

TC 3001



EUROTHERM

CONTROLS
DATA MANAGEMENT
PROCESS AUTOMATION

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: <ul style="list-style-type: none"> · 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)		

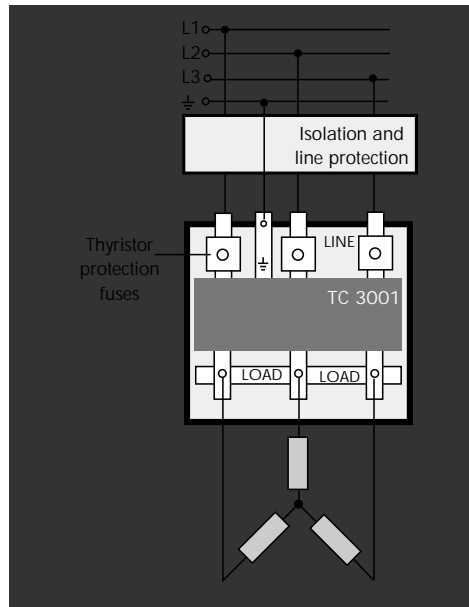
External series filters

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

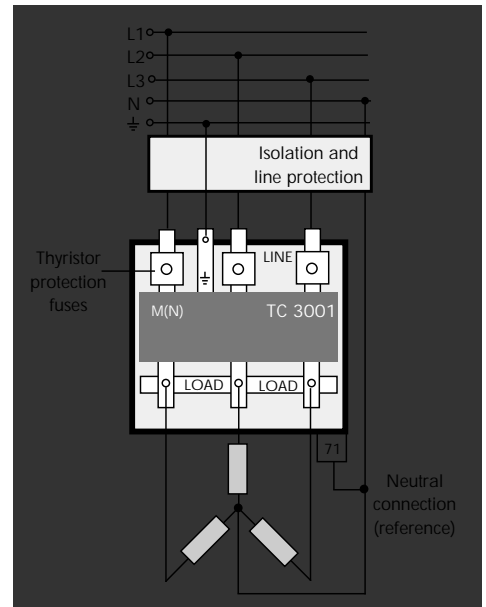
Nominal current of TC3001	Serial filter order code
25A to 60A	FILTER/TRI63A/00
75A to 100A	FILTER/TRI/100A/00
Above 100A consult your Eurotherm office	

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.

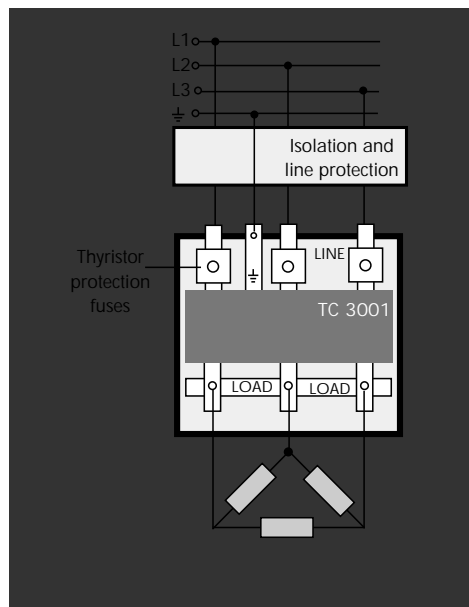
3 wire star connection



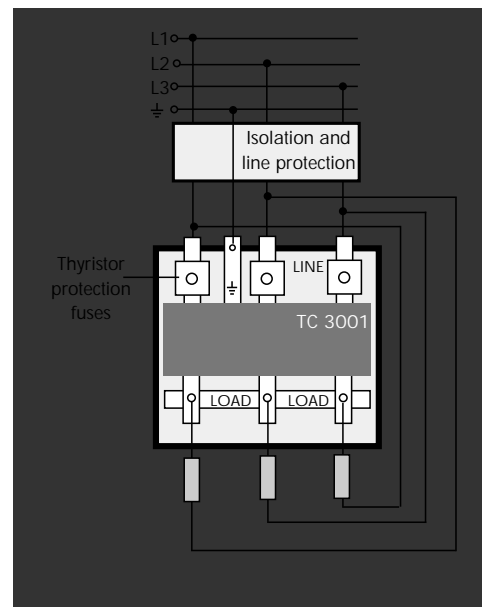
4 wire star connection



3 wire delta connection

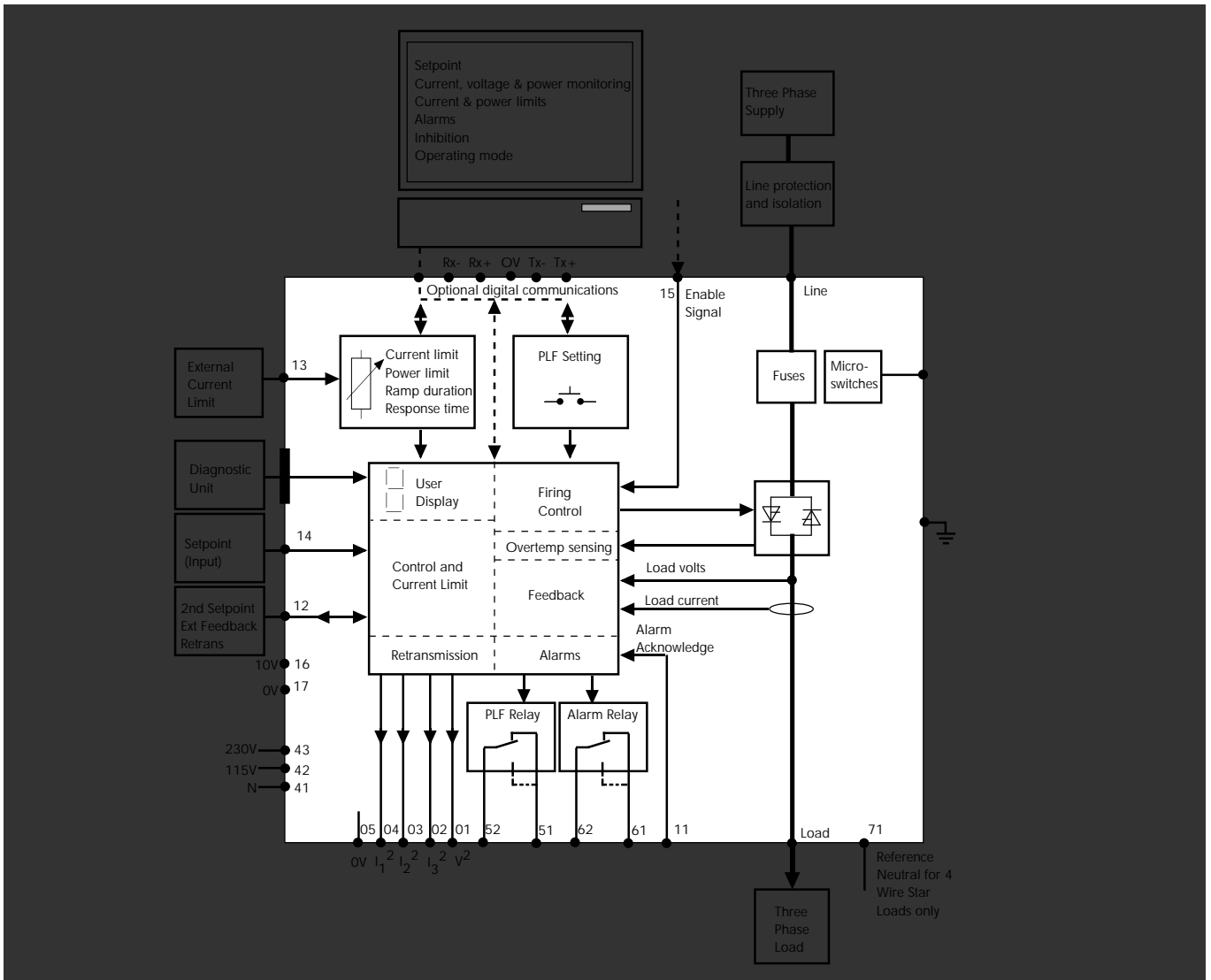


6 wire delta connection (open delta)



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:

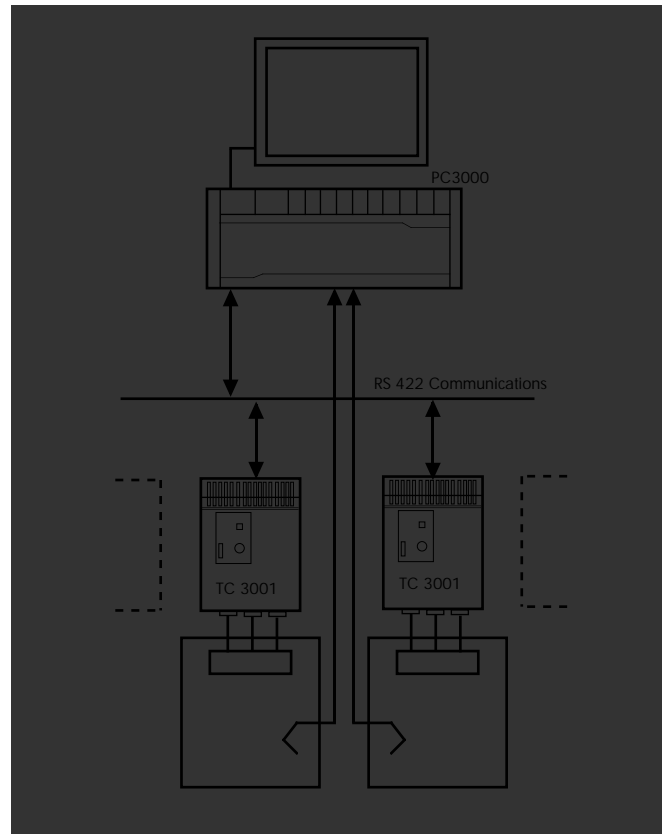
- Power setpoint
- Load and supply alarms
- Line current in all three phases
- Line voltage
- Load power
- PLF and current limit settings
- Operating mode



TC3001 with optional digital communications

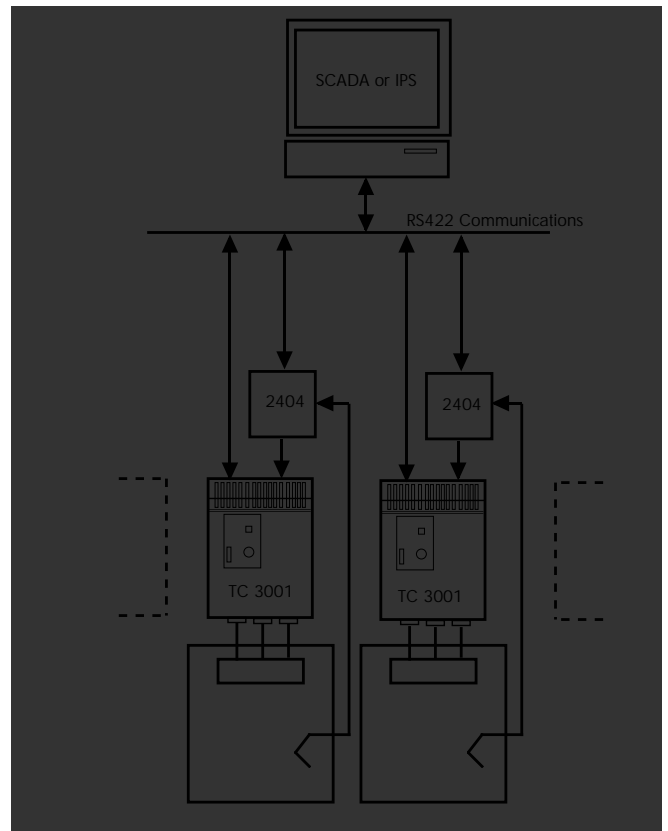
Digital communications applications

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 IPSP 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 $V_{LOAD}^2, V_{xl}, I_{AVE}^2$ 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. Input impedance > 100k Ω Current: 0-20mA, 4-20mA. Input impedance = 100 Ω
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	Loss of one phase of the supply Under voltage (70% or 50% of calibrated operating voltage depending on configuration) Frequency outside 40 to 70Hz limits Over current (logic or burst firing) Thyristor short circuit (Note with short circuit thyristors, current can continue to flow)
Indicating alarms	Over voltage (indication 20% above calibrated operating voltage) 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) Load unbalance
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

ORDERING CODE

Basic Product	Current	Max. Line to Line Voltage	Auxiliary Supply	Operating Voltage	Input	Firing Mode	Ramp, soft start/end	Load Connection	Load Type	PLF Curve
TC 3001										
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	100 volts		100V					
300 amps †		300A	110 volts		110V	Firing Mode				
400 amps †		400A	115 volts		115V	Logic (On/Off)				LGC
500 amps †		500A	120 volts		120V	Phase angle				PA
700 amps †		700A	200 volts		200V	Burst			1 period	FC1
1000 amps †		1000A	220 volts		220V				2 periods	FC2
1150 amps † *		1150A	230 volts		230V				4 periods	FC4
1350 amps † *		1350A	240 volts		240V				8 periods	FC8
1500 amps † *		1500A	277 volts		277V				16 periods	C16
1800 amps † *		1800A	380 volts		380V				32 periods	C32
† fan cooled			400 volts		400V				64 periods	C64
* Separate MC3001 Driver and stack			415 volts		415V				128 periods	128
Maximum Line to Line Voltage			440 volts		440V				255 periods	255
240 volts		240V	480 volts		480V	Phase angle burst			1 period	HC1
440 volts		440V	500 volts		500V				2 periods	HC2
480 volts		480V	600 volts		600V				4 periods	HC4
500 volts		500V	660 volts		660V				8 periods	HC8
690 volts ††		690V	690 volts		690V				16 periods	H16
†† Note 690 volt units have increased dimensions.									32 periods	H32
See diagrams.									64 periods	H64
									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	Current Limit		Code	PLU Alarm		Code
No ramp		NRP	Limit threshold for phase angle, phase angle			Detection disabled		000
Soft start of burst		URP	burst and burst with URP or UDR firing modes			Open in alarm		PLU
Soft start and end of burst		UDR	Digital communications		†† LCOM	Closed in alarm		IPU
			Potentiometer on front fascia		LINT			
Load Connection			External signal		0-5V L0V5	Manual language		
3 Wire delta		3D			1-5V LIV5	English		ENG
3 Wire star		3S			0-10V L0V10	French		FRA
4 Wire star with neutral		4S			2-10V L2V10	German		GER
6 Wire open delta		6D			0-20mA L0mA20			
					4-20mA L4mA20	Communications Mode/Speed		
Load Type			Chop off for logic, and burst firing (without URP or UDR)			No comms		000
Transformer		IND				Read only at	9600 bauds	R96
Other loads		RES	Digital communications		†† COM		19200 bauds	R192
			Potentiometer on front fascia		CINT	Profibus read only		RAUT
Partial Load Failure (PLF curve)			External signal		0-5V C0V5	Read and write at	9600 bauds	W96
Standard curve		SD			1-5V CIV5		19200 bauds	W192
Short-wave infrared curve		†† IR			0-10V C0V10	Profibus read and write		WAUT
					2-10V C2V10			
Control Mode (feedback)					0-20mA C0mA20	Communications Protocol		
V ²		V2			4-20mA C4mA20	EUROTHERM		EIP
I ²		I2				JBUS®		JBP
Power		W	Inputs and Outputs **			MODBUS®		MOP
I ² /V ² transfer		†† TR	0-10V controlled parameter retransmission		RTR	PROFIBUS		PPF
External (see inputs and outputs)		EX	0-10V external feedback (if "EX" selected)		EOVIO			
			0-10V second setpoint		WOVIO	Fuses		
						Internal fuses		FUSES
						Fuses with microswitch		FUMS
						No fuse		NOFUSE
						Options		
						PLF closed in alarm (normally open in alarm)		IPF

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

†† Only available with digital communications

* Fan cooled

** Other specialist options available. Contact Eurotherm Controls for details.

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.

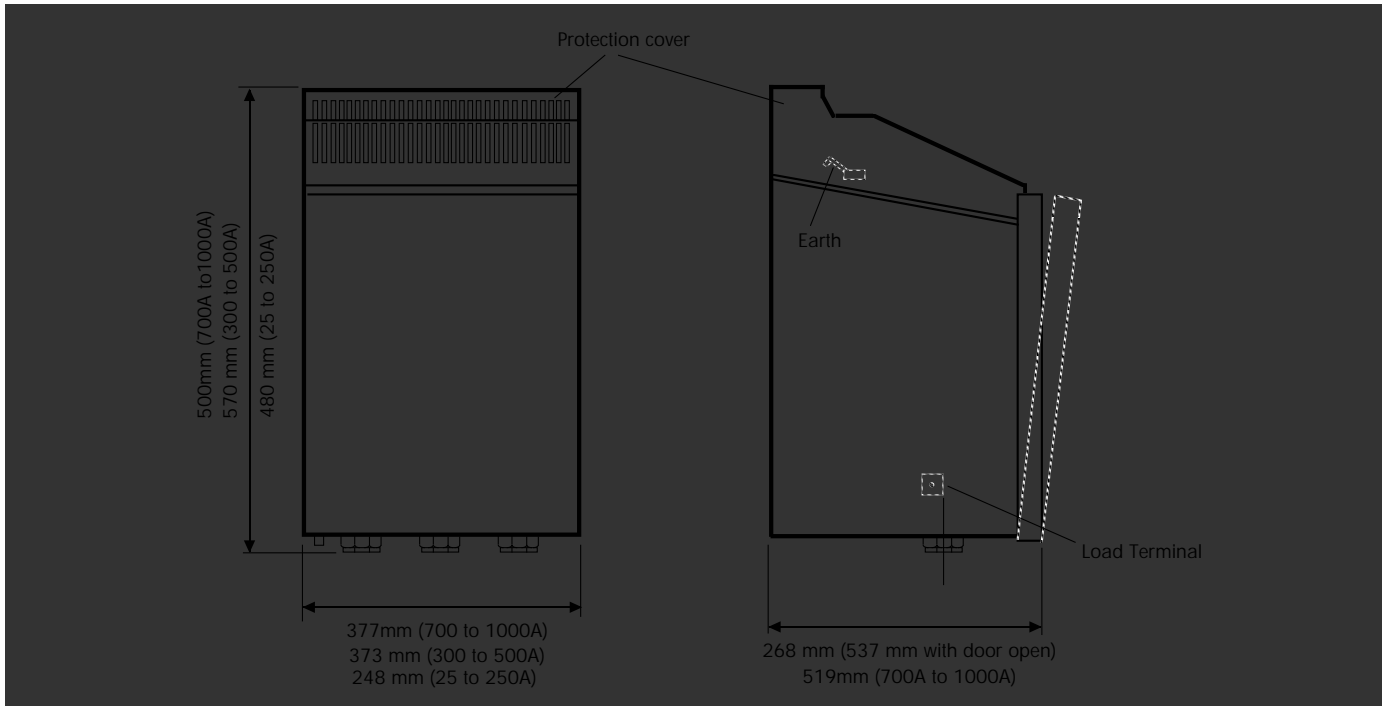
Inputs and outputs

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