

# TE10A

**Power  
controller**

**Phase Angle**



**EUROTHERM**

**User  
manual**

---

# **Thyristor power controllers**

## **TE10A**

### **Phase angle operation**

**Control of all types of load up to 25kW**  
**constant resistance**  
**short-wave infrared elements**  
**transformer primaries**  
**inductors...**

### **User Manual**

©Copyright Eurotherm Automation 1997

All rights reserved. All reproduction or transmission in any form or using any procedure,  
without written authorisation from EUROTHERM AUTOMATION, is strictly prohibited.

TE10A/PA User manual HA175548ENG Issue 1.0 06/97

---

**Before installation, please read this manual thoroughly.**

Eurotherm cannot be held responsible for any damage to persons or property, or for any financial loss or costs arising from incorrect use of the product or failure to observe the instructions given in this manual.

In order to maintain its 'leading edge' Eurotherm may have to make changes to its specifications without advance notice.

For any further information, or if in doubt, please contact Eurotherm Controls, where qualified staff are available to advise or assist you with the commissioning of your installation.

## **Guarantee**

Two years for parts and labour (return to factory)

---

## **TE10A**

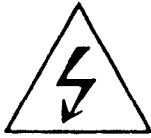
Industrial thyristor power controller Phase angle operation

### **CONTENTS**

|                                            |    |
|--------------------------------------------|----|
| SAFETY DURING INSTALLATION AND USE . . .   | 4  |
| EUROPEAN DIRECTIVES . . . . .              | 5  |
| TECHNICAL SPECIFICATION . . . . .          | 7  |
| PRODUCT CODE . . . . .                     | 9  |
| INSTALLATION AND DIMENSIONAL DETAILS       | 10 |
| FRONT FACIA . . . . .                      | 11 |
| TERMINALS AND CONNECTORS . . . . .         | 12 |
| WIRING . . . . .                           | 14 |
| Control of TE10A by temperature controller | 14 |
| Local control by potentiometer . . . . .   | 15 |
| Local control by contacts . . . . .        | 15 |
| Auxiliary power supply (option) . . . . .  | 16 |
| INPUT SIGNAL . . . . .                     | 17 |
| LAYOUT OF CONFIGURATION                    |    |
| ‘COFFEE BEANS’ . . . . .                   | 18 |
| THYRISTOR FIRING MODE . . . . .            | 19 |
| CURRENT LIMIT (OPTION) . . . . .           | 20 |
| Operation . . . . .                        | 20 |
| Adjustment . . . . .                       | 21 |
| POWER CONTROL . . . . .                    | 22 |
| COMPENSATION FOR SUPPLY VARIATIONS .       | 22 |
| CURRENT DERATING . . . . .                 | 23 |

---

## SAFETY DURING INSTALLATION AND USE



This symbol means that failure to take note of the information given in this manual may have serious consequences for the safety of personnel and may even result in electrocution.

### **DANGER!**

- Units must be installed in fan-cooled electrical cabinets to ensure that condensation and pollution are excluded. The cabinet must be closed and bonded to the safety earth in accordance with Standards NFC15-100, IEC 364 or current national Standards. It is the responsibility of the user to install and wire the installation in accordance with current professional practice.
- Before any connection or disconnection, make sure that power and control cables and leads are isolated from voltage sources.
- The safety earth must be connected before any other connection is made during wiring and should be the last cable to be disconnected.
- Thyristors are not isolating devices.

The high-speed fuse recommended is used only to protect the thyristors: under no circumstances can it be used to protect the installation. For this reason it is very important to fit a suitable device guaranteeing protection for, and electrical isolation of, the installation in compliance with current practice.

- Access to the internal components of the product is prohibited to users. Disconnect the TE10A completely before dismantling.
- The temperature of the heatsink fins may exceed 100°C. Avoid all contact, even occasional, with the heatsink while the TE10A is operational.  
The heatsink remains hot for approximately 15mins after the TE10A has been switched off.

---

## EUROPEAN DIRECTIVES

### **CE MARKING**

TE10A products carry the CE mark in compliance with the essential requirements of the Low Voltage Directive 73/23EC of 19/2/73 (amended by the Directive 93/68/EC of 22/7/93).

For safety reasons, TE10A products installed and used in compliance with this user manual meet the essential requirements of the European Directives mentioned above.

### **CE DECLARATION OF CONFORMITY**

A CE Declaration of conformity is available on request.

### **ELECTROMAGNETIC COMPATIBILITY (EMC)**

(For an industrial environment only, not to be used in domestic environments)  
Eurotherm certifies that TE10A Phase Angle fired products, installed and used in compliance with their manual, meet the following EMC standards and enable the system which incorporates them to comply with the EMC Directive as far as those TE10A products are concerned.

### **EMC STANDARDS**

|          |                   |                                                               |
|----------|-------------------|---------------------------------------------------------------|
| Immunity | Generic standard: | EN 50082-2                                                    |
|          | Test standards    | : EN 61000-4-2, EN 61000-4-4, ENV 50140, ENV 50141, ENV 50204 |
| Emission | Generic standard: | EN 50081-2                                                    |
|          | Test standard     | : EN 55011 (with external filter for conducted emissions)     |
|          | Product standard: | IEC 1800-3 (without filter)                                   |

### **EXTERNAL EMC FILTERS**

To reduce conducted emissions in accordance with standard EN50081-2, a series of EMC filters is used:

16A and 25A ratings: filter code FILTER/MON/25A/00

40A and 250A ratings: filter code FILTER/MON/63A/00

Eurotherm can supply these external filters.

To mount the filters on DIN rails use a BA175552 mounting plate.

---

## **VALIDATION BY INDEPENDENT BODY**

Eurotherm has validated the compliance of these TE10A controllers with the Low Voltage Directive mentioned above and with EMC standards through product design and laboratory testing.

The controls carried out on TE10A products are listed in a Technical Construction File validated by the LCIE (Central Laboratory for the Electrical Industries), a Recognised Competent Body.

## **PERSONNEL**

The installation, configuration, commissioning and maintenance of the power unit should only be carried out by personnel qualified and trained to work with low voltage electrical equipment in an industrial environment.

## **INDEPENDENT SAFETY DEVICE**

Given the value of the equipment controlled by TE10A, it is the responsibility of the user, and it is highly recommended, that an independent safety device (alarm) should be installed. This alarm must be tested regularly. Eurotherm can supply suitable equipment.

## **'ELECTROMAGNETIC COMPATIBILITY' INSTALLATION GUIDE**

In order to help you reduce the effects of electromagnetic interference depending on the product installation, Eurotherm can supply you with the 'Electromagnetic Compatibility' Installation Guide (ref. HA025464).

---

## TECHNICAL SPECIFICATION

### Power

|                         |                                                                                              |
|-------------------------|----------------------------------------------------------------------------------------------|
| Nominal current at 45°C | 16, 25, 40A or 50A                                                                           |
| Nominal voltage         | 100Vac to 500Vac<br>+10%, -15%                                                               |
| Supply frequency        | 50 and 60Hz (nominal) $\pm 2$ Hz                                                             |
| Current in off state    | Below 30mA (typically)                                                                       |
| Load                    | Constant resistance, short-wave<br>infrared elements, transformer<br>primaries, inductors... |

### Regulation

|                    |                                                                                                                                                                        |
|--------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Type of regulation | Load voltage squared<br>The load power is proportional to the<br>control input                                                                                         |
| Linearity          | Better than $\pm 2\%$ of the full range                                                                                                                                |
| Stability          | Automatic compensation for supply<br>variations from $\pm 10\%$ of the nominal<br>voltage. Stability better than $\pm 2\%$ of<br>the full range on constant resistance |
| Firing mode        | 'Phase angle'<br>Load power variation from 0% to<br>100% of the nominal power                                                                                          |
| Firing indicator   | Green LED on front facia                                                                                                                                               |

### Control Inputs

|                      |                                                                                                                                 |
|----------------------|---------------------------------------------------------------------------------------------------------------------------------|
| External signal type | Analogue, DC voltage or current:<br>0 - 5V, 0 - 10V or 4 - 20mA                                                                 |
| Input impedance:     | Voltage 100K $\Omega$<br>Current 250 $\Omega$                                                                                   |
| Local control        | 10K $\Omega$ external potentiometer<br>'Dry' contact: logic operation -<br>'all or nothing'<br>A '5V user' voltage is available |
| Soft-start           | A phase angle ramp allows progressive<br>variation in power applied to the load.                                                |

---

## Environment

|                            |                                                                                                                         |
|----------------------------|-------------------------------------------------------------------------------------------------------------------------|
| Operating temperature      | 0 to 60°C (see Derating Curves) at maximum altitude of 2000m                                                            |
| Operating atmosphere       | Storage: -10 to +70°C<br>Non-conductive, non-explosive and non-corrosive                                                |
| Humidity                   | RH: 5 to 95%, non-condensing nor streaming                                                                              |
| Pollution                  | Pollution degree 2 permissible (IEC 664)                                                                                |
| Thyristor protection       | External fuse, internal MOV (varistor) and RC snubber                                                                   |
| Protection degree          | IP20 (in accordance with IEC 529; ¶11.4, table 5)                                                                       |
| Insulation (1 minute test) | Isolation distances according to IEC 664<br>2000Vac between power and earth<br>3600Vac between power and control inputs |
| Cooling                    | Natural convection                                                                                                      |
| Mounting                   | Vertical on DIN rail                                                                                                    |
| Dimensions (mm)            | Height 115; depth 92.5;<br>Width: 52.5 (16A), 70 (25A), 105 (40A) and 122.5 (50A)                                       |
| Weight (g)                 | 550 (16A), 700 (25A), 900 (40A), 1200 (50A)                                                                             |

## PRODUCT CODE

### Controller

| Model | Current                  | Voltage                                                                                      | Input                | Firing            | Option                                                           | / 00 |
|-------|--------------------------|----------------------------------------------------------------------------------------------|----------------------|-------------------|------------------------------------------------------------------|------|
| TE10A | 16A<br>25A<br>40A<br>50A | 100V<br>115V<br>200V<br>230V<br>240V<br>277V<br>380V<br>400V<br>415V<br>440V<br>480V<br>500V | 0V5<br>0V10<br>4mA20 | Phase angle<br>PA | Current limit<br>CL<br>Auxiliary<br>power supply<br>115V or 230V |      |

### Options

Auxiliary power supply

115Vac or 230Vac used in the case of non-standard mains or if independent power supply required. The auxiliary supply must be in phase with load supply.

Current limit

Rms load current limit; threshold adjustable by potentiometer on front facia from 30% to 100%

### Fuses

(Thyristor protection except for short-wave infrared application)

| Current | Rating | Code (Fuse & fuse-holder) | Dimensions (mm) |
|---------|--------|---------------------------|-----------------|
| 16A     | 20A    | FU1038 / 16A / 00         | 81 x 17.5 x 68  |
| 25A     | 32A    | FU1038 / 25A / 00         | 81 x 17.5 x 68  |
| 40A     | 50A    | FU1451 / 40A / 00         | 95 x 26 x 86    |
| 50A     | 63A    | FU2258 / 50A / 00         | 140 x 35 x 90   |

---

## INSTALLATION AND DIMENSIONAL DETAILS

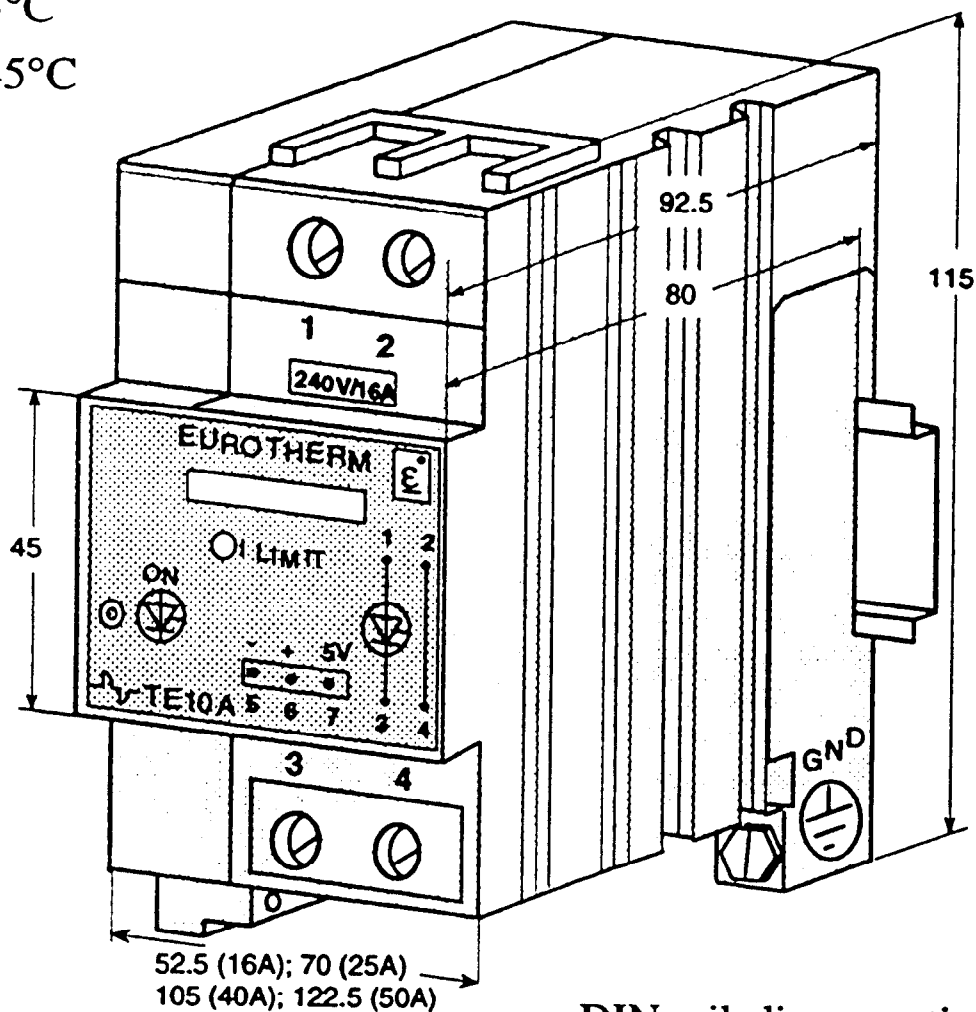
Minimum spacing between two TE10A units:

10mm up to 45°C

17.5mm over 45°C

(bi-rail adapter

BD173730)



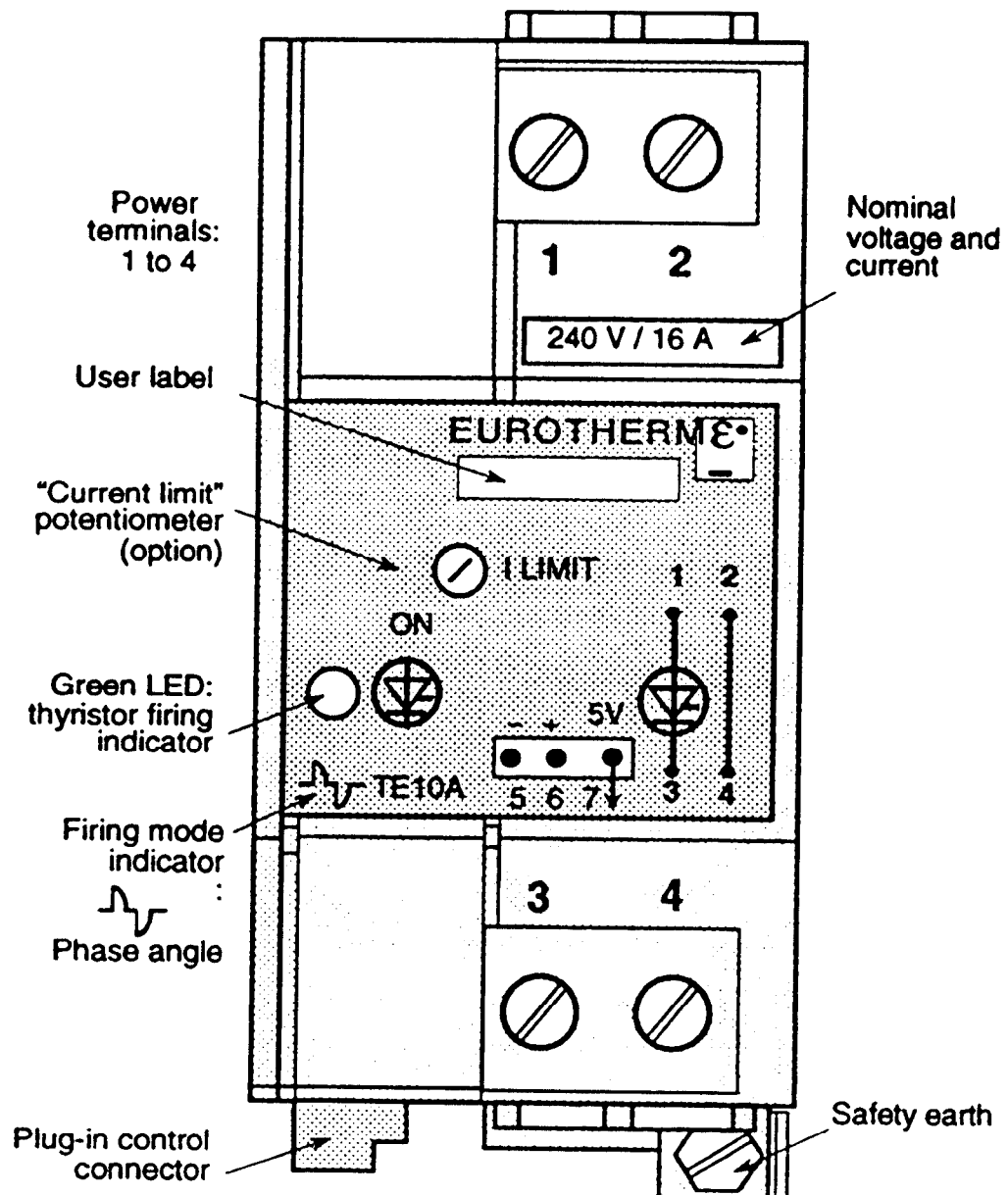
Dimensions  
(in mm)

DIN rail clip mounting

(EN 50022-35x7.5 and 35x15)

Ground continuity: For EMC reasons ensure that the DIN rail of the TE10A installation is electrically bonded to the reference ground (panel or bulkhead)

## FRONT FACIA



## TERMINALS AND CONNECTORS

### POWER

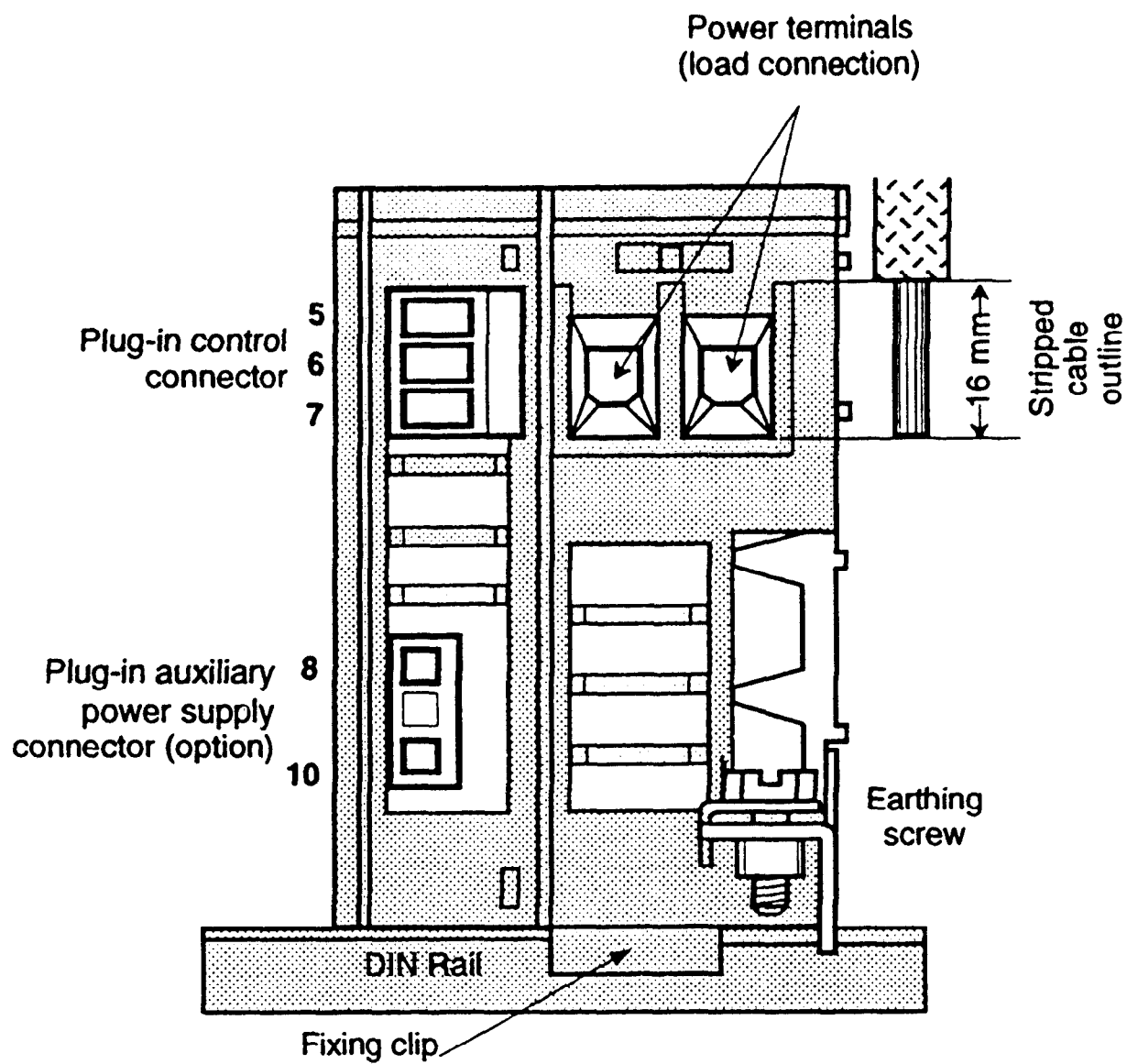
| Terminal designation                                                              | Function                     | Terminal type | Cable                                      | Stripping | Tightening torque |
|-----------------------------------------------------------------------------------|------------------------------|---------------|--------------------------------------------|-----------|-------------------|
| 1                                                                                 | Mains - Controlled phase     | Cage          | 1.5mm <sup>2</sup><br>to 16mm <sup>2</sup> | 16mm      | 1.2 Nm            |
| 2                                                                                 | Mains - Direct phase/Neutral |               |                                            |           |                   |
| 3                                                                                 | Load - Controlled phase      |               |                                            |           |                   |
| 4                                                                                 | Load - Direct phase/Neutral  |               |                                            |           |                   |
|  | Safety earth                 | M5 screw      | Same gauge as power                        | 10mm      | 2 Nm              |

### CONTROL

| Terminal designation | Function                        | Connector type | Cable                                       | Stripping | Tightening torque |
|----------------------|---------------------------------|----------------|---------------------------------------------|-----------|-------------------|
| 5                    | 0V of control signal            | Plug-in        | 0.5mm <sup>2</sup><br>to 1.5mm <sup>2</sup> | 7mm       | 0.4 Nm            |
| 6                    | '+' of control signal           |                |                                             |           |                   |
| 7                    | User 5V                         |                |                                             |           |                   |
| 8 & 10               | Auxiliary power supply (option) | Plug-in        | 0.5mm <sup>2</sup><br>to 1.5mm <sup>2</sup> | 7mm       | 0.25 Nm           |
| 9                    | Not used                        |                |                                             |           |                   |

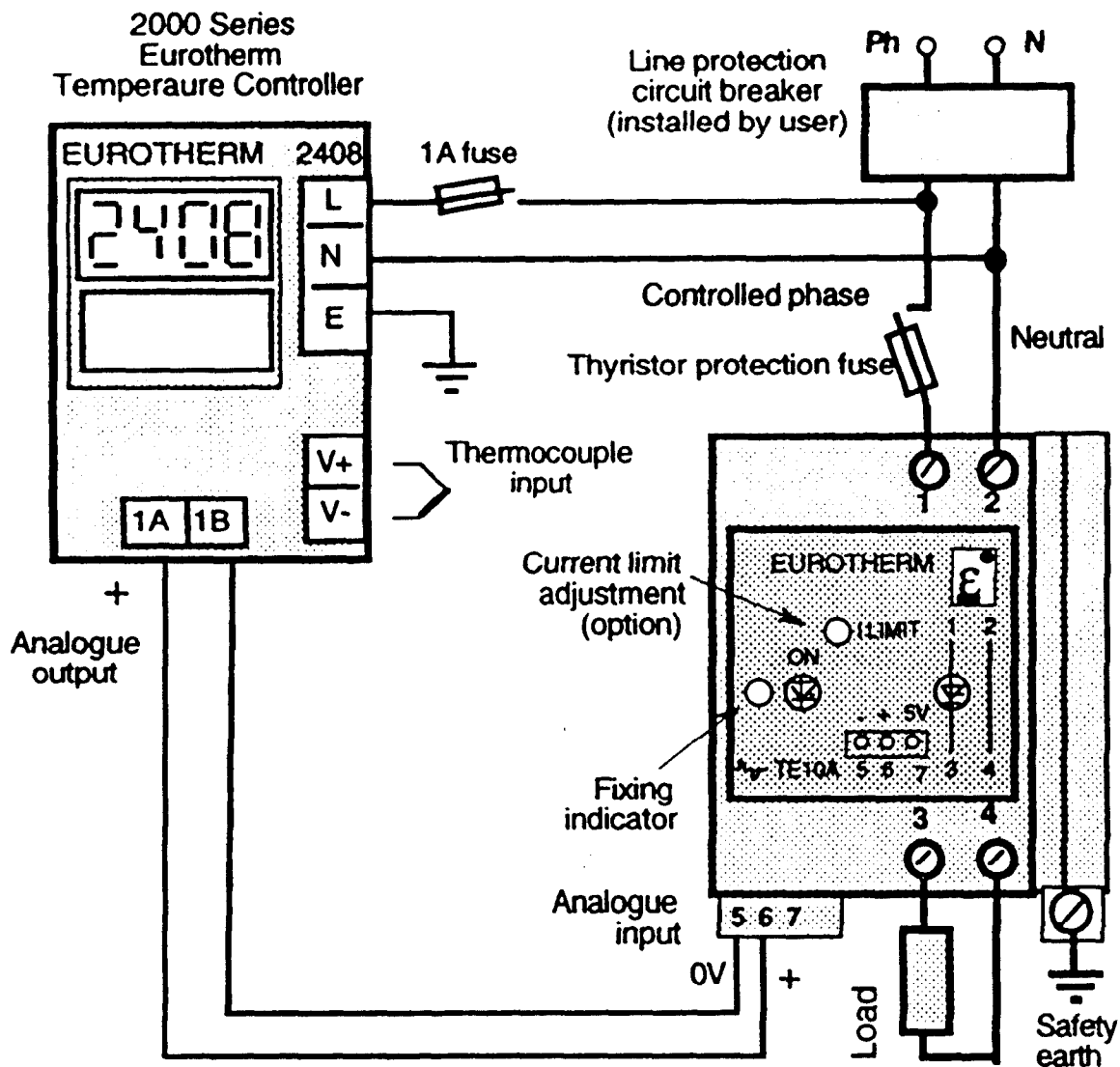
---

## VIEW FROM BELOW



## WIRING

### Control of TE10A by temperature controller

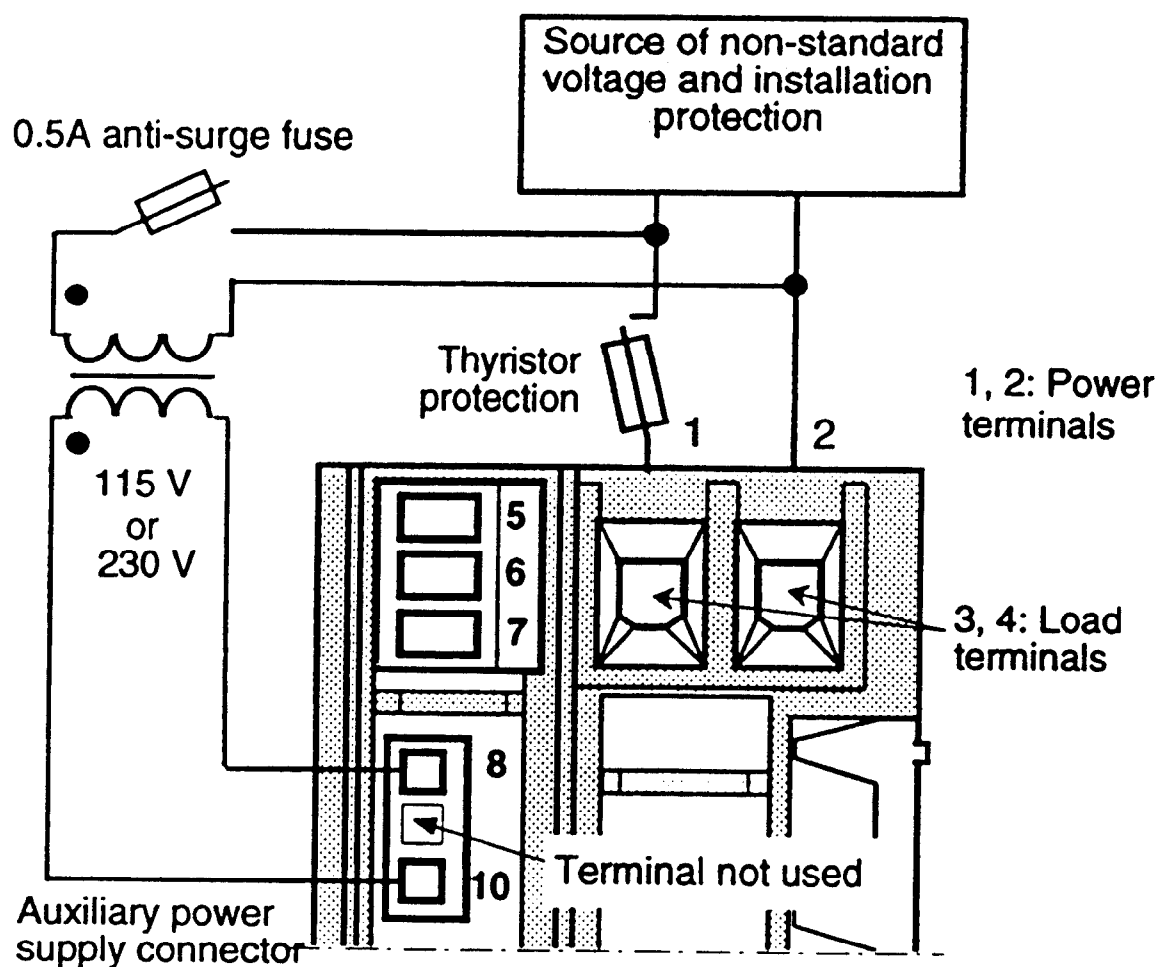


TE10A wiring example (230V supply, input 0 to 10V)



## Auxiliary power supply (option)

In the case of non-standard mains, the auxiliary power supply must be in phase or in anti-phase with the power supply voltage.



Example of auxiliary power supply wiring with non-standard mains.

---

## INPUT SIGNAL

### External control

The TE10A is controlled by a DC analogue signal.

Signal type: voltage (0 to 5V or 0 to 10V) or current (4 to 20mA).

Input impedance: voltage: 100k $\Omega$ ; in current: 250 $\Omega$ .

### Local control

Local control is possible using a 10k $\Omega$  potentiometer (analogue operation) or via 'dry' contacts (logic operation).

A '5V User' voltage output (terminal 7) is provided for these control modes (see wiring diagrams, page 15).

### Configuration

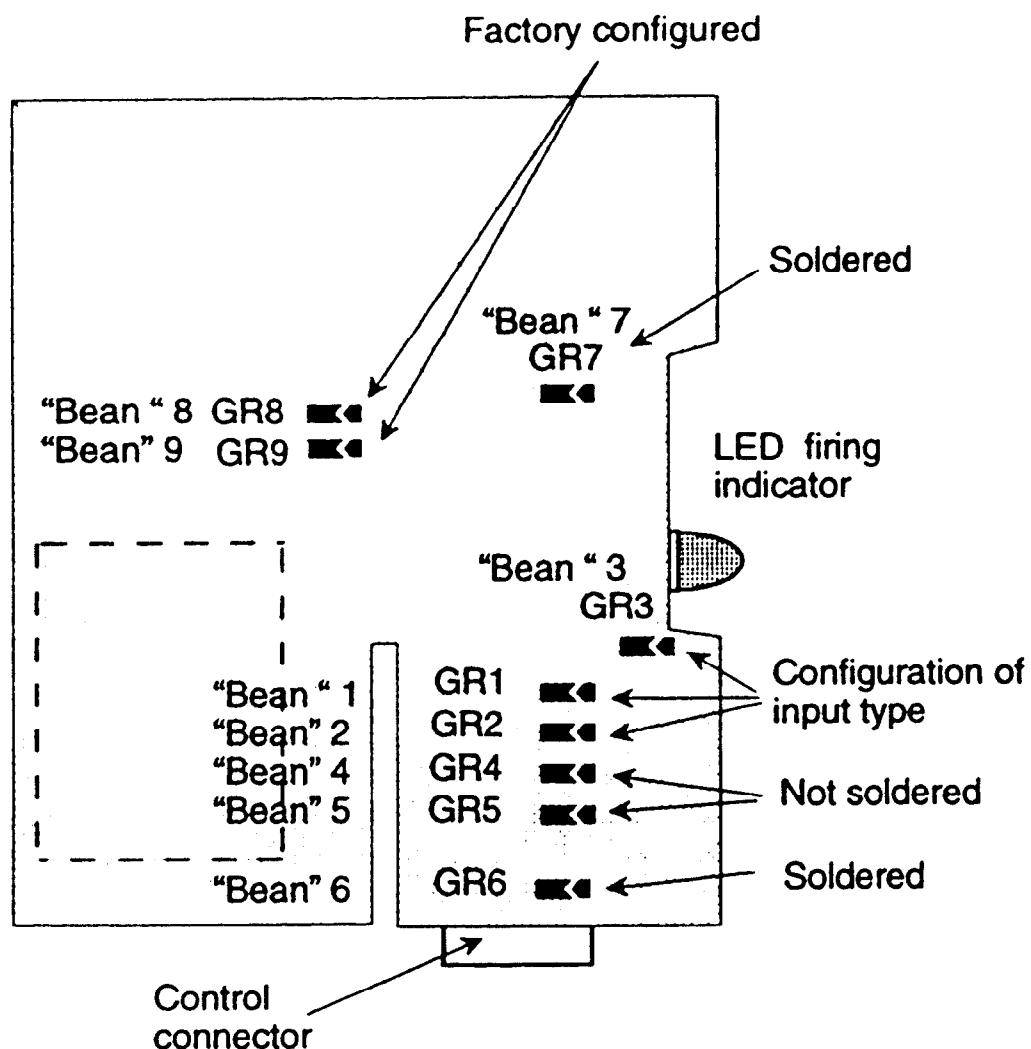
The signal type (voltage or current) and the signal level are configured in the factory by the 'Coffee beans' located on the circuit board (see page 18).

The following table enables the user to check the signal configuration or to re-configure the TE10A if required. In this table, the x denotes the corresponding solder link ('Coffee bean').

| Signal type   | Solder links ( Coffee beans ) |     |     |
|---------------|-------------------------------|-----|-----|
|               | GR1                           | GR2 | GR3 |
| 0 - 10V       |                               |     |     |
| 0 - 5V        |                               | x   |     |
| 4 - 20mA      | x                             | x   | x   |
| Local control |                               | x   |     |

---

## LAYOUT OF CONFIGURATION COFFEE BEANS



Layout of "Coffee beans" on circuit board (solder side view)

GR8 and GR9 'Coffee beans' are configured in the factory

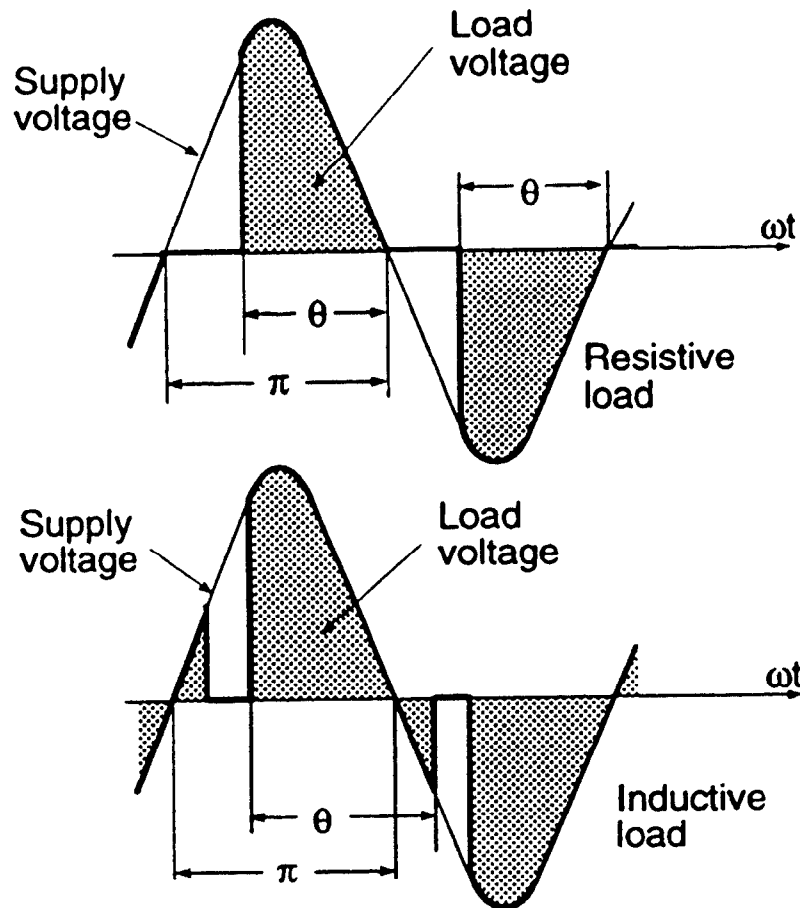
GR6 and GR7 'Coffee beans' are soldered

GR4 and GR5 'Coffee beans' are not soldered

---

## THYRISTOR FIRING MODE

In 'phase angle' thyristor firing mode the power transmitted to the load is controlled by firing the thyristors over part of the supply voltage half cycles.



Load voltage in 'phase angle' firing mode  
( $\theta$ : thyristor firing angle)

---

## **CURRENT LIMIT (OPTION)**

### **Operation**

The TE10A controller features an adjustable rms load current limit.

This function enables the user to limit the load current to a desired value independent of variation in load resistance.

The current limit threshold can be set from 30% to 100% of the nominal current of the controller using the potentiometer labelled 'I LIMIT' on the front facia.

---

## Adjustment

Current limit adjustment is possible if the rms load current is greater than or equal to 30% of the nominal current.

For this adjustment, use a true rms ammeter in order to minimise errors, which could otherwise amount to as much as 50% of the value of the current.

For current limit adjustment, proceed as follows:

- Check that the load circuit is connected
- Turn the potentiometer (labelled 'I LIMIT' on the front facia) 25 complete turns in an anti-clockwise direction (minimum position)
- Apply 0% setpoint to the controller input
- With an 'Auxiliary power supply' option, apply volts to the electronics supply
- Connect the power circuit  
The voltage at the load terminals must be zero
- Set the input signal to 100%  
The load voltage is minimal
- Turn the current limit potentiometer slowly in a clockwise direction and check that the current increases
- Adjust the potentiometer in order to attain the maximum current permitted in the load

---

## **POWER CONTROL**

TE10A/PA controls on the square of the rms load voltage.

Control precision is guaranteed to  $\pm 2\%$  of the maximum voltage.

The power controlled varies linearly from 0% to 100% of maximum power for an input signal variation from 4% to 96% of full scale.

Linearity is better than  $\pm 2\%$  of full scale.

## **COMPENSATION FOR SUPPLY VARIATIONS**

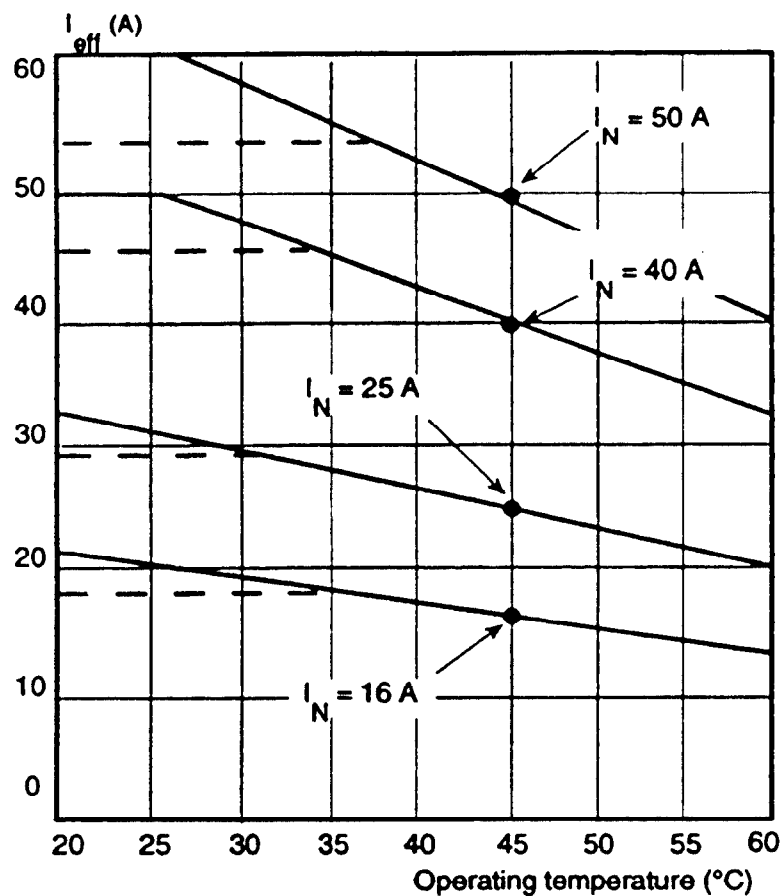
Automatic compensation for supply variations is effective in the voltage range from +10% to -10% of the nominal voltage of the controller.

Control with compensation of mains variations enables constant output power to be maintained for a constant load, despite variations in supply voltage.

Without compensation for supply variations, a reduction, for example, of 10% in supply voltage would result in a reduction of 20% in load power. This variation is less than  $\pm 2\%$  in the TE10A controller.

---

## CURRENT DERATING



Current derating curves as a function of ambient temperature

( $I_N$  = nominal current at  $45^{\circ}\text{C}$ )

Dotted line: limit of recommended fuse

With 'Current limit' option, load current may not exceed around 110% of nominal current of controller.