

1/16 & 1/32 DIN TEMPERATURE CONTROLLER MANUAL (59423-7)

MECHANICAL INSTALLATION

The Controllers are designed to be mounted either in a 1/16 or a 1/32 DIN panel cutout. The units are sleeve mounted with the front bezel assembly rated NEMA4/IP66 provided that:

- The panel is smooth and the panel cutout is accurate;
- The mounting instructions are carefully followed.

DIN PANEL CUTOUT

1/16 DIN: 45.0mm +0.6 / 0.0 wide, 45.0mm +0.6 / 0.0 high
Maximum panel thickness 9.5mm
Minimum spacing 20mm vertical, 10mm horizontal

1/32 DIN: 45.0mm +0.6 / -0 wide, 22.2mm +0.3 / -0 high

MOUNTING

To mount a Controller proceed as follows:

- 1 Check that the controller is correctly orientated and then slide the unit into the cutout.
- 2 Slide the panel clamp over the controller sleeve pressing it firmly against the panel until the controller is held firmly.
- 3 The controller front bezel and circuit board assembly can be unplugged from the sleeve. Grasp the bezel firmly by the recesses on each side and pull. A screwdriver can be used as a lever if required.
- 4 When refitting the bezel assembly it is important to press it firmly into the sleeve until the latch clicks in order to compress the gasket and seal to NEMA4X/IP66.

CLEANING

Wipe down with damp cloth (water only)
Note: The controller should be isolated before removing or refitting it in the sleeve, and electrostatic precautions should be observed when handling the controller outside the sleeve.

DIMENSIONS: MODELS

| Model | Bezel* | | Behind panel | | Overall length | Behind panel length* |
|----------------------|--------|--------|--------------|--------|----------------|----------------------|
| | Width | Height | Width | Height | | |
| 1/32 DIN – 48 x 24mm | 51.0 | 28.5 | 44.8 | 22.0 | 116.2 | 106.7 |
| 1/16 DIN – 48 x 48mm | 51.0 | 51.0 | 44.8 | 44.8 | 116.2 | 106.7 |

Dimensions in mm
* includes gasket

ELECTRICAL INSTALLATION (Also see important Safety Information)

OUTPUT DEVICES

Two of the following output devices are fitted to the controllers, depending on the model.

- 1) **Solid state relay drive (SSd/SSd1/SSd2)** 5Vdc +0/-15%, 15mA non isolating. To switch a remote SSR (or logic)
- 2) **Miniature power relay (rLY/rLY1)** 2A/250V AC resistive, Form A/SPST contacts.
- 3) **Sub miniature power relay (rLY2)** 1A/250V AC resistive, Form A/SPST contacts.

OUTPUT DEVICE ALLOCATION

Any of the available outputs may be chosen for the main setpoint (SP1), the remaining device being automatically allocated to the second setpoint (SP2).

Dual relay or dual SSd output models are available to order. Please contact your local distributor for details.

Designed for use with the following supply voltages:

- 1). 100 - 240V 50-60 Hz 4.5 VA (nominal) +/-10% maximum permitted fluctuation
- 2). 12V - 24V (AC/DC) +/-20% 4.5 VA Polarity not required

The supply voltage is dependant on the specific model, check the product label to establish the correct voltage for the unit.

WIRING THE CONNECTOR

Prepare the cable carefully, remove a maximum of 8mm insulation and ideally tin to avoid bridging. Prevent excessive cable strain. Maximum recommended wire size: 32/0.2mm 1.0mm₂ (18AWG).

INDUCTIVE LOADS

To prolong relay contact life and suppress interference it is recommended engineering practice to fit a snubber (0.1uF/100 ohms) between terminals 5 and 6.

CAUTION:Snubber leakage current can cause some electro-mechanical devices to be held ON.
Check with the manufacturers specifications.

UL61010-1 Edition 3 - /CSA 22.2 No 1010.1

- Compliance shall not be impaired when fitted to the final installation.
- Designed to offer a minimum of Basic Insulation only.
- The body responsible for the installation is to ensure that supplementary insulation suitable for Installation Category II or III is achieved when fully installed.
- To avoid possible hazards, accessible conductive parts of the final installation should be protectively earthed in accordance with UL61010-1 Edition 3 for Class 1 Equipment.
- Output wiring should be within a Protectively Earthed cabinet.
- Sensor sheaths should be bonded to protective earth or not be accessible.
- Live parts should not be accessible without the use of a tool.
- When fitted to the final installation, an IEC/CSA APPROVED disconnecting device should be used to disconnect both LINE and NEUTRAL conductors simultaneously.
- A clear instruction shall be provided not to position the equipment so that it is difficult to operate the disconnecting device.
- These products are intended for indoor use only.

SENSOR SELECTION

| Thermocouples | Description | Sensor Range | Linearity |
|----------------------------|-------------------|---------------|-----------|
| tC b | Pt-30% Rh/Pt-6%Rh | 0 to 1800°C | 2.0* |
| tC E | Chromel/Con | 0 to 600°C | 0.5 |
| tC J | Iron/Constantan | 0 to 800°C | 0.5 |
| tC K | Chromel/Alumel | -50 to 1200°C | 0.25* |
| tC L | Fe/Konst | 0 to 800°C | 0.5 |
| tC n | NiCrosil/NiSiI | -50 to 1200°C | 0.25* |
| tC r | Pt-13% Rh/Pt | 0 to 1600°C | 2.0* |
| tC s | Pt-10% Rh/Pt | 0 to 1600°C | 2.0* |
| tC t | Copper/Con | -200 to 250°C | 0.25 |
| Resistance Thermometer RTD | Pt100/RTD-2 | -200 to 400°C | 0.25* |

Linear process inputs (Input mV range: 0 to 50mV)
Displays 0 - 20mV 4 - 20mV setpoint limits

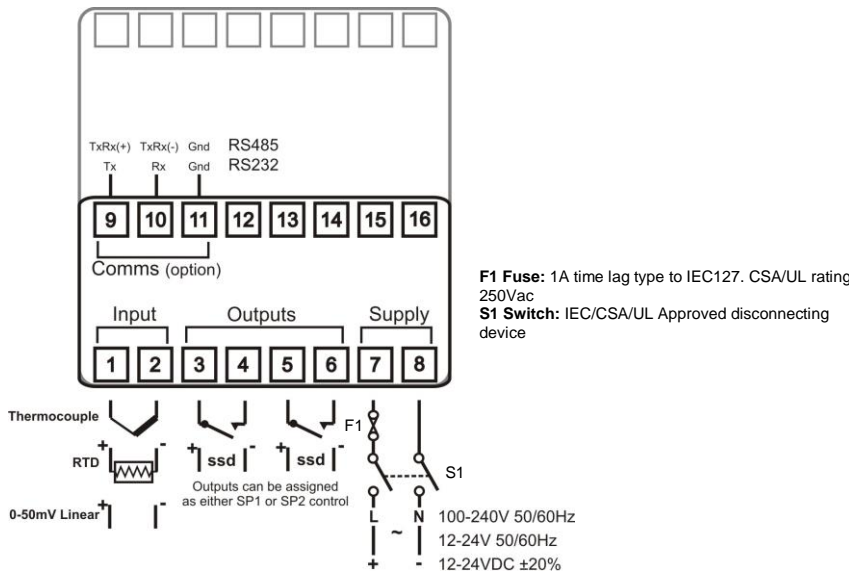
| | | |
|------|----------------------|--------|
| Lin1 | 0 - 100 0 – 400 | ± 0.5% |
| Lin2 | 0 - 100 -25 - 400 | ± 0.5% |
| Lin3 | 0 - 1000 0 - 3000 | ± 0.5% |
| Lin4 | 0 - 1000 -250 - 3000 | ± 0.5% |
| Lin5 | 0 - 2000 0 - 3000 | ± 0.5% |

Notes:

- 1 Linearity: 5-95% sensor range
- 2 * Linearity B:5° (70° - 500°C) K/N:1° >350°C exceptions: R/S: 5°<300°C T:1° <- -25° >150°C

RTD/Pt100: 0.5° <-100°C

CONNECTION DIAGRAM



SAFETY INFORMATION

INSTALLATION

Designed for use:
UL61010-1 Edition 3 / CSA 22.2 No 1010.1
To offer a minimum of Basic Insulation only.
Suitable for installation within Category II and III and Pollution Degree 2.
SEE ELECTRICAL INSTALLATION It is the responsibility of the installation engineer to ensure this equipment is installed as specified in this manual and is in compliance with appropriate wiring regulations.
Field wiring must be rated for a minimum of 70 deg C

CONFIGURATION

All functions are front selectable, it is the responsibility of the installing engineer to ensure that the configuration is safe. Use the program lock to protect critical functions from tampering.

ULTIMATE SAFETY ALARMS

Do not use SP2 as the sole alarm where personal injury or damage may be caused by equipment failure.

INSTRUMENT PANEL FEATURES



Green Display: Process temperature or program Function/Option
Orange Display: Setpoint temperature or program Option (Dual Display only)
Green LED: Setpoint 1 output indicator
Red/Orange LED: Setpoint 2 output indicator

ADJUSTMENTS

To enter or exit **program mode**: Press ▲ ▼ together for 3 seconds
To scroll through **functions**: Press ▲ or ▼
To change **levels** or **options**: Press * ▲ together or * ▼ together
To view setpoint: Press *
To increase setpoint: Press * ▲ together
To decrease setpoint: Press * ▼ together
To reset an alarm or fault condition: Press ▲ ▼ together briefly
Notes: If in difficulty by becoming "lost" in program mode, press ▲ and ▼ together for 3 seconds to return to display mode, check the INSTRUMENT ADJUSTMENTS above and try again.

When in program mode, after 60 seconds of key inactivity the display will revert to either **inPt : none** or, if the initial configuration has been completed, the measured value. Any settings already completed will be retained.

GETTING STARTED

After power-up the controller requires programming with the following information:

- **Type of Sensor**
- **Operating unit**
- **Allocation of Output Device to SP1/SP2 (Relay or SSd)**
- **Temperature Setpoint**

When the above information has been programmed into the controller it will be operational with the following factory settings.

| | |
|---------------------------------|---|
| Proportional band/Gain | 10°C/18°F |
| Integral time/Reset | 5 mins |
| Derivative time/Rate | 25 secs |
| Proportional cycle-time | 20 secs (Typical setting for relay output) |
| DAC Derivative approach control | 1.5 (Average setting for minimum overshoot) |

NOTE: The instruments covered in this manual may be fitted with either a single or a dual display. Where a single display shows more than one reading, it will alternate between them.

INITIAL SET-UP

On power-up the controller will display the self test sequence followed by the initial display **inPt : none**

- ① **Select input sensor.**
 - Press and hold * and use the ▲ or ▼ buttons to scroll through the sensor selection list until the correct sensor is displayed. Release the buttons. The display will now read selected sensor type e.g. **inPt : tCs**
 - Press ▲ once The display will now read **unit : none**
- ② **Select unit.**
 - Press and hold * and use the ▲ or ▼ buttons to scroll through the unit selection list until the correct unit is displayed. Release the buttons. The display will read selected unit e.g. **unit : °C**
 - Press ▲ once The display will now read **SP1.d : none**
- ③ **Select SP1 (Main setpoint output device)**

Note: Dual Relay and Dual SSd Output Options Models have their outputs pre-configured. Move to Step 4.

 - Press and hold * and use the ▲ or ▼ buttons to select **SSd** or **rLY** as required. The controller will now read selected output device e.g. **SP1.d : SSd**
- ④ **To enter initial configuration into controller memory**
 - Press and hold both ▲ and ▼ buttons for 3 seconds. The display will now read **ParK** and measured variable (temperature) (eg. 23) **ParK** is displayed because a setpoint has not yet been entered.
 - **To display setpoint**
Press and hold * The displays will now read **unit** (eg. °C) and 0
 - **To enter setpoint**
Press and hold * and use ▲ button to increase or ▼ button to decrease the reading and scroll to required setpoint value. (The digit roll-over rate increases with time).

THE CONTROLLER IS NOW OPERATIONAL WITH FACTORY SETTINGS

Note: For precise control of an application the controller may need to be TUNED. Please see the following section on AUTOTUNE

AUTOTUNE

This is a single shot procedure to match a controller to the process. Select either **Tune** or **Tune at Setpoint** from the criteria below.

The **Tune** program should be used when the load temperature is at or near ambient. The procedure will apply disturbances when the temperature reaches 75% of the setpoint value, causing overshoot which is monitored in order to adjust the **DAC** overshoot inhibit feature. Care should be taken to ensure that any overshoot is safe for the process.

The **Tune at Setpoint** program is recommended when:

- The process is already at setpoint and control is poor
- The setpoint is less than 100°C
- Re-tuning after a large setpoint change
- Tuning multi-zone and/or heat-cool applications.

Notes: **DAC** is not re-adjusted by Tune at setpoint.
Proportional Cycle Time can be pre-selected before running the Autotune program.

Hereafter the symbol (▲ ▼) signifies both buttons are held pressed for 3 seconds to ENTER or EXIT program mode.

TUNE OR TUNE AT SETPOINT PROGRAM

Enter program (▲ ▼) and from the display **tunE : oFF** press and hold * and press ▲ to display **tunE : on** or **tunE : At.SP**
Exit program mode (▲ ▼).

The **TUNE** program will now start. The display will show **tunE** as the process temperature climbs to setpoint.
Note: During tuning, the main setpoint (SP1) LED will flash.

When the **TUNE** or **TUNE AT SETPOINT** program is complete the PID values are entered automatically. The process temperature will rise to setpoint and control should be stable. If not, this may be because optimum cycle time is not automatically implemented. To set the cycle time see **PROPORTIONAL CYCLE-TIME**.

PROPORTIONAL CYCLE-TIME

The choice of cycle-time is influenced by the external switching device or load, eg. Contactor or SSR. A setting that is too long for a process will cause oscillation or a setting that is too short will cause unnecessary wear to an electro-mechanical switching device.

Factory set - To use the 20 sec factory set cycle-time no action is needed whether autotune is used or not.

To Manually Select AUTOTUNE Calculated CYCLE-TIME

When AUTOTUNE is completed, enter program (▲ ▼) and select **CYC.t** in **Level 1**. The display will read **CYC.t:20** (factory setting)
To view the new calculated optimum value, press and hold both * and ▼ buttons until indexing stops. The calculated value will be displayed eg. **A16**. If acceptable, exit program (▲ ▼) to implement this setting.

To Pre-select Automatic Acceptance of AUTOTUNE Calculated CYCLE-TIME

Before AUTOTUNE is initiated select **CYC.t** in **Level1**, press and hold both * and ▼ buttons until indexing stops at **A --**. Exit program (▲ ▼) to accept calculated value automatically.

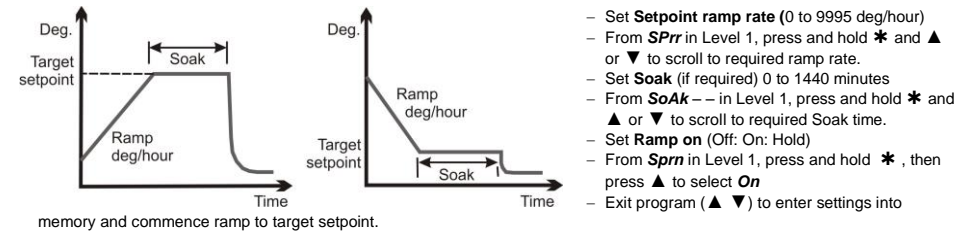
To Manually Pre-select Preferred CYCLE-TIME

Before AUTOTUNE is initiated select **CYC.t** in **Level 1**, press and hold both * and ▲ or ▼ buttons until indexing stops at preferred value then exit program (▲ ▼) to accept.

| CYCLE-TIME RECOMMENDATIONS | | |
|--|-----------------|---------------------|
| Output device | Factory setting | Recommended minimum |
| Internal relay : rLY / rLY1 / rLY2 | 20 seconds | 10 seconds |
| Solid state drives : SSd / SSd1 / SSd2 | 20 seconds | 0.1 seconds |

PROGRAMMER - RAMP-SOAK

This feature enables the controller to ramp up or down from current temperature to a target setpoint at a pre-determined rate. It then controls at the target setpoint for an adjustable soak period before switching off the SP1 output.



Notes:

- In **Ramp on** configuration, if power is removed from the controller, the Ramp will re-start when power is restored.
- The **Ramp hold** option suspends the ramp at its last value.
- If no **Soak** period has been set, control at target setpoint continues indefinitely.
- SP2 deviation alarms follow the ramp setpoint and can be used to alarm "out of limits" ramp rate.

WARNING: The Soak timer is triggered when the ramp setpoint reaches the target setpoint. If the ramp rate is set too fast for the process, the Soak timer will be triggered before the process temperature reaches the target setpoint.

SECOND SETPOINT (SP2)

SECOND SETPOINT (SP2) Alarm Output
Configure SP2 output to operate as an alarm from **SP2.A** in Level 2 and set the temperature alarm setting in **SEt.2** Level 1. The alarm will be triggered when the process temperature changes according to the options listed below.

dV.hi Rises above the main setpoint by the value inserted at **SEt.2**.
dV.Lo Falls below the main setpoint by the value inserted at **SEt.2**.
Band Rises above or falls below the main setpoint by the value inserted at **SEt.2**.
FS.hi Rises above the main setpoint by a **SEt.2** value that is greater than the setpoint.
FS.Lo Falls below the main setpoint by a **SEt.2** value that is smaller than the setpoint.

SUBSIDIARY SP2 MODE
The following additional alarm functions can be added to the above alarm configurations using the features found in **SP2.b** in Level 2

LtCh Once activated, the alarms will latch and can be manually reset when the alarm condition has been removed.
Hold This prevents any alarm operation on power-up and is automatically disabled once the process reaches setpoint in order to allow normal alarm operation.
Lt.ho Combines the effects of both **LtCh** & **Hold** and can be applied

SECOND SETPOINT (SP2) Proportional control output
Configure in **Level 1** using **CyC.2** to select proportional cycle time and **bnd.2** to adjust proportioning band.
- For Heat/Cool operation see full operating manual.
- In on/off mode, bnd.2 adjusts SP2 hysteresis.

SP2 OUTPUT AND LED INDICATION STATES - IN ALARM CONDITION

| Alarm Type | ON-OFF Operating mode | Proportional Operating mode | Legend |
|--|--------------------------------|-----------------------------|--|
| Deviation dV.hi dV.Lo bAnd | SP2 Output State | SP2 LED State | Output ON (relay or ssd energised) |
| Full scale FS.hi FS.Lo | | | Output OFF (relay or ssd de-energised) |
| CoOL Strategy | Temperature above setpoint | | LED ON |

SP2 ALARM ANNUNCIATOR
When an SP2 alarm mode is selected in SP2.A the alarm annunciator **-AL-** is displayed, alternating with the process temperature, during alarm condition.
Notes: The alarm will be automatically reset when the temperature returns within the **bnd.2** setting in Level 1.
The annunciator may be disabled by selecting function **no.AL : on** in level 4.

SP2 in cool strategy See full operating manual (ADVANCED SETTINGS)

| ERROR MESSAGES | | |
|--------------------|--|--|
| Display Flashes | Fault Type | Action |
| inPt: FAIL | SENSOR FAULT Thermocouple burnout RTD/Pt100 open or short circuit or negative over-range. | Check sensor/wiring |
| dAtA : FAIL | NON-VOLATILE MEMORY ERROR | De-power briefly, Replace unit if problem persists |
| hAnd : FAIL | MANUAL POWER ERROR SP1 set to ON/OFF in CyC.t | Select proportional mode |
| tunE : FAIL | IMMEDIATE FAIL ON AUTOTUNE START Note: To reset and clear error press ▲ ▼ together briefly to cancel message. FAIL LATER DURING AUTOTUNE CYCLE The thermal characteristics of the load exceed the autotune algorithm limits. The failure point is indicated by any display 0.0 in tech e.g. Ctb = 0.0 | 1. If display setpoint=0 then enter setpoint 2. If SP1 set to ON/OFF in CyC.t then select proportional mode 1. Change conditions. eg. raise setpoint 2. Try tunE : At.SP 3. If the error message persists, call local CAL representative for advice. |

FUNCTION LIST (LEVELS 1 TO 4) - LEVEL 1

| Function | Options [Factory settings] shown in brackets | Description |
|---------------------------------|--|---|
| Select Autotune | | |
| tunE | [oFF], on, ParK, At.Sp | Used to switch the Autotune feature on and off, to select ParK or tune at setpoint. ParK temporarily turns the output(s) off. To use select ParK and exit program mode. To disable re-enter program at tunE and select oFF . |
| SP1 Operating Parameters | | |
| bAnD | 0.1 to * C°/F [10°C/18°F] | SP1 proportional band/Gain or Hysteresis * 25% sensor maximum Proportional control eliminates the cycling of on-off control. Heater power is reduced, by time proportioning action, across the proportional band. |
| Int.t | oFF, 0.1 to 60 minutes [5.0] | SP1 integral time/reset Auto-corrects proportional control offset error |
| dEr.t | oFF 1 - 200 seconds [25] | SP1 derivate time/rate Suppresses overshoot and speeds response to disturbances |
| dAC | 0.5 - 5.0 x bAnd [1.5] | SP1 derivative approach control dAC Tunes warm-up characteristics, independent of normal operating conditions, by controlling when derivative action starts during warm-up (smaller dAC value = nearer setpoint). |
| CyC.t | A --, on.oF, 0.1 - 81 sec [20] | SP1 proportional cycle-time (see section above) Determines the cycle rate of the output device for proportional control. Select on.oF for ON/OFF mode. |
| oFSt | [0] to * °C/°F | SP1 offset/manual reset * ±50% bAnd . Applicable in proportional and ON/OFF mode with integral disable: Int.t : oFF |
| SP.LK | [oFF] on | Lock main setpoint Locks the setpoint preventing unauthorised adjustment. |
| Programmer Settings | | |
| SPrr | [0] to 9995 deg/hour | Sets the ramp rate |
| SPrn | on [oFF] hold | Switches the ramp on or off, or hold at last ramp value |
| SoAK -- | [oFF] 0 to 1440 min | Sets the soak time |
| SP2 Operating Parameters | | |
| SEt.2 | 0 to * °C/°F [0] | Adjust SP2 setpoint * Deviation Alarms DV.hi, DV.Lo, bAnd 25% sensor maximum. * Full scale alarms FS.hi, FS.Lo sensor range f/s |
| bnd.2 | 0.1 - * °C/°F [2.0 C/3.6°F] | Adjust SP2 hysteresis or proportional band/gain (see CyC.2 setting) * 25% of sensor full scale |
| CyC.2 | [on.oFF] 0.1-81 seconds | Select SP2 ON/OFF or proportional cycle-time Select on.oFF for ON/OFF mode, or the cycle rate of SP2 output device for proportional mode. |

LEVEL 2

| Function | Options [Factory settings] shown in brackets | Description |
|------------------------------------|---|--|
| Manual Control Modes | | |
| SP1.P | 0 to 100 % 'read only' | Read SP1 output percentage power |
| hAnd | [oFF] 1 to 100 % (not in ON/OFF) | SP1 manual percentage power control For manual control should a sensor fail. Record typical SP1.P values beforehand. |
| PL.1 | 100 to 0 % duty cycle [100] | Set SP1 power limit percentage Limits maximum SP1 heating power during warm-up and in proportional band. |
| PL.2 | 100 to 0 % duty cycle [100] | Set SP2 percentage power limit (cooling) |
| SP2 Operating Modes | | |
| SP2.A | [none] dV.hi dV.Lo bAnd FS.hi FS.Lo Cool | Main SP2 operating mode |
| SP2.b | [none] LtCh hoLd nLin | Subsidiary SP2 mode: latch/sequence ,Non-linear cool proportional band |
| Input Selection and Ranging | | |
| dI.SP | [1] 0.1 | Select display resolution: for display of process temperature, setpoint, OFS.t, Set.2, hi.SC, LoSC |
| hi.SC | sensor minimum [sensor maximum] °C/°F | Set full scale |
| Lo.SC | [sensor minimum] sensor maximum °C/°F | Set scale minimum (default 0°C or 32°F) |
| inPt | [none] | Select input sensor (See SENSOR SELECTION table) |
| Unit | [none] °C °F bAr Psi Ph rh SEt | Select °C/°F or process units |

LEVEL 3

| Function | Options [Factory settings] shown in brackets | Description |
|---|--|--|
| Output Configuration | | |
| Note: 'Read only' after initial configuration. rSET ALL full reset to factory settings required to change SP1.d subsequently. | | |
| SP1.d | [none] rLY SSd rLY1 rLY2 SSd1 | Select SP1 output device Dual Relay and Dual SSd output options are factory set. |
| SP2.d | [none] SSd rLY rLY2 rLY1 SSd2 | Read SP2 output device (read only) Dual Relay and Dual SSd output options are factory set. |
| For SP1.d & SP2.d Note: (when in initial configuration only) Hold * and ▲ or ▼ for 10 seconds to move to or from output options shaded. | | |
| burn | SP1 / SP2 [uP.SC] Upscale/Upscale dn.SC Downscale/Downscale 1u.2d Upscale/Downscale 1d.2u Downscale/Upscale | Sensor burn-out/break protection Caution: Settings affect fail safe state. |
| rEu.d | SP1 / SP2 [1r.2d] Reverse Direct 1d.2d Direct Direct 1r.2r Reverse Reverse 1d.2r Direct Reverse | Select output modes: Direct/Reverse Select Reverse on SP1 for heating and Direct for cooling applications. Caution: Settings affect fail safe state. |
| rEu.L | SP1 / SP2 [1n.2n] Normal Normal 1i.2n Invert Normal 1n.2i Normal Invert 1i.2i Invert Invert | Select SP1/2 LED indicator modes |
| SPAn | [0.0] to ±25% sensor maximum | Sensor span adjust For recalibrating to align readings with another instrument e.g. External Meter, data logger. See Full Operating Manual (ADVANCED SETTINGS). |
| ZERo | [0.0] to ±25% sensor f/s | Zero sensor error (see Sensor span adjust above). |
| ChEK | [oFF] on | Select control accuracy monitor |
| rEAD | [Var] hi Lo | Read control accuracy monitor |
| tECh | [Ct A] CT b Ct 1 Ct 2 Ct 3 Ct 4 oS 1 uS oS 2 | Read Autotune tuning cycle data (see Operating Manual) |
| UEr | | Software version number |
| rSET | [none] ALL | Resets all functions to factory settings Caution: This selection will lose all of the current settings. |

FUNCTIONS MENU

