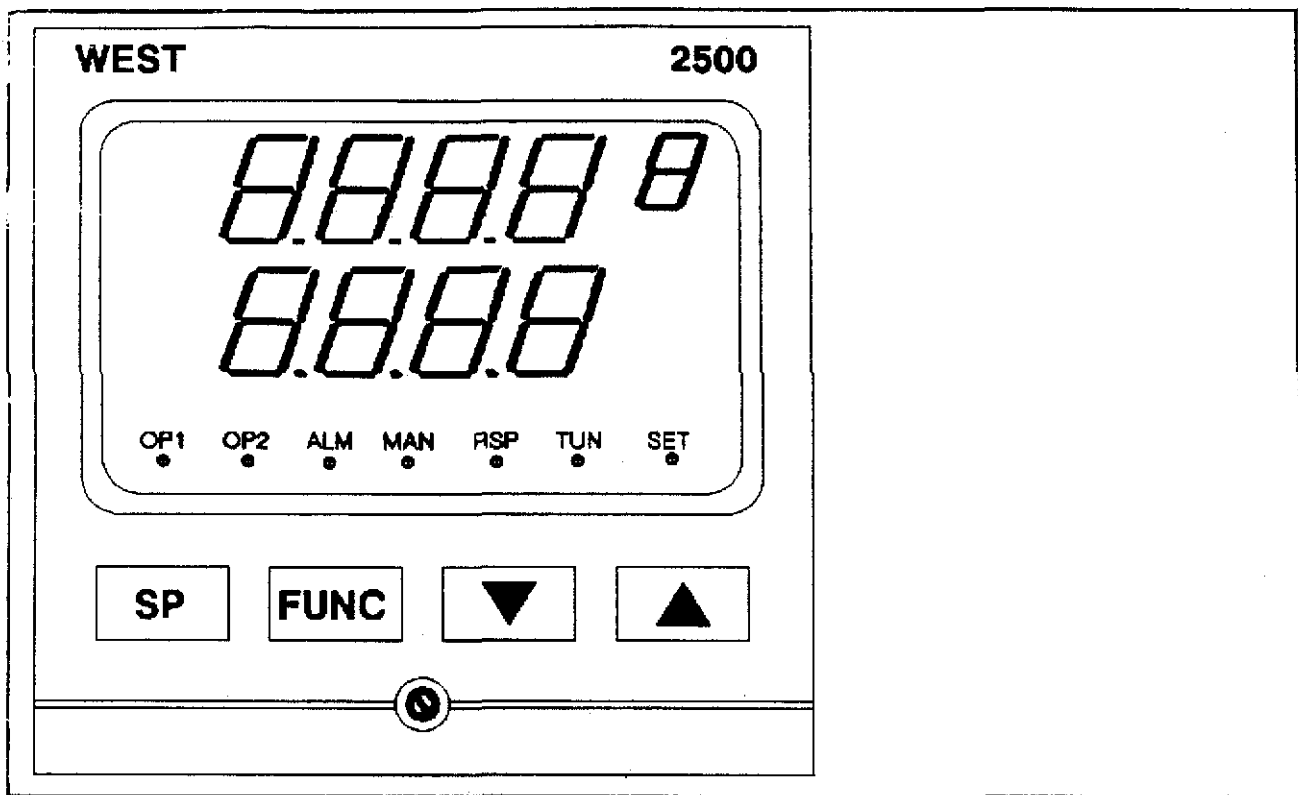


WEST 2500 CONTROLLER

Installation & Operation Instructions



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NOTE

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CAUTION: REFER TO MANUAL

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WEST 2500 CONTROLLER Installation and Operating Instructions

IM-0040-A0

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SECTION 1 INTRODUCTION

The WEST 2500 is a "proportional plus integral plus derivative" (PID) controller, retaining 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 Controller housing conforms to 1/4 DIN measurements and Controllers may be conveniently mounted side-by-side in multiple installations. The power consumption of the Controller is only 5VA (approximately); therefore, minimum ventilation is required.

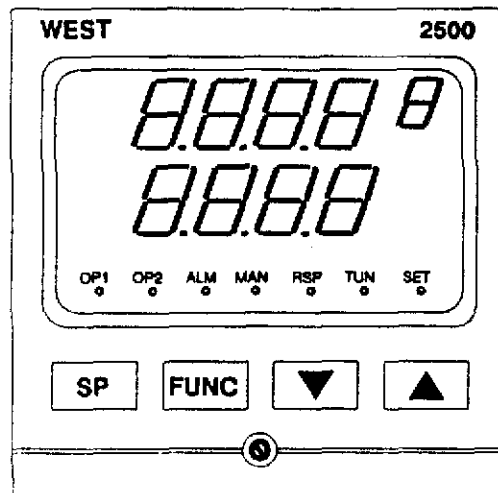


Figure 1-1 2500 Controller

1.1 OPERATOR CONTROLS AND INDICATORS

The 2500 Controller can operate in either of two modes: User Mode or Set Up 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. The 2500 front panel is shown in Figure 1-1 and 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.

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.

LED Indicators: The front panel is equipped with up to four 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.

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

1.2 OPTIONS AND VARIANTS

There is a wide range of options and variants available for the 2500 Controller. The variants and options fitted to each Controller are indicated by the product codes shown on the product code label (on the side of the Controller). 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.

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 Controller is as shown in Figure 2-1.

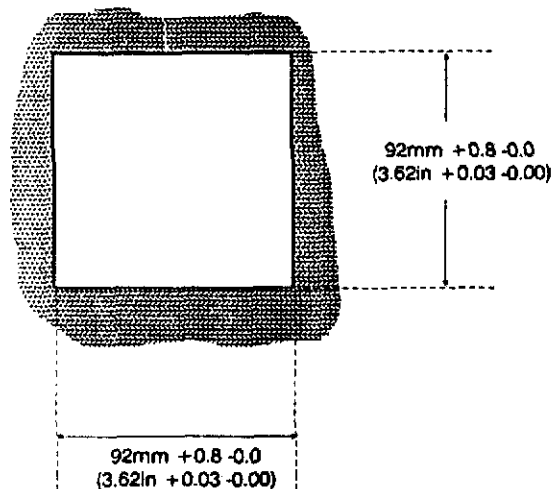


Figure 2-1 Mounting Panel Cut-out

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:

$$(96n - 4) \text{ millimetres}$$

or

$$(3.78n - 0.16) \text{ inches}$$

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.

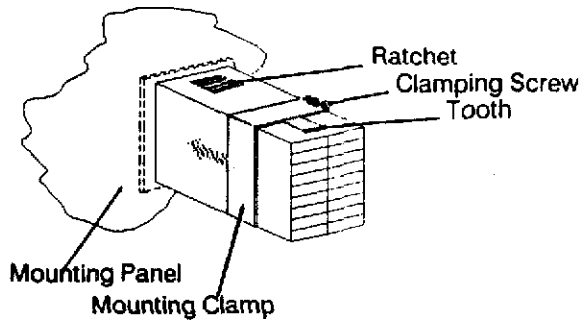


Figure 2-2 Panel-mounting a Controller

CAUTION

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

2.3 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 (1/4-inch), rotate the retaining screw at the base of the Controller front panel (see Figure 2-3) 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.

2.4 REPLACEMENT OF THE CONTROLLER IN ITS HOUSING

1. Carefully insert the Controller (rear end first) into the housing, ensuring that the PCBs engage correctly in 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.

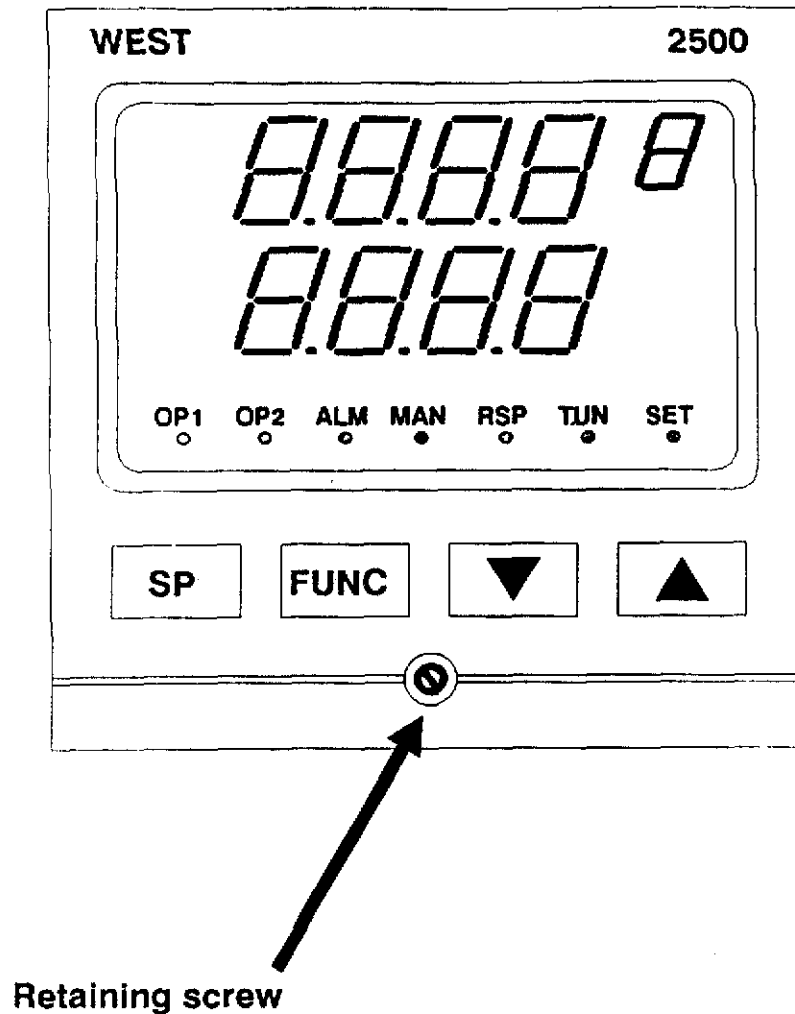


Figure 2-3 Location of Retaining Screw

2.5 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.

2.6 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 2-4).

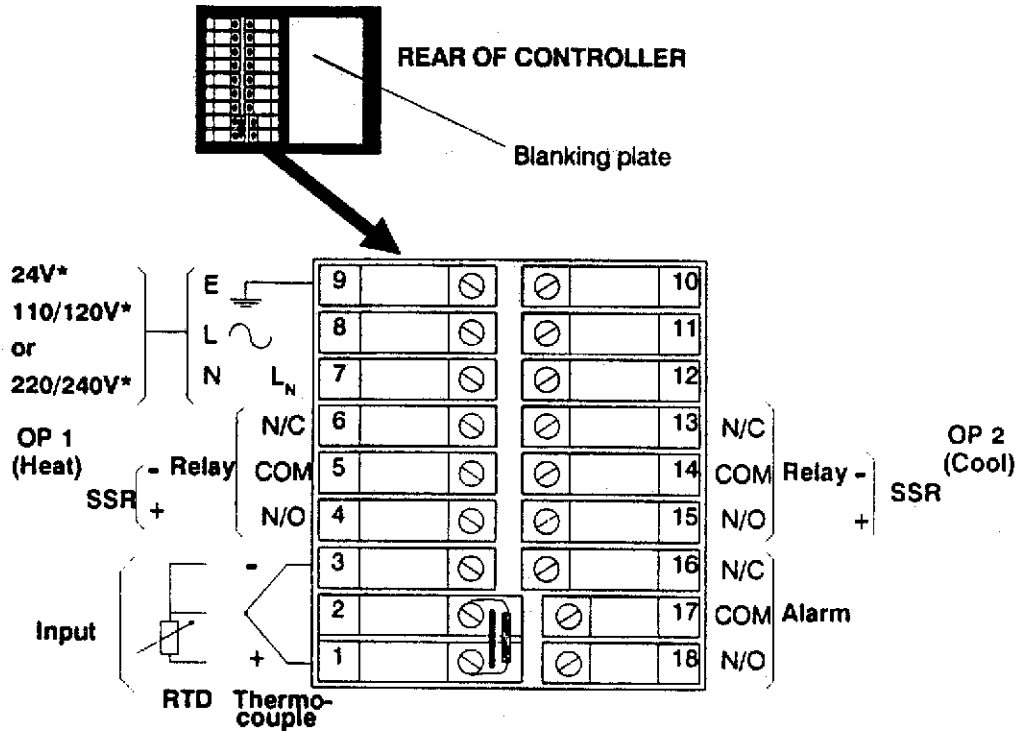


Figure 2-4 Rear Terminal Connections

2.6.1 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 2-5.

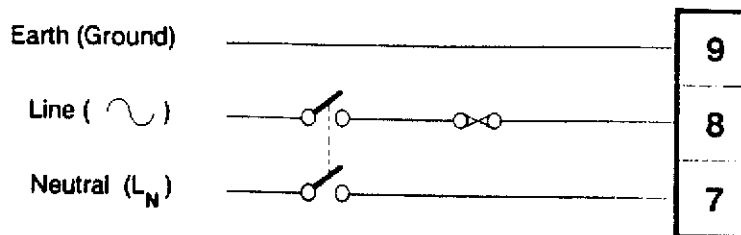


Figure 2-5 Mains (Line) Supply Connections

2.6.2 Thermocouple Input

Thermocouple connections are shown in Figure 2-6. 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.

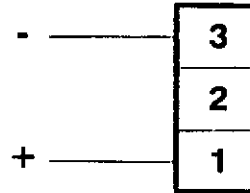


Figure 2-6 Thermocouple Input Connections

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	+ Red	+ Yellow
		- Blue	- Red	- Brown	- Blue
		* Blue	* Blue	* Brown	* Blue
J	Iron/Constantan	+ Yellow	+ White	+ Red	+ Yellow
		- Blue	- Red	- Blue	- Black
		* Black	* Black	* Blue	* Black
K	Nickel Chromium Nickel Aluminium	+ Brown	+ Yellow	+ Red	+ Yellow
		- Blue	- Red	- Green	- Purple
		* Red	* Yellow	* Green	* Yellow
R	13% Copper	+ White	+ Black	+ Red	+ Yellow
S	10% Copper Nickel	- Blue	- Red	- White	- Green
		* Green	* Green	* White	* Green
B	Platinum/Rhodium		+ Grey		
			- Red		
			* Grey		

* Colour of overall sheath.

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

2.6.3 Resistance Temperature Detector (RTD) Input

RTD input connections are shown in Figure 2-7. 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).

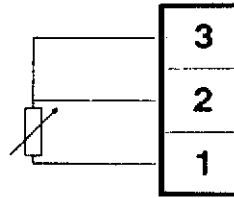


Figure 2-7 RTD Input Connections

2.6.4 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.

2.6.4.1 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 OPI indicator is ON.

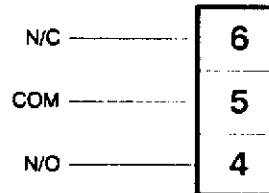


Figure 2-8 Relay Output 1 Connections

2.6.4.2 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 OPI indicator will be ON. The SSR Drive connections for Output 1 are shown in Figure 2-9.

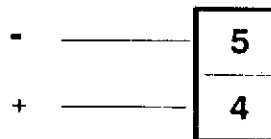


Figure 2-9 SSR Drive Output 1 Connections

2.6.5 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.

2.6.5.1 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.

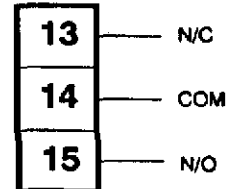


Figure 2-10 Relay Output 2 Connections

2.6.5.2 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 2-11.

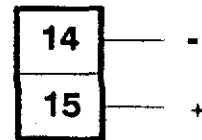


Figure 2-11 SSR Drive Output 2 Connections

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

The relay connections for the Alarm output are shown in Figure 2-12. Details of the operation of the various types of alarms are given in Subsection 4.9.

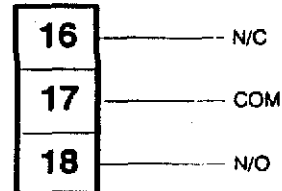


Figure 2-12 Alarm Output Connections

2.7 INDUCTIVE LOADS: EXTERNAL CONTACTORS AND MAINS-OPERATED RELAYS

WARNING

Operating the Controller with inductive loads and without the appropriate protection components may give rise to a hazard owing to high-voltage transients which may occur during the switching cycles. Removal of the Controller's internal snubber components could give rise to a serious hazard. Gulton Limited and Mark IV Industries do not accept any responsibility for any damage which may occur as a consequence of the unauthorised removal of these components.

2.7.1 General Notes

The standard relay contacts fitted in the Controller are suitable for AC supply voltages in the range 24V - 240V. The Output 1 relay is rated at up to 5A with a resistive load and up to 1A with an inductive load. The Alarm and Output 2 relays are rated at up to 2A with a resistive load and up to 1A with an inductive load. The 2500 Controller contains voltage-dependent resistors (VDRs) across all relay contacts; these protect the internal circuits for all loads up to the maximum rating. No external protection components are necessary unless an external switch or contact is fitted in series with the Controller relay contacts (see Subsection 2.8.2).

2.7.2 An External Switch in Series with an External Inductive Load

Damage may be caused to the Controller if the contacts of a switch, relay or contactor are connected externally in series with the Controller relay contacts, as shown in Figure 2-13.

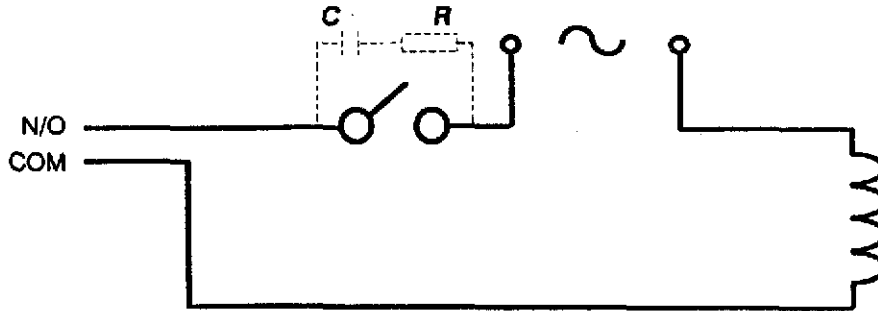


Figure 2-13 External Switch/Inductive Load in Series

Under these conditions, the external contacts may operate whilst the Controller relay contacts are closed (i.e. when the internal protection components are short-circuited and, therefore, ineffective). In applications in which it is necessary to fit the contacts of an external switch, relay or contactor in series with the Controller relay, a suitable VDR or a snubber network must be fitted, either across the inductive load or across the unprotected connected contacts (the components shown in the dotted outline in Figure 2-13. The values shown in Table 2-2 may be used for these components.

Table 2-2. Protection Network Component Values

Load Current	Value of C(μ F)	West Part No.	Value of R(Ω)	West Part No.
70mA	0.047	22206	22	23220-304
150mA	0.100	22207	47	23470-304
500mA	0.220	22208	47	23470-304
1A	0.470	22209	47	23470-304

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 HB) should have a minimum power rating of 2 watts.

SECTION 3 OPERATING INSTRUCTIONS

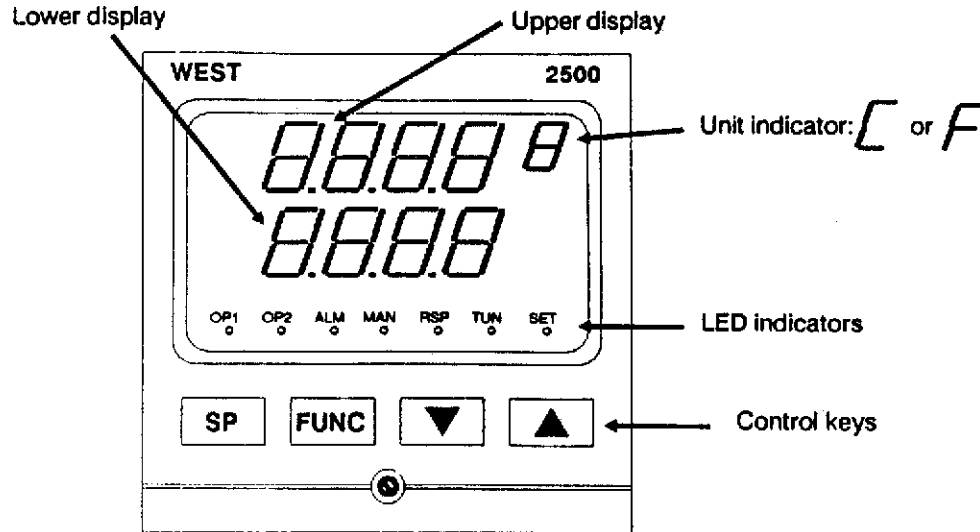


Figure 3-1 Controls, Displays and Indicators

3.1 INTRODUCTION

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

3.2 DISPLAYS (USER MODE)

Upper Display: This four-digit display shows the current value of the process variable or (if set point adjustment is selected) the current value of the set point.

Lower Display: This four-character display shows the current value of the set point or (if set point adjustment is selected) the legend SP.

3.3 FRONT PANEL INDICATORS

OP 1	This indicates the state of the Output 1 relay or SSR Drive: ON = relay energised or SSR drive ON OFF = relay de-energised or SSR drive OFF
OP 2	Optional - This 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
ALM	Optional - This indicator flashes to indicate an alarm condition (see Subsection 4.9 for details of alarm operation).
MAN	Not operational.
RSP	Not operational.
TUNE	Not operational.
SET	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.

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 10 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 1 in 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 10 seconds, the second least significant digit will be decremented at the rate of 250 units per second.



Used to select or de-select adjustment of the set point value.



In User Mode, used to select or de-select adjustment of the set point value.

3.5 SELF-TEST PROCEDURE

When power is applied to the Controller, it performs a self-test routine, during which all segments are displayed in the upper and lower displays and all operable LED indicators are ON. When this routine has been completed, the Controller automatically enters User Mode.

3.6 CONTROLLER FUNCTION - USER MODE

In User Mode, the upper display normally shows the current process variable value and the lower display shows the current set point value. When delivered, the Controller will have all its control parameters set to their default values/settings. These parameters should be adjusted to the values/settings required by the application (see Section 4). With the control parameters adjusted as desired, the values are stored in a battery-backed memory which can retain its contents for several years. In User Mode, the operator may adjust only the set point value.

3.7 SET POINT ADJUSTMENT

To adjust the set point value, with the Controller in User Mode (displaying process variable and set point values):

1. Depress the SP or FUNC pushbutton. The upper display will show the current set point value and the lower display will show the legend SP.
2. Depress the Raise pushbutton (to increment the set point value) or the Lower pushbutton (to decrement the set point value).
3. When the set point has the desired value, depress the SP or FUNC pushbutton to restore the normal User Mode display.

3.8 OPERATION WITH PARAMETERS AT THEIR DEFAULT VALUES

If the displays show all their decimal point positions, this indicates that the Controller is operating in default (see Subsection 4.4).

SECTION 4

SETTING-UP PROCEDURES

4.1 CONTROLS AND DISPLAYS - SET UP MODE

4.1.1 Displays

Upper Display: This four-digit display shows the current value/setting of the selected parameter.

Lower Display: This four-character display shows the legend for the currently-selected parameter (see Table 4-1).

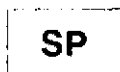
4.1.2 Controls



Raise key. Used to increment (raise) the value of the selected parameter. Depression of this key will either increment the value by 1 or will cause the parameter to be set to the next higher value in a pre-defined set of values. If this key is held down for longer than one second, a continuously-variable parameter will be incremented at the rate of 25 units per second; if the key is held down for longer than 10 seconds, the parameter will be incremented at the rate of 250 units per second. This key and the Lower key are also used to enter/leave Set Up Mode.



Lower key. Used to decrement (lower) the value of the selected parameter. Momentary depression of this key will either decrement the value by 1 or will cause the parameter to be set to the next lower value in a pre-defined set of values. If this key is held down for longer than one second, a continuously-variable parameter will be decremented at the rate of 25 units per second; if the key is held down for longer than 10 seconds, the parameter will be decremented at the rate of 250 units per second. This key and the Raise key are used to enter/leave Set Up Mode.



When a parameter other than the process variable or the set point is displayed, this key is used to restore display of the process variable. Subsequent depressions of this key will cause the display to alternate between display of the set point and display of the process variable.



Used to select the parameter to be viewed/adjusted. Successive depressions of this key cause the Controller to display the parameters in the sequence shown in Table 4-1.

4.2 TO SELECT SET UP MODE

With the Controller initially in User Mode and displaying the process variable, Set Up Mode may be selected as follows:

1. Simultaneously depress and hold down the Raise and Lower keys until the SET indicator starts to flash (after a delay of approximately five seconds).
2. Within three seconds of the SET indicator starting to flash, release the Raise and Lower keys and hold down the FUNC key until the SET indicator stays ON continuously (after a delay of approximately two seconds).

The Controller is now in Set Up Mode and will initially display the process variable. The control parameters may now be viewed and adjusted.

Table 4-1 Parameter Ranges & Default Values

Parameter	Legend (Lower Display)	Range	Default Value
Process Variable	None	Span of Controller	Read Only
Set Point	<i>SP</i>	Between SP High Limit and SP Low Limit	Range Minimum
Output Power	<i>OP</i>	0% to +100%	Read Only
Proportional Band	<i>Pb</i>	0% (ON/OFF) to 100% of span	10%
Integral Time Constant ¹	<i>rSET</i>	10 secs. - 30 mins. and OFF	5 mins. 00 secs.
Derivative Time Constant ¹	<i>rATE</i>	00 secs. - 10 mins.	30 secs.
On/Off Differential ²			
OP 1 Only	<i>dIF1</i>	0% to 10% of span of Controller	0.5% of span
OP 2 Only	<i>dIF2</i>		
OP 1 & OP2	<i>dIFF</i>		
Set Point High Limit	<i>SPHi</i>	Set Point to Range Maximum	Range Maximum
Set Point Low Limit	<i>SPLo</i>	Range Minimum to Set Point	Range Minimum
Output 1 Power Limit ¹	<i>OPHi</i>	0% to 100% of full power	100%
Output 1 Cycle Time ¹	<i>CT1</i>	1, 2, 4, 8, 16, 32 or 64 seconds	32 seconds
Output 2 Value ³	<i>Out2</i>	± span from Set Point	0
Process Alarm Value ³	<i>P_AL</i>	Range Minimum to Range Maximum	Range Maximum
Band Alarm Value ³	<i>b_AL</i>	0 to span from Set Point	5 units
Deviation Alarm Value ³	<i>d_AL</i>	±span from Set Point	5 units

NOTES ON TABLE 4-1

Span = Span of Controller (i.e. Range Maximum - Range Minimum)

1. These parameters are not operative/accessible if Proportional Band (Pb) is set to 0%.
2. Switching differential with ON/OFF relay output.
3. These parameters are optional.

4.3 TO VIEW (DISPLAY) AND ADJUST CONTROL PARAMETERS**4.3.1 To View Set Point**

With the Controller displaying the process variable, momentarily depress the **SP** or **FUNC** key. The lower display will show the legend **SP** and the upper display will show the current set point value. If the **SP** key is now depressed, the display will revert to showing the process variable.

4.3.2 To View Other Parameters

With the Controller in Set Up Mode and displaying the set point value (achieved as described in Subsection 4.3.1), repeatedly depress the **FUNC** key to step through the parameter display sequence shown in Table 4-1 until the required parameter is displayed. If the **FUNC** key is held depressed for more than one second (approximately), the display will step through the parameter sequence at an approximate rate of one parameter per second until the end of the sequence is reached, whereupon the display will revert to showing the process variable. The process variable display will remain until the **FUNC** key is released and depressed again.

4.3.3 To Adjust the Displayed Parameter Value

With the Controller in Set Up Mode and displaying the required parameter, use the Raise or Lower key, as required, to alter the parameter value.

NOTE

The upper and lower displays will flash and no action will be taken if the operator attempts to:

- 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

Table 4-1 shows the sequence of displayed control parameters and the legend (appearing in the lower display) which identifies each parameter. Where a parameter is for an optional feature which is not fitted in a specific Controller, or if a parameter is invalidated by another parameter value/setting, that parameter will be omitted from the sequence. When the Controller is delivered from the factory, the control parameters will be set to their default values (see Table 4-1). Once the desired values of the parameters are set, they are held in a battery-backed memory. If the Controller configuration is subsequently changed, the Controller will revert to operation with the parameters set to their default values (indicated by the display showing all the decimal point positions). When any control parameter (apart from set point) is set to a non-default value, the display reverts to its normal mode.

4.5 TUNING THE CONTROLLER

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 Cycle Time parameter (Ct1) has been set to a suitable value.

The technique outlined below is suitable only for processes which are not harmed by large fluctuations in the Process Variable. It provides an acceptable basis from which to start the tuning for a wide range of processes. For 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 to 1%, Integral Time Constant to OFF (i.e. increase the value until the upper display goes blank) and set the Derivative Time Constant to 0.
3. Proceed as shown in Figure 4-1. At each stage, allow sufficient time before moving on to the next stage.

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.

4.6 ALARMS

Six possible alarm configurations are available:

Product Code	Alarm Type	Action
C--46	Band Alarm	Relay ON in band
C--47	Band Alarm	Relay ON out of band
C--48	Process Alarm	Direct-acting
C--49	Process Alarm	Reverse-acting
C--50	Deviation Alarm	Direct-acting
C--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 4-2 shows the operation of the displays and relays for the different types of alarm.

4.7 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.

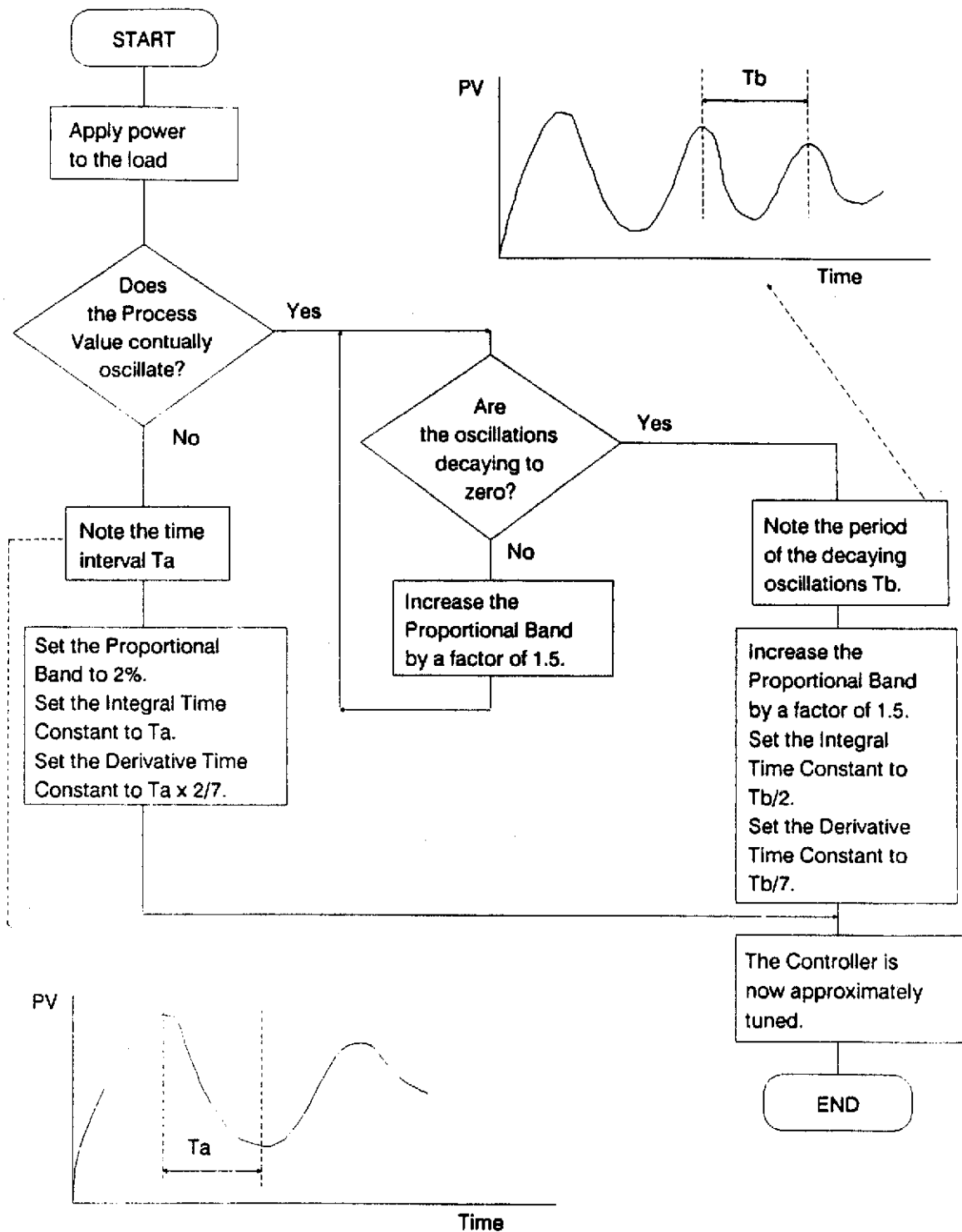


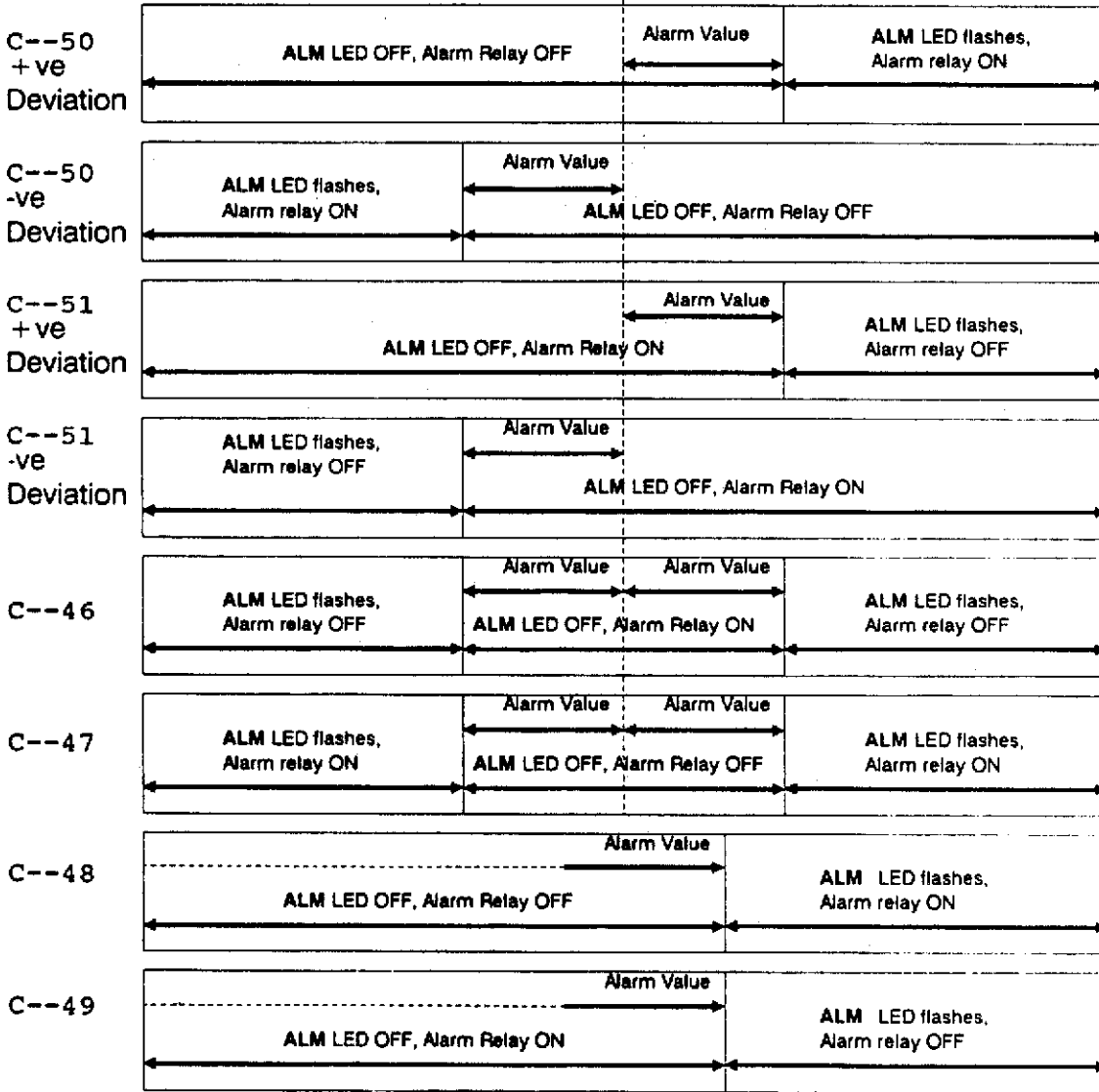
Figure 4-1 Tuning Procedure

**Product
Code/Function**

Set Point

Process variable below Set Point

Process variable above Set Point



ALM LED = Controller front panel ALM indicator

Figure 4-2 Operation of Alarms

SECTION 5

RANGE-CHANGING AND RE-CONFIGURATION

The range-changing and re-configuration operations described in this Section are confined to those which can be achieved by simply changing the positions of the appropriate link jumpers. It is not possible to change from one type of input to another or from one type of output to another, without changing the Boards.

5.1 DISMANTLING THE CONTROLLER

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.
3. The Controller also contains a lithium battery on the CPU Board. IF IT IS REQUIRED TO REPLACE THE BATTERY, THIS OPERATION SHOULD BE PERFORMED BY A TRAINED TECHNICIAN.

5.1.1 Withdrawing the Controller from its Housing

1. With an appropriate size screwdriver (5mm or 3/16-inch flat blade), rotate the retaining screw at the bottom of the Controller from panel in an anti-clockwise direction to disengage the Controller back connectors from their sockets in the housing. Continue rotating the retaining screw anti-clockwise until the screw is free from its bush in the Controller housing.
2. Gently withdraw the Controller from its housing.

5.1.2 Separating the PCBs (if an Options Board is Fitted)

If the Controller has an Options Board fitted, it will be necessary to separate the two PCBs (the CPU Board and the Options Board) in order to gain access to the link jumpers. This is achieved as follows:

1. Grasp the guides (projecting rearwards from the bottom of the front panel - see Figure 5-1) and pull them downwards until the bottom of the PCBs are released and can be withdrawn backwards; grasp the guides at the top of the front panel and disengage the top edges of the PCBs. The two PCBs may now be removed from the front panel assembly.
2. Extract the screw securing the Options Board to the pillar on the CPU Board (see Figure 5-2). Carefully pull the two Boards apart, ensuring that the Boards remain parallel to each other in order that the plugs and sockets linking them are not bent or distorted.

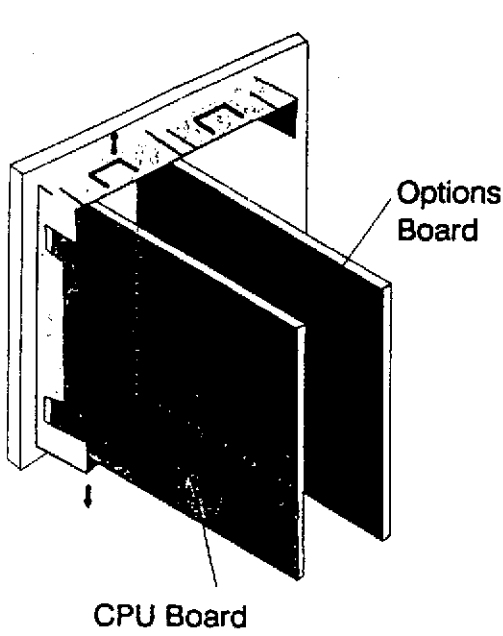


Figure 5-1 Detaching the PCBs from the Front Panel

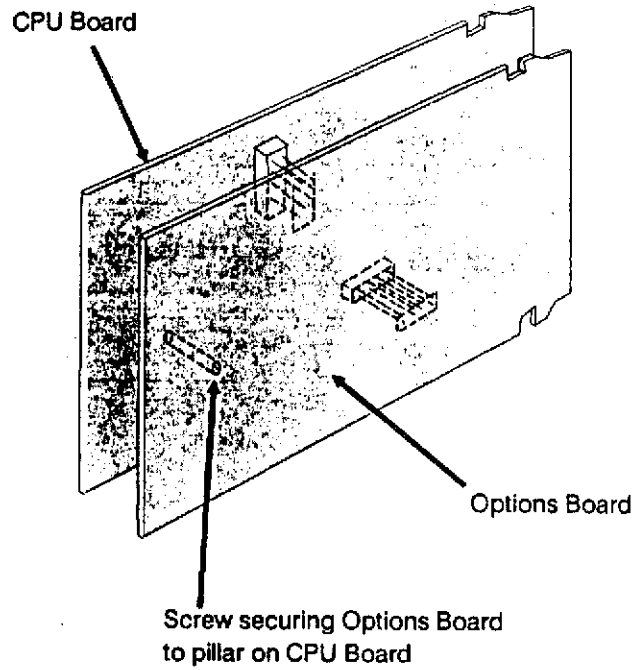


Figure 5-2 Separating the Two PCBs

5.2 CHANGING INPUT RANGES

5.2.1 Thermocouple Inputs

A Controller fitted with a thermocouple input may be re-configured to a different thermocouple input by changing jumper links on the CPU Board (see Figure 5-3) as shown in Table 5-1. Thermocouple break protection link settings are shown in Table 5-2.

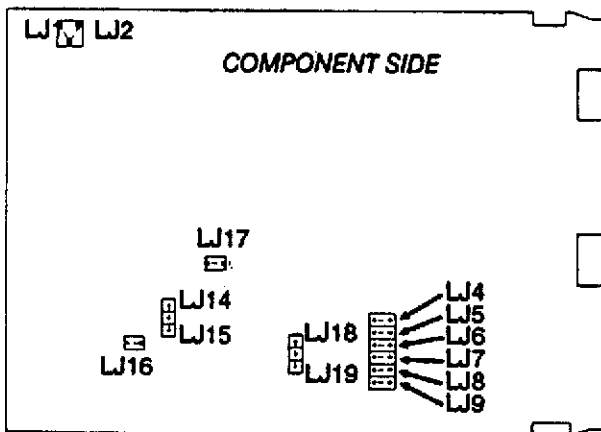


Figure 5-3 CPU Board Link Jumpers

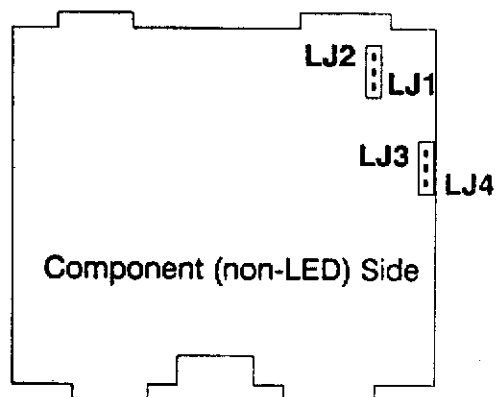


Figure 5-4 Front Panel/Display Board - Link Jumpers

Table 5-1 Thermocouple Input Link Jumpers

Product Code	Input Type	Range*	CPU Board Link Jumpers							
			LJ5	LJ6	LJ7	LJ8	LJ9	LJ17	LJ18	LJ19
T1127	R	0 - 1650°C	P	X	P	X	X	X	-	X
T1128	R	32 - 3002°F	X	X	P	X	X	X	-	X
T1227	S	0 - 1650°C	P	P	X	P	P	X	-	X
T1228	S	32 - 3002°F	X	P	X	P	P	X	-	X
T1415	J	0 - 205°C	P	P	P	P	X	P	X	-
T1416	J	32 - 401°F	X	P	P	P	X	P	X	-
T1417	J	0 - 450°C	P	P	P	X	P	P	X	-
T1418	J	32 - 842°F	X	P	P	X	P	P	X	-
T1419	J	0 - 760°C	P	P	X	X	P	P	X	-
T1420	J	32 - 1400°F	X	P	X	X	P	P	X	-
T1541	T	0 - 260°C	P	X	X	X	P	X	-	X
T1542	T	32 - 500°F	X	X	X	X	P	X	-	X
T1719	K	0 - 760°C	P	P	P	X	X	P	X	-
T1720	K	32 - 1400°F	X	P	P	X	X	P	X	-
T1723	K	0 - 1371°C	P	X	P	P	P	P	X	-
T1724	K	32 - 2500°F	X	X	P	P	P	P	X	-
T1983	B	100 - 1820°C	P	P	X	P	X	X	-	X
T1984	B	212 - 3308°F	X	P	X	P	X	X	-	X

X = Fitted

P = Parked

- = Not fitted

* On the Front Panel PCB, fit links LJ2 and LJ3 for °C or LJ1 and LJ3 for °F (see Figure 5-4).

Table 5-2 Break Protection - Link Jumper Settings

Break Protection Type	Input Product Code	Link Jumpers		
		LJ14	LJ15	
Upscale	T----	X	-	X = Fitted
Downscale	T----21	-	X	P = Parked
No protection	T----22	P	-	- = Not fitted

5.2.2 RTD Inputs

A Controller equipped with an RTD Input may be re-configured to a different RTD Input by changing link jumpers on the CPU Board (see Figure 5-3) in accordance with the information in Table 5-3.

Table 5-3 RTD Input Link Jumpers

Product Code	Input Range	CPU Board Link Jumpers					
		LJ5	LJ6	LJ7	LJ8	LJ9	LJ16
T2221	0 to +600°C	P	X	X	P	X	P
T2222	+32 to 1112°F	X	X	X	P	X	P
T2229	+32 to +572°F	X	X	X	P	P	P
T2230	-101.0 to +100.0°C	P	P	X	X	X	X
T2231	-150.0 to +212.0°F	X	P	X	X	X	X
T2251	0 to +300°C	P	X	X	P	P	P
T2295	0.0 to +100.0°C	P	X	P	P	X	X
T2296	+32.0 to +212.0°F	X	X	P	P	X	X
T2297	-200 to +205°C	P	X	P	X	P	X
T2298	-328 to +401°F	X	X	P	X	P	X
T7201	-101.0 to +300.0°C	P	X	X	X	X	P
T7202	-150 to +572°F	X	X	X	X	X	P

X = Fitted

P = Parked

* On the Front Panel PCB, fit links LJ2 and LJ3 for °C or LJ1 and LJ3 for °F (see Figure 5-4).

5.3 CHANGING THE ACTION OF OUTPUT 1

Output 1 (Relay or SSR) may be configured to be direct-acting or reverse- acting:

Reverse-Acting: Active (e.g. relay energised) when process variable is less than set point.

Direct-Acting: Active (e.g. relay energised) when process variable is greater than set point.

For a direct-acting Output 1 (Product Code H--31), link jumper LJ4 should be fitted on the CPU Board. For a reverse-acting Output 1 (the standard configuration), link jumper LJ4 on the CPU Board should be parked.

5.4 OUTPUT 2 AND ALARM OUTPUTS

The Standard Options Board (Type 450) is supplied in one of five forms:

Configuration	Product Code
Output 2 Relay, no Alarm Output	C10
Output 2 SSR, no Alarm Output	C50
Output 2 Relay with Alarm Output	C10--
Output 2 SSR with Alarm Output	C50--
Alarm Output Only (no Output 2)	C00--

The action of Output 2 is always the opposite of that for Output 1 (i.e. if Output 1 is reverse-acting, Output 2 is direct-acting, or vice versa). If Output 2 is to be used, link LJ20 on the Options Board (see Figure 5-5) should be fitted. If Output 2 is not to be used, link LJ20 should be parked. To change the action of the Alarm Output, links on the Options Board should be fitted as in Table 5-4. See Subsection 4.7 for details of Alarm Output operation.

Table 5-4 Alarm Output Link Jumper Settings

Product Code	Link Jumpers			* If Alarm Output is not supplied, link jumpers LJ21, LJ22 and LJ23 are omitted. X = Fitted P = Parked
	LJ21	LJ22	LJ23	
C--50	X	P	P	
C--51	X	P	X	
C--46	P	X	X	
C--47	P	X	P	
C--48	X	X	P	
C--49	X	X	X	
C--00*	P	P	P	

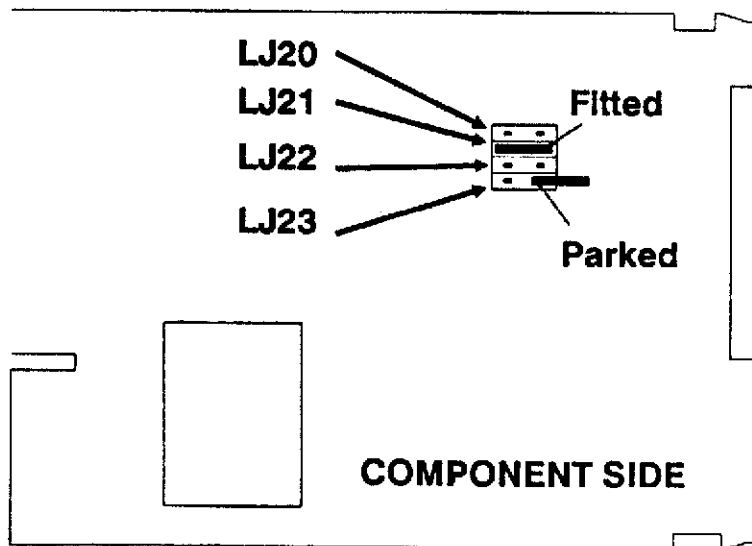


Figure 5-5 Options Board 450 - Link Jumpers

5.5 CHANGING THE MAINS (LINE) SUPPLY VOLTAGE

On the CPU Board, link jumper LJ1 is fitted for operation on a 193V - 264V supply (Code L01) and link jumper LJ2 is fitted for operation on a 100V - 132V supply (Code L02). It is not possible to re-configure the Controller to/from 24V operation (Code L04).

5.6 ASSEMBLING THE CONTROLLER

5.6.1 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.

5.6.2 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.

5.6.3 Fitting the Controller into the Housing

1. Carefully slide the Controller, rear end first, into the housing, ensuring that the circuit board(s) locate correctly in 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 - 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: > 10⁶ operations.

CONTROL

Proportional Band: 1 - 100% @ 1% resolution, and ON/OFF.
Proportioning Time: 1, 2, 4, 8, 16, 32 and 64 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 ± 1sd.
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).

Four red LED indicators (output states, alarm state and Set Up Mode selection).

Front Panel Controls:**Four keys:-**

Set Point Select

Function Select

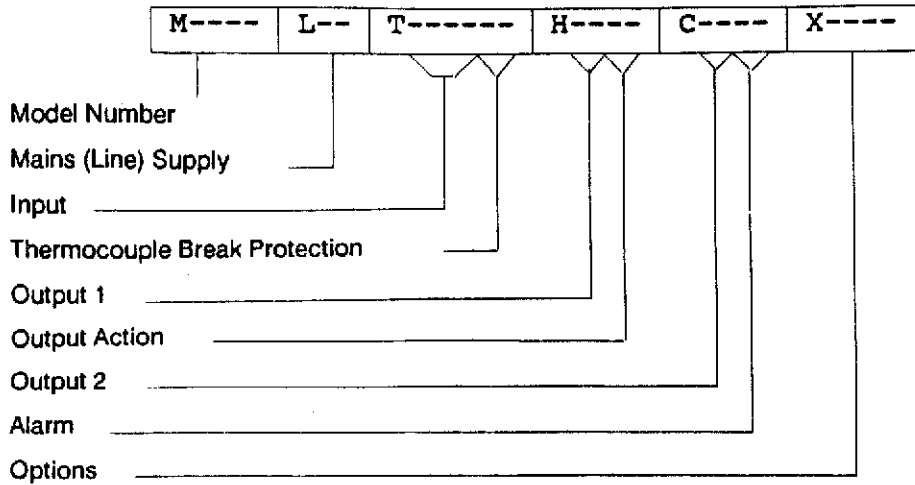
Raise

Lower

Dimensions

- Height:	96mm (3.78 inches)
- Width:	96mm (3.78 inches)
- Depth:	153mm (6.02 inches)
Weight:	0.65 kg (1.43 lb)
Power Consumption:	5VA approximately.

APPENDIX B PRODUCT CODES



MODEL NUMBER

M2500

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

Alarms

- 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)

OTHER OPTIONS

- X69 Push-on blade terminals

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