

Thyristor

SELECTION GUIDE



EUROTHERM

CONTROLS
DATA MANAGEMENT
PROCESS AUTOMATION

The Control of Power

Eurotherm is recognised worldwide for the excellence of its control and data management products. Temperature and process controllers are extensively used throughout manufacturing industry, chemical and oil production and scientific research.

Complete product range

For the control of electrical heating or other switching applications, Eurotherm has a range of thyristor units to suit every need. Whether the load is constant or variable resistance, inductive or transformer coupled, single or three phase, we have thyristors to meet your exact requirements. Our standard range will cater for currents up to 1800 amps but by using separate driver and power units, this range can be extended up to several thousand amps.

Choice of optimum firing mode

Thyristors can deliver power in long or short bursts - even down to one cycle of the supply voltage - in order to match the load and heater requirements exactly. Alternatively, phase angle firing can be used for inductive or transformer coupled loads or applications where current limit is required. This tight control of delivered power gives better temperature control which results in improved product quality. Additionally the thyristor's ability to switch rapidly reduces the thermo-mechanical stresses on the heater elements resulting in less downtime and lower maintenance costs.

Digital communications

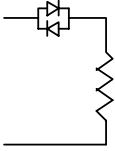
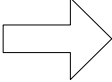
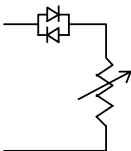
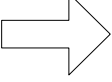
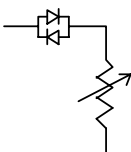
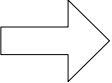
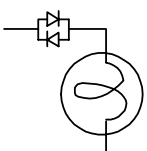

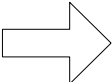
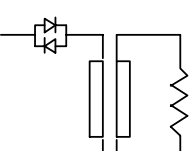
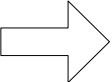
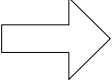
Adding digital communications to thyristor units introduces further sophistication into process management. This allows digital accuracy in downloading setpoints and is ideal for large, multi-zone installations. The need for calibration of analogue signals is eliminated and wiring is reduced since only a single digital link is needed to connect all zones to a central programmer. This can be a Eurotherm PC3000 a Programmable Logic Controller or a personal computer. Digital communications also allows logging of process parameters, energy consumption, abnormal conditions, faults and alarms.

How to use this selection guide

This Thyristor Selection Guide enables the correct thyristor unit to be chosen to match your requirements:

1. If you know what type of load you are using, then section headed "Load types" will provide a route to selecting a thyristor to suit that load.
2. If you know the features that you require of a thyristor, the "Thyristor features guide" section will allow you to select the thyristor with the appropriate characteristics.
3. The intermediate pages give additional information about the thyristors in relation to the specific load types.
4. On the back cover you will find the formulae required to calculate the thyristor currents for resistive loads.

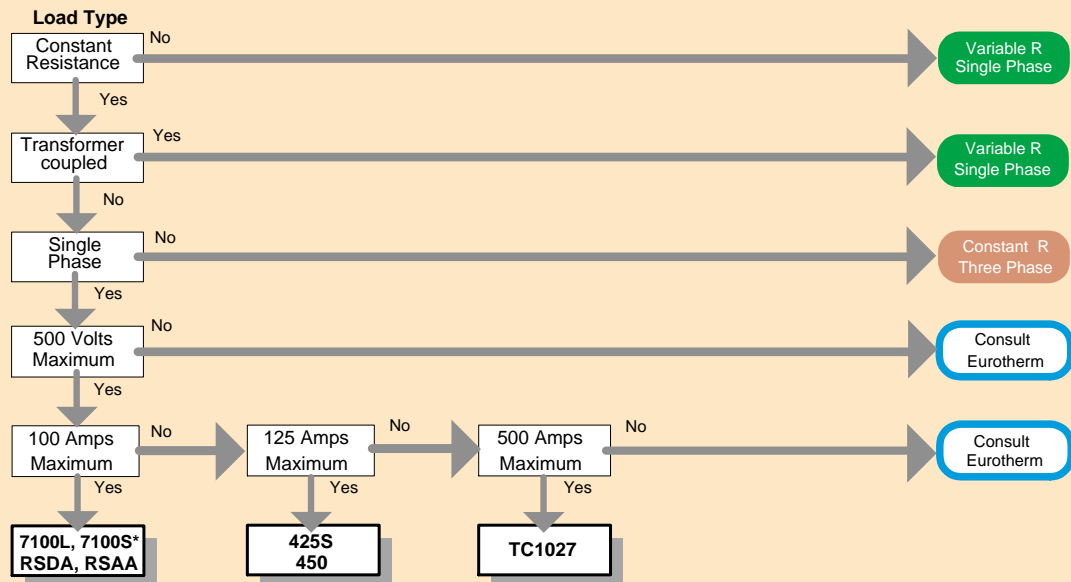
Load types

	<p>Resistive elements whose ohmic value does not change greatly over their temperature range. (Low temperature coefficient of resistance). e.g. Austenitic alloys (NiCr, NiCrFe). Example trade name is Nikrothal. Typical resistance change 7%.</p>	 <p style="text-align: center;">Go to Constant Load Resistance</p>
	<p>Resistive elements whose ohmic value changes with temperature. (Especially elements with large positive temperature coefficient of Resistance). e.g. Tungsten (W), Molybdenum (Mo), or Molybdenum disilicid (MoSi₂). Trade name for latter is Kanthal Super. Resistance change 20:1</p>	 <p style="text-align: center;">Go to Variable Load Resistance</p>
	<p>Resistive elements whose ohmic value changes with time. (They may also have a temperature change of resistance). e.g. Silicon Carbide. Example trade name is Hot Rod. Typical resistance increase of 2 to 4 times with time (and temperature).</p>	 <p style="text-align: center;">Go to Variable Load Resistance</p>
	<p>Infra Red Heaters This will be dependent on the wave length of the heaters</p>	<div style="display: flex; flex-direction: column; align-items: center;">  <p style="text-align: center;">Go to Constant Load Resistance</p>  <p style="text-align: center;">Go to Variable Load Resistance</p> </div>
	<p>Resistive elements which are connected via a transformer.</p>	 <p style="text-align: center;">Go to Variable Load Resistance</p>
<p style="text-align: center; font-size: 2em;">?</p>	<p>Load characteristics unknown</p>	 <p style="text-align: center;">Contact Eurotherm</p>

Thyristor selection chart for Single phase control

Constant Load Resistance

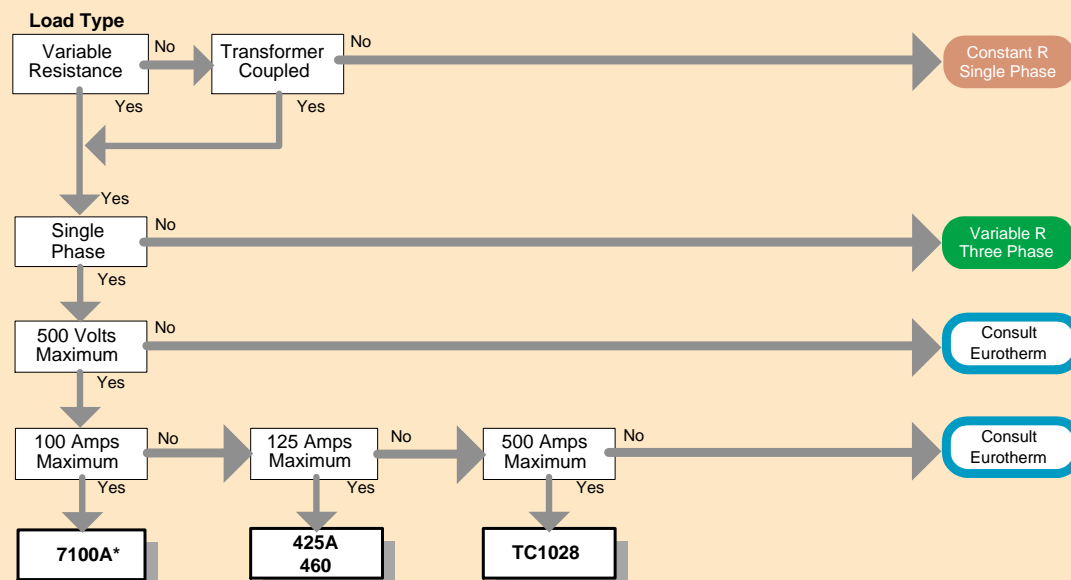
single phase



TE10S available up to 50 amps

Variable Load Resistance

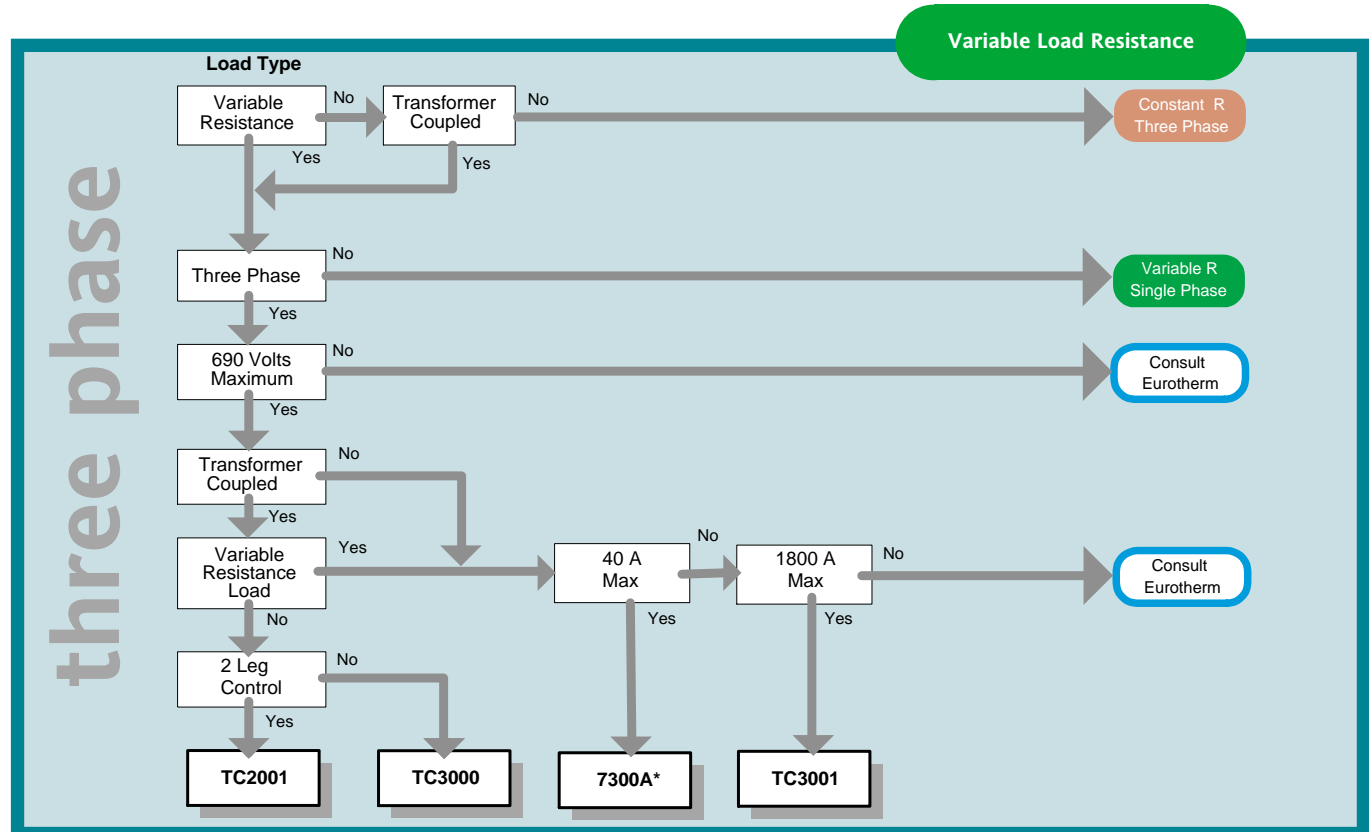
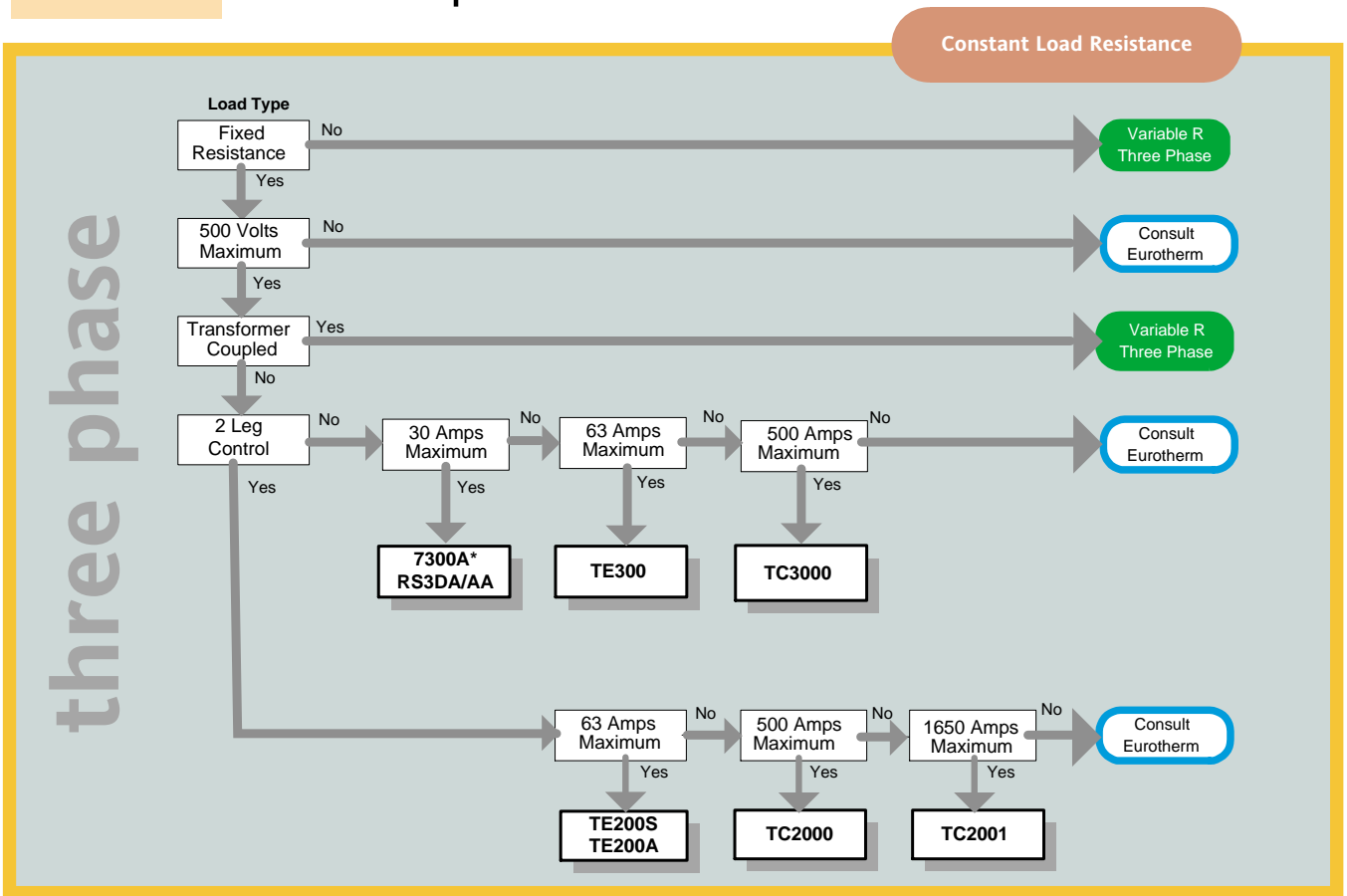
single phase



TE10A available up to 50 amps

* Note: The 7100S and 7100A ratings will be extended up to 630 A.

Thyristor selection chart for Three phase control



* Note: The 7300A rating will be extended up to 630 A, as will the 7300S solid state contactor and 7200S and 7200A two leg units when introduced.

Thyristors for single phase control

Constant Resistance Load

Constant resistance loads are the most common form of industrial electrical heating and include nickel chrome, inconel and other alloys as well as long wave and some medium wave infrared heaters.

The benefits of using thyristor control for these simple element types are better temperature control, increased heating element lifetime and simplified, reduced maintenance. For fast acting heating loads thyristors are essential for good control. Thyristors are almost silent in operation so the working environment is improved too.

For single phase applications the following solid state relays (SSR) will be suitable:

 <p>SVDA and SVAA</p>	<p>Low cost “hockey puck” style AC/DC logic input Current ratings up to 75 A External heatsink required</p>
 <p>7100L RSDA & RSAA</p>	<p>Economical “fixed build” units AC/DC logic input Current ratings up to 100 A DIN rail or bulkhead mounting</p>
 <p>7100S*</p>	<p>Also suitable for shortwave infrared loads AC/DC logic input or 4-20mA analogue input Alarm options:- Thyristor short Load open Partial load failure Current ratings up to 100 A*</p>
 <p>450</p>	<p>Plug-in facility DC Logic input Partial load failure alarm option Current ratings up to 150A</p>
 <p>TC1027</p>	<p>High current - up to 500 A AC/DC Logic or analogue input</p>

Also available TE10S, 425S and TU Series thyristors for specialist applications. * Phased introduction; check for availability and extended ratings.

Thyristors for single phase control




Inductive or Variable Resistance Loads

Some heating elements are difficult to control because they have high temperature coefficients of resistance.

Typical of these elements are:

- Those whose resistance increases as they heat up (molybdenum, molybdenum disilicide, platinum, tungsten and short-wave infrared lamps)
- Those whose resistance decreases as they heat up (glass, zirconium oxide)
- Those whose resistance changes as they age (silicon carbide)

Elements with a variable resistance may need current limit to prevent surge currents causing element or cable damage. Eurotherm thyristors are designed so that the current limit is optimised to give rapid process heating without setpoint overshoot.

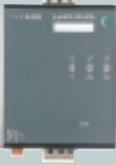





<p>Phase angle or fast cycle firing Optional current limit Alarms for; thyristor short, load open and partial load failure Also suitable for transformer burst firing. Current ratings up to 100 A*</p>	 <p>7100A*</p>
<p>Plug-in facility Phase angle or fast cycle firing Current limit Partial load failure alarm Suitable for transformer burst firing Current ratings up to 150 A</p>	 <p>460</p>
<p>High current- up to 1650 A Phase angle or fast cycle firing Current limit Partial load failure alarm Suitable for transformer burst firing See also MC1028 Driver Unit</p>	 <p>TC1028</p>

Also available TE10A, 425A and TU Series thyristors for specialist applications. * Phased introduction; check for availability and extended ratings.

Thyristors for three phase control

Selecting a thyristor unit for three phase electrical heating applications can be difficult. Eurotherm have the experience and the product range to make your selection easy. Whatever the load configuration, no matter what type of heating element, Eurotherm has the right unit, from low cost, economy two phase, to full three phase units with digital communications.

The compact size of three phase power units from Eurotherm makes them economical to install. Auto sensing of phase rotation makes them simple to connect up, and built in diagnostics on some models make setting up and fault finding easy. Since the operating mode is set by internal links and switches on the TE and TC ranges it is possible to customise power control to your exact requirements.

<p>CONSTANT RESISTANCE LOADS</p>  <p>TE200S, TE200A</p>	<p>Two leg switching of three phase, three wire constant resistance loads Current ratings up to 63 A Input can be AC or DC logic (TE200S) or analogue (TE200A). Logic/fast cycle firing.</p>
<p>CONSTANT RESISTANCE LOADS</p>  <p>TC2000</p> <p>INDUCTIVE LOADS</p> <p>TC2001</p>	<p>Two leg switching of three phase, three wire loads Both units are suitable for constant resistance loads and the TC2001 is also suitable for inductive loads. Logic or analogue inputs with logic or fast cycle firing. Current ratings up to 500 A (TC2000) or 1650 A (TC2001). See also MC2001 Driver Unit.</p>
<p>CONSTANT RESISTANCE LOADS</p>  <p>RS3DA, RS3AA</p>	<p>Low cost three leg control of three phase constant resistance loads up to 30 A. The logic input can be AC (RS3AA) or DC (RS3DA) Logic firing.</p>
<p>CONSTANT RESISTANCE LOADS</p>  <p>TE300</p>	<p>Three leg switching of three phase constant resistance loads Current ratings up to 63 A Input DC logic or analogue. Logic/fast cycle firing</p>
<p>CONSTANT RESISTANCE LOADS</p>  <p>7300A*</p> <p>INDUCTIVE OR VARIABLE RESISTANCE LOADS</p>	<p>True three phase control of inductive, resistive or variable resistance loads Phase angle or fast cycle firing. Current limit and fault detection options Current ratings up to 40 A*</p>
<p>INDUCTIVE LOADS</p>  <p>TC3000</p> <p>CONSTANT RESISTANCE LOADS</p> <p>INDUCTIVE OR VARIABLE RESISTANCE LOADS</p> <p>CONSTANT RESISTANCE LOADS</p> <p>TC3001</p>	<p>True three phase control of inductive, resistive or variable resistance loads Phase angle or fast cycle firing Current limit and partial load failure alarm available on the TC3001. Current ratings up to 500 A (TC3000) and 1800 A (TC3001). See also MC3001 Driver Unit.</p>

TU Series also available for specialist applications. * Phased introduction; check for availability and extended ratings.

Thyristors for true power control

In some heating applications you cannot measure temperature, so closed loop temperature control is not possible. High quality control is still achievable using a true power controller. By sensing the voltage and current supplied to the load these units maintain a constant power delivery to give repeatable, controllable conditions and ensure high product quality.

True power controllers also improve closed loop temperature control if the nature of the heating system can change. Here true power controllers maintain tight control if the element resistance changes through age, through damage or through design. For some applications such as crystal growing, true power control is vital.



470 Series

Single phase power control suitable for all load types

Current ratings up to 125 A. Separate driver for higher powers. Burst and phase angle firing with current limit. Voltage, current or power feedback. Plug in design and front panel diagnostic sockets aid settings up and maintenance.



TE10P

Single phase power control current ratings up to 400 A

Voltage ratings up to 500 V.
Phase angle or fast cycle firing suitable for inductive constant or variable resistance loads.
Digital communications

Related power control products

REMIO digital communications interface

Eurotherm Solid State Contactors such as the 7100L, 7100S or TE10S may be distributed using the REMIO interface to communicate with the comms master. Time proportioning control of up to 32 SSCs is available, giving economical, multizone control via digital communications.

A comms in/comms out version is for use with simple communicating SSCs.



MC series driver units

The control electronics from the TC series thyristor units is repackaged as a series of MC drivers for use with external, high current, air or water cooled thyristor devices. The MC1028 is used for single phase applications, the MC2001 for two leg control of three phase loads and the MC3001 is used for full three phase control.



483 Load Sequencer

The 483 load sequencer prevents multiple heating loads from being switched on simultaneously. This reduces disturbances to the electrical supply network. Each 483 can control up to four loads and by cascading units together up to sixteen loads can be controlled.



THYRISTOR FEATURES GUIDE

SINGLE PHASE

THREE PHASE

	SINGLE PHASE											THREE PHASE									
	SINGLE PHASE								SINGLE PHASE			Two leg switching 3 wire loads				Three leg switching 3 or 4 wire loads					
	SVDA SVAA	7100L	RSDA RSAA	7100S	450	TC1027	7100A	460	TC1028	TE10P	470	TE200S	TE200A	TC2000	TC2001	RS3DA RS3AA	TE300	7300A	TC3000	TC3001	
HEATER TYPE																					
Constant resistance	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
SWIR (Short wave infrared)				●	●	●	●	●	●	●	●	●	●	●	●		●	●	●	●	●
Variable resistance							●	●	●	●	●								●		●
Inductive/Transformer coupled							●	●	●	●	●				●			●	●	●	●
TRUE POWER CONTROL							●			●	●				●			●		●	●
Max. current (amps)	75 A	100 A	100 A	100 A†	150 A	500 A	100 A†	150 A	1200 A*	400 A	150 A*	63 A	63 A	500 A	1200 A*	30 A	63 A	40 A†	500 A	1000 A*	
Controlled phases	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	3	3	3	3	3	
INPUT	L	L	L	A	L	L	A	A	A	A	A	L	A	A	A	L	A	A	A	A	
FIRING MODE	B	B	B	B	B	B	P	P	P	P	P	B	B	B	B	B	B	P	P	P	
OPTIONS																					
PLF and/or PLU				●	●		●	●	●	●	●			●	●			●		●	
Current limit							●	●	●	●	●							●		●	
Plug in construction					●			●			●									●	
Diagnostics								●	●	●	●				●				●	●	
Alarms				●			●	●		●	●							●	●	●	
Digital comms				●			●			●	●							●		●	

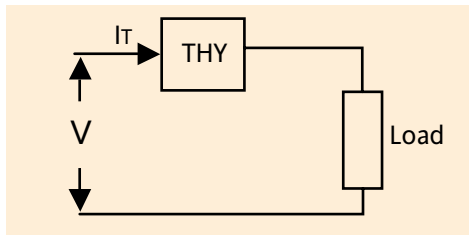
L Logic input
A Analogue input and logic input
B Burst firing
P Phase angle firing

* Increased current ratings available
 † Phased introduction. Check for availability and extended ratings.

Thyristor current calculations

The formulae given below provides a simple way to calculate the thyristor current (I_T) for various resistive loads. The calculated value of I_T should then be multiplied by 1.2 to allow for variations in supply voltage and manufacturing tolerances of the load.

Single Phase



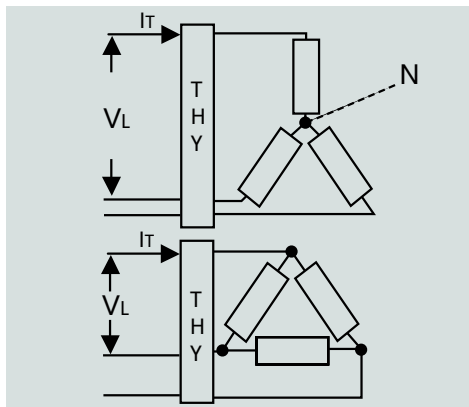
$$\text{Thyristor current } (I_T) = \frac{\text{WATTS}}{V}$$

Example: A 3kW load across 230 volts

$$I_T = \frac{3000}{230} = 13 \text{ A}$$

Applying safety factor, current = $13 \times 1.2 = 16 \text{ A}$
A 16 A, 230 volt thyristor unit can be used.

Three Phase (3 or 4 wire load)



$$\text{Thyristor current } (I_T) = \frac{\text{WATTS}}{1.732 \times V_L}$$

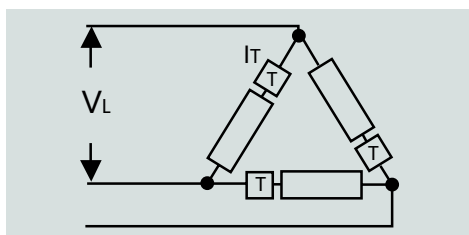
Example: A 60 kW load across 415V, 3 phase supply

$$I_T = \frac{60,000}{1.732 \times 415} = 83 \text{ A}$$

Applying safety factor, current = $83 \times 1.2 = 100 \text{ A}$
A 100 A, 415 volt three phase thyristor can be used.

HINT: If voltage = 415 volts, just multiply the number of kW by 1.4 to get I_T .
E.g. In above example $I_T = 60 \times 1.4 = 84 \text{ A}$

Three Phase (6 wire open delta load)



$$(I_T) = \frac{\text{WATTS}}{3 \times V_L}$$

Example: A 100 kW load with 415V, 3 phase supply

$$I_T = \frac{100,000}{3 \times 415} = 80 \text{ A}$$

Applying safety factor, current = $80 \times 1.2 = 96 \text{ A}$.
A 100 A, 415 volt three phase thyristor can be used.

For other loads and applications consult Eurotherm.

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