# TC 3001

EUROTHERM

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

Invensys
An Invensys company

# TC 3001

## 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:<br>· EN50081-2 (1991)<br>- Without external filter in Burst firing on resistive load up to 150A nominal<br>- With an external series filter for other configurations<br>· prEN 61800-3 (1996)<br>- Without external filter<br>Applies to the second environment (industrial environment) | | |

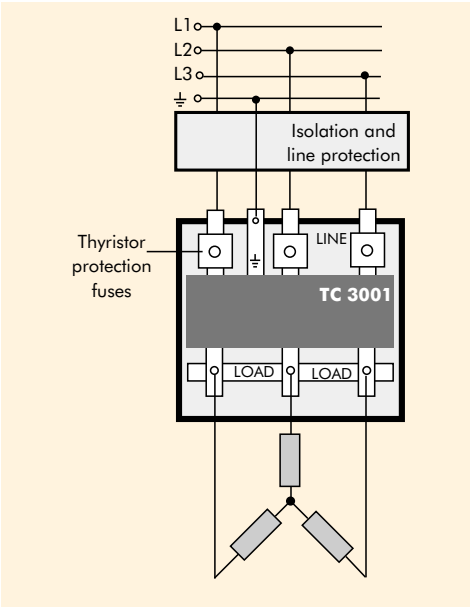
### External series filters

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

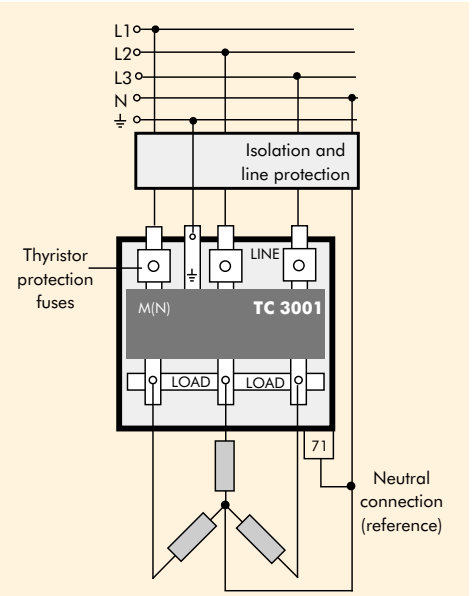
| Nominal current of TC3001 | Serial filter order code |
|---|---|
| 25A to 60A | FILTER/TRI63A/00 |
| 75A to 100A | FILTER/TRI/100A/00 |
| Above 100A consult your Eurotherm office | |

**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.

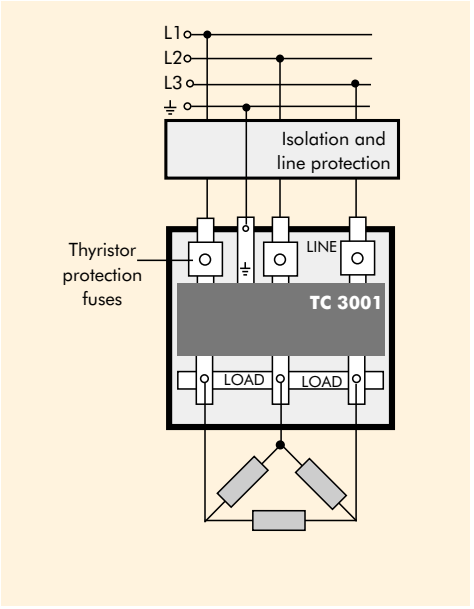
3 wire star connection



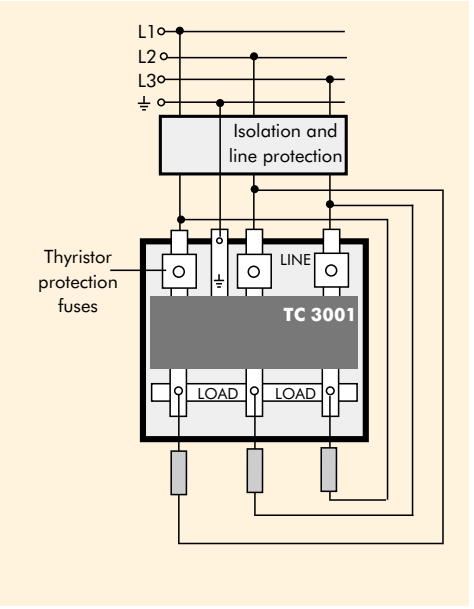

4 wire star connection




3 wire delta connection

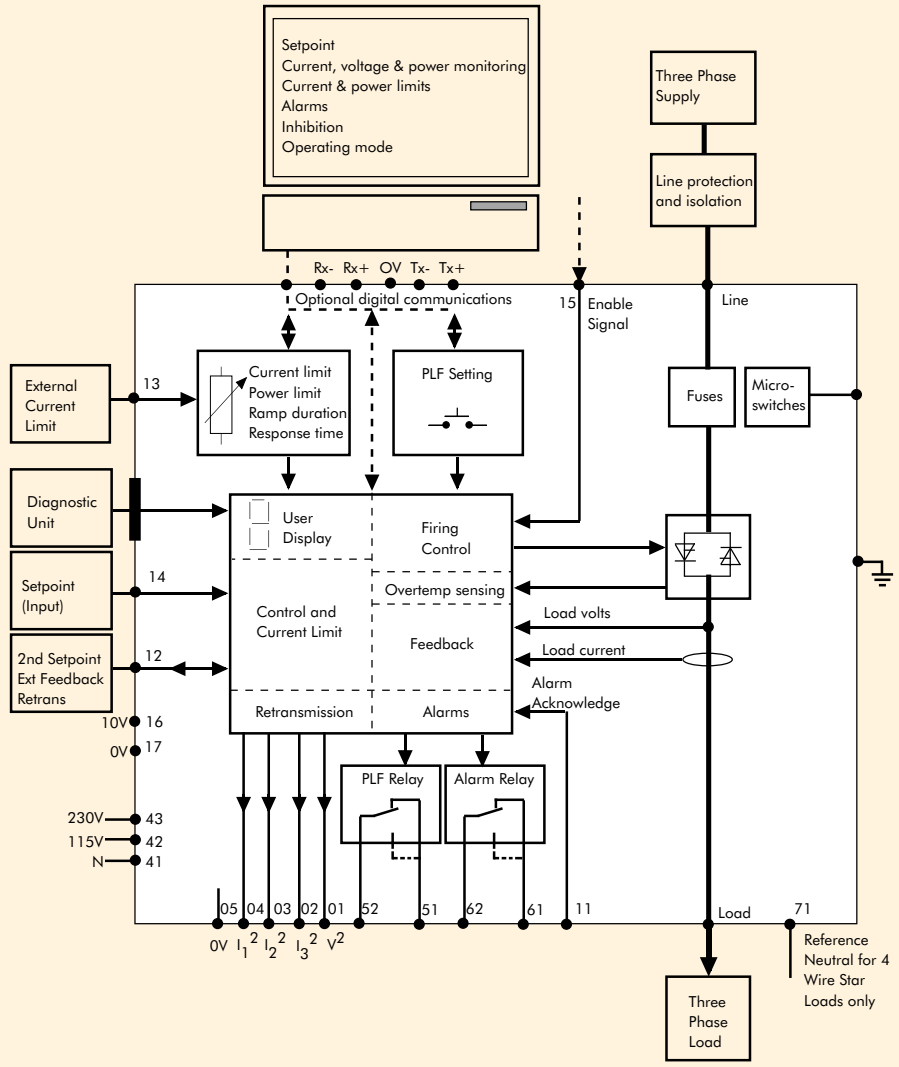



6 wire delta connection (open delta)



**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:

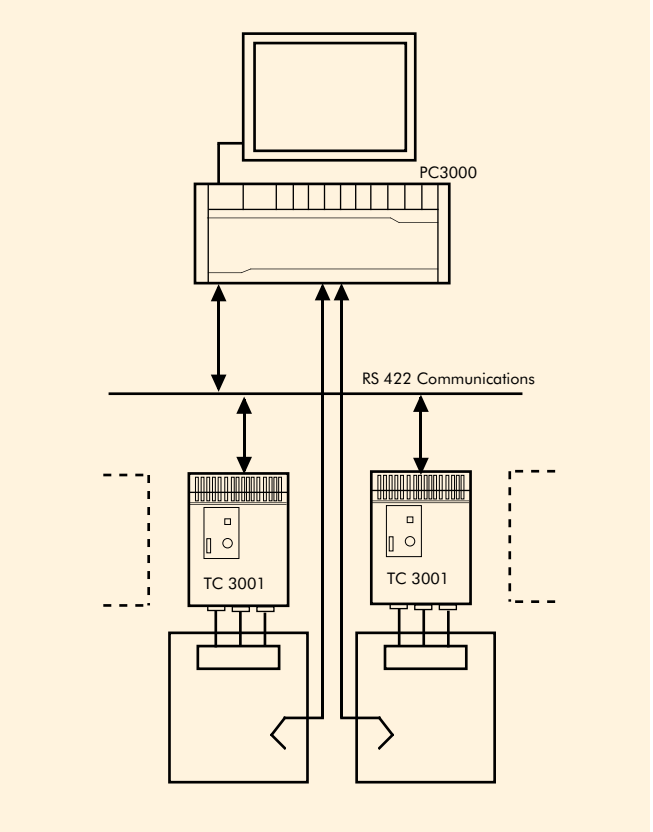
- Power setpoint
- Load and supply alarms
- Line current in all three phases
- Line voltage
- Load power
- PLF and current limit settings
- Operating mode




TC3001 with optional digital communications

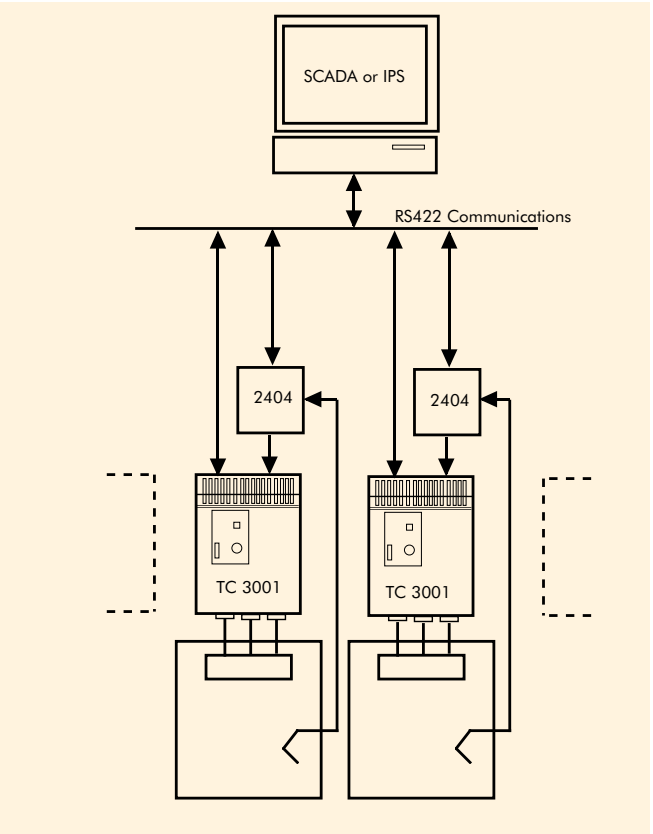
## Digital communications applications

**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 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 $V_{LOAD}^2$, VxI, $I_{AVE}^2$ 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 > 100kΩ |
| | Current: 0-20mA, 4-20mA. | 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 x 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 ±1% , Burst firing ±2% for all feedback modes | |
| Stability | Phase angle ±1% , Burst firing ±2% for +10% to -15% supply variation, for 0°C to 50°C ambient temperature and for load impedance changes of ±30% (for V x 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** |
|---|---|
| 25 amps | 25A |
| 40 amps | 40A |
| 60 amps | 60A |
| 75 amps | 75A |
| 100 amps † | 100A |
| 150 amps † | 150A |
| 250 amps † | 250A |
| 300 amps † | 300A |
| 400 amps † | 400A |
| 500 amps † | 500A |
| 700 amps † | 700A |
| 1000 amps † | 1000A |
| 1150 amps † * | 1150A |
| 1350 amps † * | 1350A |
| 1500 amps † * | 1500A |
| 1800 amps † * | 1800A |

† fan cooled

* Separate MC3001 Driver and stack

| **Maximum Line to Line Voltage** | |
|---|---|
| 240 volts | 240V |
| 440 volts | 440V |
| 480 volts | 480V |
| 500 volts | 500V |
| 690 volts †† | 690V |

†† Note 690 volt units have increased dimensions. See diagrams.

| **Auxiliary Supply** | **Code** |
|---|---|
| 100 volts | 100V |
| 110 to 120 volts | 110V120 |
| 200 volts | 200V |
| 220 to 240 volts | 220V240 |

| **Operating Voltage** | |
|---|---|
| 100 volts | 100V |
| 110 volts | 110V |
| 115 volts | 115V |
| 120 volts | 120V |
| 200 volts | 200V |
| 220 volts | 220V |
| 230 volts | 230V |
| 240 volts | 240V |
| 277 volts | 277V |
| 380 volts | 380V |
| 400 volts | 400V |
| 415 volts | 415V |
| 440 volts | 440V |
| 480 volts | 480V |
| 500 volts | 500V |
| 600 volts | 600V |
| 660 volts | 660V |
| 690 volts | 690V |

| **Input** | **Code** |
|---|---|
| 0-5 volts | 0V5 |
| 1-5 volts | 1V5 |
| 0-10 volts | 0V10 |
| 2-10 volts | 2V10 |
| 0-20mA | 0mA20 |
| 4-20mA | 4mA20 |

| **Firing Mode** | | |
|---|---|---|
| Logic (On/Off) | | LGC |
| Phase angle | | PA |
| Burst | 1 period | FC1 |
| | 2 periods | FC2 |
| | 4 periods | FC4 |
| | 8 periods | FC8 |
| | 16 periods | C16 |
| | 32 periods | C32 |
| | 64 periods | C64 |
| | 128 periods | 128 |
| | 255 periods | 255 |
| Phase angle burst | 1 period | HC1 |
| | 2 periods | HC2 |
| | 4 periods | HC4 |
| | 8 periods | HC8 |
| | 16 periods | H16 |
| | 32 periods | H32 |
| | 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** |
|---|---|
| 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 |
| I2 | 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) | E0VI0 |
| 0-10V second setpoint | W0VI0 |

| **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).

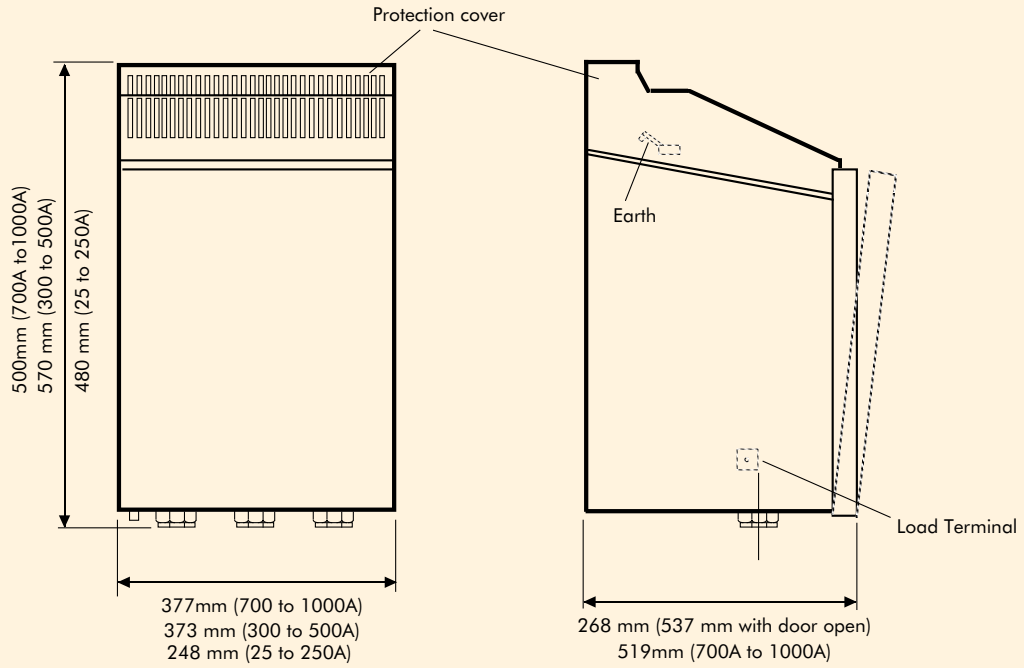
### Control mode
Option $V^2$ gives compensation for supply variations and is suitable for most applications. Current, power and external control modes are available. Please consult Eurotherm for more information on these alternatives.

### 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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