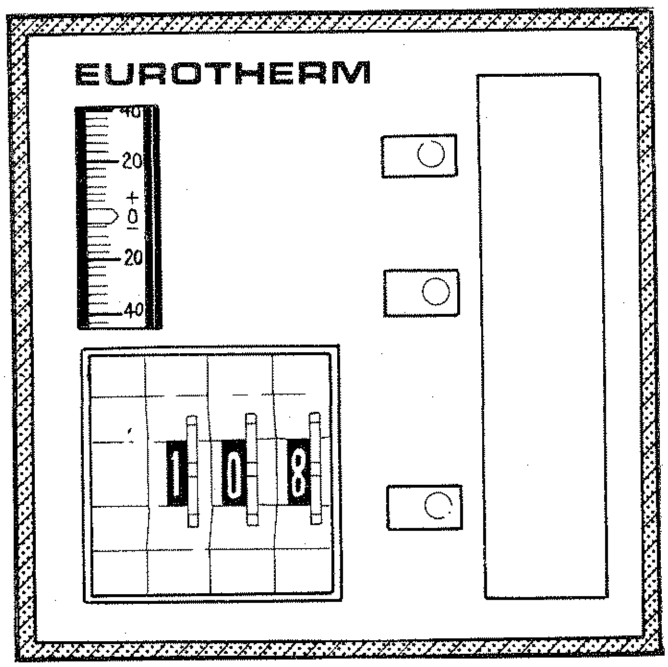
EUROTHERM

TEMPERATURE CONTROLLER TYPE 093

INSTALLATION AND OPERATING INSTRUCTIONS.



Part No. HA013135 093W-2

Ordering Information

You are welcome to order by description or by code below which is a useful check list.
To code specials: Write 99 or 999 in any part of the box where the special feature applies, write 99 before the end symbol 00 and write your special feature in words.

Basic product	Heat Output	Cool Output	Input	Scale range	Supply voltage	1st option	2nd option	3rd option	End
093 –	–	–	–	–	–	–	–	–	00

Basic Product

Basic Product	Code
High stability controller	093

Outputs

Outputs	Heating	Cooling
Fast-cycle pulses FC	001	
Phase-angle pulses PA	002	
Logic output 20mA o/c collector, max. 12V (fast cycling)	047	
Logic output 20mA o/c collector, max. 12V (slow cycling)	057	
Triac, phase angle (2A 264V A.C.)	059	
Isolated 2–10mA (12V max.)	067	
Isolated 1–5V (10mA max.)	068	
Isolated 0–5mA (12V max.)	069	
Isolated 0–5V (10mA max.)	070	
Isolated 0–10mA (12V max.)	071	
Isolated 0–20mA (12V max.)	072	
Isolated 4–20mA (12V max.)	073	
Isolated 1–5mA (12V max.)	075	
Triac, fast cycling (2A 264V a.c.)	092	092 ●
Triac, slow cycling (2A 264V a.c.) Linear Characteristics	065	
Triac, slow cycling (2A 264V a.c.) Non-Linear Characteristics		093 ●

Input

Input	
See inputs and scale ranges	

Scale

Scale	
See inputs and scale ranges	

Supply Voltage

Supply Voltage	
100–125/200–250V	19
100/200V +10% −15%	25

Options

Options	
Fastons	01
Low limit alarm (One of these options only, see note)	02 or 82
High limit alarm (One of these options only, see note)	03 or 83
Out of limit alarm (One of these options only, see note)	04 or 84
2.5% to 25% proportional band	07
10% to 100% proportional band	14
No power feedback	08
No cold junction compensation (0 °C external reference)	11
No cold junction compensation (50 °C external reference)	72
Downscale thermocouple break action	24
Alternative switched times A	62
Alternative switched times B	63
Black bezel	65
3-wire RT input	73

● Any of these cool outputs available with heat channel outputs 092, 065, 047 and 057 only.

Example Order

To specify:
High stability controller (093) with logic fast cycling output (047) in the heat channel and triac fast cycling (092) in the cool channel with 100 Ω resistance thermometer input (70) scaled 0–99.99°C (360), supply voltage 240V (19) options of high limit with contacts closed in the alarm condition (83) a 10–100% proportional band (14) and down scale thermocouple break action (24).

Write: 093-047-092-70-360-19-83-14-24-00

Note:
Option 02, 03, and 04 indicate alarm relay contacts which open in the alarm condition (relay de-energises).
Option 82, 83, and 84 indicate alarm relay contacts which close in the alarm condition (relay de-energises).

Input and Scale Ranges

Input Types

Box indicates scale is available, number in box is linearisation error in %.

Degrees (C ranges)

Input Types		Code	270 0-99.9 C	360 0-99.99 C	271 0-199 C	361 0-199.9 C	362 0-299.9 C	272 0-399 C	363 0-399.9 C	274 0-499 C	275 0-599 C	276 0-999 C	365 0-999.9 C	169 200-1199 C	190 200-1199.9 C	170 600-1599 C	277 800-1799 C	278 1000-1999 C
Iron—Constantan	J	01			60			35	35	30	30	25						
Fe-Konst	DIN 43710	02							30									
NiCr-NiAl	K	03						30	30		25	20	20	20	20			
Cu—Con	T	04						75										
Pt 13% Rh—Pt	R	05										55	55	25		20		
Pt 10% Rh—Pt	S	06										50	50	25		20		
Pt 20% Rh— Pt 5% Rh (JMC)		07														30		
Pt 30% Rh—Pt6%Rh B		08														30	25	
W-W26% Re (Engelhard)		09																20
Pt Resistance thermometer 10 Ω at 0 C		69											20	20				
Pt Resistance thermometer 100 Ω at 0 C		70	50	50	35	35	25	25	35			20	20					
DC millivolts (No CJC)		97																
■ Deviation meter range (plus and minus)		Units as scale range	6	13	13	6	6	26	6	26	26	52	13	80	13	110	110	1.10

Degrees (F ranges)

Input Types		Code	280 0-599 F	281 0-699 F	282 0-999 F	369 0-999.9 F	283 200-1199 F	284 600-1599 F
Iron—Constantan	J	01	25		20	20	20	20
Fe-Konst	DIN 43710	02				25		
NiCr-NiAl	K	03			20	20		
Cu—Con	T	04		35				
Pt 13% Rh—Pt	R	05						
Pt 10% Rh—Pt	S	06						
Pt 20% Rh— Pt 5% Rh (JMC)		07						
Pt 30% Rh—Pt6%Rh B		08						
W-W26% Re (Engelhard)		09						
Pt Resistance thermometer 10 Ω at 0 C		69						
Pt Resistance thermometer 100 Ω at 0 C		70			20			
DC millivolts (No CJC)		97						
■ Deviation meter range (plus and minus)		Units as scale range	26	52	52	13	80	110

Millivolts

Input Types		Code	150 ±0.999mV	151 0-9.999mV	148 4-13.999mV	149 5-14.999mV	175 6-15.999mV	152 0-9.999 x 2mV	176 10-19.999mV	177 30-39.99mV	153 0-49.99mV	154 0-99.99mV
Iron—Constantan	J	01		25		25						
Fe-Konst	DIN 43710	02		25		25						
NiCr-NiAl	K	03							25	25	25	25
Cu—Con	T	04										
Pt 13% Rh—Pt	R	05		25	25	25	25	25	25			
Pt 10% Rh—Pt	S	06		25	25	25	25	25	25			
Pt 20% Rh— Pt 5% Rh (JMC)		07										
Pt 30% Rh—Pt6%Rh B		08										
W-W26% Re (Engelhard)		09										
Pt Resistance thermometer 10 Ω at 0 C		69										
Pt Resistance thermometer 100 Ω at 0 C		70										
DC millivolts (No CJC)		97	25	25	25	25	25	25	25		25	25
■ Deviation meter range (plus and minus)		Units as scale range	0.13	0.13	0.13	0.13	0.13	0.50	0.13	0.13	0.50	0.50

Switched I and D Times

Standard

TD (Secs)	TI (Secs)
off	off
22	110
45	220
80	375
150	650

Alternative A

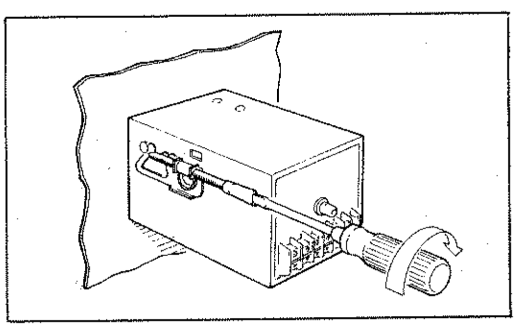
TD (Secs)	TI (Secs)
off	off
50	225
100	450
170	770
325	1330

Alternative B

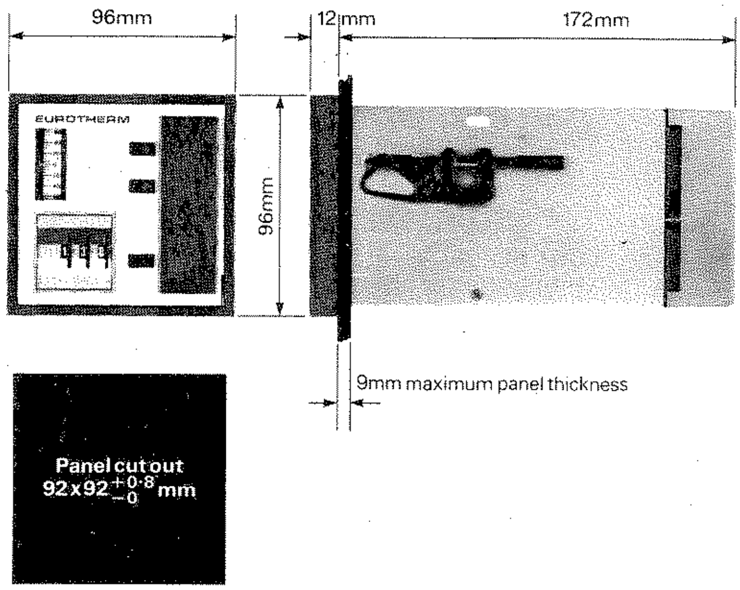
TD (Secs)	TI (Secs)
off	off
7	33
14	65
25	115
50	95

INSTALLATION

The instrument is intended for panel mounting in a DIN size 92 x 92mm cut-out as illustrated. Remove the mounting clamps and insert the instrument through the cut-out from the front of the panel. Fit the clamps from the rear of the panel and tighten lightly with a screw-driver as shown. A temperature controller coupled to its associated driver or thyristor unit with a coupling clip may be similarly mounted in a 188 x 92mm cut-out.

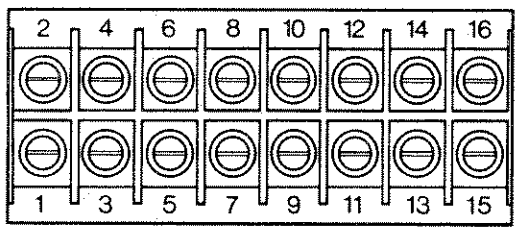


INSTALLATION & DIMENSIONAL DETAILS



CONNECTIONS & WIRING

Electrical connections are made via a 16-way terminal block fitted with screw terminals or faston terminals. All connections are low current and a 16/0.20mm wire size is adequate. A label mounted above the terminal block shows input, output and power suppy connections relevant to the particular instrument. The length of wires used for connections to the rear terminals should be sufficient to allow complete withdrawal of the instrument from the panel. This will allow removal of the instrument case without disconnecting if you should need to make adjustments inside.



SUPPLY

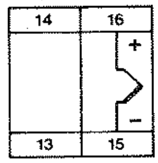
The instrument supply is connected to terminals 7 and 9 or 7 and 11 according to the supply voltage, the rated supply voltage will be shown on the label. The ground connection is made to the screw terminal marked ⏚ as indicated on the instrument panel.

8	10	12
	~ 50-60Hz	
N(Mp)	120v	240v
7	9	11

INPUT

Thermocouple

Thermocouple connections are made to terminals 15 and 16 on instruments with thermocouple sensing. Compensating lead of the correct type must be used between the thermocouple and the instrument and must be connected in the correct polarity. To check compensating lead polarity lift the leads off the thermocouple, twist them together and apply heat to the junction. The instrument pointer should move up scale.



Resistance Thermometer

Platinum resistance thermometer connections on instruments suitable for resistance thermometer sensing are made to terminals 13 to 16.

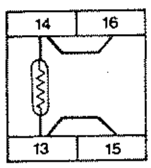
For two-wire thermometers with short leads, link 13 to 15 and 14 to 16 and join the bulb between terminals 13 and 14.

For three-wire thermometers connect the single connection side of the bulb to terminal 15 and the double connection side to terminals 14 and 16.

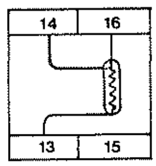
For four-wire thermometers connect one side of the bulb to terminals 14 and 16 and the other side to terminals 13 and 15.

Use copper wire.

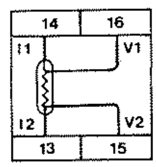
2 Wire



3 Wire

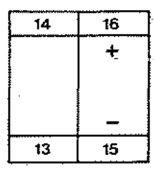


4 Wire



Millivolt or Milliamp Signals

Inputs are connected to terminals 15 and 16 as shown, using copper wire.

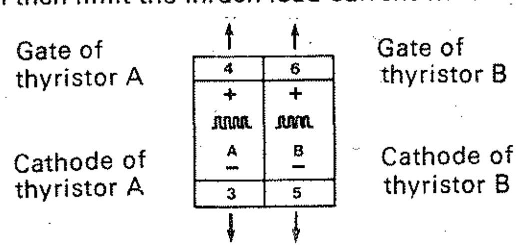


HEAT OUTPUTS

Single Phase Thyristor Pulses Types – 001, 002

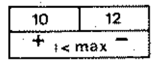
Controllers with phase angle or fast cycle outputs have pulse pairs brought out to terminals 3, 4 and 5, 6. Provision for current limit feedback is fitted to all phase angle models. Pulse outputs are fed to an external thyristor unit employing devices connected in inverse parallel.

NOTE: Use phase angle switching with inductive or tungsten filament loads and ensure that the load circuit is made simultaneously with or before the supply to the instrument. The 'soft' start feature will then limit the inrush load current which could otherwise blow the high speed fuse.



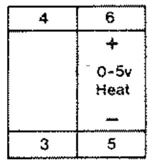
Current Limit with External Thyristors Type – 002

A current limit feedback facility is provided on controllers with phase angle pulse output. The feedback signal from the thyristor unit is connected to terminals 10 and 12.



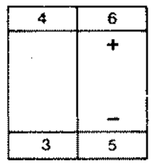
D.C. Signals Type – 067 to 073 and 075

With controllers providing d.c. analogue signals, the output is brought out to terminals 5 and 6. These outputs are suitable for use with external drivers or process controls.



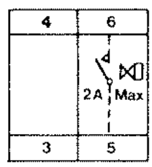
Logic Outputs Type – 047 and 057

With controllers provided with logic outputs this signal is brought out to terminals 5 and 6. These outputs are suitable for use with the Eurotherm thyristor stack type 450 series.



Triac Output Type – 059, 065 and 092

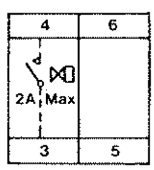
With controllers provided with triac heat output connections are made to terminals 5 and 6 as shown. During the 'on' time or whilst the triac is conducting the circuit between 5 and 6 is closed. The triac output is rated at 2 amp. at a maximum voltage of 264 volts a.c.



COOL OUTPUT

Triac Output Type – 092 and 093

With controllers provided with triac cool output connections are made to terminals 3 and 4 as shown. During the 'on' time the circuit between 3 and 4 is closed. The triac output is rated at 2 amp. at a maximum voltage of 264 volts a.c. The cool channel is available with either a triac or logic output in the heat channel.

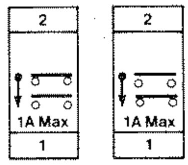


OPTIONAL FUNCTIONS

Low Limit Alarm – 02 or 82

The relay contacts on terminals 1 and 2 change state at a point below the set point. Below the switching point the relay is de-energized. The relay contacts can either be open (option 82) or closed (option 02) when the relay is energized.

The contact rating is 1A/250V a.c. maximum.

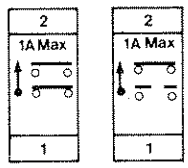


02 82

High Limit Alarm – 03 or 83

The relay contacts on terminals 1 and 2 change state at a point above the set point. Above the switching point the relay is de-energized. The relay contacts can either be open (option 83) or closed (option 03) when the relay is energized.

The contact rating is 1A/250V a.c. maximum.

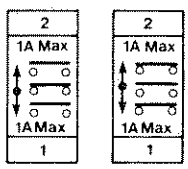


03 83

Out-of-Limit Alarm – 04 or 84

The relay contacts on terminals 1 and 2 change state equidistant above and below the set point. At set point the relay is energized. The relay contacts can either be open (option 84) or closed (option 04) when the relay is energized.

The contact rating is 1A/250V a.c. maximum.



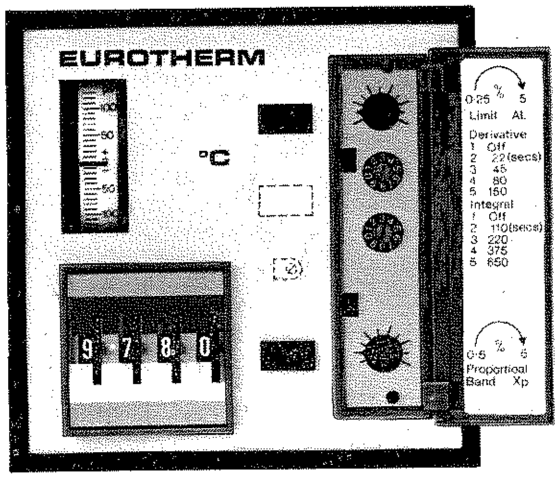
04 84

OPERATION

Temperature Setting

Set the digit switch to the required temperature and check that the deviation meter indicates zero with no supply connected to the controller. On connecting the supply, the lower lamp will illuminate to indicate that the mains supply is on and the upper lamp will illuminate indicating maximum heating power. Note if the instrument is fitted with alarms then it is likely that the lower lamp will flash indicating an alarm condition, this flashing light will turn to a steady illumination when the instrument comes out of the alarm condition.

As the load temperature increases and approaches the set temperature, the deviation meter will move upscale and the load heating power will decrease until the system stabilises at the required temperature (zero deviation). Indication of the reduction of heating power will be given by the top lamp which will dim on phase angle and d.c. output and time proportional flash on cycling output. If a cool channel is fitted to the instrument the cool output power will be indicated by a third lamp situated between the mains on lamp and the heat output lamp. This lamp will also time proportionally flash to indicate the amplitude of the cool output.



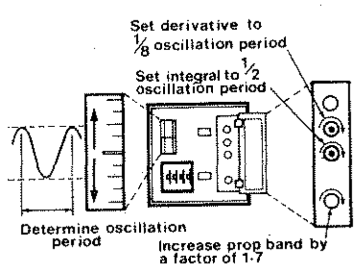
SETTING ADJUSTABLE CONTROLS

Proportional Band, Integral and Derivative Times

Set proportional band to maximum, integral and derivative to OFF (i.e. proportional band control fully clockwise, integral and derivative to position 1).

To determine the optimum setting, slowly reduce the proportional band from maximum (fully clockwise) until cycling of the load temperature begins, making one adjustment typically every 15 minutes. In this unstable condition, the load temperature will cycle regularly above and below set point. The cycle time could be anything from 1 to 30 minutes depending on the mass and time lags of the process. The waiting time between adjustments could be increased or decreased accordingly.

Note the oscillation period T and the proportional band setting X at which oscillation just begins. Now set proportional band to 1.7X. Set integral time to T/2 and derivative time to T/8 or nearest step to these values. This gives optimum control for applications. If oscillations occur on recovery from small disturbances or if there is too much overshoot on start up then control is too tight and all three adjustments should be increased.



Limit Alarm (Optional Function)

Alarms when fitted, can be set to operate between 5 and 100% of maximum proportional band width (i.e. with standard proportional band adjustment of 0.5–5%, alarms are adjustable from 0.25–5% of span) from the set point by means of this control.

Turning the control clockwise will move the alarm point away from the set temperature. The alarm point will follow the set point as the latter is adjusted. High limit alarm operates above set point and low limit alarm operates below set point. Out of limit alarms operate above and below the set point equidistant from it.

Cool Gain (Optional Function)

On instruments fitted with both a heating and cooling output a cool gain control is fitted and located behind the front facia. To gain access to this control snap off the facia. This can be achieved by inserting a thin flat piece of metal such as a small screw-driver or pen knife into the slot in the lower right hand corner of the facia and using the plastic bezel as a fulcrum, lever the facia away from the instrument. The cool gain control is a skeleton potentiometer situated between the mains on and cool output lamps.

Adjustment of this control can be effectively carried out whilst setting the proportional band, integral and derivative time as above. When the proportional band control has been adjusted to a point where the system is unstable throwing the system into a heating power and cooling power alternatively, connect a recorder across the sensor terminals to display the oscillation in temperature and adjust the cool gain control to make the recorder trace symmetrical. The facia can now be snapped back in position by inserting the top flange into the slot between the bezel and the face plate then by applying pressure with the thumb at the centre lower edge snapping the facia home.

CHECKING

The following procedure will determine whether the controller is functioning normally. With the supply connected and the thermocouple or resistance bulb disconnected, the indicator should move upscale and the output should reduce to zero. With the thermocouple connections shorted, the indicator should be mid-scale when the set point is equal to ambient temperature (a 100Ω or 10Ω, depending on input type, resistor put in place of the resistance thermometer and all connections to each side of the bulb shorted should give a mid-scale meter balance at 0°C). The indicator should move downscale as the set point temperature is increased above the ambient or zero setting, giving increasing heating power to the load. Conversely, the heating output should decrease as the set temperature is reduced, the indicator moving upscale. (If a cool channel is fitted to the controller the cool output should rise from zero as the heating output reaches zero and with further reduction of the set point the cool output should increase to maximum).

Thyristor Pulse Output

Check that the fuse on the external thyristor unit is not open circuit. Check the pulse interconnections between the controller and thyristor unit in accordance with the wiring diagram shown. With temperature well below set point, pulses should be present. You can hear the signal if you connect a 3 or 8Ω loud speaker across 3 and 4 or across 5 and 6. An a.c. voltmeter here will read about 0.7V. Where current limit is fitted check that a 47k ohm potentiometer or 47k ohm resistor is fitted between terminals 6 and 8 on the thyristor unit. Check that the correct current limit interconnections are made between the controller and the thyristor unit. Check that a line supply is available on terminal 'L' of the thyristor unit. Connect as load a 100 watt lamp between the supply neutral and terminal '〰' of the thyristor unit as in fig. 1 on the next page. With the supply connected and the indicator down scale, full brightness should be obtained from the lamp. As the indicator is raised upscale the brightness of the test lamp should reduce progressively (phase angle) or flash with a decreasing 'on' time (fast cycle).

D.C. Voltage Output 0–5V (070) 1–5V (068) 10mA Max.

Connect a d.c. voltmeter of 20kΩ/Volt (range 10V) to the output terminals. Full 5V output should be obtained with the indicator downscale and the supply connected. This output should be reduced to zero or 1V as the indicator moves upscale.

D.C. Milliamp Output

Connect a d.c. ammeter in series with the load. Connect the supply. With the indicator downscale, full output current should be indicated (5mA, 10mA or 20mA). This output should reduce towards zero as the indicator approaches midscale. The maximum voltage output is 12V.

Logic Output

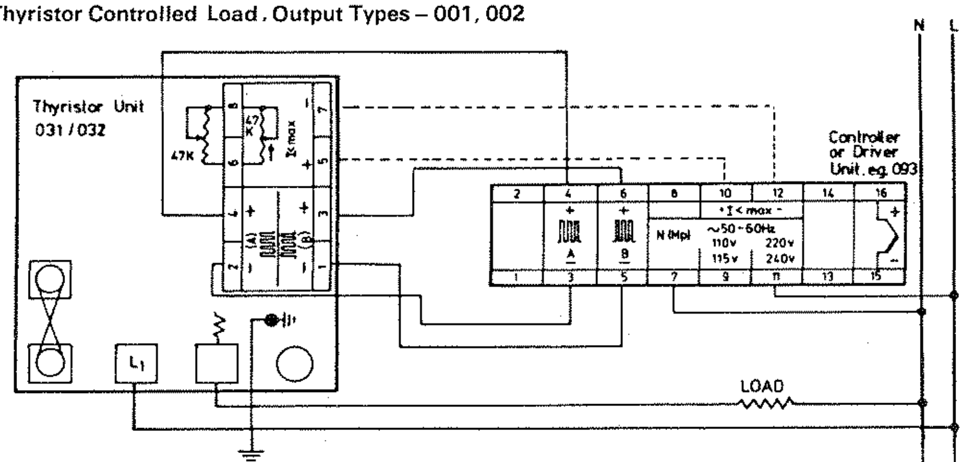
Connect a d.c. voltmeter of 20kΩ/Volt (range 25V) to the output terminals. A continuous 15V output should be obtained with the indicator downscale and the supply connected. The output should time proportion cycle, 0.4 secs. cycle time for F.C. (047) output and 24 secs. cycle time for S.C. (057) output, reducing the average output towards zero as the indicator moves upscale.

Triac Output

With the controller connected as in fig. 2 on this page but a 100 watt lamp substituted for the contactor or solenoid valve, then on all heat channels with the supply connected and the indicator downscale the lamp should be illuminated continuously. This output should either dim in the phase angle output (059) or time proportional flash with a cycle time of 0.4 sec. for F.C. (092) output or 24 secs. for S.C. (065) output, reducing the average output towards zero as the indicator moves up scale. In the cool output case the reverse action should be noted, i.e. full output for up scale indication and zero output for downscale deflection.

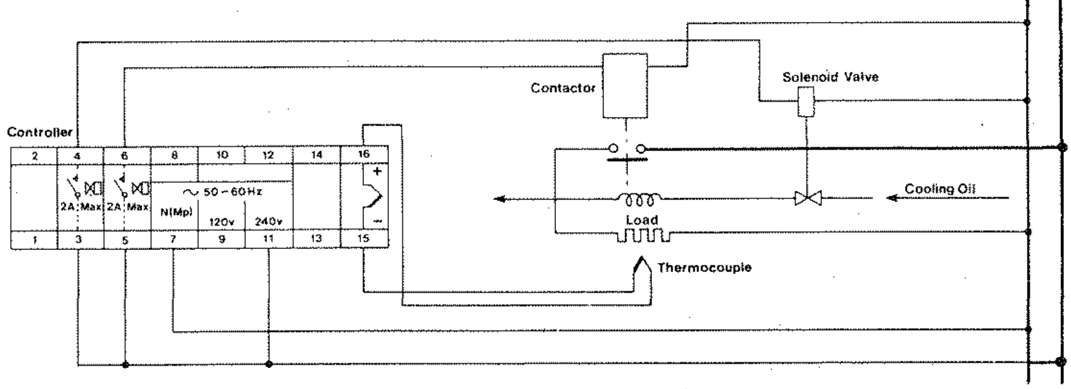
WIRING SCHEMES

1. **Single Phase Thyristor Controlled Load, Output Types – 001, 002**



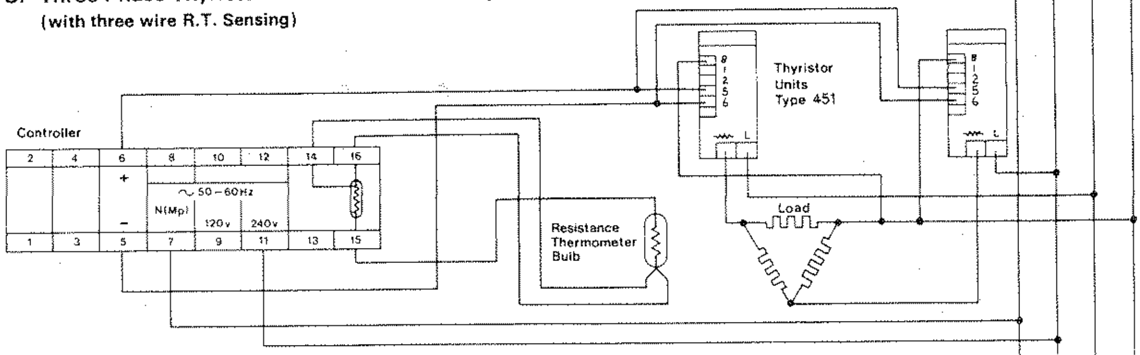
Dotted lines show current limit connections. Current limit potentiometer or fixed resistor value 47k.
Note: Load and instrument supply must be from the same phase.

2. **Heating and Cooling Control, Output Types – 065 (heating), 093 (cooling)**

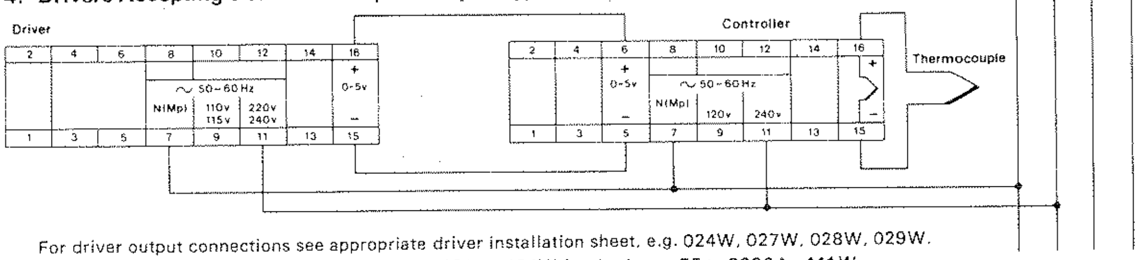


3. Three Phase Thyristor Controlled Load, Output Type – 047 to 057

(with three wire R.T. Sensing)



4. Drivers Accepting 0 to 5V D.C. Input, Output Types – 070



For driver output connections see appropriate driver installation sheet, e.g. 024W, 027W, 028W, 029W.
For thyristor connections see 031, 032W up to 40A or 434W for thyristors 75 to 2000A, 411W for three phase thyristor systems or **450–454** W for thyristor units with logic input.