Power Thyristor Units

425A Series

User
Manual

Part No HA 174778 ENG Issue 1.1 Printed in France 12/97

CE

EUROPEAN DIRECTIVES

CE MARK

The CE Mark of **425A** products implies that the essential protection requirements of the European Low Voltage Directive are observed.

ELECTROMAGNETIC COMPATIBILITY (EMC)

For industrial environments, excluding residential environments

Eurotherm certifies that the **425A** products, when installed and used in accordance with their User Manual, meets the following EMC test standards and enables the system or installation in which there are installed to comply with the EMC Directive in regards to the **425A** products.

EMC STANDARDS

Immunity	Generic Standard	: EN 50082-2
	Test Standards	: EN 61000-4-2, EN 61000-4-4, ENV 50140, ENV 50141
Emissions	Generic Standard	: EN 50081-2 (see filter using)
	Test Standard	: EN 55011
	Product Standard	: IEC1800-3 (without filters)

EMC FILTER USING

To reduce the conducted emissions that occur when using thyristor units, according to the EN 50081-2 standard, the filters hereunder are used.
Eurotherm can supply the external filters.

Nominal current of the 425A	Firing mode and Configuration		
	Phase angle	Burst and Single cycle	
	Single-phase	Single-phase	Three-phase (2 phase control)
15A à 63A	External series filter, code: FILTER/MON/63A/00 or FILTER/MON/25A/00	Internal filter (FILT option)	Internal filter (FILT option). 3 parallel filters, an ordering code : FILTER/PAR/TE10S/00
75A et 100A	External series filter, code: FILTER/MON/100A/00	Internal filter (FILT option)	Internal filter (FILT option). 3 parallel filters, an ordering code : FILTER/PAR/425S/00
125 A	2 external series filters in parallel, a filter code: FILTER/MON/100A/00		

SAFETY

The **425A** products installed and used in accordance with this User Manual are designed to comply with the essential protection requirements of the European Low Voltage Directive 73/23/EEC dated 19/02/73 (amended by Directive 93/68/EEC dated 22/07/93).

VALIDATION BY COMPETENT BODY

Eurotherm has validated the compliance of the **425A** products with EMC test standards through design and laboratory tests that have been validated with a Technical Construction File by a Competent and Notified Body: **LCIE** (Laboratoire Central des Industries Électriques).

CE DECLARATION OF CONFORMITY

A CE Declaration of Conformity is available on request.
For further information on CE Mark, please contact your nearest Eurotherm office.

EMC INSTALLATION GUIDE

In order to help you reduce risks related to the effects of electromagnetic interference depending on the installation of the product, Eurotherm can supply you with the "**EMC Installation Guide**" (Part No. HA 025464).

This guide gives the rules generally applicable for electromagnetic compatibility.

MANUALS IN USE

This 425A User Manual **Part N° HA 174778 ENG** intended for :

- the 425A thyristor units with FILT option manufactured from November 1996
- the 425A thyristor units without FILT option manufactured from December 1995.

The 425A User Manual (Part N° HA 174779) is valid for products without FILT option manufactured from December 1995.

The 425A User Manual (Part N° HA 173705) is valid for products manufactured before December 1995.

PRECAUTIONS

Important precautions and special information are indicated in the manual by two symbols:

WARNING

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

CAUTION

This symbol means that failure to take note of the information may
- **have serious consequences for the installation**
- **result in the incorrect functioning of the power unit.**

These marks must indicate specific points. The entire manual remains applicable.

PERSONNEL

The installation, configuration, commissioning and maintenance of the power unit must only be performed by a person **qualified and authorised to perform work in an industrial low voltage electrical environment.**

INDEPENDENT SAFETY

It is the responsibility of the user and it is highly recommended, given the value of the equipment controlled using 425A, to install **independent safety** devices.
This alarm must be tested regularly.
Eurotherm can supply suitable equipment.

FURTHER INFORMATION

For any further information and if in doubt, please contact your EUROTHERM office where technicians are at your disposal should you require advice or assistance with the commissioning of your installation.

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Chapter 1

IDENTIFYING THE THYRISTOR UNITS

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Chapter 1 IDENTIFYING THE THYRISTOR UNITS

GENERAL INTRODUCTION TO THE 425A SERIES

The **425A** model of the **EUROCUBE 425** range is a **thyristor unit** for electrical power control. It is composed of **two** thyristors mounted in antiparallel for control of a load connected to an AC electrical supply.

The **425A** controls currents between **15 A** and **125 A** at a voltage of **120 Vac** to **500 Vac.**

The controlled loads can be connected between **2 phases (380 Vac - 500 Vac)** or between the **phase** and the **neutral (220 Vac - 240 Vac).**

Depending on the configuration and the supply type two or three **425A** units can be used for **three-phase** loads.

The **425A** thyristor units designed to control :

- an industrial **resistive** loads (loads with low or high temperature coefficients or short wave infrared elements in single-phase or three-phase configuration)
- an industrial **inductive** loads (single-phase configuration only).

The **425A** thyristor units, equipped with a power supply voltage variation compensation system, supply the load (constant resistance) with a **constant power** even if supply voltage changes between **+10%** and **-15%** from nominal voltage.

The control signal is **DC analogue** with the choice :

- of three voltage levels (**0 - 5 V, 0 -10 V** and **1 - 5 V**)
- of four current levels (**0 - 5 mA, 0 - 10 mA, 0 - 20 mA** and **4 - 20 mA**).

The input signal is configured in the factory using 'coffee bean' links on the PC-board according to the user's order.

It is possible to control a **425A** thyristor unit in manual mode using an external potentiometer.

Four thyristor **firing** modes are available:

- **Phase angle -** thyristor firing angle variation
- **Single cycle** (cycle time **40 ms** at 50% power)
- **Fast cycle** (cycle time **320 ms** at 50% power)
- **Slow cycle** (cycle time approximately **10 s** at 50% power).

In the Burst and Single cycle firing modes, the **425A** unit thyristor switching is synchronised with the zero voltages so as not to induce any steep voltage front generating interference on the power supply.

As an option, the current allowed by the load can be controlled using the automatic adjustable threshold **current limit**.

The current limit is set using a potentiometer on the front panel of the unit.

Current limit is only **possible** in Phase angle firing mode.

425A thyristor units are very compact and can be fixed either onto a **DIN rail** or onto a **panel.** The thyristor unit housings can be disconnected mechanically after the electrical connections have been removed.

425A thyristor units offer very easy access for the connection:

- of the power supply line
- of the load
- of the control signal.

The control connector is **plug-in**.

The low level (control) and power cables are separated.

The control electronics are isolated from power and built into a unit in compliance with the standards **IEC 664**.

The heatsink enables heat dissipation by **natural convection** for the **425A** thyristors units up to a nominal current of **75 A**.

From **100 A** nominal current , the **425A** thyristor units are equipped with built-in permanent **fan cooling**. The fan supply (115 Vac or 230 Vac power supply) is provided by the user terminal block, isolated from the power.

For fan-cooled thyristor units, a **temperature safety** switch switches off the thyristor firing circuit in the event of overheating (e.g. fan failure).

The **425A** unit thyristors are protected against over-currents and over-voltages by the high speed fuse (outside the unit) and the internal snubber and varistor.

The fuse and fuse holder assembly must be provided for the by the installer and ordered **separately** at the same time as the **425A**.
The fuse holder is fixed on a **DIN rail**.

TECHNICAL DATA

The 425A is an electrical power thyristor unit designed to control an industrial resistive or inductive load or infrared emitters.

Power

Nominal current	**15 A** to **125 A**
Nominal voltage	**120** to **500 Vac** (+10% - 15%)
Frequency	**50 Hz** or **60 Hz**
Load type	• Resistive with low or high temperature coefficient and short wave infrared elements (single- or three-phase configuration). • Inductive (single-phase configuration only)
Load configuration	Single-phase load in series with thyristor unit. Three-phase load in Star with neutral or in Open delta (three 425A thyristor units). Three-phase load in Star without neutral or Closed delta (a 425A thyristor unit and 425S solid state contactor in 2 phase control).

Thyristor firing

Firing mode	• **Phase angle** (thyristor firing angle variation) • **Fast cycle** (cycle time **320 ms** at 50% power) • **Slow cycle** (cycle time approximately **10 s** at 50% power). • **Single cycle** (cycle time **40 ms** at 50% power)
Crossing	In Burst and Single cycle modes, synchronised with the zero voltage.
Voltage variation compensation	Voltage compensation for supply voltage changes between **+10%** and **-15%** of the nominal voltage. Inhibition below **70%** of the nominal voltage.

CE mark

Electrical safety	The **425A** units have the **CE** mark on the basis of compliance with the essential requirements of the **European Low Voltage Directive 73/23/EEC** (amended by Directive 93/68/EEC)

Electromagnetic compatibility

Immunity	Generic standard	: EN 50082-2
	Test standards	: EN 61000-4-2, EN 61000-4-4, ENV 50140, ENV 50141
Emission	Generic standard	: EN 50081-2
	Test standard	: EN 55011
	Product standard	: IEC 1800-3

Choice of applicable conducted emission standard depends on application
• EN 50081-2 : With filter (see Filter using, page II)
• IEC 1800-3 : Without filter. Applies for the second environment.

Control

Input	DC analogue signal
Signal type	• DC voltage: **0 - 5 V ; 0- 10 V ; 1 - 5 V** • DC current: **0 - 5 mA ; 0 - 10 mA ; 0 - 20 mA ; 4 - 20 mA** Signal type is specified in the thyristor unit order. Control signal isolated from the power.
Manual input	Input impedance **330 kΩ** Input scale **0 - 5 V** or **1 - 5 V**
'+10V' user output	Internal resistance **3.3 kΩ**
'Slave' output	Voltage **+10 V** Max. current **20 mA** Internal resistance **470 Ω**
Power supply variation compensation	On a constant load, the power control is independent of the power supply voltage variations in the range between +10% and -15% of the nominal voltage.

Options

Option CL	Automatic load current limit. Adjustable threshold from 10 to 100% of the thyristor unit nominal current. Available in Phase angle firing mode only.
FILT option	Internal filter and specific PC-board guaranteeing compliance with the EMC test standard for the Single cycle and Burst firing ('slow' or 'fast' cycle) modes. Available in Burst or Single cycle firing mode only.

Environment

Operating temperature	**0 °C** to **50 °C** at a maximum altitude of **2000 m**
Storage temperature	**-10 °C** to **70 °C**
Humidity	**RH** of **5** to **95 %** without condensation
Operating atmosphere	Non-explosive, non-corrosive and non-conducting
Degree of protection	**IP20 (according to IEC 529).**
Thyristor protection	**External** high speed fuse (to be ordered separately), **internal** RC snubber and varistor
Cooling	**Natural** convection, without fan for **15 A** to **75 A** ratings Fan and thermal safety switch for **100 A** and **125 A** ratings.
Consumption	Thyristors : **1.3 W/ A** . Electronics: **2.5 W**. Fan : **9 W** (60 Hz) or **12 W** (50 Hz) at **115 V** **10 W** (60 Hz) or **13 W** (50 Hz) at **230 V**.

CODING

425A power thyristor unit

Model 425A	Nominal current	Nominal voltage	Auxiliary power supply	Input	Firing mode	Options	End 00

Nominal current	Code
15 amperes	15A
25 amperes	25A
40 amperes	40A
63 amperes	63A
75 amperes	75A
100 amperes	100A
125 amperes	125A

Control input		Code
Voltage:	0 - 5 volts	0V5
	1 - 5 volts	1V5
	0 - 10 volts	0V10
Current:	0 - 5 milliamperes	0mA5
	0 - 10 milliamperes	0mA10
	0 - 20 milliamperes	0mA20
	4 - 20 milliamperes	4mA20

Nominal voltage	Code
120 volts	120V
240 volts	240V
440 volts	440V
480 volts	480V
500 volts	500V

Firing mode	Code
Phase angle	PA
Single cycle	FC1
'Fast' cycle	FC
'Slow' cycle	SC

Auxiliary power supply	Code
100 volts	100V
110 to 120 volts	110V120
200 volts	200V
220 to 240 volts	220V240

Options	Code
Current limit (in Phase angle firing mode)	CL
Internal EMC filter (in Burst and Single cycle firing modes)	FILT

Fuse and fuse holder assembly

Code of the fuse and fuse holder assembly	Current code	End 00

Nominal current of thyristor unit	Assembly code	Current code
15 A	FU1038	16A
25 A	FU1038	25A
40 A	FU1451	40A
63 A	FU2258	63A
75 A	FU2258	75A
100 A	FU2760	100A
125 A	FU2760	125A

Coding example

Installation parameters

Load current	**12 A**
Power supply	**400 Vac**
Electronic supply	**230 Vac**
Analogue input signal	**0 -10 Vdc**
Firing mode	**Phase angle**
Option	**Current limit**

Thyristor unit coding

425A / 15A / 440V / 220V240 / 0V10 / PA / CL / 00

Fuse and fuse holder assembly coding

FU1038 / 16A / 00

SERIAL NUMBER LABEL

The serial number label giving all the information on the characteristics of the thyristor unit when it leaves the factory is located at the back of the unit.

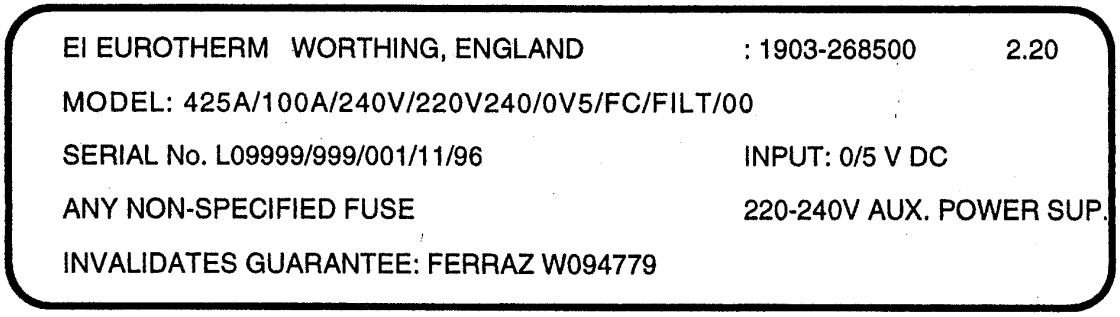

Figure 1-1 Example of a serial number label

Thyristor unit model	**425A**
Nominal current	**100 A**
Nominal voltage	**240 Vac**
Electronic and fan supplies	**230 V**
Input	**0 - 5 V**
Firing mode	**'Fast' cycle**
Option	**EMC internal filter**

Caution !

After a reconfiguration performed by the user, the compliance of the unit with the information resulting from the coding of the unit is no longer guaranteed.

Chapter 2

INSTALLATION

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Chapter 2 INSTALLATION

SAFETY DURING INSTALLATION

Warning !

425A power thyristor units must be installed by a qualified person.

Power thyristor units must be installed in fan-cooled electric cabinets, guaranteeing the absence of condensation and pollution.
The cabinet must be closed and connected to the safety earth in accordance with the standard IEC 364 or the current national standards.

For installations in fan-cooled cabinets, it is recommended to place a fan failure detection device or a thermal safety control in the cabinet.

DIN rail mountings are possible with **425A** series power thyristor units.

The power thyristor units must be mounted with the heatsink positioned vertically and with no obstructions either above or below which could block the passage of the ventilation air.

If multiple units are installed in the same cabinet, they should be arranged in such a way that the air expelled by one unit cannot be admitted into the unit located above it.

Caution !

The 425A power thyristor units are designed to be used at an ambient temperature less than or equal to **50°C** .

When mounting multiple units, leave a minimum vertical space of **10 cm** between two units and a minimum horizontal space of **one cm**.

Excessive overheating of the power thyristor unit may cause incorrect operation of the power thyristor unit, which in turn may cause damage in the components.

DIMENSIONS

The dimensions of the **425A** thyristor units are given in figure 2-1 for models with a nominal current of **15** to **63 A** and in figure 2-2 for models with a nominal current of **75** to **125 A**.

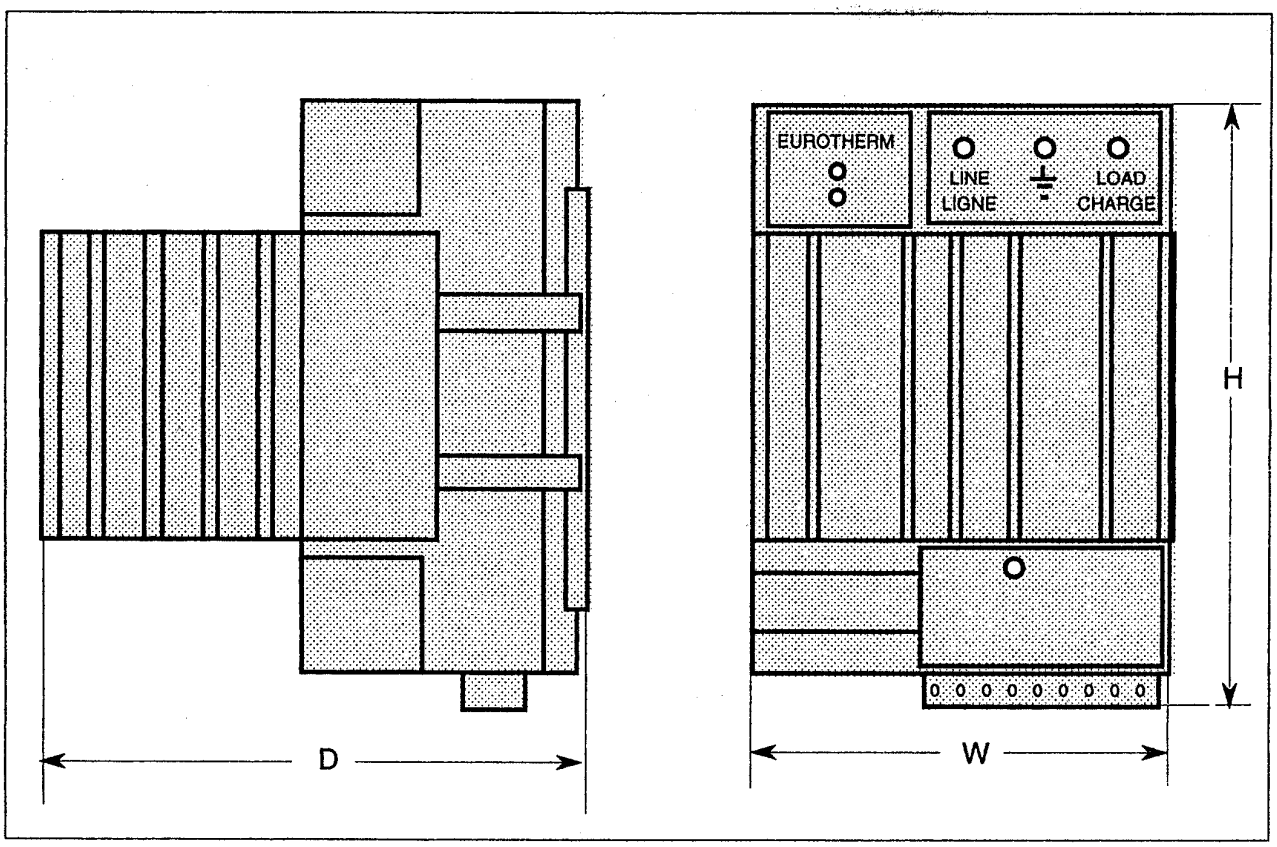

Figure 2-1 425A thyristor unit (15 A to 63 A nominal current)

Dimension (mm) and weight (kg)		Nominal current			
		15 A	**25 A**	**40 A**	**63 A**
Height	(H)	134	134	134	134
Width	(W)	98	98	116	116
Depth	(D)	94	130	155	155
Weight		0.6	0.8	1.1	1.2

Table 2-1 Dimensions and weight of 425A thyristor units (15 A to 63 A nominal current)

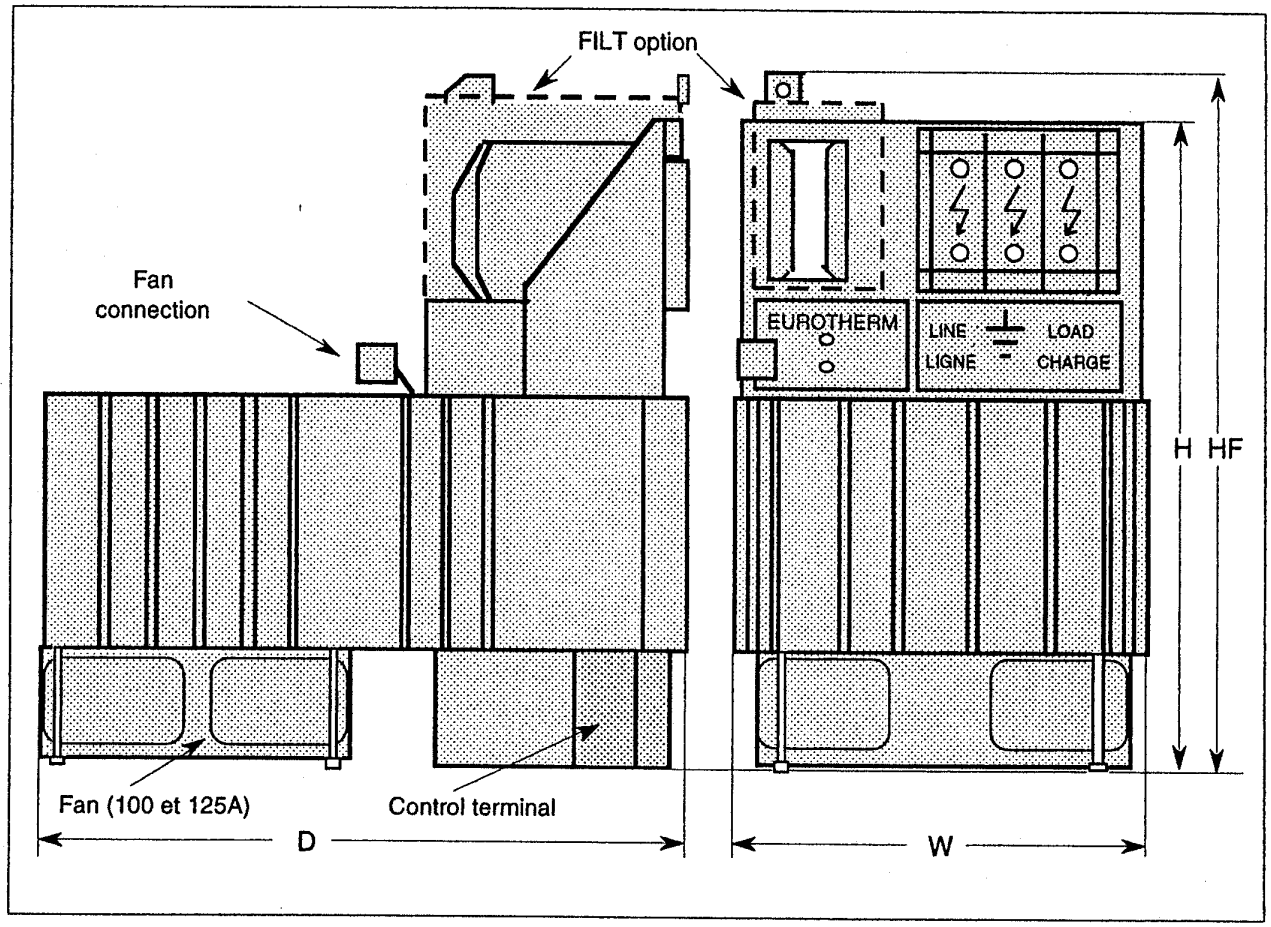

Figure 2-2 Dimensions of a 425A thyristor unit (75 A to 125 A nominal current)
Without fan for the 75 A units

Dimension (mm) and weight (kg)	Nominal current		
	75 A	100 A	125 A
Height (H)	190	190	190
Width (W)	117	117	117
Depth (D)	190	190	190
Weight	1.85	2.0	2.0
Weight (FILT option)	2.1	2.3	2.3

Table 2-2 Dimensions and weight of 425A thyristor units (75 A to 125 A nominal current)

MECHANICAL MOUNTING

Generality

425A thyristor units can be mounted:

- on a panel with its baseplate (fixing plate)
- on DIN rails (requiring a baseplate and clips supplied with the unit).

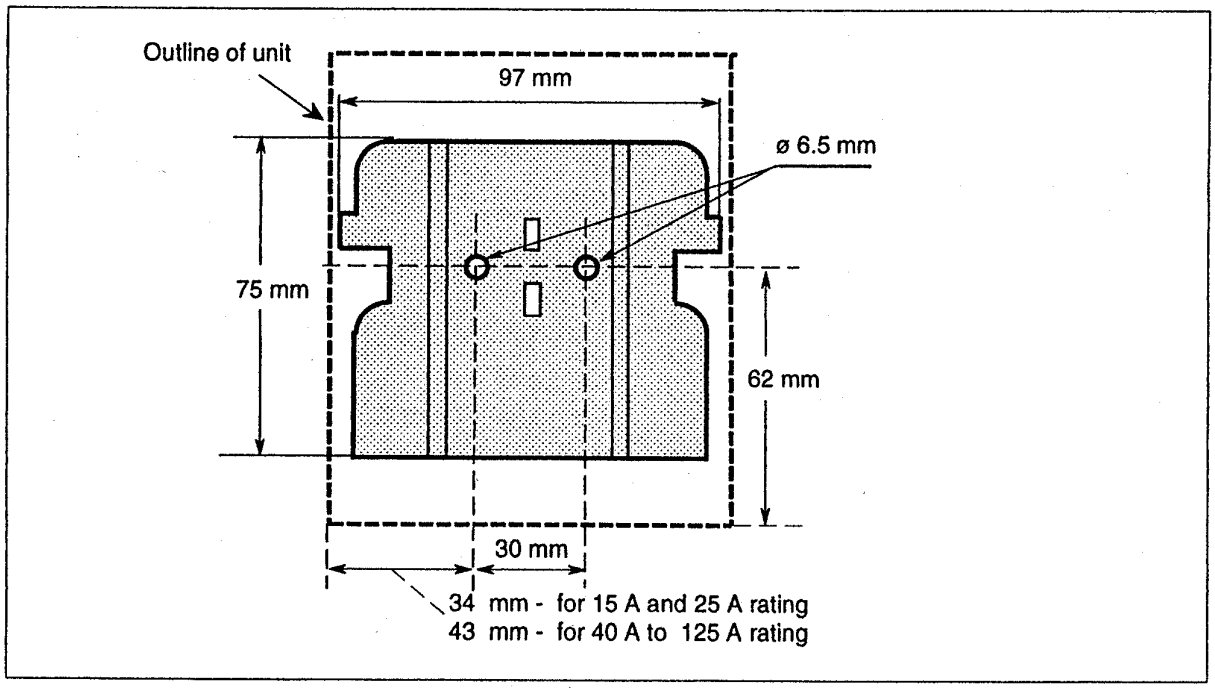

Figure 2-3 Mounting baseplate

The rail is supplied with **6.5 mm diameter** pre-drilled holes.
The length is designed for a **19 inch** assembly.
The DIN rails can be symmetrical or asymmetrical.

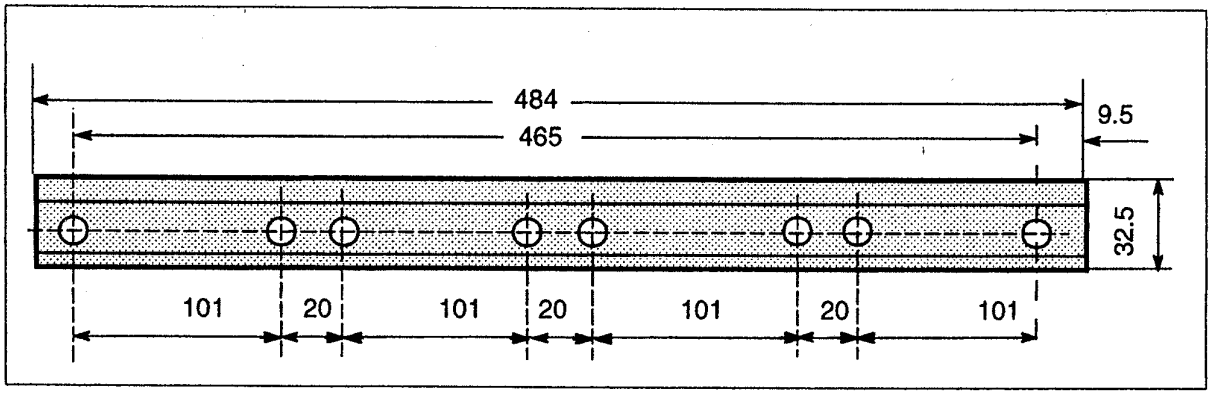

Figure 2-4 DIN rail for fixing

Panel fixing

When fixing on a panel, two holes must be drilled for power thyristor units with a nominal current of **15 A** to **63 A**, and three holes for power thyristor units with a nominal current of **75 A** to **125 A**.

The drilling values for fixing on the panel are given in figure 2-5.

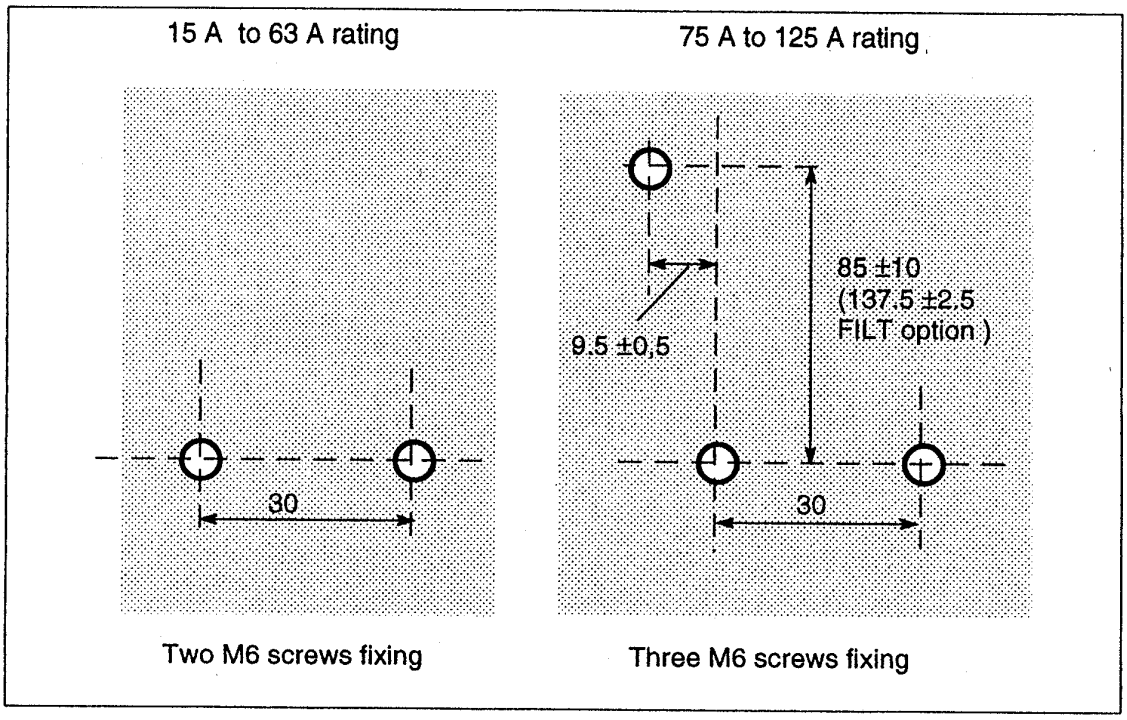

Figure 2-5 Drilling values (mm) for fixing on panel

DIN rail fixing

15 A to 63 A models

The units are mounted using a baseplate (see figure 2-3) and the fixing clips (bi-rail adaptors).

In the standard version, each unit is supplied with a set of two fixing clips (Eurotherm Part No. BD 173730) and screws.

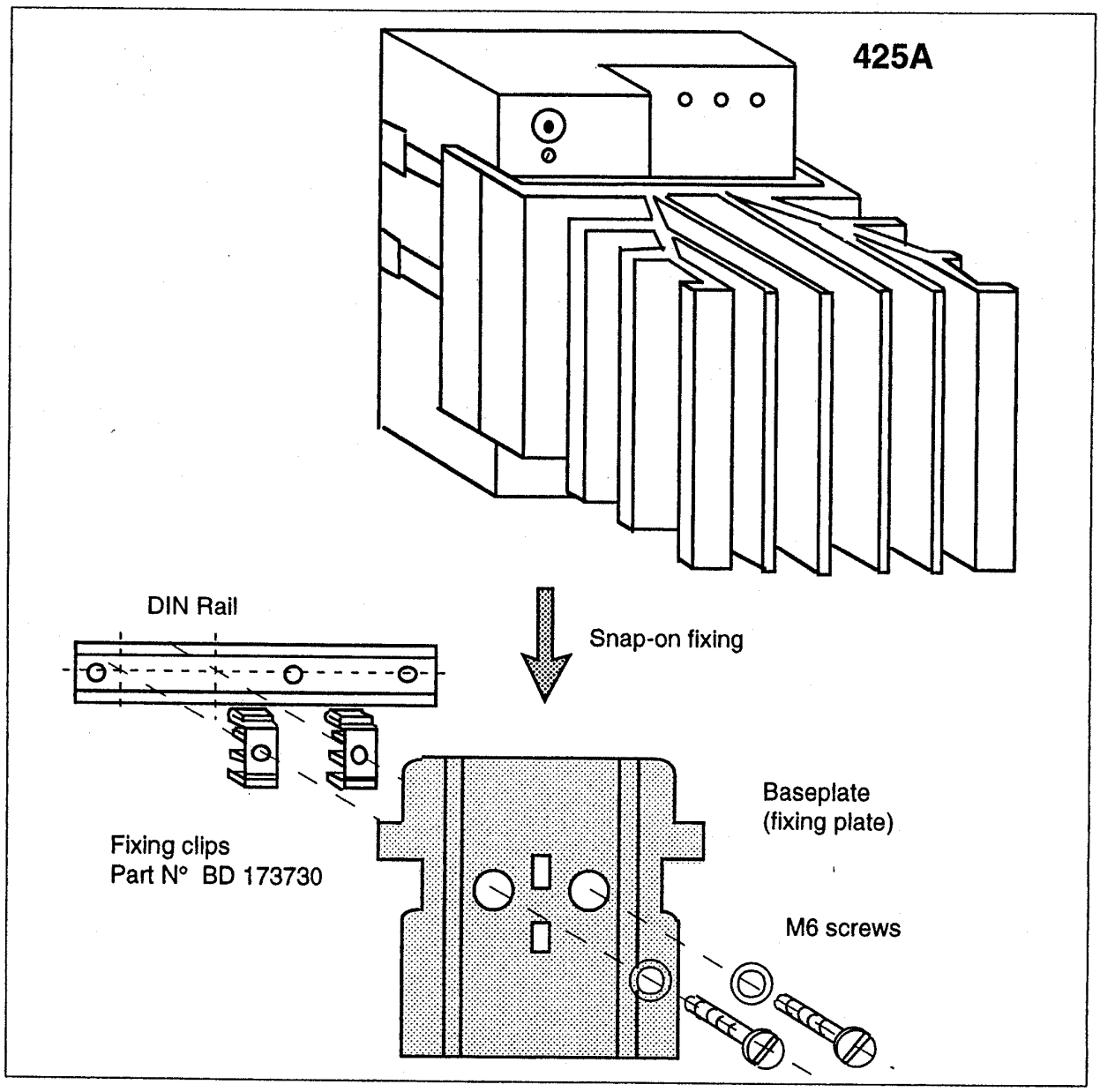

Figure 2-6 Fixing a 425A (15 A to 63 A nominal current)

75 A to 125 A models

Each unit is mounted on two DIN rails using a baseplate and three fixing clips (Eurotherm Part No. BD 173730).

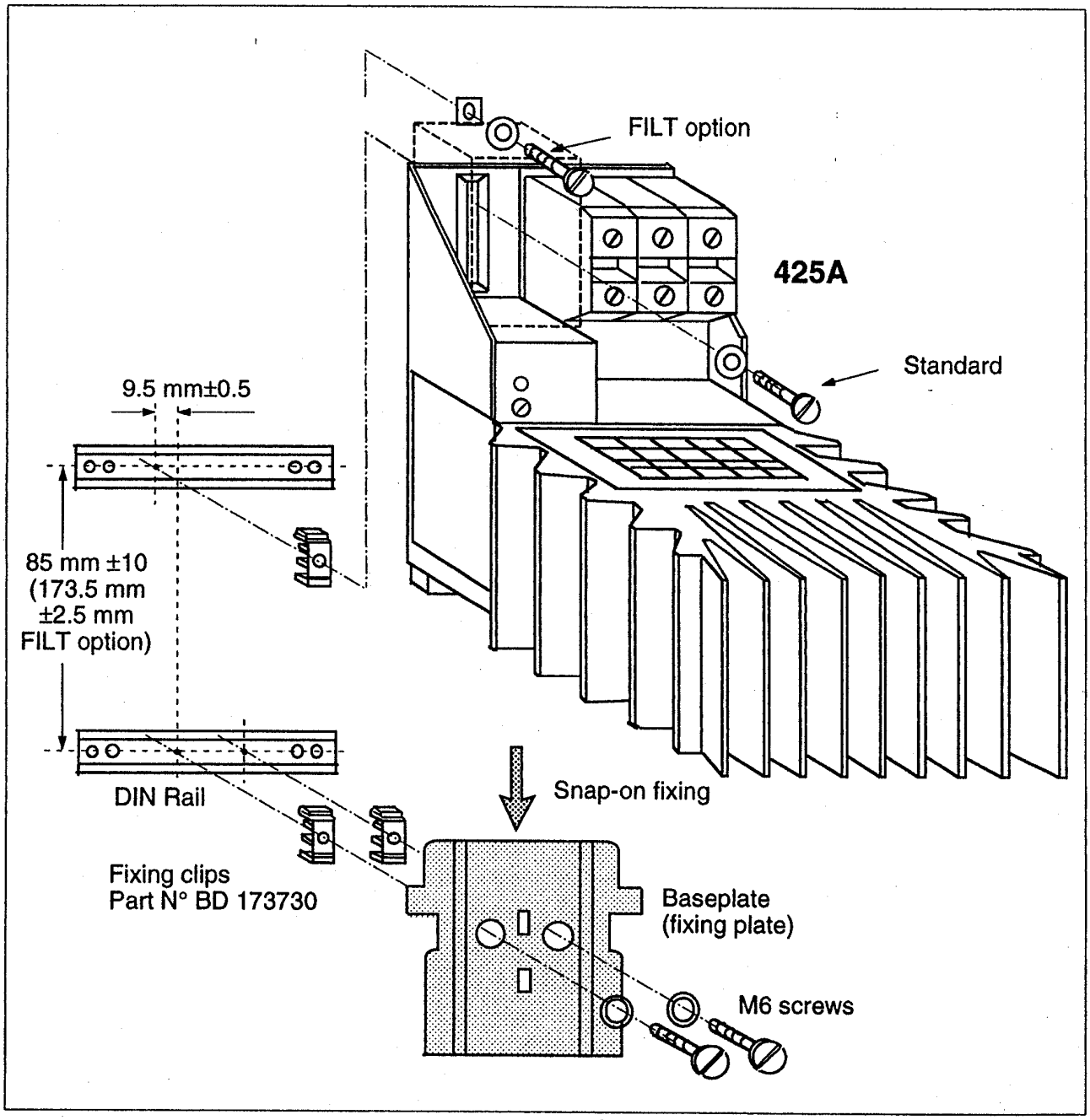

Figure 2-7 Fixing a 425A (75 A to 125 A nominal current)

Chapter 3

WIRING

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Chapter 3 WIRING

SAFETY DURING WIRING

Warning !

- Wiring must be performed by personnel who are qualified to work in an industrial low voltage electrical environment.
- It is the user's responsibility to wire and protect the installation in accordance with current professional standards.
  A suitable device guaranteeing electrical separation of the equipment and the power supply must be installed in order to perform the operation in complete safety.
- Before any connection or disconnection, make sure that the power and control cables and wires are isolated from the voltage sources.
- For safety reasons, the safety earth cable must be connected before any other connection during wiring and the last cable to be disconnected during disassembly.

The **safety earth** is connected to the screw located on the front panel of the unit and labelled as follows:

Caution !

To guarantee the correct grounding of the 425A unit, make sure that the attachment is on the **reference ground surface** (panel or bulkhead).
Failing this, it is necessary to add a ground connection of at **most 10 cm** between the earth connection and reference ground surface.

Warning !

This connection which is intended to guarantee correct **ground conduction, can never** be used to **replace** the **safety earth** connection.

TERMINAL LABELLING

The labelling of the 425A thyristor unit terminals is shown in the two figures below according to the value of the electronic supply and the value of the nominal current.

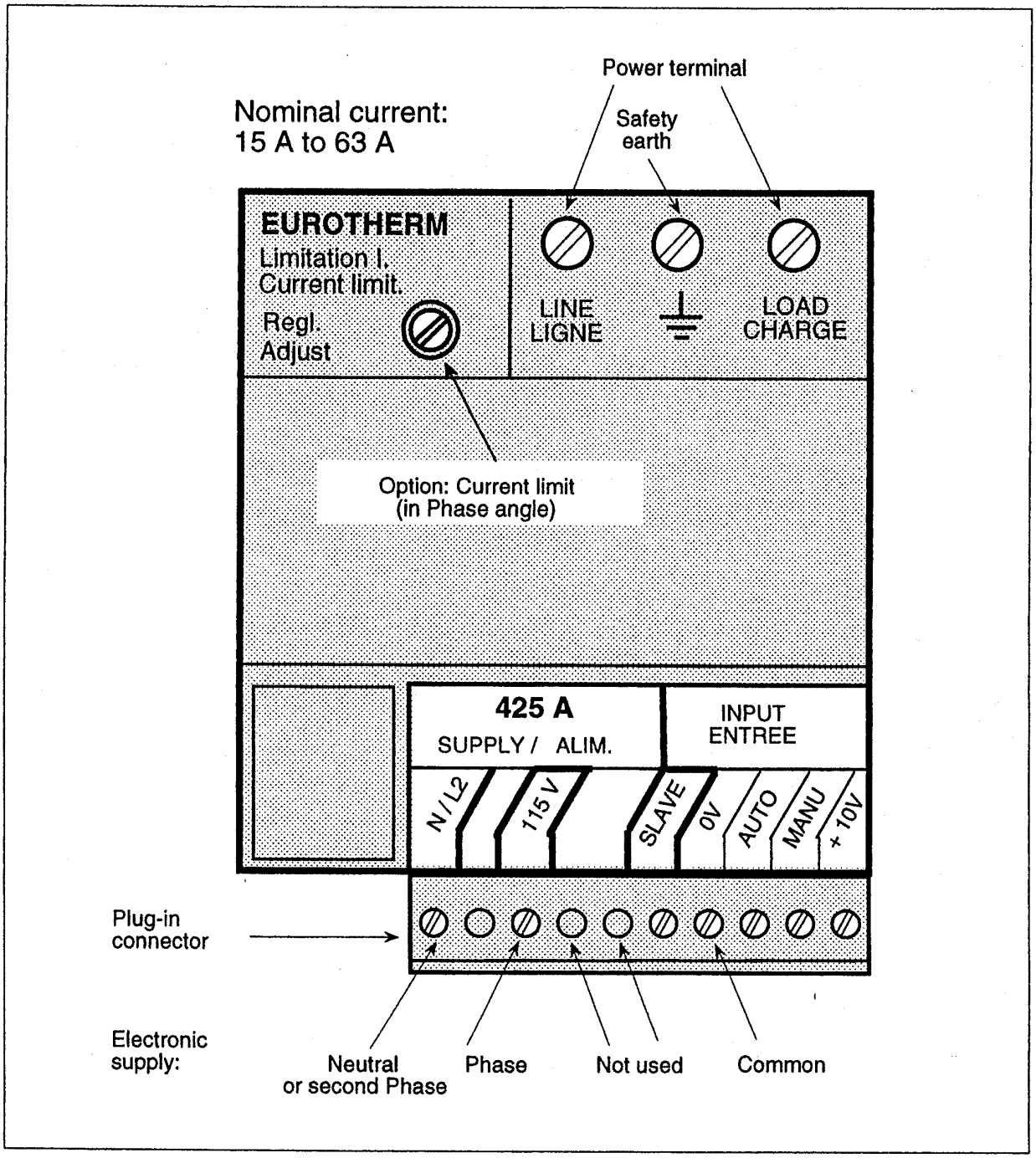

Figure 3-1 425A terminal labelling (15 A to 63 A ratings)
(Same control terminals for 75 A to 125 A units)

Example: 115 V electronic supply voltage; 'Current limit' option

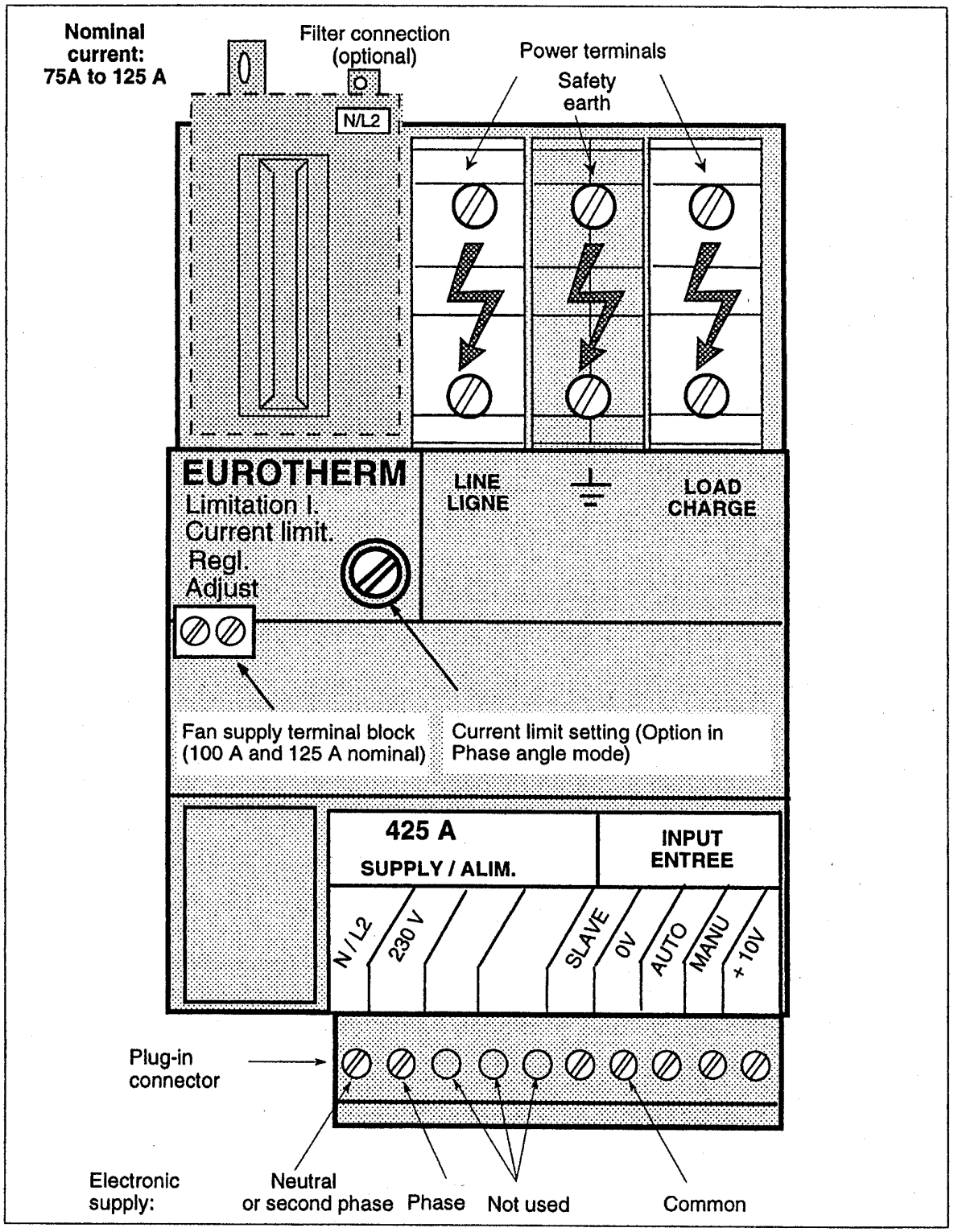

Figure 3-2 425A terminal labelling (75 A to 125 A ratings)
(Same control terminals for 15 A to 63 A 425A units)

Example: 230 V electronic supply voltage; 'Current limit' option

CABLING

Control and auxiliary power supply:

Plug-in terminal block, **0.5** to **2.5 mm²** wires
Terminal tightening: **0.7 Nm**

Filter connection (FILT option)

Screw terminal, **0.5** to **2.5 mm²** wires
Tightening: **0.7 Nm**

Fan (100 A and 125 A ratings):

Screw terminal. **0.5** to **2.5 mm²** wires
Tightening: **0.7 Nm**

Power and safety earth

Screw terminals

- 15 to 40 A **1.5** to **6 mm²** cables (10 mm² rigid with a lug)
  tightening: **1.2 Nm**
- 63 A **1.5** to **10 mm²** cables (16 mm² rigid with a lug)
  tightening: **1.2 Nm**
- 75 to 125 A **2.5** to **35 mm²** cables (flexible wires)
  tightening: **3.5 Nm**
  2.5 to **50 mm²** cables (rigid wires)
  tightening: **3.5 Nm** (for **50 mm²**: **4.7 Nm**)

GENERAL

There are two possible ways to control the thyristor unit:

- with a signal from a EUROTHERM controller or another suitable device ('**AUTO**' operating mode)
- with a voltage from an external potentiometer ('**MANU**' operating mode).

Caution !

The line protection and main circuit breaker (fuse isolator, circuit breaker or contactor, etc.) must be provided for by the user.

The external high speed fuse is designed to protect the unit's thyristors. The 'Fuse - fuse holder' assembly is to be ordered separately.

The fuse holder supplied with a thyristor unit can be used as a fuse isolator. However, as with all fuse isolators, it cannot be opened on-load.

At power-up, the electronic supply must be available after or at the same time as the load supply voltage.

When the unit is switched off, the electronic supply must be switched off before or at the same time as the load supply voltage.

Caution !

The power circuit and the electronics of the thyristor unit must be connected on the same phases.

For voltages greater than **230 V**, use a step-down transformer for the power supply (see examples on pages 3-12, 3-15, 3-17, 3-18).

The electronic supply in a line-to-line connection of the **400 V** power supply requires the use of the **400 V/230 V** external transformer (**70 VA**, Eurotherm Part No.: **CO 173562**).

The length of the wires between the 425A and the step-down transformer should not exceed **3 m.**

The same transformer can be used for the fan supply (100 A and 125 A ratings) for power supplies greater than 240 V.

EMC FILTER CONNECTION

To guarantee compliance with the standard EN 50081-2 (conducted emission), the EMC filters must be connected in series or in parallel depending on the application (see Filter using, page II).

Single-phase load

'Phase angle' firing mode

Compliance with the EMC test standard is guaranteed by connecting the single-phase filter in series with the 425A thyristor unit. The assembly and connection of EMC serial filters are described in the Installation instructions of the following single-phase filters:

25 A : HA 175306 ENG
63 A : HA 175375 ENG
100 A : HA 175307 ENG.

'Burst' firing mode

Compliance is guaranteed by an internal filter using the FILT option.

Three-phase load in Star with neutral or Open delta

A three-phase connected in Star with neutral (4-wire connection) and in Open delta (6-wire connection) can be considered as 3 independent single-phase loads.

'Phase angle' firing mode

Compliance with the EMC test standard is guaranteed by connecting a single-phase filter in series with **each** 425A thyristor unit (see above).

To reduce costs in 6-wire connections, it is possible to connect a three-phase filter between the power supply and the 'thyristor units - three-phase load' assembly. The assembly and connection of three-phase serial filters are described in the following Installation instructions:

63 A : HA 175192 ENG
100 A : HA 175305 ENG.

'Burst' firing mode

Compliance with the EMC test standard is guaranteed by an internal filter using the FILT option.

Three-phase load in 2 phase control

A three-phase load connected in Star with neutral or in Open delta (3-wire connection) can be controlled by two thyristor units (2 phase control) in **'Burst'** firing mode.
Compliance with the EMC test standard is guaranteed by the FILT option and by adding 3 parallel filters connected between the 3 phases of the power supply.

AUXILIARY AND FAN SUPPLIES

The auxiliary power supply, specified in the order, is used for the electronic supply.
It is connected between the user terminals labelled '230V' (or '115V) and 'N/L2'.

The fan supply (for the 100 and 125 A ratings) must be connected to a power supply of the same voltage value as the auxiliary power supply specified in the order.

Although the fan supply is isolated from the electronic supply, the same coding field ('Auxiliary power supply' field) determines the same voltage value .

Two terminals (indicating the specified voltage value: '115 V' or '240 V') are provided on the front panel of the thyristor unit for the fan supply.

The auxiliary and fan supplies must correspond to the specifications below.

- 115 V nominal:

  Range: 100 V to 130 V. Code 110V120
  Electronic consumption 2.5 W;
  Fan consumption 12 W (50 Hz) and 9 W (60 Hz).

- 230 V nominal (240 V on the fan label):

  Range: 200 V to 260 V. Code 220V240
  Electronic consumption 2.5 W;
  Fan consumption 13 W (50 Hz) and 10 W (60 Hz).

EXAMPLES OF SINGLE-PHASE WIRING DIAGRAMS

The thyristor unit controlles the **resistive** or **inductive** load. The 425A can be connected between the phases of the power supply or between phase and neutral, depending on the nominal voltage and the power supply used. The input signal is an analogue DC voltage or DC current signal.

The pages below give examples of complete 425A thyristor unit wiring diagrams, explaining all the specific single-phase connection features for various thyristor unit ratings.

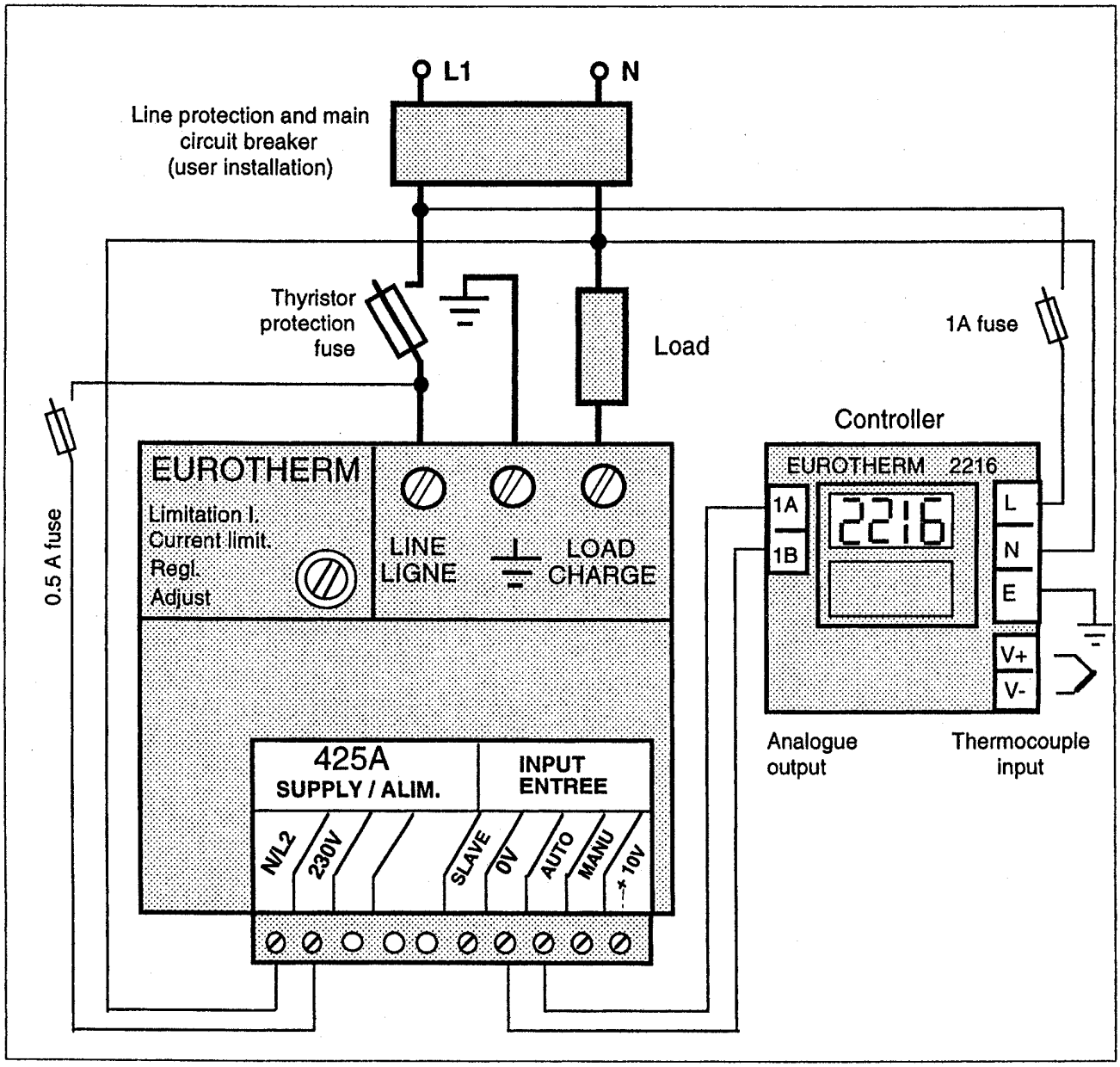

Figure 3-3 Example of 425A wiring diagram. Control by a EUROTHERM 2216 controller. 15 A to 63 A ratings. Voltage between phase and neutral 230 V. 'AUTO' control mode.

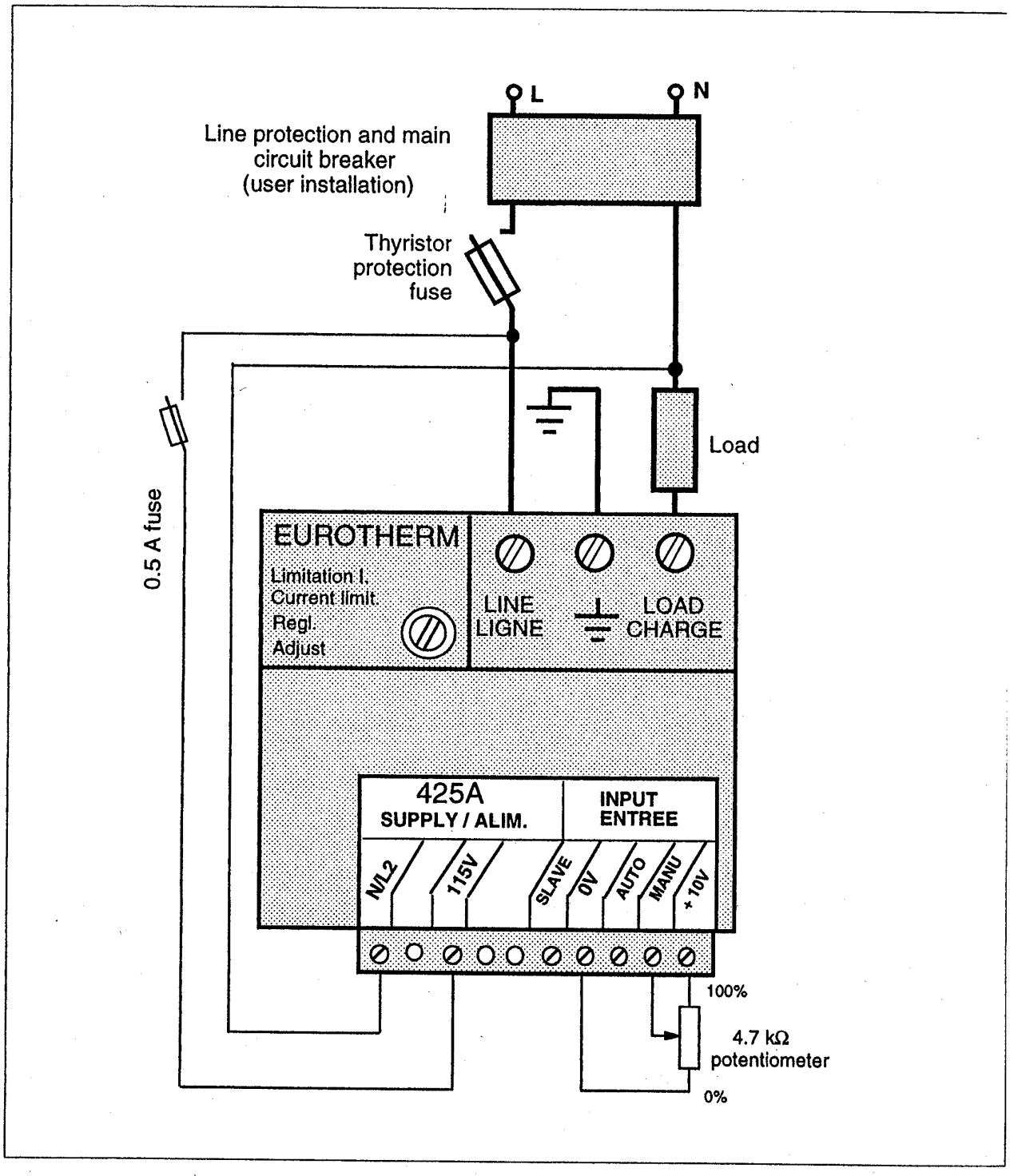

Figure 3-4 Example of 425A wiring diagram. 15 A to 63 A ratings. 115 V supply voltage between phase and neutral. Manual control

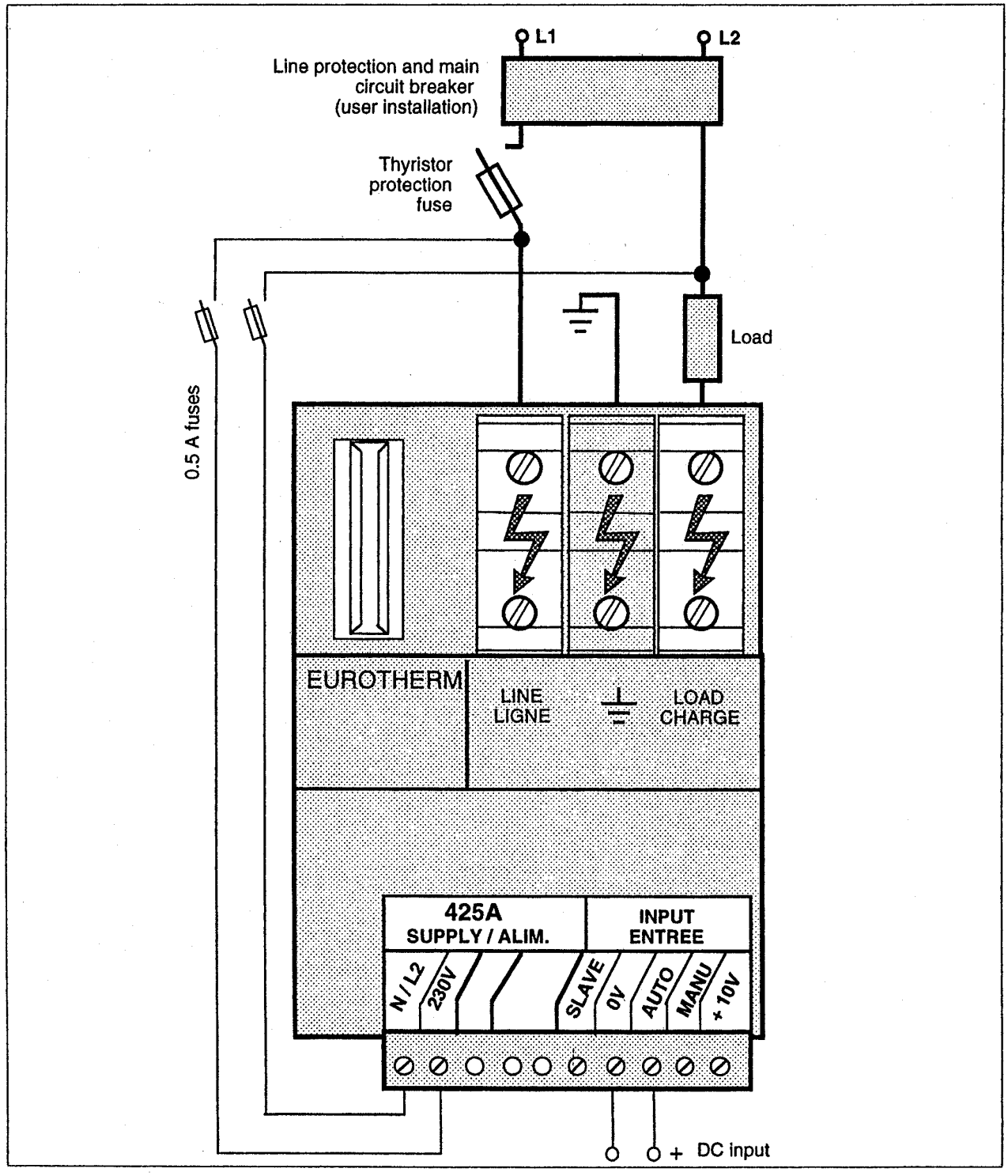

Figure 3-5 Example of 425A wiring diagram. 75 A rating.
Without fan and without FILT option.
230 V line-to-line voltage
'AUTO' control mode.

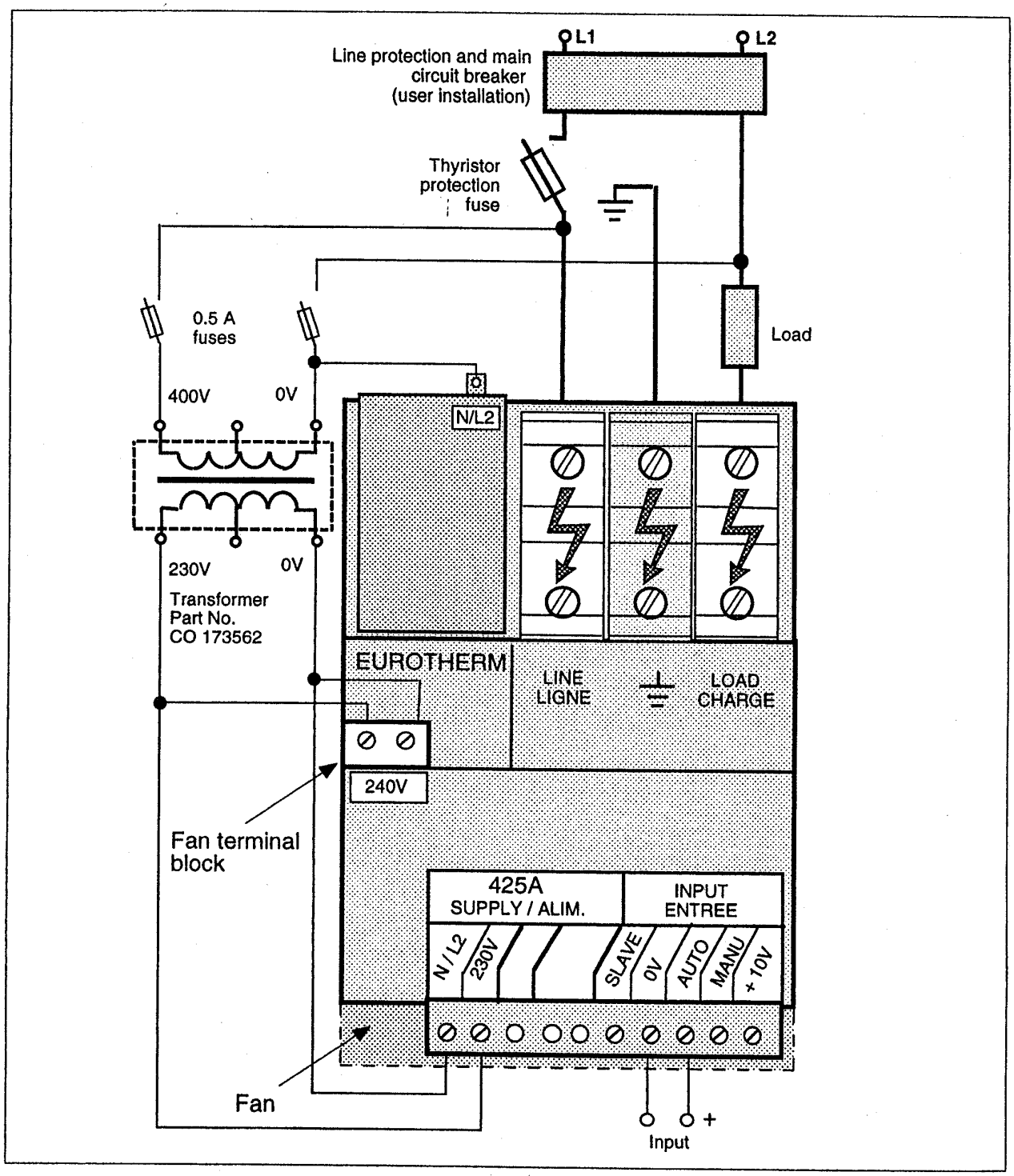

Figure 3-6 Example of 425A with FILT option wiring diagram. 100 A or 125 A ratings. 400 V line-to-line voltage. Permanent fan cooling, 230 V fan supply. 'AUTO' control mode.

EXAMPLES OF THREE-PHASE WIRING DIAGRAMS

General

Although 425A thyristor units are single-phase units, they can be used to control:

- resistive three-phase loads
- short wave infrared elements in 'Phase angle' mode.

Caution !

The electronics of each 425A thyristor unit must be powered by a voltage which is in phase with the thyristor unit power voltage.

All voltages greater than **240 V** require the use of a transformer for the electronic supply. (Eurotherm Part No.: **CO 173562**).
In 2 phase control, the primary circuit of the transformer must be connected between the phase controlled by the 425A and the direct phase.
The wire length between the 425A and the transformer must not exceed 3 m.

The pages below give examples of complete thyristor unit wiring diagrams, explaining all the specific three-phase connection features for various thyristor unit ratings.

'Phase angle' firing

(with, if applicable, current limit)

In 'Phase angle' thyristor firing mode, the three-phase loads can be connected in star with neutral (4 wires) or in open delta (6 wires).

Caution !

With a load with a high temperature coefficient (short wave infrared elements, molybdenum, etc.), the neutral current in the 4-wire connection can reach values 1.7 times greater than the line currents, even with a balanced three-phase load.

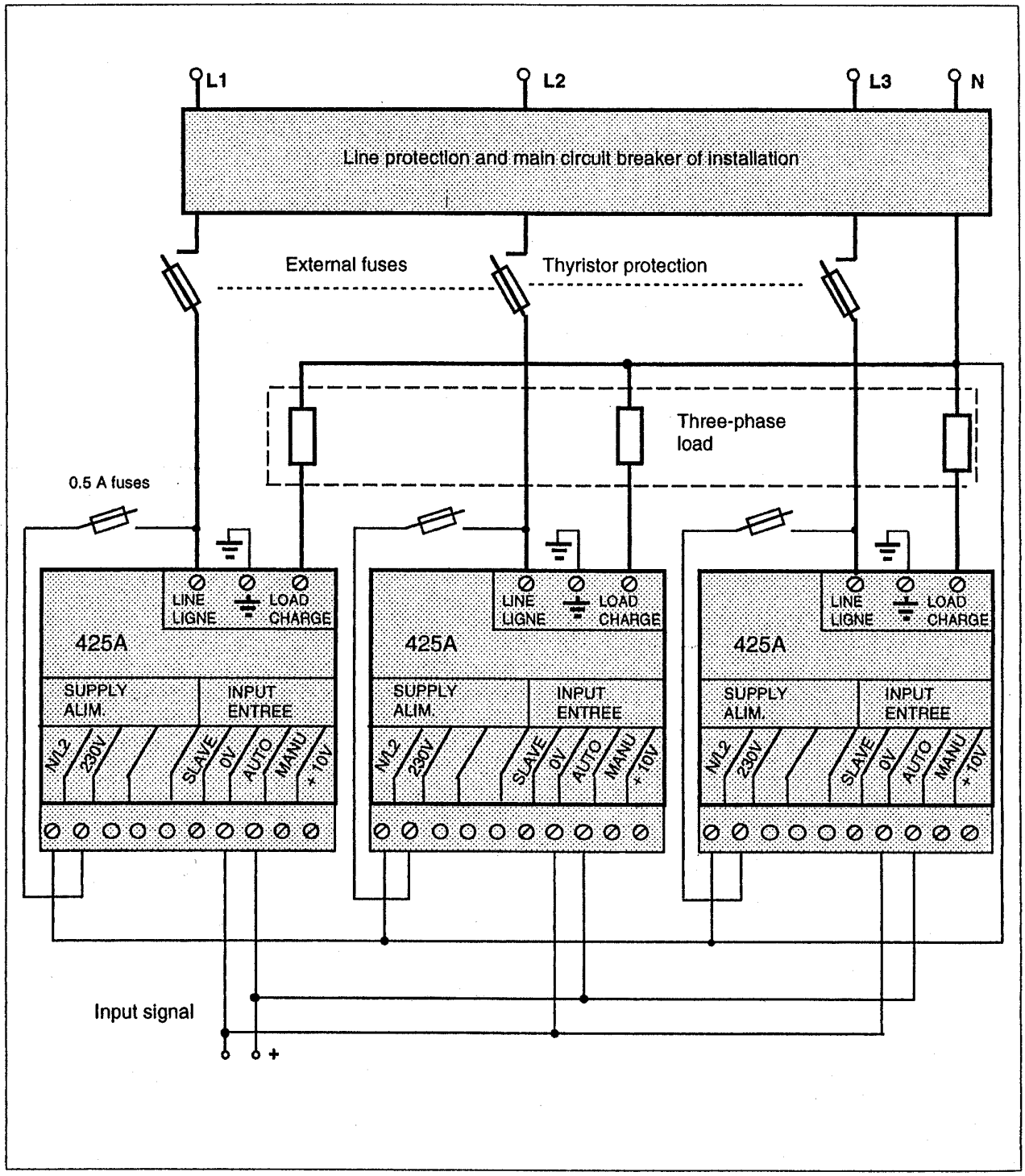

Figure 3-7 Example of three 425A units wiring diagram (15 A to 63 A ratings).
Three-phase load in Star with neutral (increase in neutral current possible, see p.3-13).
230 V power supply. Voltage inputs.
'Phase angle' firing mode.

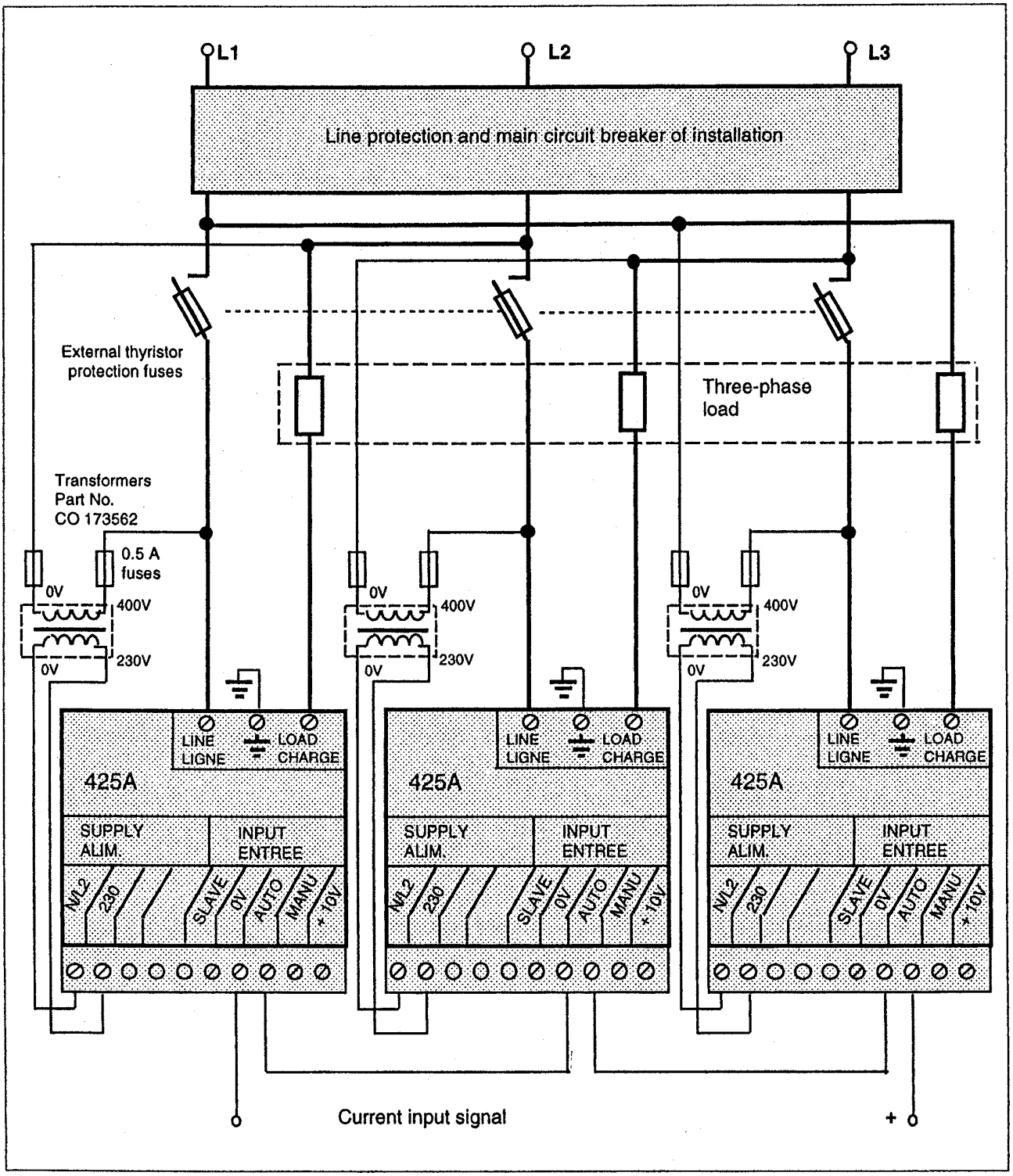

Figure 3-8 Example of three 425A units wiring diagram (15 A to 63 A ratings). 400 V line-to-line power supply. Three-phase load in Open delta. Current inputs. 'Phase angle' firing mode.

'Burst mode' firing

In Burst and Single cycle firing modes, the following three-phase connections are possible:

- star with neutral (4 wires)
- open delta (6 wires)
- star without neutral or closed delta (2 phase control).

In the FILT option, an internal filter and a specific PC-board guarantee compliance with the EMC test standard for the Single cycle and Burst firing modes ('fast' or 'slow' cycle).

Star with neutral (4 wires)

Recommended solution: A 425A thyristor unit ('Master') with a 'Slave' logic output which drives two 425S solid state contactors equipped with the PLF detection option.
In this case, the firing of the units is simultaneous.

Open delta (6 wires)

Possible solutions:

- Three 425A thyristor units driven by the same control signal (inputs in parallel for a voltage signal; inputs in series for a current signal).
  The firing of the three 425A thyristor units is not simultaneous, but randomly distributed over time.

- A 425A thyristor unit ('Master') with a 'Slave" output which drives two 425S solid state contactors equipped with the PLF detection option.
  The firing of the 3 thyristor units is simultaneous.
  It is possible to use the '20 mA =' solid state contactor inputs mounted in series and the voltage inputs mounted in parallel.

Star without neutral or Closed delta (2 phase control)

Possible solutions:

- A 425A thyristor unit ('Master') with a 'Slave' solid state output which drives one 425S solid state contactor.

- An MC425A control electronic unit controlled by the analogue input signal with a 'Slave' output which drives two 425S solid state contactors (possibly equipped with the PLF detection option).

  To improve the sensitivity of the partial load failure (PLF) detection in the direct phase, with no solid state contactors, a type 429 PLF detection module can be used.

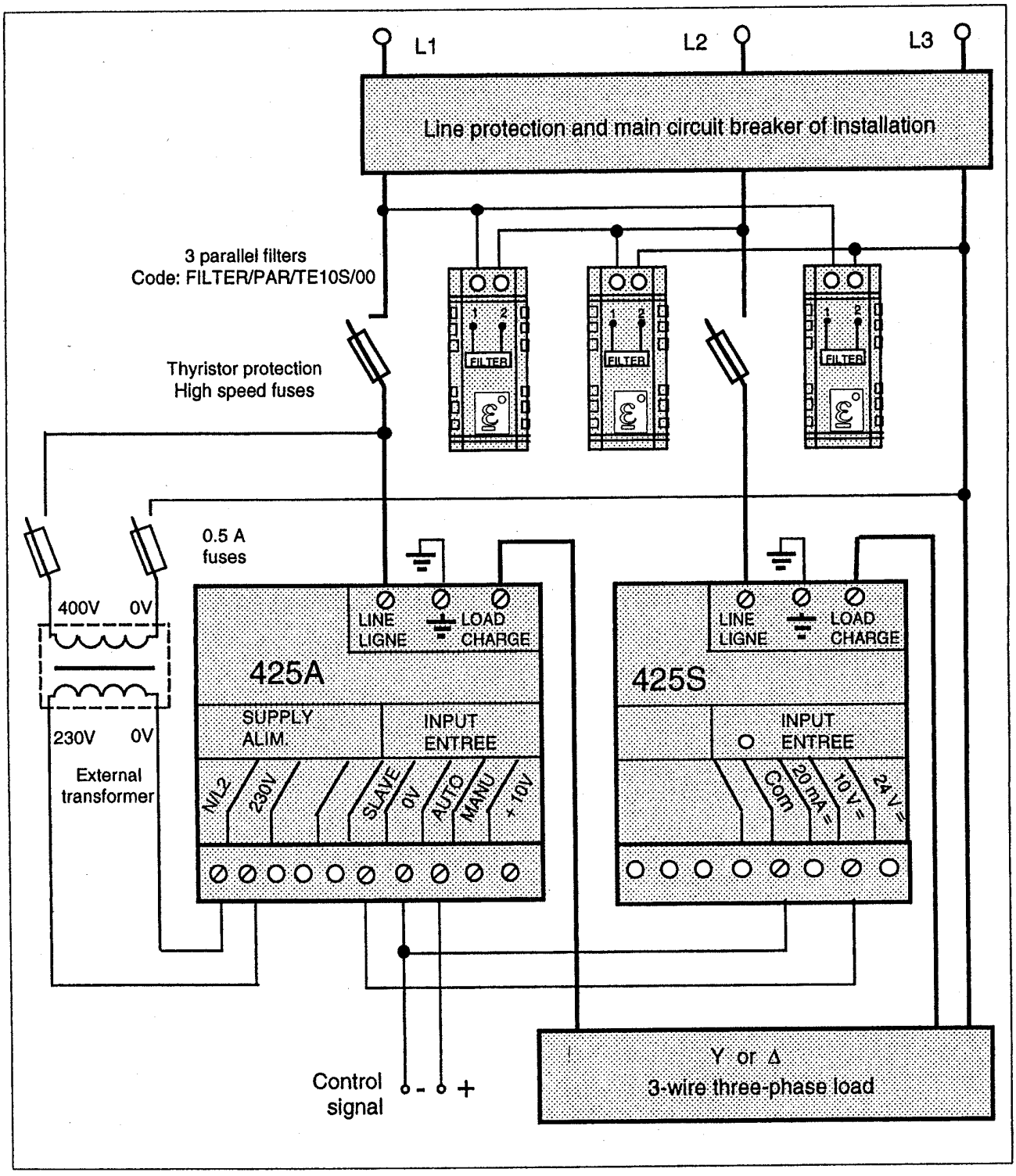

Figure 3-9 Example of 425A and 425S two phase control wiring diagram.
15 A to 63 A ratings. 400 V power supply (use of step-down transformer)
'Master-Slave' connection. Load in Star without Neutral or Closed delta.
'Burst' firing mode (slow or fast cycle).

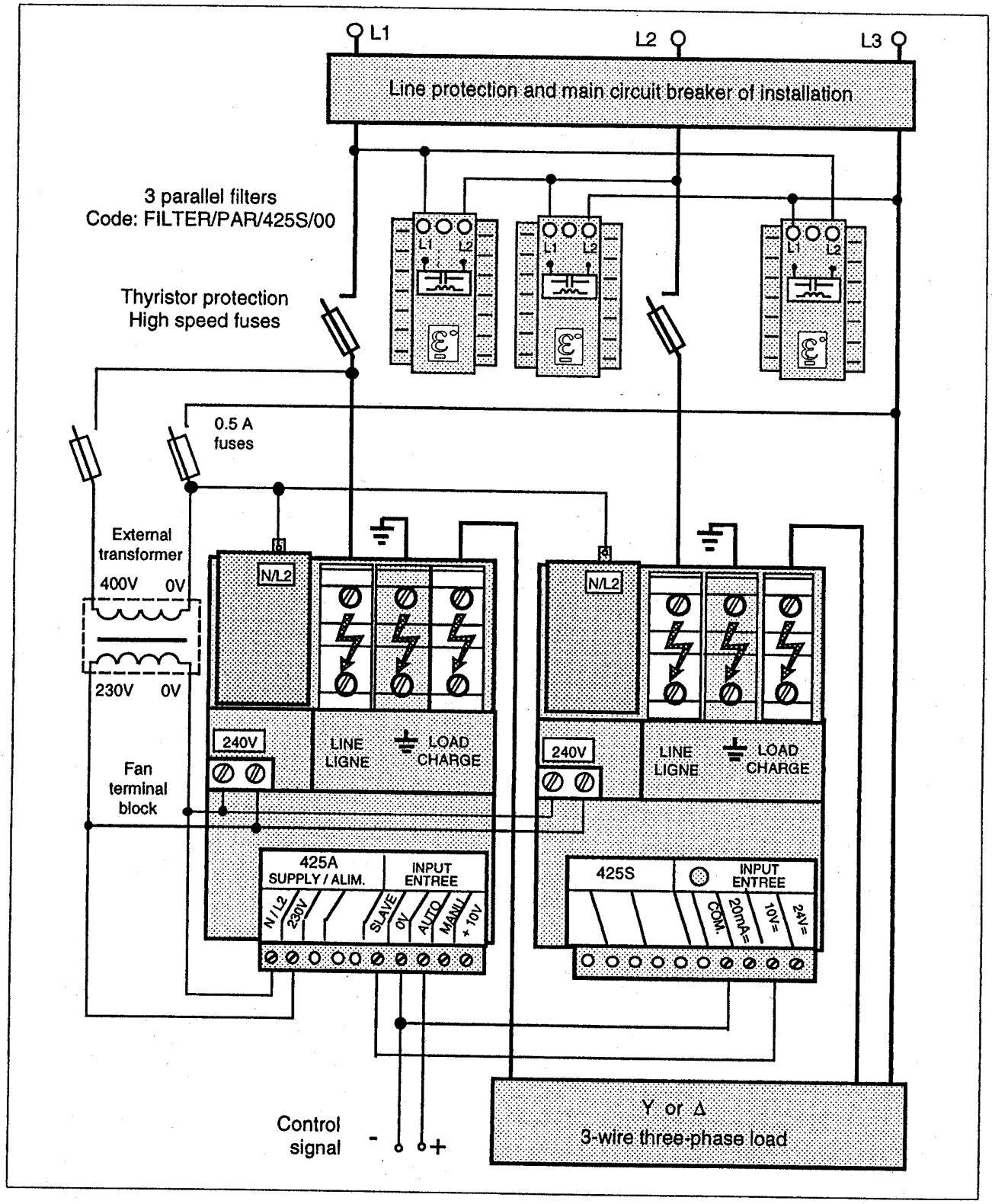

Figure 3-10 Example of 425A and 425S two phase control wiring diagram.
100 A or 125 A ratings. FILT option
400 V power supply (use of step-down transformer, part No. CO 173562)
'Master-Slave' connection. Load in Star without Neutral or Closed delta.
'Burst' firing mode (slow or fast cycle).

Chapter 4

CONFIGURATION

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Chapter 4 CONFIGURATION

SAFETY DURING CONFIGURATION

The thyristor unit is configured using **'coffee bean'** type soldered **links**.

Important

The thyristor unit is supplied fully configured according to the code on the identification label.

This chapter is included in order to

- **check** that the configuration is compatible with the application, or
- **modify,** if necessary, certain characteristics of the thyristor unit on-site.

Warning !

For safety reasons, the reconfiguration of the unit must be performed with the unit **switched off** and by qualified personnel only.

Before starting the reconfiguration procedure, check that the thyristor unit is isolated and that an untimely power-up is impossible.

After the reconfiguration of the unit on-site, correct the codes on the identification label to avoid any possible confusion and maintenance problems at a later date.

THYRISTOR FIRING MODES

General

The **425A** thyristor units have four thyristor firing modes:

- Phase angle
- 'Fast' cycle,
- 'Slow' cycle
- Single cycle.

The firing mode is preselected in the factory according to the thyristor unit order code.

'Phase angle' mode

In '**Phase angle**' mode, the power transmitted to the load is controlled by firing the thyristors for a part of the power supply voltage half-cycle (figure 4-1).

The **thyristor firing angle** (Θ) varies in the same direction as the input signal with the thyristor unit control system.

The power transmitted to the load is proportional to the input signal but is not a linear function of the firing angle.

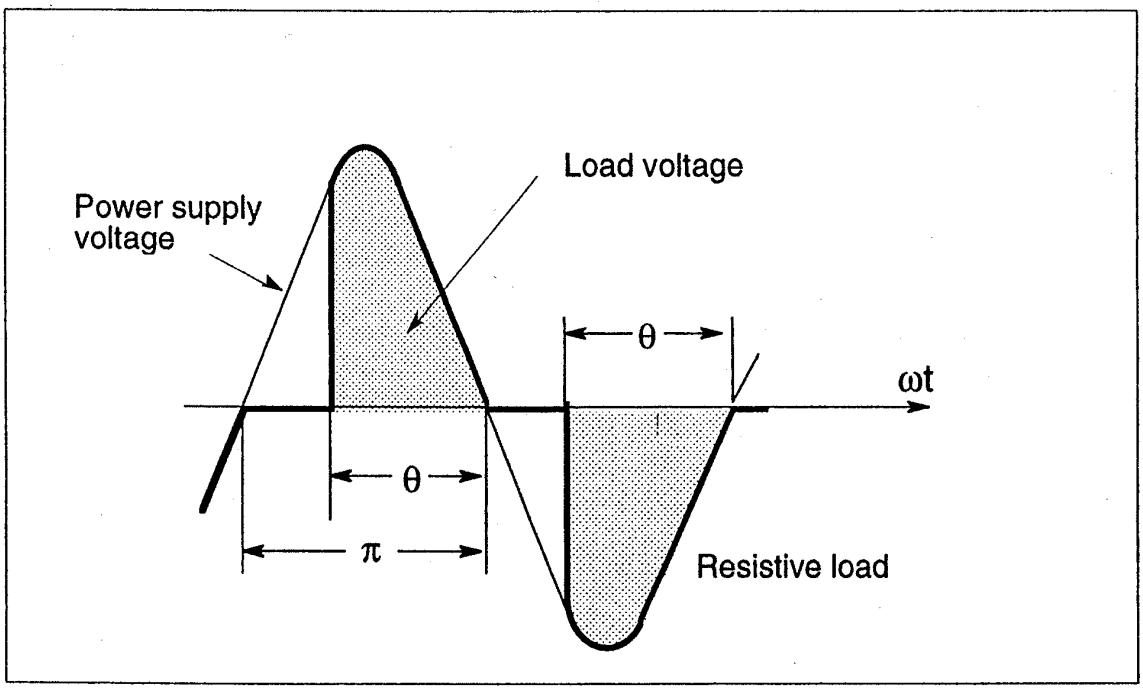

Figure 4-1 'Phase angle' firing mode

'Burst firing' mode

The '**Burst firing**' mode is a **proportional cycle** which consists of supplying a series of **complete** power supply voltage **cycles** to the load.

Thyristor firing and non-firing are synchronised with the power supply and are performed **at zero voltage** for a resistive load.

This firing eliminates the steep fronts of the power supply voltage applied to the load, **does not produce interference** on the power supply and, in particular, prevents the generation of parasites.

In the '**Burst firing**' thyristor firing mode, the power supplied to the load depends on firing times T_F and non-firing times T_{NF}. The load power is proportional to the firing rate (τ) and is defined by the ratio of the thyristor firing time (T_F) and the modulation time ($T_M = T_F + T_{NF}$).

The firing rate (or cyclic ratio) is expressed by the following ratio:

$$\tau = \frac{T_F}{T_F + T_{NF}}$$

The load power can be expressed by:

$$P = \tau \cdot P_{MAX}$$

where P_{MAX} represents the load power during thyristor firing.

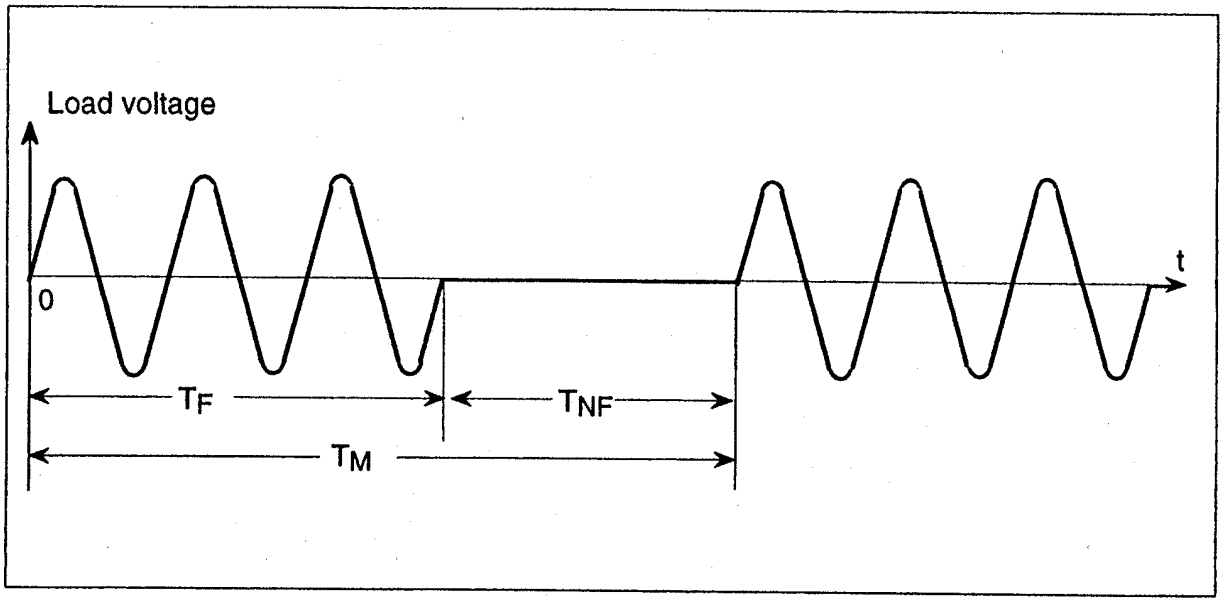

Figure 4-2 Burst firing cycle times

The modulation time in 'Burst firing' mode is **variable** according to the output power.
Due to this type of control, the 425A thyristor unit has a setting precision adapted to each specific setpoint zone:

- At **50 %** power, the typical value of the modulation time is:
  - **320 ms** for 'Fast' cycle mode and
  - **10 s** (approximately) for 'Slow' cycle mode.

- For a zone below **50 %** of the maximum setpoint, the **firing** time decreases and the modulation time increases.

- For a power zone above **50 %**, the **non-firing** time decreases with the increase in the modulation time.

For example, in 'Fast' cycle mode:
- for a 5 % power, $T_F = 80$ ms, $T_M = 1.6$ s
- for a 90 % power, $T_F = 0.72$ s, $T_M = 0.8$ s.

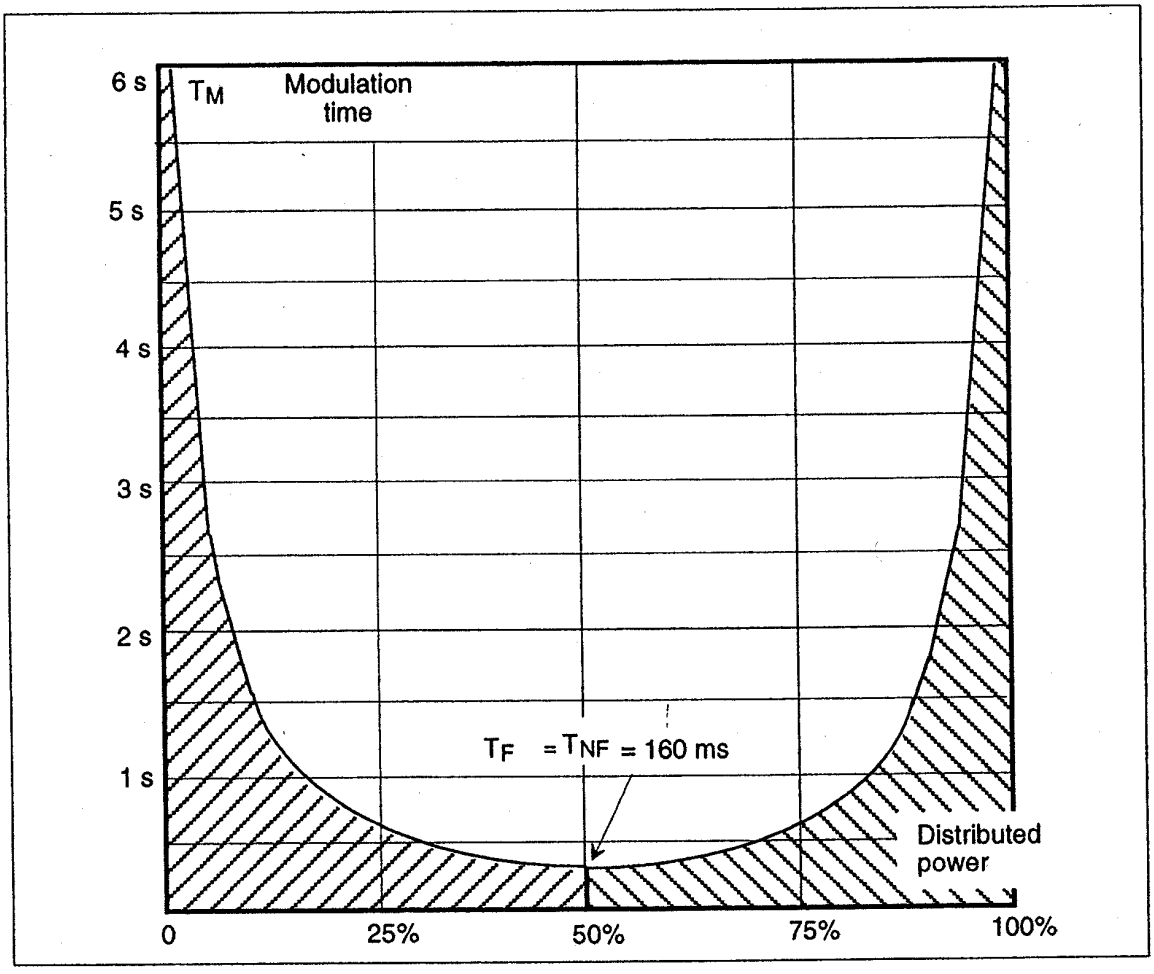

Figure 4-3 Modulation time as a function of power ('Fast' cycle)

'Single cycle' mode

The 'Burst firing' mode with a **single** firing or non-firing time is called the '**Single cycle**' mode.

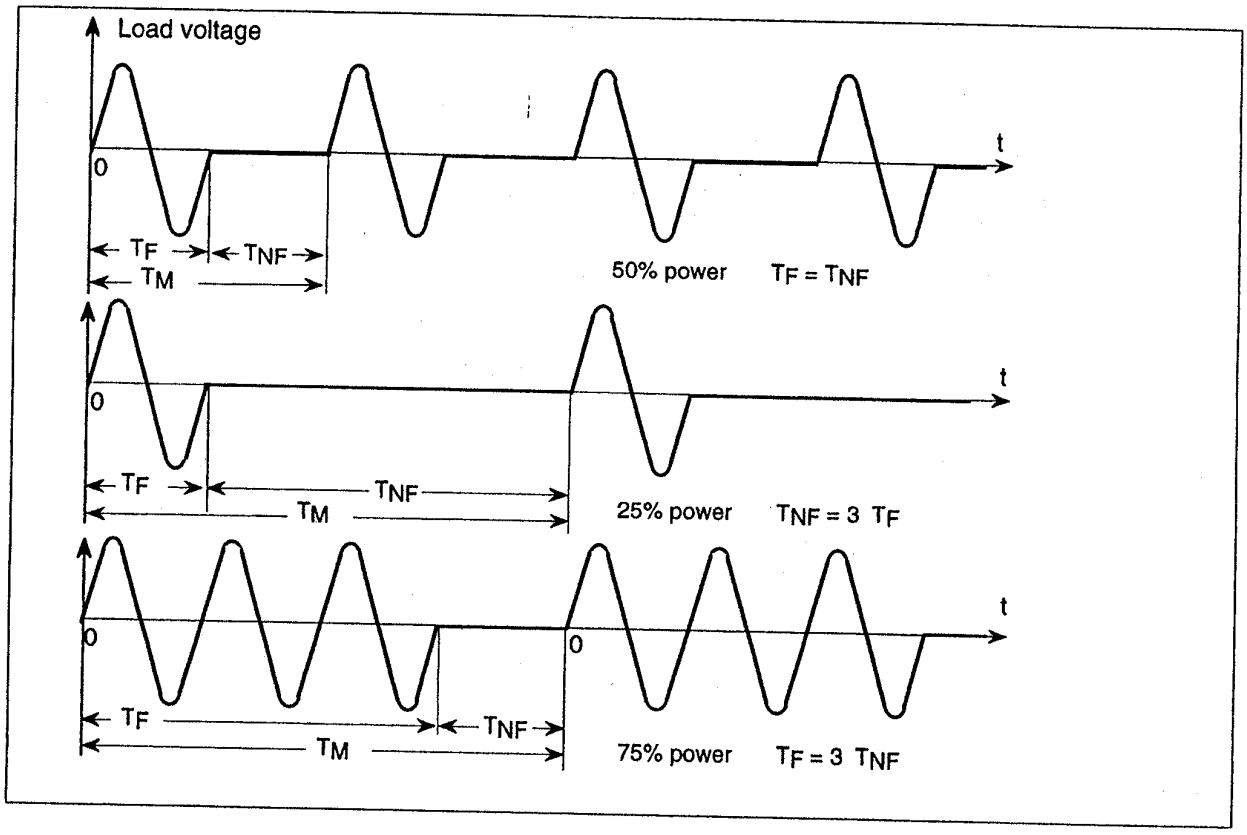

Figure 4-4 Examples of firing in 'Single cycle' mode

- At **50 %** power, the value of the modulation time in 'Single cycle' mode is **40 ms**:
  - **1** firing time (**20 ms** at **50 Hz**)
  - **1** non-firing time (**20 ms** at **50 Hz**).

- For a zone below **50 %** of the maximum setpoint:
  - the **firing** time remains stationary (1 supply cycle)
  - the non-firing time increases and, as a consequence,
  - the modulation time also increases.

- For a power zone above **50 %** of the maximum setpoint:
  - the **non-firing** time remains stationary (1 supply cycle)
  - the firing time and the modulation time increase.

For an intermediate power, the thyristor unit control system calculates the number of firing and non-firing times so that the output power corresponds to the setpoint.

THYRISTOR FIRING MODE CONFIGURATION

General

The thyristor firing mode is preselected in the factory using 'coffee bean' soldered links on the PC-board.

Two types of PC-board correspond to the firing mode, specified in the thyristor unit order, and the presence (or absence) of the 'Internal EMC filter' option

'Phase angle and burst firing' board ('Type 1' board)

This board is supplied for the following codes:

- **PA** or
- **FC , FC1** or **SC without** the **FILT** option.

The 'Type 1' board is configured in the factory according to the firing mode and, if necessary, may be reconfigured in other thyristor firing modes.

Caution !

The 'Type 1' board configured in Burst firing or Single cycle mode does not guarantee compliance with the Electromagnetic compatibility test standard.

'Burst firing' board ('Type 2' board)

This board is supplied for the codes **FC, FC1** or **SC with** the **FILT** option.

Depending on the coding, the 'Type 2' board is configured in the factory in 'Single cycle', 'Fast cycle' or 'Slow cycle' thyristor firing mode.

If necessary, the firing mode can be reconfigured in one of the above firing modes.

The 'Type 2' board cannot be reconfigured in 'Phase angle' firing mode.

'Phase angle and burst firing' board confiiguration ('Type 1' board : Order without FILT option)

If the FILT option is not ordered, the thyristor unit is supplied with the '**Type 1**' board.

This board is normally reserved for the initial configuration in 'Phase angle' mode or when easy modification of the firing mode ('Phase angle' or 'Burst firing') is selected.

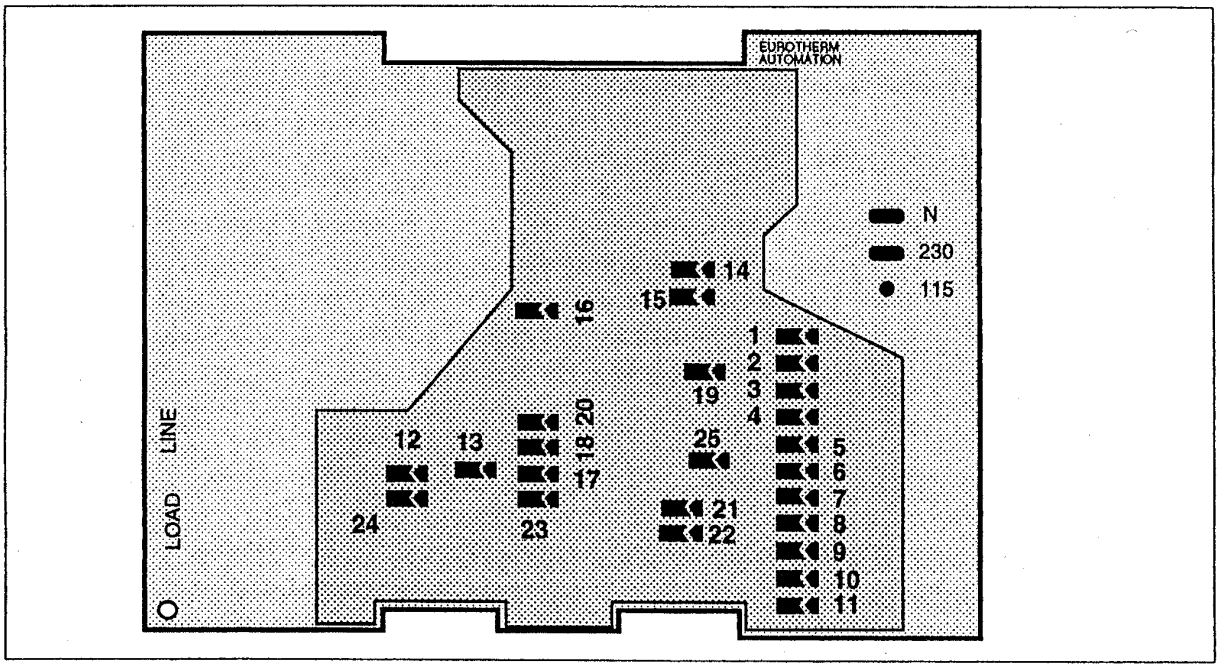

Figure 4-5 'Type 1' board. 'Coffee bean' links location (soldered side view)

To check the firing mode or change it if necessary, refer to table 4-1.

Firing Mode	'Coffee bean' soldered links													
	12	13	14	15	16	17	18	19	20	21	22	23	24	25
Phase angle		X	X	X	X		X						X	X
Fast cycle	X					X		X	X					X
Slow cycle	X					X		X	X	X				
Single cycle	X					X		X	X		X	X	X	

Table 4-1 'Type 1' board. Firing mode configuration (X : soldered 'coffee bean' link)

'Burst firing' board configuration ('Type 2' board : Order with FILT option)

If the FILT option is ordered, the thyristor unit is supplied with the '**Type 2**' board.

This board is exclusively reserved for initial configurations in 'Burst firing' or 'Single cycle' mode.

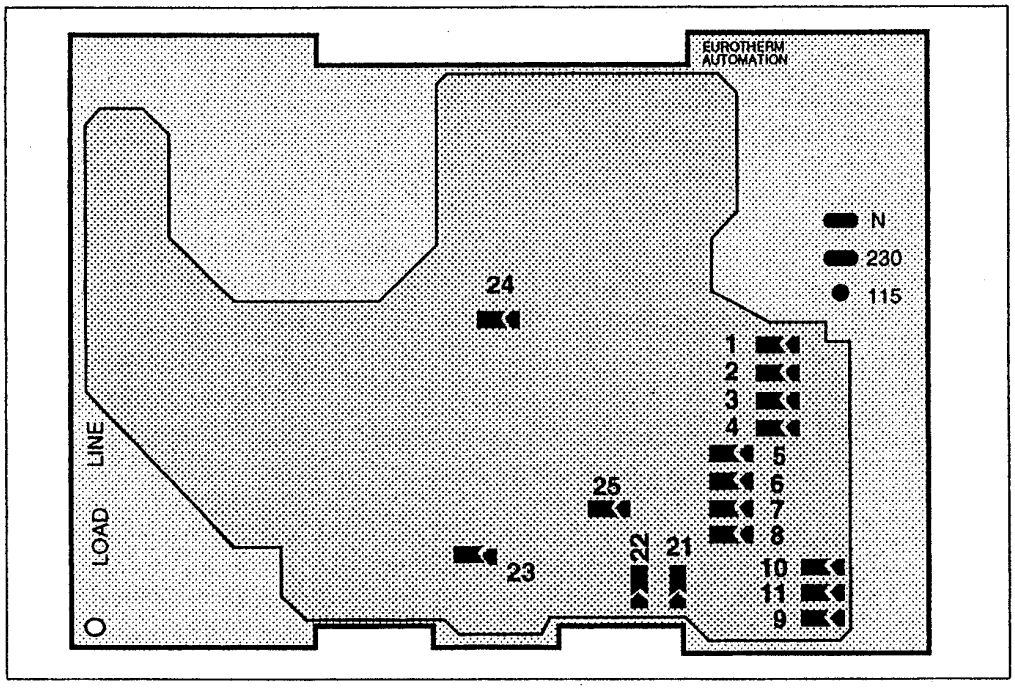

Figure 4-6 'Type 2' board. 'Coffee bean' links location (soldered side view)

To check the firing mode or change it if necessary, refer to table 4-2.

Firing Mode	Soldered 'coffee bean' links				
	21	22	23	24	25
Fast cycle					X
Slow cycle	X				
Single cycle		X	X	X	

Tableau 4-2 'Type 2' board. Firing mode configuration (X : soldered 'coffee bean' links).

OPERATION AND RECONFIGURATION POSSIBILITIES

The table below summarises all the information concerning

- the operation of the 425A thyristor unit in different firing mode
- the possibility of reconfiguration of thyristor firing
- the type of PC-board installed.

Thyristor unit operation and coding				Board type	Reconfiguration in other modes
Firing mode	**Code**	**Option**	**Code**		
Phase angle	PA	No options	-	1	Possible. EMC compliance is guaranteed with an external serial filter
		Current limit option	CL		
Burst firing	FC, SC	No options	-	1	Possible (but without Current limit option in Phase angle mode). EMC compliance is guaranteed with an external serial filter.
Single cycle	FC1	No options	-	1	
Burst firing	FC, SC	With internal EMC filter	FILT	2	Possible, except in Phase angle mode. EMC compliance is guaranteed with the FILT option
Single cycle	FC1	With internal EMC filter	FILT	2	

Table 4-3 PC-board type and reconfiguration according to thyristor unit coding

CONTROL SIGNAL

Signal type

The control signal is **analogue**.

There are **three** levels of signals in **DC voltage** and **four** in **DC current**.

The signal type (voltage or current) must be selected in the thyristor unit order.

The types, levels and impedances of **425A** thyristor unit **'AUTO'** input signals are given in table 4-4.

Signal type	**Signal level**	**Input impedance**
Analogue, DC voltage	0 - 5 V 0 - 10 V 1 - 5 V	75 kΩ 85 kΩ 70 kΩ
Analogue, DC current	0 - 5 mA 0 - 10 mA 0 - 20 mA 4 - 20 mA	1 kΩ 470 Ω 270 Ω 270 Ω

Table 4-4 Control signal parameter

The impedance of the **'MANU'** (Manual) input is **330 kΩ**.

The manual control signal can come from a **4.7 kΩ external potentiometer** powered between :

- the **'+10V'** user terminal voltage and
- the **'0V'** terminals

with the wiper connected to the 'MANU' terminal (see page 3-10).

Note : Voltage across potentiometer is only **6 V** due to **internal 3.3 kΩ resistor** in series with +10 V supply.
The **open** circuit voltage is **10 V**.

Control signal configuration

The type and level of the control signal are determined in the factory by soldered **'coffee bean'** links on the PC-board.

Two types of PC-board have the **same** control signal configuration.

Table 4-5 can be used to check the input signal used and reconfigure the **425A** thyristor unit in the event of a change of signal type.

Signal	Soldered 'coffee bean' links								
	1	**2**	**3**	**4**	**5**	**6**	**7**	**10**	**11**
0 - 5 V			X			X		X	
0 - 10 V			X		X			X	
1 - 5 V			X				X		X
0 - 5 mA				X		X		X	
0 - 10 mA		X					X	X	
0 - 20 mA	X					X		X	
4 - 20 mA	X						X		X

Table 4-5 Control signal configuration

Note : • X : soldered 'coffee bean' link.
• 'Coffee bean' links **8** and **9** are not used on the type 1 board, but are provided for a later extension.

Chapter 5

COMMISSIONING

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COMMISSIONING

Read this chapter carefully before commissioning the thyristor unit

COMMISSIONING PROCEDURE SAFETY

Important !

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

It is therefore the user's responsibility to ensure that all the nominal values of the power unit are compatible with the conditions of use and installation before commissioning the unit.

Warning !

Access to internal components of the unit is prohibited to users who are not authorised to work in industrial low voltage electrical environments.

The temperature of the heatsink may exceed 100°C.

Avoid all contact, even occasional, with the heatsink when the solid state contactor is in operation.

The heatsink remains hot for approximately 15 min after the unit has been switched off.

CHECKING THE CHARACTERISTICS

Caution !

Before connecting it to an electrical supply, make sure that the **identification code** of the thyristor unit corresponds to the coding specified in the **order** and that the characteristics of the thyristor unit are **compatible with the installation.**

Load current

The maximum current of the load must be less than or equal to the value of the nominal current of the thyristor unit.
For the configuration of 3 identical loads in a **closed delta**, the line current of the thyristor unit is $\sqrt{3}$ **times as high** as the current of each arm of the delta.
With a high temperature coefficient load, the neutral current in the 4-wire configuration can reach values 1.7 times greater than the line currents.

Supply voltage

Warning !

Never use a thyristor unit with a supply **voltage greater** than the nominal thyristor unit voltage specified in the coding.

For three-phase operation, in star without neutral or closed delta configurations, the nominal value of the thyristor unit voltage must be greater than or equal to the **line-to-line voltage used** of the supply.

Auxiliary voltage

The auxiliary voltage is used to supply power to the control electronics.
The electronics and fan (for fan-cooled units) power supply is configured in the factory, according to the 'Auxiliary power supply' code.

The fan supply voltage value must be equal to the supply auxiliary voltage value.
It is not possible to power the fan at a voltage other than that indicated on the fan terminal label.

Input signal

The configurations of the 'coffee beans' on the electronic board must be compatible with the signal type and level used for the control (*see Configuration chapter*).

CURRENT LIMIT ADJUSTMENT (OPTION)

Current limit is available as an **option** in **'Phase angle'** firing mode only.
The current limit is automatic and can be adjusted between **10** and **100%** of the thyristor unit's nominal current using a potentiometer on the front fascia.

Current limit adjustment is **possible** if the RMS load current is greater than or equal to **10%** of the nominal current. For this adjustment, use an ammeter giving the **RMS value** in order to prevent risks of errors which may reach **50%** of the value of the limited current.

Adjustment procedure

- Make sure that the load circuit is connected and powered up.
- Power up the power circuit
- Turn the potentiometer (labelled **'Régl/Adjust'** on the front fascia) fully anti-clockwise (minimum position)
- Apply a **0 V** signal to the thyristor unit input
  (or **0 mA** depending of the type of signal configured)
- Power up the electronics power supply; the voltage at the the load terminals should be zero.
- Set the input signal to **100%**.
  The load voltage should **represent approximately 15%** of the supply voltage.
- Gradually turn the current limit potentiometer clockwise and check that the current is increased.
- Adjust the potentiometer so as to obtain the maximum current allowed by the load.

Start with current limit

The current limit must be used to start up an installation on high temperature coefficient resistive loads or on short wave infrared elements.

It is recommended to adjust the current limit potentiometer to the anti-clockwise limit to obtain a minimum current.

Then increase the current by turning the potentiometer gradually so as not to exceed the nominal current value of the thyristor unit and the value allowed by the load.

For the three-phase application, take care to turn each of the 425A potentiometers in succession in order to guarantee balanced currents in the phases.

Chapter 6

FUSE

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Chapter 6 FUSE

THYRISTOR PROTECTION FUSE

The fuse and the fuse-isolator are defined **separately** in the order.

They must be provided for the installer and procured at the same time as the 425A power thyristor unit (different Part Nos.).

Caution !

The high-speed fuse is only used for the internal thyristor protection of used in the 425A power thyristor unit against wide amplitude over-loads.

This high-speed fuse may not be used to protect the installation.
The user's installation must be protected and comply with current standards.

The fuse holder supplied with a power thyristor unit can be used as a fuse-isolator. However, as for all fuse-isolators, it cannot be opened on-load.

The unit guarantee depends on the use of a fuse, the part numbers of which is given in the following table.

Caution !

For the use of high-speed fuses with short wave infrared elements or tungsten loads (inducing transient over-currents in Burst firing mode), please consult your Eurotherm Office.

Thyristor unit nominal current	Fuse rating	Part Numbers		
		Spare part fuses		'Fuse + fuse holder' assembly code
		Eurotherm	Ferraz	
15 A	20 A	CH 260024	K330013	FU1038 /16A / 00
25 A	30 A	CH 260034	M330015	FU1038 /25A / 00
40 A	50 A	CH 330054	B093910	FU1451 /40A / 00
63 A	80 A	CS 173087U080	A094829	FU2258 /63A / 00
75 A	100 A	CS 173087U100	Y094827	FU2258 /75A / 00
100 A	125 A	CS 173246U125	S078331	FU2760 /100A / 00
125 A	160 A	CS 173246U160	X076311	FU2760 /125A / 00

Table 6-1 Spare part fuses and 'fuse + fuse holder' assembly part numbers

FUSE-ISOLATOR

The fuse holder is designed for mounting on a symmetrical DIN rail.

For asymmetrical rails, the adaptor (Eurotherm part No. FE 018706) which is supplied with the fuse holder must be used.

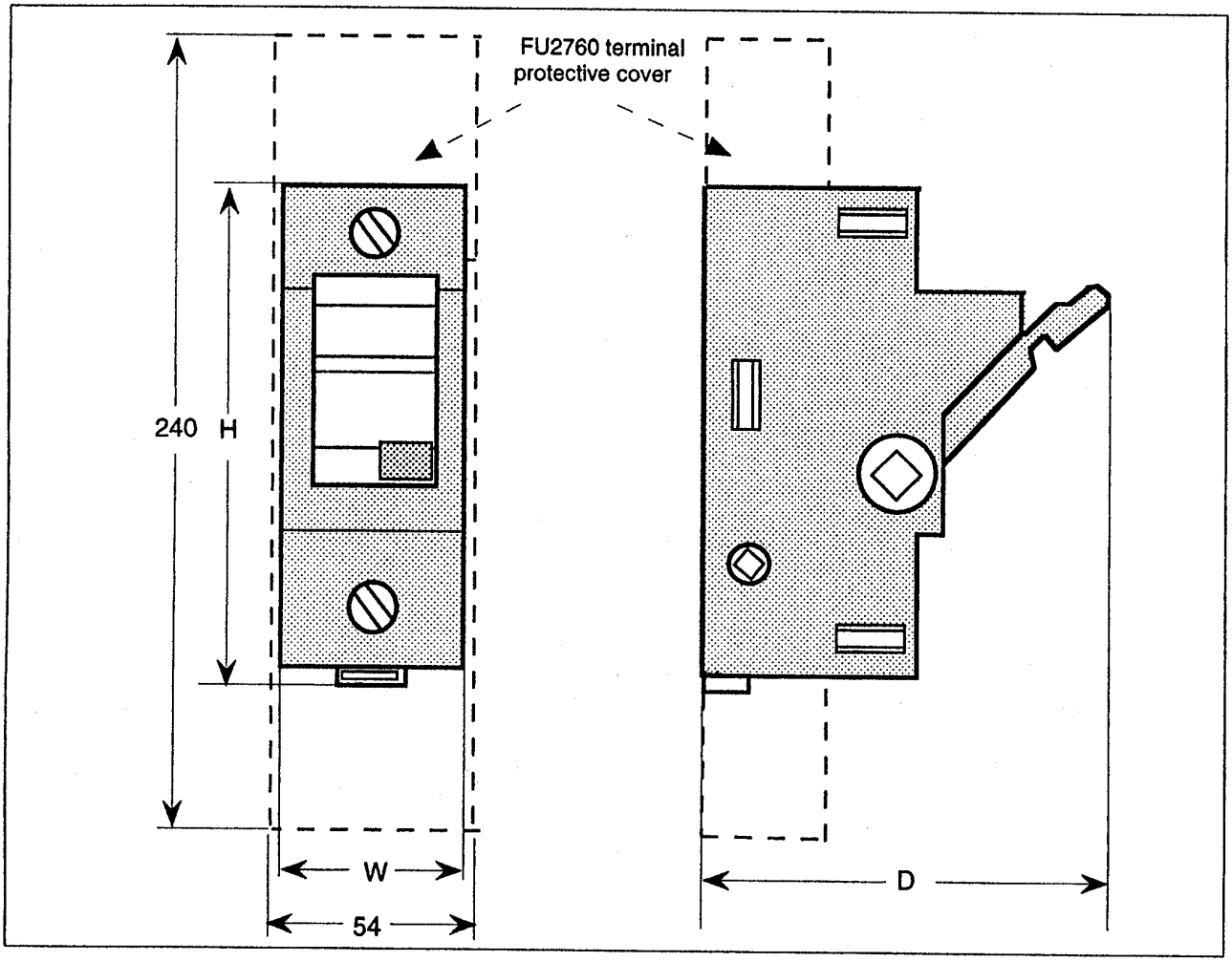

Figure 6-1 Fuse holder dimensions

Dimensions		Fuse holder			
		FU1038	FU1451	FU2258	FU2760
Height	(H)	81	95	140	240 (with terminal protective cover) 150 (without terminal protective cover)
Width	(W)	17.5	26	35	54 (with terminal protective cover) 38 (without terminal protective cover)
Depth	(D)	68	86	90	107

Table 6-2 Fuse holder dimensions (mm)