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Thyristor unit for analogue control

mounted on rail to EN 50 022 or wall-mounted



Brief description

Thyristor units are used in all applications where larger resistive and inductive loads have to be switched, for example in industrial furnaces and in plastics processing. The thyristor unit consists of two thyristors connected in inverse parallel, the isolated heat sink and the control electronics. Thyristor units up to 50A load current can either be snapped onto a 35 mm rail or wall-mounted using a mounting plate. Units from 75A load current can only be wall-mounted. Depending on the settings of the internal switches, the thyristor units operate either in phase-angle mode with adjustable current limiting, or in burst-firing mode. In burst-firing operation, the start of the first half-wave can be partly cut back to permit operation on transformer loads. A subsidiary control, which can be selected as U^2 , P or I^2 , ensures that fluctuations in the supply voltage do not affect the control loop during the process. The control range can be restricted by attenuating the input signal, and a base load can be set using an external potentiometer. An economy circuit can be used on multi-phase loads in burst-firing operation. In phase-angle operation, the phase angle set by the controller is approached slowly, starting from 180 degrees, in order to avoid high inrush currents (soft start). The thyristor units conform to VDE 0160 5.5.1.3 (5/88) and VDE 0106 Part 100 (3/83). The unit has to be grounded in accordance with the requirements of the local power supply authority.

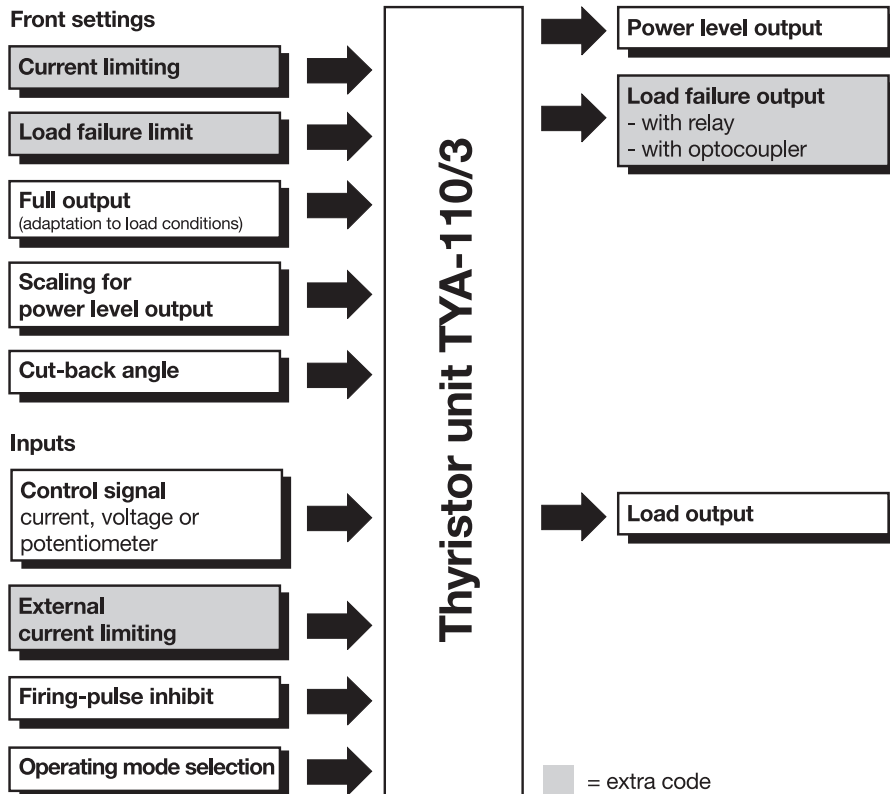


Type TYA-110/3,



Type TYA-110/3, 150...250, ...

Block structure



- input for voltage, current and potentiometer
- input signal can be freely selected
- freely selectable operating mode (phase-angle/burst-firing operation)
- adjustable cut-back of first half-wave in burst-firing operation
- supply voltage monitoring
- input signal attenuation
- soft start in phase-angle operation
- U^2 control with adjustable process value output
- master-slave economy circuit
- firing-pulse inhibit
- recognition of part-load failure for economy circuit

Technical data

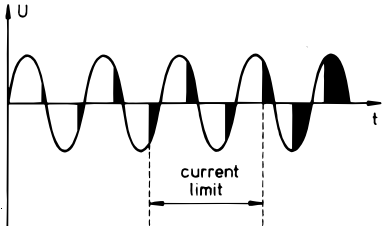
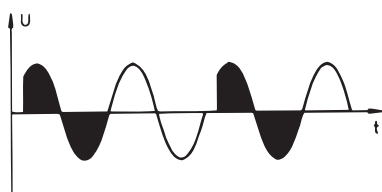
Load circuit

Nominal load voltage	24V -20%/+15% AC 45 – 63Hz 42V -20%/+15% AC 45 – 63Hz 115V -20%/+15% AC 45 – 63Hz 230V -20%/+15% AC 45 – 63Hz 265V -20%/+15% AC 45 – 63Hz 400V -20%/+15% AC 45 – 63Hz 460V -20%/+15% AC 45 – 63Hz 500V -20%/+15% AC 45 – 63Hz (control voltage = nominal load voltage)
Continuous load current I_L	25A, 50A, 75A, 100A, 150A, 250A
Load types	resistive and resistive-inductive loads (B 1.2Tesla max.)
Current limiting	in phase-angle operation, the load current can be set by a trimmer at the front within the range 10 – 100% I_N . The limitation is based on the rms value of the load current.
Fuse	super-fast semiconductor fuse
TSE circuit	RC network as standard
Power loss	$1.3V \times I_{load}$ (A) approx.
Control accuracy	supply voltage fluctuations within the tolerance range (-20%/+15%) are accurately compensated. Fluctuations 0.5% max.

Control

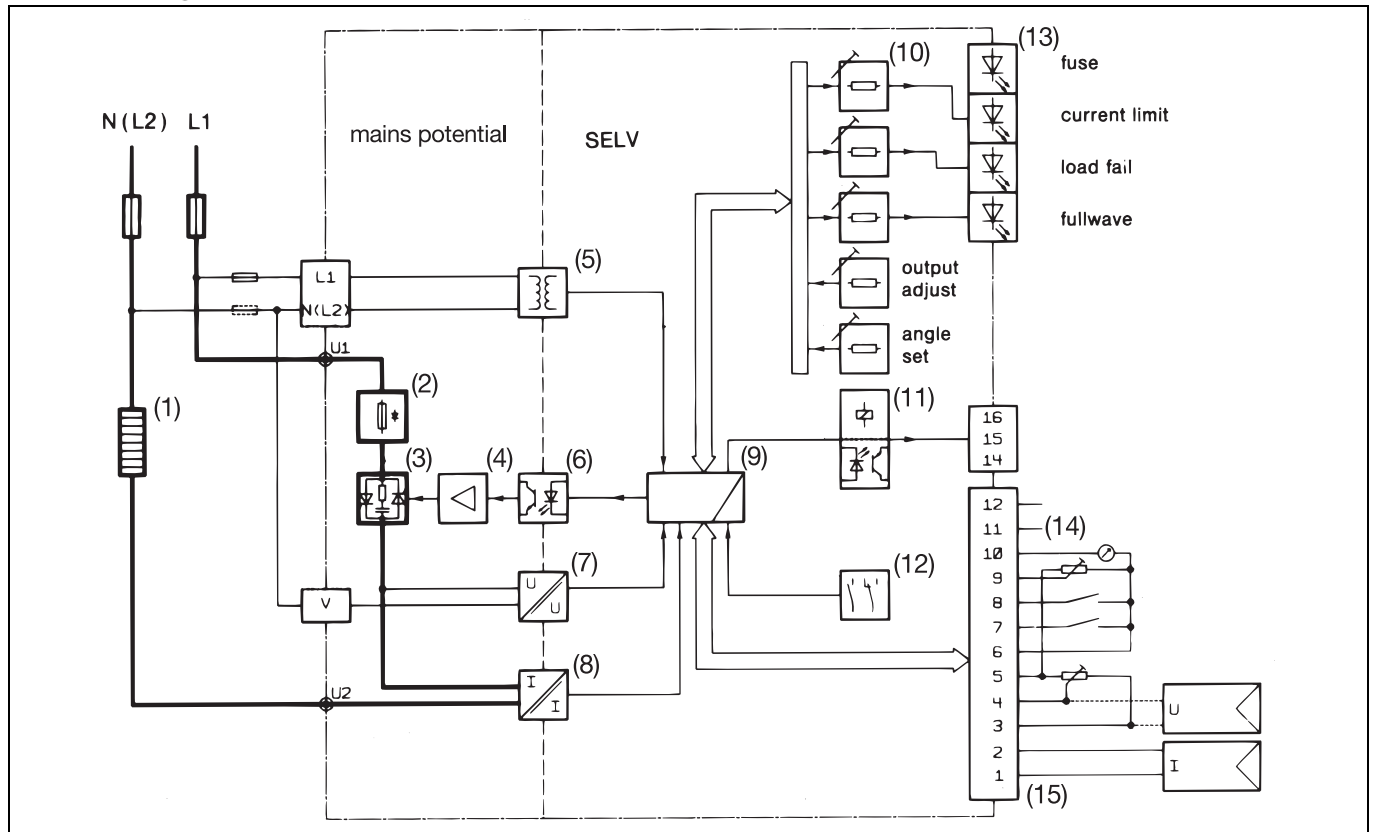
Control signal	0 (4) – 20mA $R_1 = 50 \Omega$ 0 (2) – 10V $R_1 = 25k\Omega$ 0 (1) – 5V $R_1 = 12k\Omega$ 0/10V (0/5V) $R_1 = 12k\Omega$ 0/20mA $R_1 = 50\Omega$ floating contact or manual control from an external 5 k Ω potentiometer
Input signal attenuation	adjustment range 100 – 20%

General data

Circuit variants	<ul style="list-style-type: none"> - single-phase operation - star circuit with accessible star point - open delta circuit - economy circuit with master-slave principle and subsidiary U^2 control in burst-firing operation - free-running economy circuit (star or delta), only with subsidiary P control in burst-firing operation
Operating modes	<ul style="list-style-type: none"> - phase-angle operation for resistive and transformer loads with soft start (with extra code TR, TO with current limiting)  <ul style="list-style-type: none"> - burst-firing operation for resistive or transformer load. 

Features	Two single-phase units can be linked into an economy circuit in burst-firing operation - free-running economy circuit for resistive loads - master-slave economy circuit for resistive and transformer loads
Subsidiary controls	U^2 control as standard. With extra code TR or TO: free choice between U^2 , P, I^2 control via internal switches.
Power level output	U^2 signal as standard. With extra code TR or TO: free choice between U^2 , P, or I^2 signal via internal switches, adjustable 0 – 5V to 0 – 10V. $I_{max} \approx 2\text{mA}$.
Electrical connection	Control wiring by screw terminals for conductor cross-sections 0.2 – 2.5mm ² . Load connections by cable lugs to DIN 46 212.
Protection	IP00 to EN 60 529, grounded heatsink
Permitted ambient temperature range	0 – 45°C Permitted current reduced by 2% for each °C increase in ambient temperature; the maximum permissible ambient temperature must not exceed 60°C.
Permitted storage temperature range	-10 to +70°C
Climatic conditions	rel. humidity 75% max. annual mean, no condensation
Cooling	by natural convection
Operating position	vertical
Operating conditions	The thyristor unit is designed as a built-in unit to: VDE 0160 5.5.1.3 (5/88) VDE 0106 Part 100 (3/83) pollution degree 2 to VDE 0110 Part 1 4.2 (1/89) overvoltage category U III to VDE 0160 5.7 (5/88)
Test voltage	to VDE 0160 Table 4 (5/88)
Creepage distance	control electronics to load circuit 10mm min. control electronics to housing 10mm min. Unit can be connected to SELV circuits. SELV = Separate Extra Low Voltage
Housing	TYA110/3, 25 (50) 110 x 195 x 152mm TYA110/3, 75 (100) 125 x 195 x 170mm TYA110/3, 150 (250) 150 x 220 x 280mm
Weight	TYA110/3, 25 (50) 2.8 kg TYA110/3, 75 (100) 3.7 kg TYA110/3, 150 8.6 kg TYA110/3, 250 9.0 kg
Standard accessories	1 mounting plate for wall-mounting 1 Operating Instructions B 70.9040

Block diagram



Description of the blocks

- (1) load
- (2) super-fast semiconductor fuse
- (3) thyristor module with RC protection circuit
- (4) driver stage for thyristor module
- (5) supply voltage for control electronics
- (6) optocoupler
- (7) voltage transformer
- (8) current transformer
- (9) control electronics
- (10) front trimmers
- (11) fault-report output via relay or optocoupler
- (12) configuration switches
- (13) message LED
- (14) master-slave links
- (15) output control, control inputs, power level output

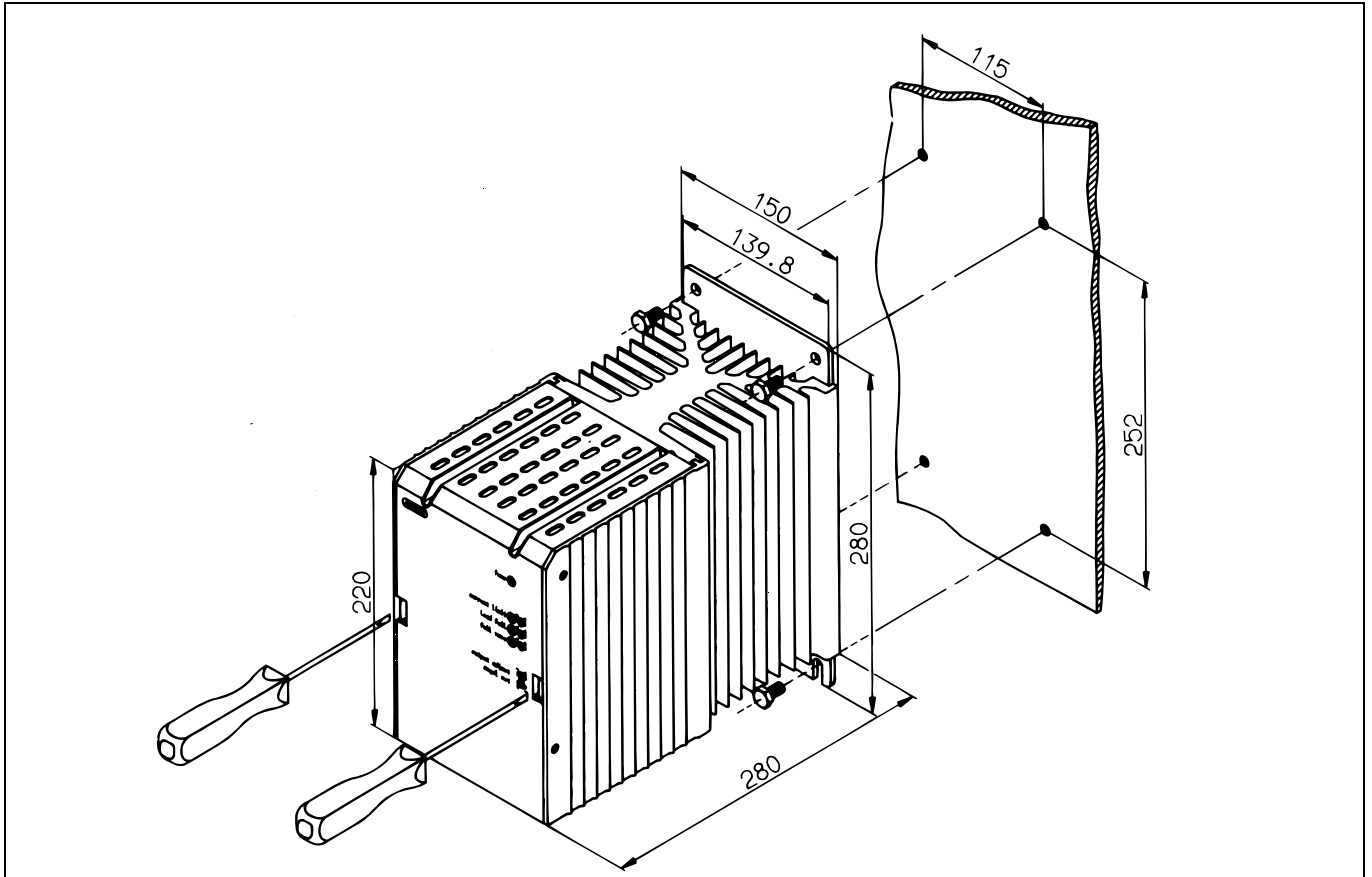
Description of function

From the control electronics (9), the firing pulses for the thyristors (3) pass through an optocoupler (6). The different operating and load types can be set by internal switches (12). Load current and voltage are sensed by the transformers (7) and (8), to provide subsidiary U^2 , I^2 or P control.

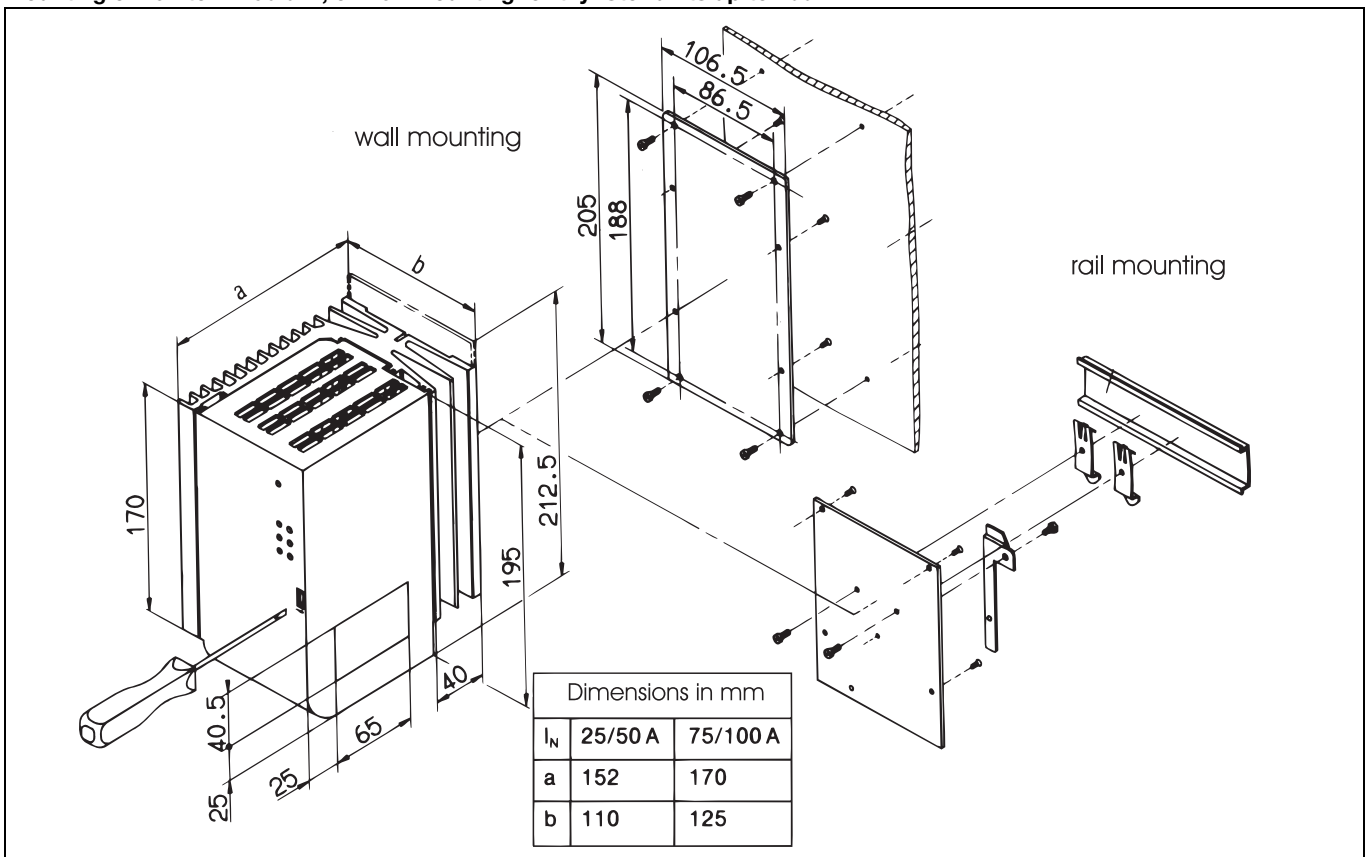
Numerous monitoring functions (10) or (13) and a fault-report output (11) via relay or optocoupler are available. The fault-report output indicates load and part-load failure, as well as a blown fuse. The transformer (5) provides the supply for the control electronics.

Dimensions/mounting

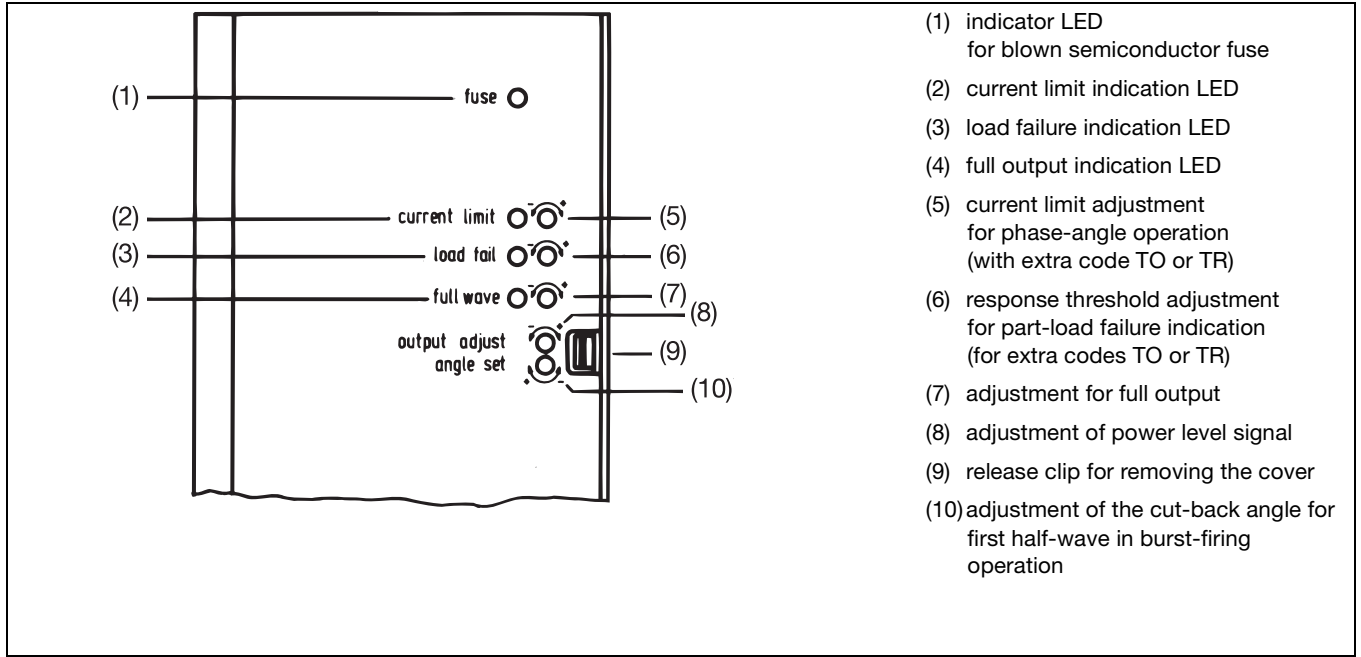
Wall mounting for 150/250-A thyristor unit



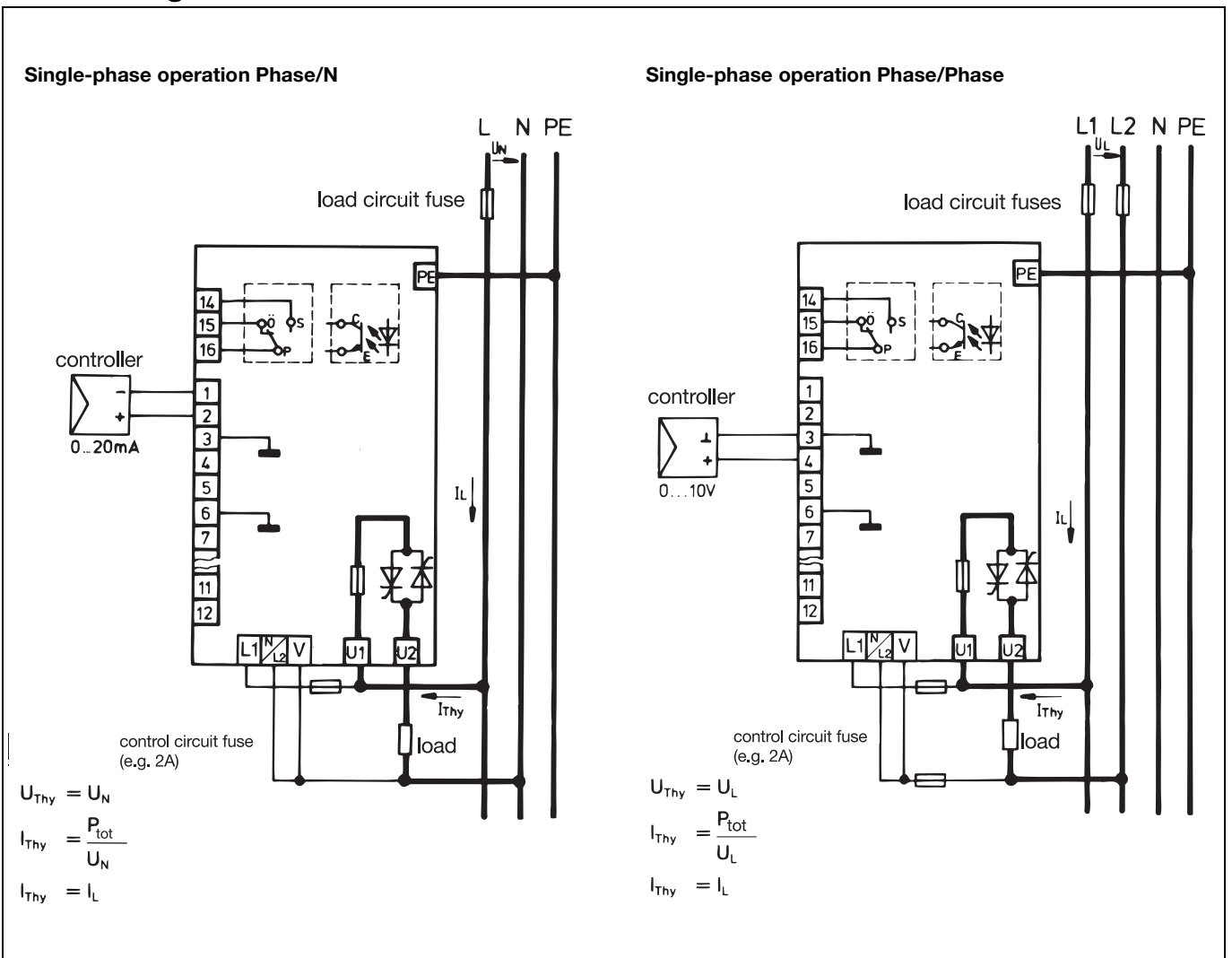
Mounting on rail to EN 50 022, or wall mounting for thyristor units up to 100 A



Front view

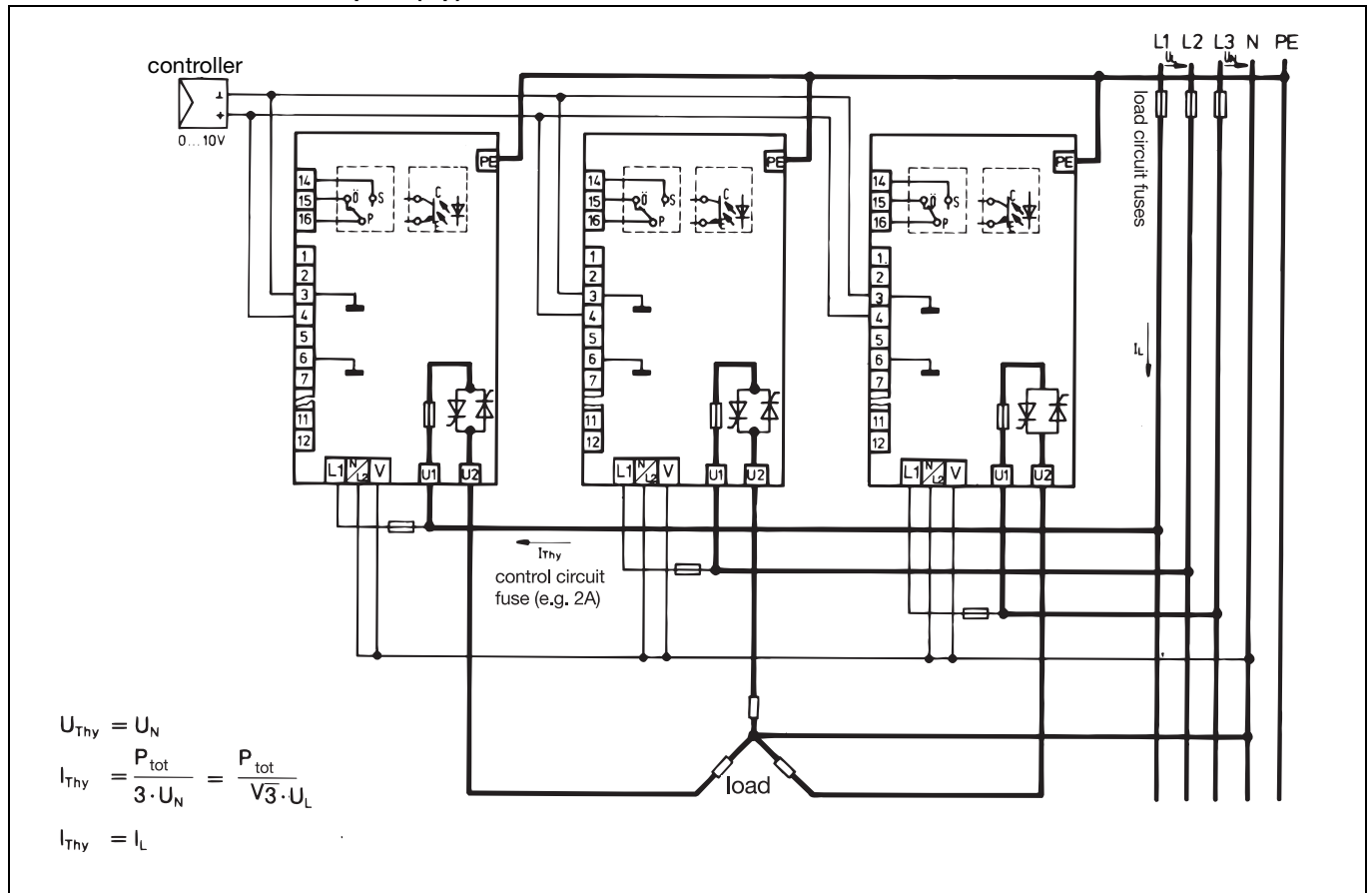


Circuit diagrams

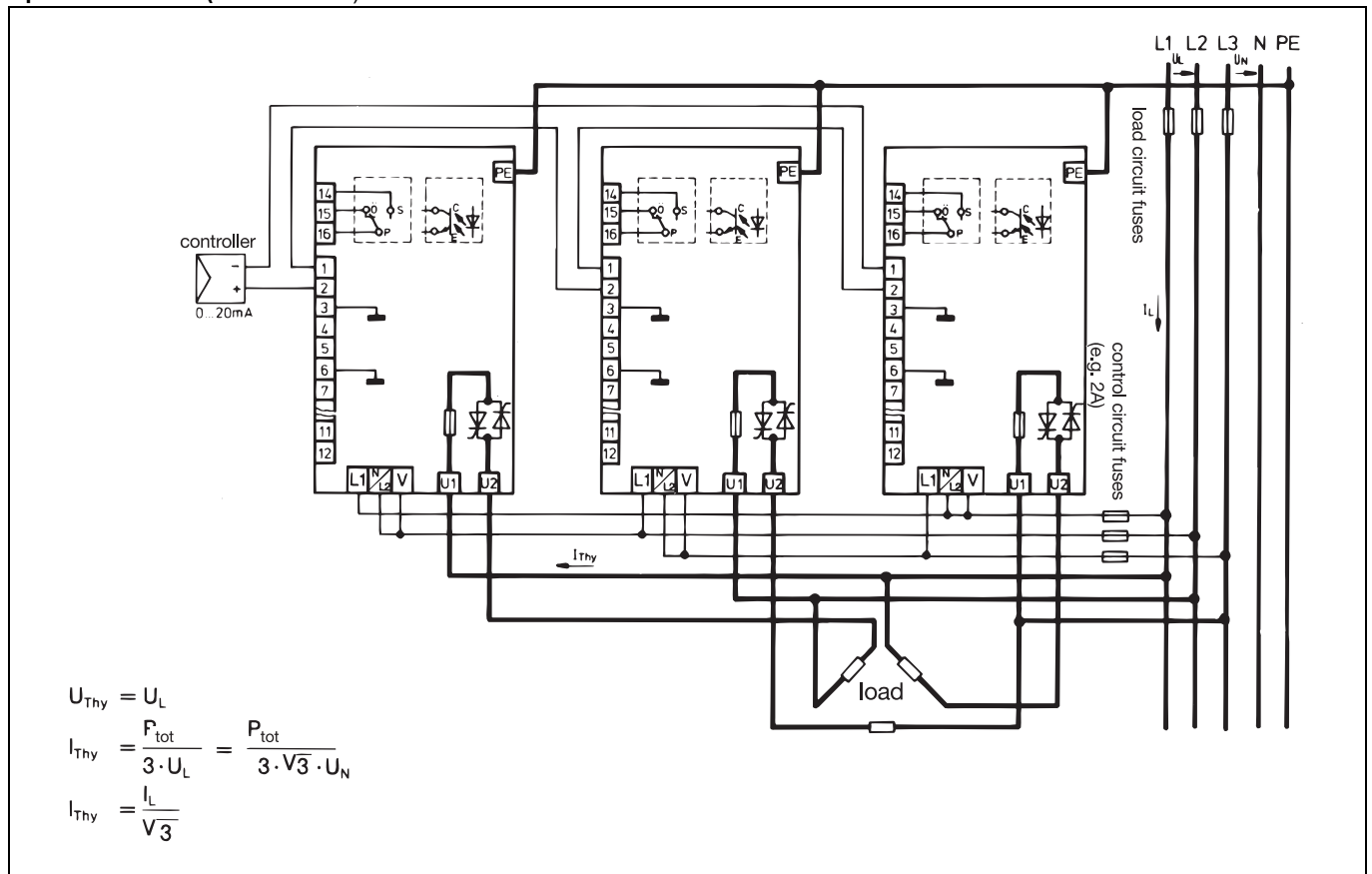


Circuit diagrams

Star circuit with accessible star point (Mp)

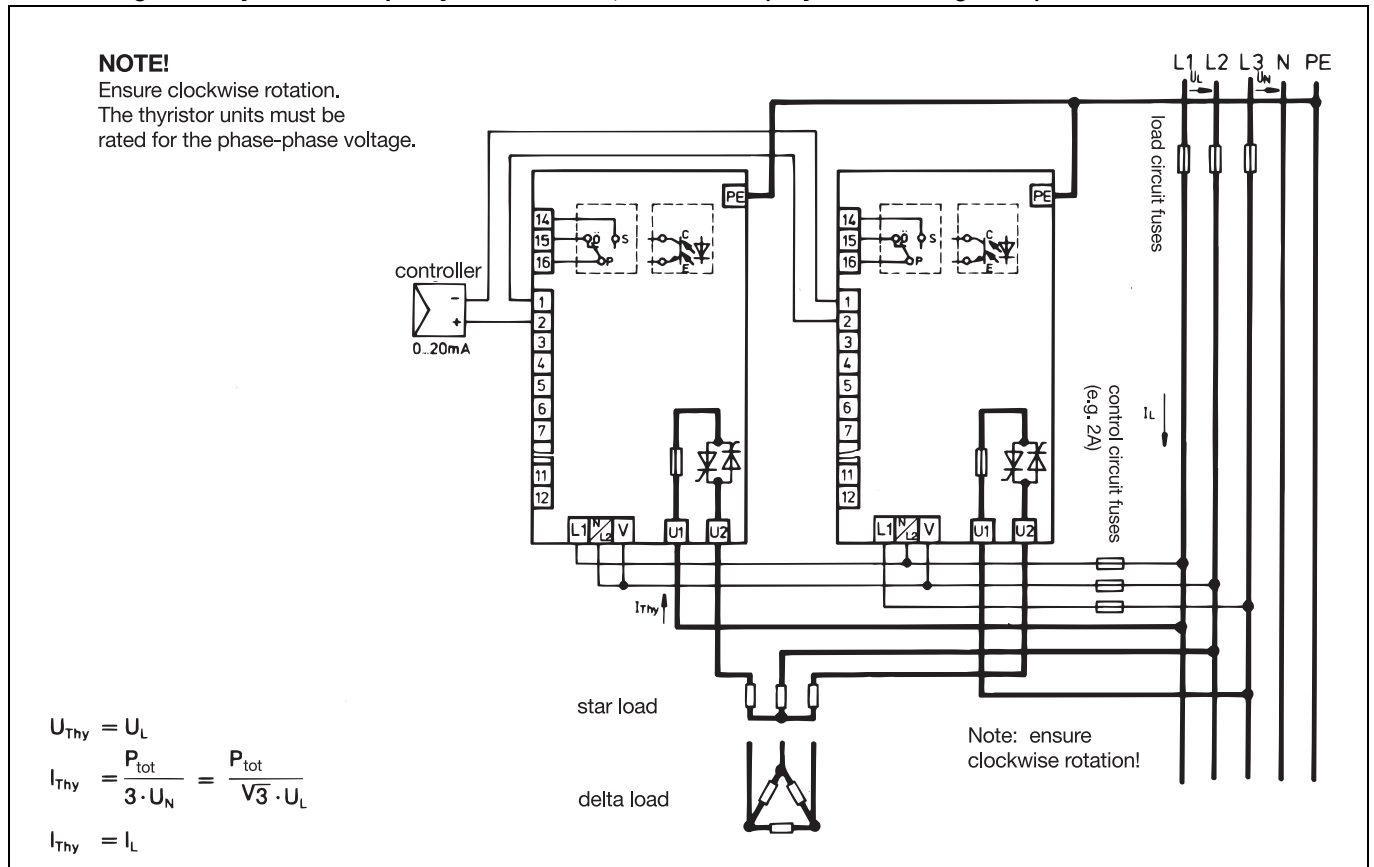


Open delta circuit (6-wire circuit)

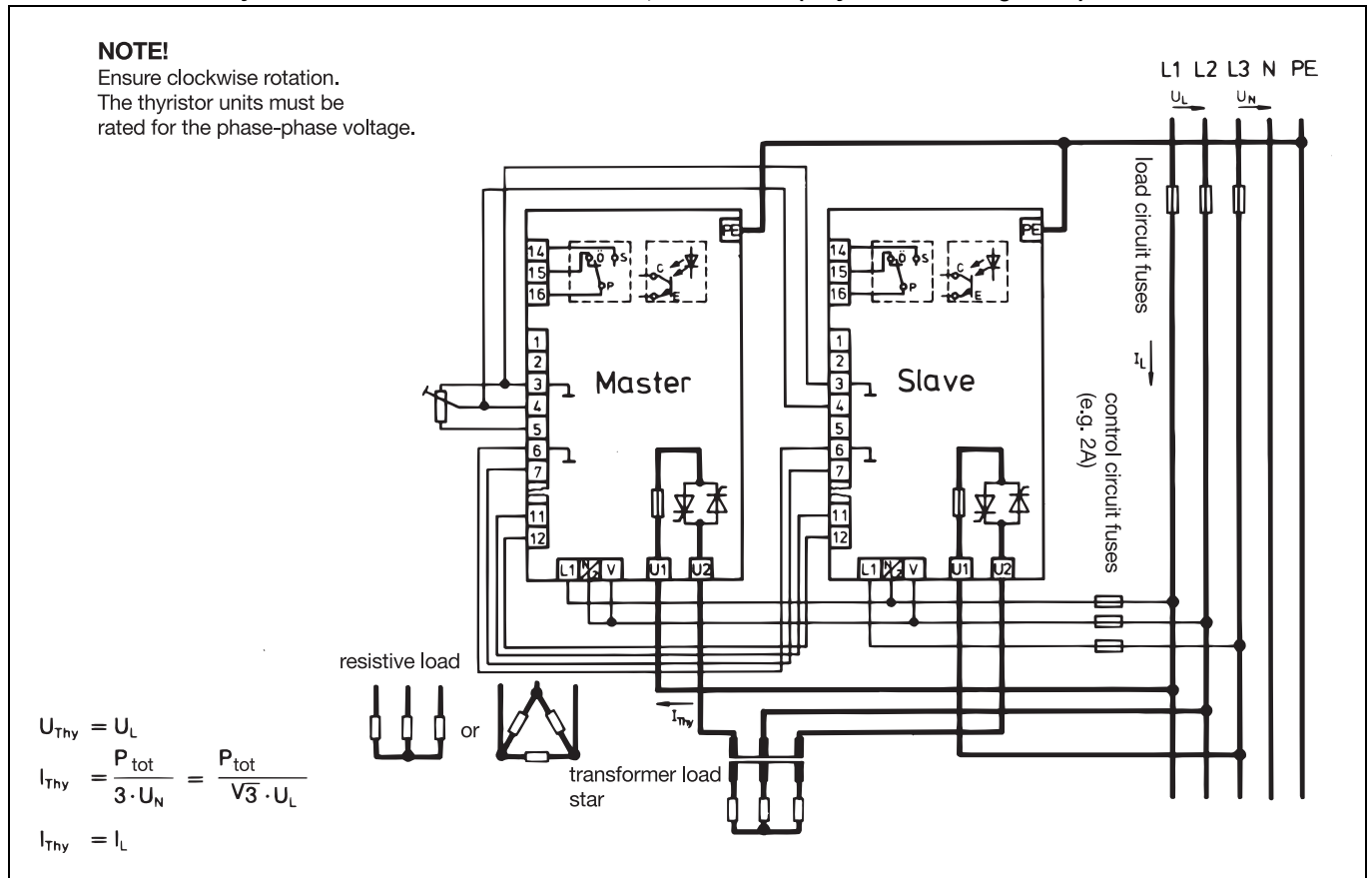


Circuit diagrams

Free-running economy circuit with purely resistive loads, star or delta (only in burst-firing mode)

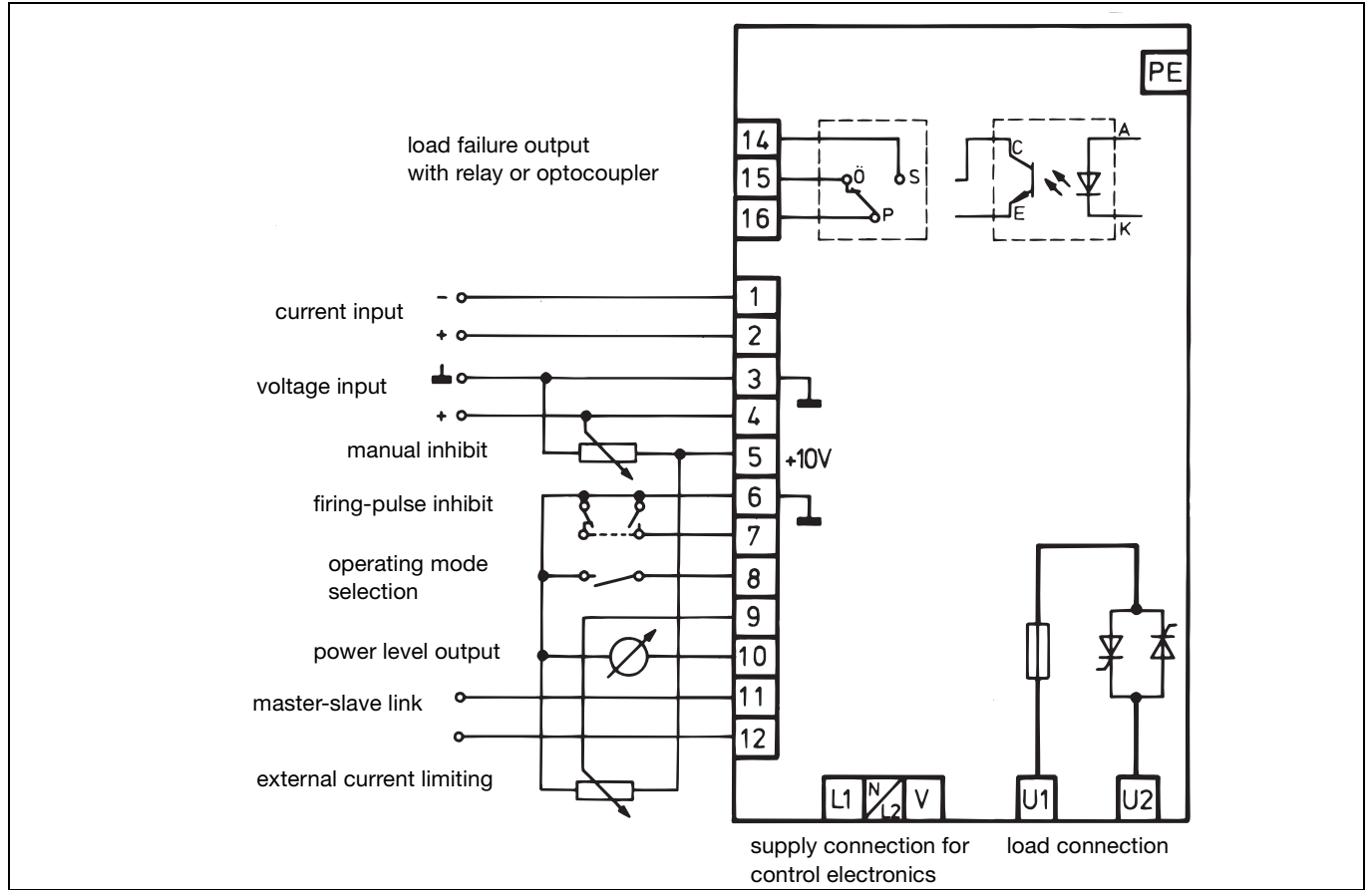


Master-slave economy circuit with resistive-inductive loads, star or delta (only for burst-firing mode)



Circuit diagrams

Connection diagram

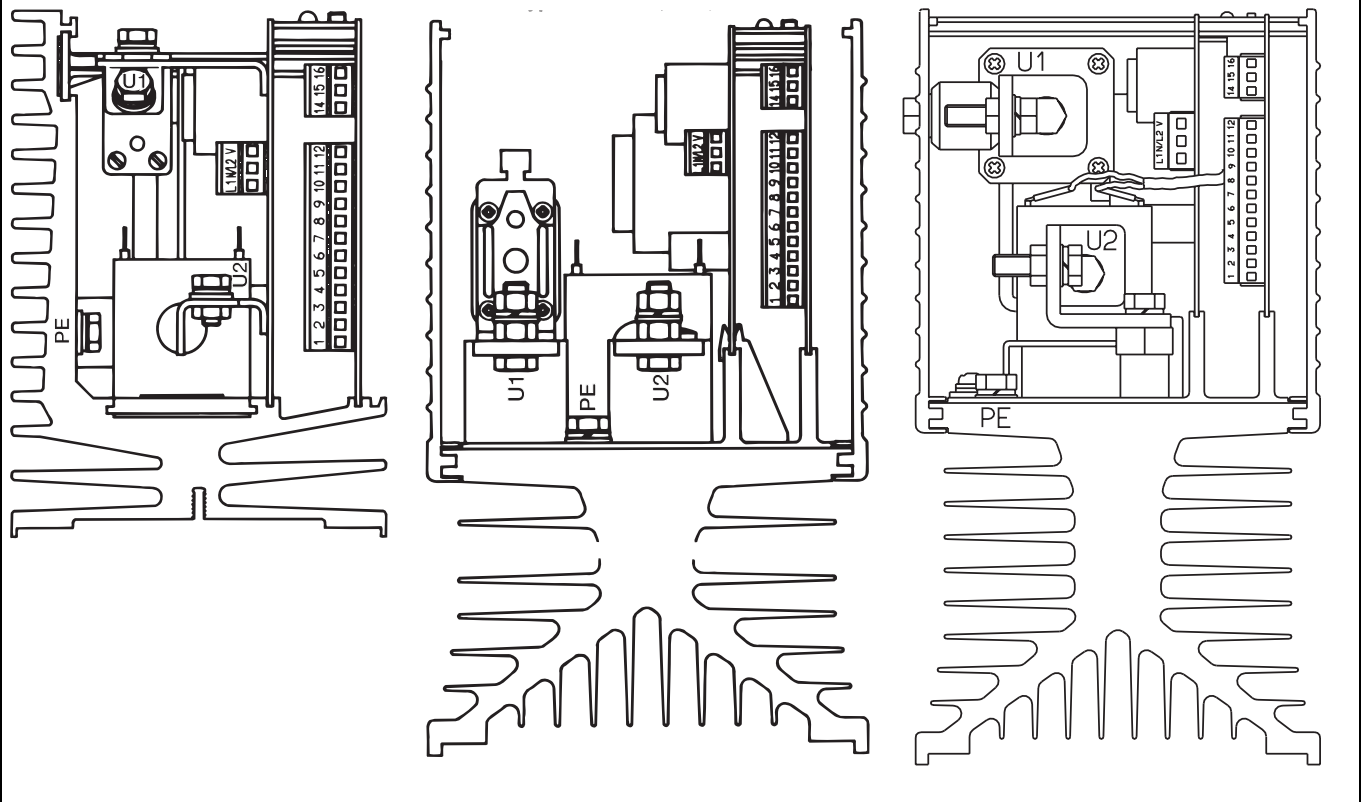


Connection diagrams

Type TYA-110/3, 025 ... 100, ...

Type TYA-110/3, 150, ...

Type TYA-110/3, 250, ...



Connection diagram

Connection for	Terminals	Symbol
Supply for control electronics; link terminal V with N/L2 (except for economy circuit)	L1 N/L2 V	
Load connection	U1 U2	
Current input (differential input)	1- 2+	
Logic input	current signal	
	voltage signal	
	floating contact	
Voltage input (referred to ground)	3⊥ 4+	
External manual adjustment with 5 kΩ potentiometer (via voltage input)	3 start (⊥) 4 slider 5 end (+10V, 2mA)	
Firing-pulse inhibit (inhibit input) $I_K \approx 1 \text{ mA}$ (n.c. or n.o.)	6⊥ 7+	
Load failure output with relay rating 5A 230V AC resistive load relay de-energised on fault	14 n.o. (make) 15 n.c. (break) 16 common	
Load failure output with optocoupler $I_{Cmax.} = 2 \text{ mA}$ $U_{CEO max.} = 32 \text{ V}$	15 collector 16 emitter	
External changeover of operating mode (phase-angle or burst-firing mode)	6⊥ 8+	
Power level output 0 – 10V $I_{max} \approx 2 \text{ mA}$	6⊥ 10+	
Master-slave link for master-slave economy circuit	6⊥ 11 12	
External current limiting with 5 kΩ potentiometer	5 start (+10V, 2mA) 6 end (⊥) 9 slider	

Suitable operating and control modes for different loads

Extra code TR, TO required	Operating mode	Load type			
		constant $R_{warm} = R_{cold}$	positive $R_{warm} > R_{cold}$	negative $R_{warm} < R_{cold}$	long-term ageing
non	phase-angle operation	X	-	-	-
yes	phase-angle operation with current limiting	-	X	X	X
no	burst-firing operation	X	-	-	-
no	burst-firing operation with initial phase-angle cut-back	X	-	-	-
yes	burst-firing operation with initial phase-angle cut-back and current limiting	-	X	X	X
	Control mode				
no	subsidiary U^2 control	X	X	-	-
yes	subsidiary I^2 control	-	-	X	-
yes	subsidiary P control	-	-	-	X

X = suitable - = not suitable

Extra code MS (master-slave circuit)

Type TYA-110/3, 025...100, ..., MS...

Mounting plate thickness: 5mm
Units are wired up.

Type TYA-110/3, 150...250, ..., MS...

Mounting plate thickness: 10mm
Units are wired up.

Ordering details

Type code

TYA-110/3, (1)
..., (2)
... - (3)
.., ...*

* list extra codes in sequence, separated by commas.

(1) Load current	025	= load current	25A
	050	= load current	50A
	075	= load current	75A
	100	= load current	100A
	150	= load current	150A
	250	= load current	250A
(2) Rated load voltage	024	= rated load voltage	24V
	042	= rated load voltage	42V
	115	= rated load voltage	115V
	230	= rated load voltage	230V
	265	= rated load voltage	265V
	400	= rated load voltage	400V
	460	= rated load voltage	460V
(3) Extra codes	TR	= expanded version with indication of part-load break (adjustable by trimmers) and blown fuse via a common relay contact and LED. This version also includes:	
		- current limiting (internal, external)	
		- rated current adjustment at $I \leq I_N/2$	
	- free selection of subsidiary control (U^2 , P or I^2); permits free-running economy circuit with P control		
	- power level output can be switched to U^2 , P or I^2 signal		
	TO	= as TR, but message via optocoupler	
	MS	= master-slave circuit on mounting plate, prepared and ready for connection	

Accessories

Assembly kit for rail mounting at 25A and 50A load current Order No. 70/00067312	
Super-fast semiconductor fuses for protecting thyristors against short-circuits (no line fuses)	
32A for $I_N = 25A$ Order No. 70/00068009	160A for $I_N = 100A$ Order No. 70/00081801
80A for $I_N = 50A$ Order No. 70/00068011	350A for $I_N = 150A$ Order No. 70/00083318
125A for $I_N = 75A$ Order No. 70/00081800	550A for $I_N = 250A$ Order No. 70/00371964