

TC3001



EUROTHERM

CONTROLS
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Three phase thyristor for resistive, inductive and temperature dependent (complex) loads



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Three phase thyristor unit for resistive, inductive and temperature dependent (complex) loads

The TC 3001 is a universal thyristor unit used to control a wide selection of three phase loads. It operates with any load configuration for all types of electrical heating. Self contained units are available for currents up to 1000A, above this the control electronics and power module are separate and extend the current capacity up to 1800A and beyond.

The TC 3001 provides precision control of direct and transformer connected heaters, variable temperature coefficient elements (e.g. platinum, tungsten, molybdenum disilicide and silicon carbide), short-wave infrared lamps, induction and RF heating and immersed electrodes for glass heating.

Safety - As with all Eurotherm products the TC 3001 has been designed to ensure operator safety and load protection. When installed and used in compliance with user manual HA174834 it meets the essential requirements of the EEC Low Voltage Directive. The self contained units are fully shrouded in an IP20 rated protective case with commissioning and diagnostics points available on the front fascia. High speed semiconductor fuses and other protection circuits are built in. Automatic alarm shutdown protects the load and supply by quenching the thyristors if the unit detects an abnormal event.

CE mark- The TC3001 is CE marked to show compliance with the essential protection requirements of the Low Voltage Directive. It is designed so that it can be used as part of a CE compliant system but it is the responsibility of the installer to establish the CE compliance of the overall system. The TC3001 technical construction file is approved by a Competent Body (LCIE France). A Declaration of Compliance with the European Directives is available on request.

EMC- Eurotherm certifies that the TC3001 products, when installed and used in accordance with their User Manual, meets the following test standards and enables the system or installation in which they are installed to comply with the EMC Directive with regard to the TC3001 products.

EMC tests		EMC test standards	
Immunity	Electrostatic discharge	EN 61000-4-2	(06/1995)
	Fast transients	EN 61000-4-4	(01/1995)
	Radioelectric frequency electromagnetic fields	prEN 61000-4-3	(1984)
Emission	Radiated	EN 55011-2	(1991)
	The choice of the Conducted Emission application standard depends on the application: · EN50081-2 (1991) - Without external filter in Burst firing on resistive load up to 150A nominal - With an external series filter for other configurations · prEN 61800-3 (1996) - Without external filter Applies to the second environment (industrial environment)		

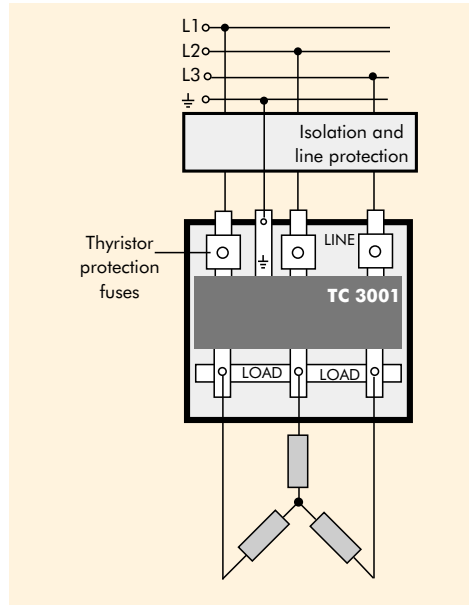
External series filters

To reduce the conducted emissions that occur when using thyristor units, Eurotherm can supply external filters.

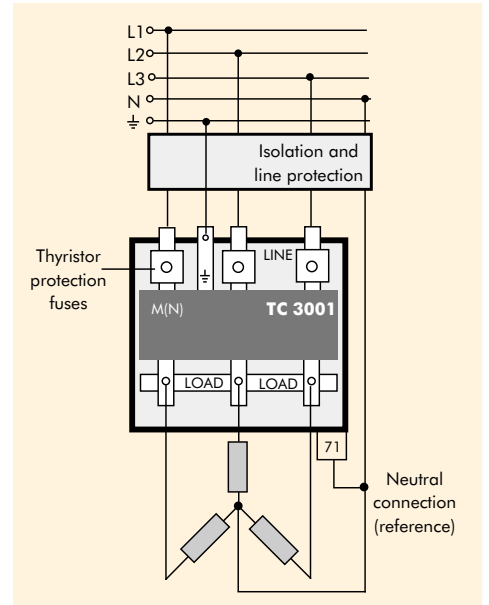
Nominal current of TC3001	Serial filter order code
25A to 60A 75A to 100A Above 100A consult your Eurotherm office	FILTER/TRI63A/00 FILTER/TRI/100A/00

Easy to connect to any load - The diagrams show how the TC 3001 can be used with any three phase load (three wire star or delta, four wire star with neutral and six wire open delta). The TC 3001 is insensitive to phase rotation so the phases can be connected in any order. The unit also synchronises itself to the supply frequency, further easing installation.

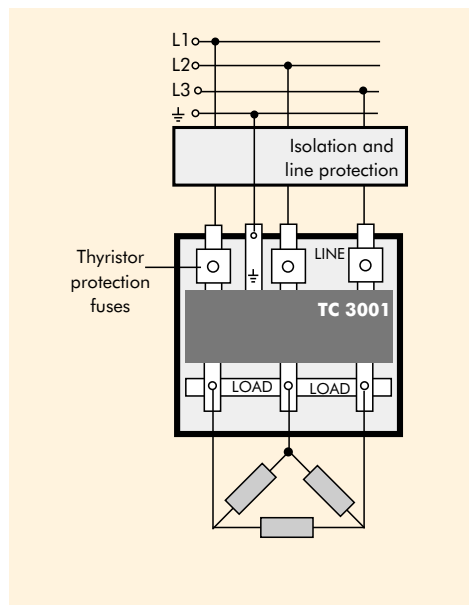
3 wire star connection



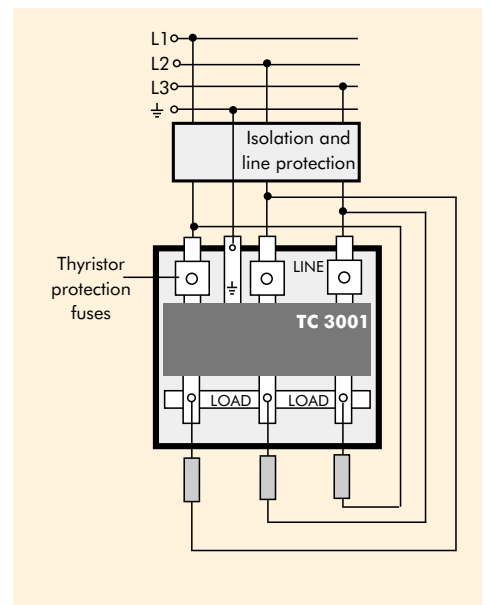
4 wire star connection



3 wire delta connection

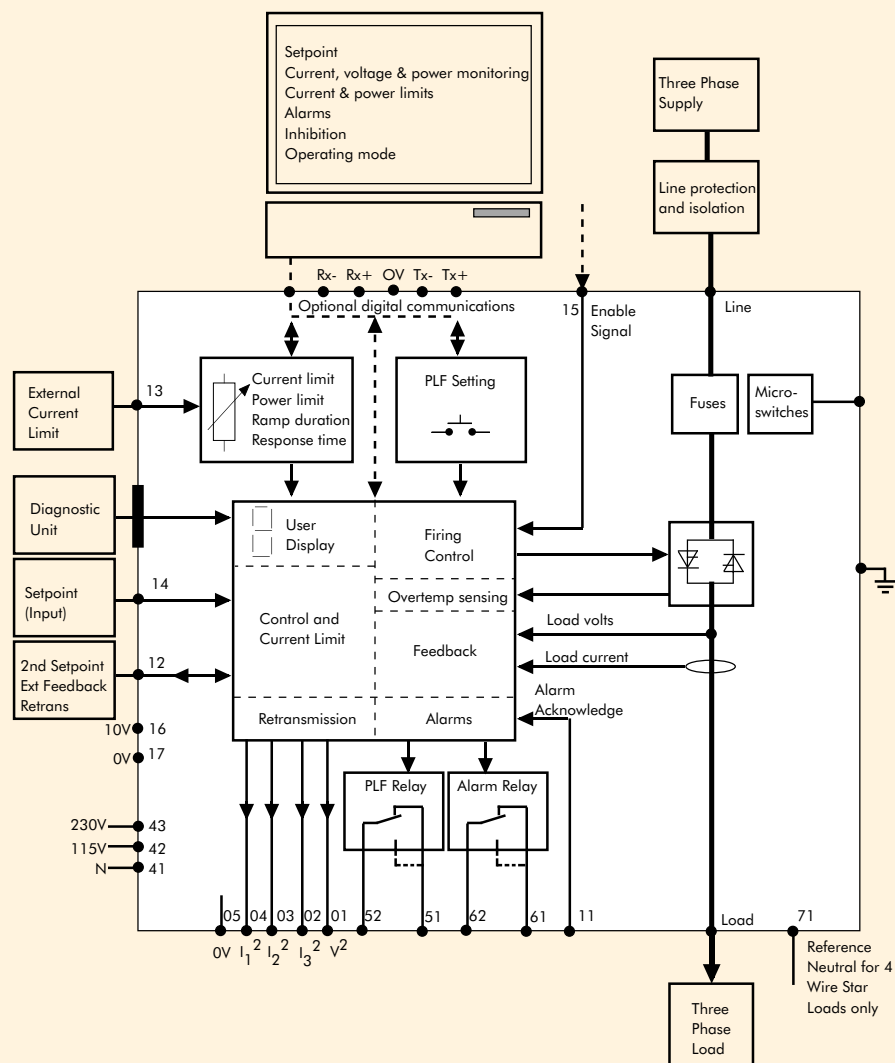


6 wire delta connection (open delta)



Digital communications - The TC 3001 is available with digital communications option giving access to all operating parameters of the thyristor unit. Especially important for supervisory systems are:

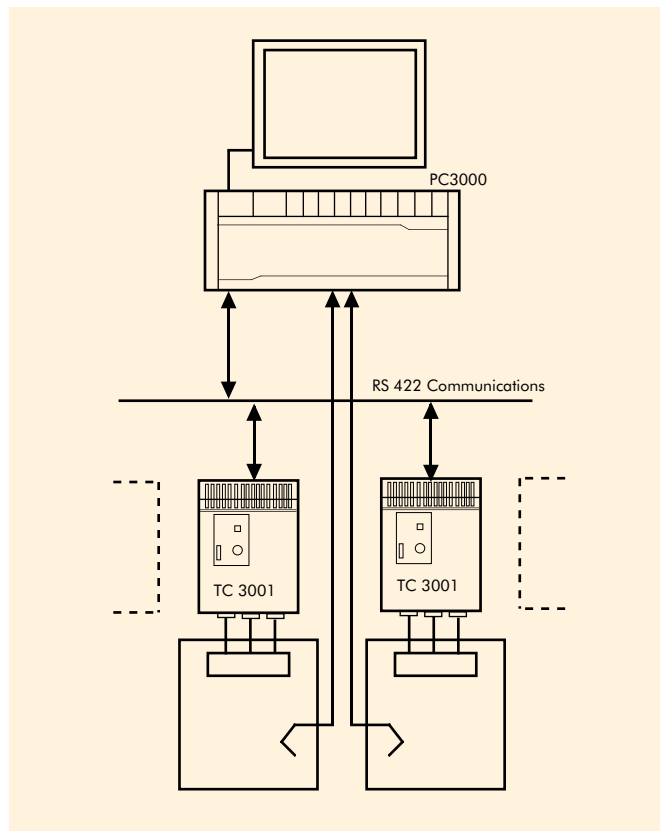
- Power setpoint
- Load and supply alarms
- Line current in all three phases
- Line voltage
- Load power
- PLF and current limit settings
- Operating mode



TC3001 with optional digital communications

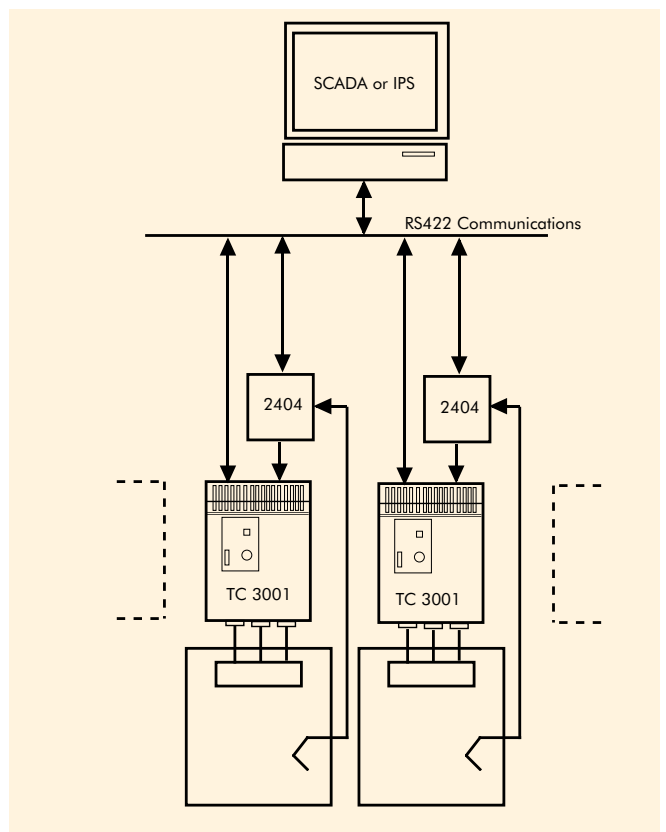
Digital communications applications

Full remote control - Allows the TC 3001 to be totally controlled over the digital communications link by a central control system such as Eurotherm's PC 3000 or a PLC. Simplified control wiring leads to significant cost savings - a single communications link connects a number of power switches. Removing the need for analogue outputs in the central system also saves money. The second advantage is better control at the central system which now has full knowledge of load state, power, current and voltage. Special control strategies can be implemented using this extra information .



Local control, remote monitoring - Digital communications also permits easy integration of the TC 3001 into plant supervisory system, a SCADA package or Eurotherm's IPSG for example.

The TC 3001 is controlled using its analogue input by a temperature controller in the normal way and the communications link allows a central monitoring station to log operating data and alert operators to alarms and other abnormal conditions. This gives the plant manager better control of his energy costs and allows scheduled maintenance to reduce the risk of breakdowns and maximise production.



TECHNICAL SPECIFICATION

Current	25A to 1000A Self contained. 1350A to 1800A using separate driver and power assemblies. (Higher ratings available on special order)
Rated voltage	240V to 690V line to line (+10%, -15%).
Operating voltage	100V to 690V line to line Unit inhibited below 70% of calibrated operating voltage (or 50% if selected)
Supply frequency	42Hz to 68Hz with automatic sensing. Unit inhibited outside 40Hz to 70Hz
Auxiliary supply	100V to 240V (+10%, -15%). Selected when ordering. Consumption 20VA plus fans (see below)
Environment	Pollution degree 2 (IEC 664)
Altitude	Maximum altitude 2000m
Storage temperature	-10°C to 70°C
Operating temperature	0°C to 50°C with unit mounted vertically. 40°C for 500A units (50°C if derated to 450A)
Cooling	Natural cooling up to 75A Two fans for 100A and 250A, (additional auxiliary supply consumption 25VA per fan) air flow 160 Cu M/H each Three fans from 300A to 500A, (additional auxiliary supply consumption 25VA per fan) air flow 160 Cu M/H each One fan for 700A and 1000A (115 VA) air flow 1060 Cu M/H Two fans for 1150A to 1800A (115 VA each) air flow 1060 Cu M/H each Over-temperature shutdown for fan cooled units
Power dissipation	Allow for 2Watts per amp per phase (includes thyristors and fuses)
Humidity	5% to 95% RH non condensing
Enclosure protection	IP20 (IEC 529)
Electrical safety	Complies with EEC Low Voltage Directive 73/23/EEC dated 19/2/73 amended by directive 93/68/EEC dated 22/7/93 EN 61010 installation category 3 (voltage transients must not exceed 4.0KV)
Electrical protection	RC snubber network and varistor Built in high speed fuses for thyristor protection only. Line protection to be provided separately
Installation	
Dimensions	See back page
Weight	Up to 150A - 16Kg; 250A - 18Kg; 300A to 500A - 21Kg, 750 to 1000A - 46Kg
Load	
Load types	Resistive, short-wave infrared, inductive, transformer and temperature dependent resistive
Load configuration	3 wire star, 4 wire star with neutral, 3 wire delta, 6 wire open delta
Control type	Three phases of a three phase system
Phase rotation	Phase rotation insensitive - connect phases in any order
Operation	
Firing modes	Logic, single cycle, burst (1 to 255 supply cycles), phase angle Phase angle start, or start and end, for use with logic and burst firing for control of inductive loads and to reduce flicker interference from very large loads. (Order URP or UDR for soft start or soft start and end)
Delayed firing	Delayed firing of first cycle with burst or logic firing into inductive loads to control current surges
Safety ramp	A 32 supply cycles initial (safety) ramp is selectable for use on each power up
Current limit	Senses three line currents. Compares the highest with front panel setting or external current limit if used. Exceeding the limit quenches firing (logic or burst mode) or reduces firing angle to limit current (phase angle)
Adjustments	Burst length, soft start/end length, firing delay, ramp length PLF adjustment, setpoint limit and current limit can all be adjusted by front panel potentiometers
Firing rotation	For resistive loads the first thyristor fired for each burst is rotated for equal power distribution throughout the load (order Load type = RES). This rotation is suppressed for inductive loads to avoid current surges (order Load type = IND)
Retransmission	
Current	I_1^2, I_2^2, I_3^2 . 0-10V = 0-100% of nominal current
Voltage	V^2 . 0-10V = 0-100% of calibrated operating voltage ²
Controlled parameter	Either V_{LOAD}^2 , V_{xI} , I_{AVE}^2 or external feedback depending on control mode 0-10V = 0-100% of controlled parameter

Control

Analogue input	Voltage: 0-5V, 1-5V, 0-10V, 2-10V. Current: 0-20mA, 4-20mA.	Input impedance > 100kΩ Input impedance = 100Ω
Second input	Same input ranges, minimum of two inputs wins (only without digital communications)	
Logic input	Range selected from analogue input. >50% =ON, <25%=OFF	
Control modes	V^2	Normal mode to eliminate power variations caused by supply fluctuations
(feedback)	$V \times I$	True power control for use without closed loop temperature control or for specialist applications
	I^2	Usually used for direct electric heating of glass under special circumstances
	External input	Controls an externally measured parameter (e.g. direct voltage or current after rectification)
	I^2 to V^2 transfer	For best temperature control of variable resistance elements over large temperature ranges (only with digital communications)
Setpoint limit	Proportional scaling of setpoint signal by front fascia potentiometer (P3)	
Feedback linearity	Phase angle $\pm 1\%$, Burst firing $\pm 2\%$ for all feedback modes	
Stability	Phase angle $\pm 1\%$, Burst firing $\pm 2\%$ for +10% to -15% supply variation, for 0°C to 50°C ambient temperature and for load impedance changes of $\pm 30\%$ (for $V \times I$ or I^2 control)	

Alarms

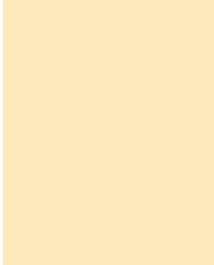
Inhibition alarms	<p>Loss of one phase of the supply</p> <p>Under voltage (70% or 50% of calibrated operating voltage depending on configuration)</p> <p>Frequency outside 40 to 70Hz limits</p> <p>Over current (logic or burst firing)</p> <p>Thyristor short circuit (Note with short circuit thyristors, current can continue to flow)</p>
Indicating alarms	<p>Over voltage (indication 20% above calibrated operating voltage)</p> <p>Partial load failure (PLF). Detection one in four to one in eight parallel identical elements per limb of the three phase load. (PLF sensitivity depends on load configuration and only works above 10% of nominal current)</p> <p>Load unbalance</p>
Alarm indication	Front fascia display, two relays and optional digital communications
Alarm acknowledge	External contact to acknowledge alarms and resume normal operation

Digital communications (optional)

Physical link	RS422 (4 wire) or RS485 (2 or 4 wire)
Protocol	EUROTHERM, MODBUS® or JBUS® also PROFIBUS (consult Eurotherm)
Baud rate	9600 or 19200 baud
Options	Communications module also has additional analogue and digital I/O

[illegible]

Current	Code	Auxiliary Supply	Code	Input	Code	
25 amps	25A	100 volts	100V	0-5 volts	0V5	
40 amps	40A	110 to 120 volts	110V120	1-5 volts	1V5	
60 amps	60A	200 volts	200V	0-10 volts	0V10	
75 amps	75A	220 to 240 volts	220V240	2-10 volts	2V10	
100 amps †	100A			0-20mA	0mA20	
150 amps †	150A	Operating Voltage		4-20mA	4mA20	
250 amps †	250A					
300 amps †	300A	100 volts	100V	Firing Mode		
400 amps †	400A	110 volts	110V		Logic (On/Off)	LGC
400 amps †	400A	115 volts	115V		Phase angle	PA
500 amps †	500A	120 volts	120V		Burst	1 period FC1
700 amps †	700A	200 volts	200V			2 periods FC2
1000 amps †	1000A	220 volts	220V			4 periods FC4
1150 amps † *	1150A	230 volts	230V			8 periods FC8
1350 amps † *	1350A	240 volts	240V			16 periods C16
1500 amps † *	1500A	277 volts	277V			32 periods C32
1800 amps † *	1800A	380 volts	380V			64 periods C64
† fan cooled		400 volts	400V		128 periods 128	
* Separate MC3001 Driver and stack		415 volts	415V		255 periods 255	
Maximum Line to Line Voltage		440 volts	440V	Phase angle burst	1 period HC1	
240 volts	240V	480 volts	480V		2 periods HC2	
440 volts	440V	500 volts	500V		4 periods HC4	
480 volts	480V	600 volts	600V		8 periods HC8	
500 volts	500V	660 volts	660V		16 periods H16	
690 volts ††	690V	690 volts	690V		32 periods H32	
†† Note 690 volt units have increased dimensions.					64 periods H64	
See diagrams.					128 periods H28	
					255 periods H55	



Control Mode	Current Limit	Inputs and Outputs	PLU Alarm	Manual Language	Comms Mode	Comms Protocol	Fuses	Options

Ramp, soft start/end	Code
No ramp	NRP
Soft start of burst	URP
Soft start and end of burst	UDR

Load Connection	
3 Wire delta	3D
3 Wire star	3S
4 Wire star with neutral	4S
6 Wire open delta	6D

Load Type	
Transformer	IND
Other loads	RES

Partial Load Failure (PLF curve)	
Standard curve	SD
Short-wave infrared curve	†† IR

Control Mode (feedback)	
V ²	V2
I ²	I2
Power	W
I ² /V ² transfer	†† TR
External (see inputs and outputs)	EX

Current Limit	Code
Limit threshold for phase angle, phase angle burst and burst with URP or UDR firing modes	
Digital communications	†† LCOM
Potentiometer on front fascia	LINT
External signal	0-5V L0V5
	1-5V LIV5
	0-10V L0V10
	2-10V L2V10
	0-20mA L0mA20
	4-20mA L4mA20

Chop off for logic, and burst firing (without URP or UDR)	
Digital communications	†† COM
Potentiometer on front fascia	CINT
External signal	0-5V C0V5
	1-5V CIV5
	0-10V C0V10
	2-10V C2V10
	0-20mA C0mA20
	4-20mA C4mA20

Inputs and Outputs **	
0-10V controlled parameter retransmission	RTR
0-10V external feedback (if "EX" selected)	E0V10
0-10V second setpoint	W0V10

PLU Alarm	Code
Detection disabled	000
Open in alarm	PLU
Closed in alarm	IPU

Manual language	
English	ENG
French	FRA
German	GER

Communications Mode/Speed	
No comms	000
Read only at	9600 bauds R96
	19200 bauds R192
Profibus read only	RAUT
Read and write at	9600 bauds W96
	19200 bauds W192
Profibus read and write	WAUT

Communications Protocol	
EUROTHERM	EIP
JBUS®	JBP
MODBUS®	MOP
PROFIBUS	PFP

Fuses	
Internal fuses	FUSES
Fuses with microswitch	FUMS
No fuse	NOFUSE

Options	
PLF closed in alarm (normally open in alarm)	IPF

†† Only available with digital communications
* Fan cooled
** Other specialist options available. Contact Eurotherm Controls for details.

SPARE FUSES

Unit Current	Fuse Part No.
25A	LA172468U050
40A	LA172468U080
60A	LA172468U080
75A	LA172468U100
100A	LA172468U125
150A	LA172468U200
250A	LA172468U315
300A	LA172468U400
400A	LA172468U500
500A	LA172468U630
700A	CS175633U900
1000A	CS175633U1250

Please note that replacement fuses are marked with a higher current rating than the thyristors. This allows correct operation up to 50°C and does not imply that higher current is permissible.

EXTRAS

	Code
Diagnostic unit (240V)	260-13-00

ORDERING CODE (continued)

Maximum line to line and operating voltage

The TC 3001 comes with different voltage thyristors. Select the “Maximum Line to Line voltage” which is closest above the *line to line* voltage for your application for *all* load configurations including four wire star loads with neutral. For best compensation for power supply fluctuations select the “Operating Voltage” nearest to the application *line to line* voltage.

Firing mode

● Logic or burst firing:

Logic firing works with logic output temperature controllers. Power is on or off depending on the logic signal.

Burst firing works with analogue output temperature controllers or PLCs. The TC 3001 time proportions power to match demand. Burst firing gives supply voltage compensation to improve temperature control. The burst length should match the size of the load: we suggest 16 period bursts for small loads, 255 periods for large loads. Reduce burst length if the temperature fluctuates with the bursts. Increase the length to reduce flicker interference to the supply. The burst length is easily changed during commissioning.

- **Single cycle or phase angle firing:** Phase angle firing gives the smoothest and fastest reacting power delivery but it can generate interference. Single cycle firing generates less interference as it delivers only whole supply cycles.

Ramp, soft start/end

If the load cannot tolerate abrupt power changes order URP for ramped power increases or, UDR for ramped increases and decreases .

For inductive loads using burst firing order URP for a soft phase angle start to each burst.

For reduced flicker interference from large loads order UDR for a soft start and end with logic or burst firing.

Load type

If load type (IND) is used, phase rotation is suppressed to reduce current surges. Load type RES provides full phase rotation.

Transformers

Magnetic saturation in a transformer core can cause current surges so firing modes must be selected carefully. Phase angle firing is always acceptable, but may need additional EMC filtering. Burst firing is acceptable with either a firing delay or phase angle start to each burst. If delayed firing is used the delay must be set when commissioning.

The transformer must be designed using a flux density of 1.2 TESLA (Weber per square metre) or less so that it does not saturate when fed with a non-sinusoidal supply voltage on the primary. Such a voltage is provided by phase angle firing.

PLF curve

In addition to the standard curve (SD), the TC 3001 has a special curve to detect the failure of short-wave infrared elements. Select (IR) to use it. (Only available with digital comms).



Control mode

Option V² gives compensation for supply variations and is suitable for most applications. Current, power and external control modes are available. Please consult Eurotherm for more information on these alternatives.

Current limit

The TC 3001 senses load current and compares it with a preset limit. For logic and burst firing the TC 3001 is quenched if the limit is exceeded. For phase angle firing the firing angle is reduced to limit the current. The limit is set by front fascia potentiometer, external input or optional digital communications.

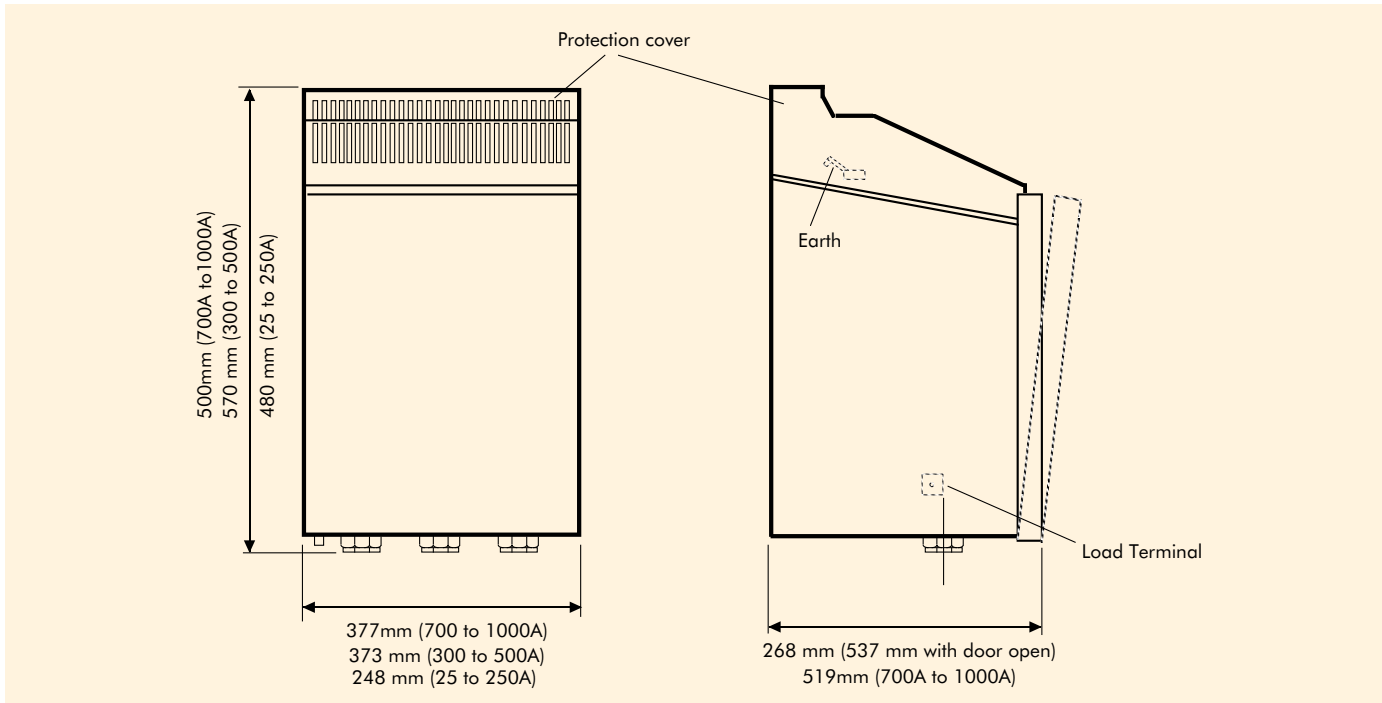
Inputs and outputs

For simplicity only the code for 0-10V retransmission or second setpoint are shown, other ranges are available.

PLU (partial load unbalance) enable

If your load is unbalanced (25% difference between line currents) then select 'PLU Detection Disabled' to avoid nuisance alarms.

DIMENSIONAL DETAILS



NOTE: 690V units up to 500A are the same size as the 500A units shown

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