TU2170

Model

EUROTHERM

Two phase control
for tree phase loads
Digital
communications

User's Manual

For further information, please contact your EUROTHERM agency. Our technicians will be pleased to advise you and eventually to assist you with the commissioning of your installation.

Every effort has been made to ensure the accuracy of the information in this manual. However, in order to maintain our technical lead we are continuously improving our products which could, without notice, result in amendments, errors and omissions. We cannot accept responsibility for damage, injury, loss or expenses resulting therein.

User's Manual TU2170 Thyristors Units with communications
Part No. HA 173939 Iss 2 03/94

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1. PRODUCT IDENTIFICATION

1.1. General description

TU2170 thyristor units are designed to control the power of three-phase loads.

The TU2170 thyristor unit controls two phases of a three-phase load such as low temperature coefficient resistive elements or short wave infra-red heating tubes.

The **TU2170** thyristor unit comprises **two single-phase channels** mounted on a common heatsink.

There are **two versions** of the **TU2170** thyristor units **which differ mechanically**.

The **first version** is designed and optimised for controlling nominal currents between **40 and 125 A** with line voltages of up to **500V** maximum; **external** ultra-fast fuses.

The **second version** is designed to control nominal currents up to **250A** with maximum line voltages of **660V**; **internal** ultra-fast fuses.

Each version has different **mounting** and **connection requirements**.

Each channel is synchronised with the phase which it controls.

The operation of the **TU2170** is microprocessor controlled.
The **microprocessor** board (control and communication circuit - code **CCC**), enables the **TU2170** thyristor unit to offer the following functions:

- **two modes of power regulation**
  V^2 or V x I
- **two modes of thyristor firing:**
  fast burst or single cycle
- voltage, current and load **monitoring**
- **digital communication.**

The **TU2170** thyristor unit comprises **2 logic firing** boards (**"thyristor firing boards"**) one for each channel, a **"microprocessor board"** (CCC Boardand a **"power supply board"** (see Fig **1.1** and **1.2**).

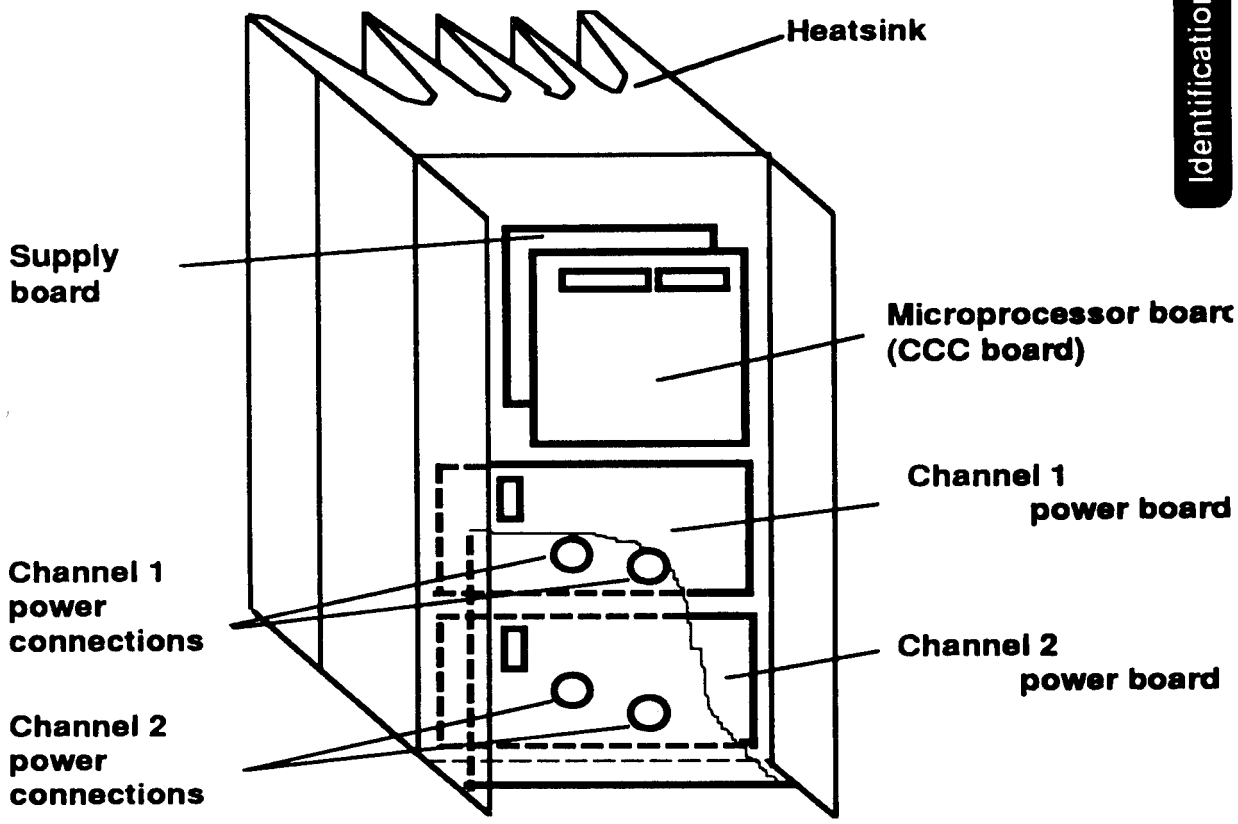


Figure 1.1. TU2170 Thyristor unit circuit boards (40 to 125A)

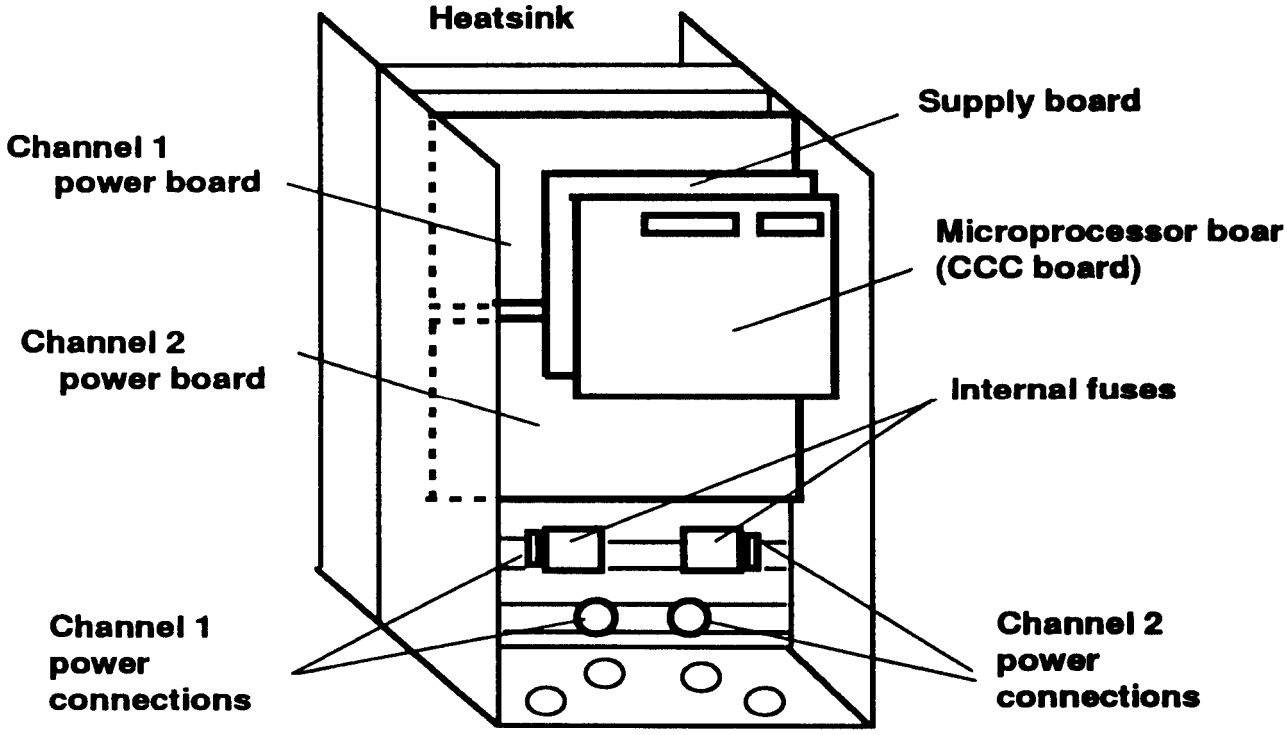


Figure 1.2. TU2170 Thyristor unit circuit boards (250A)

Depending on the choice of the microprocessor board configuration, the **TU2170** can be used with **analogue signals** or be remotely controlled by a **digital control system**, such as the **PC3000 EUROTHERM** or other suitable system.

The thyristor units may be controlled **by digital communication** with a **digital** or an **analogue setpoint**.

The input analogue signals can be chosen from four voltage levels:

0-5 V ; 1-5 V ; 0-10 V ; 2-10 V

or two current levels:

0-20 mA et **4-20 mA.**

A **green LED** indicates that the control electronics power supply is operating (ie. voltage V_{cc} is present).

Two **red LEDs** on the **power boards**, visible through the transparent front cover, show the command signals for each channel.

An alarm system detects load failures and voltage or current variations.

Indication of fault conditions is by **both digital communication** and **by fail-safe** relay.

Current monitoring ensures that the unit shuts down when the pre-set current threshold is exceeded.

On the **CCC** board, two light emitting diodes (**LEDs**) light to indicate a **total load failure**. One LED lit indicates that a **partial three-phase load failure** has occurred.

The two other red LEDs on the CCC board are not used.

The **digital communication** allows both remote control and monitoring with a significant reduction of low level wiring compared with analogue systems.

The digital communication uses the integrated **RS422** (or **RS485**) bus.

Data can be sent using either the **EUROTHERM** protocol or using **JBUS®** or **MODBUS®** protocols.

The data transfer speed is **9600 bauds**.

For more details on the digital control of the **TU** thyristor unit range, refer to the "**TU series digital communication user manual**", (ref **HA 173 688** - Issue 1 - 02/92).

Appendix 4 of this user manual shows the **characteristics** of the **TU2170** thyristor unit digital communication.

If there is an interruption in the digital communication, detected by an external system, the thyristor unit **control automatically** defaults to whatever setpoint is present on the analogue inputs.

1.2. Identification on label

All the data relating to the thyristor unit characteristics, when manufactured, is shown on an identification label located **inside** on the upper **left-hand** side of **250A** thyristor units and **outside** on the **left-hand** side of the **40** to **125 A** units.

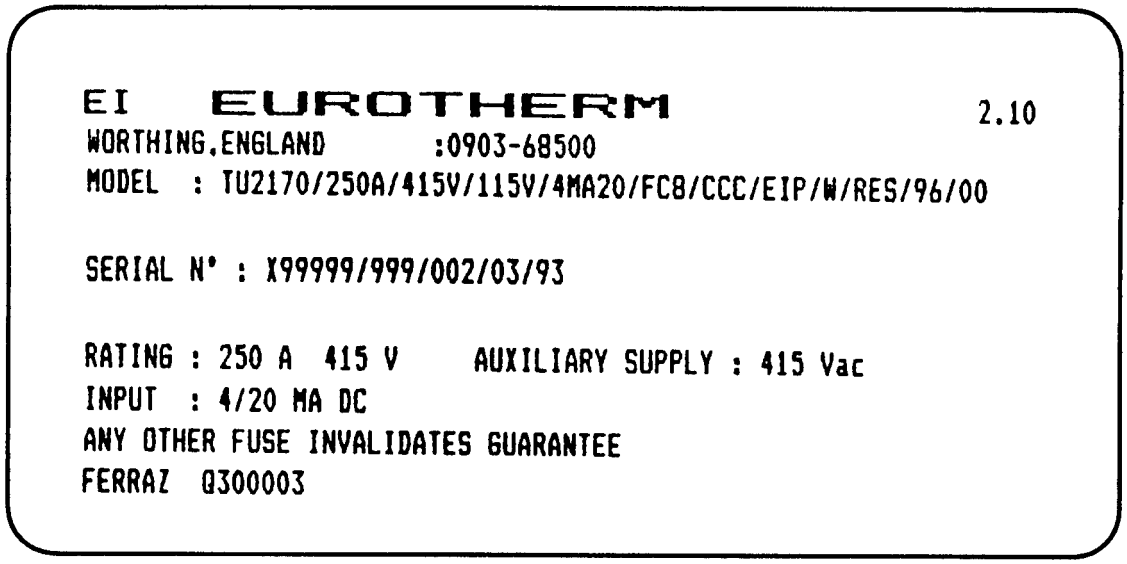


Figure 1.3 Example of a TU2170 identification label

Nominal current **250 A;**
Maximum voltage **415 V;**
Fan supply voltage **115 V;**
Anaglogue input for the microprocessor board (CCC) :
4 - 20 mA DC

Code: **FC8, CCC, EIP, W, RES, 96 , 00** - refer to appendix 1.

IMPORTANT:

Note that certain characteristics (input signal type, thyristor firing mode, type of feedback, etc) are accessible to the user. The accuracy of the data referring to these characteristics on the label cannot be guaranteed after reconfiguration.

2. INSTALLATION

Thyristor units may be installed in either of the two following ways.

- **Bulkhead** mounting
- **Through** panel mounting

Through panel mounting allows 80 to 90% of the heat generated by the thyristor units to be dissipated outside the electrical enclosure.

The dimensions of the thyristor units are given in **appendix 3**.

Note:

*When thyristor units are installed one above each other, it is important to leave at least **10cm** between each unit to enable adequate cooling.*

2.1. Mounting Details TU2170 (40 to 125A)

The mounting arrangement depends on the **type of mounting** chosen and the **cooling system** used.
The **40 to 75A** units are **convection cooled**.
The **100A and 125A** units are **fan cooled**.

Two fixing brackets (**convection cooled** units) or **one bracket** and **two fixing lugs** (**fan cooled** units) are used for mounting.

2.1.1. Mounting convection cooled units (40 to 75A)

A. Bulkhead mounting

a. Fix the two brackets on the panel using **M6** screws. Ensure that the drilling dimensions (see fig. **2.1**) are respected.
The lower bracket should be fixed through the holes at each end.
The upper bracket should be fixed by a central screw through the oblong hole.
b. Position the unit on the lower bracket. Grooves at the rear of the heat-sink are used for this purpose.
c. Loosen the central screw holding the upper bracket to allow the bracket to be raised. Position the unit and then slide the upper bracket downwards into the grooves in the heat-sink.
d. Once the upper bracket is positioned in the heat-sink, tighten all screws.

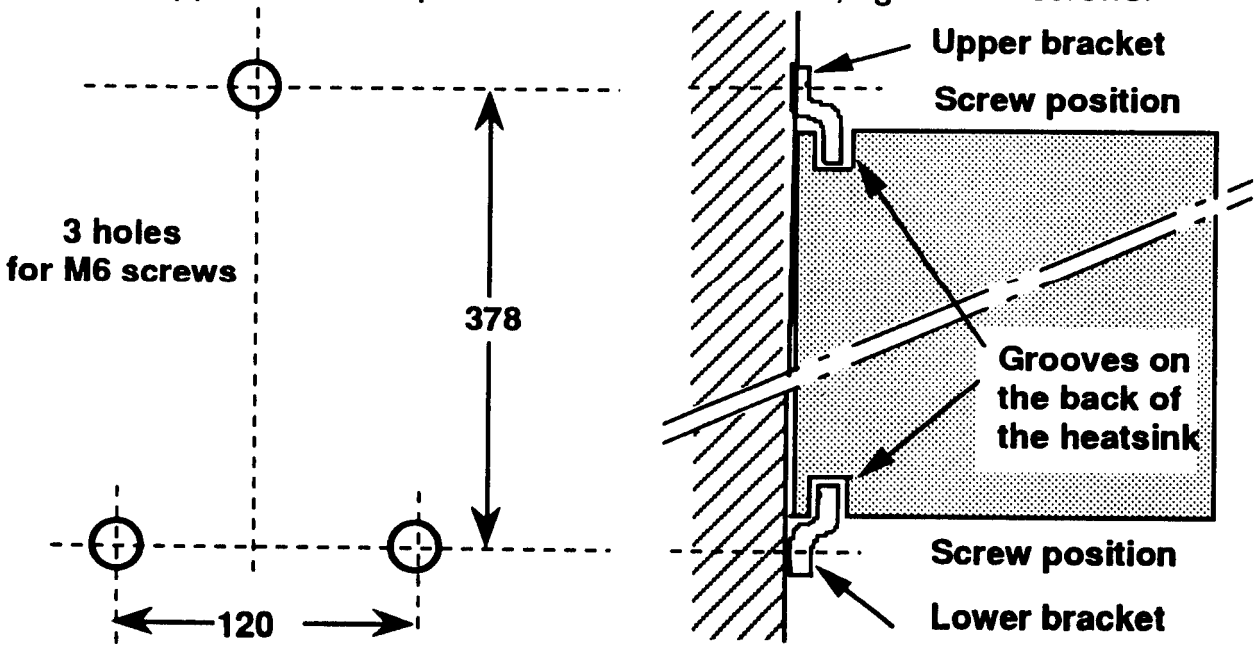


Figure 2.1. Drilling details and mounting of a convection cooled unit, bulkhead mounting

B. Through-panel mounting

a. Fix the lower bracket to the panel using **two M6** screws. Ensure that the drilling dimensions (see fig. **2.2**) are respected.
The bracket should be fixed through the holes at each end.

b. Position the unit in the panel cut-out then lower on to the lower bracket. Grooves in the **middle** of the heat-sink are used for this purpose.

c. Position the upper bracket in the grooves in the heat-sink then fix in position.
The upper bracket is held by a **central** screw through the oblong hole.

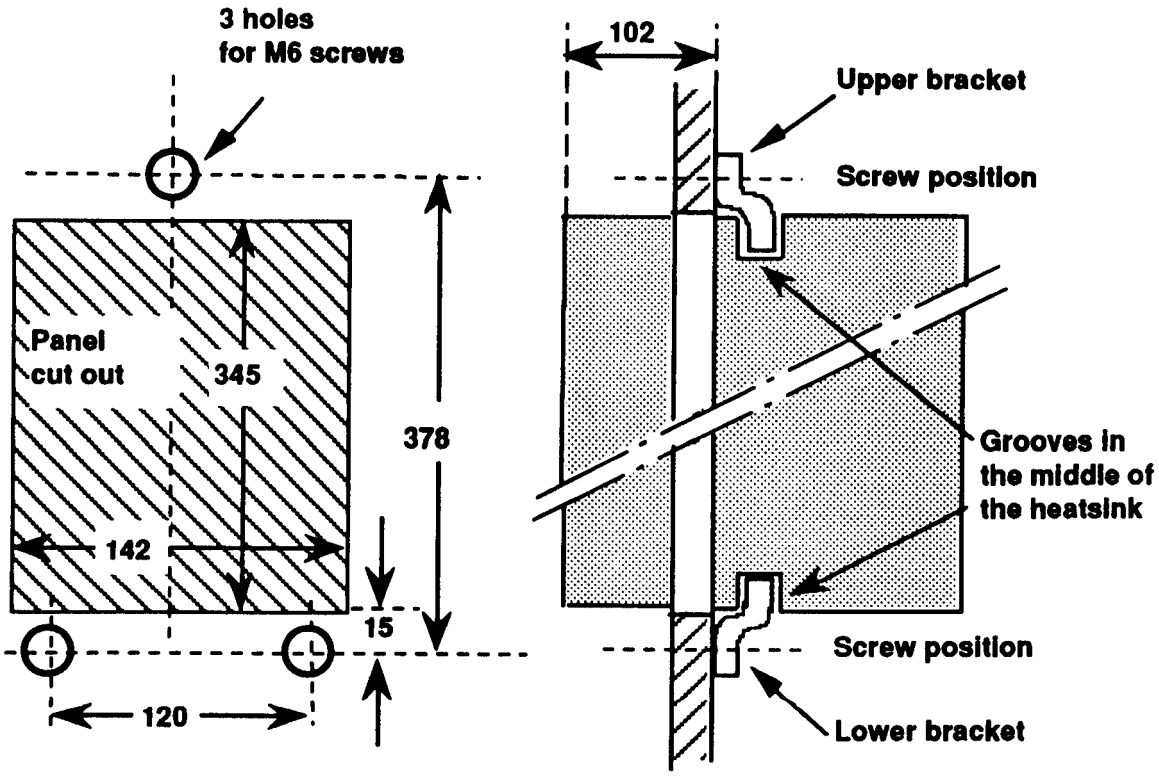


Figure 2.2. Drilling dimensions, panel cut-out and mounting of a convection cooled unit, through panel mounting

2.1.2. Mounting fan cooled units (100 and 125A)

A. Bulkhead mounting

a. Fix the upper bracket to the panel with a **M6** screw through the oblong hole.

b. Position the two lower **M6** screws into the panel. Ensure that the drilling dimensions (see fig. **2.3**) are respected.

c. Lower the thyristor unit into position. Insure that the **two mounting lugs** located on the **lower** part of the heat-sink are engaged on the two screws mounted in b, above.

d. Loosen the central screw of the fixing bracket, slide the fixing bracket up and position the thyristor unit. Slide the fixing bracket down into the heat-sink grooves.

e. When the mounting bracket is fixed in the heat-sink groove, tighten all screws.

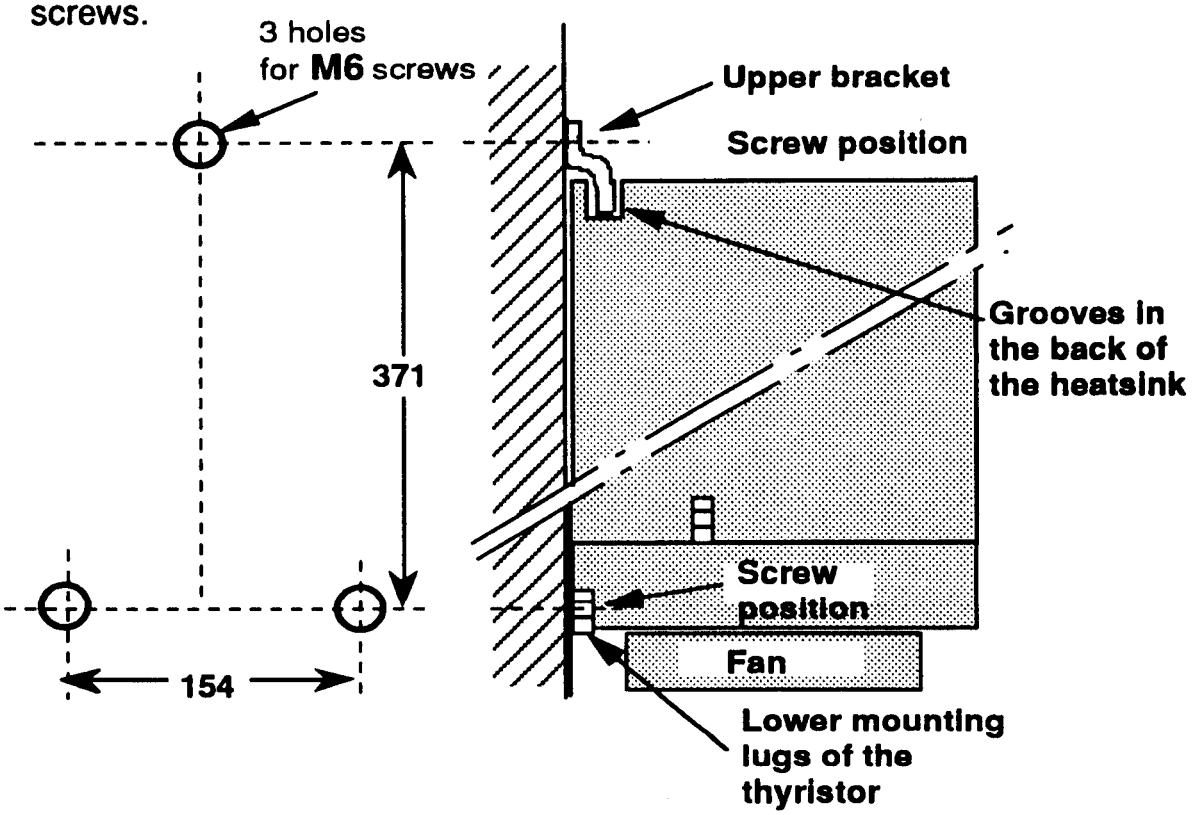


Figure 2.3. Drilling details and mounting of a convection cooled unit, bulkhead mounting

B. Through-panel mounting

a. Fit the **two** lower **M6** screws in the panel. Ensure that the drilling dimensions, (see fig. **2.4**), are respected.

b. Lower the thyristor unit into position. Insure that the **two mounting lugs** located in the **middle** of the lower part of the heat-sink are engaged on the two screws mounted in b, above.

c. Position the upper bracket into the groove in **the middle** of the heat-sink.

d. Fix the upper bracket to the panel with a **M6** screw through the **oblong hole**.

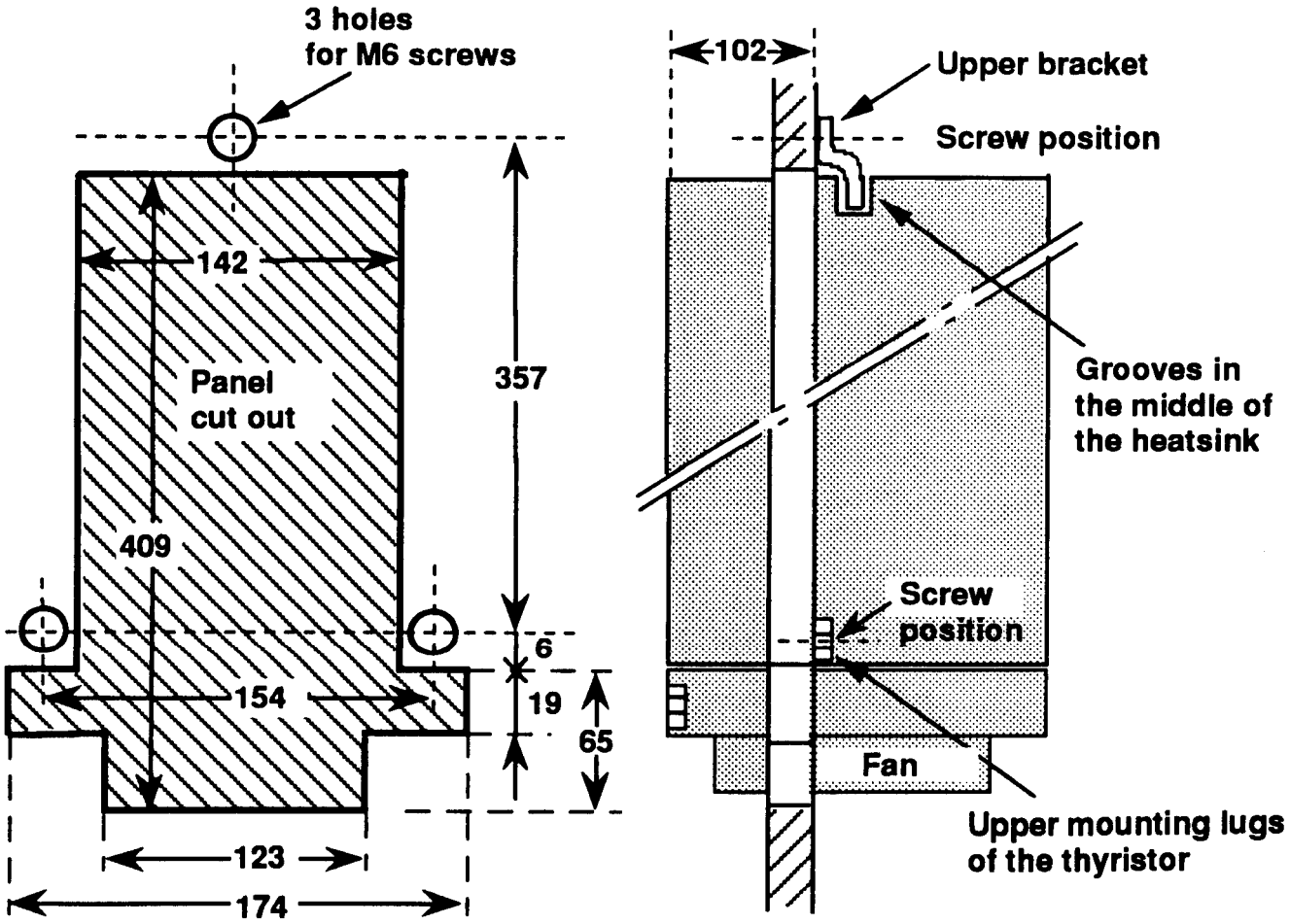


Figure 2.4. Drilling dimensions, panel cut-out and mounting of a convection cooled unit, through panel mounting

2.1.3. Removal of the front cover

a. Insert a small screw-driver and push the internal clip. (see fig **2.5**)

b. Pull the plastic locking piece upwards until resistance is felt, then pull the locking piece forward until clear of the heatsink.

c. Push the front cover assembly down and disengage the lugs on the bottom of the front cover.

2.1.4. Refitting the front cover

a. Push the front cover assembly into position, ensuring that the lugs engage in the heatsink grooves on the front cover (see fig **2.5**)

b. Push the top of the front cover into the grooves.

c. Holding the front cover up, push the plastic locking piece down until it clicks into position, approximately 5mm lower.

The front cover is now shut.

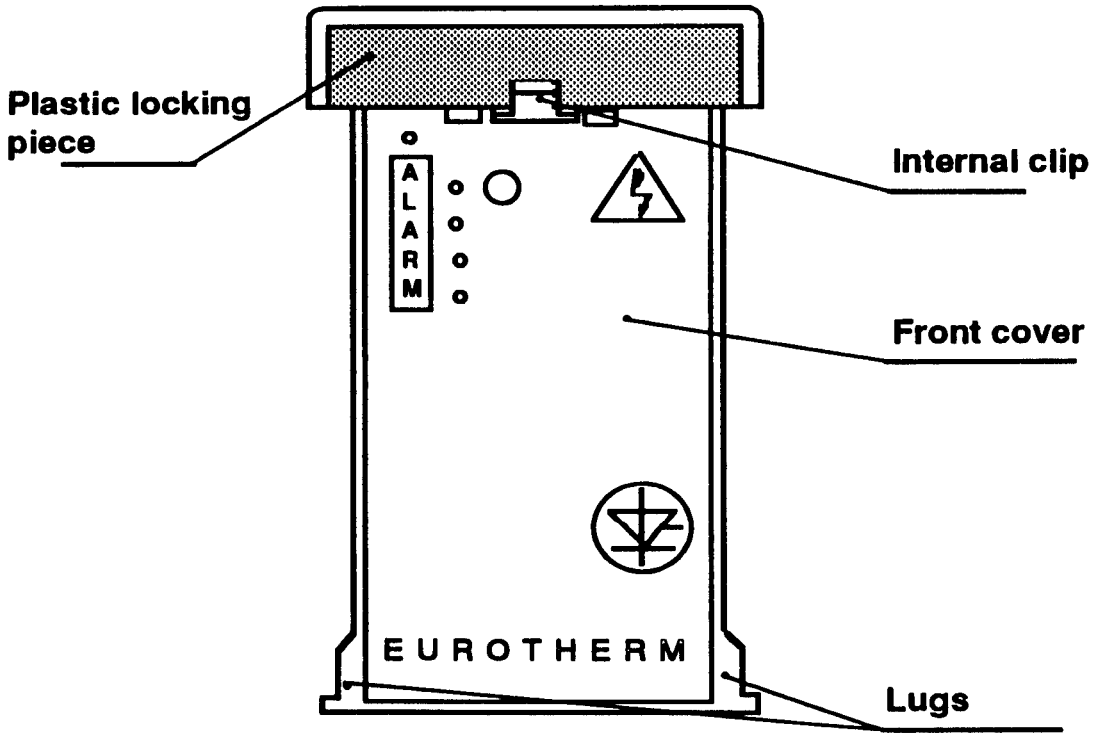


Figure 2.5. Front cover (40 to 125A)

2.2. Mounting Details TU2170 (250A)

2.2.1. Mounting

The two mounting brackets are used for mounting the unit whichever installation method has been chosen.

A. Bulkhead mounting

- Fix the two brackets on the panel using **four M6** screws. Ensure that both the drilling dimensions and the position of the brackets (see fig. **2.6**) are respected.
  The brackets should be fixed as follows:
  lower bracket, through the circular holes.
  upper bracket, through the oblong hole.

- Position the unit on the lower bracket. Grooves in the heat-sink are used for this purpose.

- Loosen the screws holding the upper bracket to allow the bracket to be raised. Position the unit and then slide the upper bracket downwards into the grooves in the heat-sink.

- Once the upper bracket is positioned in the heat-sink, tighten all screws.

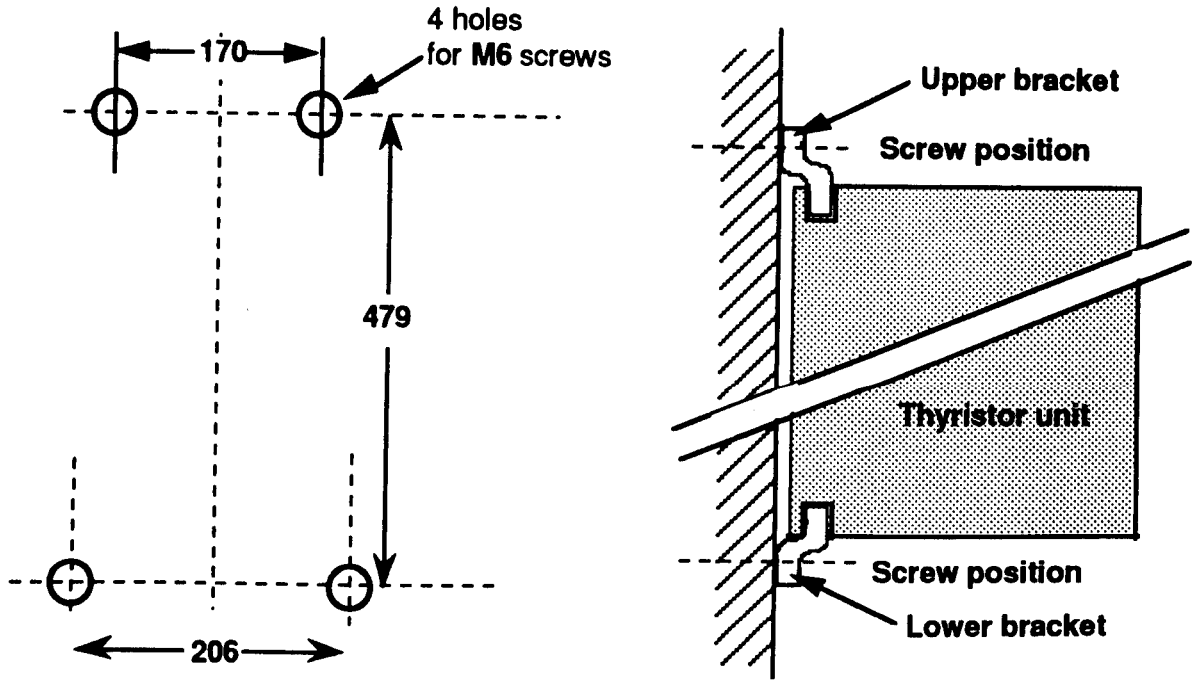


Figure 2.6. Drilling details and brackets position

B. Through-panel mounting

- Insert the thyristor unit into the opening in the panel (see fig.**2.7**).

- Fit the brackets into the grooves situated in the middle of the heatsink, at the top and bottom.

- Attach the brackets to the panel using **four M6** screws through the circular holes.

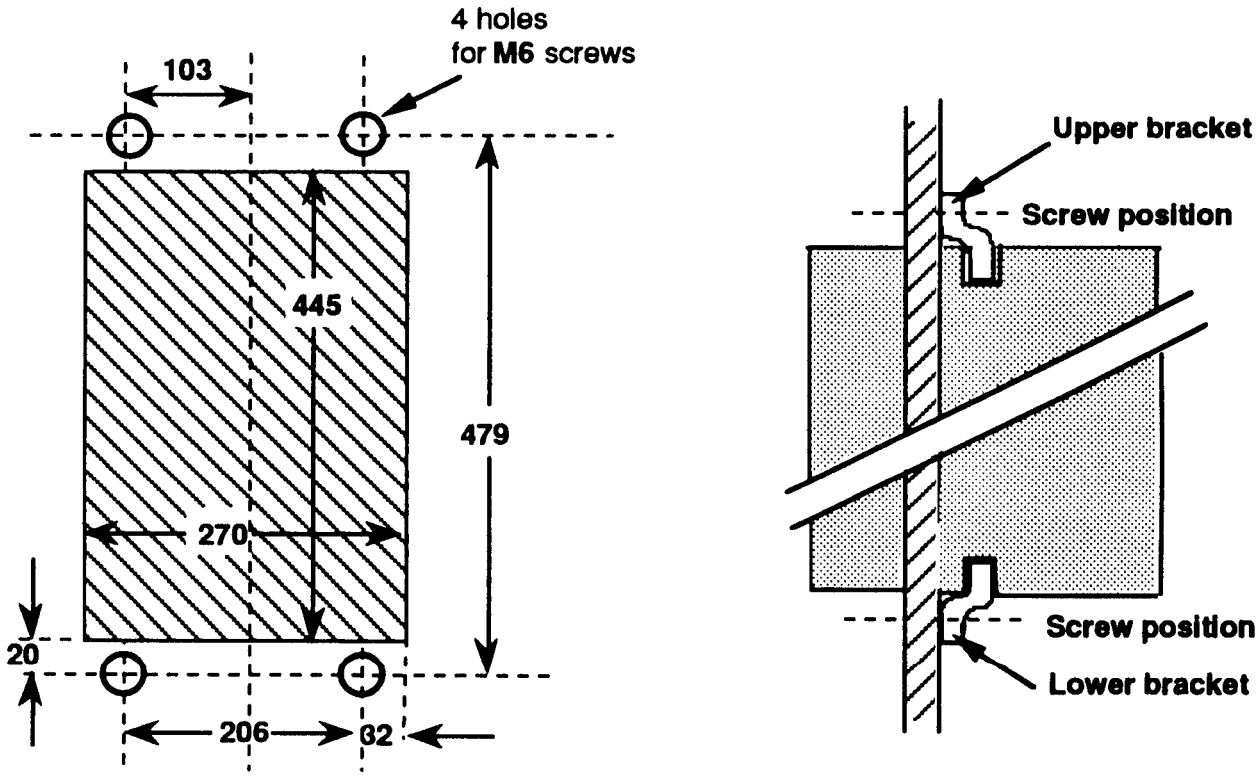


Figure 2.7. Drilling, cut-out and bracket position details

2.2.2. Removal of the front cover

a.- Loosen the two screws which hold the door bolts in place (**4mm allen screws**).
Slide the bolts to disengage them from the end covers and retighten the screws.

b.- Gently pivot the door open.

c.- Disengage the door from the heatsink by sliding it left.

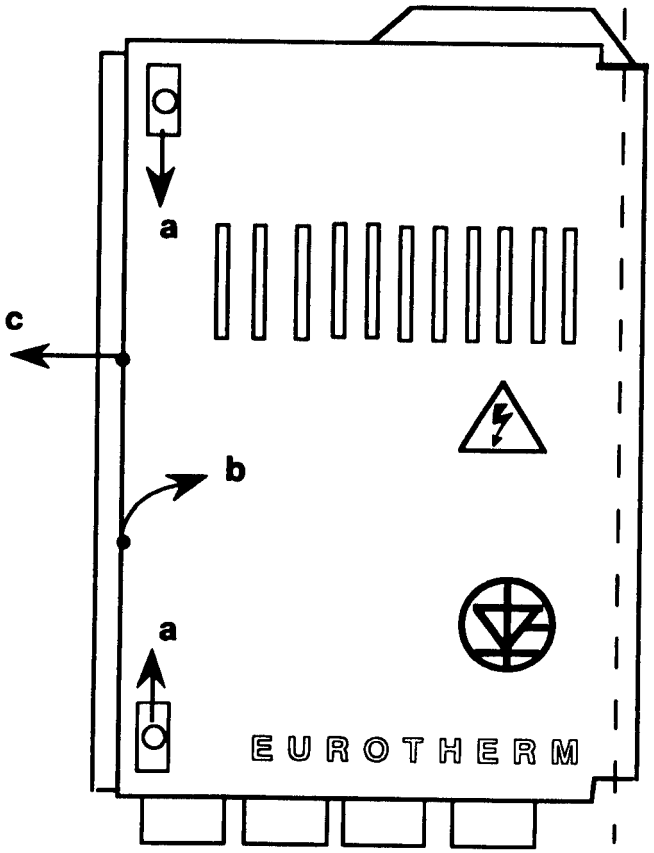


Figure 2.8. Removal of the front cover (250A)

2.2.3. Refitting the front cover

a. Centre the door with respect to the upper and lower covers and slide the edge of the door into the groove on the right hand side of the heatsink.

b. Position the door on the locating lugs on the left and push the door home.

c. Loosen the two screws holding the bolts in position and slide the bolts shut.

d. Tighten the two screws holding the bolts (**4mm Allen screws**)

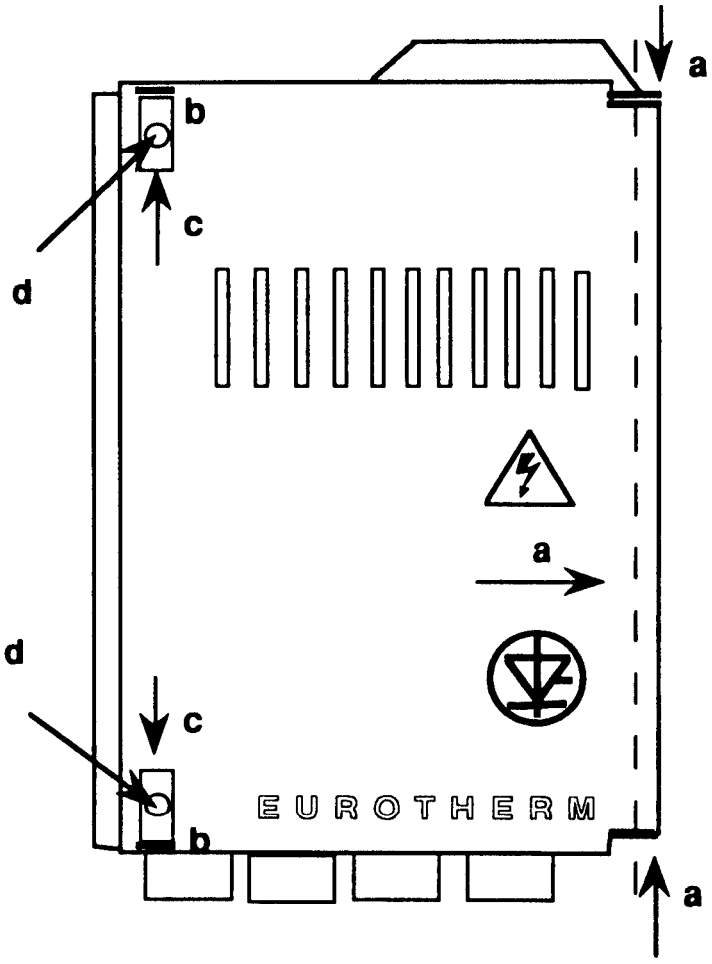


Figure 2.9. Refitting the front cover (250A)

2.3. Wiring

2.3.1. Power

2.3.1.1. Thyristor units from 40 to 125A

Terminal sizes: power cable cross-section: **4mm²** to **35mm²**.
The **unsupported** length of the power cable should not exceed **80 cm**.
Tightening torque: **2** to **4 N.m**.

To connect the supply and loads (see fig.**2.10**):

- Remove the front cover (see fig.**2.5**)
- Remove the plastic sleeves of the **LINE** and **LOAD** terminals
- Unscrew the grub screw
- Insert the line and load cables into their respective terminals
- Engage the grub screws without tightening and refit the protective sleeves before tightening
- Tighten all connections and refit the front cover.

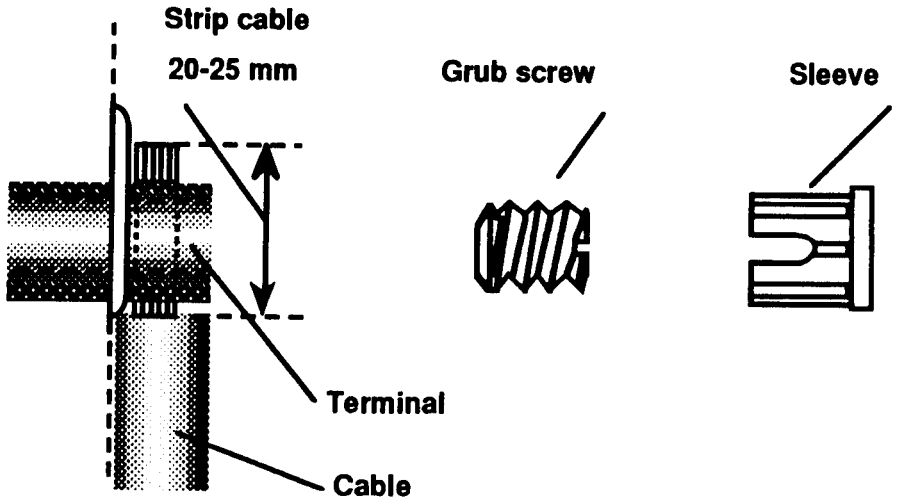


Figure 2.10. TU2170 Power Connections (40 to 125A)

2.3.1.2. 250A Thyristor units

The power cables (maximum cross-section: **120mm²**) should be passed through the cable-glands.

- For the connection of line cables on the **M8 fuse studs**, the maximum recommended torque is **12.5 N.m**.

- For the connection of load cables on the **M10 screws**, the maximum recommended torque is **25 N.m.**

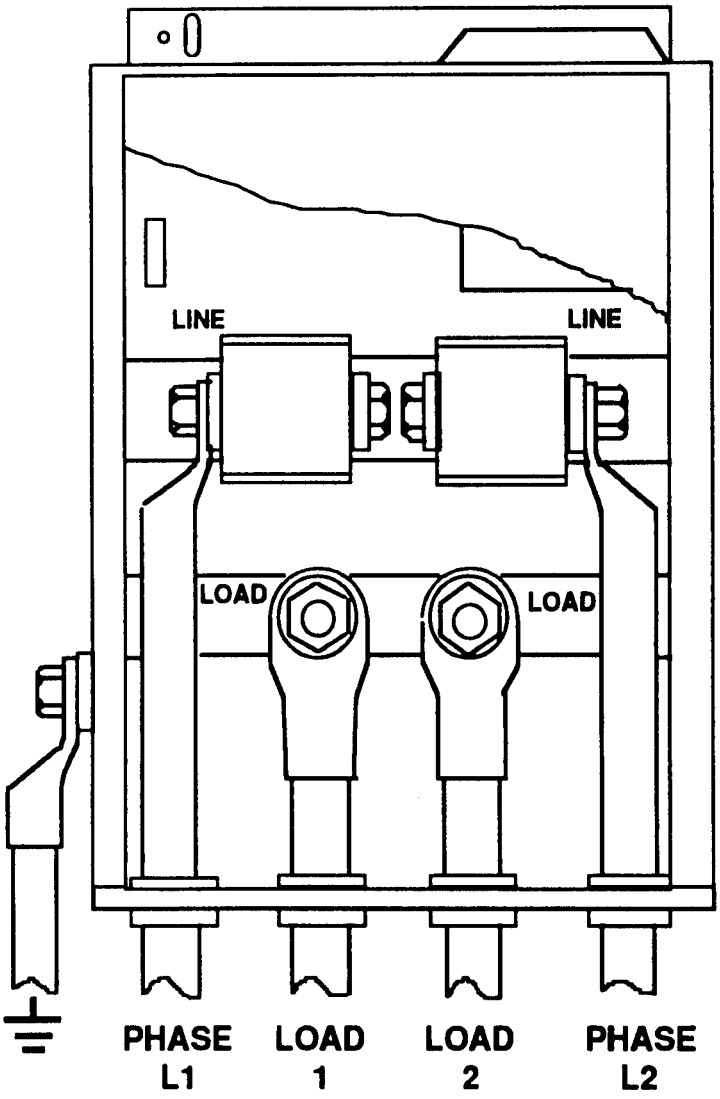


Figure 2.11. TU2170 Power Connections (250A)

2.3.2. Control

Cables connected to the control electronics should be **short and screened** with the screens **connected to ground**. They should not run close to power cables or other equipments which generate electrical noise such as contactors.

The control terminals have been designed for the following wire sizes:

0.13 to **1.5 mm²** (rigid wires)
0.50 to **1.5 mm²** (flexible wires).

The control terminal plugs can be passed through the **upper plastic protective cover**.

To **remove the protective cover**:

a. Slide a screw-driver down the guide-way at the rear of the cover, indicated by the two protrusions on the upper surface, until resistance is felt.
b. Turn slightly to unlock the clip.
c. Pull the protection cover upwards.

To **refit the protection cover** after connection:

d. Slide the upper edge of the protection into the two grooves nearest the front of the heat-sink.
e. Push the back of the protection down to clip it in place.

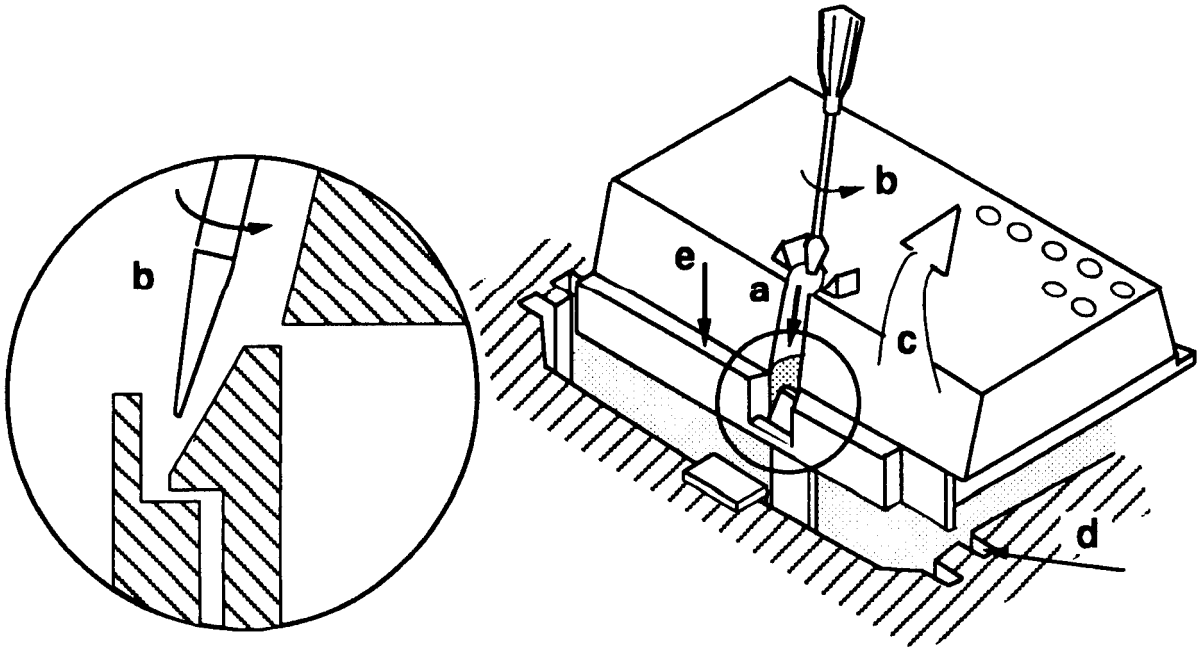


Figure 2.12. Removal of the protection

2.4. Wiring recommendations

WARNING

*Before making any connections, ensure that all cables and wires are **isolated** from the supply.*

*For safety reasons, **earth connections must be made first.***

2.4.1. Earth connection

Connect the earth cable to the M8 screw, (on the side of the heatsink), identified by the symbol:

using an **M8** round terminal.

This connection slides in a groove in the heatsink and may be **positioned** to suit the installation.

The section of the earth cable must be

10 to 16 mm² for the thyristor units from **40 to 125A**

70 mm² for the thyristor unit **250A**.

2.4.2. Control

For **all versions**, connections need to be made to the following:

A. To the **power supply** board for the electronic power supply and for the alarm relay contacts.

B. To the **thyristor firing** board for the enable signal.

C. To the **microprocessor** board (**CCC** board) for digital communication and for analogue input signals.

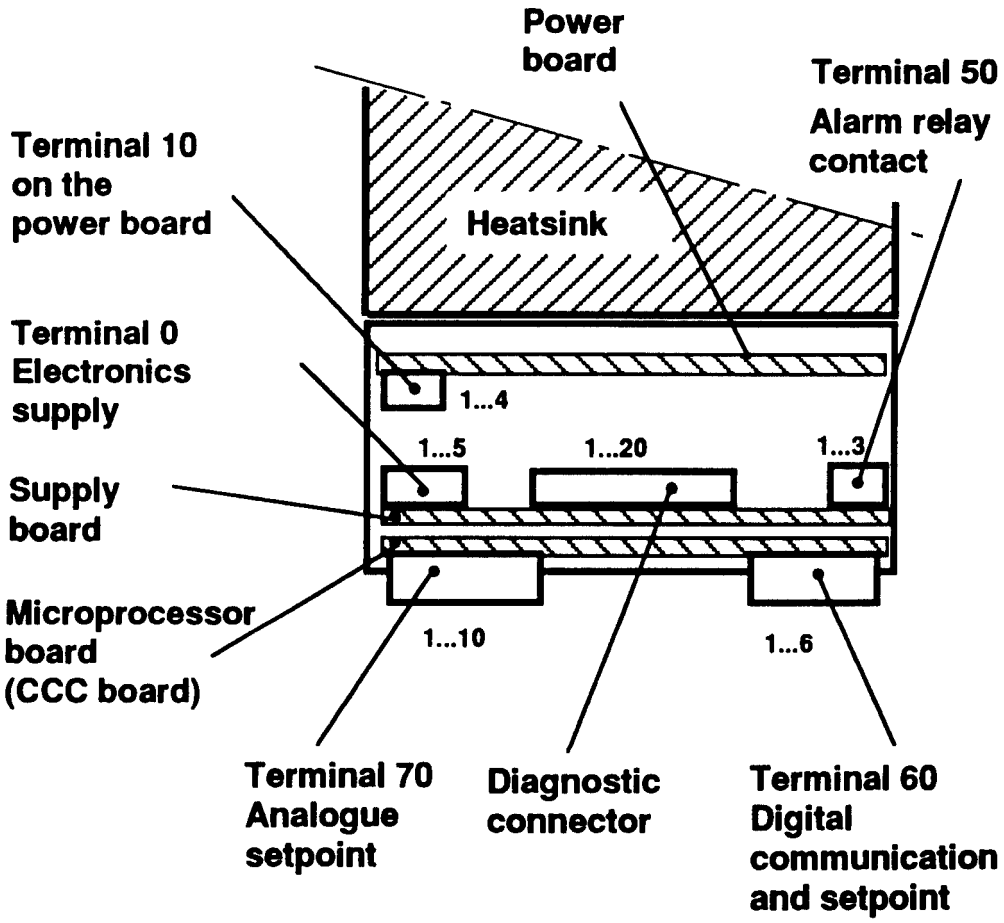


Figure 2.13. TU2170 thyristor unit connector layout
(as seen from above)

A. Power supply board

Check that the identification label code corresponds to the supply voltage.

All supply voltages above **500V** (thyristor unit **250A**) require a **step-down transformer 690/415V** (ref **EUROTHERM CO173562**) which must be ordered separately.

CAUTION:

To ensure normal thyristor unit functioning, ***the electronics power supply (connectors 3 and 5) must be connected between the two phases controlled by the thyristors (phases L1 and L2).***

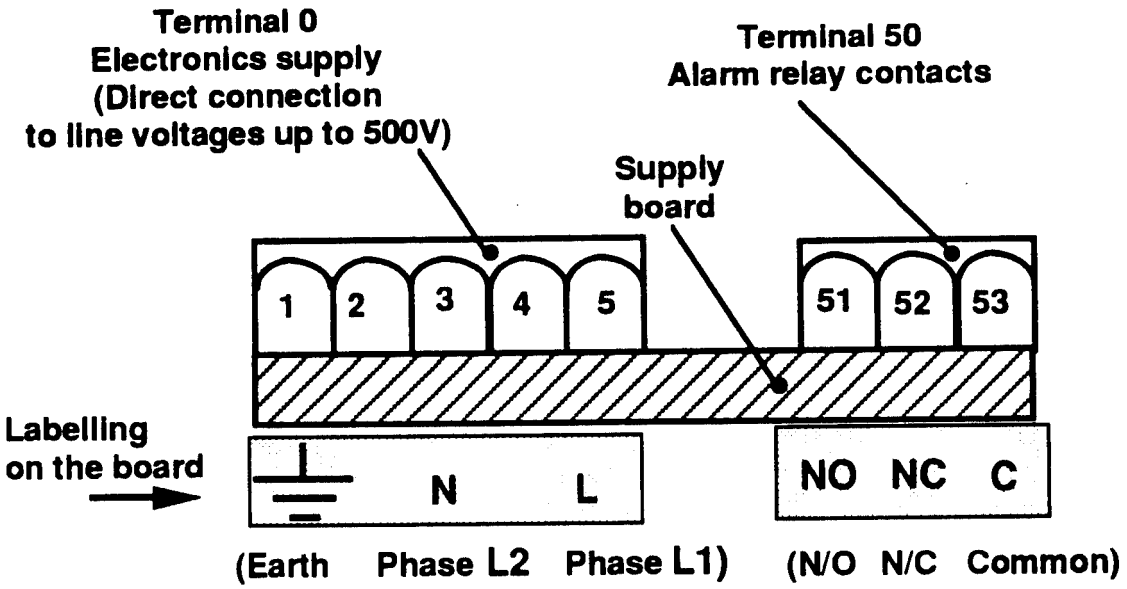


Figure 2.14. Power supply and alarm connections
(Connectors **2** and **4** are not used)

The relay is **de-energized** to indicate an alarm.
The relay contacts (normally closed (NC), normally open (NO) and common (C)) are used to indicate certain fault conditions of the supply and load.

B. Thyristor firing boards

Connections for the channel enable signals are made on the thyristor firing boards.

Connectors **10** and **20** are used to enable the board (see fig. **2.19** to **2.21 page 30-32**) by short-circuiting terminals **3** and **4**.

Failure to enable a channel will result in a **TLF** alarm when power is demanded.

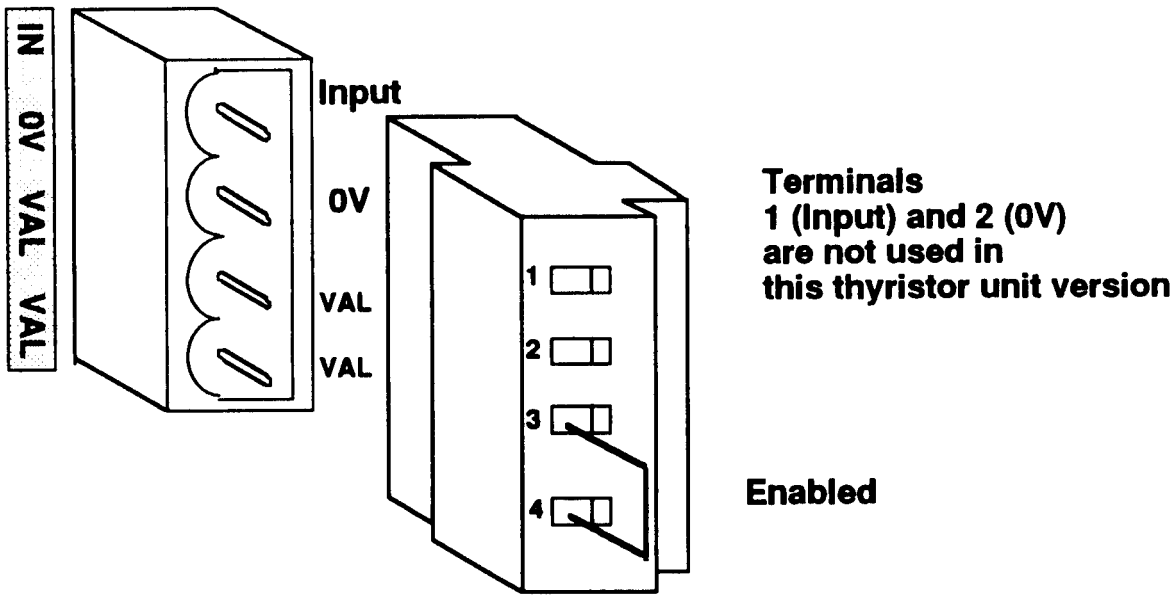


Figure 2.15. A single channel logic control input connector

C. Microprocessor board

Depending on the type of control (analogue or digital), use connectors **70** or **60** (refer to fig **2.16**).
Both connectors may be used **at the same time**:
analogue input and digital control (see schema in fig **2.20**).

Connector 70 is used for **analogue** signals.
The analogue signal may be either a setpoint coming from a regulator or a default setting in case of digital communication failure.

Connector 60 is used for **digital** signals.
The digital signals may come from **a digital control system** such as the **PC3000 EUROTHERM** or from another suitable systems. (Fig **2.17** and **2.18**).

CAUTION:

*Selection of digital or analogue control is determined by input **"A/N"** - **"Analogue/Numeric"** (terminal **74**).*

*To enable the **digital** control, terminal **74** (**"A/N"**) must be connected to terminal **73** (**"+10V"**).*

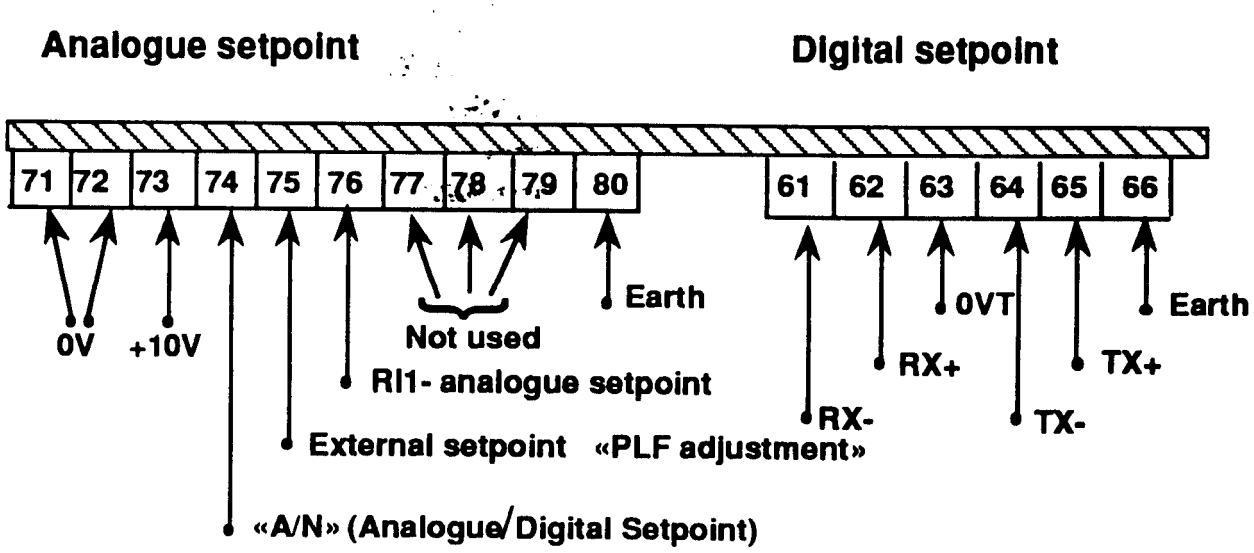


Figure 2.16. Microprocessor board connectors

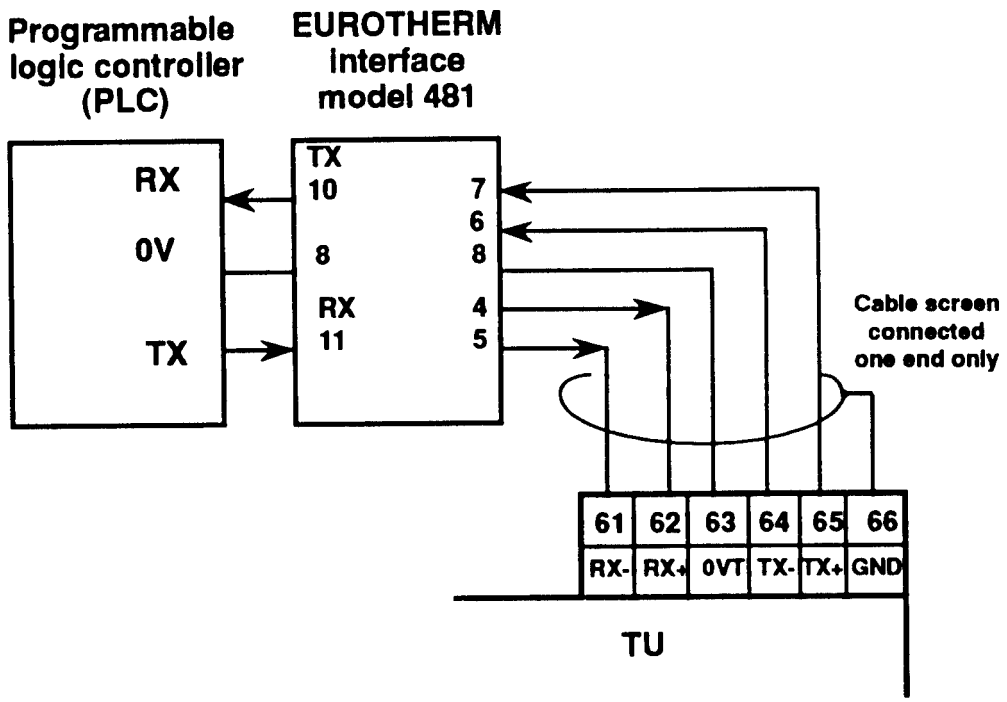


Figure 2.17. Connection to a EUROTHERM Interface 481 RS232/RS422 (RS485) Convertor

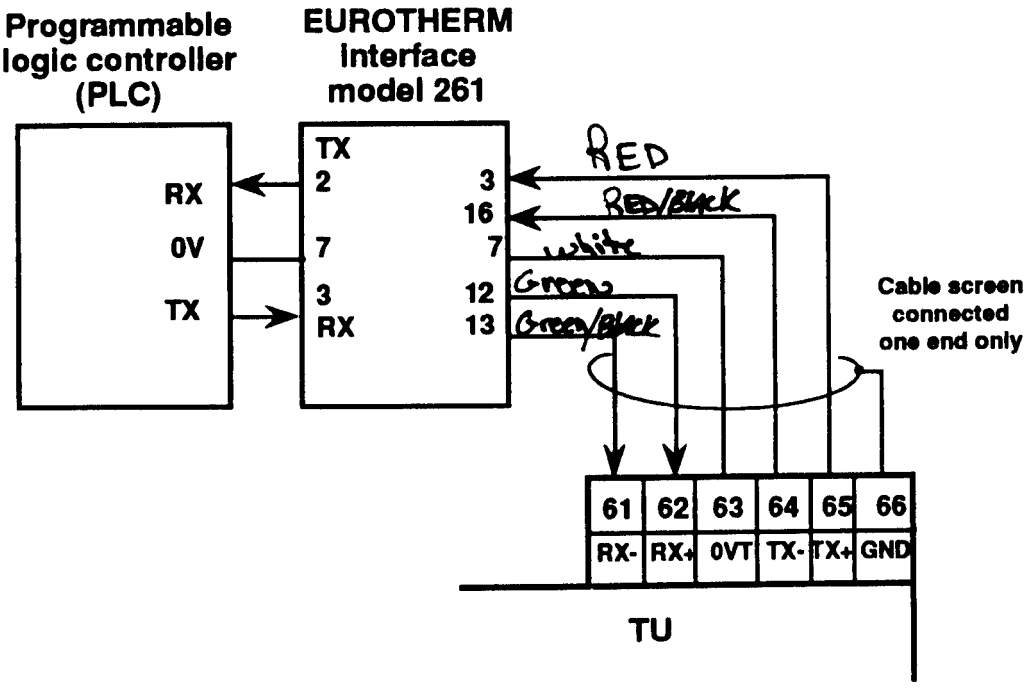


Figure 2.18. Connection to a EUROTHERM Interface 261 RS232/RS422 (RS485) Convertor

2.4.3. Power

WARNING:

> ***The external fuses*** *(**FE1** and **FE2** in fig **2.19** and **2.20**, **40** to **125A** thyristor units) and*
> ***the internal fuses*** *(**FI1** and **FI2** in fig **2.21**, **250A** thyristor units) are for the **protection of the thyristor unit and are not** a substitute for fuses designed to **protect the installation**.*
>
> *They must be fitted **before** connection to the supply.*

External fuses must be **ordered separately** (see page **75**).

Connection **by the user** to the three phase supply must be via suitable electrical switchgear and fuses to ensure **effective installation protection and isolation** and which conform to local electrical regulations.

External fuses and fuse holders supplied with the unit may be used as an isolating switch.
*However, like all isolating switches, they **should never be opened when under load**.*

To ensure normal thyristor firing, the electronic power supply and the power must be connected **across** the two **controlled** phases.

Electronics supply voltages above **500V** (thyristor unit **250A**) **require** a step-down transformer **690/415V** (EUROTHERM reference: **CO173562**).

For thyristor units of nominal current of **100 and 125A**, the power supply for the **external fan must be directly** connected to the two terminals connected to the fan (see fig.**2.20**).

For **250 A** thyristor units, the power supply for the **internal fan** must be connected to the **terminal** provided **inside** the equipment.

Fan consumption: **30 V.A.**

2.5. Wiring schemes

The following pages show several complete wiring schemes for **TU2170** thyristor units.

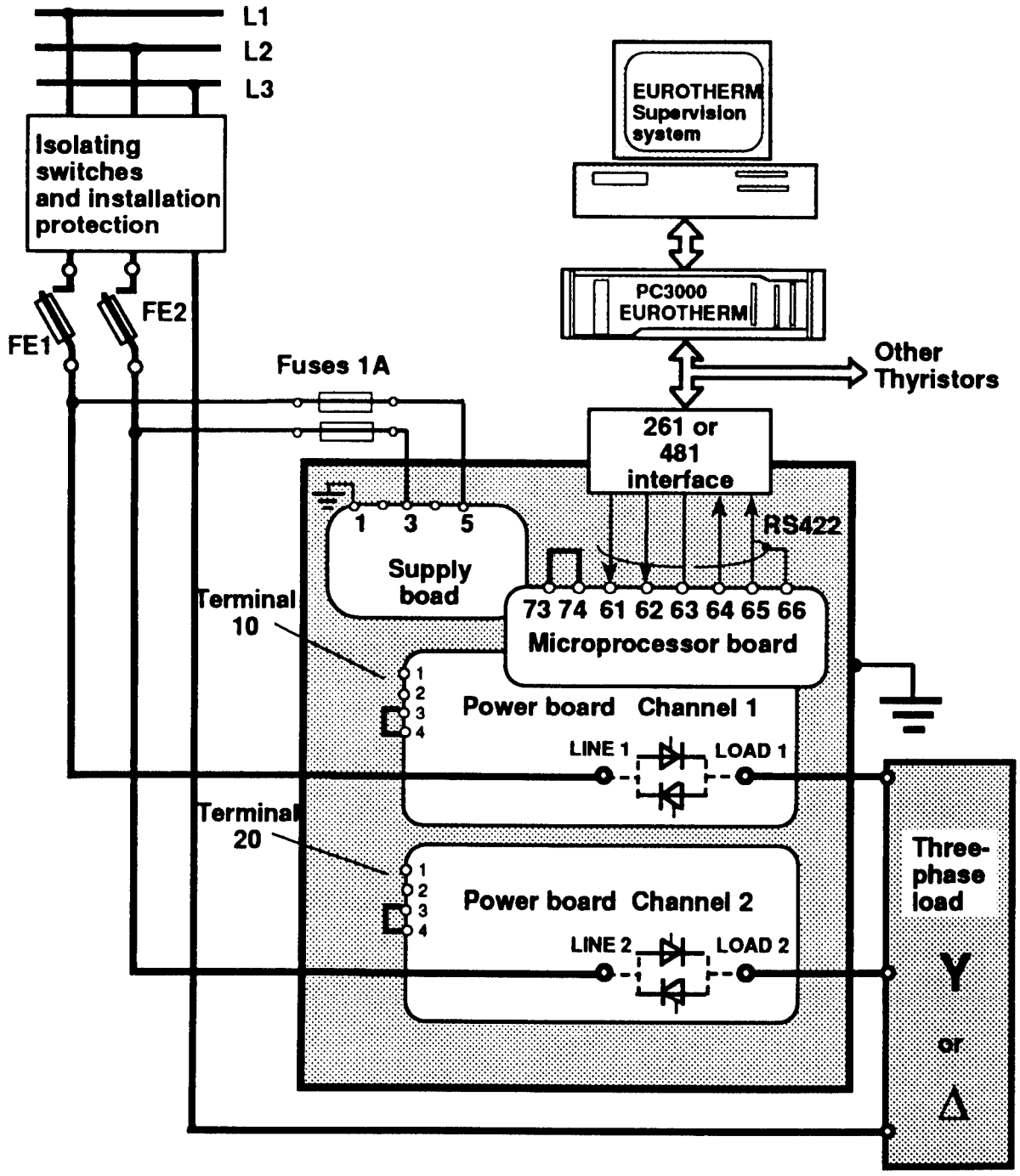


Figure 2.19. Example of a TU2170 thyristor unit wiring scheme
Nominal current from **40 to 75A**.
Digital setpoints from a **EUROTHERM digital control system** or equivalent

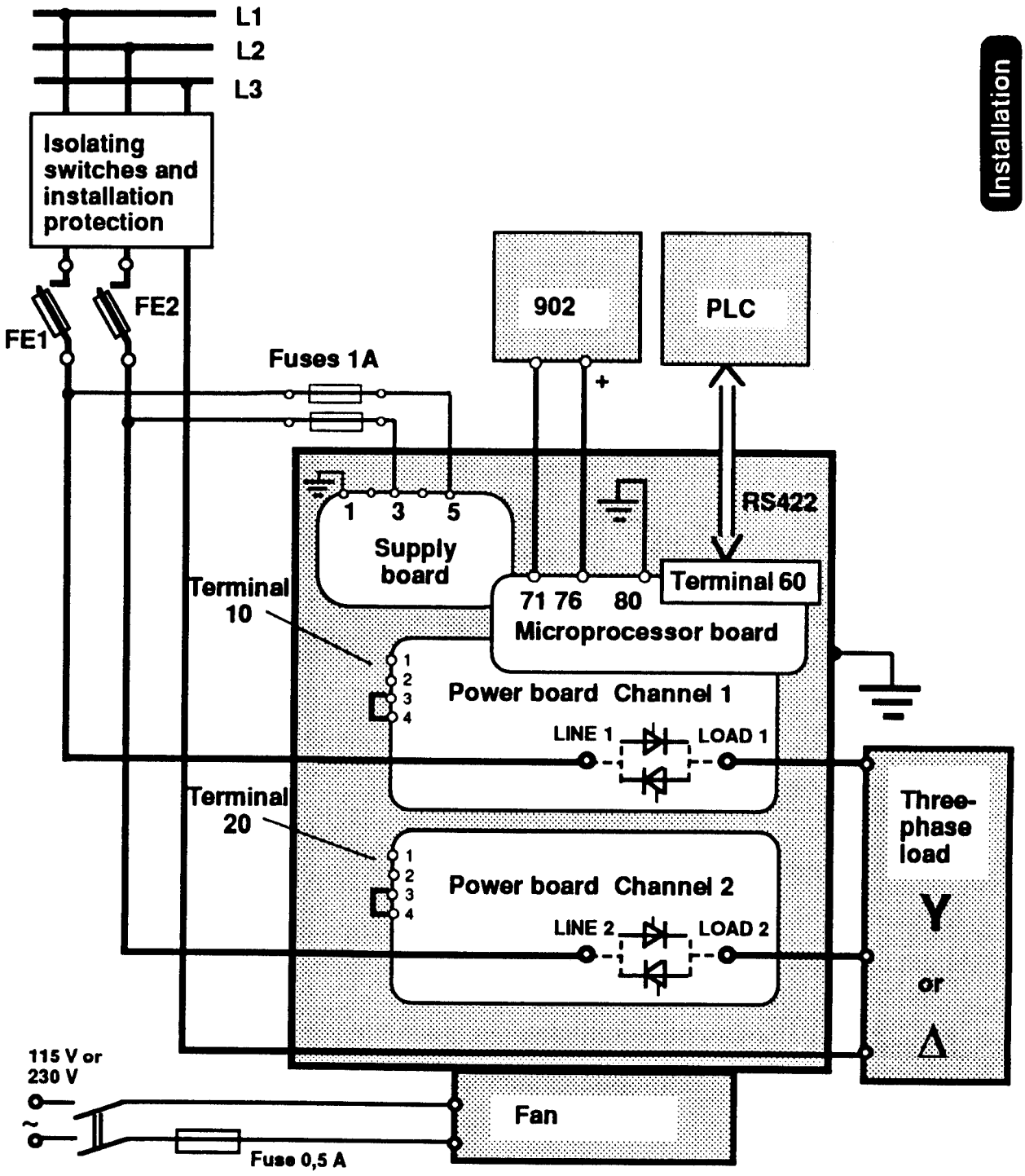


Figure 2.20. Example of a TU2170 fan cooled thyristor unit wiring scheme Nominal current 100 or 125A.

Analogue setpoints from a **EUROTHERM** regulator **902**

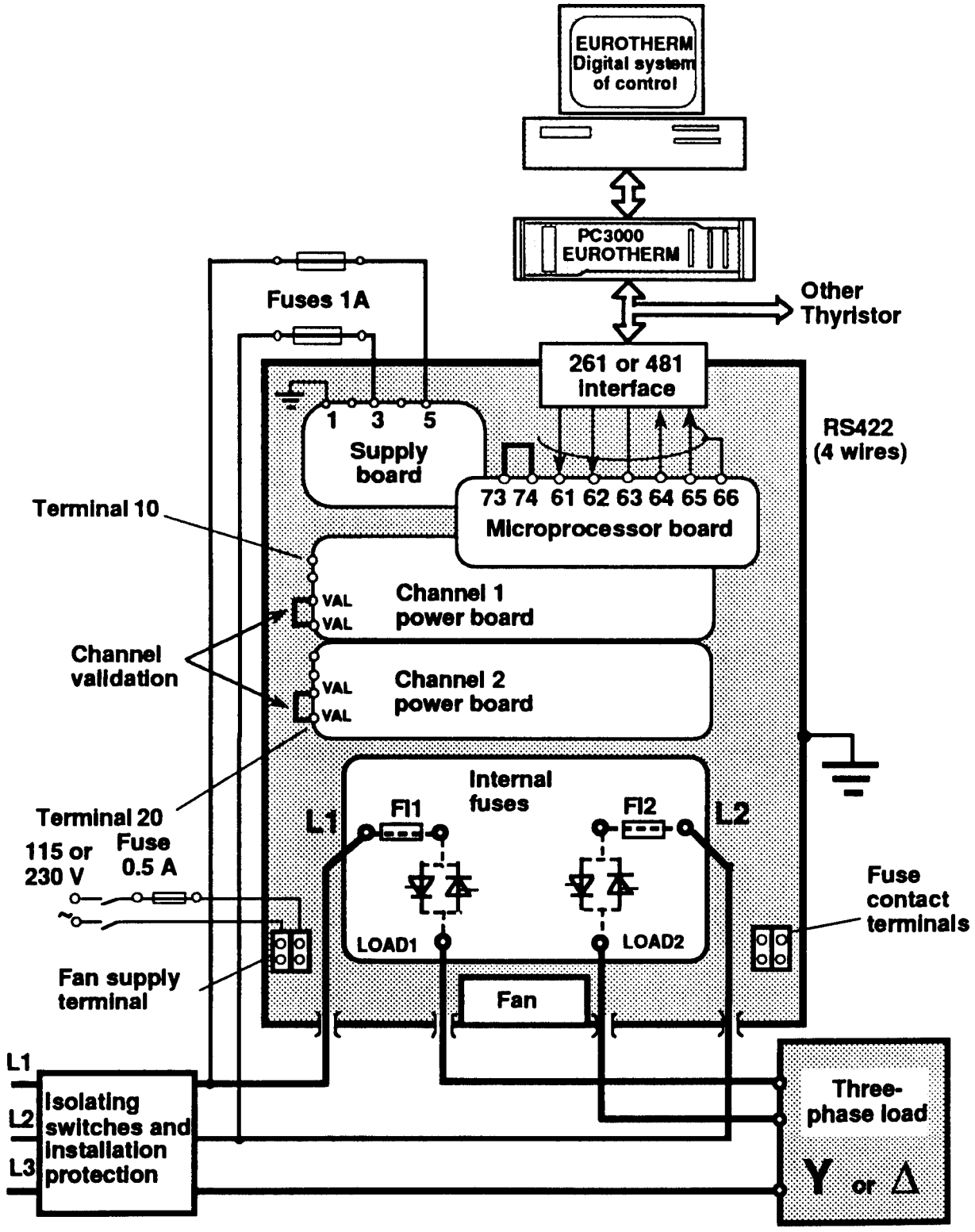


Figure 2.21. Example of a TU2170 wiring scheme, 250A nominal current.

Digital setpoints from a **EUROTHERM supervision system and digital control system (PC3000)**

3. COMMISSIONING PROCEDURE

3.1. Checking the thyristor unit characteristics

Before connection to any voltage source, **check** that the characteristics of the thyristor unit are compatible with the installation.

Load current

The maximum current of a load phase must be less than or equal to the nominal current of the thyristor unit (see field "Nominal current" of the product codes).

Line voltage

The nominal line voltage must be less than or equal to that of the thyristor unit (refer to "line voltage" in the identification label code).

If the line voltage is less than **80%** of the nominal voltage of the thyristor unit, the unit will be **inhibited** and the voltage range needs to be **recalibrated** (refer to **3.3.1**).

Electronic supply voltage

The supply voltage for the control electronics must correspond to the supply to be connected.

This voltage is determined during manufacture by the choice of the transformer to suit the order code voltage. By using a jumper on the power supply board, it is possible to supply the electronics with **220 to 240V.**

Analogue input

The configuration of the jumpers on the microprocessor board (refer to tables **3.3** and **3.4**) must be compatible with the type of analogue signals to be used.

3.2. Configuration of the jumpers

The thyristor unit version and mode of operation are determined by the position of jumpers on the circuit boards.

The thyristor unit is delivered **completely configured to suit** the order code.
The principle aim of this chapter is to allow you to **check** that the configuration conforms to the application and, if necessary, to **modify** certain thyristor unit characteristics.

3.2.1. Power supply board

On the power supply board the following functions are performed:

- the choice of the electronic supply voltage
- the selection of the voltage used for power control
- thermal monitoring connections

The supply voltage is determined by a transformer with two primary windings. 3 types of transformers are used:

CO 173047	115 /230 V ,	18 V.A
CO 173394	230/400 V ,	18 V.A
CO 173395	230/480 V ,	18 V.A.

The electronic supply voltage is selected using the jumper **ST1** (refer to fig. **3.1**) on the primary side of the supply transformer.

Regardless of the transformer fitted, position **0** of jumper **ST1** allows a supply voltage of **220 to 240V** to be used (refer to table **3.1**).

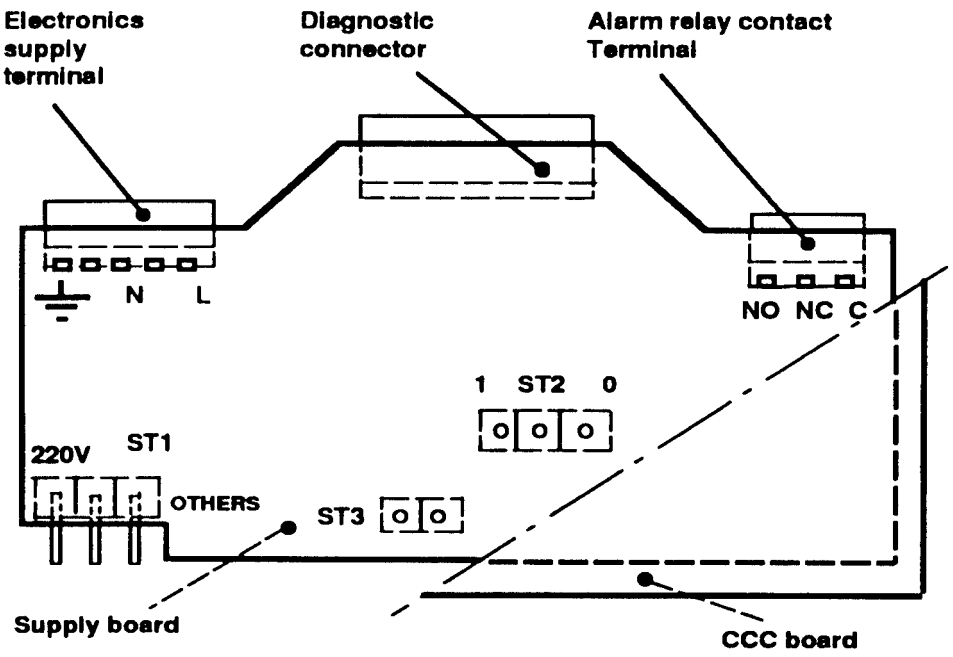


Figure 3.1. Location of the jumpers on the power supply board (seen from front)

Table 3.1

Features		Jumper positions		
		ST1	ST2	ST3
Primary Supply voltage	220 (240) V	**220**		
	110 (120)V	**OTHERS**		
	380 (415)V	**OTHERS**		
	480 (500) V	**OTHERS**		
Control voltage	All units		**0**	
Over-temperature detection(*)	All units			**Jumper**

(*) *For convection cooled thyristor units pins **THSW** on the power board must be **short circuited**.*

Selection of the **voltage** used for power **regulation** by the microprocessor board (Control and communication circuit - **CCC**) is determined by jumper **ST2**.
This voltage has a fixed relationship to the **electronics supply voltage**.

For this reason, to obtain maximum precision, it is recommended that the electronic supply voltage is connected **between the two controlled phases**.

TU2170 100, 125 and 250A thyristor units are **fan-cooled** with **over temperature detection**.
The thermal switches are mounted on the thyristor heatsink. They are connected by leads to pins **THSW** on the **thyristor firing board of each channel**.

TU2170 thyristor units from **40** to **75A** do not have over temperature detection.

Pins **ST3** on the power supply board for **all** thyristor units must be **short-circuited** by a **jumper** (refer to fig. **3.2**).

The opening of a thermal switch (in case of over-temperature detection or fan failure) or of jumper **ST3** breaks the thyristor triggering circuit.

250 A Thyristor unit **100 and 125 A Thyristor units**

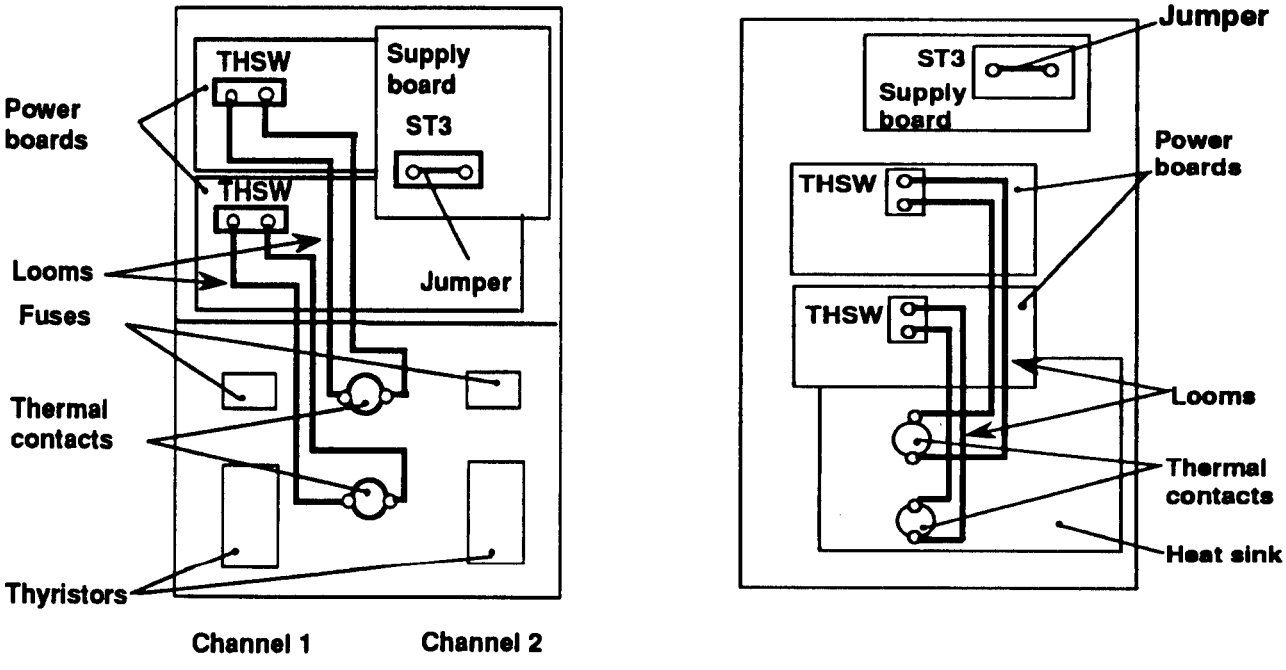


Figure 3.2. Thermal switch connections

3.2.2. Thyristor firing board

Pins **THSW** on **100, 125 and 250A** thyristor unit firing boards are used for thermal switch connections (see fig.**3.2**).

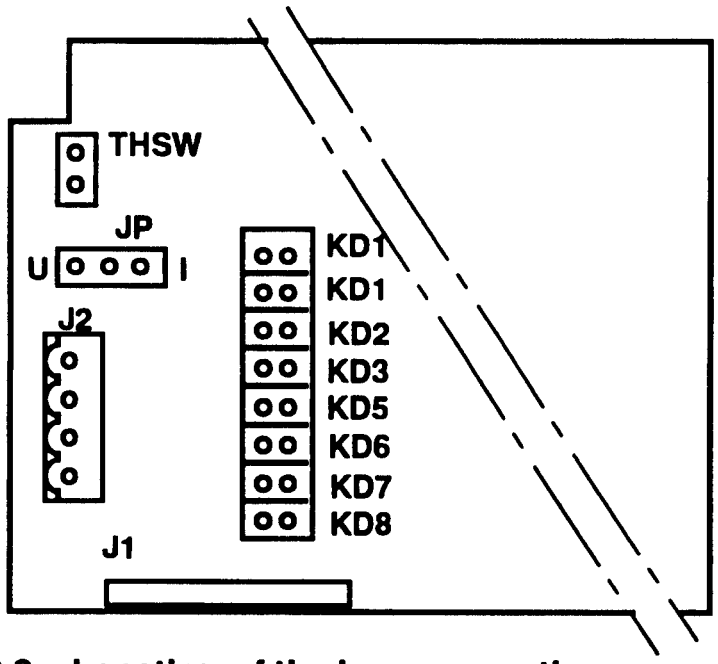


Figure 3.3. Location of the jumpers on the thyristor firing board

Jumper **JP** is present on the **40 to 125A** thyristor units **only**. It must always be set to position **U**.

The position of jumpers **KD1 to KD4**, which select the current data for the microprocessor, and of jumpers **KD5 to KD8**, which select the analogue input channel, are given in table **3.2**.

Table 3.2

Channel	Jumper position		
	KD1 and KD5	**KD2 and KD6**	**KD3, KD4 and KD7, KD8**
1	**ON**	OFF	OFF
2	OFF	**ON**	OFF

3.2.3. Microprocessor board

Configuration of chosen options is determined by **jumpers** located on the microprocessor board. Access to these jumpers requires removal of the front cover.

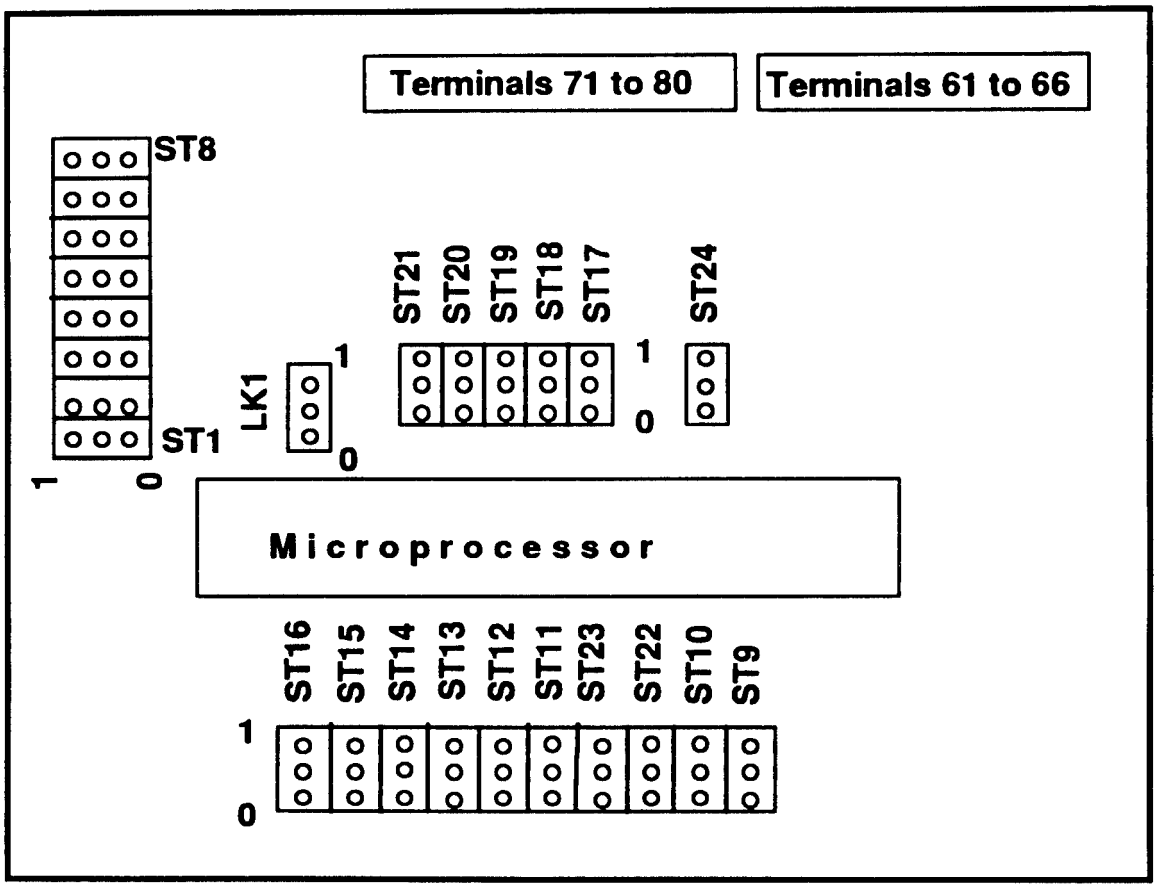


Figure 3.4. Location of jumpers on the microprocessor board

The "watchdog" jumper (**LK1** in fig. **3.4**) **must be in position 1** for correct operation of the thyristor unit.
Position 0 is only used for maintenance operations.

For use **with** digital communication, jumper **ST9** must be in position **1**.

Jumper **ST9** should be in position **0** for use **without** digital communication.

3.2.3.1. Configuration without digital control

The choice of options and operating parameters, without digital communication, are determined by the position of jumpers as shown in table **3.3**

Table 3.3

Features		REMEMBER: ST9=0					
		Jumper positions					
		ST1 to ST4	ST5 to ST8	ST19	ST18	ST17	ST20
Analogue input voltage (dc)	0-5 V	0	0	0			
	1-5 V	0	0	1			
	0-10 V	0	1	0			
	2-10 V	0	1	1			
Analogue input current (dc)	0-20 mA	1	0	0			
	4-20 mA	1	0	1			
Thyristor firing mode		Single cycle (1 period)			0		
		Fast burst (8 periods)			1		
Control		V^2				0	
		V × I				1	
Load type for PLF detection		Resistive					0
		Infra-red					1

Jumpers **ST10** to **ST16** and **ST21** to **ST23** are set to **0**.
Jumper **ST24** is set to **1**.

3.2.3.2. Configuration with digital control

The use of digital control is determined by the position of jumpers as shown in table 3.4.

Table 3.4

Features		REMEMBER: ST9=1 Jumper positions							
		ST1 to ST4	ST5 to ST8	ST19	ST11to ST16 ST22 ST23	ST17	ST18	ST20	ST21
Analogue input voltage (dc)	0-5 V	0	0	0					
	1-5 V	0	0	1					
	0-10 V	0	1	0					
	2-10 V	0	1	1					
Analogue input current	0-20 mA	1	0	0					
	4-20 mA	1	0	1					
Thyristor address					See Note 1				
Control	V^2					0			
	V X I					1			
Thyristor firing mode	Single cycle (1 period)						0		
	Fast burst (8 periods)						1		
Load type for PLF detection	Resistive							0	
	Infra-red							1	
Communication protocol (See Note 2)	EUROTHERM								0
	MODBUS®								0
	JBUS®								1

Jumper **ST10** is set to **0**; **ST24** is set to **1**.

Note 1: Address configuration

For each thyristor unit, it is necessary to configure the address of channel 1, which is the unit address and is determined by the positions of jumpers **ST11** to **ST16**, **ST22** and **ST23**.

The channel addresses are from **1 to 255.**

Position of jumpers **ST11** to **ST16**, **ST22** and **ST23** are related to the address expressed in 8 bit **binary**.

Example : the address of the unit is 92.

92 in 8 bit binary is

0 1 0 1 1 1 0 0

The corresponding configuration of the jumpers on the microprocessor board is shown in fig. **3.5.**

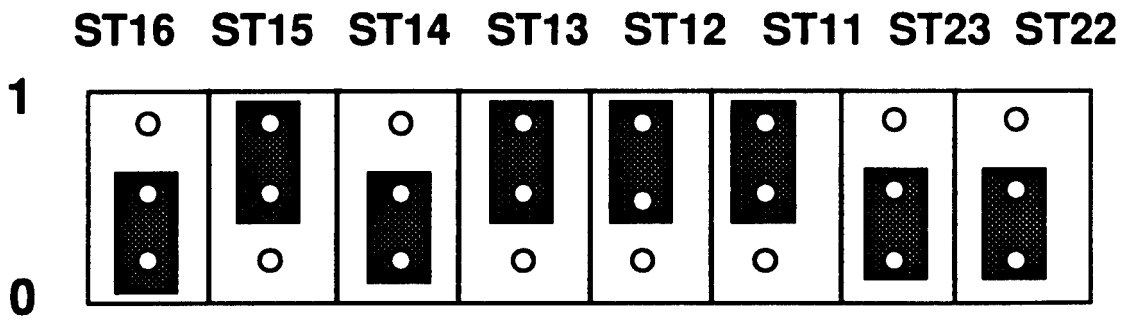


Figure 3.5. Example of address jumper configuration

Address **00** is the "**broadcast**" address and is not configurable. It allows a signal to be sent to **all** thyristor units connected to the same bus (refer to "**TU series digital communication user manual**", Eurotherm reference **HA 173688** - Issue 1 - 02/92).

Note 2: Checking the communication protocol

There are two microprocessor references:

- microprocessor programmed with the **EUROTHERM** protocol
- microprocessor programmed with the **MODBUS®** and **JBUS®** protocols.

Selection between the **MODBUS®** or **JBUS®** protocols is by jumper **ST21** (refer to table **3.4**).

The protocol loaded in the microprocessor is determined by the order code.

A label on the microprocessor itself (refer to fig **3.6**) allows identification of the protocol type.

The following codes are used:

EIP: **EUROTHERM** protocol
MOP/JBP: **MODBUS®** and **JBUS®** protocols

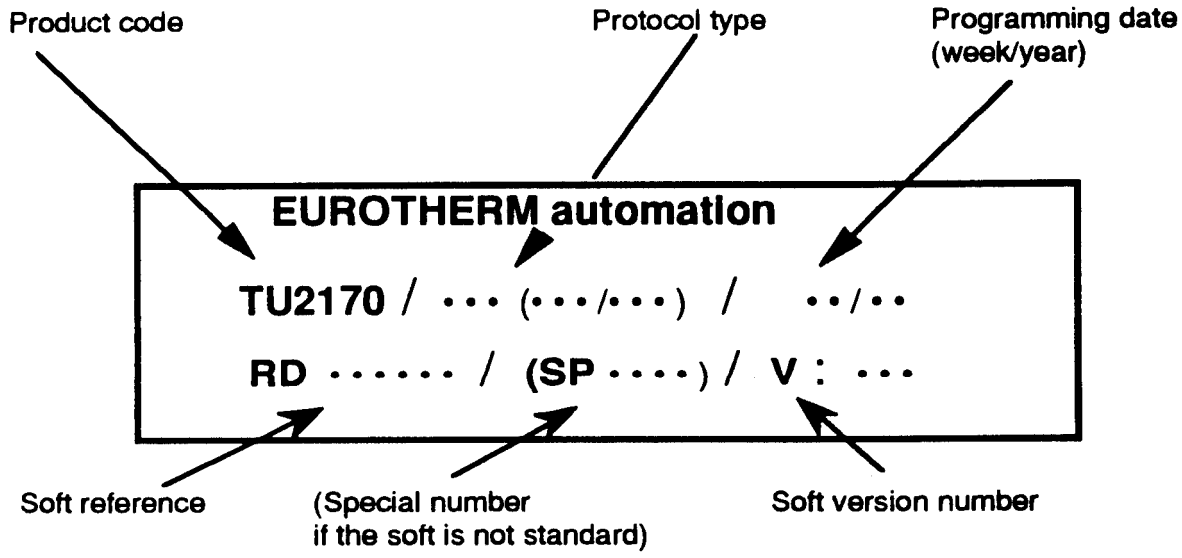


Figure 3.6 . Microprocessor label

3.3. Switching on procedure

CAUTION:

> *Check that jumper **LK1** on the microprocessor board is in position **1**.*
>
> *Regardless of which method of control is used, check that the wiring is correct and that the "**enable**" inputs (terminals **3** and **4**) on the thyristor firing boards are **connected** together directly or via closed contacts.*
>
> *Control voltages should only be applied **at the same time** or **after** the application of the power voltages.*

There are two methods of control:

- using a **digital** input (**SL**)

- using an **analogue** input (**RI**), **with** or **without** digital control.

Before starting the switching on procedure, it is necessary to **calibrate** the thyristor unit.

3.3.1. Control signal calibration

The two potentiometers labelled "**U**" and "**I1**", accessible through the front cover, allow voltage and current calibration of the thyristor unit.

The calibration can be carried out using:

- diagnostic unit **EUROTHERM, type 260**

- digital communication via **RS422 (RS485).**

Normally calibration is performed **without the unit conducting**.

3.3.1.1. Calibration with EUROTHERM diagnostic unit

The diagnostic unit connector is located on the power supply board (refer to fig.**3.1**).

To calibrate current:

- Calculate the calibration signal voltage (V_{CA})

$$V_{CA} = 5V \times \frac{I \text{ nominal load current}}{I \text{ nominal thyristor unit current}}$$

- By turning the potentiometer **P3** (labelled "**I1**"), set the value V_{CA} on the **display** of the **EUROTHERM** diagnostic unit (type **260**) with the rotary switch in position **16**.

The value V_{CA} becomes the new nominal value for all current calculations, for the feedback **V x I** and for the current limitation.

Example:

For a **40A** thyristor unit (see field "Nominal current" of the product codes) and for a nominal three-phase load current of **30A**, voltage calibration is:

$$V_{CA} = 5\ V \times (30\ A / 40\ A) = 3.75\ V$$

To calibrate voltage:

- Turn potentiometer **P2** (labelled "**V**" on the front cover) until the diagnostic unit display gives **4.00V** with the rotary switch in position **15**.

This setting is the new nominal value.

3.3.1.2. Calibration by digital control

The **RS232/RS422(RS485)** convertor must be connected to a **EUROTHERM** interface **261** or **481** as shown in the **fig. 2.17 and 2.18.**

It is possible to calibrate the thyristor unit for both current and voltage using a digital communication if the following information is available:

- nominal current of the unit I_{NU}
- nominal load current I_{NL}
- line voltage

To calibrate current:

- Calculate the parameter CA for each channel

$$CA(\%) = \frac{I_{NL}}{I_{NU}} \times 100\ \%.$$

- Connect the electronics supply and apply the voltage.

- Adjust **the potentiometer P3**, labelled "**I1**" on the front cover, to obtain the calculated value **CA**.

The mnemonic **CV** now shows the current value expressed as a % of the nominal load current.

To calibrate the voltage:

- Read the line voltage (**LV**) using the digital communication

- Adjust potentiometer **P2** (labelled "**V**" on the front cover) to set the parameter **LV** to **100%.**

3.3.3. Control by analogue setpoint

Control is effected by the analogue signal applied to input **RI1** (terminal **76**, fig. **2.16**) The chosen analogue setpoint must be compatible with the level of the analogue signals used.

- Check that jumper **ST19** is set to **0**
- Check that the positions of jumpers **ST1** to **ST8** and **ST19** correspond to the input type used (refer to tables **3.3** or **3.4**)
- Connect the input "**A/N**" on the microprocessor board to "**0V**" or leave it **floating**.

Control by the analogue setpoint can be used **with** or **without** digital communication.

Use with digital communication

- Set jumper **ST9** to position **1**
- Send command **codes**, corresponding to the operating mode in the status word **SW** (refer to **appendix 4**).

Use without digital communication

- Set jumper **ST9** to **0**
- Configure **the operating mode using** corresponding jumpers (refer to table **3.3**).

Start up

- Set the analogue command signal **RI1** to **0V** (or to **0mA**)
- Connect the thyristor unit to the supply and check that **no current flows.**

- Apply a setpoint to the input and check that load current varies with the input signal
- Check that the effective load current does **not exceed** the nominal current of the thyristor unit (250A) with the setpoint at maximum.
- Optimise the control to suit the load current and the line voltage which may be slightly different from the calibration voltage (refer to pages 45 and 46). It is possible to **recalibrate** the voltage using the same potentiometer "**P2**" to obtain a better response-time.

The thyristor unit is now ready for use.

3.3.4. Operation

After switching on, the thyristor unit **starts** in the operating mode **selected** by the jumpers **ST18**.

For a set-point of **50%** (**RI**- analogue setpoint or **SL**- digital setpoint):

- in **single cycle** firing mode, the thyristors conduct **one** cycle in **two;**
- **fast burst mode**, the thyristors conduct for **8** cycles and then do not conduct for **8** cycles.

The thyristor conduction described above corresponds to the thyristor unit calibrated on current or in V^2 control mode provided that the voltage calibration is correct.

Note:

*Current measures using an ammeter are not stable when the current is composed of full cycles (the readings **oscillate** with the current bursts) except at full power.*

To modify the operating mode of the thyristor unit chosen by jumper **ST18**, the control **code** (**0A Hex** for **single cycle** or **0B Hex** for **fast cycle**) must be sent via the digital communication in the status word **SW** (EUROTHERM protocol) or in **CW** (MODBUS® and JBUS® protocols).

Two types of regulation **V^2 or V x I**) are available.
They are selected by jumper **ST17**.

Code 06 (VxI) or **code 07** (V^2) sent via the digital communication to the thyristor unit address **modifies** the type of regulation chosen by jumper **ST17**.

The thyristor unit can either be inhibited or enabled by sending the code **00** or **01** (inhibition) or the code **02** or **03** (enable) via the digital communication.

Codes **08** and **09** are not available in this thyristor unit version.

3.3.5. Partial load failure adjustment (PLF)

Adjustment of the detection of partial load failure is **automatic**.
This adjustment may be triggered by the **push-button** on the front cover, by opening an **external contact** or by the **digital control.**

To adjust the **PLF**:

- Calibrate the current and the voltage of the thyristor unit

- Set the nominal operating values (**CA** and **LV**) so that the partial load failure detection is at its optimum sensitivity.

- Choose a method of adjustment from the three possibilities below:
  - Press the push-button "**PLF**" on the front cover
  - Apply a 0V signal to the "**PLF adjust**" input on the analogue control connector on the microprocessor board (terminal 75, see fig. **2.16**)
  - Send code 05 in the status word **SW** by the digital communication link to the **address of the thyristor unit** or to the broadcast address **00** (all units on the same bus are adjusted).

Note:
*The adjustment of the **PLF** takes into account **the mean values** of the three-phase currents (CV) and of the effective voltages (VV).*
*This adjustment is only possible when the following **conditions** are fulfilled:*
- *Current calibration greater than 25% of the nominal current of the unit **(CA>25%)***
- *Load current greater than 30% of the nominal load current **(CV>30%)***
- *Load voltage greater than 30% of the nominal load voltage **(VV>30%).***

Adjustment control using the digital communication

If bit **14** of **SW** displays **1**, the adjustment sequence has been performed **correctly**. In all other cases, the value of bit **14** of **SW** is equal to **0**.

The adjustment value (the impedance is calculated by the microprocessor) is stored in permanent memory (**EEPROM**).

4. DEBUGGING

To simplify commissioning and maintenance adjustments as well as trouble finding, the use of a **EUROTHERM diagnostic unit, type 260** is recommended. This unit is connected to the power supply board.

The **20** position rotary switch of the **EUROTHERM unit, type 260** allows the values of parameters of the thyristor unit to be indicated on the digital display.

These signals may also be seen using an **oscilloscope**.

The table **4.1** (refer to page **52**), shows what each switch setting of the **EUROTHERM** diagnostic unit represents and typical signal values measured.

All these measured values are **continuous values**.

Table 4.1

Position	Parameters shown	Typical values	Comments
1 2	Current measured Channel 1 2	For **nominal** current: Mean 3.6 V (Effective 4 V Peak 5.65 V)	Fully rectified signal
3.4			Not used
5 6	Control signal on the microprocessor board Channel 1 2	For input signals 0 - 100% 0 - 5 V	**Factory** setting
7.8			Not used
9 10	Power supply	-15.5 V (-15.45 to -15.55) +15 V (14.5 to 15.5)	**Factory** setting
11	Power supply	-21 V	Rectified filtered
12	Auxiliary voltage	-	A.C.
13	Power supply	+5 V	Regulated
14	Relay state	0-3.5 V (approx.)	0 V corresponds to an alarm (relay de-energised) 3.5 V corresponds to no alarm (relay energized)
15	Image of the line voltage after calibration	4.00 V	Adjusted by potentiometer P2
16	Current calibration Channel 1	For nominal load current equal to unit nominal current: 0-5 V	Adjusted by potentiometer: P3
18	Power supply	0 V	
17,19,20			Not used

5. ALARMS

5.1. General

The alarm signals are completely **controlled by the microprocessor** which retransmits alarm signals (alarms active or not) by the digital communication link (refer to **appendix 4**) and through an **alarm relay**.

Alarms may be either:
- **general** (control of the line voltage and the thyristor unit temperature)
- **local** (control of the load and current of each channel).

The following faults are detected:
- Under and over-voltage
- Over-temperature
- Over-load
- Thyristor short-circuits
- Exceeding the current threshold
- Total or partial load failure

Under-voltage, current limitation, total load failure and thyristor short-circuit alarms cause an **immediate shut-down** of the thyristor unit.

All alarms, except over-load, change the **alarm relay** state which has two contacts, **N/O** and **N/C**, and a common **C**.
Total and partial load **failure** of a channel is displayed, through the front cover, by a corresponding **LED**.

The alarms are ranked in an alarm **hierarchy**, ie certain active alarm states inhibit the processing of alarms at a lower level. The **highest** level alarms **inhibit** the operation of the thyristor unit.

The partial load failure adjustment value is stored in permanent memory (**EEPROM**).

CAUTION:

*If the EEPROM is **not initialised**, no parameter values will have been stored. In the case of non-initialisation or modification of the EEPROM, for no matter what reason:*

*- the microprocessor **resets** the over-current threshold to its **nominal value** ie 100%*
*- the partial load failure is **not adjusted** and the corresponding status word remains unchanged.*

5.2. General alarms

The general alarms detect major line voltage changes and overheating of the thyristor unit. Continuous monitoring of the electronics power supply voltage is used to detect line voltage variations.

5.2.1. Under-voltage

If the line voltage falls by more than **20%** with respect to its nominal value, the unit goes into an alarm state and:
- **inhibits** the 2 channels
- **de-energizes** the alarm relay
- **sets** bit **4** of SW_L to **1** (the **least significant** byte of the status word SW_L).

If the line voltage returns to above **85%** of the nominal voltage the thyristor unit will restart automatically (**enable** and resetting to **0** of bit 4 of SW_L).

5.2.2. Over-voltage

If the line voltage exceeds the nominal voltage by more than **10%** the alarm relay **is de-energized** and bit **5** of SW_L is set to **1**.

In the case of over-voltage, the operation of the unit **is not inhibited** and the regulation maintains a constant value of **V x I** or V^2 for the given set point.
A return of the line voltage to less than **105%** of the nominal voltage resets the alarm relay to a non-alarm state and sets bit **5** of SW_L to **0**.

5.2.3. Over-temperature

Two **thermal-switches** are used to monitor the thyristor unit temperature.

In the event of overheating the opening of the thermal-switch **cuts** the thyristor firing circuit. The microprocessor detects a TLF which causes:
- a **complete shut** down of the thyristor unit
- de-energizes the **alarm relay**
- bits **4** and **5** of SW_H are set to **1** (**most significant byte** of the status word **SW**)
- **LED1** and **LED2** light up

To restart it is necessary to clear the alarm (code **04** sent in the status word **SW**).

5.3. Local alarms

The following faults are detected independently on each channel:

- thyristor short-circuit
- over-load
- total load failure (**TLF**)
- partial load failure (**PLF**)
- current exceeding current threshold.

5.3.1. Thyristor short-circuit

A thyristor short-circuit is detected if the measured current is greater than **70%** of the calibrated load current **when** the thyristor current demand is zero (**OP=0**).

This detection is not carried out if the calibrated current is less than **10%** of the nominal current of the thyristor unit.

When a **thyristor short-circuit** is detected in either channel, the thyristor unit is **inhibited**, the alarm relay is **de-energized** and depending on which channel is affected, either bit **9** or **10** of **SW** (the bit **1** or **2** of SW_H - the **most** significant byte of the status word **SW**) is set to **1**.

The **PLF** detection is then **inactive** because the channels are inhibited.

Only clearing of the alarm or **disconnection** from the supply will **reset** this alarm and allow the thyristor unit to restart.

5.3.2. Over-load

The detection of an over-load is performed by a comparison of the ratio:

$$R_{NL} = (V \text{ nominal load})/(I \text{ nominal load})$$

and the ratio:

$$R_L = (V \text{ load})/(I \text{ load})$$

This comparison is carried out after each **PLF** adjustment request.

The alarm is active when:

$$R_L < R_{NL}$$

The over-load alarm occurs either with very **low resistance** loads or due to **incorrect adjustment** of the voltage or current settings.

The detection does not take into account the **type of load** (linear or non-linear).

In the event of the detection of an over-load, bit **8** of **SW** (bit **0** of SW_H) is set to **1**.

The alarm relay does not change state.

Clearing only takes place after a new PLF adjust request if the error has disappeared, or by sending code **04** in the **SW** by the digital communication.

Bit **0** of SW_H resets to **0** when the over-load alarm disappears.

5.3.3. Total load failure (TLF)

Once every supply frequency period the microprocessor compares the voltage with **R x I**.

The **TLF** detection is carried out on both channels

TLF detection is only active when the thyristor unit calibration is more than **10%** of the nominal load current.

A total load failure is detected when the current is less than **1.5%** of the nominal load current.

After an integration time of **5s**, the thyristor unit is **inhibited** and the alarm relay **de-energized**.

LED_1 or **LED_2** behind the front cover lights up.

Detection of a **TLF** sets either bit **4** or bit **5** of **SW_H** (bit **12** or **13** of **SW**) to 1, depending on which channel is affected.

The thyristor unit starts up after the alarm is cleared (code **04** sent in the **SW**).

A **TLF** alarm can result from the following:

- Over-temperature of the heat-sink (temperature switch opens)
- Fuse failure (thyristor or power supply protection)
- Total load failure
- Faulty connection
- Thyristor failure (open-circuit)
- Thyristor firing circuit failure
- Absence of voltage on the power lines of one (power failure)

5.3.4. Partial load failure (PLF)

This function allows detection of a partial load failure or an increase in resistance on each channel.

This calculation is performed on **CV** and **VV** during the **PLF adjustment** sequence (refer to page **50**).

Detection cannot take place if there has been no adjustment or if the adjustment has failed (bit **6** of SW_H or bit **14** of **SW** is set to **0**).

The alarm sensitivity is adapted to suit the load (resistive or infra-red).

The PLF detection measures the currents passing through the thyristors, consequently PLF sensitivity **differs** depending on whether the load is **star or delta connected** and whether the failure takes place in a **controlled** phase or not.

For a **star** load the PLF detects the failure of one heating element **out of four** identical elements connected in parallel for the **controlled** phases and **one out of two** for the **direct** phase.

For a **delta** load the PLF detects the failure of **one** element **out of three** identical elements connected in parallel **regardless of which** phase is affected.

If a partial load failure is detected:

- bit **7** of SW_H (bit **15** of **SW**) is set to **1**
- LED_1 lights
- the alarm relay is **de-energized**.

The alarm is cleared when:

- the fault disappears
- an alarm clearing command is detected (code **04** in **SW**)
- a PLF **adjustment** is requested.

5.3.6. Exceeding the threshold current

The current threshold set-point (current limit set-point **CL**)
sets the maximum effective current level allowed through the load.

The nominal load current value (I_{NL}) set by CA corresponds to **100%** of the **CL**.

The limited load current (I_{LIM}) is determined by:

$$I_{LIM}(A) = (I_{NL}(A) \times CL(\%)) : 100$$

Example

Nominal thyristor current I_{NU}=250A

Nominal load current I_{NL}=200A
Current limitation set-point CL=100%

Current calibration is:
CA = (200A / 250A) x 100% = 80%

The limited current is:

$$I_{LIM} = \frac{200 \times 100}{100} = 200A$$

The value of the effective load current (I_L) (*calculated by the microprocessor over the burst repetition period*) is compared to the setpoint (**CL**) at each burst cycle. **If the load current (I_L) is over 10% of the threshold limited load current (I_{LIM}), the affected channel is inhibited.**

Restarting is only possible after the alarm has been cleared by sending code **04** in the status word **SW** (or **CW** in MODBUS).

The state of the over-threshold current alarm is available using bit **3** of SW_H (bit **11** of **SW**).

Bit **3** of SW_H is set to **1** when the alarm is active and at **0** when inactive (see table **5.2** and **appendix 4**).

5.4. Alarm relay

The alarm relay is located on the power supply board.

Normally open (**NO**), normally closed (**NC**) and common contacts are available to indicate alarm states of the load and the supply. The current breaking capacity of these contacts is **1 A (220 Vac or 30 Vdc)**.

Alarm relay is **de-energised** in alarm.

5.5. Resetting the alarms

To acknowledge alarms, the electronics supply can be switched off (on the **CCC** board).

Sending **04** in the **SW** will acknowledge the following fault alarms :

- Total load failure
- Partial load failure
- Thyristor short circuit
- Overload
- Current limit exceeded.

When digital communications are not used (**ST9 = 0**), applying a positive signal across terminals « **RX-**» and «**RX+**» will acknowledge these alarms.

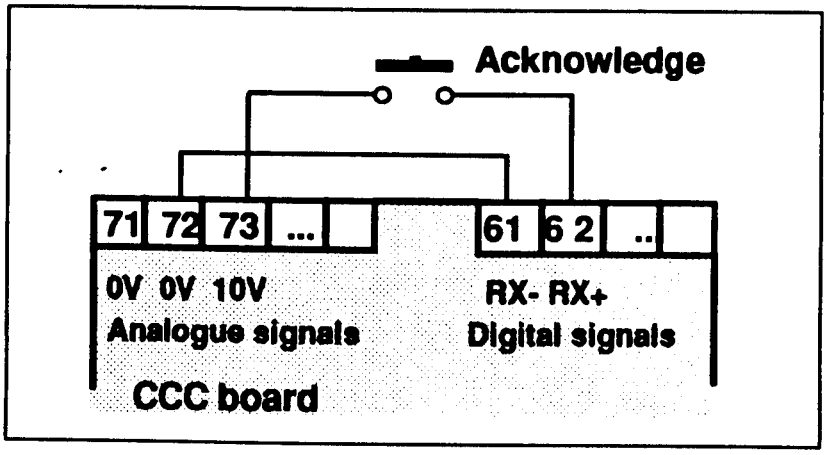


Figure 5.1. Alarm Acknowledgement when Digital Communications are not Used

5.6. Alarm management

To allow a better understanding of the operation of the alarms, the principle characteristics of all the thyristor unit alarm types are shown in table **5.1.**

Table **5.2** gives the states of the alarms, thyristors and alarm LEDs with comments.

Key:

V - line voltage
V_N - nominal line voltage
V_L - load voltage
V_{NL} - nominal load voltage

I_L - load current
I_{NL} - nominal load current
I_{NU} - nominal unit current
I_{LIM} - limited current

R_{NL} - nominal load resistance
R_L - load resistance
R_M - resistance R_{NL} stored during PLF adjustment
OP - power demand.

General alarm characteristics

Table 5.1

Alarm			Triggering conditions
Type	**Value monitored**	**Fault**	
General	Voltage	Over-voltage	$V > 110\% V_N$
		Under-voltage	$V_L < 80\% V_N$
Local	Load	Over-load	$R_L < (R_{NL} = R_M)$ and PLF adjusted
		Partial load failure (PLF)	$R_L > 106{,}25\% R_M$ (See adjustment conditions, page 50)
		Total load (TLF)	$I_L < 1{,}5\% I_{NL}$ (CA > 10% OP ≠ 0)
	Current	Thyristor short-circuit	$I_L > 70\% I_{NL}$ (CA > 10% OP = 0)
		Current exceeds threshold	$I_L > 110\% I_{LIM}$

Table 5.2

Fault		Fault states					Comment		
		Alarm relay	Thyristor inhibit	LED	Bit equal to 1		Resetting	Relay non alarm state	Function PLF
					SW_L	SW_H			
Over-voltage		+	-	-	5	-	-	105% V_N	Active
Under-voltage		+	+	-	4	-	-	85% V_N	Inactive after inhibited
Heat-sink over temperature		+	+	LED1 LED2	4.5	-	+	After resetting	
Over-load		-	-	-	-	0	+	-	Active
Partial load failure		+	-	LED1 LED2	-	7	+	$R_L=R_M$	
Total load failure	Channel1	+	+	LED1	-	4	+	After resetting	Inactive after inhibited
	Channel2			LED2		5			
Thyristor short circuit	Channel1	+	+	-	-	1	+		
	Channel2					2			
Current limitation		+	+	-	-	3	+		

6. SAFETY

Failsafe setting in case of communication failure

In the event of digital communication failure, it is possible to control the thyristor unit in **local** mode, using the **analogue inputs** available on the microprocessor board, (terminal **76**).

The default position may be set using a **10kΩ** potentiometer connected between the "**+10V**" and "**0V**" terminals (terminals **73** and **71** on the microprocessor board) or any other analogue signal. The potentiometer is connected to the channel **1** analogue input (**RI1**- terminal **76**).

As a safety measure, it is **recommended** that the wiring scheme shown in fig **6.1** be used.

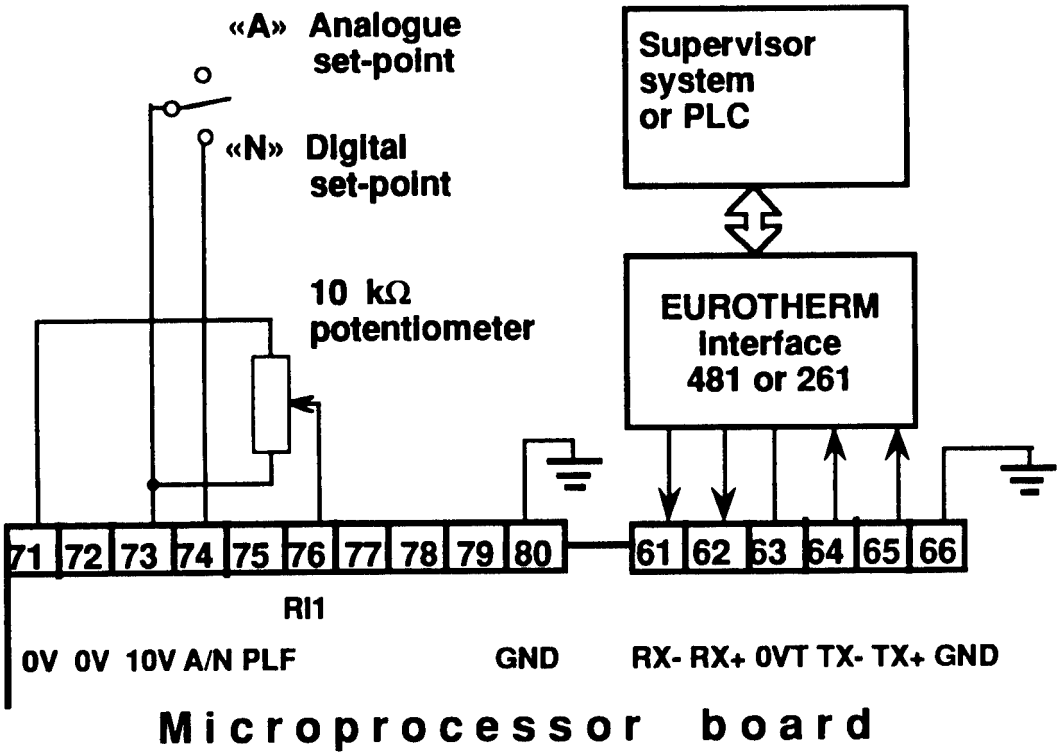


Figure 6.1. Connection in the event of digital communication failure

7. THYRISTOR PROTECTION FUSES

CAUTION:

The ultra-fast fuses recommended are intended for the protection of the ***semi-conductors*** *used in the thyristor units.*

They do not provide the line protection needed for the installation to conform to local wiring regulations.

7.1. Thyristor units 40 to 125 A. External fuses

It is important to use fuses labelled as shown in Tab. 7.1

The use of any other fuse cancels the thyristor guarantee.*

Table 7.1

Thyristor nominal current	Fuse references	
	EUROTHERM	Supplier FERRAZ
40 A	CH330054	B093910
60 A	CS173087U080	A094829
75 A	CS173089U100	Y094827
100 A	CS173246U125	S078331
125 A	CS173246U160	X076331

* When using **ultra-fast** fuses with short wave **infra-red lamps**, (which cause high current surges), please **consult us**.

Fuse holder and protective cover references are as shown in Tab.7.2.

Table 7.2

Current range	References				
	Fuse-holders		Two terminal protective covers		Fuse and fuse-holder assembly
	Eurotherm	Supplier	Eurotherm	Supplier	Eurotherm
40 A	CP171480	FERRAZ J081221	-	-	FU1451
60 to 75 A	CP173083	LEGRAND 216.01	-	-	FU2258
100 to 125 A	CP173245	FERRAZ H220071	BD173439	A220087	FU2760

7.2. Thyristor units 250 A. Internal fuses

It is **important** to use **315A** fuses with references shown in Tab. **7.3.**

Table 7.3

Protection components	References		
	EUROTHERM	**FERRAZ**	**BUSSMANN**
Original fuse	LA172468U315	Q300003	170M4460
EDV	CI172056	-	170H0066
Micro-switch	DC172267	-	170H0069
	DC172997	G310000	-
Authorized fuses	-	V078977 (440 V max)	170L5555 (660 V max)
EDV	CI172056	B096003	170H0066
Micro-switch	DC172267	P096015	170H0069

315A internal fuses use a **micro-switch** to detect operation of the fuse.

The normally closed contacts **(NC)** of the micro-switches of two fuses are connected in series and connected to the customer terminal block (refer to page **32**).

An EDV must be mounted on every fuse (except FERRAZ Q300003)

8. MAINTENANCE

To ensure adequate cooling of the thyristor unit, it is recommended that the heatsink and fan grill be **cleaned** once every **two** months.

Every **six** months, check the **tightness** of the screws retaining the power and load cables.

APPENDICES

Appendix 1. IDENTIFICATION CODE DETAILS

1.1. Thyristor unit

Basic product	/	Nominal current	/	Line voltage	/	Fan supply	/	Analogue input	/	Firing mode

Control equipment	/	Communication protocol	/	Feed-back	/	Load type for PLF detection	/	Control mode	/	End **00**

Basic product

TU2170

Nominal current

40 A	**40A**
60 A	**60A**
75 A	**75A**
100 A	**100A**
125 A	**125A**
250 A	**250A**

Line voltage

100 V	**100V**
110 V	**110V**
120 V	**120V**
200 V	**200V**
220 V	**220V**
230 V	**230V**
240 V	**240V**
380 V	**380V**
400 V	**400V**
415 V	**415V**
440 V	**440V**
480 V	**480V**
500 V	**500V**
550 V*	**550V**
600 V*	**600V**
660 V*	**660V**

* Standard for 250 A
Consult EUROTHERM
for other currents

Fan supply

No fan supply	**000**
115 V	**115V**
230 V	**230V**

Analogue input

0 - 5 V	**0V5**
1 - 5 V	**1V5**
0 - 10 V	**0V10**
2 - 10 V	**2V10**
0 - 20 mA	**0mA20**
4 - 20 mA	**4mA20**

Firing mode

Single cycle (1 cycle)	**FC1**
Fast burst (8 cycles)	**FC8**

Control equipment

Control and communication board	**CCC**

Communication protocol

EUROTHERM	**EIP**
MODBUS®	**MOP**
JBUS®	**JBP**

Feedback

V x I	**W**
V^2	**V2**

Load type for PLF detection

Infra-red	**IR**
Resistive	**RES**

Control mode

Without digital communication	**CTRL**
Digital control 9600 bauds	**96**

1.2. Fuse and fuse holder assembly (40 to 125 A)

Basic product /	Nominal current of thyristor /	End 00

Basic product

Basic product fuse (27x60)	**FU2760**

Nominal current

40 A	**40A**
60 A	**60A**
75 A	**75A**
100 A	**100A**
125 A	**125A**

1.3. Code details example

Thyristor unit	**TU2170**
Nominal current	**75A**
Line voltage	**380V**
Without fan	
Analogue setpoint on the microprocessor board	**2-10V**
Thyristor firing mode	**single cycle**
Control and communication board	**EUROTHERM**
Feedback type	**V x I**
Load	**Resistive**
Digital Baud rate	**9600 bauds**

Thyristor unit code details:

TU2170 / 75A / 380V / 000 / 2V10 / FC1 / CCC / EIP / W / RES / 96 / 00

Fuse and fuse holder assembly code details:

FU2760 / 75A / 00

Appendix 2. TECHNICAL SPECIFICATIONS

GENERAL

Thyristor unit for three wire three phase loads, 2 phase control, composed of two thyristors with zero voltage switching.

Engineering design	Conforms to standard **IEC158-2**
Operating temperature	**0 to 50C**
Storage Temperature	**-10 to 70C**
Installation	In a dry environment (humidity less than 50% at **40°C** or **90%** at **20°C**) No conductive or corrosive dust Non explosive atmosphere
Insulation	Distances according **IEC 28-A (CEI 664)**
Protection	Varistances and RC network **External** fuses (40 to 125 A) **Internal** fuses (250 A)
Weight (approx.)	**7.6kg (40 to 75A)** **8.6kg (100 to 125A)** **15kg (250A)**

POWER

Nominal current (per channel)	**40** to **125A rms** and **250 A rms**
Voltage	**100** to **500V ac** (+10%; -15%) for **40** to **125A** **100** to **660V ac** (+10%; -15%) for **250A**
Frequency	**50** to **60 Hz**
Type of control	**Thyristors** connected in inverse parallel
Cooling	Natural convection (**40 to 75A**) Fan cooled (**100A, 125A and 250A**)
Fan supply voltage	**115V or 230V ac**

CONTROL ELECTRONICS

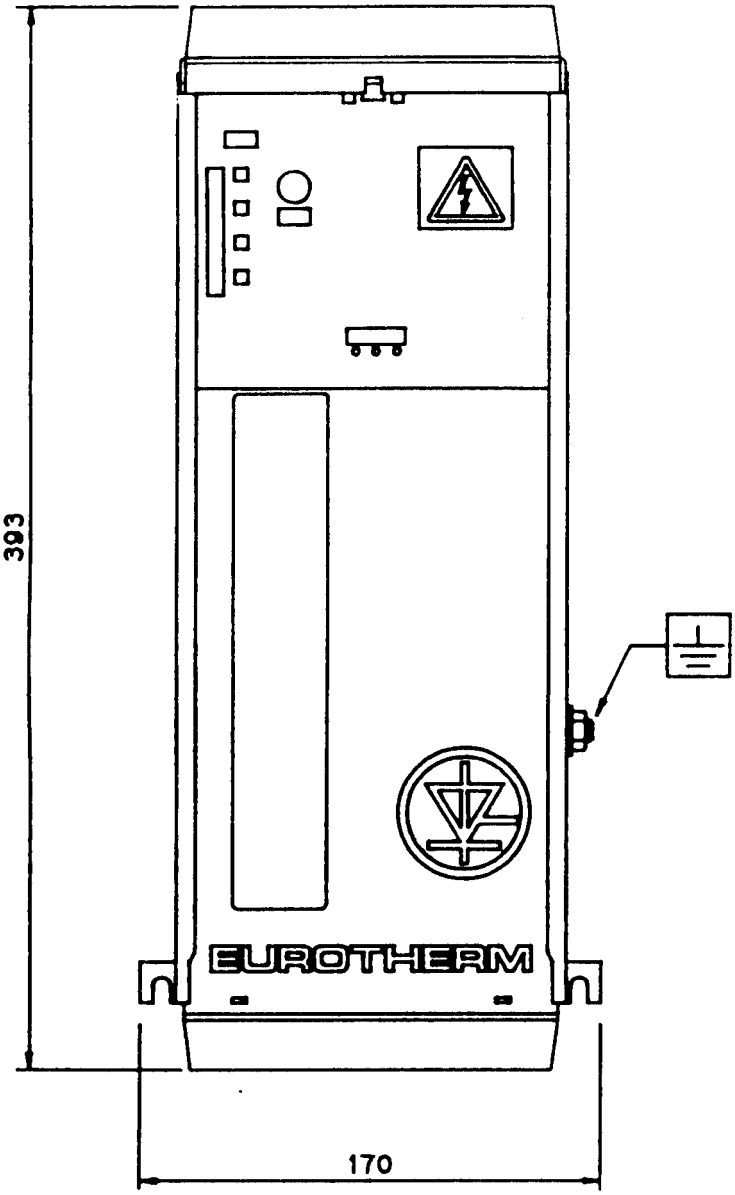
Control	**Digital communication** with **digital** or **analog** setpoint
Digital communication	Serial bus **RS485(RS422)**
Baud rate	**9600 baud**
Communication protocol	**EUROTHERM, MODBUS® or JBUSR**
Analog signal Selectable :	**0-5V; 1-5V; 0-10V; 2-10V; 0-20mA; 4-20mA.**
Input impedance on the microprocessor board	**10kΩ at 10V**

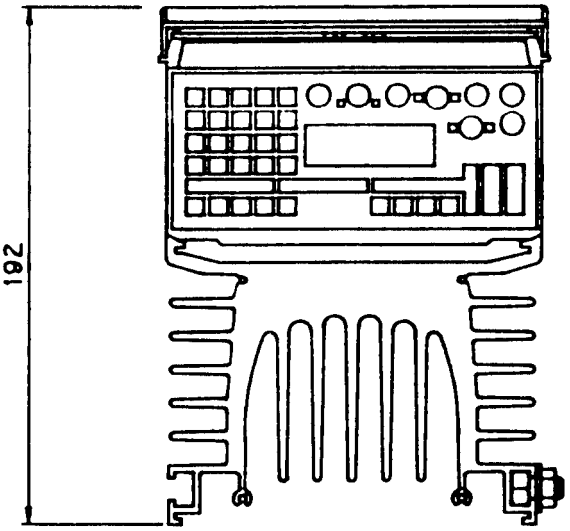
Firing mode	**Single cycle** or **fast burst** (8 cycles) firing
Control mode	**V^2 or V x I**
Regulation linearity	**2%**
ALARMS	The digital communication and a relay indicate: - unacceptable line voltage variations - the following faults on each channel: - thyristor short circuits - exceeding current threshold - Total load failure (**TLF**) or Partial Load Failure (**PLF**) Relay contact capability: **1A (250Vac** or **30Vdc)**.
TLF indication	The two channel failure **LEDs** and **the digital communication**
PLF indication	**The digital communication** and in one of the controlled channels - by one **LED**.
PLF detection	Guaranteed failure detection: - of **one** element **out of four** similar elements in paralle for the controlled phases - of **one** element **out of two** for the direct phase ie. star wired load - of **one** element **out of three** similar elements for a delta-wired load of any phase.
Exceeding the current threshold	Inhibition of the thyristor unit

CONNECTIONS

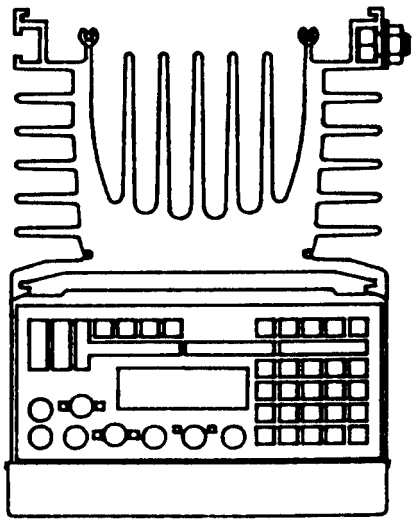
Power	**40 to 125A** : Terminals for **10** to **35mm^2** cables **250A** : Connection by **M8** studs and **M10** bolts Cables **120mm^2** (max).
Control, Electronics supply, Alarms	Plug-in connectors: **1.5mm^2** cables
Power supply and microprocessor boards	**20** way ribbon cable (supplied by Eurotherm).

Appendix 3. MECHANICAL DETAILS



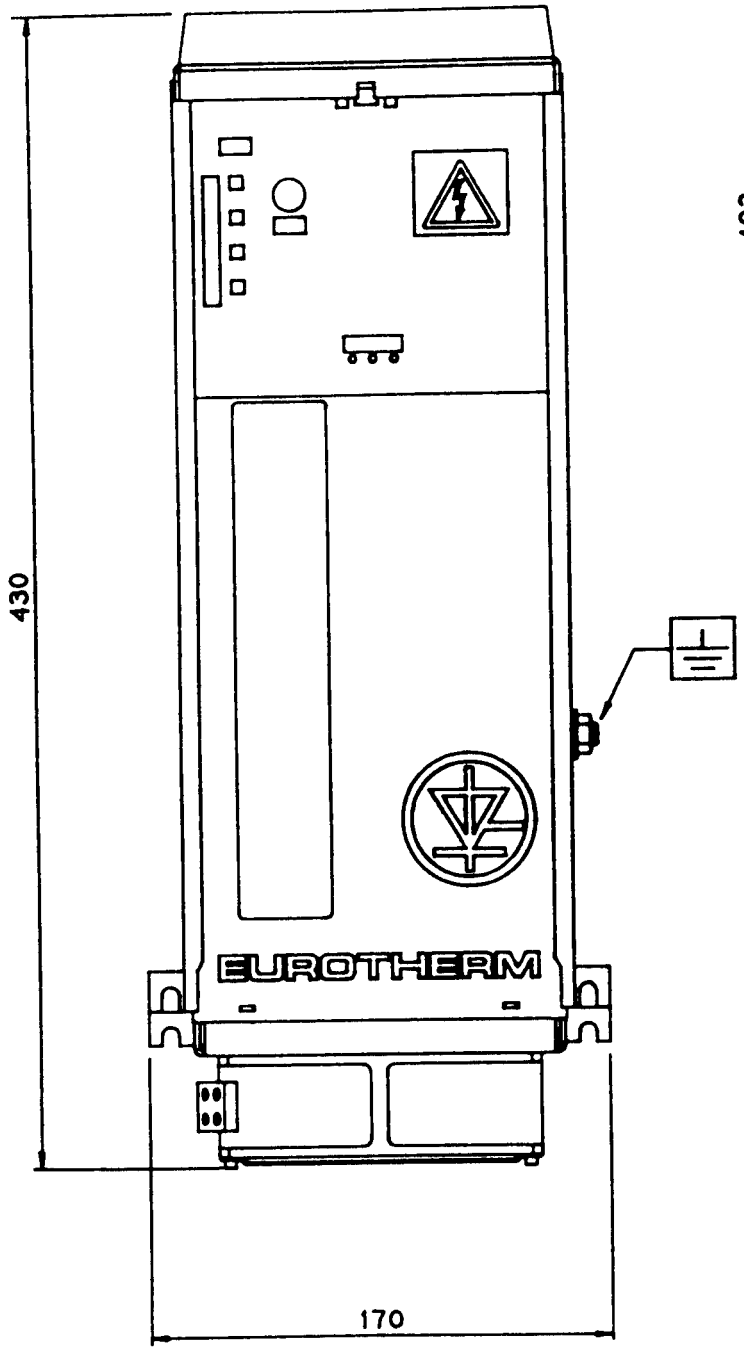


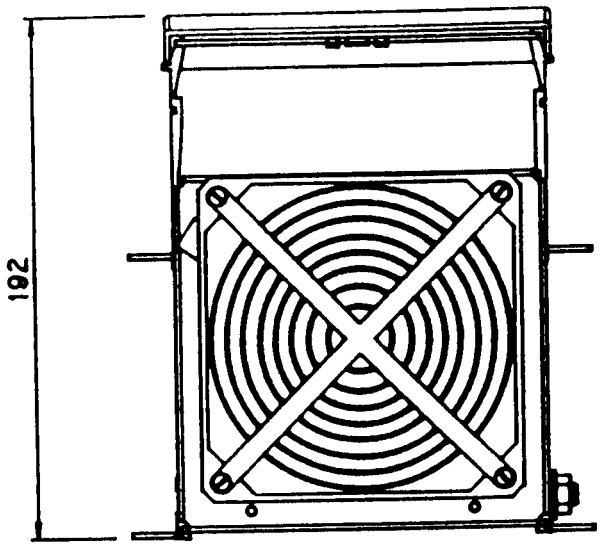
BOTTOM VIEW
VUE DE DESSOUS



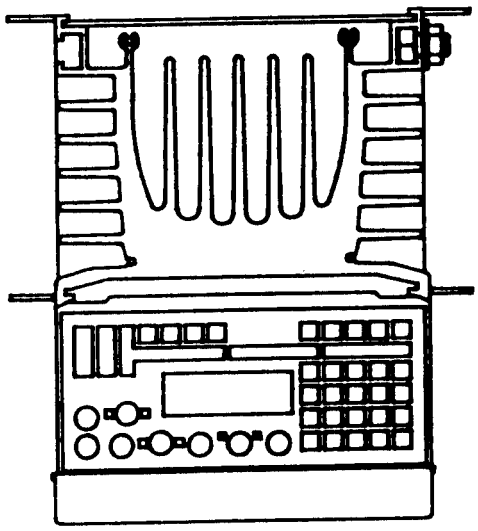
TOP VIEW
VUE DE DESSUS

Thyristor units 40 to 75A convection cooled



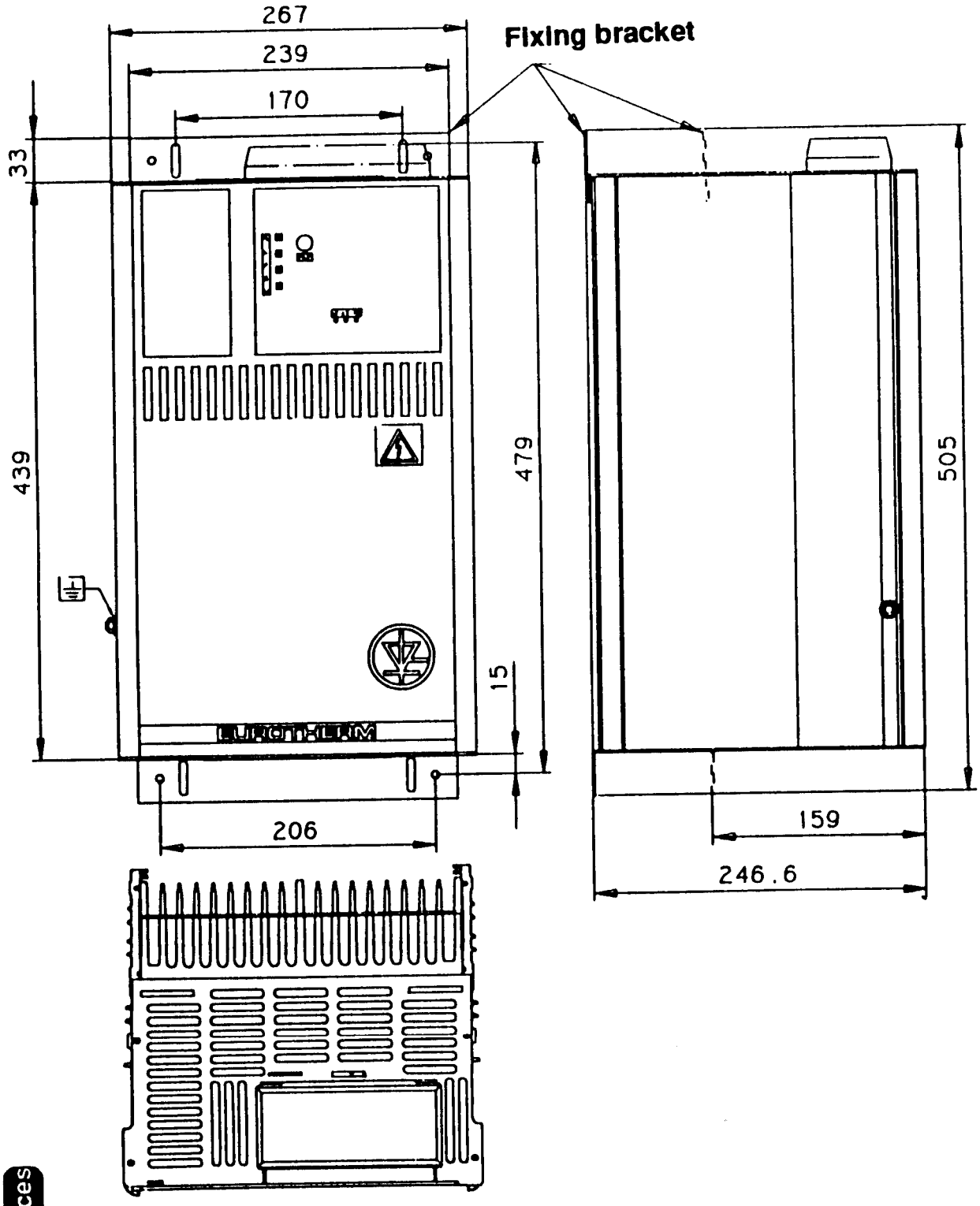


BOTTOM VIEW
VUE DE DESSOUS



TOP VIEW
VUE DE DESSUS

Thyristor units 100 to 125A fan cooled



Thyristor units 250A

Appendix 4. Digital communication characteristics

A digital communication user manual (ref. EUROTHERM **HA 173 688** - Issue 1 - 02/92) is **necessary** for the correct use of the digital link between a control system and a **TU2170** thyristor unit.
The type of communication used for the **TU2170** is the same as that used for the **TU1470** described in the manual.

The configuration of the jumpers determining the operation of the thyristor unit is **different** to the configuration of the **TU1470** (see chapter 3 **of this manual**).

Appendix **4** gives **additional information** concerning the **changing** of certain **codes**, numbers and **destinations** of bits in the status word **SW** which are exclusively used for the **TU2170**.

The addresses of the channels of the **TU2170** thyristor unit are calculated **differently** from those of the **TU1470** and have **8** bits (see page **42**).

The type of regulation used (V x I or V^2) for the two channels of the thyristor unit is available on bit **3** of the status word **SW**.

Each **command code** modifies the behaviour of the thyristor unit and affects the relevant bits of the status word **SW** (see table **A1**). All of these codes may be broadcast to all thyristor units connected to the same bus (ie. sent to the address **00**).

The thyristor unit may be **enabled** or **inhibited** (both channels at the same time) by using the digital communication (see table **A2**).
The thyristor unit is enabled after power is applied to the interface or after a **reset** by the "Watchdog".

The state (enabled or inhibited) of **the thyristor unit** is available by bit **0** of the status word **SW** (see table **A1**).

Table A.1

Byte of the status word SW	Bit number		Flag (FG)		Thyristor state	Address (HEX)	
	byte	status word	Name	State		Protocol	
						MODBUS	JBUS
SW_H Most significant byte	7	15	FGPLF	1	PLF detection	0F	10
	6	14	FGNPLF	0	PLF non adjusted	0E	0F
	5	13	FGTLF2	1	Failure detection channel 2	0D	0E
	4	12	FGTLF1	1	Failure detection channel 1	0C	0D
	3	11	FGLIMI	1	Current limitation threshold exceeded	0B	0C
	2	10	FGSCT2	1	Thyristor short-circuit channel 2	0A	0B
	1	9	FGSCT1	1	Thyristor short-circuit channel 1	09	0A
	0	8	FGOVL	1	Over-load	08	09
SW_L least significant byte	7	7	FGIR	1 0	Infra-red load Resistive load	07	08
	6	6	FGAN	0 1	Analog setpoint Digital setpoint	06	07
	5	5	FGOVV	1	Over-voltage	05	06
	4	4	FGUNDV	1	Under-voltage	04	05
	3	3	FGREGU	0 1	U2 regulation Uxl regulation	03	04
	2	2	-	0	(not used)	-	-
	1	1	FGLTO	0 1	Single cycle Firing burst	01	02
	0	0	FGINH	0 1	Thyristor unit enabled Thyristor unit inhibited	00	01

Table A.2

Control code (HEX)	Description (Destination)		Number of thyristor channels
00 01	Inhibited		2
02 03	Enabled		
04	Alarm clearing		
05	PLF adjustment control		
06	Control	V x I	
07		V^2	
08 09	Not used for TU2170		
0A	Firing mode	Single cycle (1 period)	
0B		Fast burst (8 periods)	
0C	Transfer of setpoint FS to SL		

Code addressed to **00 - broadcast** for all thyristor units using the same bus.

Appendix 5. Influence of the ambient temperature

The nominal current rating of the thyristor unit is guaranteed for ambient temperatures between 0 and 50°C

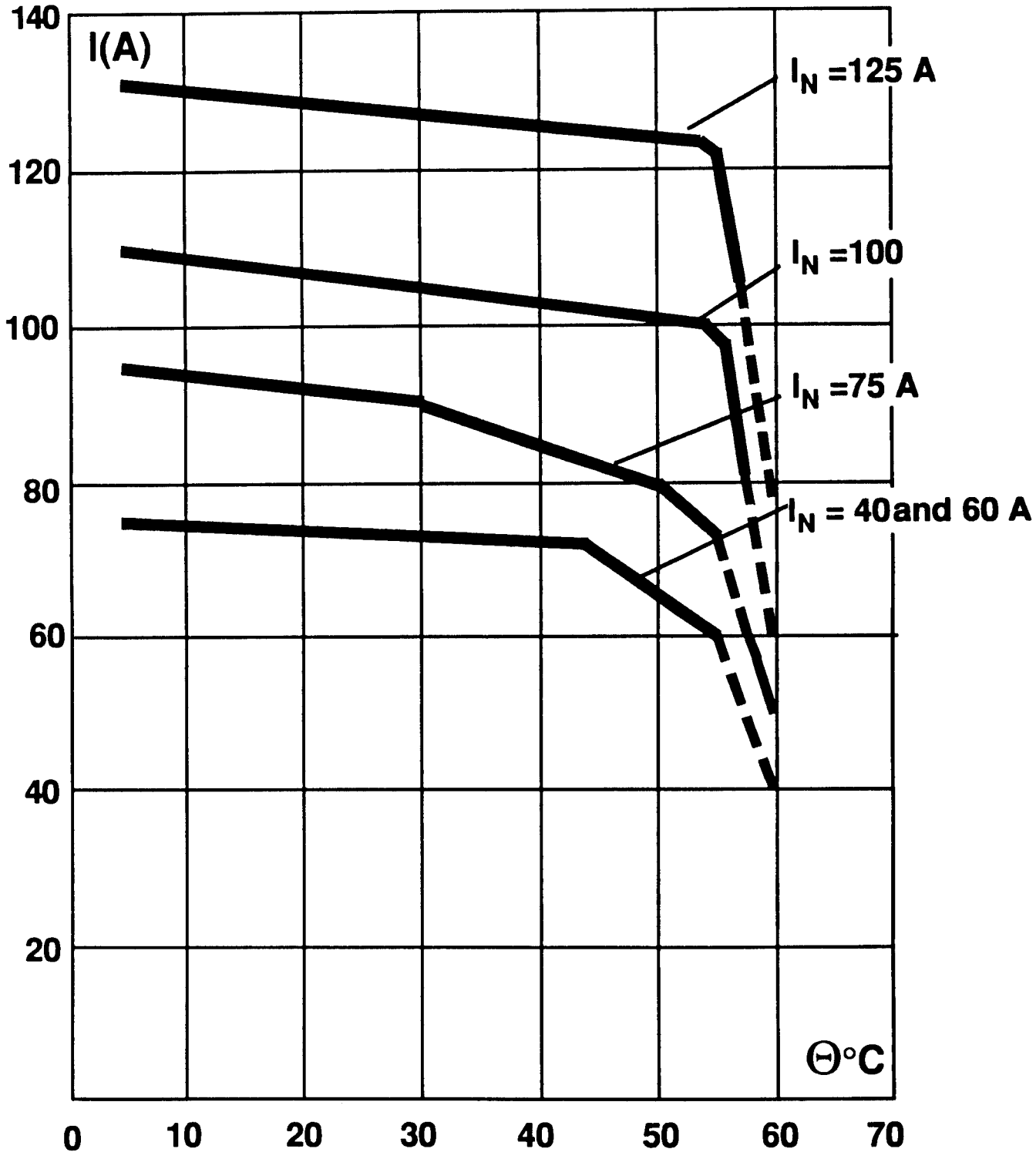
Above this temperature the use of these thyristor units is determined using **derating** curves (charts showing the maximum admissible currents as a function of the ambient temperature).

The derating curves are based on the thermal requirments of the thyristors and the diffrent modes of cooling.

These curves take into account:

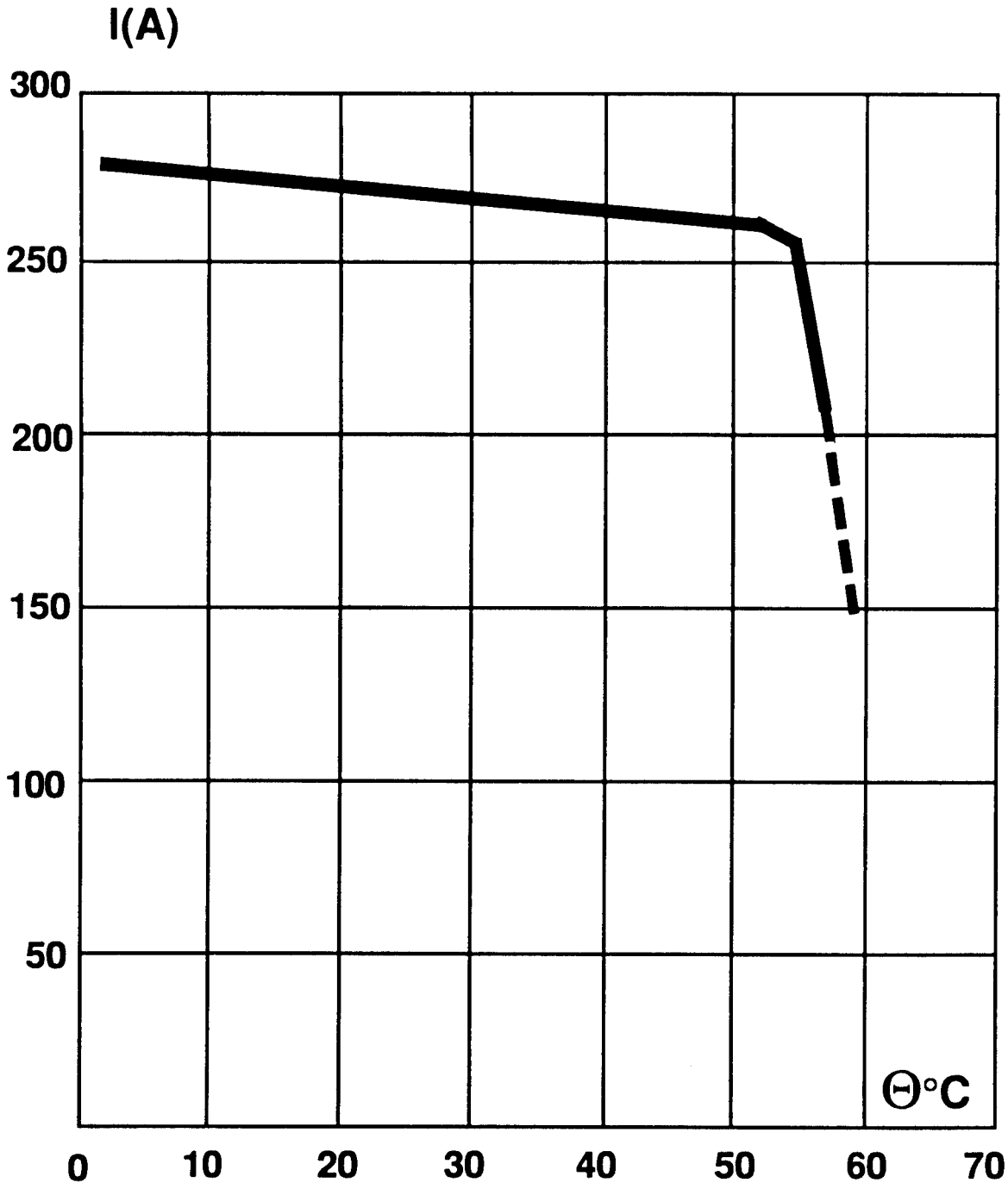
- The maximum thyristor junction temperature,
- The maximum current limits of the thyristors,
- Temperature distribution within the thyristor units, in particular **on the circuit boards**.
- Limiting values of the recommended fuses,
- Limiting values of the power connections,
- Maximum temperatures of components on the circuit boards.

Derating curves for thyristor units 40 to 125A



Θ°C - operating temperature (in degrees Centigrade)
I(A) - maximal current allowed by the thyristor unit (in Amps)
I_N - nominal current (thyristor units calibrated in Amps)

Derating curve for thyristor units 250A



Θ°C - operating temperature (in degrees Centigrade)
I(A) - maximal current allowed by the thyristor unit (in Amps)

Appendix 6. RECOMMENDED TOOLS

Operation	Screwdriver (flat blade)	Spanner or Allen key	Electrical apparatus
Mounting	-	Depends on M6 screw chosen by the customer	-
Removal (refitting) of front cover	4 - 5.5 mm (for 40 to125 A)	M4 Allen key (for 250 A)	-
Earth connection	-	HEX13 (M8) spanner	-
Power connections	6.5 mm (for 40 to 125 A)	HEX 13 (M8) spanner (for 250 A)	-
Control and fan connections	4 mm	-	-
Mounting the CCC board	-	M4 Allen key	-
Commissioning	2.5 mm	-	Ammeter or clampmeter Oscilloscope (recommended) EUROTHERM Diagnostic unit type 260 (recommended)