Installation & Operation Manual

# 1020 & 1030 Temperature Controllers


CHROMALOX
*Advanced Thermal Technologies*

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# Safety and Warranty Information

Products covered in this issue of the manual: 1020 & 1030 Process and Over-Temperature Controllers.

This manual supplements the Quick Start Product manual supplied with each instrument at the time of shipment. Information in this installation, wiring and operation manual is subject to change without notice. 

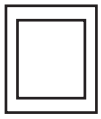
Copies of this manual are available in electronic format on the Chromalox web site (www.chromalox.com) .

***THE INTERNATIONAL HAZARD SYMBOL IS INSCRIBED ADJACENT TO THE REAR CONNECTION TERMINALS***

***IT IS IMPORTANT TO READ THIS MANUAL BEFORE INSTALLING OR COMMISSIONING THE UNIT.***

**⚠WARNING**

***WARNING: PRODUCTS COVERED BY THIS MANUAL ARE SUITABLE FOR INDOOR USE, INSTALLATION CATEGORY II, POLLUTION CATEGORY 2 ENVIRONMENTS***



***THIS SYMBOL MEANS THE EQUIPMENT IS PROTECTED THROUGHOUT BY DOUBLE INSULATION.***

## Warranty and Returns Statement

These products are sold by Chromalox under the warranties set forth in the following paragraphs. Such warranties are extended only with respect to a purchase of these products, as new merchandise, directly from Chromalox or from a Chromalox distributor, representative, or reseller and are extended only to the first buyer thereof who purchases them other than for the purpose of resale.

**Warranty**

These products are warranted to be free from functional defects in material and workmanship at the time the products leave Chromalox factory and to conform at that time to the specifications set forth in the relevant Chromalox instruction manuals sheet or sheets, for such products for a period of three years.

**THERE ARE NO EXPRESSED OR IMPLIED WARRANTIES, WHICH EXTEND BEYOND THE WARRANTIES HEREIN AND ABOVE SET FORTH. CHROMALOX MAKES NO WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE WITH RESPECT TO THE PRODUCTS.**

**Limitations**

Chromalox shall not be liable for any incidental damages, consequential damages, special damages, or any other damages, costs or expenses excepting only the cost or expense of repair or replacement as described above. Products must be installed and maintained in accordance with Chromalox instructions. There is no warranty against damage to the product resulting from corrosion. Users are responsible for the suitability of the products to their application. For a valid warranty claim, the product must be returned carriage paid to the supplier within the warranty period. The product must be properly packaged to avoid damage from Electrostatic Discharge or other forms of harm during transit.

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# 1 Installation

## 1.1 Unpacking

Carefully remove the product from its packing. Please retain the packing for future use.

A single sheet concise manual is also supplied in one or more languages. Examine the delivered items for damage or defects. If any are found, contact your supplier immediately.

## 1.2 Cleaning

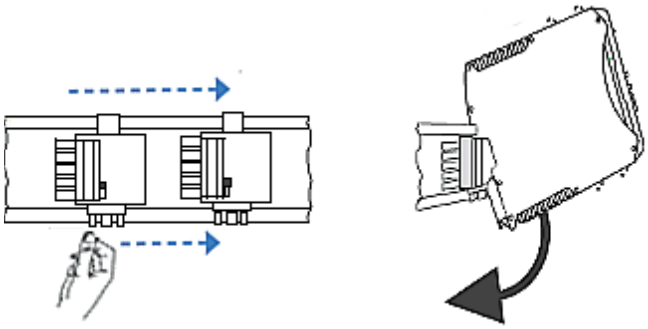
Clean the front panel by wiping down with a dry cloth. Never allow water or any other substances to ingress into the instrument.

## 1.3 Installation

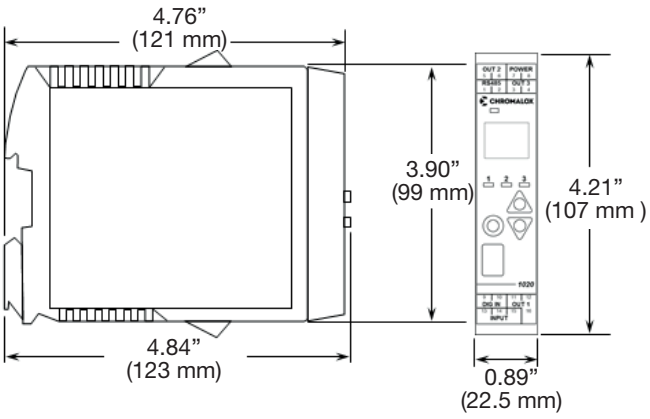
**⚠CAUTION**

***Installation should only be performed by technically competent personnel. It is the responsibility of the installing engineer to ensure that the configuration is safe. Local regulations regarding electrical installation & safety must be observed (e.g. US National Electrical Code (NEC) or Canadian Electrical Code.***

This instrument is designed for indoor back of panel use.



This bus connection links up the optional RS485 communications connections without extra wiring but does not supply power.




**⚠CAUTION**

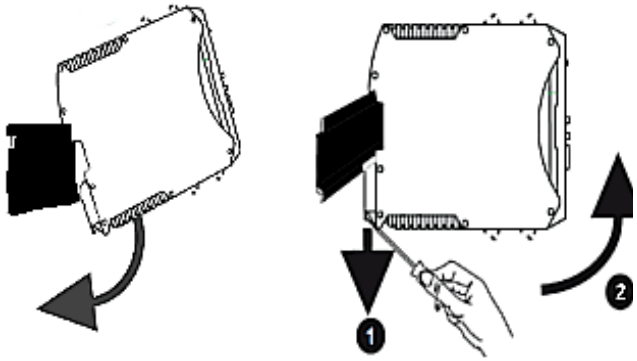
***This equipment is protected throughout by double insulation, when installed properly. This type of installation does not need an earth connection, but it is vital for safety reasons, that the instrument is replaced if the instrument housing is broken.***

The optional bus connection should be slid onto the DIN Rail before fitting the 1020/1030 Rail.

The connectors must be pushed together to share the bus.

**⚠CAUTION**

***Ensure there is adequate air flow inside the panel to prevent overheating.***



# 2 Electrical Installation

**⚠CAUTION**

***The installation should be only performed by technically competent personnel.***

**⚠CAUTION**

***It is the responsibility of the installing engineer to ensure that the configuration is safe.***

**⚠CAUTION**

***Local Regulations regarding electrical installation & safety must be observed (e.g. US National Electrical Code (NEC) or Canadian Electrical Code).***

## 2.1 Installation Considerations

Ignition transformers, arc welders, motor drives, mechanical contact relays and solenoids are examples of devices that generate electrical noise in typical industrial environments.

The following guidelines MUST be followed to minimise their effects.

If the instrument is being installed in existing equipment, the wiring in the area should be checked to ensure that good wiring practices have been followed. Noise-generating devices such as those listed above should be mounted in a separate enclosure.

If this is not possible, separate them from the instrument, by the largest distance possible.

If possible, eliminate mechanical contact relays and replace with solid-state relays. If a mechanical relay cannot be replaced, a solid-state relay can be used to isolate the instrument.

A separate isolation transformer to feed only the instrumentation should be considered. The transformer can isolate the instrument from noise found on the AC power input.

## 2.2 AC Power Wiring - Neutral (for 100 to 240V AC versions)

It is good practice to ensure that the AC neutral is at or near ground (earth) potential. A proper neutral will help ensure maximum performance from the instrument.

## 2.3 Wire Isolation

Four voltage levels of input and output wiring may be used with the unit:

- Analogue input (for example thermocouple, RTD, VDC, mVDC or mADC)
- Relays outputs
- SSR Driver outputs
- AC power

**⚠CAUTION**

***The only wires that should run together are those of the same category.***

If any wires need to run parallel with any other lines, maintain a minimum space of 6” between them. If wires MUST cross each other, ensure they do so at 90 degrees to minimize interference.

## 2.4 Use of Shielded Cable

All analog signals must use shielded cable. This will help eliminate electrical noise induction on the wires. Connection lead length must be kept as short as possible keeping the wires protected by the shielding. The shield should be grounded at one end only. The preferred grounding location is at the sensor, transmitter or transducer.

## 2.5 Noise Suppression at Source

Usually when good wiring practices are followed, no further noise protection is necessary. Sometimes in severe electrical environments, the amount of noise is so great that it must be suppressed at source. Many manufacturers of relays, contactors, etc. will supply ‘surge suppressors’ which mount on the noise source. For those devices that do not have surge suppressors supplied, Resistance-Capacitance (RC) networks and/or Metal Oxide Varistors (MOV) may be added.

**Inductive coils:** - MOVs are recommended for transient suppression in inductive coils, connected in parallel and as close as possible to the coil. Additional protection may be provided by adding an RC network across the MOV.

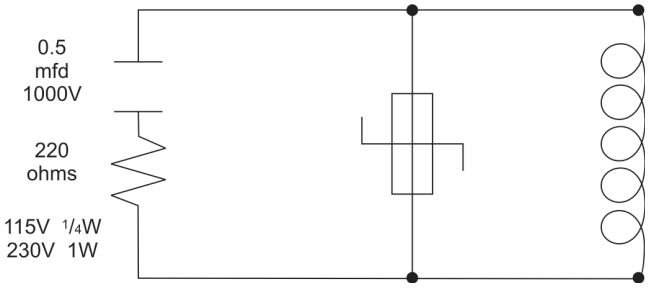
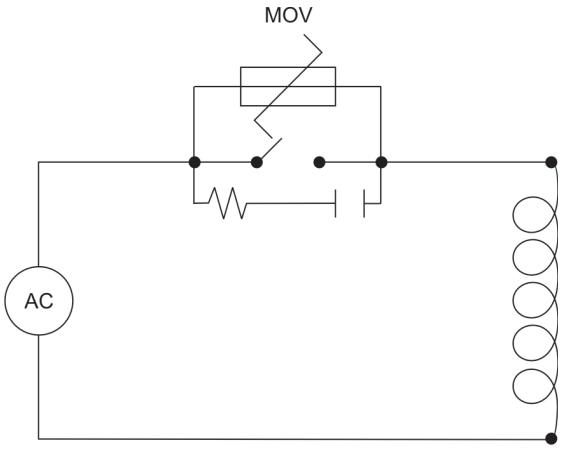



**Figure 5. Contacts:** - Arcing may occur across contacts when they open and close. This results in electrical noise as well as damage to the contacts. Connecting a properly sized RC network can eliminate this arc.

For circuits up to 3 amps, a combination of a 47 ohm resistor and 0.1 microfarad capacitor (1000 volts) is recommended. For circuits from 3 to 5 amps, connect two of these in parallel.




## 2.6 Sensor Placement (Thermocouple or RTD)

If the temperature probe is to be subjected to corrosive or abrasive conditions, it must be protected by an appropriate thermowell. The probe must be positioned to reflect true process temperature: In a liquid media, the most agitated area. In air, the best circulated area.

**⚠CAUTION**

***The placement of probes into pipe work some distance from the heating vessel leads to transport delay, which results in poor control.***

For a two wire RTD a wire link should be used in place of the third wire. Two wire RTDs must only be used with lead lengths less than 3 meters (10 ft.). Use of three wire RTDs is strongly recommended.

## 2.7 Panel Wiring

In general, all wiring connections are made to the instrument after it is installed. Copper wires must be used for all connections (except thermocouple signal wires).

**⚠CAUTION**

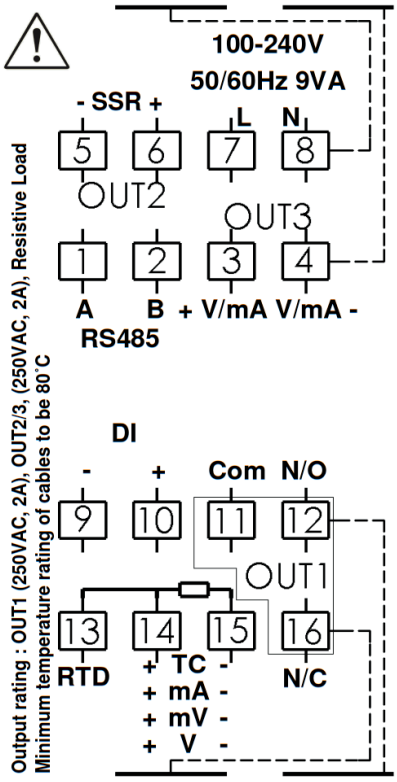
***To avoid electrical shock, AC power wiring must not be connected to the source distribution panel until all wiring procedures are completed.***

**⚠CAUTION**

***Check the information label on the case to determine the correct voltage before connecting to a live supply.***

## 2.8 Terminal Wiring

The diagram shows all possible option combinations. Please check the product configuration before wiring. Dedicated Configuration Socket (on bottom of the instrument)




The wiring label shows the power requirements, connector positions and terminal number.

This example is:

TOP
1 & 2 Rear = RS485 Comms
3 & 3 Rear = Linear Out 3
5 & 6 Front = SSR Driver Out 2
7 & 8 Front = 100-240VAC power.

BOTTOM
9 & 10 Rear = Digital Input
11, 12 Rear & 16 Front = Relay Out 1
13, 14 & 15 Front = Process Input

## 2.9 Power Connection

To avoid damaging your instrument it is critical the power connection is made to the correct terminals

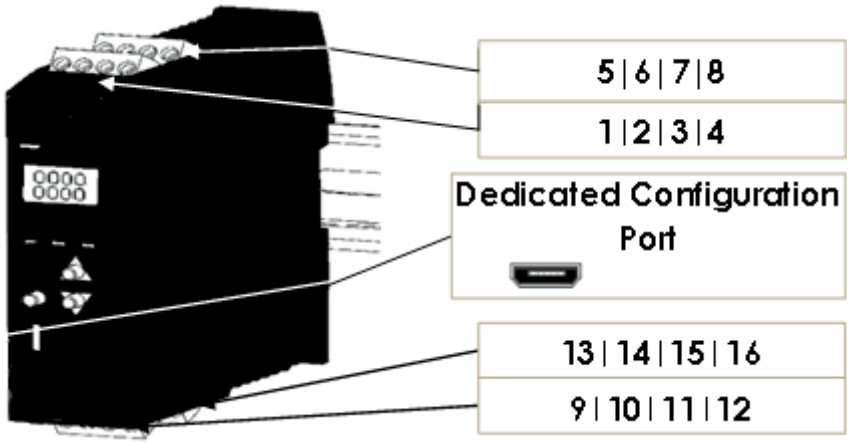
Power is connected to pins 7 & 8.
Top, rear connector on the right-hand side.
(front connector omitted from picture for clarity)

The green LED shows when power is correctly connected.

**⚠WARNING**

***NEVER DIRECTLY CONNECT THIS SOCKET TO A USB PORT.***

A configuration socket to USB adaptor can be obtained from your supplier.

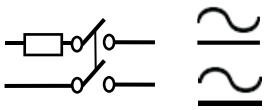
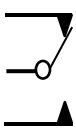
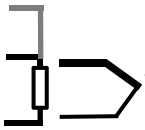


## 1020/1030 Rail Isolation Chart

| | PSU | Universal Input | Relay | SSR | Linear | RS485 Comms | Non-Isolated Digital Input | Isolated Digital Input | Configuration Port |
|---|---|---|---|---|---|---|---|---|---|
| **PSU** | | | | | | | | | |
| **Universal Input** | | | | | | | | | |
| **Relay** | | | | | | | | | |
| **SSR** | | | | | | | | | |
| **Linear** | | | | | | | | | |
| **RS485 Comms** | | | | | | | | | |
| **Non-Isolated Digital Input** | | | | | | | | | |
| **Isolated Digital Input** | | | | | | | | | |
| **Configuration Port** | | | | | | | | | |

| | |
|---|---|
| | Not Applicable |
| | No Isolation |
| | Reinforced Isolation |

## 1020/1030 Input & Output Map

| Use cables with 80°C minimum temperature rating, conductor sizes 30-12 AWG | | | |
|---|---|---|---|
| 1 | RS485 A (Rx/Tx+) | **Communications** | |
| 2 | RS485 B (Rx/Tx-) | | |
| 3 |  Relay COM / Linear + | Output 3 – Standard & Extrusion models | Output 3 (Alarm 2 or Retx PV) – Limiter model |
| 4 | Relay NO / Linear - | | |
| 5 |  Relay COM / SSR - | Output 2 – Standard & Extrusion models | Alarm 1 output – Limiter model |
| 6 | Relay NO / SSR+ | | |
| 7 |  L + | Power – low power or mains (hardware dependent) | |
| 8 | N - | | |
| 9 |  + Volt - free or TTL compatible | Digital Input | |
| 10 | - | | |
| 16 |  Relay NC | Output 1 – Standard and Extrusion models | Limit output – Limiter model (Relay only) |
| 11 | Relay COM / SSR - | | |
| 12 | Relay NO / SSR+ | | |
| 13 |  RTD | Input – thermocouple, RTD or linear | |
| 14 | TC / RTD / Linear | | |
| 15 | TC / RTD / Linear | | |

# 3 Powering Up

**⚠CAUTION**

***ENSURE SAFE WIRING PRACTICES HAVE BEEN FOLLOWED. WHEN POWERING UP FOR THE FIRST TIME, DISCONNECT THE OUTPUT CONNECTIONS.***

**⚠CAUTION**

***Check carefully the supply voltage and connections before applying power.***

The instrument must be powered from a supply according to the wiring label on the side of the unit. (100vac to 240Vac, or 24 Vac/dc depending upon the model purchased.)

## 3.1 Powering Up Procedure

At power-up, a self-test procedure is run, during which a product logo screen is displayed.

When powering up for the first time the instrument starts up in the Setup Mode after the product logo screen is displayed.

**You must complete the Setup by cycling through all of the parameters before using the device for the first time.**

## 3.2 First Power Up or Factory Default

When the unit is initially powered up or the user restores the factory defaults to the device, it immediately enters the Setup menu without requiring an unlock code. The user must then cycle through every parameter, to either view or adjust the value, and then exit the menu.

1. Use ▲ or ▼ to review every parameter.
2. Change value if necessary using ◉, then use ▲ or ▼ to adjust the value, then ◉ to save.
3. Exit Setup by pressing ◉ & ▲ together.

If the above steps are not followed the Setup has not been completed so the device will go into Setup, again, on every subsequent power up.

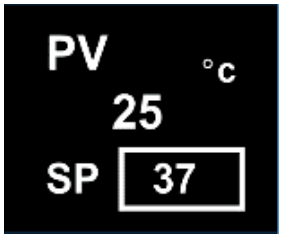
## 3.3 Auto-Tune

The controller can be auto-tuned from the Setup Mode.

1. Pre-tune
2. Auto-tune at setpoint

**Auto-Tuning will not engage if:**
- **Controller is set to On/Off Control**
- **Setpoint is ramping**
- **PV is within 5% of the input range from setpoint**

## 3.4 Front Panel




Display shows PV (process variable), units, SP (setpoint), alarm/latch statuses, error & warning messages.

By default, the display turns off after 5 minutes without any key presses. This is configurable in the Advanced Configuration, in the Display sub-menu, parameter Screen Timeout. Any key press turns the display back on.

3 navigation keys:
- ◉ Ok/Select
- ▲ Up
- ▼ Down

Standard:
3 Output Status LEDs

1 2 3

Extrusion:
3 Status LEDs for:

Heat Cool Alarm

Limiter:
3 Status LEDs for

LM EX AL

## 3.5 General Navigation & Editing

- Press ▲ or ▼ keys to navigate between parameters or menu items.
- Press ▲ to highlight a parameter value, ready for editing.
- Press ▲ or ▼ to change the parameter value, then press ▲ within 60 seconds to confirm change.

## 3.6 Mode (or Menu) Structure

There are 3 main modes (or menus) on the device – Setup and Advanced Configuration Mode.

- User Mode - the live screen used for normal operation. The process variable can always be seen in this mode
- Setup Mode – allows access to the most important parameters
- Advanced Configuration Mode - access all parameters via sub-menus

Setup Mode - press ▲ & ▼ .

Advanced Configuration - press ▼ & ▲ .

**⚠WARNING**

***Never connect the instrument's configuration socket directly to a USB port as it will damage the controller.***

## 3.7 Returning to Operator Mode

Press ▼ & ▲ to move back one level

From a sub-menu you will need to do this twice; once to return to Advanced Configuration Mode then again to exit. After 120 seconds without key presses the unit returns automatically to the first Operator mode screen.

## 3.8 Mode Access and Lock Codes

Separate lock codes can be set for the Setup mode and for the Advanced Configuration mode.

- Setup mode lock code – default 10.
- Advanced Configuration mode lock code – default 20.

Hold the ▲ button while powering up for a read-only view of lock codes.

## 3.9 Use of the Controller for Non-Temperature Applications

In the majority of applications this controller will be used for temperature sensing, either via a sensor or a linear DC input, which use heat and cool. However this controller can be used for other types of processes.

If your process is not a temperature then the parameters labelled as "HEAT"refer to reverse acting outputs used to increase the process value and "COOL" to decrease the process value.

As an example you may have a system that reads and controls humidity. The "HEAT" output drives the humidifier and the "COOL" output drives the de-humidifier. Use the "HEAT" parameters to control the humidifier and the "COOL" parameters to control the de-humidifier.

Often the "HEAT" and "COOL" is referred to as "Primary" and "Secondary" on other controllers.

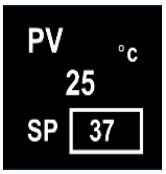
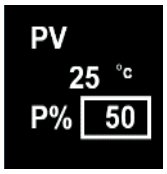
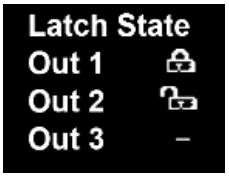
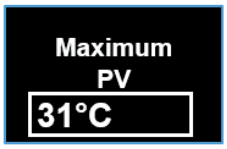
## 3.10 Controller Transmitter Function

The Standard 1020 & 1030 model can be used as a "transmitter" to retransmit the process value or controller setpoint via Output 3, if the linear option is fitted. The parameter Usage in the Linear Output sub-menu can be set to PV Retransmit or SP Retransmit.

In the Display menu, the parameter Transmitter can be used to enable Transmitter view. This hides the Setpoint from view.

**Control functions will remain active if they have been configured.**

## 3.11 User Mode & Screens on Standard & Extrusion models

| | | | |
|---|---|---|---|
| User Screen |  | Temperature Unit.<br>PV – process variable (e.g. process temperature)<br>SP - Setpoint | |
| Manual control |  | PV – process variable (e.g. process temperature)<br>Manual Power is shown as P%. | |
| Transmitter screen is present on Standard model only. | | | |
| |  | Transmitter parameter = Enable, SP is hidden.<br>**The device still functions as a controller using the local Setpoint.**<br>To act as a PV transmitter the parameter Usage in the Linear Output sub-menu needs to be set to PV Re-transmit. | |
| Important: The following parameters are only displayed if set to “Show” in the User sub-menu. | | | |
| Alarm State |  | Alarm triggered<br>Alarm configured, but not triggered<br>– Alarm not set | |
| Latch State |  | Output Latched<br>Latch configured, but output not Latched<br>– Latch not set | To clear press then to select Yes.<br>Press to accept. |
| Maximum PV<br>Minimum PV |  <br>Screens show the Maximum & Minimum PV reached.<br>  | | To clear press then to select Yes.<br>Press to accept. |
| Control Enable | OFF - Control output(s) disabled. (Ignored when in manual mode).<br>ON - Control output(s) enabled. | | |
| Manual Control Enable | OFF - Automatic control, PID or On-Off control available.<br>ON - Manual control, Manual Power shown as P% xxx | | |
| Time On Remaining | On Timer | Visible when On Timer is active.<br>See Ramp & Timers diagram. | |
| Delay Time Remaining | Delay Timer | Visible when Delay Timer is active.<br>See Ramp & Timers diagram. | |

## 3.12 Warnings & Messages

### Pop-Up Alerts

Pop-up alerts appear in front of the current screen. They must be acknowledged before you can access other screens.

Press ○ & △ together to clear the pop-up alert.

### Pop-Up Alert List

| Message | Description |
|---|---|
| **Alarm 1** | Alarm 1 is active. |
| **Alarm 2** | Alarm 2 is active. |
| **Alarm 1 & 2** | Alarm 1 and 2 are active. |
| **Control Enabled** | Alerts user that the control is re-enabled. (not Limiter.) |
| **Calibration Pass** | Factory calibration (Full Input Calibration has passed.) |
| **Calibration Fail** | Factory calibration (Full Input Calibration has failed.) |
| **Tuning in Progress** | Tune at Setpoint or Pre-Tune is running. (Not Limiter.) |
| **Setup not completed** | Please refer to First Power Up or Factory Default section. |
| **Offset in use** | SP offset is being used in Setpoint sub-menu. |
| **Limit Exceeded** | Limiter only, indicates when the limit value has been exceeded. |
| **Tune Error<br>PV within 5% of SP** | PV within 5% of the scale range input from SP (for Pre-Tune). Try a different setpoint or narrow the scale range input. |
| **Tune Error<br>Setpoint is ramping** | Setpoint is ramping. Turn off ramping and try again. |
| **Tune Error<br>Control is ON/OFF** | Control is not set to PID, i.e. the proportional band = 0. Set the proportional band to any other value and try again. |
| **Tune Error<br>Control is manual** | Manual control enabled. Set Manual Control Enable to OFF and try again. |
| **Tune Error<br>Tune at Setpoint not able to run** | Tune at setpoint has timed out or cannot run. |
| **Tune Error<br>Sensor Break** | Check your sensor. |
| **Tune Error<br>Timer Running** | Timer Running. Set the Enable Timer parameter to Disabled. |

**Message List**

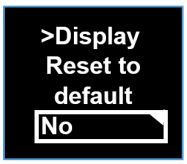
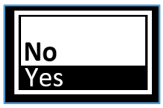
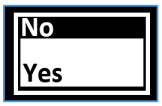
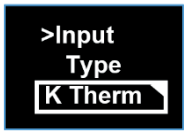
| Message | Description |
|---|---|
| **ALARM** | Alternates with PV and shows one, or both, Alarms are active. |
| **LATCH** | Alternates with PV, one or more outputs are latched on & no alarm is active. |
| **LIMIT** | On Limiter model, alternates with PV to show Limit is active. |
| **HIGH** | Process variable input >5% over-range.<br>Check for possible issues with sensor or connections.<br>Also, check that **Scale Range Maximum** is high enough for your application. |
| **LOW** | Process variable input >5% under-range.<br>Check for possible issues with sensor or connections.<br>Also, check that **Scale Range Minimum** is low enough for your application. |
| **OPEN** | Break detected in process variable input sensor, wiring or wrong input type selected. Shows **OPEN** until resolved, Control is disabled on Standard or Extrusion models), or Limit state set until resolved on Limiter model. |
| **ERROR** | Selected input range is not calibrated.<br>Shows **ERROR** until resolved. Control is disabled on Standard or Extrusion models), or Limit state set until resolved on Limiter model. |
| **TUNE** | Alternating with SP shows Auto-tuning is in progress. |
| **P%** | Manual power value replaces setpoint, shows **P% xxx** of power. |
| **Ramp** | Setpoint ramp is active (alternates with actual setpoint). |
| **OFF** | Control is disabled. Control output(s) are off.<br>Enable control by setting **Control Enable** to **ON** or check state of the Digital Input if **Digital I/P Action** is set to **Ctrl Enable/Disable**. |
| **DELAY** | Shows when Delay Timer is active, control is off until the timer finishes. |
|  | **The Automatic Tuning parameter must be changed to Off to clear any tuning message. Display alternates between the tuning code & setpoint** |
| **tErr1** | PV within 5% of the scale range input from SP (for Pre-Tune).<br>Try a different setpoint or narrow the scale range input. |
| **tErr2** | Setpoint is ramping. |
| **tErr3** | Control is ON/OFF. Control is not set to PID, i.e. the proportional band = 0. |
| **tErr4** | Control is manual. Set **Manual Control Enable** to **OFF**. |
| **tErr5** | Tune at Setpoint not able to run. |
| **tErr6** | Sensor Break. |
| **tErr7** | Timer Running. Set the **Enable Timer** parameter to **Disabled** before attempting to run tuning again. |
| **tErr8** | Control is disabled. Please check it is safe to enable control and then go to the User menu to change **Control Enable** to **ON**. |

# 4 Initial Default Settings

Your 1020 & 1030 Process and Over-temperature Controller will arrive with specific factory settings. If at any point the factory default process is performed, all the parameters will be returned to the values shown below.

**The Reset to Defaults can be found in the sub-menu Display in the Advanced Configuration on all models.**

## 4.1 Factory Reset Procedure

| | |
|---|---|
|  | Press ◉ to highlight **NO**. |
|   | Press ▲ to move highlight to **YES**.<br>Press ◉ to accept. |
|   | A confirmation screen appears.<br>If you are sure press ▲ to show **YES** (leave as **NO** to cancel).<br>Press ◉ to confirm your choice. |
|  | The instrument shows the default for the Input Type and its default value.<br>The user must review all parameters in the Set-up menu before exiting. |

# 5 Setup Mode

## 5.1 Navigating the Setup Screens

To access the Setup Mode from User Mode, press ⊙ & ▲ together. Enter code for Setup Lock (default = **10**) using ▲ & ▼ , then press ⊙.

| | | |
|---|---|---|
| Lock Code | 10 | Lock code to enter Setup Mode. Default is 10 |

| Parameter Name | Description | | Meaning & Visibility |
|---|---|---|---|
| Input Type | -200 to 1200ºC<br>-328 to 2192ºF | -128.8 to 537.7ºC<br>-199.9 to 999.9ºF | J Thermocouple |
| | -240 to 1373ºC<br>-400 to 2503ºF | -128.8 to 537.7ºC<br>-199.9 to 999.9ºF | K Thermocouple |
| | -199 to 800ºC<br>-328 to 1472ºF | -128.8 to 537.7ºC<br>-199.9 to 999.9ºF | PT100 |
| | 100 to 1824ºC | 211 to 3315ºF | B Thermocouple |
| | 0 to 2320ºC | 32 to 4208ºF | C Thermocouple |
| | 0 to 762ºC<br>32 to 1403ºF | 0.0 to 537.7ºC<br>32.0 to 999.9ºF | L Thermocouple |
| | 0 to 1399ºC | 32 to 2551ºF | N Thermocouple |
| | 0 to 1795ºC | 32 to 3198ºF | R Thermocouple |
| | 0 to 1762ºC | 32 to 3204ºF | S Thermocouple |
| | -240 to 400ºC<br>-400 to 752ºF | -128.8 to 400.0ºC<br>-199.9 to 752.0ºF | T Thermocouple |
| | 0 – 20mA | | 0 – 20mA |
| | 4 – 20mA | | 4 – 20mA |
| | 0 – 50mV** | | 0 – 50mV** |
| | 10 – 50mV | | 10 – 50mV |
| | 0 – 5V | | 0 – 5V |
| | 1 – 5V | | 1 – 5V |
| | 0 – 10V | | 0 – 10V |
| | 2 – 10V | | 2 – 10V |
| ** 0 – 50mV is only linear dc input available on Extrusion models. | | | |
| Input Units | ˚C | ˚F | Select °C or °F temperature units – Default is °C |
| Units parameter hidden when linear input is used and units are not shown on the display | | | |
| Input Decimal Place | 0000 | 00.00 | Number of decimal resolution. (2 or 3 decimal places only available. |
| | 000.0 | 0.000 | |

| Parameter Name | Description | Meaning & Visibility |
|---|---|---|
| Scale Range Upper Limit | 1000 | Upper limit of scaled input range. (Only visible in Setup Mode when a DC linear type is selected). Default is input max. |
| Scale Range Lower Limit | 0 | Lower limit of scaled input range. (Only visible in Setup Mode when a DC linear type is selected). Default is input min. |
| Input Digital I/P Action | None | None, Alarm Reset (clears latched alarms), Ctrl Enable/Disable (disables control), Ctrl Auto/Manual, Pre-Tune Start/Stop, Tune at SP Start/Stop |
| Output 1 Usage | Heat | Heat, Cool, Non Linear Cooling (on Extrusion model only), Alarm 1, Alarm 2, Alm. 1 or 2 (logical 'OR' of Alarm 1 & 2), Loop Alarm |
| Output 2 Usage | Alarm 1 | Same options as Output 1 Usage |
| Output 3 Usage | Alarm 2 | Same options as Output 1 Usage |
| If a Relay or SSR drive is fitted in Output 3 you will see >Output 3. | | |
| If the Linear option is fitted in Output 3 you will see the >Linear Output menus instead. | | |
| Linear Output Usage | PV Retx | Heat, Cool, PV Retx, SP Retx |
| Linear Output Type | 0-10V | 0-10V, 2-10V, 0-20mA, 4-20mA, 0-5V, 1-5V |
| Linear Output Scale Range Max. | 1373 | Maximum PV or SP value corresponding to maximum linear output for retransmission. |
| >Linear Output Scale Range Min. | -240 | Minimum PV or SP value corresponding to minimum linear output for retransmission. |
| Alarm 1 Adjust | 1373 | Sets the Alarm 1 value. (Range minimum to range maximum) OFF disables the alarm. (Default alarm type is high alarm) |
| Alarm 2 Adjust | -240 | Sets the Alarm 1 value. (Range minimum to range maximum) OFF disables the alarm. (Default alarm type is low alarm) |
| Setpoint Adjust | 0 | Target setpoint. Adjustable between setpoint upper and lower limits Default is 0 |
| Coms Unit Address | 1 | Modbus address from 1 to 255 |
| Coms Baud Rate | 9600 | 1200, 2400, 4800, 9600, 19200 & 38400 bps |

1. The **Start Tune at SP** function is not available for Heat & Cool processes.
2. If the **Input Type** is changed, input scaling and alarm values are set to new values based on the maximum and minimum of the new input type. If necessary, review these settings.
3. If necessary, press  &  to clear the **"Control is Enabled"** Pop Up Alert then press  &  to exit the Setup mode.

# 6 Advanced Configuration Mode

The Advanced Configuration mode gives access to all the parameters accessible from the front panel; however, the device hides parameters that are not relevant to your exact model code specification & configuration.

**It may be faster to access some parameters from the Setup Mode.**

Press ◉ & ▲ to enter Advanced Configuration from Operator screen.

Enter Advanced Lock-code using ▲ & ▼, then press ◉.

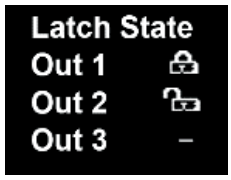
| | | |
|---|---|---|
| Lock Code | 20 | Lock code to enter Advanced Configuration Mode. Default is 20. |

| Menu Name | Meaning & Visibility |
|---|---|
| User | Provides access to User parameters including Control Enabled and Manual Control Enabled parameters. |
| Input | Set up input sensor and range. |
| Calibration | For entering calibration points. |
| Outputs | Set functions for up to 3 outputs. |
| Control | Control settings for PID, or ON/OFF control, and Auto-tune. |
| Setpoint | Setpoint and timer settings. |
| Alarm | All alarm settings including sensor break alarm. |
| Comms | Modbus address, baud rate and parity - only shown if RS485 option is fitted. |
| Display | Lock code set up and Basic Setpoint Control enable/disable. |
| Operator | Visibility setting for parameters that can be made visible in the User Mode. |
| Info | Revision level, Firmware version, Serial number and Manufactured date. |

# 7 User Mode

The normal, live screen showing the PV (process variable) or temperature is called the User Mode.

## 7.1 User Menu *(Applicable to Standard and Extrusion Models)*

| Parameter | Description | | Default Value |
|---|---|---|---|
| Alarm State |  | Alarm triggered<br>Alarm configured, but not triggered<br>– Alarm not set | N/A |
| Latch State |  | Output Latched<br>Latch configured, but output not Latched<br>– Latch not set | N/A |
| To clear any latched outputs, press then to select Yes. Press to accept. | | | |
| Maximum PV | To clear the stored value, press then to select Yes.<br>Press to accept. | | Screens show the Maximum & Minimum PV reached. |
| Minimum PV | | | |
| Control Enable | OFF - Control output(s) disabled. (Ignored when in manual mode).<br>ON - Control output(s) enabled. | | ON |
| Manual Control Enable | OFF - Automatic control, PID or On-Off control available.<br>ON - Manual control, Manual Power shown as P% xxx | | OFF |

## 7.2 Input Menu *(Applicable to Standard and Extrusion Models)*

| Parameter | Description | Default Value |
|---|---|---|
| Input Type | Refer to Input types in the table in the Setup menu section for a full list of inputs available. | K thermocouple |
| Units | Display Units either °C or °F.<br>This parameter is hidden when input is a linear type and °C or °F are hidden from the display. | °C |
| Units hidden when linear input is used and no unit is shown on the display | | |
| Decimal Place | 0000<br>000.0<br>00.00 (not for temperature)<br>0.000 (not for temperature) | 0000 |
| Scale Range Maximum | For temperature inputs, enter the maximum working range. For linear inputs, enter the display value for the maximum input level | Maximum allowed for Input Type |
| Scale Range Minimum | For temperature inputs, enter the minimum working range. For linear inputs, enter the display value for the minimum input level. | Minimum allowed for Input Type |
| Filter Time | Input filter time value to reduce noise. OFF or 0.5 to 100.0 seconds in 0.5 increments | 2.0 |
| CJC Enable | Enable Enables the internal thermocouple CJC (Cold Junction Compensation). Disable Disables the internal CJC. If disabled, external compensation must be provided. | Enable |
| Digital I/P Action | None<br>Alarm Reset (clears latched alarms)<br>Ctrl Enable/Disable (disables control)<br>Ctrl Auto/Manual<br>Pre-Tune Start/Stop<br>Tune at SP Start/Stop | None |

**The input scale range, consisting of Scale Range Maximum & Scale Range Minimum above, is used to narrow the working range of the controller.**

**The scale range also affects if Pre-Tune will run. If the PV is <5% of the scaled range from setpoint Pre-Tune cannot be used.**

**If the measured value is more than 5% above or below the scaled range PV display is replaced by HIGH (over-range) or LOW (under-range).**

## 7.3 User Calibration Menu *(Applicable to Standard and Extrusion Models)*

| Parameter | Description | Default Value |
|---|---|---|
| Offset | Shifts the input value up or down by this offset value, across the entire range. | 0 |
| Low Point | Enter value at which the low point error was measured. | Lower Limit |
| Low Offset | Enter equal, but opposite offset value to the observed low point error. | 0 |
| High Point | Enter value at which the high point error was measured. | Upper Limit |
| High Offset | Enter an equal, but opposite offset value to the observed high point error. | 0 |

## 7.4 Outputs Menu *(Applicable to Standard and Extrusion Models)*

| Parameter | Description | Default Value |
|---|---|---|
| **Output 1 Sub-menu** | | |
| Usage | Heat (Reverse acting control)<br>Cool (Direct acting control)<br>Non Linear Cooling (Extrusion model only)<br>Alarm 1<br>Alarm 2<br>Alarm 1 or 2<br>(i.e. logical 'OR' of Alarm 1 & 2)<br>Loop Alarm | Heat |
| Alarm Action | Direct - Output active when alarm triggers<br>Reverse - Output active when alarm is not triggered | Direct |
| Latching | Off - Alarm doesn't latch<br>On – Alarm latches (remains in active state until cleared) | Off |
| LED Indicator | Direct - LED Indicator lit when output is active<br>Reverse - LED Indicator lit when output is inactive | Direct |
| **Output 2 Sub-menu** | | |
| Usage | Same options as Output 1 - Usage | Alarm 1 |
| Alarm Action | Same options as Output 1 - Alarm Action | Direct |
| Latching | Same options as Output 1 - Alarm Latching | Off |
| LED Indicator | Same options as Output 1 - LED Indicator | Direct |
| **Output 3 Sub-menu** | | |
| If a Relay or SSR drive is fitted in Output 3, this sub-menu is visible. | | |
| Usage | Same options as Output 1 Usage | Alarm 2 |
| Alarm Action | Same options as Output 1 - Alarm Action | Direct |
| Alarm Latching | Same options as Output 1 - Alarm Latching | Off |
| LED Indicator | Same options as Output 1 - LED Indicator | Direct |

| Parameter | Description | | Default Value |
|---|---|---|---|
| **Linear Output Sub-menu** | | | |
| If the Linear option is fitted in Output 3, this sub-menu is visible. | | | |
| Usage | Heat (Reverse acting control)<br>Cool (Direct acting control)<br>Retransmission of PV or SP: PV Retx, SP Retx | | PV Retx |
| Type | 0-10V<br>2-10V<br>0-20mA | 4-20mA<br>0-5V<br>1-5V | 0-10V |
| Scale Range Maximum | Display value at which retransmission output is at its maximum value ( -1999 to 9999) | | 1000 |
| Scale Range Minimum | Display value at which retransmission output is at its minimum value ( -1999 to 9999) | | 0 |

## 7.5 Control Menu *(For Standard Model only)*

| Parameter | Description | Default Value |
|---|---|---|
| Proportion Heat Band | The Proportional Bands for heating and cooling control, in display units. Set to ON/OFF (0) or PID control:<br>1 to 9999 - 0 decimal places<br>0.1 to 999.9 - 1 decimal place<br>0.01 to 99.99 - 2 decimal places<br>0.001 to 9.999 - 3 decimal places<br>Possible values/resolution depends on values display resolution. | 161 |
| Proportion Cool Band | | 161 |
| Auto Reset (Integral) | 0.01 to 99.59. and OFF (0.00) (minutes & seconds). | 5.00 |
| Overlap/Deadband | In display units, range -20 to +20% of Heat & Cool Proportional Band | 0 |
| Differential (On/Off) | Visible when using On-Off control.<br>In display units centred about the setpoint.<br>Range: 0.1% to 10.0% of input span | 8 |
| Loop Alarm Time | Visible when On/Off control & Loop Alarm assigned to an output.<br>Sets time before the loop alarm triggers.<br>(minutes & seconds) | 99.59 |
| Manual Reset (Bias) | Manual Reset. Biasing of the control working point, 0 to 100%. (-100% to 100% if heat/cool control) | 25% |
| Heat Cycle Time | 0.1 to 512.0 seconds<br>Relay/SSR control output cycle times | 32.0 |
| Cool Cycle Time | | 32.0 |
| Output Interlock | Prevents simultaneous activation of both heat & cool outputs. Choose from On or Off.<br>Do not use if PB 'overlap' has been set | Off |
| Heat Power Limit | % heating and cooling power upper limits<br>0 to 100% | 100% |
| Cool Power Limit | | 100% |
| Power Up Action | **Last** - Powers up with control enable/disable in the same state as on power off or power failure.<br>**On** - Always powers up with control enabled. | Last |
| Automatic Tuning | Off<br>Start Pre-Tune<br>Start Tune at SP (Not available for Heat & Cool processes.) | Off |

## 7.6 Control Menu *(For Extrusion Model only)*

| Parameter | Description | Default Value |
|---|---|---|
| Proportion Heat Band | The Proportional Bands for heating and cooling control, in display units. Set to ON/OFF (0) or PID control:<br>1 to 9999 - 0 decimal places<br>0.1 to 999.9 - 1 decimal place<br>0.01 to 99.99 - 2 decimal places<br>0.001 to 9.999 - 3 decimal places<br>Possible values/resolution depends on values display resolution. | 161 |
| Proportion Cool Band | | 161 |
| Auto Reset (Integral) | 0.01 to 99.59. (minutes & seconds) and OFF (0.00). | 5.00 |
| Overlap/Deadband | In display units, range -20 to +20% of Heat & Cool Proportional Band. -ve values=Deadband. | 0 |
| Differential (On/Off) | Visible when using On-Off control.<br>In display units centred about the setpoint.<br>Range: 0.1% to 10.0% of input span | 8 |
| Loop Alarm Time | Visible with On-Off control & Loop Alarm assigned to an output. Sets time before the loop alarm triggers. (minutes & seconds) | 99.59 |
| Manual Reset (Bias) | Manual Reset. Biasing of the control working point, 0 to 100%. (-100% to 100% if heat/cool control) | 25% |
| Soft Start Time | 0:01 to 60:00 or OFF (0:00) (hours & minutes) | OFF |
| Soft Start Setpoint | The setpoint used by the Soft Start.<br>See Soft Start function section. | -240 |
| Heat Cycle Time | 0.1 to 512.0 seconds<br>Relay/SSR control output cycle times | 32.0 |
| Cool Cycle Time | | 32.0 |
| Output Interlock | Prevents simultaneous activation of both heat & cool outputs. Choose from On or Off.<br>Do not use if PB 'overlap' has been set | Off |
| Heat Power Limit | % heating and cooling power upper limits, adjustable from 0 to 100% | 100% |
| Cool Power Limit | | 100% |
| Minimum Cooling | Sets the minimum temperature at which water cooling will activate. | 120 |
| Impulse Length | Non-linear cooling pulse time.<br>0.01 to 99.99 (seconds) | 10 |
| Minimum Off Time | Minimum non-linear cooling pulse time.<br>0.01 to 99.99 (seconds) | 20 |
| Non Linear Adjust | Attenuates effective cooling vs PID cooling power.<br>From 1 to 999.9 | 5 |
| Power Up Action | Last - Powers up with control enable/disable in the same state as at power off.<br>On - Always powers up with control enabled. | Last |
| Automatic Tuning | Off<br>Start Pre-Tune<br>Start Tune at SP (Not available for dual Heat & Cool) | Off |

## 7.7 Setpoint Menu *(For Standard Model only)*

| Parameter | Description | Default Value |
|---|---|---|
| Enable Timer | **Enabled -** Enables the Delay and On Timers. Applies at next power-up or next control enable.<br>**Disabled -** Delay and On Timers are ignored. (Setpoint ramping still functions.) | **Disabled** |
| Delayed Start Time | Time from power-up or control enable before control begins from 00.01 to 99.59 (hours & minutes) or **OFF** (0.00). If delay is OFF control starts immediately. | **OFF** |
| Ramp Rate | Rate the actual setpoint changes from current PV to target setpoint following power-up or control enable. From 0.001 to 9999 (Units / hr) or OFF (10000). Any changes in the setpoint value also follow this rate. | **OFF** |
| On Time | The time the target setpoint will be maintained once reached, from 00.01 to 99.59 (hours & minutes) or Off (00.00)<br>Set to >99.59 for Infinite - control remains on indefinitely. | **Infinite** |
| Upper Limit | Used to limit the Maximum setpoint value. | Scale Range Maximum |
| Lower Limit | Used to limit Minimum setpoint value. | Scale Range Minimum |
| Offset | For use in multi-zone setpoint slave applications. Offsets the setpoint from -1999 to 9999. Effective SP = SP+Offset. **NOTE: effective SP is not limited by setpoint limits.**<br><br>'Offset in use' pop-up appears when SP is changed. | **0** |

## 7.8 Setpoint Menu *(For Extrusion Model only)*

| Parameter | Description | Default Value |
|---|---|---|
| Ramp Rate | Rate the actual setpoint changes from current PV to target setpoint following power-up or control enable. From 0.001 to 9999 (Units / hr) or OFF (10000). Any changes in the setpoint value also follow this rate. | **OFF** |
| Upper Limit | Used to limit the Maximum setpoint value. | Scale Range Maximum |
| Lower Limit | Used to limit Minimum setpoint value. | Scale Range Minimum |
| Offset | For use in multi-zone setpoint slave applications. Offsets the setpoint from -1999 to 9999. Effective SP = SP+Offset. **NOTE: effective SP is not limited by setpoint limits.**<br><br>'Offset in use' pop-up appears when SP is changed. | **0** |

## 7.9 Alarm Menu *(Applicable to Standard and Extrusion Models)*

| Parameter | Description | | Default Value |
|---|---|---|---|
| **Alarm 1 Sub-menu** | | | |
| Type | None<br>PV High<br>PV Low | Deviation<br>Band | PV High |
| Value | Value for the alarm, from Range minimum to range maximum, or OFF (maximum +1). **OFF** disables the alarm. | | 1373 |
| Hysteresis | Sets the alarm switching differential from 1 display unit to the full input span. | | 1 |
| **Alarm 2 Sub-menu** | | | |
| Type | Same options as Alarm 1 sub-menu. | | **PV Low** |
| Value | | | **-240** |
| Hysteresis | | | **1** |
| **Options Sub-menu** | | | |
| Alarm Inhibit | Inhibiting of 'active alarms' at power-on, control enable or controller setpoint change.<br>None • Alarm 1 • Alarm 2<br>Alarm 1 & 2 (both alarms are inhibited) | | **None** |
| Alarm Notification | Alternates 'Alarm' with PV value if selected alarm(s) are active. Red alarm output LEDs are not affected by this parameter.<br>None • Alarm 1 • Alarm 2<br>Alarm 1 and 2 (Alarm 1 OR 2) | | **Alarm 1 and 2** |
| Sensor Break Alarm | **On** - activates both alarms, if configured, when a sensor break is detected. If Off, alarms activate only break condition is an alarm condition. | | **Off** |

## 7.10 Communications Menu *(Applicable to Standard and Extrusion Models)*

| Parameter | Description | Default Value |
|---|---|---|
| Unit Address | Modbus address from 1 to 255 | 1 |
| Baud Rate | Coms data rate in kbps<br>1200, 2400, 4800, 9600, 19200 & 38400 bps. | 9600 |
| Parity | Parity checking: Odd, Even or None | **None** |

## 7.11 Display Menu *(Applicable to Standard and Extrusion Models)*

| Parameter | Description | Default Value |
|---|---|---|
| Setup Unlock Code | View & adjust Setup lock code.<br>From 1 to 9999 or Off for no lock code | 10 |
| Advanced Unlock Code | View & adjust Advanced lock code.<br>From 1 to 9999 or Off for no lock code. | 20 |
| Screen Timeout | Screensaver time. Display turns off after 5, 15 or 30 mins. | **5** |
| Selected language | Choose the display language (English plus one other).<br>From: English & German / English & French. The second language offered can be changed via the configuration software. | **English** |
| Transmitter | ‘Enable’ hides the setpoint, SP.<br>**Important: The device still functions as a controller even though the SP is hidden.** | **Disable** |
| Reset to Defaults | Used to reset all parameters back to the factory defaults, as shown on the right in parameter lists.<br>See the Default Value column in the Setup and Advanced menu tables. | |

## 7.12 Operator Screens Menu *(Applicable to Standard and Extrusion Models)*

| Parameter | Description | Default Value |
|---|---|---|
| Control Enabled | **Hide** or **Show** parameters in Operator Mode.<br>For security, or to simplify the operator screens, hide any that you do not need to allow access to. | Hide |
| Manual Ctrl Enabled | | Hide |
| Alarm State | | Hide |
| Latch State | | Show |
| Maximum PV | | Hide |
| Minimum PV | | Hide |
| Remaining On Time (Standard model only) | | Hide |
| Remaining Delay Time (Standard model only) | | **Hide** |

## 7.13 Information Menu *(Applicable to Standard and Extrusion Models, Read Only menu)*

| Parameter | Description |
|---|---|
| PRL<br>DOM | The hardware/software revision level, used for internal quality control.<br>The Date of manufacture in mmyy format |
| FW Version / FW Type | Display of the units’ firmware version & code type numbers. |
| Serial | Display of the Serial Number. |
| Out1<br>Out2<br>Out3 | Shows the outputs types fitted. These cannot be changed after manufacture.<br>Options are: –<br>SSR (SSR driver) or Relay<br>SSR (SSR driver) or Relay<br>None, SSR (SSR driver), Relay or Linear |
| Comm<br>DI | Shows other options fitted. These cannot be changed after manufacture. Options are: – RS485 communications - **Fitted** or **None**. Digital Input is isolated or not - **Iso** or **NonIs** |

## 7.14 Exiting the Advanced Configuration mode

If necessary, press ⊙ & ▲ to clear any Pop-Up Alerts.

Press ⊙ & ▲ to move up one menu level. Some menus have sub-menus so it may be necessary to press this key combination more than once to exit.

# 8 Calibration Mode

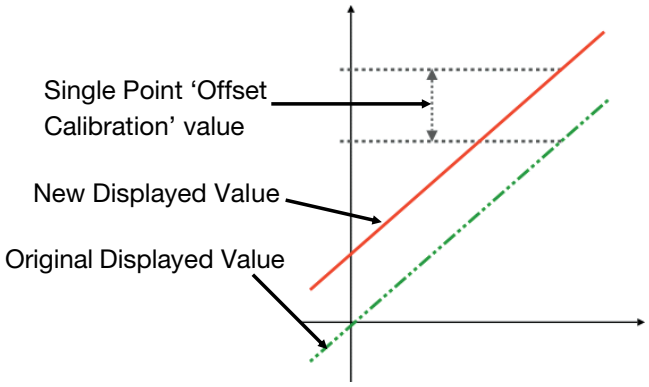
It is possible to calibrate the controller to compensate for sensor errors and other tolerance errors in the system. This is achieved using the calibration mode. The calibration mode allows an offset to be applied in one of two ways. The method used will be dependent on the process application.

**These methods do not alter the internal instrument calibration. Set the offset values back to zero to restore standard measured values. Re-calibration of the internal base calibration is also possible, but should only be attempted by qualified personnel as it overwrites the factory calibration – see Base Input Calibration below.**

## 8.1 Single Point Calibration (PV Offset)

This is a 'zero offset' applied to the process variable across the entire span. Positive values are added to the reading, negative values are subtracted. It can be used if the error is constant across the range, or the user is only interested in a single critical value. To use, select Single Point Calibration from the input calibration menu, and simply enter a value equal, but opposite to the observed error to correct the reading.

This example shows a positive offset value.

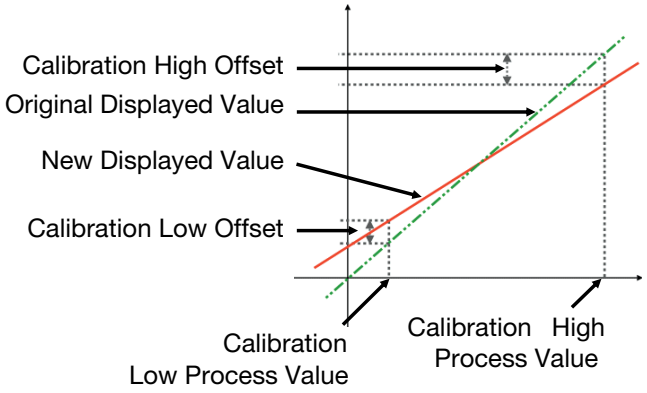



For example: If the process displays 27.8 when it should read 30, The error is -2.2 so an applied offset of +2.2 would change the displayed value to 30. The same offset is applied to all values, so at 100.0 the new displayed value would be 102.2.

## 8.2 Two Point Calibration

This method is used where an error is not constant across the range to change the calibration slop. Separate offsets are applied at two points in the range to eliminate both "zero" and "span" errors.

1. Measure and record the error at a low point in the process.
2. Measure and record the error at a high point in the process.
3. Go to the first two-point input calibration screen.
   a. Enter the desired low point value as the Calibration Low PV value.
   b. Enter an equal, but opposite value to the observed error as the Calibration Low Offset to correct the error at the low point.
4. Go to the second two-point input calibration screen.
   a. Enter the desired high point as the Calibration High PV value.
   b. Enter an equal, but opposite value to the observed error as the Calibration High Offset to correct the error at the high point.




**⚠CAUTION**

***Choose values as near as possible to the bottom and top of your usable span to achieve maximum calibration accuracy. The effect of any error can grow at values beyond the chosen calibration points.***

The single and two-point calibration methods can be used together, if you need to change the calibration slope and offset the zero point simultaneously.

## 8.3 Base Input Calibration

Calibration of the input is carried out during manufacture, and for most applications, re-calibration is not required during the lifetime of the instrument. User 1-point and 2-point calibration can be carried from the User Calibration menu.

**Re-calibration of the internal base values is possible, but should only be attempted by qualified personnel as it overwrites the factory calibration.**

A suitable calibration signal source is required for each input type. To verify the accuracy of the instrument or carry out re-calibration, the input sources listed below are required, with better than ±0.05% of the reading accuracy:

1. DC linear inputs: 0 to 50mV dc, 0 to 10V dc & 0 to 20mA dc.
2. Thermocouple inputs - complete with 0ºC reference facility, appropriate thermocouple functions and compensating leads (or equivalent).
3. RTD inputs: decade resistance box with connections for three-wire input (or equivalent).

## 8.4 Calibration Check

1. Set up the instrument to the required input type.
2. Note down, then remove any single or two-point calibration values by setting them to zero.
3. Power up the instrument and connect the correct input leads, to the correct terminals.
4. Leave powered up for at least five minutes for RTD and DC linear inputs, or at least 30 minutes for thermocouple inputs.
5. After the appropriate delay for stabilization has elapsed, check the calibration by connecting the appropriate input source and checking a small number of cardinal points.
6. Repeat the test for all required input types.
7. Check the results against the specification stated for the required input type.
8. Reinstate the calibration values removed at step if they are still appropriate.

**⚠CAUTION**

***Make the connections using the correct thermocouple cable type. For all other input types use copper cable. Using the wrong type of cable will cause incorrect readings. This is especially important with thermocouple sensors.***

## 8.5 Base Calibration Procedure

Input calibration is carried out in five phases as shown below, each phase corresponds to an input range of the instrument.

**⚠CAUTION**

***The 50mV phase must be calibrated first before any other range(s).***

Calibration phases:
i. mV for 50 mV
ii. V for 10 V
iii. mA for 20 mA
iv. RTD input (200Ω ohm resistance source)
v. CJC (K type thermocouple source at 0ºC required)
For Extrusion models phase ii and iii (V & mA) are omitted.

## 8.6 Calibrating the mV Input

1. Check your calibration source is connected to the correct terminals on the 1020 Rail. For 50mV, connect your mV source +ve to pin 14 and -ve to pin 15 located on the bottom rear connector – see wiring section.
2. Press and hold the ⏢ button, whilst the instrument is powering up, until the display shows the screen starting with mV. Be patient, may take approximately 30 seconds.
3. In the calibration phase menu displayed, highlight mV from the list.


4. With mV selected, press ⏺ . The following screen will appear:


5. Press ⏺. You should see the messages **Starting Calibration,** followed by **Calibration in Progress**. A dot moves across the display to show the progress.
6. If the input is wrongly connected or an incorrect signal is applied the calibration will be aborted and the display will show **Calibration FAIL**. The previous calibration value will be retained.

7. If the calibration was successful, the display shows **Calibration PASS.**
8. To clear the Pass or Fail pop-up press and .
9. Now press and to return to the calibration menu. From here either select another calibration phase, or press & again to return to the operator screen.

## 8.7 Calibrating Other Input Types

The 50mV calibration must be carried out first. After this, you can select the other types in turn. The other calibration phase procedures are similar to the mV phase above, but ensure that the correct input signal and connections are used – see the wiring section for connection details.


**Note:** When calibrating the RTD input type, connect an accurate 200Ω resistance source across pin 14 and pin 15, and link between pin 13 and pin 14 to replicate the 3-wire compensating lead.

When you have completed the required phases, press & to exit back to the operator screen.

The Calibration Mode automatically exits if there is no button activity for five minutes.

## 8.8 Calibration Input States

Each input can have one of three states:

| Description | State Shown |
|---|---|
| Input not calibrated | noCAL |
| Factory calibrated | factCAL |
| User calibrated | userCAL |

## 8.9 Calibration Progress

| Description | Popup |
|---|---|
| Initial popup | Starting calibration |
| During calibration | Calibration in progress |
| Calibration succeeded | Calibration PASS |
| Calibration failed | Calibration FAIL |

## 8.10 Calibration Modbus Addresses

The following Modbus addresses can be used to initiate the calibration phases and read back the status.

| Description | Comment | | Dec | Hex |
|---|---|---|---|---|
| 50mV Calibration | Write 0xCAFE to start the calibration for the selected input. | Write Only | **1700** | 6A4 |
| 10V Calibration | | | **1701** | 6A5 |
| 20mA Calibration | | | **1702** | 6A6 |
| RTD Calibration | | | **1703** | 6A7 |
| CJC Calibration | | | **1704** | 6A8 |
| Calibration Status | 0x0000 - Calibration Failed | Read Only | **1770** | 6EA |
| | 0xCAFE - Calibration Busy | | | |
| | 0xFFFF - Calibration Successful | | | |

# 9 Automatic Tuning

To avoid process time-lags that can make effective tuning difficult or even impossible, ensure correct sensor and heat source positioning in your application before use.

There are two automatic tuning methods on the 1020 and 1030 controllers. Pre-Tune and Tune at SP.

The **Pre-Tune** is a 'start-up disturbance' tuning method. It usually gives better results than **Tune at SP**. However, a minimum 5% of span distance between the process value and setpoint is required for Pre-Tune to run. This means it cannot be used if the setpoint is close to ambient temperature. In this case, use Tune at SP. A full description of Pre-tune and Tune at SP is in the Glossary.

**Refer to the Warnings & Messages section for information on the Tuning Error messages.**

## 9.1 Running the Pre-Tune

1. For best results, before running the Pre-Tune adjust the input span (**Scale Range Maximum** and **Scale Range Minimum**) to suit your process, allowing a small tolerance beyond the operating range. e.g. if operating from ambient to 180°C, perhaps set the range 0 to 200.
2. Run from cool. Ideally the process should to be cool before running Pre-Tune. Disable control, or temporarily lower the setpoint, until the PV is a least 5% of the input span difference between the current SP and PV. A larger gap is better if this is possible.
3. Allow for overshoot and undershoot. Please be aware that when the Pre-Tune is run, full power is applied to the process for some time. Although the controller cuts power before the setpoint is reached, some process over/undershoot should be expected. The overshoot might exceed the setpoint value. If exceeding SP might cause a problem, run your first Pre-Tune with a lower SP. If required and safe to do so, you can run another Pre-Tune closer to the required SP.
4. The Pre-Tune can be activated via the **Automatic Tuning** parameter in the Setup menu or the Advanced Configuration menu. It may also be activated via a Modbus command.

   The message 'TUNE' is displayed whilst Pre-Tune is running.

   Pre-Tune will not engage, and a Tune Error message will be displayed under the following conditions: **1)** There is a sensor break, **2)** The PV is <5% of span from SP, **3)** A setpoint ramp has been set, **4)** A Timer is running, **5)** The current control mode is On-OFF 6). The controller is in Manual mode. **7)** Control is Disabled*. Resolve the displayed problem then run Tune at SP again if required. ***Note:** If control is disabled, running Pre-Tune at First Power-up (or immediately after a Reset to Default) automatically sets the control to enabled.

5. Once Pre-Tune is complete it will disengage, and the 'TUNE' notification ends. The length of time the tuning takes to complete will vary from process to process.

## 9.2 Running Tune at SP

1. Initial PID values. Tune at SP needs a reasonable level of process stability to run. It is therefore recommended to set the initial PID values in the Control menu back to their default values: **Proportional Band** to 10% of your chosen input range, **Auto Reset (Integral)** to 5.00 and **Rate (Derivative)** to 1.15 before using Tune at SP.
2. The Tune at SP can be activated via the **Automatic Tuning** parameter in the Setup menu or the Advanced Configuration menu. It may also be activated via a Modbus command.

   The message 'TUNE' is displayed whilst Tune at SP is running.
3. Once Tune at SP is complete it will disengage, and the 'TUNE' notification ends. The length of time the tuning takes to complete will vary from process to process

## 9.3 Tuning at SP Troubleshooting

Tune at SP will not engage, and a Tune Error message will be displayed under the following conditions: **1)** There is a sensor break, **2)** A setpoint ramp has been set, **3)** A Timer is running, **4)** Control is Disabled. **5)** The current control mode is On-OFF **6)** The controller is in Manual mode.

Resolve the displayed problem then run Tune at SP again if required.

If Tune at SP starts, but remains running indefinitely, the cause is either the process value not achieving reasonable stability (±1% of span), or the control power variation is too great (±10%).

To resolve this:

1. Check the PID values in the control menu were at the defaults values (see above). If they were correct, go to step 2. Otherwise, correct them and run Tune at SP again.
2. If step 1 has not resolved the issue, observe the displayed process value for >5minutes and noting the highest and lowest values seen. Subtract the lowest value from the highest to find the peak-to-

peak deviation. Check the input span (Scale Range Maximum minus the Scale Range Minimum) to see if the it is >100 x the peak-to-peak deviation. If not, increase the input span to more than this value, and run Tune at SP again.

3. If this has not resolved the issue, double the current PID terms (**Proportional Band, Auto Reset and Rate** values), then run Tune at SP again.
4. In the unlikely event that the tuning still does not complete continue from step 3.

## 9.4 Tuning at SP for Heat and Cool

Tuning at SP is possible for Heating or Cooling applications, but not for both Heat and Cool together. If you have defined outputs for heating and cooling, Tune at SP is not offered in the tuning menu. Instead use Pre-Tune.

# 10 Digital Input Operation

Depending on your model, the digital input can be used to perform one of the available functions as shown in the table below.

High = Open contacts (and 2 to 24Vdc for the isolated digital input).

Low = Closed contacts (and <0.8Vdc for the isolated digital input).

| Controller | Digital Input State Transition | |
|---|---|---|
| **Functions** | **High to Low** | **Low to High** |
| Reset Latched Alarm(s) | No Action | Reset* |
| Control Enable/Disable | Disable | Enable |
| Auto/Manual | Manual | Automatic |
| Pre-Tune Start/Stop | Stop | Start* |
| Tune at SP Start/Stop | Stop | Start* |

*Alarm outputs only reset if the alarm condition is no-longer present and tuning will only start if the settings and current process conditions allow (see tuning section for more details)

| Limiter | Digital Input State Transition | |
|---|---|---|
| **Function** | **High to Low** | **Low to High** |
| Reset Latched Limit & Alarm(s) | No Action | Reset* |

*Limit and Alarm outputs only reset if the limit exceed and/or alarm conditions are no longer present.

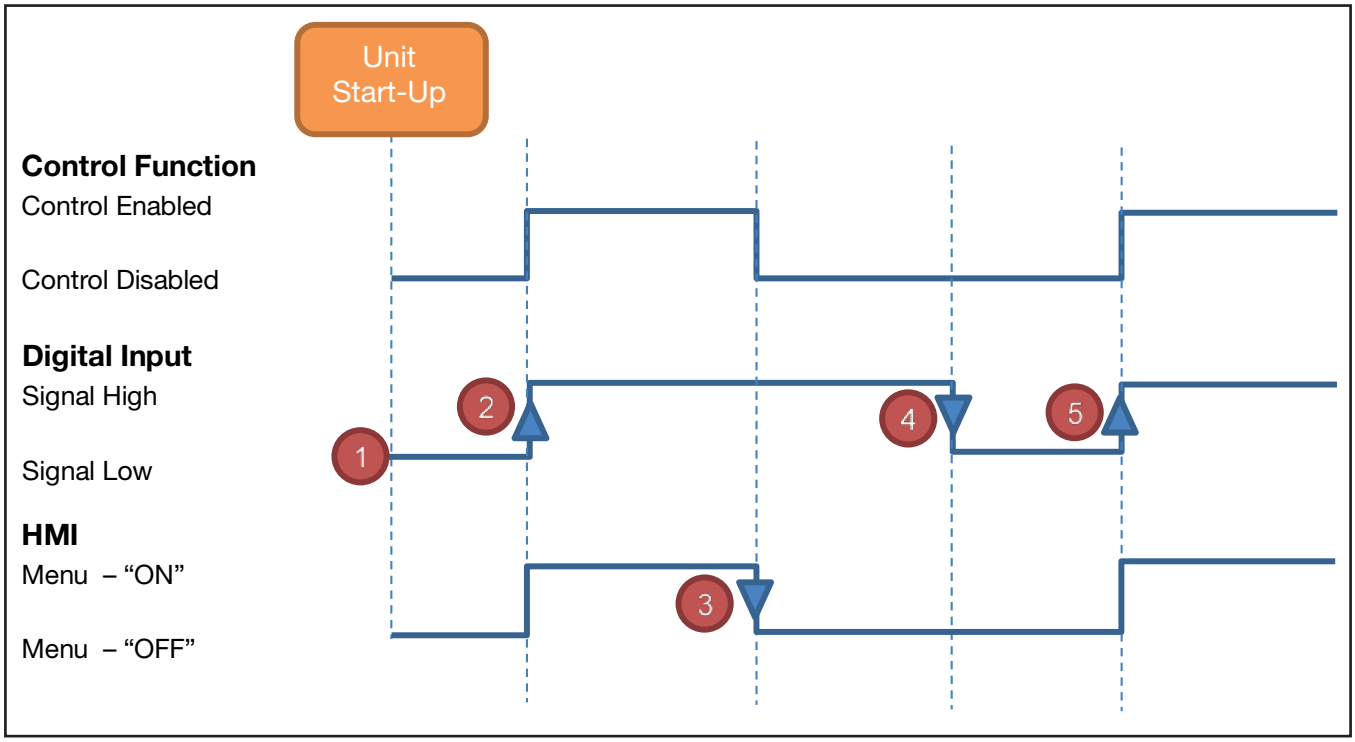
When the instrument is turned on, a change in the digital input signal from **High Low**, or **Low to High** will cause the function to change (unless it is already in the state dictated by the signal change).

The keypad can also be used to change the status of the same function via the relevant menu. **The most recent digital input or keypad instruction will be implemented.**

**The digital input is "edge sensitive", which means that it only reacts to a detected transition in the input state. The device cannot detect a status change made when it is turned off. It also means that if it is in the "ON" state, but the current condition of the unit is the "OFF" state (either because a keypad instruction or it has powered up that way) the digital input would first have to be set first to OFF and then ON again before it would set the function ON.**

However, on the Limiter model if the Digital Input is in an "ON" state at power-up it gives a Reset signal. Once powered up the Limiter model behaves the same way to a transition.

Below is an illustration of digital input and keypad use. The example is for the Control Enable function. Other functions behave in a similar way.




1. On start-up, the unit uses the Power-Up Action for its initial control state. In this example, it starts in the disabled condition.
2. Digital input signal changes from **Low to High**; therefore, control becomes enabled. The **Control Enable** parameter will say **ON**, when viewed from the HMI (front panel).
3. The keypad on the HMI (front panel) menu is used to change the control back to disabled, **Control Enable** parameter = **OFF**.
4. The digital input changes state, going from High to Low, but as the control is already disabled no change is made.
5. Then the digital input goes from Low to High again, re-enabling the control. The **Control Enable** parameter in the HMI also shows control is **ON** again.

# 11 Timer Feature

## 11.1 Timer Feature

The timer feature is only available on the Standard model. It consists of a Delay Timer and an On Timer.

When the Timer Enable parameter is set to Disabled the timer will not be used and the delayed start time and on time are ignored. **Note:** If the setpoint has been set to ramp, this will still be active, even if the timer is Disabled.

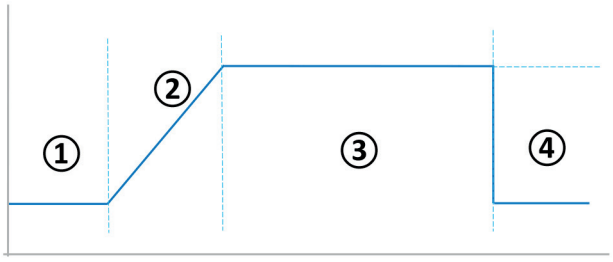
When Enabled the timer will take control of the Setpoint as defined by the Delayed Start Time and On Time parameters. Enabling the timer has no effect until the controller is power cycled or the control is disabled then re-enabled.

The timer, control power down state and the power-up action have the following relationship:

| Control state at power down | Power-up Action setting | Timer Enable parameter setting | Delayed Start Value | Control state at power-up |
|---|---|---|---|---|
| Enabled | Last | Disabled | N/A | Control Enabled |
| Disabled | Last | Disabled | N/A | Control Disabled |
| Enabled | On | Disabled | N/A | Control Enabled |
| Disabled | On | Disabled | N/A | Control Enabled |
| Enabled | Last | Enabled | Off | Control Enabled |
| Disabled | Last | Enabled | Off | Control Disabled |
| Enabled | On | Enabled | Off | Control Enabled |
| Disabled | On | Enabled | Off | Control Enabled |
| Enabled | Last | Enabled | Time Set | Control Disabled until Delay timer expires |
| Disabled | Last | Enabled | Time Set | Control Disabled |
| Enabled | On | Enabled | Time Set | Control Disabled until Delay timer expires |
| Disabled | On | Enabled | Time Set | Control Disabled until Delay timer expires |

## 11.2 Delay, Ramp & Timer Diagram

The delay, ramp and soak is only available on the standard model.




1. From power-up, if control is in the enabled state, or whenever control is changed from disabled to enabled, the unit delays process control (i.e. control is still disabled) until the Delay Timer expires (time as set by Delayed Start Time). If this is OFF, step 1 is omitted.
2. Setpoint ramps from the current PV to the target setpoint at Ramp Rate ('RAMP' alternating with the current effective SP value indicates it is still ramping). If Ramp Rate is OFF the effective setpoint steps directly to target setpoint.
3. After any Delay and/or Ramp completes, the setpoint 'Dwells' at the target value while the On-Timer counts down (time set by On Time).
4. When the On Timer finishes the control switches off (i.e. control is disabled). If the On Timer has been set to OFF, step 4 is omitted, and control is maintained at the setpoint indefinitely.

# 12 Extrusion Model Only Features

## 12.1 Non-Linear Cooling Function

The initial cooling effect with water cooling can be very strong when water first flows into a hot process. Evaporation extracts significant amounts of heat energy making the effective cooling power disproportionally high at nominally low levels of cooling output. This makes process control more difficult, particularly if “over-cooling” during the transition from heating to cooling causes the heating to be reactivated. Non-Linear Cooling can be used to counteract these effects by applying the cooling more gradually at first.

To enable the Non-Linear Cooling function the Output 1, Output 2 or Output 3 Usage parameter needs to be set to Non Linear Cooling.

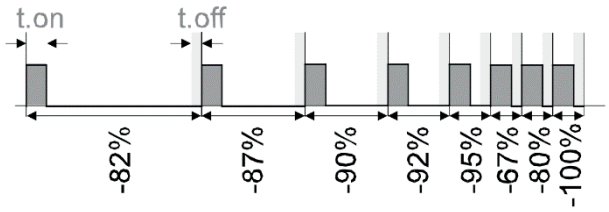
| | | |
|---|---|---|
| >Output 1 Usage | Heat Power<br>Cool Power<br>**Non Linear Cooling**<br>Alarm 1<br>Alarm 2 Alarm 1 or 2<br>Loop Alarm | Heat Power |

This table lists the Control sub-menu parameters related to non-linear cooling.

| Title | Description |
|---|---|
| Minimum Cooling | The minimum temperature for non-linear cooling to operate |
| Impulse Length | The fixed “On” pulse duration with non-linear cooling |
| Minimum Off Time | The minimum “Off” duration with non-linear cooling |
| Non-Linear Adjust | Adaptation of characteristics of the non-linear cooling |

## 12.2 Method

The cooling characteristic is altered so that the controller output is weak until approximately 70% of nominal cooling demand. Beyond this level, the correcting variable rapidly rises to the maximum cooling allowed.

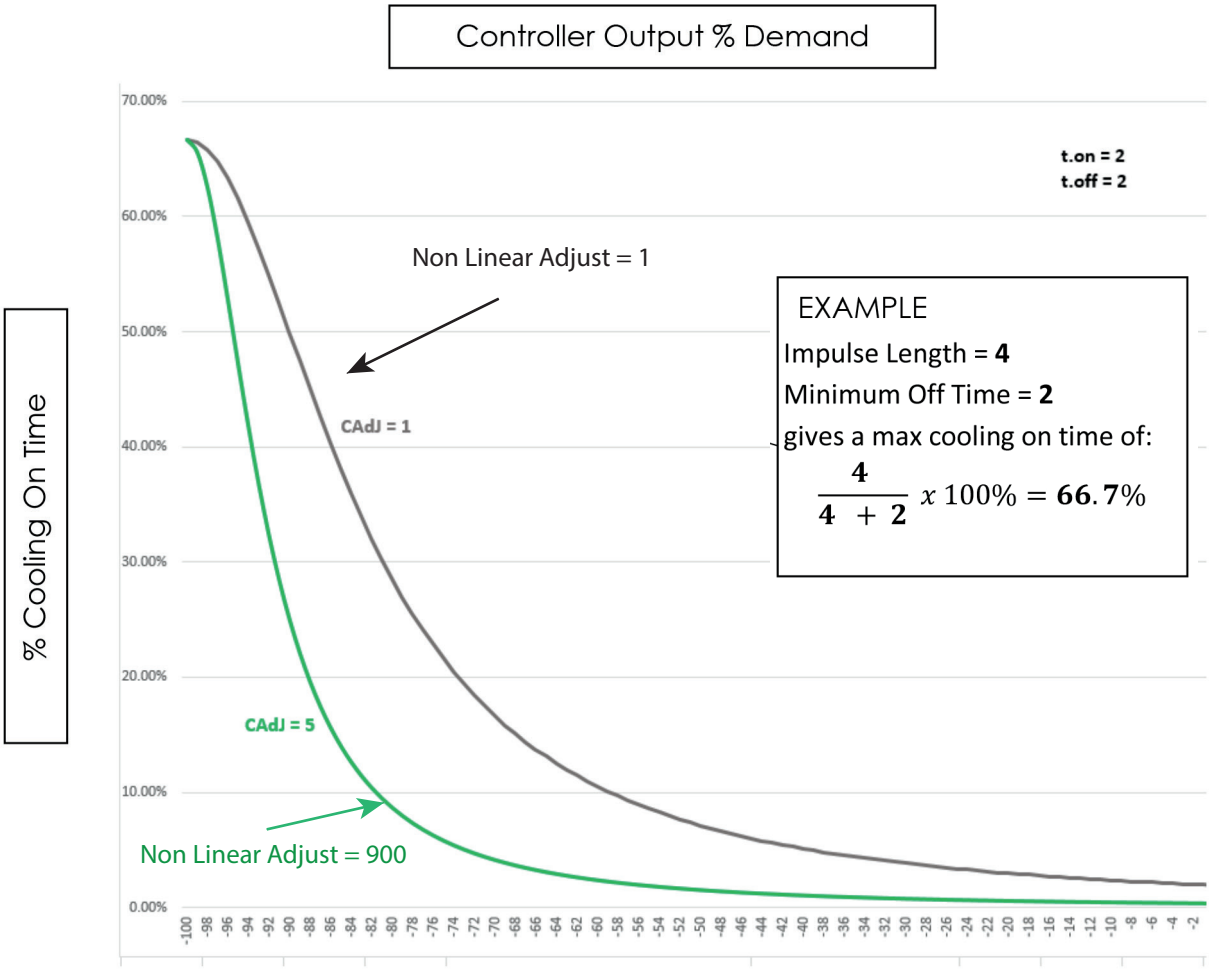



Cooling is inhibited entirely until the Minimum Cooling temperature has been exceeded. After that it turns ON with fixed duration pulses (adjustable with Impulse Length parameter). The OFF time between pulses is varied to adjust the cooling effort, but is never off for less than Minimum Off Time value whenever cooling is active. This ratio limits the maximum effective cooling.

**The maximum effective cooling is calculated as follows:**

$$\text{Max Cooling} = \frac{\textbf{Impulse Length}}{\textbf{Impulse Length + Minimum Off Time}} \times 100\%$$

The Non-Linear Adjust parameter can be reduced if the corrective action is too severe by reducing the non-linearity of the effective output. See the examples below.


Controller Output % Demand
% Cooling On Time
70.00%
60.00%
50.00%
40.00%
30.00%
20.00%
10.00%
0.00%
t.on = 2
t.off = 2
Non Linear Adjust = 1
CAdJ = 1
CAdJ = 5
Non Linear Adjust = 900
EXAMPLE
Impulse Length = 4
Minimum Off Time = 2
gives a max cooling on time of:
$\frac{4}{4+2} x\ 100\% = 66.7\%$

## 12.3 Parameter Adjustment

### Minimum Cooling

Cooling is enabled only above the temperature set because evaporation, with its associated cooling effect, is not possible at temperatures below 100°C. Set this >100, but it should be well below the normal operating setpoint.

**Note:** In manual mode cooling is still possible below this temperature.

### Impulse Length

A fixed length for cooling pulses set by this parameter. The ON pulses are this length for all cooling output values above 1% nominal cooling demand.

Relatively low values should be used, but remember that the ratio of the Minimum Off Time vs Impulse Length affects the maximum effective cooling (see above). Do not allow this to limit cooling to the extent that insufficient cooling effect is available for the process.

The impulse length is also limited by the hardware (e.g. the response time of your valve). Valves and electromechanical relays should not be switched to quickly. Consult the device manual or check with your supplier for suitable minimum settings.

### Minimum Off Time

The “off” time between pulses is varied dependent upon the PID cooling demand. The Minimum Off Time is the minimum allowed “off” time (but note that below 1% of cooling demand, the output is disabled).

The time set is hardware-dependent (e.g. the response time of your valve). Generally, it is best set to the lowest value compatible with the output switching device, but remember that valves and electromechanical relays should not be switched to quickly. Consult the device manual or check with your supplier for suitable minimum settings.

Remember that the ratio of the Minimum Off Time vs Impulse Length affects the maximum effective cooling (see above). Do not allow this to limit cooling to the extent that insufficient cooling effect is available for the process.

### Non-Linear Adjust

This attenuates the cooling curve, and altering where the output rate begins to increase more rapidly. The value can be reduced if the corrective action is too severe, this reduces the non-linearity of the effective output.

To find an appropriate Non-Linear Adjust setting:

First set **Minimum Cooling**, **Impulse Length** and **Minimum Off Time** to appropriate values (see above), and initially set Non-Linear Adjust to 5. Use Pre-Tune or manual tuning to adjust the controllers PID settings to your process.

Using these settings, and observe the transition from heating to cooling. If there is a noticeable over-reaction, where the cooling is still too strong, increase the Non-Linear Adjust value until the effect is reduced to acceptable levels. If the transition becomes too slow, with effective cooling unacceptably delayed, reduce the value set.

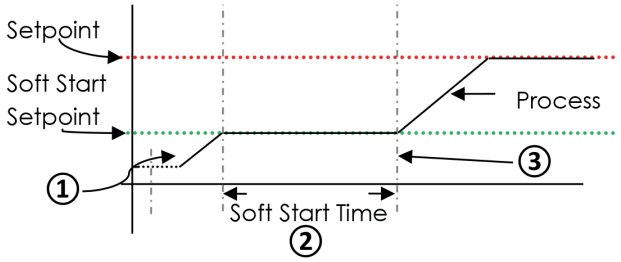
## 12.4 Soft Start Function

Soft Start is primarily intended to allow heaters to dry out gradually at start-up condensation which can form when the heaters are cold can cause damage if it evaporates too quickly.

Soft Start has its own setpoint, allowing a pre-defined low-temperature dwell period which reduces the power demand from the heaters, allowing moisture to evaporate more slowly before going to full working temperature. During this period, it also minimizes the heater-on times by reducing the cycle time and limiting the PID power demand.

**Note:** Soft Start does not limit the instantaneous current to the heaters when the output is on.

Activated by setting the parameters Soft Start Time and Soft Start Setpoint.




1. When powered up the unit will control to the **Soft Start Setpoint.** The control cycle time is 1/4 of the value entered (subject to the minimum possible value of 0.5s) and the maximum power demand is limited to the **Heat Power Limit** value (set in the Control menu). The reduced cycle time is used during the soft start phase.
2. After reaching the Soft Start Setpoint the Soft Start Time begins. The timer starts as soon as the PV is equal to Soft Start Setpoint – 1. The Soft Start Setpoint is maintained until this time has elapsed.
3. When **Soft Start Timer** expires, the unit returns to normal operation. It controls to the normal setpoint, the cycle time reverts to the value set and the **Heat Power Limit** is no longer used.

**Remember, when using the Soft Start feature the Heat Power Limit is only active from power-on and during the Soft Start Time. It remains in use until the Soft Start timer expires or all the time if no Soft Start time is OFF.**

## 12.5 Extrusion Only Parameters in the Control menu

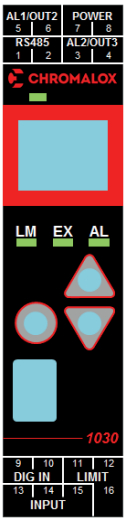
Soft Start Parameters

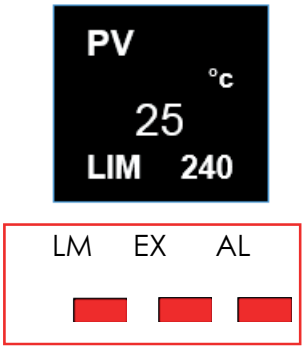
Non-Linear Cooling parameters

| Parameter | Description | Default Value |
|---|---|---|
| Soft Start Time | OFF, 0.01 to 60.00 hrs.minutes | OFF |
| Soft Start Setpoint | See Soft Start diagram. | 0 |
| Heat Cycle Time | 0.1 to 512.0 seconds | 32.0 |
| Cool Cycle Time | | 32.0 |
| Output Interlock | Prevents simultaneous activation of both heat & cool outputs. On / Off | Off |
| Heat Power Limit | % power upper limit 0 to 100% | 100% |
| Cool Power Limit | % power upper limit 0 to 100% | 100% |
| Cooling Minimum | Minimum temperature at which water cooling will activate. | 120 |
| Impulse Length | 0.01 to 99.99 secs | 10 |
| Minimum Off Time | 0.1 to 999.9 secs | 20 |
| Non Linear Adjust | 0.1 to 999.9 | 5 |
| Power Up Action | Last - Powers up with control enable in the same state as on power off or power failure.<br>On - Always powers up with control enabled. | Last |
| Automatic Tuning | Off<br>Start Pre-Tune<br>Start Tune at SP | Off |

# 13 Limiter Models

## 13.1 Introduction to the Limiter Model




The Limiter model has fixed output functions.

Depending upon which option is fitted in Output 3 it is Alarm 2 or Retransmit PV.

Refer to the Information menu or check the product label identify your version.

Output 1. = **Limit**

Output 2. = **Alarm 1**

Output 3. If Relay or SSR = **Alarm 2** / If Linear = Re-**transmit PV**

The Limiter LEDs have fixed functions: Limit, **Exceed & Alarm.**

When the PV enters the Exceed condition both the Limit and Exceed LEDs turn ON. Going from the Exceed condition back into the Safe condition the Exceed LED will turn off but the Limit LED will stay latched until it is reset. Remember the Limit output itself is energized in Safe condition but de-energizes when in the Limit condition.

Navigating is the same as the Standard and Extrusion versions, see General Navigation & Editing, but for security, users cannot change parameter values such as the Limit Setpoint in the Operator mode on the Limiter model. These can only change values via the lock code protected Setup or Advanced Configuration modes.

Warning & Error messages on the Limiter model are similar to the Standard and Extrusion versions, with the exclusion of control or tuning related messages. On the Limiter, there is the additional pop-up alert **Limit Exceeded** message if the process is beyond the limit value set.

Please refer to the Warnings & Messages section.

The Annunciator alarm type, which can be selected for Alarm 1 or Alarm 2, cannot be inhibited.

## 13.2 Limiter Modbus Communications

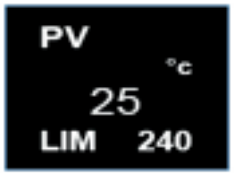
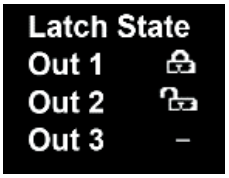
Please refer to the Commonly Used Modbus Addresses and the Limiter Modbus Addresses for the Modbus register addresses.

See the Serial Communications for general communications information.

## 13.3 Limiter Digital Input

The Digital Input has only one function on the Limiter model. There is no need for a configuration parameter because it is always a Limit & Alarm Reset. Refer to the Digital Input Operation section. However, in addition on the Limiter model, if the Digital Input is in an Open state at power-up it gives a Reset signal.

## 13.4 Limiter Operator Mode & Screens

| | | | |
|---|---|---|---|
| User Screen |  | PV – top<br>Temperature & Unit – centre & right.<br>LIM & Limit Setpoint - bottom | |
| **IMPORTANT:** Visibility for parameters below must be set to **Show** in the **Operator** menu**.** | | | |
| Alarm State |  | Alarm triggered<br>Alarm configured, but not triggered<br>– Alarm not set | |
| Latch State |  | Output Latched<br>Latch set, but output not Latched<br>– Latch not set | To clear press ● then ▲ to select Yes.<br>Press ● to accept. |
| Maximum PV<br>Minimum PV | Screens show the Maximum & Minimum PV reached. | | To clear press ● then ▲ to select Yes.<br>Press ● to accept. |

## 13.5 Limiter Output Latching

When an SSR drive or Relay output is configured to 'latch' it will remain on after the limit or alarm condition has cleared. The latch enable parameter, **Output Latching,** needs to be **ON** for outputs you want to latch.

### Limiter Clearing Latched Outputs

The latch condition, shown by 🔒 in the Latch State screen, needs to be cleared either via a Modbus command, digital input or from the front panel.

To clear latches from the front panel, in the Latch State screen, press ● then ▲ to select Yes.

Press ▲ to accept.

### Limiter Start-up Latch

The parameter Startup Latch, is only present on the limiter model. It determines how latching outputs behave when the unit is powered up. It is set individually for each of the outputs (limit and/or the 2 alarms). The three possible modes are as follows:

- **Reset Latch:** The latch state is not remembered when the unit is powered off. The latch becomes active again only if the associated limit / alarm state is present at or after power-on.
- **Always Latch:** The instrument will always power on with the chosen output in the latched state, even if the associated limit or alarm is not active.
- **Last Latch:** The latch state is remembered on power down. Any output that was latched on power down it will still be latched when power is restored, even if that limit or alarm is no longer active.

**Note: If a limit or alarm state exists at power-up, previously unlatched outputs always activate immediately, no matter how the Start-up Latch has been set.**

### Limiter Sensor Break Detection

If a "Sensor break" is detected on the Limiter model, this always triggers the Limit exceed condition, place the process into a safe state. Correct the input problem, then unlatch the limit output to resolve this.

### Limiter Output 3 – Linear, Relay or SSR drive

- If the linear output is fitted to Output 3 on the Limiter model, it can only be used for a PV re-transmit function.
- If a relay or SSR drive is fitted in Output 3 then it is fixed as Alarm 2.

## 13.6 Limiter Setup Mode Parameters

If necessary, press ⊙ & △ to enter Setup from Operator mode.

Enter **Setup Lock**-code (default of **10**) using △ and △, then press ⊙.

1. Some parameters may be hidden depending upon configuration & hardware.
2. Note the permissible ranges for each temperature sensor type, below. For example, the B type thermocouple readings cannot have a decimal point, and it cannot measure below 100ºC or above 1824ºC.
3. The number of decimal points is set by the Decimal Place parameter.

The parameters are shown in the following table

| Parameter | Description | | Default Value |
|---|---|---|---|
| *** Maximum of 1 decimal place for temperature inputs, in the blue square.** | | | |
| >Input Type | J Thermocouple * | | **K Thermocouple** |
| | -200 to 1200ºC<br>-328 to 2192ºF | -128.8 to 537.7ºC<br>-199.9 to 999.9ºF | |
| | K Thermocouple * | | |
| | -240 to 1373ºC<br>-400 to 2503ºF | -128.8 to 537.7ºC<br>-199.9 to 999.9ºF | |
| | PT100 * | | |
| | -199 to 800ºC<br>-328 to 1472ºF | -128.8 to 537.7ºC<br>-199.9 to 999.9ºF | |
| | B Thermocouple | | |
| | 100 to 1824ºC | 211 to 3315ºF | |
| | C Thermocouple | | |
| | 0 to 2320ºC | 32 to 4208ºF | |
| | L Thermocouple * | | |
| | 0 to 762ºC<br>32 to 1403ºF | 0.0 to 537.7ºC<br>32.0 to 999.9ºF | |
| | N Thermocouple | | |
| | 0 to 1399ºC | 32 to 2551ºF | |
| | R Thermocouple | | |
| | 0 to 1795ºC | 32 to 3198ºF | |
| | S Thermocouple | | |
| | 0 to 1762ºC | 32 to 3204ºF | |
| | T Thermocouple * | | |
| | 240 to 400ºC<br>-400 to 752ºF | -128.8 to 400.0ºC<br>-199.9 to 752.0ºF | |
| | Linear dc | | |
| | 0 – 20mA<br>0 – 50mV<br>0 – 5V<br>0 – 10V | 4 – 20mA<br>10 – 50mV<br>1 – 5V<br>2 – 10V | |
| > Input Units | °C or °F (not available for Linear dc inputs) | | **°C** |
| >Input Decimal Place | 0000 – no decimal point<br>000.0 – one decimal point<br>00.00 – two decimal points (linear dc only)<br>0.000 – three decimal points (linear dc only) | | **0000** |
| **Scale Range maximum & minimum are only visible when input is a linear dc type.** | | | |

| Parameter | Description | | Default Value |
|---|---|---|---|
| >Input Scale Range Maximum | The scaling value for the input range maximum. | | **1000** |
| >Input Scale Range Minimum | The scaling value for the input range minimum. | | **0** |
| | | | |
| >Limit Type | **High** – device will limit when PV is greater than the Limit value. (Exceed condition if PV>Limit Value).<br>**Low** - device will limit when PV is less than the Limit value. (Exceed condition if PV<Limit value). | | **High** |
| >Limit Value | The exceed condition value at which the Limit output will trip. | | **-240** |
| | | | |
| **PV Retrans parameters are only visible if Output 3 is Linear.** | | | |
| > PV Retrans Type | 0-10V<br>2-10V<br>0-20mA | 4-20mA<br>0-5V<br>1-5V | **0-10V** |
| >PV Retrans Scale Range Maximum | Displayed PV value corresponding to maximum linear output. | | **1373** |
| > PV Retrans Scale Range Minimum | Displayed PV value corresponding to minimum linear output. | | **-240** |
| | | | |
| >Alarm 1 Value | Range minimum to range maximum,<br>or OFF (maximum +1) where OFF disables alarm.<br>Default alarm type is **PV High**. | | **1373** |
| **If a Relay or SSR drive is fitted in Output 3 you will see Alarm 2.** | | | |
| >Alarm 2 Value | Same options as Alarm 1.<br>Default alarm type is **PV Low.** | | **-240** |
| | | | |
| >Coms Unit Address | Modbus address from 1 to 255 | | **1** |
| >Coms Baud Rate | 1200, 2400, 4800, 9600, 19200 & 38400 | | **9600** |
| >Coms Parity | Odd, Even or None | | **None** |

**If the Input Type is changed the relevant values from the table above are used for the Scale Range Maximum and Scale Range Minimum. Review and change if required.**

If necessary, press ◉ & ▲ to clear any Pop Up Alerts.

Press ◉ & ▲ to exit the Setup mode.

## 13.7 Limiter Advanced Configuration Parameters

**Sub-menu Name**

1. Input
2. User Calibration
3. Outputs
4. Communication
5. Display
6. Information

If necessary, press ⊙ & △ to enter Advanced Configuration mode from Operator mode.

Enter **Advanced Lock**-code (default of **20**) using △ and △, then press ⊙.

## 13.8 Limiter - Input Menu

| Parameter | Description | Default Value |
|---|---|---|
| Input Type | Possible Input types are as listed in the Limiter Setup mode parameters above | **K thermocouple** |
| Units | Display Units either °C or °F.<br><br>This parameter is hidden when input is a linear type and °C or °F are hidden from the display. | **°C** |
| Decimal Place | 0000<br>000.0<br>00.00 (not for temperature)<br>0.000 (not for temperature) | **0000** |
| Scale Range Maximum | The scaling value for the input range maximum. | **Maximum allowed for Input Type.** |
| Scale Range Minimum | The scaling value for the input range minimum. | **Minimum allowed for Input Type.** |
| Filter Time | **OFF** or **0.5** to **100.0** seconds in **0.5** increments | **2.0** |
| CJC Enable | **Enable** – Enables the internal thermocouple CJC (Cold Junction Compensation).<br>**Disable** – Disables the internal CJC.<br>External compensation must be provided for thermocouples. | **Enable** |

**The input scale range, consisting of Scale Range Maximum & Scale Range Minimum above, is used to narrow the working range (input span) of the controller**

At 5% beyond the scaled range the controller with give over-range or under-range warnings.

For example, a range 0 to 100 gives a span of 100c, so when the PV is >105c the display will show **HIGH**.

## 13.9 Limiter - User Calibration Menu

| Parameter | Description | Default Value |
|---|---|---|
| Offset | Shifts the input value up or down by a single offset amount across the entire range. | **0** |
| Low Point | Enter value at which the low point error was measured. | **Lower Limit** |
| Low Offset | Enter equal, but opposite offset value to the observed low point error. | **0** |
| High Point | Enter value at which the high point error was measured. | **Upper Limit** |
| High Offset | Enter an equal, but opposite offset value to the observed high point error. | **0** |

## 13.10 Limiter - Outputs Menu

| Parameter | Description | Default Value |
|---|---|---|
| **Limit Output** | | |
| Type | **High** – device will limit when PV is greater than the Limit value. (Exceed condition if PV>Limit Value).<br>**Low** - device will limit when PV is less than the Limit value. (Exceed condition if PV<Limit value). | **High** |
| Value | The exceed condition value at which the Limit output will trip. Adjustable within the Scaled Range set in Input. | **-240** |
| Output Latching | **ON** – Limit output latches & needs to be cleared<br>**OFF**- Limit output doesn't latch | **ON** |
| Startup latch | Valid only if limit output latching is set to ON<br>**Reset Latch** (resets at power on)<br>**Always Latch** (latches at power on)<br>**Last Latch** (keeps last state at power on) | **Last Latch** |
| **Alarm 1** | | |
| Type | None<br>PV High<br>PV Low<br>Deviation<br>Annunciator | **PV High** |
| Value | Adjustable within the Scaled Range set in In-put.<br>Range minimum to range maximum,<br>or OFF (maximum +1) where OFF disables alarm | **1373** |
| Hysteresis | Sets the alarm switching differential from 0 to full span, on the "safe" side of the alarm point. | **1** |
| Action | **Direct** - Output active when alarm is active.<br>**Reverse** - Output active when alarm is not active. | **Direct** |
| Output Latching | **ON** – Alarm 1 output latches. Reset to continue<br>**OFF** – Alarm 1 output doesn't latch | **ON** |
| Startup latch | Valid only if Alarm 1 output latching is set to ON<br>**Reset Latch** (resets at power on)<br>**Always Latch** (latches at power on)<br>**Last Latch** (keeps last state at power on) | **Last Latch** |

| Parameter | Description | | Default Value |
|---|---|---|---|
| **Alarm 2 menu is only shown if Output 3 is Relay or SSR drive** | | | |
| **Alarm 2** | | | |
| Type | None<br>PV High<br>PV Low<br>Deviation<br>Annunciator | | **PV Low** |
| Value | Adjustable within the Scaled Range set in In-put.<br>Range minimum to range maximum,<br>or OFF (maximum +1) where OFF disables alarm. | | **-240** |
| Hysteresis | Sets the alarm switching differential from 0 to full span,<br>on the “safe” side of the alarm point | | **Off** |
| Action | **Direct** - Output active when alarm is active.<br>**Reverse** - Output active when alarm not active | | **Direct** |
| Output Latching | **ON** – Alarm 2 output latches. Reset to continue<br>**OFF** – Alarm 2 output doesn’t latch | | |
| Startup latch | Valid only if Alarm 2 output latching is set to ON<br>**Reset Latch** (resets at power on)<br>**Always Latch** (latches at power on)<br>**Last Latch** (keeps last state at power on) | | |
| **PV Retrans menu is only shown if Output 3 is Linear** | | | |
| **PV Retrans** | | | |
| Output Type | 0-10V<br>2-10V<br>0-20mA | 4-20mA<br>0-5V<br>1-5V | **0-10V** |
| Scale Range Maximum | Display value for maximum output -1999 to 9999 | | **1000** |
| Scale Range Minimum | Display value for minimum output -1999 to 9999 | | **0** |
| **Alarm Options** | | | |
| Start-up Inhibit | Inhibit the alarm(s) on Start up :-<br>None<br>Alarm 1<br>Alarm 2<br>Alarm 1 & 2 | | **None** |
| Sensor Break | Either **OFF** or **ON**.<br>**ON** - triggers Alarm output(s) when sensor break<br>is detected. | | **ON** |

## 13.11 Limiter - Communications Menu

| Parameter | Description | Default Value |
|---|---|---|
| Unit Address | Modbus address from 1 to 255 | **1** |
| Baud Rate | Coms data rate in kbps<br>1200, 2400, 4800, 9600, 19200 & 38400. | **9600** |
| Parity | Parity checking: Odd, Even or None. | **None** |

## 13.12 Limiter - Display Menu

| Parameter | Description | Default Value |
|---|---|---|
| Setup Unlock Code | View & adjust Setup mode lock code (password).<br>From 1 to 9999 or Off for no lock code. | 10 |
| Advanced Unlock Code | View & adjust Advanced mode lock code (password).<br>From 1 to 9999 or Off for no lock code. | 20 |
| Screen Timeout | Screensaver time. Display turns off after 5, 15 or 30 mins. | 5 |
| Selected language | Display language – English, German or French. | English |
| Reset to Defaults | Used to reset all parameters back to the factory defaults.<br>See 1020 Controller Factory Defaults. | |

## 13.13 Limiter - Information Menu

| Parameter | Description |
|---|---|
| PRL<br>DOM | The hardware/software revision level. Shows the product update status.<br>Date of manufacture in the form of month and year, **mmyy.** |
| FW Version<br>FW Type | The firmware version number & code type. |
| Serial | Serial Number of unit. |
| Out1<br>Out2<br>Out3 | Shows factory fitted hardware options –<br>Output 1 can be: **SSR** (SSR driver) or **Relay**<br>Output 2 can be: **SSR** (SSR driver) or **Relay**<br>Output 3 can be: **None**, **SSR** (SSR driver), **Relay** or **Linear** |
| Comm<br>DI | RS485 communications option - **Fitted** or **None**.<br>Digital Input is isolated or not - **Iso** or **NonIs** – see the Isolation Chart |

## 13.14 Limiter - Exiting from Advanced Configuration Mode

If necessary, press ⊙ & △ to clear any Pop-Up Alerts.

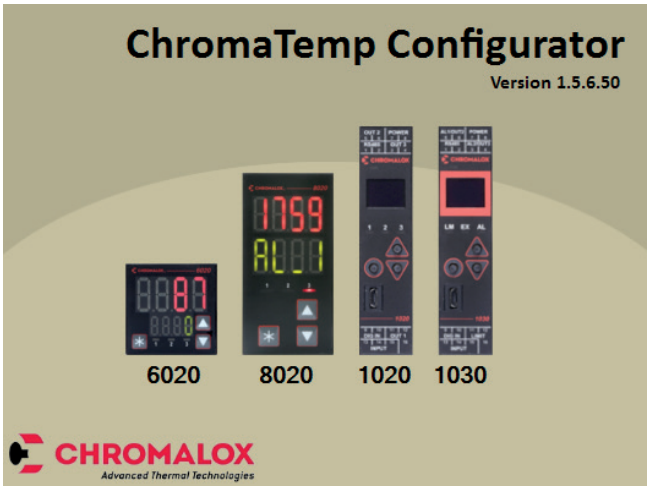
Press ⊙ & △ to exit up one menu level. Repeat if required.

Some menus have sub-menus so it may be necessary to press this key combination more than once. For example, to go back to the Operator screen from inside the Output 2 sub-menu you need to go up 3 levels and then press ⊙ & △ to exit the Advanced Configuration mode.

# 14 Configuration Software

## 14.1 Introduction

The ChromaTemp Configurator Software Program is available at no charge from the Chromalox website: www.chromalox.com. It facilitates the cloning of multiple controllers and fast parameter file uploads and downloads to and from the controller or PC. It also comes with a Setup Wizard which covers the most basic wiring, input type and programming requirements.



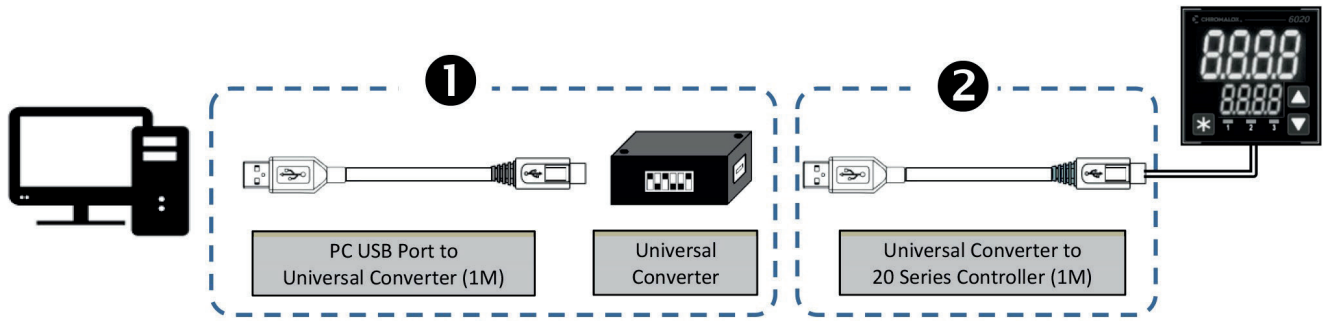

## 14.2 Connectivity Requirements

In order to use the ChromaTemp Configuration Software, you must connect to a PC in one of two ways: 1. Use the RS485 control terminals and PC connection (controller must have the RTU/RS485 feature) or 2. Use the Chromalox Universal Converter & ChromaTemp Configurator Cable.

1. The Universal converter comes with a cable which connects to the USB port on your PC.
2. The ChromaTemp Cable connects to a dedicated port on the bottom of your DIN Controller. (See connection details below)

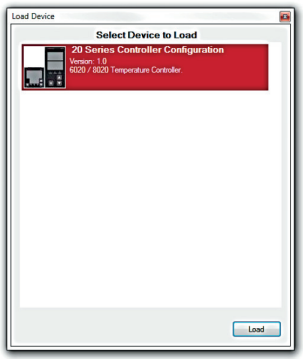
**⚠CAUTION**

***The ChromaTemp dedicated configuration port is very similar to a micro USB socket. It should never be directly connected to a standard USB port or USB charger. Use of this socket requires the Universal Converter to ChromaTemp Controller cable which is available from Chromalox. See the Accessories on the DIN Controller Order Table.***



## 14.3 Installing & Accessing the Configuration Program

Locate the program on the Chromalox website and install it to a known location on your PC. You may choose to have a quick launch icon located on your desktop for fast access. After the program is loaded, locate the quick launch icon and open the program.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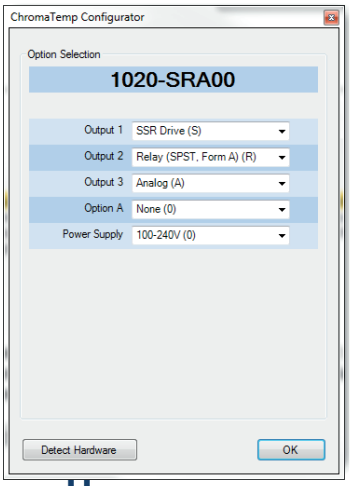
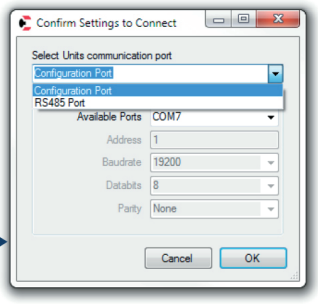
## 14.4 Getting Started

You will be presented with the ChromaTemp Configurator Option Selection window. You may accept the model that is presented to you or modify the outputs, options and supply voltage or Read (upload) the options and settings from an existing DIN controller. If you wish to accept the Model presented to you, simply select [ OK ] to and proceed to the Section 12.7 Navigating The Configurator.




To read the settings from a DIN controller, the unit must be powered up and properly connected to your compter via the **Universal Converter.** (See 12.2 above)

Select the Read from Device button

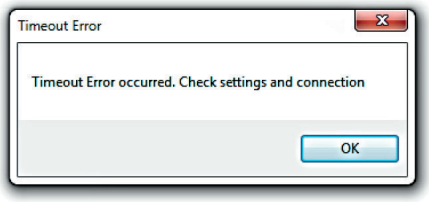



From the **Confirm Settings to Connect** window, choose which communication port (Configuration Port or RS485 Port) and the respective Port Settings.
Select **[ OK ]**

## 14.5 Troubleshooting the ChromaTemp Configurator

When connecting the controller to the PC for the first time, Windows will attempt to load the device drivers. In some cases, you may need to direct this Windows function to the file location of your ChromaTemp Configuration Program.

When attempting to run the program the first time, you may need to shut down/restart the Configuration Program.




You may receive this Timeout Error message if:

A. The connection is not correct or,

B. The device files have not been loaded or,

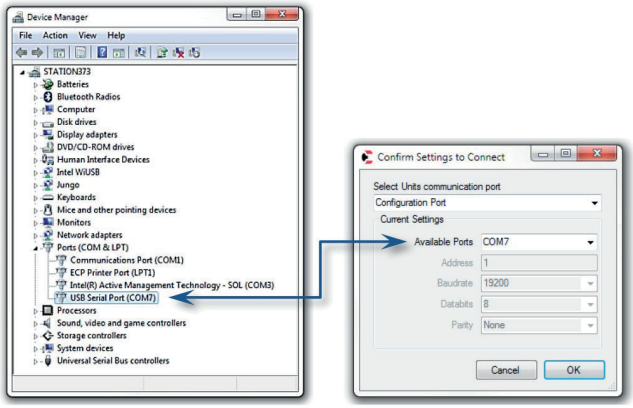
C. The USB connection tree has not yet been populated.

You may receive this **USB Device Not Recognized** window. This occurs when your controller is connected but the computer has not completed the installation of the necessary device drivers or it has not completed populating the USB connection tree.

Be patient. Verification of the drivers and populating the COM ports and USB connection tree may take several minutes.


If you are still having connectivity/program recognition errors, you may wish to investigate your Windows **Device Manager**. Ensure that you have no warning symbols.

In this example, the **COM7** is the Communications Port to which the Universal Converter is attached. Select **[OK]**.



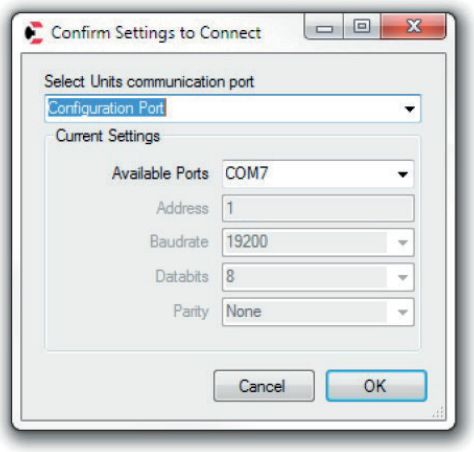
## 14.6 Getting Started

14.6 Getting Started (continued)

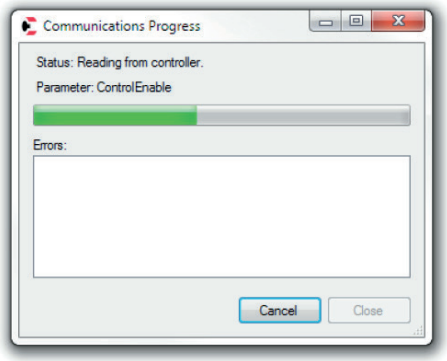
We are back at attempting to Read all Parameter Settings and Model Features from an existing device.

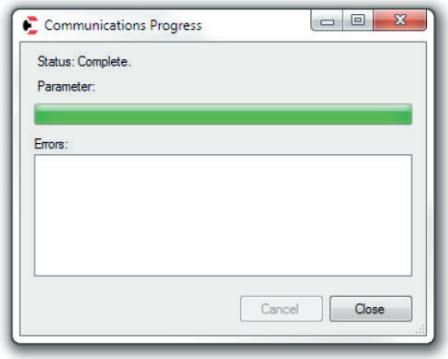
The controller is properly connected and the converter is recognized by your PC.

(See 12.5 for troubleshooting suggestions).



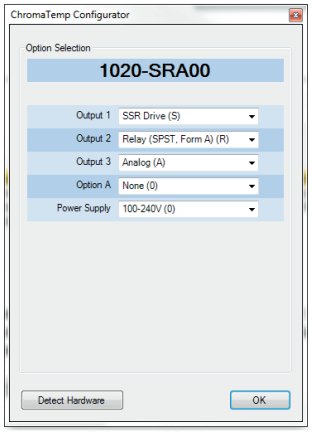

From the **Confirm Settings to Connect window**, choose which communication port (Configuration Port or RS485 Port) and the respective Port Settings (COM1 or COM7 for example). Select **[ OK ]**



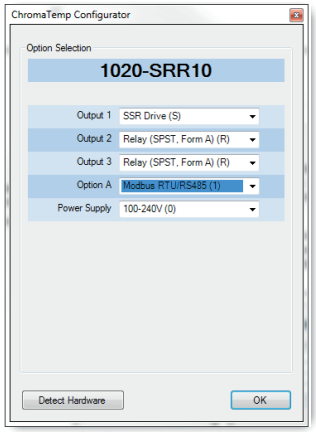




The progress of the device reading will be displayed in the Communications Progress window. The device reading should take approximately 10 seconds.

Upon a successful reading from your device, you will see that the Outputs and Options displayed in the ChromaTemp Configurator Option Selection window are now the same as your controller.



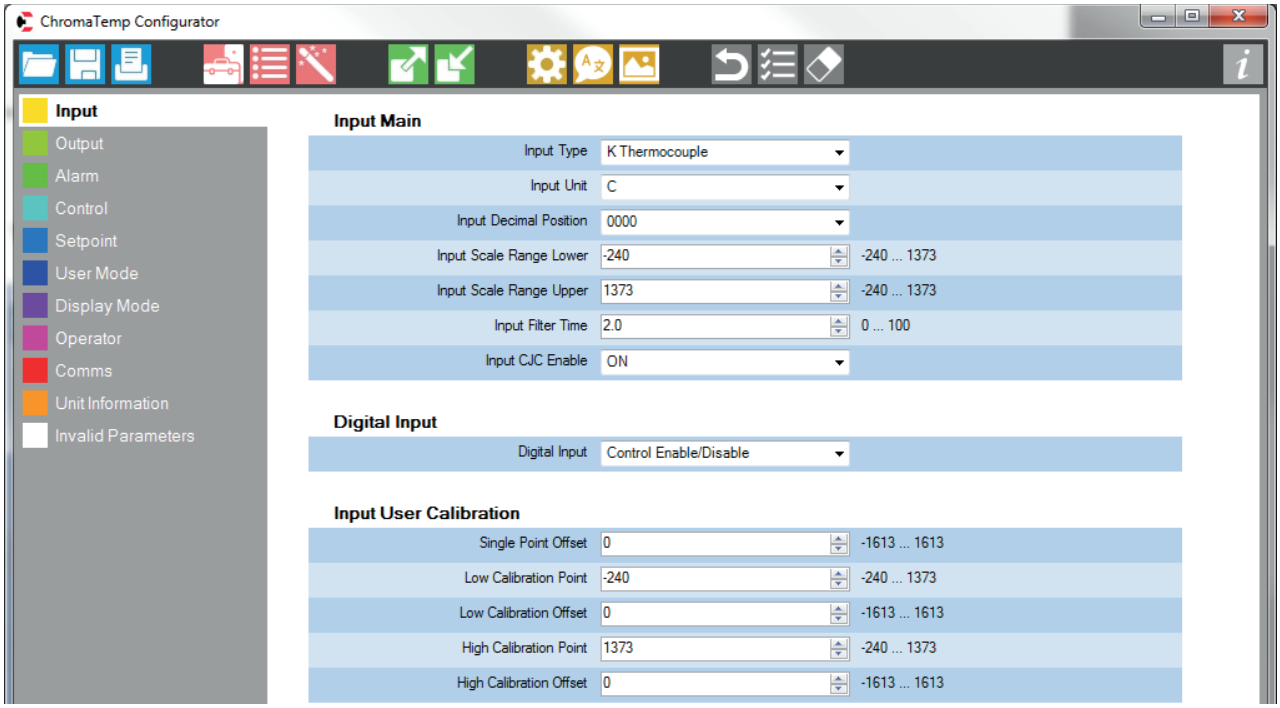

**Original Factory Configuration**




**Uploaded Device Configuration**

Parameter value changes may be made within the Configuration Software program. These changes may be saved to a file, downloaded to the controller, or hard copy printed for review.

## 14.7 Navigating the Configurator




### File Toolbar

The File Toolbar contains several file-related function icons:

Open a previously saved configuration file via Windows Explorer

Save a new configuration file in Windows Explorer

Hard copy printout of all parameter settings

Opens the Option Selection window

Opens the Setup Wizard (See Section 12.8 below)

Read from a Controller, opens the Confirm Settings to Connect window

Write to a Controller, opens the Confirm Settings to Connect window

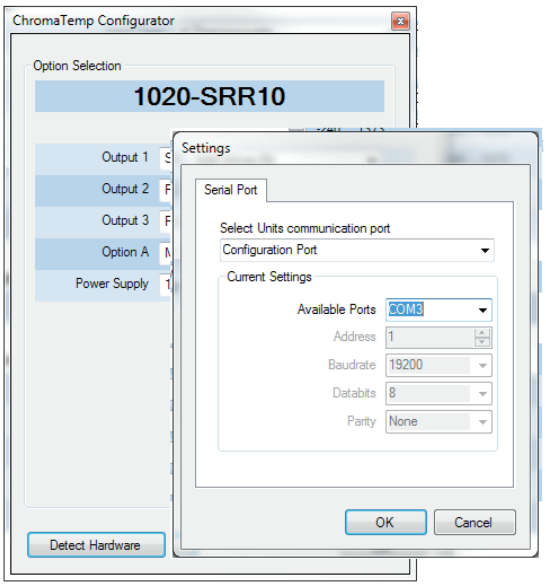
Opens Settings window – Program language, communication settings & firmware update

## Read in Your Hardware

If you are working online with your instrument, press Detect Hardware, then check and adjust Units' Communication Port, the PC COM port number, and if using RS485, enter the correct Address, Baudrate, Databits and Parity (as currently setup in your instrument).

Then press OK to read in your 1020 Controller hardware options.

This step reads in the hardware settings from the connected unit but not the parameter settings.

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### Read in Parameter Configuration

Before reading in the parameters, first upload the hardware options (see above).

Then press  to read in the current settings from the unit.

### Make Configuration Changes

Edit the configuration to your requirements.

### Write to Unit

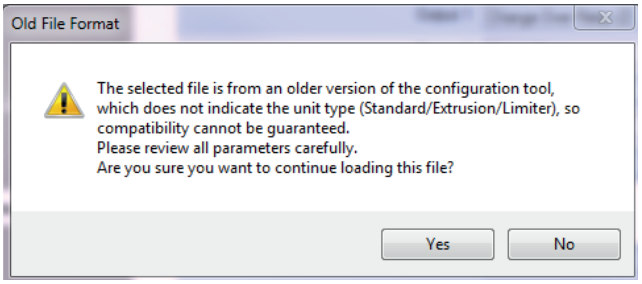
Press  to download your new configuration to the unit.

### Save Changes to File

Press  to save any changes to a file if you wish to use it later.

### Loading in Older Configuration Files

The ChromaTemp configurator may give a warning when loading in a file from older versions of the configurator.

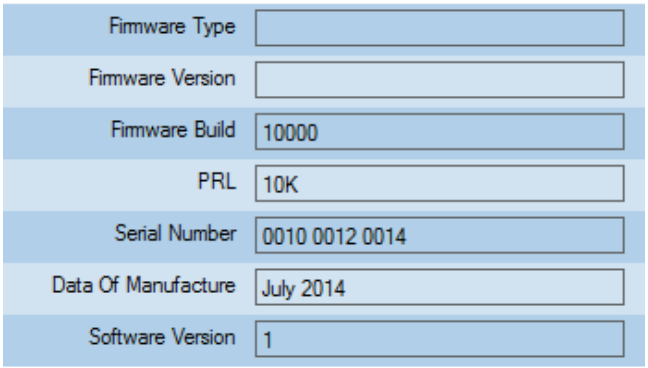



If you open this file you need to consider that the Unit Information-Details section may not be complete or correct.

Opening files in older versions of the configurator will not give a warning message but can give misleading information in the Details.

For example, see screenshot where the DoM is July 2014.

### Details



### Firmware and Language Updating

If advised by the factory or your authorized supplier, you can upgrade the firmware in the connected instrument by pressing  . Set the communications parameters (see above), then press the 

button.

Follow the on-screen instructions, ensuring you select the correct type and version of firmware file (*.s19) for your 1020 Controller type.

| Model | Firmware Name |
|---|---|
| Standard | V227E_Encrypt.s19 |
| Extrusion | V227F_Encrypt.s19 |
| Limiter | V227G_Encrypt.s19 |

If you are uploading language files (1020 Controller only) the version needs to match the firmware.

# 15 Serial Communications

## 15.1 Supported Protocol

The unit supports Modbus RTU protocol through the RS485 interface.

For a complete description of the Modbus protocol refer to the description provided at http://www.modbus.org/

## 15.2 RS485 Configuration

The RS485 address, bit rate and character format are configured via the front panel from the Communications Sub-menu.
**Data rate:** 4800, **9600** (default), 19200 or 38400 bps
**Parity:** **None** (default), Even or Odd
**Device Address:** 1 to 255 - See RS485 Device Addressing

**For successful communication the master device must have matching communications settings.**

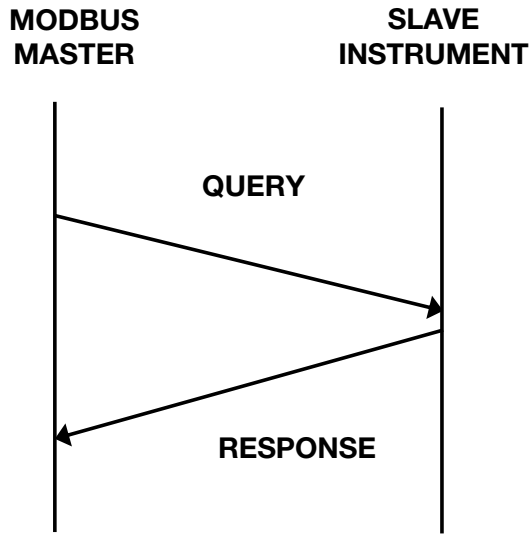
## 15.3 RS485 Device Addressing

The instrument must be assigned a unique device address in the range 1 to 255. This address is used to recognise Modbus queries intended for this instrument.

Except for globally addressed broadcast messages sent to device address 0, the instrument ignores Modbus queries from the master that do not match the address that has been assigned to it. These global queries are processed when received but no response messages are returned.

## 15.4 Link Layer

A Query (or command) is transmitted from the Modbus Master to the Modbus Slave. The slave instrument assembles the reply to the master.




A message for either a QUERY or RESPONSE is made up of an inter-message gap followed by a sequence of data characters. The inter-message gap is at least 3.5 data character times - the transmitter must not start transmission until 3 character times have elapsed since reception of the last character in a message, and must release the transmission line within 3 character times of the last character in a message.

**Three character times is approximately 0.75ms at 38400 bps, 1.5ms at 19200 bps, 3ms at 9600 bps and 6ms at 4800bps.**

Data is encoded for each character as binary data, transmitted LSB first. For a QUERY the address field contains the address of the slave destination. The slave address is given together with the Function and Data fields by the Application layer. The CRC is generated from the given address, function and data characters.

For a RESPONSE the address field contains the address of the responding slave. The Function and Data fields are generated by the slave application. The CRC is generated from the address, function and data characters.

The standard MODBUS RTU CRC-16 calculation employing the polynomial 216+215+22+1 is used.

| Inter-message gap | Address 1 char. | Function 1 char. | Data *n* char. | CRC Check 2 char. |
|---|---|---|---|---|

## 15.5 Supported Modbus Functions

The following Modbus function types are supported by this instrument:

| Function Code decimal (hexadecimal) | Modbus Meaning | Description |
|---|---|---|
| 03 (0x03)<br>04 (0x04) | Read Holding Registers<br>Read Input Registers | Read current binary value of specified number of parameters at given address.<br>Up to 64 parameters can be accessed with one query. |
| 06 (0x06) | Write Single Holding Register | Writes 2 bytes to a specified word address. |
| 08 (0x08) | Diagnostics | Used for loopback test only to check the communications work. |
| 16 (0x10) | Write Multiple Holding Registers | Writes up to 253 bytes of data to the specified address range. |

## 15.6 Function Descriptions

The following is interpreted from the Modbus Protocol Description obtainable from http://www.modbus.org/.

In the function descriptions below, the preceding device address value is assumed, as is the correctly formed two-byte CRC value at the end of the QUERY and RESPONSE frames.

## 15.7 Function 03 / 04 - Read Holding/Input Registers

Reads the current binary value of data at the specified word addresses.

**Query**

| Function | Address of 1st Word | | Number of Words | |
|---|---|---|---|---|
| 03/04 | HI | LO | HI | LO |

**Response**

| Function | Number of Bytes | First Word | | Last Word | |
|---|---|---|---|---|---|
| 03/04 | n | HI | LO | HI | LO |

In the response, the “Number of Bytes” ‘n’, indicates the number of data bytes read from the instrument. E.g. if 5 words are read, the count will be 10 (A hex). The maximum number of words that can be read is 64. If a parameter does not exist at one of the addresses read, then a value of 0000h is returned for that word.

**Function 06 – Write Single Register**

**Query**

| Function | Diagnostic Code | | Value | |
|---|---|---|---|---|
| 06 | HI = 00 | LO = 00 | HI | LO |

**Response**

| Function | Sub-Function | | Value | |
|---|---|---|---|---|
| 06 | HI = 00 | LO = 00 | HI | LO |

### Function 08 – Loopback Diagnostic Test

**Query**

| Function | Diagnostic Code | | Value | |
|---|---|---|---|---|
| 08 | HI = 00 | LO = 00 | HI | LO |

**Response**

| Function | Sub-Function | | Value | |
|---|---|---|---|---|
| 06 | HI = 00 | LO = 00 | HI | LO |

**The Response normally returns the same data as the loopback query itself and so can be used to test the communications. Other Diagnostic Codes are not supported.**

### Function 16 – (0x10 Hex) - Write Multiple Registers

**Query**

| Function | 1st Write Address | | Number of Words to Write | | Number of Query Bytes | 1st Query Byte | 2nd Query Byte | etc | Last Query Byte |
|---|---|---|---|---|---|---|---|---|---|
| 10 | HI | LO | HI | LO | | | | -----> | |

**Response**

| Function | 1st Word Address | | Number of Words | |
|---|---|---|---|---|
| 10 | HI | LO | HI | LO |

**The number of data bytes that can be written in one message is 253 bytes.**

# 16 Modbus Addresses

Register addresses are given in Decimal and Hexadecimal formats.

Parameter access can be Read Only (RO), Write Only (WO) or Read & Write (R/W)

## 16.1 Input Parameters

| Parameter Name | Modbus Address (Dec) | Modbus Address (Hex) | Access R/W | Notes |
|---|---|---|---|---|
| Process Variable | **1070** | 42E | RO | Read process variable value |
| Actual Setpoint | **1270** | 4F6 | RO | Actual effective setpoint (e.g. instantaneous value when setpoint in ramping). Not applicable for limiter |
| Setpoint | **1200** | 4B0 | R/W | Target controller Setpoint, settable within setpoint upper/ lower limit values. Not applicable for limiter |
| Limit Value | **1481** | 5C9 | R/W | The 'Exceed' value at which the limit output will trip. Settable within the input range. Limiter only. |
| Limit Exceed Status | **1492** | 5D4 | RO | 0 = Limit value not exceeded<br>1 = Limit value exceeded |
| Alarm 1 Value | **1402** | 57A | R/W | Alarm 1 value. Limited by the input span |
| Alarm 2 Value | **1406** | 57E | R/W | Alarm 2 value. Limited by the input span |
| Alarm 1 Status | **1470** | 5BE | RO | 0 = Alarm 1 inactive, 1 = Alarm 1 active |
| Alarm 2 Status | **1471** | 5BF | RO | 0 = Alarm 2 inactive, 1 = Alarm 2 active |
| Output Latch Status | **1170** | 47F | RO | A bit mask where bit 1 = Output 1 latched, bit 2 = Output 2 latched, bit 3 = Output 3 latched. E.g. binary 00000101 = outputs 1 & 3 are latched |
| Latch Reset | **1151** | 492 | WO | 1 = Attempts to reset all latched outputs (effect is subject to process conditions) |
| Sensor Break Status | **1072** | 430 | RO | 0 = Ok, 1 = Sensor Break |
| Control Enable/Disable | **1375** | 55F | R/W | 0 = Control Disabled, 1 = Control Enabled<br>Not applicable to Limiter model |
| Control Enable State | **1376** | 560 | RO | 0 = Control Disabled, 1 = Control Enabled<br>Not applicable to Limiter model |
| Manual Power Enable | **1315** | 523 | R/W | 0 = Automatic Control, 1 = Manual Control<br>Not applicable to Limiter model. |
| Combined Power (Manual Power in Manual Mode) | **1316** | 524 | RO/RW | A read only combined heat/cool power level in automatic mode, or used to write the power level in manual mode.<br>-100 (max cooling) to 100 (max heating)<br>Not applicable to Limiter model. |
| Heat Power Output (Primary) | **1370** | 55A | RO | 0-100% heating/primary power. Not applicable on Limiter |
| Cool Power Output (Secondary) | **1371** | 55B | RO | 0-100% cooling/secondary power. Not applicable on Limiter |
| Automatic Tuning | **1384** | 568 | R/W | Read: 0 = Inactive, 1 = PreTune Active 2 = Tune at SP Active<br>Write: 0 = Stop Tune, 1 = Run PreTune 2 = Run Tune at SP |

## 16.1 Standard and Extrusion Modbus Addresses

| Parameter Name | HMI Mode | Modbus Address (Dec) | Modbus Address (Hex) | Access R/W | Notes |
|---|---|---|---|---|---|
| Process Variable | Operator/User | **1070** | 42E | RO | Read process variable value |
| Sensor Break Status | Operator/User | **1072** | 430 | RO | 0 = Ok, 1 = Sensor Break. |
| Digital Input Status | Operator/User | **1075** | 433 | RO | 0 = Off, 1 = On |
| Alarm 1 Status | Operator/User | **1470** | 5BE | RO | 0 = Alarm 1 inactive, 1 = Alarm 1 active |
| Alarm 2 Status | Operator/User | **1471** | 5BF | RO | 0 = Alarm 2 inactive, 1 = Alarm 2 active |
| Latch Reset | Operator/User | **1151** | 47F | WO | 1 = Attempts to reset all latched outputs (effect is subject to process conditions) |
| Output Latch Status | Operator/User | **1170** | 492 | RO | A bit mask where bit 1 = Output 1 latched, bit 2 = Output 2 latched, bit 3 = Output 3 latched. E.g. binary 00000101 = outputs 1 & 3 are latched |
| Output 1 Latch Status | Operator/User | **1171** | 47F | RO | 0 = Output 1 not latched, 1 = latched |
| Output 2 Latch Status | Operator/User | **1172** | 47F | RO | 0 = Output 2 not latched, 2 = latched |
| Output 3 Latch Status | Operator/User | **1173** | 47F | RO | 0 = Output 3 not latched, 3 = latched |
| Output 1 Status | Operator/User | **1175** | 47F | RO | 0 = Output 1 OFF, 1 = ON |
| Output 2 Status | Operator/User | **1178** | 47F | RO | 0 = Output 2 OFF, 1 = ON |
| Output 3 Status | Operator/User | **1181** | 47F | RO | 0 = Output 3 OFF, 1 = ON |
| Actual Setpoint | Operator/User | **1270** | 4F6 | RO | Actual effective setpoint (e.g. instantaneous value when setpoint in ramping). Not applicable for limiter, |
| Manual Power Enable | Operator/User | **1315** | 523 | R/W | 0 = Automatic, 1 = Manual Control |
| Combined Power (or Manual mode power value) | Operator/User | **1316** | 524 | RO (RW) | A read only combined heat/cool power level in automatic mode (or used to write the power level in manual mode).<br>-100 (max cooling) to 100 (max heating)<br>Not applicable to Limiter model. |
| Heat Power Output (Primary) | Operator/User | **1370** | 55A | RO | 0-100% heating/primary power. Not applicable on Limiter |
| Cool Power Output (Secondary) | Operator/User | **1371** | 55B | RO | 0-100% cooling/secondary power. Not applicable on Limiter |
| Control Enable/Disable | Operator/User | **1375** | 55F | R/W | 0 = Control Disable, 1 = Control Enable |
| Control Enable State | Operator/User | **1376** | 560 | RO | 0 = Control Disabled, 1 = Control Enabled |

| Parameter Name | HMI Mode | Modbus Address (Dec) | Modbus Address (Hex) | Access R/W | Notes |
|---|---|---|---|---|---|
| Digital Input Function | Input | **1007** | 3EF | R/W | Sets the function digital input controls:<br>0 - No Action (Default)<br>1 - Alarm Reset (High)<br>2 - Control Enable (High) / Disable (Low)<br>3 - Control Auto (High) / Manual (Low)<br>4 - Pre-tune Stop (High) / Start (Low)<br>5 - Tune at SP Stop (High) / Start (Low) |
| Cold Junction Compensation | Input | **1006** | 3EE | R/W | 0 = Cold Junction Disabled,<br>1 = Enabled |
| Filter Time | Input | **1004** | 3EC | R/W | 0 (OFF) or 5 to 1000 = Input filter time OFF or 0.5 to 100.0 seconds, in 0.5s increments |
| Scale Range Lower Limit | Input | **1002** | 3EA | R/W | Max working temperature, or display value for the max linear input level |
| Scale Range Upper Limit | Input | **1001** | 3E9 | R/W | Min working temperature, or display value for the min linear input level |
| Decimal Point Position | Input | **1003** | 3EB | R/W | The number of decimal places displayed:<br>0 - XXXX<br>1 – XXX.X<br>2 – XX.XX (linear inputs only)<br>3 – X.XXX (linear inputs only) |
| Input Units | Input | **1005** | 3ED | R/W | 0 = Deg˚C, 1 = Deg˚F |

| Parameter Name | HMI Mode | Modbus Address (Dec) | Modbus Address (Hex) | Access R/W | Notes | |
|---|---|---|---|---|---|---|
| | | | | | **Value** | **Range** |
| Input Type | Input | **1000** | 3E8 | R/W | 0<br>1<br>2<br>3<br>4<br>5<br>6<br>7<br>8<br>9<br>10<br>11<br>12<br>13<br>14<br>15<br>16<br>17 | J Thermocouple<br>K Thermocouple<br>PT100<br>B Thermocouple<br>C Thermocouple<br>L Thermocouple<br>N Thermocouple<br>R Thermocouple<br>S Thermocouple<br>T Thermocouple<br>0 – 20mA<br>4 – 20mA<br>0 – 50mA<br>10 – 50mA<br>0 – 5V<br>1 – 5V<br>0 – 10V<br>2 – 10V |
| | | | | | | |
| User High Calibration Offset | User Calibration | **1605** | 645 | R/W | The required adjustment +/- Span | |
| User High Calibration Point | User Calibration | **1604** | 644 | R/W | The adjustment point: Input range maximum to input range minimum | |
| User Low Calibration Offset | User Calibration | **1603** | 643 | R/W | The required adjustment +/- Span | |
| User Low Calibration Point | User Calibration | **1602** | 642 | R/W | The adjustment point: Input range maximum to input range minimum | |
| User Single Point Offset | User Calibration | **1601** | 641 | R/W | The required adjustment +/- Span | |
| | | | | | | |
| Linear Output 3 Type | Outputs | **1140** | 474 | R/W | Possible types. Valid if linear output fitted.<br>1 = 0-10V<br>2 = 2-10V<br>3 = 0-20mA<br>4 = 4-20mA<br>0 = 0-5V<br>5 = 1-5V | |
| Linear Out 3 Scale Max. | Outputs | **1141** | 475 | R/W | PV or SP value where retransmit output is at min level (e.g. 4mA if type is 4-20). Adjustable from -1999 to 9999 | |
| Linear Out 3 Scale Min. | Outputs | **1142** | 476 | R/W | PV or SP value where retransmit output is at max level (e.g. 20mA if type is 4-20). Adjustable from -1999 to 9999 | |

| Parameter Name | HMI Mode | Modbus Address (Dec) | Modbus Address (Hex) | Access R/W | Notes |
|---|---|---|---|---|---|
| Output 3 Usage | Outputs | **1130** | 46A | R/W | If Relay/SSR fitted:<br>0 = Heat Output<br>1 = Cool Output<br>2 = Non-Linear Cooling – Only Extrusion<br>3 = Alarm 1<br>4 = Alarm 2<br>5 = Alarm 1 or Alarm 2<br>6 = Loop Alarm<br><br>If Linear out fitted:<br>0 = Heat Output<br>1 = Cool Output<br>7 = Retransmit Setpoint<br>8 = Retransmit Process value |
| Output 3 Indicator Invert | Outputs | **1131** | 46B | R/W | 0 = Sync with output, 1 = Opposite to output (e.g. ON when output off) |
| Output 3 Alarm Latching | Outputs | **1133** | 46D | R/W | 0 = Off, 1 = On (will latch on when active) |
| Output 3 Alarm Action | Outputs | **1132** | 46C | R/W | 0 = Direct, 1 = Reverse (off if alarm active) |
| Output 2 Indicator Invert | Outputs | **1121** | 461 | R/W | 0 = Sync with output, 1 = Opposite to output (e.g. ON when output off) |
| Output 2 Alarm Latching | Outputs | **1123** | 463 | R/W | 0 = Off, 1 = On (will latch on when active) |
| Output 2 Alarm Action | Outputs | **1122** | 462 | R/W | 0 = Direct, 1 = Reverse (off if alarm active) |
| Output 2 Usage | Outputs | **1120** | 460 | R/W | 0 = Heat Output<br>1 = Cool Output<br>2 = Non-Linear Cooling – Only Extrusion<br>3 = Alarm 1<br>4 = Alarm 2<br>5 = Alarm 1 or Alarm 2<br>6 = Loop Alarm |
| Output 1 Indicator Invert | Outputs | **1101** | 44D | R/W | 0 = Sync with output, 1 = Opposite to output (e.g. ON when output off) |
| Output 1 Alarm Latching | Outputs | **1103** | 44F | R/W | 0 = Off, 1 = On (will latch on when active) |
| Output 1 Alarm Action | Outputs | **1102** | 44E | R/W | 0 = Direct, 1 = Reverse (off if alarm active) |
| Output 1 Usage | Outputs | **1100** | 44C | R/W | 0 = Heat Output<br>1 = Cool Output<br>2 = Non-Linear Cooling – Only Extrusion<br>3 = Alarm 1<br>4 = Alarm 2<br>5 = Alarm 1 or Alarm 2<br>6 = Loop Alarm |

| Parameter Name | HMI Mode | Modbus Address (Dec) | Modbus Address (Hex) | Access R/W | Notes |
|---|---|---|---|---|---|
| Automatic Tuning | Control | **1384** | 568 | R/W | Read: 0 = Inactive, 1 = PreTune Active 2 = Tune at SP Active<br>Write: 0 = Stop Tune, 1 = Run PreTune 2 = Run Tune at SP |
| Tune Status / Error Messages | Control | **1378** | 562 | RO | 0= No tuning active<br>1= Tuning active<br>2= PV within 5% of setpoint<br>3= Setpoint is Ramping<br>4= Control On/Off<br>5= Manual Control<br>6= Pulse Tune Error<br>7= Sensor Break<br>8= Timer running<br>9= Control disabled<br>10= Setup not completed |
| Power Up Action | Control | **1377** | 561 | R/W | On power-up control enable/disable is:<br>0=Last State, 1=Always Enabled |
| Cool Power Limit | Control | **1312** | 520 | R/W | Sets limit from 0-100% cooling |
| Heat Power Limit | Control | **1311** | 51F | R/W | Sets limit from 0-100% Heating |
| Output Interlock | Control | **1185** | 4A1 | R/W | 0=Interlock Off or 1=Interlock On (On prevents simultaneous heating & cooling)<br>Do not use if PB 'overlap' has been set |
| Cool Cycle Time | Control | **1318** | 526 | R/W | 0 (OFF) or 1 to 5120 = Cycle time OFF or 0.1 to 512.0 seconds, in 0.1s increments |
| Heat Cycle Time | Control | **1317** | 525 | R/W | 0 (OFF) or 1 to 5120 = Cycle time OFF or 0.1 to 512.0 seconds, in 0.1s increments |
| Bias (Manual Reset) | Control | **1307** | 51B | R/W | Biases the working point 0% to 100% or -100 to +100% for dual control |
| On/Off Differential | Control | **1308** | 51C | R/W | 0.1% to 10.0% of input span |
| Overlap/Deadband | Control | **1306** | 51A | R/W | In display unit, values from -20% to 20% of combined primary and secondary proportional band values |
| Loop Alarm Time | Control | **1310** | 51E | R/W | 1- 5999 seconds (used in manual mode if loop alarm has been configured |
| Derivative Time (Rate) | Control | **1305** | 519 | R/W | 0 (Off) or 1 to 5999 seconds |
| Integral Time (Automatic Reset) | Control | **1304** | 518 | R/W | 0 (Off) or 1 to 5999 seconds |
| Cool Proportional Band | Control | **1303** | 517 | R/W | 0 = On/Off control, or 1 to 9999 cooling band, in display units (e.g. = 0.001 to 9.999 if display has 3 decimal places) |
| Heat Proportional Band | Control | **1302** | 516 | R/W | 0 = On/Off control, or 1 to 9999 heating band, in display units (e.g. = 0.001 to 9.999 if display has 3 decimal places) |

| Parameter Name | HMI Mode | Modbus Address (Dec) | Modbus Address (Hex) | Access R/W | Notes |
|---|---|---|---|---|---|
| Soft Start Setpoint | Control | **1290** | 50A | R/W | Setpoint during Soft Start. Settable within setpoint upper/lower limit values. Extrusion model only |
| Soft Start Time | Control | **1291** | 50B | R/W | 0 = Soft Start Off, or 1 to 3600 minutes duration. Extrusion model only |
| Soft Start Time Remaining | Control | **1292** | 50C | RO | Extrusion model only |
| Soft Start Time Remaining Secs | Control | **1293** | 50D | RO | Extrusion model only |
| Soft Start Time Remaining = ( (Soft Start Time Remaining – 1) + Soft Start Time Remaining Secs) | | | | | |
| | | | | | |
| Setpoint Offset | Setpoint | **1205** | 4B5 | R/W | Offset the entered SP by -1999 to 9999 Effective SP = SP+Offset. NOTE: effective SP is not limited by the setpoint limits. |
| Setpoint | Setpoint | **1200** | 4B0 | R/W | Target controller Setpoint value, settable within setpoint upper/lower limit values |
| Setpoint Lower Limit | Setpoint | **1202** | 4B2 | R/W | Minimum value for target Setpoint. Adjustable within scale range. NOTE: does not limit effective SP with 'Offset' |
| Setpoint Upper Limit | Setpoint | **1201** | 4B1 | R/W | Maximum value for target Setpoint. Adjustable within scale range. NOTE: does not limit effective SP with 'Offset' |
| Timer On-Time | Setpoint | **1277** | 4FD | R/W | Time the setpoint is maintained (the 'dwell' after any delay or ramp). Set 1 to 5999 minutes, 0 = No Dwell. Control is disabled when Dwell ends. 6000 = Infinite Dwell. Standard controller model only. |
| Setpoint Ramp Rate | Setpoint | **1204** | 4B4 | R/W | The rate from 1 to 9999 display units for 'ramping' the setpoint. 10000 = Off (SP steps straight to the target value) |
| Delayed Start Time Value | Setpoint | **1276** | 4FC | R/W | Time from power-up or control enable before control actually begins. Set 1 to 5999 minutes, 0 = No Delay. |
| Timer Enable | Setpoint | **1275** | 4FB | R/W | 0 = Delay & On-Timer disabled, 1 = Enabled. Standard model only |
| | | | | | |
| Sensor Break Activate Alarm | Alarms | **1409** | 581 | R/W | 0 = Off, 1 = Detected break always activates both alarms (if configured).<br>If Off, alarms only activate if break condition is also an alarm condition. |

| Parameter Name | HMI Mode | Modbus Address (Dec) | Modbus Address (Hex) | Access R/W | Notes |
|---|---|---|---|---|---|
| Alarm Notification | Alarms | **1408** | 580 | R/W | While display is active, this alternates 'Alarm' with PV value if selected alarm(s) are active. Red alarm output LEDs are not affected. 0 = None, 1 = Alarm 1, 2 = Alarm 2, 3 = Alarm 1 or Alarm 2 |
| Alarm Inhibit | Alarms | **1410** | 582 | R/W | Set alarms to Inhibit at power-up or controller setpoint change. 0 = None, 1 = Alarm 1, 2 = Alarm 2 3 = Both Alarms |
| Alarm 2 Hysteresis | Alarms | **1407** | 57F | R/W | Alarm 2 switching hysteresis. Limited by the input span |
| Alarm 2 Value | Alarms | **1406** | 57E | R/W | Alarm 2 value. Limited by the input span |
| Alarm 2 Type | Alarms | **1404** | 57C | R/W | 0 = None (alarm not used) 1 = High Alarm 2 = Low Alarm 3 = Deviation 4 = Band Alarm |
| Alarm 1 Hysteresis | Alarms | **1403** | 57B | R/W | Alarm 1 switching hysteresis. Limited by the input span |
| Alarm 1 Value | Alarms | **1402** | 57A | R/W | Alarm 1 value. Limited by the input span |
| Alarm 1 Type | Alarms | **1400** | 578 | R/W | 0 = None (alarm not used) 1 = High Alarm 2 = Low Alarm 3 = Deviation 4 = Band Alarm |
| | | | | | |
| Parity | Communi-cations | **1501** | 5DD | R/W | 0 = None, 1 = Even, 2 = Odd |
| Baud Rate | Communi-cations | **1502** | 5DE | R/W | 0 = 1200 bps 1 = 2400 bps 2 = 4800 bps 3 = 9600 bps 4 = 19200 bps 5 = 38400 bps |
| Modbus Address | Communi-cations | **1500** | 5DC | R/W | Unique instrument network address from 1 to 255 |
| | | | | | |
| Selected Language | Display | **1828** | 724 | R/W | Language selection. 0 = English, 1 = The installed alternative language |
| Alternative Language | Display | **1808** | 710 | RO | The Installed alternative language. 00 = German, 01 = English, 02 = French |
| Screen Timeout | Display | **1830** | 726 | R/W | 0 = 5mins, 1 = 15mins & 2 = 30mins without keypress before timeout |
| Transmitter View Enable | Display | **1806** | 70E | R/W | 0 = Off, 1 = Hide setpoint on display, but control functions are still active. |

| Parameter Name | HMI Mode | Modbus Address (Dec) | Modbus Address (Hex) | Access R/W | Notes |
|---|---|---|---|---|---|
| Advanced Lock Code | Display | **1803** | 70B | R/W | The password to enter the Advanced Menu 0 = Off, or 1 to 9999 |
| Setup Lock Code | Display | **1804** | 70C | R/W | The password to enter the Setup Menu 0 = Off, or 1 to 9999 |
| | | | | | |
| Unhide Delay Time Remaining | Operator | **2207** | 89F | R/W | 0 = Hide, 1 = Show remaining time |
| Unhide Time On Remaining | Operator | **2206** | 89E | R/W | 0 = Hide, 1 = Show remaining time |
| Unhide Manual Control Enable | Operator | **2205** | 89D | R/W | 0 = Hide, 1 = Show auto/manual select |
| Unhide Control Enable | Operator | **2204** | 89C | R/W | 0 = Hide, 1 = Show control enable/disable |
| Unhide Alarm Status | Operator | **2203** | 89B | R/W | 0 = Hide, 1 = Show alarm status |
| Unhide Alarm Latch | Operator | **2202** | 89A | R/W | 0 = Hide, 1 = Show alarm latch screen |
| Unhide PV Min | Operator | **2201** | 899 | R/W | 0 = Hide, 1 = Show stored minimum PV |
| Unhide PV Max | Operator | **2200** | 898 | R/W | 0 = Hide, 1 = Show stored maximum PV |
| | | | | | |
| Date of Manufacture | Information | **505** | 1F9 | RO | Encoding e.g. 0403 for April 2003 is returned as 193 hex. |
| Serial Number formed of aaaa bbbb cccc (12 BDC digits): | | | | | |
| Serial Number High | Information | **504** | 1F8 | RO | First four digits, aaaa, bits 32-47 |
| Serial Number Mid | Information | **503** | 1F7 | RO | Middle four digits, bbbb, bits 16-31 |
| Serial Number Low | Information | **502** | 1F6 | RO | Last four digits, cccc, bits 0-15 |
| PRL | Information | **506** | 1FA | RO | Formatted as high byte hardware number as integer [0-99], low byte ascii character [A-Z] for software |
| Firmware Type Low | Information | **65451** | FFAB | RO | (e.g. 227E). Returned as ascii |
| Firmware Type High | Information | **65450** | FFAA | RO | (e.g. 227E). Returned as ascii |
| Firmware Ver. High | Information | **65458** | FFB2 | RO | (e.g. 10p12). Returned as ascii |
| Firmware Ver. Mid | Information | **65457** | FFB1 | RO | (e.g. 10p12). Returned as ascii |
| Firmware Ver. Low Mid | Information | **65456** | FFB0 | RO | (e.g. 10p12). Returned as ascii |
| Firmware Ver. Low | Information | **65455** | FFAF | RO | (e.g. 10p12). Returned as ascii |
| | | | | | |
| Communications Option (RS485) | Information | **603** | 25B | RO | 0 = Not Fitted, 1 = Fitted. |
| Option 3 | Information | **602** | 25A | RO | 0= None, 1= Relay, 5= Linear |
| Option 2 | Information | **601** | 259 | RO | 0= None, 1= Relay, 3= SSR |
| Option 1 | Information | **600** | 258 | RO | 0= None, 1= Relay, 3= SSR |
| Supply Voltage | Information | **511** | 1FF | RO | 0= 240V, 1= Low Voltage |
| Variant | Information | **510** | 1FE | RO | 1= Standard, 0= Extrusion, 2= Limit |
| Digital Input | Information | **509** | 1FD | RO | 0= Non-isolated, 1= Isolated. |

## 16.3 Limiter Modbus Addresses

| Parameter Name | HMI Mode | Modbus Address (Dec) | Modbus Address (Hex) | Access R/W | Notes |
|---|---|---|---|---|---|
| Process Variable | Operator/User | **1070** | 42E | RO | Read process variable value |
| Sensor Break Status | Operator/User | **1072** | 430 | RO | 0 = Ok, 1 = Sensor Break. |
| Limit Exceed Status | Operator/User | **1492** | 5D4 | RO | 0 = Limit value not exceeded,<br>1 = Limit value exceeded |
| Alarm 1 Status | Operator/User | **1470** | 5BE | RO | 0 = Alarm 1 inactive, 1 = Alarm 1 active |
| Alarm 2 Status | Operator/User | **1471** | 5BF | RO | 0 = Alarm 2 inactive, 1 = Alarm 2 active |

| Parameter Name | HMI Mode | Modbus Address (Dec) | Modbus Address (Hex) | Access R/W | Notes |
|---|---|---|---|---|---|
| Digital Input Function | Input | 1007 | 3EF | R/W | The function digital input controls:<br>0 - No Action<br>1 – Limit & Alarm Reset (High) |
| Cold Junction Compensation | Input | 1006 | 3EE | R/W | 0 = Cold Junction Disabled, 1 = Enabled |
| Filter Time | Input | 1004 | 3EC | R/W | 0 (OFF) or 5 to 1000 = Input filter time OFF or 0.5 to 100.0 seconds, in 0.5s increments |
| Scale Range Lower Limit | Input | 1002 | 3EA | R/W | Max working temperature, or display value for the max linear input level. |
| Scale Range Upper Limit | Input | 1001 | 3E9 | R/W | Min working temperature, or display value for the min linear input level. |
| Decimal Point Position | Input | 1003 | 3EB | R/W | The number of decimal places displayed:<br>0 - XXXX<br>1 – XXX.X<br>2 – XX.XX (linear inputs only)<br>3 – X.XXX (linear inputs only) |
| Input Units | Input | 1005 | 3ED | R/W | 0 = Deg˚C, 1 = Deg˚F |

| Parameter Name | HMI Mode | Modbus Address (Dec) | Modbus Address (Hex) | Access R/W | Notes | |
|---|---|---|---|---|---|---|
| | | | | | **Value** | **Range** |
| Input Type | Input | **1000** | 3E8 | R/W | 0<br>1<br>2<br>3<br>4<br>5<br>6<br>7<br>8<br>9<br>10<br>11<br>12<br>13<br>14<br>15<br>16<br>17 | J Thermocouple<br>K Thermocouple<br>PT100<br>B Thermocouple<br>C Thermocouple<br>L Thermocouple<br>N Thermocouple<br>R Thermocouple<br>S Thermocouple<br>T Thermocouple<br>0 – 20mA<br>4 – 20mA<br>0 – 50mA<br>10 – 50mA<br>0 – 5V<br>1 – 5V<br>0 – 10V<br>2 – 10V |
| | | | | | | |
| User High Calibration Offset | User Calibration | **1605** | 645 | R/W | The required adjustment +/- Span | |
| User High Calibration Point | User Calibration | **1604** | 644 | R/W | The adjustment point: Input range maximum to input range minimum | |
| User Low Calibration Offset | User Calibration | **1603** | 643 | R/W | The required adjustment +/- Span | |
| User Low Calibration Point | User Calibration | **1602** | 642 | R/W | The adjustment point: Input range maximum to input range minimum | |
| User Single Point Offset | User Calibration | **1601** | 641 | R/W | The required adjustment +/- Span | |
| | | | | | | |
| Sensor Break Activate Alarm | Alarms | **1409** | 581 | R/W | 0 = Off, 1 = Detected break always activates both alarms (if configured). If Off, alarms only activate if break condition is also an alarm condition. | |
| Alarm Inhibit | Alarms | **1410** | 582 | R/W | Set to inhibit alarms at power-up.<br>0 = None, 1 = Alarm 1, 2 = Alarm 2<br>3 = Both Alarms | |
| Alarm 2 Hysteresis | Alarms | **1407** | 57F | R/W | Alarm 2 switching hysteresis. Limited by the input span | |
| Alarm 2 Value | Alarms | **1406** | 57E | R/W | Alarm 2 value. Limited by the input span | |
| Alarm 2 Type | Alarms | **1404** | 57C | R/W | 0 = None (alarm not used)<br>1 = High Alarm<br>2 = Low Alarm<br>3 = Deviation<br>4 = Annunciator | |
| Alarm 1 Hysteresis | Alarms | **1403** | 57B | R/W | Alarm 1 switching hysteresis. Limited by the input span | |

| Parameter Name | HMI Mode | Modbus Address (Dec) | Modbus Address (Hex) | Access R/W | Notes |
|---|---|---|---|---|---|
| Alarm 1 Value | Alarms | **1402** | 57A | R/W | Alarm 1 value. Limited by the input span |
| Alarm 1 Type | Outputs | **1400** | 578 | R/W | 0 = None (alarm not used)<br>1 = High Alarm<br>2 = Low Alarm<br>3 = Deviation<br>4 = Annunciator |
| Limit Startup Latch | Outputs | **1104** | 450 | R/W | 0 = Reset Latch (resets at power on)<br>1 = Always Latch (latches at power on)<br>2 = Last Latch (keep last state at power on) |
| Limit Value | Outputs | **1481** | 5C9 | R/W | The 'Exceed' value at which the limit output will trip. Settable within the input range. |
| Limit Type | Outputs | **1480** | 5C8 | R/W | 0 = High Limit Action, 1 = Low Limit Action |
| Linear Type | Outputs | **1140** | 474 | R/W | PV Retransmit<br>Possible types. Valid if linear output fitted.<br>0=0-5V<br>1=0-10V<br>2=2-10V<br>3=0-20mA<br>4=4-20mA<br>5=1-5V |
| Linear Output 3 Scale Maximum | Outputs | **1141** | 475 | R/W | PV value where retransmit output is at min level (e.g. 4mA if type is 4-20). Adjustable from -1999 to 9999 |
| Linear Output 3 Scale Minimum | Outputs | **1142** | 476 | R/W | PV value where retransmit output is at max level (e.g. 20mA if type is 4-20). Adjustable from -1999 to 9999 |
| Output 3 Indicator Invert | Outputs | **1131** | 46B | R/W | 0 = Sync with output, 1 = Opposite to output (e.g. ON when output off) |
| Alarm 2 StartUp Latch | Outputs | **1134** | 46E | R/W | 0 = Reset Latch (resets at power on)<br>1 = Always Latch (latches at power on)<br>2 = Last Latch (keep last state at power on) |
| Output 3 Alarm Latching | Outputs | **1133** | 46D | R/W | 0 = Off, 1 = On (will latch on when active) |
| Output 3 Alarm Action | Outputs | **1132** | 46C | R/W | 0 = Direct, 1 = Reverse (off if alarm active) |
| Output 2 Indicator Invert | Outputs | **1121** | 461 | R/W | 0 = Sync with output, 1 = Opposite to output (e.g. ON when output off) |
| Alarm 1 Startup Latch | Outputs | **1124** | 464 | R/W | 0 = Reset Latch (resets at power on)<br>1 = Always Latch (latches at power on)<br>2 = Last Latch (keep last state at power on) |

| Parameter Name | HMI Mode | Modbus Address (Dec) | Modbus Address (Hex) | Access R/W | Notes |
|---|---|---|---|---|---|
| Output 2 Alarm Latching | Outputs | **1123** | 463 | R/W | 0 = Off, 1 = On (will latch on when active) |
| Output 2 Alarm Action | Outputs | **1122** | 462 | R/W | 0 = Direct, 1 = Reverse (off if alarm active) |
| Output 1 Indicator Invert | Outputs | **1101** | 44D | R/W | 0 = Sync with output, 1 = Opposite to output (e.g. ON when output off) |
| Limit Output 1 Latching | Outputs | **1103** | 44F | R/W | 0 = Off, 1 = On (will latch on when active) |
| | | | | | |
| Parity | Communications | **1501** | 5DD | R/W | 0 = None, 1 = Even, 2 = Odd |
| Baud Rate | Communications | **1502** | 5DE | R/W | 0 = 1200 bps<br>1 = 2400 bps<br>2 = 4800 bps<br>3 = 9600 bps<br>4 = 19200 bps<br>5 = 38400 bps |
| Modbus Address | Communications | **1500** | 5DC | R/W | Unique instrument network address from 1 to 255 |
| | | | | | |
| Selected Language | Display | **1828** | 724 | R/W | Language selection. 0 = English, 1 = The installed alternative language |
| Alterative Language | Display | **1808** | 710 | RO | The Installed alternative language. 0 = German, 1 = English, 2 = French |
| Screen Timeout | Display | **1830** | 726 | R/W | 0 = 5mins, 1 = 15mins & 2 = 30mins without keypress before timeout |
| Advanced Lock Code | Display | **1803** | 70B | R/W | The password to enter the Advanced Menu 0 = Off, or 1 to 9999 |
| Setup Lock Code | Display | **1804** | 70C | R/W | The password to enter the Setup Menu 0 = Off, or 1 to 9999 |
| | | | | | |
| DOM | Information | 505 | 1F9 | RO | Encoding e.g. 0403 for April 2003 is returned as 193 hex. |
| Serial Number formed of aaaa bbbb cccc (12 BDC digits): | | | | | |
| Serial Number High | Information | 504 | 1F8 | RO | First four digits, aaaa, bits 32-47 |
| Serial Number Mid | Information | 503 | 1F7 | RO | Middle four digits, bbbb, bits 16-31 |
| Serial Number Low | Information | 502 | 1F6 | RO | Last four digits, cccc, bits 0-15 |
| PRL | Information | 506 | 1FA | RO | Formatted as high byte hardware number as integer [0-99], low byte ascii character [A-Z] for software. |
| Firmware Type Low | Information | 65451 | FFAB | RO | (e.g. 227E). Returned as ascii |
| Firmware Type High | Information | 65450 | FFAA | RO | (e.g. 227E). Returned as ascii |
| Firmware Version High | Information | 65458 | FFB2 | RO | (e.g. 10p12). Returned as ascii |
| Firmware Version Mid | Information | 65457 | FFB1 | RO | (e.g. 10p12). Returned as ascii |

| Parameter Name | HMI Mode | Modbus Address (Dec) | Modbus Address (Hex) | Access R/W | Notes |
|---|---|---|---|---|---|
| Firmware Version Low Mid | Information | **65456** | FFB0 | RO | (e.g. 10p12). Returned as ascii |
| Firmware Version Low | Information | **65455** | FFAF | RO | (e.g. 10p12). Returned as ascii |
| Communications Option (RS485) | Information | **603** | 25B | RO | 0= Not Fitted, 1= Fitted. |
| Option 3 | Information | **602** | 25A | RO | 0= None, 1= Relay, 5=Linear |
| Option 2 | Information | **601** | 259 | RO | 0= None, 1=Relay, 3=SSR |
| Option 1 | Information | **600** | 258 | RO | 1= Relay as fixed output for Option 1. |
| Supply Voltage | Information | **511** | 1FF | RO | 0= 240V, 1= Low Voltage |
| Variant | Information | **510** | 1FE | RO | 1= Standard, 0= Extrusion, 2= Limit |
| Digital Input | Information | **509** | 1FD | RO | 0= Non-isolated, 1= Isolated. |

# 17 Specifications

| | |
|---|---|
| **Universal Input** | |
| Thermocouple calibration: | ±0.25% of full range, ±1LSD & ±1°C for Thermocouple CJC.<br>BS4937, NBS125 & IEC584. |
| PT100 calibration: | ±0.25% of full range, ±1LSD.<br>BS1904 & DIN43760 (0.00385Ω/Ω/°C). |
| DC Calibration | ±0.25% of full range, ±1LSD. |
| Sampling Rate: | 4 per second. |
| Impedance: | >1MΩ resistive, except dc mA (5Ω) and V (47kΩ) |
| Sensor Break Detection: | Thermocouple, RTD, 4 to 20mA, 10 to 50mV, 2 to 10V and 1 to 5V ranges only. Control outputs turn off when a sensor break is detected. Limiter versions go to Exceed condition. |
| **Digital Input (Isolation & Non-isolated version)** | |
| Functions: | Reset Alarm, Control Enable/Disable, Auto/Manual, Pre-Tune Start/Stop or Tune at SP Start/Stop.<br>Fixed function Reset Limit/Alarms only on limiter versions. |
| Signal: | Non-isolated - Open or Closed contacts only.<br>Isolated - Open (2 to 24Vdc) or Closed (< 0.8Vdc).<br>Closed to Open transition = **Reset, Enabled, Auto or Start.**<br><br>In addition, on Limiter model – Open on power up gives a **Reset** signal. |
| **Outputs (Isolation & Non-isolated version)** | |
| **Relays** | |
| Contact Type: | Output 1 (Limit on Limiter) – Form C SPDT, 2A @250vac, resistive.<br>Output 2 (Alarm 1 on Limiter) & Output 3 (Alarm 2 on Limiter) – Form A SPST relay, 2A @ 250Vac, resistive. |
| Lifetime: | >150,000 operations at rated voltage/current, resistive load. |
| **SSR Driver** | |
| Capacity: | SSR drive voltage >10Vdc at 20mA |
| **Linear Output** | |
| Linear Types: | 0 to 20mA, 4 to 20mA, 0 to 5V, 0 to 10V or 2 to 10V |
| Load Resistance: | Current Output 500Ω max, Voltage Output 500Ω min. |
| Resolution: | 8 bits in 250ms (10 bits in 1s typical, >10 bits in >1s typical). |

| Serial Communications (RS485 – Modbus RTU) | |
|---|---|
| The rear bus connection and top RS485 connection are not intended for use at the same time. | |
| Data Rate: | 1200, 2400, 4800, 9600, 19200 or 38400 bps. |
| Parameter Defaults: | Address:1 Baud Rate: 9600 Parity: None. |
| Please refer to Modbus Addresses section for more information. | |
| **Operating Conditions** | |
| Usage: | For indoor use only. Din-Rail mounted in a suitable enclosure. |
| Relative Humidity: | 20% to 95% non-condensing. |
| Operating Temperature: | <95% humidity 0°C to 55°C |
| Storage Temperature: | <95% humidity –10°C to 80°C |
| Altitude: | < 2000m |
| Power Supply: | Mains power version - 100 to 240Vac ±10%, 50/60Hz, 9VA<br>Low voltage version - 24Vac +10/-15% 50/60Hz 9VA or 24Vdc +10/-15% 5W. |
| **Environmental** | |
| Standards: | CE, UL & cUL. FM 3545 applies to the Limiter model only. |
| EMI: | EN61326-1:2013, Table 2 & Class A. |
| ***WARNING: This is a Class A product. In a domestic environment, this product may cause radio interference in which case the user may be required to take adequate measures.*** | |
| Safety: | UL61010-1 Edition 3 & EN61010 Version 2010, Pollution Degree 2 & Installation Class 2. |
| Protection Rating: | IP20 |
| **Physical** | |
| Unit Size: | Height: 99mm; Width: 22.5mm; Depth: 121mm. |
| Ventilation: | 80mm free space required above and below each unit. |
| Weight: | 0.20kg maximum. |

# 18 Glossary

This Glossary explains the technical terms and parameters used in this manual. The entry type is also shown:

## Actual Setpoint

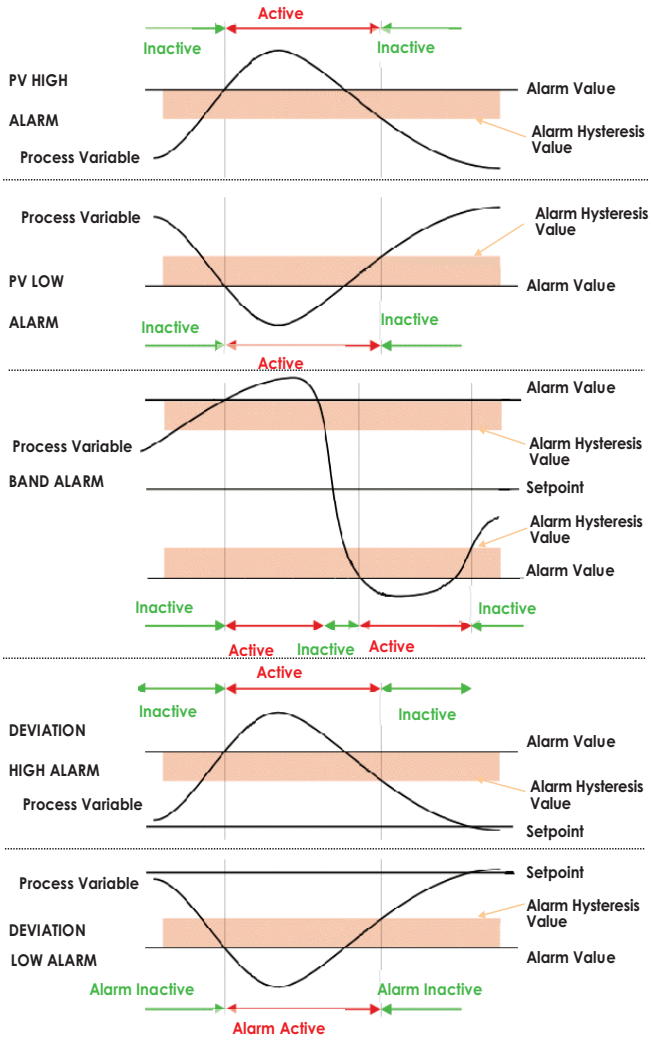
Actual Setpoint is the current **effective value** of the Setpoint. This will be different to the target value of the setpoint if it is currently ramping. The actual setpoint s rises or falls at the ramp-rate set, until it reaches the target Setpoint value.

*Also refer to Active Setpoint, Setpoint, Setpoint Ramp Enable and Setpoint Select*

## Alarm Hysteresis

An adjustable band on the “safe” side of an alarm point, through which the process variable must pass before the alarm will change state, as shown in the diagram below.

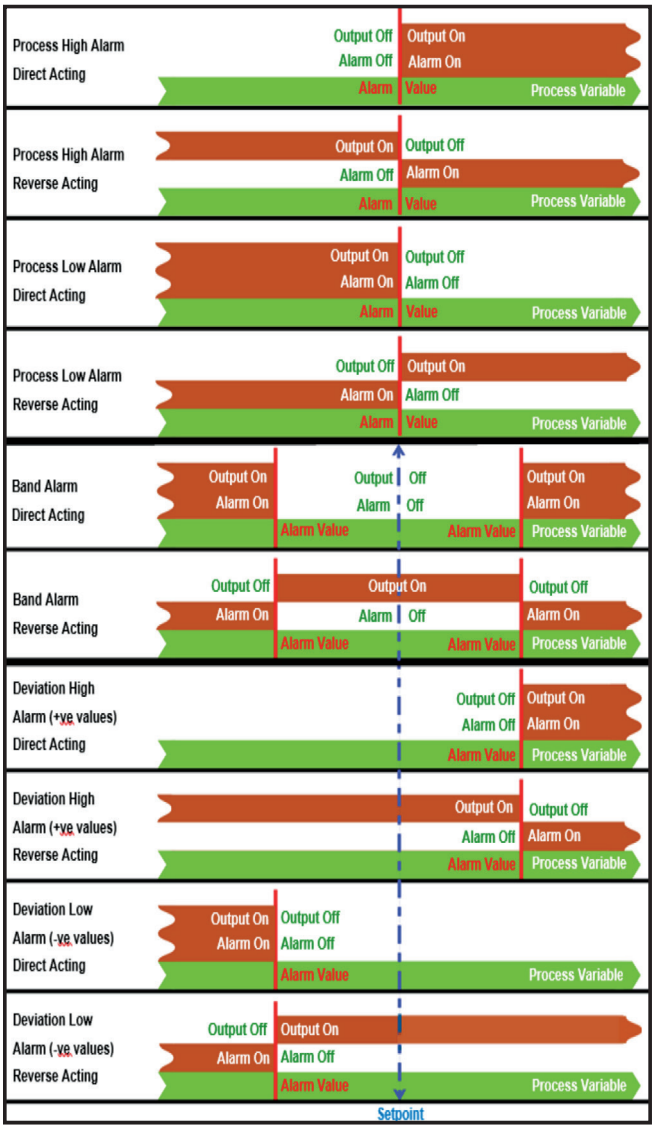
*Also refer to Alarm Operation*




## Alarm Operation

The different alarm types are shown below, together with the action of any outputs.

*Also refer to Alarm Hysteresis, Alarm Inhibit, Band Alarm, Deviation Alarm, Latching Relay, Logical Alarm Combinations, Loop Alarm, Process High Alarm and Process Low Alarm*



## Alarm Inhibit

Inhibits an alarm at power-up or when the controller setpoint is changed, until that alarm would become inactive. The alarm operates normally from that point onwards.

Note that on the Limiter there is a similar function called Start Up Inhibit which is applicable only at power up, not when the limit setpoint is changed.

*Also refer to Alarm Operation.*

## Automatic Reset (Integral time)

Used to automatically bias proportional control output(s) to compensate for process load variations. It is adjustable in the range 1 seconds to 99 minutes 59 seconds per repeat and OFF Decreasing the time increases Integral action. This parameter is not available if the primary output is set to On-Off.

*Also refer to Heat Proportional Band, Cool Proportional Band, Rate, and Tuning.*

## Auto-Tune

*Refer to Pre-Tune and Tune at Setpoint.*

## Band Alarm Value

*Refer to Alarm Operation.*

## Basic Setpoint Control

When Basic Setpoint Control is enabled the user can only change the set point or the Auto/Man power from the User mode screen. To change other settings the user must enter the Advanced Configuration Mode. The parameter to enable/disable Basic Setpoint Control is in the Display menu.

## Bias (Manual Reset)

Used to manually bias the proportional output(s) to compensate for process load variations. Bias is expressed as a percentage of output power, and is adjustable in the range 0% to 100% (for Heat or Cool outputs alone) or -100% to +100% (for both Heat and Cool Outputs). This parameter is not applicable if the primary output is set to ON-OFF control mode. If the process settles below setpoint use a higher Bias value to remove the error, if the process variable settles above the setpoint use a lower value. Lower Bias values also help to reduce overshoot at process start up.

*Also refer to ON/OFF Control.*

## Bumpless Transfer

A method used to prevent sudden changes to the output power level when switching between automatic and manual control modes. During a transition from automatic to manual, the initial Manual Power value is set equal to the previous automatic mode value. The user then adjusts as required.

During a transition from Manual to Automatic, the initial Automatic Power value is set to equal the previous manual value. The correct power level is gradually applied by the control algorithm at a rate dependant on the integral action (see Automatic Reset). Since integral action is essential to Bumpless Transfer, this feature is not available if Automatic Reset is turned off.

*Also refer to Automatic Reset (Integral time) and Manual Mode.*

## Calibration - 2 Point (High/Low PV Offset)

Two-point calibration uses two separate points of reference, usually at the process high and low operating limits, to determine the required offsets. These offsets are used to rescale all readings over the full range of the controller minimizing inaccuracies in the input reading. See the User Calibration section.

*Also refer to Calibration - Single Point (PV Offset) , Input Span & Span and Process Variable.*

## Calibration - Single Point (PV Offset)

Single point calibration uses one point of reference, usually set at a critical process operating value, for the required calibration offset. This offset is applied to all measurements across the input span. See the User Calibration section.

This can be used to compensate for errors in the displayed process variable. Positive values are added to the process variable reading, negative values are subtracted, so MUST be used with care. Incorrect use could cause the displayed value not to show the actual process value.

*Also refer to Calibration - 2 Point (High/Low PV Offset), Input Span & Span and Process Variable.*

## Control Type

In the Out 1, Out 2 and Out 3 parameters to set the direction of output increase/decrease vs the movement of the process. Heat is reverse acting, Cool is direct acting (e.g. cooling output in-creases when the temperature rises).

*Refer to Heat Proportional Band, and Cool Proportional Band.*

## Controller

An instrument that can control a process, using either PID or On-Off control methods. Alarm outputs are also available, as are other options and Serial Communications.

*Refer to Alarm Operation, Limit Controller, On-Off Control, and Serial Communications.*

## Cool Proportional Band

The Cool Proportional Band is only applicable when a Cool Output is used. It is the portion of the input span over which the Cool Output power level is proportional to the process variable value. Adjustable in input units' equivalent to 0.5% to 999.9% of span (zero = On-Off control). The Control action for the Cool outputs is direct acting.

*Refer to Control Type, On-Off Control, Heat Proportional Band and Tuning.*

## Cycle Time

For time-proportioning outputs, cycle time is used to define the time over which the average ON vs. OFF time is equal to the required PID output level. The range of values is 0.1 to 512 seconds in 0.1s steps. Shorter cycle times will give better control, but at the expense of reduce life when used with an electromechanical control device (e.g. relays or solenoid valves).

*Also refer to Time Proportioning.*

## Deadband

*Refer to Overlap/Deadband.*

## Derivative

*Refer to Rate.*

## Deviation Alarm

*Refer to Alarm Operation.*

## Heat or Cool Output Power Limits

Used to limit the power level for heating or cooling to protect the process or heaters. Adjustable from 0% to 100%. This parameter is not applicable if the primary output is set for On-Off control.

*Also refer to On-Off Control.*

## Heat Proportional Band

The Heat Proportional Band is only applicable when a Heat output is used. It is the portion of the input span over which the Heat Output power level is proportional to the process variable value. Adjustable in input units' equivalent to 0.5% to 999.9% of span (zero = On-Off control). The Control action for the Heat outputs is reverse acting.

*Also refer to Control Type, On-Off Control, Cool Proportional Band, and Tuning*.

## Input Filter Time

Used to filter out extraneous impulses ("noise") on the process input. The filtered PV is used for all PV-dependent functions (display, control, alarm etc). The time constant is adjustable from 0.0 seconds (off) to 100.0 seconds in 0.5 second increments.

*Also refer to Process Variable.*

## Input Range and Input Span

The Input Range is the overall non-restricted range as determined by the Type parameter in the input menu.

The Input Span (or Scaled Range) is the limited working range set by the upper and lower limits in the input menu. The input span is used as the basis for calculations that relate to the span of the instrument (e.g. controller proportional bands).

*Also refer to Scale Range Lower and Scale Range Upper.*

## Limit Controller

A protective device that can shut down a process at a pre-set Exceed Condition, to prevent possible damage to equipment or products. They are recommended for any process where product or equipment damage might occur, or if it could become hazardous under fault conditions.

## Loop Alarm

This is a special alarm, to detect problems with the control feedback loop. It continuously monitors the process response to the control output.

If control is at the maximum or minimum limit (0% or 100% for single Heat or Cool output and -100% & +100% for dual Heat and Cool outputs), an internal timer starts. If the process variable is not moved in the expected direction by a predetermined amount 'V' after time 'T' has elapsed, the loop alarm becomes active.

Only when the process has moved by "V", or when the output is no longer at the limit, does the loop alarm deactivate.

*If the heat or cool power limits are less than 100% the limited value is used as the maximum. E.g. if the limit is 70%, the timer begins at 70%.

For PID control, the loop alarm time 'T' is always twice the Automatic Reset (Integral) parameter value. For On-Off control, a user defined value for the Loop Alarm Time parameter is used.

The value of 'V' is dependent upon input type. For temperature inputs, V = 2°C or 3°F. For linear inputs, V = 10 least significant display units.

Correct operation of the loop alarm depends upon reasonably accurate PID tuning. The loop alarm is automatically disabled during manual control mode and during automatic tuning.

*Also refer to Manual Mode, On-Off Control, and Process Variable.*

## Manual Mode

If manual mode is selected from operator mode (if enabled), via the digital input or serial comms, the PID algorithm is suspended. It must therefore be used with care, because the controller is no longer in control of the process. The operator must maintain the process at the required value, by adjusting the % power output value.

In Manual mode, the display shows the current process value as normal, but the setpoint is replaced with the % output power. This value may be adjusted using keypad, between 0% to 100% for controllers using Heat control only, and -100% to +100% for controllers using dual Heat and Cool control.

Switching between automatic and manual modes is achieved using bumpless transfer.

**Note:** Manual power is not limited by the power output limits.

*Also refer to Bumpless Transfer, and Heat/Cool Output Power Limit.*

## Master & Slave

The terms master & slave are used to describe the controllers in applications where one instrument controls the setpoint of another. The master controller (e.g. a profile controller) transmits a setpoint to 1020 using RS485 serial communications (analog signals cannot be used because 1020/1030 does not have a remote setpoint input option). 1020/1030 cannot act as a Master.

*Also refer to Serial Communications and Setpoint*

## On-Off Control

On-Off control mode, the output(s) turn on or off as the process variable crosses the setpoint just like a home heating thermostat. Some oscillation of the process variable is inevitable with On-Off control.

On-Off control is enabled by setting the corresponding proportional band(s) to Off (zero). It can be assigned to the Heat output alone (Cool output not present), Heat and Cool outputs or Cool output only (with the Heat Output set for time proportional).

*Also refer to Heat Proportional Band, Cool Proportional Band, On-Off Differential, Setpoint and Time Proportioning Control.*

## On-Off Differential (Hysteresis)

A switching differential, centred about the Setpoint, when one or both control outputs have been set to On-Off. It is adjustable from 0.1% to 10.0% of input span, entered in display units.

Relay chatter can be eliminated by proper adjustment of this parameter, but larger values do increase amplitude of process oscillations.

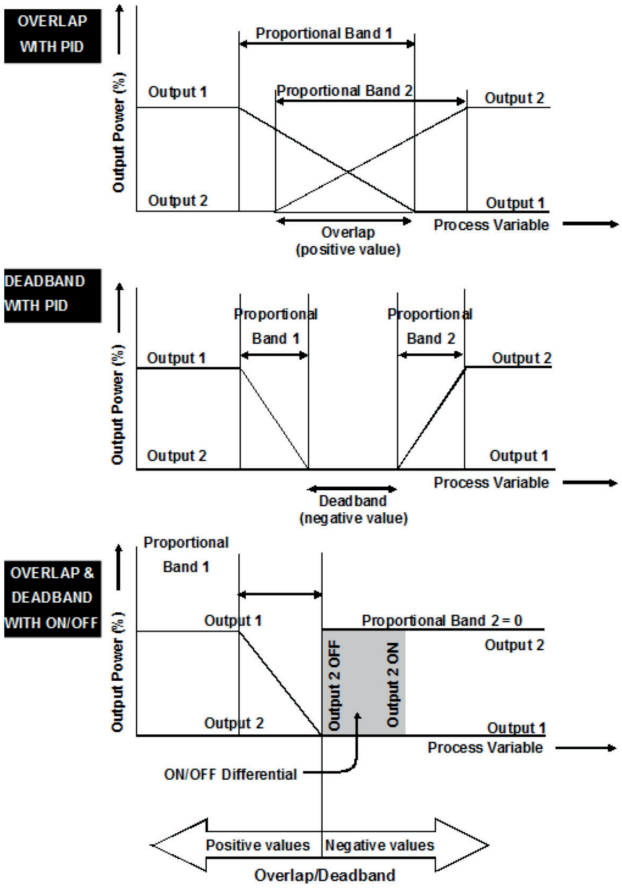
*Also refer to Input Range and Input Span and On-Off Control.*

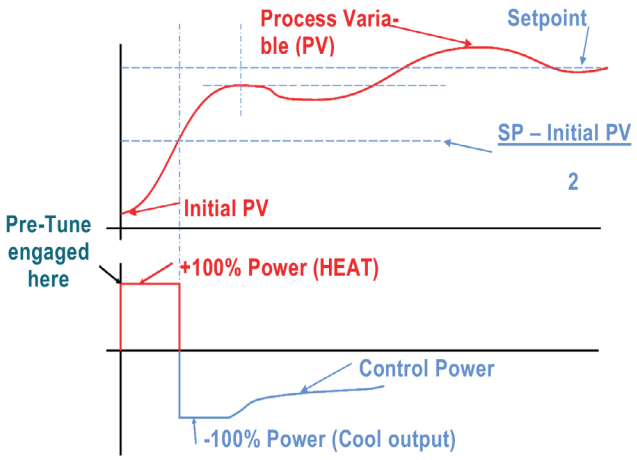
## Overlap/Deadband

Defines the portion of the Heat and Cool proportional bands over which both outputs are active (Overlap), or neither is active (Deadband). It is set in display units, within a range of -20% to +20% of the sum of the two proportional bands (e.g. If Heat PB is 3 and Cool PB is 2, their sum is 5, and ±20% is -1 to +1). Positive + values = Overlap, Negative - values = Deadband.

If the Cool Output is set for On-Off, this parameter moves the Differential band of the Cool Output to create the overlap or deadband. When Overlap/Deadband = 0, the "OFF" edge of the Cool Output Differential band coincides with the point at which the Heat Output = 0%. ).

*Also refer to Differential, On-Off Control, Heat Proportional Band and Cool Proportional Band.*




## PID Control

Proportional Integral and Derivative control maintains accurate and stable levels in a process (e.g. temperature control). It avoids the oscillation characteristic of On-Off control by continuously adjusting the output to keep the process variable stable at the desired Setpoint.

*Also refer to Automatic Reset, Controller, Manual Mode, On-Off Control, PI Control, Heat Proportional Band, Process Variable, Rate, Cool Proportional Band, Setpoint and Tuning*

## Pre-Tune

Starting with the load cool*, Pre-Tune disturbs the process start-up pattern, so that the PID values are calculated before the setpoint is reached.

During Pre-Tune, the controller outputs full Heat Power until the process value has moved approximately halfway to the Setpoint. At that point, power is removed (or full Cool Power with dual control), thereby introducing a process oscillation. Once the oscillation peak has passed, the instrument calculates the PID tuning terms: proportional band(s), automatic reset and rate. Normal PID control operation begins using these calculated values, and Pre-Tune automatically disengages.

*Ideally the Tune program should be used when the load temperature is close to ambient.

Care should be taken to ensure that any overshoot is safe for the process and if necessary tune at a lower setpoint.

Pre-Tune will not engage if either Heat or Cool outputs on a controller are set for On-Off control, the controller is set to Manual, during Setpoint ramping, or if the process variable is less than 5% of the input span from the Setpoint. Refer to the Automatic Tuning section for further details.

*Also refer to Automatic Reset, On-Off Control, Input Span, PID, Heat Proportional Band, Process Variable, Rate, Cool Proportional Band, Setpoint, Setpoint Ramping and Tuning.*

## PV High Alarm Value

*Refer to Alarm Operation.*

## PV Low Alarm Value

*Refer to Alarm Operation.*

## Process Variable (PV)

Process Variable is the signal measured by the primary input. The PV can be anything that can be converted into a compatible electronic signal. Common types are Thermocouple or PT100 temperature probes, %RH or pressure etc. from transducers that convert them to linear dc signals (e.g. 4 to 20mA). These signals are scaled into engineering units using the Scale Range Lower Limit and Scale Range Upper Limit parameters.

*Also refer to Input Range & Span, Scale Range Lower Limit and Scale Range Upper Limit.*

## Rate (Derivative)

Rate is adjustable from 0 (OFF) to 99 minutes 59 seconds. It defines how the control output responds to the rate of change in the process. Rate is not available in On-Off.

*Also refer to On-Off Control, PID, Process Variable and Tuning.*

## Reset / Integral

*Refer to Automatic Reset.*

## Reverse Acting

*Refer to Direct/Reverse Action of Control Output*

## Scale Range Maximum

For linear inputs, this parameter is used to scale the process variable into engineering units. It defines the displayed value when the process variable input is at its maximum value. It is adjustable from -1999 to 9999 and can be set to a value less than (but not within 100 units of) the Scale Range Lower Limit, in which case the sense of the input is reversed.

For thermocouple and RTD inputs, this parameter is used to reduce the effective range of the input. All span related functions work from the trimmed input span. The parameter can be adjusted within the limits of the Input Range selected. It is adjustable to within 100 degrees of the Scale Range Lower Limit.

*Also refer to Input Range & Span, Process Variable and Scale Range Lower Limit.*

## Scale Range Minimum

For linear inputs, this parameter can be used to display the process variable in engineering units. It defines the displayed value when the process variable input is at its minimum value. It is adjustable from -1999 to 9999 and can be set to a value more than (but not within 100 units of) the Scale Range Upper Limit, in which case the sense of the input is reversed.

For thermocouple and RTD inputs, this parameter is used to reduce the effective range of the input. All span related functions, work from the trimmed span. The parameter can be adjusted within the limits of the Input Range selected. It is adjustable to within 100 degrees of the Scale Range Upper Limit.

*Also refer to Input Range & Span, Process Variable and Scale Range Upper Limit.*

## Serial Communications Option

A feature that allows devices such as PC's, PLC's or a master controller to read or change an instrument's parameters via a communications link. 1020 & 1030 Controllers optionally support RS485 Modbus RTU communications as a factory fitted option, in addition to the front configuration port.

*Also refer to Controller, Indicator, Master & Slave and Limit Controller.*

## Setpoint

The target value at which a controller will attempt to maintain the process by adjusting its power output level. Setpoints can be adjusted between the Setpoint Upper Limit and Setpoint Lower Limits.

*Also refer to Limit Setpoint, Process Variable, and Setpoint Upper & Lower Limits*

## Setpoint Upper Limit and Setpoint Lower Limit

The maximum and minimum values allowed for setpoint adjustments. Set as required to prevent the process going too high or low. Setting both limits to the same value locks the setpoint at that value.

The adjustment range for Setpoint Upper Limit is between current Setpoint and Scale Range Maximum. The value cannot be moved below the current value of the Setpoint.

The adjustment range is between Scale Range Lower Limit and current Setpoint. The value cannot be moved above the current value of the Setpoint.

*Also refer to Scale Range Lower Limit, Scale Range Upper Limit and Setpoint*

## Ramp Rate

The rate at which the actual effective setpoint value moves towards its target value, when the Setpoint is adjusted. With ramping in use, the initial value of the actual Setpoint at power up, enabling control or when switching back to automatic mode from manual control, is equal to the current process variable value. The Actual Setpoint will rise/fall at the ramp rate set, until it reaches the target Setpoint value.

Setpoint ramping is used to protect the process from sudden changes in the Setpoint, which would result in a rapid rise in the process variable. If the setpoint is changed controller attempts to follow at the predefined ramp rate until the new setpoint is reach.

*Also refer to Actual Setpoint, Manual Mode and Setpoint.*

## Solid State Relay (SSR)

An external device manufactured using Silicone Controlled Rectifiers, which can be used to replace mechanical relays in most AC power applications. As a solid-state device, an SSR does not suffer from contact degradation when switching electrical current. Much faster switching cycle times are also possible, leading to superior control. 1020 optional SSR Driver outputs give time-proportioned 10Vdc pulses, which causes conduction of current to the load when the pulse is on.

*Also refer to Cycle Time and Time Proportioning Control.*

## Solenoid Valve

An electro-mechanical device to control gas or liquid flow. It has two states, open or closed. Typically, a spring holds the valve closed until current passes through the solenoid coil, forcing it open. Standard Process Controllers with Time Proportioned outputs are used to control solenoid valves.

Solenoid valves are often used with high/low flame gas burners. A bypass supplies some gas at all times, but not enough to heat the process more than a nominal amount (low flame). The controller output opens the valve when the process requires additional heat (high flame).

## Time Proportioning Control

This type of control can be used with electrical contactors, Solid State Relays or valves whenever Relay or SSR Driver outputs are used for either primary (Heat) or secondary (Cool) control.

Time-proportioning control is accomplished by cycling the output on and off during the prescribed cycle time, whenever the process variable is within the proportional band. The control algorithm determines the ratio of time (on vs. off) to achieve the level of output power required to correct any error between the process value and Setpoint. E.g. for a 32 second cycle time, 25% power demand would result in the output turning on for 8s, then off for 24s.

*Also refer to Cycle Time, PID, Heat Proportional Band, Process Variable, Cool Proportional Band, Setpoint and SSR.*

## Tuning PID

PID Controllers must be tuned to the process for them to maintain optimum control. Adjustment is made to the tuning terms either manually, or by using the controller's automatic tuning facilities. Tuning is not required if the controller is configured for On-Off Control.

*Also refer to Automatic Reset, Cool Proportional Band, Heat Proportional Band, ON-OFF control, PID, Pre-Tune, Rate and Tune at Setpoint.*

## Tune at Setpoint

This automatic tuning method can be used if Pre-Tune cannot to run, because the current process temperature is too close to the target setpoint.

Tune at SP is activated via the Setup or Advanced Configuration menus. It can also be activated via the Digital Input or a Modbus command. It works by waiting for the process to "line-out" (approximately stable), then adds a pulse to the control output to cause a small process disturbance. This disturbance is analyzed to establish the correct PID tuning terms for the application – see below.

The message 'TUNE' is displayed whilst Tune at SP is running. The 'TUNE' notification ends when the tuning is complete.

Tune at Setpoint will not engage, and a Tune Error message will be displayed if:
1). There is a sensor break
2). A setpoint ramp has been set
3). A Timer is running
4). Control is Disabled
5). The current control mode is On-OFF). The controller is in Manual mode.

If you have defined outputs for heating and cooling, Tune at SP is not offered in the tuning menu. Instead use Pre-Tune.

## Running Tune at Setpoint from Automatic Control

It is important to set Scale Range Maximum and Scale Range Minimum correctly before tuning, Also, because Tune at SP needs a reasonable level of process stability to run, it is recommended to set the initial PID values in the Control menu back to their default values. See the Automatic Tuning section for further information.

1. Activate Tune at SP.
2. When Tune at SP begins, the controller carries out a “steady state estimation”. It waits until the process has achieved reasonable stability (±1% of span & max control power variation ±10)% for 5 minutes.
3. After 5 minutes of stability (see T0 below) the Pulse response evaluation is carried out.

A “power pulse” is applied that reduces the current control power by -20% (except if the current power is already 20% or less, when a positive +20% power pulse is applied instead).

4. The power pulse is maintained until the process responds by 1% of span (see T1 below). E.g. falling by 1% if the power pulse was negative, or rising if the pulse was positive.
5. The 20% pulse is removed, returning the power to the value just before T0.

The process will continue to its maximum deflection, and returns towards the original value.

6. The controller notes the time taken to recover 0.15% of span, then waits for the recovery to reach 0.3% (see T2 and T3 below) before using the pulse response deflection and the time T3 - T2 to calculate new PID terms.

**Note:** The time tuning takes to complete will vary from process to process.

*Also refer to Automatic Reset, Cool Proportional Band, Heat Proportional Band, ON-OFF control, PID, Pre-Tune, Rate and Tuning.*

# 19 Order Tables

**20 Series DIN Rail Over Temperature Controller**

**1020** DIN Rail Mountable Temperature Controller. Standard Features: Universal Input, PID or On/Off Control with Auto or Manual Tuning, Up to 3 Outputs (SSR Drive, Relay or Analog/DC Linear), Bright LED text/Icon Display, Heat/Cool Operation, Digital Input, Latching/Non-Latching Alarms and Configuration via Front Panel or Software. Options: ModBus RTU/RS485 Digital Communications, Low Voltage Supply. Operating Temperature: 32°-131°F (0°-55°C), IEC IP20 Enclosure Protection. CE, UL, CUL & 2-Year Warranty

| Code | Output 1 |
|---|---|
| **S** | SSR Drive (>10VDC @ 20mA) |
| **R** | Relay (SPDT, Form C, 2A at 250VAC) |

| Code | Output 2 |
|---|---|
| **S** | SSR Drive (>10VDC @ 20mA) |
| **R** | Relay (SPST, Form A, 2A at 250VAC)[1] |

| Code | Output 3 |
|---|---|
| **0** | None |
| **R** | Relay (SPST, Form A, 2A at 250VAC) |
| **A** | Analog (Linear DC: 0/4-20mA, 0-5V, 0/2-10V) |

| Code | Digital Communications |
|---|---|
| **0** | None |
| **1** | Modbus RTU/RS485 Digital Communications |

| Code | Power Supply |
|---|---|
| **0** | 100 to 240VAC 50/60Hz |
| **1** | 24VDC/VAC +10%/-15%, AC 50/60Hz |

| | | | | | | |
|---|---|---|---|---|---|---|
| **1020** | **S** | **R** | **A** | **0** | **0** | **Typical Model Number** |

[1]Only available when Output 1 is Relay

## 30 Series DIN Rail Over Temperature Controller

**1030** DIN Rail Mountable Over Temperature Controller. Universal Input, Fixed Relay Output 1 with Up to 2 additional Alarms/Outputs (SSR Drive, Relay or Analog/DC Linear), Bright OLED Display, Digital Input, Latching/Non-Latching Alarms and Configuration via Front Panel or Software. Options: ModBus RTU/RS485 Digital Communications, Low Voltage Supply. Operating Temperature: 32°-131°F (0°-55°C), IEC IP20 Enclosure Protection. CE, UL, CUL & 2-Year Warranty

| Code | Output 1 |
|---|---|
| **1** | Relay - SPDT Form C, 2A at 250VA (Resistive) |

| Code | Alarm 1 / Output 2 |
|---|---|
| **S** | SSR Drive (>10VDC @ 20mA) |
| **R** | Relay (SPST, Form A, 2A at 250VAC) |

| Code | Alarm 2 / Output 3 |
|---|---|
| **0** | None |
| **R** | Relay (SPST, Form A, 2A at 250VAC) |
| **A** | Analog (Linear DC: 0/4-20mA, 0-5V, 0/2-10V) |

| Code | Digital Communications |
|---|---|
| **0** | None |
| **1** | Modbus RTU/RS485 Digital Communications |

| Code | Power Supply |
|---|---|
| **0** | 100 to 240VAC 50/60Hz |
| **1** | 24VDC/VAC +10%/-15%, AC 50/60Hz |

| | | | | | | |
|---|---|---|---|---|---|---|
| **1030** | **-** | **1** | **R** | **A** | **0** | **0** **Typical Model Number** |

**Limited Warranty:**
Please refer to the Chromalox limited warranty applicable to this product at
http://www.chromalox.com/customer-service/policies/termsofsale.aspx.

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