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# **Solid state contactors**

## **450 Series**

### **Control of single-phase resistive loads**

#### **User Manual**

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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.**

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



**DANGER**

**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.**



**ATTENTION**

**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.

It is the responsibility of the user and it is highly recommended, given the value of the equipment controlled using 450, to install **independent safety** devices.

This alarm must be tested regularly.

Eurotherm can supply suitable equipment.

As a result of the constant improvement of its products, Eurotherm may modify these specifications without warning.  
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.

# EUROPEAN DIRECTIVES

## COMPONENT

**450** thyristor unit is a component according to the **Directive 89/336/EEC** designed to be fitted in systems submitted to CE Marking according to the same Directive. It is the responsibility of the installer to **affix** the CE Mark and **to establish** the CE declaration of conformity of its overall system in relation to the applicable European Directives.

In order to facilitate the integration of our components in the systems concerned by the CE Mark, Eurotherm has taken the following measures :

### SAFETY

For **safety**, the **450** products **installed and used in compliance with this manual** meet the essential requirements of the **Low Voltage Directive 73/23/EEC** of 19/02/73 (amended by the Directive 93/68/EEC of 22/07/93) according to their design.

### ELECTROMAGNETIC COMPATIBILITY

For **Electromagnetic Compatibility**, a distinction is made between immunity and conducted and radiated emissions.

#### Immunity

For immunity, the **450** products **installed and used in compliance with this manual** **meet** the essential requirements of the **Electromagnetic Compatibility Directive 89/336/EEC** of 03/05/89 (amended by the Directives 92/31/EEC of 12/05/92 and 93/68/EEC of 22/07/93) according to their design.

#### Radiated emission

For radiated emission, the **450** products **installed and used in compliance with this manual** **meet** the essential requirements of the above mentioned **Electromagnetic Compatibility Directive** according to their design.

#### Conducted emission

To reduce the noise due to the utilization of its solid state contactors, Eurotherm can supply specific filters. The purpose of these filters is to help you to filter your system and to make it compliant with the essential requirements of the **Electromagnetic Compatibility Directive**.

A declaration attesting the above mentioned statements is available on request.

# CE MARKED APPARATUS

Eurotherm can supply equipment made of a thyristor unit and an external filter (referenced hereunder) that both form a **CE Marked apparatus** and is intended to be used in an installation.

Please, also refer to the installation guide of the filters.

In order to guarantee the best service, Eurotherm **have validated the compliance** of the 450 products with the essential European Directive requirements **through product design and laboratory tests** described in a technical file for attention of official authorities.

**A declaration of compliance** with the European Directives is available on request.

## EXTERNAL FILTERS (Single-phase application)

<b>Nominal current of 450 product</b>	<b>Series filter EUROTHERM Part No.</b>
15 A	LA 174936U025
25 A	LA 174936U025
40 A	LA 174936U063
55 A	LA 174936U063
75 A	LA 174936U100
100 A	LA 174936U100
125 A	LA 174936U160
150 A	LA 174936U160

The electromagnetic compatibility of the 450 products has been specially developed for the **industrial environment** and must not be used in residential type environments.

For further details, contact your Eurotherm office.

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**This 450 User Manual (Part No. HA 174912)** intends for the **450** series power thyristor units manufactured from **January 1996**.

The 451-455-461 User Manual (Part No. HA 174485) is valid for products manufactured **before** this date.

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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.

**Manufactured by Eurotherm Automation S.A.**  
**ISO 9001 - EN 29001 certified**

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## 450 USER MANUAL

**The safety recommendations  
for the installation and use of the 450 series units  
are shown on the following pages :**

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- cabling 3-2, 3-7, 3-8, 3-10, 3-12
- operation 4-2
- commissioning 5-2
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# Chapter 1

## IDENTIFICATION OF THE UNITS

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# Chapter 1 IDENTIFICATION OF THE UNITS

## GENERAL INTRODUCTION TO THE 450 SERIES

The **450** solid state contactors are devices intended for **controlling single phase** industrial electrical loads with low resistance variations as a function of temperature.

A solid state contactor includes a pair of **thyristors** connected in antiparallel on a thermal dissipator (heatsink).

The **450** series solid state contactors control currents of between **15 A** and **150 A**.

The nominal line-to-line voltage varies from **120 V** to **480 V**.

Solid state contactors, driven by a **logic** signal, operate in '**ON/OFF**', and deliver the maximum power in the load when the control signal is present.

For **450** series solid state contactors, the thyristor firing and cut-out are **synchronised to the zero voltage**, eliminating the sharp current fronts which generate supply disturbances.

The thyristors are protected by a high speed fuse, which is either **internal** (units from 15 to 125 A nominal) or **external** (150 A nominal). If the fuse fitted inside the unit blows, this is signalled by an indicator light on the front panel.

Optionally, the **partial load failure (PLF)** detection circuit detects a **25%** increase in the load impedance (independently of supply voltage variations). The PLF detection is adjusted with a potentiometer on the front panel for the real load current used. The PLF alarm is signalled by the alarm relay contact and the '**Load Fail.**' indicator on the front panel.

The **450** solid state contactors have permanent fan cooling starting at **100 A** nominal.

The **thermal protection** for the 100 A, 125 A and 150 A nominal units is provided by a thermal switch which detects the stoppage of the fan or the overheating of the heatsink.

An **indicator** is located on the front panel to show when the internal thyristor protection **fuse blows**.

As an option, the front panel also includes:

- the partial load failure detection **adjustment** potentiometer
- the '**Test**' push button for testing the adjustment of the PLF alarm
- the indicator showing the **detection** of partial load failure
- the indicator showing the '**Overload**' fault detection.

Three types of isolated logic inputs are available:

- The standard input is suitable for all logic control signals generated by Eurotherm controllers.
- The **TTL** input, available as an option, has a greater sensitivity without increasing the current consumption. This input can be controlled by standard TTL logic.
- The '**Multi-control**' input, available as an option, is used when several units need to be driven by a single logic signal.

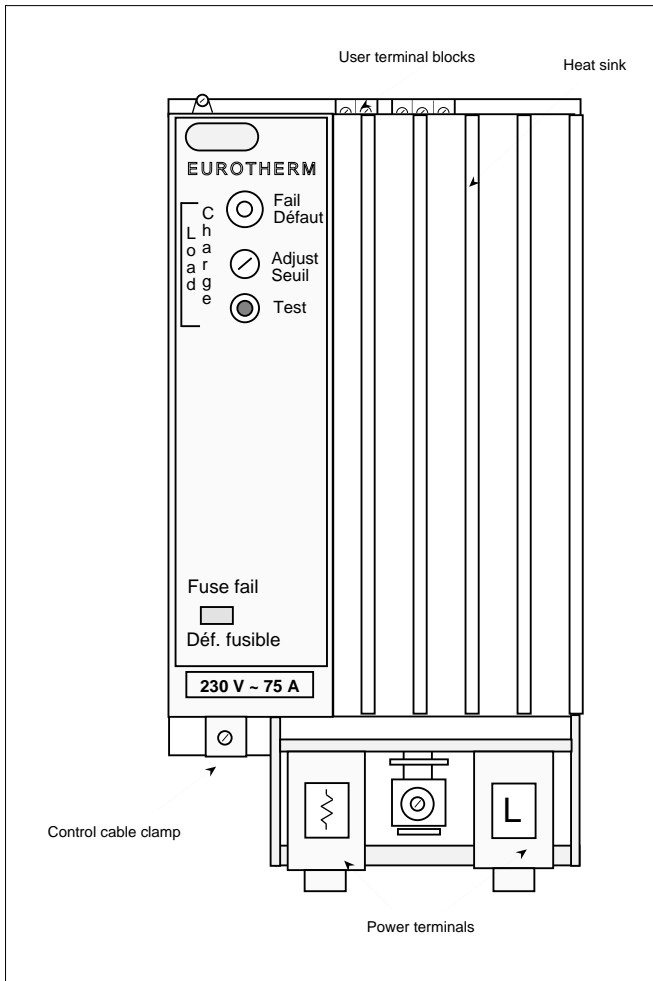


Figure 1-1 Overall view of the 450 series solid state contactor

## TECHNICAL SPECIFICATIONS

**The 450 is a solid state contactor intended for thyristor control of a single phase industrial load.**

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### Attention !



It is the user's responsibility to ensure that all the nominal values of the solid state contactor comply with the conditions of installation and use, before start-up.

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### Power

Nominal current	<b>15 A to 150 A</b>
Nominal line-to-line voltage	<b>120 Vac to 480 Vac</b> (+10%,-15%)
Residual current	In the locked state, typically less than <b>30 mA</b>
Supply frequency	<b>50 Hz or 60Hz</b> (±2 Hz)
Dissipated power	<b>1.3 W</b> (approx.) per ampere
Cooling	<b>Permanent</b> fan cooling above <b>100 A</b> nominal
Fan	Consumption <b>23 VA</b> Supplied by the auxiliary supply voltage
Load	<b>Resistive</b> with low temperature coefficient

### Environment

Operating temperature	<b>0°C to +50°C</b> in a vertical position
Maximum altitude	<b>2000 m</b>
Storage temperature	<b>-10°C to +70°C</b>
Protection	<b>IP00</b> (can be opened without tools according to <b>IEC 592</b> )
Thyristor protection	High speed <b>internal</b> fuse Internal fuse blown indicator light For 150 A nominal (model 454), external fuse. <b>Varistor</b> and <b>snubber</b> circuit
Atmosphere	Non-explosive, non-corrosive and non-conducting
Humidity	RH from <b>5%</b> to <b>95%</b> without condensation
Pollution	Degree <b>2</b> admissible, defined by <b>IEC 664</b>
External cabling	To be performed according to <b>IEC 364</b>

## Control

Signal type	<b>dc logic</b>
Options:	<ul style="list-style-type: none"> <li>• High sensitivity input</li> <li>• Multi-control input</li> </ul>
Thyristor firing mode	'ON/OFF'
Configuration	<b>Shielded</b> cable, earthed at <b>both</b> ends.
Connection	Wires from <b>0.5 mm<sup>2</sup></b> to <b>2.5 mm<sup>2</sup></b> Tightening <b>0.4</b> to <b>0.6 N.m</b> The control terminals are isolated from the power and the load circuit.
Consumption	<b>7 VA</b> (non fan-cooled unit) <b>30 VA</b> (fan-cooled unit)

## Partial load failure detection (option)

Alarm	Detection of a <b>20%</b> current decrease. <b>Adjustment</b> on front panel using ' <b>Adjust/Seuil</b> ' potentiometer.
Test	Using ' <b>Test</b> ' push button on front panel.
Signalling	<b>'Load Fail.'</b> indicator on front panel. Alarm relay switch (open or closed in alarm state depending on the option chosen)

## Overload detection (option)

Alarm	Detection of a 50 % current increase
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### Attention !



Due to the continual improvement of products, Eurotherm may be required to modify specifications without notice. For any further information and in the event of doubt, please contact your Eurotherm office.

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## CODING

### Solid state contactor

Model / Nominal current / Nominal voltage / Auxiliary supply voltage / Options / 00

Model	Nominal current	Code
451	15 A	081
	25 A	082
	40 A	083
	55 A	062
452	55 A	062
	75 A	113
453	100 A	114
454	125 A	117
	150 A	100

Auxiliary supply voltage (fan-cooled units, 453 and 454 models)	Code
Single-voltage :	
115 V	11
230V	36
Two-voltage :	
100V and 230 V	41
115 V and 230 V	19
200 V and 230 V	42
277 V and 230 V	46
380 V and 230 V	43
440 V and 230 V	47
440 V and 230 V	44
For two phase control of a 3 phase application and with PLF option, auxiliary supply voltage must be the same as 3 phase line-to-line voltage	

Nominal voltage	Code
120 V	10
240 V	13
277 V	32
440 V	28
480 V	29

For other voltages, contact your EURO THERM office

Options	Code
TTL high sensitivity input	10
'Multi-control' input for single control of several units connected in series	24
Partial load failure (PLF) detection. Contact <b>open</b> in alarm state	37
Partial load failure (PLF) detection. Contact <b>closed</b> in alarm state	37/83
Unit without backplate	76
Overload detection (only with PLF option)	68

## Backplate

Solid state contactor model / Nominal current / Backplate code / 00

For advance installation, order the attachment backplate without a unit.

Solid state contactor model	Nominal current	Backplate code
451	15 A to 55 A	LA 015309
451 with PLF option	15 A to 55 A	LA 015308
452	55 A to 75 A	LA 015314
452 with PLF option	55 A to 75 A	LA 015315
453	100 A	LA 171053
453 with PLF option	100 A	LA 171054
454	125 A to 150 A	LA 171120
454 with PLF option	125 A to 150 A	LA 171121

For later orders of units for pre-installed backplates, use the 'unit without backplate' coding option for the solid state contactors - code **76**.

## Coding example

### Parameters of the 450 series solid state contactor and the installation

Nominal load current	<b>105 amperes</b>
Nominal supply voltage	<b>440 volts line-to-line</b>
Auxiliary supply	<b>230 Vac</b>
Firing mode	'ON/OFF'
Input	TTL high sensitivity
Options :	Partial load failure detection
	• Alarm relay switch
	<b>closed</b> in alarm state
	• Unit without backplate.

### Coding of the solid state contactor

**454 / 117 / 13 / 36 / 10 / 37 / 83 / 76 / 00**



## SERIAL NUMBER LABEL

An **identification** label (specifying the **coding** of the solid state contactor) gives all the information relating to the factory settings of the solid state contactor.

The identification label is located at the top on the right hand **outer** panel of the unit.

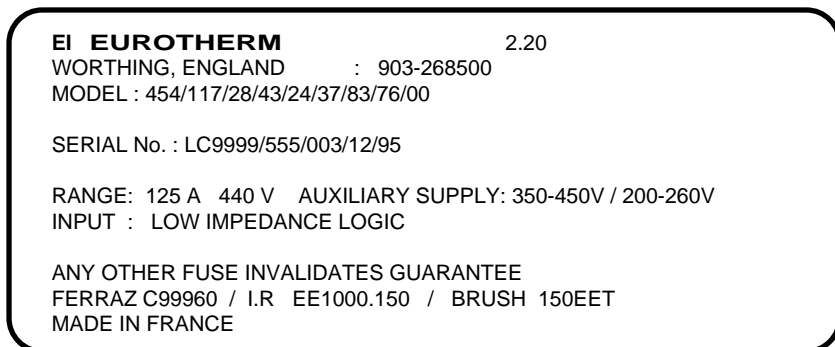


Figure 1-2 Example of an identification label for a model 454 solid state contactor.

The information shown on the label in figure 1-2 correspond to a 454 solid state contactor:

- the nominal current 125 A,
- the nominal voltage 440 V,
- the auxiliary supply in the range 350 to 450 V,
- the 'multi-control' input,
- the PLF option,
- the PLF alarm switch closed in alarm state,
- the unit supplied without backplate.

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### Attention !



Following any reconfiguration on the part of the user, there is no guarantee that the thyristor unit and this information corresponds to the information related to the unit coding.

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## Chapter 2

# INSTALLATION

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## Chapter 2 INSTALLATION

### SAFETY DURING INSTALLATION

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#### Danger !



450 units must be installed by a person authorised to work in an industrial low voltage electrical environment.

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 ground in accordance with standards IEC 364 or the current national standards.

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

Bulkhead mountings are possible with **450** series units.

The units must be mounted with the heatsink positioned vertically and with no obstructions either above or below which could reduce or block the flow of 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.

Leave a vertical gap of at least **80 mm** between two units.

Leave a gap of at least **20 mm** between two units installed side by side.

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#### Attention !



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

Excessive overheating may cause incorrect operation of the unit, which in turn may cause damage to the components

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450 series power units have **permanent** fan cooling for nominal currents above **100 A**.

## DIMENSIONS

The dimensions of the 450 solid state contactors are given in figure 2-1 and table 2-1.

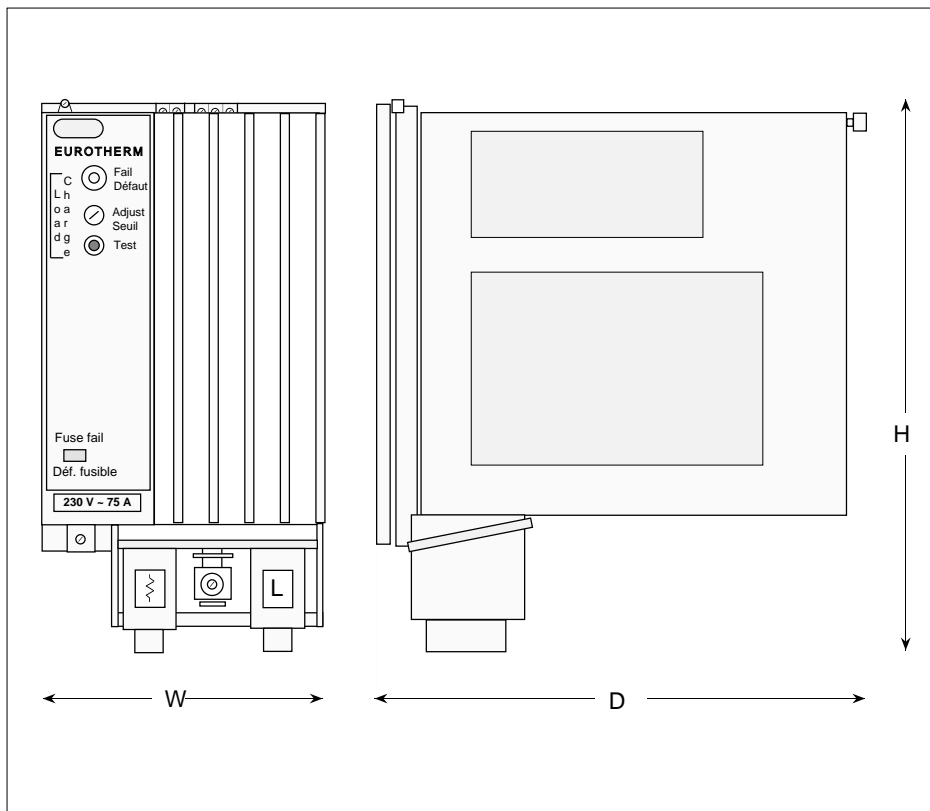


Figure 2-1 Overall dimensions

Model	Height (H) mm	Width (W) mm	Depth (D) mm	Weight kg
451	247	76	236	3
452	247	114	236	4
453	247	152	236	5
454	280	152	236	5

Table 2-1 Overall dimensions and weight

## MECHANICAL MOUNTING

**450** series solid state contactors are slotted into a steel backplate located at the rear of the unit.

The backplate can be mounted:

- on a pair of asymmetric DIN rails
- on a vertical wall.

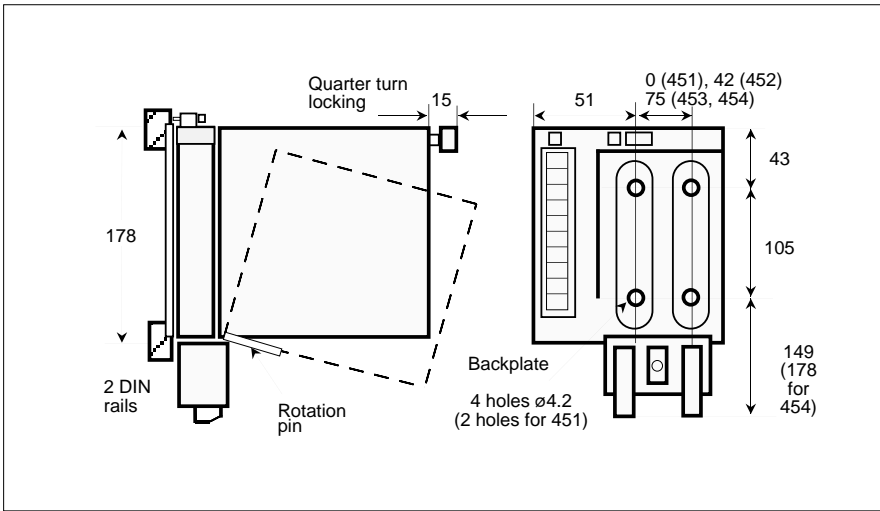


Figure 2-2 Dimensions for attachment to a vertical wall (mm)

To **mount** the unit:

- tilt the unit forwards to approximately 20 degrees from the horizontal
- fit the rotation pin into the slot in the backplate
- raise the unit to the horizontal
- lock by a quarter of a turn.

To **dismount** the unit:

- unlock the upper attachment by a quarter of a turn
- tilt the unit forwards to approximately 20 degrees from the horizontal
- free the unit from the backplate.

### Danger !



Before dismantling the unit, ensure that it is switched off and that the heatsink is not hot.

## Chapter 3

### CABLING

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## Chapter 3 CABLING

### SAFETY DURING CABLING

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#### Danger !



Cabling must be performed by personnel who are qualified to work with low voltage electrical equipment.

It is the user's responsibility to cable and protect the installation in accordance with current professional standards. A suitable device guaranteeing electrical separation of the equipment and the supply must be installed upstream from the unit in order to perform the operation in complete safety.

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All power and control connections are made to the terminal blocks located on the attachment backplate and must be made without a unit present.

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#### Danger !



Before any connection or disconnection, make sure that the power and control cables and wires are insulated from the voltage sources. For safety reasons, the safety earth cable must be connected before any other connection during cabling and must be the last cable to be disconnected.

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The **safety earth** is connected to the screw located on the strip provided for this purpose in the top part of the unit, behind the power terminals and labelled as follows:



#### Attention !



To ensure that the 450 unit is grounded correctly, make sure that it is attached to the **reference ground plane** (panel or bulkhead). If this is not the case it is necessary to add a ground connection **no more than 10 cm long** between the ground connection and the reference ground plane.

#### Danger !



The purpose of this connection is to guarantee correct **ground continuity**. It is **not**, in any circumstances, a **substitute** for the **safety earth connection**.

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## FIXING THE POWER CABLES

The external **cabling** is performed from the front, on the backplate terminal blocks, once the backplate has been fixed, with the unit disconnected.

The power cables are attached to the power terminal blocks marked "L" (**Line**) and "⎓" (**Load**) located on the lower part of the unit.

The power and ground cables are connected to **tunnel** terminal blocks (15 A to 100 A) or **screw** terminals (125 A and 150 A).

Above **125 A**, the power cables must be connected using round lugs.

The capacities of the power terminals are shown in table 3-1.

The **tightening torques** must comply with the limit values shown in the same table.

### Attention !



Tighten the power connections correctly.  
Poor tightening can lead to incorrect operation of the thyristor unit and can have serious consequences for the installation.

Nominal current	Capacity of the power and earth terminals mm <sup>2</sup>	Tightening torque N.m
15 A to 55 A Model 451	2.5 to 16	1,8
55 A to 100 A Models 452 and 453	2.5 to 50	2,5
125 A and 150 A Model 454	Power: 50 or 70 Earth: 2.5 to 50	10 2,5

Table 3-1 Power cabling details for the 450 units



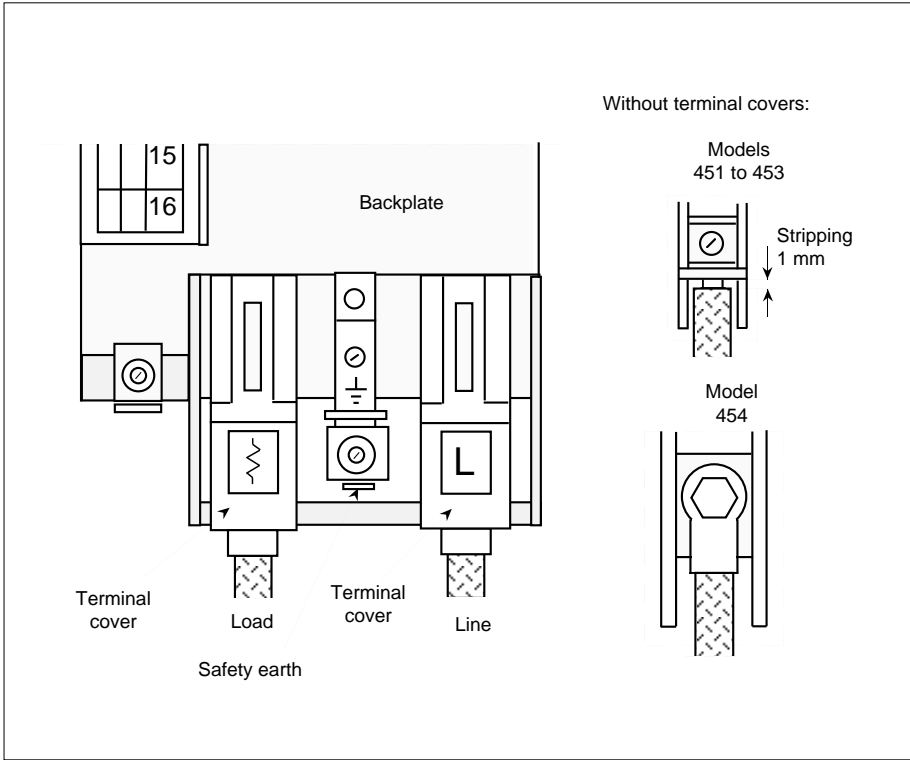


Figure 3-1 Attachment points for the power and safety earth cables

The cross-section of the connection conductors used must comply with the **IEC 943** standard.

Model	Connection	Distance between terminals mm
451	16 mm <sup>2</sup> tunnel terminal	25.4
452	35 mm <sup>2</sup> tunnel terminal	55
453	35 mm <sup>2</sup> tunnel terminal	82
454	M10 screw	61.5

Table 3-2 Power cabling details for the 450 units

## CONTROL CABLES



### Attention !

The control connections must be made with **shielded cables, connected to earth at both ends** to ensure satisfactory immunity against interference.

**Separate** the control cables from the power cables in the cable routes.

### Fixing

The control wires must be grouped together in a shielded cables passing through the **control clamp** below the unit, to the left of the power terminal block.

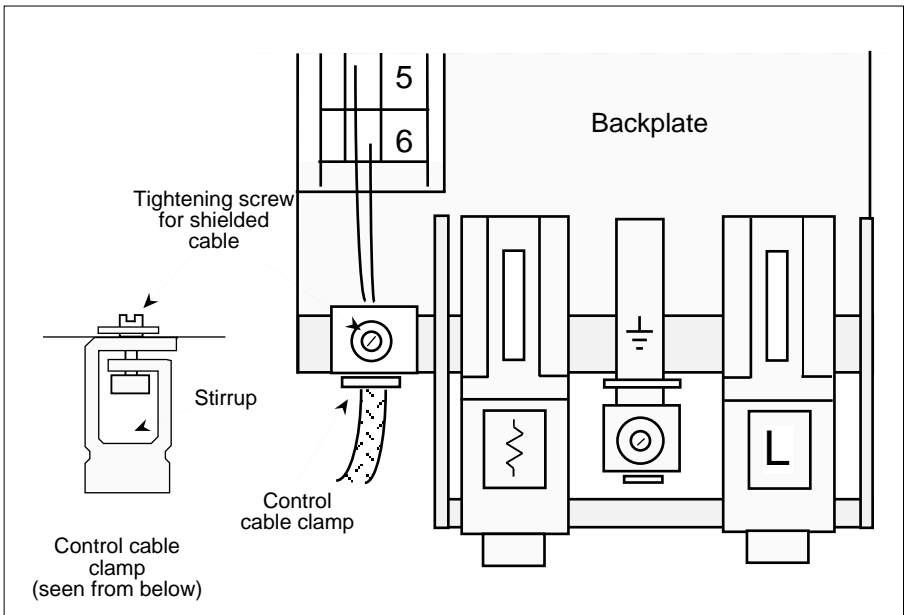


Figure 3-2 Layout of the control cable clamps

### Important !

To facilitate the earthing of the cable shield and to ensure maximum immunity to electromagnetic interference, the **metal cable clamp is fixed directly to the ground** of the unit.

## Connecting the shield to the ground

To **insert** the control cable and **earth** its shield:

- **Strip** the shielded cable as shown in figure 3-3,a.

The control wires must be long enough for the connection between the metal cable clamp and the control terminal block. The cabling inside the unit must be as short as possible.

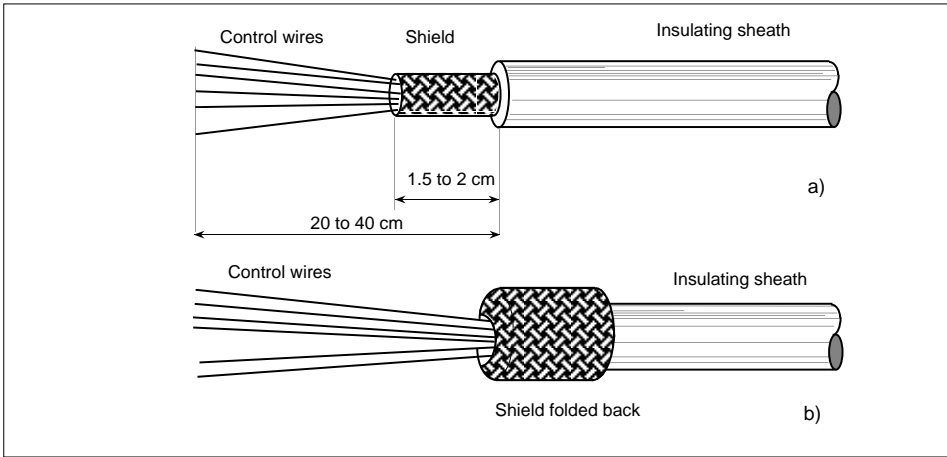


Figure 3-3 Control cable stripping

- **Fold back** the shield on the insulating sheath (figure 3-3,b)
- **Insert** the cable in the metal cable clamp so that the shield is located in the stirrup and does not pass the cable clamp.
- **Tighten** the stirrup (**4 x 1** flat screwdriver; tightening: **0.7 N.m.**)

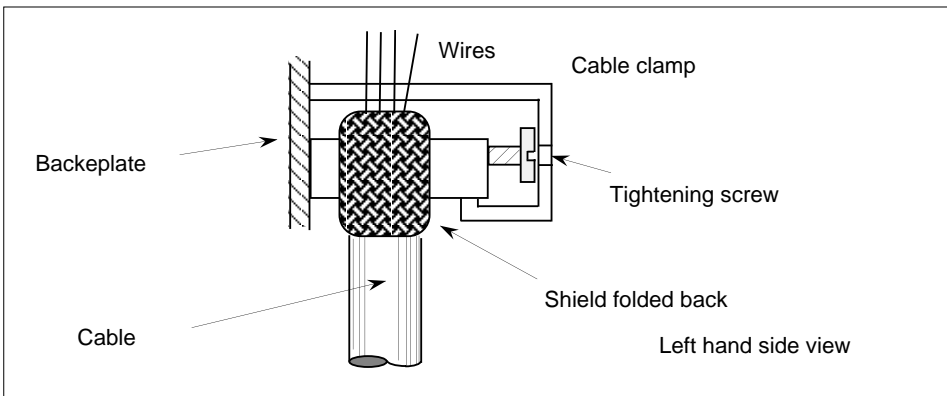


Figure 3-4 Cable tightening and shield grounding

**The possible diameters** of the cables with the shield folded back are **5 to 10 mm** per cable clamp.

## CONTROL TERMINAL BLOCK

The logic input signals are connected to the control terminal block on the control board (terminals **5** and **6**).

The terminal block is attached to the backplate and is accessible after the 450 thyristor unit has been unplugged.



### Danger !

Dangerous live parts may be accessible when the unit is unplugged.

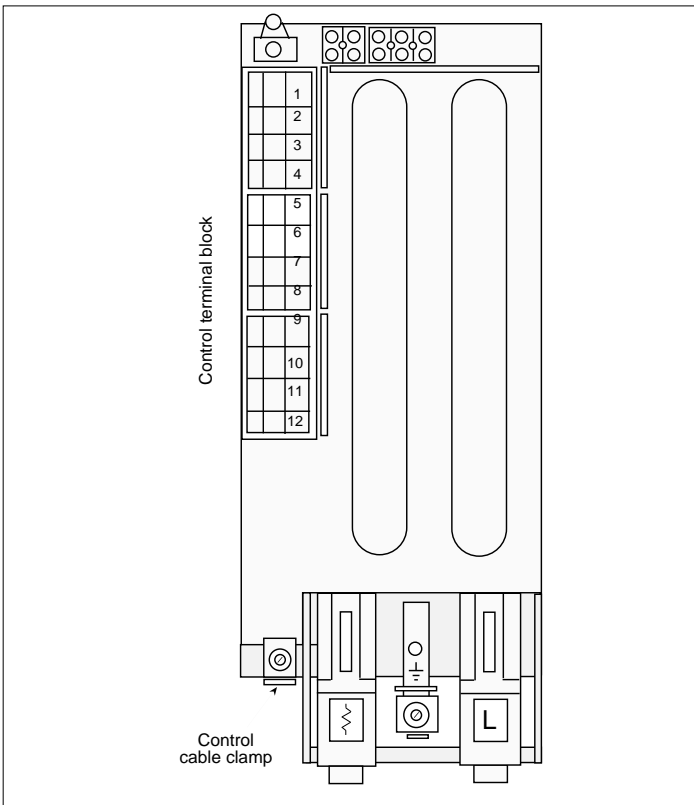


Figure 3-5 Control terminals of the 450 solid state contactor

Capacity of the terminals on the control terminal block: **0.5 mm<sup>2</sup> to 2.5 mm<sup>2</sup>.**  
 Tightening torque for the control terminals : **0.4 N.m to 0.6 N.m.**

## INPUT SIGNAL

### Configuration

The control wires are connected to the screw terminal block (control terminal block) located on the backplate. The logic signal from a temperature controller can be connected to terminals **5** and **6** of the solid state contactor (figure 3-5), taking account of the polarity (terminal **5** is the positive terminal, terminal **6** is negative).

The logic input is isolated from the power section by an opto-coupler.

The control terminal block is accessible with the 450 solid state contactor unplugged from the backplate.

To unplug the solid state contactor from the backplate:

- unlock the upper attachment by a quarter of a turn
- tilt the unit forwards to approximately 20 degrees from the horizontal.
- unplug the unit from the backplate.

---

#### **Danger !**



Before unplugging the unit, check that the heatsink is not hot.

---

---

#### **Danger !**



Dangerous live parts can be accessible when the unit is unplugged if the thyristor unit is switched on.

---

## Available input parameters

### Standard input

For thyristor firing to occur, the standard input signals must correspond to the parameters shown below:

#### Thyristor firing state

The standard input signal must be greater than or equal to :

	: <b>3.5 V</b> (consumption <b>1.5 mA</b> )
Maximum voltage	: <b>28 V</b>
Maximum current	: <b>25 mA</b>
Input impedance	: <b>2.5 kΩ</b> .

#### Thyristor non-firing state

To stop the thyristors firing, the standard input signal must be less than **2 V** (current less than **1 mA**)

### High sensitivity input (TTL option)

The **TTL** option provides a higher sensitivity input for the **450** solid state contactor without increasing the current consumption.

This input can be controlled by standard **TTL** logic.

#### Thyristor firing state

The **TTL** input signal must be greater than or equal to :

	: <b>2.5 V</b>
Current consumption	: <b>0.4 mA</b> at <b>2.5 V</b> <b>7 mA</b> at <b>4 V</b>
Maximum current	: <b>25 mA</b>
Input impedance	: <b>1 kΩ</b> at <b>3 V</b> .

#### Thyristor non-firing state

To stop the thyristors firing, the **TTL** input signal must be less than **1.5 V** (current less than **0.20 mA**)

## 'Multi-control' input (option)

The 'Multi-control' input, available as an option, is used when several solid state contactors must be driven by a single control logic signal with minimum current consumption.

### Thyristor firing state

The 'Multi-control' input signal of a solid state contactor must be greater than **2.5 V** (consumption **5 mA**).

The current must be limited externally to **25 mA**.

Input impedance: **500  $\Omega$** .

To protect the inputs of the **450** series solid state contactors (which are optionally fitted with a **low impedance** 'Multi-control' input), two types of configuration are possible.

The inputs must be connected:

- in series with a standard input unit or
- in series with a resistor.

### Thyristor non-firing state

To stop the thyristors firing, the 'Multi-control' input signal of a solid state contactor must be less than **1.2 V** at **0.5 mA**.

Connection in series with a **standard input**

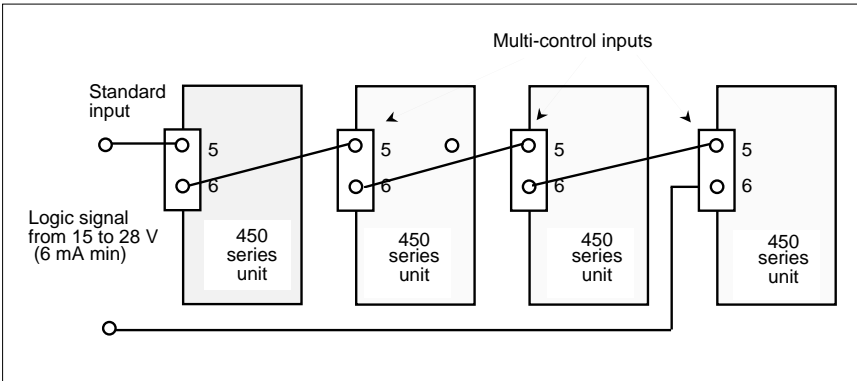


Figure 3-6 Configuration of 'Multi-control' inputs with a standard input

The maximum number of units which can be connected in series is:

$$N = (V - 7.5) / 2.5$$

where

V : control signal voltage

N : number of units in series.

Connection in series with a **protective resistor R**

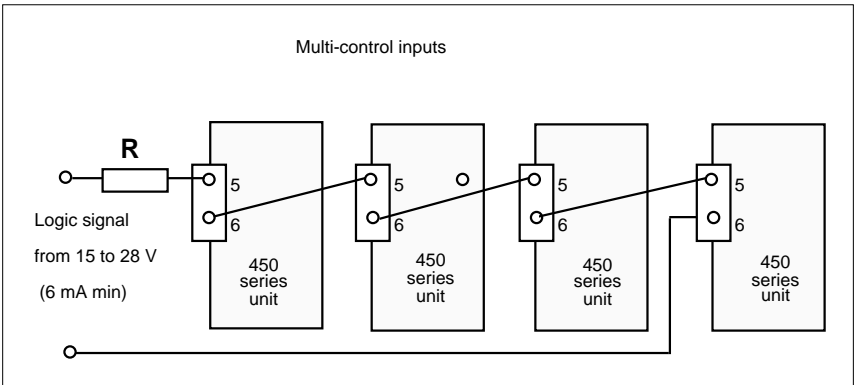


Figure 3-7 Configuration of 'Multi-control' inputs with a resistor

The value R of the protective resistor, expressed in kΩ, is:

$$R = (V - 2.5) / 6$$

where

V : control signal voltage

N : number of units in series.

R must correspond to  $R/N \geq 50 \Omega$  and must be able to dissipate **1 W**.



## USER TERMINAL BLOCKS

The terminal blocks used for connecting :

- the auxiliary supply voltage (for fan-cooled units)
- the PLF detection circuit supply (PLF option)
- the PLF alarm relay switch (PLF option)

are located at the top left of the backplate.

To access the user terminal blocks, the unit must be unplugged.

The connections are made to screw terminals.

The maximum wire cross-section is **2.5 mm<sup>2</sup>**; terminal tightening torque: **0.4 N.m to 0.6 N.m**.

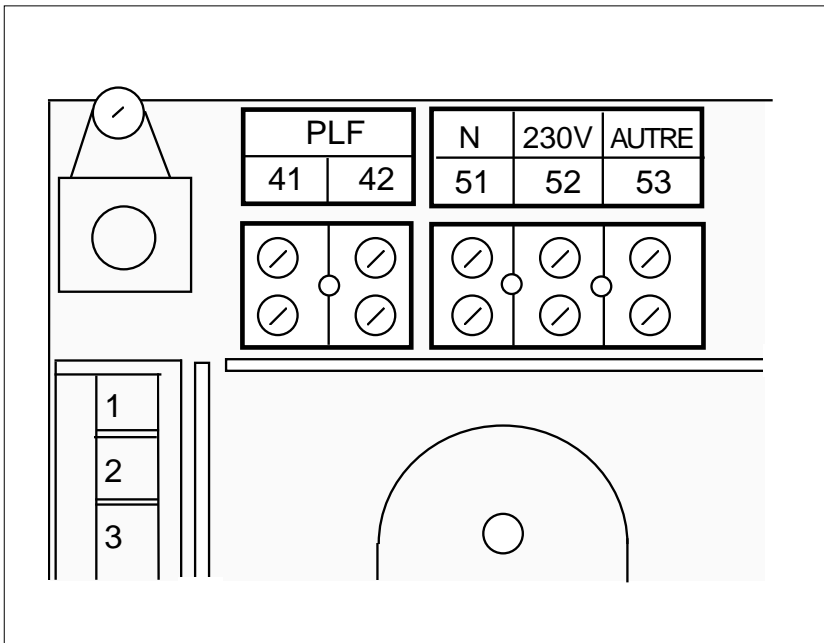


Figure 3-8 User terminal blocks (for fan-cooled units and units with PLF option)

## Auxiliary supply

The auxiliary supply voltage powers the fan (for models **453** and **454**).

Terminals **52** and **53** are used when the fan in models **453** and **454** has a **230 V** supply (with a voltage range from 200 V to 260 V).

Terminals **51** and **53** are used for fan voltages **other** than the range 200-260 V (110 or 400 V, for example).

Terminal **51** is the neutral or the second phase of the auxiliary supply.

The auxiliary supply voltage is specified in the solid state contactor's code.



### Attention !

- Each wire from the auxiliary supply which is connected to a **phase** must be protected by a **1 A** fuse.
  - For two phase control of a 3 phase application and with PLF option, auxiliary supply voltage must be the same as 3 phase line-to-line voltage
- 

Examples of different types of connection for the auxiliary supply are given in the wiring diagrams below (figures 3-11 to 3-15).

## PLF detection circuit supply

If the 'Partial load failure detection' **option** is used, terminal 51 must be connected to the neutral or to the second phase, **directly connected** to the load (figure 3-10, 3-12, 3-13).

Terminal **51** is common of the auxiliary supply.



### Attention !

For two phase control of a 3 phase application of the fan-cooled units with PLF option, auxiliary supply voltage must be the same as 3 phase line-to-line voltage.

---

## Alarm relay switch (PLF option)

The partial load failure detection (**PLF** alarm) relay switch, which signals the active alarm state, is connected on the user terminal block at the top **left** of the thyristor unit.

The switch output terminals are marked **41** and **42** on the terminal block label.

The PLF alarm relay is **de-energised in alarm state** and when the unit is switched off.

With **option 37**, the relay switch available between terminals **41** and **42**, is **open** in alarm state and in the event of a power cut.

With **option 37/83**, the alarm relay switch is **closed** in alarm state.

The partial load failure alarm relay switch is protected against disturbances by a **snubber** circuit on the driver board.

The alarm switch cut-off ability is **0.25 A** at **250 Vac** or **30 Vdc**.

The switch cut-off voltage must not exceed **250 Vac** in any circumstances.

The PLF alarm relay switch output is suitable for driving an alarm unit.

The PLF alarm relay is acknowledged either by switching off the thyristor unit or by a return to the nominal current.

## SINGLE-PHASE LOAD WIRING DIAGRAMS

The load current passes through the power terminals 'L' (Line) and 'L' (Load).

The other end of the load is connected either to the neutral or to the second supply phase, depending on the configuration selected. The 'L' terminal must be connected to the supply **line**. This configuration must be followed in order to avoid any malfunctions.

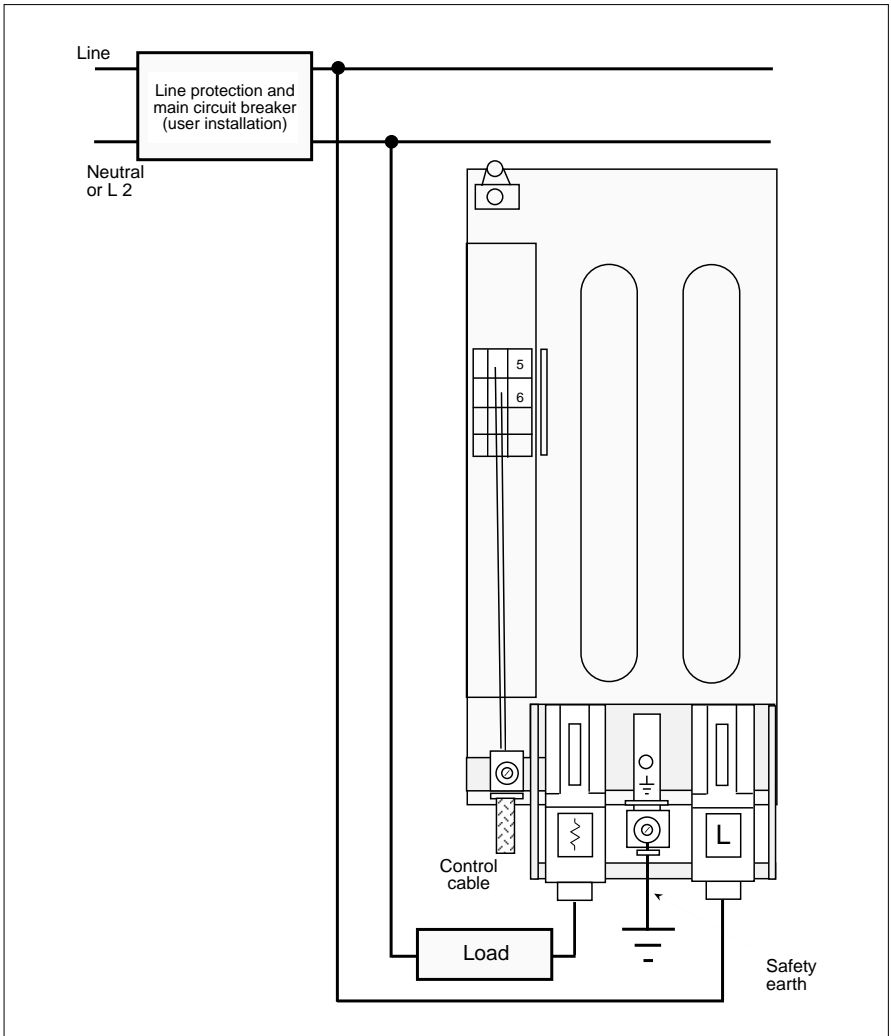


Figure 3-9 Single-phase configuration of a non fan-cooled 450 solid state contactor, without PLF option.

Figure 3-10 shows the wiring diagram for single-phase configuration of the 450 solid state contactor, non fan-cooled (models 451 and 452), with PLF option

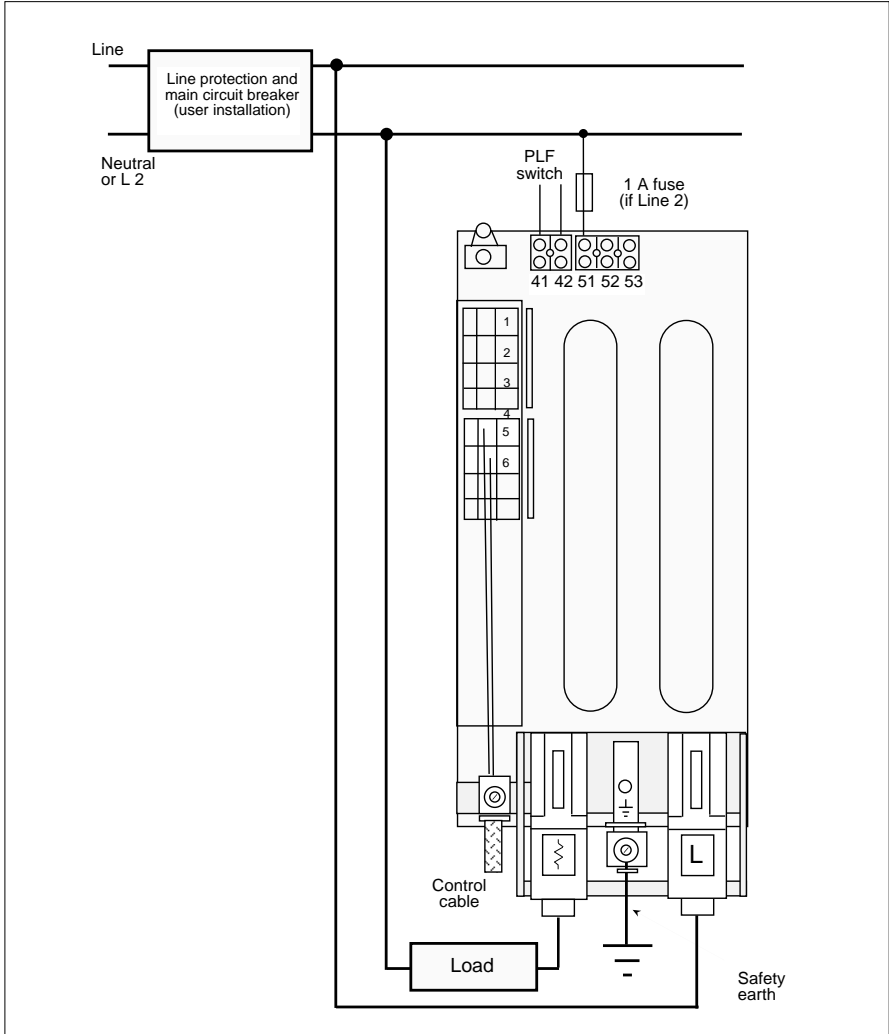


Figure 3-10 Single-phase configuration of the non fan-cooled 450 solid state contactor, with PLF option.

Figure 3-11 shows the single-phase wiring diagram for the **fan-cooled** 450 solid state contactor (models 453 and 454). The fan is powered at **230 V**.

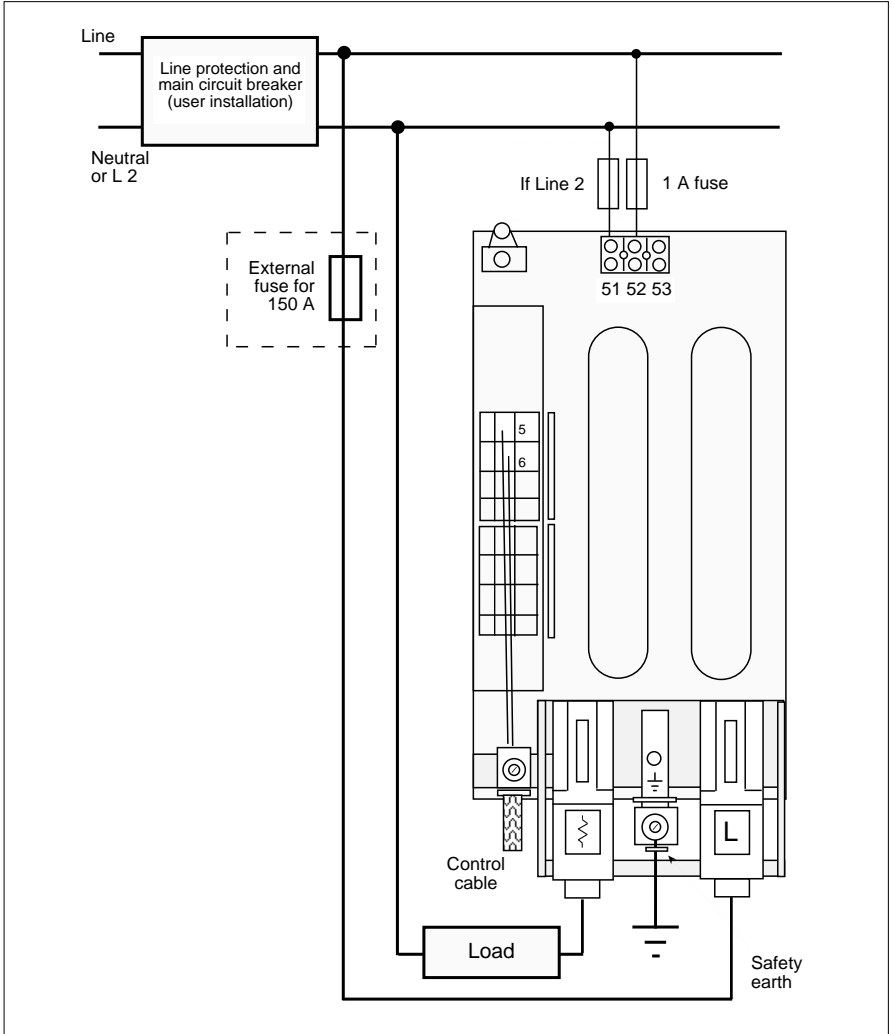


Figure 3-11 Single-phase connection of a **fan-cooled** 450 solid state contactor, 230 V supply

Figure 3-12 shows the single-phase wiring diagram for the **fan-cooled** 450 series solid state contactor (models 453 and 454). The fan is supplied at **380 V (other than 230 V)**.

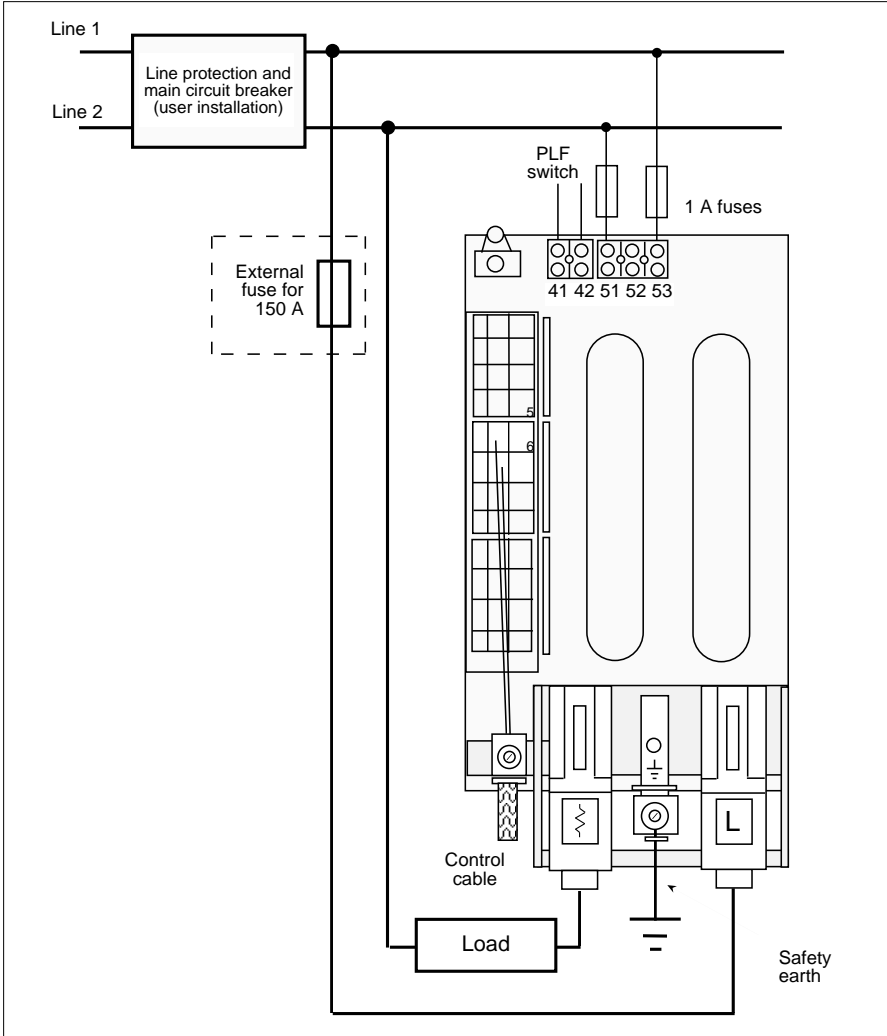


Figure 3-12 Single-phase configuration of the **fan-cooled** 450 solid state contactor, 380 V supply, PLF option

---

## THREE-PHASE LOAD WIRING DIAGRAMS

Although the **450** series solid state contactors are single-phase devices, they can be used to control three-phase loads.

In **three-phase use**, the connection of the power and the auxiliary voltage depends on the configuration and the load type.

Three-phase configurations use :

- **450** series solid state contactors or
- **460** thyristor units which drive the **450** solid state contactors in 'Master-Slave' operation.

The '**Slave**' logic output is provided on the control terminal block of the **460** for '**Master-Slave**' operation with solid state contactors.

The configuration of the auxiliary power supply voltage for **460** series thyristor units is described in the '460 User Manual' (Part No. **HA 174914**).

The three-phase configuration can be selected according to the guidelines below.

For connecting resistive loads with low temperature coefficient in Star with neutral or in Open delta, use one of the following configurations:

- three 450 series solid state contactors, or
- one 460 power thyristor unit and two 450 solid state contactors, or
- one TC3000 three-phase power thyristor unit.

For connecting resistive loads with low temperature coefficient in Star without neutral or in Closed delta, use one of the following configurations:

- two 450 series solid state contactors, or
- one 460 power thyristor unit and one 450 solid state contactor (two-phase 'Master-Slave' control), or
- a TC2000 power unit in two-phase control

The **450** solid state contactors must have 'Multi-control' type inputs connected in series.

Examples of different types of 3 phase connection for the power and the auxiliary supply are given in the wiring diagrams below (figures 3-13 to 3-15).



## Load in star without neutral or in closed delta (2 phase control)

For three-phase loads connected in star without neutral or closed delta (**3 wire** configuration), the use of **2 phase control** is recommended.

One supply phase is direct (not controlled).

In the 2 controlled phases, either can be connected :

- two **450** series solid state contactors or
- one **460** thyristor unit operating (as the 'Master') and a **450** solid state contactor ('Slave').

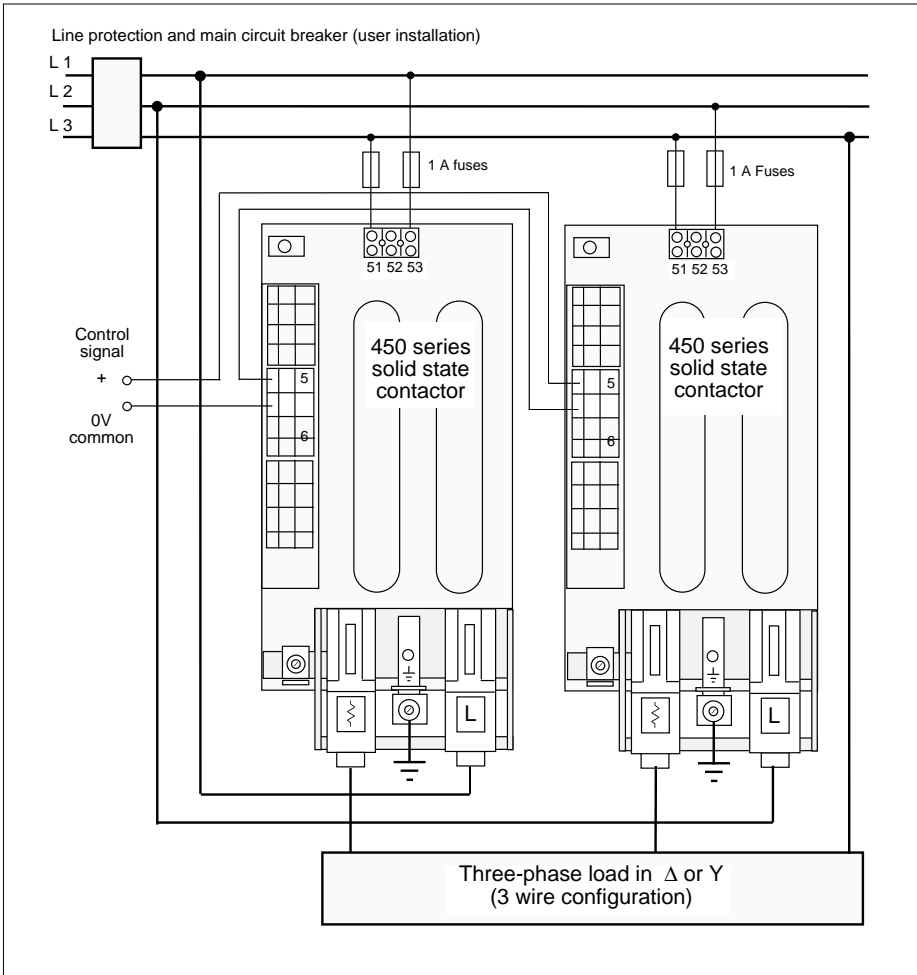


Figure 3-13 Configuration with two fan-cooled 450 units in 2 phase control (line-to-line voltage other than 230 V)

## Load in star with neutral

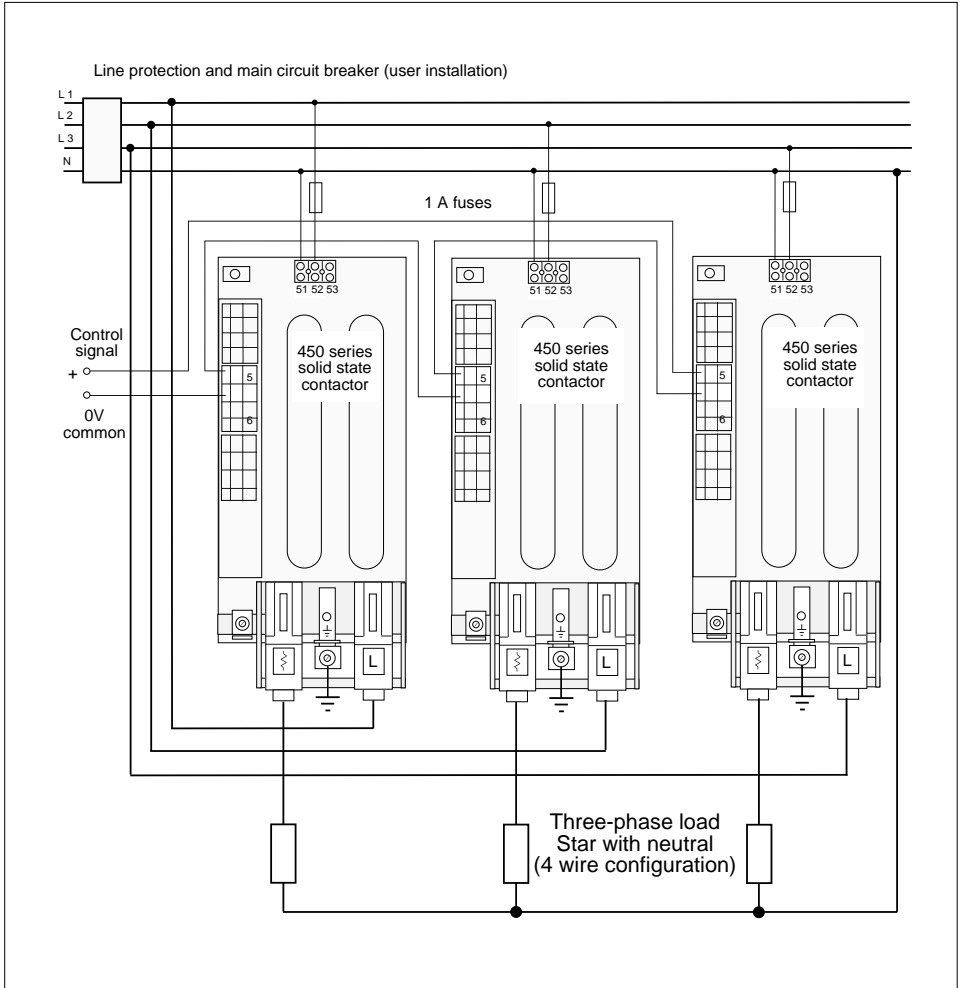


Figure 3-14 Configuration of three fan-cooled 450 units in 3-phase control of a star with neutral load.  
230 V between one line and neutral

## Load in open delta

To connect a load in open delta (6 wire configuration) use three 450 old state contactors. The power must be connected as shown on the figure below.

### Danger !



The power and electronics circuits are at the line-to-line voltage

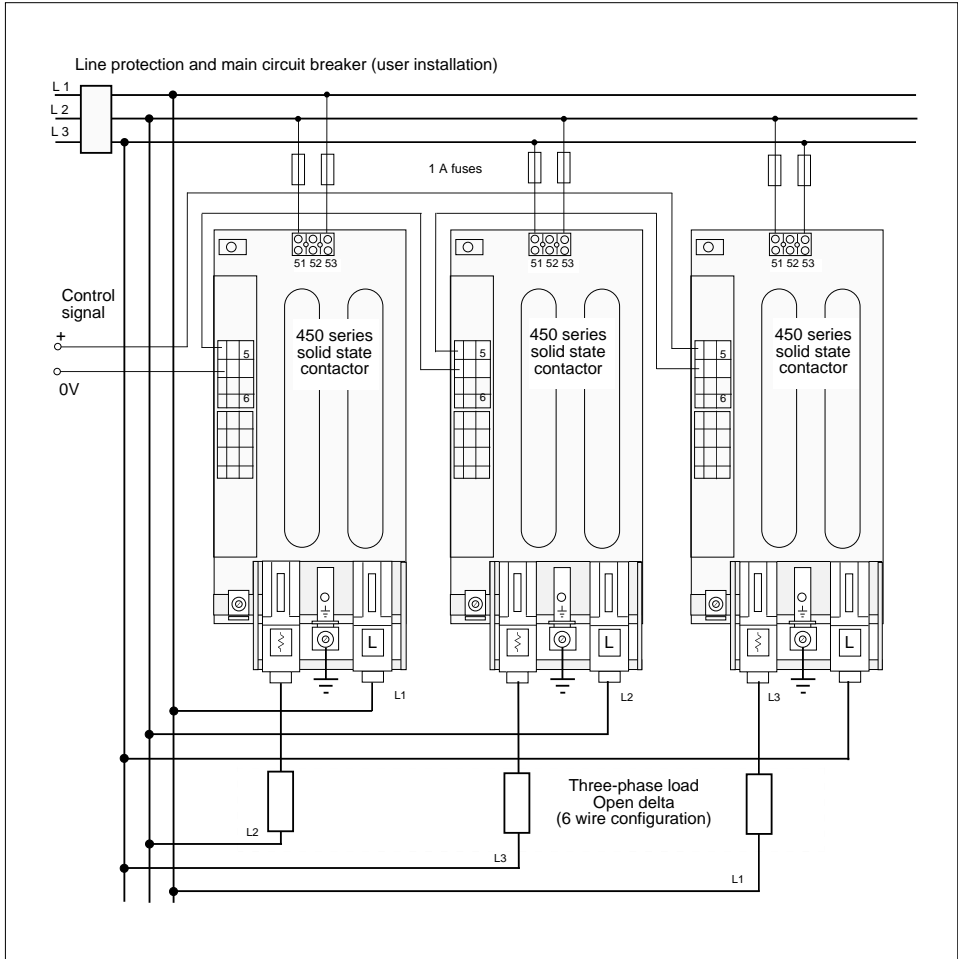


Figure 3-15 Wiring diagram for three fan-cooled 450 units, 380 V supply

## Chapter 4

# OPERATION

Contents	page
Thyristor firing mode .....	4-2
General .....	4-2
Logic mode .....	4-3
Partial load failure detection (option) .....	4-4

## Chapter 4 OPERATION

### THYRISTOR FIRING MODE

#### General

---

#### **Important !**

The thyristors of the 450 series units are fired and switched off at the supply voltage **zero**.

---

This firing mode eliminates the sharp supply voltage fronts applied to the load, **does not create supply disturbances and above all avoids generating interference.**

The **450** series **solid state contactors** use the **Logic (ON/OFF)** firing mode.

Thyristor firing lasts for a whole number of half waves.

The supply voltage applied to the load is modulated by an external controller (e.g. temperature controller), using the controller's logic output.

## 'Logic' mode

The **'Logic'** thyristor firing mode (also known as **'ON/OFF'** mode) controls a power in the load proportionally to the firing mode imposed by the control logic signal.

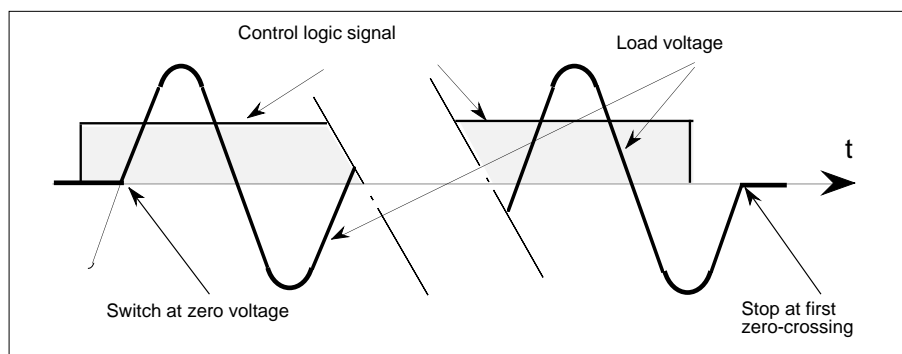


Figure 4-1 'Logic' firing mode

This firing mode is activated from a logic input signal greater than a 'firing state' threshold (full thyristor firing), and remains active until the input signal is not less than a 'cut-off state' threshold.

### Attention !



In logic firing mode (except for special applications), use a control signal whose external modulation time is less than **10 s** in order to reduce ageing from thermal fatigue in the various elements of the installation (heating elements, high speed thyristor protection fuse) and thus increase their service life.

## PARTIAL LOAD FAILURE DETECTION (OPTION)

The 'partial load failure' (**PLF**) alarm detects an increased load impedance due, for example, to the rupture of heating elements.

The sensitivity of the PLF circuit allows detection of a **25 %** increase in the load impedance, which ensures detection in the event of the rupture of **1** of **5** identical elements mounted in parallel.

On the 450 solid state contactor, the alarm is indicated by:

- an **indicator light** located on the front panel and marked '**Load Fail**' (lit when a partial load failure is detected)
- by the **switch** of an alarm relay (switch output available on terminals **41** and **42** on the user terminal block at the top left of the solid state contactor).

The alarm relay is **de-energised** in alarm state when the solid state contactor is switched on.

The alarm switch has a cut-off capacity of **0.25 A** under **250 Vac** or **30 Vdc**.

The switch cut-off voltage must not exceed **250 V** under any circumstances.

The PLF alarm relay is acknowledged either by switching off the solid state contactor or by a return to the nominal current.

The PLF alarm relay switch is **open** in alarm state or in the event of a supply failure (option **37**).

With option **37/83**, this switch is **closed** in alarm state or in the event of a supply failure.

---

## Chapter 5

# COMMISSIONING PROCEDURE

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Safety during the commissioning procedure .....	5-2
Checking the characteristics .....	5-3
Load current .....	5-3
Network voltage .....	5-3
Electronics supply voltage .....	5-3
Input type .....	5-3
Partial load failure detection .....	5-3
Partial load failure detection adjustment .....	5-4
Overload (option) .....	5-6



## Chapter 5 COMMISSIONING PROCEDURE

**Read carefully before commissioning the solid state contactor**

### SAFETY DURING THE COMMISSIONING PROCEDURE

---

#### 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.

---

---

#### Danger !



- **Never use** a solid state contactor with a supply voltage greater than the nominal voltage specified in the coding.
  - Dangerous live parts can be accessible when the unit is dismantled from its backplate.
  - Access to internal components of the thyristor unit is prohibited to users who are not authorised to work in industrial low voltage electrical environments.
  - The temperature of the heatsink can be greater than 100 °C.  
Avoid any contact with the heatsink, even momentarily, when the solid state contactor is operating.  
The heatsink remains hot for approximately 15 minutes after the unit has been switched off.
-

---

## CHECKING THE CHARACTERISTICS



---

### Attention !

Before switching on, make sure that the unit's **identification code** corresponds to the coding specified in the order and that the characteristics are **compatible with the installation**.

---

### Load current

The maximum load current must be less than or equal to the nominal current rating of the solid state contactor, taking account of supply and load variations.

**In three-phase use** for connecting **3** identical loads in a **closed delta**, the line current of the solid state contactor is  $\sqrt{3}$  **times as large** as the current in each branch of the load.

### Supply voltage

The nominal voltage rating of the solid state contactor must be greater than or equal to the supply voltage used. In three-phase use,, the nominal voltage of the solid state contactor must be greater than or equal to the **line-to-line** voltage.

### Electronics supply voltage

The electronics supply voltage for fan-cooled units is selected by the choice of the transformers. This selection is carried out in the factory, depending on the electronics supply voltage code.

### Input type

The input type (standard, multi-control or high sensitivity) must be compatible with the type of control signal used.

### Partial load failure detection

The voltage used for the PLF detection circuit is that of the load supply. Consequently, this voltage must correspond to the power voltage.



---

### Attention !

The relay switch of the PLF alarm must be connected to a circuit in which the voltage does not exceed 250 V in any circumstances (230 V single-phase or three-phase supply).

---

## PARTIAL LOAD FAILURE DETECTION ADJUSTMENT

The partial load failure (PLF) detection is adjusted using the potentiometer labelled '**Adjust/Seuil**' on the front panel (see figure 5-1).

The purpose of this adjustment is to adapt the PLF detection with the maximum sensitivity to the real thyristor unit load.

To guarantee correct operation of the PLF detection circuit, the load current must not be less than **10 %** of the thyristor unit nominal current (if a bulb is used as a load for the thyristor unit test in the workshop, the PLF detection indicator light '**Load Fail.**' is always lit).

During commissioning, the following adjustments must be made:

- First of all, make sure that the thyristor unit is connected correctly and that the thyristors are in permanent firing mode.
- Turn the PLF detection adjustment potentiometer completely **anti-clockwise** and check that the '**Load Fail.**' indicator light on the front panel is off.
- Turn the '**Adjust/Seuil**' potentiometer slowly **clockwise** until the indicator light comes on.
- Turn the potentiometer slowly anti-clockwise until the '**Load Fail**' indicator just switches off.

The potentiometer adjusted in this way is used to obtain maximum partial load failure detection sensitivity for the load really connected to the thyristor unit.

The push button on the front panel (labelled '**Test**'), which simulates a current drop of **10%** in the load, is used to check the operation of the PLF circuit without having to disconnect the load. This button should place the thyristor unit **in the alarm state** if the adjustment has been performed correctly.

---

### Important !

The PLF detection circuit uses the load voltage.

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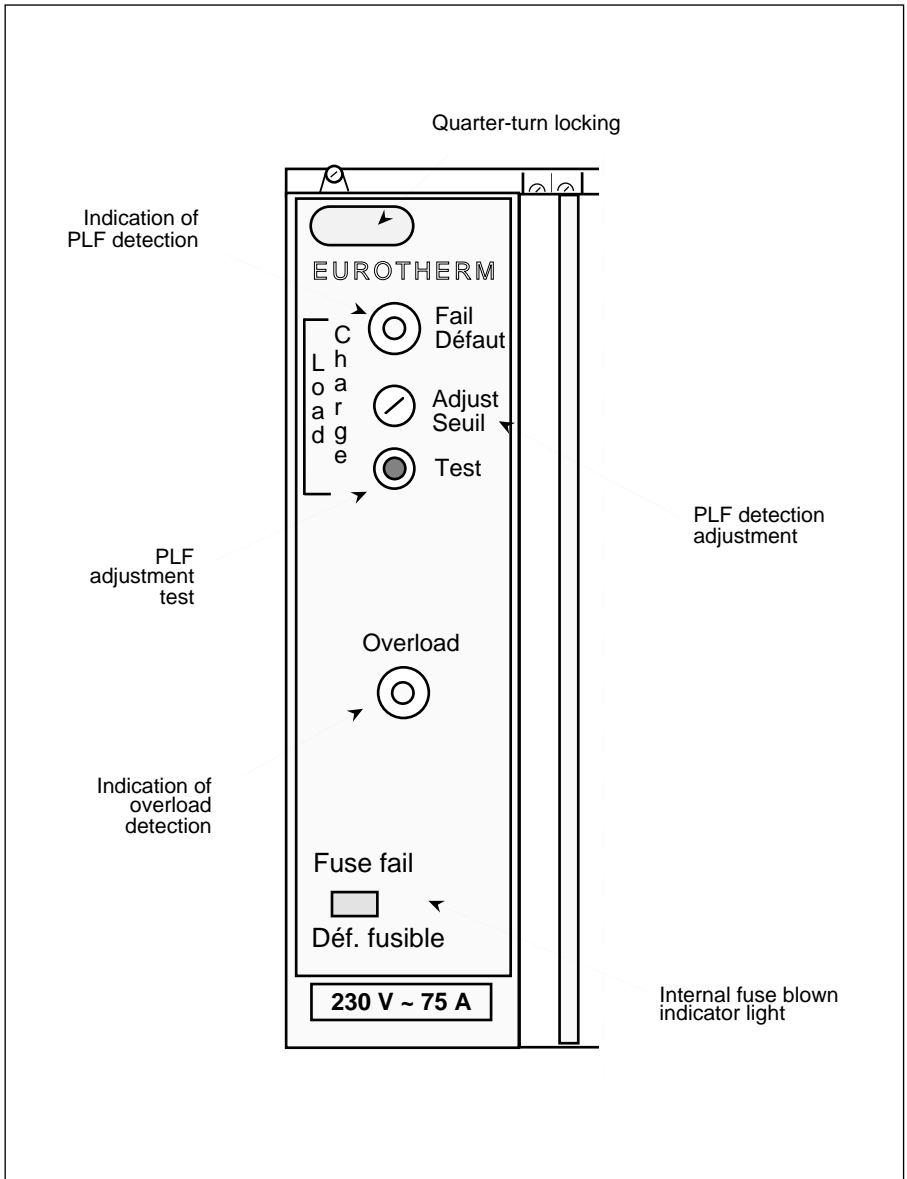


Figure 5-1 Front panel of the 450 solid state contactor (with PLF and overload options)

## OVERLOAD (Optional)

The '**Overload**' alarm detects a load current increase more than **150 %** of the unit's nominal current due to a decrease in the load resistance.

The overload information is generated by the same circuit as the partial load failure detection.

This explains why the 'Overload' option is only possible with the PLF option.

The **adjustment** performed for the PLF detection is also used to adjust the overload detection.

When an overload is detected:

- the unit operation is stopped,
- the '**Overload**' indicator light on the front panel is lit,
- the alarm relay changes state.

The 'Overload' alarm is **stored**.

The 'Overload' alarm is **acknowledged** by switching off the 450 solid state contactor.

## Chapter 6

# MAINTENANCE

Contents	Page
Thyristor protection .....	6-2
Thyristor protection fuse .....	6-3
Replacing the high speed fuse .....	6-4
Electronics supply protection fuse .....	6-4
Maintenance .....	6-5
Tools .....	6-6

## Chapter 6 MAINTENANCE

---

### Danger !



The solid state contactor must be maintained by qualified personnel, authorised to perform work in a low voltage industrial electrical environment.

---

## THYRISTOR PROTECTION

The thyristors of the 450 series solid state contactors are protected as follows:

- an internal high speed fuse against over-currents
- an RC snubber circuit and a varistor against too fast voltage variations and transient over-voltages when the thyristors are not firing.
- a thermal switch for models **453** and **454**.

In the event of accidental overheating of the cooler or if the fan stops, the thermal switch opens, which causes the thyristor firing to be stopped.

---

### Danger !



- The internal thyristor protection fuse does not **protect the installation** in any circumstances.
  - The user's installation must be **protected upstream** (non high-speed fuse, thermal or electromagnetic circuit breaker, appropriate fuse-isolator) and must comply with current standards.
-

## THYRISTOR PROTECTION FUSE

The 450 series solid state contactors are supplied with the internal fuse fitted (up to 125 A). For the 150 A nominal current, the external fuse must be ordered separately.

### Attention !



The high speed fuse is only used for the internal protection of the **thyristors** against wide amplitude over-loads.

Table 6-1 contains all the references of the original internal fuses (as fitted in the factory) and the fuses which are authorised for replacement during maintenance.

The guarantee of the solid state contactor unit is subject to the use of the high speed fuses specified in this table.

### Attention !



The use of **other fuses** **invalidates the guarantee** of the solid state contactor.

Model	Nominal current	Max. voltage	References				
			Eurotherm	Suppliers			
				Ferraz	I.R.	Brush	G.E.C
451	15 A	240 V 480 V	CH 380 163 CH 110 153	Q076650 X220958	E 1000.15	15 ET	
	25 A	240 V 480 V	CH 380 253 CH 110 253	R076651 V082450	E 1000.25	25 ET	GSG 1000.25
	40 A	480 V	CH 110 044	C220963	E 1000.40	40 ET	GSG 1000.40
	55 A	480 V	CH 110 753	S075893	E 1000.75	75 ET	--
452	55 A	480 V	CH 120 094	A099958	EE 1000.90	90 EET	--
	75 A	480 V	CH 120 114	B099959	EE 1000.110	110 EET	GSG1000.110
453	100 A	480 V	CH 120 154	C099960	EE 1000.150	150 EET	GSG1000.150
454	125 A	480 V	CH 120 154	C099960	EE 1000.150	150 EET	GSG1000.150
	150 A External fuse Fuse holder		CH 340 025 CP 171 482	H300019 V98711	Overall dimensions of 'Fuse and fuse holder' assembly (mm) 220 x 50 x 110		

Table 6-1 Recommended high speed fuses for thyristor protection



## REPLACEMENT OF THE INTERNAL HIGH SPEED FUSE

The 450 series solid state contactors (nominal currents from 15 to 125 A) are fitted with **internal** high speed fuses.

These fuses are mounted at the rear of the pluggable module.

For the 150 A nominal current, the high speed fuse and its holder are **external** and ordered separately from the thyristor unit.

If the internal fuse **blows**, a **red indicator light** on the front panel of the unit lights up (except for the 150 A nominal current unit).

To replace the internal fuse:

- unplug the module from its backplate
- loosen the two fuse attachment screws
- fit the appropriate fuse (the references are given in table 6-1).

Tightening torque **3.5 N.m**.

## ELECTRONICS SUPPLY PROTECTION FUSES

These fuses should be installed in the cables which connect the electronics power supply voltage (see 'Cabling' chapter).

Electronics supply voltage (max)	1 A fuse 6.3 x 32 mm	Fuse-holder isolator	Overall 'Fuse-isolator' dimensions (mm)
480 V	CS174289U1A0	CP174293	63 x 15 x 52

Table 6-2 Recommended fuse for protection if the electronics supply connection

---

## MAINTENANCE

The **450** solid state contactors must be mounted with the heatsink vertical, with no obstructions above or below which could reduce or hinder the air flow.

---

### Attention !



If several units are fitted in the same cabinet, arrange them so that the air expelled by one unit **is not taken in** by the unit placed above it.

---

For correct cooling of the unit, it is recommended that the **heatsink** and the fan protection **mesh** be cleaned periodically, depending on the degree of pollution of the environment.

---

### Danger !



Every **six months**, check that the screws holding the power cables and the safety earth are correctly **tightened** (see 'Cabling').

---

## TOOLS

Operation	Flat screwdriver (mm)	Wrench	Electrical equipment
Attachment of the backplate	Depending on M4 screw heads selected		
Safety earth connection	1 x 6 (451) 1 x 8 (452 to 454)		
Power connection (supply side) and load connection	1 x 8 (451 to 453)	HEX17 M10 (454)	
Thyristor fuse replacement	2 x 15		
Cable clamp tightening	0.5 x 3.5		
Control and electronics power supply voltage connection	0.5 x 3.5		
Commissioning and adjustment	0.4 x 2.5		RMS ammeter or clip.

Table 6-3 Tools



**EUROTHERM**

## **Eurotherm Companies**

### **Australia**

**Eurotherm Pty Ltd**  
Unit 3  
16-18 Bridge Road  
Hornsby New South Wales 2077  
Telephone: (61)-2-477 7022  
Fax: (61)-2-477 7756

### **Hong Kong**

**Eurotherm Ltd**  
Unit D  
18/F Gee Chang Hong Centre  
65 Wong Chuk Hang Road  
Aberdeen  
Telephone: (852)-873 3826  
Telex: 69257 EIFEL HX  
Fax: (852)-870 0148

### **Norway**

**Eurotherm A/S**  
Post Boks 199  
N-1412 Sofiemyr  
Telephone: (47) 66 80 33 30  
Fax: (47) 66 80 33 31

### **Austria**

**Eurotherm GmbH**  
Geiereckstrasse 18/1  
A 1110 Vienna  
Telephone: (43)-1-787 601  
Telex: 1132000 EI AUT A  
Fax: (43)-1-787605

### **Ireland**

**Eurotherm Ireland Ltd**  
I.D.A. Industrial Estate  
Monread Road  
Naas Co Kildare  
Telephone: (353)-45-79937  
Telex: 60745 ETMA EI  
Fax: (353)-45-75123

### **Spain**

**Eurotherm Espana SA**  
Calle La Granja 74  
Pol. Ind. Alcobendas  
28100 Alcobendas  
Madrid  
Telephone: (34)-1-661 6001  
Fax: (34)-1-6619093

### **Belgium**

**Eurotherm BV**  
Herentalsebaan 71-75  
B-2100 Deurne Antwerpen  
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