count
LOCKOUT	YES	= Locks out the front panel totalizer commands indicated R/H,RSET = Run/hold, reset commands locked if run/stop selected RESET = Reset commands locked if run/reset selected RUN/HOLD = Run/hold commands locked if run/hold selected
	NO	= Allows all front panel commands to the totalizer algorithm
		Also see note in 2.1.2 above.
LOCKOUT	YES	= Locks out the front panel selection of active set-point
	NO	= Allows front selection of active set-point When both digital inputs are used for set-point selection, this choice applies to both. They are not independent. Also see note 2.1.2 above.

Table 3. Digital Input Setup Menu

Step	Step Description	Top Display
3.1.9	**Local to Remote Transition Allowed.** *UP* or *DN* selects YES or NO. *SCRL* to advance to Step 3.1.10.	LOC-REM
3.1.10	**Digital Input 2 Action.** *UP* or *DN* selects REVERSE or DIRECT. *SCRL* to advance to: Step 4 if either digital input function is SETP SEL or both functions are SETP SEL and input 2 is enabled, or Step 1 otherwise.	DIG IN 2
4	**Digital Set-Point Selection List.** *UP* or *DN* selects set-point. *SCRL* to return to Step 1.	DI SETPT

Table 3. Digital Input Setup Menu

Middle Display	Bottom Display	Entry Description
ALLOWED	NO	= Digital input transition selects any set-point for which it is configured, except remote
	YES	= Digital input transition selects any set-point for which it is configured
		When both digital inputs are used for set-point selection, this choice applies to both. They are not independent.
ACTION	REVERSE DIRECT	Causes a closed contact to be treated as an open contact and vice versa
SEL LIST	LOC,LO2 LOC,LO3 LOC,LO4 LO2,LO3 LO2,LO4 LO3,LO4 LOC,REM LO2,REM LO3,REM LO4,REM	= When selecting with one digital input, for digital input values 0 (Open), 1 (Closed) (Remote options are only available if Input 2 is enabled)
	L1,2,3,4 L1,2,3,R L1,2,4,R L1,3,4,R L2,3,4,R	= When selecting with two digital inputs, for DI2/DI1 values of 00,01,10,11 Where R is remote set-point (remote options are only available if Input 2 is enabled)

Table 4. Milliamp Output Setup Menu

Step	Step Description	Top Display
1	**Milliamp Output Menu.** *UP* moves to DIG INPT **MENU**. *DN* moves to RELAYS **MENU**. *SCRL* to begin setup at Step 2.	MA. OUTP
2	**Output Current at 100%.** *UP* or *DN* sets value. *SCRL* to advance to Step 3.	OUTPUT
3	**Output Current at 0%.** *UP* or *DN* sets value. *SCRL* to advance to: Step 4 if output type is HEAT/COOL, or Step 6 otherwise.	OUTPUT
4	**Heat Output High Limit.** *UP* or *DN* sets value. *SCRL* to advance to Step 5.	HEAT OUT
5	**Cool Output High Limit.** *UP* or *DN* sets value. *SCRL* to advance to Step 9.	COOL OUT
6	**Output High Limit.** *UP* or *DN* sets value. *SCRL* to advance to Step 7.	OUTPUT
7	**Output Low Limit.** *UP* or *DN* sets value. *SCRL* to advance to Step 8.	OUTPUT
8	**Output Limited in Manual** *UP* or *DN* selects YES or NO *SCRL* to advance to Step 9.	LIMIT IN
9	**Power-Up Output Source.** *UP* or *DN* selects LAST or FIXED. *SCRL* to advance to: Step 9.1 from FIXED, or Step 1 from LAST if output 2 is NOT installed, or Step 11 from LAST if output type is HC/CC (heat/cool, dual mA), or Step 10 otherwise	POWER UP

Table 4. Milliamp Output Setup Menu

Middle Display	Bottom Display	Entry Description
MENU		None.
MA. HIGH	xx.x	01.0 to 54.0 mA dc The current produced by 100% output from the control algorithm. (i. e. ,100% = 20 mA dc)
MA. LOW	xx.x	0 to (mA high – 1) mA dc The current produced by 0% output from the control algorithm. Example: 0% = 4 mA dc
HI LIMIT	xx.x	0.1 to 110.0% of heat output span The maximum value for heat output.
HI LIMIT	xx.x	0.1 to 110.0% of cool output span The maximum value for cool output.
HI LIMIT	xx.x	10.0 to 110.0% of mA output span 10.0 to 100% of relay output span (limited to 50 mA maximum)
LO LIMIT	xx.x	–8% to (high limit – 1.0)% of mA output span 0% to (high limit – 1.0)% of relay output span (limited to 0 mA minimum)
MANUAL	YES	=Output HI and LO limits apply in manual or output tracking.
	NO	= Output is not limited in manual or output tracking.
OUTP SRC	LAST	= Power up with the same output value as at power down
	FIXED	= Power up with fixed value below

Table 4. Milliamp Output Setup Menu

Step	Step Description	Top Display
9.1	**Fixed Output Value.** *UP* or *DN* sets fixed initial power up output value. *SCRL* to advance to: Step 10 if output 2 is installed, and output type is NOT HC/CC, or Step 11 if output 2 is installedand output type is HC/CC, or Step 1 otherwise (output 2 is NOT installed).	FIXD PWR
10	**Retransmission Variable.** *UP* or *DN* selects variable. SETPOINT, INPUT 2 and BUS_ONLY selectable only when available per base configuration menu. *SCRL* to advance to: Step 1 from NONE, MANUAL or BUS_ONLY, or Step 10.1 otherwise.	RETRANS
10.1	**Retransmission Process High Variable.** *UP* or *DN* sets value. *SCRL* to advance to Step 10.2.	RETRANS
10.2	**Retransmission Process Low Variable.** *UP* or *DN* sets value. *SCRL* to advance to Step 1.	RETRANS
11	**Output 2 Current at 100%.** *UP* or *DN* sets value. *SCRL* to advance to Step 12.	OUTPUT 2
12	**Output 2 Current at 0%.** *UP* or *DN* sets value. *SCRL* to return to Step 1.	OUTPUT 2

Table 4. Milliamp Output Setup Menu

Middle Display	Bottom Display	Entry Description
UP OUTPT	xx.x	–8.0 to 110.0. Limited by output high and low limits above. If heat/cool is used, output value (OV) can be determined from heat output (HO) or cool output (CO) and crossover value (CV): OV (Heat) = CV + {[(100CV)xHO]/100} OV (Cool) = CV [(CVxCO)/100]
VARIABLE	PROCESS	= Retransmit the process variable on output 2
	SETPOINT	= Retransmit the active set-point variable on output 2
	INPUT 2	= Retransmit input 2 on output 2
	MANUAL	= Manually control output 2 from front panel
	BUS_ONLY	= Output 2 is controlled via the computer and RS-485 Communications
	NONE	= Fix second output at 0 mA.
PROC HI *or* SETPT HI	xxxx	–3000 to 30000. Decimal placed per Inputs, Table 2. Value of the retransmission variable, in engineering units, which produces the 100% current on output 2.
PROC LO *or* SETPT LO	xxxx	–3000 to 30000. Decimal placed per Inputs, Table 2. Value of the retransmission variable, in engineering units, which produces the 0% current on output 2.
MA. HIGH	xx.x	01.0 to 54.0 mA dc The current produced by 100% output from the control algorithm. Example: 100% = 20 mA dc
MA. LOW	xx.x	0 to (mA high – 1) mA dc The current produced by 0% output from the control algorithm. Example: 0% = 4 mA dc

Table 5. Output Relays Setup Menu

Step	Step Description	Top Display
1	**Output Relays Menu.** *UP* moves to MA. OUTP **MENU**. *DN* moves to RAT BIAS **MENU** if A/M ratio bias is enabled, or to SETPTS **MENU**. *SCRL* to begin setup at Step 2.	RELAYS
2	**Relay A Setup.** *UP* begins setup at Step 2.1. *SCRL* to advance to Step 3.	RELAY A
2.1	**Relay A Function.** *UP* or *DN* selects function. *SCRL* to advance to: Step 2.1.1 if function is ALARMS, or Step 3 otherwise.	RELAY A
2.1.1	**Relay A Alarm Trip Action.** *UP* or *DN* selects alarm combination. *SCRL* to advance to Step 3.	RELAY A
3	**Relay B Setup.** *UP* begins setup at Step 3.1. *SCRL* to advance to Step 4.	RELAY B
3.1	**Relay B Function.** *UP* or *DN* selects function. *SCRL* to advance to: Step 3.1.1 if function is ALARMS, or Step 4 otherwise.	RELAY B

Table 5. Output Relays Setup Menu

Middle Display	Bottom Display	Entry Description
MENU		None.
SETUP		None.
FUNCTION	NONE ALARMS TOTALIZE RAMPSOAK REM/LOC AUTO/MAN MANUAL CMP ONLY	Note: If relay is used for control (per output type in BASE CGF), 'CONTROL' will appear for one second and displays will advance to **Relay B Setup**. = Relay action controlled from front panel = Relay action controlled by computer
TRIP ACT	1 2 3 4 • • • 1234	15 possible combinations of the four display alarms. Any of the alarms in the chosen set will cause the relay to trip (de-energize). (See **Alarm** Section.) All must be off to release (energize) it. Valid combinations are: 1, 2, 3, 4, 12, 13, 14, 23, 24, 34, 123, 124, 134, 234, and 1234.
SETUP		None.
FUNCTION	NONE ALARMS TOTALIZE RAMPSOAK REM/LOC AUTO/MAN MANUAL CMP ONLY	Note: If relay is used for control (per output type in BASE CGF), 'CONTROL' will appear for one second and displays will advance to **Relay C Setup**. = Relay action controlled from front panel = Relay action controlled by computer

Table 5. Output Relays Setup Menu

Step	Step Description	Top Display
3.1.1	**Relay B Alarm Trip Action.** *UP* or *DN* selects alarm combination. *SCRL* to advance to Step 4.	RELAY B
4	**Relay C Setup.** *UP* begins setup at Step 4.1. *SCRL* to return to Step 1.	RELAY C
4.1	**Relay C Function.** *UP* or *DN* selects function. *SCRL* to advance to: Step 4.1.1 if function is ALARMS, or Step 1 otherwise.	RELAY C
4.1.1	**Relay C Alarm Trip Action.** *UP* or *DN* selects alarm combination. *SCRL* to return to Step 1.	RELAY C

Table 5. Output Relays Setup Menu

Middle Display	Bottom Display	Entry Description
TRIP ACT	1 2 3 4 • • • 1234	15 possible combinations of the four display alarms. Any of the alarms in the chosen set will cause the relay to trip. Valid combinations are: 1, 2, 3, 4, 12, 13, 14, 23, 24, 34, 123, 124, 134, 234, and 1234.
SETUP		None.
FUNCTION	NONE ALARMS TOTALIZE RAMPSOAK REM/LOC AUTO/MAN MANUAL CMP ONLY	 = Relay action controlled from front panel = Relay action controlled by computer
TRIP ACT	1 2 3 4 • • • 1234	15 possible combinations of the four display alarms. Any of the alarms in the chosen set will cause the relay to trip. Valid combinations are: 1, 2, 3, 4, 12, 13, 14, 23, 24, 34, 123, 124, 134, 234, and 1234.

Table 6. RS-485 Setup Menu

Step	Step Description	Top Display
1	**RS-485 Menu.** (requires option board) *UP* moves to RELAYS **MENU**. *DN* moves to RAT BIAS **MENU** if A/M ratio bias is enabled, or to SETPTS **MENU** otherwise. *SCRL* advances to Step 2.	RS-485
2	Go to ***Table 1, RS-485 Setup Menu***, in the **MODBUS Communications Supplement IB-23C650M**. All information pertaining to RS-485 setup and Modbus communications is provided in the supplement.	

Table 6. RS-485 Setup Menu

Middle Display	Bottom Display	Entry Description
MENU		None.

Table 7. Auto/Manual Ratio Bias Setup Menu

Step	Step Description	Top Display
1	**A/M Ratio Bias Menu.** *UP* moves to RELAYS **MENU**. *DN* moves to TOTALIZE **MENU** if integrator/totalizer is enabled, or to ALARMS **MENU** otherwise. *SCRL* to begin setup at Step 2.	RAT BIAS
2	**Type of Ratio Bias Station.** *UP* or *DN* selects type. *SCRL* to advance to: Step 3 from RATIO, or Step 4 from BIAS, or Step 7 from RAT BIAS.	RAT BIAS
3	**Source for Ratio Only Type.** *UP* or *DN* selects source. *SCRL* to advance to Step 5.	RATIO
4	**Source for Bias Only Type.** *UP* or *DN* selects source. *SCRL* to advance to Step 6.	BIAS
5	**Balance for Ratio Only Type.** *UP* or *DN* selects type. *SCRL* to return to Step 1.	RATIO
6	**Balance for Bias Only Type.** *UP* or *DN* selects type. *SCRL* to return to Step 1.	BIAS

Table 7. Auto/Manual Ratio Bias Setup Menu

Middle Display	Bottom Display	Entry Description
MENU		None.
TYPE	RATIO	= Ratio only station
	BIAS	= Bias only station
	RAT BIAS	= Ratio and bias station
SOURCE	LOCAL	
	REMOTE	Remote source requires option board.
SOURCE	LOCAL	
	REMOTE	Remote source requires option board.
BALANCE	STANDARD	= Outputs may bump when switching from manual to auto
	AUTO	= Bumpless transfer when switching from manual to auto. Not valid if source is remote. Calculated value of ratio can exceed 30000 during normal operation. *UP* or *DN* will change value though display reads 30000. To calculate new ratio or bias value: New bias value = Output – proc. variable New ratio value = Output/proc. variable
BALANCE	STANDARD	= Outputs may bump when switching from manual to auto
	AUTO	= Bumpless transfer when switching from manual to auto. Not valid if source is remote. See Step 5 for explanation of calculation.

Table 7. Auto/Manual Ratio Bias Setup Menu

Step	Step Description	Top Display
7	**Ratio Source for Ratio and Bias Type.** *UP* or *DN* selects source. *SCRL* to advance to: Step 8 from LOCAL, or Step 9 from REMOTE.	RATIO
8	**Bias Source for Ratio and Bias Type.** *UP* or *DN* selects source. *SCRL* to advance to Step 9.	BIAS
9	**Ratio Balance for Ratio and Bias Type.** *UP* or *DN* selects type. *SCRL* to advance to: Step 10 from STANDARD, or Step 1 from AUTO.	RATIO
10	**Bias Balance for Ratio and Bias Type.** *UP* or *DN* selects type. *SCRL* to return to Step 1.	BIAS

Table 7. Auto/Manual Ratio Bias Setup Menu

Middle Display	Bottom Display	Entry Description
SOURCE	LOCAL	Initial value can be set in "TUNE MENU", Table 12, and Ratio can be changed in operator's display.
	REMOTE	Initial value can be viewed in "TUNE MENU", Table 12, and Ratio can be viewed in operator's display. Note: Only one remote source is allowed. If ratio is REMOTE, bias must be LOCAL.
SOURCE	LOCAL	Same as Step 7.
	REMOTE	Same as Step 7. Note: Only one remote source is allowed. If ratio is REMOTE, bias must be LOCAL.
BALANCE	STANDARD	= Outputs may bump when switching from manual to auto
	AUTO	= Bumpless transfer when switching from manual to auto. Not valid if source is remote. Calculated value of ratio can exceed 30000 during normal operation. See Step 5 for explanation of calculation.
BALANCE	STANDARD	= Outputs may bump when switching from manual to auto
	AUTO	= Bumpless transfer when switching from manual to auto. Not valid if source is remote. Calculated value of ratio can exceed 30000 during normal operation. See Step 5 for explanation of calculation.

Table 8. Set-Point Setup Menu

Step	Step Description	Top Display
1	**Set-Point Menu.** *UP* moves to RELAYS **MENU**. *DN* moves to RAMPSOAK **MENU** if ramp/soak is enabled, or to TOTALIZE **MENU** if integrator/totalizer is enabled, or to ALARMS **MENU** otherwise. *SCRL* to begin setup at Step 2.	SETPTS
2	**Local Set-Point.** *UP* begins set-point configuration at Step 2.1. *SCRL* to advance to Step 3.	LOC SETP
2.1	**Local Set-Point Fixed.** *UP* or *DN* selects YES or NO. *SCRL* to advance to Step 2.2.	LOC SETP
2.2	**Local Set-Point High Limit.** *UP* or *DN* sets value. *SCRL* to advance to Step 2.3.	LOC SETP
2.3	**Local Set-Point Low Limit.** *UP* or *DN* sets value. *SCRL* to advance to Step 2.4.	LOC SETP
2.4	**Local Set-Point Initial Value.** *UP* or *DN* sets value. *SCRL* to advance to Step 3.	LOC SETP
3	**Local Set-Point 2.** *UP* begins set-point 2 configuration at Step 3.1. *SCRL* to advance to Step 4.	SETPT 2
3.1	**Local Set-Point 2 Enable.** *UP* or *DN* selects YES or NO. *SCRL* to advance to Step 3.2.	SETPT 2
3.2	**Local Set-Point 2 Fixed.** *UP* or *DN* selects YES or NO. *SCRL* to advance to Step 3.3.	SETPT 2
3.3	**Local Set-Point 2 High Limit.** *UP* or *DN* sets value. *SCRL* to advance to Step 3.4.	SETPT 2

Table 8. Set-Point Setup Menu

Middle Display	Bottom Display	Entry Description
MENU		None.
		None.
FIXED	NO YES	= Allows changes in Displays menu = This local set-point can be changed at the Initial Value entry only, Step 2.4.
HI LIMIT	xxxx	Low limit to 30000
LO LIMIT	xxxx	–3000 to high limit
INIT VAL	xxxx	Low limit to high limit The current value of this local setpoint.
		None.
ENABLE	NO YES	= This set-point cannot be selected = Set-point selectable from front panel and/or digital input(s)
FIXED	NO YES	= Allows changes in Displays menu = This local set-point can be changed at the Initial Value entry only, Step 3.5.
HI LIMIT	xxxx	Low limit to 30000

Table 8. Set-Point Setup Menu

Step	Step Description	Top Display
3.4	**Local Set-Point 2 Low Limit.** *UP* or *DN* sets value. *SCRL* to advance to Step 3.5.	SETPT 2
3.5	**Local Set-Point 2 Initial Value.** *UP* or *DN* sets value. *SCRL* to advance to Step 4.	SETPT 2
4	**Local Set-Point 3.** *UP* begins set-point 3 configuration at Step 4.1. *SCRL* to advance to Step 5.	SETPT 3
4.1	**Local Set-Point 3 Enable.** *UP* or *DN* selects YES or NO. *SCRL* to advance to Step 4.2.	SETPT 3
4.2	**Local Set-Point 3 Fixed.** *UP* or *DN* selects YES or NO. *SCRL* to advance to Step 4.3.	SETPT 3
4.3	**Local Set-Point 3 High Limit.** *UP* or *DN* sets value. *SCRL* to advance to Step 4.4.	SETPT 3
4.4	**Local Set-Point 3 Low Limit.** *UP* or *DN* sets value. *SCRL* to advance to Step 4.5.	SETPT 3
4.5	**Local Set-Point 3 Initial Value.** *UP* or *DN* sets value. *SCRL* to advance to Step 5.	SETPT 3
5	**Local Set-Point 4.** *UP* begins set-point 4 configuration at Step 5.1. *SCRL* to advance to Step 5.	SETPT 4
5.1	**Local Set-Point 4 Enable.** *UP* or *DN* selects YES or NO. *SCRL* to advance to Step 5.2.	SETPT 4

Table 8. Set-Point Setup Menu

Middle Display	Bottom Display	Entry Description
LO LIMIT	xxxx	–3000 to high limit
INIT VAL	xxxx	Low limit to high limit The current value of this local setpoint.
		None.
ENABLE	NO YES	= This set-point cannot be selected = Set-point selectable from front panel and/or digital input(s)
FIXED	NO YES	= Allows changes in Displays menu = This local set-point can be changed at the Initial Value entry only, Step 4.5.
HI LIMIT	xxxx	Low limit to 30000
LO LIMIT	xxxx	–3000 to high limit
INIT VAL	xxxx	Low limit to high limit The current value of this local setpoint.
		None.
ENABLE	NO YES	= This set-point cannot be selected = Set-point selectable from front panel and/or digital input(s)

Table 8. Set-Point Setup Menu

Step	Step Description	Top Display
5.2	**Local Set-Point 4 Fixed.** *UP* or *DN* selects YES or NO. *SCRL* to advance to Step 5.3.	SETPT 4
5.3	**Local Set-Point 4 High Limit.** *UP* or *DN* sets value. *SCRL* to advance to Step 5.4.	SETPT 4
5.4	**Local Set-Point 4 Low Limit.** *UP* or *DN* sets value. *SCRL* to advance to Step 5.5.	SETPT 4
5.5	**Local Set-Point 4 Initial Value.** *UP* or *DN* sets value. *SCRL* to advance to Step 6.	SETPT 4
6	**Power-up Set-Point Source.** *UP* or *DN* selects LAST or FIXED. *SCRL* to advance to: Step 7 from LAST, from REM SETP when input 2 is enabled, or from LOC SETP or SETPT 2 - 4 when chosen local set-point is ‘fixed,’ or Step 6.1 from REM SETP when input 2 is not enabled or option board not installed, or Step 6.2 from LOC SETP or from SETPT 1 - 4 when the chosen local set-point is not ‘fixed’.	POWER UP

Table 8. Set-Point Setup Menu

Middle Display	Bottom Display	Entry Description
FIXED	NO	= Allows changes in Displays menu
	YES	= This local set-point can be changed at the Initial Value entry only, Step 5.5.
HI LIMIT	xxxx	Low limit to 30000
LO LIMIT	xxxx	–3000 to high limit
INIT VAL	xxxx	Low limit to high limit The current value of this local setpoint.
SETP SRC	LAST	= Power up with same set-point value as at power down
	LOC SETP SETPT 2 SETPT 3 SETPT 4	= If the chosen local set-point is ‘fixed’, powers up with that value. Otherwise powers up with ’fixed’ value below, Step 6.2. The chosen local set-point does not have to be enabled to provide the power up value.
	REM SETP	= Power up using remote set-point, if it exists. Otherwise, same as LAST.

Table 8. Set-Point Setup Menu

Step	Step Description	Top Display
6.1	**Input 2 is Missing.** This warning will time out in 1 second and return to step 6 with a choice of LOC SETPT.	INPUT 2
6.2	**Fixed Set-Point Value.** *UP* or *DN* sets value. *SCRL* to advance to Step 7.	FIXD PWR
7	**Set-Point Tracking.** *UP* or *DN* sets value. *SCRL* to return to Step 1.	SETPOINT

Table 8. Set-Point Setup Menu

Middle Display	Bottom Display	Entry Description
MISSING	REM SETP	None.
UP SETPT	xxxx	–3000 to 30000, within local set-point limits
TRACKING	NO	= Set-point tracking not activated
	YES	= Activate set-point tracking. Tracks process input when controller in manual. No set-point/process deviation when switching from manual to auto.
		Note: Local set-points 1-4 will not track if configured to be ‘fixed’. Remote set-point cannot track.

Table 9. Ramp/Soak Profile Setup Menu

Step	Step Description	Top Display
1	**Ramp/Soak Menu.** *UP* moves to SETPTS **MENU**. *DN* moves to TOTALIZE **MENU** if integrator/totalizer is enabled, or to ALARMS **MENU** otherwise. *SCRL* to begin setup at Step 2.	RAMPSOAK
2	**Ramp/Soak Repeat.** *UP* selects YES or *DN* selects NO. *SCRL* to advance to Step 3.	RAMPSOAK
3	**Soak Hysteresis.** *UP* or *DN* sets value. *SCRL* to advance to Step 4.	SOAK
4	**Ramp Hysteresis.** *UP* or *DN* sets value. *SCRL* to advance to Step 5.	RAMP
5	**Ramp/Soak Status.** *SCRL* to advance to Step 6.	RAMPSOAK
6	**Ramp/Soak Time Units.** *UP* or *DN* sets units. *SCRL* to advance to Step 7.	RAMPSOAK
7	**Ramp/Soak Segments.** *UP* or *DN* sets value. *SCRL* to advance to: Step 8 if number of segments is 0, or Step 7.1 otherwise.	RAMPSOAK
7.1	**Ramp/Soak Segment 1 Setup.** *UP* begins segment 1 setup at Step 7.1.1. *SCRL* to advance to Step 7.2.	SEG 1

Table 9. Ramp/Soak Profile Setup Menu

Middle Display	Bottom Display	Entry Description
MENU		None.
REPEAT	NO YES	= Stops ramp/soak cycle after last segment = Repeats ramp/soak cycle after last segment
HYST	xxxx	0 to 30000 Value of hysteresis band for guaranteed soaks.
HYST	xxxx	0 to 30000 Value of hysteresis band for guaranteed ramps.
IS OFF *or* IS ON		Note: If *SCRL* is pressed when ramp/soak is on, message 'RAMPSOAK RD ONLY' is displayed for one second, to indicate ramp/soak is on and setup therefore is read only. To make changes to the setup, turn off ramp/soak in Displays. Any change to setup will cause profile to reset. If no change is made, ramp/soak can be turned back on in Displays, and will continue from stopping point.
UNIT TIM	MINUTES *or* HOURS	Time base for all segments used in profile
SEGMENTS	xx	0 to 10 Number of segments to be used in profile. If data is not entered for all segments, profile will use whatever values are in unconfigured segments.
SETUP		None.

Table 9. Ramp/Soak Profile Setup Menu

Step	Step Description	Top Display
7.1.1	**Segment 1 Start Value.** *UP* or *DN* sets value. *SCRL* to advance to Step 7.1.2.	SEG 1
7.1.2	**Segment 1 End Value.** *UP* or *DN* sets value. *SCRL* to advance to: Step 7.1.3 if start and end values are the same, or Step 7.1.4 if start and end values are different.	SEG 1
7.1.3	**Segment 1 Soak Time.** *UP* or *DN* sets time. *SCRL* to advance to: Step 7.1.5 if relay A is set for ramp/soak (in Relays), or Step 7.1.6 if relay B is set for ramp/soak, or Step 7.1.7 if relay C is set for ramp/soak, or Step 7.1.8 otherwise.	SEG 1
7.1.4	**Segment 1 Ramp Rate.** *UP* or *DN* sets rate. *SCRL* to advance to: Step 7.1.5 if relay A is set for ramp/soak (in Relays), or Step 7.1.6 if relay B is set for ramp/soak, or Step 7.1.7 if relay C is set for ramp/soak, or Step 7.1.8 otherwise.	SEG 1

Table 9. Ramp/Soak Profile Setup Menu

Middle Display	Bottom Display	Entry Description
START SP	xxxx	Between ‘Local Set-point Low Limit’ and ‘Local Set-point High Limit’ Note: If a decimal point change is made in the INPUTS **MENU** after configuring the ramp / soak profile, the profile will require reconfiguration.
END SP	xxxx	Between ‘Local Set-point Low Limit’ and ‘Local Set-point High Limit’
SOAK TIM	xxx.x	0 to 3000.0 (hours or minutes, per Time Units, Step 6)
RMP RATE	xxx.x	Change per unit time (hours or minutes) in engineering units Example: a ramp of 10 degrees at 2 degrees every minute, and time unit = minutes, then the value = 2.0. The Displays ramp/soak status display indicates minutes remaining and counts down from 5 minutes. Note: Ramp rates excessively high could cause the ending set-point to be exceeded. Will be corrected when next segment starts. Ramp rates excessively low over a wide range cannot be displayed properly in the time remaining display in Displays. Maximum time shown is 3200 units of time; display will decrement when time remaining is less than 3200.

Table 9. Ramp/Soak Profile Setup Menu

Step	Step Description	Top Display
7.1.5	**Segment 1 Relay A State.** *UP* or *DN* selects ON or OFF. *SCRL* to advance to: Step 7.1.6 if relay B is set for ramp/soak, or Step 7.1.7 if relay C is set for ramp/soak, or Step 7.1.8 otherwise.	SEG 1
7.1.6	**Segment 1 Relay B State.** *UP* or *DN* selects ON or OFF. *SCRL* to advance to: Step 7.1.7 if relay C is set for ramp/soak, or Step 7.1.8 otherwise.	SEG 1
7.1.7	**Segment 1 Relay C State.** *UP* or *DN* selects ON or OFF. *SCRL* to advance to Step 7.1.8.	SEG 1
7.1.8	**Guaranteed Ramp or Soak.** *UP* or *DN* selects YES or NO. *SCRL* to advance to Step 7.2.	SEG 1
7.2	**Ramp/Soak Segment 2 Setup.** *UP* begins segment 2 setup at Step 7.2.1. *SCRL* to advance to Step 7.3.	SEG 2
7.2.1	**Segment 2 Start Value.** *UP* or *DN* sets value. *SCRL* to advance to Step 7.2.2.	SEG 2
•	•	•
•	•	•
•	•	•
7.10	**Ramp/Soak Segment 10 Setup.** *UP* begins segment 10 setup at Step 7.10.1. *SCRL* to return to Step 1.	SEG 10
7.10.1	**Segment 10 Start Value.** *UP* or *DN* sets value. *SCRL* to advance to Step 7.10.2.	SEG 10

Table 9. Ramp/Soak Profile Setup Menu

Middle Display	Bottom Display	Entry Description
RELAY A	ON OFF	State of the relay during segment.
RELAY B	ON OFF	State of the relay during segment.
RELAY C	ON OFF	State of the relay during segment.
GUARANTD	NO YES	= = Time is counted only if process variable is within hysteresis deadband set above (Step 3 or 4)
SETUP		None.
START SP	xxxx	Between ‘Local Set-point Low Limit’ and ‘Local Set-point High Limit’
•	•	•
•	•	•
•	•	•
SETUP		None.
START SP	xxxx	Between ‘Local Set-point Low Limit’ and ‘Local Set-point High Limit’

Table 9. Ramp/Soak Profile Setup Menu

Step	Step Description	Top Display
7.10.2	**Segment 10 End Value.** *UP* or *DN* sets value. *SCRL* to advance to: Step 7.10.3 if start and end values are the same, or Step 7.10.4 if start and end values are different.	SEG 10
7.10.3	**Segment 10 Soak Time.** *UP* or *DN* sets time. *SCRL* to advance to: Step 7.10.5 if relay A is set for ramp/soak (in Relays), or Step 7.10.6 if relay B is set for ramp/soak, or Step 7.10.7 if relay C is set for ramp/soak, or Step 7.10.8 otherwise.	SEG 10
7.10.4	**Segment 10 Ramp Rate.** *UP* or *DN* sets rate. *SCRL* to advance to: Step 7.10.5 if relay A is set for ramp/soak (in Relays), or Step 7.10.6 if relay B is set for ramp/soak, or Step 7.10.7 if relay C is set for ramp/soak, or Step 7.10.8 otherwise.	SEG 10
7.10.5	**Segment 10 Relay A State.** *UP* or *DN* selects ON or OFF. *SCRL* to advance to: Step 7.10.6 if relay B is set for ramp/soak, or Step 7.10.7 if relay C is set for ramp/soak, or Step 7.10.8 otherwise.	SEG 10
7.10.6	**Segment 10 Relay B State.** *UP* or *DN* selects ON or OFF. *SCRL* to advance to: Step 7.10.7 if relay C is set for ramp/soak, or Step 7.10.8 otherwise.	SEG 10

Table 9. Ramp/Soak Profile Setup Menu

Middle Display	Bottom Display	Entry Description
END SP	xxxx	Between ‘Local Set-point Low Limit’ and ‘Local Set-point High Limit’
SOAK TIM	xxx.x	0 to 3000.0 (hours or minutes, per Time Units, Step 6)
RMP RATE	xxx.x	Change per unit time (hours or minutes) in engineering units See Note in Step 7.1.4.
RELAY A	ON OFF	State of the relay during segment.
RELAY B	ON OFF	State of the relay during segment.

Table 9. Ramp/Soak Profile Setup Menu

Step	Step Description	Top Display
7.10.7	**Segment 10 Relay C State.** *UP* or *DN* selects ON or OFF. *SCRL* to advance to Step 7.10.8.	SEG 10
7.10.8	**Guaranteed Ramp or Soak.** *UP* or *DN* selects YES or NO. *SCRL* to return to Step 1.	SEG 10

Table 9. Ramp/Soak Profile Setup Menu

Middle Display	Bottom Display	Entry Description
RELAY C	ON OFF	State of the relay during segment.
GUARANTD	NO = YES =	Time is counted only if process variable is within hysteresis deadband set above (Step 3 or 4)

Table 10. Integrator/Totalizer Menu

Step	Step Description	Top Display
1	**Totalizer Menu.** *UP* moves to RAMPSOAK **MENU** if ramp/soak is enabled, or to RAT BIAS **MENU** if ratio bias is enabled, or to SETPTS **MENU** otherwise. *DN* moves to ALARMS **MENU**. *SCRL* to begin setup at Step 2.	TOTALIZE
2	**Wrap at Predetermined Count.** *UP* or *DN* selects YES or NO. *SCRL* to advance to Step 3.	WRAP AT
3	**Set Threshold Value.** *UP* or *DN* sets value. *SCRL* to advance to Step 4.	INPUT
4	**Totalizer Status.** *SCRL* to advance to Step 5.	TOTALIZE
5	**Totalizer Direction.** *UP* or *DN* selects UP or DOWN. *SCRL* to advance to Step 6.	TOTALIZE
6	**Totalizer Flow Rate Time Base.** *UP* or *DN* selects time base. *SCRL* to advance to Step 7.	TOTALIZE

Table 10. Integrator/Totalizer Menu

Middle Display	Bottom Display	Entry Description
MENU		None.
PRED CNT	NO	= Counts until turned off or until maximum count (9,999,999) is reached. At maximum count, totalizer will hold until operator resets.
	YES	= Counts until predetermined count is reached, then resets to preset value and starts counting again.
THRSHOLD	xxxx	0 to 'Engineering Units High Value' in engineering units for electrical inputs. Temperature inputs can be set from engineering low to high value. Totalizer will not count signals below threshold value.
IS OFF *or* IS ON		Note: If *SCRL* is pressed when totalizer is on, message 'TOTALIZE RD ONLY' is displayed for one second, to indicate totalizer is on and setup therefore is read only. To make change to the setup, turn off totalizer in Displays Menu. Any change to setup will cause profile to reset. If no change is made, totalizer can be turned back on in Displays Menu, and will continue from stopping point.
DIRECT	UP	= Totalizer counts up from preset value.
	DOWN	= Totalizer counts down from preset value.
RATE	PER SEC *or* PER MIN *or* PER HOUR	Example: If input is 100 engineering units, time base is PER SEC, and scale factor (Step 8) is 1.0, totalized count will increase at rate of 100 counts per sec. If scale factor is 2.0, totalized count will increase at rate of 50 counts per sec. See Table 13 for more examples.

Table 10. Integrator/Totalizer Menu

Step	Step Description	Top Display
7	**Totalizer Scale Decimal Point.** *UP* or *DN* sets decimal point. *SCRL* to advance to Step 8.	SCALE
8	**Totalizer Scale Factor.** *UP* or *DN* sets scale factor. *SCRL* to advance to Step 9.	SCALE
9	**Totalizer Preset Value.** *UP* begins entry of preset value at most significant digit (It will flash). Then *UP* or *DN* sets digit, *SCRL* to next digit. Repeat for all digits. *SCRL* to advance to Step 10.	PRESET
10	**Totalizer Predetermined Count.** *UP* begins entry of predetermined count at most significant digit (It will flash). Then *UP* or *DN* sets digit, *SCRL* to next digit. Repeat for all digits. *SCRL* to return to Step 1.	PREDETRD

Table 10. Integrator/Totalizer Menu

Middle Display	Bottom Display	Entry Description
DEC PT		Sets decimal location for scale factor in Step 8.
	0.	= 1 to 30000
	0.0	= .1 to 3000.0
	0.00	= .01 to 300.00
	0.000	= .001 to 30.000
FACTOR	xxxx	0.001 to 30000 (Set decimal point in Step 7). See also flow rate time base (Step 6), and the **Totalizer Operation** section.
VALUE	xxxxxxx	.000 to 9999999 (7 significant digits, with decimal point placed per Inputs) Value at which totalizer starts counting at startup or reset.
COUNT	xxxxxxx	.000 to 9999999 (7 significant digits, with decimal point placed per Inputs) Value at which totalizer resets when wrap function is enabled. If totalizer event relay enabled in Alarms, relay transfers to signal that predetermined count has been reached.

Table 11. Alarm Settings Menu

Step	Step Description	Top Display
1	**Alarms Menu.** *UP* moves to TOTALIZE **MENU** if totalizer is enabled, or to RAMPSOAK **MENU** if ramp/soak is enabled, or to RAT BIAS **MENU** if ratio bias is enabled, or to SETPTS **MENU** otherwise. *DN* moves to TUNE **MENU**. *SCRL* to begin setup at Step 2.	ALARMS
2	**Beep on Occurrence Of.** *UP* or *DN* selects type. *SCRL* to advance to Step 3.	BEEP ON
3	**Alarm Acknowledge Required.** *UP* selects YES or *DN* selects NO. *SCRL* to advance to Step 4.	ALRM ACK
4	**Overconfigured Diagnostic** *UP* selects YES or *DN* selects NO. *SCRL* to advance to: Step 5 if acknowledge is required on priority 1 process alarms, or Step 6 if acknowledge is required on priority 2 process alarms, or Step 7 otherwise.	OVERCFGD

Table 11. Alarm Settings Menu

Middle Display	Bottom Display	Entry Description
MENU		None.
OCCUR OF	NONE	= Beeper never sounds for an alarm condition
		Beeper sounds on:
	DG	= diagnostic alarm
	P1	= priority 1 process alarm
	DG, P1	= diagnostic or priority 1 process alarm
	P2	= priority 2 process alarm
	DG, P2	= diagnostic or priority 2 process alarm
	P1, P2	= priority 1 or 2 process alarm
	DG,P1,P2	= diagnostic, or priority 1 or 2 process alarm
REQD ON	NONE	= No alarm acknowledgment required for any alarm condition
		Alarm acknowledgement required for:
	DG	= diagnostic alarm
	P1	= priority 1 process alarm
	DG, P1	= diagnostic or priority 1 process alarm
	P2	= priority 2 process alarm
	DG, P2	= diagnostic or priority 2 process alarm
	P1, P2	= priority 1 or 2 process alarm
	DG,P1,P2	= diagnostic, or priority 1 or 2 process alarm
DIAG ON	YES	= Report the overconfigured condition.
	NO	= Don't report the overconfigured condition.
		Time related items such as ramp soak, totalized count, and integral and derivative responses will be in error in this condition. The diagnostic should only be turned off if it is both necessary and acceptable to run in the overconfigured condition.

Table 11. Alarm Settings Menu

Step	Step Description	Top Display
5	**Priority 1 Relay Action.** *UP* or *DN* selects action. *SCRL* to advance to: Step 6 if acknowledge is required on priority 2 process alarms, or Step 7 otherwise.	P1 RELAY
6	**Priority 2 Relay Action.** *UP* or *DN* selects action. *SCRL* to advance to Step 7.	P2 RELAY
7	**Alarm 1 Setup.** *UP* begins setup at Step 7.1. *SCRL* to advance to Step 8.	ALARM 1
7.1	**Alarm 1 Type.** *UP* or *DN* selects type. *SCRL* to advance to: Step 8 if type is NONE, or Step 7.1.1 if output type is heat/cool and output High or low is selected, or Step 7.1.2 otherwise.	ALARM 1
7.1.1	**Alarm 1 Trip-Point in Heating Band.** *UP* or *DN* selects YES or NO. *SCRL* to advance to Step 7.1.2.	AL1 TRIP
7.1.2	**Alarm 1 Trip-Point.** *UP* or *DN* sets trip-point. *SCRL* to advance to Step 7.1.3.	ALARM 1

Table 11. Alarm Settings Menu

Middle Display	Bottom Display	Entry Description
ACTION	LATCHING	= Relay assigned to alarm will trip (deenergize) when the alarm occurs and release (energize) when alarm is acknowledged
	NO LATCH	= Relay assigned to alarm will trip (deenergize) when the alarm occurs and release (energize) when alarm trip condition, including hysteresis, is no longer present
ACTION	LATCHING	= Relay assigned to alarm will trip (de-energize) when the alarm occurs and release (energize) when alarm is acknowledged
	NO LATCH	= Relay assigned to alarm will trip (de-energize) when the alarm occurs and release (energize) when alarm trip condition, including hysteresis, is no longer present
SETUP		None.
TYPE	NONE	= Not used
	PROC HI	= High process variable
	PROC LO	= Low process variable
	DEV HI	= High deviation
	DEV LO	= Low deviation
	INP2 HI	= High input 2
	INP2 LO	= Low input 2
	OUT HI	= High output
	OUT LO	= Low output
IN HEAT	NO	= Select cooling band as location for trip-point
	YES	= Select heating band as location for trip-point
TRIP	xxxx	In engineering units. Range: PROC HI –2995 to 30000 PROC LO –3000 to 29995 DEV HI 1 to 30000 DEV LO 1 to 30000 INP2 HI –2995 to 30000 INP2 LO –3000 to 30000 OUT HI ‘MA. OUTP’ output limits OUT LO ‘MA. OUTP’ output limits

Table 11. Alarm Settings Menu

Step	Step Description	Top Display
7.1.3	**Alarm 1 Priority.** *UP* or *DN* selects 1 or 2. *SCRL* to advance to Step 7.1.4.	ALARM 1
7.1.4	**Alarm 1 Hysteresis.** *UP* or *DN* sets value. *SCRL* to advance to Step 8.	ALARM 1
8	**Alarm 2 Setup.** *UP* begins setup at Step 8.1. *SCRL* to advance to Step 9.	ALARM 2
8.1	**Alarm 2 Type.** *UP* or *DN* selects type. *SCRL* to advance to: Step 8 if type is NONE, or Step 8.1.1 if output type is heat/cool, or Step 8.1.2 otherwise.	ALARM 2
8.1.1	**Alarm 2 Trip-Point in Heating Band.** *UP* or *DN* selects YES or NO. *SCRL* to advance to Step 8.1.2.	AL2 TRIP
•	•	•
•	•	•
•	•	•
10.1.4	**Alarm 4 Hysteresis.** *UP* or *DN* sets value. *SCRL* to return to Step 1.	ALARM 4

Table 11. Alarm Settings Menu

Middle Display	Bottom Display	Entry Description
PRIORITY	2 1	= Lower priority = Higher priority
HYST	xxxx	0 to 1000, in engineering units Hysteresis is an adjustable deadband at alarm trip-point. Alarm output turns off only after process value has moved into safe region by an amount equal to hysteresis. Applies to both process and deviation alarms.
SETUP		None.
TYPE	NONE PROC HI PROC LO DEV HI DEV LO INP2 HI INP2 LO OUT HI OUT LO	= Not used = High process variable = Low process variable = High deviation = Low deviation = High input 2 = Low input 2 = High output = Low output
IN HEAT	NO YES	= Select cooling band as location for trip-point = Select heating band as location for trip-point
•	•	•
•	•	•
•	•	•
HYST	xxxx	0 to 1000, in engineering units Hysteresis is an adjustable deadband at alarm trip-point. Alarm output turns off only after process value has moved into safe region by an amount equal to hysteresis. Applies to both process and deviation alarms.

Table 12. Tune Menu

Step	Step Description	Top Display
1	**Tune Menu.** *UP* moves to ALARMS **MENU**. *DN* moves to DISPLAYS **MENU**. *SCRL* to begin setup at Step 2.	TUNE
2	**Tag Name.** *UP* begins tag entry. First tag character will flash. Then *UP* or *DN* sets character (Selecting *UP* first begins selections at 'A'; selecting *DN* first begins selection at '9'.) *SCRL* to next character. Repeat for all characters, *SCRL* to beginning. *UP* repeats tag entry, or *SCRL* to advance to: Step 12 if A/M ratio bias is enabled and type is BIAS, or Step 11 if A/M ratio bias is enabled and type is any other, or Step 3 if A/M ratio bias is not enabled and output type is ON/OFF, or Step 4 if A/M ratio bias is not enabled and output type is HEAT/COOL, or Step 6 if A/M ratio bias is not enabled and output type is any other.	TAG
3	**On/Off Differential Gap.** *UP* or *DN* sets value. *SCRL* to advance to: Step 9 if remote set-point is enabled, or Step 14 otherwise.	ON/OFF
4	**Gain, Heat.** *UP* or *DN* sets value. *SCRL* to advance to Step 5.	GAIN
5	**Gain, Cool.** *UP* or *DN* sets value. *SCRL* to advance to Step 7.	GAIN
6	**Gain (proportional response).** *UP* or *DN* sets value. *SCRL* to advance to Step 7.	

Table 12. Tune Menu

Middle Display	Bottom Display	Entry Description
MENU		None.
NAME	xxxxxxxx	x= any of the following characters: Letters ‘A’ through ‘Z’, Any of the special characters: b, c, super c, d, h, sub L, super L, super m, super n, o, r, super T, u, super V, w, <, >, =, +, –, *, #, /, %, degrees (super o), or space, Numbers ‘0’ through ‘9’, This tag will appear in top display in Displays menu
DIFF GAP	xxxx	0 to span value Deviation between set-point and process when output relay is off (in on/off control only).
HEAT	xxx.x	0.1 to 3000.0
COOL	xxx.x	0.1 to 3000.0
GAIN	xxx.x	0.1 to 3000.0

Table 12. Tune Menu

Step	Step Description	Top Display
7	**Reset Enable.** *UP* selects YES or *DN* selects NO. *SCRL* to advance to: Step 7.1 from YES if output type is HEAT/COOL, or Step 7.3 from YES if output type is any other, or Step 7.4 from NO.	RESET
7.1	**Reset Value Heat.** *UP* or *DN* sets value. *SCRL* to advance to Step 7.2.	RESET
7.2	**Reset Value Cool.** *UP* or *DN* sets value. *SCRL* to advance to Step 8.	RESET
7.3	**Reset Value.** *UP* or *DN* sets value. *SCRL* to advance to Step 8.	
7.4	**Fixed Manual Reset.** *UP* selects YES or *DN* selects NO. *SCRL* to advance to: Step 7.4.1 from YES, or Step 8 from NO.	FIXED
7.4.1	**Manual Reset Value.** *UP* or *DN* sets value. *SCRL* to advance to Step 8.	MANUAL
8	**Preact Value.** *UP* or *DN* sets value. *SCRL* to advance to: Step 11 if A/M ratio bias is enabled and type is RATIO ONLY or RATIO AND BIAS, or Step 12 if A/M ratio bias is enabled and type is BIAS ONLY, or Step 9 if A/M ratio bias is not enabled and input 2 is enabled, or	

Table 12. Tune Menu

Middle Display	Bottom Display	Entry Description
ENABLE	YES NO	= Enable integral response = Don't enable integral response
HEAT	xxx.xx	0.01 to 120.00 repeats/minute
COOL	xxx.xx	0.01 to 120.00 repeats/minute
RESET	xxx.xx	0.01 to 120.00 repeats/minute
MAN RSET	NO YES	= Must calculate manual reset value when switching from manual to auto: MR = Output – (Gain x Error) = Fixes manual reset at value in Step 7.4.1
RESET	xxx.x	0.0 to 100.0% Note: Manual reset can be turned off by setting this value to 0.
PREACT		0.0 to 3000.0 seconds Derivative response

Table 12. Tune Menu

Step	Step Description	Top Display
8 (cont'd)	**Preact Value.** Step 13 if A/M ratio bias is not enabled and output type is POS PROP, or Step 15 if A/M ratio bias is not enabled and output type is TIM PROP or ON/OFF, or Step 16 if A/M ratio bias is not enabled and output type is HEAT/COOL, or Step 1 otherwise.	
9	**Remote Set-Point Ratio.** (requires option board) *UP* or *DN* sets value. *SCRL* to advance to Step 10.	REM SETP
10	**Remote Set-Point Bias.** (requires option board) *UP* or *DN* sets value. *SCRL* to advance to: Step 13 if output type is POS PROP, or Step 15 if output type is TIM PROP or ON/OFF, or Step 16 if output type is HEAT/COOL, or Step 1 otherwise.	REM SETP
11	**Auto/Manual Ratio Bias, Ratio.** *UP* or *DN* sets value. *SCRL* to advance to: Step 12 if type is BIAS or RATIO AND BIAS, or Step 13 if output type is POS PROP, or Step 15 if output type is TIM PROP or ON/OFF, or Step 16 if output type is HEAT/COOL, or Step 1 otherwise.	A/M R-B
12	**Auto/Manual Ratio Bias, Bias.** *UP* or *DN* sets value. *SCRL* to advance to: Step 13 if output type is POS PROP, or Step 15 if output type is TIM PROP or ON/OFF, or Step 16 if output type is HEAT/COOL, or Step 1 otherwise.	A/M R-B

Table 12. Tune Menu

Middle Display	Bottom Display	Entry Description
RATIO	xxx.xx	-300.00 to 300.00 Ratio value applied to remote set-point. If ratio function is not required, set value to 1.
BIAS	xxxx	–3000 to 30000 (decimal point per Inputs) Bias value added to or subtracted from remote set-point. If bias function is not required, set value to 0.
RATIO	xx.xx	0.01 to 300.00 Initial value of local ratio applied to process input. During operation, this local value can be changed from the operator's display. If ratio source is remote, this display provides the ratio value.
BIAS	xxxxx	–30000 to 30000 (decimal point per Inputs) Initial value of local bias applied to process input. During operation, this local value can be changed from the operator's display. If bias source is remote, this display provides the bias value.

Table 12. Tune Menu

Step	Step Description	Top Display
13	**Position Proportioning Deadband.** *UP* or *DN* sets value. *SCRL* to advance to Step 14.	POS PROP
14	**Position Proportioning Preact.** *UP* or *DN* sets value. *SCRL* to return to Step 1.	POS PROP
15	**Time Proportioning Cycle Time.** *UP* or *DN* sets value. *SCRL* to return to Step 1.	CYCLE
16	**Heat/Cool Output Crossover.** *UP* or *DN* sets value. *SCRL* to advance to Step 17.	CROSSOVR
17	**Crossover Transition Band Width.** *UP* or *DN* sets value. *SCRL* to advance to Step 18.	CROSSOVR
18	**Crossover Output Off Hysteresis.** *UP* or *DN* sets value. *SCRL* to advance to: Step 19 if output type is HC/RR, or Step 20 output type is HC/CR, or Step 1 otherwise.	OUTPUT
19	**Heat Cycle Time.** *UP* or *DN* sets value. *SCRL* to advance to Step 20.	HEAT
20	**Cool Cycle Time.** *UP* or *DN* sets value. *SCRL* to return to Step 1.	COOL

Table 12. Tune Menu

Middle Display	Bottom Display	Entry Description
DEADBAND	xx.x	0.0 to 50.0% Percent difference in calculated output and valve position (input 2) required to actuate open relay on increasing output or closed relay on decreasing output.
PREACT	xx.x	0.0 to 50.0% This is the percent overshoot that would occur is preact were set to zero. See the **Position Proportioning Control** section for information on determining values for position proportioning deadband and preact.
TIME	xxx.x	1.0 to 300.0 seconds Period of oscillation of output relay. Applies to time proportioning control and manual operation of on/off control.
VALUE	xx.x	0.1 to 300.0% Calculated controller output value at which change from cooling to heating or heating to cooling occurs.
BNDWIDTH	xx.x	0 to crossover value, in % output Determines the rate of change from heat to cool proportional bands when a crossover occurs.
HYST	xx.x	0 to 25.0, in % output centered on crossover value (±25.0) Determines calculated controller output values at which both heat and cool outputs are off.
CYC TIME	xxx.x	1.0 to 300.0 seconds Period of oscillation of output relay.
CYC TIME	xxx.x	1.0 to 300.0 seconds Period of oscillation of output relay.

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BASIC OPERATION

INTRODUCTION

Operator activities related to ongoing operations are performed in the DISPLAYS MENU. Some operator activities may also be associated with tuning (TUNE MENU), alarm settings (ALARMS MENU), and set-point manipulation (SETPTS MENU) especially during startup. Other activities in menus labeled RELAYS, MA OUTP, DIG INPT, INPUTS, and BASE CFG are for various setup, configuring, and calibration procedures. Operator access into menus other than the DISPLAY MENU may be restricted by configure and tune passwords. If required, a correct code entry (up to five digits) must be made to gain access into these menus.

Operator activities available in the DISPLAYS MENU include:

- Monitoring process variable input and set-point
- Monitoring controller output to the control device
- Monitoring alarm status
- Acknowledging alarms
- Monitoring totalization values, suspending totalizer, resetting totalization values
- Changing any one of the four local set-point variables if enabled
- Changing mode between manual and automatic
- Changing output value while in manual mode
- Changing set-point source between any one of four local set-point sources (if enabled) and remote set-point (if enabled)
- Changing ratio and/or bias when A/M Ratio Bias Station is enabled
- Activating the automatic tuning (if enabled)
- Activating ramp/soak profile, and monitoring ramp/soak segment number, time remaining in segment, and cycle number
- Resetting ramp/soak profile, and skipping ramp/soak segment
- Monitoring computer activity when controller has RS-485 Communications Option (**Refer to MODBUS Communications Supplement, IB-23C650M)**

FRONT PANEL

The front panel has three 8-character engineering displays, three 3-character status displays, and three 50-segment bar graphs. Figure 15 shows the instrument front panel.

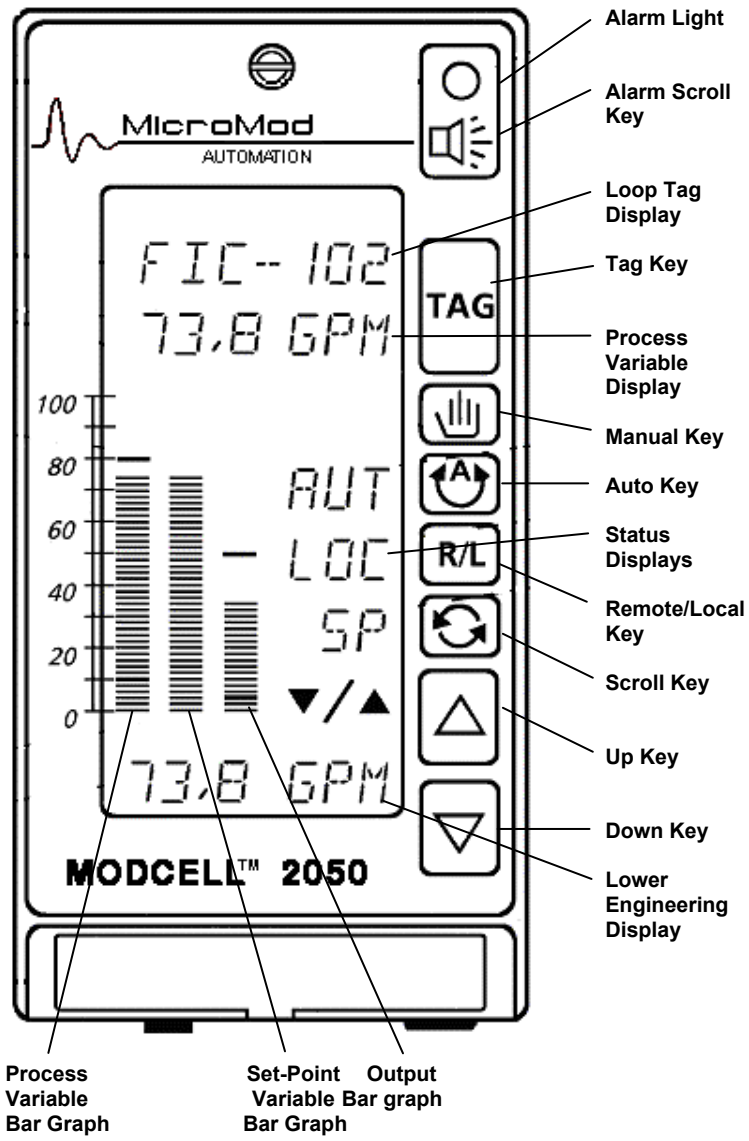
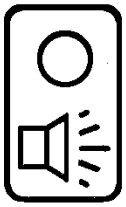


Figure 15. Instrument Front Panel

CONTROL KEYS

The operator control keys are:



Alarm: Press to stop flashing and beeping alarm indication. Press repeatedly to view list of existing conditions (unacknowledged diagnostics, priority 1 then 2, then acknowledged alarms). Bottom display indicates ACKED or UNACKED alarms. Use UP key to acknowledge. All other keys are inactive until you return to the normal display.



Tag: Press to advance from the top of any menu to the top of the DISPLAYS MENU.



Manual: Press to place the controller into manual operation from automatic. Pressing this key while the controller is executing Autotune will remove the controller from the Autotune routine. [MAN] is displayed in the auto/manual status display.



Auto: Press to change the operating mode from manual to automatic control. [AUT] is displayed in the auto/manual status display.



Remote/ Local: Press to select either a remote set-point or set-points 1 through 4. [REM], [LOC], [LO2], [LO3] or [LO4] will be displayed in the remote/local status display.



Scroll (*SCRL*): When in the instrument configuration mode, press to advance through the steps of the currently active menu. If in the operations mode, press to advance through enabled features of the DISPLAYS MENU.



Up (*UP*): Used in the configuration mode to answer prompts by toggling between YES and NO or other option, and to increment values where applicable. Also used in the DISPLAYS MENU to ramp up the set-point or output variable, whichever was selected or to acknowledge alarms.



Down (*DN*): Used in the configuration mode to answer prompts by toggling between YES and NO or other options, and to decrement values where applicable. Also used in the DISPLAYS MENU to ramp down the set-point or output variable, whichever was selected.

ENGINEERING DISPLAYS

The top, middle and bottom engineering displays are composed of eight characters, each character having fourteen segments. Each character can produce the characters listed in the Tag Name field of the Tune Menu.



Top: **Tag Display**
Indicates the loop tag and is configured in the TUNE MENU.
Example: [LIC-1202].



Middle: **Process Variable Display**
Indicates the process value in engineering units and may also include the engineering units label.
Example: [102 H2O]. As the engineering value consumes digits towards the right the engineering units label will push to the right and disappear.



Bottom: **Lower Engineering Display**
Indicates engineering unit values for output,set-point, ratio and bias as indicated by the third status display. An engineering units label can also be displayed. Assumes other roles during routines such as ramp/soak, totalizer, alarms, etc.

STATUS DISPLAYS

There are three 3-character status displays located to the right of the bar graphs.

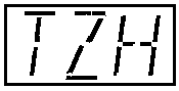
TOP DISPLAY



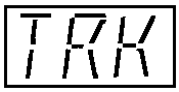
Manual: Instrument is in manual control and the output may be adjusted manually.



Auto: Instrument is in automatic, so its output is controlled by the controller algorithm.



Totalize Hold: Totalizer has been enabled and is in the hold position. This display alternately flashes with [MAN] if controller is manual or [AUT] if controller is in automatic.



Output Track: Output tracking has been enabled by digital input. The controller output is tracking Input 2. See Operation Using Digital Inputs.

BASIC OPERATION

MIDDLE DISPLAY



Remote: Set-point is derived from a remote location and is brought into the instrument through the remote set-point input on the option card.



Local: Set-point is derived at the instrument and may be fixed in the SETPTS MENU or adjusted in the DISPLAYS MENU.



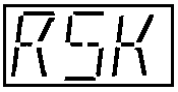
Local 2: Local set-point number 2 is derived at the instrument and may be fixed in the SETPTS MENU or adjusted in the DISPLAYS MENU.



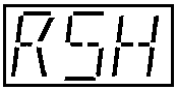
Local 3: Local set-point number 3 is derived at the instrument and may be fixed in the SETPTS MENU or adjusted in the DISPLAYS MENU.



Local 4: Local set-point number 4 is derived at the instrument and may be fixed in the SETPTS MENU or adjusted in the DISPLAYS MENU.



Ramp/ Soak: Ramp/soak profile has been enabled in the BASE CFG MENU and is active. See operation of Ramp/Soak.

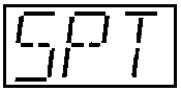


Ramp/ Soak Hold: Ramp/soak profile has been enabled in the BASE CFG MENU and is in the hold state. [RSH] intermittently flashes with [LOC]. See operation of Ramp/Soak.

BOTTOM DISPLAY



Output: Controller output in percent is being shown in the lower engineering display.



Set-Point: The controller's active set-point value is being shown in the lower engineering display.



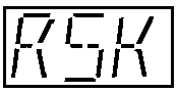
Balance: An imbalance exists between the active set-point and the newly selected set-point. See Automatic Operation with Remote or Multiple Set-Points.



Totalize: The totalized count is being displayed in the lower engineering display. See operation of Totalizer.



Autotune: Autotune has been enabled in the BASE CNFG MENU. At this display's menu prompt, pressing the *UP* key will initiate the Autotune routine.



Ramp/ Soak: Ramp/soak has been enabled in the BASE CFG MENU. Pressing the *UP* key provides ramp/soak status such as run/hold, time left per segment, active segment, cycle, reset and skip. See operation of Ramp/Soak.



Ratio: Ratio or ratio/bias has been enabled in the BASE CFG MENU, and the ratio value is being displayed in the lower engineering display.

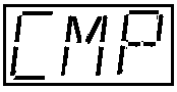


Bias: Bias or ratio/bias has been enabled in the BASE CFG MENU, and the bias value is being displayed in the lower engineering display.



Deviation: Deviation has been selected as the Right Bar Displayed Variable in the INPUTS MENU, and the deviation value is being displayed in the lower engineering display.

BOTTOM, TOP or MIDDLE DISPLAY



Bottom

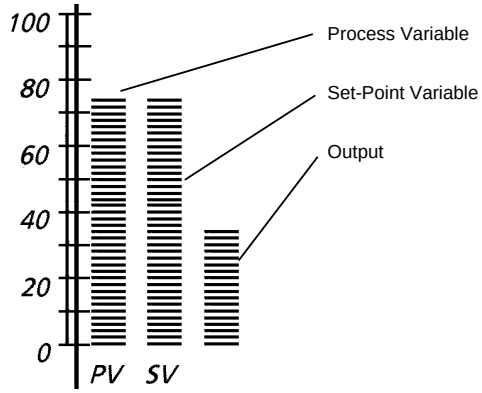


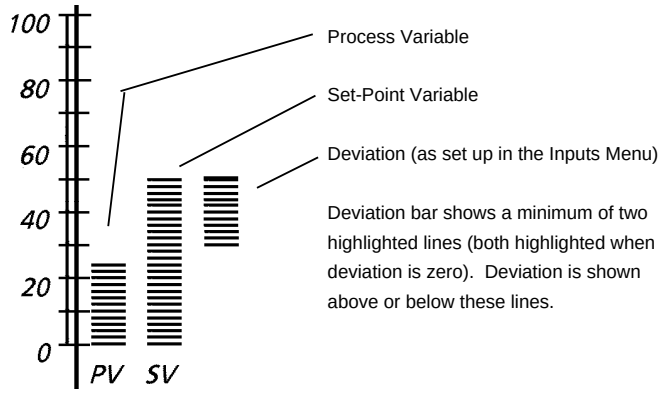
Top & Middle

Computer: Display appears in bottom location when RS-485 is enabled in BASE CFG MENU. Pressing *UP* toggles computer status between LOCKED and ENABLED. Display can also appear in top location (indicating computer control status), and middle location (indicating computer setpoint status) when computer is active the mnemonic in each location is configurable; CMP is default.

BAR GRAPHS

Three 50-segment bar graphs provide visual indication of process, set-point and either output or deviation.





ALARM INDICATOR

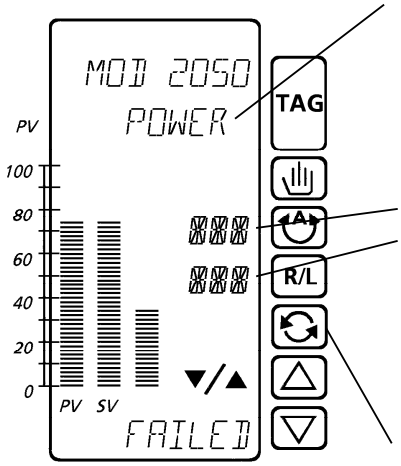


The alarm indicator is located in the upper right hand corner of the instrument front face. This LED indicator may be continuously on or flashing, depending on alarm activity.

RESTART

Power up mode, set-point and output conditions can be defined so that at an instrument power up condition the controller will assume these positions and values. Power up data is stored in non-volatile memory and is read into the operating memory at instrument power up. Controller mode at power up is defined in the BASE CFG MENU and may be set at auto, manual, or last, where last causes the controller to power up in the same mode as it was when power was lost. Set-point source at power up is defined in the SETPTS MENU and may be LOC, LO2, LO3, LO4, REM or fixed. The controller output at power up is defined in the MA. OUTP MENU and may be last or fixed.

At power up, the instrument goes immediately to the DISPLAYS MENU, and indicates a power failure.



If “hold power up” message located in the BASE CFG menu has been disabled, this message will only appear briefly. Otherwise, press *SCRL* to clear the message. If diagnostic messages are present, they will show next. See diagnostics section.

AUT, MAN
LOC, REM, LO2-LO4
Status displays will appear, as configured prior to the last power down, or defined for power up. Press the auto key to change mode to auto, or the manual key to change mode to manual.

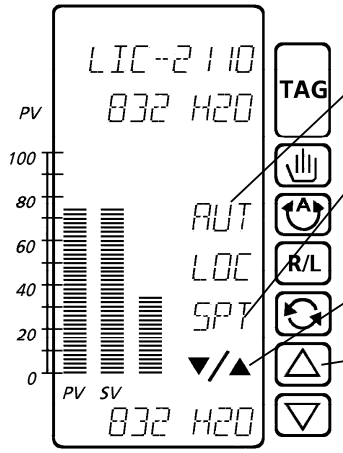
Press the scroll key to display the process and set-point variables. Press again to see prompts for ramp/soak and totalizer, if enabled.

OPERATION IN AUTOMATIC MODE

This section describes operations for local set-points, remote or multiple set-points, and A/M ratio bias while the controller is in the automatic mode. For automatic ramp/soak and totalizer operations, refer to those operations sections.

Note: If tune or configure passwords have been employed, the passwords will be required to change any values.

Automatic Operation with Local Set-Point

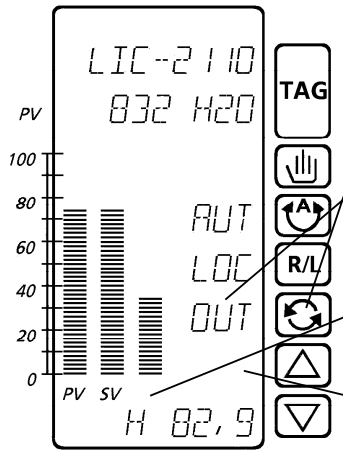


[AUT] indicates that the controller is in automatic mode.

Bottom status display indicates lower engineering display is showing the current set-point and its engineering units label.

DN/*UP* display indicates that set-point value can be changed in automatic.

Press *DN* or *UP* to change set-point variable



Press the scroll key to display the output in percent in the lower engineering display.

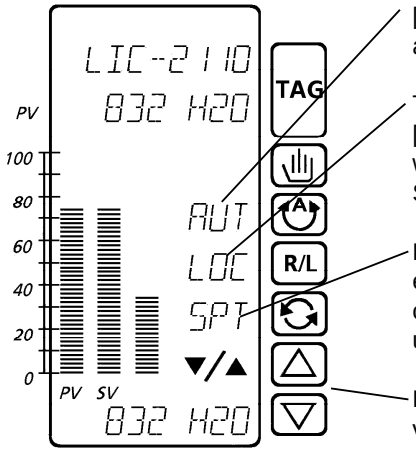
[OUT] appears in the third status display indicating that lower engineering display is showing the current output value.

H or C indicates Heat or Cool if controller was configured for heat/cool operation.

DNUP status indicator disappears, since output cannot be changed in automatic.

Automatic Operation with Remote or Multiple Set-Points

The controller may be in either auto or manual as selected in the power up mode section of the BASE CFG MENU. If the controller is in automatic, the front face will resemble the example below.
Note: Remote set-point requires the option board be installed.

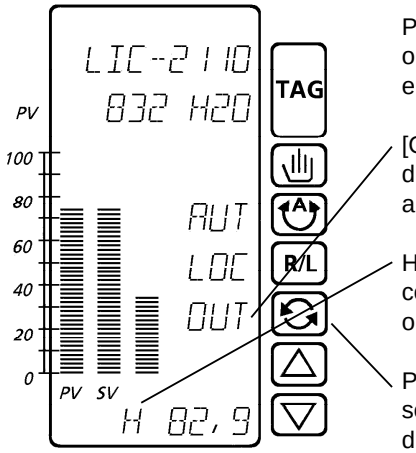


[AUT] indicates that the controller is in automatic.

The set-point may be [LOC], [LO2], [LO3], [LO4] or [REM], depending on which set-points were enabled in the SETPTS MENU.

Bottom status display indicates lower engineering display is showing the current set-point and its engineering units label.

Press *DN* or *UP* to change set-point variable .



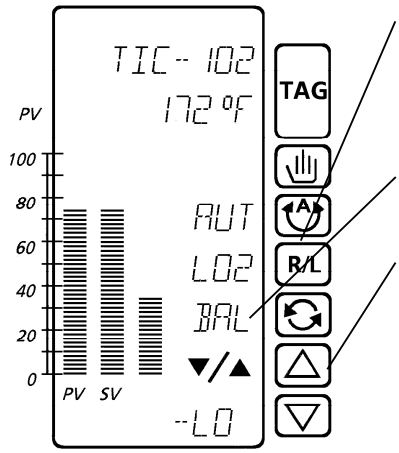
Press the scroll key to display the output in percent in the lower engineering display.

[OUT] appears in the third status display (output cannot be changed in automatic).

H or C indicates Heat or Cool if controller was configured for heat/cool operation.

Press the scroll key again to return the set-point in the lower engineering display.

To perform a set-point bumpless transfer, complete the following steps:



1) With set-point displayed, press the R/L key to advance the controller through the menu-enabled set-points.

[BAL] appears in the third status display.

2) Press the *UP* or *DN* key until the lower engineering display reaches “0.“

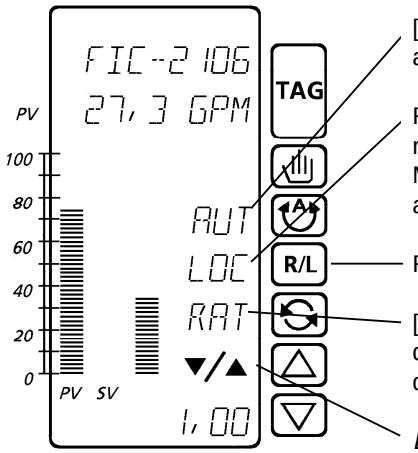
This adjusts the active set-point to the value of the new set-point, in this case the value of LO2.

3) Press the scroll key to enable the new set-point.

Note: If the set-point is fixed (“fixed” was selected in the individual SETPTS MENU), bumpless transfer cannot be achieved and the *DN*/*UP* display will not appear. But the new set-point can be enabled by pressing the scroll key.

Automatic Operation with A/M Ratio Bias

If ratio, bias or ratio/bias was enabled in the RAT BIAS MENU, the instrument display will resemble the examples below.



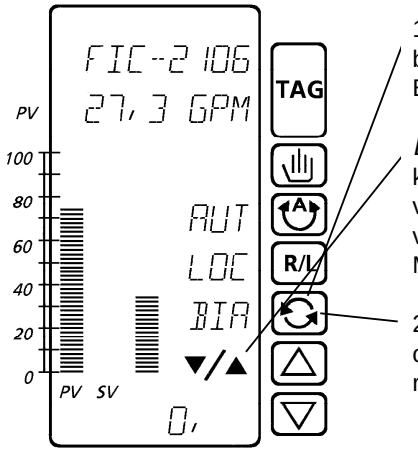
[AUT] indicates that the station is in automatic mode.

Ratio and/or bias source is local or remote as selected in RAT BIAS MENU (remote requires installation of an option board).

Remote/Local switch is disabled

[RAT] indicates that the ratio value is displayed in the lower engineering display.

DN/*UP* indicates that the *UP* and *DN* keys can be used to change the ratio value in automatic. The initial ratio value is configured in the TUNE MENU.



1) Press the scroll key to advance to bias, if bias was enabled in the RAT BIAS MENU.

DN/*UP* indicates that the *UP* and *DN* keys can be used to change the bias value in automatic. The initial bias value is configured in the TUNE MENU.

2) Press scroll key again to display output in percent, then press again to return to ratio.

AUTO/MANUAL TRANSFER

Transfer from auto to manual is accomplished by pressing the manual key. Either of the digital inputs may be used to select manual if configured to do so. When the controller is in manual mode the upper status display will show [MAN].

Transfer from manual to automatic is made by pressing the auto key. Either of the two digital inputs may be used to select auto if configured to do so. When in automatic, the upper status display will show [AUT].

Auto/Manual Transfer with Local Set-Point

When the controller is operating on local set-point, transfers from automatic to manual and from manual to automatic are always bumpless. After switching from local manual to local automatic, the process variable will be under automatic control in response to the adjustment of local set-point in the controller.

Auto/Manual Transfer with Local Set-Point Tracking

If the controller has been configured for local set-point tracking, the local set-point tracks the process value when the controller is in manual, and the process is always at the local set-point when a transfer to automatic is made, regardless of set-point limits. If a set-point was enabled as “fixed” in the SETPTS MENU, set-point tracking will not apply to that set-point.

Auto/Manual Transfer without Local Set-Point Tracking

If the controller does not have local set-point tracking, the local set-point and process may not be at the same value at the time of transfer from manual to automatic. The transfer will be bumpless, but the response following the transfer depends on the controller setup. If the controller has integral response, the process will ramp toward the local set-point at the reset rate. If the controller does not have integral response, the local set-point/process deviation at the time of transfer will be maintained. This deviation can be eliminated by using a fixed manual reset value or a calculated manual reset value, by returning to manual, adjusting output to eliminate the deviation, then switching bumplessly back to automatic with local set-point.

Auto/Manual Transfer for On-Off Control

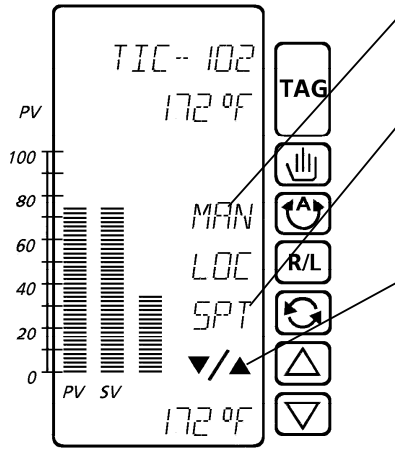
If the controller is set up for on-off control, the bumpless transfer feature does not apply when switching from automatic to manual. When switched to manual, the on-off controller output is always initialized at 0%. The transfer is bumpless only if the automatic output happens to be at 0% when switched. Operation in manual is the same as for a time proportioning controller. When switching from manual back to automatic, operation is the same as for all other types of control.

OPERATION IN MANUAL

This section describes operations for local set-points, remote or multiple set-points, and A/M ratio bias while the controller is in the manual mode. For manual ramp/soak and totalizer operations, refer to those operations sections.

Manual Operation with Local Set-Points

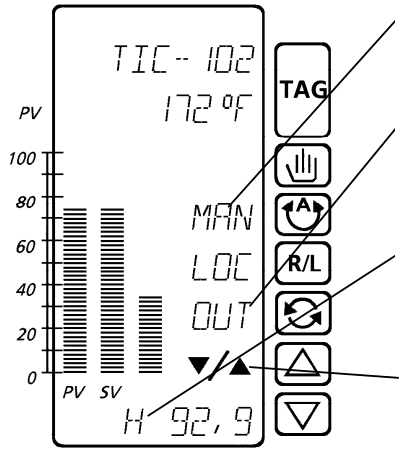
The instrument is initially in manual mode with set-point displayed in the lower engineering display, as indicated by [SPT] in the third status display.



[MAN] indicates that the controller is in manual mode.

Bottom status display indicates lower engineering display is showing the current set-point and its engineering units label.

DN/*UP* status display indicates the *UP* and *DN* keys are active and can be used to adjust the set-point value.



1) Press the scroll key to display the output in percent in the lower engineering display.

[OUT] appears in the third status display.

H or C indicates Heat or Cool if controller was configured for heat/cool operation.

DN/*UP* status display indicates the *UP* and *DN* keys are active and can be used to adjust the output value in manual.

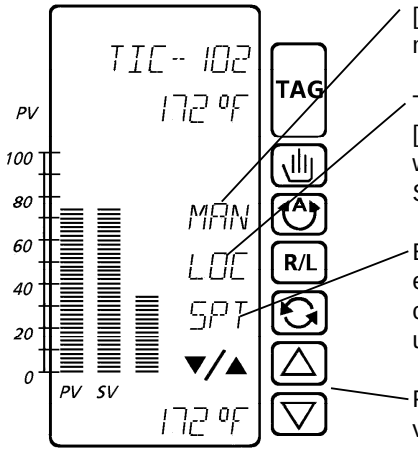
When the controller is set up for on/off control, the manual output is a time proportioning signal. This gives the output infinite adjustability between 0 and 100% rather than limited to the two-state 0 and 100% values of the automatic mode. In manual the output can be adjusted to any value needed to maintain the process at the set-point.

When the controller is set up for manual reset, manual reset values entered while in auto or manual take effect when the controller is switched from manual to auto.

Manual Operation with Remote or Multiple Set-Points

When the controller is in manual mode with remote or multiple set-points enabled in the SETPTS MENU, the front face will resemble the examples below:

Note: Remote set-point requires the option board be installed.

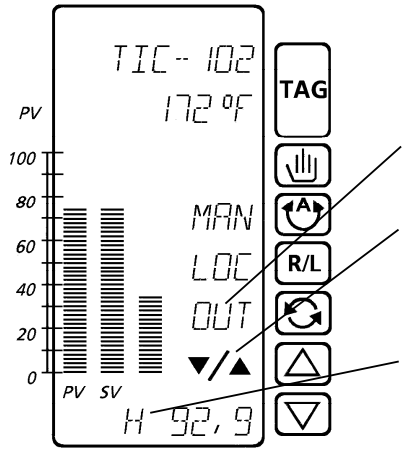


[MAN] indicates that the controller is in manual mode.

The set-point may be [LOC], [LO2], [LO3], [LO4] or [REM], depending on which set-points were enabled in the SETPTS MENU.

Bottom status display indicates lower engineering display is showing the current set-point and its engineering units label.

Press *DN* or *UP* to change set-point variable.

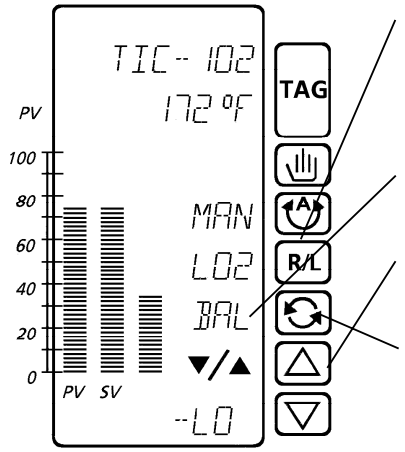


Press the scroll key to display the output in percent in the lower engineering display.

[OUT] appears in the third status display.

DN/*UP* status display indicates the *UP* and *DN* keys are active and can be used to adjust the output value in manual.

Press the scroll key again to return the set-point in the lower engineering display.



Remote or multiple set-point transfer is made by pressing the R/L key (press and release)

[BAL] appears in the third status display.

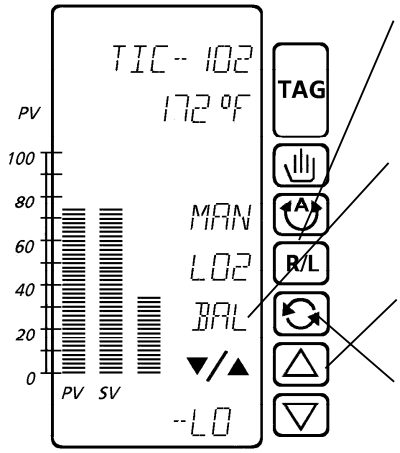
For a bumpless set-point transfer, press the *UP* or *DN* key until the lower engineering display reaches “0.“

Press scroll to enact the new set-point.

The active set-point may be changed using the up or down key.

If the active set-point was enabled as “fixed” in the SETPTS MENU, it cannot be adjusted in the DISPLAYS MENU. Pressing scroll again will select the next enabled set-point followed by a balance display. Repeat the previous procedure to balance the set-point, pressing scroll to enact the new set-point.

Use the following steps to prepare to switch from a local to a remote set-point:



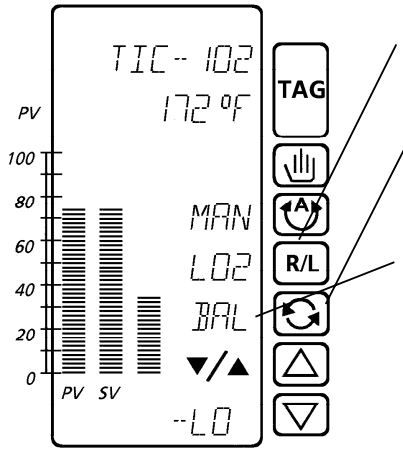
1) Press the R/L key until [REM] is displayed in the middle status display.

2) [BAL] appears in the third status display with the difference between the remote set-point and the current set-point displayed in the lower engineering display.

3) Press the *UP* or *DN* key until the lower engineering display reaches “0.“

4) Press scroll to enact the remote source as the new set-point source.

Use the following steps to switch from a remote set-point source to one of the four local set-points. The balance procedure is bypassed because the remote set-point can only be adjusted at the remote source (this will not be a bumpless set-point transfer).



1) Press the R/L key until the desired set-point source is displayed in the middle status display.

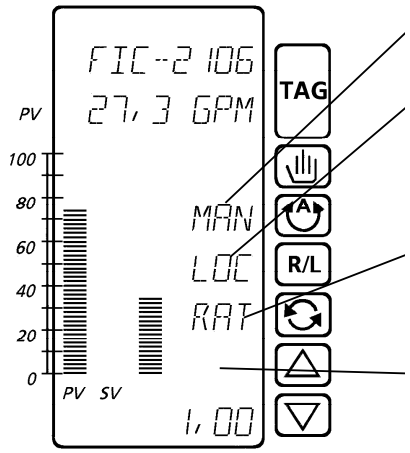
2) Press scroll to enact the new set-point. The middle status display indicates the set-point source (LOC, LO2, LO3, LO4) .

3) The third status display will indicate SPT with the current set-point value in the lower engineering display.

The controller is now operating on a local set-point.

Manual Operation with A/M Ratio Bias

If ratio, bias, or ratio/bias was enabled in the RAT BIAS MENU, the instrument display will resemble the examples below:

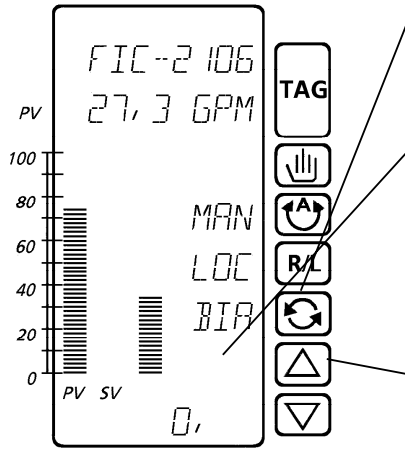


[MAN] indicates that the station is in manual mode.

Ratio and/or bias source is local or remote as selected in RAT BIAS MENU (remote requires installation of an option board).

[RAT] indicates that the ratio value is displayed in the lower engineering display.

DN/*UP* status indicator disappears, since ratio cannot be changed in manual. The initial ratio value is configured in the TUNE MENU.



1) Press the scroll key to advance to bias, if bias was enabled in the RAT BIAS MENU.

DN/*UP* status indicator disappears, since bias cannot be changed in manual. The initial bias value is configured in the TUNE MENU.

2) Press scroll key again to display output in percent.

3) Press *UP* to ramp output value up or *DN* to ramp output value down.

4) Press scroll key again to return to ratio.

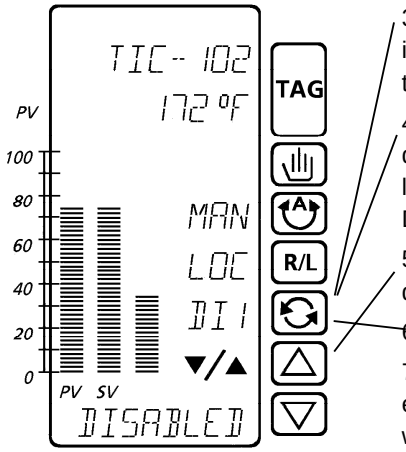
OPERATION USING DIGITAL INPUTS

Digital inputs 1 and 2 can be used to control auto/manual transfer, acknowledge alarms, start totalization or ramp/soak operations, and select between enabled local or remote set-points. This section discusses using digital inputs for auto/manual transfer and set-point selection. For information on totalization and rampsoak operations, refer to the Totalization Operation and Ramp/Soak Operation sections.

Enabling Digital Inputs

Digital inputs must be set up in the DIGITAL INPUTS MENU and then enabled in the DISPLAYS MENU to be used for any transfer or control operation. Use the following steps to enable digital inputs:

1. Go to the DISPLAYS MENU (enter password if requested).
2. Place the instrument in manual.



3) Press scroll. This allows the digital input enable prompt to be displayed in the DISPLAYS MENU.

4) Press scroll until the third status display reads [DI1] (or [DI2]) and the lower engineering display reads DISABLED.

5) Press the *UP* key to enable the digital input.

6) Press scroll.

7) If the second digital input was enabled in the DIG INPT MENU, it too will have to be enabled in the DISPLAYS MENU.

NOTE: Digital input functions, except alarm acknowledge, are disabled when a diagnostic alarm occurs.

Auto/Manual Transfer Using Digital Inputs

Either of the two digital inputs (but not both) can be used to select controller auto or manual mode. A transfer from auto to manual using a digital input can be configured to leave output at its current value or to set the output to a configured fixed value. The digital input can also be configured to switch only from auto to manual or to switch from either auto to manual or manual to auto.

If the digital input action is configured to be REVERSE, a closed contact will be treated as an open contact and vice versa.

Note: Unless “A/M key lockout” is enabled in the DIG INPT MENU, the controller mode can be changed at the front panel regardless of the digital input state, causing possible conflict.

To effect auto/manual transfer using digital inputs, complete the following steps:

1. In the DIG INPT MENU, enable “auto/man” as the digital input function of the digital input to be used for auto/manual transfer.
2. Select whether a fixed output value will be used when switching from auto to manual mode, whether the front panel is locked out from changing control mode, and whether the digital input can be used to switch only from auto to manual or from auto to manual and from manual to auto.
3. Enable the digital input in the DISPLAYS MENU.

   Once enabled, the digital input can be used for auto/manual transfer.

Local/Remote and Multiple Set-point Selection Using Digital Inputs

Either of the two digital inputs can be used to select between two set-points or between a local and a remote set-point. Both digital inputs can be used to select between four set-points or between three local set-points and a remote set-point. The set-points between which the digital input(s) will select must be enabled in the SETPTS MENU. Remote set-point requires the option board.

Set-point selection can be configured to lock out front panel selection of the active set-point and to allow selection between local and remote set-points or only between local set-points. To switch between local and remote, Input 2 must be enabled in the BASE CFG MENU. If the digital input action REVERSE, a closed contact is treated as an open contact and vice versa.

Note: Unless “R/L key lockout” is enabled in the DIG INPT MENU, the set-point can be changed at the front panel regardless of the digital input state, causing possible conflict.

To select the set-points using one digital input, complete the following steps:

1. In the DIG INPT MENU, enable “set-point select“ as the digital input function of the digital input to be used for set-point transfer.

2. Select whether to lock out the front panel from making set-point transfers, whether transitions are allowed between local and remote set-points, and the digital input action (DIRECT or REVERSE).
3. Choose which set-points to select between in the digital set-point selection list (e.g., LOC, LO2). Refer to Table 3 for information on the DIG INPT MENU.
4. Enable the digital input in the DISPLAYS MENU.

A transition in the digital input state (opened to closed, or closed to opened) will now cause a set-point transfer. For example, if a digital input is set up for set-point selection between LOC and LO2 (using DIRECT action), a state change of the digital input from closed to opened will cause a transfer to LO2, and a change from opened to closed will cause a set-point transfer to LOC. Similarly, if the digital input is set up for set-point selection between a local set-point and a remote set-point, changing the digital input state will cause a set-point transfer between local and remote.

Example of Digital Input Action vs Set-point Source for One Digital Input

Digital Input Action*		**Set-Point Source**	
DI-1 or DI-2		**(LOC, LO2) selected**	**(LO3, REM) selected**
DIRECT	**REVERSE**	**SPT Source**	**SPT Source**
closed	open	LOC	LO3
open	closed	LO2	REM

To select the set-point using both digital inputs, complete the following steps:

1. In the DIG INPT MENU, enable “set-point select“ as the digital input function for digital inputs.
2. Select whether or not to lock out the front panel from making set-point transfers, whether transitions are allowed between local and remote set-points, and the digital input action (DIRECT or REVERSE).
3. Choose which set-points to select between in the digital set-point selection list (e.g., L1, 3, 4, R). Refer to Table 3 for information on the DIG INPT MENU.
4. Enable the digital inputs in the DISPLAYS MENU.

A transition in the state of either digital input (opened to closed, or closed to opened) will now cause a set-point transfer. For example, if the digital inputs are set up for set-point selection between LOC, LO3, LO4, and REM (using DIRECT action, with Input 2 enabled and local/remote transfer allowed), a state change of the digital inputs to DI-1 closed and DI-2 opened will cause a transfer to LO4. The following table shows the results of digital input state transitions of two digital inputs used for set-point transfer between LOC, LO2, LO3, and LO4 and for transfers between LOC, LO3, LO4, and REM using DIRECT and REVERSE action.

Example of Digital Input Action vs Set-point Source for Two Digital Inputs

Digital Input Action*				**Set-Point Source**	
DI-2		**DI-1**		**(L1,L2,L3,L4) selected**	**(L1,3,4,R) selected**
DIR	**REV**	**DIR**	**REV**	**SPT Source**	**SPT Source**
closed	open	closed	open	LOC	LOC
closed	open	open	closed	LO2	LO3
open	closed	closed	open	LO3	LO4
open	closed	open	closed	LO4	REM

Output Tracking using Digital Input

When output tracking is enabled as a digital input function and the assigned digital input goes ON, then the controller goes to manual and the current proportioning output tracks input 2 (an electrical not temperature input). Auto and Manual keys are ignored, front panel adjustment is not allowed, autotune is not allowed and, if the computer activity timer is not in use, the mode annunciator (upper 3 character display) will indicate TRK. When the digital input goes OFF, the controller transfers bumplessly back to its original mode.

CONTROL OUTPUT LIMITING

High and low output limits are entered in MA. OUTP MENU. The output limiting function applies when the controller is operating in automatic, and also in manual if manual limiting is selected. If manual limiting is not selected, the manual output can be adjusted to its maximum or minimum value regardless of the limit settings.

ALARMS

Four display alarms and up to three alarm relays may be configured to respond to alarm conditions. The trip action on the relays may include any

combination of the four display alarms. Monitoring and acknowledging alarms are basic operator activities. Acknowledgment of alarms may or may not be required depending on the alarm set up in the ALARMS MENU. During power-up the alarm relay(s) remained powered down until an accurate process input reading was made. Relays selected as alarms will be in a fail-safe condition (powered when alarm is not active) until the alarm is active. See Figure 16 for display and relay operation under different alarm conditions.

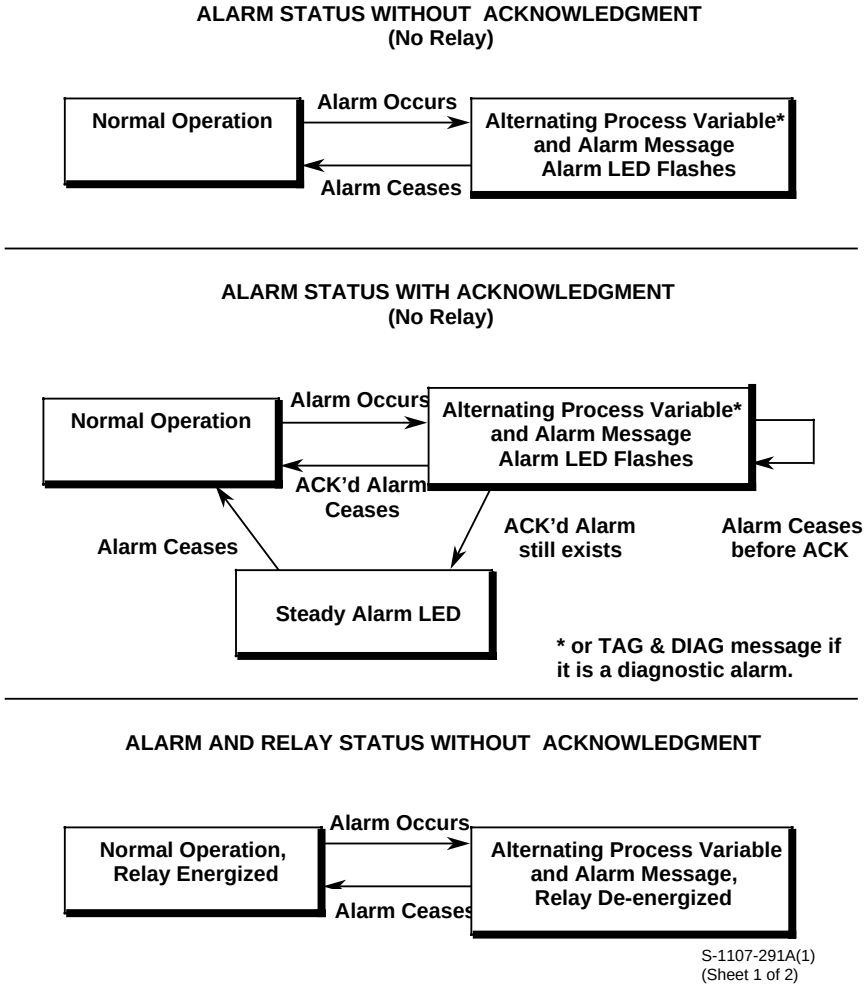


Figure 16a. Controller Alarm Display and Relay Status Conditions (Sheet 1)

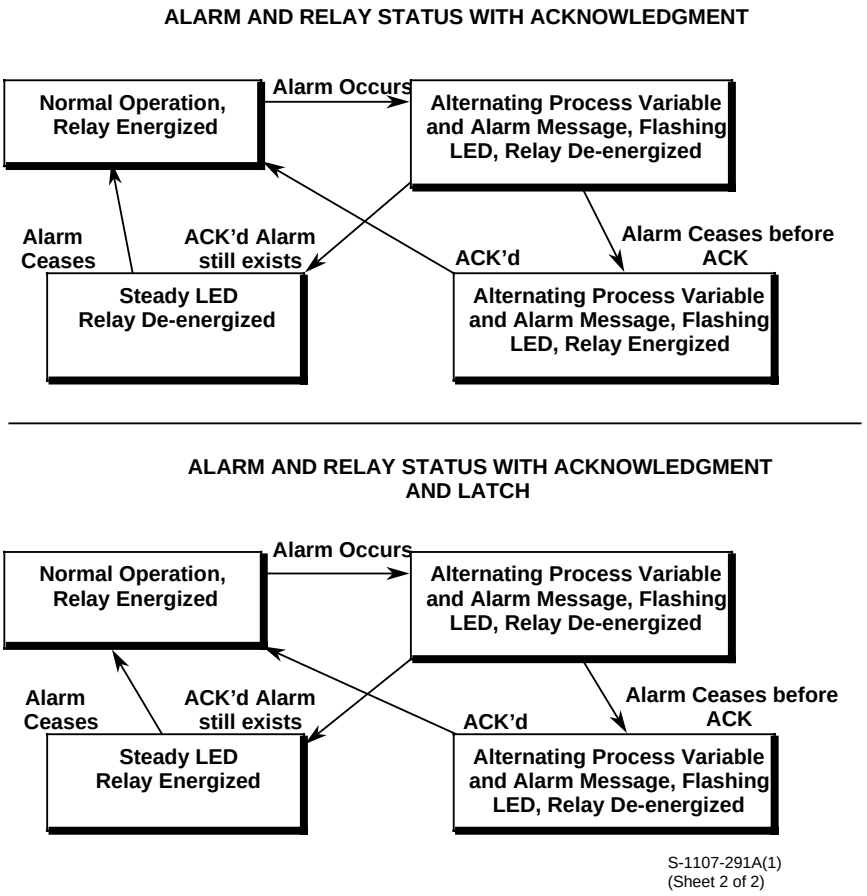


Figure 16b. Controller Alarm Display and Relay Status Conditions (Sheet 2)

Alarm Messages

An alarm is active when the process input (PROC), input 2 (INP2), control output (OUT), or deviation value (DEV) exceeds its alarm limit. When an alarm is active, the alarm indicator flashes and the front panel alarm message for the appropriate high (HI) or low (LO) turns on and flashes alternately with the process display. Any such configured alarm output relay is also active. The alarm remains on until the variable returns to a value within the preset limits; then it extinguishes. These alarm messages alternate with the alarmed variables value when the alarm is unacknowledged: [PROC HI], [PROC LO], [INP2 HI], [INP2 LO], [DEV HI], [DEV LO], [OUT HI], and [OUT LO].

Alarm Trip Points

The high and low alarm trip-points for the controller are determined at the time of setup; refer to Table 10 Alarms Setting Menu (ALARMS MENU). Process and deviation are triggered by the process input. A process alarm trips when the process reaches a preset high or low trip-point. A deviation alarm trips when the process value deviates from the controller set-point by a preset amount. An input 2 alarm trips when the input 2 value reaches a preset high or low trip-point. An output alarm is activated when the control output reaches a preset high or low trip-point. Alarms resulting from rising values are defined as high, and those resulting from falling values are defined as low.

Alarm Priority

One of two possible priorities (1 and 2) can be assigned to an alarm. Alarm priority can be used to display a more important alarm before a less important alarm. Priority one (1) is the higher priority and any alarm message of this priority will flash instead of any priority two (2) message.

Beep on Alarm Occurrence

The controller can be configured in the ALARMS MENU to beep on the occurrence of specific levels of alarms (priority 1, priority 2, or diagnostic). Whenever the specified level of alarm becomes active, the beeper will sound alerting the operator to the alarm.

Alarms with Acknowledgment

Alarm acknowledgement can be configured in the ALARMS MENU to be required for specific levels of alarms (priority 1, priority 2, or diagnostic). If an alarm for which acknowledgement is required has become active, the alarm indicator will flash and the alarm type (e.g. PROC HI) will alternately flash with the process value until the alarm has been acknowledged, even if the alarm condition has ceased to exist. If the alarm condition still exists after the time of alarm acknowledgment, just the alarm indicator will remain light (but not flashing) indicating that the alarm has been acknowledged but is still present.

When the alarm finally stops, the alarm indicator will go out. If there is an alarm at one limit that has not been acknowledged (e.g. HI), and then the process subsequently trips the alarm at another limit (LO, HI-HI, or LO-LO), only the highest priority unacknowledged alarm will flash. If the low alarm remains when the alarm is acknowledged, the high alarm will extinguish and the low alarm will assume a steady-on condition. Priorities are: diagnostics (1), priority 1 (2), priority 2 (3).

Acknowledgment of an alarm does not change the alarm output (relay state). The alarm output follows the alarm state; it turns on when the alarm is tripped and turns off when the alarm state ceases.

Alarms with Acknowledgment and Latch

The controller can be set up so the alarm output (relay) will remain on until the alarm has been acknowledged even though the alarm condition may have ceased to exist. The only way an alarm output can be turned off is to acknowledge the alarm condition. This feature is enabled in the ALARMS MENU and is called “P1 RELAY ACTION” or “P2 RELAY ACTION“ for priority level 1 or 2 alarm latching. “NO LATCH“ causes the alarm output to follow the alarm condition, i.e. the alarm output releases when the alarm ceases. “LATCHING” requires the alarm be acknowledged even if the alarm condition ceases to exist.

Alarm Acknowledgment Procedure

Alarms are acknowledged in the DISPLAYS MENU. To acknowledge an alarm, press the alarm key. The process display will indicate the alarm type (e.g. AL1 HOP) and the lower engineering display will show [UNACKED]. Press the up key to acknowledge the alarm. Note the lower engineering display shows [ACKED] to indicate the alarm has been acknowledged. Repeat this procedure for all active alarms, pressing the alarm key to scroll through the alarms. If the digital input has been enabled as a global alarm acknowledgment, a contact closure or voltage less than 1.5Vdc will acknowledge all alarms.

Alarm Type Messages

Alarm type messages that appear when scrolling through the list with the ALARM key are: AL1 HPR (process high), AL1 LPR (process low), AL1 HDV (deviation high) AL1 LDV (deviation low), AL1 HI2 (input 2 high), AL1 LI2 (input 2 low), AL1 HOP (output high), and AL1 LOP (output low). Process alarm 2, 3 and 4 are the same.

STARTUP

Procedures may vary from application to application, depending upon individual requirements and controller setup. The initial operating mode (usually manual), the set-point source (usually local), set-point value, and controller output can be configured for specified safe values when power to the controller is first applied. Each time a control application is first started up, check all these items before turn-on.

Startup Without Set-Point Tracking

To start up the controller in the manual mode:

1. Place controller in manual mode with local set-point.
2. Adjust controller (local) set-point to starting value required for process variable.
3. Adjust manual output of controller to a safe starting value for the process. This is usually below 0% or above 100% of span.
4. Open block valve ahead of control valve or perform any other procedure required to make the process variable available, such as starting a pump, turning on a power supply, etc.
5. Manually adjust output of controller to bring process variable up to set-point value. Ramping the output should be slow enough to allow the process to respond to the change without overshooting the set-point. Process is now operating under manual control with process at the set-point.

Startup With Set-Point Tracking

The startup procedure is simplified when set-point tracking is used. With the controller in the manual mode, the set-point tracks the process so that the process and set-point values are together when the operator switches to the automatic mode.

To start up the controller with set-point tracking:

1. Place controller in manual mode.
2. Adjust manual output of controller to a safe starting value for the process. This is usually below 0% or above 100% of span.
3. Open block valve ahead of control valve or perform any other procedure required to make the process variable available, such as starting a pump, turning on a power supply, etc.

4. Manually adjust output of controller to bring process variable up to final value. Ramping the output should be slow enough to allow the process to respond without overshooting the required control point.

An alternate procedure in Step 4 is to bring the process variable up part way, to see that the control application responds in a controllable manner, then switch to the automatic mode early in the startup and bring the process variable up to the operating point under automatic control by adjusting the set-point.

TUNING

MANUAL TUNING

The controller response parameters: Gain (P), Integral (I), and Derivative (D) are adjustable over a wide range of values to accommodate many different process characteristics. After the controller is installed in a specific control application, these response parameters must be tuned to the characteristics of the process so that overall system performance is at its best.

Optimum settings provide a compromise between the maximum deviation from set-point and the time away from set-point during recovery after a disturbance. Recovery after a disturbance should take approximately two and one-half cycles.

These settings are an approximation. Other factors may require more conservative or less conservative settings. For example, if there are frequent disturbances, the responses may be set for greater stability with less gain, so as to reduce the demand on the manipulated variable or minimize wear on the valve.

The settings on many controllers are made by someone who has previous experience with the same or a similar application, and the settings found to be successful are used as a starter. Readjustments are made only when necessary.

The procedures outlined here start with very stable settings and work toward less stability primarily because this is less disturbing to the process. Some processes can tolerate much disturbance. This is frequently true with flow control loops, which may be fast acting and quick to recover. It is not uncommon to start OFF with a cycling system, and adjust the gain for the smallest sustained cycle.

Tuning Procedure

The following procedure for tuning a controller is applicable to controllers set up for P (gain), PI (gain plus integral), PD (gain plus derivative), and PID (gain plus integral plus derivative) responses. If a recorder is available to record the process variable, it will be helpful in determining optimum controller settings.

1. Start up controller in manual mode as described in the Setup section.
2. When process and set-point are together, switch to automatic mode.
3. For PI, PD, and PID controllers, turn off integral and derivative responses as follows.
    a. Access the TUNE MENU using the tag and *UP* keys.
    b. In the TUNE MENU, scroll to [GAIN] and use the *UP* or *DN* key to set a value of 1.0.
    c. Scroll to [RESET ENABLE] and enter NO to turn off the integral response.
    d. Scroll to [PREACT] and set the value to “0” to turn off the derivative response.
    e. Return to the DISPLAYS MENU. This procedure has removed all but the gain response from the system.
4. Create a disturbance in the system by adjusting the set-point a small amount either up or down.

    The resulting disturbance must be large enough to observe, but not so large that it causes signal saturation at any point in the control loop. This means that the controller output should be within its working range of 0 to 100% at all times during the recovery, and the process variable change during recovery should be small enough to be considered linear about the set-point.
5. Hold the set-point at this value until the process variable begins to move, then return the set-point to its original value.
6. Compare the recorded oscillation with Figure 17. Cycle B should be approximately 1/4 of cycle A as shown in the figure. If it is not, change the gain setting and repeat Steps 4 and 5.

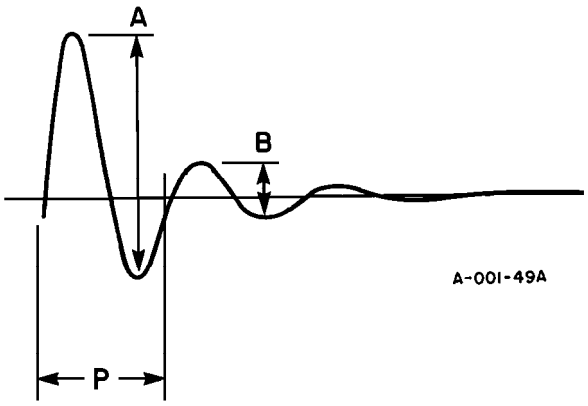


Figure 17. Process Recovery Cycle with Optimum Response Settings

Increasing the gain setting increases cycle B relative to cycle A. If the controller has gain response only, no further adjustment is required. If the controller has two or three responses, proceed to Step 7.

7. Measure the period (P) of oscillation in minutes. The period is the time required for one complete cycle.

8. Calculate I (integral) and D (derivative) values as follows:

   a. Controller with P and I responses:

$$I = P\ (Minutes)$$

b. Controller with P and D responses:

$$D = \frac{P\ (Minutes)}{8}$$

c. Controller with P, I, and D responses:

$$I = \frac{1.5}{P\ (Minutes)}$$

$$D = \frac{P\ (Minutes)}{6}$$

9. Access TUNE MENU and adjust settings to values determined in Step 8.
10. Repeat Steps 4, 5, and 6 to obtain optimum gain setting.

AUTOMATIC TUNING

Automatic tuning (autotune) is an on-demand user activated feature which automatically calculates either PI or PID response values based on process reaction during an autotune cycle. This is accomplished by manipulating the controller output to effect a periodic response by the intended process. The autotune cycle requires 6 process oscillations to determine the tuning parameters. The controller output and a typical process response are as shown in Figure 18. After successful completion of the autotune cycle, calculated response values are entered into the control algorithm calculations and the controller is operational in the automatic mode with the new values. The parameter values may be observed and/or changed in the TUNE MENU. Automatic tuning is not applicable to dual output (heat/cool) or on-off control.

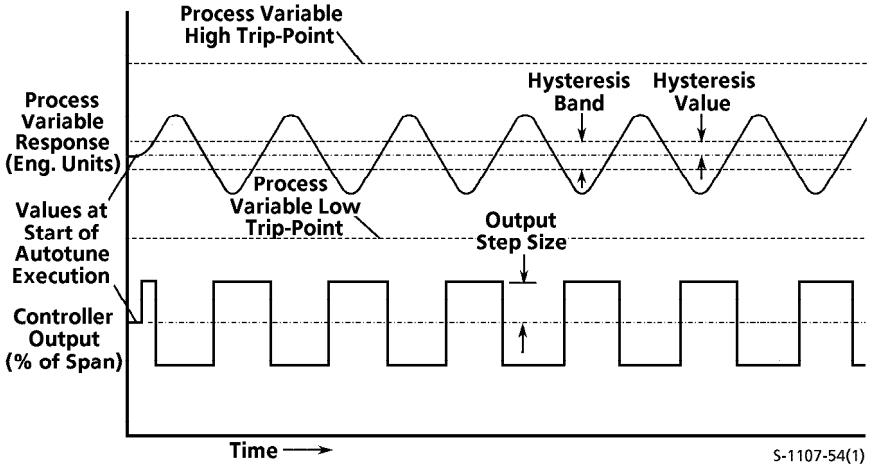


Figure 18. Typical Process Variable and Controller Output Response During Autotune Execution

Setup Procedure

In order to use the autotune feature, it must be enabled in the BASE CFG MENU. The procedure in Table 13 explains various rules and guidelines which apply to the autotune setup. Autotune setup also requires user input to define certain operating parameters and constraints. Table 13 provides a detailed description of each of the five setup parameters.

Table 13. Autotune Procedure

Step	Step Description	Top Display
1	**Displays Menu.** *UP* moves to TUNE **MENU**. *DN* moves to BASE CFG **MENU**. *SCRL* to obtain process/set-point display, Step 2.	DISPLAYS
2	**Process/Set-Point Display.** *UP* increases set-point value. *DN* decreases set-point value. *SCRL* to obtain process/output display Step 3.	*TAG NAME*
3	**Adjust Starting Output (manual only).** *UP* or *DN* to adjust output to a safe starting value for the process. *SCRL* to obtain process/autotune display Step 4.	*TAG NAME*

Table 13. Autotune Procedure

Middle Display	Bottom Display	Entry Description
MENU		**Installation and Setup Check.** Installation, and Setup must be completed before executing auto tune. Note the following: • Output limits are applied during autotune execution. • Digital input must be set at [none] or not enabled to use autotune. • Correct control action is essential for successful autotune execution. **Control Action Check.** Check that control action (direct or reverse) is properly defined for the application. **Operating Mode.** If automatic mode is selected, advance to auto tune activation. The output and process values must be as stable as possible before activating.
xxx *Process Value*	xx *Set-Point Value*	None
xxx *Process Value*	xx *Output Value*	Ramping the output should be slow enough to allow process response to the change without overshooting the set-point. **Make Process Available.** If necessary open block valve ahead of control valve or perform any other procedure required to make the process available, such as starting a pump, turning on a power supply, etc. **Set Final Output Value.** With control in manual, use UP, DN to adjust output to bring process value to the normal operating set-point. The closer the process is to the set-point, the more effective the autotune cycle will be.

Table 13. Autotune Procedure

Step	Step Description	Top Display
4	**Autotune Activation.** *UP* enters autotune setup. *SCRL* to return to Step 2.	*TAG NAME*
5	**Output Step Size.** *UP* or *DN* adjusts output step size. *SCRL* to Step 6.	*TAG NAME*
6	**Hysteresis Value.** *UP* or *DN* adjusts hysteresis value. *SCRL* to Step 7.	*TAG NAME*

Table 13. Autotune Procedure

Middle Display	Bottom Display	Entry Description
xxx *Process Value*		ATN is displayed to indicate the Autotune point of entry.
STEP SIZ	10.1	Valid values are 0.1 to 50.0. The controller output will change by plus and minus the output step size from its initial starting value when autotune is executed (refer to Figure 18). This value should be large enough so that the amplitude of the process variable excursions is at least 4 times larger than the hysteresis parameter. This will allow the best possible response data. The output step size should also be small enough to avoid crossing either of the process variable trip-points.
HYST	2.0	Valid values are: 0.1 to 3000.0, or 0.01 to 300.00, or 0.001 to 30.000. The hysteresis value is used in determining when to change the controller output value (refer to Figure 18). When the process variable crosses the hysteresis band (plus and minus the [HYST] value), the controller output will change by plus and minus the [STEP SIZ] value from its initial starting value. The hysteresis value must be set so that it is larger than the noise in the process variable signal, allowing best possible response data. **CAUTION** *The value of the hysteresis parameter must be greater than the process noise value, including any contribution of time proportioning cycling to process signal noise. If hysteresis does not exceed noise, the autotune calculations may be inaccurate.*

Table 13. Autotune Procedure

Step	Step Description	Top Display
7	**Process High Trip-Point.** *UP* or *DN* adjusts process high trip-point value. *SCRL* to Step 8 or press and hold *SCRL* to return to STEP SIZ (Step 5).	*TAG NAME*
8	**Process Low Trip-Point.** *UP* or *DN* adjusts process low trip-point value. *SCRL* to Step 9 or press and hold *SCRL* to return to STEP SIZ (Step 5).	*TAG NAME*
9	**Parameter Tune Selection.** *UP* or *DN* selects PI or PID tuning. *SCRL* to start autotune execution Step 10. Note: Autotune cycle can be canceled by pressing the auto key.	*TAG NAME*
10	**Autotune Execution.** If autotune was successful but there is a caution message, go to Step 11. If autotune was successful and there is no message, return to Process/Set-Point display. If autotune was not successful, go to Step 12.	*TAG NAME*
11	**Autotune Caution.** *SCRL* to advance to: Step 11.1 for an increase step size message, or Step 11.2 for a response limited message.	*TAG NAME*

Table 13. Autotune Procedure

Middle Display	Bottom Display	Entry Description
PROC HI	100	Valid values are: -2997 or PROC LO+3 to 30000. Remember, the range shown is for the units decimal position. The process value must be between the high and low trip-point values when autotune is activated. If the process value exceeds one of these, the autotune cycle will shut itself off by going to the manual mode and returning the controller output to the value it was at when autotune was activated. These high and low values are desired trip-points for canceling autotune execution.
PROC LO	0.	Valid values are: –30000 to 29997 or PROC HI –3 .
TUNE	PID PI	= PID tuning = PI tuning
xxx *Process Value*	AUTOTUNE	Autotune execution proceeds automatically. No operator activity is required unless a failure or caution message appears. See **Autotune Completion** description.
AUTOTUNE	CAUTION	Autotune execution completed and new tuning constants are being used, but an INCREASE STEP SIZ, or a RESPONSE LIMITED message follows.

Table 13. Autotune Procedure

Step	Step Description	Top Display
11.1	**Increase Step.** *SCRL* to Step 11.2 for a response limited message. Otherwise returns to Process/Set-Point display.	*TAG NAME*
11.2	**Proportional Band or Reset High.** *SCRL* returns to Process/Set-Point display.	*TAG NAME*
12	**Autotune Failure.** *SCRL* to advance to: Step 12.1 for a process slow message, or Step 12.2 for a decrease step size message.	*TAG NAME*
12.1	**Process Slow.** *SCRL* to advance to: Step 12.2 for a decrease step size message. Otherwise return to Process/Set-Point display.	*TAG NAME*
12.2	**Decrease Step.** *SCRL* returns to Process/Set-Point display.	*TAG NAME*

Table 13. Autotune Procedure

Middle Display	Bottom Display	Entry Description
INCREASE	STEP SIZ	The ratio of process oscillation to hysteresis value is too small for best results. Check tuning constants. If desired, restart autotune with a larger output step size or a smaller hysteresis value. Hysteresis must be at least equal to, and preferably greater than, process noise.
RESPONSE	LIMITED	The controller is using the high limit for proportional band or reset. Check tuning constants. The controller is using the newly calculated constants. Because of process characteristics, restart is not likely to improve tuning constant calculations.
AUTOTUNE	FAILED	Autotune execution has been canceled, the controller is in manual, and the output is at the starting output value. A PROCESS TOO SLOW, or a DECREASE STEP SIZ message follows.
PROCESS	TOO SLOW	Autotune will not work on this process because it is too slow.
DECREASE	STEP SIZ	The process has exceeded one of the configured process trip-points. Restart autotune with a smaller output step size or expand the high and low trip-point of the process variable.

Autotune Completion

Autotune will generally result in successful calculation of tuning constants. When a completely successful autotune cycle is completed, the controller will be in the automatic mode using the newly calculated tuning constants, and will display the process variable and the controller set-point. If autotune was activated while in the automatic mode, or in manual without set-point tracking, the set-point will be at the same value it was at prior to autotune. If autotune was activated while in the manual mode and set-point tracking is enabled, then the set-point will be at the last process value before the execution of the autotune cycle. The calculated tuning constants may be reviewed and manipulated by entering the TUNE loop.

Autotune completion may be successful but a warning message (“Caution”) may be displayed. The controller will be functioning as if a completely successful autotune occurred except for the message.

Autotune execution may result in a cancellation error message. In this case, the controller will be put in the manual mode and the output value will be the starting value at the execution of autotune. An error message will be displayed on the digital displays.

Cancellation During Setup

To cancel out of the autotune menus during setup of the autotune parameters, make a mode change. For example, if you are setting up autotune while in automatic mode, press the manual key to exit the set-up menu and enter manual mode. If you are setting up autotune while in manual mode, press the auto key to exit the set-up and switch to auto mode. If switching modes is not acceptable at this time, press the auto or manual key to transfer back to desired mode. If you are setting up autotune from manual mode and placing the controller in automatic is totally undesirable at this time, continue autotune setup and cancel (press manual key) immediately after autotune execution begins. A cancellation during execution places the controller in manual.

Cancellation During Execution

Press the manual key to cancel the autotune cycle during execution by the controller. This will prevent completion and will place the controller in the manual mode. The controller output will be changed to the starting output value prior to the execution of autotune.

If the controller is in automatic mode when the cancellation is executed, the controller will cancel the autotune cycle and will change to manual mode. The controller output value will be at the last automatic calculated value prior to the cancel execution. The controller output can be manipulated with the UP/DN keys, or pressing the auto/manual key again will bumplessly transfer back to automatic mode and the controller will be using the tuning constants that existed prior to autotune activation.

Autotune Restart

Autotune can be reactivated at anytime after a cancellation. Repeat the setup procedure in Table 13.

Automatic Cancellation and Diagnostics

The controller may cancel the completion of an autotune execution or may allow successful completion while providing a caution prompt to the operator. There will be a series of two display prompts on the digital displays. The first prompt informs the operator that either an autotune cancellation (failure) or a caution has occurred. Pressing the scroll key when this first prompt occurs provides a second prompt that allows the operator to determine what should be done to obtain a completely successful autotune.

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RAMP/SOAK OPERATION

DESCRIPTION OF RAMP/SOAK PROFILE

The Ramp/Soak Profile option complements any type of control implementation by adding a ramp/soak set-point profile with up to 10 ramp or soak segments. The ramp function changes the local set-point up or down at a specified rate. The soak function maintains the set-point at a fixed value for a specified period of time. Figure 19 shows a typical profile and some of its features. The profile is run in either hours or minutes and each segment can contain up to 30,000 units of time. Ramp/Soak features include: repeating a profile, resetting a profile, skipping segments, guaranteed ramps and soaks, and three segment event states using output relays A, B and C. When all three event states are enabled, high or low alarm outputs are not available.

The process variable may be either a temperature or electrical input. When ramp/soak is running with the controller in automatic, the control algorithm receives an active local set-point which changes as a function of the ramp/soak profile. The control algorithm performs its normal function of calculating an output which will bring the process variable to the set-point based on the configuration of the P, I, D, or on/off responses.

When the controller is in automatic, ramp/soak can be set for either run or hold using the scroll and up/down keys. When ramp/soak is on hold, the set-point can be adjusted using the up/down keys. When ramp/soak is switched back to run, the profile is started at the point where it was held. When the switch is made, any difference between the adjusted set-point value and the profile value causes a step change in the active set-point.

When control is switched to manual, the ramp/soak profile pauses and the output value can be changed via the up/down keys. Output adjustment while in manual is from 0 to 100% of span. The switch from manual back to automatic is not bumpless. If the process value is at 70% in manual and the ramp or soak profile segment calls for 80%, the switch to automatic immediately causes the process to begin changing to the 80% value.

When ramp/soak is running, the remote set-point cannot be made active and autotune cannot be entered. If the remote set-point is active, ramp/soak cannot be started in the DISPLAYS MENU.

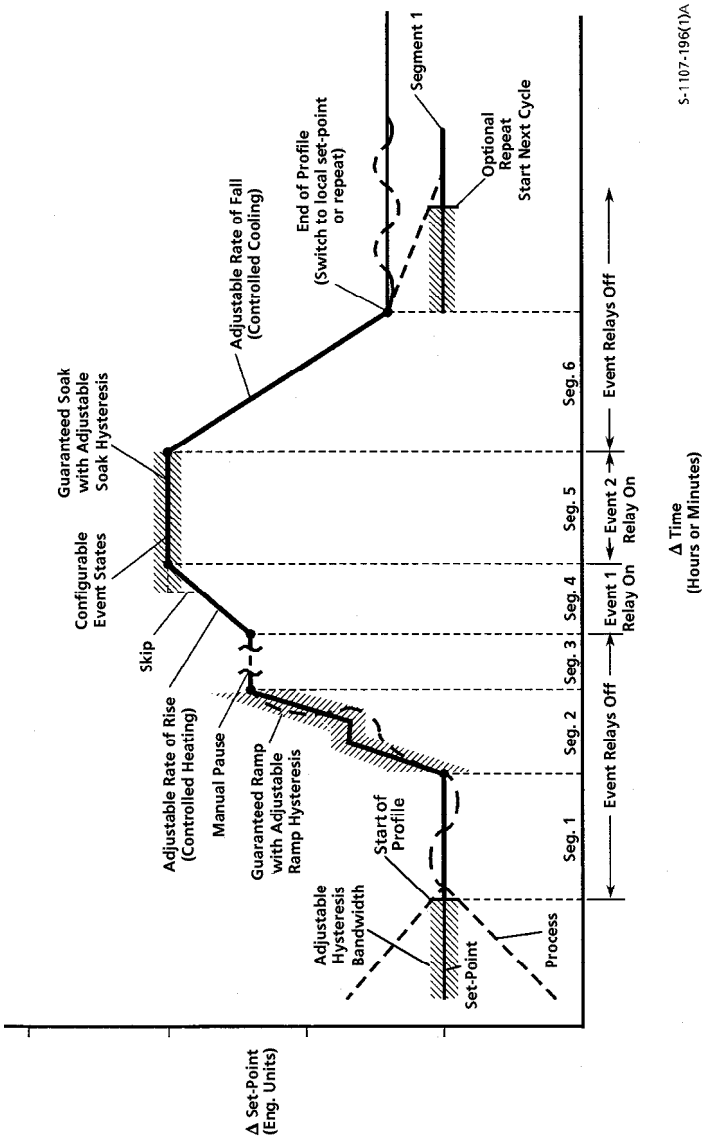
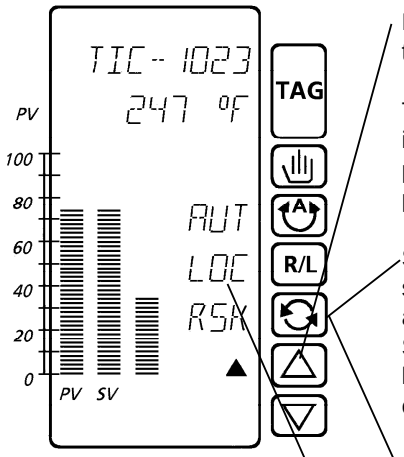


Figure 19. Typical Six-Segment Ramp/Soak Profile

OPERATION IN AUTOMATIC

The ramp/soak sequence is initiated and monitored in the DISPLAYS MENU where the instrument display appears similar to the example below. To access Autotune or remote set-point capabilities, the ramp/soak profile must be turned off. If tune or configuration passwords were configured in the BASE CFG MENU, these codes are required to initiate a reset or segment skip. Also, if a ramp soak profile is on hold and the set-point is not local, the profile cannot be put into run. You must return to the local set-point to get the arrows to change the profile status.



Press *UP* to place the controller into the ramp/soak routine

The profile status is displayed as either in [HOLD] or in [RUN]. Press *UP* to place ramp/soak in run, or press *DN* to place ramp/soak in hold.

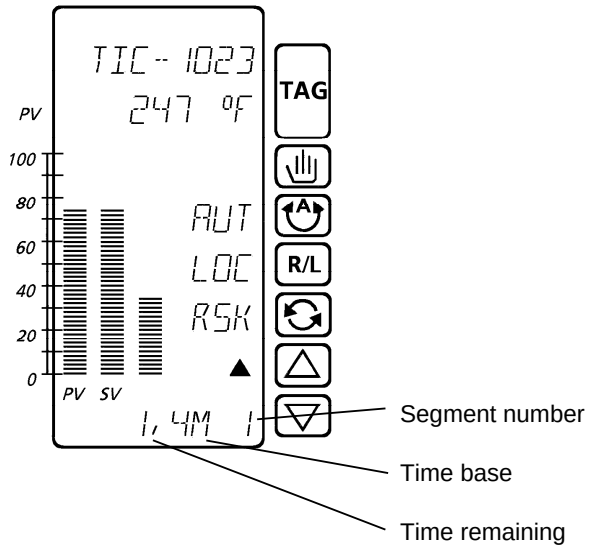
Scroll to view other ramp/soak data such as time remaining, time base, and active segment number (next figure). Scroll again to get cycle number in the lower engineering display, and to enable a cycle reset and segment skip.

Scroll after [SKIP] to exit the ramp/soak profile sequence and display the current set-point, then controller output in percent.

The middle status display alternates between [LOC] and [RSH] until you scroll to the beginning of the ramp/soak sequence and return to the profile [RUN] state.

RAMP/SOAK OPERATION

After selecting RUN or HOLD at the beginning of the ramp/soak display sequence, scrolling accesses the segment status display as shown below:



In this example, 1.4 minutes are left in segment 1 of the profile. The initial value for time remaining in a segment is 0.1 units more than the configured value even though the actual time a segment runs is the configured time. If the time remaining exceeds 3200, the display will read 3200 until the time remaining falls below this value. The total minutes or hours remaining could be excessively large if the set-point start and end points are far apart and the increment per unit of time change rate is very small. For example, a span of 325°F going through a change of .1°F every minute would take 3250.0 minutes to complete. This means the display of minutes remaining would stay at 3200 for 50.0 minutes before counting down.

The cycle number appears after scrolling from the segment display, and indicates the active cycle the profile is currently running in. This number starts at one and is reset to one when the profile is reset. The cycle number stops counting once the number reaches 65535; however, the ramp/soak algorithm continues to run if the repeat attribute is active.

If the [SKIP] or [RESET] prompts do not appear, a password has been configured in the BASE CFG MENU and is required to access these prompts in addition to making changes in other menus.

CONTROLLING RAMP/SOAK PROFILE

Control of the ramp/soak profile is accomplished in the DISPLAYS MENU where the ramp/soak functions for reset and skip may be manipulated while ramp/soak is on [RSK] [RUN]. Additional features are in the RELAYS MENU, where relays can be turned on or off as ramp/soak event markers, and in the RAMPSOAK MENU, where ramp or soak hysteresis may be manipulated. Additional access to the ramp/soak profile configuration in the RAMPSOAK MENU can only be made if the ramp/soak status is turned off [RSK] [HOLD] in the DISPLAYS MENU. The configuration can be placed in [HOLD] in the DISPLAYS MENU, viewed without changes, and then continued from the current segment and cycle by being placed back in [RUN] in the DISPLAYS MENU.

Reset

The ramp/soak reset prompt [RSK] [RESET] is a DISPLAYS MENU ramp/soak command that appears when ramp/soak is in [HOLD] or [RUN]. Pressing the up key when RESET is displayed resets the ramp/soak profile to the start of Segment 1, Cycle 1. If the profile is running when the reset is initiated, the profile is switched to hold and the controller is switched to manual. The profile is restarted by switching the controller to automatic, and selecting RUN at the beginning of the ramp/soak display sequence. If a reset is not required, scroll past the reset prompt to the skip function.

Skip

The ramp/soak prompt [RSK] [SKIP] is a DISPLAYS MENU ramp/soak command that appears when ramp/soak is in [HOLD] or [RUN]. Pressing the up key when SKIP is displayed causes the remainder of the current segment to be skipped. The segment status display appears showing the total time and segment number for the next segment.

When the controller is in automatic with ramp soak running the response to a skipped segment is as follows:

- If the skipped segment is not the last segment the profile continues at the start of the next segment. If the next segment is a guarenteed ramp or soak, timing does not start until the process value is within the configured hysteresis band.

.

- If the skipped segment is the last segment in the profile and the cycle is configured to repeat, the skip returns the profile to the start of the first segment. This action is the same as a reset except that cycle number is not changed. The controller responds in the manner described for a reset.

- If the skipped segment is the last segment in the profile and the cycle is not configured to repeat, the skip stops the cycle and the segment status display appears showing the cycle has ended [0M 0]. Control is immediately switched to the local set-point. A new cycle can be started by selecting RUN at the beginning of the ramp/soak display sequence.

When the controller is in mnual or ramp/soak is on hold, segments can be skipped but there is no affect on operation until the profile is restarted. If one or more segments have been skipped while the profile is not running, the profile starts on the new current segment.

If a skip is not required, scroll past the skip prompt and into the displays menu.

Relays A, B and C Indicating Ramp/Soak Segments

Relays A, B, and C can be set up in the RELAYS MENU as event relays for ramp/soak segments. Each of the 10 ramp/soak segments can be configured in the RAMP/SOAK MENU to trip relay A, B, or C. For example, Relay A could be used to indicate the state (on or off) of ramp/soak segments 1, 3, 4, and 6. Similarly, all three relays can be set up to specify which segment is on. For example, relays A and B on and Relay C off could indicate that ramp/soak segment 3 is on.

Repeat

The repeat function permits a ramp/soak profile to be repeated automatically without operator intervention. The ramp/soak repeat prompt [RAMPSOAK] [REPEAT] is in the RAMPSOAK MENU. No repeat causes the profile to turn off after the last segment is completed; control continues in automatic with the ending set-point from the profile. When the repeat function is selected, the entire profile is repeated each time the last segment ends. The new cycle starts whenever the process variable is within the hysteresis bandwidth for segment 1.

Ramp or Soak Hysteresis

The hysteresis function provides for setting up a band of process variable values relative to the set-point. For example, a temperature hysteresis value of 10*F provides a band between 290 and 310*F when the set-point is 300*F. The band also applies to the set-point, preventing a profile from starting if the set-point is outside the band.

For each profile segment which is configured as guaranteed, the hysteresis band affects the time duration of the segment because the timer stops when the process value is outside the hysteresis band. The soak hysteresis value applies to the set-point of all guaranteed soaks, and segment one when it is a soak segment. The ramp hysteresis value defines a bandwidth around the set-point of all guaranteed ramps, and segment one when it is a ramp segment. For segment one, the ramp or soak hysteresis bandwidth is used to determine when to start the profile.

The ramp hysteresis prompt [RAMP] [HYST] and the soak hysteresis prompt [SOAK] [HYST] are tunable functions in the RAMPSOAK MENU. A hysteresis value (xxxx = 0 to 30000) is selected using the up key and defines a bandwidth around each guaranteed ramp or soak segment.

Ramp/Soak Hold

The ramp/soak profile can be put on hold while the controller is in automatic by initiating a [HOLD] in the ramp/soak display sequence of the DISPLAYS MENU. This sequence is entered by scrolling to obtain RSK in the bottom status display location. Pressing the up key toggles the profile between RUN and HOLD. Outside the ramp/soak display sequence this hold is indicated by an alternating [LOC] and [RSH] in the middle status display location.

In the hold mode, the set-point can be changed using the up or down keys and the controller may be placed in manual. While in automatic the controller will control to the new set-point as long as it is in hold. Changing the run/hold status back to [RUN] causes the controller to continue the ramp/soak profile where it was when it was placed in hold. If the profile is on the first segment or a guaranteed segment, the active set-point must be within the hysteresis band for the profile to start. If it is not, the controller is forced to manual and the profile is returned to hold.

AUTO/MANUAL TRANSFER WITH RAMP/SOAK

Transfers from automatic to manual or manual to automatic during ramp/soak operation are made by pressing the auto or manual key. Transfers from automatic to manual are always bumpless and put the ramp/soak profile into a paused state. Transfers from manual to automatic result in a bump if the

manual set-point is not at the same value as the ramp/soak profile set-point (the ramp/soak profile is paused at its current set-point value when the controller is put in manual). The switch back to automatic causes the process variable to be under automatic control in response to the ramp/soak set-point.

Auto/Manual Transfer with Set-Point Tracking

If the controller has been configured for set-point tracking, the set-point tracks the process value when the controller is in manual. When a transfer to automatic is made, the process may not be at the ramp/soak set-point. If the profile is already running or the tracked set-point is within the ramp/soak set-point hysteresis, a set-point bump will occur. If the profile is waiting to start because the process is not within the ramp/soak set-point hysteresis, then the set-point will stay at the tracked set-point and the set-point must be moved (use the hold feature) to within ramp/soak set-point hysteresis for the profile to begin.

Auto/Manual Transfer without Set-Point Tracking

If the controller does not have set-point tracking, the set-point and process may not be together at the time of transfer from manual to automatic. Again, the transfer will cause a bump. The response following the transfer depends on the controller configuration. If the controller has integral response, the process will ramp to the set-point at the reset rate. If the controller does not have integral, the set-point/ process deviation at the time of transfer will be maintained. This deviation can be eliminated by returning to manual, adjusting output to eliminate the deviation, and switching back to automatic.

Auto/Manual Transfer for On/Off Control

If the controller is set up for on-off control, the bumpless transfer feature does not apply when switching from automatic to manual. When switched to manual, the on-off controller output is always initialized at 0% when switched. Operation in manual is the same as for a time proportioning controller. When switching from manual back to automatic, operation is the same as for all other types of control as described in the operations section.

OPERATION IN MANUAL

When the controller is switched to manual, the first display seen is process/output. Output can be adjusted using the up and down keys. The scrolling sequence is the same as for the automatic mode. The ramp /soak profile does not run in manual.

TOTALIZER OPERATION

DESCRIPTION OF INTEGRATION/TOTALIZATION FUNCTION

The integrator/totalizer provides the capability to integrate process signals and display totalized values on the front panel. Signals which have a linear relationship can be integrated and totalized directly. Flow signals, which are proportional to differential pressure, require the application of square law linearization which is available as a standard function. Integration/totalization also applies to thermocouple or RTD inputs (to count BTUs, calories, etc.).

The integrator/totalizer algorithm converts process signals representing engineering units in terms of units per unit time (e.g., gal/hr) into counts which are summed to provide a continuous readout of the total units. The integrator/totalizer can be configured to accept rate time bases in hours, minutes, or seconds. Alarm relays (A, B and C) can be used to signal the point at which the totalized value reaches the predetermined count.

The totalized value can be selected for readout on the lower engineering display using the control keys. When the totalizer display is selected, the total value is continuously displayed until the operator selects another display. The totalized number is a seven digit number; leading zeros are not suppressed.

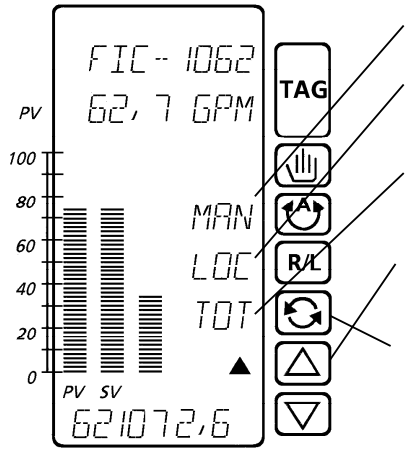
Integrator/totalizer parameters are configured using the front panel keys in the same manner as for other parameters. Features which can be configured are as follows:

- **Preset Value** (0 to 9,999,999)
  The value from which the totalizer starts its count.
- **Predetermined Count** (0 to 9,999,999)
  The value at which the totalizer automatically resets when the wrap function is selected. Also, optional relays trip when the count reaches the predetermined count.
- **Wrap Function**
  When selected, the wrap function causes the totalizer to automatically reset to the preset value and start over each time the predetermined count is reached.
- **Threshold Value**
  The process input value below which the signal is not totalized.
- **Totalizer Type**
  This feature permits the totalizer to be set up to count either up or down.

- **Scale Factor**
  This feature allows custom scaling of the totalized value. The reciprocal of the entered value (0.001 to 30000) is used as the totalizer scale factor.

OPERATION OF CONTROLLER USING TOTALIZATION

The operating procedure for integration/totalization is very similar to that of a controller without totalization enabled. After the totalizer has been configured in the TOTALIZE MENU, return to the DISPLAYS MENU and scroll until the display appears similar to the example below.



Mode can be AUT or MAN.

Setpoint can be LOC, LO2, LO3, LO4, or REM

Scroll to totalizer entry prompt (TOT) from the SPT and OUT displays.

Press the up key to access the totalizer status display (see below).

Scroll to monitor totalized count display (totalizer can be on or off) and scroll again to see and manipulate totalizer reset (see below).

Totalizer Status Display

The totalizer status display can indicate whether the totalizer is in the hold state or the run state. If the totalizer is in [RUN], pressing the down key places the totalizer in the [HOLD] state. The totalized value stops counting in the hold state and begins again when placed in the run state. If the totalizer is in [HOLD], pressing the up key places the totalizer in the [RUN] state. When in hold, TZH will alternate with the auto or manual display.

Totalizer Reset Display

Pressing the up key at the reset prompt [RESET] resets the totalized count to the preset value and the count continues if the totalizer is in the [RUN] mode (display returns to count value). If a configure or tune password has been configured but not entered, you must go back and enter the correct password (press TAG, enter password, and return to get the reset display).

Preset Value

The preset value is the number from which the totalizer starts counting after a wrap or when the totalizer was first initiated. This value is typically 0. Leading zeros are not suppressed.

Predetermined Count

The predetermined count is the value at which the totalizer resets and starts over when the wrap function is enabled. If a totalizer event relay is enabled in the RELAYS MENU, the relay transfers to signal that the predetermined count has been reached.

The predetermined count has the same form as the preset value, and its decimal point location is the same as the decimal location in the process variable engineering units. Setup entries for the predetermined count are made in the same manner as for the preset value, and all the same limitations apply.

When the wrap function is enabled, entries for the predetermined count are restricted as follows:

1. The predetermined count must not be equal to the preset value. The totalizer cannot be turned on if this condition exists.
2. The predetermined count must be greater than the preset value if the totalizer is configured to count up, and less than the preset value if the totalizer counts down. For example, if the preset value is 100 and the predetermined count is zero, the totalizer must count down. If it is configured to count up, it cannot be turned on.
3. The predetermined count must be set at a value which makes the difference between the preset value and the predetermined count greater than the maximum value of the process variable engineering units to make the totalizer relay function correctly.

If the wrap function is not enabled, violation of restrictions 1 and 2 will not prevent the totalizer from being turned on. Restriction 3 does not apply when wrap is off. The relay will function correctly for any predetermined count value except the value which equals the preset value.

Totalizer Digital Input Function

Digital input 1 or 2 can be used to control the totalizer status ((Run/Stop, Run/Hold, Run/Skip). The front panel can also be locked out. See digital input setup (Table 3) for details.

EXAMPLES OF TOTALIZER COUNT FACTORS

There are three configurable factors that affect what one totalized count equals in actual engineering units and how quickly the totalizer counts. The first factor is the engineering units configured in the TOTALIZE MENU. The other factors are the rate (engineering units time base), and the totalizer scale factor. Table 14 and its notes give several flow examples of how these factors affect the totalizer count. Flow is normalized to zero (engineering units low is 0 for a nonlinear flow input using square root).

If you are totalizing on a temperature signal, the configured engineering low value becomes your zero based process value and is subtracted from the process value to get the difference for count. For example, a 75°C process value with a 50°C low value and a 100°C high value will produce a count of 25 in one minute if the time base is minutes and the scale factor is 1.

Table 14. Examples of Totalizer Count Factors

Actual Flow at 100%	**Configured Engineering Units** (Note 1)	**Scale (Disp. Mult.)**	**Config-ured Rate**	**Scale Fac-tor** (Note 2)	**1 Count Equals** (Note 3)	**Mini-mum Rollover Time** (Note 4)
6,000,000 gal/day	0 to 4167 gal/min	x 1	MIN	1	1 gal	40.0 Hrs
6,000,000 gal/day	0 to 416.7 gal/min	x 10	MIN	0.1	1 gal	40.0 Hrs
6,000,000 gal/day	0 to 416 gal/min	x 10	MIN	1	10 gal	400 Hrs
6,000,000 gal/day	0 to 2500 gal/hr	x 100	HOURS	1	100 gal	167 Days
6,000,000 gal/day	0 to 2500 gal/hr	x 100	HOURS	0.01	1 gal	40.0 Hrs
600 gal/sec	0 to 600 gal/sec	x 1	SEC	6	6 gal	27.8 Hrs
600 gal/sec	0 to 100 gal/sec	x 6	SEC	1	6 gal	27.8 Hrs
600 gal/sec	0 to 3600 gal/min	x 10	MIN	1	10 gal	46.3 Hrs
600 gal/sec	0 to 360.0 gal/min	x 100	MIN	0.1	10 gal	46.3 Hrs
600 gal/sec	0 to 6 gal/sec	x 100	SEC	1	100 gal	463 Hrs
600 gal/sec	0 to 360 gal/min	x 100	MIN	1	100 gal	463 Hrs
600 gal/sec	0 to 600 gal/sec	x 1	SEC	600	600 gal	115.7 Days
600 gal/sec	0 to 1 gal/sec	x 600	SEC	1	600 gal	115.7 Days
60 gal/min	0 to 60 gal/min	x 1	MIN	1	1 gal	115.7 Days
60 gal/min	0 to 60.00 gal/min	x 1	MIN	1	1 gal	27.78 Hrs

Notes:

1.) The configured engineering units rate for totalization must be **hours**, **minutes**, or **seconds**. For example, 6 million gallons per day converts into minutes as follows: 6,000,000/(24*60) = 4166.66 gals/min. Converting to hours, 6,000,000/24 = 250,000 gals/hour. Both of these are a 1:1 conversion (display multiplier= 1). Since engineering units is 30000 maximum, 2500 could be used in place of 250,000 (display multiplier = 100).

2.) Configured scale factors are 0.001 to 30000. The unscaled total is divided by the configured scale factor to get the scaled count.

3.) The calculation for 1 count is based upon the display multiplier and scale factor. Since the scale factor is a divisor of the count, it has an inverse effect on the display multiplier when calculating count and so a multiplier of 10 times a scale factor of 0.1 equals 1, or 1 count equals 1 unit.

4.) The rollover time is based upon a maximum totalizer count of 9,999,999 when the decimal place is nnnn., or 999,999.9 when the decimal place is nnn.n, etc.

RATIO BIAS CONTROL

RATIO BIAS CONTROLLER

Ratio bias control systems maintain two or more process variables at a predetermined relationship, or ratio. In a ratio bias controller the ratio or bias value is applied to the remote set-point input before the set-point is passed to the PID algorithm. The output of the PID algorithm controls the dependent flow valve in order to maintain the correct ingredient relationship. Ratio and bias values are entered locally through the instrument operators display. If ratio or bias values are to be entered from a remote source, see **A/M Ratio Bias Station**.

In figure 20, the instrument is acting as a single station ratio or bias controller where two flow streams are blended. This application requires that an option card be installed to bring in the remote set-point signal (independent flow).

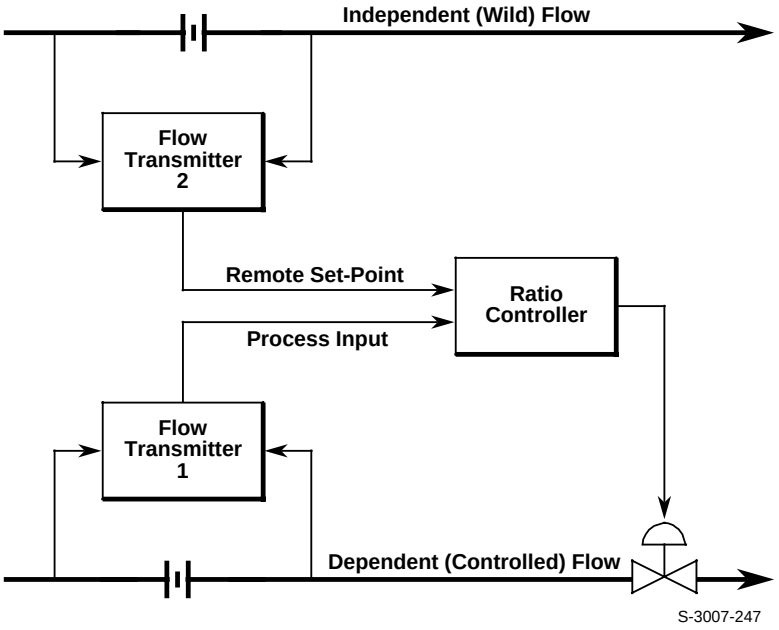


Figure 20. Ratio Control of Flow (Two-Stream Blending System)

The independent (wild) flow changes from time to time, and in order to maintain the correct proportions of the blend the other (dependent) flow must be controlled to change in a like manner. The dependent flow must change in the same relationship, or ratio, to changes in the independent flow. The wild flow is not necessarily uncontrolled; it is only wild insofar as the ratio system is concerned. For instance, in air-to-fuel ratio control in boilers, air flow is controlled to maintain the required air-to-fuel ratio. The wild fuel flow is in turn controlled by another system, based on the boiler steam demand. Thus it is actually the controlled flow in another ratio system.

Instrument Set-up

To implement ratio bias control, simply follow Figure 20 for process input connections. In the BASE CFG **MENU**, Table 1, enable input two. Do not enable "A/M Ratio Bias Station". Ratio and bias values are entered in the TUNE ** MENU, Table 12, as **Remote Set-Point Ratio** or **Remote Set-Point Bias**.

Control Method

The method used to accomplish ratio control is to let the changeable variable (also called the independent variable) adjust the remote set-point of the controller that manipulates the other variable (also called the dependent variable or controlled variable). This instrument includes an adjustable multiplier and adjustable bias on the remote set-point so that the required relationship between dependent and independent variables can be established and maintained.

Ratio Function

Ratio, as it applies to process control systems, is defined as follows:

$$\text{Ratio} = \frac{\text{Dependent Variable}}{\text{Independent Variable}} \quad \text{or} \quad \frac{\text{Controlled Variable}}{\text{Wild Variable}} \qquad (1)$$

In the ratio control system shown in Figure 20 the set-point of the dependent variable controller is:

$$\text{Dependent Variable Set-Point} = \text{Independent Variable} \times \text{Ratio} \qquad (2)$$

It is important to consider proper scaling of the two variables when using equations 1 and 2. If the flow streams in the system shown have the same flow range, computation of the flow ratio is very simple. The two variables may be expressed in either percent of span or engineering units to obtain the

correct ratio value. When the streams do not have the same flow range, the variables must be expressed in engineering units to obtain the correct flow and signal ratio values.

Most applications require direct ratio; the dependent variable increases as the independent variable increases. If the signal representing the variable is not linear, it can be linearized using the square root extraction function. Linearization is often required in flow ratio applications where the process flow signal from a differential pressure transmitter is proportional to flow squared.

Some applications require inverse ratio; the dependent variable decreases as the independent variable increases. Inverse ratio is easily accomplished because the analog signal output can be configured to be reverse acting.

Bias Function

Some ratio control applications require that the ranges of the independent and dependent variables have different starting points. This means that the ratio lines will not radiate from the 0-0 origin. This is usually true when temperature is used to adjust flow, pressure, or another temperature. A bias adjustment can be configured to shift the ratio line. The bias is added or subtracted from the set-point value to shift the operating range of the controller.

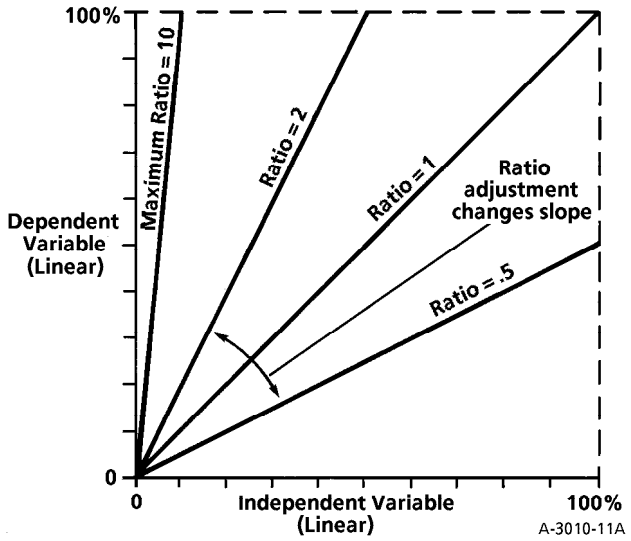


Figure 21. Effect of Ratio Adjustment in a Direct Ratio Control System

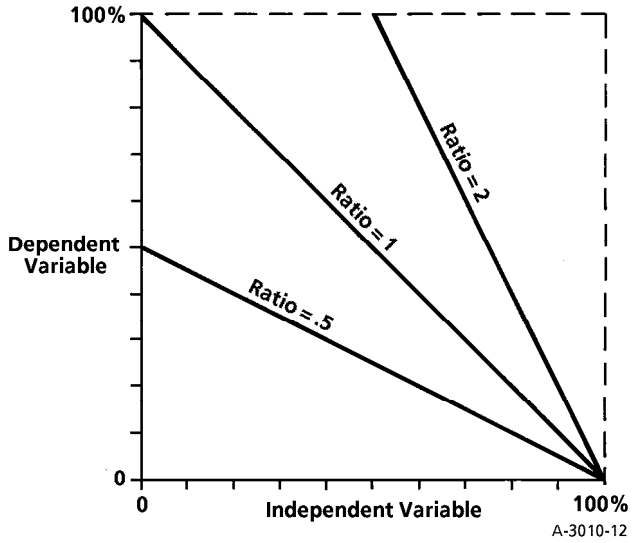


Figure 22. Effect of Ratio Adjustment in an Inverse Ratio Control System

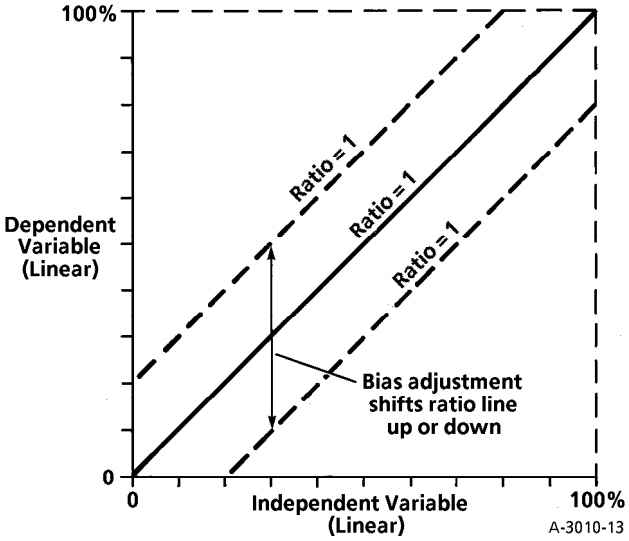


Figure 23. Effect of Bias Adjustment on a Ratio Relationship

A/M RATIO BIAS STATION

The A/M ratio bias station applies a ratio or bias to the process input. The output of the station is equal to the process x ratio, process ± bias, or process x ratio ± bias. In this arrangement the PID algorithm is not used. Ratio or bias values can be entered from either the operators display or through the remote ratio or bias input (second analog input). In the blending system, shown in Figure 24, a controller (shown in the shaded area) is used with an A/M Ratio Bias station. This combination provides two station ratio bias control with a remote ratio or bias source which serves as the remote set-point for the separate dependent variable controller. Both instruments used in a two-station system must be equipped with an option card to provide the second analog input.

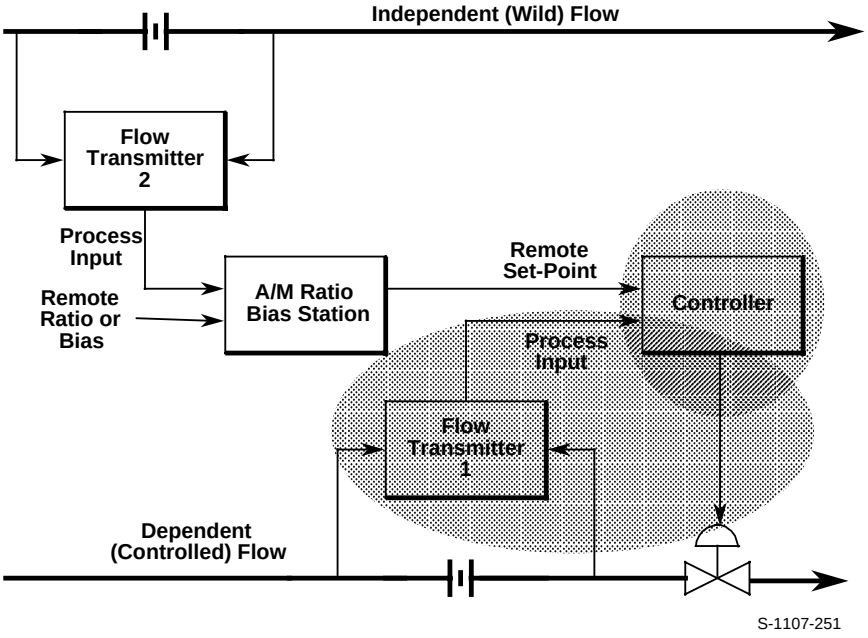


Figure 24. Two-Stream Blending System Using A/M Ratio Bias Station

RATIO BIAS CONTROL

A typical A/M Ratio Station application where a plant master steam flow controller provides an input to two boiler masters (A/M ratio stations) is shown in Figure 25.. Each of the two A/M Ratio Stations receive the same process signal from the plant master but their outputs to the combustion control system are different due to different ratios applied to their common process inputs. This is done to balance boiler loading in an effort to optimize boiler efficiency. In this example boiler number two is more efficient if run above 50% capacity. Boiler number one runs more efficiently between 40% and 50%. Boiler master number two receives a 45% input signal from the plant master and a ratio of 1.1 is applied to achieve a 50% output. Likewise boiler master number one receives a 45% input signal from the plant master but here a ratio of 0.89 is applied to achieve a 40% output

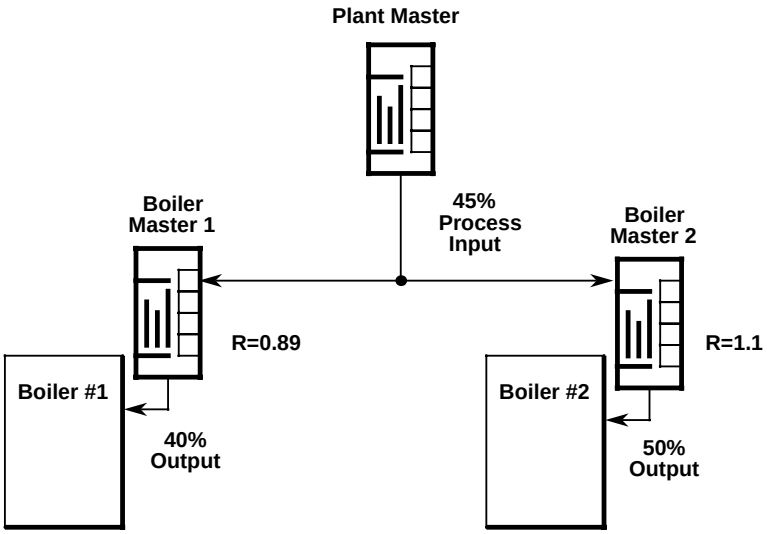


Figure 25. Example of an A/M Ratio Station Application

Instrument Set-up

To implement an A/M Ratio Bias Station, enter into the BASE CFG **MENU**, Table 1, and enable **A/M Ratio Bias Station** at the RAT BIAS ENABLE prompt. If the ratio or bias value is to come from an external source, input two must also be enabled. Configure the station using the RAT BIAS **MENU**, Table 7. The station type can be designated as ratio only, bias only or both ratio and bias. Initial (startup) values for local ratio and bias can be entered in the TUNE **MENU**,Table 12, at the A/M R-B RATIO or A/M R-B BIAS prompt. The bias value is displayed in engineering units and is converted to percent for calculation of the output. Setting the process input engineering high and low values to 100 and 0 respectively allows the user to work in percent.

A/M Switching

Auto/manual switching in the A/M ratio bias station and dependent variable controller have very similar functions. Switching from automatic to manual in either instrument breaks the connection between the independent and dependent variables. When the A/M ratio bias station is switched to manual, the manual control adjustment in the station provides the set-point for the dependent variable. When the controller is switched to manual, the dependent variable is under direct manual control from the front panel of the controller.

Note: The remote/local switch does not function in an A/M Ratio Bias Station. The source of the ratio or bias is configured as local or remote in the RAT BIAS **MENU**.

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TIME PROPORTIONING CONTROL

DESCRIPTION

Time proportioning control permits PID control to be used in applications where the control element is an on/off device. The control output is provided by a mechanical SPDT relay.

The local set-point and manual control adjustments are made using front panel keys. Process and set-point values are displayed in engineering units, and the calculated output is displayed in percent of output span.

When the controller is operating in automatic, the control algorithm receives the active set-point and process input signals. A calculated output signal is generated based on set-point/process deviation and the configuration of the P, I, and D responses. Response adjustments are made from the front of the controller using a series of display prompts provided in the controller firmware.

The calculated output goes to the output driver to control the duty cycle of the continuously oscillating output relay. The period of oscillation is determined by the value of the cycle time tuning parameter. The diagram in Figure 26 shows the duty cycle for an output relay with a cycle time setting of 10 seconds. When the calculated output value is 50%, the relay is on for half its cycle and off for half its cycle. Decreasing output reduces on-time (1 second on, 9 second off at 10% output), and increasing output proportionally increases the on-time (9 second on, 1 second off at 90% output).

When the controller is switched to manual, the output relay continues to oscillate as a function of the cycle time setting the same as in automatic. The duty cycle is controlled manually by changing the calculated output value via the front panel keys. Output adjustment while in manual is from 0 to 100% of span.

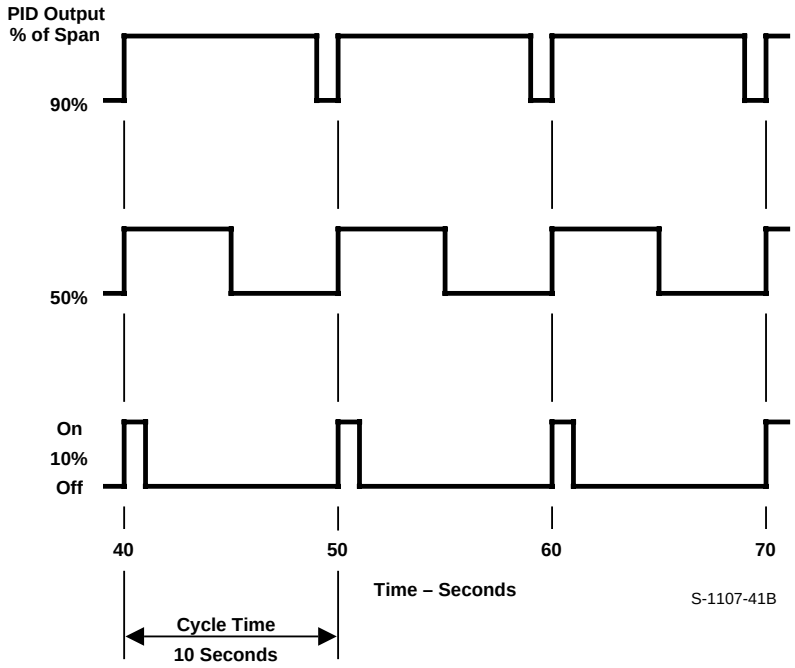


Figure 26. Output Relay Duty Cycle for Time Proportioning Control

CURRENT PROPORTIONING CONTROL

DESCRIPTION

The controller provides an adjustable dc current output signal for current proportioning (analog) control applications. The maximum output load is 1000 ohms for 20 mA and 400 ohms for 50 mA.

Control adjustments, displays, and calculated outputs are similar to the time proportioning controller.

The calculated output goes to the output driver which generates the current output signal. When the controller is switched to manual, the calculated output can be changed manually via the front panel keys. Output adjustment while in manual is from 0 to 110% of span.

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DUAL OUTPUT (HEAT/COOL) CONTROL

DESCRIPTION

The controller can provide dual output (heat/cool) control with each of the three available output types; dual dc current, dual SPDT relay, or dc current and SPDT relay. When the controller is set up for dual control, manual tuning is required. An option board is required when using heat/cool with dual curent output.

Implementation of Heat/Cool control is accomplished by dividing the 0 to 100% calculated output into two parts; a heating band and a cooling band. Activation of the heat or cool output is dependent upon the controller output calculation and a user configured crossover point. On one side of the crossover point the heat output is manipulated, and on the other side the cool output is manipulated. This is illustrated in Figure 27 for reverse control action. Heat action follows the control action of the calculated output, while cool action is the opposite (unless the output is reversed). Note that while one output is being manipulated (above 0% heat or 0% cool) the other output will always be at 0% (displayed value). Both heat and cool outputs are at 0% when within the crossover output off hysteresis set in the TUNE MENU. This value can be set at up to ±25.0 from the crossover output value.

When Heat/Cool control is being set up, two sets of response values must be tuned; one for heating and one for cooling. Gain and Integral (reset) adjustments are provided for each band (heat and cool). Therefore, a transfer from one set of tuning constants to the other must be made when the controller output changes between the heat and cool bands at the crossover point. The rate of change between heat gain and cool gain can be established by configuring an adjustable crossover band width (hysteresis) in percent of calculated output. The transition of the gain value will be linear within this band, and the rate of change will depend on the width of the band as shown in Figure 28. The reset transition is a step change at the crossover point. There is a single derivative (rate) adjustment common to both the heat and cool bands.

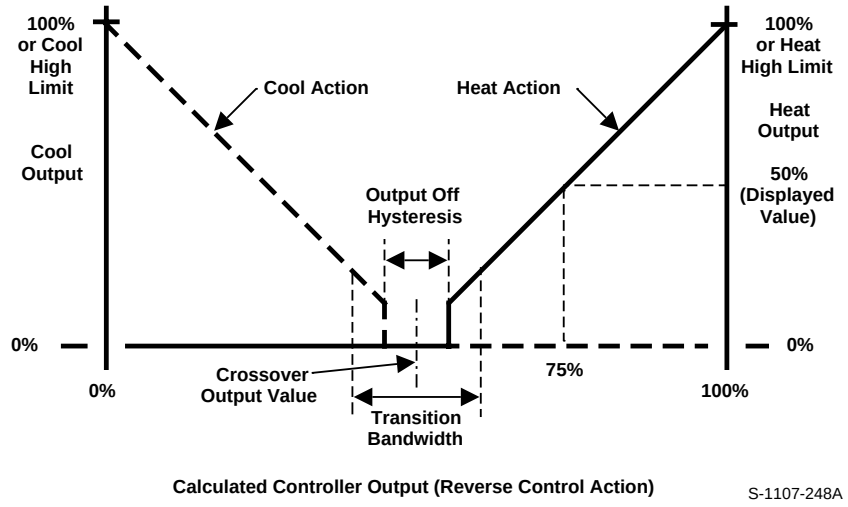


Figure 27. Dual Output (Heat/Cool) Output Transition

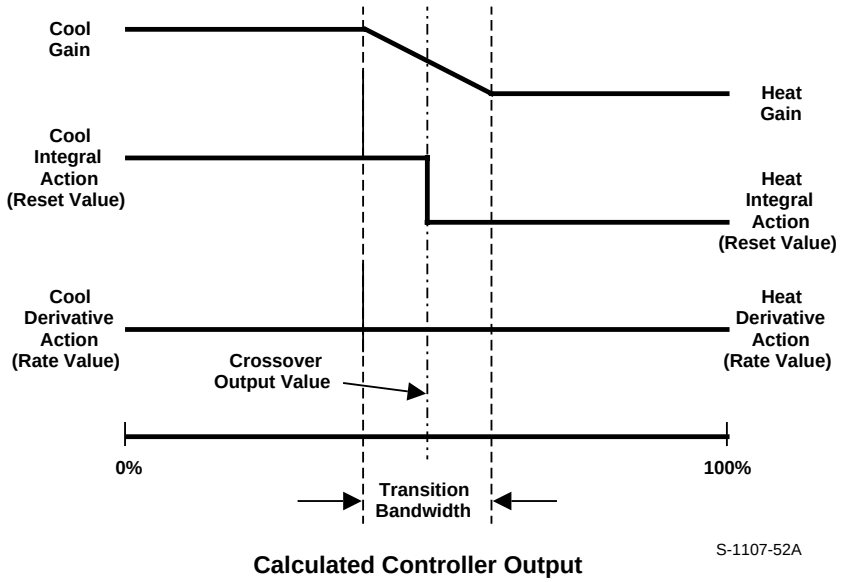


Figure 28. Dual Output (Heat/Cool) Tuning Constant Transition

ON/OFF CONTROL

DESCRIPTION

The on/off output calculation diagram is shown in Figure 29. The local set-point adjustment is made using the front panel keys. The calculated output signal, either ON or OFF is displayed as a percentage. ON is indicated by 100% and OFF is indicated by 0%.

When the controller is operating in automatic, the control algorithm receives the active set-point and process input signals. A calculated output signal is generated based on set-point/process deviation and the differential gap setting. The calculated output is a 2-state on/off signal as illustrated in Figure 30. The calculated output goes to the output driver to control the action of the output relay. The output relay on-time and off-time is determined by the requirement to eliminate deviation between the process and set-point. Relay chatter or hunting is eliminated by proper adjustment of the differential gap value.

When the on/off controller is switched to manual, the calculated output value is initialized at 0% and the relay output becomes a time proportioning signal. This time proportioning approach provides a useful method for handling manual operation in an on/off controller. Operation in manual is essentially the same as manual operation on a time proportioning controller.

When the calculated output initializes at 0% following a transfer to manual, the output relay commences continuous oscillation. The period of oscillation is determined by the value of the cycle time tuning parameter; this parameter is only active in manual. The duty cycle of the output relay can now be controlled by changing the calculated output value manually via the front panel keys. The calculated output responds continuously between 0 and 100% of span allowing an appropriate duty cycle to be selected. Sample duty cycles are shown in Figure 26.

ON/OFF CONTROL

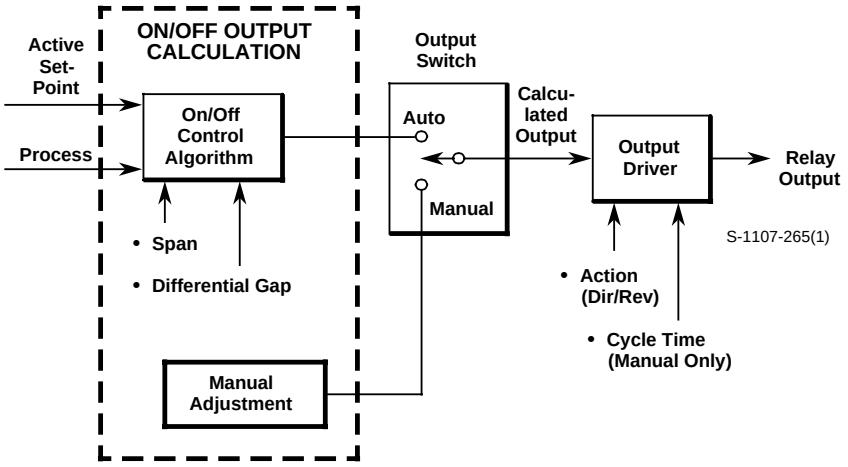


Figure 29. On/Off Output Calculation

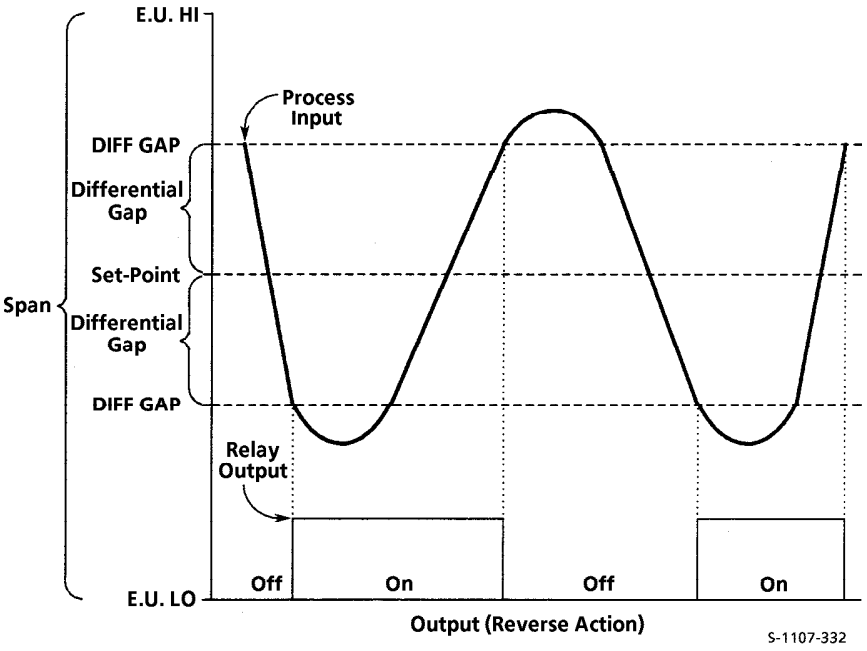


Figure 30. On/Off Control Response in Automatic

POSITIONING PROPORTIONING CONTROL

DESCRIPTION

Positioning proportioning control permits PID control to be used in applications where the control element is an on/off positioning device such as a motorized valve. The controller output is provided by two SPDT relays. One relay actuates opening of the valve, and the other closing of the valve. Positioning proportioning control requires the option board to receive the valve position feedback.

The calculated output generated by the control algorithm goes to a valve motor driver as shown in Figure 31. The driver operates the output relays and receives stem position feedback via input 2. An increase in calculated output opens the valve by actuating the opening relay, and decreasing the output closes the valve by actuating the closing relay. The position feedback gives the controller a measure of valve stem position so that valve position in percent full stem travel corresponds to percent calculated output.

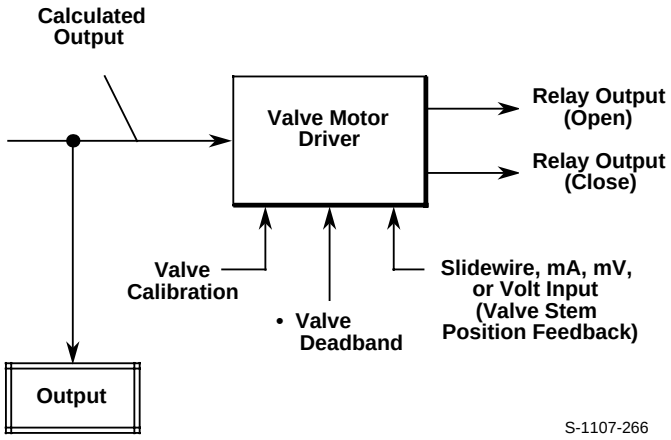


Figure 31. Output Driver Stage of Position Proportioning Controller

POSITION PROPORTIONING CONTROL

Reasonable values for Position Proportioning Deadband and Preact can be determined using the following procedure.

1. Perform the valve calibration in the BASE CFG MENU.

2. In the TUNE MENU, set the controller gain to 0.1, Reset to OFF. and Preact to 0. Due to the very slow control action with these settings, valve position can now be read by switching to Auto and quickly observing the output display. (With position proportioning output in use, the controller shows valve position in the numerical output display in Auto mode, and controller output in that display in Manual mode).

3. Set Position Proportioning Deadband to 5 - 10% to eliminate its effect from the measurement.

4. Put the controller in Manual and ramp the output (holding the button down continuously) all the way to 100% and back to 0%. This guarantees acquisition of maximum valve speed.

5. Ramp the output up and down 20 to 30% (or more) several times, each time noting the percent overshoot of the valve position relative to the controller output. Set the Position Proportioning Preact to the average of these values.

6. Repeat step 4 and confirm that the overshoot is now near zero. Adjust the Preact value as necessary.

7. Set the Position Proportioning Deadband to 0.1% and ramp the output up and down to observe performance. Pay particular attention to very small output changes once a position has been reached. Increase deadband as necessary to eliminate “hunting”. This setting will vary with the valve and application.

DIAGNOSTICS

INPUT FAILURE AND POWER FAILURE DETECTION

The fault detection level for volt inputs is determined by the percent of volt input span value entered in the INPUTS MENU. If there is a process input signal failure, the controller responds as follows:

- If the recovery option is manual, the controller in the automatic mode is forced to manual with local set-point and the output value is switched to the fault output value. The input failure must be corrected and acknowledged in the DISPLAYS MENU before the controller can be placed back into auto.

- If the recovery option is last, the controller in the automatic mode is forced to manual with local set-point and the output value is switched to the fault output value. The input failure, when corrected, is cleared and the controller is automatically placed back into auto. If ramp/soak was running, it will need to be restarted.

- In the manual mode, the controller is not forced to a fault output. The ramp keys remain functional. The input failure must be corrected and acknowledged in the DISPLAYS MENU before the controller can be placed back into auto.

If there is a power failure or shutdown, the relays fail-safe by going to their alarm state. Upon restart, the displays show [POWER] [FAIL] if the message was enabled in the BASE CFG MENU. During power-up, the relays remain in their alarm state until an accurate process input reading is made, after which the relays follow their configured action.

DIAGNOSTIC MESSAGES

Like process alarms, the controller provides diagnostic messages which alert the user to input failures or operational problems. Diagnostic messages are displayed on the TAG line. When one or more unacknowledged process or diagnostic alarms exist, the red LED on the ALARM key flashes, the alarm message alternates with the TAG or the value or the alarmed variable (for process alarms) on the top display, and the beeper sounds if configured to do so. This activity continues until all alarm and diagnostic conditions are either acknowledged or no longer active. When only acknowledged alarms exist, the red LED is steady and the tag display shows only the tag.

Press the alarm key to view messages and acknowledge any unacknowledged

conditions using the UP key.

Input Failure Messages

- [OPEN TC1 (2)] Open Thermocouple 1 (or 2) (upscale burnout)
- [HIGH TC1 (2)] Overtemperature Thermocouple 1 (or 2)
- [LOW TC1 (2)] Undertemperature Thermocouple 1 (or 2)
- [RTD1 (2) LO] Failed RTD1 (or 2), Low (active lead shorted against another lead)
- [RTD1 (2) HI] Failed RTD1 (or 2), High (any one lead open)
- [CJC1 (2) BAD] Failed Cold Junction RTD 1 (or 2)
- [MA1 (2) LOW] Out of range low for 4-20 mA Input 1 (or 2)
- [MA1 (2) HIGH] Out of range high for 4-20 mA Input 1 (or 2)
- [V1 (2) LOW] Out of range low for Voltage Input 1 (or 2)
- [V1 (2) HIGH] Out of range high for Voltage Input 1 (or 2),
- [MV1 (2) LOW] Out of range low for mv Input 1 (or 2)
- [MV1 (2) HIGH] Out of range high for mv Input 1 (or 2)

NOTE

Turn off power to the unit before replacing controller or repairing wiring. Failure to do so may cause a loss of calibration.

Operational Failure Messages

Failures in the general operation of the instrument are indicated by the following diagnostic messages:

- [POWER] [FAILED]
  This is the first display to appear after power-up if the power-up message was not suppressed in BASE CFG MENU. It indicates that the power has been off due either to a normal shutdown or an accidental power failure. Pressing any key clears this message and starts the operating display sequence.
- [BUS INHB], [CMP ERB], [BUS ERR], [OVERCFGD]
  These messages identify communication problems. They are described in the **Modbus Communications Supplement, IB-23C650M.**

The following messages may indicate a failure of a component. If the message is temporary, the cause may be some other electrical problem causing a glitch and no action is necessary. If the message does not go away, after cycling the power for example, return your instrument to an authorized service representative.

- [MAIN CAL] or [OPTN CAL]
  Main or Option board factory calibration constants are missing or bad.
- [DB CHKSUM]
  Database checksum error. Instrument could be operating on bad data.
- [ADC1 TIM] or [ADC2 TIM]
  Indicates a timeout failure on the primary analog input 1 ASIC or the remote set-point input 2 analog ASIC.
- [ADC1 INI] or [ADC2 INI]
  Indicates a “no initialization since power up” failure in the primary analog input 1 ASIC or the remote set-point input 2 analog ASIC.
- [ADC1 UND] or [ADC2 UND]
  Indicates an under range or incomplete conversion condition in the primary analog input 1 ASIC or the remote set-point input 2 analog ASIC.
- [ADC1 OVR] or [ADC2 OVR]
  Indicates an over range condition in the primary analog input 1 ASIC or the remote set-point input 2 analog ASIC.

TROUBLESHOOTING

The list of symptoms shown in the troubleshooting chart below provides a guide for isolating possible faults. Before concluding that a problem is caused by a hardware or firmware fault, carefully check the following.

- The control and input types in the BASE CFG MENU match the process input being used and the type of control required.
- All connectors in controller assembly are fully seated.
- Power and I/O wiring connections are correct. Refer to installation section.
- Controller is properly configured for the required application via setup in the BASE CFG MENU, etc. Refer to setup section.

If none of the listed items is the source of the problem, refer to the table below to isolate the most probable cause. If, after verifying that installation and setup are correct, it is determined that a hardware or firmware fault exists, call for service.

Problem	Possible Cause	Action
No display	a. No power to controller. b. Controller not fully seated in housing. c. Incorrect power connections. d. Display ribbon cable not seated on the display board or the processor board.	a. Turn on power. b. Tighten two jack screws in bezel until controller seats. c. Check power connections. d. Reseat ribbon cable into its connector
Display of process value is erratic.	a. Process signal wiring has been run near lines with high inductive radiation. b. Process signal wires connected incorrectly to the termination assembly. c. Lost calibration in the processor board.	a. Re-route signal wires. b. Check and rewire. c. Recalibrate controller. (May require service call.)
No control output	a. High and low current output values were incorrectly assigned in the MA. OUTP MENU. b. Controller configured for the wrong type of control output, i.e. relay out when controlling a voltage driven element.	a. Set correct current value for mA control output. b. Set type of control output in the BASE CFG MENU to the correct type of control needed.

CALIBRATION DATA

INTRODUCTION

The 2050R base controller (main board) is factory calibrated and does not require calibration data. The main board calibration data procedure is for factory use only and is included for reference only.

Option board calibration data is entered after installing the option board. Follow the steps in the BASE CFG MENU to get to the OPTN BRD CALIBRAT entry point. (You must have a non-zero configuration password to get this field.). Enter the calibration data supplied with the option board as instructed in Table 15.

Table 15. Main/Option Board Calibration (Base Configuration Menu)

Step	Step Description	Top Display
16	**Main Board Calibration.** *UP* begins calibration at Step 16.1 (**Factory ONLY**). *SCRL* advances to Step 17 (Option Board Calibration).	MAIN BRD
16.1	**Process Input Voltage Ref. High** *UP* begins entry at most significant digit. Use *UP* or *DN* to set the digit, then *SCRL* to scroll to the next digit. Repeat for all digits. *SCRL* advances to: Step 16.1.1 if value was changed. Step 16.2 otherwise.	PROC INP
16.1.1	**Are You Sure You Want to Change Process Vref Hi?** *UP* selects YES or *DN* selects NO. *SCRL* advances to: Step 16.1 on NO. Step 16.2 on YES.	ARE YOU
16.2	**Process Input Voltage Ref. Low** *UP* begins entry at most significant digit. Use *UP* or *DN* to set the digit, then *SCRL* to scroll to the next digit. Repeat for all digits. *SCRL* advances to: Step 16.2.1 if value was changed. Step 16.3. otherwise.	PROC INP
16.2.1	**Are You Sure You Want to Change Process Vref Lo?** *UP* selects YES or *DN* selects NO. *SCRL* advances to: Step 16.2 on NO. Step 16.3 on YES.	ARE YOU

Table 15. Main/Option Board Calibration (Base Configuration Menu)

Middle Display	Bottom Display	Entry Description
CALIBRAT		NOTE: These are factory calibration values and should be altered only on the advice of authorized service personnel. Changing any or all of the 4 calibration values will cause the instrument to mark the main instrument calibration valid.
VREF HI	XXXXXXXX	= Any hexadecimal digit. See note on Step 16.
SURE?	YES NO	This step is present only to guard against accidentally changing this critical calibration value.
VREF LO	XXXXXXXX	= any hexadecimal number. See note on Step 16.
SURE?	YES NO	This step is present only to guard against accidentally changing this critical calibration value.

Table 15. Main/Option Board Calibration (Base Configuration Menu)

Step	Step Description	Top Display
16.3	**Process Input Ma. Resistance Ratio** *UP* begins entry at most significant digit. Use *UP* or *DN* to set the digit, then *SCRL* to scroll to the next digit. Repeat for all digits. *SCRL* advances to: Step 16.3.1 if value was changed. Step 16.4. otherwise.	PROC INP
16.3.1	**Are You Sure You Want to Change Process Ma. Res. Ratio?** *UP* selects YES or *DN* selects NO. *SCRL* advances to: Step 16.3 on NO. Step 16.4 on YES.	ARE YOU
16.4	**Process Input Circuit Compensation** *UP* begins entry at most significant digit. Use *UP* or *DN* to set the digit, then *SCRL* to scroll to the next digit. Repeat for all digits. *SCRL* advances to: Step 16.4.1 if value was changed. Step 16.5. otherwise.	PROC INP
16.4.1	**Are You Sure You Want to Change Process Input Circuit Compensation?** *UP* selects YES or *DN* selects NO. *SCRL* advances to: Step 16.4 on NO. Step 16.5 on YES.	ARE YOU
16.5	**Output Current Ratio** *UP* begins entry at most significant digit. Use *UP* or *DN* to set the digit, then *SCRL* to scroll to the next digit. Repeat for all digits. *SCRL* advances to: Step 16.5.1 if value was changed. Step 17. otherwise.	OUTPUT
16.5.1	**Are You Sure You Want to Change Output Current Ratio?** *UP* selects YES or *DN* selects NO. *SCRL* advances to: Step 16.5 on NO. Step 17 on YES.	ARE YOU

Table 15. Main/Option Board Calibration (Base Configuration Menu)

Middle Display	Bottom Display	Entry Description
MR RATIO	xxxxxxxx	= any hexadecimal number. See note on Step 16.
SURE?	YES NO	This step is present only to guard against accidentally changing this critical calibration value.
CKT COMP	xxxxxxxx	= any hexadecimal number. See note on Step 16.
SURE?	YES NO	This step is present only to guard against accidentally changing this critical calibration value.
MA RATIO	xxxxxxxx	= any hexadecimal number. See note on Step 16.
SURE?	YES NO	This step is present only to guard against accidentally changing this critical calibration value.

Table 15. Main/Option Board Calibration (Base Configuration Menu)

Step	Step Description	Top Display
17	**Option Board Calibration. Constants** *UP* begins calibration at Step 17.1. *SCRL* advances to step 18, Default Database entry point, in BASE CFG MENU (Table 1).	OPTN BRD
17.1	**Input 2 Voltage Ref. High** *UP* begins entry at most significant digit. Use *UP* or *DN* to set the digit, then *SCRL* to scroll to the next digit. Repeat for all digits. *SCRL* advances to: Step 17.1.1 if value was changed. Step 17.2 otherwise.	INPUT 2
17.1.1	**Are You Sure You Want to Change Input 2 Vref Hi?** *UP* selects YES or *DN* selects NO. *SCRL* advances to: Step 17.1 on NO. Step 17.2 on YES.	ARE YOU
17.2	**Input 2 Voltage Ref. Lo** *UP* begins entry at most significant digit. Use *UP* or *DN* to set the digit, then *SCRL* to scroll to the next digit. Repeat for all digits. *SCRL* advances to: Step 17.2.1 if value was changed. Step 17.3. otherwise.	INPUT 2
17.2.1	**Are You Sure You Want to Change Input 2 Vref Lo?** *UP* selects YES or *DN* selects NO. *SCRL* advances to: Step 17.2 on NO. Step 17.3 on YES.	ARE YOU

Table 15. Main/Option Board Calibration (Base Configuration Menu)

Middle Display	Bottom Display	Entry Description
CALIBRAT		NOTE: These calibration values should be altered only when installing the option board for the first time. Changing any or all of the 4 calibration values will cause the instrument to mark the option board calibration valid. Calibration data is shipped with the option board.
VREF HI	XXXXXXXX	= Any hexadecimal digit. See note on Step 17.
SURE?	YES NO	This step is present only to guard against accidentally changing this critical calibration value.
VREF LO	XXXXXXXX	= any hexadecimal number. See note on Step 17.
SURE?	YES NO	This step is present only to guard against accidentally changing this critical calibration value.

Table 15. Main/Option Board Calibration (Base Configuration Menu)

Step	Step Description	Top Display
17.3	**Input 2 Ma. Resistance Ratio** *UP* begins entry at most significant digit. Use *UP* or *DN* to set the digit, then *SCRL* to scroll to the next digit. Repeat for all digits. *SCRL* advances to: Step 17.3.1 if value was changed. Step 17.4 otherwise.	INPUT 2
17.3.1	**Are You Sure You Want to Change Input 2 Ma. Res. Ratio?** *UP* selects YES or *DN* selects NO. *SCRL* advances to: Step 17.3 on NO. Step 17.4 on YES.	ARE YOU
17.4	**Input 2 Circuit Compensation** *UP* begins entry at most significant digit. Use *UP* or *DN* to set the digit, then *SCRL* to scroll to the next digit. Repeat for all digits. *SCRL* advances to: Step 17.4.1 if value was changed. Step 17.5 otherwise.	INPUT 2
17.4.1	**Are You Sure You Want to Change Process Input Circuit Compensation?** *UP* selects YES or *DN* selects NO. *SCRL* advances to: Step 17.4 on NO. Step 17.5 on YES.	ARE YOU
17.5	**Output 2 Current Ratio** *UP* begins entry at most significant digit. Use *UP* or *DN* to set the digit, then *SCRL* to scroll to the next digit. Repeat for all digits. *SCRL* advances to: Step 17.5.1 if value was changed. Step 18 in BASE CFG MENU otherwise.	OUTPUT 2
17.5.1	**Are You Sure You Want to Change Output 2 Current Ratio?** *UP* selects YES or *DN* selects NO. *SCRL* advances to: Step 17.5 on NO. Step 18, Default Database entry point, in BASE CFG MENU on YES.	ARE YOU

Table 15. Main/Option Board Calibration (Base Configuration Menu)

Middle Display	Bottom Display	Entry Description
MR RATIO	xxxxxxxx	= Any hexadecimal digit. See note on Step 17.
SURE?	YES NO	This step is present only to guard against accidentally changing this critical calibration value.
CKT COMP	xxxxxxxx	= Any hexadecimal digit. See note on Step 17.
SURE?	YES NO	This step is present only to guard against accidentally changing this critical calibration value.
MA RATIO	xxxxxxxx	= Any hexadecimal digit. See note on Step 17.
SURE?	YES NO	This step is present only to guard against accidentally changing this critical calibration value.

PARTS AND MAINTENANCE

PARTS AVAILABILITY

The MODCELL 2050 Controller parts available for purchase are:

- Termination Assembly (124S2330-1)
- CPU Board (ac), for 205_RZ23___A (125U2951-3)*
- CPU Board (ac), for EU EMC 205_RZ12___A (125U2951-15)
- Display Assembly (125U2955-3)*
- Option Board (2050NZ10100A)*

* Recommended Spare Parts.

The Option Board provides an additional isolated universal analog input and analog output. Adding or replacing the option board requires entry of calibration data.

MAINTENANCE



CAUTION. Disconnect power before servicing.

Use lens cleaning tissue or a soft cloth for cleaning the display overlay. Do not use paper towels or industrial wipes. Remove dust from the rear of the instrument by removing it from the instrument housing and spraying exposed surfaces with non-corrosive, non-toxic, non-flammable inert dusting gas.

RECORD OF DATABASE

DESCRIPTION

This section provides tables of the database fields for planning and recording your configuration entries via the configuration menus. The database records provide a reference when entering the configuration and then a record of your configuration. Make copies of these pages as needed.

Blank fill-in fields on these tables represent configuration fields that require a selection. Fields that are grayed-out either do not require a selection or are entry points into other parts of the menu. Refer to the tables in the **Setup** section for more information on the fields and valid entries.

Fields that are logically grouped in the configuration menus are indicated in the database record with lines running along the left side of the Bottom Display Entry column. When one logical grouping immediately follows another, lines of different shading are used to distinguish the two groups.

NOTE; The database record table for the **RS-485 Menu** is included in the **Modbus Communications Supplement, IB23C650M.**

Data Base Record					
Top Display	**Middle Display**	**Bot. Disp. Entry**	**Top Display**	**Middle Display**	**Bot. Disp. Entry**
BASE CFG	****MENU****		* BRD	CALIBRAT	
MAIN PWR	FREQ		DEFAULT	DATABASE	
PROC INP	TYPE		LOCK CFG	MENUS	
PROC INP	TC TYPE		SOFTWARE	VERSION	
PROCESS	TEMP CAL		DISPLAY	VERSION	
PR TEMP=	xxxx		**INPUTS**	****MENU****	
INPUT 2	ENABLE		DECIMAL	POINT	
INPUT 2	TYPE		PROC INP	SETUP	
INPUT 2	TC TYPE		PRC TEMP	UNITS	
INPUT 2	TEMP CAL		PROC INP	*****HI	
I2 TEMP=	xxxx		PROC INP	*****LO	
OUTPUT	TYPE		PROCESS	LIN TYPE	
CONTROL	ACTION		PROC ENG	UNITS HI	
MA. OUTP	ACTION		PROC ENG	UNITS LO	
HEAT OUT	ACTION		PR FAULT	OUTPUT	
COOL OUT	ACTION		FIXED	FAULT OP	
VALVE	CALIB		PR FAULT	LEVL PCT	
CALIBRAT	OPEN POS		RECOVERY	OPTION	
CALIBRAT	CLSD POS		INPUT 2	SETUP	
HOLD PWR	UP MSG		IN2 TEMP	UNITS	
POWER UP	MODE		INPUT 2	*****HI	
RAT BIAS	ENABLE		INPUT 2	*****LO	
AUTOTUNE	ENABLE		INPUT 2	LIN TYPE	
RAMPSOAK	ENABLE		IN2 ENG	UNITS HI	
TOTALIZE	ENABLE		IN2 ENG	UNITS LO	
RS-485	ENABLE		I2 FAULT	ACTION	
TUNE	PASSWORD		I2 FAULT	VALUE	
CONFIG	PASSWORD		I2 FAULT	LEVL PCT	
CHK SUM	DATABASE		ENG UNIT	LABEL	

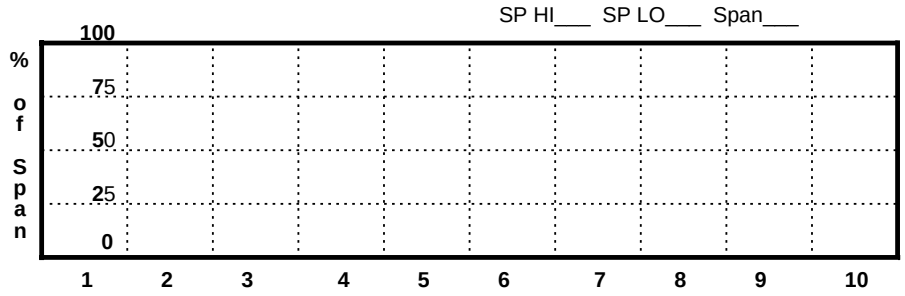
Data Base Record					
Top Display	**Middle Display**	**Bot. Disp. Entry**	**Top Display**	**Middle Display**	**Bot. Disp. Entry**
RIGHT	BAR		DI SETPT	SEL LIST	
DEV BAR	FULL SCL		**MA. OUTP**	****MENU****	
DIG INPT	****MENU****		OUTPUT	MA. HIGH	
DIGITAL	INPUT 1		OUTPUT	MA. LOW	
DIG IN 1	FUNCTION		HEAT OUT	HI LIMIT	
DIG A-M	OUT ENAB		COOL OUT	HI LIMIT	
DIG A-M	OUT VAL		OUTPUT	HI LIMIT	
A/M KEY	LOCKOUT		OUTPUT	LO LIMIT	
MAN-AUTO	ALLOWED		LIMIT IN	MANUAL	
RAMPSOAK	DI1 FUNC		POWER UP	OUTP SRC	
*****	LOCKOUT		FIXD PWR	UP OUTPT	
TOTALIZE	DI1 FUNC		RETRANS	VARIABLE	
*****	LOCKOUT		RETRANS	*****HI	
R/L KEY	LOCKOUT		RETRANS	*****LO	
LOC-REM	ALLOWED		OUTPUT 2	MA. HIGH	
DIG IN 1	ACTION		OUTPUT 2	MA. LOW	
DIGITAL	INPUT 2		**RELAYS**	****MENU****	
DIG IN 2	FUNCTION		RELAY A	SETUP	
DIG A-M	OUT ENAB		RELAY A	FUNCTION	
DIG A-M	OUT VAL		RELAY A	TRIP ACT	
A/M KEY	LOCKOUT		RELAY B	SETUP	
MAN-AUTO	ALLOWED		RELAY B	FUNCTION	
RAMPSOAK	DI2 FUNC		RELAY B	TRIP ACT	
*****	LOCKOUT		RELAY C	SETUP	
TOTALIZE	DI2 FUNC		RELAY C	FUNCTION	
*****	LOCKOUT		RELAY C	TRIP ACT	
R/L KEY	LOCKOUT		RS-485	****MENU****	
LOC-REM	ALLOWED		See	Supplement	**IB-23C650M**
DIG IN 2	ACTION				

Data Base Record					
Top Display	**Middle Display**	**Bot. Disp. Entry**	**Top Display**	**Middle Display**	**Bot. Disp. Entry**
RAT BIAS	****MENU****		SETPT 3	LO LIMIT	
RAT BIAS	TYPE		SETPT 3	INIT VAL	
RATIO	SOURCE		SETPT 4		
BIAS	SOURCE		SETPT 4	ENABLE	
RATIO	BALANCE		SETPT 4	FIXED	
BIAS	BALANCE		SETPT 4	HI LIMIT	
SETPTS	****MENU****		SETPT 4	LO LIMIT	
LOC_SETP			SETPT 4	INIT VAL	
LOC SETP	FIXED		POWER UP	SETP SRC	
LOC SETP	HI LIMIT		FIXD PWR	UP SETPT	
LOC SETP	LO LIMIT		SETPOINT	TRACKING	
LOC SETP	INIT VAL		**TOTALIZE**	****MENU****	
SETPT 2			WRAP AT	PRED CNT	
SETPT 2	ENABLE		INPUT	THRSHOLD	
SETPT 2	FIXED		TOTALIZE	IS ON / OFF	
SETPT 2	HI LIMIT		TOTALIZE	DIRECT	
SETPT 2	LO LIMIT		TOTALIZE	RATE	
SETPT 2	INIT VAL		SCALE	DEC PT	
SETPT 3			SCALE	FACTOR	
SETPT 3	ENABLE		PRESET	VALUE	
SETPT 3	FIXED		PREDETRD	COUNT	
SETPT 3	HI LIMIT				

Data Base Record					
Top Display	**Middle Display**	**Bot. Disp. Entry**	**Top Display**	**Middle Display**	**Bot. Disp. Entry**
RAMPSOAK	****MENU****		SEG *	SETUP	**See Below**
RAMPSOAK	REPEAT				
SOAK	HYST				
RAMP	HYST				
RAMPSOAK	IS ON / OFF				
RAMPSOAK	UNIT TIM				
RAMPSOAK	SEGMENTS				

SEG	START SP	END SP	SOAK TIM	RMP RATE	RELAY A	RELAY B	RELAY C	GUAR ANTD
1								
2	*							
3	*							
4	*							
5	*							
6	*							
7	*							
8	*							
9	*							
10	*							

* = Same value as previous segments end value.



Data Base Record					
Top Display	**Middle Display**	**Bot. Disp. Entry**	**Top Display**	**Middle Display**	**Bot. Disp. Entry**
ALARMS	****MENU****		ALARM 4	PRIORITY	
BEEP ON	OCCUR OF		ALARM 4	HYST	
ALRM ACK	REQD ON		**TUNE**	****MENU****	
OVERCFGD	DIAG ON		TAG	NAME	
P1 RELAY	ACTION		ON/OFF	DIFF GAP	
P2 RELAY	ACTION		GAIN	HEAT	
ALARM 1	SETUP		GAIN	COOL	
ALARM 1	TYPE			GAIN	
AL1 TRIP	IN HEAT		RESET	ENABLE	
ALARM 1	TRIP		RESET	HEAT	
ALARM 1	PRIORITY		RESET	COOL	
ALARM 1	HYST			RESET	
ALARM 2	SETUP		FIXED	MAN RSET	
ALARM 2	TYPE		MANUAL	RESET	
AL2 TRIP	IN HEAT			PREACT	
ALARM 2	TRIP		REM SETP	RATIO	
ALARM 2	PRIORITY		REM SETP	BIAS	
ALARM 2	HYST		A/M R-B	RATIO	
ALARM 3	SETUP		A/M R-B	BIAS	
ALARM 3	TYPE		POS PROP	DEADBAND	
AL3 TRIP	IN HEAT		POS PROP	PREACT	
ALARM 3	TRIP		CYCLE	TIME	
ALARM 3	PRIORITY		CROSSOVR	VALUE	
ALARM 3	HYST		CROSSOVR	BNDWIDTH	
ALARM 4	SETUP		OUTPUT	HYST	
ALARM 4	TYPE		HEAT	CYC TIME	
AL4 TRIP	IN HEAT		COOL	CYC TIME	
ALARM 4	TRIP				

The Company's policy is one of continuous product improvement and the right is reserved to modify the information contained herein without notice, or to make engineering refinements that may not be reflected in this bulletin. Micromod Automation assumes no responsibility for errors that may appear in this manual.

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