TO SELECT SENSOR AND ADJUST SET POINT

Step 1
POWER UP
Self check sequence

Step 2
ZERO FLASHES ON LEFT
Indicating no sensor selected

Step 3
PRESS A TO SELECT SENSOR e.g. Type K
(Sensor options: For full table shown green)

Step 4
PRESS P TO ENTER TO MEMORY
Set point

Step 5
PRESS TO DISPLAY SET POINT

Step 6
PRESS AND HOLD TO INCREASE SET POINT

Step 7
TO START AUTOTUNE 'AT' near ambient

Step 8
PRESS P TO ACCESS PROGRAM MODE
Function O flashes on right

Step 9
PRESS TO CHANGE TO OPTION SELECTION
Option O flashes on left

Step 10
PRESS A TO SELECT AUTOTUNE 'AT'

Step 11
PRESS P TO START AUTOTUNE 'AT'

The controller is now operational with factory PID settings:
- Prop band 2.5%
- Prop time 20 sec
- Derivative 25 sec
- Integral 5 min
- DAC approach control 15

AUTOTUNE TYPES AND USES

Two types of Autotune are provided to ensure optimum control of a wide range of applications:

AUTOTUNE AT = Normal method. tunes during warm up

AUTOTUNE PT = (Push-to-Tune) = For difficult applications. tunes at set point

OVERDING AUTOTUNE VALUES

After AT/PT any Autotune parameter may be changed to an Option from the table. The original Autotuned value is retained in memory unless or until it is changed.

Note: Subsequent Autotune AT or PT run replaces manual selections with new calculated values (except Cycle time)
4 CONTROLLER FUNCTIONS
DISPLAY AND SELECTION PROCEDURE

The facilities at the 9900 are selected from the Functions and Options Table see 5 using program mode

Functions (Fn) - The available controller functions
Options (Opt) - The available values for each function eg. Function 5 Option 0 (Fn 5/0) = 15 Prop band Gain
Note. Should difficulty occur in adjusting options check the parameter block see 14
Note 2. Normal control is maintained with existing settings during programming.

1. Step 1
PRESS P TO ENTER PROGRAM MODE

2. Step 2
PRESS AND HOLD \( \Delta \) TO INDEX FUNCTION
eg. Function 16 (Sensor select) flashes

3. Step 3
PRESS \( \downarrow \) or \( \uparrow \) TO SELECT OPTION
eg. Option 2 (Type K)

4. Step 4
PRESS P TO ENTER PROGRAM MODE

5 AUTOTUNE HINTS

5.1 Autotune error messages see 11 (EE6-7)
(Latched. PRESS \( \downarrow \) to reset)
ATU/PI tunes most applications satisfactorily, but if tuning fails or error messages repeatedly occur the application has unusual characteristics requiring manual tuning see 21

5.2 Tunnelling point too close to ambient.
Difficult both to control and Autotune. Use SP if tuning fails try with Fn 5/0. Otherwise increase set point or tune manually

5.3 In High Resolution (0.1%)
Should error message E6 occur during tuning, select normal resolution (Fn 15/0) then Autotune and afterwards re-select H-Res. (check range setting Fn 24)

5.4 AUTOTUNE VALUE DISPLAY
At the end of an Autotune run the AT value is automatically entered and may be displayed in Functions
Prop band Gain
Derivative time/Rat
DAC panel control
Integral time/Reset

Step 1
PRESS P TO ENTER PROGRAM MODE

Step 2
PRESS \( \uparrow \) TO INDEX TO FUNCTION
eg. Function 5 Prop Gain
AT value = 35%

Note 3 LEDs show AT value displayed

6 PROPORTIONAL CYCLE TIME

6.1 Autotune cycle time
Autotune calculates the optimum value but for safety reasons does not automatically implement it!

6.2 If the cycle time needed is known
Applications known to require shorter times than the 20 seconds factory setting, including SSR drive (1 sec), linear outputs (0.05 sec)
should select the appropriate Option in Function 4 using the procedure see 4.
This setting will not be changed but may be replaced with the calculated AT value if preferred after the Autotune run

6.3 Normal procedure
Run Autotune AT see 2 when complete (alternating AT display stops) display the AT calculated cycle time and accept it. Suitable value is then replaced the 20 sec factory setting

Step 1
Index to Function 4
For procedure see 4
Option 0: 20 sec factory setting

Step 2
PRESS \( \uparrow \) TO CHANGE TO OPTION SELECTION

Step 3
PRESS \( \downarrow \) TO DISPLAY CALCULATED AT VALUE
eg. 98 sec
Note flashing bar shows calculated AT value is displayed

6.4 AT Cycle time values in Function 4
Two AT cycle time values are stored, to enable the current operational value to be retained, until a new value from a subsequent Autotune run is considered. Example of two AT cycle time values after a subsequent Autotune run.

Step 5
Index to Function 4
Operational AT value = 98 sec
As accepted previously
(Step 4) Note 3 LEDs ON

Step 6
PRESS \( \uparrow \) TO DISPLAY
Latest calculated AT value = 72 sec
Note flashing bar

Step 8 Alternative actions:
PRESS P to accept the latest calculated AT value = 72 sec which replaces 98 sec on the operational AT value
OR PRESS \( \downarrow \) to display current operational AT value. Then PRESS P to retain 98 sec
OR PRESS \( \downarrow \) to select Option from Table

7 ALARMS

7.1 SP2 Operating mode
The operating mode must be selected at Function 19 before adjusting SP2 at Function 2.

7.2 Alarm output operation
The alarm output is safe, SP2 relay is de-energised and SP2 red LED on during the alarm condition (Not with SP2 in Proportion mode)

7.3 LBA - Loop break alarm see Fig. 3
LBA detects a control loop fault and displays an error message (EE3). The alarm relay may be configured to order or bypass LBA operates if the controller fails to receive the correct response from the output within a set time limit.
LBA occurs when SP1 output is saturated at 0 or 100% and the process temperature falls below the SP1 band in the LBA time. SP1 output state is unaffected by LBA alarm condition

Fig. 3 Typical faults detected by LBA

7.4 Selecting LBA - EE3 message only
1. Enter for Function 18 - LBA Time
Option 0 - LBA OUT, displayed
2. PRESS \( \uparrow \) to change to option selection
3. PRESS \( \downarrow \) to select Option 14
4. LBA alarm condition: EE3 displayed, alternating with process temperature display, to reset PRESS \( \uparrow \) together
To configure alarm relay SP2 to LBA Select Option 6 in Function 19 (Relay latches in alarm condition, to reset PRESS \( \downarrow \)
Note Use LBA with SP2 ON/OFF mode only (Fn 10/Opt 0). Restart EE3/Relay before any other program changes
### OPERATING MODE

#### Protected

<table>
<thead>
<tr>
<th>Fn</th>
<th>Opt No.</th>
<th>Parameter</th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td>1</td>
<td>Normal Operation</td>
</tr>
<tr>
<td>4</td>
<td>0</td>
<td>Normal operation PT</td>
</tr>
<tr>
<td>2</td>
<td>3</td>
<td>Autotune AT</td>
</tr>
<tr>
<td>2</td>
<td>3</td>
<td>Autotune AT</td>
</tr>
<tr>
<td>5</td>
<td>2</td>
<td>Park mode</td>
</tr>
<tr>
<td>2</td>
<td>1</td>
<td>Manual Reset (OUT IN PID)</td>
</tr>
<tr>
<td>2</td>
<td>0</td>
<td>SP2 Adjust</td>
</tr>
<tr>
<td>3</td>
<td>1</td>
<td>SP1 Lock</td>
</tr>
</tbody>
</table>

#### Operating mode

- **0**: Normal operation
- **1**: Start Autotune AT
- **2**: Start Autotune AT
- **3**: Park mode
- **4**: Manual Reset

#### USER SETTINGS

- **Manual Reset**: OUT IN PID
- **SP2 Adjust**: 1° steps (max ±127° / 50% prop band)

### OPERATIONAL PARAMETERS

#### Protected

<table>
<thead>
<tr>
<th>Fn</th>
<th>Opt No.</th>
<th>Parameter</th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td>1</td>
<td>SP1 DAC approach control</td>
</tr>
<tr>
<td>9</td>
<td>1</td>
<td>Sensor error correction</td>
</tr>
<tr>
<td>10</td>
<td>1</td>
<td>SP2 Proportional cycle time</td>
</tr>
<tr>
<td>11</td>
<td>1</td>
<td>SP2 Proportional band/Gain in ON/OFF mode</td>
</tr>
<tr>
<td>12</td>
<td>1</td>
<td>LPB... Loop break alarm...time</td>
</tr>
<tr>
<td>15</td>
<td>1</td>
<td>Reset Services O...24 to factory settings</td>
</tr>
</tbody>
</table>

#### Operating mode

- **0**: Normal operation
- **1**: Start Autotune AT
- **2**: Start Autotune AT
- **3**: Park mode
- **4**: Manual Reset

#### USER SETTINGS

- **Manual Reset**: OUT IN PID
- **SP2 Adjust**: 1° steps (max ±127° / 50% prop band)

#### OPERATIONAL PARAMETERS

<table>
<thead>
<tr>
<th>Fn</th>
<th>Opt No.</th>
<th>Parameter</th>
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</thead>
<tbody>
<tr>
<td>7</td>
<td>1</td>
<td>SP1 DAC approach control</td>
</tr>
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<tr>
<td>10</td>
<td>1</td>
<td>SP2 Proportional cycle time</td>
</tr>
<tr>
<td>11</td>
<td>1</td>
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</tr>
<tr>
<td>12</td>
<td>1</td>
<td>LPB... Loop break alarm...time</td>
</tr>
<tr>
<td>15</td>
<td>1</td>
<td>Reset Services O...24 to factory settings</td>
</tr>
</tbody>
</table>

#### Abbreviations:

- **Fn**: Function
- **Opt**: Option
- **SR**: Sensor range
- **CR**: Configured range

### INITIAL CONFIGURATION

#### Protected

<table>
<thead>
<tr>
<th>Fn</th>
<th>Opt No.</th>
<th>Parameter</th>
</tr>
</thead>
<tbody>
<tr>
<td>16</td>
<td>1</td>
<td>Sensor Select and Range Table</td>
</tr>
</tbody>
</table>

#### Table |

<table>
<thead>
<tr>
<th>Type</th>
<th>Factory set</th>
<th>Sensor range (SR)</th>
</tr>
</thead>
<tbody>
<tr>
<td>T/C</td>
<td>°C</td>
<td>°F</td>
</tr>
<tr>
<td>1</td>
<td>4°C</td>
<td>40°F</td>
</tr>
<tr>
<td>2</td>
<td>8°C</td>
<td>40°F</td>
</tr>
<tr>
<td>3</td>
<td>16°C</td>
<td>60°F</td>
</tr>
<tr>
<td>4</td>
<td>35°C</td>
<td>95°F</td>
</tr>
<tr>
<td>5</td>
<td>60°C</td>
<td>140°F</td>
</tr>
<tr>
<td>6</td>
<td>80°C</td>
<td>180°F</td>
</tr>
<tr>
<td>7</td>
<td>120°C</td>
<td>250°F</td>
</tr>
<tr>
<td>8</td>
<td>200°C</td>
<td>400°F</td>
</tr>
</tbody>
</table>

#### Range minimum: **0°C/32°F**

- **Except 1/2/100**
- **Factory set 0°C/32°F**
- **Minimum available -200°C/°F**

#### Linear process inputs Display

| 11 | 2 | O: 20mV |
| 12 | 3 | O: 20mV |
| 13 | 4 | O: 20mV |
| 14 | 5 | O: 20mV |

#### Negative temperature ranging

| 17 | 1 | Disabled |
| 18 | 1 | Display resolution |
| 19 | 2 | SP2 Operating mode |
| 20 | 1 | SPI Sensor break |
| 21 | 1 | SP2 Sensor break |
| 22 | | °C/°F (Note: Change top fascia) |
| 23 | | Software version number |
| 24 | | Configured range (CR) adjustment |

#### Abbreviations:

- **Fn**: Function
- **Opt**: Option
- **SR**: Sensor range
- **CR**: Configured range

#### Further notes:

- **Mode B adjustment see 4.2**
- **(See Range Table in Function 16)**
10 ELECTRICAL INSTALLATION

& INSTALLATION: IMPORTANT SAFETY INFORMATION PLEASE REVIEW
1. Should the unit malfunction, return it to the factory. If defective it will be repaired or replaced at no charge.
2. The warranty does not cover any damage caused by misuse.
3. Components which wear or damage with misuse, are excluded. e.g. Relays, SSR.
4. To comply with this warranty the installation and use must be by suitably qualified personnel.
5. West Control Solutions shall not be responsible for any damage or loss to other equipment however caused, which may or may not have resulted as a result of the installation or use of this product.
6. West Control Solutions liability for any breach of this agreement shall not exceed the purchase price paid.

11 ERROR MESSAGES

Fuses: 250VAC rated, time lag type to IEC 127.

12 9900 SPECIFICATION

Inputs

See Table 1 for range Table

Thermocouple - 9 types

<table>
<thead>
<tr>
<th>Type</th>
<th>Resistance</th>
<th>Voltage</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>J</td>
<td>4.6704</td>
<td>1.625</td>
<td>0-1000</td>
</tr>
<tr>
<td>K</td>
<td>3.9229</td>
<td>1.257</td>
<td>0-1200</td>
</tr>
<tr>
<td>E</td>
<td>2.7364</td>
<td>0.975</td>
<td>0-1380</td>
</tr>
<tr>
<td>R</td>
<td>2.3203</td>
<td>0.807</td>
<td>0-1500</td>
</tr>
<tr>
<td>S</td>
<td>2.8666</td>
<td>0.996</td>
<td>0-1600</td>
</tr>
<tr>
<td>N</td>
<td>2.5978</td>
<td>0.949</td>
<td>0-1700</td>
</tr>
<tr>
<td>B</td>
<td>2.4327</td>
<td>0.884</td>
<td>0-1800</td>
</tr>
<tr>
<td>J</td>
<td>3.9487</td>
<td>1.345</td>
<td>0-1900</td>
</tr>
<tr>
<td>Chromel/Alumel</td>
<td>5.929</td>
<td>2.088</td>
<td>0-2000</td>
</tr>
</tbody>
</table>

Outputs

Output module - Dual Standard

<table>
<thead>
<tr>
<th>Type</th>
<th>Voltage</th>
<th>Current</th>
</tr>
</thead>
<tbody>
<tr>
<td>SPI</td>
<td>24VDC</td>
<td>25mA</td>
</tr>
</tbody>
</table>

Control

See Table 1 for range Table

Thermocouple - 9 types

<table>
<thead>
<tr>
<th>Type</th>
<th>Resistance</th>
<th>Voltage</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>J</td>
<td>4.6704</td>
<td>1.625</td>
<td>0-1000</td>
</tr>
<tr>
<td>K</td>
<td>3.9229</td>
<td>1.257</td>
<td>0-1200</td>
</tr>
<tr>
<td>E</td>
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</tr>
<tr>
<td>R</td>
<td>2.3203</td>
<td>0.807</td>
<td>0-1500</td>
</tr>
<tr>
<td>S</td>
<td>2.8666</td>
<td>0.996</td>
<td>0-1600</td>
</tr>
<tr>
<td>N</td>
<td>2.5978</td>
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<tr>
<td>B</td>
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<td>J</td>
<td>3.9487</td>
<td>1.345</td>
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</tr>
<tr>
<td>Chromel/Alumel</td>
<td>5.929</td>
<td>2.088</td>
<td>0-2000</td>
</tr>
</tbody>
</table>

10.2 MECHANICAL

1. Prepare a 1/16 DIN panel cut-out: 45 x 45mm +0.6 -0
2. Remove the socket, pressing in the lock buttons
3. Slide the controller into the cut-out
4. Fit the mounting clip see fig. pressing it firmly against the panel, fixing screws optional
5. Plug on the socket
6. After installation remove and discard the protective front window label
7. Cleaning - if required wipe with damp cloth (water only)

Environments

Humidity: Max. 80%
Altitude: Up to 2000M
Installation: Categories II and III
Pollution: UL61010-1 Edition 3
Protection: IP54 (with gasket)
EMC Emission: EN61326-1:2013
EMC Immunity: EN61326-1:2013 Table 1.
Ambient: 0.5°C (32-130°F)
Mouldings: Flame Retardant Polycarbonate

West Control Solutions policy of continuous development may cause detail changes to the enclosed information. E & O.E
**13 ADVANCED FUNCTIONS SECURITY**

The advanced functions are intended for OEM's and process engineers. Access is therefore protected in the Function table.

**13.1 HIDDEN ACCESS TO ADVANCED FUNCTIONS**

To avoid unauthorised use of these functions remove this section from the manual before supply to end user.

**13.2 ADVANCED FUNCTIONS ... Protected**

<table>
<thead>
<tr>
<th>Fn</th>
<th>Opt</th>
<th>Parameter</th>
<th>Normal</th>
<th>Off when logically ON</th>
</tr>
</thead>
<tbody>
<tr>
<td>26</td>
<td></td>
<td>SPI Heat Power limit</td>
<td>1 25% max</td>
<td>1 50%</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>2 25% max</td>
<td>2 50%</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>3 25% max</td>
<td>3 50%</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>27</td>
<td></td>
<td>SP2 Cool limit</td>
<td>0 100% max</td>
<td>4 40%</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>1 75% max</td>
<td>5 30%</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>2 50% max</td>
<td>6 20%</td>
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<td></td>
<td></td>
<td></td>
<td>3 30% max</td>
<td>7 10%</td>
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<td></td>
<td></td>
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<td>4 20% max</td>
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<td></td>
</tr>
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<td></td>
<td></td>
<td></td>
<td>7 1% max</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Not in SPI ON/OFF mode</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Direct/Reverse mode selection</td>
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<td></td>
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<tr>
<td>28</td>
<td></td>
<td>SPI Output</td>
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</tr>
<tr>
<td>29</td>
<td></td>
<td>SPI LED</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>30</td>
<td></td>
<td>SP2 Output</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>31</td>
<td></td>
<td>SP2 LED</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>32</td>
<td></td>
<td>Error indicator resolution</td>
<td>0 Normal (2% range/segment)</td>
<td>0 Normal (2% range/segment)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>1 High (1%)</td>
<td>1 High (1%)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>2 Low (1%)</td>
<td>2 Low (1%)</td>
</tr>
<tr>
<td>33</td>
<td></td>
<td>Temperature display sensitivity</td>
<td>0 Normal</td>
<td>0 Normal</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>1 High</td>
<td>1 High</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>2 Low</td>
<td>2 Low</td>
</tr>
<tr>
<td>34</td>
<td></td>
<td>Derivative polling ratio</td>
<td>0 0.5 x derivative time</td>
<td>0 0.5 x derivative time</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>1 0.2</td>
<td>1 0.2</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>2 0.7</td>
<td>2 0.7</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>3 0.1</td>
<td>3 0.1</td>
</tr>
<tr>
<td>35</td>
<td></td>
<td>Sensor span adjust</td>
<td>0.1% steps (+15% /-16% max)</td>
<td>0.1% steps (+15% /-16% max)</td>
</tr>
</tbody>
</table>

Note: 'Hidden' Fn 15/ Opt 5 resets ALL functions, except Fn 22.
Cool strategy: A change in load causes movement of the linked heat and cool prop bands.

1. Integer causes linked prop bands to move up
2. Stabilises e.g. 30% heat
3. Exothermic load change causes integer to move prop bands down minimising disturbance
4. Minimum offset achieved (4a – offset without cool strategy integral action)
5. Stabilises e.g. 50% cool
6. Consistent dead band throughout

17.1 Set up routine for heat cool (single zone procedure)

Step 1. Run Autotune AT: Set normal operating temp Accept AT proportional cycle time FN 4/0pt 15
Note: SPI/SP2 cycle times must be compatible with switching devices used (SP2 cool output is off at this stage)

When temperature stable set point:

1. Select cool strategy FN 19/0pt 7
2. Select cool prop band option value from table nearest to heat prop band value (view FN 11)
3. Select cool cycle option value nearest to heat cycle time value (view FN 10)
4. Adjust SP2 dead band to 0°C (factory set 5°C)

3. Run with normal background exothermic thermal conditions, good results should be achieved and provide the basis for fine tuning

4. Further adjustments:
   - Water cooling: Should convection occur try (in order):
     - Double cool prop band value FN 11 and reduce integral time value FN 8
     - I2 cycle time FN 10
     - Introduce cool overlap FN 21/(-)ve

5. Linear cooling for water cooling above 100°C where frost to steam occurs. Select linear ranges in cool cycle time FN 10/0pt 13-15

6. Fine tuning
   - If overshoot (into cool) or undershoot (into heat) occurs, slowly make the following adjustments, observing the result:
     - Increase cool overlap FN 21/(-)ve
     - Apply SP2 cool limit progressively FN 27/0pt 1
     - If needed: SPI heat limit FN 26/0pt 1

7. Contact CAL for more application advice and data if required

18 Notes on other functions

Function item FN 0 Park mode (Opt 3)
Temporarily turns outputs off
Display: 1 and Process temperature
Useful in commissioning and troubleshooting e.g. Multiple applications
Manual heat (Opt 4/10/0)
If sensor break occurs (E82/2) SPI output (heater power) may be manually controlled 4-100% (Not in ON/OFF mode)
Display: XX (XX = % output)

FN 3 SPI Set point lock
Stops unauthorised adjustment

FN 5 Retransmission
With 100% prop band, accuracy ±5% configuration range using linear input/output

FN 16 Linear process inputs
Options: 0-10V/0-20mA process interface module (Data from CAL)
This remote module provides greater versatility when using the 9900 with linear inputs

FN 17 Negative temperature ranges
Enables type 7/100-DJ0100 to be used below 0°C/32°F
Note: Increased range to -200°C/F, may effect PID values

FN 18 Display resolution
Note: Effect on set point and other values set in °C/F e.g. 100.0°C in h-res 10°C in normal

FN 26 SPI heat power limit
Limits maximum heater power during warm up. Useful if heaters oversized

FN 27 SP2 cool power limit
Limits maximum cooling power outside prop band in heat-cool

19 Calibrating to a remote standard

To enable the 9900 calibration to match an external meter, data logger etc (i.e. remote reading)

SENSOR ERROR CORRECTION: FN 9
Provides correction at one single temperature (FN 4)

Example Reads
9900 400°C
Remote 400°C
Error +4°C (set-4) correction at 9900
Note: Error polarity applies to 9900 correction

Sensor span adjustment FN 35
Provides correction where two temperatures require differing amounts of adjustment

Example: T1 reads 9900 60°C Remote 60°C Error E1 = +4°C E2 = +5°C

4. Calculation of span adjustment for FN 35
Formula: FN 35 = E1 – E2 (as FN 24)

Example: FN 35 = 60°C – 59°C (FN 24)
FN 35 = 59°C in FN 35

5. A span error entered in FN 35 immediately changes the reading, allow time to stabilise at 12 if an error exists correct with FN 9. Then check FN 11. If an error exists check the reading and calculations repeat if necessary

20 PID tuning notes

1. Proportional cycle time: FN 4/10
   Determines the cycle rate of the output device
   Output device Recommended time
   9900 internal relays 10 sec minimum
   9900 thermal relays 5 sec with derated contacts & snubbers
   SSR linear output 1 sec
   OOS sec

   Ideal
   Too long (oscillates)

2. Proportional band/Gain: FN 5/11
   Smooths out oscillation occurring in ON/OFF control
   Too short (overshoots and oscillates)
   Too long (slow warm up and response)

3. Integral time/Reset: FN 8
   Automatically corrects set error caused by proportional control
   Too short (overshoots and oscillates)
   Too long (slow warm up and response)

4. Derivative time/Space: FN 6
   Suppresses overshoot and limits response to disturbances
   Too long (overshoots and over corrects)
   Too short (slow warm up and response under corrects)

5. DAC approach control: FN 7
   Tunes warm up characteristics independent of normal operating conditions. Controls when derivative action starts on warm up, smaller setting = closer to set point. Useful when sensor very remote from heater
   Too small (overshoots)
   Too large (slow stepped warm up)

21 PID manual tuning guide

For unusual applications producing error messages (E8/E9) on Autotune AT/PT
1. Initial settings:
   FN 9/0/0 (or default functions: FN 5/0/0)
   FN 4/0/1 (ON/OFF mode)
   Normal operating set point
   (Then allow process to stabilise)

2. Take several readings of:
   - Amplitude A
   - Time period T

   (Diagnose functions FN 38/39 may help)

3. Set PID values:
   FN 4 Prop cycle T sec
   FN 5 Int. time T sec
   FN 6 Derivative T sec
   FN 8 Integral T sec
   FN 7 DAC Offset setting

   For next prop cycle
   Next time setting
   Longer
   1.5
   1.0

   For next prop cycle
   FN 9/0/0
   FN 4/0/1 (ON/OFF mode)
   FN 5/0/0

   (Then allow process to stabilise)
Notes: These products are intended for indoor use only
Field wiring employed must be rated for a minimum of 70 deg C