Users Manual

CAL 3300 / 9300 / 9400
Autotune Temperature Controllers

CAL Controls
Temperature Controllers
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INSTRUMENT PANEL FEATURES

This page can be photocopied and used as a visual aid and bookmark when working in other parts of the manual.

Green Display: Process temperature or program Function/Option
Orange Display: Setpoint temperature or program Option (9400 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** (See list of temperature sensors p.11)

**Operating unit** (See list of units p.8)

**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
- DAC Derivative approach control: 1.5
- (Typical setting for relay output)
- (Average setting for minimum overshoot)

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 AUTO TUNE

AUTO TUNE

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

Proportional Cycle Time can be pre-selected before running the Autotune program. (see p5)
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, SSR, valve. A setting that is too long for the process will cause oscillation and 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 (the 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 Level 1, 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**

<table>
<thead>
<tr>
<th>Output Device</th>
<th>Factory Setting</th>
<th>Recommended Minimum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Internal relay: rLY/rLY1/rLY2</td>
<td>20 seconds</td>
<td>10 seconds</td>
</tr>
<tr>
<td>Solid state drives: SSd/SSd1/SSd2</td>
<td>20 seconds</td>
<td>0.1 seconds</td>
</tr>
</tbody>
</table>

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

**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.

**Setpoint ramp rate** (0 to 9995 deg/hour)

From SPrr in Level 1, press and hold • and ▲ or ▼ to scroll to required ramp rate.

**Set Soak** (if required) 0 to 1440 minutes

From SoAk – – in Level 1, press and hold • and ▲ or ▼ to scroll to required Soak time.

**Set Ramp on (Off: On: Hold)**

From Sprn in Level 1, press and hold •, then press ▲ to select On

Exit program (▲▼) to enter settings into memory and commence ramp to target setpoint.

**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 SEL2 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 SEL2.
- **dV.Lo**: Falls below the main setpoint by the value inserted at SEL2.
- **BAnd**: Rises above or falls below the main setpoint by the value inserted at SEL2.
- **FS.hi**: Rises above the main setpoint by a SEL2 value that is greater than the setpoint.
- **FS.Lo**: Falls below the main setpoint by a SEL2 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.

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 Operating Manual. In on/off mode, bnd.2 adjusts SP2 hysteresis.

SP2 OUTPUT AND LED INDICATION STATES - IN ALARM CONDITION

<table>
<thead>
<tr>
<th>Alarm type</th>
<th>ON-OFF operating mode</th>
<th>Proportional operating mode</th>
</tr>
</thead>
<tbody>
<tr>
<td>Deviation</td>
<td>SP2 Output state</td>
<td>SP2 Output state</td>
</tr>
<tr>
<td></td>
<td>SP2 LED state</td>
<td>SP2 LED state</td>
</tr>
<tr>
<td>bAnd</td>
<td>bAnd : on-off mode only</td>
<td></td>
</tr>
<tr>
<td>Full scale</td>
<td></td>
<td></td>
</tr>
<tr>
<td>FS.hi</td>
<td></td>
<td></td>
</tr>
<tr>
<td>FS.Lo</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cool</td>
<td></td>
<td>Temperature above setpoint</td>
</tr>
<tr>
<td>Strategy</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Legend**
- Output ON (Relay or SSd energised)
- Output OFF (Relay or SSd de-energised)
- 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

**SENSOR FAULT**
Display flashes: inPt: FAIL
Indicates: thermocouple burnout RTD/Pt100 open or short circuit or negative over-range.
Action: Check sensor/wiring

**NON-VOLATILE MEMORY ERROR**
Display flashes: dAtA : FAIL
Action: De-power briefly. Replace unit if problem persists

**MANUAL POWER ERROR**
Display flashes: hAnd : FAIL
Action: SP1 set to ON/OFF in CyC.t

**IMMEDIATE FAIL ON AUTOTUNE START**
Display flashes: tunE : FAIL
Setpoint display 0
1. No setpoint entered.
Action: Enter setpoint
2. SP1 set to ON/OFF in CyC.t
Action: Select proportional mode

**FAIL LATER DURING AUTOTUNE CYCLE**
The thermal characteristics of the load exceed the Autotune algorithm limits. The failure point indicated by any display 0.0 in tech e.g. Ctb = 0.0
Action: 1. Change the 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)

**Note:** A Functions Menu is shown on page 3.

## LEVEL 1

<table>
<thead>
<tr>
<th>Function</th>
<th>Options</th>
<th>[Factory settings] shown in brackets</th>
</tr>
</thead>
<tbody>
<tr>
<td>SELECT AUTOTUNE</td>
<td></td>
<td>(see pages 4/5)</td>
</tr>
<tr>
<td><strong>tunE</strong> [off]</td>
<td>on</td>
<td><strong>ParK</strong> At.Sp</td>
</tr>
</tbody>
</table>

Used to switch the Autotune feature on and off, to select ParK or Autotune 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 output 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 * 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.1** A _ on.oF 0.1 - 81 sec [20]
  
  SP1 proportional cycle-time (see pages 9/10)
  
  Determines the cycle rate of the output device for proportional control. Select on.oF for ON/OFF mode.

- **oFS.t** [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]
  
  Lock main setpoint
  
  Locks the setpoint preventing unauthorised adjustment.

## LEVEL 2

### MANUAL CONTROL MODES

- **SPI.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 **SPI.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** *(see page 6)*

<table>
<thead>
<tr>
<th>Function</th>
<th>Options</th>
<th>[Factory settings] shown in brackets</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>SP2.A</strong> [nonE]</td>
<td>dV.hi dV.Lo bAnd FS.hi FS.Lo Cool</td>
<td>Main SP2 operating mode</td>
</tr>
<tr>
<td><strong>SP2.b</strong> [nonE]</td>
<td>LtCh hoLd nLin</td>
<td>Subsidiary SP2 mode: latch/sequence</td>
</tr>
</tbody>
</table>

**INPUT SELECTION AND RANGING**

| dl.SP | 0.1 | Select display resolution: for display of process temperature, setpoint, OFSt, Set.2, hi.SC, Lo.SC. |
| 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) |

**unit** [nonE] °C °F bAr Psi Ph rh SEt

Select °C/°F or process units

**LEVEL 3**

**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
Select SP1 output device

**SP2.d** [nonE] SSD rLY
Read SP2 output device (read only)

**burn** Sensor bum-out/break protection
Caution: Settings affect fail safe state.

**rEu.d** Select output modes: Direct/Reverse
Caution: Settings affect fail safe state.

**rEu.L** 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** [CI-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.

Dual Relay and Dual SSD output options are factory set.

Note: (when in initial configuration only)Hold * and ▲ or ▼ for 10 seconds to move to or from output devices in shaded portion.
LEVEL 4

Access to level 4 is gained through UER in level 3. Press and hold ▲ and ▼ for 10 seconds.

Enter level 4 at Lock, release ▲ and ▼ together. Display reads LOCK none.

Program security using Lock
Select from three Lock options: Press and hold *, press ▲ to index.

LEV3 locks level 3 and 4 only - Technical Functions.
LEV2 locks levels 2, 3 and 4 only - Configuration and Technical Functions.
ALL locks all functions LOCK ALL

Note: Locked functions and options may be read. Press ▼ to access following functions

Function Options
Prog [Auto] [Factory settings] shown in brackets
Stay
ProG [Auto] Program mode auto-exit switch
Auto-exit returns display to normal if 60 seconds of key inactivity, select STAY to disable

No.AL [Off] on
Disable SP2 alarm annunciator -AL-
Select on to disable -AL-

DiSS dir 1 to 32 [6]
Display sensitivity
dir = direct display of input 1 = maximum, 32 = minimum sensitivity

dEr.S 0.1 to 1.0 [0.5]
Derivative sensitivity

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: 45.0 mm +0.6/0.0 wide, 45.0 mm +0.6/0.0 high
1/32 DIN: 45.0 mm +0.6/-0 wide, 22.2 mm +0.3/-0 high

Maximum panel thickness 9.5 mm
Minimum spacing 20 mm vertical, 10 mm horizontal

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 3300 / 9300 / 9400

<table>
<thead>
<tr>
<th>Model</th>
<th>Bezel* Width</th>
<th>Bezel* Height</th>
<th>Behind Panel Width</th>
<th>Behind Panel Height</th>
<th>Overall Length</th>
<th>Behind panel Length*</th>
</tr>
</thead>
<tbody>
<tr>
<td>3300</td>
<td>51.0</td>
<td>28.5</td>
<td>44.8</td>
<td>22.0</td>
<td>116.2</td>
<td>106.7</td>
</tr>
<tr>
<td>9300</td>
<td>51.0</td>
<td>51.0</td>
<td>44.8</td>
<td>44.8</td>
<td>116.2</td>
<td>106.7</td>
</tr>
<tr>
<td>9400</td>
<td>51.0</td>
<td>51.0</td>
<td>44.8</td>
<td>44.8</td>
<td>116.2</td>
<td>106.7</td>
</tr>
</tbody>
</table>

Dimensions in mm
* includes gasket
ELECTRICAL INSTALLATION

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 CAL distributor for details.

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.

EN61010 - /CSA 22.2 No 1010.1 92
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 EN6010 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.

TYPICAL CONNECTION DIAGRAM
In this example the SSR driver output is allocated to SP1 and wired to switch the load (heater) using an SSR.

F1 Fuse: 1A time lag type to IEC127. CSA/UL rating 250Vac
F2 Fuse: High Rupture Capacity (HRC) Suitable for maximum rated load current
S1 Switch: IEC/CSA/UL Approved disconnecting device
**SENSOR SELECTION**

<table>
<thead>
<tr>
<th>Thermocouples</th>
<th>Description</th>
<th>Sensor range</th>
<th>Linearity</th>
</tr>
</thead>
<tbody>
<tr>
<td>tC b</td>
<td>Pt-30%Rh/Pt-6%Rh</td>
<td>0 to 1800 °C</td>
<td>2.0 *</td>
</tr>
<tr>
<td>tC E</td>
<td>Chromel/Con</td>
<td>0 to 600 °C</td>
<td>0.5</td>
</tr>
<tr>
<td>tC J</td>
<td>Iron/Constantan</td>
<td>0 to 800 °C</td>
<td>0.5</td>
</tr>
<tr>
<td>tC K</td>
<td>Chromel/Alumel</td>
<td>-50 to 1200 °C</td>
<td>0.25 *</td>
</tr>
<tr>
<td>tC L</td>
<td>Fe/Konst</td>
<td>0 to 800 °C</td>
<td>0.5</td>
</tr>
<tr>
<td>tC n</td>
<td>NiCrSi/NiSil</td>
<td>-50 to 1200 °C</td>
<td>0.25 *</td>
</tr>
<tr>
<td>tC r</td>
<td>Pt-13%Rh/Pt</td>
<td>0 to 1600 °C</td>
<td>2.0 *</td>
</tr>
<tr>
<td>tC s</td>
<td>Pt-10%Rh/Pt</td>
<td>0 to 1600 °C</td>
<td>2.0 *</td>
</tr>
<tr>
<td>tC t</td>
<td>Copper/Con</td>
<td>-200 / 250 °C</td>
<td>0.25 *</td>
</tr>
</tbody>
</table>

| Resistance thermometer | rtd | Pt100/RTD-2 | 0.25 * |

**Linear process inputs (Input mV range: 0 to 50mV)**

<table>
<thead>
<tr>
<th>Displays</th>
<th>0 - 20mV</th>
<th>setpoint limits</th>
<th>4 - 20mV</th>
<th>setpoint limits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lin1</td>
<td>0 - 100</td>
<td>0 - 400 ± 0.5%</td>
<td>Lin2</td>
<td>0 - 100</td>
</tr>
<tr>
<td>Lin3</td>
<td>0 - 1000</td>
<td>-25 - 400 ± 0.5%</td>
<td>Lin4</td>
<td>0 - 1000</td>
</tr>
<tr>
<td>Lin5</td>
<td>0 - 2000</td>
<td>-250 - 3000 ± 0.5%</td>
<td></td>
<td>0 - 3000</td>
</tr>
</tbody>
</table>

**Notes:**
1. Linearity: 5-95% sensor range
2. * Linearity 0.5% (700 - 500 °C) K/N: 1% >350°C
   exceptions: R/S: 5% <300°C T: 1% < -25 °C >150°C
   RTD/Pt100: 0.5° < 100°C

**SPECIFICATION**

**Thermocouple**
- 9 types
- Standards: IPTS/68/DIN 43710
- CJC rejection: 20:1 (0.05°C/C) typical
- External resistance: 100Ω maximum

**Resistance thermometer**
- RTD-2/Pt100 2 wire
- Standards: DIN 43760
- (100Ω 0°C/138.5Ω 100°C Pt)
- Bulb current: 0.2mA maximum

**Linear process inputs**
- mV range: 0 to 50mV
- Applicable to all inputs SM = sensor maximum

**Calibration accuracy:** ±0.25%SM ±1°C
**Sampling frequency:** input 10Hz, CJC 2 sec.
**Common mode rejection:** Negligible effect up to 140dB, 240V, 50-60Hz
**Series mode rejection:** 60dB, 50-60Hz
**Temperature coefficient:** 150ppm/°C SM
**Reference conditions:** 22°C ±2°C, rated voltage after 15 minutes settling time.

**Output devices**
- SSd/SSd1/SSd2:
  - solid state relay driver: To switch a remote SSR 5Wdc +0/-15% 15mA non-isolated
- rLY and rLY1:
  - form A/SPST contacts (AgCdO)
  - 2A/250ac resistive load
- rLY2:
  - 1A/250ac resistive load

**General**
- Displays:
  - Upper, 4 Digits, high brightness green LED, 10mm (0.4”) high.
  - Lower, 4 Digits, Orange LED, 9mm (0.35”) high (9400 only)
- Digital range -199 to 9999
- Hi-res mode -199.9 to 9999.9
- LED output indicators - flashing SP1 square, green; SP2 round, red
- Keypad:
  - 3 elastomeric buttons

**Environmental**
- Humidity: Max 80%
- Altitude: up to 2000M
- Installation: Categories II and III
- Pollution: Degree II
- Protection: NEMA 4X, IP66
- EMC emission: EN50081-1  FCC Rules 15 subpart J Class A
- EMC immunity: EN50082-2
- Ambient: 0-50°C (32-130°F)
- Mouldings: flame retardant polycarbonate
- Weight: 130g (4.2 oz)
SAFETY AND WARRANTY INFORMATION

INSTALLATION

Designed for use:
UL873 - only in products where the acceptability is determined by Underwriters Laboratories Inc.
EN61010-1 / CSA 22.2 No 1010.1 - 92
To offer a minimum of Basic Insulation only.
Suitable for installation within Category II and III and Pollution Degree 2.

SEE ELECTRICAL INSTALLATION [Page 10]

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.

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.

WARRANTY

CAL Controls warrant this product free from defect in workmanship and materials for three (3) years from date of purchase.
1. Should the unit malfunction, return it to the factory. If defective it will be repaired or replaced at no charge.
2. There are no user-servisable parts in this unit. This warranty is void if the unit shows evidence of being tampered with or subjected to excessive heat, moisture, corrosion or other misuse.
3. Components which wear or damage with misuse, are excluded e.g. relays.
4. CAL Controls shall not be responsible for any damage or losses however caused, which may be experienced as a result of the installation or use of this product.
CAL Controls liability for any breach of this agreement shall not exceed the purchase price paid E. & O. E.