WEST 3500
COMPACT THREE-TERM CONTROLLER
Installation & Operating Instructions

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Our policy is one of continued improvement, and subsequently 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.

CAUTION: REFER TO MANUAL

THE INTERNATIONAL HAZARD SYMBOL IS INSCRIBED ADJACENT TO THE REAR CONNECTION TERMINALS. IT IS IMPORTANT TO READ THE MANUAL BEFORE INSTALLING OR COMMISSIONING THE UNIT.

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IM - 0035 - A0

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APPENDICES

SECTION 1
INTRODUCTION

The WEST 3500 is a compact "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 1/8 DIN measurements and Controllers may be conveniently mounted side-by-side in multiple installations. The power consumption of the Controller is only 3 watts (approximately); therefore, minimum ventilation is required.

1.1 OPERATOR CONTROLS AND INDICATORS

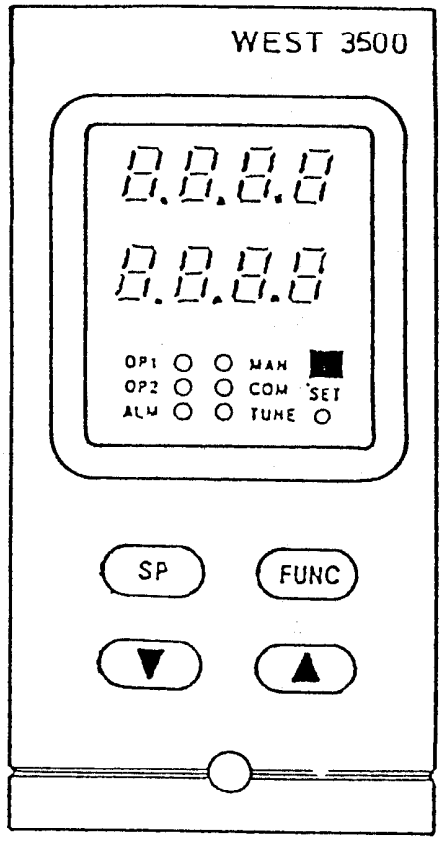


FIGURE 1-1 3500 CONTROLLER - FRONT PANEL

Introduction

The 3500 Controller can operate in either of two modes: User Mode or Set Up Mode. In User Mode, the operator may only adjust the set point value and monitor the output(s). In Set Up Mode, all control parameters may be viewed and adjusted. The 3500 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 deceimal points (displaying numbers in the range 9999 to -1999) 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 3500 Controller. The variants and options fitted to each Controller are indicated by the product codes shown on the product code label (on the Controller top plate). Space is available on the label for alteration of these codes should any of the variants or options be changed subsequent to installation. 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 Remote Front Panel Option (Product Code X74, X75 or X79) has been ordered, the package should also contain the Remote Front Panel and the connecting cable with terminating lugs. The length of the cable is dependent upon the Product Code:

X79	0.5 metres
X74	2 metres
X75	5 metres

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 is found, notify the carrier immediately. Check that the product code(s) shown on the product code label (on the Controller top plate) corresponds to the configuration ordered.

2.2 PANEL-MOUNTING THE STANDARD 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.

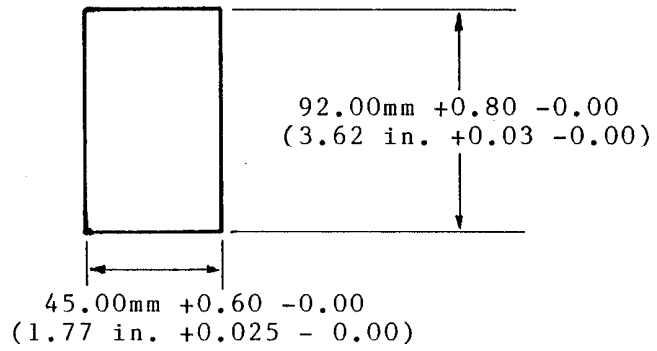


FIGURE 2-1 PANEL CUT-OUT DIMENSIONS

Installation

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:

(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 48mm (1.89 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 clamo 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.

CAUTION

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

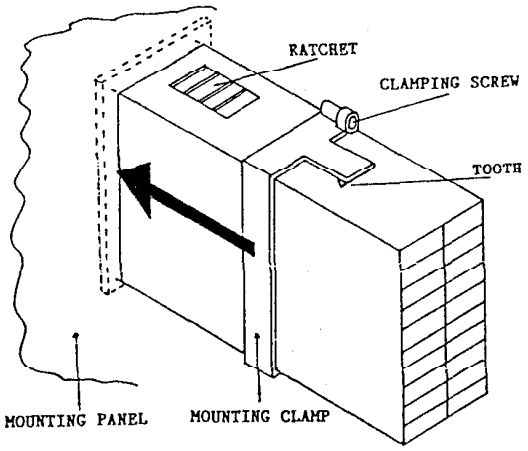


FIGURE 2-2 PANEL-MOUNTING A CONTROLLER

2.3 PANEL-MOUNTING A CONTROLLER WITH A REMOTE FRONT PANEL

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

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 to the mounting panel.

2.3.2 Mounting the Controller

The Controller may be installed on a mounting panel either in the same manner as a standard Controller (as described in Subsection 2.2.2) or by using the Chassis Mounting Bracket Option X76 (see Figure 2-3).

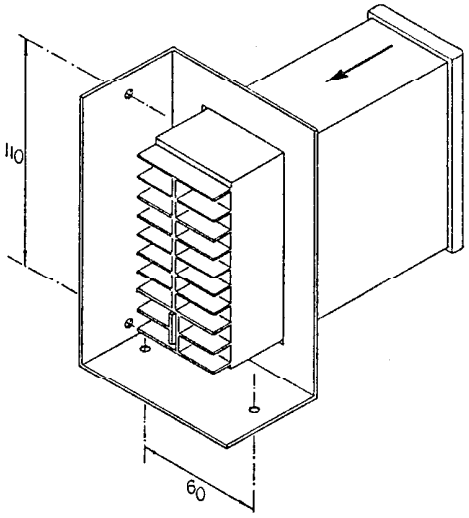


FIGURE 2-3
CHASSIS MOUNTING BRACKET

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 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 be run in close proximity to power-carrying cables.**

1. Plug in the two ends of the cable to the IDC sockets on the Remote Front Panel and the Controller (with the square plastic key on each cable plug mating with 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 (a) from static discharge and (b) of short-circuiting the battery:

* Do not place the unhoused Controller on a conducting surface.

* Touch only the edges of the PCBs in the Controller. Ensure that fingers do not come into contact with any of the components or tracks on the PCBs.

* Before handling the unhoused Controller, touch a nearby ground connection (e.g. a metal bench frame or rack).

* If possible, wear an earth wrist strap whilst handling the unhoused Controller.

If battery replacement is required, this should be performed by a trained technician.

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 2-4) 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.

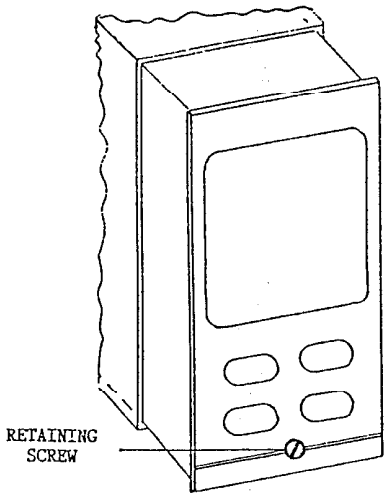


FIGURE 2-4 REMOVAL AND REPLACEMENT OF THE CONTROLLER

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 2-1).
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. Local requirements regarding electrical installation should be rigidly observed. Ground terminals must be separately connected 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.

Connections are provided at the rear of the Controller for the following inputs and outputs (some of which may not be present, depending upon the configuration of the Controller):

* Mains (Line) Input
* Thermocouple or Resistance Temperature Detector (RTD) Input
* Output 1 (Heat) - Relay or Solid State Relay (SSR)
* Output 2 (Cool) - Relay or Solid State Relay (SSR)
* Alarm Output

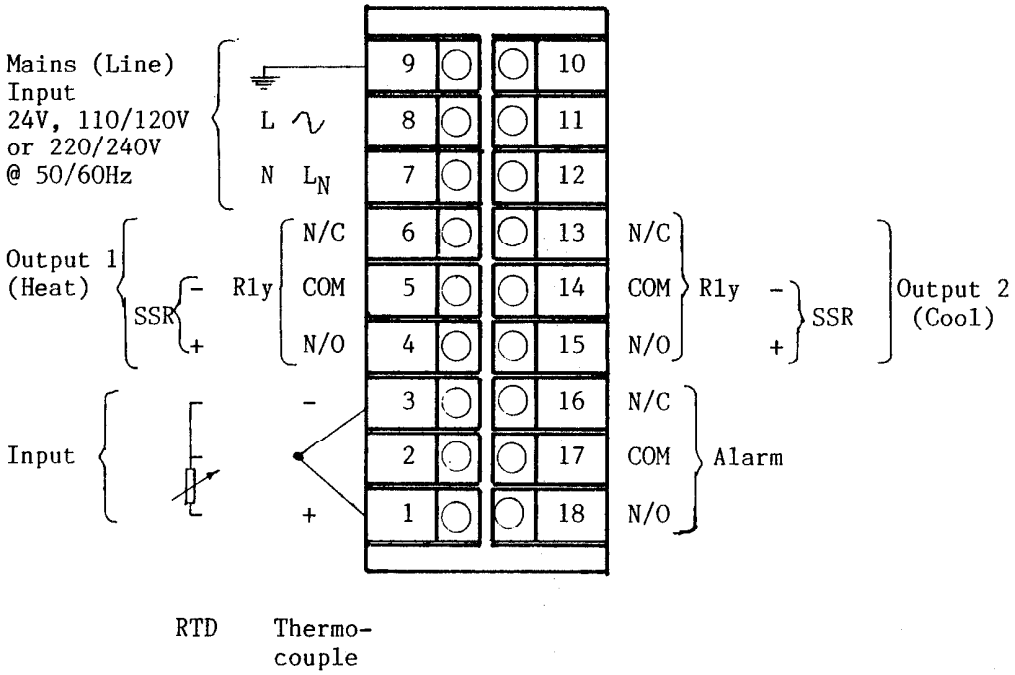


FIGURE 2-5 REAR CONNECTIONS

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 POWER CONNECTIONS

2.7.2 Thermocouple Input

Thermocouple connections are shown in Figure 2-7.

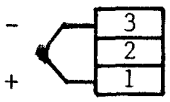


FIGURE 2-7
THERMOCOUPLE INPUT CONNECTIONS

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. All Controllers supplied with a thermocouple input have a cold junction compensation unit connected across Terminals 1 and 2; **this unit should never be removed.**

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

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

2.7.3 Resistance Temperature Detector (RTD) Input

RTD Input connections are shown in Figure 2-8. The compensating lead should be connected to Terminal 3. For 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).

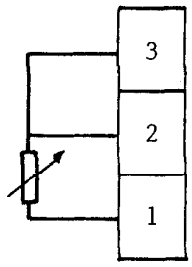


FIGURE 2-8
RTD INPUT CONNECTIONS

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 indicator **OP 1** is illuminated.

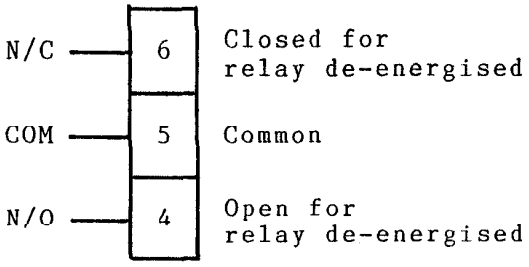


FIGURE 2-9
OUTPUT 1 RELAY CONNECTIONS

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 the WEST 2200 Series Thyristor Units or other solid state relays with an isolated input. When Output 1 is ON, the fron panel **OP 1** indicator will be illuminated. The SSR Drive connections for Output 1 are shown in Figure 2-10.

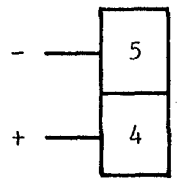


FIGURE 2-10
OUTPUT 1 SSR DRIVE CONNECTIONS

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 has contacts 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 indicator **OP 2** is illuminated.

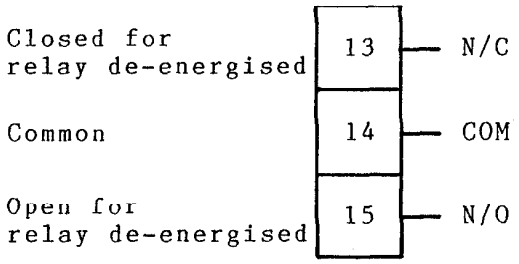


FIGURE 2-11
OUTPUT 2 RELAY CONNECTIONS

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 the WEST 2200 Series Thyristor Units or other solid state relays with an isolated input. When Output 2 is ON, the fron panel **OP 2** indicator will be illuminated. The SSR Drive connections for Output 2 are shown in Figure 2-12.

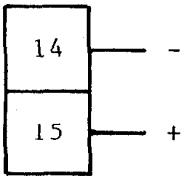


FIGURE 2-12
OUTPUT 2 SSR DRIVE CONNECTIONS

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

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

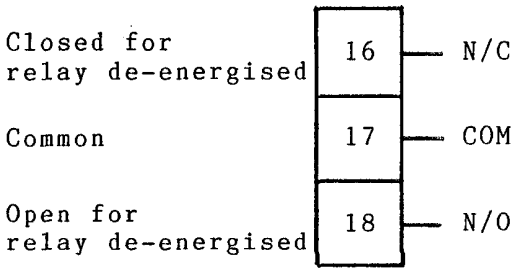


FIGURE 2-13
ALARM RELAY CONNECTIONS

2.8 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.*

2.8.1 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 3500 Controller contain 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).

2.8.2 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 2-14.

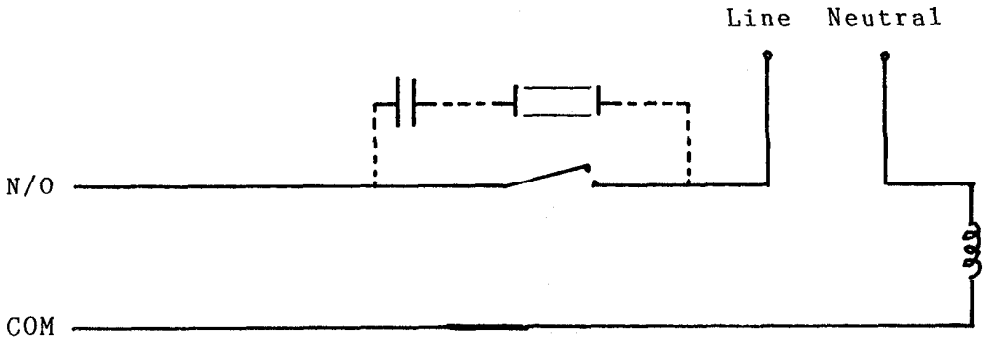


FIGURE 2-14 EXTERNAL SWITCH IN SERIES WITH EXTERNAL INDUCTIVE LOAD

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 2-14. The values shown in Table 2-2 may be used for these components.

TABLE 2-1 VALUES FOR PROTECTIVE NETWORK COMPONENTS

Load Current	Value of C (µF)	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

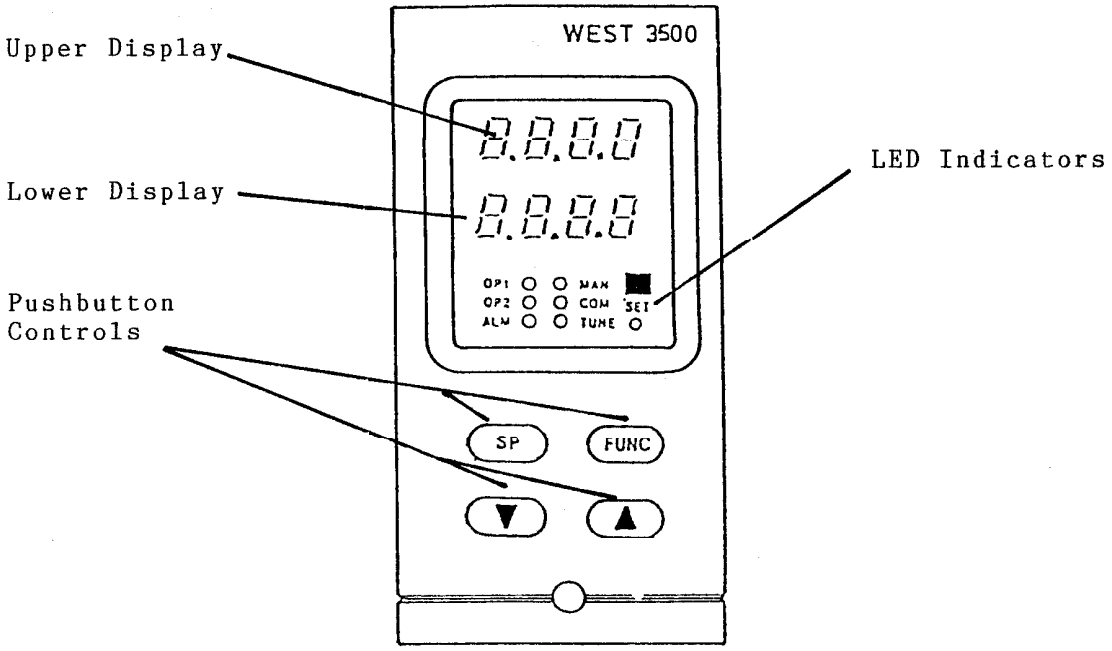


FIGURE 3-1 FRONT PANEL CONTROLS, INDICATORS AND DISPLAYS

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.**

NOTE

The units for the process variable (^{o}F or ^{o}C) are displayed in a window on the lower right of the display group.

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

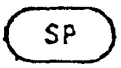
ALM Optional - This indicator flashes to indicate an alarm condition (see Subsection 4.9 for details of alarm operation).

COM Not operational.
MAN Not operational.
TUNE Not operational.

3.4 FRONT PANEL CONTROLS

Raise pushbutton. Used to increment (raise) the value of the set point. Momentary depression of this pushbutton will increment the set point value by 1 in the least significant digit. If this pushbutton 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 pushbutton is held down for longer than 10 seconds, the second least significant digit will be incremented at the rate of 25 units per second.

Lower pushbutton. Used to decrement (lower) the value of the set point. Momentary depression of this pushbutton will decrement the set point value by 1 in the least significant digit. If this pushbutton 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 pushbutton is held down for longer than 10 seconds, the second least significant digit will be decremented at the rate of 25 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

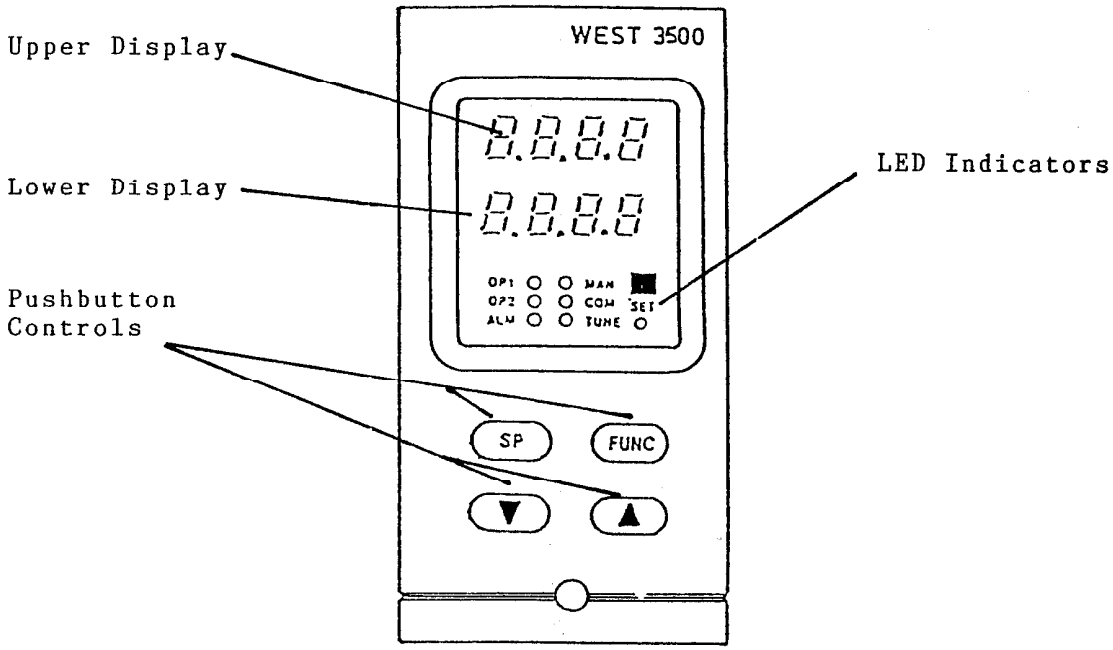


FIGURE 4-1 FRONT PANEL

4.1.1 Displays

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

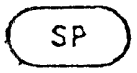
Lower Display: This four-character display shows the legend which identifies the currently-selected control parameter (see Table 4-1).

4.1.2 Controls

Raise pushbutton. Used to increment (raise) the value of the selected control parameter. Depression of this pushbutton will either increment the parameter value by 1 in the least significant digit or will cause the parameter to be set to the next higher value in a pre-defined set of values. If this pushbutton is held down for longer than one

second, the least significant digit of a continuously-variable parameter will be incremented at the rate of 25 units per second. If the pushbutton is held down for longer than 10 seconds, the second least significant digit will be incremented at the rate of 25 units per second. This pushbutton and the Lower pushbutton are also used to enter/leave Set Up Mode.

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



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

Used to select the control parameter to be viewed/adjusted. Successive depressions of this pushbutton 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 pushbuttons 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 pushbuttons and hold down the **FUNC** pushbutton until the **SET** indicator stays ON continuously (after a delay of approximately two seconds).

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

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** pushbutton. The lower display will show the legend **SP** and the upper display will show the current set point value. If the **SP** button 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** pushbutton to step through the parameter display sequence shown in Table 4-1 until the required parameter is displayed. If the **FUNC** pushbutton 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** pushbuton 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 pushbutton, as required, to alter the parameter value.

NOTE

The upper and lower displays will flash and no adjustment will be made 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 dislayed 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 (e.g. Proportional Band **PB%** is set to 0), 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.

TABLE 4-1 PARAMETER LEGENDS, RANGES AND DEFAULT VALUES

Parameter	Legend	Range	Default Value
Process Variable	None	Span of Controller	Read Only
Set Point	**SP**	Within SP MAX and Range Min.	Range Min.
Output Power	**OP**	0 - 100%	Read Only
Proportional Band	**Pb**	0% - 100% of span	10%
Integral Time Constant[1]	**rSEt**	10 secs - 30 mins and OFF	5 mins 00 secs
Derivative Time Constant[1]	**rAtE**	00 secs - 10 mins	30 secs
On/Off Differential[2]			
O/P 1 only	**diF1**		
O/P 2 only	**diF2**	0% - 10% of span	0.5% of span
O/P 1 & O/P 2	**diFF**		
Set Point High Limit	**SPhi**	Span of Controller	Range Max.
Set Point Low Limit	**SPLo**	Span of Controller	Range Min.
Output 1 Power Limit[1]	**OPhi**	0% - 100% of full power	100%
Output 1 Cycle Time[1]	**Ct1**	1, 2, 4, 8, 16, 32 or 64 secs	32 secs
Output 2 Value[3]	**Out2**	± span from Set Point	0
Alarm Value[3]			
Process Alarm	**P_AL**	Range min. - Range Max.	Range Max.
Band Alarm	**b_AL**	0 - span from Set Point	5 units
Deviation Alarm	**d_AL**	± span from Set Point	5 units

NOTES ON TABLE 4-1

Span = Span of Controller i.e. Range Max. - Range Min.

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

4.5 CONTROL PARAMETERS

Set Point (SP): This parameter is the desired value of the Process Variable. It may be adjusted within the range defined by Set Point High Limit (**SPhi**) and the Range Minimum of the Controller.

Output Power (OP): This "Read Only" parameter indicates the power output from the Controller. It may vary in the range 0% - 100%.

Proportional Band (Pb): This parameter may be set to a value in the range 0% - 100% of the span of the Controller. If this parameter is set to 0%, the Controller operates in ON/OFF mode.

Integral Time Constant (rSEt): This parameter may be set to a value in the range 10 seconds - 30 minutes. If this paramter is set to a value greater than 30 minutes, it becomes inoperative and the upper display goes blank.

Derivative Time Constant (rAtE): This may be set to a value within the range 0 seconds - 10 minutes.

On/Off Differential (diF1, diF2 or diFF): This parameter applies to Output 1 if the Proportional Band is set to 0% and to Output 2 if it is fitted. It provides a dead band to prevent too-frequent load switching and can be set to a value in the range 0.1% - 10% of the span of the Controller.

Set Point High Limit (SPhi): This parameter should be set to the highest value of Set Point which is safe for the process.

Output 1 Power Limit (OPhi): This parameter is used to limit the power level of Output 1 and may be used to protect the process. If *no protection is required, it may be set to 100%. This parameter* is omitted from the sequence if the Proportional Band is set to 0.

Output 1 Cycle Time (Ct1): The selection of cycle time is dependent upon the process being controlled. For relay output, the cycle time should be as large as possible (consistent with satisfactory control) in order to maximise the life of the relay. If the SSR Drive Output is fitted, the cycle time may be selected from the lower values in the permitted range:

1/2, 1, 2, 4, 8, 16, 32 and 64 seconds

Output 2 Value (Out2): *This parameter defines the switch-on and* switch-off levels for Output 2 operating in On/Off mode. For a direct-acting Output 2, these levels are defined as:

Switch-on: Set Point + Output 2 Value + 1/2 x On/Off Differential
Switch-off: Set Point + Output 2 Value - 1/2 x On/Off Differential

Note that the Output 2 Value may be negative, in which case the above expressions are still valid but Output 2 will switch on when the Process Variable is below the Set Point.

Alarm Value (P_AL, b_AL, d_AL): This parameter defines the process variable value at which the alarm (process, band or deviation) will operate (see Subsection 4.7 for details of alarm operation). This parameter will be omitted from the sequence if an alarm option is not fitted.

4.6 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.

NOTE

The techniques outlined below are suitable only for processes which are not harmed by large fluctuations in the Process Variable. They provide an acceptable basis from which to start the tuning for a wide range of processes. For additional information on tuning, including alternative tuning techniques, refer to the book "Principles of Temperature Control" available form WEST.

Option 1:

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 4-2. At each stage, allow sufficient time before moving on to the next stage.

Option 2:

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 0%, and the On/Off Differential to 0.1% (this sets the Controller to On/Off control and the Integral Time Constant and Derivative Time Constant parameters will be omitted from the Set-Up sequence).
3. Switch on the power supply to the heater. Under these conditions, the Process Variable will oscilate 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 4-3).
4. The control settings should then be adjusted as follows:

$$\text{Proportional Band} = \frac{P}{\text{Scale Range}} \times 100\%$$

$$\text{Integral Time Constant} = T \text{ minutes}$$

$$\text{Derivative Time Constant} = \frac{T}{6} \text{ minutes}$$

NOTE

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.

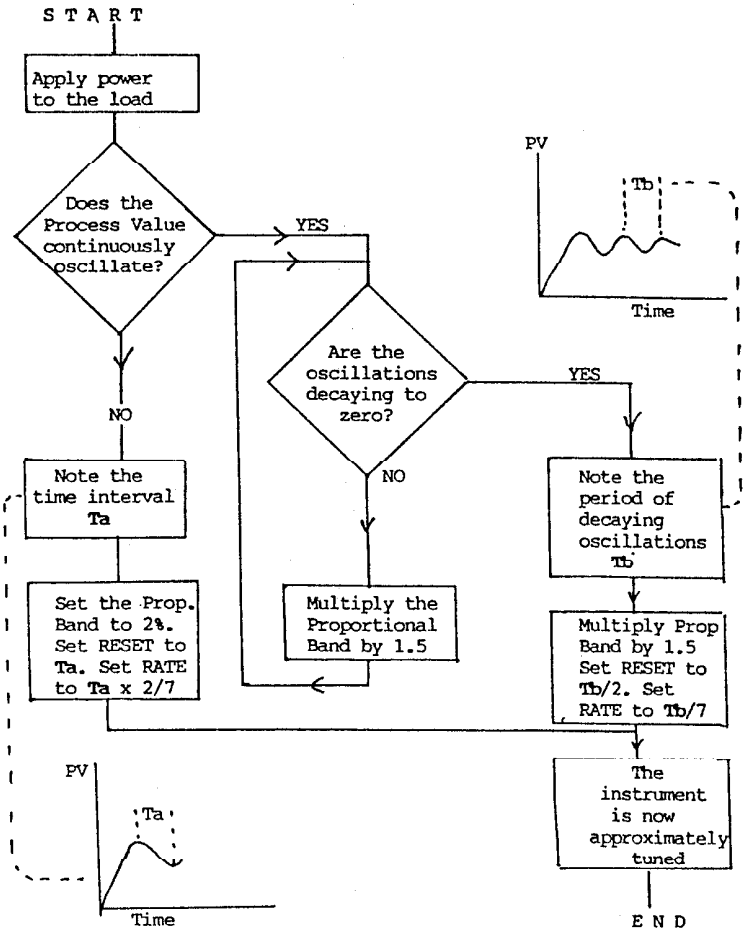


FIGURE 4-2 TUNING THE CONTROLLER

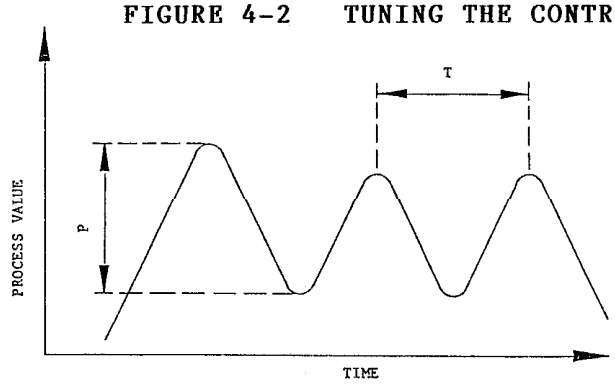


FIGURE 4-3 OPTION 2 SETTING-UP PROCEDURE

4.7 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 4-4 shows the operation of the displays and relays for 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** pushbutton).

2. With the Process Variable displayed, simultaneously depress and hold down the Raise and Lower pushbuttons 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 pushbuttons and depress and hold down the **FUNC** pushbutton until the **SET** indicator is extinguished. The Controller is then in User Mode.

NOTE

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

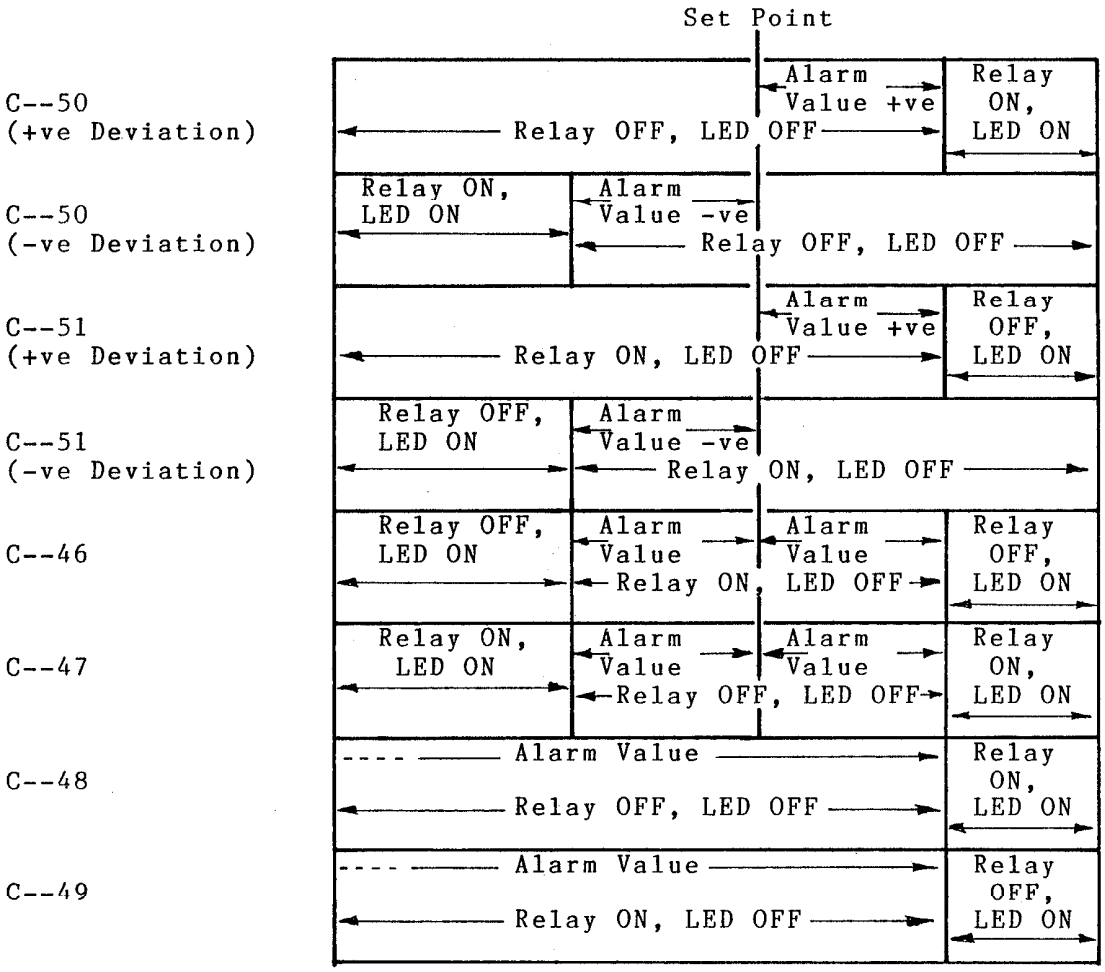


FIGURE 4-7 OPERATION OF ALARM LEDs AND RELAYS

SECTION 5

RANGE-CHANGING AND RE-CONFIGURATION

It is possible to change the range of the input and to re-configure the Model 3500 Controller by changing the positions of link jumpers on the CPU Board and (if fitted) the Options Board. In order to gain access to these link jumpers, it is necessary to dismantle the Controller.

NOTE

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 starting the dismantling procedure, ensure that the mains (line) supply has been disconnected.

2. The Controller contains devices which are vulnerable to damage from electrostatic discharge. In order to minimise the risk of such damage occurring during handling of the Controller and its sub-assemblies, it is recommended that certain precautions be taken:

   (a) Never touch the tracks or components (except for link jumpers) on the PCBs.

   (b) Before handling a PCB, momentarily touch a convenient earthing point (e.g. a metal bench or rack) in order to discharge most of the static electricity stored.

   (c) Wear a wrist earthing strap.

3. The Controller also contains a lithium battery on the CPU Board. When removing the CPU Board from the Controller, ensure that it is not placed on a conducting surface; such contact would short-circuit the battery. 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 fron 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. Extract the screw securing the CPU Board (on the right-hand side as viewed from the front of the Controller) to the bracket attached to the Controller front panel assembly.

2. 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.

3. Extract the screw securing the Options Board to the pillar on the CPU Board. 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.

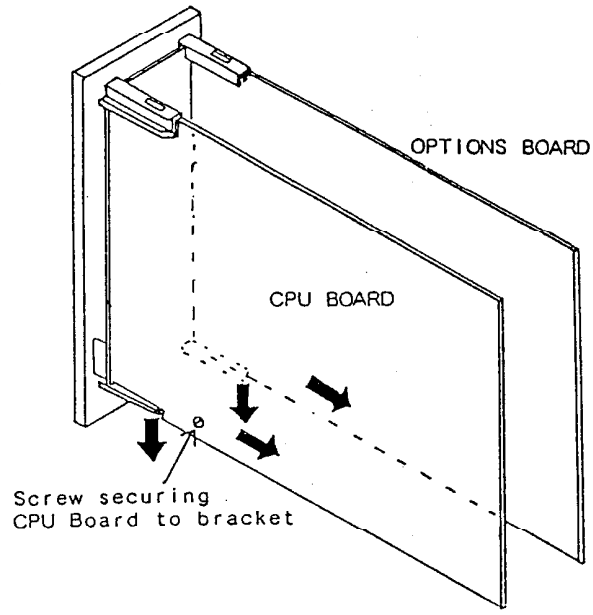


FIGURE 5-1 DETACHING THE PCBs FROM THE FRONT PANEL

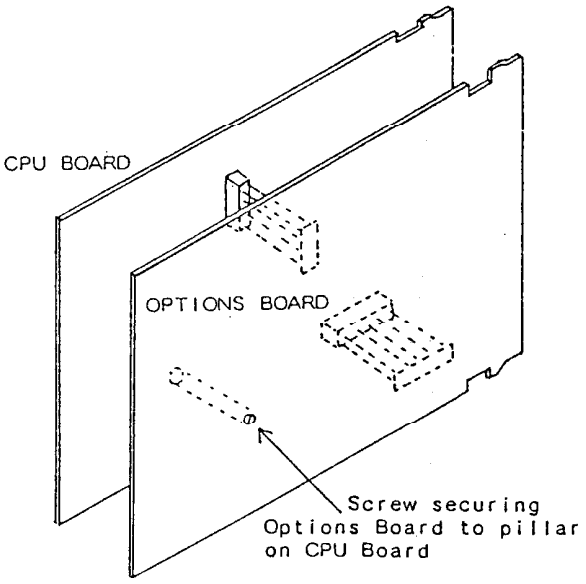


FIGURE 5-2 SEPARATING THE TWO PCBs

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.

TABLE 5-1 THERMOCOUPLE INPUT LINK JUMPERS

Product Code	Input Type	Input 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 = Active P = Parked - = Not fitted

TABLE 5-2 THERMOUCOUPLE BREAK PROTECTION - LINK JUMPER SETTINGS

Break Protection Type	Input Product Code	Link Jumpers LJ14	LJ15
Upscale	T----	X	-
Downscale	T----21	-	X
No protection	T----22	P	-

X = Active P = Parked - = Not fitted

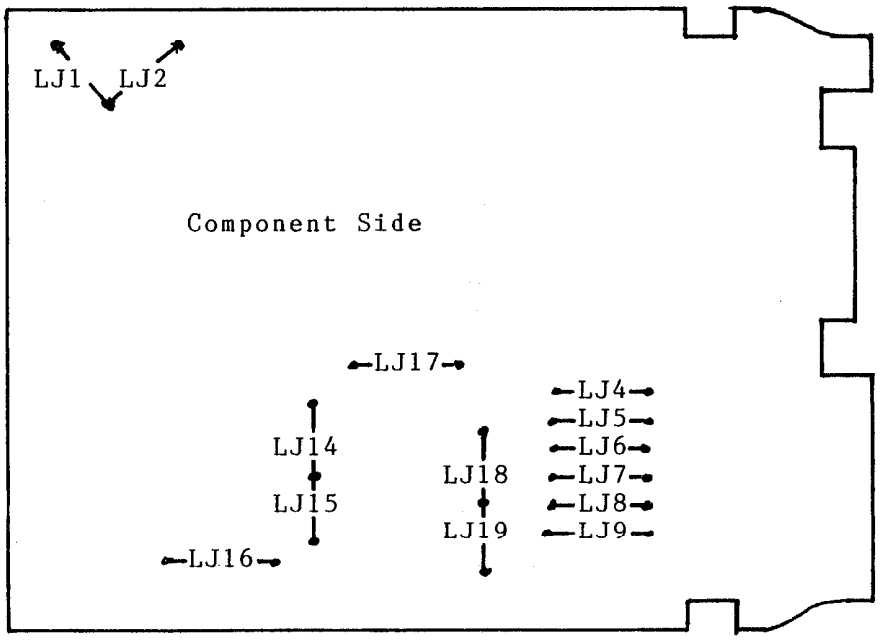


FIGURE 5-3 CPU BOARD - LINK JUMPER POSITIONS

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

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

X = Active P = Parked

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: Output 1 is reverse-acting if the Output is active (e.g. relay energised) when the process variable value is less than the set point value.

Direct-Acting: Output 1 is direct-acting if the Output is active (e.g. relay energised) when the process variable value is more than the set point value.

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), if fitted, provides Output 2 and/or an Alarm Output. This Options Board 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 5-4) 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 in accordance with the information in Table 5-4. Refer to Subsection 4.7 for details of Alarm Output operation.

TABLE 5-4 ALARM OUTPUT LINK JUMPERS

Product Code	Link Jumpers 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

* If Alarm Output is not supplied, links LJ21, LJ22 and LJ23 are ommitted.

X = Active P = Parked

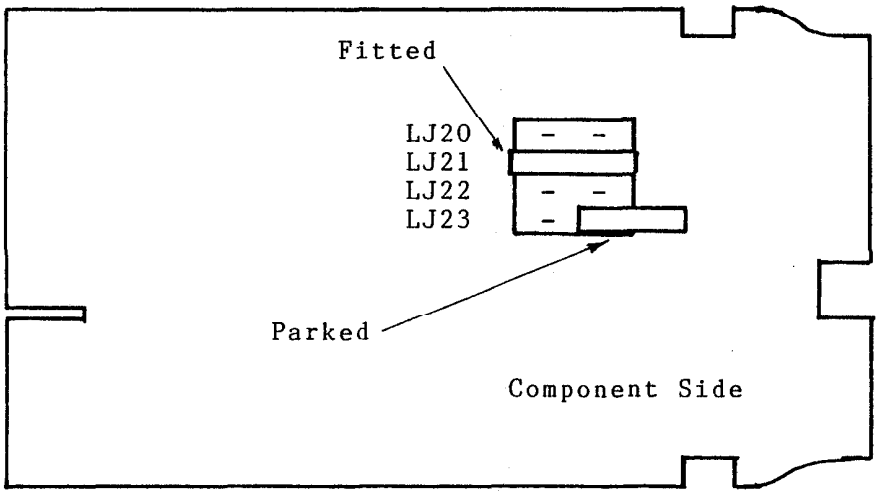


FIGURE 5-4 STANDARD OPTIONS BOARD - LINK JUMPER POSITIONS

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.

3. Insert the screw (made available during the previous dismantling of the Controller) through the CPU Board into the bracket attached to the front panel; tighten the screw to secure the boards in position.

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 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 - 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

Alternative configurations (continued):

Alarm Type	**Relay Energised**	**ALM Flashes**
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: 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: $20^oC \pm 2^oC$

Mains (Line) Supply Voltage: 120V or 240V $\pm$ 1% @ 50/60Hz $\pm$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^oC - $+50^oC$
- Storage: -20^oC - $+60^oC$

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

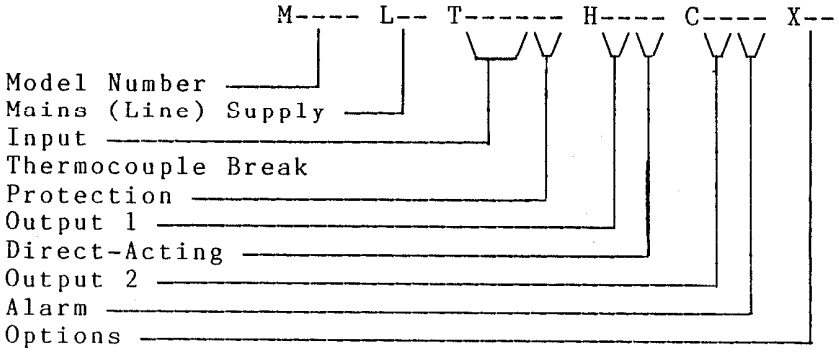
Reference Accuracy:	Typically ±0.5% of span ± 1sd.
Temperature Stability:	<0.015% of span for 1°C change in ambient temperature.
Cold Junction Compensation:	<0.1°C change for 1°C change in ambient temperature.
Effect of Thermocouple Resistance:	<0.1% of span error for resistance 0 - 100 Ohms.
Effect 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 alpha-numeric displays (for parameter values and identifiers). Four red LED indicators (output states, alarm state and Set Up Mode selection).
Front Panel Controls:	Four pushbuttons:- Set Point Select Function Select Raise Lower
Dimensions - Height:	48mm (1.89 inches)
- Width:	96mm (3.78 inches)
- Depth:	153mm (6.02 inches)
Weight:	0.65 kg (1.43 lb)
Power Consumption:	3VA approximately.

APPENDIX B

PRODUCT CODES



MODEL NUMBER

M3500

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

Product Codes

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
X73	1/4 DIN to 1/8 DIN conversion plate.
X79	Remote Front Panel with 0.5m connecting cable
X74	Remote Front Panel with 2.0m connecting cable
X75	Remote Front Panel with 5.0m connecting cable
X76	Chassis Mounting Bracket for use with X74, X75 or X79.