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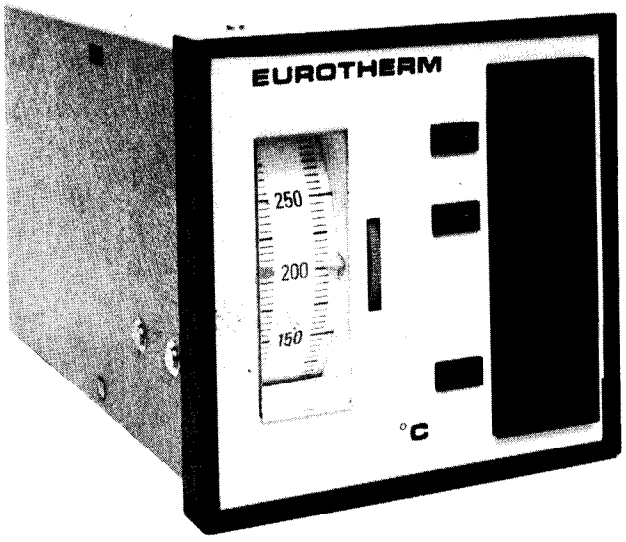
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EUROTHERM eurotherm

OPERATION AND MAINTENANCE MANUAL FOR



ANALOG TEMPERATURE CONTROLLER

MODEL 917

EUROTHERM CORPORATION
A EUROTHERM INTERNATIONAL COMPANY
11485 Sunset Hills Road ❙ Reston, Virginia 22090 ❙ Telephone: (703) 471-4870 ❙ Telex: 89-9449

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CAUTION

Before installing, operating, or servicing equipment supplied by Eurotherm Corporation, please read the following:

INSTRUCTIONS FOR SAFE USE OF EUROTHERM EQUIPMENT

(Note: These instructions represent good engineering principles and are applicable to all control equipment of the same type, whether from Eurotherm or any other supplier.)

OVERCURRENT PROTECTION

It is recommended that A.C. power supplies to Eurotherm instruments be protected by fuses or automatic circuit breakers rated at not more than 2 amperes.

Each Output circuit should be protected by line fuses or automatic circuit breakers rated at the same current and voltage as the output device.

Note: Fuses fitted to Eurotherm Thyristor (S.C.R.) Units are for protection of the internal components only. They are not intended to replace normal line fuses. All installations using Eurotherm Thyristors or Triac units must be equipped with line fuses of appropriate ratings.

Note: The "Current Limit" feature (available as an option on some Eurotherm equipment) is not a substitute for fuses. This feature is provided to accommodate the variation in load resistance of some types of electric heating elements. It provides no protection against excess current due to insulation failure or short circuits, and suitable fuses must be provided in all cases.

VOLTAGE RATINGS

Care must be taken to ensure that maximum voltage ratings are not exceeded.

Unless otherwise stated in the specification of any particular unit, the maximum voltage which may be applied between any two isolated circuits, or between any isolated circuit and ground is limited to the highest rated supply voltage for that unit.

ENCLOSURE OF LIVE PARTS

Some metal parts of certain types of Eurotherm equipment can become electrically 'live' in some conditions of normal operation, (for example: cooling fins on some thyristor units).

Unless clearly intended to be panel mounted and accessible during normal operation, all units should be installed inside a suitable grounded metal enclosure to prevent live parts being accessible to human hands and metal tools.

It is recommended that rear terminal covers (available as an option on most Eurotherm units) be fitted wherever possible.

WIRING

It is important to connect all equipment correctly in accordance with the installation data provided for each type of unit.

Unlabelled terminals must not be used as "tie points" for other wires (unless the installation instructions mention that this is permissible). Such unlabelled terminals may be internally connected. Any questions concerning the correct wiring of a Eurotherm unit should be directed to the nearest Eurotherm Sales and Service representative.

Most connections to Eurotherm equipment require correct polarity to be maintained, and due attention must be given to ensure this.

Wiring should conform to appropriate standards of good practice and local codes and regulations. Conductors should be commensurate with voltage and current ratings of the units.

GROUNDING

All "Ground" terminals must be securely connected to ground by conductors appropriate to the current ratings of the units.

Most Eurotherm controllers have internal circuits which are isolated or "floating." This is necessary to prevent the occurrence of "ground loop" in signal circuits. To avoid possible shock hazards in the event of an internal fault causing breakdown of insulation, it is recommended that all equipment connected to any Eurotherm unit be enclosed in a grounded metal enclosure. Sheaths of thermocouples (or other sensors) should be properly grounded by a separate conductor (instead of being dependent on grounding via the machine framework).

OUT-OF-LIMITS ALARMS

In applications where excessive deviation of a controlled parameter due to equipment failure could cause damage to machinery or materials, or injury to personnel, it is recommended that an additional separate unit be used to give alarm indication or to shut down the process or both, as may be appropriate. (Note: 'Alarm boards' fitted inside controllers may not give sufficient protection in these circumstances). When 'alarm units' or 'alarm boards' are used they should be checked for correct operation and calibration at regular intervals.

SUPPLY ISOLATORS

Every electrical system should be provided with means for isolating the system from the A.C. supply to allow safe working during repair and maintenance. S.C.R.'s and Triacs are not adequate means of isolating the supply, and should always be backed by a suitable mechanical disconnect switch.

HAZARDOUS ATMOSPHERES

Unless otherwise stated in the published specification of any particular unit, Eurotherm products are not suitable for use in areas subject to hazardous atmospheres. No Eurotherm product should be connected to a circuit which passes into or through a hazardous area unless appropriate precautions are taken (even though the controller itself may be located in a safe area). Such an installation should conform to the requirements of the relevant Authority. (In USA: Factory Mutual Research Corporation and Underwriters' Laboratories Inc.)

PROCEDURE IN THE EVENT OF FAILURE

Before beginning any investigation of a fault, the electrical supplies to all equipment concerned should be switched off and isolated. Units suspected of being faulty should be disconnected and removed to a properly equipped workshop for testing. Any attempt to trouble-shoot while installed could be hazardous to personnel and equipment.

IF IN DOUBT, ASK!

If you have any questions regarding any aspect of installing, operating or servicing your Eurotherm equipment, please contact your nearest Eurotherm Sales and Service Representative.

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SECTION I

INTRODUCTION

1.1 Scope.

This manual contains installation, operation and maintenance instructions for Eurotherm Model 917 Analog Setpoint Potentiometric Temperature Controller, herein referred to as the Controller (figure 1-1). Additionally, this manual includes an illustrated parts list, identifying replaceable piece parts, subassemblies and assemblies. Lastly, a product brochure, summarizing Controller specifications and ordering data is included as an attachment at the end of this document.

1.2 Purpose and Use.

The Temperature Controller is a compact high performance temperature control unit, designed for industrial and laboratory applications where precision temperature control conditions are required.

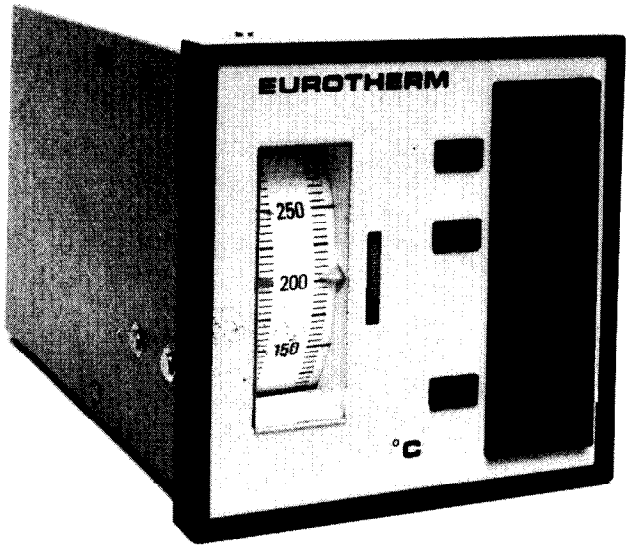


Figure 1-1 Eurotherm Model 917 Temperature Controller

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SECTION II

DESCRIPTION AND DATA

2.1 General Description

The Temperature Controller is an indicating, solid state, compact three mode (proportional, rate and reset) instrument, featuring a wide range of interchangeable outputs, temperature ranges and sensor types.

Controller inputs can be either thermocouple, resistance temperature detector (RTD), or millivolt signals fed from sensors. Thermocouple break protection and cold junction compensation are standard on thermocouple input types.

Precise temperature settings are assured through a nine inch analog drum scale with an integral mounted quadrant deviation indicator to provide setpoint/temperature indication.

Plug in circuit modules for input, amplifier, output and optional alarm functions enables operational versatility and ease of maintenance.

Precision control is ensured by the three-mode control features and unique circuitry, designed to inhibit overshoot on start-up or setpoint change. Additionally, supply voltage compensation circuitry corrects for variations in line voltages (brown-outs).

Adjustable controls, including proportional bandwidth, maximum power, alarm setpoint and optional variable time constants are accessible behind an optional hinged door, located on the instrument's fascia. The modernized control panel layout contains LED indicators for monitoring instrument functions.

The controller is ruggedly constructed and physically housed in a 3.78 inch square by 6 inch deep package.

The slotted bezel, when assembled, provides card guides and separators for the plug-in boards, in addition to mechanical rigidity. The instrument has been designed to be mounted independently in DIN size cutouts in a cabinet or panel using mounting clips or the optional plug-in sleeve.

All external electrical connections are made on the terminal block located on the back of the instrument. The label containing connection information, model number and serial number is placed on the back of the instrument.

2.2 Optional Equipment

Electical and mechanical options, available with the Controller are referenced in Table 8 in the attached product brochure.

2.3 Technical Characteristics

Pertinent technical characteristics for the Controller are listed in Table 2-1. Refer to product brochure for additional unit coverage.

2.4 Special Test Equipment

Special test equipment required to operate and maintain the Controller are referenced in Table 2-2. Similar equipment may be substituted providing operation and maintenance performance is not degraded.

2.5 Major Assemblies

Major subassemblies comprising the controller are listed in Table 2-3.

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TABLE 2-1. Technical Characteristics

CHARACTERISTICS	SPECIFICATIONS
Operating Conditions	
Temperature	0 - 50° C (122° F)
Input Power	115/230 VAC 50 - 60 Hz
Power Consumption	5 VA Maximum
Instrument Setpoint	Rotating drum calibrated over 9 inches to facilitate reading and adjustment.
Setpoint Resolution	± 0.25% of span
Instrument Stability	
Power Supply	less than 0.1% calibration shift for ± 15% variation from nominal supply voltage.
Common Mode	300 VAC sensor to ground maximum. Resulting error less than 0.1% of span.
Temperature	typically less than 2μ V/° C drift.
Maximum Thermocouple Resistance	100 ohms
Input Signals	Thermocouple, RTD, mA or mV (8mVDC min.)
Deviation Indication	± 10% of span
Calibration Accuracy	± 0.5% of instrument span
Proportional Band	adjustable 1 - 10% standard, 2.5 - 25% optional.
Integral (Reset)	Fixed 6 min. (.17 repeats/minute) standard; Switched variable times optional.
Derivative (Rate)	Fixed 1 min. standard; Switched variable time optional.
Overall Dimensions	3.78 in. W x 3.78 in. H x 6 in. Deep.
Weight	3 lbs.

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TABLE 2-2. Special Test Equipment

Nomenclature	Mfr. and Model	Operating Range
Millivolt Source	Eurotherm 039/mV Source	0 – 0.59.999mV CJC compensated for R, S, K, J, E, & T Thermocouples

TABLE 2-3. Major Subassemblies

Part No.	Nomenclature	Common Name
	Mother Board Assembly	Mother Board
	Power Supply and Amplifier Board Assembly	Amplifier Board
	Output Board Assembly	Output Board
	Analog Calibration Board	Calibration Board
	Alarm Board Assembly *	Alarm Board

*Optional

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SECTION III

PRINCIPLES OF OPERATION

3.1 Scope

This section contains the electrical and mechanical principles of operation for the Temperature Controller. The discussion is keyed to an exploded view drawing (figure 3-1) illustrating the Controller in dissassembly form and to a functional block diagram which shows the interrelationship of the Controller's subassemblies and components. To facilitate understanding instrument operation, a brief description of each plug-in module is initially provided followed by a detailed functional description (figure 3-2).

3.2 Mother Board

The mother board houses all plug-in modules and is mounted together with the terminal block in the base of the instrument. Removal is accomplished by first detaching the bezel assembly and then removing each of the plug-in modules.

3.3 Amplifier/Power Supply Board

The amplifier/power supply board contains the power supply and 3-term amplifier circuitry. The board is constructed as a unit such that preset tray adjusters mechanically link with the switch and potentiometers necessary to give external control over the operating parameters and the alarm point. To remove this board, the bezel assembly must first be removed by unscrewing two chassis screws. The board can then be easily withdrawn.

3.4 Calibration Board

The calibration board carries the thermocouple compensating cable and is joined as a unit with the setpoint and indicator assembly. In addition, the board contains the meter/drum assembly as an integral unit. Calibration and meter drive potentiometers which are mounted on the board, are accessible from the left side of the instrument upon removal of the cover. The calibration board assembly is easily removed once the bezel assembly is detached and the compensating cable is removed from the terminal block, pins 15 and 16 (figure 4-3).

3.5 Output Board

The output board contains the necessary circuitry to develop the desired output signal from the 3-term amplifier control signal. The board also contains the LED's which provide indications of important instrument functions. The instrument output control mode can be easily changed by removal and insertion of a new output stage and reconfiguration of rear terminal connections. The output board can be unplugged directly once the bezel assembly is removed.

3.6 Alarm Board

The optional alarm board contains circuitry which provides front panel LED illumination when the Controller is in the alarm condition. The board fits into the card slot on the rear left of the mother board. The alarm point setting, however, is located on the preset tray on the amplifier/power supply board.

3.7 Electrical Theory

The demand from the temperature setpoint is fed to the calibration board where it is subtracted from the temperature detected by the sensor. The resultant error signal is fed to the error amplifier whose output in turn is routed to the deviation meter via the meter amplifier, the alarm board and to the 3-term amplifier in the amplifier board.

In the alarm board, the signal is compared with reference voltages set for the high level (HL) and/or low level (LL) amplifiers. The resultant amplifier outputs de-energize the alarm relay if the temperature conditions are above and/or below the alarm setpoints.

The control terms are generated by the 3-term amplifier on the amplifier board. The proportional bandwidth is determined by scaling the error output from the calibration board which is variable between 1

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percent and 10 percent of full scale. Other bandwidths are available, (see product brochure) for applications requiring greater or less proportional band. The Integral (Reset) and Derivative (Rate) terms are determined by the 3-term amplifier feed back and feed forward components.

The standard values are:

a. Derivative (Rate) - 1 minute

b. Integral (Reset) - 6 minutes

Other fixed values are available on request and can be fitted by exchanging the plug-in amplifier/power supply board for one with appropriate components or by substituting components on the amplifier/power supply board.

The optional, switchable values of Integral (Reset) and Derivative (Rate) are:

a.) Derivative (Rate) — O, 1/16, 1/8, 1/4, 1/2, 1, 2, 4, 8 minutes

b.) Integral (Reset) — 1/8, 1/4, 1/2, 1, 2, 4, 8, 16, 32 minutes

In addition to the Derivative and Integral switch positions outlined both switches have a "P" position which when both are placed in this position the Controller is a proportional only Controller; that is no derivative or integral terms are present.

The output of the 3-term amplifier is fed into one of the various output boards depending on the mode of output desired. For thermocouple and RTD inputs, the output signal is fully isolated from the instrument supply and the sensor input signal.

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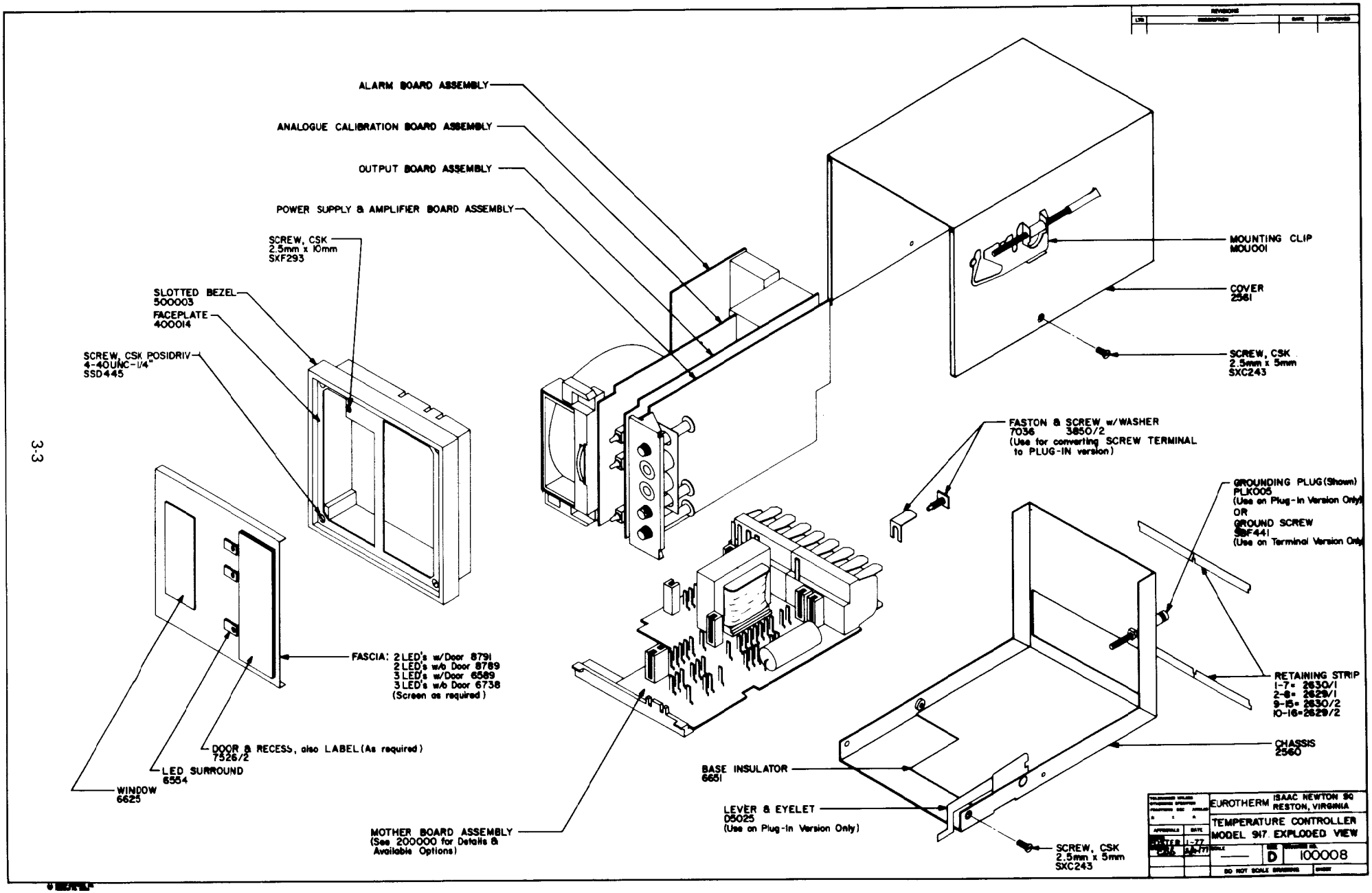


Figure 3-1.

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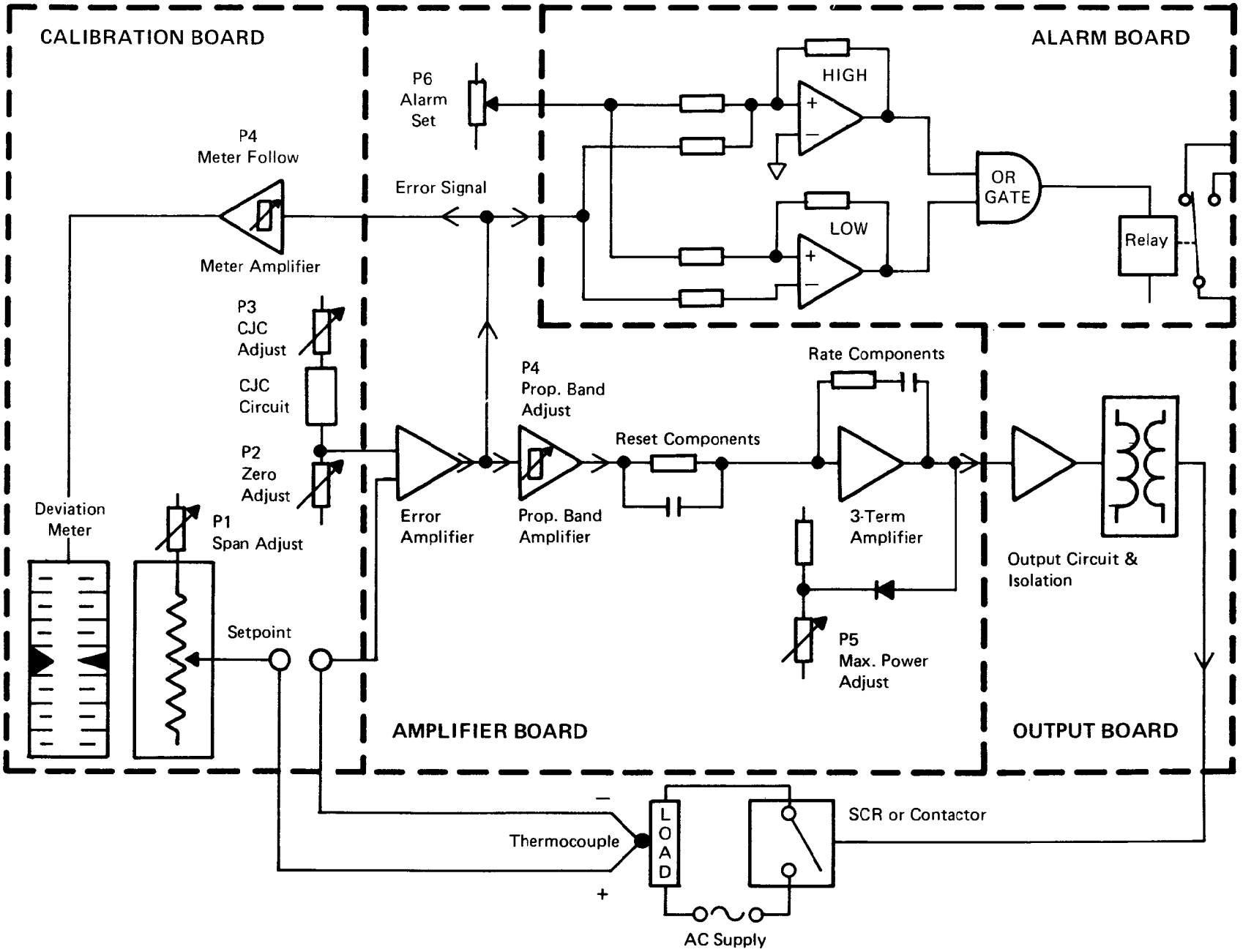


Figure 3-2

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SECTION IV

RECEIVING INSPECTION AND INSTALLATION INSTRUCTIONS

4.1 Unpacking and Unassembly Instructions

The Controller is shipped fully assembled and ready for installation. Exercise the normal precautions associated with unpacking electronic instruments. Visually check for any physical damage to the packing material. A detailed inspection should be made of the equipment surfaces that were adjacent to the damaged area.

4.2 Inspection Upon Receipt

Inspect the equipment for damage incurred during shipment as evidenced by bent or dented hardware, or cracked indicator lenses. Inventory the equipment against the packing list. If there is evidence of equipment damage, or if a part is missing, report the discrepancy.

4.3 Installation Instructions

The Temperature Controller is designed for fixed panel mounting in a 3.625 inch square (92mm) cutout, and retained by two (2) mounting clips. The optional plug-in mounting facility fitted with rear terminal tabs to engage the plug-in mounting sleeve uses a slightly larger 3.66 inch square (93mm) cutout. A 16 position rear mounted screw terminal block either directly mounted on the instrument or optionally on the plug-in sleeve allows interwiring for standard and optional instrument configurations.

a. Fixed Mounting

Fixed mounting installation procedures, keyed to figure 4-2a. and b. are as follows:

(1) Unclip the screw clamps from the sides of the instrument.

(2) Fit the instrument into the cut-out from the front of the panel (figure 4-2a.). Ease the stud projections through the cut-out by rotating the instrument slightly counterclockwise.

(3) Reclip the screw clamps to the instrument (figure 4-2b.), either on opposite sides or at the top and bottom as appropriate.

(4) Gently tighten the clamping screws with a long screwdriver to secure the instrument in the panel.

b. Plug-in Mounting

Plug-in mounting installation procedures keyed to figure 4-2c. and d. are as follows:

(1) Partially unscrew two flange screws (A) so that the open end of the sleeve will fit into the panel cut-out from the rear.

(2) Tighten flange screws (A) so that the sleeve grips the panel at the bottom.

(3) Tighten the clamping screws (B) to secure the sleeve in the panel.

(4) At the front of the panel, push the instrument firmly into the mounting sleeve, and secure by pressing down the locking catch.

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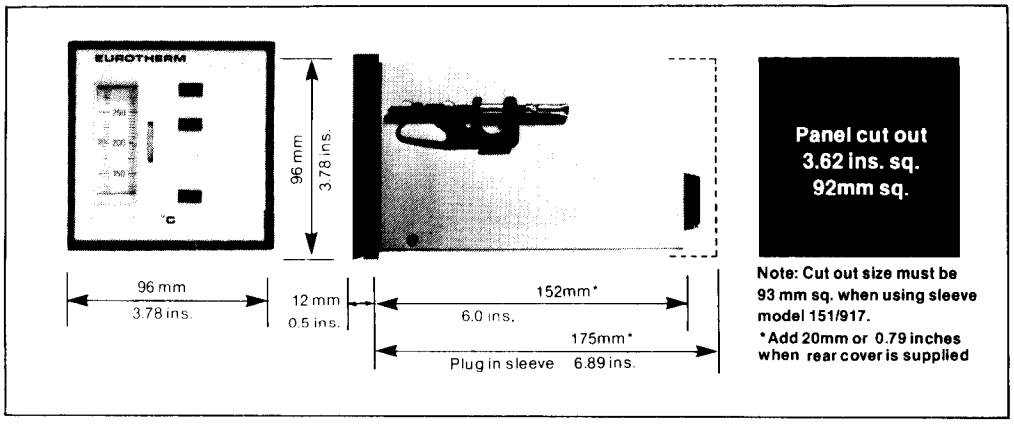


Figure 4-1. Instrument Mounting

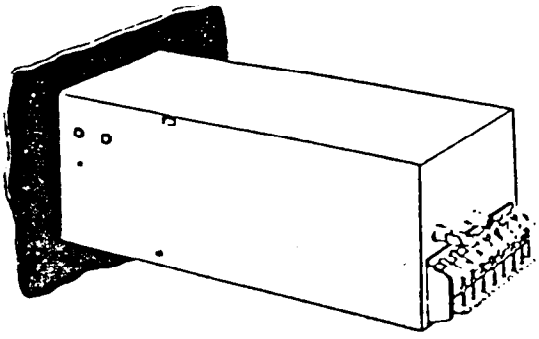


Figure 4-2a. Fixed Mounting

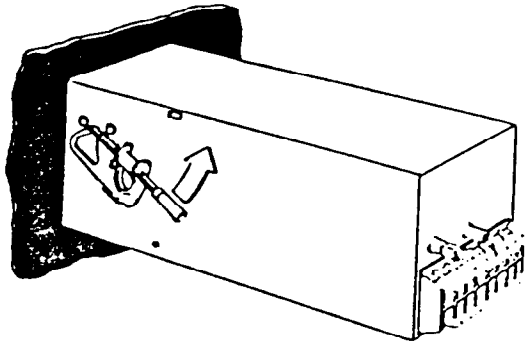


Figure 4-2b. Fixed Mounting

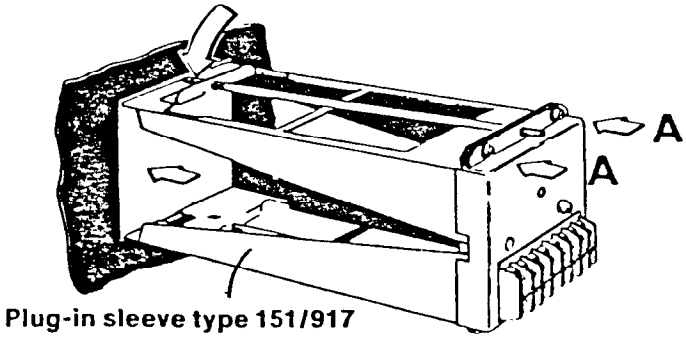


Figure 4-2c. Plug-in Mounting

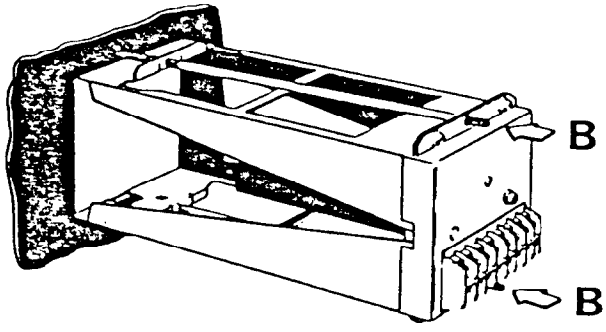


Figure 4-2d. Plug-in Mounting

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4.4 Instrument Termination Procedures

a. General

Electrical connections are made on the terminal block fitted with either 16 screw terminals or with faston male terminals which connect with female sleeve receptacles. All connections are low current and usage of 16/AWG wire gauge size is adequate. A label mounted above the terminal block (figure 4-2e.) identifies all connections relevant to the instrument. When wiring sleeves, the terminal block on the sleeve is wired identically to the label on the instrument.

Note: Unlabeled Terminals should not be used as Tie-Points as they may be internally connected.

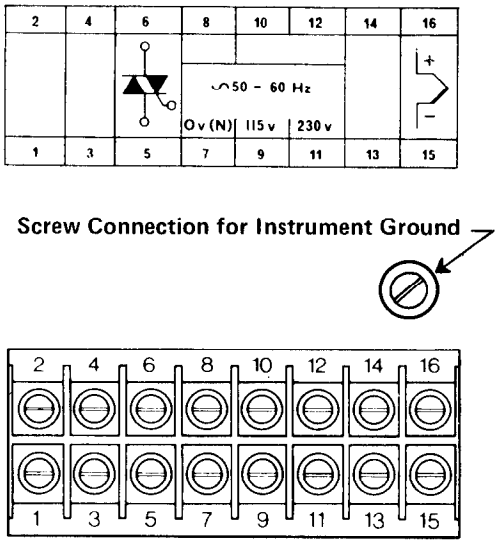


Figure 4-2e. Terminal Block

To facilitate making wiring connections for the various instrument configurations, all pertinent data including connector functions, terminal block locations, wiring diagram figure reference and remarks column are referenced in Table 4-1.

b. Instrument Ground Connection

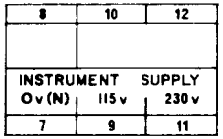
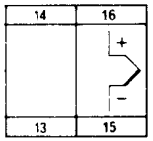
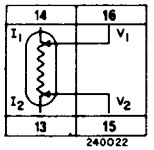
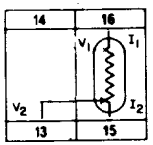
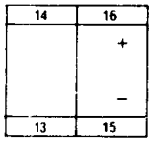
Ground connection procedures for fixed and plug-in mounting instruments are provided below. Refer to figure 4-2e. during procedures.

(1) **Fixed Mounting.** Attach ground wire to screw connection located above and between terminals 14 and 16 on rear terminal block.

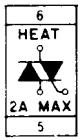
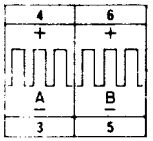
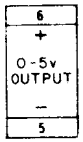
(2) **Plug-in Mounting.** Ground wire screw connection attachment is replaced with a male plug to mate with ground bushing on plug-in sleeve. (Ground wire screw connection attachment is on rear of sleeve above connector pins 14 & 16.)

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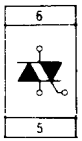
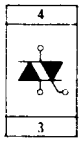
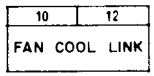
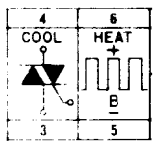
TABLE 4-1. Temperature Controller Model 917 Terminal Block Connections

FUNCTION	TERMINAL CONNECTOR NO.	TERMINAL BLOCK LOCATION	REMARKS
Instrument Power	7 - 9 or 7 - 11		Connect leads between connectors 7 and 9 or 7 and 11 as required. Tolerances on the input transformer allow sufficient variation of supply voltages to accomodate standard instrument power, (115V/230V) 50 or 60 HZ.
Controller Inputs a. **Thermocouple**	15 - 16		Thermocouple connections are made between terminals 15 and 16 on instruments with thermocouple sensing. Compensating lead wire of the correct type must be used between the thermocouple and the instrument and must be connected in the correct polarity.
b. **Resistance Thermometer 2 & 4 wire**	13 through 16		Platinum resistance thermometer connections on instruments suitable for resistance thermometer sensing are made between terminals 13 and 16. For 2 wire thermometers with short leads, connect leads between 13 and 14 and jumber 14 to 16 and 13 to 15. For thermometers with long leads, a 4 wire connection is made as shown in diagram
c. **Resistance Thermometer 3-wire**	13 through 16		Platinum resistance thermometer connections for 3 wire RTD
d. **Millivolt/ Milliamp Signals**			For instruments accepting linear or d.c. inputs, connect leads between terminals 15 and 16.

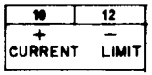
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FUNCTION	TERMINAL CONNECTOR NO.	TERMINAL BLOCK LOCATION	REMARKS
Controller Outputs a. **Single Output Heat Only** (1) Slow Cycle Triac (SCT)	5 - 6 (See figure 4-3 Wiring Diagram)	 (Minimum current 40mA)	Triac heating output connections are made between terminals 5 and 6. During the ON phase of the output cycle with the triac fired, the internal connection between terminals is made. This output is normally used to energize the coil of an external single or three phase conventional contactor or control relay. Triac rating is 2A/250 V. External fast blow fusing (AGC 2A/250V or equiv.) is recommended.
(2) Single Phase SCR Pulses (ZCP/PAP)	3-4-5-6 (See figure 4-4 Wiring Diagram)		Controllers with zero crossing (ZCP) or phase angle (PAP) pulse outputs have pulse pairs connected to terminals 3, 4, 5 and 6. Provision for current limit feedback is incorporated in all phase angle pulse (PAP) outputs. Pulse outputs are fed to an external Eurotherm SCR unit employing SCR devices connected in inverse parallel. NOTE: When using phase angle switching with inductive loads, ensure that load circuit is concurrently made with or before the supply to the instrument. The soft start feature of PAP will limit the inrush load current which may otherwise blow the semiconductor fuse. Controller and SCR units should be connected to the same phase of the supply.
(3) D.C. Signals (0-5V 4 - 20mA, etc.)	5 - 6 (See figure 4-5 Wiring Diagram)		For controller providing DC analog signals, the output is connected to terminals 5 and 6. Outputs are isolated and suitable for use with external Eurotherm drivers or other process controllers and power packs.

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FUNCTION	TERMINAL CONNECTOR NO.	TERMINAL BLOCK LOCATION	REMARKS
b. **Dual Outputs (Heat/Cool)** (1) Heat channel (SCT)	5 - 6 (See figure 4-6 Wiring Diagram)		Triac heating output connections are made to terminals 5 and 6, enabling heating power to be fed to load when triac is fired. The heat channel output is normally used to energize the coil of a conventional single or three phase contactor or control relay. Triac rating is 2A, 250V. External fast blow fusing (AGC 2A/250V or equivalent) is recommended.
(2) Cool Channel (SCT)	3 - 4 (See figure 4-6 Wiring Diagram)		Triac cooling output connections are made on terminals 3 and 4, enabling cooling power to be fed to load when the triac is fired. The cooling channel output is normally used to energize the coil of a fan motor contactor for air cooling, or the coil of a solenoid valve for water cooling. Triac rating is 2A, 250V. External fast blow fusing (AGC2A/250 or equivalent) is recommended.
(a) **Air Cooling**	10 - 12 (See figure 4-6 Wiring Diagram)		Air cooling characteristics are selected by JUMPERING terminals 10 and 12.
(b) **Water Cooling**	N/A (See figure 4-6 Wiring Diagram)	N/A	Water cooling characteristics are selected by NOT JUMPERING between terminals 10 and 12. By omitting connection, the cycle time is set for short on time bursts to match water cooling characteristics.
(3) Heat/Cool (ZCP/SCT)	3 - 4 5 - 6 (See figure 4-7 Wiring Diagram)		The heat channel output is a single pulse pair, zero crossing pulse, connected to terminals 5 and 6. This pulse pair is in turn connected to an external Eurotherm SCR unit employing SCR devices connected in inverse parallel. However, since standard SCR units accept 2 pulse pairs, the SCR unit used with a heat/cool controller must be fitted with an internal pulse transformer. All model 932 SCRs are automatically fitted with this transformer. SCRs for use at 240V must be specified as Model 931 rather than 031 to insure the pulse transformer is included. Controller and SCR should be connected to the same phase supply. Triac cooling output connections including air and water cooling characteristics are identical to and selected same as dual SCT output controllers previously described.

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FUNCTION	TERMINAL CONNECTOR NO.	TERMINAL BLOCK LOCATION	REMARKS
Optional Functions a. Current Limit (CL)	10 - 12		When using a "heat only" controller with phase angle pulse outputs to Eurotherm SCR units, a current limit facility is available as a standard option. A current limit feedback signal is fed from the SCR unit to the terminals 10 and 12. This option is not available on heat/cool controllers.
b. **Low Limit Alarm. (LL)**	1 - 2		Alarm output relay is deenergized with power OFF, and with power ON and temperature in "ALARM" condition (below alarm setpoint). Relay will be energized with power ON and temperature in the "SAFE" condition (above alarm setpoint). Alarm contact output is available as either normally open (NO) or normally closed (NC). Contact rating is 2A, 240V. Normally Open Contact (NO contact) - Below setpoint contact is open. Above setpoint contact is closed. Normally Closed Contact (NC contact) - Below setpoint contact is closed. Above setpoint contact is open. Wire connections are made between connectors 1 and 2.
c. **High Limit Alarm. (HL)**	(See figure 4-8 Wiring Diagram) 1 - 2		Alarm output relay is deenergized with power OFF, and with power ON and temperature in the "ALARM" condition (above alarm setpoint). Relay is energized with power ON and temperature in the "SAFE" condition (below alarm setpoint). Alarm contact output available as NO or NC. Contact rating is 2A, 240V. Normally Open Contact - Below setpoint contact is open. (NO Contact) Above setpoint contact is closed. Normally Closed Contact - Below setpoint contact is open. (NC Contact) Above setpoint contact is closed

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FUNCTION	TERMINAL CONNECTOR NO.	TERMINAL BLOCK LOCATION	REMARKS
d. Deviation Limit Alarm (DL)	1 - 2 (See figure 4-8 Wiring Diagram)		Output relay is deenergized with power OFF and with power ON and temperature in the "ALARM" condition (out of band about setpoint). Relay is energized with power ON and temperature in the "SAFE" condition (within band). Alarm contact output can be provided either as NO or NC. Contacts 2A, 240 V. Normally Open Contact — Within band contact is closed. Out of band contact is open Normally Closed Contact— Within band contact is open. Out of band contact is closed.

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CAUTION: Interconnections made to instruments other than as shown, can result in improper operation or equipment damage.

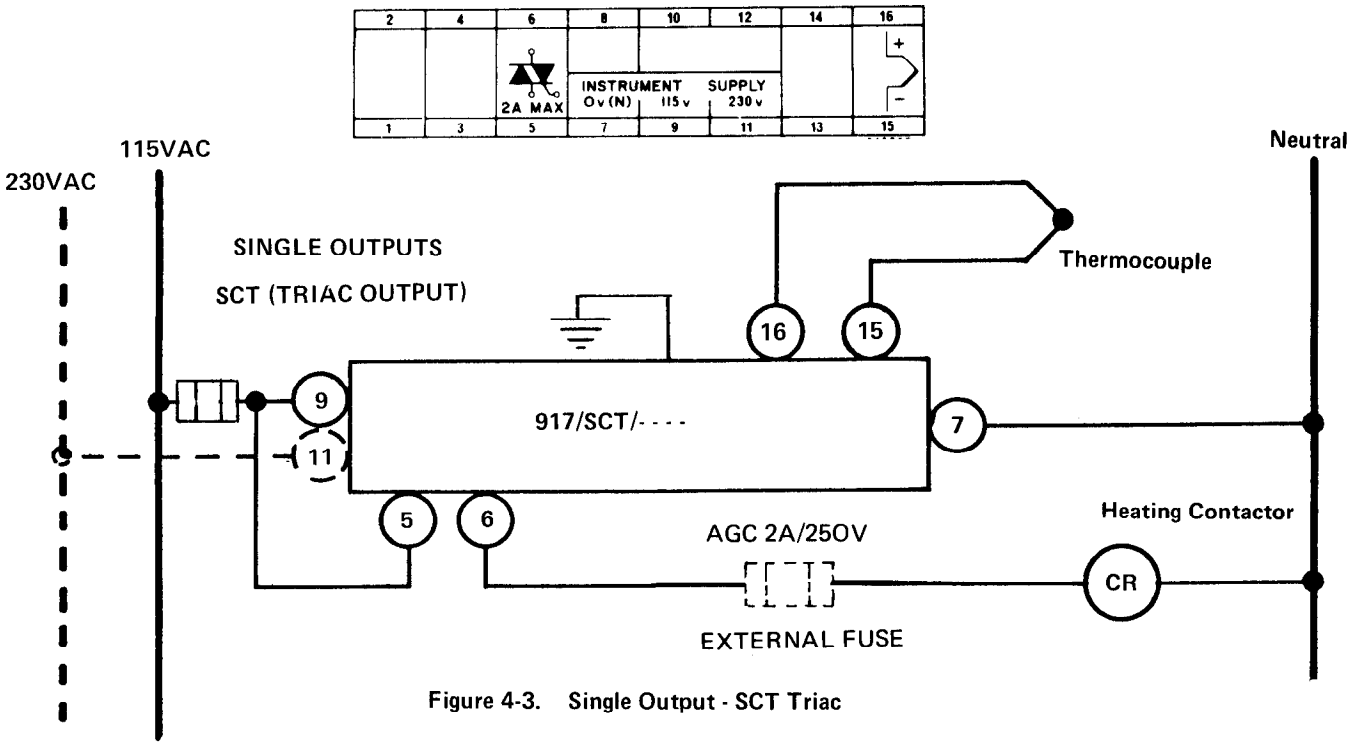


Figure 4-3. Single Output - SCT Triac

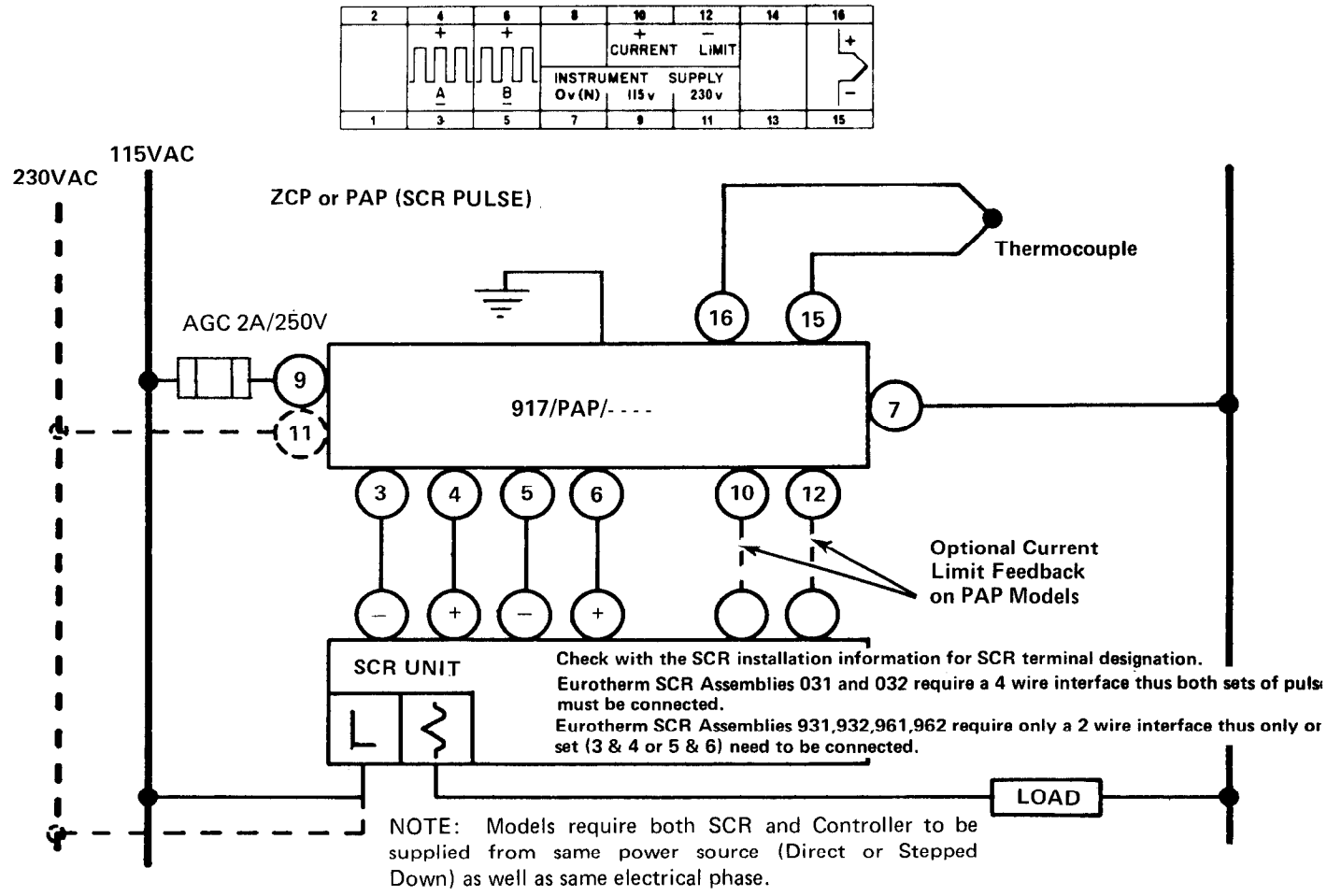


Figure 4-4. Single Output-(ZCP)/(PAP) SCR Pulse Outputs

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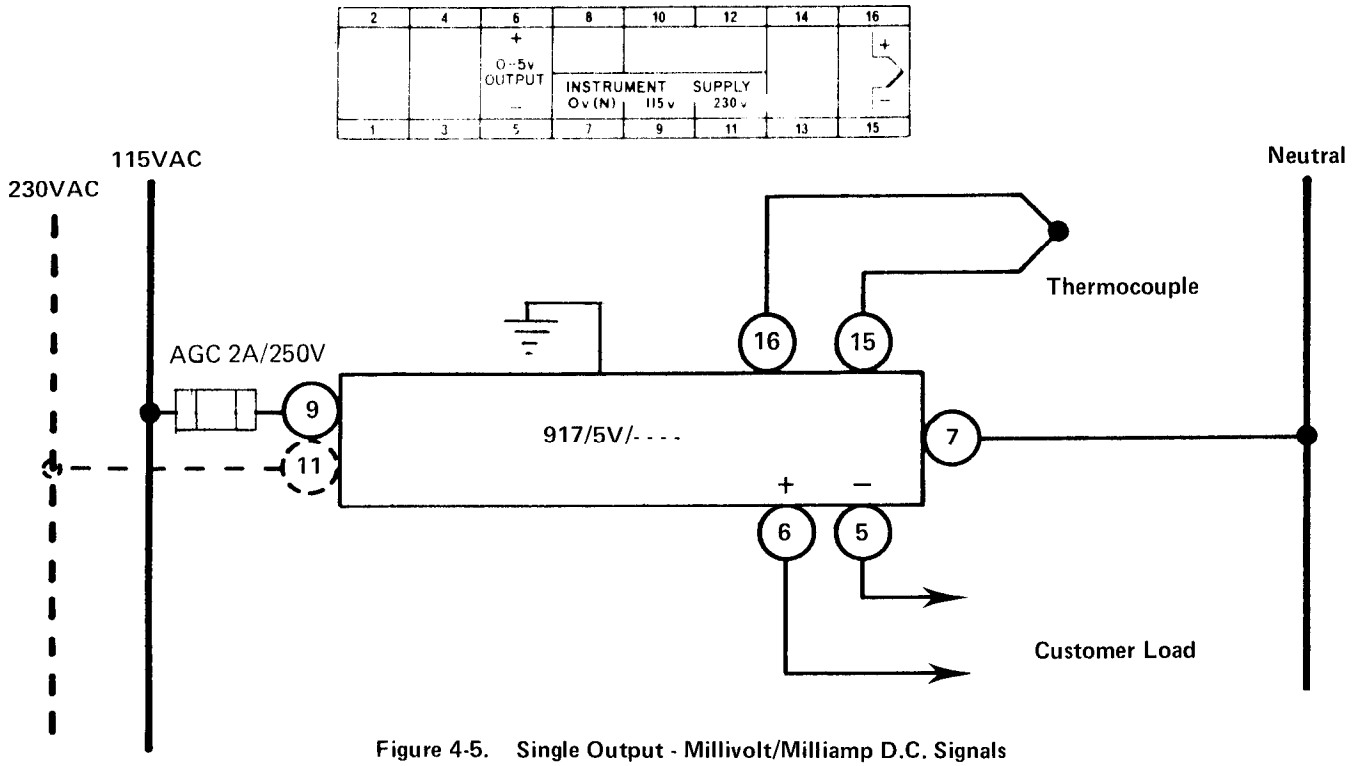


Figure 4-5. Single Output - Millivolt/Milliamp D.C. Signals

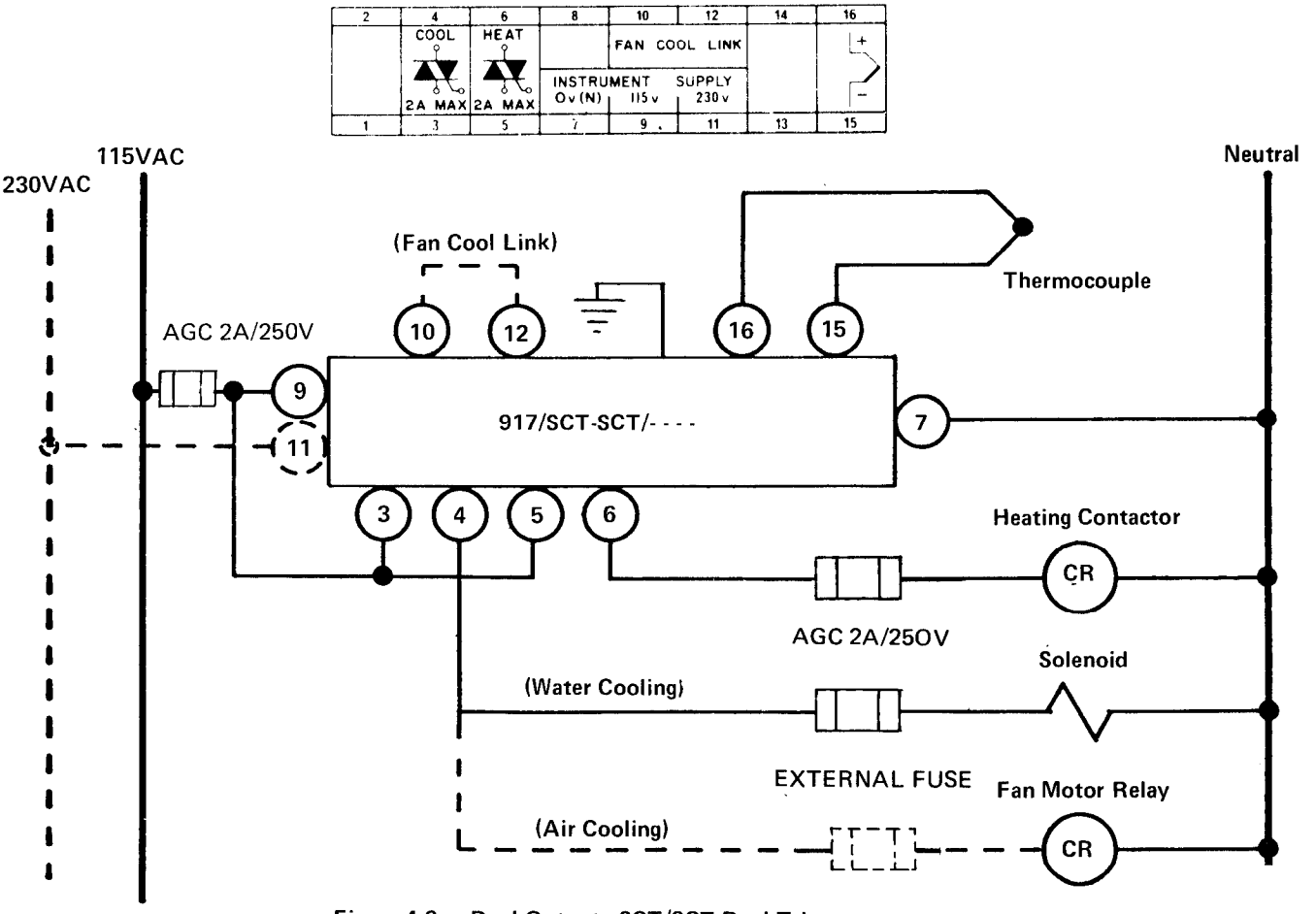
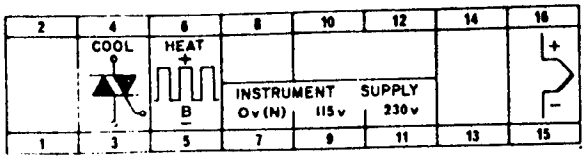


Figure 4-6. Dual Output - SCT/SCT Dual Triac.

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CAUTION: Interconnections made to instruments other than as shown, can result in improper operation or equipment damage.

ZCP-SCT (SCR PULSE HEAT/TRIAC COOL)



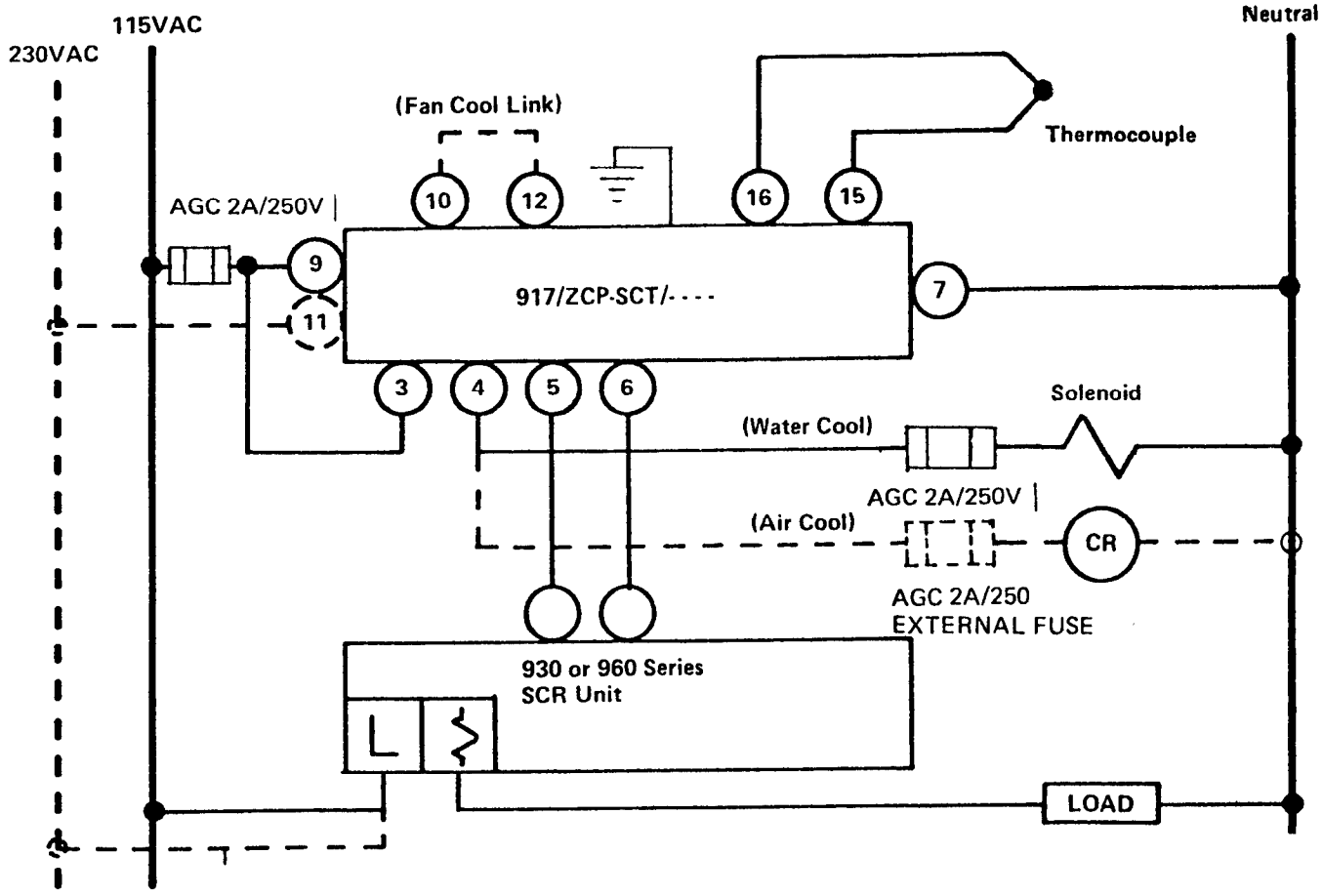


Figure 4-7. Dual Output - ZCP-SCT (SCR Pulse Heat/Triac Cool).

ALARMS (HL, LL, DL)

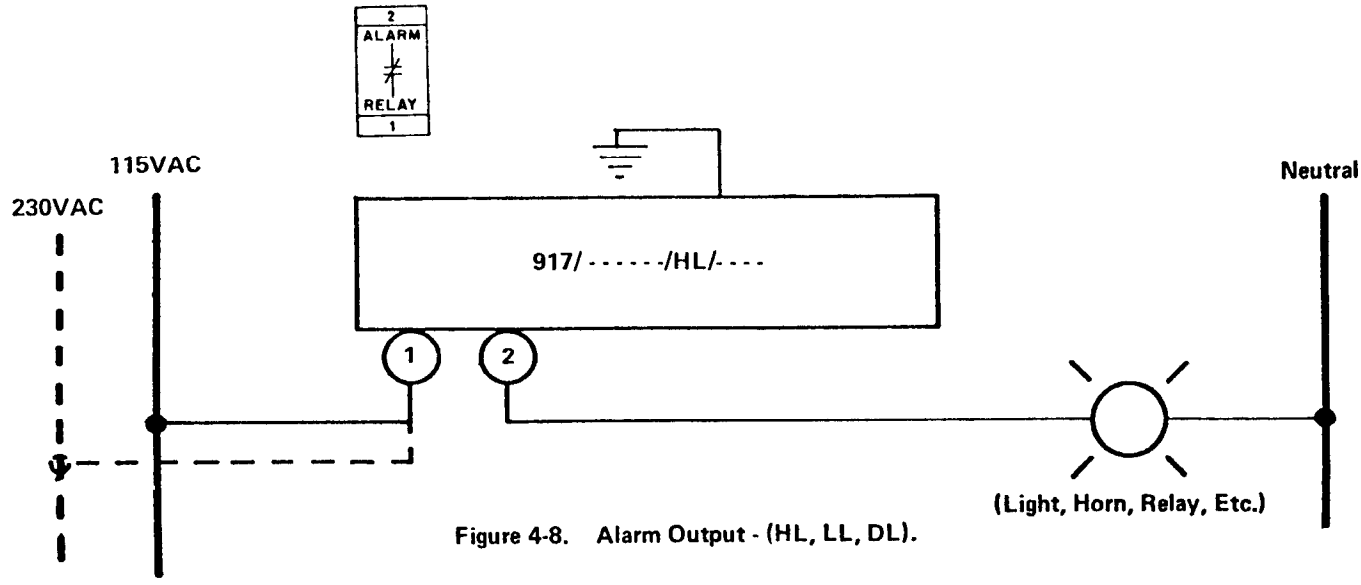


Figure 4-8. Alarm Output - (HL, LL, DL).

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SECTION V

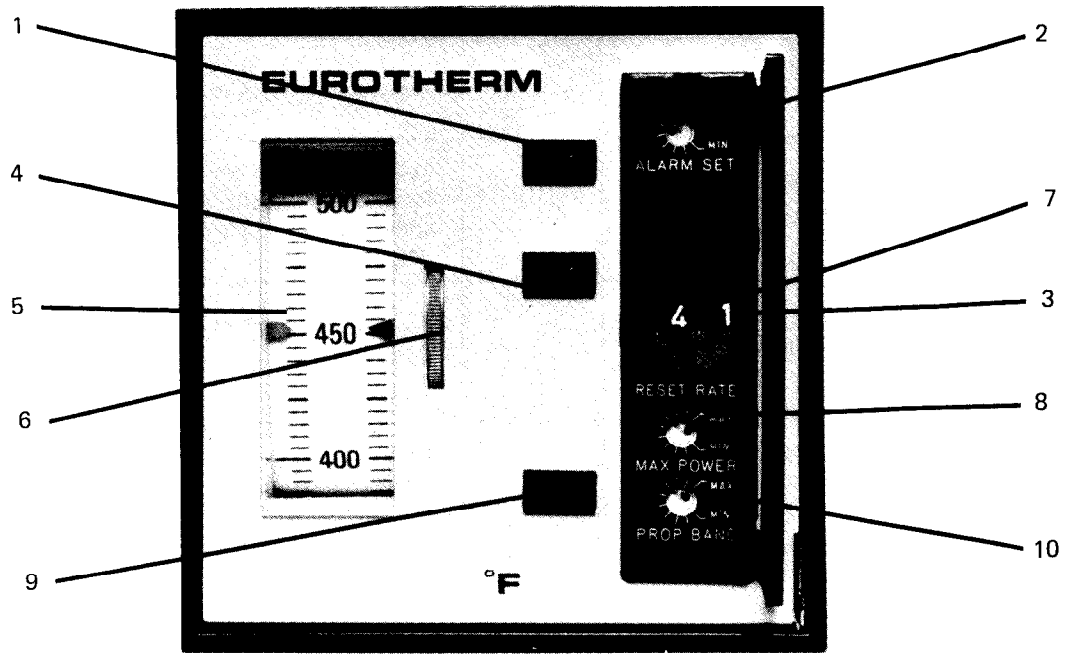
OPERATING INSTRUCTIONS

5.1 General

This section contains operating instructions for Eurotherm Temperature Controller, Model 917. Instructions consist of controls and indicator description and detailed operating procedures.

5.2 Controls and Indicators

Operator controls and indicators are listed and described in Table 5-1. Control/indicator locations, which numerically correspond with Table, are illustrated in Figure 5-1.



1. Heat Channel Output Indicator, LED 1 (Red)
2. Alarm Setpoint Control
3. Variable Rate Control (Optional)
4. Cool Channel Output Indicator, LED 2 (Green) available on Heat/Cool outputs only
5. Temperature Drum Scale (Deviation Indicator)
6. Temperature Setpoint Control Wheel
7. Variable Reset Control (Optional)
8. Maximum Power Control
9. Power on/Alarm Condition Indicator LED 3 (Red)
10. Proportional Bandwidth Control

Figure 5-1. Controls and Indicators for Model 917 Temperature Controller

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TABLE 5-1. Model 917 Temperature Controller Controls and Indicators

ITEM NO.	CONTROL/INDICATOR	REF. DES.	FUNCTION
1.	Heat Channel Indicator, LED 1 (Red)		Indicates power to the load and is Red for all outputs. For DC outputs, the degree of brightness intensifies as the voltage (or current) increases from minimum to maximum at output. In the zero crossing fired (fast cycle fired) SCR pulse output, the LED blinks brightly at each zero cross firing. In the phase angle fired SCR pulse output, brightness intensifies as firing angle increases. In the slow cycle fired triac output, the LED display full brightness when the triac is fired and passing current. In all cases LED indicator is **Heat to Load**.
2.	Alarm Setpoint Control		Adjusts setpoints for low limits. (LL), high limits, (HL), and deviation limits (DL) temperature conditions.
3.	Variable Rate Control		Adjusts derivative time constants.
4.	Cool Channel Indicator, LED 2 (Green)		Indicator is used only in heat/cool instruments, for monitoring state of cool channel. Illumination of LED 2 occurs under the same conditions as that described for LED 1 (Item 1)
5.	Temperature Drum Scale (Deviation Indicator)		Provides temperature indication /Deviation
6.	Temperature Control Wheel		Knurled control wheel used for selecting desired temperature on drum scale.
7.	Variable Reset Control		Adjusts integral time constants.
8.	Max Power Control		Limits application of output power (0 - 100%) to load.
9.	Power On/Alarm Condition Indicator, LED 3 (Red)		Indicates Instrument Power ON and in units having alarm feature, LED intermittently flashes when the controller is in alarm condition.
10.	Proportional Bandwidth Control		Provides for adjustment of proportional bandwidth.

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5.3 Temperature Controller Operation

Detailed instructions for operating the instrument and associated instrument controls are provided in the following paragraphs.

a. Temperature Settings

Adjust the drum scale temperature setting by the knurled Temperature Control Wheel to align the desired temperature with the fixed red index to the right of the scale window. With no supply connected, the temperature indicator to the left of the scale window should align with the fixed red index. On connecting the supply, the lowest red LED indicator will illuminate and the temperature indicator will move downscale; full power will be applied to the load. As the load temperature increases, the left indicator will approach the set temperature and the load power will reduce until the system stabilizes at the required temperature.

b. Proportional Bandwidth

The Proportional band adjustment control is located behind the hinged door on the front panel. To obtain optimum control conditions, set the proportional bandwidth control to maximum (fully clockwise) and check that stable control is achieved, i.e., the indicator shows that the required temperature has been achieved and remains steady at the required setpoint. (If not, the system must be stabilized, using procedures discussed under paragraph 5-4, control stability.) The proportional bandwidth is now reduced until the system becomes unstable, i.e., when the temperature cycles between regular limits above and below the setpoint and the power to the load correspondingly cycles, sometimes between full on and full off conditions. The cycle time may be seconds or hours, depending on the system under control and the heat transfer and load power characteristics of that system. The proportional bandwidth should be now increased sufficiently to regain stable control.

c. Maximum Power

The Maximum power control concealed behind removable a "Plug Button" is normally adjusted at 100% setting (fully clockwise). This function limits the maximum power that may be applied to the load and has a linear rotation/power characteristic. The control may be used in place of a variac in many applications and can also be used to approximately control the rate of rise of temperature during warm up to the setpoint. Turning the control counterclockwise, limits the maximum power that can be applied to the load. An important use for the control is in limiting electrical current supplied to loads which display a large negative temperature coefficient of resistance or to over-powered heaters.

d. Variable Time Constants

Optional Variable time constants (Rate and Reset) are supplied in the 917 for applications demanding compensation of heat transport conditions over widely varying conditions, where single valued constants give unsatisfactory control. Adjustments of these controls is discussed in paragraph 5:4, system stability.

e. Limit Alarm

When the optional alarm card is installed, a relay is provided that operates at some preset temperature below setpoint low limit (LL), above setpoint high limit (HL), or equidistant on either side of setpoint deviation limit (DL). Alarm setpoints are adjusted on the alarm control located behind the door on the fascia, and this adjustment is concealed behind a removeable "Plug Button". Adjustments can be made between 1% and 10% of scale span below and above setpoint for LL and HL alarms and between 1% and 10% of span away from setpoint for DL versions. Turning the control counterclockwise moves the alarm point toward the setpoint. The alarm point will follow the setpoint as the latter is adjusted.

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f. **Air Cooling**

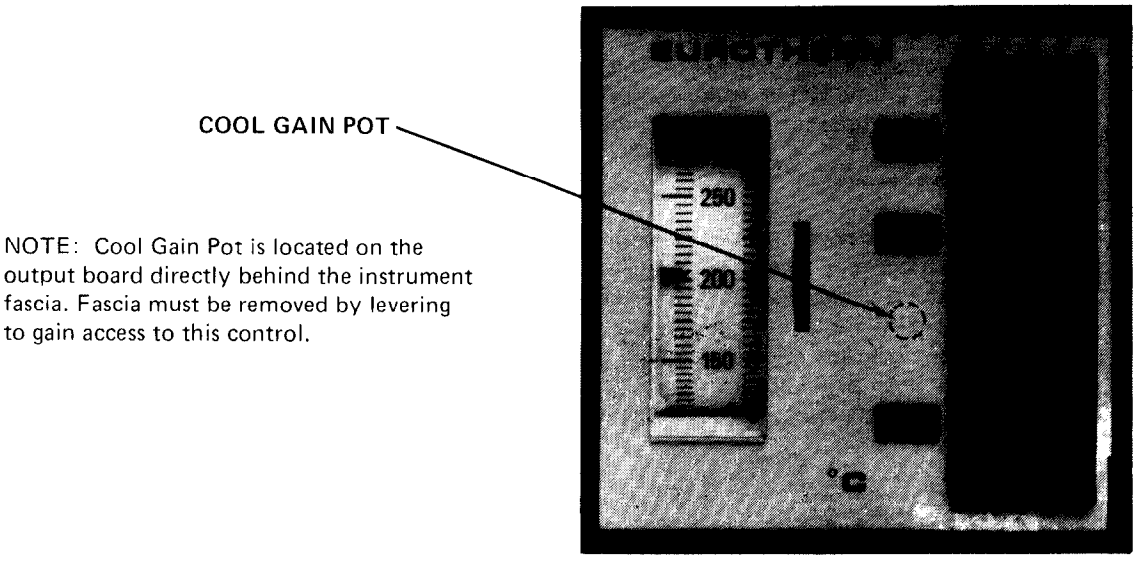
The cool gain pot (figure 5-2) is normally adjusted full counterclockwise for fan cooling. Rotating pot clockwise will "decrease" the output on time.

NOTE: A connection jumper between pins 10 and 12 **must be made** for proper operation.

g. **Water Cooling**

The cool gain pot (figure 5-2) is normally adjusted fully clockwise for water cooling. Rotating pot counterclockwise will **increase** the output on time.

NOTE: A connection jumper between terminals 10 and 12 **should not** be made for proper water cooling results.



NOTE: Cool Gain Pot is located on the output board directly behind the instrument fascia. Fascia must be removed by levering to gain access to this control.

Figure 5-2 Cool Gain Pot (Heat/Cool Output Only)

h. **Indicators**

There are 2 or 3 LED indicating positions on the instrument front panel. (2 for heating units and 3 for heat/cool units). In all "heat only" instrument applications (single mode output), only the top and bottom positions are fitted with LED indicators. In all "heat/cool" instrument applications (dual output), the upper two positions and bottom position are fitted with LED indicators. Functional identification of these indicators (Table 5-1) depends on instrument application.

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5.4 Control Stability

The values of proportional bandwidth, integral (reset) and derivative (rate) time constants fitted to the 917 Series Controller have been found by experience to give extremely good control for the majority of systems encountered. However, sometimes it is necessary to change one or more of these parameters to achieve stable control.

It is possible that a system will not give stable control if:

The Proportional Bandwidth is too narrow,
The Integral (Reset) time is too short,
The Derivative (Rate) time is too long.

The 3-term amplifier is fitted with feed forward (lead) and feedback (lag) RC networks to compensate the control signal for system characteristics. The feed forward and feedback time constants, T1 and T2 respectively, combine to form the proportional gain, integral and derivative times as follows:

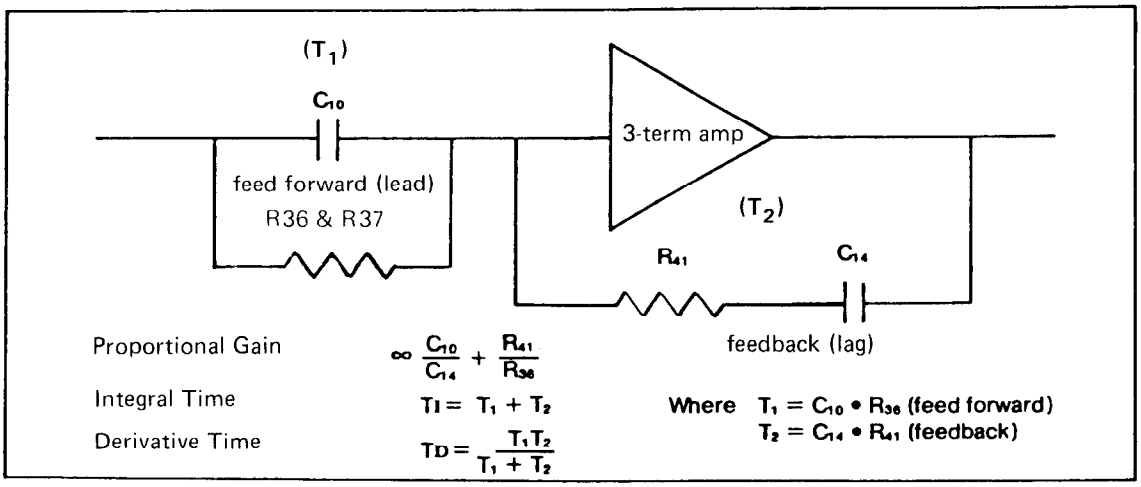


Fig. 5-3.

Standard values of these components are:

C10= 2.2 uf	C14 = 1uf	T1 = 442 Secs.
R36 & R37 = 164 M ohms	R41 = 82 M ohms	TD = 67 Secs.
T1 = 360 Secs.	T2 = 82 Secs.	

When variable time constants are fitted, resistors are switched to alter the integral and derivative times (See Figure 5-5).

There are many ways of determining optimum control term values. The method suggested here is a simple, practical method of stabilization and optimization.

In cases where stabilization is difficult it is of great help if a strip chart recording of the start-up response can be obtained.

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a. **For instruments with variable proportional band but fixed integral and derivative times.**

1. Set the proportional band and max power controls fully clockwise to maximum.

2. Apply power to the system and allow it to settle at selected temperature. The time to reach this steadystate condition will depend on system characteristics but typically will be greater than 15 minutes. **If the system will not stabilize but continues to oscillate indefinitely, contact Eurotherm.**

3. Reduce the setting of the proportional band control by 50% and allow the system to settle. Repeat this procedure until the temperature begins to oscillate regularly—the system is now unstable. Note the minimum proportional band control position that gives stable control. This will give an underdamped response as shown in Fig. 5-4a.

4. To obtain a "Normal" response increase the proportional band control setting determined in Step 3 by 1.7.

5. To obtain an overdamped response increase the proportional band control setting by a factor of at least 2.5.

b. **For instruments with variable proportional, integral and derivative terms.**

1. Set the proportional band and maximum power controls fully clockwise to maximum. Set the Integral and Derivative Times to the "OFF" position.

2. Apply power to the system and allow it to settle at a steady temperature. **The steadystate temperature will be below the set point temperature.** —This is known as the "Droop error" which will be removed by Integral action. The time to reach the steadystate condition will depend on system characteristics but typically will be greater than 15 minutes. **If the system will not stabilize but continues to oscillate indefinitely, contact Eurotherm.**

3. Reduce the setting of the proportional band control by 50% and allow the system to settle—it will settle closer to set-point. Repeat this procedure until the temperature begins to oscillate regularly—the system is now unstable. Note the period of oscillation and the minimum proportional band control position that gives stable control.

4. Set the proportional band, integral and derivative times as indicated below.

   a. Undamped response—see Fig. 5-4a.
      Proportional Band equal to the value determined in step 3
      Integral Time equal to T/2
      Derivative Time equal to T/8
   b. **Normal response—see Fig. 5-4b.**
      Proportional Band equal to 1.7 times the value determined in step 3
      Integral Time equal to T
      Derivative Time equal to T/6
   c. Overdamped response—see Fig. 5-4c.
      Proportional Band equal to 2.5 times the value determined in step 3
      Integral time equal to 1.5T
      Derivative Time equal to T/6

5. If the system becomes unstable when the integral and derivative terms are included then increase the integral time and/or decrease the derivative time.

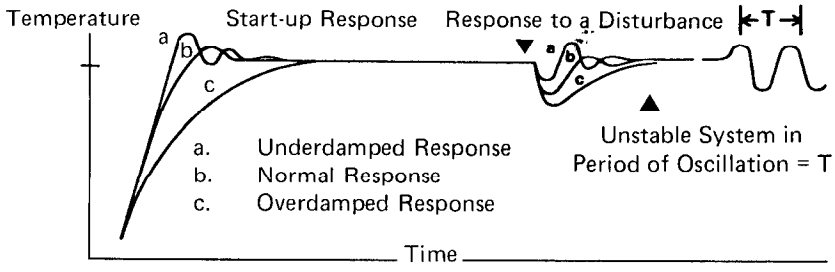


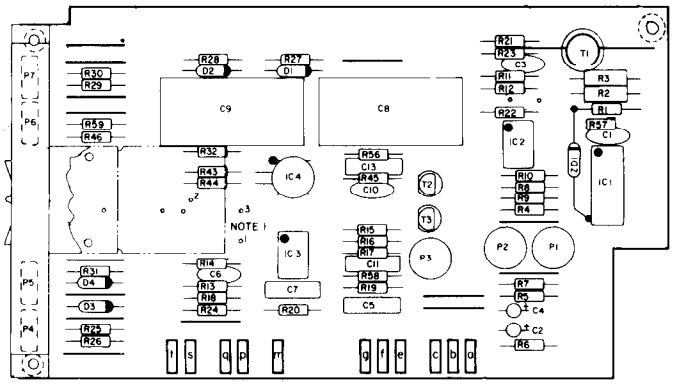
Figure 5-4

Response characteristics with various values of Proportional, Integral and Derivative C

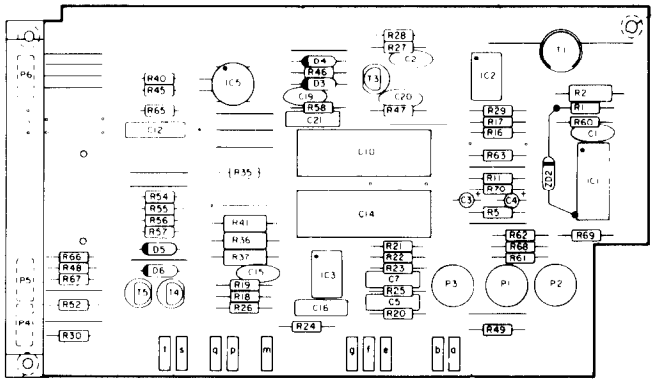
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Amplifier Board Component Layout

Figure 5-5



Variable Time Constants



Fixed Time Constants

TABLE 5-2. Time Switch Positions

SWITCH	SWITCH POSITION	TIME
Rate Time (Derivative Time) Right Switch	0	Off
	1/16	1/16 Minute
	1/8	1/8 Minute
	1/4	1/4 Minute
	1/2	1/2 Minute
	1	1 Minute
	2	2 Minutes
	4	4 Minutes
	8	8 Minutes
	P*	Proportional only
Reset Time (Integral Time) Left Switch	P*	Proportional only
	1/8	1/8 Minutes
	1/4	1/4 Minutes
	1/2	1/2 Minutes
	1	1 Minute
	2	2 Minutes
	4	4 Minutes
	8	8 Minutes
	16	16 Minutes
	32	32 Minutes

*Note: For proportional only control both switches must be in the "P" position.

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SECTION VI

MAINTENANCE INSTRUCTIONS

6.1 General

This chapter provides information pertaining to the maintenance of the Temperature Controller. Maintenance instructions in this section includes preventive maintenance, cleaning, calibration and trouble shooting.

6.2 Preventive Maintenance

Preventive maintenance, when properly performed at prescribed intervals, helps to ensure that the instrument will continue to operate properly. The controller should be inspected periodically so that defects can be corrected before they result in degradation or failure. The preventive maintenance checks and services to be performed are listed and described in table 6-1. Defects discovered during operation of the unit will be noted and corrected as soon as operation has ceased. Stop the operation immediately if a deficiency is discovered that could result in ultimate damage to the equipment. Reasonable intervals for performing preventive maintenance checks and services should be established, based on the operating environment and frequency of operation.

WARNING: Be aware of, and avoid contact with, areas of the equipment where 230-volt, 60 Hz power is normally present. Failure to observe the appropriate safety precautions may result in serious injury due to electrical shock.

6.3 Cleaning

The equipment should be kept free of dust, moisture, grease, and foreign matter. The fascia and exterior of the unit may be cleaned with a lint-free cloth dampened with a mild detergent then wiped with a clean cloth.

TABLE 6-1. Preventive Maintenance Checks and Services

Sequence Number	Item to Be Inspected and Procedure
1	**Connectors and Cable Assemblies** Check wiring and connectors for evidence of bent pins, damaged shells, worn or frayed insulation, and oxidation. Replace damaged parts.
2	**Components** Inspect components for evidence of physical damage and overheating. If discoloration due to overheating is observed, determine the cause of the overheating. Replace board containing damaged components.
3	**Screws, Nuts and Bolts** Tighten all loose hardware
4	**Controls and Indicators** Inspect front panel controls and lamp housings for loose retaining hardware; tighten as necessary. Replace if a switch or lamp housing is physically damaged.

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6.4 Calibration

All calibration/adjustments are made on the analog calibration board, joined as a unit to the indicator assembly. A millivolt source, thermocouple compensating cable and thermocouple reference tables are required for calibration of controllers. The calibrator can be either a cold junction compensated millivolt source (Eurotherm Model 039) or an uncompensated potentiometer. Connect the calibrator to the controller with the correct compensating cable, being careful to ensure correct polarity. Refer to figure 6-1 during calibration adjustment procedures.

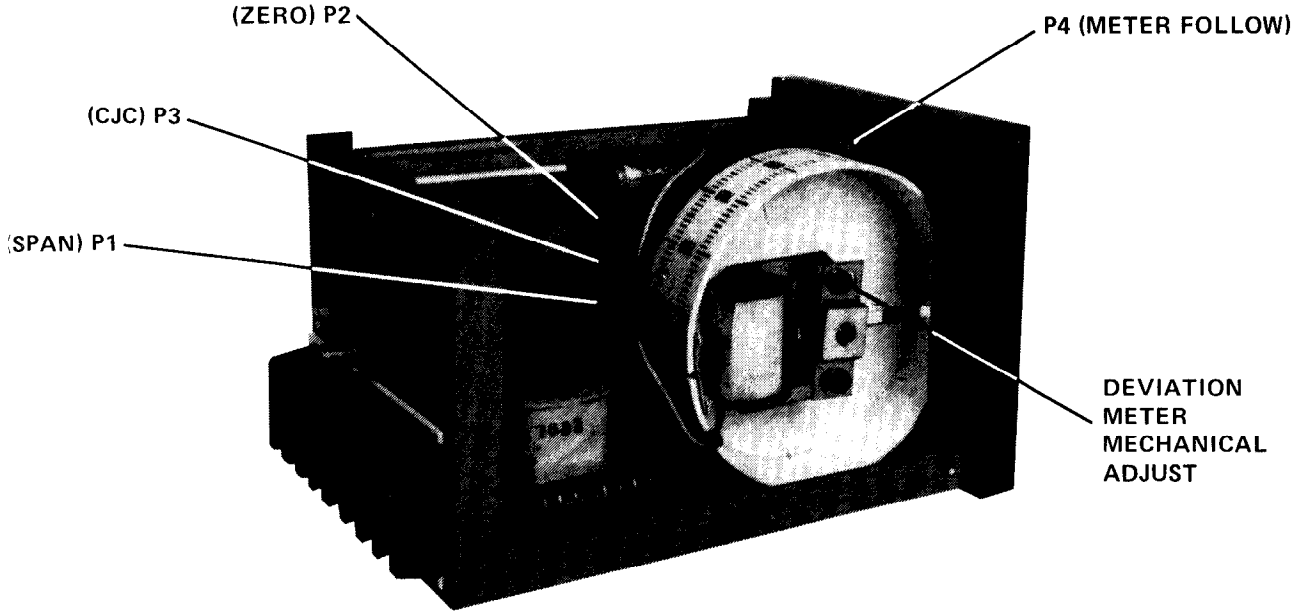


Figure 6-1. Instrument Calibration Adjustments

a. **Indicator Mechanical Check**

(1) Check indicator for exact mid-scale position with the controller standing on a level surface, the case removed and with supply disconnected.

(2) If necessary, adjust indicator by moving the spring loaded magnet retainer on the left side of the drum. It can be moved by moderate finger pressure, causing the indicator to move up or down.

b. **Span and Zero Calibration**

(1) Switch on the supply to the Controller and calibrator, allow 10 minutes for warm up; longer if either is radically different than ambient temperature to start.

(2) Adjust the controller setpoint to minimum temperature. Set the calibrator for a millivolt output equivalent to this temperature. Adjust the Zero potentiometer, P2, on the calibration board until the indicator is positioned exactly mid-scale.

(3) Adjust the controller setpoint to maximum temperature. Set the calibrator for a millivolt output equivalent to this temperature. (See appropriate MV/temperature reference table). Adjust the Span potentiometer, P1, on the calibration board until the indicator is positioned exactly mid-scale.

(4) Recheck the calibration at maximum and minimum temperatures and repeat procedure if necessary.

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c. **Uncompensated Calibrator**

If the calibrator is uncompensated, read the temperature at the calibrator terminals by means of a thermometer and obtain the millivolts equivalent to the measured temperature from the reference tables. Reduce the calibrator settings by this amount of millivolts when calibrating the controller in subparagraph b, above.

d. **Cold Junction Compensation Adjustment**

This is normally a **factory adjustment**. It does not require adjustment in the field under normal circumstances, however, should the need arise, the following procedure should be followed:

(1) Remove the cold junction compensation by shorting pin 2 of the calibration board to the 15 volt line (junction of P2 and P3).

(2) Introduce a millivolt error signal, from the calibrator, to give approximately mid-scale temperature for the instrument span.

(3) Null the indicator using the setpoint thumb wheel on the controller.

(4) Determine the proper compensating voltage for the type thermocouple being used (Table 6-2) and subtract this voltage from the setting of the calibrator.

(5) Remove the jumper, injecting the cold junction compensation.

(6) Re-null the indicator by adjusting P3 potentiometer.

TABLE 6-2. Cold Junction Compensating Voltages

Compensating Voltages (25 Deg. C)			
Thermocouple Type	**Voltage**	**Thermocouple Type**	**Voltage**
E	17.76mV	T	11.94mV
J	15.12 mV	S	1.78 mV
K	11.88 mV	C	4.14 mV
R	1.76 mV	G2	0.71 mV
G1	1.15 mV		

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e. **Calibration of Platinum Resistance Thermometer Input**

NOTE: A source of precision resistance and Platinum Resistance Thermometer Tables for the sensor being used are required for calibration of RTD input controllers.

(1) Switch on the supply to the controller and allow 10 minutes for warm-up, longer if it is radically different than ambient temperature to start.

(2) Connect the precision resistance source to controller terminals 15 and 16, ensuring that the connecting leads are as short as possible.

(3) Jumper terminals 13 to 15 and 14 to 16 on the controller rear terminal block.

(4) Adjust controller temperature setpoint to minimum temperature (or other desired minimum reference point).

(5) Select the resistance value corresponding to the minimum temperature from the tables and dial it on the source of resistance.

(6) Adjust zero potentiometer, P2, on the calibration board until the indicator is exactly mid-scale.

(7) Adjust the controller temperature setpoint to maximum temperature (or to 80 or 90 percent of span or other desired reference point.) From the resistance tables, select the resistance value corresponding to the maximum temperature setting and dial it on the resistance source.

(8) Adjust the span potentiometer P1, on the calibration board until the temperature indicator is exactly mid-scale.

(9) Since this adjustment is very interactive, the span and zero set procedure should be repeated until no further adjustment is necessary. Upon completing, apply cementing material to pots P1 and P2 to maintain adjustment.

(10) No cold junction compensation adjustment is necessary with resistance temperature detection RTD inputs. However, meter drive potetiometer, P4, should be set up according to the procedure for meter drive adjustment.

(11) Scale accuracy may be verified at several points through the span by dialing the setpoint to the desired point and inputing a resistance value corresponding to it from the tables. Indicator accuracy should be within ± .5% of span at each setting.

f. **Meter Drive Adjustment**

(1) With the controller adjusted to mid-scale temperature, introduce equivalent millivolts from the calibrator to exactly position the indicator mid-scale.

(2) Dial the drum scale setpoint a small number of degrees above the original setpoint. Observe that the temperature indicator moves downscale the same number of degrees.

(3) Adjust P4 on the calibration board to cause the temperature indicator to position exactly the correct number of degrees below setpoint.

(4) Repeat the procedure, dialing the temperature the same number of degrees below the original setpoint. The indicator should move upscale the precise amount of degrees dialed in.

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6.5 Troubleshooting Guide

If upon completion of installation or during normal operation, the instrument fails to function properly, check all installation wiring for loose or faulty wiring connection. Particularly check that the AC power connections are wired to the correct terminals. If these items are correct, refer to Table 6-3, "Trouble-shooting Guide" to assist in isolating common malfunctions. Potential problems which could be at fault and recommendations for corrective action are listed in Table 6-3.

NOTE:

1. Before trouble shooting, ensure that Max Power Control is set fully clockwise and Proportional Bandwidth and Alarm Setpoint Control (if included in instrument) is set fully clockwise.

2. If a fault is indicated in the thermocouple or thermocouple interconnections, confirmation can be made as follows:

   Disconnect the compensating cable from the controller thermocouple terminals and connect a millivolt source to these terminals. Check that the controller indicator moves up and down the scale as millivolt signals corresponding to temperatures above and below the set point are injected. If the indicator fails to respond in this way, an internal fault exists in the controller.

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TABLE 6-3. Troubleshooting Guide

Condition	Fault	Action
With Supply Off. Indicator not exactly mid-scale.	Meter mechanical zero incorrectly set.	Adjust meter mechanical zero. See Section 6, para. 6-4a.
With Supply on: Supply on LED does not illuminate	a) break in supply connections or b) LED failure (will not interfere with control), or c) Transformer failure. Check-Read voltage between alternative supply terminal and N. Absence of voltage indicates transformer failure.	a) Repair supply connection b) Replace LED c) Check cause of transformer failure if possible. Replace transformer.
Indicator upscale	Break in thermocouple or compensating cable.	Replace thermocouple or compensating cable and check all connections. See Note on page 6-5.
Indicator downscale but heating power is off.	a) Break in load wiring or fuse failure or b) Output stage failure (internal or external).	a) Repair wiring. Check for cause of fuse failure before replacing fuse. b) Replace output stage
Indicator upscale with hot load but full heating power is on.	a) Short circuit in load wiring or b) Output stage failure (internal or external) either latched on or SCRs broken down.	a) Repair load wiring. b) Replace output stage
Indicator downscale with hot load and full heating power on.	Incorrect thermocouple polarity	Re-connect thermocouple in correct polarity (ensure correct polarity of compensating cable)
With dual output controller - Indicator upscale but cooling power is off.	a) Break in cooling load wiring or cooling circuit fuse failure. or b) Controller cooling output stage failure (internal or external)	a) Repair wiring. Check cause of fuse failure before replacing fuse. b) Replace cooling output stage
With system at temperature indicator swings regularly above and below mid-scale position.	a) Excessively narrow proportional band. or b) Incorrect time constants.	a) Increase proportional band control b) Modify time constants - see Section 5, para. 5.-4
With system at temperature, indicator hunts in a random manner.	a) Poor thermocouple connection or b) Thermocouple junction deteriorating.	a) Repair thermocouple connection b) Replace thermocouple. See Note on page 6.-5.
With system at temperature, indicator is steady at mid-scale but an error exists between actual temperature and set temperature.	Controller calibration error NOTE—If error is very large, a fault exists on the calibration board.	Calibrate controller as directed in Section 6, para. 6-4. If a calibration board fault is indicated, replace the calibration board.

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