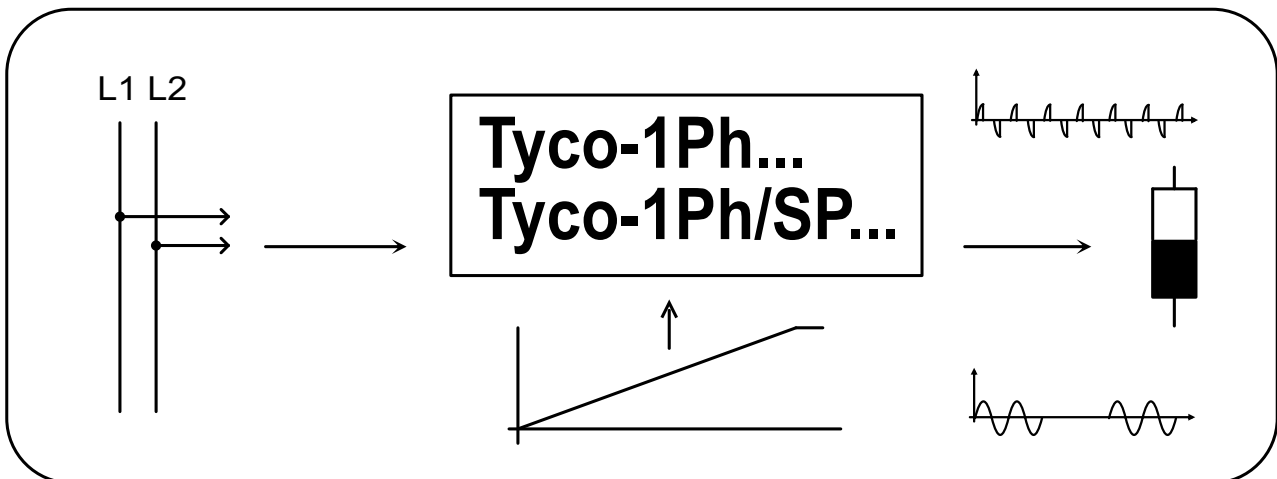




## Start-up instructions

### Thyristor controller Type: Tyco-1Ph, Tyco-1Ph/SP



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## 1. Important safety instructions

This manual contains instructions, which have to be observed for your personal safety and for the prevention of material damage. The instructions about your personal safety are highlighted with a warning triangle labelled with three exclamation marks, hints about material damages are listed with a warning triangle and one exclamation mark.



### **Danger-symbol**

Personal injury **may** occur, if appropriate safety precautions are not taken.



### **Caution-symbol**

Material damages may occur, if appropriate safety precautions are not taken into account.



### **Disposal regulations**

The devices contain electrical components and must not be disposed together with household garbage. The devices for disposal have to be recycled according to local and currently valid regulations for electronic waste.

### **Qualified personnel**

The corresponding device/system may only be set up and operated in conjunction with this documentation. Commissioning and operation of the device/system may only be performed by **qualified personnel**. Qualified personnel within the meaning of the safety instructions in this documentation are persons with the authority to put electric circuits into operation, provide ground connections and label them according to current safety regulations.

The device should only be used in applications described in this document. The reliable and proper use of the product depends on appropriate transport, storage, installation and careful commissioning.

## 2. General instructions

### **Use of the document**

This instruction should demonstrate the technical application possibilities of the thyristor controller to the engineer in charge.

### **Target group**

The document should assist the user during commissioning. It also helps in case of service and maintenance work. It supports the planner and project engineer with the conception of new plants.

### **Necessary competence**

Generic skills in the field of electrical engineering are necessary.

### **Validity**

The present document is valid for the thyristor controller of the type Tyco-1Ph, Tyco-1Ph/SP. It contains the currently valid description of the unit. We reserve the right to attach new descriptions of the devices. This involves types and options with modified version status of the technical documents.

### **Standards and approvals**

The thyristor controller of the type Tyco-1Ph, Tyco-1Ph/SP are based on the IEC/EN 60947-4-3 standard.

**Disclaimer**

It lies within the responsibility of the plant manufacturer of the technical equipment or machine to ensure the proper overall function. The producer can not guarantee all properties of the overall system or the machine.

**3. Technical explanations on thyristor controllers**

The situations in which thyristor controllers have to be employed can be found in all the areas where greater resistor and inductive loads have to be controlled (e.g. industrial heating systems, tems, plastics processing, transformers, infrared elements, etc.)

Because of its modular, compact assembly and the controlling with a continuous control signal these power controllers have to be regarded as a perfect final controlling device for the industrial power controlling.

The power device of the thyristor controllers consists of two thyristor moduls, an isolated heat sink and the control unit. The possibility to adapt to any application the largest advantages of these devices.

**Type description:**

<b>Tyco-1Ph...</b>	alternating current power controller single-phase, phase angle control
<b>Tyco-1Ph/SP...</b>	alternating current power controller single-phase, multicycle control
<b>Tyco-1Ph.../V3</b>	alternating current power controller single-phase, switchable between phase angle control and multicycle control output of the load current as voltage signal (0-10V) linearised output of the load voltage (0-100%)
<b>Tyco-3Ph...</b>	three phase controller, phase angle control
<b>Tyco-3Ph/N...</b>	three phase controller, phase angle control with neutral point connnection (option)
<b>Tyco-3Ph/SP...</b>	three phase controller, multicycle control
<b>Tyco-3Ph/SP/N...</b>	(Option) three phase controller, multicycle control with neutral point connnection
<b>Tyco-3Ph.../V3</b>	three phase controller, switchable between phase angle control and multicycle control output of the load current as voltage signal (0-10V) linearised output of the load voltage (0-100%)

**Construction:**

The thyristor controller agrees with Low voltage directive: 2014/35/EU, EN60947-4-3 and EMC Directive: 2014/30/EU, EN60947-4-3 KI.A.

The thyristor controller Tyco-1Ph... is assembled modularly. It consists of two basic elements:

- power element with cooling system and thyristor modules
- control unit with firing and control board (diagnostic display, control outputs, etc.)

## 4. Installation of the thyristor controller Tyco-1Ph, Tyco-1Ph/SP

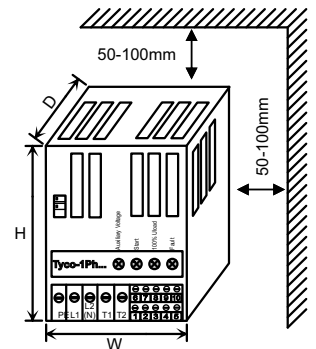
The thyristor controller (IP 40) should be mounted vertically in a housing. The upper and lower side of the heat sink have to be kept free to allow cooling air to circulate freely. The temperature may not cross 50 ° C. Controllers must be mounted on a flat surface to ensure that cooling air is channelled to the heat sink. The thyristor configuration is indifferent to the order of the supply phase rotation.

Further conditions to the operating area:



- protection from dust and moisture
- protection from aggressive atmosphere
- free from vibrations

No other devices should be placed closer than 50 to 100mm to the device, in order to provide adequate cooling.



The housing design according to IP 54 (Option) can be mounted in places which are not protected from dust and humidity.

### Wiring the device:



The mains connections L1, L2 (N) have to be connected by using a disconnecting switch and usual fuses.

The connection for mains cable and the connections for controlling have to be laid in channels and protector tubes.

The electric installation always has to comply with the essential protection requirements of the European Low Voltage Directive 2014/35/EU and Electromagnetic compatibility Directive 2014/30/EU.

## 5. EMC-equitable assembly

According to EMC standards thyristor controllers are regarded as components, which do not fulfil any intended use by themselves. The devices constitute a functional unit of the entire plant. The control electronics of the thyristor controllers are implemented according to valid EMC standards.

The builder of the plant has to supply the plant with appropriate mains chokes and mains filters. These components can also be obtained from us. Thyristor controllers with multicycle control usually do not require any additional mains filter circuit.

It should be noted that the standards of the resource category A are not sufficient in a special industrial sector, for example if sensitive measuring channels are affected. In this case, the user has to apply equipment of class B.

The class A is the usual class of equipments, which is normally intended for the use in the industrial sector. The devices are connected to the industrial network via an assigned transformer. Power controllers of class B are required if they should be used in the area of industry and small-scale industry and if they should be connected to the public low-voltage system.

### Use of mains chokes:

On the input side of the thyristor controllers, mains chokes reduce the current-dependent line reactions and effect an improvement of the performance factor. This reduces the current harmonics and improves the mains quality. The use of mains chokes is particularly recommended when connecting thyristor controllers with phase angle control to a grid-feeding point and when other electronic devices are attached to this network.

**Use of mains filters:**

Radio interference filters and mains filters (combination of radio interference filter and one mains choke) serve for protection against high-frequency disturbances, which are sent out via the power cable or the radiation of the power cable. The high-frequency disturbances should be limited to a mandatory or legal degree. Mains filters should possibly be mounted close to the thyristor controller and moreover it is necessary to ensure that the connecting cable between the thyristor controller and the mains filter is as short as possible.

**CAUTION:** The mounting surfaces of the thyristor controllers and the radio interference filters have to be free from paint and well conducting in the high-frequency range.

Furthermore, mains filters have leakage currents, which may become significantly larger than the nominal values in case of failure (phase failure, unbalanced load). To avoid dangerous voltages, the mains filters have to be grounded. As the leakage currents are high-frequent disturbances, the grounding measures have to be low-resistance and extensive.

With leakage currents, which exceed the value of 3,5mA, VDE 0160 or EN 60335 specify that either:

- the cross section of the protective conductor has to be  $\geq 10\text{mm}^2$ ,
- the protective conductor has to be monitored on interruption or
- a second protective conductor has to be laid.

**Shielding measures:**

Shielding measures help to reduce the radiated interference energy. Electrical lines between thyristor controller and load can be laid shielded. Thereby the shield must not replace the PE line. Four-wire cables (three phases + PE), whose shield is double-sided and extensive laid on earth potential (PES), are recommended. The shield must not be applied over the connecting wires. Interruptions of the shielding e.g. in the case of clamps, contactors, mains chokes etc. have to be bridged with low-resistance and appropriate space considerations.

In practice this can be done for example by interrupting the shield close to the assembly and then connecting it extensively with the earth potential (PES, shield clamp). The free cables, which are not shielded, should not be longer than 100mm.

**Grounding measures:**

Grounding measures are absolutely necessary to fulfil legal provisions. They constitute a prerequisite for an efficient use of further measures such as filters and shielding. All conductive, metallic housing components have to be electroconductive connected with the earth potential. For the EMC-measure, the important factor is not the cable's crosssection, but its surface, since this is where high frequency current flows to earth. Once again, all grounding points have to be led directly, extensively and with low-resistance to the central grounding point (equipotential bonding bar, star-shaped grounding system). The contact points have to be free from paint and corrosion (use galvanized mounting plate and materials).

## 6. Operation

First, all the electrical connections have to be made according to the enclosed circuit diagrams: L1, L2 (N), T1, T2. The thyristor controllers have to be connected to the mains supply as per VDE regulations, so that they can be disconnected from the mains supply by means of corresponding separation devices (e.g. main switch, contactor, circuit breaker).

### **Cable laying:**

The mains supply line, the consumer supply line and the control lines have to be led in separated cables.

To avoid disturbances, it is advisable to do the wiring of the electronic signal lines isolated from the power and/or contactor control lines and to twist the toward and return lines of the signal lines (see also point 5. EMC-equitable assembly).

### **Fuses:**

The mains fusing depends on the recommended or used wire cross-section and has to be made according DIN 57100 part 430/VDE 0100 part 430/6.81.

### **General information:**

Thyristor controller for phase angle (Tyco-1Ph..., Tyco-1Ph.../V3, Tyco-3Ph... and Tyco-3Ph.../V3) serve to control ohmic and inductive loads. The activation is standardly made via proportional signals (0...10V, 0...20mA or 4...20mA). The phase angle or the input and output clock ratio with multicycle control (Tyco-1Ph/SP...; Tyco-1Ph.../V3; Tyco-3Ph/SP... and Tyco-3Ph.../V3) is constantly adjusted by the control electronics, to achieve an adequate proportionality between the activation of the thyristor controller and the output (T1, T2).

Beside these already mentioned device series, Tyco-1Ph..., Tyco-1Ph.../V3, Tyco-3Ph... and Tyco-3Ph.../V3, we also have single-phase and three-phase versions, which cover the upper voltage range up to 2500A. These devices are also for short delivery.

Devices in special designs are also available after clarification of the technical specifications and adjustment with our technicians.

## 7. Meaning of the clamp connections

Clamps	Function	State	Description of the function
1-2	start	closed	softstart and operation will be activated
		open	ready for operation
3	$U_{ref}$	10V	to be used during potentiometer adjustment
4	$U_{steuer}$	0-10V 0-20mA 4-20mA 2,5-10k $\Omega$ (Poti)	input of voltage and current signal and potentiometer adjustment
5	ground (GND)	X	for using of current, voltage and potentiometer adjustment
6-7	fault relay output	ter. 6, 7 closed	switching at fault
8-9	auxiliary voltage	230V/50-60Hz	voltage supply of the internal electronic by the load voltage (in case of internal supply it is generated out of the mains voltage L1, L2(N))
10	not connected	X	X
L1-L2(N)	main potential ( $U_{Netz}$ )	400V AC (optional: 110V, 230V, 240V, 440V, 500V)	voltage of power circuit
T1-T2	Load	0- $U_{Main}$ (according to voltage at L1-L2(N))	Load (thermal resistor, motor, transformer)

### Controlling with voltage signal:

Switch (Ri1, Ri2)	set 0-10V	
Clamp:	4	signal input
	5	ground (GND)

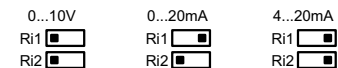
### Controlling with current signal:

Switch (Ri1, Ri2)	set 0-20mA or 4-20mA	
Clamp:	4	signal input
	5	ground (GND)

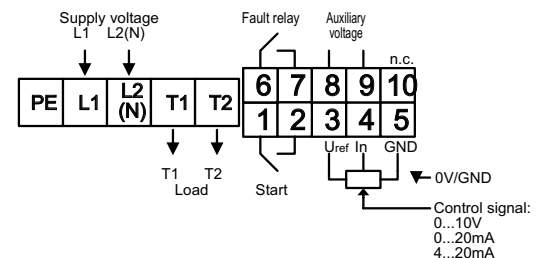
### Controlling with poentiometer:

Switch (Ri1, Ri2)	set 0-10V	
Clamp:	3	reference voltage (10V, supply voltage for potentiometer)
	4	sliding contact
	5	ground (GND)

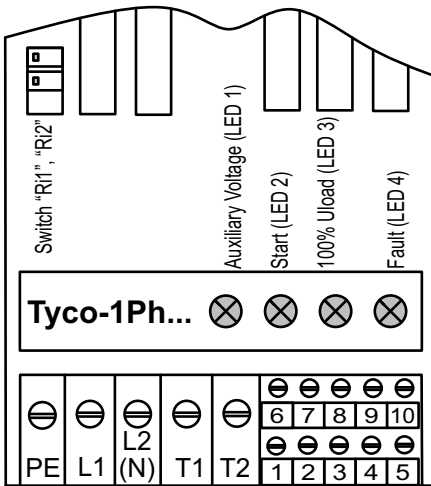
Setting of the switch "Ri1" and "Ri2" for control input:



Note:  
The black square in the switch picture is the slide control.



## 8. Meaning of the LEDs



<b>LED 1</b>	green	lights if there is any auxiliary voltage (ter. 8, 9) (or in case of internal supply, if L1 and L2(N) are connected to mains)
<b>LED 2</b>	yellow	lights if "Start" (ter. 1, 2) is bridged
<b>LED 3</b>	yellow	lights if output voltage has reached 100%
<b>LED 4</b>	red	lights if ambient temperature is too high; switch-off threshold is at approx. 90°C  What to do in case of temperature exceedance? <ul style="list-style-type: none"> <li>• cool down the whole system</li> <li>• check load</li> <li>• check power input</li> <li>• reset with "Start" (ter. 1, 2) and restart</li> </ul>

### Helping you understand the different functions of the LEDs:

Pos.	LED 1	LED 2	LED 3	LED 4	State	Fault relay output (at the same time with LED 4)
1	green	*	*	*	<ul style="list-style-type: none"> <li>• auxiliary voltage connected (ter. 8, 9)</li> <li>• device is ready for use</li> </ul>	
2	green	yellow	*	*	<ul style="list-style-type: none"> <li>• device is ready for use</li> <li>• "Start" is enabled (ter. 1, 2 are bridged)</li> </ul>	
3	green	yellow	yellow	*	<ul style="list-style-type: none"> <li>• device is ready for use</li> <li>• "Start" is enabled</li> <li>• <math>U_{Load}</math> beträgt 0-100%</li> </ul>	
4	green	*	*	red	<ul style="list-style-type: none"> <li>• device is ready for use</li> <li>• "Fault" is activated</li> </ul>	ter. 6, 7 closed
5	green	yellow	*	red	<ul style="list-style-type: none"> <li>• device is ready for use</li> <li>• "Start" is enabled</li> <li>• "Fault" is activated</li> </ul>	ter. 6, 7 closed

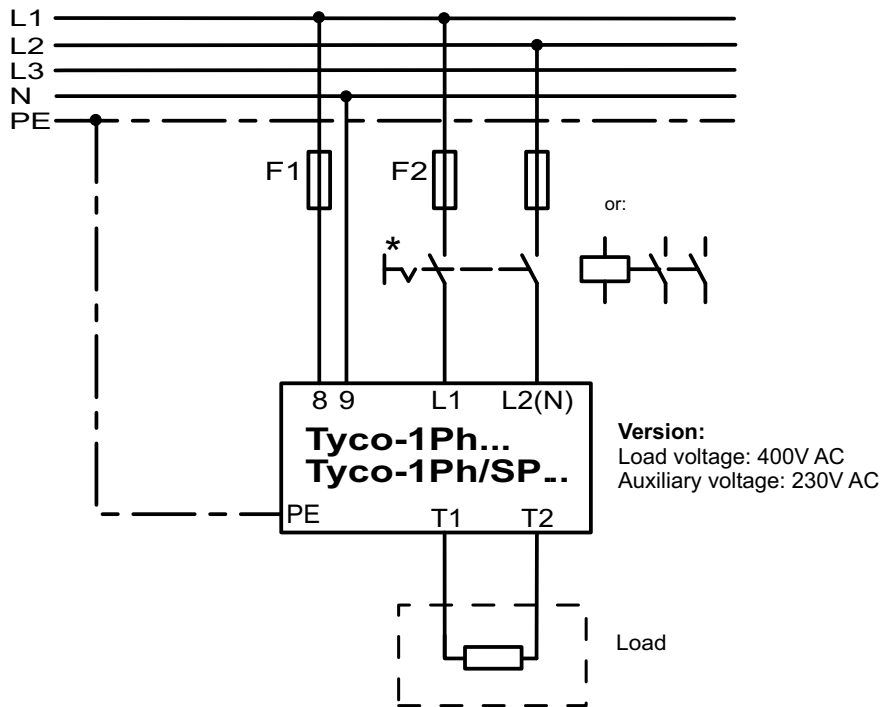
\* no change



## 9. Basic circuit

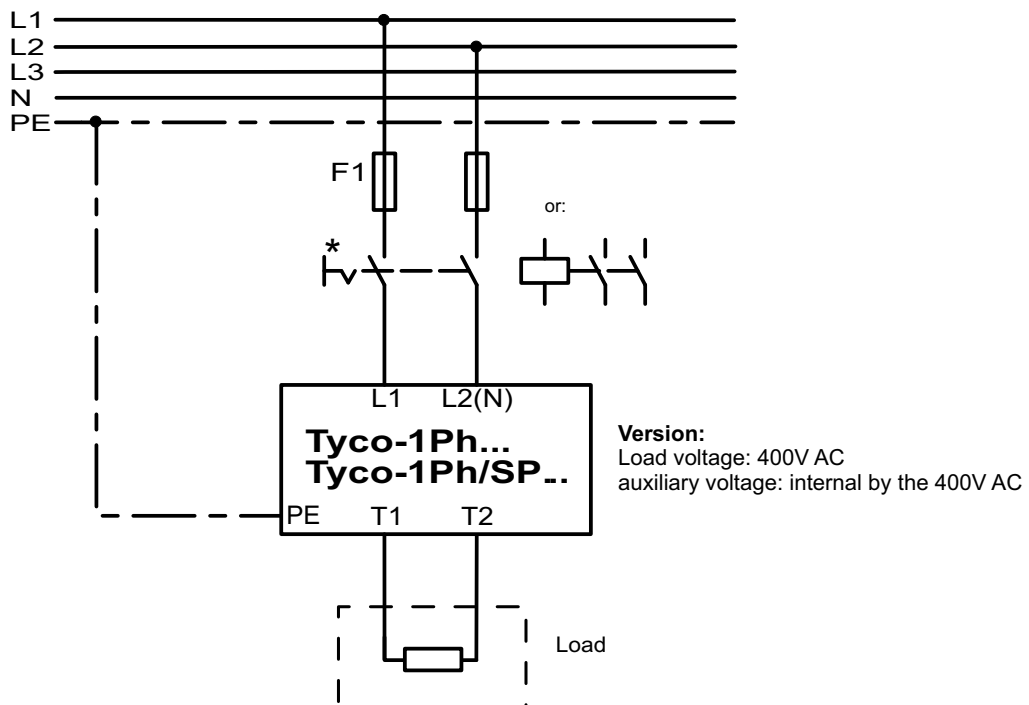
### Standard version:

Connection: Load voltage: 400V AC, auxiliary voltage: 230V AC, name of the order: Tyco-1Ph...



### Version with 400V between two phases (internal voltage supply):

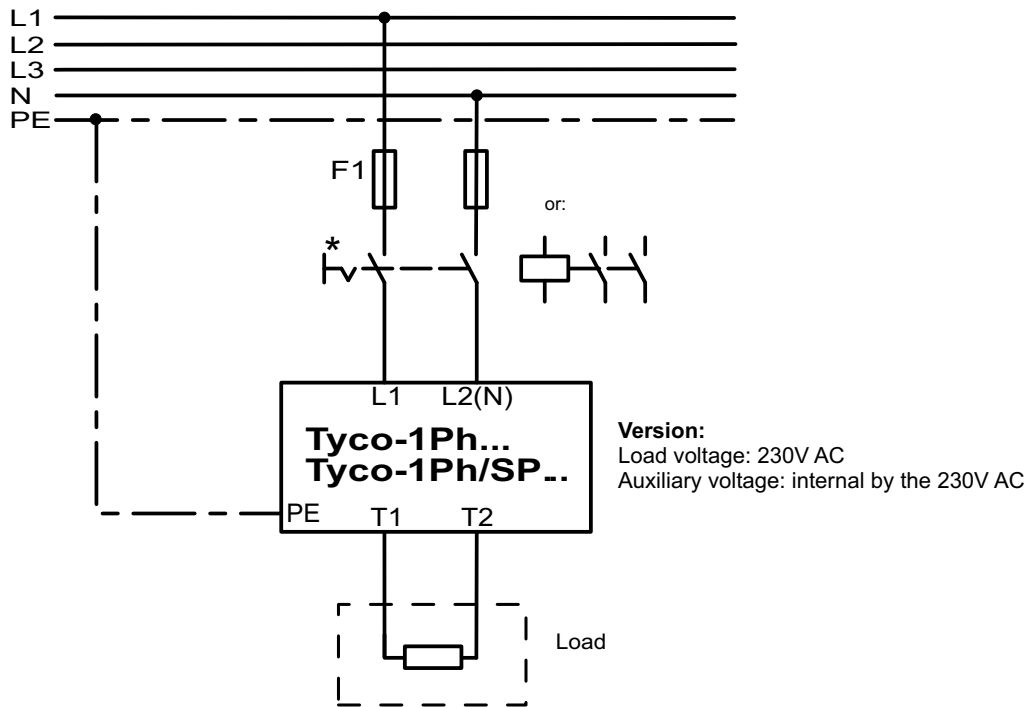
Connection: Load voltage: 400V AC between two phases (supply of the internal electronic by the load voltage), name of the order: Tyco-1Ph.../IV/400V



\* For isolate you can plug connection, fuses, circuit-breakers, load-breakers and residual current devices (RCDs). Contactor, however, can be used only in exceptional cases and due to isolate.

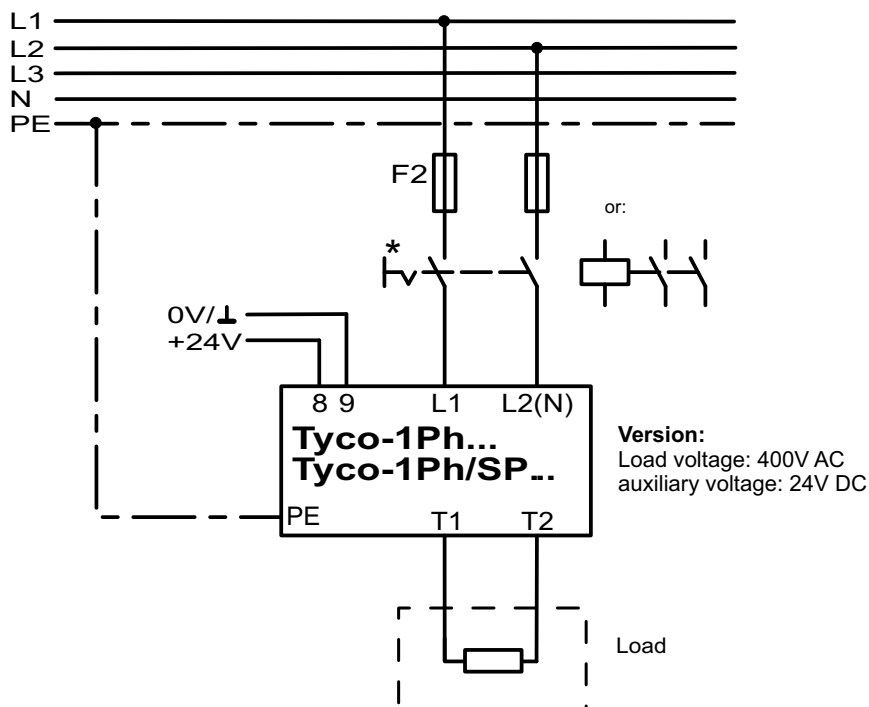
**Version with 230V single-phase (internal voltage supply):**

Connection: Load voltage: 230V AC between phase and neutral wire (supply of the internal electronic by the load voltage), name of the order: Tyco-1Ph.../IV/230V



**Version with 400V between two phases and auxiliary voltage: 24V DC:**

Connection: Load voltage: 400V AC, auxiliary voltage: 24V DC, Name of the order: Tyco-1Ph.../24VDC/400V



\* For isolate you can plug connection, fuses, circuit-breakers, load-breakers and residual current devices (RCDs). Contactor, however, can be used only in exceptional cases and due to isolate.

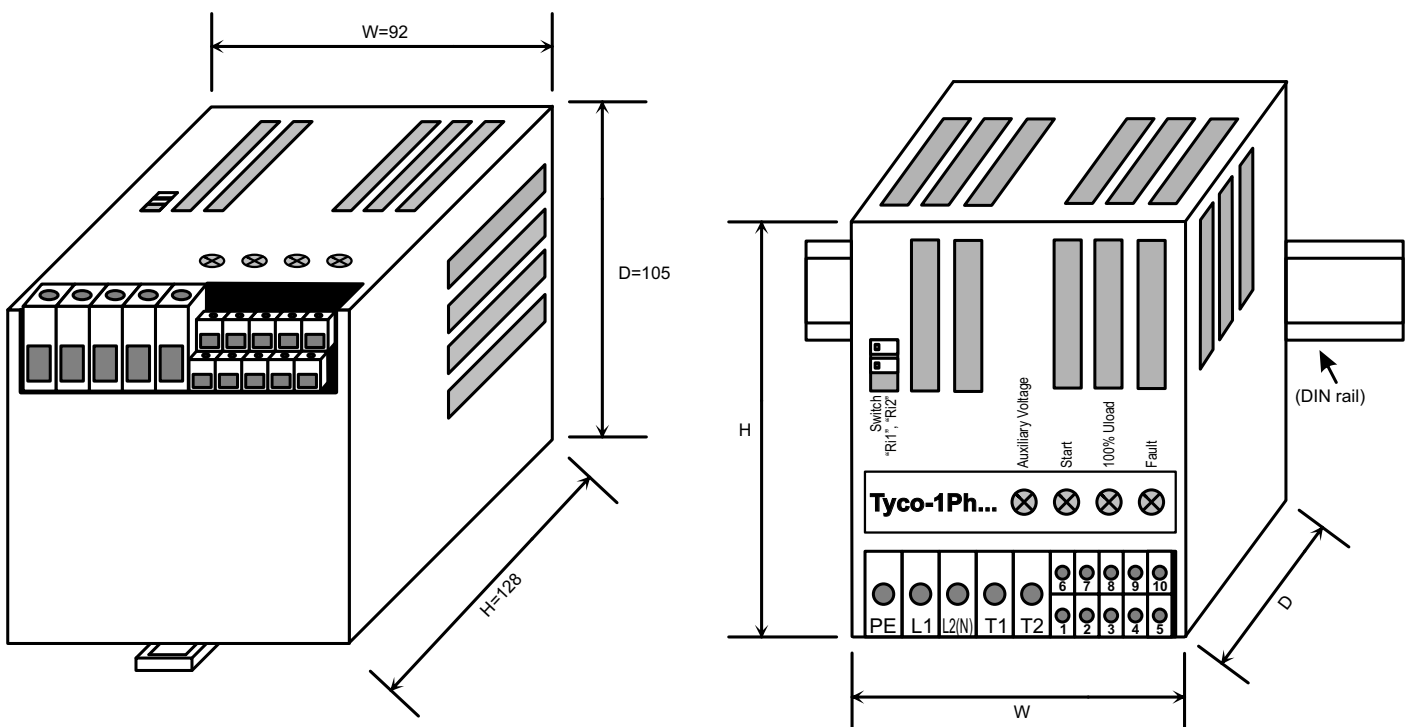
## 10. Survey of the individual types

Type	max. load current	rec. semi-conductor fuses	Mains fuse	rec. cross-section	max. power (U=400VAC)	Power loss at nominal rating	Weight	Dimensions WxHxD (with assembly for mounting on a DIN rail)
	[A]	[A]	[A]	[mm <sup>2</sup> ]	[kW]	[W]	[kg]	[mm]
Tyco-1Ph 05	5	10	16	2,5	2	4	0,8	92x128x105
Tyco-1Ph 15	15	25	25	2,5	6	13	0,8	92x128x105
Tyco-1Ph 25	25	30	32	4	10	22	0,8	92x128x105
Tyco-1Ph 35	35	40	50	6	14	31	0,8	92x128x105
Tyco-1Ph 50	50	60	80	10	20	45	0,8	92x128x105

Errors and technical modifications excepted (Date: 2016/05)

- The given details also apply to the version with multicycle control Tyco-1Ph/SP...

The given values refer to the operation voltage of 400V AC. The values given for overload refer to a surrounding temperature exceed of max. 50°C and an installation altitude of 1000m. Semiconductor fuses can be ordered optionally.



## 11. Technical data

Voltage of power circuit	400V AC $\pm$ 15% (optional: 110V, 230V, 240V, 440V, 500V)
Rated controller current	cf. table "Survey of the individual types", p. 10
Auxiliary voltage	230V AC, ter. 8 and 9 (optional: 24V DC, internal voltage supply)
Frequency	45 - 65Hz, self-synchronizing
Input	<ul style="list-style-type: none"> <li>• 0 - 10V</li> <li>• 0 - 20mA</li> <li>• 4 - 20mA</li> <li>• potentiometer input: 2,5 - 10k<math>\Omega</math></li> </ul>
Input impedance	<ul style="list-style-type: none"> <li>• voltage input signal: 1M<math>\Omega</math></li> <li>• current input signal: 500<math>\Omega</math></li> </ul>
Protection system	switch-off because of temperature exceedance, indicated by LED "Fault"
LED-Display	auxiliary voltage, Start, 100% U <sub>Load</sub> , Fault
Softstart time	2 sec.
Outputs	fault condition: ter. 6, 7 closed, load 2A, 230V AC, AC1
Power terminals	<ul style="list-style-type: none"> <li>• L1, L2 (N) input voltage</li> <li>• T1, T2 output voltage</li> </ul>
Kind of controlling	phase angle control (optional: multicycle control (SP))
Power loss	0,9W/A
Operating temperature	0 - 50°C
Storage temperature	-10 - 70°C
Humidity	5 - 95% relative humidity, not condensing
Environment	dry, non-conducting environments
Max. altitude	1000m
Weight	0,8kg
Protection	IP 40
Dimensions (WxHxD)	92x128x105mm
Mounting	proposed to be mounted on a DIN rail (Option: mounting on mounting plate)
CE-regulations	Declaration of Conformity 2014/35/EU (Low voltage directive) EMC Directive 2014/30/EU for industrial environments

Errors and technical modifications excepted (Date: 2016/05)

### Options:

- internal voltage supply (/IV)
- modified auxiliary voltage 24V DC (/24VDC)
- current limitation (/IB)
- output of the power signal (0...100% output power = 0...10V) (/AP)
- kind of protection IP 55 (/IP55)
- kind of protection IP 65 (/IP65)