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CAL 3200
AUTOTUNE TEMPERATURE CONTROLLER
OPERATING MANUAL



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1 IMPORTANT SAFETY INFORMATION ... PLEASE REVIEW

1.1 INSTALLATION

Designed for use:
UL873 – only in products where the acceptability is determined by Underwriters laboratories Inc.
EN61010-1– within Installation Categories II and III environment and pollution degree 2.
To avoid possible hazards accessible conductive parts of final installation should be protectively earthed in accordance with EN61010 for Class 1 equipment.
Output wiring should be within a grounded cabinet.
Sensor sheaths should be bonded to ground or not be accessible.
Live parts should not be accessible without use of a tool.
It is the responsibility of the installation engineer to ensure that this equipment's compliance to EN61010 is not impaired when fitted to the final installation and to use this equipment as specified in this manual, failure to do so may impair the protection provided.
Ensure the installation is in compliance with appropriate wiring regulations

1.2 CONFIGURATION

All functions are front key 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

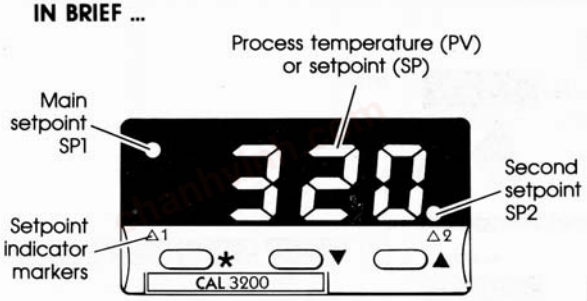
1.3 ULTIMATE SAFETY ALARMS

Normal safety advice: 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 of defects in workmanship and

IN BRIEF ...



Routine adjustments

- ✱ View setpoint
- ✱ ▲ Increase setpoint
- ✱ ▼ Decrease setpoint

To reset alarm or fault message

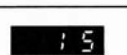
- ▼ ▲ Momentarily press together

SYMBOLS USED IN THE MANUAL

✱ ▼ ▲ Keys



Indicator: flashing



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Thank you for choosing the CAL 3200 ..... a new concept in advanced, full feature, compact temperature control

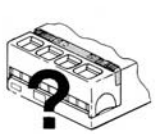


Please ....

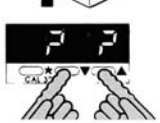
1. **Familiarise yourself:**
Scan the contents list and look through the manual, note sections of interest



2. **Before installation:**
Review the important safety information in section 1

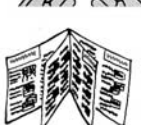


3. **Installation and connection:**
Instructions see sections 4/5



4. **Setting-up instructions**
Choose the format you prefer:

—



Fully explained step-by-step
Start section 6

or ...

INTRODUCTION

Section		Page
1	IMPORTANT SAFETY INFORMATION	*P1*
2	CONTROL FUNCTIONS MENU	*P3*
3	ABBREVIATED SETTING-UP GUIDE	*P4*
4	MECHANICAL INSTALLATION	*P5*
5	ELECTRICAL INSTALLATION	*P6*
6	INITIAL CONFIGURATION / SETTING-UP / FACTORY SETTINGS	*P7*
7	AUTOTUNE	*P9*
8	VIEWING AND SELECTING FUNCTIONS	*P11*
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10	SECOND SETPOINT – SP2 ALARMS AND COOL STRATEGY	*P15*
11	RANGING AND SETPOINT LOCK	*P17*
12	IMPROVING CONTROL ACCURACY	*P17*
13	OEM PROGRAM SECURITY	*P18*
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15	ERROR MESSAGES AND DIAGNOSIS	*P19*
16	FUNCTIONS AND OPTIONS: LEVEL 1	*P20*

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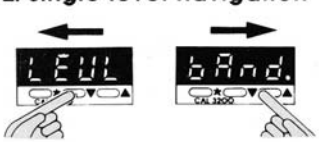
2 FUNCTIONS MENU AND PROGRAM MODE GUIDE

Brief Guide:

1. Enter/exit
program mode
Press and hold
▼ ▲ 3 sec



2. Single level navigation



3. View/Change Option

View
Function/
Option



Autotune
Option value



To change
Option value
(or ✱ ▼)
Release: check correct



MENU LEVEL

LEUL

3

Read SP1 output device	Read SP2 output device	Burn-out protection	Select output modes: Direct/Reverse	Select SP1/2 LED modes	Sensor span adjust	Zero sensor error	Select control accuracy monitor	Read monitor results	Read Autotune tuning data	Software version	Functions Reset
SP1d	SP2d	burn	rEUd	rEUL	SPAn	2Ero	ChEY	rEAd	dAtA	UEr	rSEt

OUTPUT CONFIGURATION — TECHNICAL

2

Read SP1 output power %	SP1 manual power control %	Set SP1 power limit %	Set SP2 power limit %	Main SP2 operating mode: Alarms/Cool strategy	Subsidiary SP2 mode: Alarm (latch/sequence)	Select display resolution	Set full scale	Set scale minimum	Select input sensor	Select °C/°F or Process units
SP1P	hAnd	PL.1	PL.2	SP2A	SP2b	d.SP	h.SC	Lo.SC	inPt	unit

MANUAL CONTROL MODES — SP2 OPERATING MODES — INPUT SELECT & RANGING

Autotune or Park	band/Gain	Time/Reset	Time/Rate	Approach	Cycle-time	Manual reset	Setpoint SP1	Setpoint	Hysteresis or	ON/OFF
AT	bAnd	tIME	rAtE	APPr	CYC	rES	SP1	SP2	HYS	ONOF

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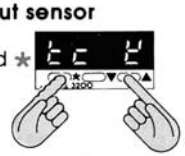
3 ABBREVIATED SETTING-UP INSTRUCTIONS

... FOR FULL INSTRUCTIONS SEE SECTION 6 ...

1. Power-up
Alternating display after self-test



2. Select input sensor
To select:
Press and hold ✱
Press ▲



Check correctly selected



3. Select °C/°F

Press once





4. Select main setpoint output device see 5.3

Press once





Select:
SSR drive



or

2A relay



Important:
Check correct device selected



If any difficulty in initial

5. Enter initial configuration

Hold both 3 sec



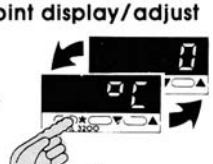
Normal operating mode:
No setpoint entered yet



6. Select other functions
Now or later:
see guide and menu to left

7. Setpoint display/adjust

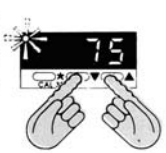
Display setpoint



To increase setpoint



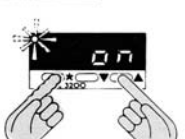
8. To Autotune
Enter program mode hold both 3 sec



Entry point



Select
tunE/on



Exit program mode Hold both 3 sec



Display during Autotune



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4 MECHANICAL INSTALLATION

1. Prepare a 1/32 DIN panel cutout:
   45.0mm + 0.6/-0 x 22.2mm +0.3/-0
   1.77" +0.02/-0 x 0.87" +0.01/-0
2. Unplug connector now if wiring seperately
3. Slide the controller into the cutout
4. Slide the panel clamp on the controller and press it firmly against the panel
   Note: To remove the panel clamp the two side levers should be pressed in
5. Refit the connector if removed. To further secure the connector slide the green lock as shown
6. After installation remove protective front window label
7. Cleaning – wipe down front with damp cloth (water only)

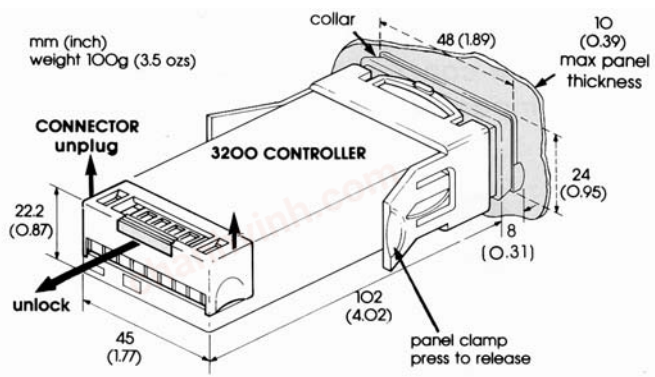
4.1 3200 CONTROLLER PROTECTION RATING

The 3200 controller front of panel assembly is rated NEMA 4X/IP66 provided:

- The panel is smooth, and cutout accurate
- The panel clamp is pressed firmly against the panel, ensuring that the clamp springs are fully compressed

4.2 MULTIPLE 3200 INSTALLATIONS



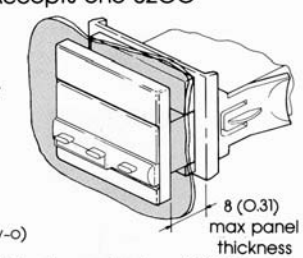


OPTIONAL 1/16 DIN PANEL ADAPTORS: 48 (1.89) square
Enable 3200(s) to be mounted in a 1/16 DIN cutout

4.3 1/16 DIN 3200 adaptor: Accepts one 3200

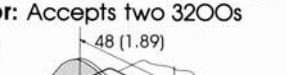
1. Remove collar/gasket from 3200, grip firmly and pull off
2. Assemble adaptor halves either side of panel, locate pegs
3. Slide 3200 into adaptor, fit panel clamp and press firmly against adaptor

1/16 DIN PANEL CUTOUT 45 x 45 +0.6/-0
(1.77 x 1.77 +0.02/-0)



4.4 1/16 DIN 3200 Twin adaptor: Accepts two 3200s

1. Remove collars from both 3200s
2. Fit special collars included



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5 ELECTRICAL INSTALLATION

⚠ **CAUTION RISK OF ELECTRIC SHOCK**

5.1 Supply Voltage: 100-240V 50-60 Hz±10% 3VA
12V or 24V (AC/DC)±20% 3VA
Polarity not required
3200 is fitted with internal 250mA time lag fuse

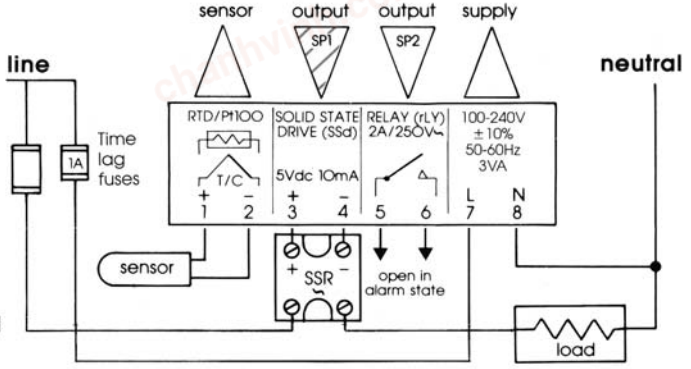
5.2 Output devices (two)
Solid state relay drive SSd
5Vdc +0/-15%, 10mA non-isolated
To switch a remote SSR (or logic)

Miniature power relay rLY
2A/250V~resistive, Form A/SPST contacts

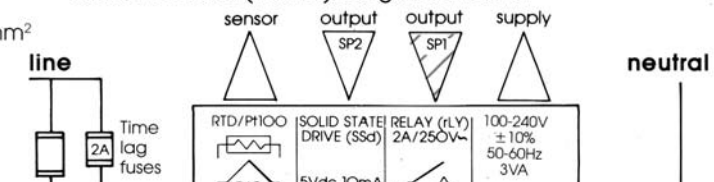
5.3 Output device allocation
Either the SSd or the relay may be chosen as the output device for the main setpoint SP1, the remaining device being automatically allocated to the second setpoint SP2. Choose the most suitable output device arrangement for the application and wire accordingly

5.4 Wiring the 8 way connector
Maximum recommended wire: 32/0.2mm 1.0mm² (18AWG 0.04"²). Prepare cables carefully.
Important: remove a maximum of 6mm (0.25") insulation to avoid bridging. Prevent excessive cable strain on the connector

Example A
The SSd output is allocated to SP1 and wired to switch the load (heater) using an SSR



Example B
The relay output is allocated to SP1 and wired to switch the load (heater) using a contactor



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6 INITIAL SETTING UP

6.1 OVERVIEW

Three steps from initial power-up to accurately tuned control

6.1.1 Details required for initial configuration

1. The temperature sensor being used: thermocouple or RTD/Pt100
2. °C or °F
3. Choice of controller output device for the main setpoint SP1, either:
   The solid state relay drive **SSd**
   or the miniature power relay **rLY**
4. Any additional controller functions, e.g. SP2 Alarms, may be selected now or later

6.1.2 Set the temperature required

The controller is now operational with factory PID settings

6.1.3 To tune the 3200 precisely to the application:

- Run the Autotune program **see 7**
  This automatically adjusts the PID control parameters to the characteristics of the application
- Or enter PID values manually
  Where the optimum values are already known

6.2 INITIAL CONFIGURATION

6.2.1 Power up



Self test sequence (and brief display blanking)

The alternating display shows that no input sensor is selected and that one is required

6.2.2 To enter the input sensor type



Press and hold ★
Press ▲ to select the sensor e.g. K
Press ▼ to reverse indexing

Input sensor options (also see 16.2.10)

Thermocouples

sensor type	mnemonic	sensor type	mnemonic
B	tc b	N	tc n
E	tc E	R	tc r
J	tc J	S	tc S
K	tc K	T	tc t
L	tc L		

Resistance thermometer

RTD-2	rtd
Pt100	

Linear process inputs see 16.2.10

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6.2.3 To select display in °C or °F

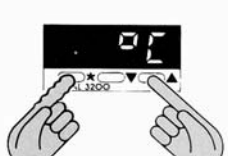
Press ▲ once



The display shows that no display unit is selected



To select °C or °F (Bar, PSI, Ph, Rh)
Press and hold ✱
Press ▲ to select °C, °F etc
Release ✱
Check display alternating with **unit** is correct



6.2.4 To allocate SP1 – main setpoint output device

Press ▲ once



The display shows that no output device has been allocated to SP1



To select SP1 output device
Press and hold ✱
Press ▲ to select



Important:
Check correct device selected, as fixed once entered in memory, changeable only on full reset, **see 16.3.12**

6.2.5 To enter the initial configuration into the Controllers memory

Press and hold both ▼ and ▲ for 3 seconds (Display may differ)

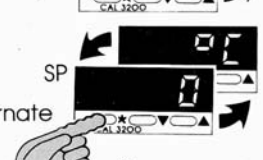


Process temperature displayed e.g. Ambient 23 °C and **PArk** alternate as no setpoint yet selected



6.2.6 To display setpoint

Press and hold ✱
°C/O or **°F/32** alternate



6.2.7 To adjust setpoint

Press and hold ✱
Press ▲ to increase/



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7 AUTOTUNE

7.1 TO USE AUTOTUNE – TUNE PROGRAM

7.1.1 For best results:

- Start with the load cool
- Set the usual setpoint temperature and use normal load conditions

7.1.2 To enter program mode

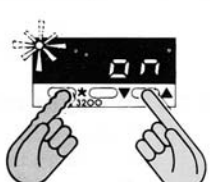


Press and hold both ▼▲ for 3 seconds

Release together when **tunE** is displayed on entry to program mode If display differs, **see 2** for functions menu, press ▼ or ▲ to locate **tunE**



7.1.3 To select tunE/on



Press and hold ✱
Press ▲ once

7.1.4 To start TUNE program

Press and hold both ▼▲ for 3 seconds
To exit program mode starting **tunE** (Display may differ)
Release ▼▲
Display during **tunE** program



NOTE: Setpoint is locked during **tunE** to adjust select **tunE/oFF**



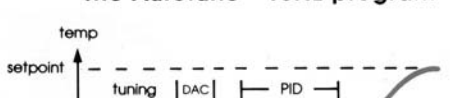
TUNE program complete
Alternating display stops
New PID values are entered automatically



Process temperature climbs to setpoint



The Autotune – TUNE program



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7.2 MORE ON AUTOTUNE

7.2.1 Operation

Autotune 'teaches' the controller the main characteristics of the process. For best results run Autotune with the usual setpoint temperature under normal load conditions

Autotune 'learns' by cycling the output on and off. The results are measured and used to calculate optimum PID values which are automatically entered in the controller memory

PID Parameters tuned

1. Proportional band/Gain
2. Proportional cycle-time (requires manual acceptance unless pre-selected, **see 9**)
3. Integral time/Reset
4. Derivative time/Rate
5. Derivative approach control (DAC)

Two alternative forms of Autotune are provided, **TUNE** and **TUNE AT SETPOINT**, the use of each is described below

7.2.2 The Autotune – TUNE program



To run **TUNE** select **tunE/on** , **see 7.1**

7.2.3 The Autotune – TUNE AT SETPOINT program



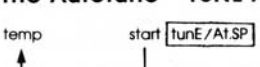
To run **TUNE AT SETPOINT** select **tunE/At.SP**
see 7.1.3: Press ★ and hold, press ▲ 3 times
The tuning cycle occurs **at setpoint** and in some applications, may give better results, see examples below:

The TUNE AT SETPOINT program is recommended:

1. When the setpoint is below 100°C/200°F, where **TUNE's** tuning cycle at 75% setpoint may be too close to ambient to produce good results
2. When the process is already hot and the cooling rate is slow
3. When controlling multi-zone or heat-cool applications
4. To re-tune if the setpoint is changed substantially from the previous Autotune

Note: DAC is not re-tuned by Tune at Setpoint

The Autotune – TUNE AT SETPOINT program



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8 VIEWING AND SELECTING FUNCTIONS

8.1 FUNCTIONS AND OPTIONS

The facilities of the 3200 are selected from the multi-level menu using program mode

For menu of main Functions .. see 2
For Functions and Options list .. see 16

8.1.1 Definitions

Functions (Fn): The controllers facilities
Options (Opt): The available values for a function

Example:
Function: Proportional band
Option: 15 °C/ °F selected



Short reference: bAnd/15 (Fn/Opt)

8.1.2 Control during programming

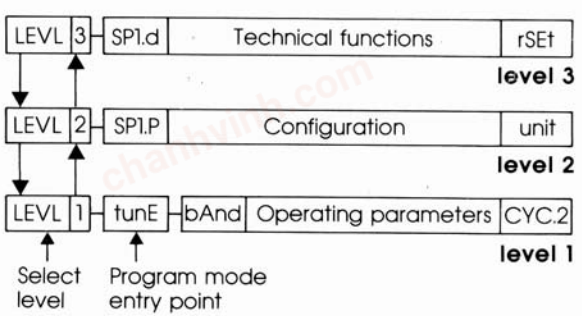
Control with existing settings is maintained during programming. Control with new instructions commences only on exiting program mode, when the controller memory is updated

8.1.3 Hints when using program mode

Some options will not adjust! Maybe the lock has been applied. All functions and current

8.1.4 The multi-level Function and Option menu

For menu of main Functions .. see 2



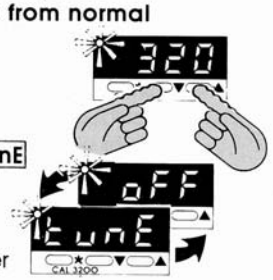
8.2 USING PROGRAM MODE

8.2.1 To enter program mode from normal operating mode

Press and hold both ▼▲ for 3 seconds

Enter program mode at tunE Function on level 1, see diagram above

Release both ▼▲ together



8.2.2 To exit program mode at any time returning to normal operating mode

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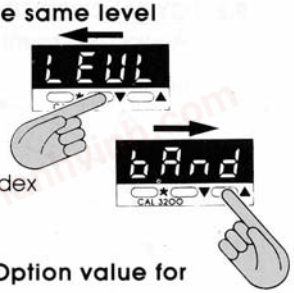
8.2.3 To view Functions on the same level



Press ▼ or ▲ once to view the next Function

or hold ▼ or ▲ to auto-index through the Functions

8.2.4 To display the current Option value for a Function



On release of ▼ or ▲ Option alternates with the Function:
Function bAnd
Option 10 °

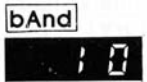
8.2.5 Autotune Option values



Autotune calculated value indicator
If a manual Option is selected, the Autotune value is retained in memory

8.2.6 To change an Option value or setting

Index to the required Function e.g. bAnd
Press and hold ✱
Current Option displayed: 10 °



IMPORTANT:
Check the new Option value **before** moving to another Function or exiting program mode



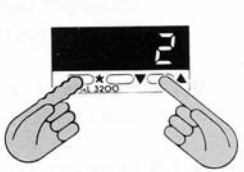
8.2.7 To change menu levels



Press and hold ▼ to reach the level selection function



Release ▼ to display the current level 1



Press and hold ✱
Press ▲ to increase level (2)
or Press ▼ to decrease level



Release ✱ to display the new level 2

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9 PROPORTIONAL CYCLE-TIME

Optimum cycle-time is calculated by Autotune **TUNE** or **TUNE AT SETPOINT** programs, but **not** automatically implemented

The choice of cycle-time is influenced by the external switching device or load, e.g. contactor, SSR, valve

Note: A setting that is too long for the process will cause oscillation
Too short a setting will cause unnecessary wear to an electro-mechanical switching device

9.1 ALTERNATIVE CYCLE-TIME SELECTION METHODS
see instructions opposite

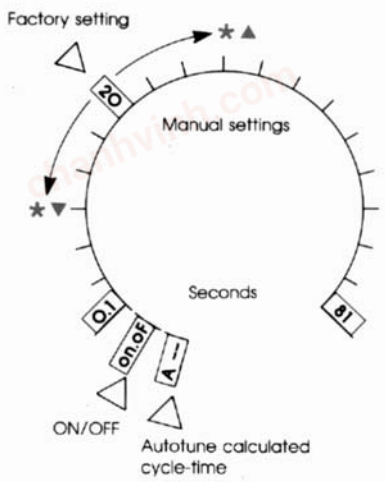
9.1.1 Run Autotune. On completion check the calculated cycle-time, **see 9.4**
- Accept
- Or select nearest suitable value
(20 sec factory setting applies unless replaced)

9.1.2 Pre-select automatic acceptance of **any** calculated Autotune cycle-time, **see 9.5**

9.1.3 Manually pre-select any cycle-time between 0.1 and 81 sec, this will not be changed, **see 9.6**

9.1.4 To use the 20 sec factory set cycle-time no

9.2 CYC.t CYCLE-TIME SETTINGS
Analog representation



9.3 CYCLE-TIME RECOMMENDATIONS
To avoid premature relay failure

Output device	Cycle-time	Load (resistive)
Internal relay rLY	**20 sec or more Recommended** 10 sec minimum	2A/250V~

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9.4 TO SELECT AUTOTUNE CALCULATED CYCLE-TIME

On completion of Autotune

9.4.1 Enter program mode

Press and hold both ▼ ▲ for 3 seconds



9.4.2 Index to cycle-time Function

Press and hold ▲



Release ▲

20 second factory setting displayed



9.4.3 To view calculated optimum cycle-time

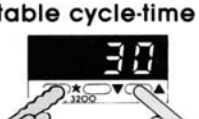
Press and hold ✱ then Press and hold ▼ until indexing stops: e.g. calculated cycle-time is 16 sec



If suitable accept

9.4.4 Manual selection of more suitable cycle-time

If the calculated value is not compatible with the switching device e.g. 30 sec more



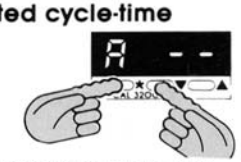
9.5 TO PRE-SELECT AUTOMATIC ACCEPTANCE OF ANY AUTOTUNE CYCLE-TIME

9.5.1 Before Autotune is selected

Enter program mode, index to cycle-time Function [CYC.t] **see 9.4**

9.5.2 Select Autotune calculated cycle-time

Press and hold ✱ then Press and hold ▼ until indexing stops



[A --] Shows no Autotune cycle-time yet exists

9.5.3 Autotune [tunE/on../At.SP] must be selected now, BEFORE exiting program mode



Press and hold ▼ to [tunE] Function

9.6 TO PRE-SELECT CYCLE-TIME BEFORE AUTOTUNE

9.6.1 Before Autotune is selected

Enter program mode Index to cycle-time Function [CYC.t] **see 9.4**

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10 USING THE SECOND SETPOINT – SP2

10.1 TO CONFIGURE SP2 AS AN ALARM

1. Select the main SP2 operating mode in **SP2.A**, **see 10.4**
2. If required, select a subsidiary SP2 mode in **SP2.b**, **see 10.5**
3. If the factory set 2.0°C/3.6°F hysteresis is unsuitable, change in **bnd.2**
   Set **CYC.2** ON/OFF (factory setting)
4. Adjust SP2 setpoint in **SEt.2** (to set y° in 10.4)
5. Exit program mode – SP2 is now operational as an alarm

10.2 TO CONFIGURE SP2 AS A PROPORTIONAL CONTROL OUTPUT

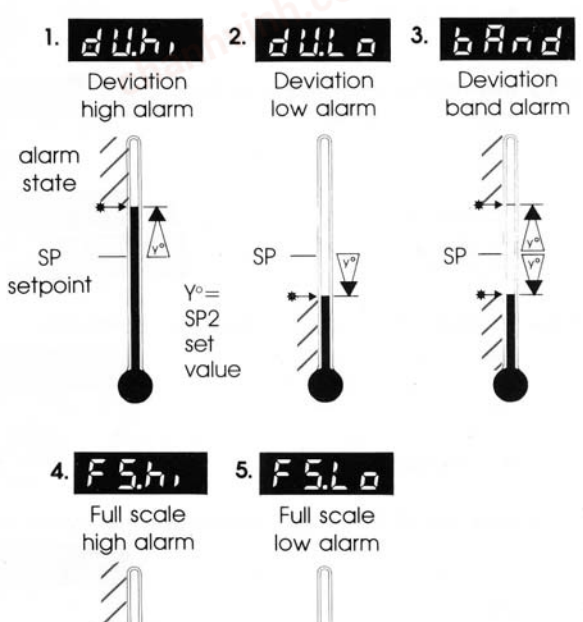
1. Select the main operating mode in **SP2.A**, **see 10.4**
2. Select SP2 proportional band in **bnd.2** and SP2 cycle-time in **CYC.2**
3. Adjust SP2 setpoint in **SEt.2** (to set y° in 10.4)
4. Exit program mode – SP2 is now operational as a control output with time proportioning control action

10.3 SP2 IN COOL STRATEGY

For full instructions see separate data: '3200 control of heat-cool applications'

10.4 SP2.A MAIN SP2 OPERATING MODE: ALARMS OR COOL STRATEGY

factory setting **nonE**



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10.5 SP2.b SUBSIDIARY SP2 MODE: LATCH/ SEQUENCE OR NON-LINEAR COOL

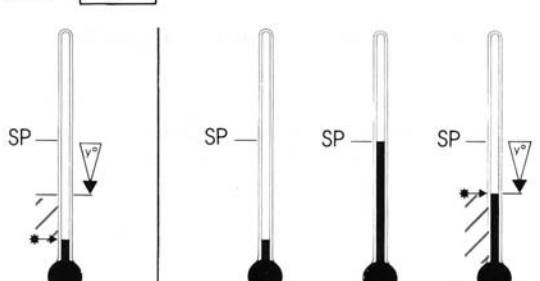
factory setting nonE

10.5.1 LtCh Latch alarm

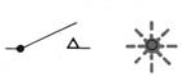
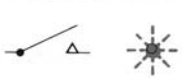
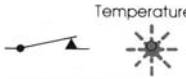
When selected the alarm output and indicator latch, **When the alarm condition has been cleared, momentarily press ▼▲ together to reset**

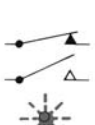
10.5.2 hoLd Sequence alarm

When selected, in any alarm mode, prevents an alarm on power up. The alarm is enabled only when the process temperature reaches setpoint
Example: Sequence alarm used with deviation low alarm – dV.Lo



10.6 SP2 OUTPUT AND LED INDICATOR STATES – IN ALARM CONDITION

ALARM TYPE	ON-OFF OPERATING MODE		PROPORTIONAL OPERATING MODE	
	SP2 Output state	SP2 LED state	SP2 Output state	SP2 LED state
Deviation dV.hi dV.Lo bAnd			 bAnd : on-off mode only	
Full scale FS.hi FS.Lo				
CooL Strategy	Temperature above setpoint 			



Output ON (Relay or SSd energised)
Output OFF (Relay or SSd de-energised)
LED ON

10.7 -AL- SP2 ALARM ANNUNCIATOR

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11 RANGING AND SETPOINT LOCK

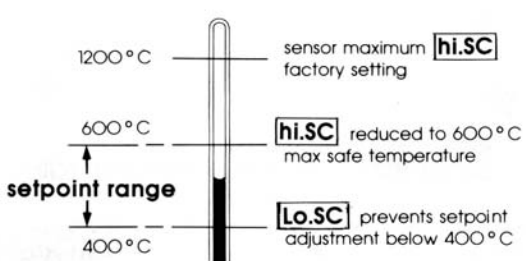
11.1 RANGING: IMPORTANT SAFETY NOTE

The factory setting of full-scale **hi.SC** is the sensor maximum value, **see 16.2.10** this should be reduced to a safe maximum for the plant or process

11.1.1 hi.SC full-scale and Lo.SC scale minimum

1. **hi.SC** limits the maximum setpoint adjustment, **Lo.SC** limits the minimum. Both adjust over the full sensor range, including negative
2. Factory settings:
   hi.SC = sensor maximum, **Lo.SC** = **0°C/32°F**
   Reduce **Lo.SC** to set below **0°C/32°F**
3. **hi.SC** may not be adjusted below the **Lo.SC** setting, **Lo.SC** not above **hi.SC**

11.1.2 Example: Setpoint limited to 400° – 600°C



IMPROVING CONTROL ACCURACY 12

11.2 SP.LK SETPOINT LOCK

This function in level 1 enables the machine setter to lock the setpoint preventing unauthorised adjustment

12 TOOLS TO IMPROVE CONTROL ACCURACY

To assist engineers with machine development, commissioning and trouble shooting

12.1 SP1.P READ SP1 OUTPUT PERCENTAGE POWER

Poor control may be due to incorrectly sized heaters. **SP1.P** constantly displays the output percentage power applied, which at normal setpoint should be within 10-80% (preferably 20-70%) to achieve accurate control

12.2 ChEK CONTROL ACCURACY MONITOR

12.2.1 This enables the accuracy of the temperature control, to within 0.1°C/°F, to be established. The monitor is started using **ChEK** and the variance (deviation), maximum and minimum temperatures are displayed and constantly updated in **rEAd**



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12.2.3 Using the ChEK Control accuracy monitor

1. To start the monitor select **ChEK** **on**
2. During monitoring either return to normal operation or remain in program mode
3. To view monitor readings: Index to **rEAd**

   Release ▼ or ▲



4. Press and hold ✱
   Displays **variance** (0.6°)



5. Hold ✱ pressed
   Press ▲ once
   Displays **maximum** (320.3°)



6. Hold ✱ pressed
   Press ▲ once more
   Displays **minimum** (319.7°)

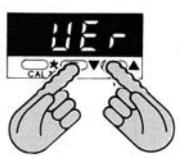


NOTE FOR OEM's: For safety and to protect settings from tampering ... THEN REMOVE THIS SECTION

13.1 ENTRY TO HIDDEN LEVEL 4

Access to level 4 only at **VEr** in level 3

Press and hold ▼▲ **10** sec
Hint: Press ▲ to index along level, then ▼ also immediately **VEr** is reached



Enter level 4 at **LoCK**
Release ▼▲ together
Factory setting: **nonE**



13.2 PROGRAM SECURITY USING LoCK

Select from 3 **LoCK** options:

Press and hold ✱ Press ▲ to index

Locks levels 3 and 4 only – TECHNICAL FUNCTIONS



Locks levels 2, 3 and 4 only – CONFIGURATION AND TECHNICAL FUNCTIONS



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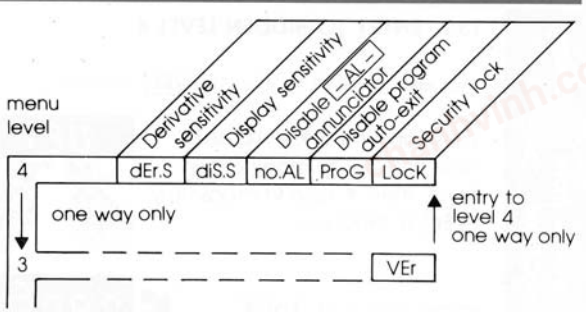
14 TECHNICAL FUNCTIONS: SECURE LEVEL 4



14.(4.1) dEr.S [0.1] – [1.0] x [dEr.t] [0.5]
Derivative sensitivity

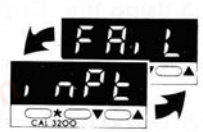
14.(4.2) di.SS [dir] [1] – [32] [6]
Display sensitivity
[dir] = Direct display of input
[1] = Maximum [32] = Minimum sensitivity

14.(4.3) no.AL [oFF] [on]
Disable SP2 Alarm annunciator [-AL-]
Select [on] to disable [-AL-]

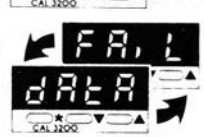
14.(4.4) ProG [Auto] [StAY]
Program mode auto-exit switch
Auto-exit returns display to normal if 60 sec

ERROR MESSAGES 15

15.1 Sensor fault
Thermocouple burnout
RTD/Pt100 short circuit
Negative over-range
Action: Check sensor/wiring



15.2 Non-volatile memory error
Action: De-power briefly
Replace unit if it persists



15.3 Manual power error
SP1 in ON/OFF in [CYC.t]
Action: Select proportional mode



15.4 Immediate fail on Autotune start
1. Setpoint unset on new unit
2. SP1 at ON/OFF in [CYC.t]
Select proportional mode
Note: Message latches
Press ▲▼ briefly to reset



15.5 Fail during Autotune tuning cycle
The thermal characteristics of the load exceed the Autotune algorithm limits. The failure point is the first display in [dAtA] with [0.0]

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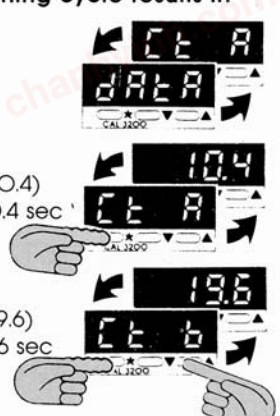
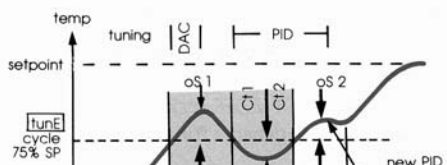
15.6 Reading Autotune tuning cycle results in dAtA



1. Index to **dAtA**
   Release ▼ or ▲
2. Press and hold ✱
   Displays **Ct A** value (10.4)
   i.e. Cycle time 'A' = 10.4 sec
3. Keep ✱ pressed
   Press ▲ once
   Displays **Ct b** value (19.6)
   i.e. Cycle time 'b' = 19.6 sec
4. Repeat step 3 above to view:
   Ct 1 **Ct 2** **Ct 3** **Ct 4** , **oS 1** **uS** **oS 2**

15.7 Autotune tuning data and limits



SELECT AUTOTUNE

16(1.1) **tunE** **oFF** **on** **PArK** **At.SP**

Select Autotune, see 7, or PArK

PArK temporarily turns the output(s) off. To use, select **PArK** and exit program mode. **oFF** disables Useful when commissioning fast loads or multizones

SP1 OPERATING PARAMETERS

16(1.2) **bAnd** **0.1** – **✱** °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



Too narrow
(oscillates)
Increase **bAnd**



Too wide
(slow warm up and response)
Decrease **bAnd**

16(1.3) **, nt.t** **oFF** **0.1** – **60** minutes **5.0**

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16 FUNCTIONS AND OPTIONS: LEVEL 1

16(1.4) dEr.t [oFF] [1] – [200] seconds [25]

SP1 Derivative time/Rate

Suppresses overshoot and speeds reponse to disturbances



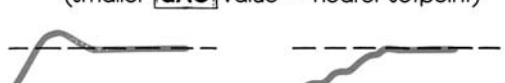
Too short
(slow warm up and response, under corrects)

Too long
(oscillates and over corrects)

16(1.5) dAC [O.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)



Too small
(overshoots)

Too large
(slow stepped warm up)

16(1.6) CYC.t [A --] [on.oF] [O.1] – [81] secs [20]

SP1 Proportional cycle-time, see 9

Determines the cycle rate of the output device for proportional control. Select [on.oF]

16(1.7) oFSt [O] – [*] °C/°F

SP1 Offset/Manual reset

* ± 50% [bAnd]. Applicable in proportional and ON/OFF mode with integral disabled: [Int.t / oFF]

16(1.8) SPLY [oFF] [on]

Lock main setpoint, see 11.2

SP2 OPERATING PARAMETERS

16(1.9) SEt.2 [O] – [*] °C/°F

Adjust SP2 setpoint, see 10

* Deviation alarms [DV.hi] [DV.Lo] [bAnd] : 25% sensor maximum
* Full-scale alarms [FS.hi] [FS.Lo] : sensor range

16(1.10) bnd.2 [O.1] – [*] °C/°F [2.0°C/3.6°F]

Select SP2 hysteresis or Proportional band/ Gain

* 25% sensor maximum

16(1.11) CYC.2 [on.oF] [O.1] – [81] seconds

Select SP2 ON/OFF or Proportional cycle-time

Select [on.oF] for ON/OFF mode or the cycle rate of SP2 output device for proportional mode

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MANUAL CONTROL MODES

16(2.1) SP1.P [0] – [100] % 'Read only'
Read SP1 output percentage power, see 12

16(2.2) hAnd [oFF] [1] – [100] % (Not in ON/OFF)
SP1 manual percentage power control
For manual control should a sensor fail
Record typical [SP1.P] values beforehand

16(2.3) PL.1 [100] – [0] % duty cycle
Set SP1 power limit percentage
Limits max SP1 heating power during warm up and in proportional band

16(2.4) PL.2 [100] – [0] % duty cycle
Set SP2 percent power limit (cooling)

SP2 OPERATING MODES, see 10

16(2.5) SP2.A **Main SP2 operating mode**
[nonE] [dV.hi] [dV.Lo] [bAnd] [FS.hi] [FS.Lo] [CooL]

16(2.6) SP2.b [nonE] [LtCh] [hoLd] [Lt.ho] [nLin]
Subsidiary SP2 mode: latch/sequence
Non-linear cool proportional band

INPUT SELECTION AND RANGING

16(2.7) d.SP [1] [0.1] °
Select display resolution: 0.1° display of PV, SP, [OFSt] [SEt.2] [hi.SC] [Lo.SC]

16(2.10) inPt **Select input sensor** [nonE]

Option/ sensor type		sensor range		linearity ±°C
Thermocouples				
tc b	B	0 to 1800°C	32 to 3272°F	Pt-30%Rh/Pt-6%Rh 2.0 *
tc E	E	0 to 600°C	32 to 1112°F	Chromel/Con 0.5
tc J	J	0 to 800°C	32 to 1472°F	Iron/Constantan 0.5
tc K	K	-50 to 1200°C	-58 to 2192°F	Chromel/Alumel 0.25*
tc L	L	0 to 800°C	32 to 1472°F	Fe/Konst 0.5
tc n	N	-50 to 1200°C	-58 to 2192°F	NiCroSil/NiSil 0.25*
tc r	R	0 to 1600°C	32 to 2912°F	Pt-13%Rh/Pt 2.0 *
tc S	S	0 to 1600°C	32 to 2912°F	Pt-10%Rh/Pt 2.0 *
tc t	T	-200 / 250°C	-273 / 482°F	Copper/Con 0.25*
Resistance thermometer				
rtd		-200 / 400°C	-273 / 752°F	Pt100/RTD-2 0.25*

Linear process inputs (Input mV range: -10 to 50mV)

displays	0-20mV	4-20mV	setpoint limits	
Lin1	0 – 100		0 – 400	±0.5%
Lin2		0 – 100	-25 – 400	
Lin3	0 – 1000		0 – 3000	
Lin4		0 – 1000	-250 – 3000	
Lin5	0 – 2000		0 – 3000	

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

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16 FUNCTIONS AND OPTIONS: LEVEL 3

OUTPUT CONFIGURATION

16(3.1) SP1.d [nonE] [rLY] [SSd]
Select SP1 output device, see 5.3/6.2.4
Note: 'Read only' after initial configuration.
[RSEt] [ALL] full reset to factory settings
required to change [SP1.d] subsequently

16(3.2) SP2.d. [nonE] [SSd] [rLY] 'Read only'
Read SP2 output device, see 5.3/6.2.4
Shows SP2 output device

TECHNICAL FUNCTIONS

16(3.3) burn **Sensor burn-out/break protection**
Caution: Setting affects fail safe state

	SP1	SP2
[uP.SC]	Upscale	Upscale
[dn.SC]	Downscale	Downscale
[1u.2d]	Upscale	Downscale
[1d.2u]	Downscale	Upscale

16(3.4) rEU.d **Select output modes: Direct/Reverse**
Caution: Setting affects fail safe state

	SP1	SP2
[1r.2d]	Reverse	Direct

16(3.5) rEU.L **Select SP1/2 LED indicator modes**

	SP1	SP2
[1n.2n]	Normal	Normal
[1i.2n]	Invert	Normal
[1n.2i]	Normal	Invert
[1i.2i]	Invert	Invert

16(3.6) SPAn [O.O] - [±25% sensor maximum]
Sensor span adjust
For recalibrating to a remote standard
e.g. External meter, data logger

16(3.7) ZEro [O.O] - [±25% sensor maximum]
Zero sensor error, see [SPAn]

16(3.8) ChEU [oFF] [on]
Select control accuracy monitor, see 12.2

16(3.9) rEAd [VAr°] [hi °] [Lo °]
Read control accuracy monitor, see 12.2

16(3.10) dAtA [Ct A] [Ct b] [Ct 1] [Ct 2] [Ct 3] [Ct 4] [oS 1] [uS] [oS 2]
Read Autotune tuning cycle data, see 15

16(3.11) UEr Software version number

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INPUTS, see 16(2.10)

Thermocouple – 9 types
Standards: IPTS 68/DIN 43710
CJC rejection: 20:1 (0.05°/°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: –10 to 50mV
See "PIM Process Interface Module" for additional input/output options

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: 150 ppm/°C SM
Reference conditions: 22°C ±2°C, rated voltage, after 15 minutes settling time

OUTPUT DEVICES (Standard), see 5.3

- **SSd:** Solid state relay drive: To switch a remote SSR 5Vdc +0/–15% 10mA non-isolated
- **Miniature power relay:** Form A/SPST

CONTROL CHARACTERISTICS See 16:

SP1 PID Parameters:	**16(1.1) – 16(1.8)**
SP2 Parameters:	**16(1.9) – 16(1.11)**
SP2 Operating modes:	**16(2.5) – 16(2.6)**
Manual control modes:	**16(2.1) – 16(2.4)**

GENERAL

Supply Voltage:	100-240V±10% 50-60 Hz 3VA 12V or 24V⎓ ±20% 3VA
Digital LED display:	4 digits, 10mm (0.4in), high brightness green, Display range: –199 to 9999
Range:	Sensor limited: 2000°C/3500°F 0.1 hi-res mode –199.9 to 999.9°
Displaying:	Process temperature (PV), Setpoint (SP), SP1/2 indicators (flashing), Error messages. Function/Option mnemonics
Keypad:	3 Elastomeric buttons

ENVIRONMENTAL **Approvals**

Safety:	UL873, CSA 22.2/142-87, EN61010
Humidity:	Max. 80%
Altitude:	Up to 2000M
Installation:	Categories II and III
Pollution:	Degree II
Protection:	NEMA 4X, IP66
EMC Emission:	EN 50 081-1, VDE 0871/78-Class A & B FCC Rules 15 subpart J Class A

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18 CUSTOMER CONFIGURATION RECORD

SER No.					
LEVL ▼ DATE ▶	/	/	/	/	/
1. bAnd					
int.t					
dEr.t					
dAC					
CYC.t					
SEt.2					
bnd.2					
CYC.2					
2. SP1.P					
SP2.A					
SP2.b					
hi.SC					
Lo.SC					
inPt					
unit					
3. SP1.d					

CAL Controls
Temperature Controllers

ISO 9002
BS 5750