WEST

Process Control Instrumentation

WEST 3400

Compact Self-Tuning Micro Controller

User Installation and Operating Instructions

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1675 Delany Rd.
Gurnee, IL. 60031
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847-782-5277 Applications Support Fax
800-873-8731 Sales/Order Entry
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Please disregard all phone numbers and addresses in this manual. The phone numbers and address on this page are the correct phone number and addresses to use for sales, repair, and application support.

IM-0022-A0

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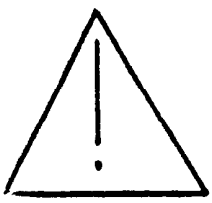
NOTE

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



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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CONTENTS

SECTION 1 - INTRODUCTION

The WEST 3400 is a compact PID controller, and is an enhanced version of the WEST 3200 self-tuning microprocessor based controller. The extra facilities include a wider range of inputs and proportional cooling output. A specially designed multi-colour liquid crystal display combines a clear and comprehensive display with very low power consumption.

The case conforms to 1/8 DIN measurements, and controllers can be conveniently mounted side by side in multiple installations. Power consumption is only about 3W, so that minimum ventilation is required.

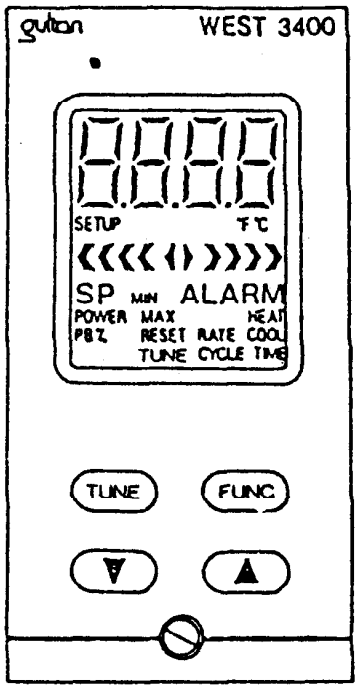
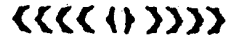


FIGURE 1-1 FRONT PANEL DISPLAY AND CONTROLS

The controller operates in three User Modes, Manual Tune Mode, Self-tune Mode, and Pre-tune Mode. In these modes the operator can only adjust set-point value and monitor the outputs. In Self-tune and Pre-tune Modes the instrument automatically adjusts the PID terms to suit the current conditions of load and power available. In any of these modes Setup Mode can be selected, where all control parameters can be reviewed and adjusted.

1.1 DISPLAYS

Numeric — Four digits, with decimal points; negative numbers up to -1999. Normally displays the value of the process variable. Set-point and other control parameter values are displayed after selection by means of the front panel pushbuttons.

Bar Graph 	A nine segment bar graph shows deviation of the process variable (PV) from the set-point (SP) It shows green in the centre when the PV is the same as the SP; it shows an increasing number of blue segments as the PV goes below the SP, and an increasing number of red segments as the PV goes above the SP.

1.2 LEGENDS

SP	This section of the display is activated when the set-point value is being shown on the numeric display.
ALARM	This flashes when the Process Variable has reached the alarm level, which can be set for a deviation limit or an absolute level.
TUNE	This is displayed when the instrument is in Self-tune Mode. It flashes in Pre-tune Mode.
SETUP	This display indicates Setup Mode, which allows the control parameters to be examined and adjusted.
HEAT	This is displayed when Heat Output is on.
COOL	This is displayed when Cool output is on.
CONTROL PARAMETER LEGENDS	When a control parameter is selected for examination/adjustment, the appropriate legend is displayed and the value of the parameter is shown on the numeric display.

1.3 PUSHBUTTON CONTROLS

	When pressed as part of a sequence this selects Manual Tune, Self-tune or Pre-tune Mode.
	Operating this pushbutton in Setup Mode causes the control parameters to be selected and displayed in sequence. The selected parameter can be adjusted by means of the RAISE and LOWER buttons
	When the LOWER button is pressed momentarily the value of the displayed parameter will be reduced by one unit. If the button is held in for more than a second the value is reduced continuously.
	The RAISE button operates in the same way as the LOWER button, but increases the value.

SECTION 2 - INSTALLATION

2.1 UNPACKING THE 3400

The 3400 is supplied with a mounting clamp and two screws included in the transit package.

Remove the equipment from the transit package and check for damage. Notify the carrier immediately in case of any damage or deficiences. Check that the Product Code matches your order code and requirements (supply voltage, input type etc)

2.2 MOUNTING

The instrument can be mounted on a rigid panel of up to 6mm (.25 inches) thickness with a cut-out 92mm, +0.8 -0mm (3.62in, +0.03 -0in) high and 45mm, +0.6 -0mm (1.77in, +0.025 -0in) wide. Units can be mounted side by side in a continuous cut-out, and in this case the width of the cut-out should be (n x 48mm) - 4mm [(n x 1.89in) - 0.16in], where n is the number of instruments.

The instrument is 150mm (5.9in) deep, measured from the rear face of the front panel. The front panel is 96mm (3.8in) high and 48mm (1.89in) wide; when mounted on a panel it projects 6mm (0.25in).

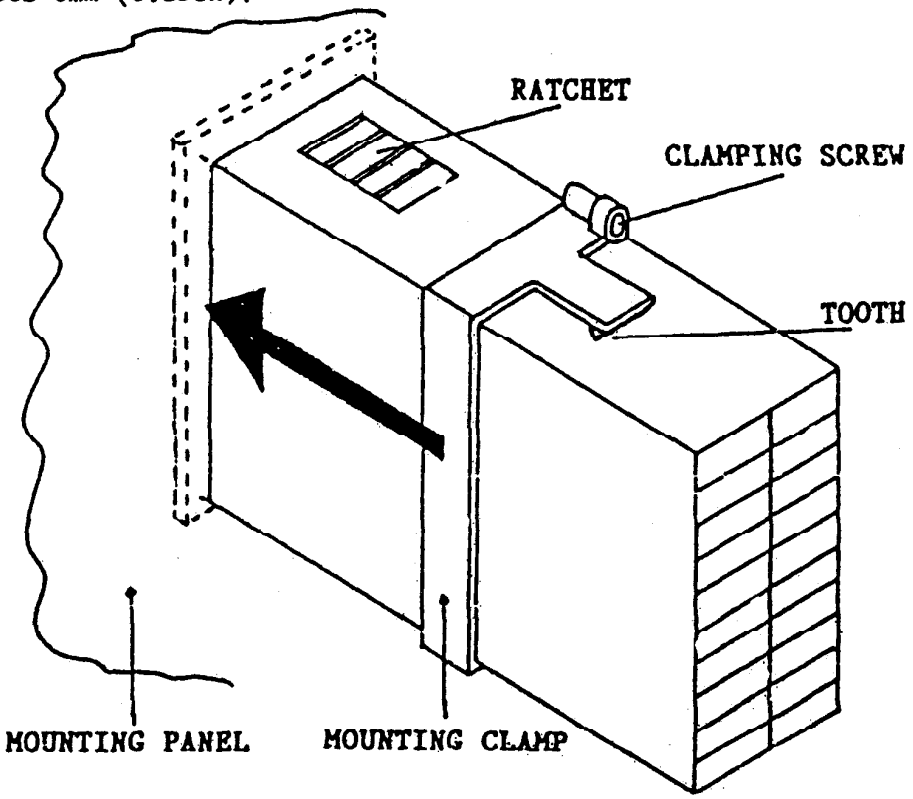


FIGURE 2-1 ATTACHMENT OF HOUSING TO MOUNTING PANEL

2.2.1 Attaching Housing to Mounting Panel

Insert the rear of the housing (or housing with instrument in it) through the cut-out and hold the instrument lightly against the front panel.

The instrument is held in place by a plastic mounting clamp. Slide this onto the instrument and push it forwards until it touches the mounting panel. Teeth on the arms projecting to the rear of the clamp engage with ratchets moulded into the top and bottom of the case. Next gently tighten the screws in the clamp so that the front panel of the instrument is a snug fit on the front of the mounting panel. **Do not over-tighten the screws and distort the clamp.**

2.2.2 Removal of Instrument from Housing (see Figure 2-2)

For replacement or servicing the instrument can be easily removed from the housing, leaving the housing and back-wiring attached to the mounting panel.

> **WARNING**
> **The mains (line) supply must be disconnected from the instrument before attempting to remove it from its housing.**

CAUTION: THIS INSTRUMENT CONTAINS STATIC SENSITIVE DEVICES AND A LITHIUM BATTERY. PRECAUTIONS SHOULD BE TAKEN, DURING HANDLING, TO MINIMISE THE RISK OF STATIC DAMAGE OR BATTERY SHORT CIRCUIT.

With a suitable size screwdriver turn the screw near the base of the front panel anti-clockwise. This will first jack out the instrument and disengage the connector at the rear; then the screw will disengage itself from the bush in the housing. Carefully pull the instrument out from the housing.

2.2.3 Inserting Instrument into Housing

Carefully slide the the instrument into the housing previously mounted on the mounting panel; **make sure that the circuit board(s) locate against the outside of the card guides moulded in the top and bottom of the housing.** Push the instrument firmly home so that the rear connections of the circuit boards make a good connection with the rear terminals.

Engage the screw near the base of the front panel and tighten until the instrument is firmly in place.

2.2.4 Removal of Housing from Mounting Panel

Loosen the clamping screws (shown in figure 2-1). Support the housing with one hand and remove the plastic mounting clamp by disengaging the teeth from the ratchets and sliding the mounting clamp rearwards. (Inserting stiff card or plastic between the teeth and the ratchets helps.) Remove the housing from the mounting panel by pulling the housing forwards through the mounting hole.

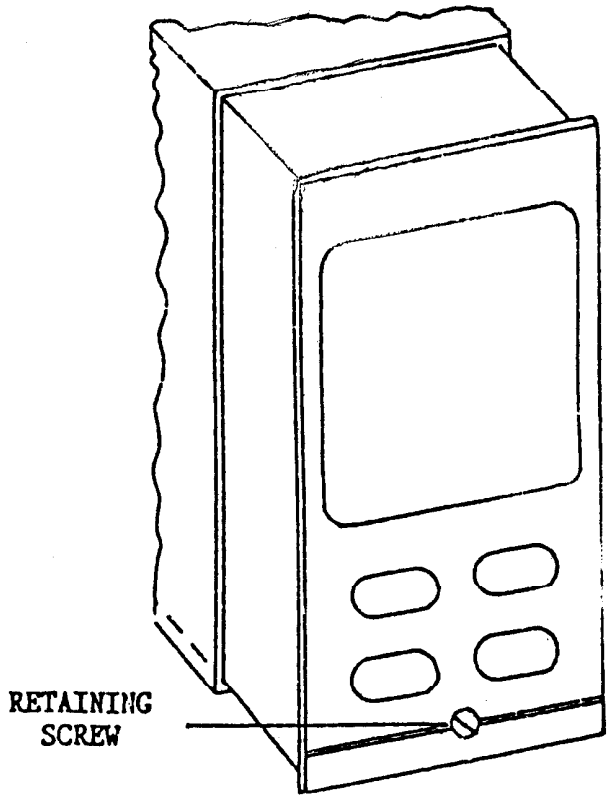


FIGURE 2-2 REMOVAL AND REPLACEMENT OF 3400 WITHIN HOUSING

2.3 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 not made common to the neutral. Consideration should be given to the prevention of unauthorised personnel gaining access to the power terminations.

The following inputs and outputs are provided on the rear of the instrument housing. (Depending on configuration, some of the connections may not be present).

- Mains (Line) Input (See Section 2.4)
- Thermocouple, RTD, or linear Input (See Section 2.5)
- Output 1 (HEAT) - Relay or SSR (See Section 2.6)
- Output 2 (COOL) - Relay or SSR (See Section 2.7)
- Alarm output (See Section 2.8)

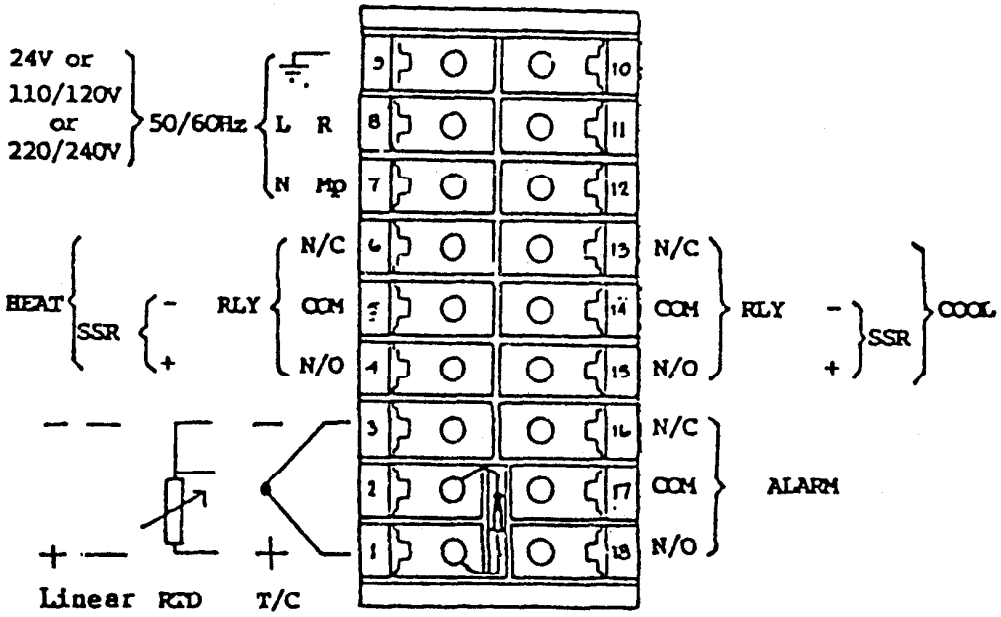


FIGURE 2-3 3400 REAR CONNECTIONS

2.4 Mains (Line) Input

The instrument is supplied for operation on 24V, 193V - 264V or 100V - 132V 50/60Hz as stated on the label attached to the side of the instrument. **Check voltage before applying power.**

Local requirements regarding electrical installation should be rigidly observed. Ground terminals must be separately connected and not made common to the neutral. Consideration should be given to the prevention of unauthorised personnel gaining access to power terminations.

The ground terminal 9 should be connected to a protective ground conductor before any other connections are made, and should remain connected at all times.

2.5 Inputs

DO NOT RUN INPUT LEADS ADJACENT TO POWER CARRYING CONDUCTORS. IF THE WIRING IS RUN IN A CONDUIT, USE A SEPARATE CONDUIT FOR THE INPUT WIRING. IF THE THERMOCOUPLE IS GROUNDED, THIS MUST BE DONE AT ONE POINT ONLY. IF THE INPUT LEADS ARE SHIELDED, THE SHIELD MUST BE GROUNDED AT ONE POINT ONLY.

2.5.1 Thermocouple Input

Thermocouple connections are made to the terminals as shown in Figure 2-4

An open circuit thermocouple will cause |¯ ¯| to be displayed and output power to go to either 0% or 100% as defined by the configuration and the Product Code.

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 instrument and the thermocouple, ensuring that the correct polarity is observed throughout. Joints in the cable should be avoided if possible. All instruments supplied with a thermocouple input have a cold junction compensation unit connected across terminals 1 & 2. This unit should never be removed.

Thermocouple Leadwire Colour Codes (last colour in each group refers to the overall sheath).

	Thermocouple 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	Platinum/ 13% Rhodium	+ white - blue green	+ black - red green	+ red - white white	+ yellow - green green
S	Platinum/ 10% Rhodium	+ white - blue green	+ black - red green	+ red - white white	+ yellow - green green

*Last colour in each group refers to the overall sheath.

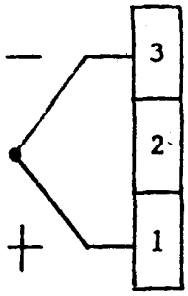


FIGURE 2-4. THERMOCOUPLE INPUT CONNECTIONS

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

2.5.2 Resistance Temperature Detector Input

RTD connections are made as shown in Figure 2-5, with the compensating lead connected to terminal 3. For 2-wire RTDs 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.)

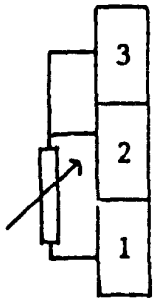


FIGURE 2-5 3-WIRE RESISTANCE THERMOMETER INPUT CONNECTIONS

2.5.3 Linear Input

A range of linear inputs can be accommodated, and details of these are given in Appendix 2, Product Codes.

Connect positive input lead to terminal 1 and negative input to terminal 3.

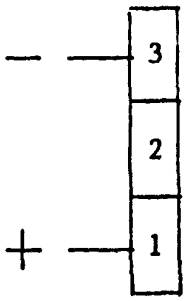


FIGURE 2-6 CONNECTIONS FOR LINEAR INPUT

2.6 Heat Output

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

2.6.1 Relay (Product Code ..H10..)

The output relay has contacts connected to the rear terminals. The contacts are rated at 5A 240V a.c. with a resistive load. When the relay is energised the front panel displays HEAT.

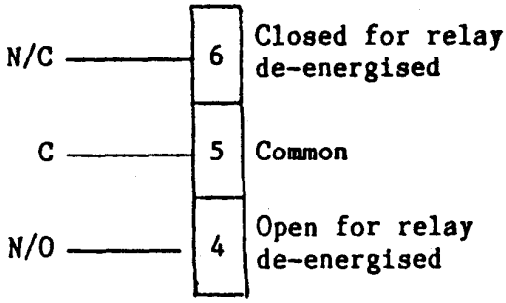


FIGURE 2-6 OUTPUT 1 RELAY CONNECTIONS

2.6.2 SSR Drive (Product Code ..H50..)

Instruments with this output produce a time proportioned non-isolated D.C. signal, 0V/12V nominal, output impedance 1kΩ. This is suitable for driving the WEST 2200 Series Thyristor Units or other solid state relays with an isolated input. When the output is ON the display shows HEAT.

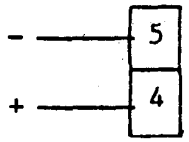


FIGURE 2-7 HEAT OUTPUT SSR DRIVE CONNECTIONS

2.7 Cool Output (optional)

NOTE: This output is always the opposite of Heat Output; if Heat Output is reverse acting, Cool Output is direct acting, i.e. the relay is energised if the Process Variable is above the Set-point

2.7.1 Relay (Product Code ..C10..)

The output relay has SPDT contacts connected to the rear terminals. The contacts are rated at 2A 240V a.c. with a resistive load. When the relay is energised the front panel displays COOL.

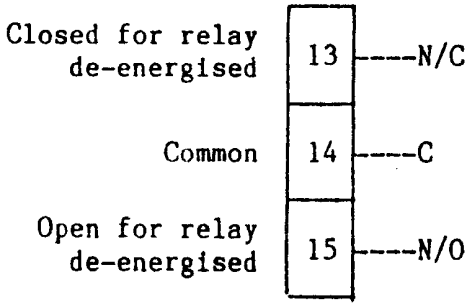


FIGURE 2-8 COOL OUTPUT RELAY CONNECTIONS

2.7.2 SSR Drive (Product Code ..C50..)

Instruments with this output produce a time proportioned non-isolated D.C. signal, 0V/12V nominal, output impedance 1kΩ. This is suitable for driving the WEST 2200 Series Thyristor Units or other solid state relays with an isolated input.

When the output is ON the display shows COOL.

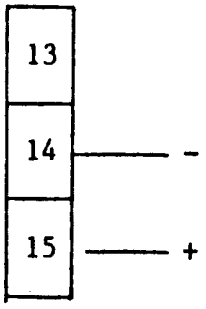


FIGURE 2-9 COOL OUTPUT SSR DRIVE CONNECTIONS

2.8 Alarm Output (optional) (Product Codes ..C—46. to ..C—51.)

The relay connections are shown in Figure 2-10

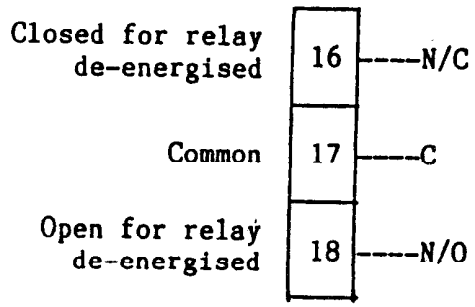


FIGURE 2-10 ALARM CONNECTIONS

Section 4.10 gives details of alarm operation. The above connections apply to all alarm configurations.

2.9 INDUCTIVE LOADS, EXTERNAL CONTACTORS AND MAINS OPERATED RELAYS AS LOADS

W A R N I N G

Operating the instrument with inductive loads and without the appropriate protection network may give rise to a hazard due to high voltage transients which may occur during the switching cycles.

2.9.1 GENERAL

The 3400 Controller relays have an internal protection (snubber) network which provides adequate protection for resistive loads and inductive loads up to 40mA.

Higher inductive loads can cause the following problems if the recommended procedures as outlined in this document are not followed.

1) Damage to the contacts of the internal relay(s) of the instrument.

2) High voltage transients that can damage the PCB tracks with the possibility of a serious hazard

3) Radio frequency interference (RFI) which can affect the performance of the instrument.

External contactors used as loads can (under exceptional circumstances) cause problems by failing to release. This can occur with a contactor which is of the very low current type so that the current through internal protection network capacitors is greater than the release current.

Mains operated solid state relays can cause problems by 'holding on' due to the current through the internal protection network capacitors not allowing the input voltage to fall sufficiently to turn the device off.

The recommendations for the above situations are given for the following load applications:

1) Inductive loads
   Applications up to 40mA (See Section 2.9.2)
   Applications greater than 40mA (See Section 2.9.3)
   External switch in series with inductive load (See Section 2.9.4)

2) Very low current external contactors (See Section 2.9.5)

3) Mains operated solid state relays (See Section 2.9.6)

2.9.2 Inductive Loads in Applications up to 40mA

The snubber network already fitted in the instrument provides adequate protection for inductive load applications up to 40mA.

2.9.3 Inductive Loads in Applications greater than 40mA

Additional external protection components are required for inductive load applications greater than 40mA. For SPDT relay contacts these components are two capacitors and a resistor and are fitted in parallel with (and preferably close to) the load(s) as shown in Figure 2-11. For SPST relay contacts (or if only one contact of an SPDT relay is used) the connections for the required capacitor and a resistor are as shown in Figure 2-12.

The required values for the components used for up to 240V r.m.s. applications are as shown in the following Table.

LOAD CURRENT	VALUE OF C µF	VALUE OF R ohms
70mA	0.047	22
150mA	0.1	47
0.5A	0.22	47
1A	0.47	47

NOTE: ALL CAPACITORS SHOULD CONFORM TO VDE (CLASS X) & BE SUITABLE FOR OPERATION AT 260V A.C

ALL RESISTORS (WIREWOUND OR ALLEN BRADLEY TYPE HB) SHOULD HAVE A MINIMUM RATING OF 2 WATTS

TABLE OF VALUES FOR PROTECTION NETWORK COMPONENTS

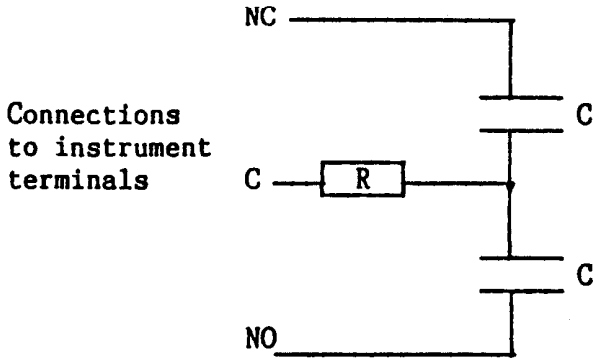


FIGURE 2-11 CONNECTION OF EXTERNAL PROTECTION COMPONENTS FOR SPDT RELAY CONTACTS

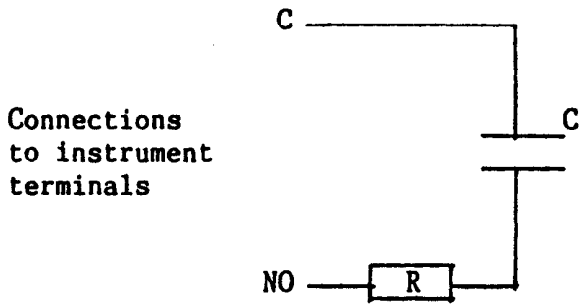


FIGURE 2-12 CONNECTION OF EXTERNAL PROTECTION COMPONENTS FOR SPST RELAY CONTACTS

2.9.4 External switch in series with an external inductive load

Damage to the instrument may result if unprotected switch, relay or contactor contacts are connected externally in series with the instrument relay contacts as shown in Figure 2-13.

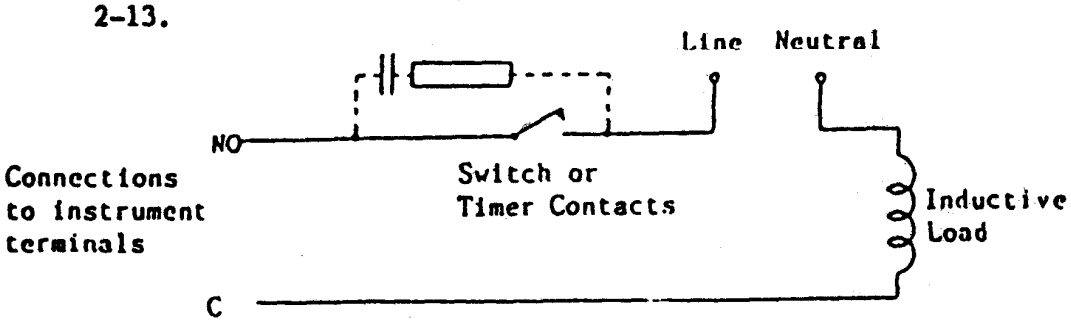


FIGURE 2-13 EXTERNAL SWITCH IN SERIES WITH AN EXTERNAL INDUCTIVE LOAD

Under these conditions the external contacts may operate while the instrument relay contacts are closed (i.e. the internal protection components short circuited and therefore ineffective).

In applications wnere it is necessary to fit external switch, relay or contactor contacts in series with the instrument relay a snubber network must be fitted either across the inductive load or across the unprotected contacts. The values given in the table may be used.

2.9.5 Very low current contactor

In exceptional cases where the contactor requires a very low nominal energising current (20mA at 240V) it is possible that the current through the snubber network capacitor(s) (when the relay contacts are open) will be sufficient to continue to energise the contactor.
A solution to the problem is to fit a resistor in parallel with the contactor coil. Normal contactor operation can be restored by fitting an 18K ohm resistor, of at least a 5 Watt rating, across the contactor coil.

An alternative solution is to connect the contactor as shown in Figure 2-14, using the back contact of the relay to short circuit the contactor coil.

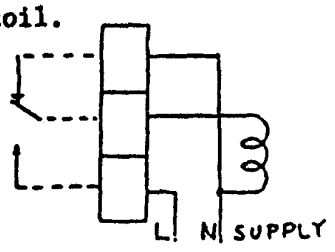


FIGURE 2-14 USING THE BACK CONTACT OF THE RELAY

Note: Connecting alarm outputs in parallel increases the leakage current which increases the possibility of an external contactor not releasing.

2.9.6 Mains Operated Solid State Relays

The use of mains operated solid state relays driven from the relay output of the instrument is not recommended.

The current through the instrument's internal snubber network capacitors may allow the input voltage of the SSR to remain above the minimum release voltage. This prevents any control of the power output.

A resistor across the SSR is NOT a solution due to the excessive power dissipation.

For solid state switching we recommend that the West 2200 Series Thyristor Units are used, in conjunction with the appropriate SSR output configuration on the 3400 controller.

W A R N I N G

Removal of the instrument's internal snubber components could give rise to a serious hazard. Gulton Limited and Gulton Industries Inc. do not accept responsibility for any damage which may arise as a result of the unauthorised removal of these components.

SECTION 3 - OPERATING INSTRUCTIONS

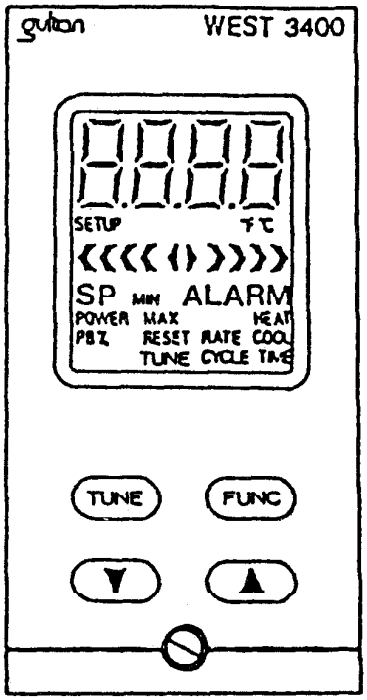


FIGURE 3-1 FRONT PANEL CONTROLS AND DISPLAYS

3.1 INTRODUCTION

These instructions assume that the instrument has been set up and put into User Mode, to prevent unauthorised tampering with the control parameters. In this mode all functions can be monitored on the display, but only the setpoint parameter is adjustable.

In Self-tune or Pre-tune the proportional band, the integral, the derivative and the relative gain are always locked, whichever Mode the controller is in.

If adjustment of functions other than set-point is required it is necessary to put the controller into SETUP Mode as described in section 4

For most applications the instrument will be operated with Self-tune operating and in the normal display mode (except when it is necessary to adjust the setpoint value). In the normal display mode, the front panel display provides sufficient information for the operator to assess whether the process is under satisfactory control.

3.2 DISPLAYS (User Mode)

Numeric Display — This indicates numerical information relating to the function selected. Where the value is a temperature °C or °F will also be displayed.

Bargraph Display — 

Both green chevrons displayed indicates that PV is within 1% of SP Each blue or red chevron indicates a deviation of 1% high (red) or 1% low (blue).

3.3 Front Panel Legends (Outputs)

HEAT — This indicates when the Heat Output relay is energised or the SSR drive is on.

ALARM — (Optional) This display flashes to indicate an alarm condition. (See Section 4.9 for details of alarm operation)

3.4 Self Test Procedure

When power is applied to the controller it first carries out a self test procedure which displays all the segments of the numeric display and bargraph, and displays the legends for all the outputs and control parameters.

3.5 Controller Function

On completion of the self-test routine the 3400 starts operating in Self-tune Mode (or Manual Tune Mode if previously selected) with the numeric display showing the value of the Process Va le.

For normal operation, the 3400 will function in Self-tune Mode, operating with the parameters previously set. In this mode the operator can adjust only the set-point. To review and adjust other control parameters see Section 4, Setting Up Procedures.

3.6 Set-point Adjustment

Display: SP

To adjust the set-point press the FUNC pushbutton. The front panel will show SP flashing and the numeric value of the current set-point. Next press RAISE (▲) or LOWER (▼). When one of these buttons is pressed momentarily the set-point value is changed by one unit in the least significant digit. If a button is held in for more than a second, the least significant digit of the set-point value will change

at a rate of 25 units per second. If a button is held in for more than 10 seconds the 2nd lsd will change at a rate of 25 units per second.

To get the numeric display back to showing the process variable, press the FUNC or TUNE button.

3.7 Default Parameter Indication

If the controller is operating with the default parameters this is indicated by the numeric display showing all the decimal points. See Section 4 for details of setting up control parameters.

SECTION 4 SETTING UP PROCEDURES

4.1 CONTROLS AND DISPLAYS

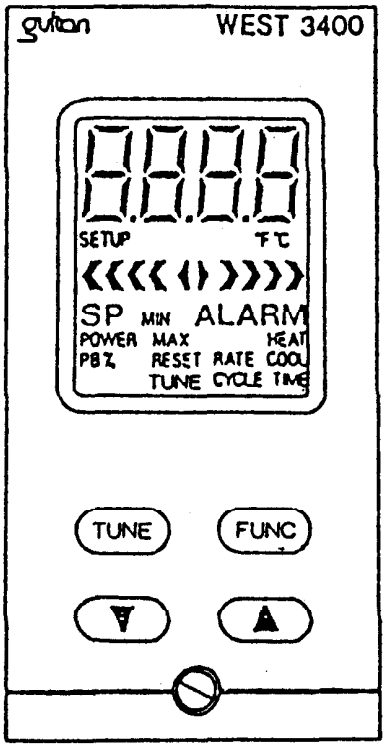


FIGURE 4-1 INSTRUMENT FRONT PANEL

4.1.1 Displays

Numeric Display: This indicates numerical information relating to the function selected. Where the value is a temperature °C or °F will also be displayed.

Bargraph Display: ❮❮❮❮❬❭❯❯❯❯ (BLUE / GREEN \ RED)

Both green chevrons displayed indicates that PV is within 1% of SP
Each blue or red chevron indicates a deviation of 1% high (red) or 1% low (blue).

Legends: HEAT, COOL and ALARM are used as output indicators in User Mode (see Section 4.5) and as parameter labels in Setup Mode.
SETUP shows that the controller is in Setup Mode.
TUNE displayed continuously shows that the controller is in Self-tune Mode. When flashing it indicates Pre-tune Mode.
SP, POWER, PB%, RESET, RATE, CYCLE, TIME, MAX, MIN are used singly and in combination as parameter labels.

4.1.2 Control Pushbuttons

RAISE (▲) — Used to increase the value of the selected parameter. Also used, in conjunction with other buttons, to change between User Mode and Setup Mode.

LOWER (▼) — Used to decrease the value of the selected parameter. Also used, in conjunction with other buttons, to change between User Mode and Setup Mode.

(TUNE) — Used with other buttons in sequence selects Self-tune, Pre-tune or Manual Tune Modes.

(FUNC) — Selects parameters in sequence for display and adjustment. Also used, in conjunction with other buttons, to change between User Mode and Setup Mode.

4.2 TO PUT THE CONTROLLER INTO SET-UP MODE

4.2.1 With Process Variable being displayed press RAISE and LOWER simultaneously and hold them in until the SETUP legend on display starts to flash (5 seconds).

4.2.2 Within the next 3 seconds press FUNC and hold it in until SETUP is displayed continuously (two seconds). The controller is now in Setup Mode.

4.2.3 To return the controller to User Mode select the Process Variable display (using the FUNC button), and follow the same procedure as in 4.2.1 and 4.2.2. SETUP will now go off.

4.2.4 If the sequence in incorrectly carried out, the controller will revert to the mode it was in before the attempt.

4.2.5 When the controller is is Setup Mode, it will automatically revert to User Mode if a minute elapses and no control button has been pushed.

NOTE: The instrument continues to function as a controller (with Self-tune, Pre-tune or Manual Tune) when it is in Setup Mode.

4.3 TO DISPLAY A PARAMETER

4.3.1 Set-point

Press the FUNC button when the controller is in User Mode. The display will show SP legend and the numeric display will show current value of Set-point.

When SP is being displayed, if the TUNE or FUNC button is pressed the numeric display will revert to showing the process variable.

4.3.2 All Parameters

Put the controller into Setup Mode, as explained in 4.2. Then press FUNC momentarily to access the parameters in the sequence shown in table 4-1. If the button is held in for more than a second, the parameters will be stepped through at approximately one per second until the end of the sequence, when the display will revert to the process variable, and will stay there until the button is released and pressed again.

4.4 TO ADJUST A PARAMETER

All parameters may be displayed, but Proportional Band, Reset, Rate and Relative Cool Gain cannot be adjusted if the controller is in Self-tune or Pre-tune Mode.

Operate the FUNC buttons as described in section 4.3 until the required parameter is displayed. The legends for each parameter are shown in Table 4-1.

Press RAISE (▲) or LOWER (▼) momentarily.
The value will be incremented or decremented by one unit in the least significant digit every time a button is pressed. If a button is held in for more than a second the 1sd will change at 25 units per second. After 10 seconds, if the button is still held in the value will change at 250 units a second.

The numeric display and the parameter label will flash and no adjustment will be made if the user:-

- attempts to adjust a parameter to a value outside the range of the instrument
- attempts to adjust a parameter to a value beyond the limit set by another parameter (such as an SP Limit)
- attempts to adjust a 'read only' parameter such as PV value
- attempts to adjust Proportional Band, Reset, Rate or Relative Cool Gain when the controller is in Pre-tune or Self-tune Mode.

4.5 FRONT PANEL LEGENDS (USER MODE)

HEAT - This indicates when Heat Output relay is energised or the SSR drive is on.

COOL - (Optional) This indicates when Cool Output relay is energised or the SSR drive is on.

ALARM - (Optional) This display flashes to indicate an alarm condition (See section 4.9 for details of alarm operation).

4.6 FRONT PANEL LEGENDS (SETUP MODE)

When the controller is in Setup Mode, HEAT, COOL and ALARM are used to indicate parameter selection, and do not indicate that an output is active.

TUNE, displayed continuously to indicate Self-tune Mode or flashing to indicate Pre-tune, is not affected when the controller is put into Setup Mode.

Table 4-1 shows the parameters and their legends in the order in which they are selected by the FUNC button in Setup Mode. Where a parameter is for an optional feature which is not fitted, or where the parameter is invalidated by another parameter setting (e.g. PB% set to 0), the parameter is skipped in the sequence.

Parameter	Legend	Range	Default Value
Process Variable	None	Span of Instrument	Read Only
Set-point	SP	Between SP MIN and SP MAX	Range min
Output Power	POWER	‡-100% to +100%	Read Only
Proportional Band	PB%	0 to 100% of span	10%
*Integral Time Constant	RESET	10 sec to 30 min	5 min 00 s
*Derivative Time Constant	RATE	00 sec to 10 min	30 sec
*Relative Cool Gain	COOL PB%	2% to 100% and ON/OFF (>100%)	100%
*Overlap	HEAT COOL PB%	-20% to +20% of PB	0
†On/Off Differential	PB% RESET HEAT : COOL	0.1 to 10.0% of span	0.5%
SP High Limit	SP MAX	SP to range max	Range max
SP Low Limit	SP MIN	Range min to SP	Range min
*Heat Power Limit	POWER MAX	0 to 100% of full pwr	100%
*Heat Cycle Time	HEAT CYCLE TIME	1/2, 1, 2, 4, 8, 16, 32, 64 sec	32 sec
*Cool Cycle Time	COOL CYCLE TIME	1/2, 1, 2, 4, 8, 16, 32, 64 sec	32 sec
¶Cool Value	COOL	± Span from SP	0
§Process Alm Val	ALARM	Range min to range max	Range max
§Band Alarm Val	ALARM	0 to Span from SP	5 Units
§Dev Alarm Val	ALARM	± Span from SP	5 Units

TABLE 4-1 PARAMETER LEGENDS, RANGES AND DEFAULT VALUES

NOTES 'Span' = pan of instrument i.e. range max - range min
* The functions are not operative or accessible if PB% is set to 0
‡ 0 to 100% on instruments with HEAT output only or with COOL output set to On/Off.

} These functions are optional. See Section 4.9. for details of Alarm operation.

† If PB% = 0 the display shows PB% RESET HEAT. If Cool Output is fitted and Relative Cool Gain set to OFF, display shows PB% RESET COOL. If PB% = 0 and Cool Output is fitted the display shows PB% RESET HEAT COOL.

‖ Accessible only if COOL output is fitted and set to On/Off.

When the controller is delivered from the factory parameters are set to the default values shown in the table. Once set the working values are held in a memory with battery back-up. If the configuration of the controller is changed, the controller reverts to operating with the default values. This action is signalled to the operator by the numeric display showing decimal points after every digit. When any parameter, apart from set-point, is set again, the display reverts to normal.

4.7 CONTROL PARAMETERS

4.7.1 Proportional Band

Can be set between 0 and 100% of span of instrument. If set to 0 the controller operates in On/Off mode. When Self-tune or Pre-tune are operative, the Proportional Band is always set automatically to a non-zero value.

4.7.2 Integral Time Constant (RESET) - Skipped if PB% = 0

Can be set to between 10 sec and 30 min. If raised above 30 min it becomes inoperative, and the numeric display is blank

4.7.3 Derivative Time Constant (RATE) - Skipped if PB% = 0

Can be set to between 0 sec and 10 min.

4.7.4 Relative Cool Gain (COOL PB%) - Skipped if PB% = 0 or no COOL output fitted.

This defines the Cool gain relative to Heat, within the Proportional Band, and the maximum Cool outside the Proportional Band. It can be set between 2% and 100%. If it is raised above 100% the display shows blank and the Cool output operates in On/Off mode. When Self-tune or Pre-tune are operative Cool gain is automatically taken out of On/Off mode.

4.7.5 Overlap/Deadband (HEAT COOL PB%) - Skipped if PB% = 0, or COOL not fitted or set to On/Off.

This defines the area within the proportional band where Heat and Cool are both active (0 to +20%) or the area where neither is active (0 to -20%)

4.7.6 On/Off Differential (PB% RESET) - Skipped unless PB% = 0 or COOL set to On/Off

This applies to Heat and Cool Outputs if the Proportional Band is set to zero, and to Cool Output if Relative Cooling Gain is set to On/Off. It provides a dead band to prevent too frequent load switching, and can be set to between 0.1 and 10% of span of instrument.

4.7.7 Set-point Minimum and Set-point Maximum (SP MIN, SP MAX)

These should be set so that in User Mode the operator cannot adjust the Setpoint to a value which might damage the process.

4.7.8 Heat Output Power Limit (POWER MAX) - Skipped if PB% = 0

This is used to limit the power level of Heat output and may be used to protect the process. If no process protection is required, it may be set at 100%.

4.7.9 Heat Output Cycle Time (HEAT CYCLE TIME) - Skipped if PB% = 0

The selection of cycle times depends on the type of process to be controlled. For relay outputs, the cycle time should be as large as possible (consistent with satisfactory control) in order to maximise relay life. If the instrument has the SSR output option, the cycle time can be selected from the lower values in the range. The values available are 1/2, 1, 2, 4, 8, 16, 32 and 64 seconds.

4.7.10 Cool Output Cycle Time (COOL CYCLE TIME) - Skipped if PB% = 0

This can be selected in the same way as Heat Cycle Time.

4.7.11 Cool Output Deviation Value (COOL) [Action opposite to HEAT]

This parameter is not accessed unless Cool Output is set for On/Off operation. With Cool Output direct acting, it will switch on at SP + COOL + 1/2 PB% RESET (On/Off Differential) and switch off at SP + COOL - 1/2 PB% RESET. Note that COOL can be set to a negative value, and in this case the above formulae are still applicable but Cool Output switches on below the set-point.

4.8 TUNING THE CONTROLLER

BEFORE STARTING TO TUNE THE INSTRUMENT TO THE LOAD, CHECK:
- **POWER MAX SET TO THE REQUIRED LEVEL.(See 4.7.8).**
- **SET-POINT MIN AND MAX SET TO SAFE LEVELS (See 4.7.7)**
- **CYCLE TIMES SET TO SUITABLE VALUES (See 4.7.9 and 4.7.10)**

4.8.1 Using the Pre-tune Function

This function provides a quick way of setting up the controller to approximately the right values of proportional band, integral and derivative. It is intended as a base from which the Self-tune will carry out further optimisation. For the Pre-tune routine to operate the measured variable must be at least 5% of span from the setpoint.

To select Pre-tune use the following procedure:

1. With the numeric display showing the Process Variable value (i.e. no control parameter selected for display or adjustment) hold in RAISE and LOWER for 5 seconds -- SETUP starts fo flash.

2. Within 3 seconds press TUNE and FUNC simultaneously and hold in for 2 seconds. SETUP stops flashing and TUNE starts to flash. Tune will continue to flash until the Pre-tune routine is completed. Tbe controller will then return to the mode it was in before selection of Pre-tune, i.e. to Self-tune Node (with TUNE displayed continuously), or to Manual Tune Node.

The controller now applies maximum allowed heating power (setpoint above measured variable) or maximum cooling power (setpoint below measured variable) until the measured variable is halfway between the starting point and the setpoint. The controller then applies maximum reverse power until the measured variable value starts to reverse, i.e. at the peak of the overshoot.

The value and duration of the overshoot are used as a basis for calculating appropriate values for the control parameters.

At the end of the Pre-tune routine the controller normally reverts to Self-tune operation, provided that it was in Self-tune prior to entering Pre-tune.

4.8.2 Self-tune operation

Self-tune operation is indicated by the front panel displaying TUNE. In this mode the proportional band, the integral, the derivative and the relative Cool gain are

under automatic control and cannot be adjusted by the operator. After any manual changes or a Pre-tune routine, once the instrument is put into Self-tune it uses the revised parameters as a basis for optimising the control function. If no manual or Pre-tune changes are made the Self-tune routine uses the default parameters set when the instrument is manufactured.

To select Self-tune Mode from Manual Tune Mode use the following procedure:

1. With the numeric display showing the Process Variable value (i.e. no control parameter selected for display or adjustment) hold in RAISE and LOWER for 5 seconds -- SETUP starts to flash.

2. Within 3 seconds press TUNE and hold in for 2 seconds -- SETUP stops flashing and TUNE is displayed.

3. The controller will now remain in Self-tune Mode (even if switched off and on again) until Pre-tune or Manual Tune Mode is selected.

The Self-tune routine starts when there is any disturbance to the load or the setpoint, and also on start-up. The response of the instrument and the measured variable are used by algorithms in the software to adjust the proportional band (PB%), the integral (RESET), the derivative (RATE) and the relative cool gain (COOL PB%). The adjusted parameters are stored and used as a basis for any further adjustments which the process requires.

4.9 ALARMS

Six possible configurations are available:-

Product Code	Type	Action
C--46	Limit Comparator	
C--47	Band Alarm	
C--48	Process Alarm	Direct
C--49	Process Alarm	Reverse
C--50	Deviation	Direct
C--51	Deviation	Reverse

Product Codes C--46, C--47, C--50, and C--51 refer to Deviation Alarms. Codes C--48 and C--49 refer to alarms with a value which is absolute, i.e. not relative to set-point.

For configurations C--50 and C--51 the value may be set positive or negative.

Codes C--46 and C--47 refer to band alarms.

Table 4-2 shows the operation of the displays and relays for the various alarm functions.

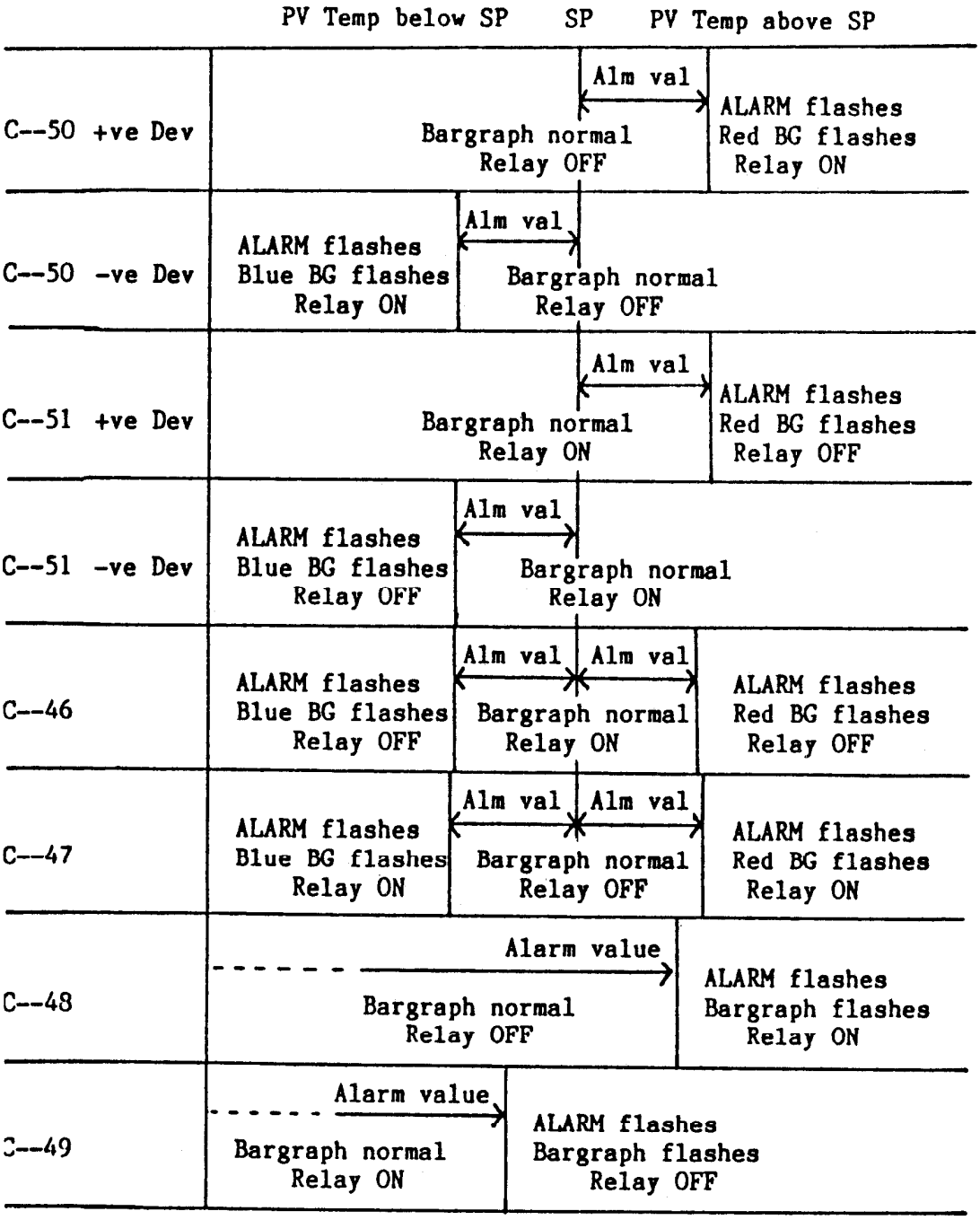


TABLE 4-2 OPERATION OF ALARM

The operations of the alarm shown in Table 4-2 represent typical settings. However it should be noted that if the value for one of the alarms is set to less than 1% of span from set-point, the alarm level will be reached when only the green <> is being displayed, and this will flash.

SECTION 5 - RERANGING AND RECONFIGURING

5.1 GENERAL

The options board, which is required for Cool Output or Alarm Output may be added if these functions are required.

Changes described in these instructions are confined to those which can be effected by changing links. It is not possible to change between relay and SSR outputs, or between linear, RTD and thermocouple inputs.

5.2 DISMANTLING THE CONTROLLER

5.2.1 To withdraw the instrument from its housing

ENSURE THAT THE MAINS SUPPLY IS DISCONNECTED

With a suitable size screwdriver turn the screw on the front panel near the base anti-clockwise to disengage the back connectors from their sockets, then continue turning until the screw is free from the bush in the housing.

Withdraw the controller gently from its housing.

CAUTION: THIS INSTRUMENT CONTAINS STATIC SENSITIVE DEVICES AND A LITHIUM BATTERY. PRECAUTIONS SHOULD BE TAKEN, DURING HANDLING OF EXPOSED PARTS, TO MINIMISE THE RISK OF STATIC DAMAGE OR BATTERY SHORT CIRCUIT.

5.2.2 To separate the circuit boards (Only necessary if the Option Board is fitted)

1) Extract the screw securing the CPU Board (RH side viewed from the front) to the metal bracket attached to the front panel assembly.

2) Grasp the plastic guides projecting rearwards from the bottom of the front panel (See Figure 5-1), and pull them downwards until the bottoms of the PCBs can be disengaged from the guides and withdrawn backwards. Next grasp the plastic guides at the topof the front panel and disengage the tops of the PCBs. The two PCBs can now be detached from the front panel asembly.

3) Extract the screw securing the Options Board to the pillar on the CPU Board (See Figure 5-2), then pull the two boards apart, keeping them parallel to avoid bending the plugs and sockets which link them.

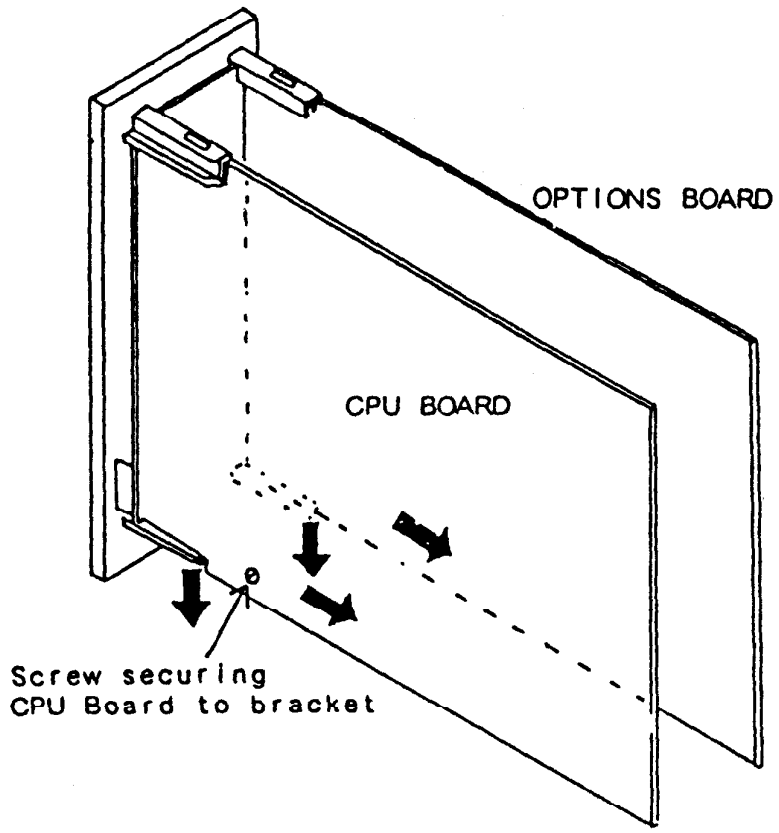


FIGURE 5-1 - DETACHING THE PCBs FROM THE FRONT PANEL

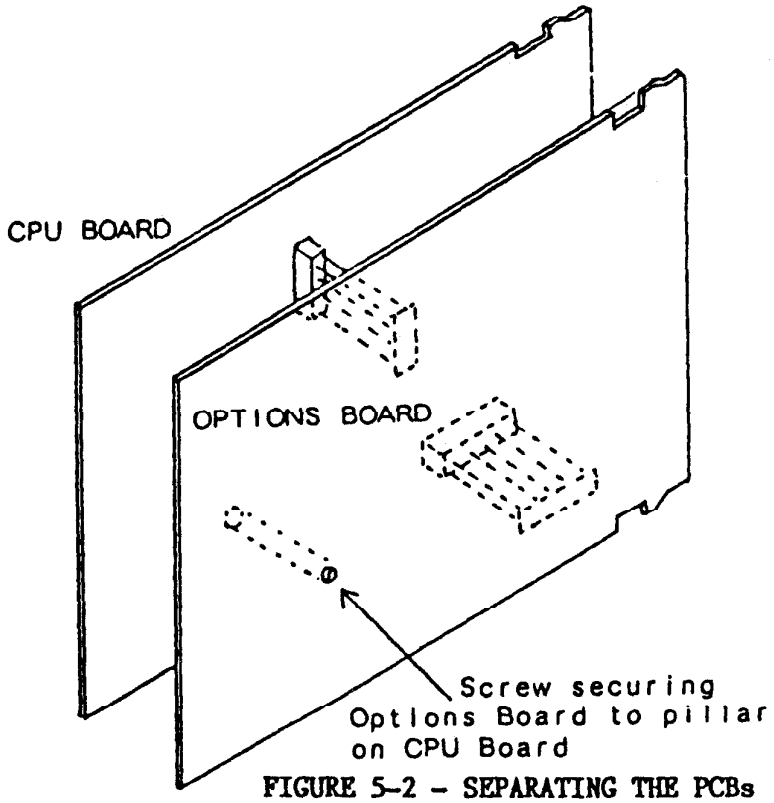


FIGURE 5-2 - SEPARATING THE PCBs

5.3 CHANGING INPUT RANGES (See Appendix 2 for details of inputs available)

5.3.1 Thermocouple inputs

A controller with thermocouple input can be reconfigured to a different thermocouple input by changing links on the CPU Board (See Figure 5-3) in accordance with Table 5-1.

Product	LJ5	LJ6	LJ7	LJ8	LJ9	LJ17	LJ18	LJ19
T1127	P	X	P	X	X	X	-	X
T1128	X	X	P	X	X	X	-	X
T1227	P	P	X	P	P	X	-	X
T1228	X	P	X	P	P	X	-	X
T1415	P	P	P	P	X	P	X	-
T1416	X	P	P	P	X	P	X	-
T1417	P	P	P	X	P	P	X	-
T1418	X	P	P	X	P	P	X	-
T1419	P	P	X	X	P	P	X	-
T1420	X	P	X	X	P	P	X	-
T1719	P	P	P	X	X	P	X	-
T1720	X	P	P	X	X	P	X	-
T1723	P	X	P	P	P	P	X	-
T1724	X	X	P	P	P	P	X	-
T1983	P	P	X	P	X	X	-	X
T1984	X	P	X	P	X	X	-	X
*T4443	P	P	P	P	P	P	X	-
*T4499	X	P	P	P	P	P	X	-

X = Active P = Parked - = Not Fitted

* A controller with thermocouple input can be changed to 0 - 50 mV or 10 - 50mV linear input, but not to any other linear input range nor to RTD input.

TABLE 5-1 - THERMOCOUPLE INPUT JUMPERS

5.3.2 Break Protection for Thermocouple Inputs

The controller can be configured for upscale break protection (controller treats open circuit input as above range maximum), downscale break protection, or no protection. To change the protection set the links in accordance with Table 5-2.

Product Code	LJ 14	LJ 15
T ----	X	-
T ----21	-	X
T ----22	P	-

X = Active
P = Parked
- = Not Fitted

TABLE 5-2 - THERMOCOUPLE BREAK PROTECTION

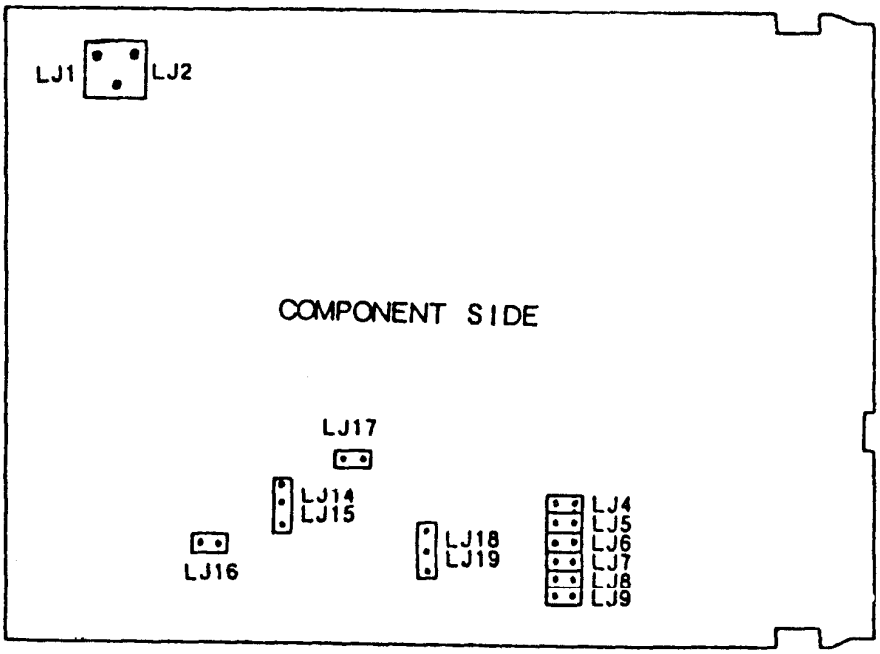


FIGURE 5-3 - POSITION OF LINK JUMPERS ON CPU BOARD

PRODUCT CODE	RANGE	LINK JUMPER 5*
T4412 T4416	0 - 100 mV 20 - 100 mV	Parked Fitted
T4444 T4415	0 - 1 V 0.2 - 1 V	Parked Fitted
T4445 T4434	0 - 5 V 1 - 5 V	Parked Fitted
T3413 T3414	0 - 20 mA 4 - 20 mA	Parked Fitted

* Apart from link 5, no other link jumpers should be altered.

TABLE 5-4 LINEAR INPUT LINK JUMPERS

5.4 CHANGING HEAT OUTPUT ACTION

The Heat Output (Relay or SSR) can be configured to be direct or reverse acting. It is not possible to change between relay and SSR.

For a direct acting output, Product Code H--31, LJ4 should be fitted on the CPU board. Otherwise it should be parked.

5.5 COOL AND ALARM OUTPUTS

The Options board is required if Cool and/or Alarm Outputs are required. This board is supplied in five forms:

1 Cool Relay Output, no Alarm. Code C10
2 Cool SSR Output, no Alarm. Code C50
3 Cool Relay Output, with Alarm Output. Code C10--.
4 Cool SSR Output, with Alarm Output. Code C50--
5 Alarm Output only. Code C00--

The Cool Output action cannot be changed on its own; the action is always the opposite of Heat Output, i.e. if Heat Output is reverse acting Cool Output is direct, and vice versa.

If Cool Output is used LJ20 on the Options Board (See Figure 5-4) should be fitted, otherwise it should be parked. If LJ 20 is parked when Cool Output is fitted, the output will not operate, and the parameters associated with it will not be included in the display sequence.

To Change the operation of the Alarm, links on the Option Board should be fitted in accordance with Table 5-5.

5.3.3 RTD Inputs

A controller supplied with RTD input can be reconfigured to a different RTD input by changing links on the CPU Board (See Figure 5-3) in accordance with Table 5-3.

Product	LJ5	LJ6	LJ7	LJ8	LJ9	LJ16
T2221	P	X	X	P	X	P
T2222	X	X	X	P	X	P
T2229	X	X	X	P	P	P
T2230	P	P	X	X	X	X
T2231	X	P	X	X	X	X
T2251	P	X	X	P	P	P
T2295	P	X	P	P	X	X
T2296	X	X	P	P	X	X
T2297	P	X	P	X	P	X
T2298	X	X	P	X	P	X

X = Active P = Parked

TABLE 5-3 RTD INPUT LINK JUMPERS

5.3.4 Linear Inputs

CPU boards with linear input have different components for different ranges, and hence only limited re-ranging can be effected with link jumper. Controllers with Product Codes T4443 and T4499 can be changed from one to the other, and also reconfigured for thermocouple input, as described in Section 3.3.1.

With other linear input configurations the only change possible is to change the range minimum between zero and 20% of range maximum.

Table 5-4 shows the pairs of Product Codes which can be exchanged.

Product Code	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

X = Active

P = Parked

TABLE 5-5 ALARM OUTPUT LINK JUMPERS

NOTE: If Alarm Output is not supplied LJ21, LJ22 and LJ23 are omitted.

If the Alarm Output is fitted, but it is required to prevent its operation, LJ21, LJ22 and LJ23 should all be parked. This will also cause the Alarm function to be skipped in Setup Mode.

See Section 4.9 for details of Alarm operation.

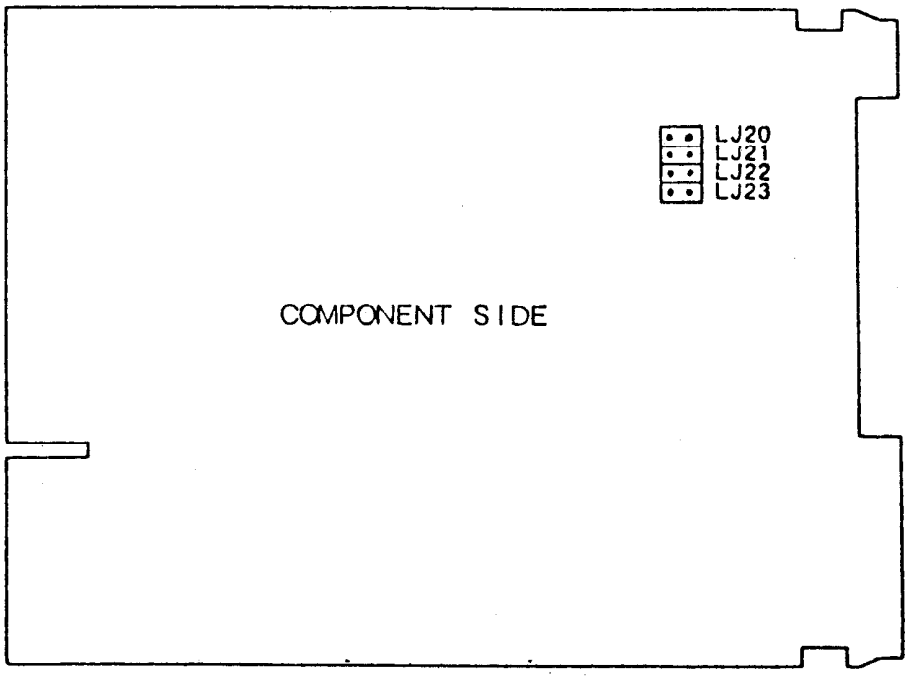


FIGURE 5-4 - POSITION OF LINK JUMPERS ON OPTIONS BOARD

5.6 CHANGING SUPPLY VOLTAGE

With link 1 in position on the CPU board the controller will operate on 193V to 264V (Code L01) and with link 2 in position it will operate on 100V to 132V (Code L02).

It is not possible to change to/from 24V operation (Code L04)

5.7 ASSEMBLING THE CONTROLLER

5.7.1 Fitting CPU Board to Options Board (if required)

Hold the two boards side by side with components sides facing each other and PC connectors corresponding. Carefully align the multiple pin plugs on the Options Board with the sockets on the CPU board, then gently engage the plugs and sockets.

Insert the screw through the Options Board into the pillar on the CPU Board and tighten.

5.7.2 Fitting Boards to Front Panel Assembly

Align the boards with the guides attached to the front panel; the CPU board (with the transformer on it) should be on the RH side when viewed from the front.

Make sure that the plugs on the CPU board are aligned with the sockets on the front panel assembly.

Push the boards into the guides until <u>all</u> the teeth on the boards click into the holes in the guides.

Insert the screw through the CPU Board into the bracket attached to the front panel assembly and tighten.

5.7.3 Fitting the Controller into the Housing

Carefully slide the controller into the housing, making sure that the circuit board(s) locate against the outside of the guides moulded in to the top and bottom of the housing. Push the controller firmly home so that the rear connections of the circuit boards make a good connection with the rear terminals.

Engage the screw near the base of the front panel and tighten it until the controller is firmly in place.

SECTION 6 FAULT FINDING

The following instructions are provided to assist in operational fault identification:

1) Display blank when power applied

   a) Check the mains wiring (see Section 2.4)
   b) Check fuses.
   c) Internal component failure; consult WEST

2) Display reads |‾ ‾|

   a) Check the input wiring
   b) Is the input outside the range of the instrument?

3) All decimal points on display (e.g. .1.0.0 instead of 100) indicates that a parameter has been corrupted.

   a) This can occur when power is first applied during setting up. If this is the case, set up the instrument (see Section 4). After adjustment the decimal points will disappear.
   b) If this has occurred during operation, a parameter has been corrupted. To clear the decimal points, enter Setup Mode and change a parameter (not setpoint) Check all other parameters and reset if necessary.

4) Output not switching

   a) Check that power limit has been set (POWER MAX)

5) Process undershoots

   a) Check that the power limit (POWER MAX) has been set to provide sufficient power to the load.
   b) Check that the instrument has been tuned to the load (see Section 4.8).

7) The display flashes on and off when the raise or lower pushbuttons are pressed.

   a) An illegal operation is being attempted:

      1) A change of a parameter that is locked is being attempted.
      2) A change of a parameter that is not alterable from the front panel (e.g. POWER) is being attempted.
      3) A change of a parameter beyond its limits is being attempted.

APPENDIX 1 - SPECIFICATION FOR CONTROLLER TYPE 3400

INPUT

Input types: Thermocouple, RTD, and DC Linear.
Common Mode Rejection: Negligible effect up to 264V 50/60 Hz
Series Mode Rejection: 1000% of span (at 50/60Hz) causes negligible effect.
Thermocouple Break Protection: Upscale/Downscale optional
Thermocouple Calibration: Complies with BS4937, NBS125 and IEC584 standards.
RTD (Pt100) Calibration: Complies with BS 1904 and DIN 43760 standards.

OUTPUTS

Heat Output
Relay: SPDT contact rating 5A resistive at 120/240V a.c.
Relay life $>10^6$ operations
SSR drive: 0 - 12V nominal, 18V max. Output impedance 1kΩ.

Cool Output (Optional)
Relay: SPDT contact rating 2A resistive at 120/240V a.c.
Relay life $>10^6$ operations
SSR drive: 0 - 12V nominal, 18V max. Output impedance 1kΩ.

Alarm (Optional)
Alternative Configurations:-

	Relay Energised	ALARM flashes
Process high alarm (fail safe)	PV below Alm value	PV above Alarm value
Process high alarm	PV above Alm value	PV above Alarm value
Limit comparator	PV within deviation band	PV outside deviation band
Band alarm	PV outside deviation band	PV outside deviation band
+ deviation direct	PV > SP + Dev	PV > SP + Dev
- deviation direct	PV < SP - Dev	PV < SP - Dev
+ deviation reverse	PV < SP + Dev	PV > SP + Dev
- deviation reverse	PV > SP - Dev	PV < SP - Dev

Relay: SPDT contact rating 2A resistive at 120/240V a.c.
Relay life $>10^6$ operations

CONTROL

Self-tune and Pre-tune Facility: Automatic adjustment of:-
Proportional Band
Reset (Integral Time)
Rate (Derivative Time)
Relative Cool Gain

SPECIFICATION

Proportional Band: 1 - 100% at 1% resolution and ON/OFF
Proportioning Time: 1/2, 1, 2, 4, 8, 16, 32, 64 seconds
Integral Time: 10 sec to 30 min and OFF (1 sec increments)
Derivative Time: 0 sec to 10 min 00 sec (1 sec increments)
ON/OFF Differential (Hysteresis): 0.1 - 10% of span

ENVIRONMENT

REFERENCE CONDITIONS

Ambient temperature: 20 $\pm$2°C
Supply voltage: 120 or 240V $\pm$1% 50/60 Hz $\pm$1%
Thermocouple source resistance: <10 Ohms
RTD (Pt 100): <0.1 Ohm per lead, both leads equal
Relative humidity: 60 to 70%

OPERATING CONDITIONS

Ambient Temperature
0 to +50°C operating
-20 to +60°C storage

Supply Voltage:
193 to 264V 50/60 Hz
100 to 132V 50/60 Hz

Maximum Source Resistance:
Thermocouple <1000 Ohms
RTD (Pt100) <5 Ohms per lead (equal resistance in each lead)

PERFORMANCE

Reference Accuracy: Typically $\pm$0.5% of span $\pm$1 lsd
Temperature Stability: <0.015% of span for 1°C change in ambient temperature.
Cold junction compensation: <0.1°C change for 1°C change in ambient temperature
Effect of thermocouple resistance: <0.1% of span error for resistance 0 to 100 Ohms
Effect of RTD lead resistance: <0.1% of span error for 3 Ohm lead resistance.
Supply voltage influence on accuracy: less than $\pm$0.1% of span error for supply voltage within specified limits.

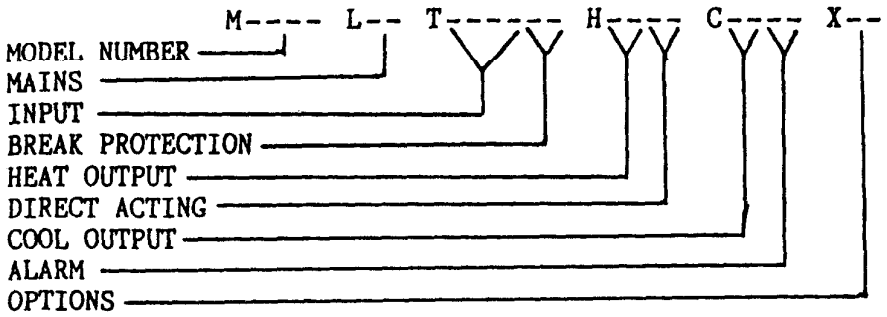
GENERAL

Display: Liquid Crystal showing:-
Four digit seven segment numeric display
Nine segment bar graph
18 parameter labels

Front panel controls: Four pushbuttons:-
Function select, Self-tune select, Raise, Lower

Dimensions: 48mm x 96mm x 153mm
Weight: 0.65 kg
Power consumption: Approx 3VA

APPENDIX 2 - PRODUCT CODES



MODEL NUMBER

M 3400

MAINS VOLTAGE

L 01	220/240V Nominal 50/60 Hz
L 02	110/120V Nominal 50/60 Hz
L 04	24V Nominal 50/60 Hz

INPUT - TYPE AND RANGE

Thermocouple

T 1127	'R' 0 - 1650°C
T 1128	'R' 32 - 3002°F
T 1227	'S' 0 - 1650°C
T 1228	'S' 32 - 3002°F
T 1983	'B' 100 - 1820°C
T 1984	'B' 212 - 3308°F
T 1415	'J' 0 - 205°C
T 1416	'J' 32 - 401°F

PRODUCT CODES

3-wire Resistance Temperature Detector (RTD)

T 2230	-101.0 to +100.0°C
T 2231	-150.0 to +212°F
T 2297	-200 to +205°C
T 2298	-328 to +401°F
T 2295	0.0 - 100.0°C
T 2296	32.0 - 212.0°F
T 2251	0 to 300°C
T 2229	32 to 572°F
T 2221	0 to 600°C
T 2222	32 to 1112°F

DC Linear Input

T 4443	0 - 50mV
T 4499	10 - 50mV
T 4412	0 - 100mV
T 4416	20 - 100mV
T 4444	0 - 1V
T 4415	0.2 - 1V
T 4445	0 - 5V
T 4434	1 - 5V
T 3413	0 - 20mA
T 3414	4 - 20mA

OUTPUTS

Heat Output

H 10	Relay
H 50	SSR drive

Heat Output Option (Normally Reverse Acting)

H —31	Direct acting

Cool Output (Reverse/Direct Acting — Opposite to Heat)

C 00	Not fitted
C 10	Relay
C 50	SSR drive

Alarm

C —50	Relay, high/low deviation (direct)
C —51	Relay, high/low deviation (reverse)
C —46	Relay, Limit comparator
C —47	Relay, band alarm
C —48	Relay, process alarm (direct)
C —49	Relay, process alarm (reverse)

INDEPENDENT OPTIONS

X 69	Push-on blade terminals
X 73	1/4 to 1/8/ DIN conversion plate.