WEST 2510/3510 CONTROLLERS
INSTALLATION AND OPERATING INSTRUCTIONS

IM-0047-A0

Our policy is one of continued improvement and, consequently, the information contained in this publication may differ in some respects from the instrument in question. Therefore, this document does not constitute an offer or part of an offer for sale.

Dynapar, Veeder Root, and Eagle Signal Brands:

pair, and Application Support:
any Rd.
L. 60031
4150 Sales/Order Entry Fax
5277 Applications Support Fax
8731 Sales/Order Entry
8731 Applications Support

Star Brand:

pair, and Application Support:
any Rd.
L. 60031
5288 Sales/Order Entry Fax
5277 Applications Support Fax
6216 Sales/Order Entry
6216 Applications Support

w, West, Rustrak, and LFE Brands:

pair, and Application Support:
any Rd.
L. 60031
4150 Sales/Order Entry Fax
5277 Applications Support Fax
8731 Sales/Order Entry
6659 Applications Support

sregard all phone numbers and addresses in this manual. The
umbers and address on this page are the correct phone number and
s to use for sales, repair, and application support.

Tables

Illustrations

SECTION 1
INTRODUCTION

The WEST 2510 and 3510 are "proportional plus integral plus derivative" (PID) controllers (the 3510 being the more compact of the two); they retain many of the features incorporated in the other instruments in the West microprocessor-based controller range. A red light-emitting-diode (LED) front panel display provides clear and comprehensive information for the user.

The 2510 Controller housing conforms to ¼–DIN measurements and the 3510 conforms to ⅛-DIN measurements: Controllers may be conveniently mounted side-by-side in multiple installations. The approximate power consumption of the 2510 Controller is only 5VA and that of the 3510 Controller is 3VA; therefore, minimum ventilation is required.

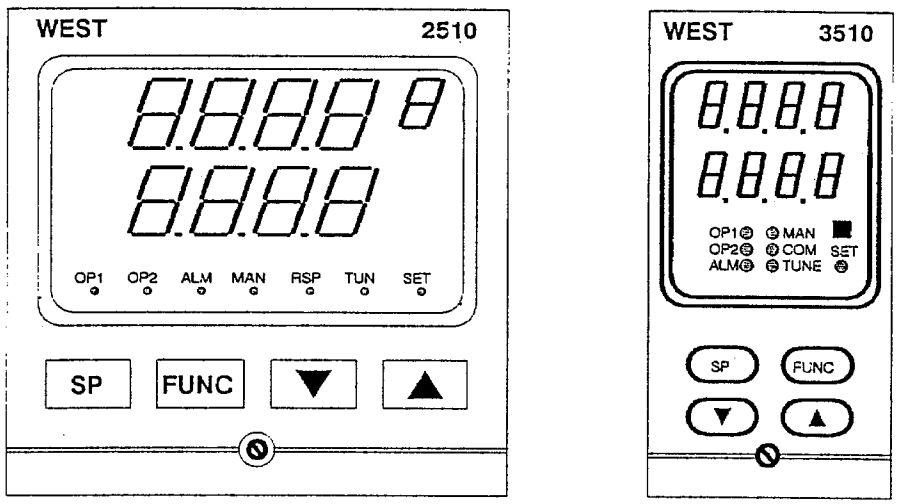


Figure 1-1 2510 and 3510 Controllers

1.1 OPERATOR CONTROLS AND INDICATORS

The Controllers can operate in any one of three modes: User Mode, Set Up Mode or Configuration Mode. In User Mode, the operator may adjust the set point value and monitor the output(s). In Set Up Mode, all control parameters may be viewed and adjusted. In Configuration Mode, the operator may select (a) input range, (b) Control Output 1 action (Reverse or Direct action), (c) Alarm type and (d) Output 2 usage (Alarm or Cool). The 2510 and 3510 front panels are shown in Figure 1-1; each has a number of operator controls and indicators to serve the following functions:

Upper Display: Comprises four digits with decimal points, displaying numbers from 9999 to -1999. In User Mode, displays the value of the process variable. In Set Up Mode, displays the value of the set point and other selected control parameters. Parameter selection is by means of front panel controls. In Configuration Mode, displays the input code (the numeric part of the T--- code for the input), Output 1 action, Alarm 1 type or Output 2 usage.

Lower Display: Comprises four digits with decimal points or up to four alphabetic characters. In User Mode, displays the set point value. In Set Up Mode, displays a legend (up to four alphanumeric characters) which identifies the control parameter being viewed/adjusted. In Configuration Mode, identifies the parameter being configured (Input Code, Control Output 1 action, Alarm 1 type or Output 2 usage).

LED Indicators: The front panel is equipped with up to five LEDs which indicate the various output states and Controller functions.

Controls: Four pushbuttons are provided for parameter entry and selection of control parameters or Controller functions and Configuration operations.

Full details of the use of these controls and indicators may be found in Section 3 (User Mode), Section 4 (Set Up Mode) and Section 5 (Configuration Mode).

1.2 OPTIONS AND VARIANTS

There is a wide range of options and variants available for the 2510 and 3510 Controllers. The variants and options fitted to each Controller are indicated by the product codes shown on the product code label (attached to the Controller housing). Full details of the options and variants available and guidance on interpretation of the product codes can be found in Appendix B.

SECTION 2
INSTALLATION

2.1 UNPACKING PROCEDURE

1. Remove the Controller from its packaging. The Controller is supplied with a mounting clamp and two screws. If the shipment is of a 3510 Controller equipped with e Remote Front Panel (Product Code X74, X75 or X79), the package should also contain the remote Front Panel and an inter-connecting cable with terminating lugs. The length of this cable is dependent upon the product code:

Product Code	Cable Length (metres)
X74	2
X75	5
X79	0.5

NOTE

Retain the packaging for future use, should it be necessary to transport the Controller to another site or to return to the supplier for repair.

2. Examine the delivered items to check for damage or deficiency. If any discrepancy is found, notify the carrier immediately. Check that the product code(s) shown on the product label corresponds to the configuration ordered.

2.2 PANEL-MOUNTING THE CONTROLLER

2.2.1 Pre-Requisites

The panel on which the Controller is to be mounted must be rigid and may be up to 6.00mm (0.25 inches) thick. The cut-out required for a single 2510 Controller or 3510 Controller is as shown in Figure 2-1.

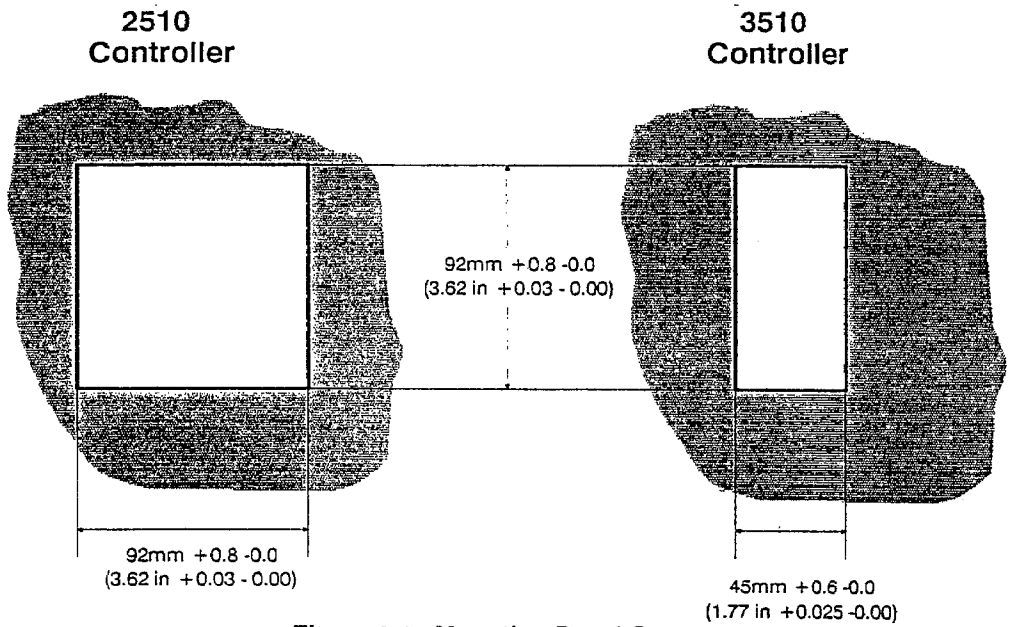


Figure 2-1 Mounting Panel Cut-outs

Several Controllers may be mounted side-by-side in one continuous cut-out, in which case the width of the cut-out (for n Controllers) should be:

For 2510 Controllers:

(96n - 4) millimetres
or
(3.78n - 0.16) inches

For 3510 Controllers:

(48n - 4) millimetres
or
(1.89n - 0.16) inches

The Controller is 150mm (5.9 in) deep, measured from the rear face of the front panel. The front panel is 96mm (3.8 in) high and 96mm (3.8 in) wide; when the Controller is panel-mounted, the front panel projects 6mm (0.25 in) from the panel surface.

2.2.2 Panel-Mounting Procedure

1. Insert the rear of the Controller housing through the cut-out (from the front of the mounting panel) and hold the Controller lightly in position against the panel.

2. Slide the mounting clamp into place on the Controller (see Figure 2-2) and push it forwards until it touches the rear face of the mounting panel. The mounting clamp has teeth which project to the rear and these will engage in ratchets moulded into the top and bottom faces of the Controller housing.

3. Gently tighten the two screws on the clamp until the Controller front panel is fitted snugly in the cut-out in the mounting panel.

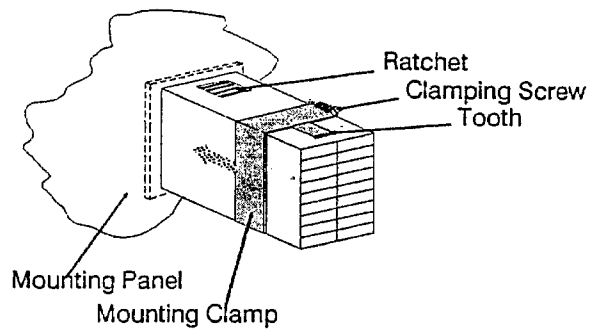


Figure 2-2 Panel-mounting a Controller

CAUTION

Do not over-tighten the screws; this will distort the mounting clamp.

2.3 PANEL-MOUNTING A 3510 CONTROLLER WITH A REMOTE FRONT PANEL

The Remote Front Panel may be mounted on a rigid front panel in the same manner as the standard Controller. The Remote Front Panel is 28mm (1.1 inches) deep, measured from the rear face of the front panel. The Remote Front Panel is 96mm (3.8 inches) high and 48mm (1.89 inches) wide; when panel-mounted, it projects 6mm (0.25 inches) from the mounting surface.

2.3.1 Mounting the Remote Front Panel

1. Remove the screw securing the metal spring clamp to the rear of the Remote Front Panel and remove the clamp.

2. Insert the rear of the Remote Front Panel into the panel cut-out (from the front of the mounting panel) and re-attach the spring clamp to the rear of the remote Front Panel, thereby securing it in position.

2.3.2 Mounting the Controller

The Controller may be installed in the standard manner (as described in Subsection 2.2.2) or by using the Chassis Mounting Bracket Option (Product Code X76) - see Figure 2-3.

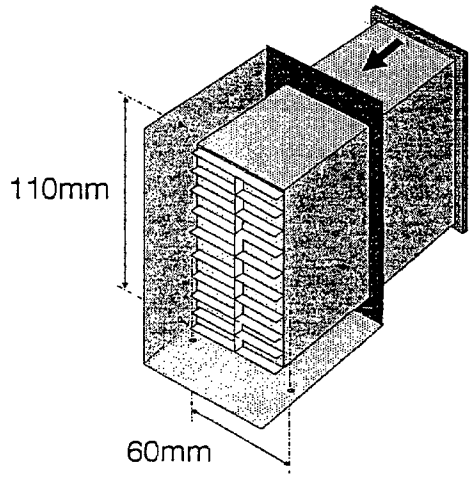


Figure 2-3 Chassis Mounting Bracket

1. Attach the Chassis Mounting Bracket to the mounting panel with suitable screws or bolts (maximum thread diameter = 4mm). Note that the Chassis Mounting Bracket may be positioned such that the Controller may be mounted either upright or on its side; in the latter case, the right side (as viewed from the front of the Controller) should be lowermost.

2. Insert the rear of the Controller housing through the aperture in the Chassis Mounting Bracket and secure it in position in the same manner as in panel-mounting a standard Controller (see Subsection 2.2.2).

2.3.3 Installing the Controller - Remote Front Panel Cable

The Controller is connected to the Remote Front Panel by the cable supplied. *This cable should not run in close proximity to any power-carrying cables.*

1. Plug the two ends of the cable into the IDC sockets on the Remote Front Panel and the Controller (with the suare plastic key on each cable plug engaging in the keyway in each socket).

2. Press the two plastic retainer clips together to secure the cable connector at each end of the cable.

2.4 REMOVAL OF THE CONTROLLER FROM ITS HOUSING

For the purposes of replacement or servicing, the Controller may be easily removed from its housing, leaving the housing and back-wiring attached to the mounting panel.

WARNING

The mains (line) supply must be disconnected from the Controller before any attempt is made to remove the Controller from its housing.

CAUTION

The Controller contains static-sensitive devices and a lithium battery. When the Controller is handled, precautions should be taken to minimise the risk of damage from static discharge and from short-circuiting the battery.

To remove the Controller from its housing:

1. With a flat-bladed screwdriver of appropriate size (¼-inch), rotate the retaining screw at the base of the Controller front panel (see Figure 2-4) anticlockwise. This will cause the Controller to be partially withdrawn from its housing and will dis-engage the connector at the rear of the Controller.

2. When the screw has become dis-engaged from the housing, carefully withdraw the Controller from the housing.

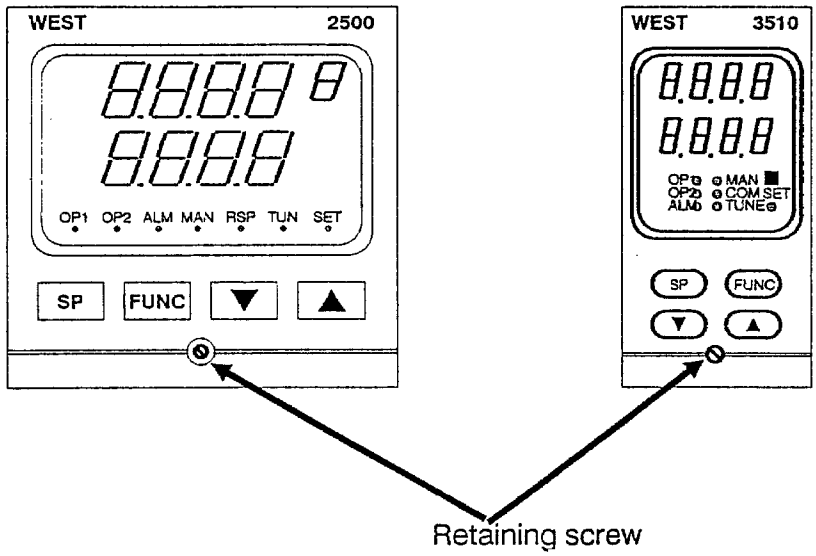


Figure 2-4 Location of Retaining Screw

2.5 REPLACEMENT OF THE CONTROLLER IN ITS HOUSING

1. Carefully insert the Controller (rear end first) into the housing, ensuring that the PCBs engage in the card guides moulded in the top and bottom of the housing.

2. Firmly push the Controller fully into the housing in order that the rear connections on the PCBs make good contact with the terminals at the rear of the housing.

3. Engage the locking screw into the threaded hole at the bottom of the front of the housing and tighten this screw to secure the Controller in position.

2.6 REMOVAL OF THE HOUSING FROM THE MOUNTING PANEL

1. Loosen the two clamping screws (see Figure 2-2).

2. Supporting the housing with one hand, remove the mounting clamp by dis- engaging the teeth from the ratchets (using a piece of stiff card) and sliding the mounting clamp towards the rear of the housing.

3. Extract the housing forwards through the aperture in the mounting panel.

2.7 CONNECTIONS AND WIRING

CAUTION

This equipment is designed for installation in an enclosure which provides adequate protection against electric shock.

Connections are provided at the rear of the Controller for the inputs and outputs (see Figure 2-5).

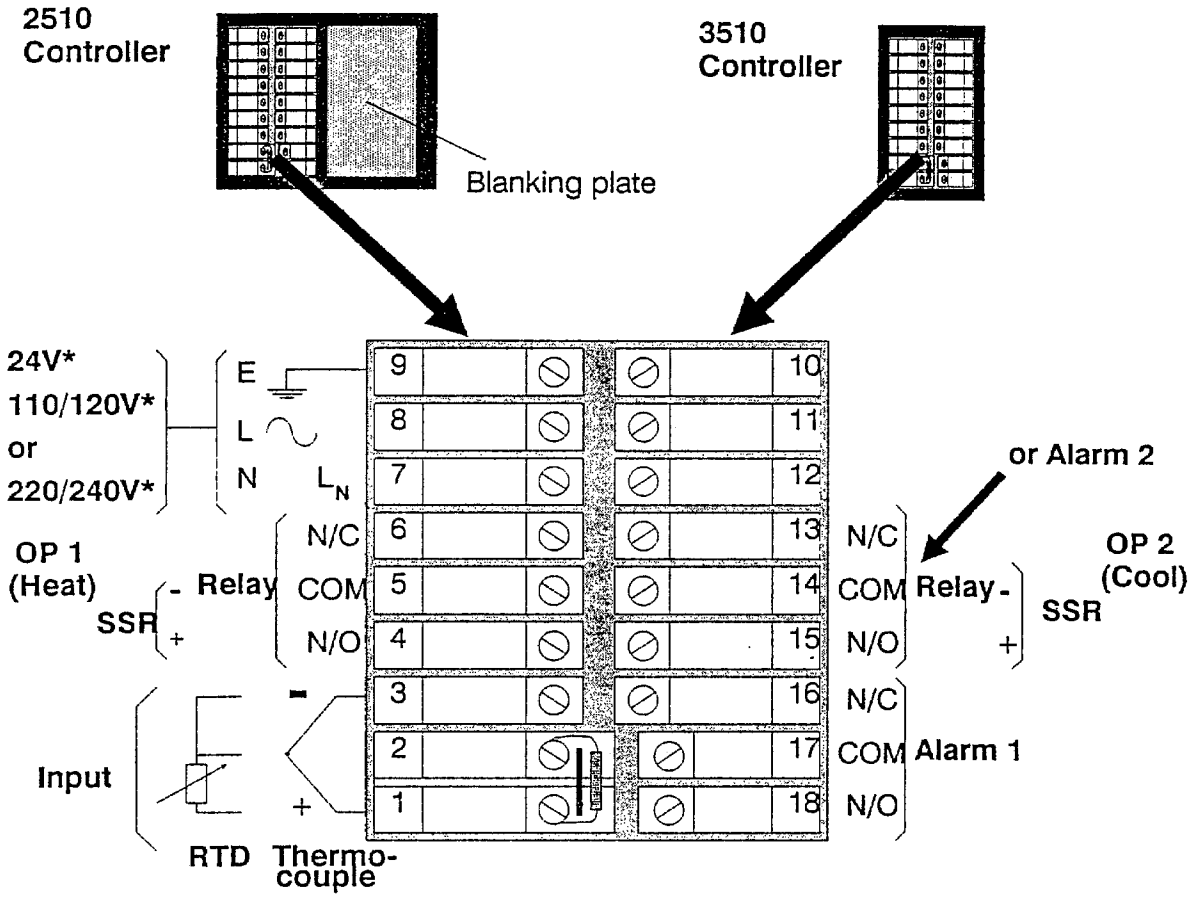


Figure 2-5 Rear Terminal Connections

2.7.1 Mains (Line) Input

The Controller is supplied for operation on 24V, 193V - 264V or 100V - 132V (50/60Hz) as stated on the Product Code Label. **Check that the designated voltage is correct before applying power.** Local requirements regarding electrical installation should be rigidly observed. Ground terminals must be connected separately and must not be made common to the neutral connection. Consideration should be given to the prevention of access by unauthorised personnel to the power terminations. The ground terminal (Terminal 9) should be connected to a protective ground conductor before any other connections are made; this should remain connected at all times. Power should be connected via a two-pole switch and a fuse (1A for 100V - 132V and 193V - 264V, 5A for 24V operation) as shown in Figure 2-6.

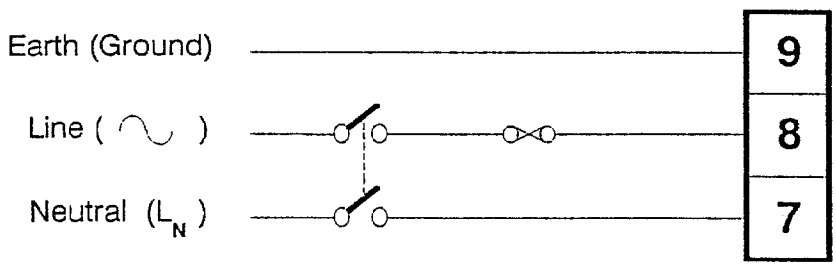


Figure 2-6 Mains (Line) Supply Connections

2.7.2 Thermocouple Input

Thermocouple connections are shown in Figure 2-7. Thermocouple leads should be connected to Terminal 1 (positive) and Terminal 3 (negative). The correct type of thermocouple extension leadwire or compensating cable must be used for the entire distance between the Controller and the thermocouple, ensuring that the correct polarity is maintained throughout. Joints in the cable should be avoided, if possible.

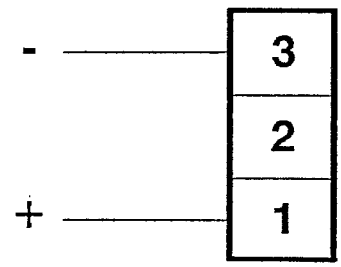


Figure 2-7 Mains (Line) Supply Connections

NOTE

Do not run thermocouple cables adjacent to power-carrying conductors. If the wiring is run in a conduit, use a separate conduit for the thermocouple wiring. If the thermocouple is grounded, this must be done at one point only. If the thermocouple extension lead is shielded, the shield must be grounded at one point only.

The colour codes used on thermocouple extension leads are shown in Table 2-1.

Table 2-1 Thermocouple Cable Colour Codes

Thermocouple Type	Cable Material	British (BS)	American (ASTM)	German (DIN)	French (NFE)
T	Copper Constantan	+ White – Blue * Blue	+ Blue – Red * Blue	+ Red – Brown * Brown	+ Yellow – Blue * Blue
J	Iron/Constantan	+ Yellow – Blue * Black	+ White – Red * Black	+ Red – Blue * Blue	+ Yellow – Black * Black
K	Nickel Chromium Nickel Aluminium	+ Brown – Blue * Red	+ Yellow – Red * Yellow	+ Red – Green * Green	+ Yellow – Purple * Yellow
R S	13% Copper 10% Copper Nickel	+ White – Blue * Green	+ Black – Red * Green	+ Red – White * White	+ Yellow – Green * Green
B	Platinum/Rhodium		+ Grey – Red * Grey		

* Colour of overall sheath

WEST manufactures and supplies a range of suitable thermocouples and thermocouple extension cables.

2.7.3 Resistance Temperature Detector (RTD) Input

RTDInput connections are shown in Figure 2-8. The compensating lead should be connected to Terminal 3. Four two-wire RTD inputs, Terminals 2 and 3 should be linked. The extension leads should be of copper and the resistance of the wires connecting the resistance element should not exceed 5 ohms per lead (the leads should be of equal length).

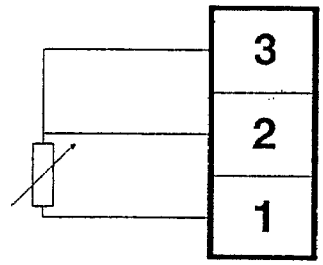


Figure 2-8 RTD Input Connections

2.7.4 Output 1 (Heat)

NOTE

Product Codes H10 and H50 have Output 1 reverse-acting i.e. the relay is energised when the process variable is below the set point and is de- energised when the process variable is above the set point. If Output 1 is direct-acting, the Product Code H10 or H50 has a suffix 31.

2.7.4.1 RELAY OUTPUT 1 (PRODUCT CODE H10--)

The output relay has contacts connected to the Controller's rear terminals. The contacts are rated at 5A 240V AC with a resistive load. When the relay is energised, the front panel OP1 indicator is ON.

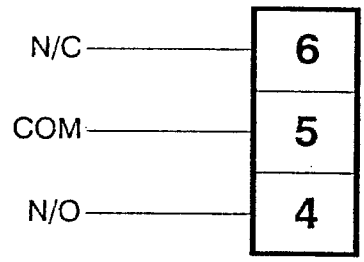


Figure 2-9 Relay Output 1 Connections

2.7.4.2 SSR DRIVE OUTPUT 1 (PRODUCT CODE H50--)

Controllers with this output produce a time-proportioned non-isolated DC signal (0V - 12V nominal, output impedance 250 ohms). This is suitable for driving thyristor units or solid state relays with an isolated input. When Output 1 is ON, the front panel OP1 indicator will be ON.The SSR Drive connections for Output 1 are shown in Figure 2-10.

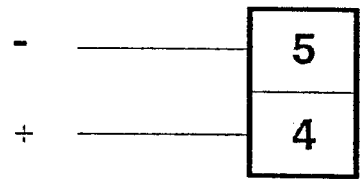


Figure 2-10 SSR Drive Output 1 Connections

2.7.5 Output 2 (Cool)

NOTE

The action of Output 2 is always the reverse of that for Output 1 i.e. if Output 1 is reverse-acting, Output 2 is direct-acting or vice versa.

2.7.5.1 RELAY OUTPUT 2 (PRODUCT CODE C10--)

The output relay contacts are connected to the Controller's rear terminals. The contacts are rated at 2A 240V AC with a resistive load. When the relay is energised, the front panel OP2 indicator is ON.

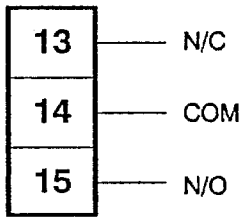


Figure 2-11 Relay Output 2 Connections

2.7.5.2 SSR DRIVE OUTPUT 2 (PRODUCT CODE C50--)

Controllers with this output produce a time-proportioned non-isolated DC signal (0V - 12V nominal output impedance 250 ohms). This is suitable for driving thyristor units or solid state relays with an isolated input. When Output 2 is ON, the front panel OP2 indicator will be ON. The SSR Drive connections for Output 2 are shown in Figure 2-12.

Figure 2-12 SSR Drive Output

2.7.6 Alarm 1 Output - Optional (Product Codes C--46 to C--51)

The relay connections for the Alarm 1 output are shown in Figure 2-13. Details of the operation of the various types of alarms are given in Subsection 4.9.

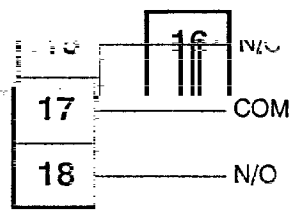
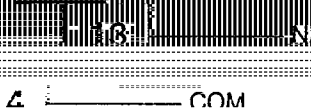


Figure 2-13 Alarm 1 Output Connections

2.7.7 Alarm 2 Output - Optional (Product Codes C--46 to C--51)

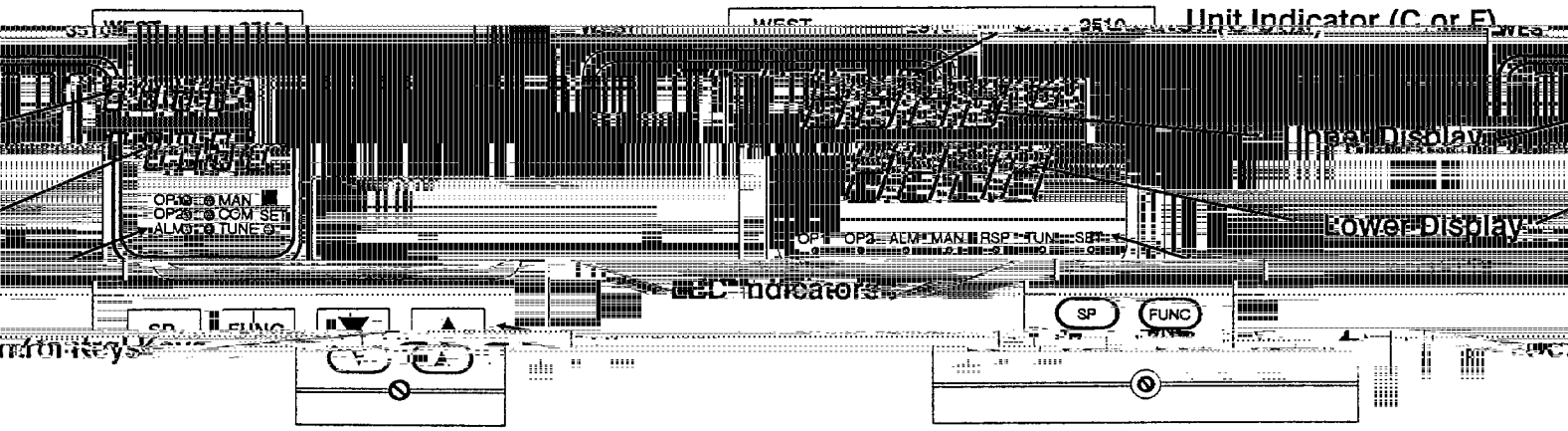
The relay connections for the Alarm 2 output are shown in Figure 2-14. Details of the operation of the various types of alarms are given in Subsection 4.9.



NOTE

All capacitors should conform to VDE (Class X) and should be suitable for operation at 260V AC. All resistors (wirewound or Allen Bradley Type GB) should have a minimum power rating of 2 watts.

SECTION 3



ys and Indicators Figure 3-1 Controls, Displa

3.1 INTRODUCTION

figured and is in User
et point value (shown

These instructions are based on the assumption that the Controller has been set up and conf
Mode. In User Mode, both the process variable value (shown in the upper display) and the s
in the lower display) may be viewed. The set point value may be adjusted

PLAYS (USER MODE)

3.2 DIS

er Display: This four-digit display shows the current value of the process variable or (if set
ected) the current value of the set point.
ur-character display shows the current value of the set point or (if set point
the legend SP.

Upp
point adjustment is sel
Lower Display: This fou
adjustment is selected)

NDICATORS

3.3 FRONT PANEL IN

his indicates the state of the Output 1 relay or SSR Drive:

OP 1 T

ON = relay energised for SSR drive ON
OFF = relay de-energised for SSR drive OFF

ptional - This LED either

OP 2 O

(a) indicates the state of the Output 2 relay or SSR Drive:

ON = relay energised or SSR drive ON
OFF = relay de-energised or SSR drive OFF

or (b) flashes to indicate an Alarm 2 condition

ALM Optional - This indicator flashes to indicate an Alarm 1 condition (see Subsection 4.9 for details of alarm operation).

MAN Not operational

Not operational. RSP

Flashes whilst the Pre-Tune routine is being executed. Otherwise OFF TUNE

Flashes during selection/de-selection of Set Up Mode. Is ON continuously whilst the Controller is in Set Up Mode. Refer to Subsection 4.2 SET

3.4 FRONT PANEL CONTROLS

Raise key. Used to increment (raise) the value of the set point. Momentary depression of this key will increment the set point value by 1 in the least significant digit. If this key is held down for longer than one second, the least significant digit will be incremented at the rate of 25 units per second. If the key is held down for longer than five seconds, the second least significant digit will be incremented at the rate of 250 units per second.

Lower key . Used to decrement (lower) the value of the set point. Momentary depression of this key will decrement the set point value by 1in the least significant digit. If this key is held down for longer than one second, the least significant digit will be decremented at the rate of 25 units per second. If the key is held down for longer than five seconds, the second least significant digit will be

SECTION 4
SET-UP MODE

4.1 CONTROLS AND DISPLAYS

4.1.1 Displays

urrent value/setting of the selected parameter

Upper Display: This four-digit display shows the c

d for the currently-selected par-

Lower Display: This four-character display shows the legen
ameter (see Table 4-1).

4.1.2 Controls

Table 4-1 Parameter Ranges & Default Values

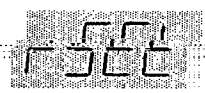
Parameter	Legend	Range	Default Value (Lower Display)
Read Only		Process Variable	None	Span of Controller
nd Range Minimum		Set Point		Between SP High Limit a SP Low Limit
0		Process Variable Offset [5]		±Span of Controller
Output Power		0% to 100% ±100% or ±100%	Read Only
Proportional Banc		0% (ON/OFF) to 100% of span	10%
Integral Time Constant [1]		10 secs to 60 mins and OFF	5 mins 00 secs
Derivative Time Constant [1]		00 secs to 10 mins	00 secs
0.02 to [1] 1.00 and ON/OFF		1.00	Relative Gain (> 1.00)

Table 4-4 (Cont.) Parameters, Ranges, Default Values

Parameter	Default Value	Range	Legend (Lower Display)
1	100%	0% to 100% of full power	

4.3 TO VIEW (DISPLAY) AND ADJUST CONTROL PARAMETERS

4.3.1 To View Set Point

y depress the SP or FUNC key. The lower display
ent set point value. If the SP key is now depressed,

With the Controller displaying the process variable, momentarily
will show the legend SP and the upper display will show the curr
the display will revert to showing the process variable.

4.3.2 To View Other Parameters

ved as described in Subsection 4.3.1)
equence shown in Table 4-1 until the
re than one second (approximately),
meter sequence at an approximate rate of one parameter per second until
Thereupon the display will revert to showing the process variable. The process
FUNC key is then released and depressed again.

With the Controller in Set Up Mode and displaying the set point value (actu
repeatedly depress the FUNC key to step through the parameter display s
required parameter is displayed. If the FUNC key is held depressed for mo
the display will step through the para
the end of the sequence is reached, wh
briefly displays will vary with which pa

meter value

4.3.3 To Adjust the Displayed Value

ying the required parameter, use the Raise or Lower key, as

With the Controller in Set Up Mode and displa
required, to alter the parameter value.

NOTE

o action will be taken if the operator attempts to

the upper and lower displays will flash and n

- adjust a parameter to a value outside the range of the Controller
- adjust a parameter to a value beyond the limit set by another parameter e.g. Set Point High Limit.
- attempts to adjust the value of a "read only" parameter e.g. the process variable.

4.4 DISPLAYED PARAMETERS AND LEGENDS

wer display,

Table 4-1 shows the sequence of displayed control parameters and the legend (appearing in the lo
which identifies each parameter. Where a parameter is for an optional feature which is not fitted
Controller, or if a parameter is invalid for the current configuration, that parameter will be omitted
from the sequence. When the Controller is delivered from the factory, t
default values (see Table 4-1). Once the desired values of the parameters are set, they are held in a battery-
memory in the Cont

he control parameters will be set to their
backed
roller configuration is subsequently changed, the Controller will revert to operation with the
parameters set to
their default values (indicated by the displays showing all the decimal point positions). When any

additional information on tuning, including details of alternative tuning techniques, refer to the book "Principles of Temperature Control" available from WEST.

1. Set the Set Point to the normal operating process value (or to a lower value if overshoot beyond the normal process value is likely to cause damage).

2. Set the Proportional Band (**Pb**) to 0% and the ON/OFF Differential (diF1) to 0.1%; this sets the Controller to ON/OFF control and the Integral Time Constant (**rSEt**) and Derivative Time Constant (**rAtE**) parameters are omitted from the set-up sequence.

3. Switch on the power supply to the heater. Under these conditions, the Process variable will oscillate about the Set Point and the following parameters should be noted:

   (a) The peak-to-peak variation (P) of the first cycle (i.e. the difference between the highest value of the first overshoot and the lowest value of the first undershoot).

   (b) The cycle time (T) of this oscillation in minutes (see Figure 4-1).

4. The control setting should then be adjusted as follows:

   Proportional Band (**Pb**) = $\frac{P}{\text{Scale Range}}$ x100%

   Integral Time Constant (**rSEt**) = T minutes

   Derivative Time Constant (**rAtE**) = T/6 minutes

After setting up the control parameters, return the Controller to the User Mode (see Subsection 4.8) to prevent unauthorised adjustment to the parameter values.

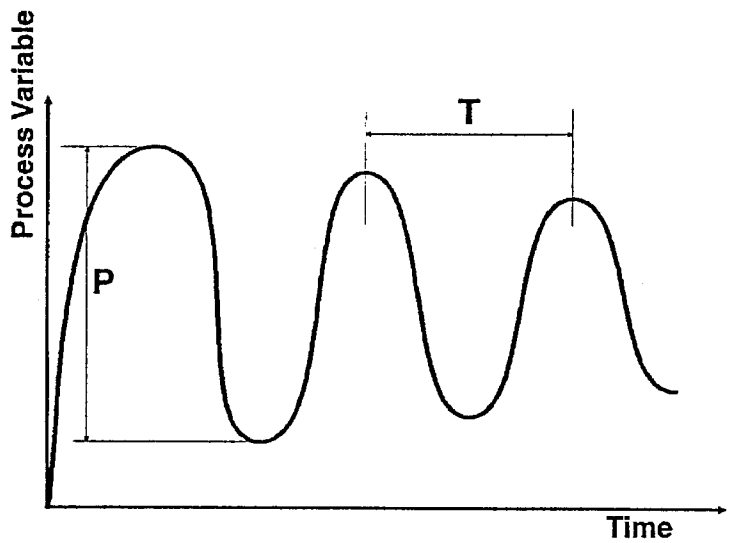


Figure 4-1 Tuning Procedure - OP1 Only Fitted

4.5.2 Controllers Equipped With Output 1 and Output 2

CAUTION

Before attempting to tune the Controller, ensure that:

- the Output 1 Power Limit parameter (**OPhi**) has been set to the required level.
- the Set Point High Limit parameter (**SPhi**) has been set to a safe level.
- the Output 1/Output 2 Cycle Times (**Ct1** and **Ct2**) have been set to suitable values.

In addition to the Proportional Band, Integral and Derivative, two more control parameters are provided in the Set-Up sequence:

(a) Relative Gain (**rCG**)

(b) Deadband/Overlap (**OL**)

The relationship between these parameters and and controller output is illustrated in Figure 4-2.

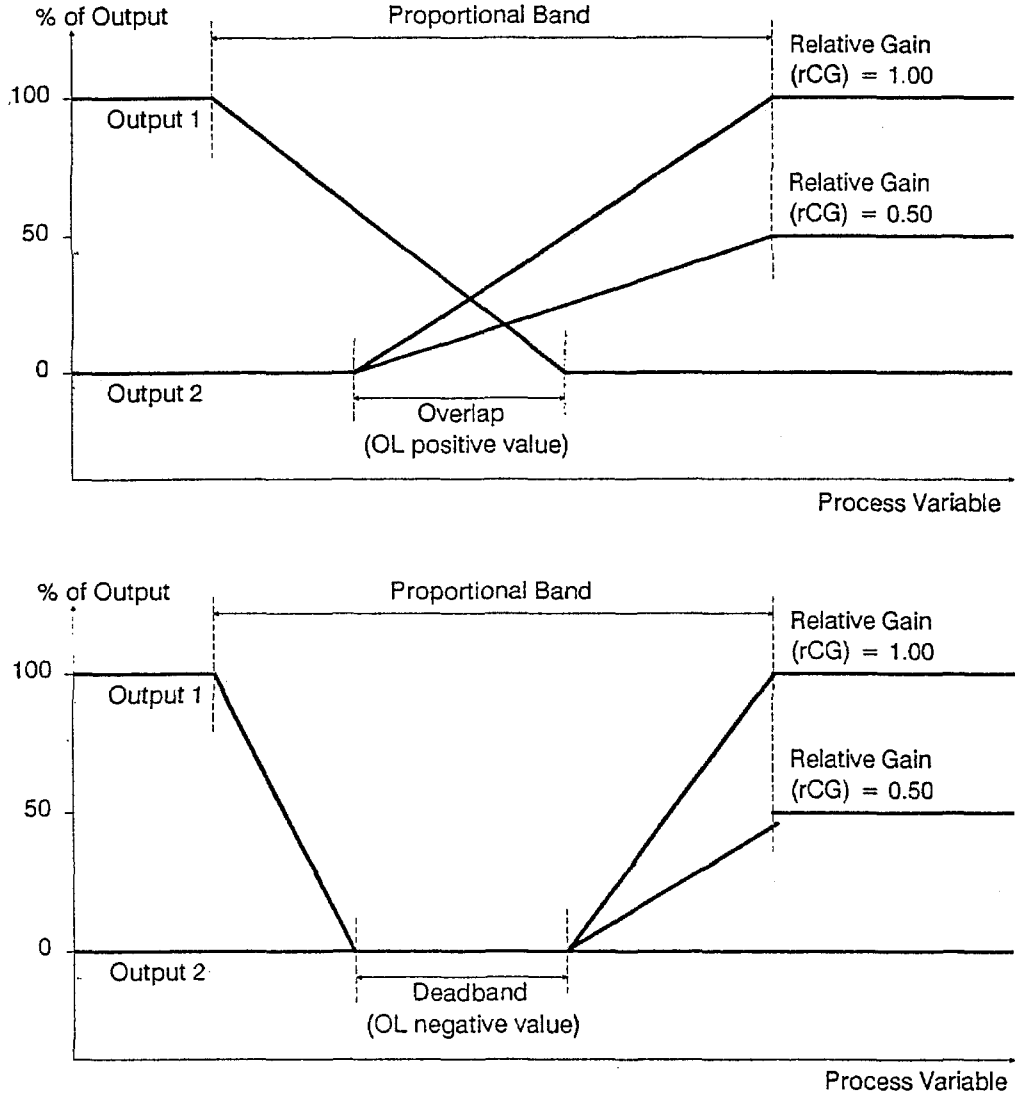


Figure 4-2 Overlap/Deadband - OP1 & OP2 Fitted

1. Set the Deadband/Overlap (**OL**) to 0%.

2. Set the Relative Gain (**rCG**) to 1.00.

3. With power connected to the heater but with the machine not running, perform the tuning process described in Subsection 4.5.1.

4. Start the machine and observe the oscillations (if any) of the process variable bout the set point.

5. Follow the instructions shown in Figure 4-3.

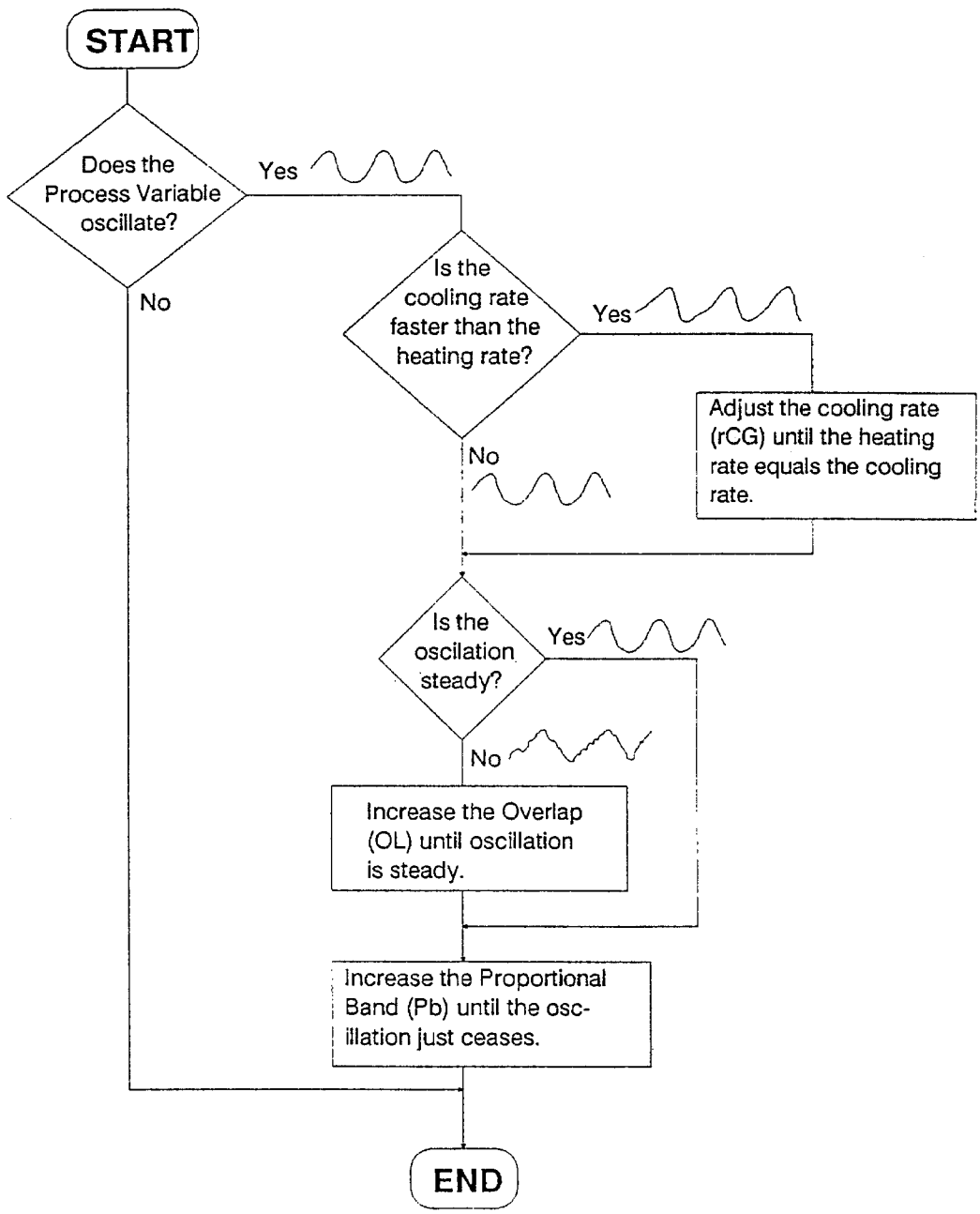


Figure 4-3 Tuning Procedure - OP1 & OP2 Fitted

4.6 USING THE PRE-TUNE FACILITY

The Pre-Tune facility provides a fast method of setting up the Controller to the approximate correct values of Proportional Band (**Pb**), Integral (**rSEt**) and derivative (**rAtE**). If automatic pre-tune has been selected (i.e. the Auto Pre-tune Enable/Disable parameter APT has been set to 1), the Controller will execute the Pre-Tune routine automatically on power-up in an identical manner to that executed when the routine is activated manually. If the value or setting of any control parameter is changed during execution of the Pre-Tune routine, the routine will be aborted and the Controller will revert to Manual Tune mode. To activate the Pre-Tune routine:

1. With the Controller in User Mode and Normal Display Mode (i.e. Process Variable on the upper display, Set Point on the lower display), depress and hold down simultaneously the Raise and Lower keys. After a delay of approximately five seconds, the **SET** indicator will start to flash.

2. When the **SET** indicator starts to flash, release the Raise/Lower keys and depress and hold down simultaneously the **SP** and **FUNC** keys. After a delay of approximately five seconds, the **SET** indicator will go OFF and the **TUNE** indicator will start to flash.

3. When the **TUNE** indicator starts to flash, release the **SP** and **FUNC** keys.

The **TUNE** indicator will flash throughout execution of the Pre-Tune routine and will go OFF when the routine is completed, whereupon the Controller will return to User Mode. At the start of the Pre-Tune routine, the Controller applies maximum permitted Output 1 power (if the Set Point is greater than the Process Variable) or Output 2 power (if the Set Point is less than the Process Variable) until the Process Variable is mid-way between its initial value and the Set Point. The Controller then applies maximum reverse power until the Process Variable starts to reverse its rate of change (i.e. at the peak of an overshoot). The level and duration of the overshoot are used as a basis for calculation of appropriate values for the control parameters.

4.7 ALARMS

Six possible alarm configurations are available:

Product Code		Alarm Type	Action
Alarm 1	Alarm 2		
C--46	C00--46	Band Alarm	Relay ON in band
C--47	C00--47	Band Alarm	Relay ON out of band
C--48	C00--48	Process Alarm	Direct-acting
C--49	C00--49	Process Alarm	Reverse-acting
C--50	C00--50	Deviation Alarm	Direct-acting
C--51	C00--51	Deviation Alarm	Reverse-acting

Process alarms have values which are absolute i.e. they are not related to the Set Point value. For deviation alarms, the values may be positive or negative. Figure 4-4 shows the operation of the different types of alarm.

4.8 RETURNING TO USER MODE

With the Controller initially in Set Up Mode, to return to User Mode:

1. Select the Process Variable display (by depressing the **SP** or **FUNC** key).

2. With the Process Variable displayed, simultaneously depress and hold down the Raise and Lower keys until the **SET** indicator starts to flash (after a delay of approximately five seconds).

3. Within three seconds of the **SET** indicator starting to flash, release the Raise and Lower keys and depress and hold down the **FUNC** key until the **SET** indicator is extinguished. The Controller is then in User Mode.

NOTE

If, whilst the Controller is in Set Up Mode, no key activity is detected during a period of one minute, the Controller will return automatically to the User Mode.

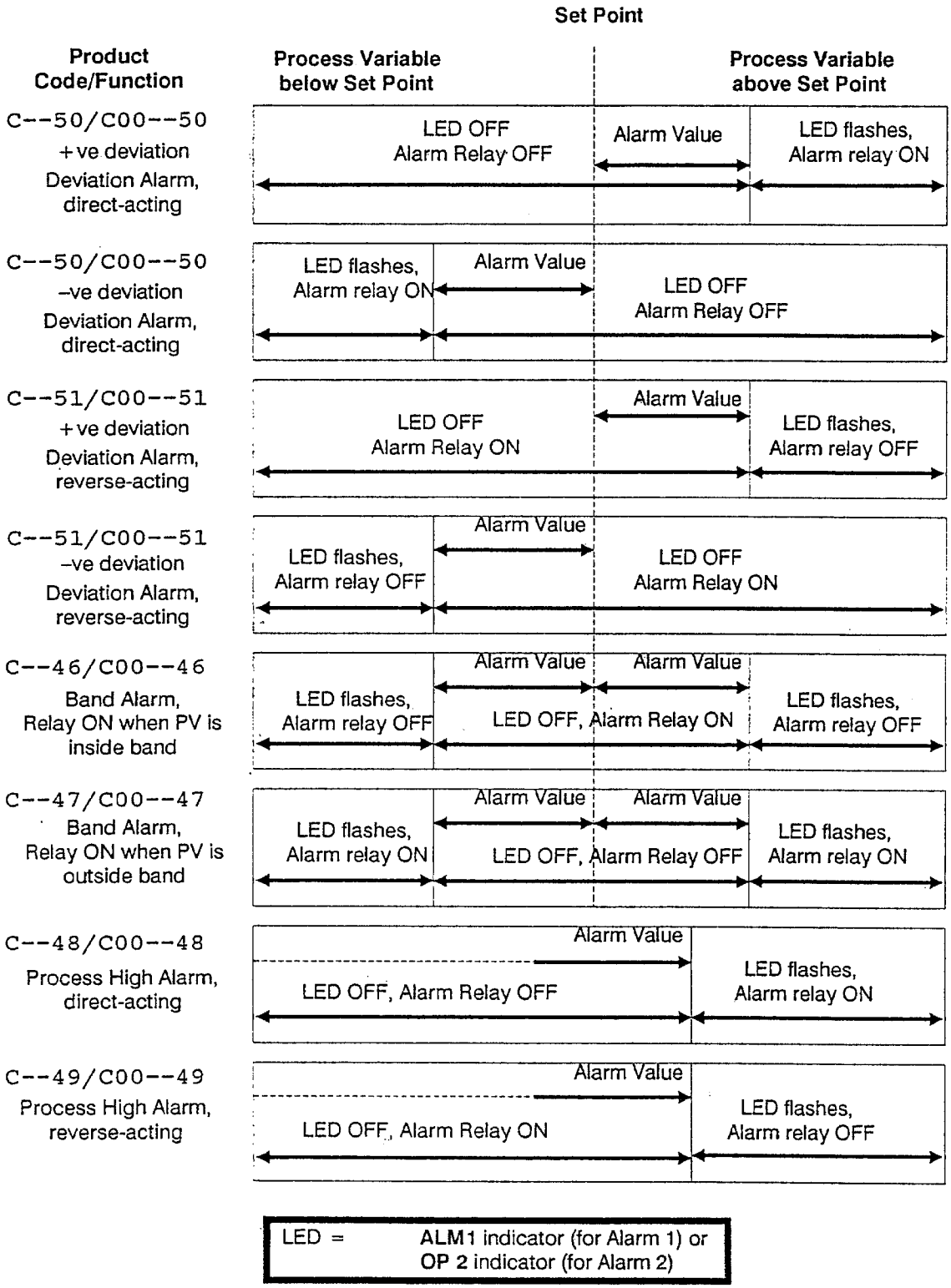


Figure 4-4 Operation of Alarms

SECTION 5
CONFIGURATION MODE

In this mode, the operator may perform the following functions:

- Select input range
- Select Output 1 action (reverse-acting or direct-acting)
- Select alarm type
- Select secondary output usage (either as an alarm output or as Output 2 (Cool)

All parameters defined in this mode are stored in a high- integrity EEPROM.

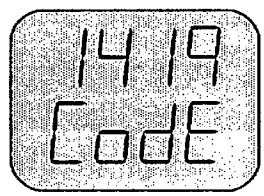
5.1 ENTERING CONFIGURATION MODE

Configuration Mode may be selected as follows:

1. If the Controller is powered up, power-down.

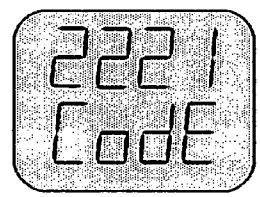
2. Power Up and, during the power-up and self-test routine, depress and hold the **FUNC** and Raise keys simultaneously.

Upon completion of the self-test routine, the Controller will enter Configuration Mode. The initial display will be either one of:



(Thermocouple Inputs)

or



(RTD Inputs)

these being the initial displays for Input Range Selection (see below). Release the **FUNC** and Raise keys.

Each depression of the **FUNC** key will now cause the displays to step through the sequence of Configuration Mode functions:

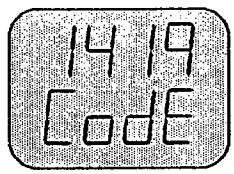
- Input Rage selection
- Output 1 action
- Alarm 1 type selection
- Secondary output usage
- Alarm 2 type selection (if Output 2 usage is set to Alarm)

These functions are accessed in a cyclic manner i.e. depression of the **FUNC** key when the last function in the sequence is selected will cause the Input Range Selection displays to appear again.

5.2 CONFIGURATION MODE FUNCTIONS

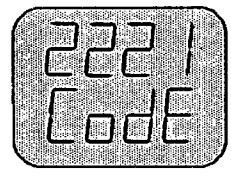
5.2.1 Input Range Selection

When this function is selected, the initial display will be:



(Thermocouple Inputs)

or



(RTD Inputs)

where the upper display shows the numeric part of a T---- product code. This will be for either a thermocouple input or an RTD input - dependent upon the setting of the switch S1 on the CPU Board (see Subsection 6.2 and Table 6-1). The input ranges available are:

Thermocouple Input			RTD Input	
Type	**Range**	**Code**	**Range**	**Code**
R	0 to 1650°C	T1127	0 to 600°C	T2221
R	32 to 3002°F	T1128	32 to 1112°F	T2222
S	0 to 1650°C	T1227	32 to 572°F	T2229
S	32 to 3002°F	T1228	–101.0 to +100.0°C	T2230
J	0 to 205°C	T1415	–150.0 to +212.0°F	T2231
J	32 to 401°F	T1416	0 to 300°C	T2251
J	0 to 450°C	T1417	0.0 to 100.0°C	T2295
J	32 to 842°F	T1418	32.0 to 212.0°F	T2296
J	0 to 760°C	T1419	–200 to +205°C	T2297
J	32 to 1400°F	T1420	–328 to +401°F	T2298
T	–200 to +260°C	T1525	–101.0 to +300.0°C	T7201
T	–328 to +500°F	T1526	–150 to +572°F	T7202
T	0 to 260°C	T1541		
T	32 to 500°F	T1542		
K	0 to 760°C	T1719		
K	32 to 1400°F	T1720		
K	0 to 1371°C	T1723		
K	32 to 2500°F	T1724		
L	0 to 205°C	T1815		
L	0 to 450°C	T1817		
L	0 to 760°C	T1819		
B	212 to 3308°F	T1934		
B	100 to 1820°C	T1938		

The operator may select the required input product code as follows:

1. Use the Raise/Lower keys to step through (on the upper display) the input product codes available in numerical order of product code and in a cyclic manner. As soon as the upper display is changed, it will flash (indicating that the code shown has not been confirmed for selection).

2. When the desired product code is displayed, depress the **SP** key to confirm selection. The upper display will cease to flash.

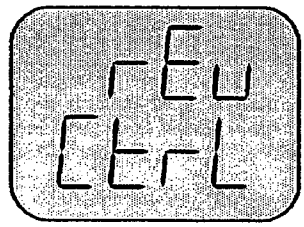
NOTE

If the upper display flashes for more than ten seconds without any key activity, it will revert to its original (static) display.

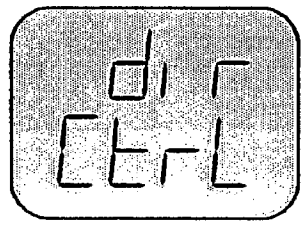
Whilst this function's displays are shown, depression of the **FUNC** key will cause selection of the Output 1 Action function.

5.2.2 Output 1 Action

Selection of this function will cause the displays to show initially:



Depression of the Raise or Lower key will cause the Controller to show a flashing display:



Subsequent repeated depressions of the Raise or Lower key will cause the Controller to alternate between these two displays above. When the required action is displayed, depress the **SP** key to confirm selection. The upper display will cease to flash.

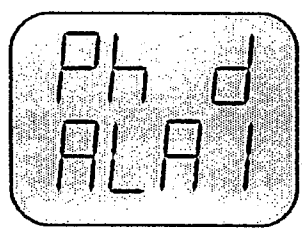
NOTE

If the upper display flashes for more than ten seconds without any key activity, it will revert to its original (static) display.

Whilst this function's displays are shown, depression of the **FUNC** key will cause selection of the Alarm 1 Type function.

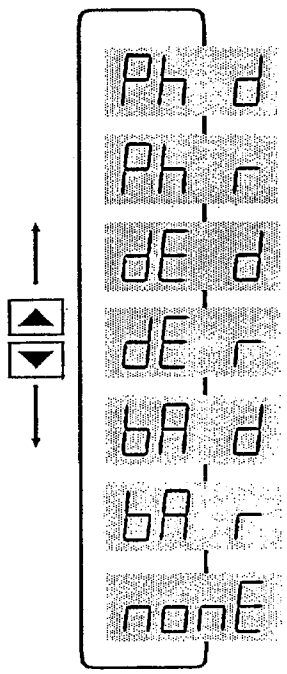
5.2.3 Alarm 1 Type

Selection of this function will cause an initial (static) display:



The alarm type may be selected as follows:

1. Use the Raise/Lower keys to step through, in a cyclic manner, the following sequence on the upper display:



Process High Alarm - Direct-acting (C--48 or C00--48)

Process High Alarm - Reverse-acting (C--49 or C00--49)

Deviation Alarm - Direct-acting (C--50 or C00--50)

Deviation Alarm - Reverse-acting (C--51 or C00--51)

Band Alarm - Direct-acting (C--47 or C00--47)

Band Alarm - Reverse-acting (C--46 or C00--46)

No alarm type set

As soon as the upper display is changed, it will flash (indicating that the displayed alarm type has not been confirmed for selection).

2. When the desired alarm type is displayed, confirm the selection by depressing the **SP** key, whereupon the upper display will become static.

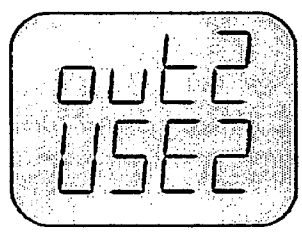
NOTE

If the upper display flashes for more than ten seconds without any key activity, it will revert to its original (static) display.

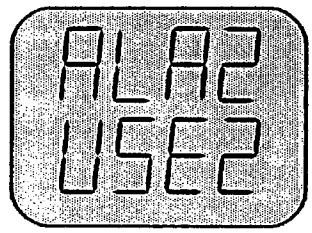
Whilst this function's displays are shown, depression of the **FUNC** key will cause selection of the Secondary Output Usage function.

5.2.4 Secondary Output Usage

Selection of this function will cause an initial (static) display:



indicating that the secondary output is to be used as Output 2 (Cool). Depression of the Raise or Lower key will cause the Controller to show the flashing display:



Subsequent depressions of the Raise or Lower key will cause the Controller to alternate between the two displays shown above, both being flashing displays. When the required usage is shown, confirm selection by depressing the **SP** key, whereupon the display will become static.

NOTE

If the upper display flashes for more than ten seconds without any key activity, it will revert to its original (static) display.

Whilst this function's displays are shown, depression of the **FUNC** key will cause selection of either:

(a) the Alarm 2 Type function (if Secondary Output Usage is currently set to Alarm 2), or

(b) a return to the Input Range Selection function.

5.2.5 Alarm 2 Type

Selection of this function will cause an initial static display of the form:

The Alarm 2 Type may be selected as follows:

1. Use the Raise/Lower keys to step through, in a cyclic manner, the same sequence on the upper display as for Alarm 1 (see facing page). As soon as the upper display is changed, it will flash (indicating that the displayed Alarm 2 type has not been confirmed for selection).

2. When the desired alarm type is displayed, confirm the selection by depressing the **SP** key, whereupon the upper display will become static.

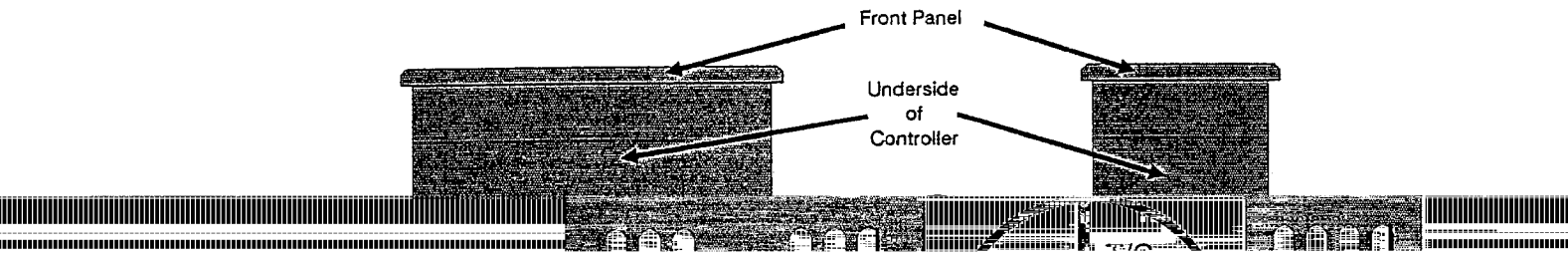
NOTE

If the upper display flashes for more than ten seconds without any key activity, it will revert to its original (static) display.

Whilst this function's displays are shown, depression of the **FUNC** key will cause selection of the Input Range function.

5.3 CHANGING INPUT TYPE

If it is required to change the type of input (thermocouple to RTD or vice versa), this may be achieved by altering the setting of switch S1 on the CPU Board; this switch is accessible through one of the ventilation slots on the underside of the Controller (see Figure 5-1); the setting may be changed using a thin-bladed screwdriver. The required input range may then be selected as described in Subsection 5.2.1. When changing between thermocouple, RTD and DC input, it may be necessary to alter switch settings on the CPU Board - see Table 6-1.


Front Panel
Underside
of
Controller

SECTION 6
INTERNAL LINKS/SWITCHES

The operations described in this Section are confined to those which require the dis-assembly of the Controller:

- Selection of thermocouple break protection
- Output 2 Type
- Selection of
- put units from oF to oC or vice versa
- Changing inp
- lection of Output 2/Alarm configuration
- Se
- lection of mains (line) voltage
- Se
- cess to link jumpers and DIL switches on the CPU Board..

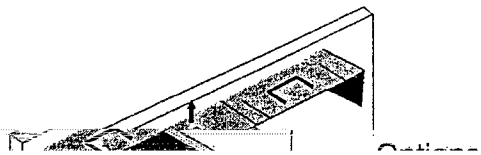
in order to gain acc

KTLING THE CONTROLLER

6.1 DISMANTLING THE UNIT

NOTES

1. Before dismantling, ensure that the mains (line) supply has been disconnected.
2. The Controller contains devices which are vulnerable to damage from electrostatic discharge. It is recommended that care be taken during handling of the Controller and its sub-assemblies in order to minimise the risk of such damage occurring.



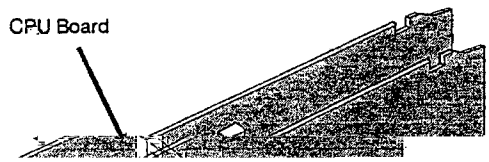

CPU Board

Table 6-1 Input Type/Break Protection Selection

):

CPU Board DIL Switch S2							Break Protection (selected by S2/3 & S2/4 only
S1	S2/1	S2/2	S2/3	S2/4	S2/5	S2/6	Product Code	Input/Break Protection Type
R	OFF	ON	OFF	ON	OFF	OFF	T----	Upscale
B	OFF	ON	ON	OFF	OFF	OFF	T----21	Downscale
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	T----23	No action

election.
Junction Compensation sensor.
ication.

See Subsection 6.2.1 for input range s
See Subsection 6.3 for fitting the Cold
See Subsection 7.4 for P/C ind

):

CPU Board DIL Switch S2							RTD Input Selection (selected by S2/1 only
S1	S2/1	S2/2	S2/3	S2/4	S2/5	S2/6	Product Code
[illegible]	OFF	ON	*	*	OFF	OFF	T2--- & T7---

2/4 may be set to either position.
for input range selection

* Switches S2/3 and S
See Subsection 6.2.1

Table 6-3 Input Units Selection

Input Units	Link Jumpers LJ1	LJ2	LJ3
°F	X	–	X
°C	–	X	X

X = Fitted
– = Omitted

Controller, if, during Configuration Mode (see Section 5), an input range is changed from °C to °F or ... On a 3510 ... all that is required is the changing of the units indicator (accessible from the rear of the Front Panel ... vice versa ... assembly).

ONFIGURATION

6.5 SELECTING OUTPUT 2/ALARM C

... The Standard Options Board (Type 450) is fitted with 4 link jumpers ... jumper locations are shown in Figure 6-5. Board configurations available are given in Table 6-4 and ...

Table 6-4 Output 2/Alarm Selection

Link Jumpers LJ20	LJ21	LJ22	LJ22	Configuration	Product Code		
P	X	P	P	Alarm 1 only	C00xx		
P				Alarm 1 & Alarm 2	C00xxxx	X	X	P
P				Relay O/P 2	C10	X	P	P
P				Relay O/P 2 + Alarm 1	C10xx	X	X	P
P	P	P		SSR O/P 2	C50			X
X	P	P		SSR O/P 2 + Alarm 1	C50xx			X

rked X = Fitted P = Pa

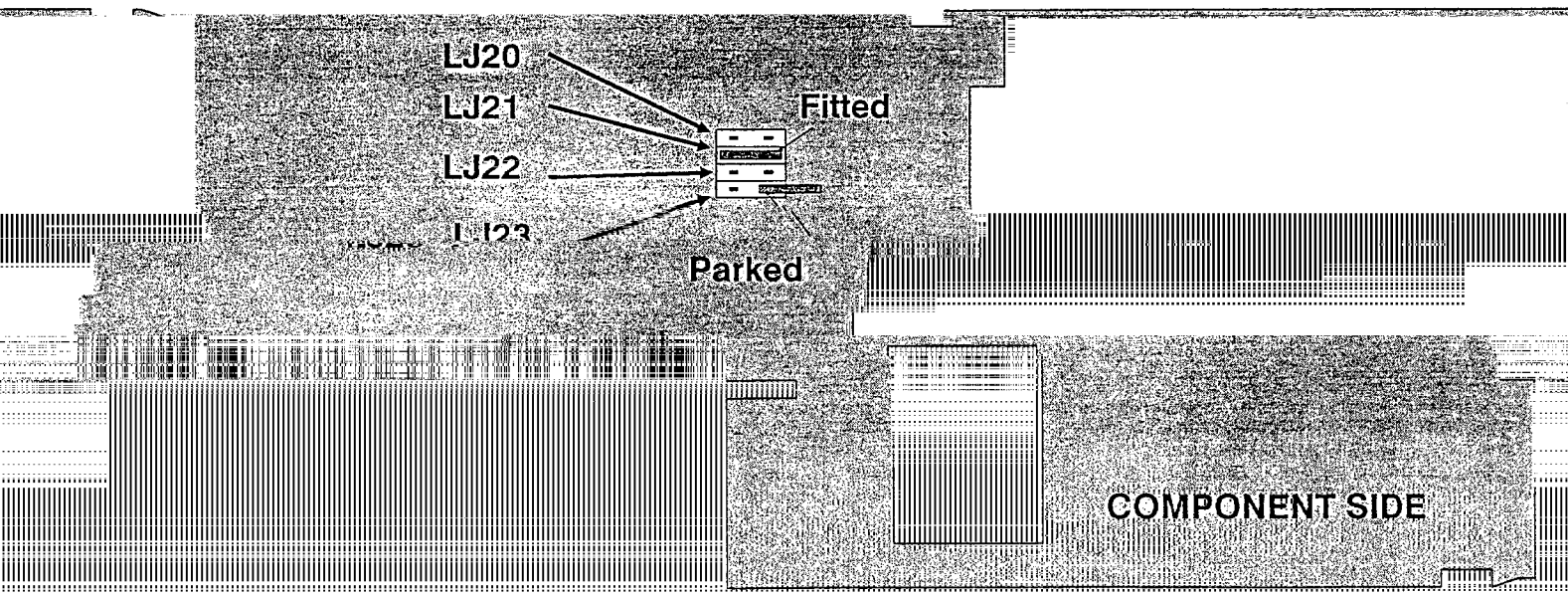


Figure 6-5 Options Board 450 - Link Jumpers

6.6 CHANGING THE MAINS (LINE) SUPPLY VOLTAGE

ly (Code L01)
o re-configure

On the CPU Board (see Figure 6-3), link jumper LJ1 is fitted for operation on a 193V - 264V supp
and link jumper LJ2 is fitted for operation on a 100V - 132V supply (Code L02). It is not possible t
the Controller to/from 24V operation (Code L04).

6.7 ASSEMBLING THE CONTROLLER

6.7.1 Fitting the Options Board to the CPU Board (if required)

1. Hold the two boards side-by-side with the component sides facing each other and the PC connectors aligned.

2. Carefully align the multiple-pin plugs on the Options Board with the sockets on the CPU Board and gently engage the plugs and sockets.

3. Insert the screw (made available during the previous separation of the two boards) through the hole in the CPU Board into the pillar on the Options Board and tighten until both boards are secured together.

6.7.2 Fitting the Boards to the Front Panel Assembly

1. Align the boards with the guides attached to the front panel; the CPU Board (the one with a transformer) should be on the right-hand side when viewed from the front. Ensure that the plugs on the CPU Board are aligned with the sockets on the front panel assembly.

2. Push the boards into the guides until all the teeth on the boards locate firmly into the holes in the guides.

6.7.3 Fitting the Controller into the Housing

1. Carefully slide the Controller, rear end first, into the housing, ensuring that the circuit board(s) locate against the outside of the guides moulded into the top and bottom of the housing.

2. Push the Controller firmly into position in order that the rear connectors of the circuit board(s) make good connection with the terminals at the rear of the housing.

3. Engage the locking screw (at the bottom of the front panel) in its bush in the housing and tighten until the Controller is secured in its housing.

APPENDIX A
PRODUCT SPECIFICATION

INPUT

Input Types:	Thermocouple and Resistance Temperature Detector (RTD).
Common Mode Rejection:	Negligible effect up to 264V 50/60Hz.
Series Mode Rejection:	1000% of span (at 50/60Hz) causes negligible effect.
Thermocouple Break Protection:	Upscale - standard
	Downscale or none - optional
Thermocouple Calibration:	Complies with BS4937, NBS125 and IEC584 standards.
RTD (Pt100) Calibration:	Complies with BS1904 and DIN43760 standards.

OUTPUTS

Output 1 (Heat)

Relay:	SPDT contact rated at 5A (resistive load) @ 120/240V AC.
Relay Life:	$>10^6$ operations.
SSR Drive:	0 - 12V nominal, 18V maximum. Output impedance 250 Ohms.

Output 2 (Cool) - Optional

Relay:	SPDT contact rated at 2A (resistive load) @ 120/240V AC.
Relay Life:	$>10^6$ operations.
SSR Drive:	0 - 12V nominal, 18V maximum. Output impedance 250 Ohms.

Alarm 1 and Alarm 2 - Optional

Alternative configurations:

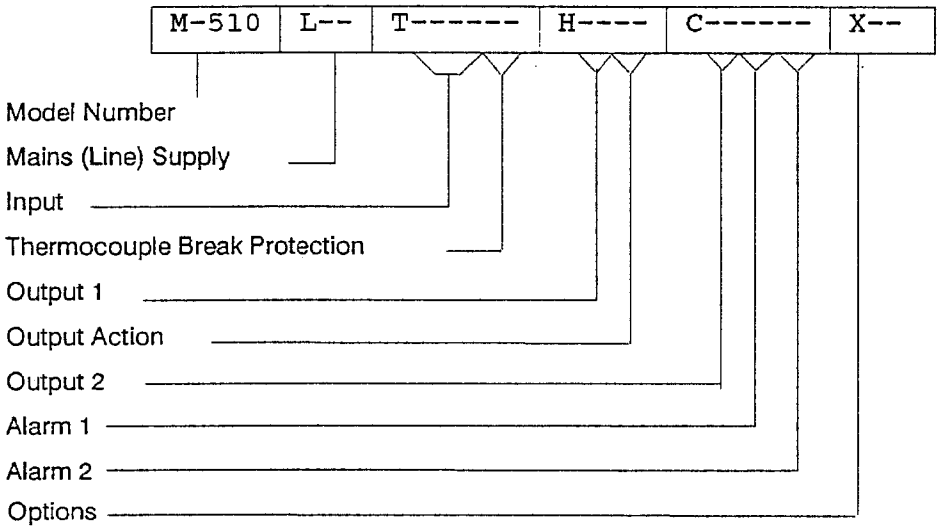
Alarm Type	Relay Energised	ALM Flashes
Process High Alarm (Failsafe)	PV below alarm value	PV above alarm value
Process High Alarm	PV above alarm value	PV above alarm value
Band Alarm (relay ON inside band)	PV within deviation band	PV outside deviation band
Band Alarm (relay ON outside band)	PV outside deviation band	PV outside deviation band
+ve deviation, direct-acting	PV > SP + deviation	PV > SP + deviation
-ve deviation, direct-acting	PV < SP - deviation	PV < SP - deviation
+ve deviation, reverse-acting	PV < SP + deviation	PV > SP + deviation
-ve deviation, reverse-acting	PV > SP - deviation	PV < SP - deviation

Alarm Relay:	SPDT contact rated at 2A (resistive load) @ 120/240V AC.
Alarm Relay Life:	$>10^6$ operations.
CONTROL	
Proportional Band:	1 - 100% @ 1% resolution, and ON/OFF.
Proportioning Time - Output 1:	1, 2, 4, 8, 16, 32 and 64 seconds.
- Output 2:	1, 2, 4, 8, 16, 32, 64, 128, 256 and 512 seconds
Integral Time Constant:	10 seconds - 30 minutes 00 seconds (one-second increments) and ON/OFF.
Derivative Time Constant:	0 seconds - 10 minutes 00 seconds (one-second increments).
On/Off Differential (Hysteresis):	0.1% - 10% of span.
ENVIRONMENT	
REFERENCE CONDITIONS	
Ambient Temperature:	20°C ±2°C
Mains (Line) Supply Voltage:	120V or 240V ±1% @ 50/60Hz ±1%.
Thermocouple Source Resistance:	< 10 ohms
RTD (Pt100):	< 0.1 ohm per lead, both leads equal.
Relative Humidity:	60% - 70% non-condensing.
OPERATING CONDITIONS	
Ambient Temperature	
- Operating:	0°C - +50°C
- Storage:	-20°C - +60°C
Mains (Line) Supply Voltage:	193V - 264V @ 50/60Hz
	100V - 132V @ 50/60Hz
Maximum Source Resistance	
Thermocouple:	< 1000 ohms
RTD (Pt100):	< 5 ohms per lead (equal resistance in each lead).
PERFORMANCE	
Reference Accuracy:	Typically ±0.5% of span ±1 lsd.
Temperature Stability:	< 0.015% of span for 1°C change in ambient temperature.
Cold Junction Compensation:	< 0.1°C change for 1°C change in ambient temperature.
Effect of Thermocouple Resistance:	< 0.1% of span error for resistance 0 - 100 Ohms.
Effect of RTD Lead Resistance:	< 0.1% of span error for 3 Ohm lead resistance.
Supply Voltage Influence on Accuracy:	< ±0.1% of span error for supply voltage within specified limits.

GENERAL

Display:		Light-emitting diode showing: Two 4-digit 7-segment displays (for parameter values and identifiers). Five red LED indicators (output states, alarm state, Set Up Mode selection and Pre-Tune facility).
Front Panel Controls:		Four keys:- Set Point Select Function Select Raise Lower
Dimensions		
2510 Controller		
	- Height:	96mm (3.78 inches)
	- Width:	96mm (3.78 inches)
	- Depth:	153mm (6.02 inches)
	- Weight:	0.65 kg (1.43 lb)
3510 Controller		
	- Height:	96mm (3.78 inches)
	- Width:	48mm (1.89 inches)
	- Depth:	153mm (6.02 inches)
	- Weight:	0.65 kg (1.43 lb)
Power Consumption:		5VA approximately (2510) 3VA approximately (3510)

APPENDIX B
PRODUCT CODES



MODEL NUMBER

M2510	Model 2510 ¼-DIN Controller
M3510	Model 3510 ⅛-DIN Controller

MAINS (LINE) VOLTAGE

L01	220V/240V nominal @ 50/60Hz
L02	110V/120V nominal @ 50/60Hz
L04	24V nominal @ 50/60Hz

INPUT - TYPE AND RANGE

Thermocouple

T1127	R	0 - 1650°C	T1541	T	0 - 260°C
T1128	R	32 - 3002°F	T1542	T	32 - 500°F
T1227	S	0 - 1650°C	T1719	K	0 - 760°C
T1228	S	32 - 3002°F	T1720	K	32 - 1400°F
T1415	J	0 - 205°C	T1723	K	0 - 1371°C
T1416	J	32 - 401°F	T1724	K	32 - 2500°F
T1417	J	0 - 450°C	T1815	L	0 - 205°C
T1418	J	32 - 842°F	T1817	L	0 - 450°C
T1419	J	0 - 760°C	T1819	L	0 - 760°C
T1420	J	32 - 1400°F	T1983	B	100 - 1820°C
T1525	T	–200 - +260°C	T1984	B	212 - 3308°F
T1526	T	–328 - +500°F			

Thermocouple Break Protection

T----	Upscale break protection (standard)
T----21	Downscale break protection
T----22	No break protection

Three-wire Resistance Temperature Detector (RTD)

T2221	0 - +600°C	T2295	0.0 - +100.0°C
T2222	+32 - +1112°F	T2296	+32.0 - +212.0°F
T2229	+32 - +572°F	T2297	-200 - +205°C
T2230	-101.0 - +100.0°C	T2298	-328 - +401°F
T2231	-150.0 - +212.0°F	T7201	-101.0 - +300.0°C
T2251	0 - +300°C	T7202	-150 - +572°F

OUTPUTS

Output 1 (Normally reverse-acting)

H10 Relay

H50 SSR Drive

Output 1 Option

H--31 Direct-Acting

Output 2 (Action opposite to Output 1 i.e. normally direct-acting)

C00 Output 2 not fitted

C10 Relay

C50 SSR Drive

Alarm 1

C--50	Relay, high/low deviation (direct-acting)
C--51	Relay, high/low deviation (reverse-acting)
C--46	Band Alarm, relay ON if process variable inside band (i.e. limit comparator)
C--47	Band Alarm, relay ON if process variable outside band
C--48	Relay, process alarm (direct-acting)
C--49	Relay, process alarm (reverse-acting)

Alarm 2

C----50	Relay, high/low deviation (direct-acting)
C----51	Relay, high/low deviation (reverse-acting)
C----46	Band Alarm, relay ON if process variable inside band (i.e. limit comparator)
C----47	Band Alarm, relay ON if process variable outside band
C----48	Relay, process alarm (direct-acting)
C----49	Relay, process alarm (reverse-acting)

NOTES

1. Alarm 2 is not available if Output 2 has been selected or if Alarm 1 has not been selected.
2. Alarm 1 and Alarm 2 are available if Output 2 has not been selected.

OTHER OPTIONS

X69	Push-on (Faston) blade terminals
X73	1/4-DIN - 1/8-DIN Conversion Plate *
X74	Remote Front Panel with 2-metre connecting cable *
X75	Remote Front Panel with 5-metre connecting cable *
X76	Chassis Mounting Bracket for use with option X74, X75 or X79 *
X79	Remote Front Panel with 0.5-metre connecting cable *

* Not available for 2510 Controller.