Thyristor power units
and
Solid state contactors

TC1027 Series

User
Manual

Part No. HA 174761 ENG - Issue 3 - 05/96 (Old Part No : HA174762)

EUROPEAN DIRECTIVES

COMPONENT

TC1027 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 **TC1027** 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

The electromagnetic compatibility of the TC1027 has been specially developed for the **industrial environment** and must not be used in residential type environments.

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

Immunity
For immunity, the **TC1027** products **installed and used in compliance with this manual meet** the essential requirements of the **EMC 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 **TC1027** products **installed and used in compliance with this manual meet** the essential requirements of the above mentionned **EMC Directive** according to their design.

Conducted emission
To reduce the noise due to the utilization of its thyristor units, 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 **EMC Directive**.

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

CE MARKED APPARATUS

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

For the filter application, please contact Eurotherm.

In order to guarantee the best service, Eurotherm **have validated the compliance** of the TC1027 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.

USER MANUAL

This T**C1027 User Manual** Part No. **HA 174761 ENG** (Old Part No: HA 174762) intends for the TC1027 series power thyristor units manufactured from November 1995.

The TC1027 User Manual Part No. HA 021468 is valid for the products manufactured **before** this date.

For further details, contact your Eurotherm office.

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 TC1027, 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.

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IDENTIFYING THE UNIT

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Chapter 1 IDENTIFYING THE UNIT

GENERAL INTRODUCTION TO THE TC1027 SERIES

The **TC1027** thyristor unit series is designed for the electrical power control of industrial single-phase loads with low resistance variation.

The range of nominal currents of the **TC1027** series power units is from **300** to **500 A** at nominal voltages of **120** to **500 V**.

Depending on the type of operation, the **TC1027** series is composed of two types of unit:

- **Solid state contactors** (**logic** operation).
  Units driven by a logic signal, operating in **ON/OFF** mode, and emitting the maximum power to the load when the control signal is present.

- **Power thyristor units** (**analogue** operation).
  Units driven by an analogue signal emitting an output power proportional to the input signal for thyristor firing and in **Burst firing** mode including a whole number of alternations.

For the solid state contactors and the power thyristor units, the thyristor firing and non-firing are synchronised at zero voltage , eliminating the steep current fronts which generate supply interference.

The thyristors are protected by an internal high-speed fuse.
The fuse blow-out detection installed inside the unit is performed by the fuse blown indication micro-switch (optional).

The supply side power cables pass through the opening of the protective cover.
The load cable pass through the **cable sheath** under the unit.

The control wires are connected on the user terminal block of the driver board.
They must be **shielded** and grounded at **both ends**.

The control cable passes through the **cable clamp** which secures the cable and **grounds** the shielding simultaneously.

The units are equipped with fans.
The thermal switch inhibits the fan-cooled unit in the event of thyristor heatsink **overheating.**

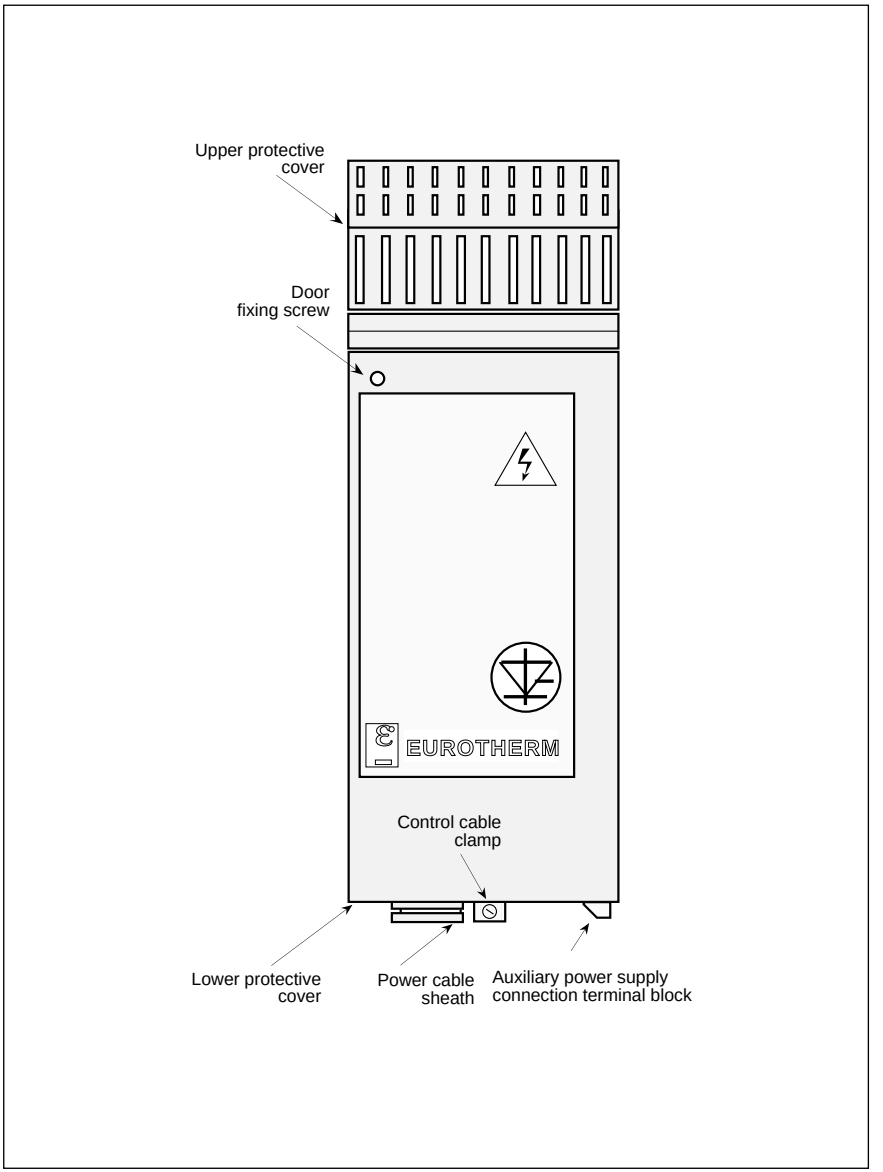

Figure 1-1 Overall view of the TC1027 series power unit

The TC1027 series unit is equipped with a **driver board** which performs the feedback, measurement (for power thyristor units) and thyristor firing functions.

The input is located on the user terminal block of the driver board.

Solid state contactors.

The input signals of the TC1027 series static contactors must be logic.

- dc signal : 10 Vdc (20 mA)
- ac signal : 100 Vac to 240 Vac.

Power thyristor units.

The input signals of the TC1027 series power thyristor units must be analogue.

- dc voltage signals:
  - 0 - 5 V
  - 0 - 10 V
  - 1 - 5 V
  - 2 - 10 V
- dc current signals:
  - 0 - 20 mA
  - 4 - 20 mA.

The TC1027 series power thyristor units possess a supply voltage variation compensation within the range + 10% to -15% of the nominal voltage.

This instantaneous compensation is used to maintain the power transmitted to the load constant in spite of the supply voltage variations, thus preventing fluctuations of the controlled value.

The filters guaranteeing immunity to electromagnetic interference are installed:

- at the auxiliary power supply input
- between the power supply phase ("LINE") and the safety earth connector
- between the load connection ("LOAD") and the safety earth connector.

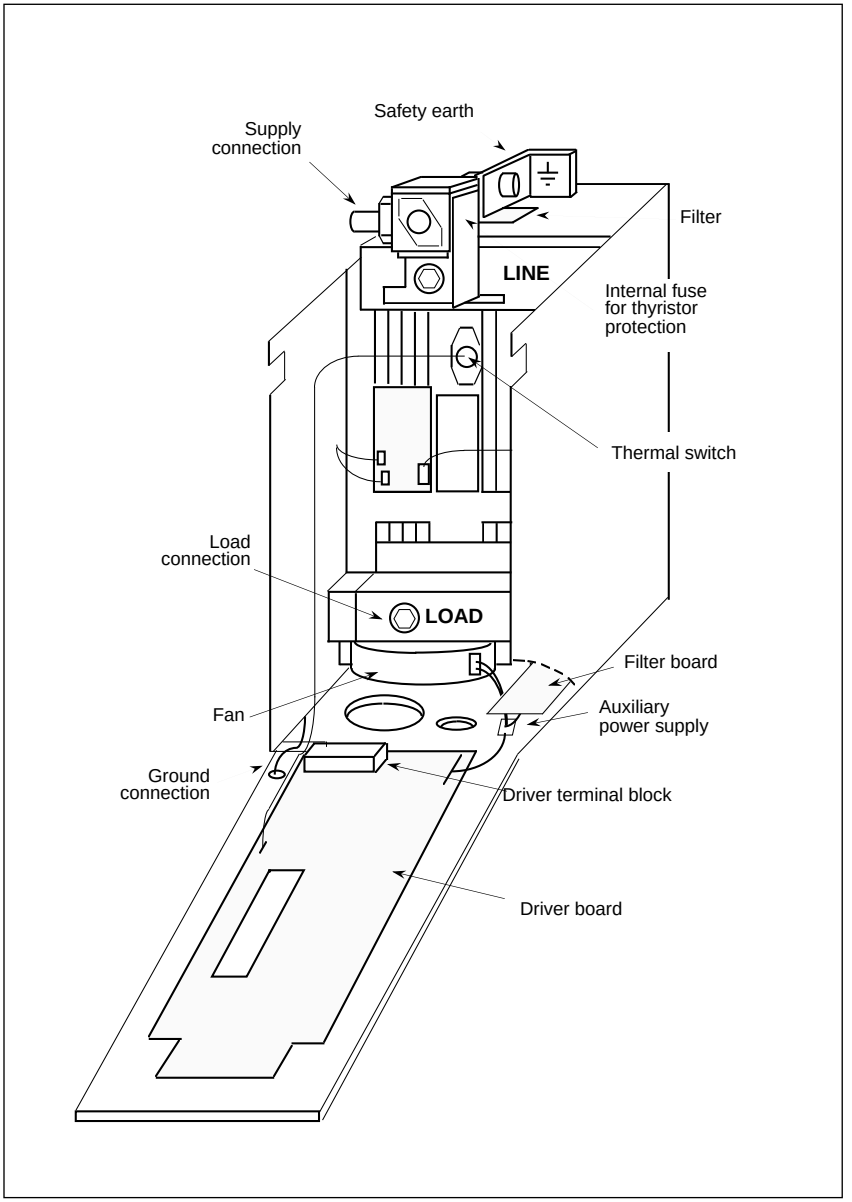

Figure 1-2 Overall view of the TC1027 unit with the access door open

TECHNICAL DATA

The **TC1027** series is a series of **static contactors** and **power thyristor units** designed to control the electrical power of industrial three-phase and single-phase loads.

Attention !

It is the user's responsibility to ensure that the unit is compatible with the technical data before commissioning the unit.

Power

Nominal current	**300 A , 400 A, 500 A**
Nominal voltage	**120** to **500 Vac** line to line (+10% -15%)
Frequency	**50** or **60 Hz**
Operation type	• **Solid state contactors** Thyristor firing in Logic (ON/OFF) mode Logic signals • **Power thyristor units** Thyristor firing in Burst firing mode Analogue signals
Thyristor firing	Burst firing mode: firing ON/OFF when zero voltage crossing is reached.
Load type	**Resistive** loads with low temperature coefficient

Protection

Thyristors	Internal high-speed **fuses**. **RC** snubbers and **Varistor** at thyristor terminals. Fuse blown trip indicator. As an option, fuse blown indication micro-switch.
Auxiliary power supply	**1 A** external fuse (not supplied)
Mechanical protection	Covers guaranteeing **IP20** protection.
Thermal protection	Thermal safety switch (stops thyristor firing if the maximum heatsink temperature is exceeded).

Insulation

Unit	Insulated from the power part, connected to the internal terminal of the safety earth and should be connected to the appropriate earth.
Coolers	Not insulated from the thyristors (phase potential)
Control signals	Insulated from the load circuit

Control

Solid state contactors	Logic signal which can be selected in the factory
Firing mode	ON/OFF (according to the presence of the control signal)
• dc signal	- Voltage **10 V** V max = 25 V ON state V > 5 V (4 mA min) OFF state V < 1 V - Current **20 mA** I max = 40 mA ON state I > 4 mA OFF state I < 0.2 mA
• ac signal	Voltage **100 to 240 V** V max = 264 V ON state V > 85 V OFF state V < 10 V
Power thyristor units	Analogue signal which can be selected by the user using jumpers
Firing mode	Burst firing. The typical modulation cycle at 50 % power is **0.6 s**
• dc signal	- Voltage **0-5 V; 0-10 V; 1-5 V; 2-10 V** - Current **0-20 mA; 4-20 mA**
• Manual control	External **5 kΩ** potentiometer Input configured in **0-5 V** **+ 15 V** voltage available on the user terminal block
Auxiliary power supply	**115 V** or **230 V** (+10 %-15 %). The exact definition of the power supply voltage is used to adjust the supply variation compensation accurately.
Consumption	**35 VA**

Thermal characteristics

Operating temperature	**0 to 50°C** in vertical position (40°C for the 500 A nominal current, to 50°C for units redesigned for 450 A)
Storage temperature	**- 10°C to 70°C**
Heat dissipation	The thyristor units dissipate on average **1.3 W** per ampere
Cooling	Permanent fan-cooling. Built-in fan-cooling.
Fan power supply	**115 V** or **230 V** The power supply is used to power the fans.

CODING

Series / Nominal current / Nominal voltage / Auxiliary power supply / Input / Options / 00

Series	Code
Solid state contactors and power thyristor units	**TC1027**

Nominal current	Code
300 amperes	**300A**
400 amperes	**400A**
500 amperes	**500A**

Nominal voltage *)	Code
120 volts	**120V**
240 volts	**240V**
277 volts	**277V**
440 volts	**440V**
480 volts	**480V**
500 volts	**500V**

Auxiliary power supply	Code
100 volts	**100V**
110 volts	**110V**
115 volts	**115V**
120 volts	**120V**
200 volts	**200V**
220 volts	**220V**
230 volts	**230V**
240 volts	**240V**

Input	Code
Power thyristor units	
"Burst mode" thyristor firing	
Analogue signal :	
0-5 volts	**0V5**
1-5 volts	**1V5**
0-10 volts	**0V10**
2-10 volts	**2V10**
0-20 milliamperes	**0mA20**
4-20 milliamperes	**4mA20**
Solid state contactors	
"ON/OFF"	
thyristor firing :	
DC logic signal	**LGC**
100 to 240 Vac logic signal	**ACL**

Options	Code
Fuse blown indication micro-switch	**FUMS**
No internal fuses	**NOFUSE**

*) For other voltages, contact your Eurotherm office

CODING EXAMPLE

Installation : The power thyristor unit for the load 300 A at 440 V, auxiliary power supply 240 V, analogue signal 0-5 V, fuse blown indications micro-switches.

Coding : **TC1027 / 400A / 440V / 240V / 0V5 / FUMS / 00**

SERIAL NUMBER LABELS

Two **identification** labels (specifying the **coding** of the unit) and a **configuration** label provide all the information relating to the factory settings of the unit.

An identification label is **externally** located on the right-hand side panel of the unit.

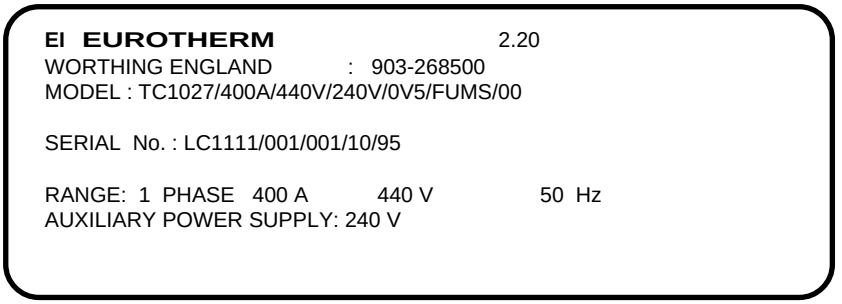

Figure 1-3 Example of identification label for a TC1027 model unit
The information corresponds to the coding example.

The second identification label and a configuration label are located **inside** the thyristor unit.

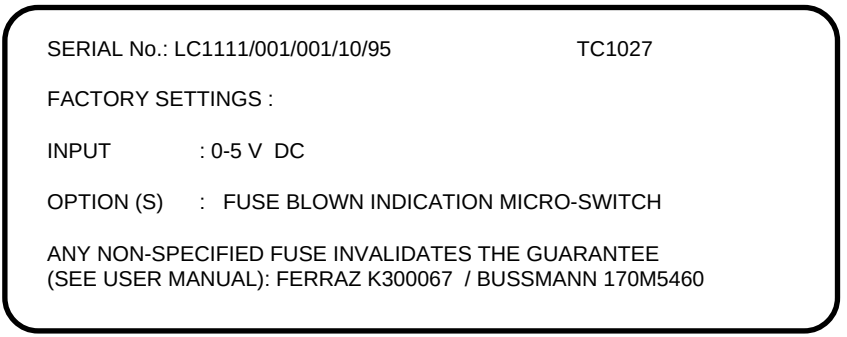

Figure 1-4 Example of configuration label for a TC1027 unit

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.

Chapter 2

INSTALLATION

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Chapter 2 INSTALLATION

SAFETY DURING INSTALLATION

Danger !

TC1027 units must be installed by a qualified person.

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 the standard IEC 364 or the current national standards.

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

Bulkhead mountings are possible with **TC1027** series units.

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

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

Attention !

The units are designed to be used at an ambient temperature less than or equal to **50°C** (40°C for 500 A nominal units)

Leave a minimum space of **5 cm** between two units placed beside each other.

Excessive overheating of the unit may cause incorrect operation of the unit, which in turn may cause damage or even fire in the components.

TC1027 series units have **permanent** fan cooling.

DIMENSIONS

The dimensions, values and weights of the **TC1027** series thyristor units are given in figure 2-1 and in table 2-1.

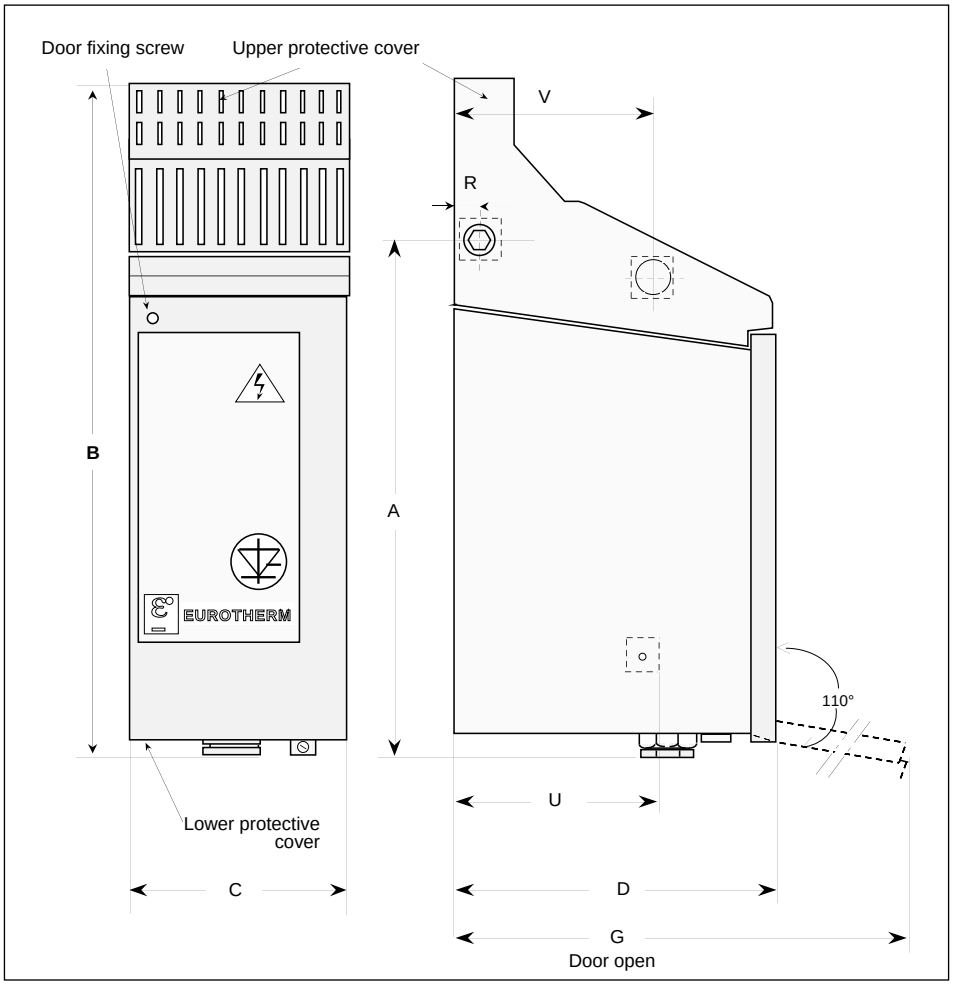

Figure 2-1 Overall dimensions with and without upper protective cover

Values	Dimensions	Description
A	425 mm	Height without protective cover
B	570 mm	Height with cover
C	133 mm	Width
D	268 mm	Depth
E	88 mm	Width between fixing holes
F	328 mm	Height between fixing holes
G	557 mm	Depth with door open
K	350 mm	Height of lateral fascias
R	20 mm	Distance between "Earth" busbar and panel
U	150 mm	Depth between "LOAD" terminal and panel
V	170 mm	Depth between "LINE" terminal and panel
Weight	10 kg	

Table 2-1 Dimensions, fixing values and weight of TC1027 series units

MECHANICAL MOUNTING

TC1027 units have two protective covers (upper and lower).

The units can be fixed with the protective covers in place.
However, for the connection, the upper protective cover must be removed.

After drilling the support panel at the dimensions and values given in table 2-1, insert the fixing screws half-way in the partition holes or mounting plate.

Position the thyristor unit by first inserting the upper screw heads in the respective holes of the upper section.

Lower the unit making sure that the lower screws planned can be inserted correctly.

Then lower the unit completely until it is in position.

Fasten the 4 screws correctly.

INSTALLATION DETAILS

TC1027 series units are designed to be mounted directly on panels at the fixing points located on the rear of the unit.

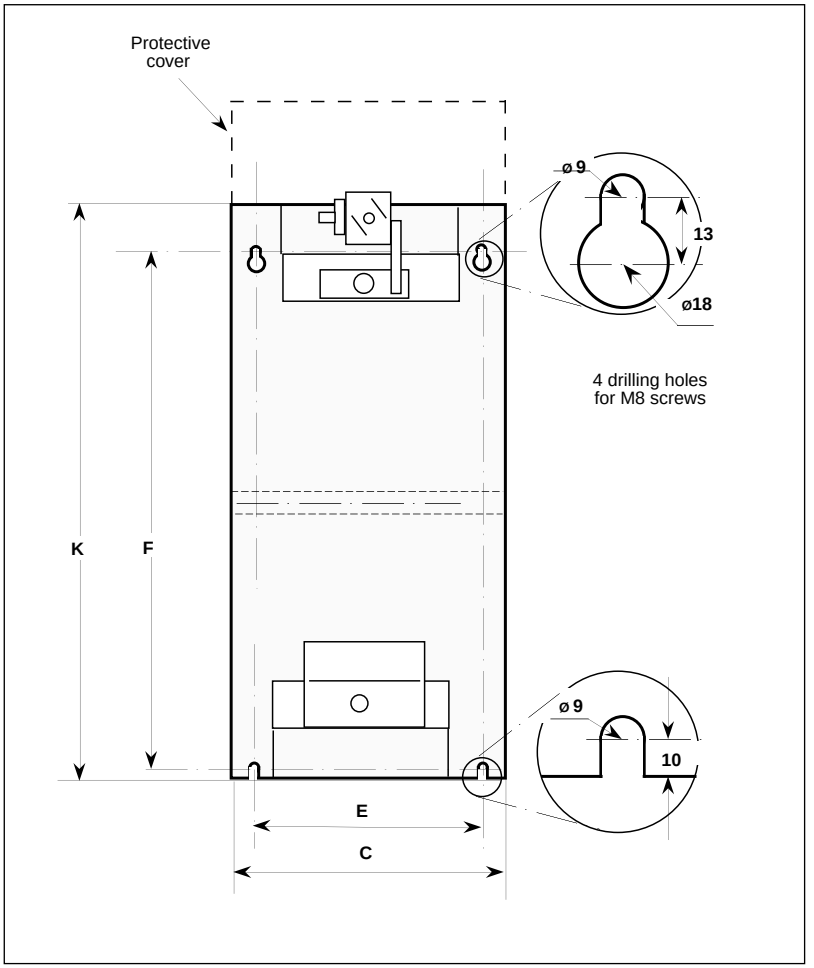

Figure 2-2 Fixing details

Chapter 3

CABLING

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Chapter 3 CABLING

SAFETY DURING CABLING

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 in order to perform the operation in complete safety.

TC1027 series units possess **two protective covers**: upper and lower.
The upper cover should be raised to facilitate cabling.
After connection and before power-up, put the upper protective cover back in place to ensure the specified **degree of protection**.

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 the last cable to be disconnected during disassembly.

The **safety earth** is connected to the screw (**M12**, tightening **28.8 Nm**) located on the strip provided for this purpose in the top part of the unit, behind the phase terminal and labelled as follows:

Attention !

To ensure that the TC1027 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**.

FIXING POWER CABLES

The **supply side** power cables pass through the opening of the upper protective cover of the TC1027 unit. The upper covers of the units are raised in order to facilitate the connection of these cables.

For connection, this cover, which is fixed to the unit, must be raised. In order to do this:

- open the door by unfastening the front screw on the top left-hand corner of the door
- raise the door in order to release it from its notches
- open the door completely by pulling it towards you
- remove the upper cover by unfastening its two fixing nuts by sliding it one cm forwards to release the two catches located at the rear and raising it.

The supply side connection is performed on the terminal of the fuse at the upper part of the unit, labelled **LINE** (see figures 3-1 and 3-2).

The **load side** power cables are placed inside the unit through a cable sheath below the unit. The load is cabled on the screw located in the bottom part of the unit and labelled **LOAD** (see figure 3-1).

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

Tightening must not exceed the limit values according to the same table.

Terminal	**Cabling details**
Supply and load Earth cable	185 to 2x150 mm^2 95 to 185 mm^2
Fuse terminal Tightening torque	M10 26 N.m
Load screw Tightening torque	M12 28.8 N.m
Earth screw Tightening torque	M12 28.8 N.m

Table 3-1 Details of power cabling for TC1027 thyristor units

The cross-section of the connection wires to be used must correspond to the Standard **IEC 943.**

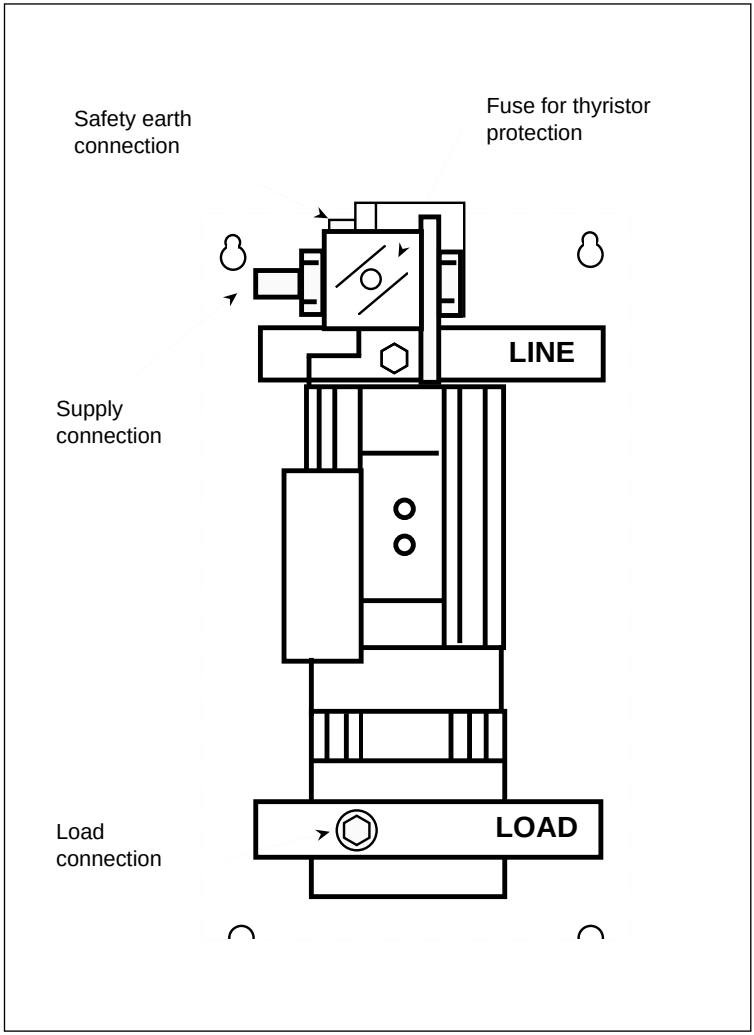

Figure 3-1 Power cable fixing points

Description of distance	Dimension
"Earth" busbar and upper fixing hole	30 mm
"Earth" busbar and left fixing hole	96 mm
"LOAD" terminal and lower fixing hole	70 mm
"LOAD" terminal and left fixing hole	20 mm
"LINE" terminal and upper fixing hole	20 mm

Table 3-2 Power cabling details

Attention !

The power cables to a load pass through **cable sheaths** which must be tightened correctly after cabling.

POWER WIRING DIAGRAMS

The installation must be cabled by the user on the supply using a suitable line protection and main circuit breaker.

The wiring of the TC1027 series unit can be performed:

- between one of the phases of the supply to neutral
- between two phases of the supply.

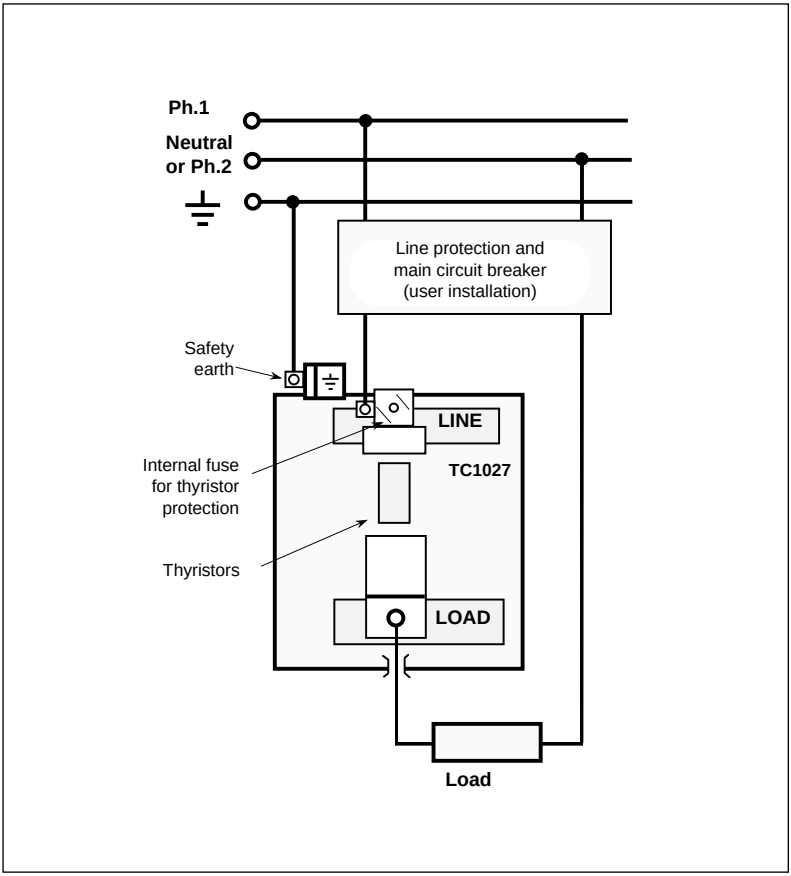

Figure 3-2 Example of TC1027 unit power wiring

If there are **several** TC1027 units on the same power supply, cable the units by producing a **circular permutation** of the supply phases.

AUXILIARY POWER SUPPLY

The auxiliary power supply is connected to a 3-terminal pluggable user terminal block, located to the right below the unit.

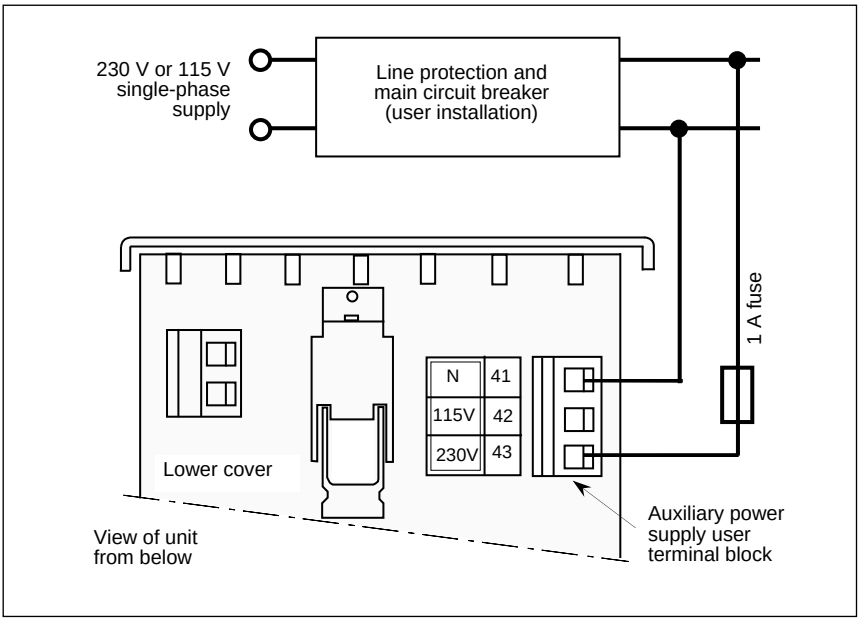

Figure 3-3 Auxiliary power supply terminal block

The auxiliary power supply voltage is determined in the unit order.

The auxiliary voltage is set at **100-110-115 -120 Vac** or **200-220-230-240 Vac** and must be connected to a **115 V** or **230 V single-phase** supply**.**

External **1 A** fuses must be connected in series on the auxiliary power supply.

The auxiliary power supply is configured in the factory and indicated on the terminal block **label**.

CONTROL CABLES

Attention!

The control connections must be made with **shielded cables connected to the earth (or ground) at both ends** in order to ensure satisfactory immunity against electromagnetic interference.
Insulate the control cables from the power cables in the cable routes.

Fixing

The control wires must be grouped together in a shielded cable passing through the **cable clamp** under the unit.

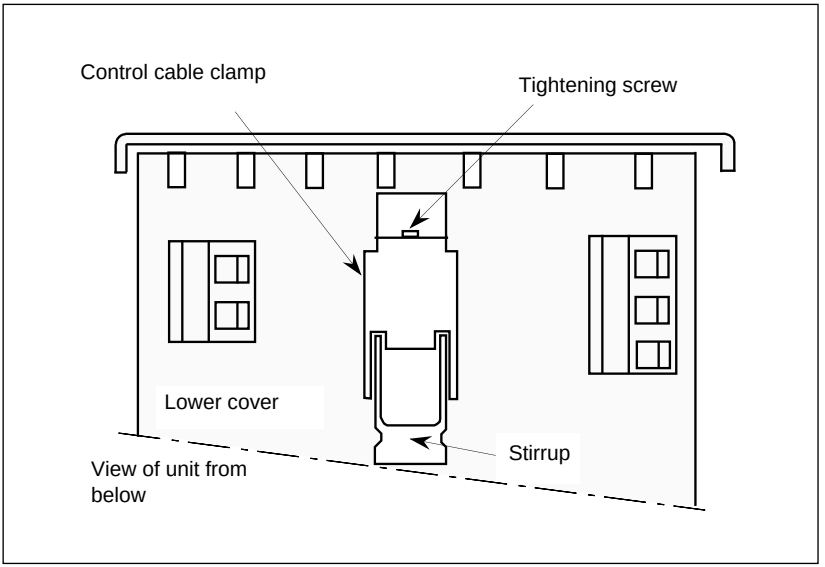

Figure 3-4 Control cable clamp layout

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 to the ground

- **Strip** the shielded cable as shown in figure 3-5,a.

The length of the control wires must ensure the connection between the metal cable clamp and the board user terminal blocks, with the door open.
The cabling inside the unit must be as short as possible.

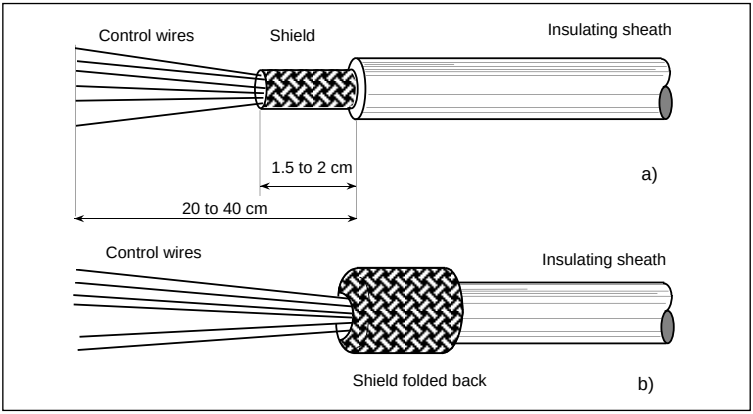

Figure 3-5 Control cable stripping

- **Fold back** the shield on the insulating sheath (figure 3-5,b)
- **Insert** the cable in the metal cable clamp so that the shield is located in the stirrup and does not enter the unit (it must not pass the lower cover).

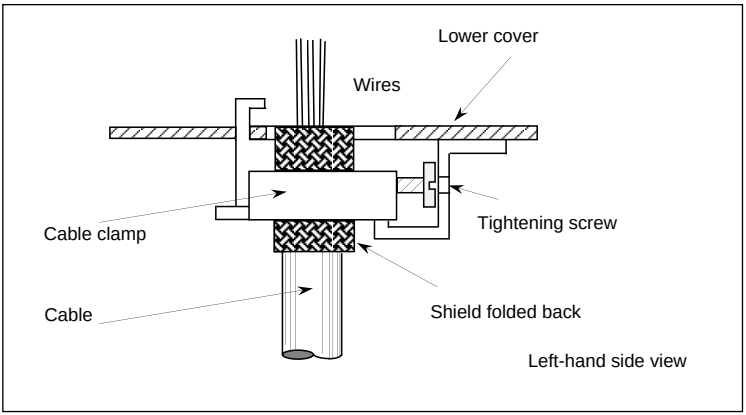

Figure 3-6 Cable tightening and shield grounding

- **Tighten** the stirrup (**4 x 1** flat screwdriver; tightening torque: **0.7 N.m.)**

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

DRIVER TERMINAL BLOCK

The following connections are made on the driver board user terminal block:

- the analogue or logic input signals
- the manual input potentiometers.

The terminal block can be accessed by opening the front door.

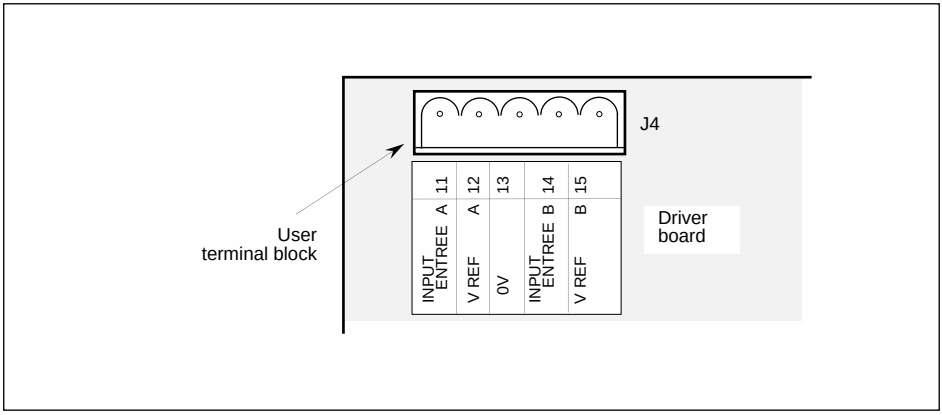

Figure 3-7 Driver terminal marking

Term.	Name on label	Destination
11	INPUT/ENTREE A	Control input
12	V REF A	+15 V voltage output
13	0V	Control 0 V
14	INPUT/ENTREE B	Not used
15	V REF B	

Table 3-3 Destination of the driver terminal block terminals

INPUT SIGNAL CONNECTION

The control wires are connected on the pluggable user terminal block, located on the **driver board** (in below of the unit for the ac signal only).

Driver terminal block terminal capacity: **0.22 mm² to 1.5 mm².**
Driver terminal tightening torque: **0.5 N.m.**

The input is **insulated** from the power supply and the load circuit.

The driver terminal block is accessible with **the front door open.**

To open the door, unfasten the front **screw**, release the door from its notches by raising it and pull it towards you.

Danger !

Dangerous live parts may be accessible when the door is open.

Solid state contactors

Two types of signal are available:

- dc logic signals (driver board user terminal block)
- ac logic signals (below the unit user terminal block).

Signal type		ON state	OFF state	Maximum	Impedance
dc	Voltage	> 5 V	< 1 V	25 V	390 Ω
	Current	> 4 mA	< 0.2 mA	20 mA	
ac	Voltage	> 85 V	< 10 V	264 V	10 kΩ

Table 3-4 Solid state contactor input parameters

The **DC** logic signal is applied to terminals **11** and **13** of the driver board user terminal block of the solid state contactor.

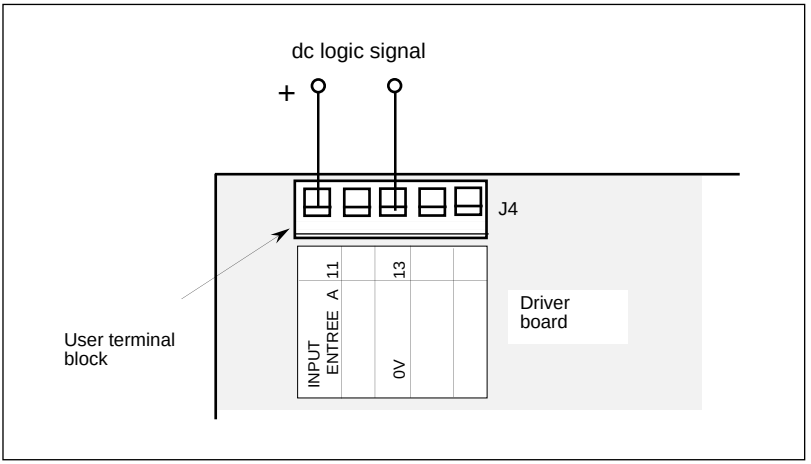

Figure 3-8 Solid state contactor dc input configuration

An **AC** control signal is applied to terminals **11** and **14** of the user terminal block located in below of the solid state contactor.

The input is insulated from the power supply and from the load.

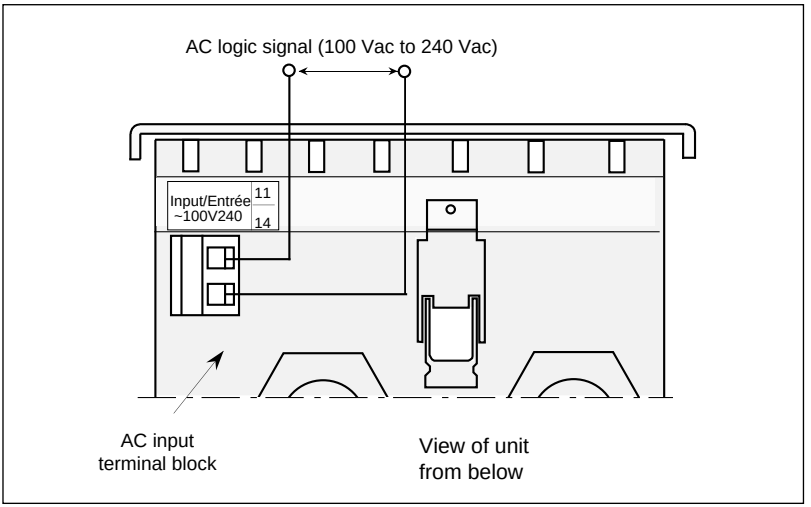

Figure 3-9 Solid state contactor ac input configuration

External input

The power thyristor units are controlled by analogue signals.

The dc analogue signal is applied to terminals **11** and **13** of the driver board user terminal block.

The signal type and level can be configured using suitable jumpers.

Signal type	Signal level	Input impedance
Voltage	0 - 5 V 1 - 5 V 0 - 10 V 2 - 10 V	68 kΩ
Current	0 - 20 mA 4 - 20 mA	250 Ω

Table 3-5 Power thyristor unit analogue input parameters

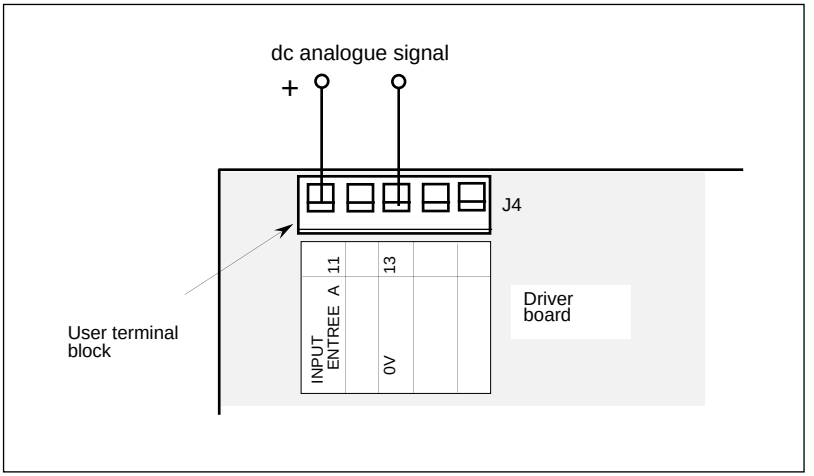

Figure 3-10 Power thyristor unit analogue input configuration

Manual input

The power thyristor units (analogue operation) can be driven by an external potentiometer.

For the connection of this potentiometer, a **"+15 V** " dc voltage output is provided on the driver terminal block (terminal **12**).

The **"+15 V"** internal voltage is available via a **10 kΩ** resistance of the driver board.

The **5 kΩ** potentiometer is connected between terminals **12** and **13.**

The **viper** is connected to terminal **11**.

The power thyristor unit input must be configured to **0-5 V**.

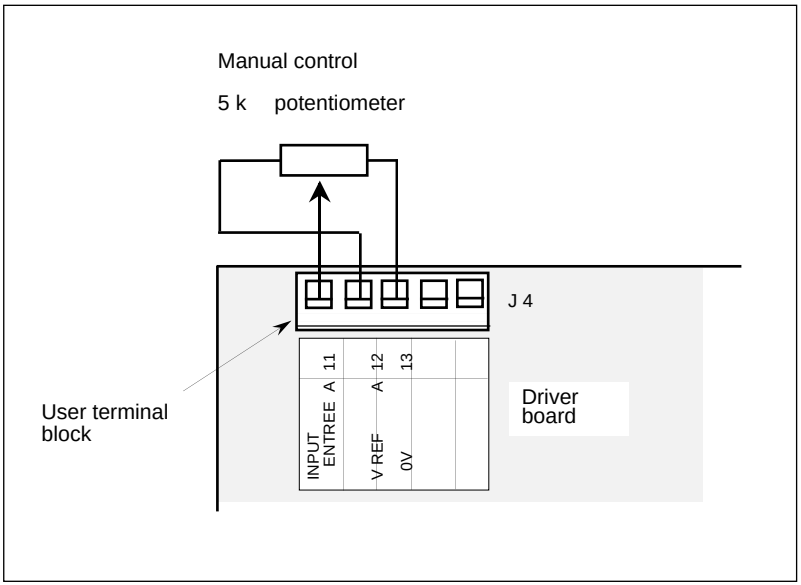

Figure 3-11 Power thyristor unit manual input configuration

Chapter 4

CONFIGURATION

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Chapter 4 CONFIGURATION

SAFETY DURING CONFIGURATION

The thyristor unit is configured using moveable **jumpers** on the driver board.

Important

The unit is supplied fully configured in accordance with the code on the identification label.

This chapter is included in order to

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

Danger !

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

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

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

POSSIBLE CONFIGURATIONS

The **type** of the driver board of **TC1027** series units and configuration determines:

- the operation type
  - solid state contactor with "ON/OFF" firing mode
  - power thyristor unit with "Burst" firing mode
- the input signal level.

The thyristor firing mode (ON/OFF or Burst mode) is determined by the code on the identification label ("Input").

The input can only be configured for power thyristor units.

Operation	**Control signal**	**Input configuration jumpers**	**Thyristor firing mode**
Solid state contactor	DC logic	Absent	ON/OFF
	AC logic	Absent	ON/OFF
Power thyristor unit	DC analogue	Present	Burst mode
	Manual	Present	Burst mode
Reconfigurated power thyristor unit (order code not available)	DC logic	Present	ON/OFF

Table 4-1 Possible configurations of TC1027 series units

Note: The manual control of the power thyristor units requires the configuration of the inputs to **0 - 5 V**.

OPERATION TYPE

The operation type of the TC1027 unit (power thyristor unit and solid state contactor) is configured in the factory (by driver board type and by configuration) according to the unit order code.

- The codes **LGC** or **ACL** correspond to the operation of the unit as a **solid state contactor** with the "ON/OFF" thyristor firing mode and logic input.

- The codes **0V5** to **4mA20** correspond to the operation of the unit as a **power thyristor unit** with the "Burst mode" thyristor firing mode and analogue input.

For the solid state contactors : the jumper **K1** is in position **1**, the jumper **K4** is absent.

For the power units : the jumper **K1** is absent, the jumper **K4** is in position **0.**

For all operation types jumpers **K2** and**K3** must be in position **1**.

Power thyristor units configured in the factory according to the order code for operation with the analogue signal in Burst mode, can be **reconfigured**, if necessary, to operate with a logic signal in ON/OFF mode.

This reconfiguration can be performed using jumpers **K16** to **K18** on the driver board.

Power thyristor operation	**Position of jumpers**		
	K16	**K17**	**K18**
Analogue signal (Burst mode)	1	1	0
Logic signal (ON/OFF)	0	0	Insensitive position

Table 4-2 Power unit operation type configuration

The positions of jumpers **K21** to **K28** are insensitive.

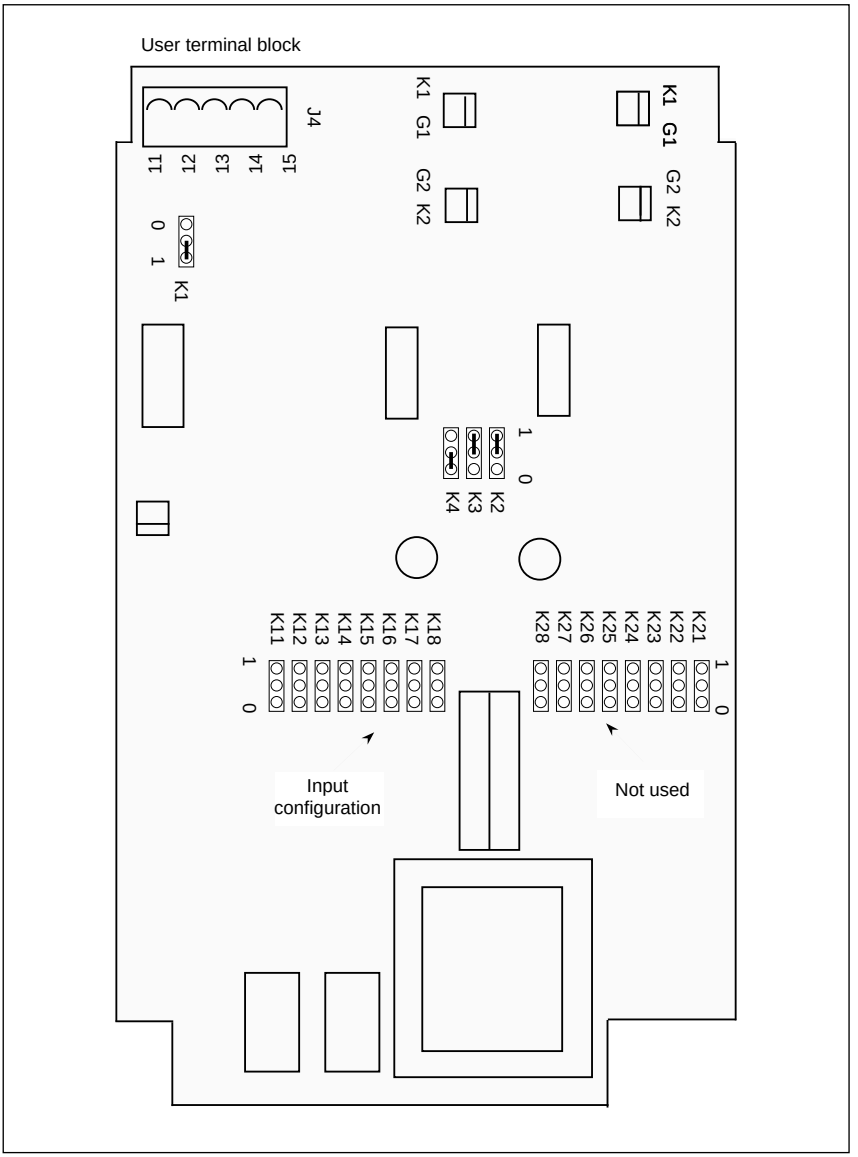

Figure 4-1 Location of the configuration jumpers on the power thyristor unit driver board

Note: The solid state contactor driver board does not contain jumpers K11 to K28.

INPUT TYPE AND LEVEL

Solid state contactors

The static contactors are driven by **logic** signals (ON/OFF firing).

There are two possible types of input signal to control the static contactors:

- a 10 V **dc** signal (20 mA)
  ON state greater than or equal to 5 V (or 4 mA), maximum 25 V (or 20 mA)
  OFF state less than 1 V (or 0.2 mA).
- a 100 to 240 V **ac** signal
  ON state greater than or equal to 85 Vac, maximum 264 V
  OFF state less than 10 Vac.

The solid state contactor signal type is configured in the factory according to the code (**ALC** or **LGC**) using soldered bridges and specific components. It is **impossible** to reconfigure it.

Power thyristor units

The power thyristor units are driven by analogue signals (Burst firing).

The input signal can be configured with a choice of four voltage levels and two current levels. Jumpers **K11 to K17** are used for this configuration.

The position of jumpers **K21** to **K27** is **insensitive.**

Control	**Input level**	**Position of jumpers**						
		K11	**K12**	**K13**	**K14**	**K15**	**K16**	**K17**
Analogue	0-5V	0	0	1	0	1	1	1
	1-5V	0	0	1	1	0	1	1
	0-10V	0	1	0	0	1	1	1
	2-10V	0	1	0	1	0	1	1
	0-20 mA	1	0	1	1	0	1	1
	4-20 mA	1	0	1	1	0	1	1
Manual	Potentiometer external 5 kΩ	0	0	1	0	1	1	1

Table 4-3 Input configuration for power thyristor units

Chapter 5

OPERATION

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Chapter 5 OPERATION

THYRISTOR FIRING MODE

General

Important

TC1027 series unit thyristors switch on and off at the **zero** supply voltage.

This firing mode eliminates the steep fronts of the supply voltage applied to the load, **does not apply disturbances on the supply and, above all, prevents the generation of interference.**

The thyristor firing mode of the TC1027 series units is determined by the type of operation of the unit (solid state contactor or power thyristor unit):

- the **solid state contactors** possess the **Logic (ON/OFF)** firing mode
- the **power thyristor units** possess the **Burst firing** mode**.**

For both these modes, the thyristor firing includes a whole number of alternations.

The modulation of the supply voltage applied to the load is performed:

- for the solid state contactors, by an external controller (e.g. temperature controller) with the use of a logic controller output;

- for the power thyristor units, by the internal modulator with an analogue input.

Supply variation compensation

TC1027 series **power thyristor units** which are driven by analogue signals **(analogue control)** are equipped with a compensation function for voltage variations within the range: **+ 10 %** to **- 15 %.**

This voltage is measured on the power supply.

Attention !

To benefit from the supply voltage variation compensation functions, the power supply must be connected to the **same voltage** as the **power** (use an external step-down transformer, if necessary).

Without a compensation of the supply voltage variations, a decrease (or increase) of 10% in the supply voltage would lead to a decrease (or increase) of 20% in the power sent to the thyristor unit load.

By compensating for the supply voltage variation simultaneously, the thyristor unit does not transmit a power variation to the load.

The supply variation compensation thus prevents fluctuations of the controlled value and the intervention of the controller after the detection of the corresponding interference.

"Logic" mode

The "**Logic**" mode of thyristor firing (also known as the "**ON/OFF**" mode) controls power in the load as a proportion of the firing time specified by the logic control signal.

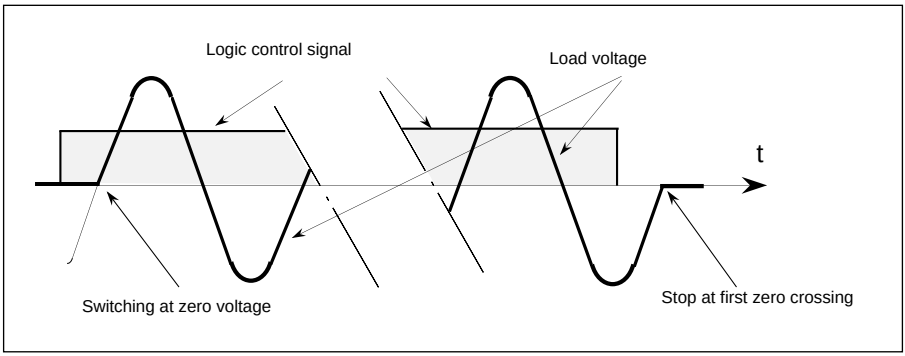

Figure 5-1 "Logic" firing mode

This firing mode is activated by a logic input signal greater than an "ON status" threshold (full thyristor firing), provided that the input signal is not less than an "OFF status" threshold.

Attention !

In logic firing mode (except specific application), use a control signal with an external modulation period less than **10 s** to reduce aging due to thermal fatigue of various elements of the installation (heating elements, thyristors, thyristor protection high-speed fuses) as much as possible and thus increase their service life.

"Burst firing" mode

In Burst firing mode, the power dissipated in the load is defined by the ratio of the thyristor firing period ($\mathbf{T_F}$) and the modulation cycle ($\mathbf{T_M}$).

The power delivered by a thyristor unit in Burst firing mode is therefore set by the firing cycle $\mathbf{T_F}$ varying within the modulation cycle $\mathbf{T_M}$.

The load power is proportional to the firing rate τ which depends on the firing cycle ($\mathbf{T_F}$) and the non-firing cycle ($\mathbf{T_{NF}}$):

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

or, using the modulation cycle ($\mathbf{T_M} = \mathbf{T_F} + \mathbf{T_{NF}}$), the firing rate (or cyclic ratio) can be expressed by:

$$\tau = \frac{\mathbf{T_F}}{\mathbf{T_M}}$$

The load power can be expressed by:

$$\mathbf{P} = \tau \,.\, \mathbf{P_{MAX}} \ ,$$

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

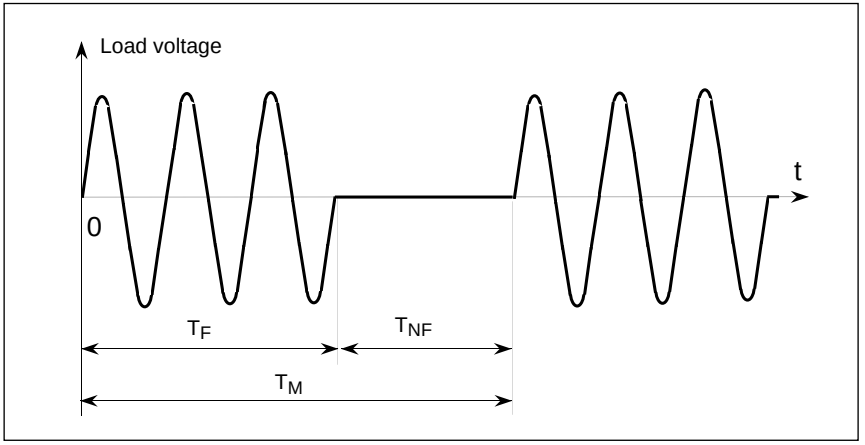

Figure 5-2 Burst firing cycles

Using a variable modulation cycle according to the output power, the adjustment precision of the TC1027 unit is adapted to each specific setpoint zone.

- At **50 %** power, the typical value of the modulation cycle is **0.6 s**; the firing time = non-firing time.
- For a power zone greater than 50 % of the maximum setpoint, the firing cycle is decreased and the modulation cycle is increased.
- In the power zone greater than 50%, the non-firing cycle is reduced with the increase in the modulation cycle.

E.g. (fasr Burst mode) :

- for 5 % power , T_F = 250 ms, T_M = 5 s
- for 90 % power, T_F = 2.25 s, T_M = 2.5 s

The unit output power is thus perfectly linear between **0** and **100 %** of maximum power for the analogue signal varying between **4** and **84%** of the maximum scale.
The control does not have an adjustment stage as in fixed modulation cycle units.

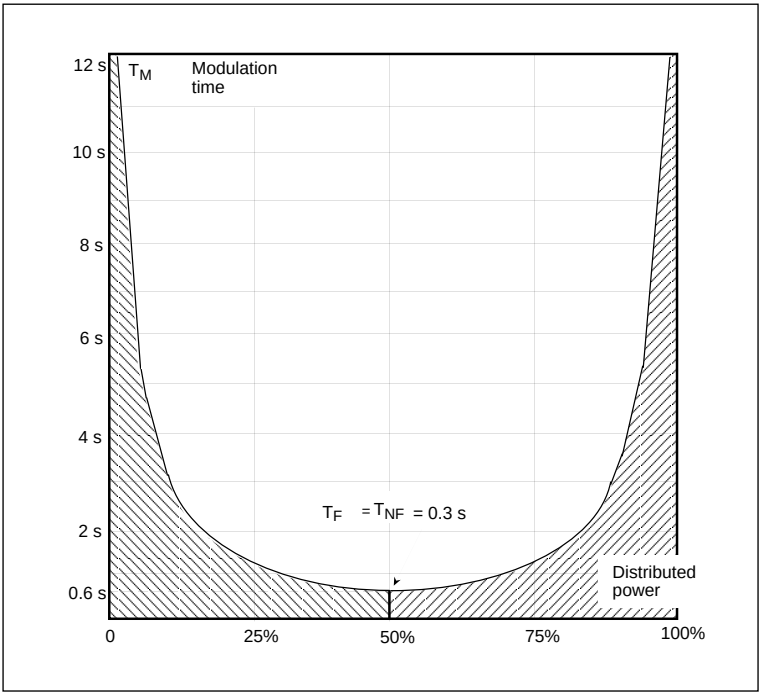

Figure 5-3 Fast modulation cycle as a function of power

Chapter 6

COMMISSIONING PROCEDURE

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Chapter 6 COMMISSIONING PROCEDURE

Read this chapter carefully before commissioning the thyristor unit

COMMISSIONING PROCEDURE SAFETY

Important !

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

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

Danger !

Never use a power unit on a voltage supply greater than the nominal voltage of the unit specified on the order and in the coding.

Dangerous live parts may be accessible when the front door is open.
Only personnel qualified and authorised to work in industrial low voltage electrical environments can access inside the unit, after it has been insulated (wait for at least 5 s before accessing inside the unit).

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

The temperature of the heatsink may exceed 100°C.
Avoid all contact, even occasional, with the heatsink when the unit is operational.

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

CHECKING THE CHARACTERISTICS

Attention !

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

Load current

The maximum current of the load must be less than or equal to the value of the nominal current of the TC1027 series unit.

Supply voltage

The nominal value of the TC1027 series unit voltage must be greater than or equal to the voltage of the supply used (**line to line** voltage or between a **phase and neutral** depending on the configuration).

Danger !

Never use a thyristor unit with a supply **voltage greater** than the nominal voltage specified on the serial number label code.

Auxiliary power supply voltage

The auxiliary power supply voltage is determined on the unit order.

It powers:

- the control electronics of the power units
- the fan.

The auxiliary voltage is set to two levels:

- 100-110-115 -120 Vac or
- 200-220-230-240 Vac.

There are two types of internal transformer:

- for the voltages 100 / 200 V
- for the voltages 110-115-120 / 220-230-240 V.

The auxiliary power supply transformers are selected in the factory, according to the coding of the auxiliary power supply.

The configured auxiliary voltage is marked on the label of the connection user terminal block for the auxiliary voltage (below the unit).

Input signals

For power thyristor units, the jumper configurations on the driver board must be compatible with the levels of the signals used for control (see "Configuration").

Chapter 7

MAINTENANCE

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Chapter 7 MAINTENANCE

Danger !

The unit must be maintained by qualified personnel only

THYRISTOR PROTECTION

The thyristors of the TC1027 series power units are protected as follows:

- internal high-speed fuses against over-currents;
- RC snubber and
- varistors - against too fast voltage variations and transient over-voltages when the thyristors are not conductors.
- thermal switch (in the event of accidental overheating of the cooler, the thermal switch opens, which causes the thyristor firing to be stopped).

Attention !

If several units are connected with a **single** control current signal **in series,** the action of the thermal safety switch of one of the units causes the control signal circuit to open and thus switches off **all** the units.

THYRISTOR PROTECTION FUSE

The standard version of TC1027 series units is supplied with a high-speed fuse mounted on the line busbar.

Attention !

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

This high-speed fuse may not be used to **protect the installation.**

Danger !

The user's installation **must be protected** (non-high-speed fuses, thermal or electromagnetic circuit breaker, suitable fuse-isolator) and comply with current standards.

Table 7-1 contains all the references of the original internal fuses (when the thyristor unit leaves the factory) and the fuse which can be used for replacements during maintenance.

Maximum line-to-line voltage: **500 V.**

Nominal current		**Part No.**		
Unit (A)	**Fuse (A)**	**EUROTHERM**	**FERRAZ**	**BUSSMANN**
300	400	LA172468U400	H300065	170M5458
400	500	LA172468U500	K300067	170M5460
500	630	LA172468U630	M300069	170M5462

Table 7-1 Recommended high-speed fuses for thyristor protection

The use of any fuses **other** than those recommended for thyristor protection **renders the unit guarantee null and void.**

FUSE BLOWN INDICATION MICRO-SWITCH

As an option, high-speed fuses may be equipped with a fuse blown indication micro-switch (**FUMS** option) with the part No.:

for BUSSMANN fuses:
EUROTHERM DC172267 or FERRAZ P96015 or BUSSMANN 170H0069
for FERRAZ fuses:
EUROTHERM DC172997 or FERRAZ G310 000

To ensure improved insulation between the cabling of the micro-switches and the power and the cover, TC1027 units are supplied with "flag" type lugs and insulating sleeves.

Each external terminal of the fuse blown indication micro-switch must be cabled with a "flag" lug and an insulating sleeve in compliance with figure 7-1.

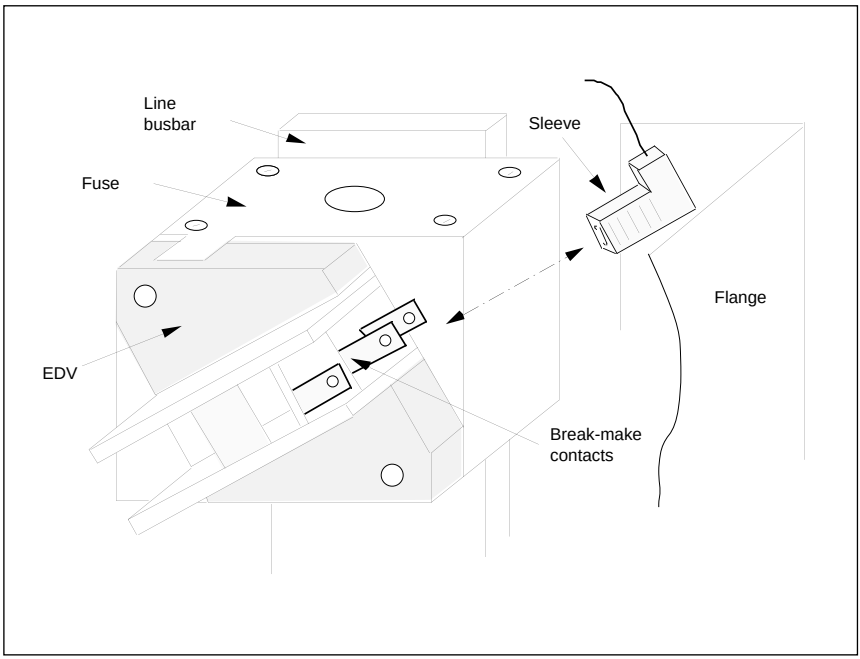

Figure 7-1 Use of "flag" lugs and insulating sleeves to observe insulating distances.

PROTECTION FUSES FOR AUXILIARY POWER SUPPLY

These fuses must be installed in each connection wire of the auxiliary power supply (see "Cabling").

Reference voltage (max)	1 A fuse 6.3 x 32 mm	Fuse-isolator support	Overall "Fuse-isolator" dimensions (mm)
500 V	CS174289U1A0	CP174293	63 x 15 x 52

Table 7-2 Recommended protection fuses for the auxiliary power supply connection

SERVICING

TC1027 units must be mounted with the heatsink positioned vertically and with no obstructions either above or below which could block the passage of the air.

Attention !

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.

In order to ensure correct cooling of the unit, users are advised to **clean the heatsink and the protective grill** of the fans regularly according to the degree of environmental pollution.

Danger !

Every **six months**, check that the screws of the power cables and safety earth are **tightened** correctly (see "Cabling", page 3-3).

TOOLS

Operation	Flat screw-driver (mm)	Wrench	Electrical equipment
Fixing		Depending on M8 screw heads selected	
Opening (closing) of front door		CHc No. 4 for M5 screw	
Safety earth connection		HEX19 (M12)	
Power connection (supply side) and thyristor fuse change		HEX17 (M10)	
Load connection		HEX19 (M12)	
Cable clamp tightening	0.5 x 3.5		
Control and auxiliary power supply connection	0.5 x 3.5		
Board fixing	0.8 x 5.5	For M4 nut	
Commissioning	0.4 x 2.5		Ammeter or RMS clip.

Table 7-3 Tools