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iR2

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Measurement & Control System**



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PART 1

INTRODUCTION

1.1 Description

The **iR2™ Series** is the state-of-the-art instrument for difficult and demanding high temperature (300°C - 3000°C) applications. It is ideally suited for measurement and control applications involving metals, glass, semiconductors and more. The **iR2** is extremely fast and accurate with a response time of 10 msec and accuracy of 0.2% of full scale. Despite its extraordinary technological sophistication and performance, the **iR2** is also incredibly user friendly and simple to configure. The **iR2** is designed and manufactured in the USA to the highest quality standards backed by a 5 year extended warranty.

2-COLOR RATIO MEASUREMENT

The **iR2** measures temperature using a 2-color ratio technique in which a temperature is computed from the ratio of two different infrared frequencies, unlike a standard infrared thermometer that measures the absolute amount of infrared energy. The 2-color ratio technique is essential for accurate measurements in many common applications: when the target is obscured by smoke or steam, when the target is viewed through a window or screen that reduces energy, or when the emissivity of the target is unknown or changes. Unlike a standard infrared thermometer that determines an average temperature for everything within its field of view, the **iR2** does not require that the target completely fill the lens field of view as long as the temperature of the target is higher than the background or material in the foreground. This capability allows the **iR2** lens to be installed farther from the target, or outside a window or screen as well as more accurately measure temperatures of small and moving targets. The **iR2** can also be switched to one-color operation if required.

CAST ALUMINUM or PANEL MOUNT ENCLOSURE

The **iR2** is available in two practical packages: The **iR2C** model is an extremely rugged cast aluminum enclosure (with NEMA 4 rating) that can be mounted on any surface and is powered by 20-36 Vdc or 24 Vac. The **iR2P** model is a 1/8 DIN panel mount package with a NEMA 4 front bezel for rack or cabinet mounting with other instrumentation, and runs on 90-240 Vac power.

FULL PID CONTROL

The **iR2** is much more than the typical infrared transmitter. It is a complete autotune PID TEMPERATURE CONTROLLER in a single extremely compact enclosure (an important, unique feature). The **iR2** features a totally programmable analog output that can be programmed within a range of 0-10 Vdc or 0-20mA. The analog output is selectable as either a control output or as a calibrated retransmission of the temperature. The **iR2** also offers a choice of two Form C (SPDT) Relays or Solid State Relays for controlling or alarms. The control functions feature the full suite of capabilities from simple on-off to full Proportional Integral Derivative (PID) control. Instead of connecting a simple infrared transmitter to a separate temperature controller, the **iR2** can do it all.

BIG BRIGHT DISPLAY

The **iR2** features a big bright LED dual display. The smaller numbers display the set points or alarm points. The larger numbers (a full 21mm, .83" high) display the measured temperature. The display can be programmed to change color between green, amber and red at any set point or alarm point and the change in color is quickly seen from a distance.

FIBER OPTICS

The **iR2** comes complete with a compact NEMA 4 lens and a flexible fiber optic cable assembly. With the **iR2** it's possible to measure the temperature of targets that would simply not be visible with conventional instruments. The fiber optic cable and lens allows the instrument electronics to be kept away from the target environment where it would be subjected to higher temperatures, smoke, dust, steam or powerful electromagnetic emissions such as generated by induction heating. Both the stainless steel lens and rugged cable assembly can be replaced in the field without returning the instrument for calibration (a unique feature). The lens can operate in ambient temperatures up to 200°C without external cooling. The variable focus lens can focus on targets from any distance between 200 millimeters (8 inches) to more than 4 meters (14 feet). The 25:1 field of view is ideal for most applications. We also offer a wide selection of compatible application-specific lens assemblies and fiber optic probes developed during three decades of experience servicing the most demanding infrared temperature applications.

UNIQUE BUILT-IN LASER SIGHT

The **iR2** features a built-in laser that shows the operator precisely what the lens is seeing (a unique feature). This innovative laser illuminates the precise spot on the target that the lens is viewing, and allows the operator to focus on the target with absolute precision. The laser can be turned on to sight the target and off to make a measurement with the simple push button on the front panel, or remotely via network or serial communications. The cable and lens do not have to be disconnected and connected to a separate apparatus to provide a conventional or laser light for sighting.

Available Probe Types

L1 Lens Probe (Standard)

L2 Ceramic/Metal Tip

L3 Polymer Bolt

L4 Ejector Pin Probe

Custom application-specific lens assemblies and fiber optic probes.

Please note that the custom fiber optic assemblies are not field replaceable.

The **iR2** can control a process with simple ON-OFF control through full Autotune PID control, and everything in between. The dual control outputs can be configured for a variety of independent control and alarm applications such as heat/heat, heat/cool, heat/alarm, and more. The ramp-to-setpoint feature allows the user to define the rate of rise to setpoint, minimizing thermal shock to the load during start-up.

NOTES, WARNINGS and CAUTIONS

Following labels identifies information that is especially important to note:

- **NOTE**
- **WARNING or CAUTION**
- **IMPORTANT**



NOTE: provides you with information that is important to successfully setup and use the Programmable Digital Meter.



CAUTION or WARNING: tells you about the risk of electrical shock.



CAUTION, WARNING or IMPORTANT: tells you of circumstances or practices that can effect the meter's functionality and must refer to accompanying documents.

1.2 Safety Considerations



This device is marked with the international Caution symbol. It is important to read this manual before installing or commissioning this device as it contains important information relating to Safety and EMC (Electromagnetic Compatibility).

The iR2P instrument is a panel mount device protected in accordance with Class I of EN 61010 (115/230 AC power connections). Installation of this instrument should be done by Qualified personnel. In order to ensure safe operation, the following instructions should be followed.



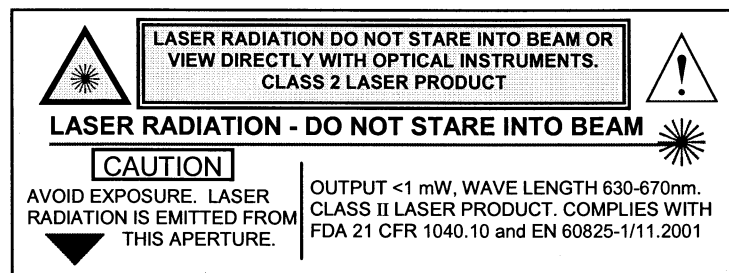
This instrument has no power-on switch. An external switch or circuit breaker shall be included in the building installation as a disconnecting device. It shall be marked to indicate this function, and it shall be in close proximity to the equipment within easy reach of the operator. The switch or circuit breaker shall not interrupt the Protective Conductor (Earth wire), and it shall meet the relevant requirements of IEC 947-1 and IEC 947-3 (International Electrotechnical Commission). The switch shall not be incorporated in the mains supply cord.



Furthermore, to provide protection against excessive energy being drawn from the mains supply in case of a fault in the equipment, an overcurrent protection device shall be installed.



- Do not exceed voltage rating on the label located on the top of the instrument housing.
- Always disconnect power before changing signal and power connections.
- Do not use this instrument on a workbench without its case for safety reasons.
- Do not operate this instrument in flammable or explosive atmospheres.
- Do not expose this instrument to rain or moisture.
- Unit mounting should allow for adequate ventilation to ensure instrument does not exceed operating temperature rating.
- Use electrical wires with adequate size to handle mechanical strain and power requirements. Install without exposing bare wire outside the connector to minimize electrical shock hazards.



- Use of Controls or Adjustments or Performance of Procedures other than those specified here may result in hazardous radiation exposure.
- Do not look at the laser beam coming out of the lens or view directly with optical instruments. Eye damage can result.
- Use extreme caution when operating the laser sighting.
- Never point the laser beam at a person.
- Keep out of reach of all children.

EMC Considerations

- Whenever EMC is an issue, always use shielded cables.
- Never run signal and power wires in the same conduit.
- Use signal wire connections with twisted-pair cables.
- Install Ferrite Bead(s) on signal wires close to the instrument if EMC problems persist.

Failure to follow all instructions and warnings may result in injury!

1.3 Before You Begin

- **Inspecting Your Shipment**

Remove the packing slip and verify that you have received everything listed. Inspect the container and equipment for signs of damage as soon as you receive the shipment. Note any evidence of rough handling in transit. Immediately report any damage to the shipping agent. The carrier will not honor damage claims unless all shipping material is saved for inspection. After examining and removing the contents, save the packing material and carton in the event reshipment is necessary.

- **Customer Service**

If you need assistance, please call the Customer Service Department, which is listed in this manual

- **To Disable Outputs**

Standby mode is useful during setup of the controller or when maintenance of the system is necessary. When the controller is in standby, it remains in the ready condition but all outputs are disabled. This allows the system to remain powered and ready to go.

- When the controller is in "RUN" mode, **push ↵ twice** to disable all outputs and alarms. It is now in "STANDBY" mode. Push ↵ once more to resume "RUN" mode.

Tip: **PUSH ↵ TWICE** to disable the system during an EMERGENCY.

- **To Reset the Meter**

When the controller is in the "MENU" mode, **push ▼ down button once** to direct controller one step backward of the top menu item. **Push ▼ twice** to reset controller, prior to resuming "Run" mode except after "Setpoints" and "Alarms" that will go to the "Run" mode without resetting the controller.

**PART 2
SETUP**

2.1 iR2P Controller Views & Dimensions

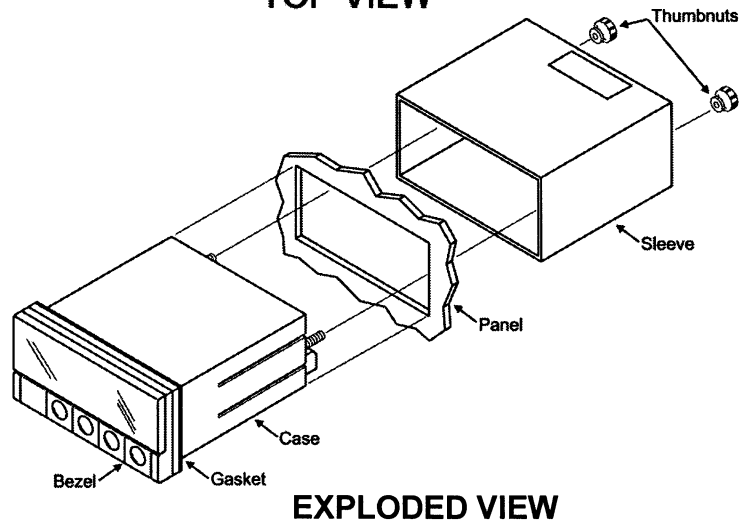
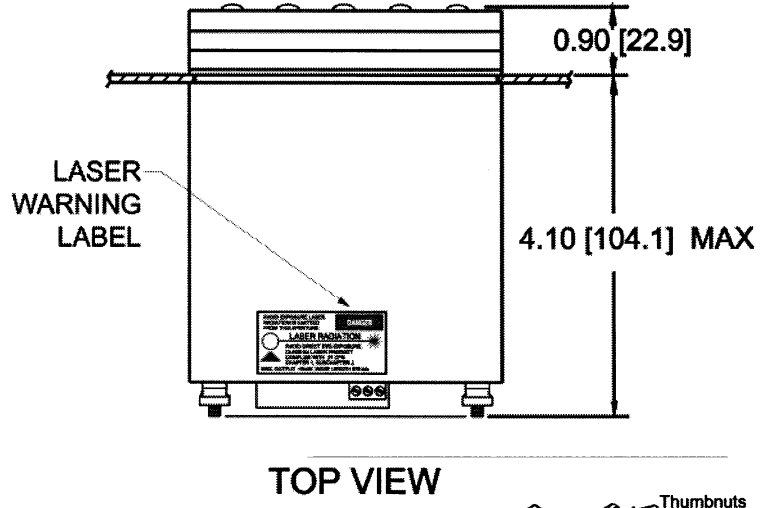
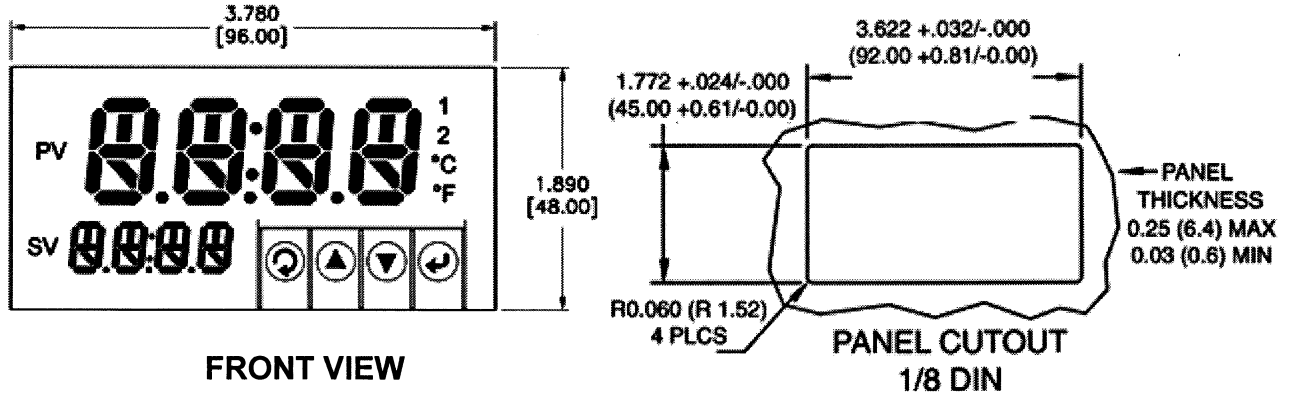


Figure 2.1 Front Panel Display and Dimensions of Model: iR2P

2.2 iR2C Controller Views & Dimensions.

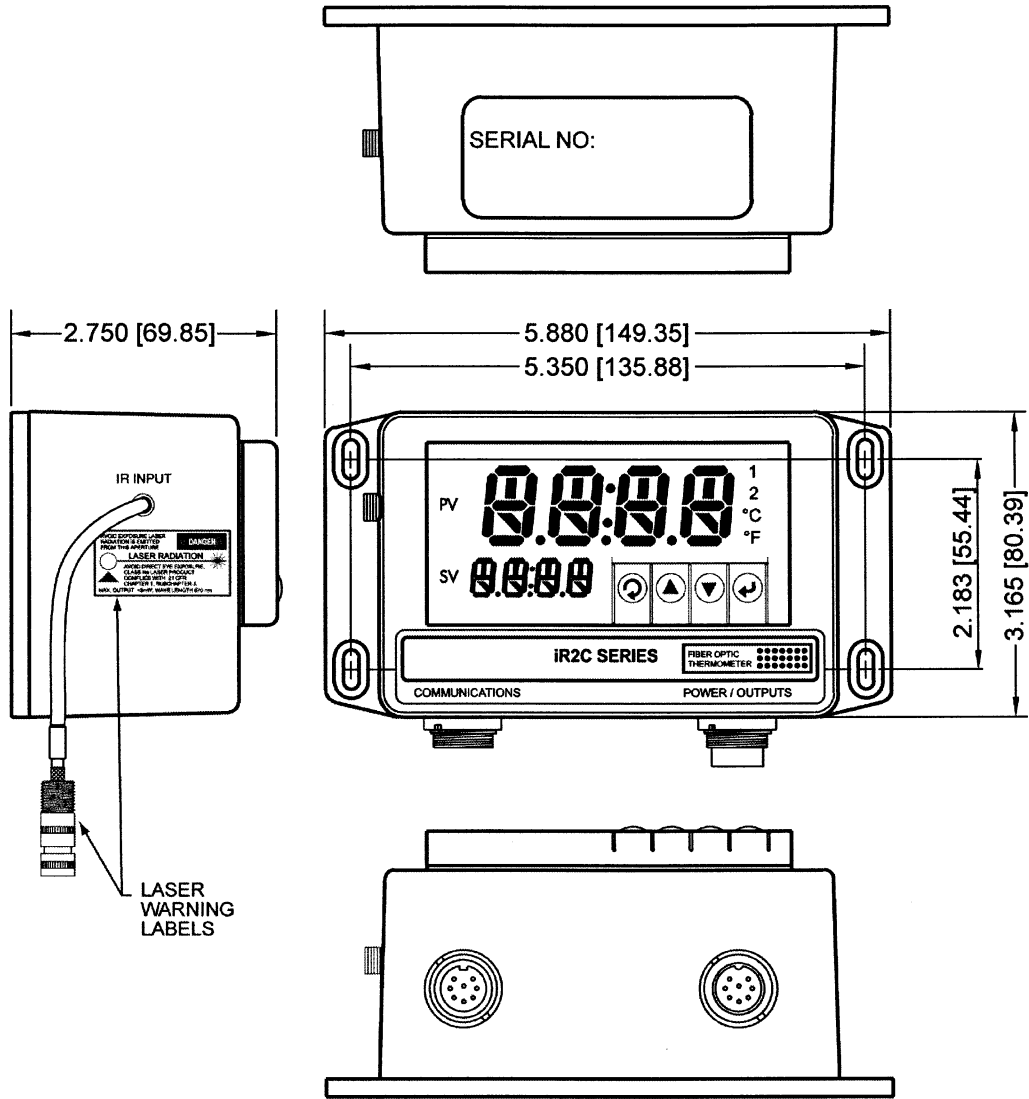


Figure 2.2 Front Panel Display and Dimensions of Model: iR2C

2.3 Front Panel Annunciations

1	Output 1/Setpoint 1/Alarm 1 indicator
2	Output 2/Setpoint 2/Alarm 2 indicator
°C	C unit indicator
°F	°F unit indicator
⊙	Changes display to Configuration Mode and advances thru menu items*
▲	Used in program mode and peak recall*
▼	Used in program mode and valley recall*
┘	Accesses submenus in Configuration Mode and stores selected values*

- See Part 3 Operation: Configuration Mode

Table 2.1 Front Panel Annunciations

2.4 Side and Rear Panel Connections

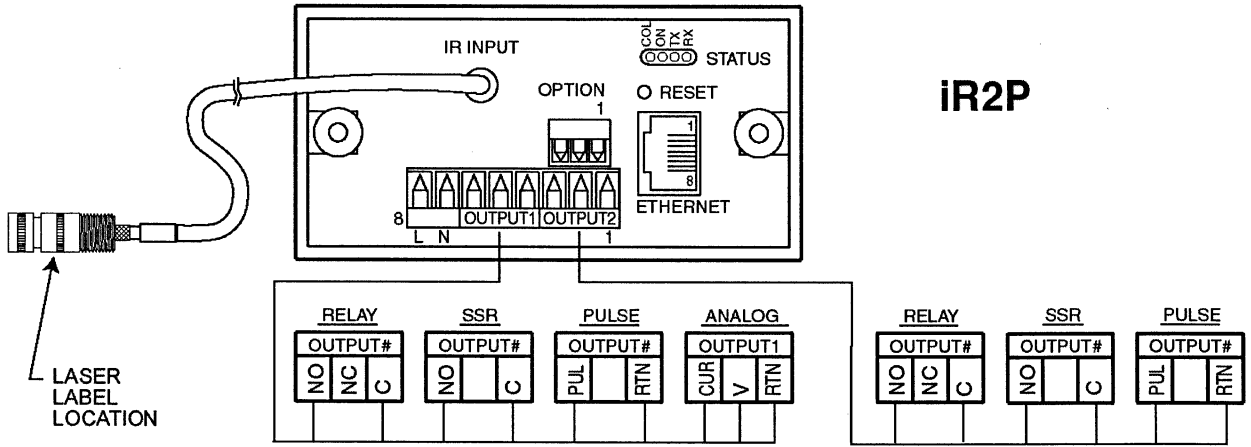


Figure 2.3A iR2P Rear Panel Power and Output Connector Labels.

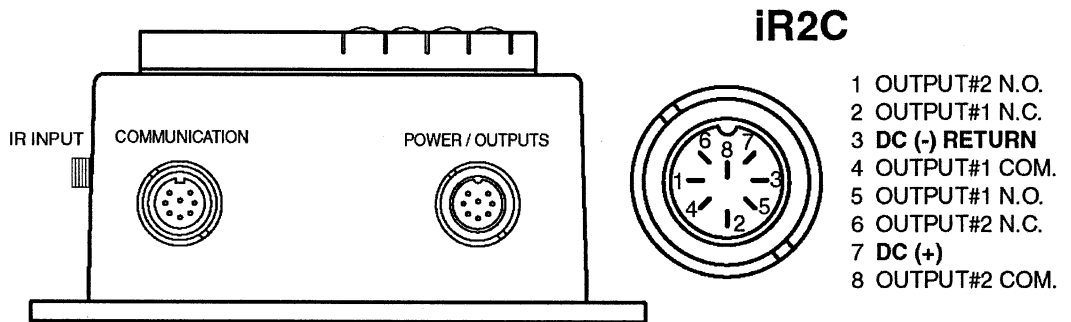


Figure 2.3B iR2C Side Panel Power and Output Connector Labels.

POWER	iR2C: Controller 20-36 Vdc power: cast aluminum enclosure iR2P: Controller 90-240 Vac power: 1/8 DIN Panel mount
IR INPUT	Input Connector: All models
OUTPUT 1	Based on one of the following models: Relay SPDT Solid State Relay Pulse Analog Output (Voltage and Current)
OUTPUT 2	Based on one of the following models: Relay SPDT Solid State Relay Pulse.
OPTION	Based on one of the following models: RS232C or RS-485 Serial Communication with programmable Protocols and Parameters.

Table 2.2 Rear Panel Connector Descriptions

2.5 Electrical Installation

2.5.1 Power Connections.



WARNING: Do not connect ac power to your meter until you have completed all input and output connections. Failure to do so may result in injury!

Connect the main power connections as shown in **Figure 2.4**

Fuse recommendation: For 110 Vac use 100 mA (T) fuse
For 220 Vac use 50 mA (T) fuse

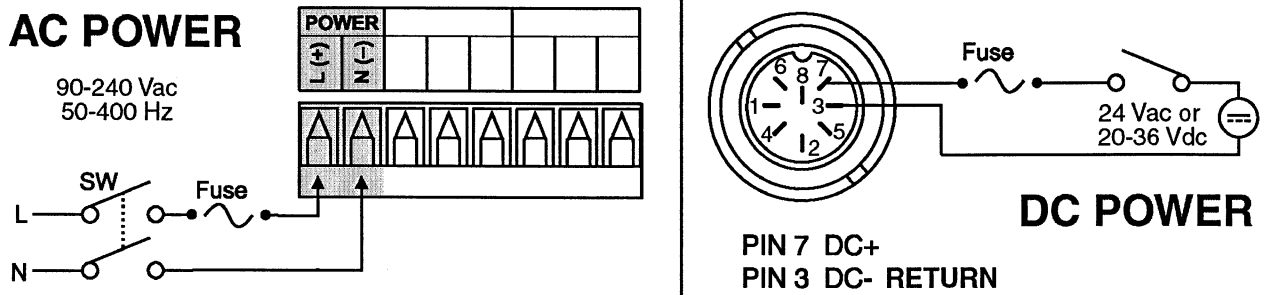


Figure 2.4 ac Power (iR2P) and dc Power (iR2C) Connections.

2.5.2 IR Input Connection.

Refer to **Figure 2.3** for hookup of Lens Probe and Fiber optic Probes.

When configuring your controller, select Lens Probe and Fiber Optic Probe type, in the IR Input Setup menu for your desired application (see **Part 3**).

2.5.3 Output Connections.

This meter has two factory-installed outputs. The SPDT Mechanical Relay, SPST Solid State Relay, Pulse and Analog Output Connection are shown in **Figure 2.3** Rear Panel Power and Output Connector labels.

Note: This meter has snubber circuits designed to protect the contacts of the mechanical relays when switching inductive loads (i.e. solenoids, relays). These snubbers are internally connected between the Common (C) and Normally Open (NO) relay contacts of Output 1 and Output 2. If you have an inductive load connected between the Common (C) and Normally Closed (NC) contacts of the mechanical relays and want to protect them from the rush current during the switching period, connect an external snubber circuit between Common (C) and Normally closed (NO) contacts as indicated in the figure below.

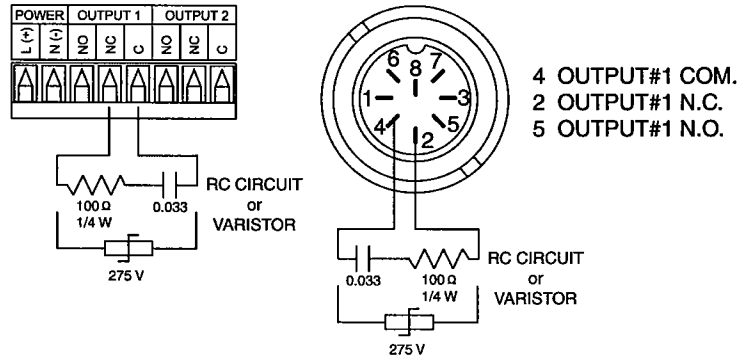


Figure 2.5 Snubber Circuits Wiring Hook up

2.5.4 Serial Communication Connections.

This meter may also have a programmable communication output. The RS232 and RS485 Output Wiring Connections are shown below.

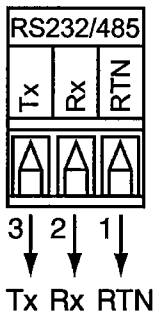


Figure 2.6A RS-232



Figure 2.6B RS-485

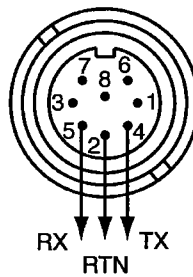


Figure 2.6C RS-232

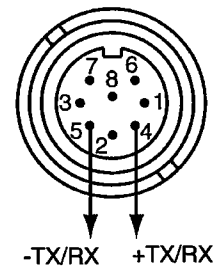
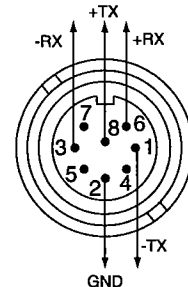
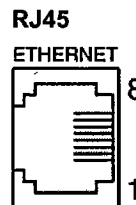


Figure 2.6D RS-485

2.5.5 Ethernet Connections.

This meter may also have a programmable ethernet output. The Wiring Connections are shown below.

M12	RJ-45 Pin	Name	Description
3	6	-Rx	-Receive Data
2	5		Ground
6	3	+Rx	+Receive Data
1	2	-Tx	-Transmit Data
8	1	+Tx	+Transmit Data



- M12**
- 1 -TX
 - 2 GROUND
 - 3 -RX
 - 6 +RX
 - 8 +TX

Figure 2.7 Ethernet Wiring Hook up

PART 3

Operation: Configuration Mode

3.1 Introduction

The Controller has two different modes of operation. The first, Run Mode, is used to display values for the process variable, and to display or clear peak and valley values. The other mode, Menu Configuration Mode, is used to navigate through the menu options and configure the controller. Part 3 of this manual will explain the Menu Configuration Mode. For your controller to operate properly, the user must first "program" or configure the menu options.

Turning your Controller On for the First Time

The Controller becomes active as soon as it is connected to a power source. It has no On or Off switch. The Controller at first momentarily shows the software version number, followed by reset ("RS"), and then proceeds to the Run Mode.

BUTTON	Function in Configuration Mode
⏏	<ul style="list-style-type: none"> To enter the Menu, the user must first press ⏏ button. Use this button to advance/navigate to the next menu item. The user can navigate through all the top-level menus by pressing ⏏. While a parameter is being modified, press this button to escape without saving the parameter.
▲	<ul style="list-style-type: none"> Press the up ▲ button to scroll through "flashing" selections. When a numerical value is displayed press this key to increase value of a parameter that is currently being modified. Holding the ▲ button down for approximately 3 seconds will speed up the rate at which the set point value is increments. In the Run mode, pressing ▲ causes the display to flash the "PEAK" value – press again to return to the Run mode.
▼	<ul style="list-style-type: none"> Press the down ▼ button to go back to a previous Top Level Menu item. Press this button <u>twice</u> to reset the controller to the Run Mode. When a numerical value is flashing (except set point value) press this button to scroll digits from left to right allowing the user to select the desired digit to modify. When a setpoint value is displayed press this button to decrease value of a setpoint that is currently being modified. Holding the ▼ button down for approximately 3 seconds will speed up the rate at which the set point value decrements. In the Run mode, pressing ▼ causes the display to flash the "VALY "(Valley) value – press again to return to the Run mode.
↵	<ul style="list-style-type: none"> Press this button to access the submenus from a Top Level Menu item. Press this button to store a submenu selection or after entering a value — the display will flash a "StRd" message to confirm your selection. To reset flashing Peak or Valley press ENTER. In the run mode, press ENTER twice to enable standby mode with flashing "StbY".

Table 3.1 Front Panel Push Buttons' Functions Descriptions

NOTE:

- Reset: Except for Set Points and the Alarms, modifying any setting of the menu configuration will reset the controller prior to resuming run mode. Every Menu underlined item, number, or state is the factory default/preset value.

3.2 Menu Configuration.

Note: It is recommended that you put the controller in the standby mode for any configuration change other than setpoints & alarms.

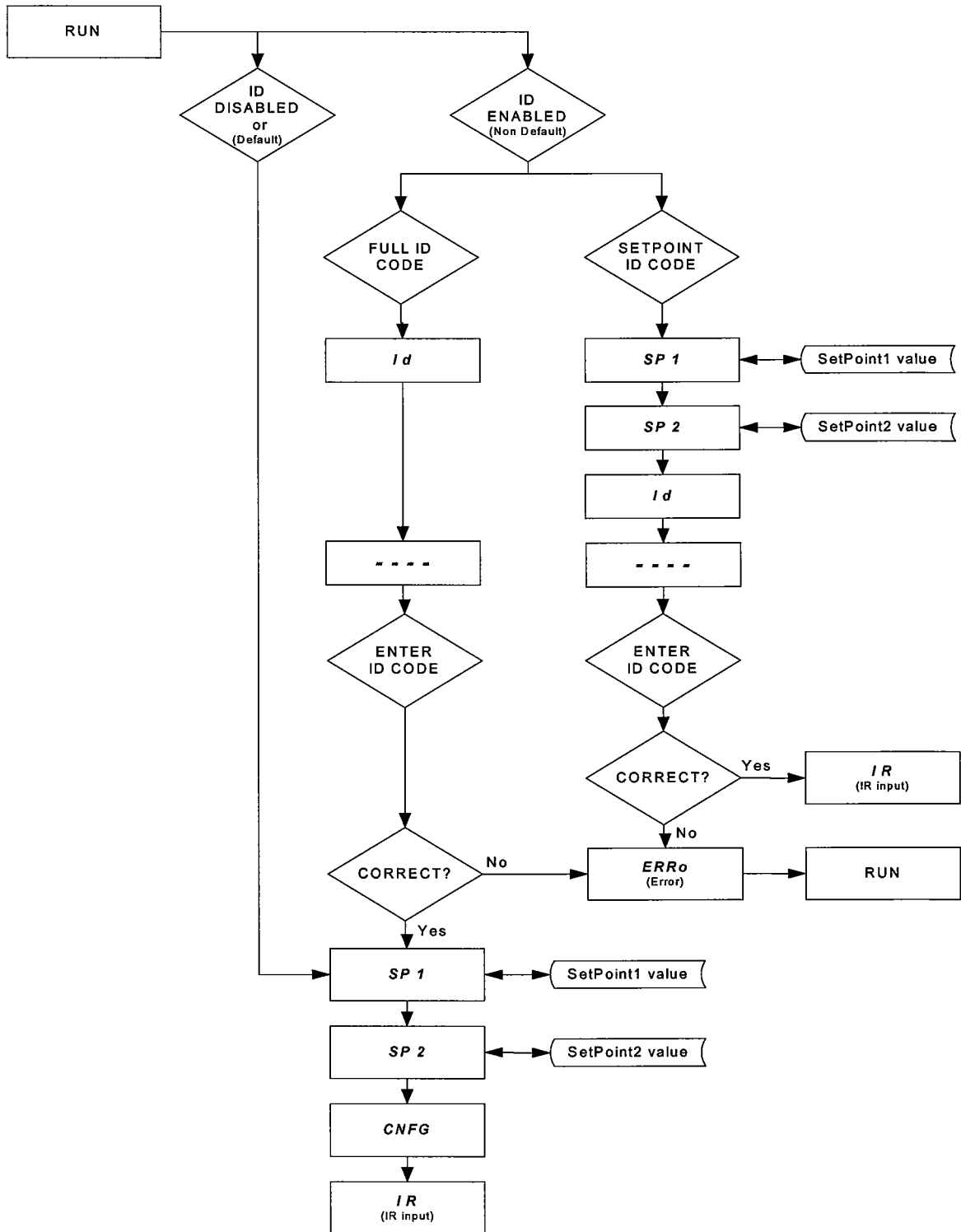


Figure 3.1 Flow Chart for ID and Setpoints

3.2.1 ID Number

SEE ID MENU SELECTION IN CONFIGURATION SECTION FOR ENABLE/DISABLE OR CHANGE ID CODE.

Note: If ID Code is **Disabled** or set as **Default** (0000) the menu will skip the ID step to Set Point Menu.
 If ID Code is set to **Full** Security Level and user attempts to enter the Main Menu, they will be prompted for an ID Code.
 If ID Code is set to **Setpoint/ID** Security Level and user attempts to enter the Configuration Menu, he will be prompted for an ID Code.

Display	Action	Response
		ENTERING YOUR NON-DEFAULT FULL SECURITY ID NUMBER.
	Press \cup	1) Display shows "I d".
	Press \downarrow	2) Display advances to " _ _ _ _ "
	Press \blacktriangle and \blacktriangledown	3) Press \blacktriangle to increase digit 0-9. Press \blacktriangledown to activate next digit (flashing). Continue to use \blacktriangle and \blacktriangledown to enter your 4-digit ID code.
	Press \downarrow	4) If the correct ID code is entered, the menu will advance to the Set Point 1 menu, otherwise an error message "ERRo" will be displayed and the controller will return to the Run mode.

Note: To change ID Code see ID menu in the Configuration section.

		ENTERING YOUR NON-DEFAULT SETPOINT/ID SECURITY ID NUMBER
	Press \cup	5) Display shows "SP1" Set Point 1 menu.
	Press \cup	6) Display shows "SP2" Set Point 2 menu.
	Press \cup	7) Display shows "I d" ID Code menu.
	Press \downarrow	8) Display advances to " _ _ _ _ "
	Press \blacktriangle and \blacktriangledown	9) Use \blacktriangle and \blacktriangledown to change your ID code.
	Press \downarrow	10) If correct ID Code is entered, the display will advance to the "I R" IR Input Configuration menu, otherwise the error message "ERRo" will be displayed and the controller will return to the Run mode.

Note:

- To prevent unauthorized tampering with the setup parameters, the controller provides protection by requiring the user to enter the ID Code before allowing access to subsequent menus. If the ID code entered does not match the ID code stored, the controller responds with an error message and access to subsequent menus will be denied.
- Tip:** Use numbers those are easy for you to remember. If the ID code is forgotten or lost, call customer service with your serial number to access and reset the default to "0000".

3.2.2 SetPoints.

Display	Action	Response
		SETPOINT 1
	Press \cup	1) Press \cup , if necessary until "SP1" prompt appears.
	Press \downarrow	2) Display shows previous value of "Setpoint 1" with 1 st digit flashing.
	Press \blacktriangle and \blacktriangledown	3) Press \blacktriangle and \blacktriangledown to increase or decrease setpoint 1 respectively.
		Note: Holding \blacktriangle and \blacktriangledown buttons down for approximately 3 seconds will speed up the rate at which the set point value increments or decrements.
	Press \blacktriangle and \blacktriangledown	4) Continue to use \blacktriangle and \blacktriangledown to enter your 4-digit Setpoint1 value.

Press ↵ **5)** Display shows **"StRd"** stored message momentarily and then advances to **"SP2"**, only if a change was made, otherwise press ⏏ to advance to **"SP2"** Set Point 2 menu.

SETPOINT 2:

Press ↵ **6)** Display shows previous value of setpoint 2 with 1st digit flashing.
 Press ▲ and ▼ **7)** Press ▲ or ▼ to increase or decrease setpoint 2 respectively.

Note: Holding ▲ or ▼ buttons down for approximately 3 seconds will speed up the rate at which the set point value is increments or decrements.

Press ↵ **8)** Display shows **"StRd"** stored message momentarily and then advances to **"CNFG"**, only if a change was made, otherwise press ⏏ to advance to **"CNFG"** Configuration Menu.

3.2.3 Configuration Menu.

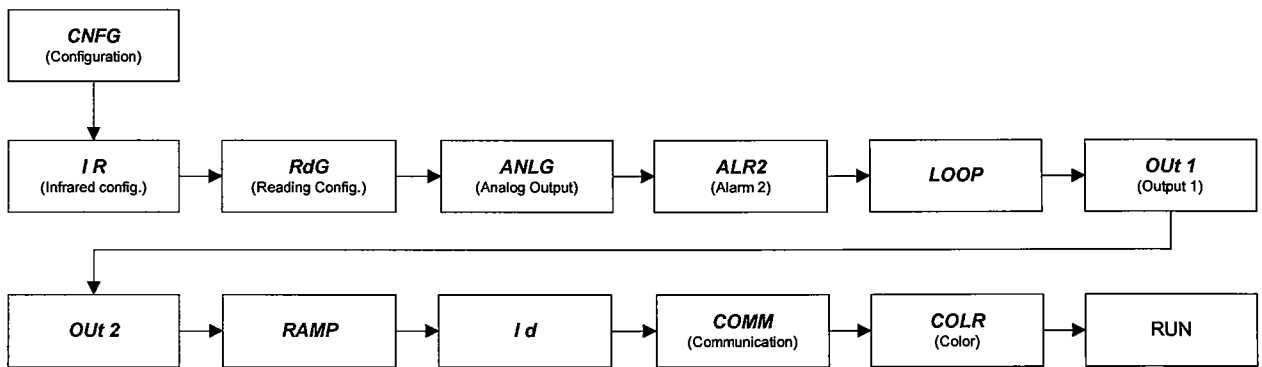


Figure 3.2 Flow Chart for Configuration Menu

Display	Action	Response
Enter Configuration Menu:		
Press ⏏		1) Press ⏏, if necessary, until "CNFG" prompt appear.
Press ↵		2) Display advance to "IR" IR Input Setup Menu.
Press ⏏		3) Pressing and releasing ⏏ to scroll through all available menus of Configuration section.

3.2.4 IR Input Setup Menu

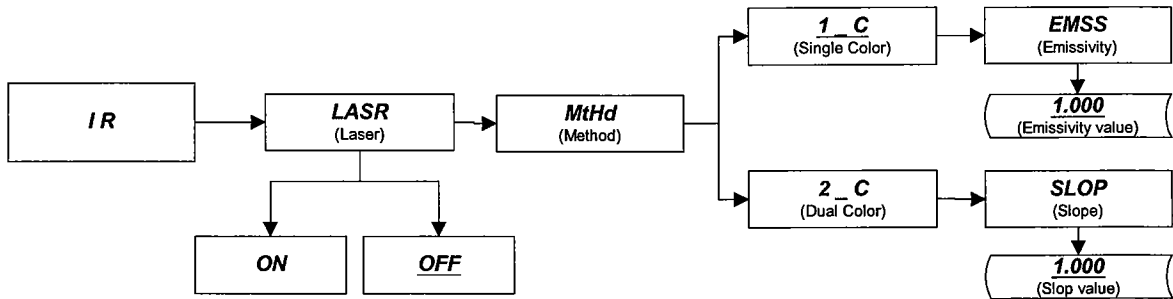


Figure 3.3 Flow Chart for IR Input Setup Menu

- **Laser Sight Control**
Note:

- The IR2 is equipped with a built-in laser that shows the operator precisely what the lens is seeing (a unique feature). This innovative laser illuminates the precise spot on the target that the lens is viewing, and allows the operator to focus while aiming on the target with absolute precision. The laser can be turned on to sight the target and off to make a measurement with the following procedure with the front panel push buttons, or remotely via network or serial communications. The cable and lens do not need to be disconnected and connected to a separate apparatus to provide a conventional or laser light for targeting.

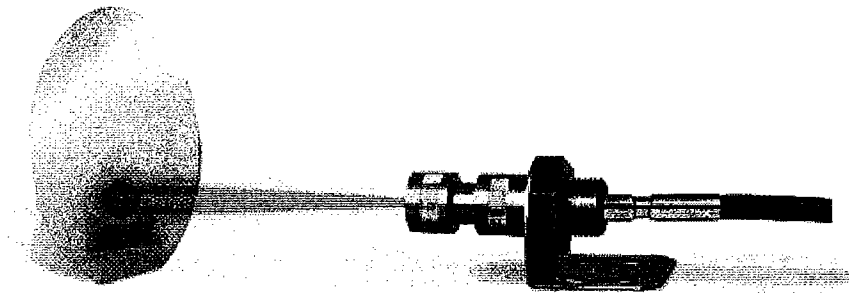


Figure 3.4 Targeting by BUILT-IN LASER SIGHT thru Lens Probe and Fiber Optic Cable.

Display	Action	Response
		ENTER IR INPUT SETUP MENU:
	Press \cup	1) Press \cup , if necessary, until "CNFG" prompt appears.
	Press \downarrow	2) Display advance to "IR" IR Input Setup Menu.
		LASER SIGHT CONTROL SUBMENU:
	Press \downarrow	3) Display shows "LASR" Laser Sight Control menu.
	Press \downarrow	4) Display flashes "OFF" as Laser Sight is being switched off, as default.

Press ▲

5) To turn on the BUILT-IN LASER SIGHT as display flashes "ON" the above figure illustrated through Lens Probe and Fiber Optic cable, or to turn it off, by selecting "OFF".



WARNING: While the laser beam is on, align the sensor head with respect to the target area. Then, turn-off the laser beam before leaving the Configuration menu. The laser beam can only be turned on during the Configuration menu.

Note: The variable focus lens can focus on targets from any distance between 200 millimeters (8 inches) to more than 4 meters (14 feet). The 25:1 field of view is ideal for most applications.

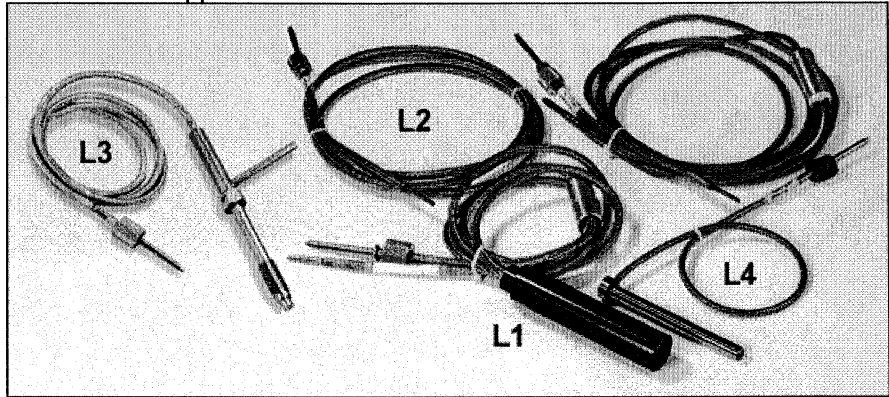


Figure 3.5 Available Probe Types

- **Available Probe Types:**
 - L1 Lens Probe (Standard)
 - L2 Ceramic/Metal Tip
 - L3 Polymer Bolt
 - L4 Ejector Pin Probe

Custom application-specific lens assemblies and fiber optic probes are illustrated in Figure 3.5.

- **IR Thermometry Method Selection**

Press ↓

6) Display shows "StRd" stored message momentarily and then advances to the "MtHd" IR Thermometry Method Selection menu.

ENTER "2 - C" DUAL / 2-COLOR METHOD MENU:

Press ↓

7) Display flashes "2 - C" Dual / 2 - Color Method Menu (as default) or "1 - C" Single Color Method.

Note:

- **"1 - C", Single Color (Wavelength) Measurement Method:** The basic principle of this method design measures total IR Radiation (as form of Thermal Radiation) energy emitted from a surface target at a prescribed wavelength.

- **2 – C”, Dual / 2 - Color (Wavelength) Ratio Measurement Method:** For more sophisticated applications where absolute accuracy is critical, and where the product is undergoing a physical or chemical change, Dual / 2- Color (Wavelength) Ratio Thermometry Method directly measures the ratio of infrared (spectral) energy emitted from the target at two different wavelengths (spectral band), rather than the absolute energy at one wavelength as “1 – C” method. The advantage of this method is that temperature readings are independent of emissivity fluctuations and /or sight path obscurations or disturbances, and are automatically compensated for moving target.
- **Sight path obscurations or disturbances:** Gases, water vapor, dust, and other aerosols in the sight path of a sensor may affect the temperature reading. Using one of the "atmospheric windows" in the IR region (i.e., areas of the IR spectrum that provide maximum loss-free transmission through water vapor) greatly reduces measurement errors. Since both optical channels are equally attenuated, a 2- Color ratio measurement is generally immune to sight path obscurations.

Press ▲

8) To select “1 – C” or “2 – C” for your choice of Measurement Method. Go to step **12)** if “1 – C” is your selection otherwise continue to next step.

Press ↵

9) Display shows “StRd” stored message momentarily and then advances to the “SLOP” Slope Adjustment Menu. If “2 – C” was selected.

Note:

- Materials for which emissivity does change equally at different wavelengths are called **gray bodies**. Materials for which this is not true are called **non-gray bodies**.
- “SLOP” Slope Adjustment: Phenomena which are non-dynamic in nature, such as the non-gray bodiness of materials, can be compensated with by biasing the ratio of the wavelengths accordingly. This adjustment is called **slope**. The appropriate slope setting must be determined experimentally.

Press ↵

10) Display shows “1.000” Slope Value with the first digit flashing.

Press ▲ and ▲

11) To modify the value of Slope Value for your choice of setting.

ENTER “2 – C” DUAL / 2-COLOR METHOD MENU:

Press ↵

12) From step **8)**, Display shows “StRd” stored message momentarily and then advances to the “EMSS” Emissivity Setting Menu. If “1 – C” Single Color Method was chosen.

Note:

- **Emissivity:** Emissivity is a modifying factor used in single color temperature measurement to achieve a correct temperature reading. Emissivity, or radiating efficiency, of most materials is a function of surface condition, temperature and wavelength of measurement. This quality defines the fraction of radiation emitted by an object as compared to that emitted by a perfect radiator (blackbody) at the same temperature. Emissivity is used to calculate the true temperature of an object from its measured brightness or spectral radiance. Emissivity is determined in part by the type of material and its surface condition, and may vary from close to zero (for a highly reflective mirror) to almost 1 (for a blackbody simulator). Because an object's emissivity may also vary with wavelength.

- There is typically a lot of confusion regarding **emissivity error**, but the users need to remember only four things:
 1. IR sensors are inherently colorblind.
 2. If the target visually reflective (like a mirror), beware – you will measure not only the emitted radiation, as desired, but also reflected radiation.
 3. If you can see through it, you need to select IR filtering (e.g., glass is opaque at 5 μm).
 4. Nine out of ten applications do not require absolute temperature measurement. Repeatability and drift-free operation yield close temperature control.

- How to **determine emissivity**? – There are two methods for obtaining emissivity of a material:
 1. By referring to The Published Tables, as Values for the total emissivity of various surfaces, as well as spectral emissivity at a given temperature have been tabulated. Use this web link:
<http://www.omega.com/literature/transactions/volume1/emissivitya.html> for obtaining emissivity value from the complete listing of Emissivity of Common Materials or refer to Appendix A and B.
 2. By comparing the IRT (Infrared Thermometer) measurement with a simultaneous measurement obtained by thermocouple or resistance thermometer and adjusting the emissivity setting until the IRT reads the same.

- Common Observation on Emissivity:

Material Class	Properties	EMISSION
Opaque, Non-Metallic	High /stable	85 – 9.0
Un-oxidized, Metallic	Low/medium	.2 - .05
Gold / Silver / Aluminum	Reflective / difficult to measure	.02 / .03 / .04

Table 3.2 Common Observation on Emissivity

3.2.5 Reading Configuration.

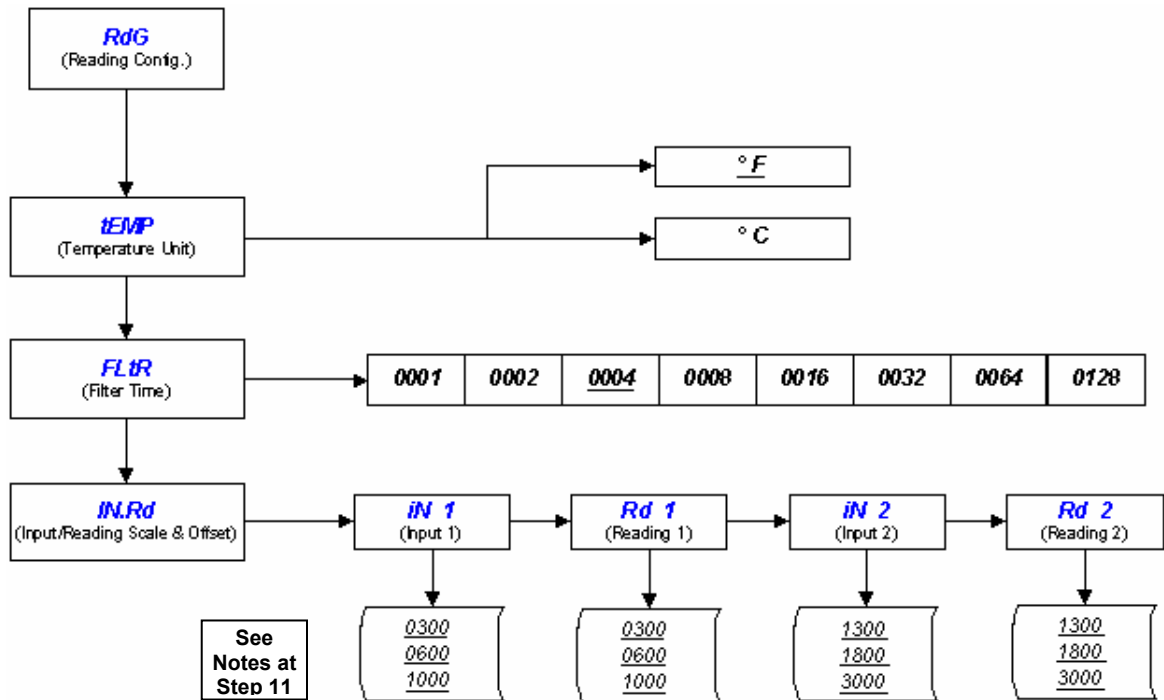


Figure 3.6 Flow Chart for Reading Configuration Menu

Display	Action	Response
ENTER READING CONFIGURATION MENU:		
	Press \cup	1) Press \cup , if necessary, until "CNFG" prompt appears.
	Press \downarrow	2) Display advances to "IR" IR Input Setup Menu.
	Press \cup	3) Display advances to "RdG" Reading Configuration menu.
	Press \downarrow	4) Display advances to "tEMP" Temperature Unit Select Submenu.
TEMPERATURE UNIT SELECT SUBMENU:		
	Press \downarrow	5) Display flashes "°F" Fahrenheit Degree (default) or previous selection, "°C" Celsius Degree.
	Press \blacktriangle	6) To select your choice of Temperature Unit.
	Press \downarrow	7) Display shows "StRd" stored message momentarily and then advances to "FLtR" Filter Time Constant.
FILTER TIME CONSTANT SUBMENU:		
	Press \downarrow	8) Display flashes previous selection for filter constant.
	Press \blacktriangle	9) Scroll through the available selections: 0001, 0002, 0004, 0008, 0016, 0032, 0064, and 0128. – Default is 0004
	Press \downarrow	10) Display shows "StRd" stored message momentarily only, if change was made, otherwise press \cup to advance to "IN.Rd" Input/Reading Scale & Offset Submenu.

Note:

- For PID control select filter value 0001-0004. A filter value of 2 is approximately equal to 1 sec. RC low pass time constant.
- The Filter Time Constant submenu allows the user to specify the number of readings stored in the digital averaging filter.

ENTER INPUT/READING SCALE AND OFFSET SUBMENU

This menu allows users to utilize the 2-data point method for scaling the meter to display meaningful engineering readings.

Note: Do not change these values unless you are converting to Kelvin.

Example for Model iR2*-300: to convert from degrees Fahrenheit (°F) to absolute degrees Kelvin (°K) as displayed for reading with two known points as following:

- **Point 1:** "**IN 1**" to be entered with value "**332**"
"**Rd 1**" to be entered with value "**573**"
As known as 32 °F = 573 °K
- **Point 2:** "**IN 2**" to be entered with value "**512**"
"**Rd 2**" to be entered with value "**673**"
As known as 212 °F = 673 °K

Note:

- For Model iR2*-1000: Do not enter "**IN.Rd**" values below 1000.
- For Model iR2*-600: Do not enter "**IN.Rd**" values below 600.
- For Model iR2*-300: Do not enter "**IN.Rd**" values below 300.

- Press ↵ 11) Press ↵ at the "**IN.Rd**" prompt. Display shows "**IN 1**" Input 1 submenu.
- Press ↵ 12) Display shows Input 1 value with 1st digit flashing.
- Press ▲ and ▼ 13) Use ▲ and ▼ buttons to enter "**IN 1**" value as above example: "**332**"
- Press ↵ 14) Display advances to "**Rd 1**" Reading 1 submenu.
- Press ▲ and ▼ 15) Use ▲ and ▼ buttons to enter "**Rd 1**" value as above example: "**573**"
- Press ↵ 16) Display shows "**IN 2**" Input 2 submenu.
- Press ↵ 17) Display shows Input 2 value with 1st digit flashing.
- Press ▲ and ▼ 18) Use ▲ and ▼ buttons to enter "**IN 2**" value as above example "**512**"
- Press ↵ 19) Display advances to "**Rd 2**" Reading 2 submenu.
- Press ▲ and ▼ 20) Use ▲ and ▼ buttons to enter "**Rd 2**" value as above example "**673**"
- Press ↵ 21) Display flashes "**StRd**" "stored message momentarily and then advances to "**ANLG**" Analog Output menu, if change was made.

3.2.6 Analog Output

This unit is equipped with two physical outputs that can only be configured as follows:

- **Analog Out & Alarm 2,**
- **Analog Out & Output 2**
- **Output 1 & Alarm 2**
- **Output 1 & Output 2**

Analog Output is available only, if Analog output option board is factory installed.

Note: If Analog Output Option is installed, the controller will skip to Alarm 2 menu.

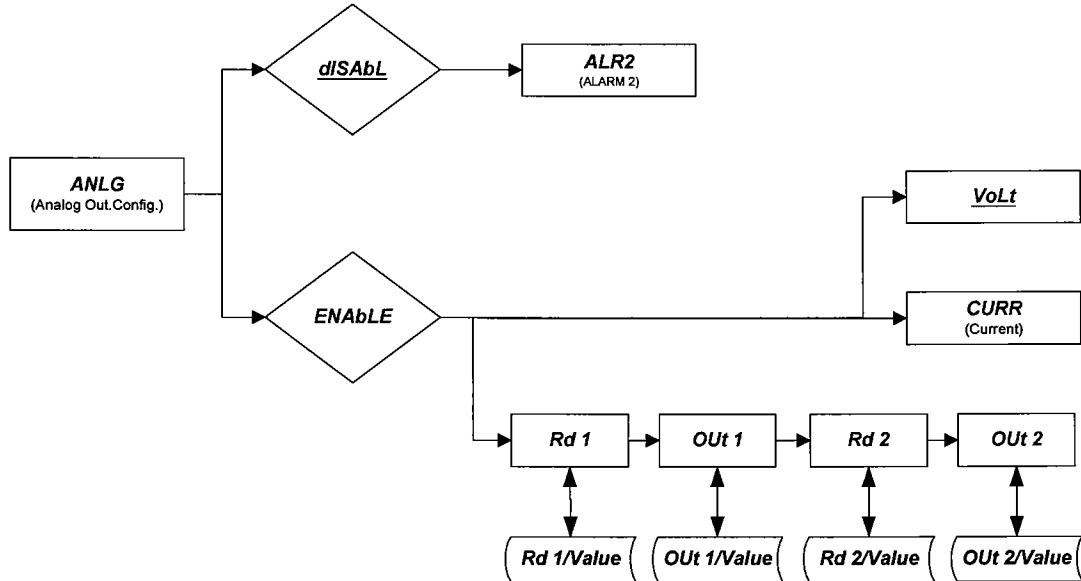


Figure 3.7 Flow Chart for Analog Output Menu.

Display	Action	Response
		ENTER ANALOG OUTPUT MENU:
	Press \cup	1) Press \cup , if necessary, until "CNFG" prompt appears.
	Press \downarrow	2) Display advances to "IR" IR Input Setup Menu.
	Press \cup	3) Press \cup , if necessary, until Display advances to "ANLG" Analog Output menu.
	Press \downarrow	4) Display advances to Analog Output "ENbL" Enable or "dSbL" Disable submenu and flashes the previous selection.
		ANALOG OUTPUT ENABLE/DISABLE SUBMENU:
	Press \blacktriangle	5) Scroll though the available selection until "ENbL" displays to use Analog Output.
	Press \downarrow	6) Display shows "StRd" stored message momentarily only if \blacktriangle button was pressed and then flashes "CURR" or "VoLt" submenu. Otherwise press \cup also to advances to "CURR" or "VoLt" Current/Voltage submenu.

Note:

- If "dSbL" Analog Output **Disabled** was selected, all submenus of Analog Output menu will be skipped and meter will advanced to "ALR2" Alarm 2 menu.
- If "ENbL" Analog Output **Enabled** was selected, Output 1 will be automatically **Disabled**, and reassigned as Analog Output.

CURRENT/VOLTAGE OUTPUT SUBMENU:

- Press ↵ 7) Display flashes **"CURR"** Current or **"VoLt"** Voltage.
Press ▲ 8) Scroll through the available selection: **Current** or **Voltage**. (Example **"VoLt"**).
Press ↵ 9) Display shows **"StRd"** stored message momentarily and then advances to **"Rd 1"** submenu only if it was changed, otherwise press ⏏ to advances to **"Rd 1"** Reading 1 submenu.

3.2.7 Analog Output Scale & Offset

READING 1

- Press ↵ 10) Display flashes 1st digit of previous "Reading 1" value.
Press ▲ and ▼ 11) Enter "Reading 1" value. (Example 0000).
Press ↵ 12) Display advances to **"Out.1"** Out 1 submenu
OUT 1
Press ↵ 13) Display flashes 1st digit of previous "Out 1" value.
Press ▲ and ▼ 14) Enter "Out 1" value. (Example 00.00).
Press ↵ 15) Display advances to **"Rd 2"** Reading 2 submenu.

READING 2

- Press ↵ 16) Display flashes 1st digit of previous "Reading 2" value.
Press ▲ and ▼ 17) Enter "Reading" 2 value. (Example 9999).
Press ↵ 18) Display advances to **"Out.2"** Out 2 submenu.
OUT 2
Press ↵ 19) Display flashes 1st digit of previous Out 2 value.
Press ▲ and ▼ 20) Enter Out 2 value. (Example 10.00).
Press ↵ 21) Display advances to the **"ALR2"** Alarm 2 menu.

3.2.8 Alarm 1 and 2

This unit is equipped with two physical outputs that can only be configured as following four cases:

- Analog Out & Alarm 2,
- Analog Out & Output 2
- Output 1 & Alarm 2
- Output 1 & Output 2

Analog Output is available only, if Analog output option board is factory installed.

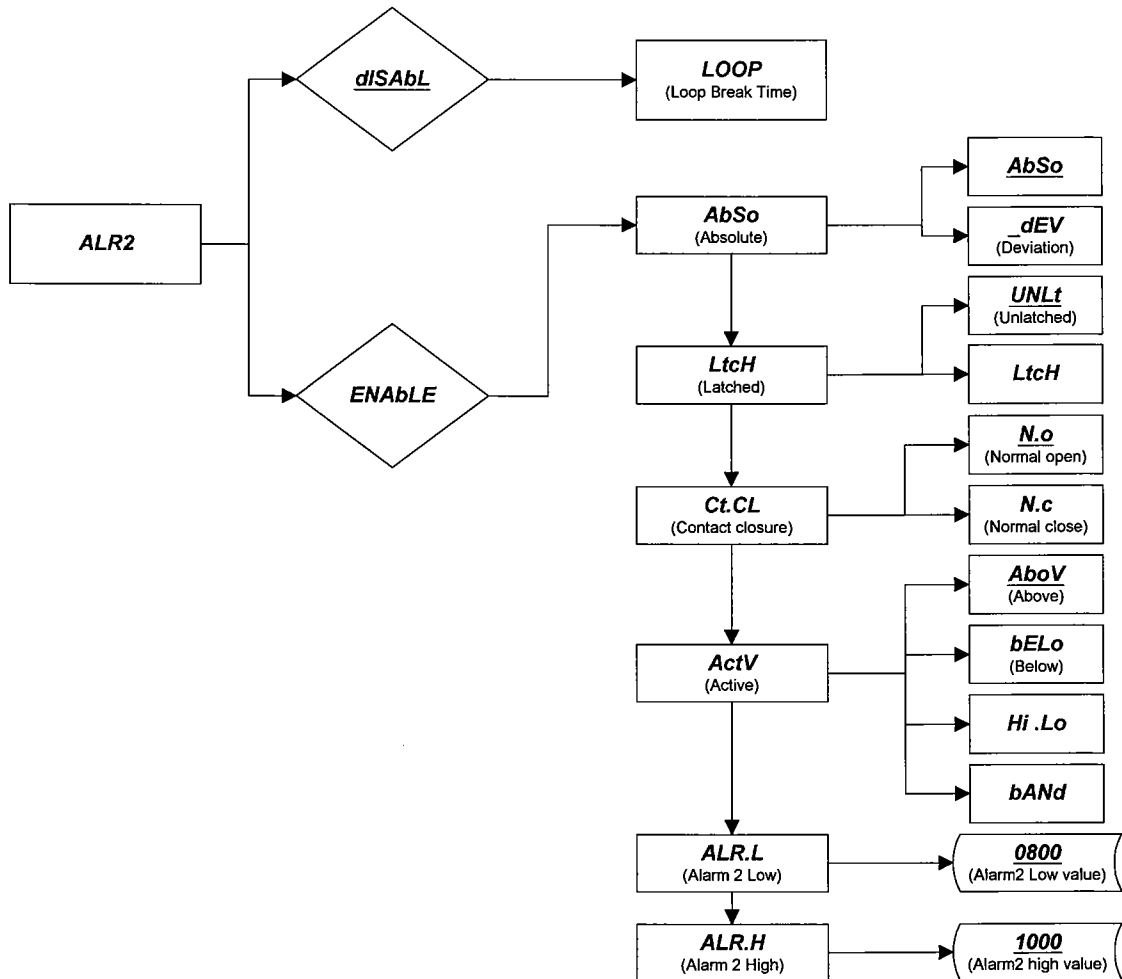


Figure 3.8 Flow Chart for Alarm 2

Display	Action	Response
ENTER ALARM 2 MENU:		
	Press \cup	1) Press \cup , if necessary, until "CNFG" prompt appears.
	Press \downarrow	2) Display advances to "IR" IR Input Setup Menu.
	Press \cup	3) Press \cup , if necessary, until Display advances to "ALR2" Alarm 2 menu.
	Press \downarrow	4) Display advances to Alarm 2 "ENbL" Enable or "dSbL" Disable submenu.
ALARM 2 ENABLE/DISABLE SUBMENU:		
	Press \blacktriangle	5) Display flashes previous selection. Press \blacktriangle until "ENbL" displays to use Alarm 2.

Press ↓ 6) Display shows "**StRd**" stored message momentarily and then advances to "**AbSo**" only if it was changed, otherwise press ⏏ to advances to "**AbSo**" Absolute submenu.

Note: If "**dSbL**" Alarm 2 **Disabled** was selected, all submenus of Alarm 2 will be skipped and meter advances to "**LOOP**" Loop Break Time menu. If "**ENbL**" Alarm 2 **Enabled** was selected, Output 2 will automatically **Disabled**, and reassigned as Alarm 2.

ALARM 2 ABSOLUTE SUBMENU:

Press ↓ 7) Display flashes previous selection. Press ▲ to scroll or select "**AbSo**" Absolute or "**_dEV**." Deviation Option.

Press ↓ 8) Display shows "**StRd**" stored message momentarily and then advances to "**Ltch**" only if it was changed, otherwise press ⏏ to advances to "**Ltch**" Alarm 2 Latch submenu.

Note:

- **Absolute** mode allows Alarm 2 to function independently from Set Point 2. If the process being monitored does not change often, then "absolute" mode is recommended.
- **Deviation** mode allows changes to Set Point 2 to be made automatically to Alarm 2. Deviation mode is typically the ideal mode if the process temperature changes often. In deviation mode, set Alarm 2 a certain number of degrees or counts away from Set Point 2 — this relation remains fixed even if Set Point 2 is changed.

ALARM 2 LATCHED SUBMENU:

Press ↓ 9) Display flashes previous selection. Press ▲ to "**Ltch**" Latched or "**UNL**" Unlatched.

Press ↓ 10) Display shows "**StRd**" stored message momentarily and then advances to "**Ct.CL**" only, if it was changed, otherwise press ⏏ to advances to "**Ct.CL**" Contact Closure submenu.

CONTACT CLOSURE SUBMENU:

Press ↓ 11) Display flashes previous selection. Press ▲ to "**N.c.**" Normally Closed or "**N.o.**" Normally Open.

Press ↓ 12) Display shows "**StRd**" stored message momentarily and then advances to "**ActV**" only if it was changed, otherwise press ⏏ to advances to "**ActV**" Active submenu.

ACTIVE SUBMENU:

Press ↓ 13) Display flashes previous selection. Press ▲ to scroll through the available selections: "**AboV**" Above, "**bELo**" Below, "**Hi.Lo**" HI/Low and "**bANd**" Band (Band is active if "**_dEV**" Deviation was selected).

Press ↓ 14) Display shows "**StRd**" stored message momentarily and then advances to "**ALR.L**" only if it was changed, otherwise press ⏏ to advances to the ALR.L Alarm 2 Low Value submenu.

Note:

- **Above:** Alarm 2 condition triggered when the process variable is greater than the Alarm Hi Value. (Lo value ignored)
- **Below:** Alarm 2 condition triggered when the process variable is less than the Alarm Low Value. (Hi value ignored)

- **Hi/Low:** Alarm 2 condition triggered when the process variable is less than the Alarm Low Value or above the Hi Value.
- **Band:** Alarm 2 condition triggered when the process variable is above or below the "band" set around Set Point 2. Band equals Hi Value (Lo Value ignored). A "band" is set around the Set Point by the controller only in the "deviation" mode.

ALARM 2 LOW VALUE SUBMENU:

- Press ↵ 15) Display flashes 1st digit of previous value. Use ▲ and ▼ to enter new value.
- Press ▲ and ▼ 16) Use ▲ and ▼ to enter Alarm 2 Low Value.
- Press ↵ 17) Display shows "StRd" storage message momentarily and then advances to "ALR.H" only, if it was changed, otherwise press ⏏ to advances to "ALR.H" Alarm 2 HI Value submenu.

ALARM 2 HI VALUE SUBMENU:

- Press ↵ 18) Display flashes 1st digit of previous value. Use ▲ and ▼ to enter new value.
- Press ▲ and ▼ 19) Use ▲ and ▼ to enter Alarm2 High Value.
- Press ↵ 20) Display shows "StRd" stored message momentarily and then advances to the next menu only, if it was changed, otherwise press ⏏ to advances to the next menu.

Note:

- **Latched mode:** Relay remains "latched" until reset. To reset already latched alarm, select Alarm Latch and press Max twice (i.e. Unlatch and then back to Latch).
- **Unlatched mode:** Relay remains latched only as long as the alarm condition is true.
- **Normally Closed:** "Fail Safe" mode, relay is energized under "normal" conditions and becomes de-energized during alarm or power failure.
- **Normally Open:** If this feature is selected, then the relay is "energized" only when an alarm condition occurs.

3.2.9 Loop Break Time

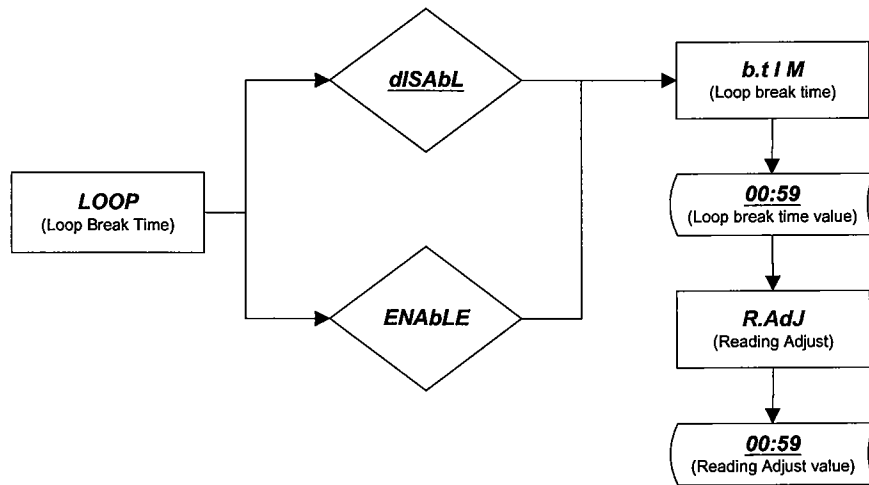


Figure 3.9 Flow Chart for Loop Break Time.

Display	Action	Response
		ENTER LOOP BREAK TIME MENU:
	Press \cup	1) Press \cup , if necessary, until " CNFG " prompt appears.
	Press \downarrow	2) Display advances to " IR " IR Input Setup Menu.
	Press \cup	3) Press \cup , if necessary, until Display advances to " LOOP " Loop Break Time menu.
		LOOP BREAK ENABLE/DISABLE SUBMENU:
	Press \downarrow	4) Display advances to Loop Break Time " ENbL " Enable or " dSbL " Disable submenu and flashes the previous selection.
	Press \blacktriangle	5) Scroll through the available selections: " ENbL " or " dSbL ".
	Press \downarrow	6) Display shows " StRd " stored message momentarily and then advances to " b.t I M " Loop Break Time Value submenu.

Note:

- Loop Break is an additional safety feature intended to monitor the rate of change of the process value, while approaching the SPI. It is strictly intended as an additional warning system, therefore its use is entirely optional. An active Loop Break will cause the Process Value digits to blink in a rotating pattern. If the process value reaches the set point or proportional band value, the blinking will stop and "**b.t I M**" is completed successfully, otherwise "**bR.AL**" warning will flash, and output 1 will be turned off.

Display	Action	Response
		LOOP BREAK TIME VALUE SUBMENU:
	Press \downarrow	7) Display flashes 1st digit of previous Loop Value.
	Press \blacktriangle and \blacktriangledown	8) Press \blacktriangle and \blacktriangledown buttons to enter a new Loop Value (0 to 99.59).
	Press \downarrow	9) Display shows " StRd " stored message momentarily and then advances to " R.AdJ " Reading Adjust submenu.
		READING ADJUST SUBMENU:
	Press \downarrow	10) Display flashes 1st digit of previous reading adjust value.
	Press \blacktriangle and \blacktriangledown	11) Press \blacktriangle and \blacktriangledown buttons to enter a new Reading Adjust value (-1999 to 9999).
	Press \downarrow	12) Display shows " StRd " stored message momentarily and then advances to " Out 1 " Output 1 menu.

Note:

- **Loop Break Time Value** allows the user to determine the time interval in MM:SS (from zero to 99 minutes and 59 seconds) that the process value changes 10 counts or if the input type is either RTD or Thermocouple, the value changes 4° Fahrenheit or 2° Celsius. At the specified time interval, if the process value change is less than the stated rate, flashing "**bR.AL**" will be displayed, the output 1 will be de-energized. Loop break time will be disabled when the process value (PV) enters the control band.
- **Reading Offset Adjust** allows the user to fine tune a minor error of the transducer, however some applications may require a large offset adjust. (Displayed Process Value = Measured Process Value \pm R.AdJ). R.AdJ is adjustable between -1999 to 9999.
- **Set Point Deviation:** This feature is not presently supported as iSeries is. Call Our Support 800 number for our future upgrade.

3.2.10 Output 1

Note:

- Analog Output and Output 1 are sharing the same contacts on the rear panel connector. If Analog Output is **Enabled**, Output 1 is automatically **Disabled**.

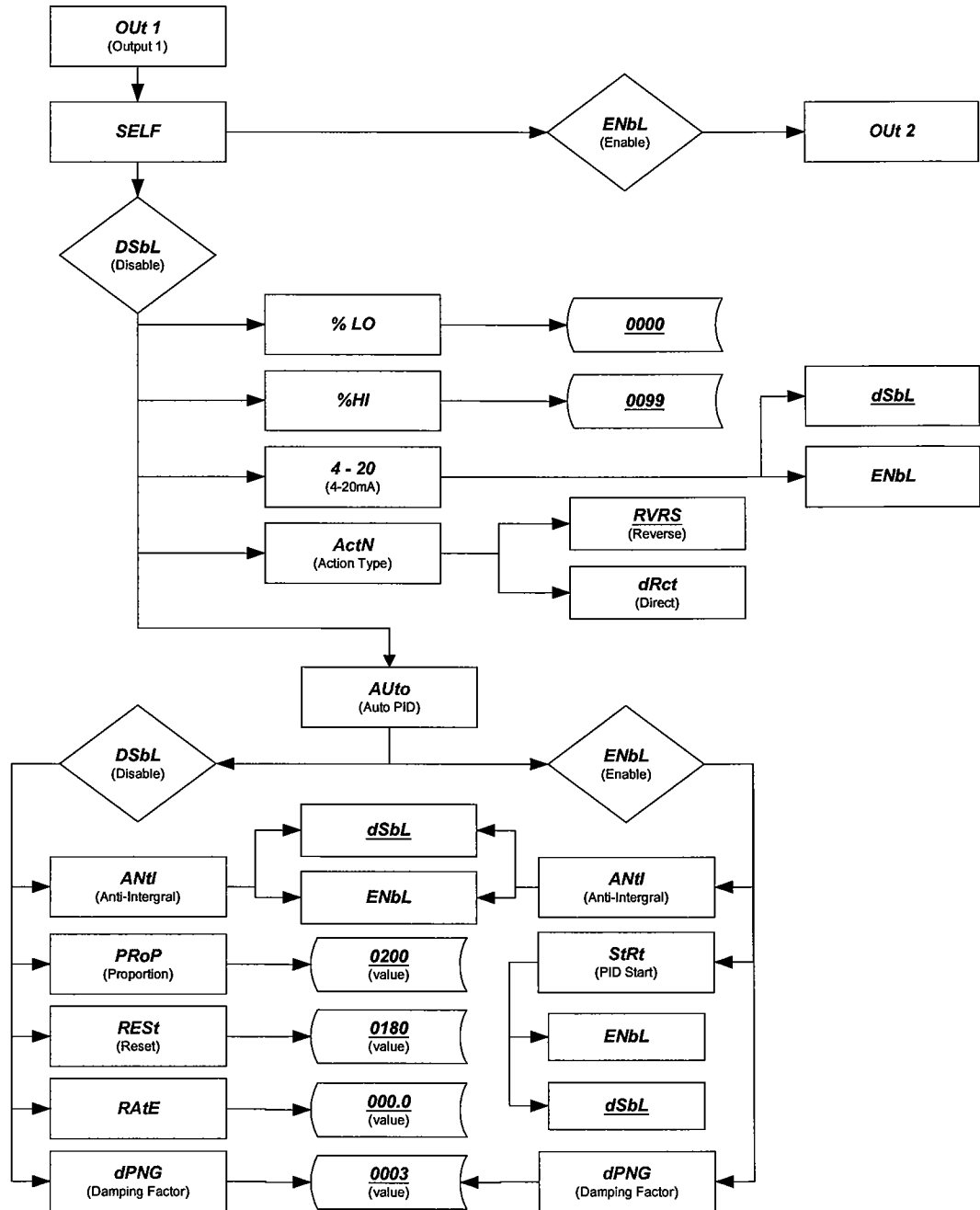


Figure 3.10 Flow Chart for Output 1

Display	Action	Response
		ENTER OUTPUT 1 MENU:
	Press \cup	1) Press \cup , if necessary, until " CNFG " prompt appears.
	Press \downarrow	2) Display advances to " IR " IR Input Setup Menu.
	Press \cup	3) Press \cup , if necessary, until Display advances to " Out1 " Output 1 menu.
	Press \downarrow	4) Display advances to " SELF " Self submenu.
		SELF SUBMENU:
		The Self option allows the output of the controller to be controlled manually from the front panel.
	Press \downarrow	5) Display flashes the current setting of Self, " ENbL " Enabled or " dSbL " disabled.
	Press \blacktriangle	6) Press the \blacktriangle button to select between Enable and Disable.
	Press \downarrow	7) If Self " ENbL " Enabled was selected, display shows " StRd " stored message momentarily and then advances to the next menu (Output 1 setting is completed).
		On the Run mode display shows MX.X The output is now under the direct control of the operator and can be adjusted in the run mode (0 to 99.9), by pressing the \blacktriangle and \blacktriangledown buttons. For example, setting of 0050 of an analog output of 0 to 10 Vdc would produce roughly 5 Vdc at the output.
	Press \downarrow	8) If Self " dSbL " Disabled was selected, display shows " StRd " stored message momentarily and then advances to " o°LO " Minimum/Percent Low submenu of Output 1 menu.
		NOTE: Unlike iSeries, This controller does not allow users to disable or enable Output Self Mode manually with front panel push buttons in Run mode.
		MINIMUM/PERCENT LOW SUBMENU
		Specify in percent, the minimum value (0000) for control output. If the output is analog proportional (Current or Voltage), then the minimum voltage or current, in percent, is specified. If the output is time proportional (Relay, SSR or Pulse), then the minimum duty-cycle, in percent, is specified.
	Press \downarrow	9) Display flashes 1st digit of previous "Percent Low" setting.
	Press \blacktriangle and \blacktriangledown	10) Use \blacktriangle and \blacktriangledown buttons to enter a new value for "Percent Low".
	Press \downarrow	11) Display shows " StRd " stored message momentarily and then advances to " o°HI " Maximum/Percent High submenu.
		MAXIMUM/PERCENT HIGH SUBMENU:
		Specify in percent, the maximum value (0099) for control output. If the output is analog proportional (Current or Voltage), then the maximum voltage or current, in percent, is specified. If the output is time proportional (Relay, SSR, or Pulse), then the maximum duty-cycle, in percent, is specified.
	Press \downarrow	12) Display flashes 1st digit of previous "Percent High" setting.
	Press \blacktriangle and \blacktriangledown	13) Use \blacktriangle and \blacktriangledown buttons to enter a new value for "Percent High".
	Press \downarrow	14) Display shows " StRd " stored message momentarily and then advances to " 4 – 20 " 4-20 mA Current Output Option submenu.

4-20 CURRENT OUTPUT SUBMENU:

- Press ↵ **15)** Display flashes the current option of **"4 – 20"** Analog Output Current, **"ENbL"** Enabled or **"dSbL"** disabled (as default).
- Press ▲ and ▼ **16)** Scroll through the available selections to select **"ENbL"** for a 4-20 mA output or **"dSbL"** for a 0-20 mA output. If 4-20mA is enabled, %HI/LO setting will have no effect.

NOTE: Both Current and Voltage (0 – 10V) control outputs are active simultaneously.

- Press ↵ **17)** Display flashes **"StRd"** stored message momentarily and then advances to **"ActN"** only, if it was changed, otherwise press ⏏ to advances to **"ActN"** Action Type submenu.

Note:

- Due to the Output is Analog Output (Current/Voltage), The **PID** control is only supported output control type and is best for processes where the set point is continuously changing and/or a tight control of the process variable is required. PID control requires tuning and adjustment of the "Proportional", "Integral or Reset" and "Derivative or Rate" terms by a trial-and-error method. The Controller provides an "Auto Tuning" feature making the tuning process automatic, possibly optimum.

ACTION TYPE SUBMENU:

- Press ↵ **18)** Display flashes **"dRct"** Direct or **"RVRS"** Reverse.
- Press ▲ **19)** Scroll through the available selections: "Direct" or "Reverse".
- Press ↵ **20)** Display shows **"StRd"** stored message momentarily and then advances to **"AUto"** only, if it was changed, otherwise press ⏏ to advances to **"Auto"** Auto PID submenu.

Note:

- The error that results from the measurement of the process variable may be positive or negative since it may be greater or smaller than the set point. If a positive error should cause the controller output to increase (i.e. cooling), it would be called **Direct Acting**. If a negative error should cause the output to decrease (i.e. heating), it would be called **Reverse Acting**.

AUTO PID SUBMENU:

- Press ↵ **21)** Display flashes **"ENbL"** or **"dSbL"**.
- Press ▲ **22)** Scroll through the available selections: "Enable" or "Disable".
- Press ↵ **23)** Display shows **"StRd"** stored message momentarily and then advances to **"ANti"** only, if it was changed; otherwise press ⏏ to advance to **"ANti"** Anti Integral submenu.

Note:

- If **"Enabled"**, the controller can determine, by enabling Start PID, the optimum values for the three adjustments — Proportional, Reset and Rate corresponding to P, I, and D. These values may be changed once the auto tuning is complete. If **"Disabled"** is selected, the user will manually enter these three adjustment values. If you want the controller to do the auto PID and the P, PI or PID, first select auto disable and enter 0000 for unwanted parameter i.e. PI enter 0000 for the rate.

ANTI INTEGRAL SUBMENU:

Press ↓
Press ▲
Press ↓

27) Display flashes **"ENbL"** or **"dSbL"**.

28) Scroll through the available selections: "Enable" or "Disable".

29) Display shows **"StRd"** stored message momentarily and then advances to **"StRt"** only, if it was changed, otherwise press ⌵ to advances to **"StRt"** to Start Auto Tune PID submenu (If auto PID was Enabled).

Note: If auto PID was disabled display advances to **"ProP"** Proportional Band submenu.

Note:

- If Anti Integral (Anti Windup) submenu **"Enabled"**, this feature allows the error term outside the proportional band to be calculated and accumulated for integration. This may be an important feature in applications where fast response time is desirable.

START AUTO TUNE PID:

Press ↓
Press ▲
Press ↓

30) Display flashes **"ENbL"** or **"dSbL"**.

31) Scroll through the available selections: "Enable" or "Disable".

32) Display shows **"StRd"** stored message momentarily and then advances to **"dPNG"** only, if it was changed, otherwise press ⌵ to advances to **"dPNG"** Damping Factor submenu.

Note:

- - If **"Enabled"**, the controller is ready to calculate P, PI or PID parameters. The controller performs this by activating the output and observing the delay and rate at which the process value changes. The set points must be at least 20°F or 11°C above the (PV) process value in order to perform auto tune, otherwise an error message will be displayed.
 - To start auto tune PID select PID, enable Auto PID and enable Start PID. Sometimes Auto PID parameter needs fine tuning i.e. for each 5°F over shoot increase the Proportional Band (PB) by 15% and for each ±1°F fluctuation at the Set Point (SP) increase reset by 20%. Once started, display shows **"A.tun"** with letters blinking in the rotating pattern. When auto tune stops, display will show process value. Do not perform any operations or settings before first stopping auto tune. Any alarms or other output is disabled during auto-tune.

If " AUTO PID" was "DISABLED", the display will show the following three submenus so the user may manually enter values for Proportional, Reset and Rate terms corresponding to P, I, and D. It also can be used for auto PID for disabling unwanted parameters e. g. PI enter 0000 for Rate or P enter 0000 for Reset and 0000 for Rate

PROPORTIONAL BAND SUBMENU:

- Press ↵ 28) Display flashes 1st digit of the previous "PRoP" Proportional band value.
Press ▲ and ▼ 29) Press ▲ and ▼ buttons to enter a new "Proportional Band" value
Press ↵ 30) Display shows "StRd" stored message momentarily and then advances to "RESr" only, if it was changed, otherwise press ␣ to advances to "RESr" Reset Setup submenu.

Note:

- Proportional band is in degree of temperature or counts of process. Proportional band is defined, as the change in the controller input to cause a 100% change in the controller output.

RESET SETUP SUBMENU:

- Press ↵ 28) Display flashes 1st digit of the previous "RESr" Reset" value.
Press ▲ and ▼ 29) Press ▲ and ▼ buttons to enter a new "Reset" value.
Press ↵ 30) Display shows "StRd" stored message momentarily and then advances to "RArE" only, if it was changed, otherwise press ␣ to advances to "RArE" Rate Setup submenu. **Note:** Reset unit is in seconds 0-3999.

RATE SETUP SUBMENU:

- Press ↵ 34) Display flashes 1st digit of previous "RArE" Rate value.
Press ▲ and ▼ 35) Press ▲ and ▼ buttons to enter a new "Rate" value.
Press ↵ 36) Display shows "StRd" stored message momentarily and then advances to "dPNG" only, if it was changed, otherwise press ␣ to advances to "dPNG" Damping Factor submenu.

Note: Rate unit is in seconds 000.0-399.9

DAMPING FACTOR SUBMENU:

- Press ↵ 37) Display flashes the previous "Damping Factor" selection.
Press ▲ 38) Scroll through the available selections: 0000, 0001, 0002, 0003, 0004, 0005, 0006, 0007 - Default is 0003
Press ↵ 39) Display flashes "StRd" stored message and then advances to "OUt2" only, if it was changed, otherwise press ␣ to advances to "OUt2" Output 2 menu.

Note:

- Damping Factor is a measure of speed, overshoot, and undershoot in which the process variable responds to the output changes of the controller, which were used during the Auto Tune. This value is typically set to the ratio of Rate to Reset. This Default value is (0004). For fast response time, this value should be decreased while for slow response time it should be increased.

3.2.11 Output 2

Note: Output 2 and Alarm 2 are sharing the same contacts on rear panel connector. If Alarm 2 is **Enabled**, Output 2 is automatically **Disabled**.

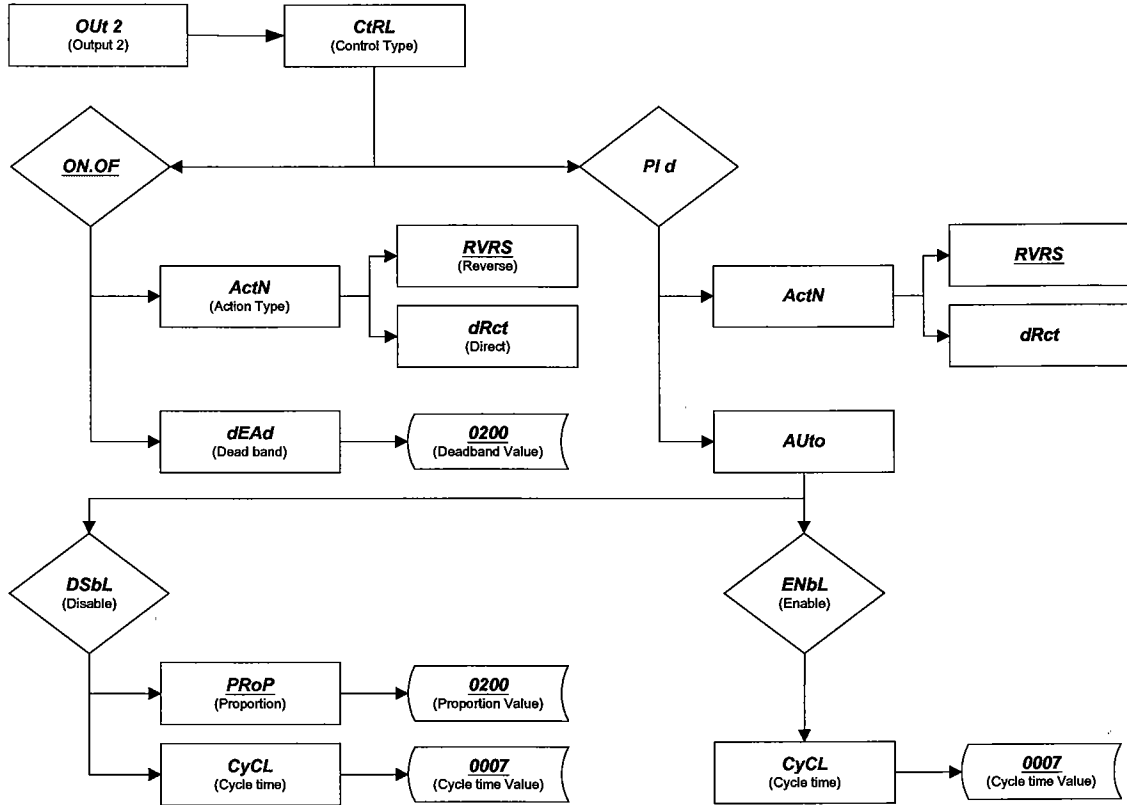


Figure 3.11 Flow Chart for Output 2

Display	Action	Response
ENTER OUTPUT 2 MENU:		
	Press \cup	1) Press \cup , if necessary, until "CNFG" prompt appears.
	Press \downarrow	2) Display advances to "IR" IR Input Setup Menu.
	Press \cup	3) Press \cup , if necessary, until Display advances to "Out2" Output 2 menu.
	Press \downarrow	4) Display advances to "CtRL" Control Type submenu.
CONTROL TYPE SUBMENU:		
	Press \downarrow	3) Display flashes "ON.OF" ON/OFF, or "Pid" PID.
	Press \blacktriangle	4) Scroll through the available selections: "ON/OFF" or "PID".
	Press \downarrow	5) Display shows "StRd" stored message momentarily and then advances to "ActN" only, if it was changed, otherwise press \cup to advances to "ActN" Action Type submenu.

Note:

- The ON/OFF control is a coarse way of controlling the process. The "Dead Band" improves the cycling associated with the ON/Off control. The PID control is best for processes where the set point is continuously changing and/or tight control of the process variable is required.

ACTION TYPE SUBMENU:

Press ↵
Press ▲
Press ↵

6) Display flashes **"dRct"** Direct or **"RVRS"** Reverse.
7) Scroll through the available selections: "Direct" or "Reverse".
8) Display shows **"StRd"** stored message momentarily and then advances to **"AUto"** only, if it was changed, otherwise press ⏏ to advance to **"AUto"** Auto Tune PID submenu.
If ON/OFF was selected in the Control Type, the display skips to the Dead Band submenu.

Note:

- The error that results from the measurement of the process variable may be positive or negative since it may be greater or smaller than the set point. If a positive error should cause the controller output to increase (i.e. cooling), it would be called Direct Acting. If a negative error should cause the output to decrease (i.e. heating), it would be called **Reverse Acting**.

AUTO PID SUBMENU:

Press ↵
Press ▲

Press ↵

9) Display flashes **"ENbL"** Enable or **"dSbL"** Disable.
10) Scroll through the available selections: "Enable" or "Disable".
If "Enabled", the PID parameter of Output 1 will be copied to Output 2.
11) Display shows **"StRd"** stored message momentarily and then advances to the next submenu only, if it was changed, otherwise press ⏏ to advance to the next submenu.

If AUTO PID was ENABLED", the display skips to the "CYCL" CYCLE TIME submenu.
If "AUTO PID" was "DISABLED", the display will show "PRoP" PROPORTIONAL BAND submenu allowing the user to manually enter the Proportional Band value.

Note: The Reset and Rate value are the same as Output 1.
PROPORTIONAL BAND SUBMENU:

Press ↵
Press ▲ and ▼
Press ↵

12) Display flashes 1st digit of the previous Proportional Band value.
13) Press ▲ and ▼ buttons to enter a new Proportional Band value
14) Display shows **"StRd"** stored message momentarily and then advances to **"CYCL"** only, if it was changed, otherwise press ⏏ to advances to the **"CYCL"** Cycle Time submenu.

Note: Refer to "Proportional Band" submenu of "Output 1" menu

CYCLE TIME SUBMENU:

Press ↵
Press ▲ and ▼

Press ↵

15) Display flashes 1st digit of the previous "Cycle Time" value.
16) Press ▲ and ▼ buttons to enter a new "Cycle Time" value. (1 to 199 seconds)
17) Display shows **"StRd"** stored message momentarily and then advances to **"RAMP"** only, if it was changed, otherwise press ⏏ to advances to **"RAMP"** Ramp Value submenu.

Note:

- A cycle time selected between 1 to 199 seconds indicates the total On/Off time of each proportional cycle. For example, a 15 second cycle time means that every 15 seconds the output will turn on for part or all of the cycle. For Relay control outputs, do not select a cycle time of less than 7 seconds or the relays life time will be shortened. For a cycle time of less than 7 seconds select SSR or DC pulse. Use an external SSR with the DC pulse option for higher current (higher than 1 Amp).

The DEADBAND submenu will only appear if the ON/OFF was selected from the "Control Type" menu.

DEADBAND SUBMENU:

- Press ↵ 18) Display flashes 1st digit of the previous "Deadband" value.
- Press ▲ and ▼ 19) Press ▲ and ▼ buttons to enter a new "Deadband" value.
- Press ↵ 20) Display shows "StRd" stored message momentarily and then advances to "RAMP" only, if it was changed, otherwise press ⏏ to advances to "RAMP" Ramp Value menu.

Note: Dead band units are the same as proportional band units.

Note:

- The Deadband is the number of degrees or counts around the set point, which the process variable must pass through before the output changes state.

3.2.12 Ramp & Soak

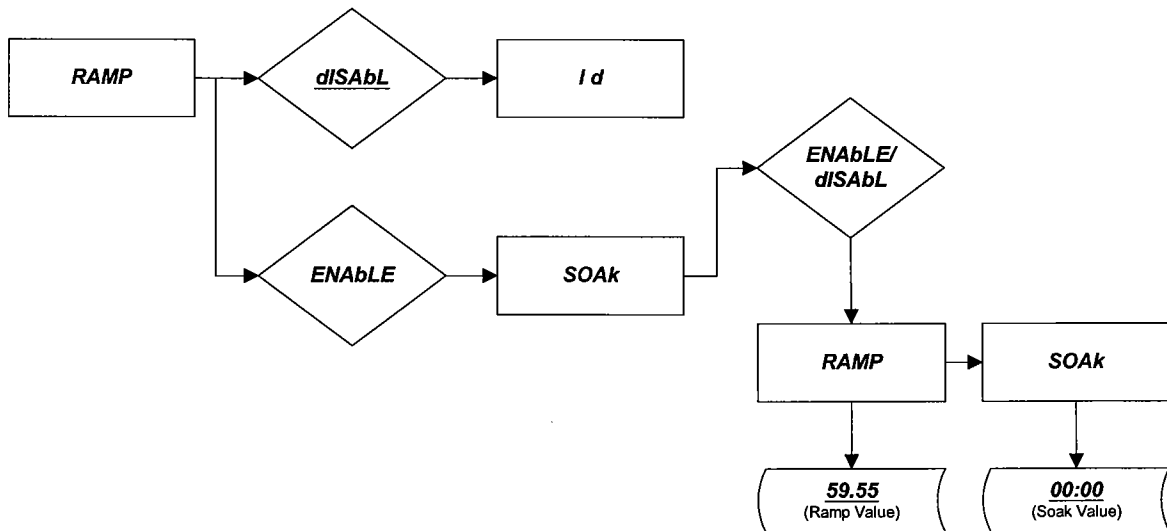


Figure 3.12 Flow Chart for Ramp and Soak.

Display	Action	Response
		ENTER RAMP AND SOAK MENU:
	Press ⏏	1) Press ⏏, if necessary, until "CNFG" prompt appears.
	Press ↵	2) Display advances to "IR" IR Input Setup Menu.
	Press ⏏	3) Press ⏏, if necessary, until Display advances to "RAMP" Ramp and "SOAK" Soak menu.
		RAMP ENABLE/DISABLE SUBMENU:
	Press ↵	4) Display advances to "Ramp Enable/Disable" submenu and flashes "ENbL" or "dSbL".
	Press ▲	5) Scroll through the available selections: "Enable" or "Disable".
	Press ↵	6) Display shows "StRd" stored message momentarily and then advances to "SOAK" Soak Enable/Disable" menu.

Note: If "Ramp" Disable was selected, display skips to the next menu item (ID Code).

SOAK ENABLE/DISABLE SUBMENU:

- Press ↵ 7) Display flashes **"ENbL"** or **"dSbL"**.
Press ▲ 8) Scroll through the available selections: "Enable" or "Disable".
Press ↵ 9) Display shows **"StRd"** stored message momentarily and then advances to "Ramp Value" submenu.

Note:

- Ramp & Soak provide users with the flexibility to slowly bring the process variable to the desired set point. Ramp & Soak Values are specified in HH.MM format. The Ramp value indicates the time specified to bring the process variable to Setpoint 1. Once set point is reached, the PID takes over and the process variable will be controlled at the desired set point indefinitely. If Soak is enabled, PID will control the process variable at the specified Setpoint for the duration of soak time and then will turn off Output 1. To start a new ramp/soak cycle, reset the controller. An active ramp/soak will change SP1 one degree above the PV and will cause the most significant digit to blink. The SP1 will be incremented by one degree until it reaches the original SP1. The minimum ramp time must be at least twice the time that it will take the PV to reach the SV with OUT 1 fully ON.

RAMP VALUE SUBMENU:

- Press ↵ 10) Display flashes 1st digit of previous stored "Ramp Value".
Press ▲ and ▼ 11) Press ▲ and ▼ buttons to enter a new "Ramp Value"
Press ↵ 12) Display shows **"StRd"** stored message momentarily and then advances to "Soak value" submenu.

SOAK VALUE SUBMENU:

- Press ↵ 13) Display flashes 1st digit of previous stored "Soak value".
Press ▲ and ▼ 14) Press ▲ and ▼ buttons to enter a new "Soak Value"
Press ↵ 15) Display shows **"StRd"** stored message and advances to the **"Id"** ID Code menu.

Note:

- The ramp and soak time is 00:00 to 99:59 i.e. HH.MM. (From zero to 99 hours and 59 minutes)
During Ramp & Soak do not perform any operations or settings before first stopping it. Any alarms or other outputs are disabled during this time. To stop Ramp & Soak first put meter into Standby mode, then go to Ramp & Soak menu and disable it.

3.2.13 ID CODE

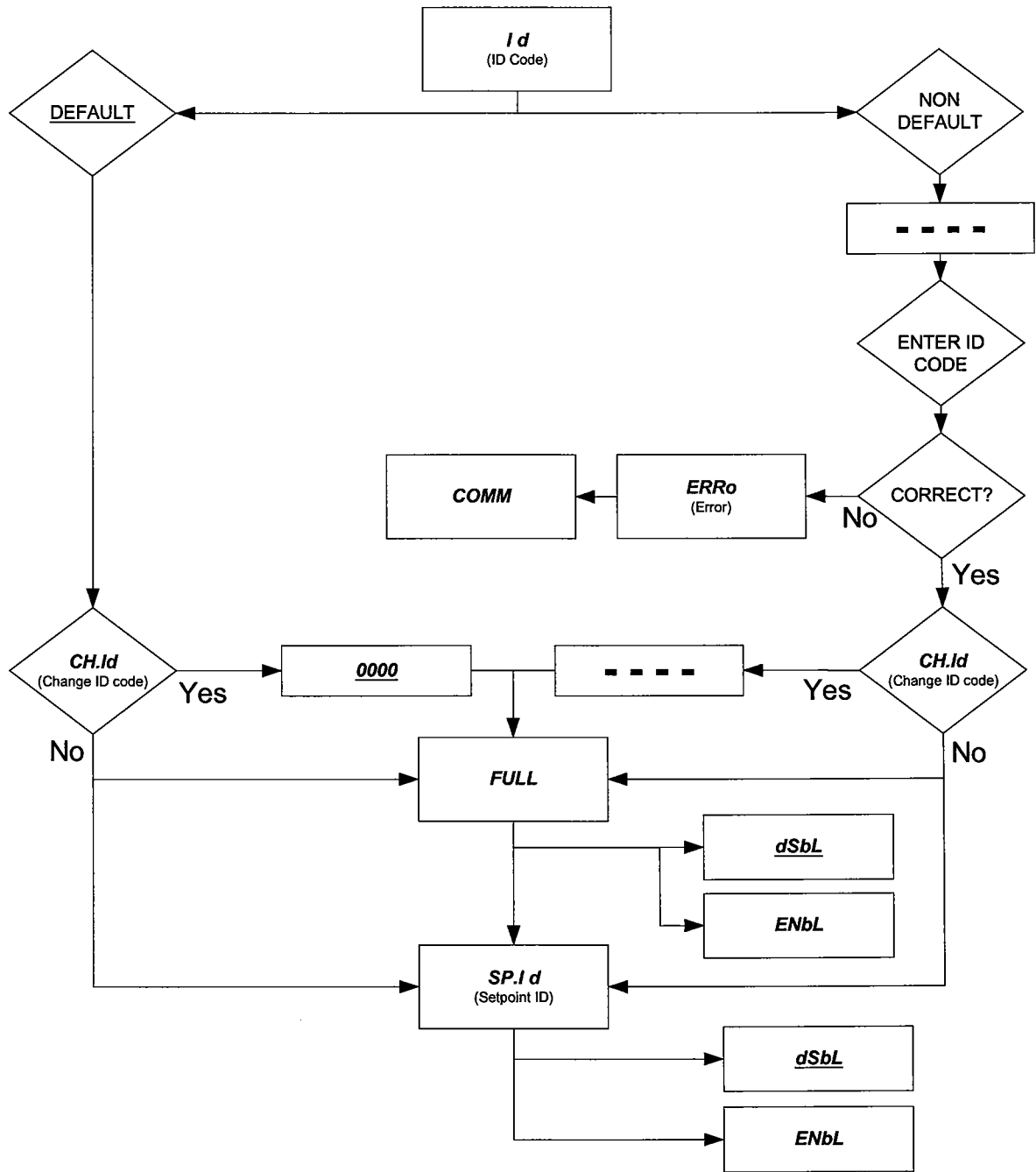


Figure 3.13 Flow Chart for ID Code

Display	Action	Response
ENTER ID CODE MENU:		
Press \cup		1) Press \cup , if necessary, until "CNFG" prompt appears.
Press \downarrow		2) Display advances to "IR" IR Input Setup Menu.
Press \cup		3) Press \cup , if necessary, until Display advances to "Id" ID Code menu.

ENTERING OR CHANGING YOUR (NON-DEFAULT) ID CODE.

Press ↵

Press ▲ and ▼

Press ↵

4) Display advances to “_ _ _ _” with 1st under score flashing.

5) Press ▲ and ▼ to enter your 4-digit “ID Code” number.

6) Display advances to “*CH.Id*” Change ID Code submenu.

Note: If entered “ID Code” is incorrect display shows “*ERRo*” Error message momentarily and then skips to the Run mode.

Press ↵

Press ▲ and ▼

Press ↵

7) Display flashes the first digit of previous entered “ID Code” number.

8) Press ▲ and ▼ buttons to enter your new “ID Code” number.

9) Display shows “*StRd*” stored message momentarily and then advances to the “*FULL*” Full Security submenu.

ENTERING OR CHANGING YOUR (DEFAULT) ID CODE .

Note: Enter “*Id*” menu (Repeat steps from 1 to 3)

Press ↵

Press ↵

10) Display advances to “*CH.Id*” Change ID Code submenu.

11) Display shows “*0000*” message with flashing 1st digit.

Note: If you want to change your default “ID Code” you can do it now, otherwise press ⏏ and menu will skip to “*FULL*” Full Security submenu.

Press ▲ and ▼

Press ↵

12) Press ▲ and ▼ buttons to enter your new “ID Code” number.

13) Display shows “*StRd*” stored message momentarily and then advances to the “*FULL*” Full Security submenu.

FULL SECURITY LEVEL SUBMENU.

Press ↵

Press ▲

Press ↵

14) Display flashes “*ENbL*” Enable or “*dSbL*” Disable.

15) Scroll through the available selection: “Enable” or “Disable”

16) Display shows “*StRd*” stored message momentarily and then advances to “*SP.ID*” Set Point/ID submenu.

If “Full” security level is “Enabled” and the user attempts to enter the Main Menu, he will be prompted for an ID Code. The ID Code should be correct to enter the meter Menu item.

SETPOINT/ID SECURITY LEVEL SUBMENU.

Note: This security level can be functional only if “*Full*” security level is Disabled.

Press ↵

Press ▲

Press ↵

17) Display flashes “*EnbL*” Enable or “*dSbL*” Disable.

18) Scroll through the available selection: “Enable” or “Disable”

19) Display shows “*StRd*” stored message momentarily and then advances to “*COMM*” Communication submenu only, if “Setpoint/ID” security level is “Disabled”.

If “Setpoint/ID” security level is “Enabled” and the user attempts to advance into the “CNFG” Configuration Menu, he will be prompted for ID Code number. The ID Code should be correct to proceed into the Configuration Menu; otherwise display will show an Error and skip to the Run mode.

Note:

- If “Full” and “Setpoint/ID” security levels are “Disabled”, the ID code will be “Disabled” and user will not be asked for ID Code to enter the Menu items (“*Id*” submenu will not show up in “ID/Setpoint” menu).

3.2.14 COMMUNICATION OPTION

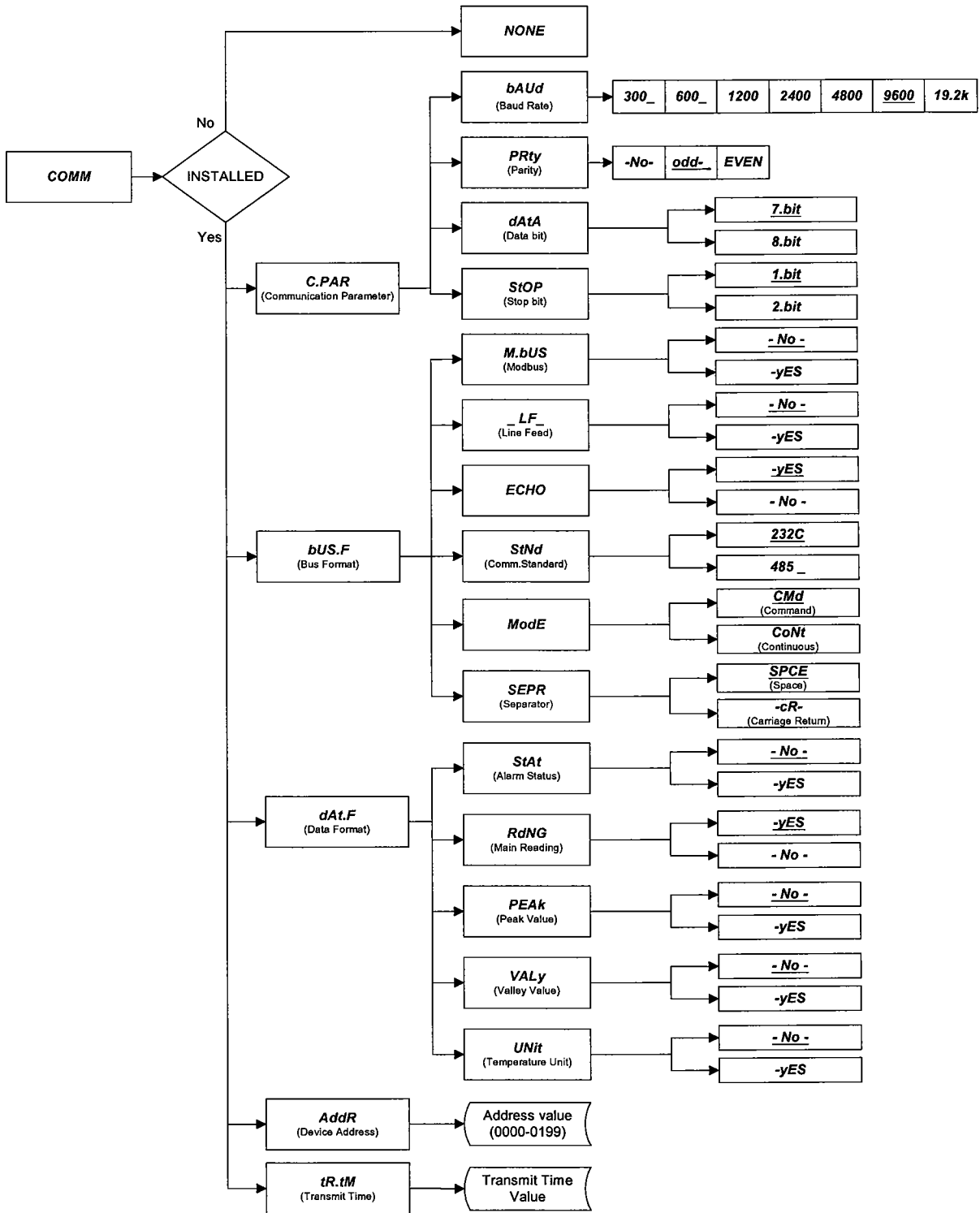


Figure 3.14 Flow Chart for Communication Option.

ENTER COMMUNICATION OPTION MENU:

- Press **␣** 1) Press **␣**, if necessary, until "**CNFG**" prompt appears.
Press **↓** 2) Display advances to "**IR**" IR Input Setup Menu.
Press **␣** 3) Press **␣**, if necessary, until Display advances to "**COMM**" Communication options menu.
Press **↓** 4) Display advances to "**C.PAR**" Communication Parameters submenu

COMMUNICATION PARAMETERS SUBMENU:

- Press **↓** 5) Display advances to "**baUd**" Baud submenu.

BAUD SUBMENU:

- Press **↓** 6) Display flashes previous selection for "**baUd**" value.
Press **▲** 7) Scroll through the available selections: **300_**, **600_**, **1200**, **2400**, **4800**, **9600**, **19.2K**.
Press **↓** 8) Display shows "**StRd**" stored message momentarily and then advances to "**PRtY**" only, if it was changed, otherwise press **␣** to advances to "**PRtY**" Parity submenu.

PARITY SUBMENU:

- Press **↓** 9) Display flashes previous selection for "Parity".
Press **▲** 10) Scroll through the available selections: **NO**, **Odd**, **EVEN**.
Press **↓** 11) Display shows "**StRd**" stored message momentarily and then advances to "**dAtA**" only, if it was changed, otherwise press **␣** to advances to "**dAtA**" Data Bit submenu.

DATA BIT SUBMENU:

- Press **↓** 12) Display flashes previous selection for "Data Bit".
Press **▲** 13) Scroll through the available selections: **7 Bit**, **8 Bit**.
Press **↓** 14) Display shows "**StRd**" stored message and then advances to "**StOP**" only, if it was changed, otherwise press **␣** to advances to "**StOP**" Stop Bit submenu.

STOP BIT SUBMENU:

- Press **↓** 15) Display flashes previous selection for "Stop Bit".
Press **▲** 16) Scroll through the available selections: **1 Bit**, **2 Bit**.
Press **↓** 17) Display shows "**StRd**" stored message momentarily and then advances to "**bUS.F**" only, if it was changed, otherwise press **␣** to advances to "**bUS.F**" BUS FORMAT" submenu.

BUS FORMAT SUBMENU:

- Press **↓** 18) Display advances to "**M.bUS**" Modbus Protocol submenu.

MODBUS SUBMENU

- Press **↓** 19) Display flashes previous selection for "Modbus".
Press **▲** 20) Scroll through the available selections: **NO**, **YES**.
Press **↓** 21) Display shows "**StRd**" stored message momentarily and then advances to "**_LF_**" only, if it was changed, otherwise press **␣** to advance to "**_LF_**" Line Feed submenu.

Note: To Enable the Newport Protocol, set Modbus menu item to "No". To select the Modbus Protocol, set Modbus menu item to "Yes"

- Press ↓
Press ▲
Press ↓
- LINE FEED SUBMENU:**
22) Display flashes previous selection for "Line Feed".
23) Scroll through the available selections: **NO, YES**.
24) Display shows "**StRd**" stored message momentarily and then advances to "**ECHO**" only, if it was changed, otherwise press ␣ to advances to "**ECHO**" Echo submenu.
- Press ↓
Press ▲
Press ↓
- ECHO SUBMENU:**
25) Display flashes previous selection for "ECHO".
26) Scroll through the available selections: **NO, YES**.
27) Display flashes "**StRd**" stored message momentarily and then advances to "**StNd**" only if it was changed, otherwise press ␣ to advances to "**StNd**" Standard submenu.
- Press ↓
Press ▲
Press ↓
- STANDARD SUBMENU:**
28) Display flashes previous selection for "Standard".
29) Scroll through the available selections: **232C, 485**.
30) Display shows "**StRd**" stored message momentarily and then advances to "**ModE**" only, if it was changed, otherwise press ␣ to advances to "**ModE**" Mode submenu.
- Press ↓
Press ▲
Press ↓
- MODE SUBMENU:**
31) Display flashes previous selection for "Mode".
32) Scroll through the available selections: **CMd_** "Command", **CoNt** "Continuous".
33) Display shows "**StRd**" stored message momentarily and then advances to "**SEPR**" only, if it was changed, otherwise press ␣ to advances to "**SEPR**" Separation submenu.
- Press ↓
Press ▲
Press ↓
- SEPARATION SUBMENU:**
34) Display flashes previous selection for "Separation" submenu.
35) Scroll through the available selections: **SPCE** "Space" or **_cR_** "Carriage Return".
36) Display shows "**StRd**" stored message momentarily and then advances to "**dAt.F**" only, if it was changed, otherwise press ␣ to advances to "**dAt.F**" Data Format submenu.
- Press ↓
- DATA FORMAT SUBMENU:**
Note: This menu is applicable for continuous mode of RS232 communication.
37) Display advances to "**StAt**" Status submenu.
- Press ↓
Press ▲
Press ↓
- STATUS SUBMENU:**
38) Display flashes previous selection for "Status" (alarm status).
39) Scroll through the available selections: **_NO_** or **_YES**.
40) Display shows "**StRd**" stored message momentarily and then advances to "**RdNG**" only, if it was changed, otherwise press ␣ to advances to "**RdNG**" Reading submenu.
- Press ↓
Press ▲
Press ↓
- READING SUBMENU:**
41) Display flashes previous selection for "Reading".
42) Scroll through the available selections: **_NO_** or **_YES**.
43) Display shows "**StRd**" stored message momentarily and then advances to "**PEAK**" only, if it was changed, otherwise press ␣ to advances to "**PEAK**" Peak submenu.

PEAK SUBMENU:

- Press ↓ 44) Display flashes previous selection for "Peak" submenu.
Press ▲ 45) Scroll through the available selections: **_NO_** or **_YES**
Press ↓ 46) Display shows **"StRd"** stored message momentarily and then advances to **"VALY"** only, if it was changed, otherwise press ␣ to advances to **"VALY"** Valley submenu.

VALLEY SUBMENU:

- Press ↓ 47) Display flashes previous selection for "Valley".
Press ▲ 48) Scroll through the available selections: **_NO_** or **_YES**.
Press ↓ 49) Display shows **"StRd"** stored message momentarily and then advances to **"Unit"** only, if it was changed, otherwise press ␣ to advances to **"Unit"** Unit submenu.

UNIT SUBMENU:

- Press ↓ 50) Display flashes previous selection for "Unit".
Press ▲ 51) Scroll through the available selections: **_NO_** or **_YES**.
Press ↓ 52) Display shows **"StRd"** stored message momentarily and then advances to **"Id"** only, if it was changed, otherwise press ␣ to advances to **"Id"** ID submenu.

ID SUBMENU:

- Press ↓ 53) Display flashes previous selection for "Reading".
Press ▲ 54) Scroll through the available selections: **_NO_** or **_YES**.
Press ↓ 55) Display shows **"StRd"** stored message momentarily and then advances to **"AddR"** only, if it was changed, otherwise press ␣ to advances to **"AddR"** Address Setup submenu.

ADDRESS SETUP SUBMENU:

- Note:** This menu is applicable to the RS 485 option only
Press ↓ 56) Display advances to "Address Value" (0000 to 0199) submenu.

ADDRESS VALUE SUBMENU:

- Press ↓ 57) Display flashes 1st digit of previously stored address value.
Press ▲ and ▼ 58) Press ▲ and ▼ to enter new "Address Value".
Press ↓ 59) Display shows **"StRd"** stored message momentarily and then advances to **"tRtM"** only, if it was changed, otherwise press ␣ to advances to **"tRtM"** Transmit Time submenu.

TRANSMIT TIME SUBMENU:

- Note:** This menu is applicable if "Continuous" mode was selected in the "Mode" submenu.
Press ↓ 60) Display advances to "Transmit Time Value" submenu.

TRANSIT TIME VALUE SUBMENU:

- Press ↓ 61) Display flashes 1st digit of previous "Transmit Time Value" in seconds.
Press ▲ and ▼ 62) Press ▲ and ▼ to enter new "Transmit Time Value", e.g. 0030 will send every 30 seconds the data in continuous mode.
Press ↓ 63) Display shows **"StRd"** stored message momentarily and then advances to **"COLR"** only, if it was changed, otherwise press ␣ to advances to **"COLR"** Color Display Selection menu.

3.2.15 DISPLAY COLOR SELECTION.

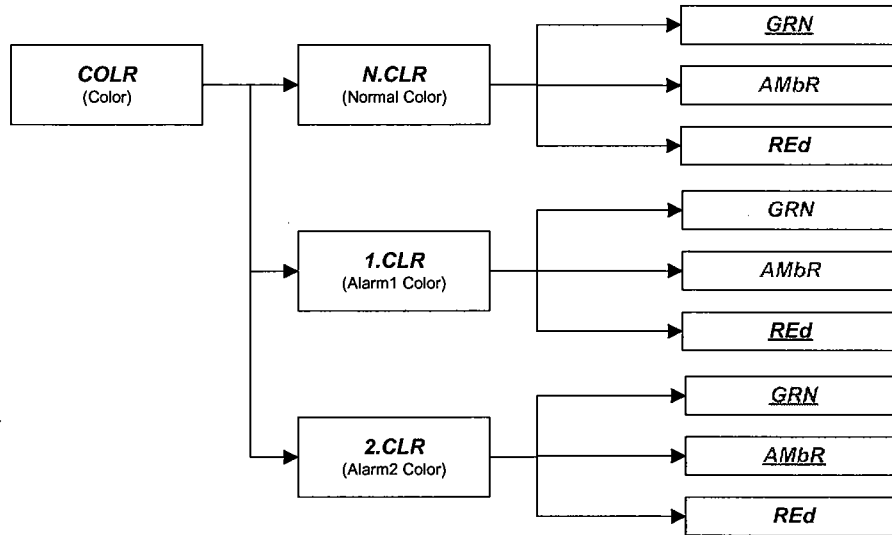


Figure 3.15 Flow Chart for Display Color Selection

This submenu allows the user to select the color of the display and change color when Alarm is triggered.

ENTER DISPLAY COLOR SELECTION MENU:

- | | |
|--------------------|---|
| Press \cup | 1) Press \cup , if necessary, until " CNFG " prompt appears. |
| Press \downarrow | 2) Display advances to " IR " IR Input Setup Menu. |
| Press \cup | 3) Press \cup , if necessary, until Display advances to " COLR " Display Color Selection menu. |
| Press \downarrow | 4) Display advances to " N.CLR " Normal Color submenu. |

NORMAL COLOR DISPLAY SUBMENU:

- | | |
|------------------------|--|
| Press \downarrow | 5) Display flashes the previous selection for "Normal Color". |
| Press \blacktriangle | 6) Scroll through the available selections: GRN , RED or AMBR |
| Press \downarrow | 7) Display shows " StRd " stored message momentarily and then advances to " 1.CLR " only, if it was changed, otherwise press \cup to advances to " 1.CLR " Alarm 1 Display Color submenu. |

ALARM 1 DISPLAY COLOR SUBMENU:

(Not Applicable to Models with Analog Output Option, proceed to next submenu)

- | | |
|--------------------|---|
| Press \downarrow | 8) Display flashes previous selection for "Alarm 1 Color Display" |
| Press \cup | 9) Scroll through the available selections: GRN , RED or AMBR |
| Press \downarrow | 10) Display shows " StRd " stored message momentarily and then advances to " 2.CLR " only, if it was changed, otherwise press \cup to advances to " 2.CLR " Alarm 2 Display Color submenu. |

ALARM 2 DISPLAY COLOR SUBMENU:

- | | |
|------------------------|--|
| Press \downarrow | 11) Display flashes previous selection for "Alarm 2 Color Display" |
| Press \blacktriangle | 12) Scroll through the available selections: GRN , RED or AMBR |
| Press \downarrow | 13) Display shows " StRd " stored message momentarily and then momentarily shows the software version number, followed by " RSt " Reset, and then proceed to the Run Mode. |

IN ORDER TO DISPLAY ONLY ONE COLOR, SET THE SAME DISPLAY COLOR ON ALL THREE SUBMENUES ABOVE.

Note: RESET: The controller automatically resets after the last menu of the Configuration Mode has been entered. After the controller resets, it advances to the Run Mode.

PART 4 SPECIFICATIONS

Accuracy: 0.2% of Full Scale

Repeatability: 0.2% of Full Scale

Temperature Resolution: 1 Degree

Temperature Range:

300 to 1300 °C (572 to 2372 °F) Single Color; 450 to 1300 °C (842 to 2372 °F) Dual Color

600 to 1800 °C (1112 to 3272 °F) Single and Dual Color

1000 to 3000 °C (1832 to 5432 °F) Single and Dual Color

Response time: 10 msec (0 to 63% of final value)

Spectral Response: 0.8 to 1.7 microns

IR Temperature Measurement: Selectable Between Single Color & Dual Color

Emissivity: Adjustable 0.1-1.0 (Single)

Slope: 0.85 – 1.15 (Two Color)

Optical Field of view: 25 : 1, Adjustable Focus from 200mm to more than 4 meters distance (8" to 14 ft)

Laser Beam Diameter: Smallest Spot Size 8mm (0.32") Minimal focus distance is 200mm (8")

Dimensions (Optical Assembly): Ø 20 x 62mm (Ø 0.79 x 2.43") Maximum Length

Fiber Cable: 1m included, 2m and 3m optional (3', 6' and 10')

Power: 90 to 240 Vac for **iR2P** model; 20 to 36 Vdc or 24 Vac for **iR2C** model

Operating Ambient temperature:

Controller: 0 to 50 °C

Optical Assembly: 0 to 200 °C, without cooling required

Display: Three Color Dual Display (Amber, Green & Red), Programmable

Environmental Rating: IP65 , NEMA4 (Both the Optical Assembly & the Front Panel)

Serial Communication: RS232 or RS485/422 Ethernet and RS485/422

Controller: ON / OFF or PID Controller with Autotune

Outputs: Two Control or Alarm Outputs

Output type: Analog voltage or current, Relay, DC Pulse

Analog Output Response: 1 second; **Pulse Output Response:** 1 second

Laser Sighting: Built-into the Controller for Optical assembly alignment

Wavelength (Color): 650nm (RED)

Operating Distance: 20cm to 4m (8" to 14')

Maximum Laser Power output: <1mW

Location of Laser Warning Label: On the control system box and circumference of optical head.

Safety Classification: Class 2; Complies with FDA 21 CFR 1040.10; CE EN 60825-1/11.2001

Laser Power Switch: Set via the Controller Menu

Laser Indicator: Displays on the Controller

PART 5

FACTORY PRESET VALUE TABLE

MENU ITEMS	FACTORY PRESET VALUES	NOTES
Set Point 1 (SP1) : 300 Range	0800	
Set Point 2 (SP2) : 300 Range	0800	
Set Point 1 (SP1) : 600 and 1000 Range	1000	
Set Point 2 (SP2) : 600 and 1000 Range	1000	
Menu configuration (CNFG)		
IR input Setup (I R)		
Laser Sight Control menu (LASR)	"OFF"	
IR Thermometry Method (MtHd)	Dual /2 - Color Method (2 - C)	
Slope Adjustment (SLOP)	1.000	
Reading Configuration (RdG):		
Temperature unit (tEMP)	°C	
Filter value (FLtR)	0004	
Input/Reading Scale & Offset (IN.Rd) 300 Range	IN 1 and Rd 1 0300 IN 2 and Rd 2 1300	
Input/Reading Scale & Offset (IN.Rd) 600 Range	IN 1 and Rd 1 0600 IN 2 and Rd 2 1800	
Input/Reading Scale & Offset (IN.Rd) 1000 Range	IN 1 and Rd 1 1000 IN 2 and Rd 2 3000	
Analog Output Configuration (ANLG)	Disable (dSbL)	
If set enable (EnbL) : 300 Range	300 = 0V or 4mA	
If set enable (EnbL) : 300 Range	1300 = 10V or 20mA	
If set enable (EnbL) : 600 Range	600 = 0V or 4mA	
If set enable (EnbL) : 600 Range	1800 = 10V or 20mA	
If set enable (EnbL) : 1000 Range	1000 = 0V or 4mA	
If set enable (EnbL) : 1000 Range	3000 = 10V or 20mA	
Alarm 1 and 2:		
Alarm 1 (ALR1) Alarm 2 (ALR2)	Disable (dSbL)	
Absolute/Deviation (AbSO/DEV)	Absolute (AbSO)	
Latch/Unlatch (LtCH/UNLt)	Unlatch (UNLt)	
Contact Closure (Ct.CL)	Normally Open (N.O.)	
Active (ACTV)	Above (ABOV)	
Alarm Low (ALR.L) 300 Range	0400 (AL 2) 0600 (AL 1)	
Alarm High (ALR.H) 300 Range	0600 (AL 2) 0800 (AL 1)	
Alarm Low (ALR.L) 600 Range	0800 (AL 2) 1000 (AL 1)	
Alarm High (ALR.H) 600 Range	1000 (AL 2) 1500 (AL 1)	
Alarm Low (ALR.L) 1000 Range	1200 (AL 2) 1400 (AL 1)	
Alarm High (ALR.H) 1000 Range	1400 (AL 2) 1800 (AL 1)	
Loop Brake Time (LOOP)	Disable (dSbL)	
Loop Value (B.tlM)	00:59	
Reading Adjust Value (R.AdJ)	0000	
Output 1 & 2:		
Self (SELF)	Disabled (dSbL)	Output 1 only
% Low Value (%LO)	0000	Output 1 only
% High Value (%HI)	0099	Output 1 only
Control Type (CtRL)	On/Off	
Action Type (ACTN)	Reverse (RVRS)	
Dead Band (dEAd)	0200	
PID:		
PID Auto (AUtO)	Disable (dSbL)	

MENU ITEMS	FACTORY PRESET VALUES	NOTES
Anti Integral (ANtI)	Disable (dSbL)	Output 1 only
Proportion Value (PROP)	0200	
Reset Value (RESf)	0180	Output 1 only
Rate Value (RAtE)	0000	Output 1 only
Cycle Value (CYCL)	0007	
Damping Factor (dPNG)	0003	
Ramp & Soak (RAMP):		
Ramp (RAMP)	Disable (dSbL)	
Soak (SOAK)	Disable (dSbL)	
Ramp Value (RAMP)	00:00	
Soak Value (SOAK)	00:00	
ID:		
ID Value	0000	
Full ID (FULL)	Disable (dSbL)	
Set Point ID (Id.SP)	Disable (dSbL)	
Communication Parameters:		
Baud Rate (BAUd)	9600	
Parity (PRtY)	Odd	
Data bit (dAtA)	7 bit	
Stop Bit	1 bit	
Modbus Protocol (M.bUS)	No	
Line Feed (LF)	No	
Echo (ECHO)	Yes	
Standard Interface (StNd)	RS232 (232C)	
Command Mode (MOdE)	Command (CMd)	
Separation (SEPR)	Space (SPCE)	
Alarm Status (StAt)	No	
Reading (RdNG)	Yes	
Peak (PEAK)	No	
Valley (VALY)	No	
Units (UNIt)	No	
Multipoint Address (AddR)	0001	
Transmit Time (tR.tM)	0016	
Display Color (COLR):		
Normal Color (N.CLR)	Green (GRN)	
Alarm 1 Color (1.CLR)	Red (REd)	
Alarm 2 Color (2.CLR)	Amber (AMbR)	

Table 5.1 Factory Preset Value Table

Appendix A

Table of Total Emissivity

These tables are presented for use as a guide when making infrared temperature measurements with the IR2 or other infrared Thermometers. The total emissivity (ϵ) for Metals, Non-metals and Common Building Materials are given. Since the emissivity of a material will vary as a function of temperature and surface finish, the values in these tables should be used only as a guide for relative or delta measurements. The exact emissivity of a material should be determined when absolute measurements are required.

METALS

ϵ = Emissivity

Material	Temp °F (°C)	ϵ	Material	Temp °F (°C)	ϵ	Material	Temp °F (°C)	ϵ
Alloys			Polished	100 (38)	.03	Monel, Ni-Cu Oxid. At		
20-Ni, 24-CR, 55-FE, Oxid.	392 (200)	.90	Highly Polished	100 (38)	.02	1110°F	1110 (599)	.46
20-Ni, 24-CR, 55-FE, Oxid.	932 (500)	.97	Rolled	100 (38)	.64	Nickel	100 (38)	.05
60-Ni, 12-CR, 28-FE, Oxid.	518 (270)	.89	Rough	100 (38)	.74	Polished	100-500 (38-260)	.31-.46
60-Ni, 12-CR, 28-FE, Oxid.	1040 (560)	.82	Molten	1000 (538)	.15	Oxidized	77 (25)	.05
80-Ni, 20-CR, Oxidized	212 (100)	.87	Molten	1970 (1077)	.16	Unoxidized	212 (100)	.06
80-Ni, 20-CR, Oxidized	1112 (600)	.87	Molten	2230 (1221)	.13	Unoxidized	932 (500)	.12
80-Ni, 20-CR, Oxidized	2372 (1300)	.89	Nickel Plated	100-500 (38-260)	.37	Unoxidized	1832 (1000)	.19
Aluminium			Dow Metal	0.4-600 (-18-316)	.15	Unoxidized	100 (38)	.04
Unoxidized	77 (25)	.02	Gold			Electrolytic	500 (260)	.06
Unoxidized	212 (100)	.03	Enamel	212 (100)	.37	Electrolytic	1000 (538)	.10
Unoxidized	932 (500)	.06	Plate (.0001)			Electrolytic	2000 (1093)	.16
Oxidized	390 (199)	.11	Plate on .0005 Silver	200-750 (93-399)	.11-.14	Electrolytic	1000-2000 (538-1093)	.59-.86
Oxidized	1110 (599)	.19	Plate on .0005 Nickel	200-750 (93-399)	.07-.09	Nickel Oxide		
Oxidized at 599°C (1110°F)	390 (199)	.11	Polished	100-500 (38-260)	.02	Palladium Plate (.00005		
Oxidized at 599°C (1110°F)	1110 (599)	.19	Polished	1000-2000 (538-1093)	.03	on .0005 silver)	200-750 (93-399)	.16-.17
Heavily Oxidized	200 (93)	.20	Haynes Alloy C,			Platinum	100 (38)	.05
Heavily Oxidized	940 (504)	.31	Oxidized	600-2000 (316-1093)	.90-.96	"	500 (260)	.05
Highly Polished	212 (100)	.09	Haynes Alloy 25,			"	1000 (538)	.10
Roughly Polished	212 (100)	.18	Oxidized	600-2000 (316-1093)	.86-.89	Platinum, Black	100 (38)	.93
Commercial Sheet	212 (100)	.09	Haynes Alloy X,			"	500 (260)	.96
Highly Polished Plate	440 (227)	.04	Oxidized	600-2000 (316-1093)	.85-.88	"	2000 (1093)	.97
Highly Polished Plate	1070 (577)	.06	Inconel Sheet	1000 (538)	.28	" Oxidized at 1100°F	500 (260)	.07
Bright Rolled Plate	338 (170)	.04	Inconel Sheet	1200 (649)	.42	"	1000 (538)	.11
Bright Rolled Plate	932 (500)	.05	Inconel Sheet	1400 (760)	.58	Rhodium Flash (0.0002		
Alloy A3003, Oxidized	600 (316)	.40	Inconel X, Polished	75 (24)	.19	on 0.0005 Ni)	200-700 (93-371)	.10-.18
Alloy A3003, Oxidized	900 (482)	.40	Inconel B, Polished	75 (24)	.21	Silver		
Alloy 1100-0	200-800 (93-427)	.05	Iron			Plate (0.0005 on Ni)	200-700 (93-371)	.06-.07
Alloy 24ST	75 (24)	.09	Oxidized	212 (100)	.74	Polished	100 (38)	.01
Alloy 24ST, Polished	75 (24)	.09	Oxidized	930 (499)	.84	"	500 (260)	.02
Alloy 75ST	75 (24)	.11	Oxidized	2190 (1199)	.89	"	1000 (538)	.03
Alloy 75ST, Polished	75 (24)	.08	Unoxidized	212 (100)	.05	"	2000 (1093)	.03
Bismuth, Bright	176 (80)	.34	Red Rust	77 (25)	.70	Steel		
Bismuth, Unoxidized	77 (25)	.05	Rusted	77 (25)	.65	Cold Rolled	200 (93)	.75-.85
Bismuth, Unoxidized	212 (100)	.06	Liquid	2760-3220 (1516-1771)	.42-.45	Ground Sheet	1720-2010 (938-1099)	.55-.61
Brass			Cast Iron			Polished Sheet	100 (38)	.07
73% Cu, 27% Zn, Polished	476 (247)	.03	Oxidized	390 (199)	.64	"	500 (260)	.10
73% Cu, 27% Zn, Polished	674 (357)	.03	Oxidized	1110 (599)	.78	"	1000 (538)	.14
62% Cu, 37% Zn, Polished	494 (257)	.03	Unoxidized	212 (100)	.21	Mild Steel, Polished	75 (24)	.10
62% Cu, 37% Zn, Polished	710 (377)	.04	Strong Oxidation	40 (104)	.95	Mild Steel, Smooth	75 (24)	.12
83% Cu, 17% Zn, Polished	530 (277)	.03	Strong Oxidation	482 (250)	.95	Mild Steel,		
Matte	68 (20)	.07	Liquid	2795 (1535)	.29	Liquid	2910-3270 (1599-1793)	.28
Burnished to Brown Colour	68 (20)	.40	Wrought Iron			Steel, Unoxidized	212 (100)	.08
Cu-Zn, Brass Oxidized	392 (200)	.61	Dull	77 (25)	.94	Steel, Oxidized	77 (25)	.80
Cu-Zn, Brass Oxidized	752 (400)	.60	Dull	660 (349)	.94	Steel Alloys		
Cu-Zn, Brass Oxidized	1112 (600)	.61	Smooth	100 (38)	.35	Type 301, Polished	75 (24)	.27
Unoxidized	77 (25)	.04	Polished	100 (38)	.28	Type 301, Polished	450 (232)	.57
Unoxidized	212 (100)	.04	Lead			Type 301, Polished	1740 (949)	.55
Cadmium	77 (25)	.02	Polished	100-500 (38-260)	.06-.08	Type 303, Oxidized	600-2000 (316-1093)	.74-.87

Carbon			Rough	100 (38)	.43	Type 310, Rolled	1500-2100 (816-1149)	.56-.81
Lampblack	77 (25)	.95	Oxidized	100 (38)	.43	Type 316, Polished	75 (24)	.28
Unoxidized	77 (25)	.81	Oxidized at 1100°F	100 (38)	.63	Type 316, Polished	450 (232)	.57
Unoxidized	212 (100)	.81	Gray Oxidized	100 (38)	.28	Type 316, Polished	1740 (949)	.66
Unoxidized	932 (500)	.79	Magnesium	100-500 (38-260)	.07-.13	Type 321	200-800 (93-427)	.27-.32
Candle Soot	250 (121)	.95	Magnesium Oxide	1880-3140 (1027-1727)	.16-.20	Type 321 Polished	300-1500 (149-815)	.18-.49
Filament	500 (260)	.95	Mercury	32 (0)	.09	Type 321 wBK Oxide	200-800 (93-427)	.66-.76
Graphitized	212 (100)	.76	"	77 (25)	.10	Type 347, Oxidized	600-2000 (316-1093)	.87-.91
Graphitized	572 (300)	.75	"	100 (38)	.10	Type 350	200-800 (93-427)	.18-.27
Graphitized	932 (500)	.71	"	212 (100)	.12	Type 350 Polished	300-1800 (149-982)	.11-.35
Chromium	100 (38)	.08	Molybdenum	100 (38)	.06	Type 446, Polished	300-1500 (149-815)	.15-.37
Chromium	1000 (538)	.26	"	500 (260)	.08	Type 17-7 PH	200-600 (93-316)	.44-.51
Chromium, Polished	302 (150)	.06	"	1000 (538)	.11	Type 17-7 PH		
Cobalt, Unoxidized	932 (500)	.13	"	2000 (1093)	.18	Polished 300-	300-1500 (149-815)	.09-.16
Cobalt, Unoxidized	1832 (1000)	.23	* Oxidized at 1000°F	600 (316)	.80	Type C1020,		
Columium, Unoxidized	1500 (816)	.19	* Oxidized at 1000°F	700 (371)	.84	Oxidized 600-	600-2000 (316-1093)	.87-.91
Columium, Unoxidized	2000 (1093)	.24	* Oxidized at 1000°F	800 (427)	.84	Type PH-15-7 MO	300-1200 (149-649)	.07-.19
Copper			* Oxidized at 1000°F	900 (482)	.83	Stellite, Polished	68 (20)	.18
Cuprous Oxide	100 (38)	.87	* Oxidized at 1000°F	1000 (538)	.82	Tantalum, Unoxidized	1340 (727)	.14
Cuprous Oxide	500 (260)	.83	Monel, Ni-Cu	392 (200)	.41	"	2000 (1093)	.19
Cuprous Oxide	1000 (538)	.77	Monel, Ni-Cu	752 (400)	.44	"	3600 (1982)	.26
Black, Oxidized	100 (38)	.78	Monel, Ni-Cu	1112 (600)	.46	"	5306 (2930)	.30
Etched	100 (38)	.09	Monel, Ni-Cu Oxidized	68 (20)	.43	Tin, Unoxidized	77 (25)	.04
Matte	100 (38)	.22	Tungsten			"	212 (100)	.05
Roughly Polished	100 (38)	.07	Unoxidized	77 (25)	.02	Tinned Iron, Bright	76 (24)	.05
Titanium			Unoxidized	212 (100)	.03	"	212 (100)	.08
Alloy C110M,			Unoxidized	932 (500)	.07	Uranium Oxide	1880 (1027)	.79
Polished	300-1200 (149-649)	.08-.19	Unoxidized	1832 (1000)	.15	Zinc		
Oxidized at			Unoxidized	2732 (1500)	.23	Bright, Galvanized	100 (38)	.23
538°C (1000°F)	200-800 (93-427)	.51-.61	Unoxidized	3632 (2000)	.28	Commercial 99.1%	500 (260)	.05
Alloy Ti-95A,			Filament (Aged)	100 (38)	.03	Galvanized	100 (38)	.28
Oxid. at			Filament (Aged)	1000 (538)	.11	Oxidized	500-1000 (260-538)	.11
538°C (1000°F)	200-800 (93-427)	.35-.48	Filament (Aged)	5000 (2760)	.35	Polished	100 (38)	.02
Anodized onto SS	200-600 (93-316)	.96-.82				Polished	500 (260)	.03
						Polished	1000 (538)	.04
						Polished	2000 (1093)	.06

Appendix B

Table of Emissivity

NON-METALS

Material	Temperature (F)	(C)	E-Emissivity
Adobe	68	20	.90
Asbestos			
Board	100	38	.96
Cement	32-392	0-200	.96
Cement, Red	2500	1371	.67
Cement, White	2500	1317	.65
Cloth	199	93	.90
Paper	100-700	38-371	.93
Slate	68	20	.72
Asphalt, pavement	100	38	.93
Asphalt, tar paper	68	20	.93
Basalt	68	20	.72
Brick			
Red, rough	70	21	.93
Gault Cream	2500-5000	1371-2760	.26-.30
Fire Clay	2500	1371	.75
Lime Clay	2500	1371	.43
Fire Brick	1832	100	.75-.80
Magnesite, Refractory	1832	1000	.38
Gray Brick	2021	1100	.75
Silica, Glazed	2000	1093	.88
Silica, Unglazed	2000	1093	.80
Sandlime	2500-5000	1371-2760	.59-.63
Carborundum	1850	1010	.92
Ceramic			
Alumina on Inconel	800-2000	427-1093	.69-.45
Earthenware, Glazed	70	21	.90
Earthenware, Matte	70	21	.93
Greens No. 5210-2C	200-750	93-399	.89-.82
Coating No. C20A	200-750	93-399	.73-.80
Porcelain	72	22	.92
White Al ₂ O ₃	200	93	.90
Zirconia on Inconel	800-2000	427-1093	.62-.45
Clay	68	20	.39
" Fired	158	70	.91
" Shale	68	20	.69
" Tiles, Light Red	2500-5000	1371-2760	.32-.34
" Tiles, Dark Purple	2500-5000	1371-2760	.78
Concrete			
Rough	32-2000	0-1093	.94
Tiles, Natural	2500-5000	1371-2760	.63-.62
" Brown	2500-5000	1371-2760	.87-.83
" Black	2500-5000	1371-2760	.94-.91
Cotton Cloth	68	20	.77
Dolomite Lime	68	20	.41

Material	Temperature (F)	(C)	E-Emissivity
Emery Corundum	176	80	.86
Glass			
Convex D	212	100	.80
Convex D	600	316	.82
Convex D	932	500	.76
Nonex	212	100	.82
Nonex	939	500	.76
Smooth	32-200	0-93	.92-.94
Granite	70	21	.45
Gravel	100	38	.28
Gypsum	68	20	.80-.90
Ice, Smooth	32	0	.97
Ice, Rough	32	0	.98
Lacquer			
Black	200	93	.96
Blue, on Al Foil	100	38	.78
Clear, on Al Foil (2 coats)	200	93	.08 (.09)
Clear, on Bright Cu	200	93	.66
Clear, on Tarnished Cu	200	93	.64
Red, on Al Foil (2 coats)	200	93	.61 (.74)
White	200	93	.95
White, on Al Foil (2 coats)	100	38	.69 (.88)
Yellow, on Al Foil (2 coats)	100	38	.57 (.79)
Lime Mortar	100-500	38-260	.90-.92
Limestone	100	38	.95
Marble, White	100	38	.95
" Smooth, White	100	38	.56
" Polished Gray	100	38	.75
Mica	100	38	.75
Oil on Nickel			
0.001 Film	72	22	.27
0.002 "	72	22	.46
0.005 "	72	22	.72
Thick "	72	22	.82
Oil, Linseed			
On Al Foil, uncoated	250	121	.09
On Al Foil, 1 coat	250	121	.56
On Al Foil, 2 coats	250	121	.56
On Polished Iron, .001 Film	100	38	.22
On Polished Iron, .002 Film	100	38	.45
On Polished Iron, .004 Film	100	38	.65
On Polished Iron, Thick Film	100	38	.83
Paints			
Blue, Cu2O3	75	24	.94
Black, CuO	75	24	.96
Green, Cu2O3	75	24	.92
Red, Fe2O3	75	24	.91
White, Al2O3	75	24	.94
White, Y2O3	75	24	.90
White, ZnO	75	24	.95
White, MgCO3	75	24	.91

Material	Temperature (F)	(C)	E-Emissivity
White, ZrO2	75	24	.95
White, ThO2	75	24	.90
White, MgO	75	24	.91
White, PbCO3	75	24	.93
Yellow, PbO	75	24	.90
Yellow, PbCrO4	75	24	.93
Paints, Aluminum	100	38	.27-.67
10% Al	100	38	.52
26% Al	100	38	.30
Dow XP-310	200	93	.22
Paints, Bronze	low	low	.34-.80
Gum Varnish (2 coats)	70	21	.53
Gum Varnish (3 coats)	70	21	.50
Cellulose Binder (2 coats)	70	21	.34
Paints, Oil			
All colors	200	93	.92-.96
Black	200	93	.92
Black Gloss	70	21	.90
Camouflage Green	125	52	.85
Flat Black	80	27	.88
Flat White	80	27	.91
Gray-Green	70	21	.95
Green	200	93	.95
Lamp Black	209	98	.96
Red	200	93	.95
White	200	93	.94
Quartz, Rough, Fused	70	21	.93
Glass, 1.98 mm	540	282	.90
Glass, 1.98 mm	1540	838	.41
Glass, 6.88 mm	540	282	.93
Glass, 6.88 mm	1540	838	.47
Opaque	570	299	.92
Opaque	1540	838	.68
Red Lead	212	100	.93
Rubber, Hard	74	23	.94
Rubber, Soft, Gray	76	24	.86
Sand	68	20	.76
Sandstone	100	38	.67
Sandstone, Red	100	38	.60-.83
Sawdust	68	20	.75
Shale	68	20	.69
Silica, Glazed	1832	1000	.85
Silica, Unglazed	2012	1100	.75
Silicon Carbide	300-1200	149-649	.83-.96
Silk Cloth	68	20	.78
Slate	100	38	.67-.80
Snow, Fine Particles	20	-7	.82
Snow, Granular	18	-8	.89
Soil			
Surface	100	38	.38
Black Loam	68	20	.66

Material	Temperature (F)	(C)	E-Emissivity
Plowed Field	68	20	.38
Soot			
Acetylene	75	24	.97
Camphor	75	24	.94
Candle	250	121	.95
Coal	68	20	.95
Stonework	100	38	.67
Water	100	38	.67
Waterglass	68	20	.96
Wood	low	low	.80-.90
Beech Planed	158	70	.94

WARRANTY/DISCLAIMER

OMEGA ENGINEERING, INC. warrants this unit to be free of defects in materials and workmanship for a period of **13 months** from date of purchase. OMEGA's WARRANTY adds an additional one (1) month grace period to the normal **one (1) year product warranty** to cover handling and shipping time. This ensures that OMEGA's customers receive maximum coverage on each product.

If the unit malfunctions, it must be returned to the factory for evaluation. OMEGA's Customer Service Department will issue an Authorized Return (AR) number immediately upon phone or written request. Upon examination by OMEGA, if the unit is found to be defective, it will be repaired or replaced at no charge. OMEGA's WARRANTY does not apply to defects resulting from any action of the purchaser, including but not limited to mishandling, improper interfacing, operation outside of design limits, improper repair, or unauthorized modification. This WARRANTY is VOID if the unit shows evidence of having been tampered with or shows evidence of having been damaged as a result of excessive corrosion; or current, heat, moisture or vibration; improper specification; misapplication; misuse or other operating conditions outside of OMEGA's control. Components in which wear is not warranted, include but are not limited to contact points, fuses, and triacs.

OMEGA is pleased to offer suggestions on the use of its various products. However, OMEGA neither assumes responsibility for any omissions or errors nor assumes liability for any damages that result from the use of its products in accordance with information provided by OMEGA, either verbal or written. OMEGA warrants only that the parts manufactured by the company will be as specified and free of defects. OMEGA MAKES NO OTHER WARRANTIES OR REPRESENTATIONS OF ANY KIND WHATSOEVER, EXPRESSED OR IMPLIED, EXCEPT THAT OF TITLE, AND ALL IMPLIED WARRANTIES INCLUDING ANY WARRANTY OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE ARE HEREBY DISCLAIMED. LIMITATION OF LIABILITY: The remedies of purchaser set forth herein are exclusive, and the total liability of OMEGA with respect to this order, whether based on contract, warranty, negligence, indemnification, strict liability or otherwise, shall not exceed the purchase price of the component upon which liability is based. In no event shall OMEGA be liable for consequential, incidental or special damages.

CONDITIONS: Equipment sold by OMEGA is not intended to be used, nor shall it be used: (1) as a "Basic Component" under 10 CFR 21 (NRC), used in or with any nuclear installation or activity; or (2) in medical applications or used on humans. Should any Product(s) be used in or with any nuclear installation or activity, medical application, used on humans, or misused in any way, OMEGA assumes no responsibility as set forth in our basic WARRANTY/DISCLAIMER language, and, additionally, purchaser will indemnify OMEGA and hold OMEGA harmless from any liability or damage whatsoever arising out of the use of the Product(s) in such a manner.

RETURN REQUESTS/INQUIRIES

Direct all warranty and repair requests/inquiries to the OMEGA Customer Service Department. BEFORE RETURNING ANY PRODUCT(S) TO OMEGA, PURCHASER MUST OBTAIN AN AUTHORIZED RETURN (AR) NUMBER FROM OMEGA'S CUSTOMER SERVICE DEPARTMENT (IN ORDER TO AVOID PROCESSING DELAYS). The assigned AR number should then be marked on the outside of the return package and on any correspondence.

The purchaser is responsible for shipping charges, freight, insurance and proper packaging to prevent breakage in transit.

FOR **WARRANTY** RETURNS, please have the following information available BEFORE contacting OMEGA:

1. Purchase Order number under which the product was PURCHASED,
2. Model and serial number of the product under warranty, and
3. Repair instructions and/or specific problems relative to the product.

FOR **NON-WARRANTY** REPAIRS, consult OMEGA for current repair charges. Have the following information available BEFORE contacting OMEGA:

1. Purchase Order number to cover the COST of the repair,
2. Model and serial number of the product, and
3. Repair instructions and/or specific problems relative to the product.

OMEGA's policy is to make running changes, not model changes, whenever an improvement is possible. This affords our customers the latest in technology and engineering.

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