WEST Control Solutions

Datasheet

Relay C

Thyristor power controller

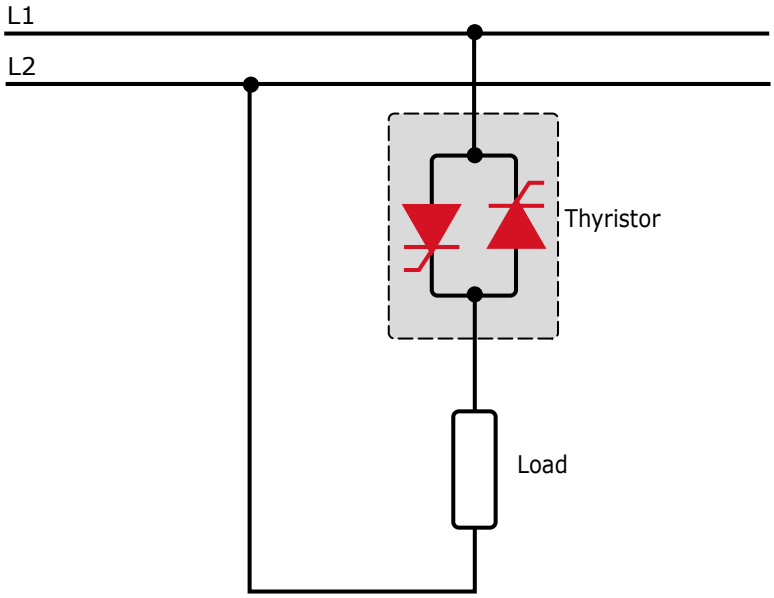
Overview

A thyristor power controller is an electronic device which functions like a switch formed by two anti-parallel thyristors.By applying the control voltage, the thyristor is turned on and the AC supply can flow. After switching off the control signal, the thyristor remains conductive until the next ac voltage zero crossing.The advantages of thyristor actuators over electro-mechanical contactors are:No moving parts, low maintenance, very high switching frequency.

Thyristor controllers are the best solution to control transformers and non-linear loads or heaters that change their resistance with temperature and with age.

Key features

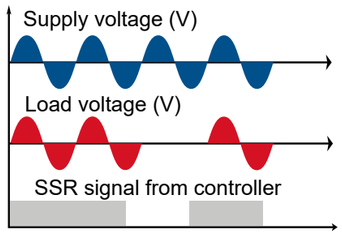
- Load voltage 24 to 690 V
- 30 to 800 A load current per phase
- 1-, 2- or 3-phase version
- Selectable input signals
- Selectable operating modes
- Current limit, heater current monitoring
- Integrated semiconductor fuse
- Data-logger function
- Energy meter
- Fieldbus communication
- OLED display and USB interface for PC configuration



Operating modes and feedback / control

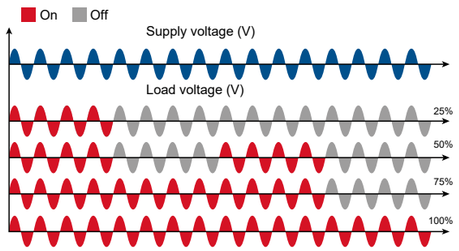
Zero Crossing ZC

In zero cross switching mode, the SSR signal is used by a temperature controller or PLC.The thyristor power controller operates like a switch with the on and off cycles triggered by the controller PLC. The cycle time is specified by the controller/PLC.The zero crossing switching mode minimises noise and interference as the thyristor turns on and off at zero voltage.



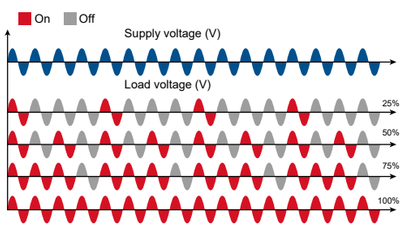
Burst Firing BF

The thyristor switches at the zero crossing point, therefore no disruptive harmonics (interference) are generated.For this operating mode, an analogue input signal (0 ... 10V or.4 - 20 mA) is necessary.The number of complete cycles at 50% power requirement can be chosen from 2 to 255.



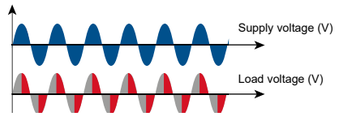
Single cycle operation (Single Cycle SC)

The single cycle mode is the fastest zero point switching mode.This operating mode is controlled by analogue input signals.At 50% power, a full-wave is on then a full-wave off.At 75%, 3 full waves are on and one full wave off.At 76%, the thyristor behaves as it does at 75%, but each time it is turned on, the electronics divide 76/75 and when the sum of the remainder reaches 1, an additional full wave is switched.



Half Cycle HC

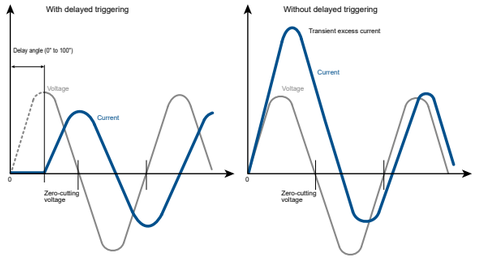
To reduce the power fluctuations on the ignition period, the half cycle mode use the half periods as periods on/off. This is an extremely fast mode for shortwave IR emitters to avoid flickering and harmonics as in phase gating.



Delayed Triggering DT

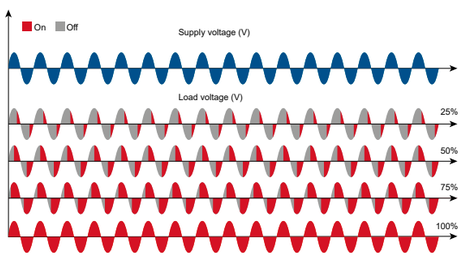
The triggering delay is used to turn a transformer with a secondary, simple resistance load on and off.A delayed turn-on in the first half cycle avoids an inductive surge.The thyristor switching is delayed in the positive half cycle and the packet ends with a negative half wave to avoid transformer saturation.

With delay Without delay



Phase angle PA

PA controls the power to the load by allowing the thyristor to conduct for part of the AC supply cycle only. The more power required, the more the conduction angle is advanced until virtually the whole cycle is conducting for 100% power. The load power can be adjusted from 0 to 100% as a function of the analogue input signal, normally determined by a temperature controller or potentiometer, PA is normally used with inductive loads.



Soft Start

In addition to the above operating modes, a soft start can be selected.During soft start, the operating mode starts with phase angle control.This adjustable ramp runs up to the maximum voltage over a set time and the thyristor then switches to the selected operating mode, e.g. pulse packet.

Feedback and regulation

V2 = Squared
The input signal is proportional to the output square voltage. This means that input signal becomes a power demand. The power remains constant if the load impedance doesn't change.

V = Voltage regulation
The input signal is proportional to the output voltage. This means that the input signal directly controls the voltage at the load. This mode compensates for the voltage fluctuations of the input line.

I = Current regulation
The input signal is proportional to the current output. This means that the input signal directly controls the current of the load.*This mode keeps the power upright even when the load* impedance changes.

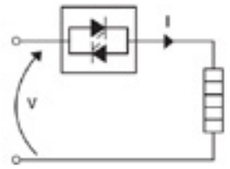
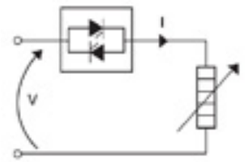
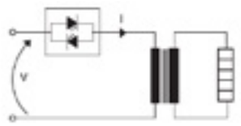
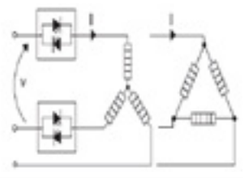
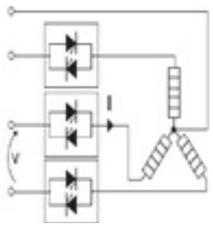
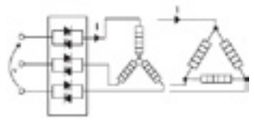
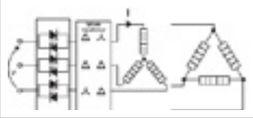
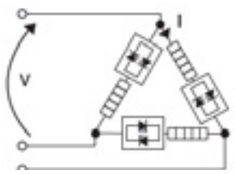
P(VxI) = Power control
The input signal is proportional to the output power. This means that the input signal directly controls the power of the load.The power remains constant even when voltage and load impedance change.This control mode is used with silicon carbide elements that change their resistance with temperature and with age.In addition, the voltage fluctuations of the mains supply are compensated.

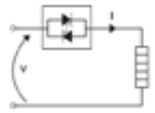
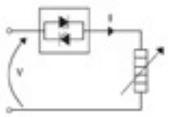
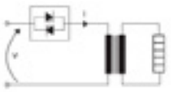
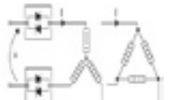
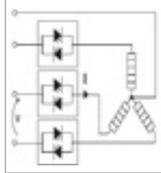
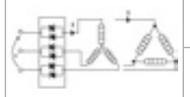
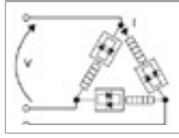
I2 = Squared current control
The input signal is proportional to the squared value of the output current.This type of control is recommended for applications where the load has cold resistance.

None = No regulation – Open Loop.The input is proportional to the firing angle (α).

External = External control (0…10 V, 4…20 mA or 0…20 mA).
The input signal is proportional to an external signal. This means that the input signal specifies the set-point of the power controller.The task of the power controller is to switch the corresponding output signal through and keep it constant.This control mode is used e.g. in galvanic systems where it is necessary to control the current value across the electrodes.

Application overview

	Application	Load type	Comment
Relay C 1PH		Resistance, medium and long wave-length IR emitters	For ohmic loads with low temperature coefficients or no ageing.For low thermal inertia, single cycle or phase gating is used.
		Quartz lamps, shortwave infrared radiators	
		Molybdenum, tungsten, super-kan-thal, platinum	The resistances change strongly with temperature but not with age.The inrush current can be up to 16x the rated current for cold elements (Kanthal-Super).
		Silicone carbide elements	
		Transformer with resistance	Transformers and inductors generate a high inrush current.Phase angle control plus soft start are necessary.To turn the transformer on / off, the trip delay is selected.
		Transformer with temperature dependent resistance (Kantal-Super)	
Relay C 2PH		Resistance	Relay C 2PH can switch three-phase or star-connected resistors without N.
Relay C 3PH		Resistance	For 3 phases and N, all 3 phases must be controlled.
		Silicone carbide elements	For 3-phase silicon carbide elements, power control is recommended.Thus, constant power is ensured because the resistance changes with temperature and time.
		Molybdenum, tungsten, super-Kan-thal, platinum, quartz lamps, short-wave IR emitters	
		Three-phase transformer	Relay 3PH is ideal for using a 3-phase transformer, secondary circuit with normal or special resistors.
Relay C 1PH		Three-phase resistance load - Open delta	
		Three-phase resistance load with temperature-dependent resistors - open triangle	

	Model	Number of de-vices	Controlled phases	Recommended operating mode						Other functions		Dimensions	
				Zero-cross switching	Half cycle	Single cycle	Burst Fire	Delayed Triggering	Phase angle	Current limit	Regulation	V	I
	Relay C 1PH	1	1	●			●					V	$\frac{P}{V}$
	Relay C 1PH	1	1		●	●			●		V²		
	Relay C 1PH	1	1						●	●	I²	V	$\frac{P}{V}$
	Relay C 1PH	1	1						●		V x I		$\frac{P}{V}$
	Relay C 1PH	1	1					●	●	●	V x I	V	$\frac{P}{VcosØ}$
	Relay C 1PH	1	1						●	●	I²		$\frac{P}{VcosØ}$
	Relay C 2PH	1	2				●				V x I	V	$\frac{P}{1.73V}$
	Relay C 3PH	1	3				●				V x I	$\frac{V}{1.73}$	$\frac{P}{1.73V}$
	Relay C 3PH	1	3						●		V x I	V	$\frac{P}{1.73V}$
	Relay C 3PH	1	3						●	●	I²		
	Relay C 3PH	1	3						●	●	I²	V	$\frac{P}{1.73VcosØ}$
	Relay C 1PH	3	3						●	●	I²	V	$\frac{P}{3V}$
	Relay C 1PH	3	3						●	●	I²		$\frac{P}{3V}$

Relay C Function Overview

	Description	Relay C		
	Version:	1-phase	2-phase	3-phase
Load type	Max. voltage 480 V	●	●	●
	Max. voltage 600 V	●	●	●
	Max. voltage 690 V	● from 60A	● from 60A	● from 60A
	Single phase	●		
	3-phase load, star (no neutral) or delta		●	●
	3-phase load, star with neutral			●
	3-phase load, open delta			●
Input signal	SSR 4 - 30V	●	●	●
	4 - 20 mA	●	●	●
	0 - 10 V	●	●	●
	Potentiometer	●	●	●
operating mode	Zero cross switching / with soft start	● / ●	● / -	● / ●
	Single cycle operation / with soft start	● / ●		
	Burst-fire operation / with soft start	● / ●	● / -	● / ●
	Half-cycle operation / with soft start	● / ●		
	Phase angle operation / with soft start	● / ●		● / ●
	Delayed triggering / with soft start	● / ●		● / -
Return	Voltage V	●	●	●
	V2	●	●	●
	Current I	●	●	●
	I2	●	●	●
	Power (V x I)	●	●	●
Options	Current limit	○		○
	Heater current and short circuit monitoring	○	○	○
	Fuse and fuse holder	● ≤ 40A	● ≤ 40A	● ≤ 40A
	Integrated fuse	● > 40A	● > 40A	● > 40A
	Data-logger function	○	○	○
	Energy meter	○	○	○
Communication	OLED display with plain text and keypad	●	●	●
	Configuration PC software + Micro USB	●	●	●
	Modbus RTU	○	○	○
	Modbus RTU + Profibus DP	○	○	○
	Modbus RTU + Profinet	○	○	○
	Modbus RTU + Modbus TCP	○	○	○

● = Standard

○ = Option

Dimensions and weight

Load current	Housing type					
	1-phase		2-phase		3-phase	
	600V max	690 V	600V max	690 V	600V max	690 V
30			SR10		SR11	
35	SR9		SR10		SR11	
40	SR9		SR10		SR11	
60	SR12	S11	SR13	S11	SR14	S11
90	SR15	S11	SR16	S11	SR17	S11
120	SR15	S11	SR16	S13	SR17	S13
150	SR15	S11	SR16	S13	SR17	S13
180	SR15	S11	SR16	S13	SR17	S13
210	SR15	S11	SR16	S13	SR17	S13
300	S12	S12	S14	S14	S14	S14
400	S12	S12	S14	S14	S14	S14
450			S14	S14	S14	S14
500	S12	S12	S14	S14	S14	S14
600	S12	S12	S14	S14	S17	S17
700	S12	S12	S14	S14	S17	S17
800	S15	S15	S16	S16	S17	S17

CE and UL version — Only in CE version

All figures in mm

SR9 H 121 x W 72 x D 185 - 1.15kg.

SR10 H 121 x W 108 x D 185 - 1.76kg.

SR11 H 121 x W 144 x D 185 - 2.4kg.

SR12 H 269 x W 93 x D 170 - 3.4 kg
SR15 H 273 x W 93 x D 170 - 3.6 kg

SR13 H 269 x W 186 x D 170 - 6.8 kg
SR16 H 273 x W 186 x D 170 - 7.0 kg

SR14 H 269 x W 279 x D 170 - 10.2 kg
SR17 H 273 x W 279 x D 170 - 10.6 kg

S11 H 440 x W 137x D 270 - 10.5kg.

S12 H 520 x W 137 x D 270 - 15 kg

S13 / S14 H 440/520 x W 262 x D 270 - 18/22 kg

S15 H 560 x W 137x D 270 - 17.2kg.

S16 H 560 x W 275 x D 270 - 34.4kg.

S17 H 560 x W 411 x D 270 - 51.6kg.

Technical specifications

Single-phase versions

General

Material of cover and base:	V2 Polymer
Mounting:	DIN rail (maximum thickness 1 mm) - only 30 - 40 A version
Utilisation category	AC-51 AC-55b AC-56 A
Protection	IP 20
Load	1-PH Single-phase
Supply voltage for the control electronics, 8 VA max. Order number:RC1 _ _ _- _1 ... mains voltage:100/120 V transformer range 90 to 135 V Order number:RC1 _ _ _- _2 ... mains voltage:200/208/220/230/240 V Transformer range 180 to 265 V Order number:RC1 _ _ _- _3 ... mains voltage:277 V transformer range 238 to 330 V Order number:RC1 _ _ _- _5 ... mains voltage:380/400/415/440/480 V Transformer range 342 to 528 V Order number:RC1 _ _ _- _6 ... mains voltage:600 V transformer range 540 to 759 V Order number:RC1 _ _ _ -_7 ...Mains voltage:690 V Transformer range 540 to 759 V	
Supply voltage fieldbus communication	24VDC, 500mA (serves as a backup in case of power failure or failure)
Relay output for the HB alarm (only with the HB option)	125 VAC 0.5 A

Input

Analogue input V:	0 - 10 VDC Impedance 15 kΩ
Analogue input A:	4 - 20 mA Impedance 100 Ω
Potentiometer	10 kΩ min.
Digital input	4 - 30 VDC 5 mA max. (ON> 4 VDC OFF <1 VDC)

Output

Current	Load voltage range (Ue)	Repeatable peak blocking voltage Uimp:		Holding current	Max. peak current (one cycle)	Leakage current	Fuse I²T recommended value for 500 VAC	Frequency range	Power loss Thyristor + fuse	Isolation voltage (Ui)
(A)	(V)	(480 V)	(600 V)	(MArms)	(10 ms) (A)	(MArms)	tp = 10 ms	(Hz)	I = Inom (W)	(V)
30	24 - 600	1200	1600	250	360	15	525	47 - 70	38	2500
35	24 - 600	1200	1600	250	540	15	1260	47 - 70	44	2500
40	24 - 600	1200	1600	250	700	15	1260	47 - 70	50	2500
60	24 - 600	1200	1600	600	1900	15	10780	47 - 70	102	3000
90	24 - 600	1200	1600	600	1900	15	10780	47 - 70	145	3000
120	24 - 600	1200	1600	600	1900	15	14280	47 - 70	200	3000
150	24 - 600	1200	1600	300	5000	15	17500	47 - 70	205	3000
180	24 - 600	1200	1600	300	5000	15	30800	47 - 70	235	3000
210	24 - 600	1200	1600	300	5000	15	53900	47 - 70	304	3000
300	24 - 600	1200	1600	200	7800	15	73500	47 - 70	443	3000
400	24 - 600	1200	1600	200	7800	15	150500	47 - 70	547	3000
500	24 - 600	1200	1600	1000	17800	15	294000	47 - 70	591	2500
600	24 - 600	1200	1600	1000	17800	15	246400	47 - 70	832	2500
700	24 - 600	1200	1600	1000	17800	15	246400	47 - 70	945	2500
800	24 - 600	1200	1600	1000	15000	15	246400	47 - 70	1144	2500

Fan specification

60 - 210 A:

Supply voltage 230 VAC (default) — Power 16 W (one fan)
Supply voltage 115 VAC (option) — Power 14 W (one fan)
Supply voltage 24 VDC (option) — Power 7 W (one fan)

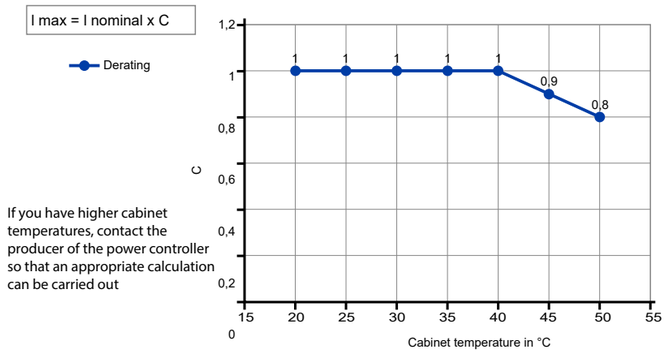
300 - 800 A:

Device type	Number of fans for CE	Number of fans for cULus LISTED
400A, 500A, 600A	One fan 17W	Two fans 34 W (2 x 17 W)
700 A	Two fans 34 W (2 x 17 W)	Two fans 34 W (2 x 17 W)
800 A	Two fans 34 W (2 x 17 W)	Two fans 34 W (2 x 17 W)

Environmental conditions

ambient temperature	0-40 °C (32-104 °F) up to rated current. Observe the derating curve above 40 °C (104 °F).
Storage temperature	-25 °C to 70 °C (-13 °F to 158 °F)
Installation location	Do not install in places where direct sunlight, conductive dust, corrosive gas, vibrations or water are present, or where the environment is saline.
Sea level	All specifications are valid up to 1000 m above sea level. For higher altitudes, the maximum load current is reduced by 2% for each 100 m over 1000 m.
Humidity	5 - 95% relative humidity with no condensation or icing
Pollution degree	Up to pollution degree 2 (IEC 60947-1 6.1.3.2)

Derating curve



If you have higher cabinet temperatures, contact the producer of the power controller so that an appropriate calculation can be carried out

Installation conditions:

All thyristor units have power losses whilst operating. power lossThis leads to heat generated within the control cabinet.For this reason, the internal temperature of the control cabinet will be higher than the ambient temperature.

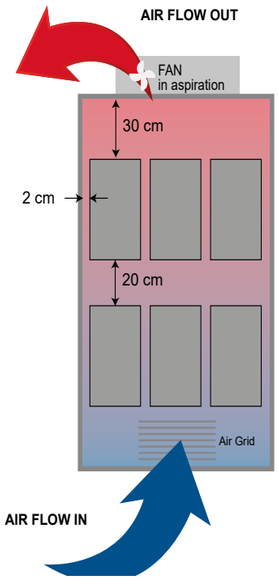
Observe the minimum distances in the vertical and horizontal as shown, this area must be free of obstacles (wire, copper rail, plastic channel).
If several devices are mounted in the cabinet, ensure that the air circulation is uninhibited as shown in the illustration.

It may be necessary to use an additional fan cooling system.
The volume of air flow must at least comply with the calculated values.

$$V = f * \frac{Qv}{tc\text{-}ta}$$

Qv = Total power loss (w)
(Loss at the thyristor and the fuse)
ta = Ambient temperature (°C)
tc = Cabinet temperature (°C)
V = Fan air mass flow (m³/h)
f = Height coefficient (see right column)

Height → (Height coefficient)
0 - 100 metres f = 3.1 m³K/Wh
100 - 250 metres f = 3.2 m³K/Wh
250 - 500 metres f = 3.3 m³K/Wh
500 - 750 metres f = 3.4 m³K/Wh



Wiring instructions

The thyristor controller in some circumstances could be disrupted by interference from other devices or via the mains supply.For this reason, the following precautions should be taken:

- Coils of contactors, relays and other inductive loads must be equipped with a suitable RC filter.
- Use shielded bipolar cables for all input and output signals.
- Signal cables must not be routed near or parallel to the power cables.
- Local regulations for electrical installation must always be followed.

Only use copper cables or copper busbars rated for at least 75 ° C (90 ° C for 30 - 40A), which are for field wiring, line sections (AWG), line terminal type (ZMVV), and torques as shown in the tables

Line power - load cable and load rail dimensions are listed.

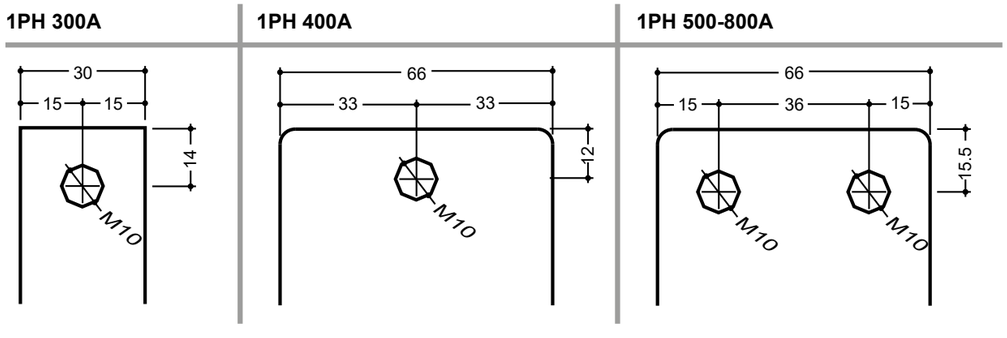
Power connections (recommended)					
Type	Terminal type	Torque	Cable cross section	Max. terminal current	Wire ends UL-listed (ZMVV)
030 035 040	M5 screw	3.0 Nm	1.5 - 10 mm² (AWG 16 - 8)	40 A	Solid/Flexible Fork cable lug

Cable sizes of the control cables:0.5 mm² (AWG 18) **Temperature class** 90°C or higher
Cable sizes for ground connection (recommended):6 mm² (AWG 18) **Temperature class** 75°C or higher

Power connections (recommended)					
Type	Terminal type	Torque	Cable cross section	Max. terminal current	Wire ends UL-listed (ZMVV)
060 090 120	M6 screw	8.0 Nm	16 mm² (AWG 5) 25 mm² (AWG 3) 35 mm² (AWG 2)	150 A	Fork cable lug Copper pipe Crimp connections
150 180 210	M8 screw	16.0 Nm	50 mm² (AWG 0) 70 mm² (AWG 00) 90 mm² (AWG 000)	250 A	

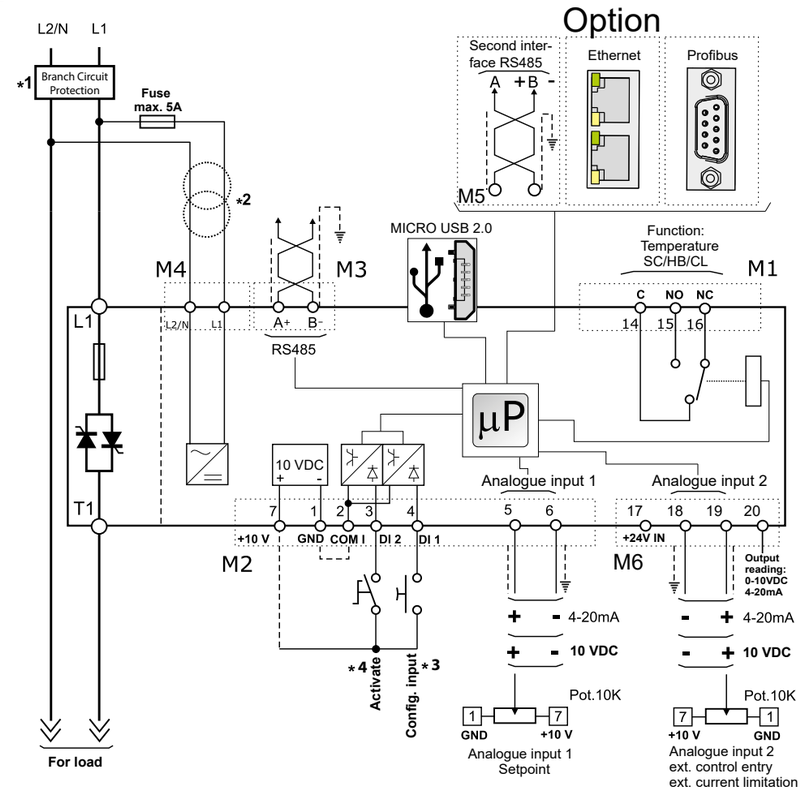
Cable sizes of the control cables:0.5 mm² (AWG 18) **Temperature class** 90°C or higher
Cable sizes for ground connection (recommended):6 mm² (AWG 4) **Temperature class** 75°C or higher

Current	Connection type	Torque (Nm)	Cables			Cable connection	Busbar (mm)
			AWG	mm²	kcmil		
300 A (S14)	Wiring of the power Busbar with an M10 screw	30.0 Nm	2 x 1/0	2 x 70	350	UL-listed (ZMVV) Fork cable lug copper tube crimp connections	30 x 5mm
400 A (S14)			2 x 3/0	2 x 95	600		66 x 4 mm
500 A (S14)			-	2 x 150	2 x 250 900		66 x 6 mm
600 A (S14)			-	2 x 185	2 x 350 1500		66 x 6 mm
700 A (S14)			-	2 x 300	2 x 500		66 x 6 mm
800 A (S16)			-	2 x 300	2 x 500		66 x 6 mm



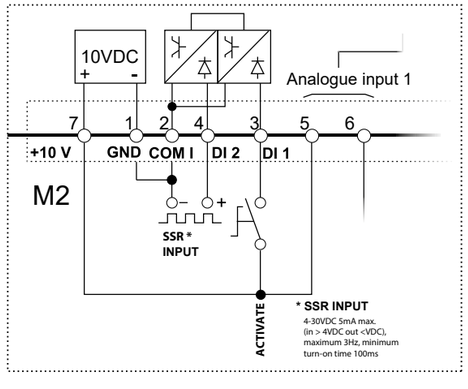
Connection diagram

30 to 40 A

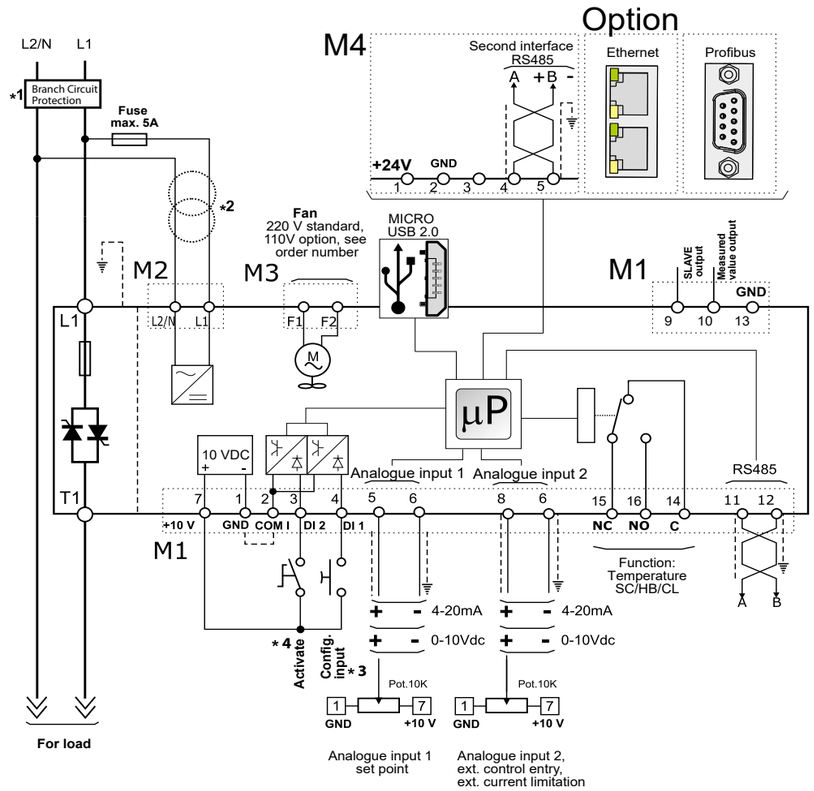


Note:

- * 1 The installation must be protected by a circuit breaker or fuse disconnector.The fuse must be in accordance with "branch circuit protection".For UL, all external fuses are suitable according to the "National Electrical Code" for ohmic loads with 125% load current nominal value to protect the external lines.
- * 2 The power supply for Relay C electronics must be synchronised with the load voltage.The required power supply for the electronics can be gauged from the order number.If this differs from the load voltage, use an external transformer as indicated.
- * 3 For an SSR input, please use this wiring:
- * 4 IMPORTANTStart Strategy (enable)
  1.Switch on the supply voltage (L1-L2-L3)
  2.Switch on the auxiliary power
  3.Close the "Activate" contact to start operation.

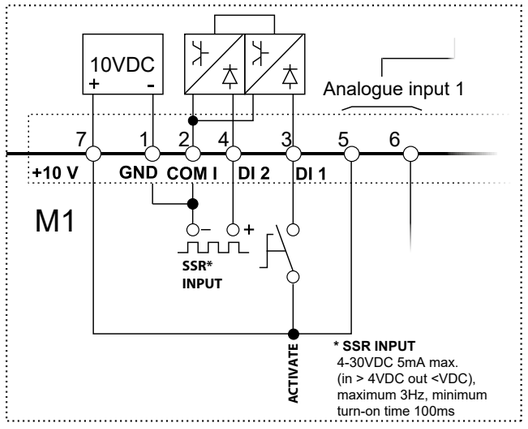


60 to 210 A

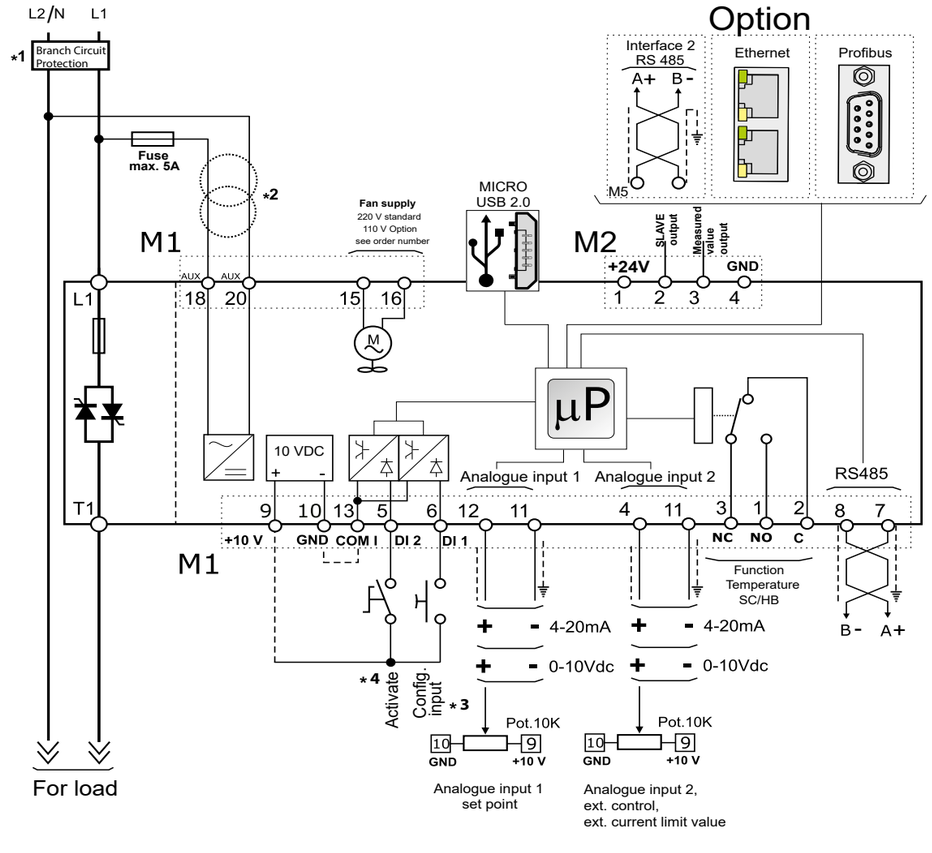


Note:

- * 1 The installation must be protected by a circuit breaker or fuse disconnector.The fuse must be in accordance with "branch circuit protection".For UL, all external fuses are suitable according to the "National Electrical Code" for ohmic loads with 125% load current nominal value to protect the external lines.
- * 2 The power supply for Relay C electronics must be synchronised with the load voltage.The required power supply for the electronics can be gauged from the order number.If this differs from the load voltage, use an external transformer as indicated.
- * 3 For an SSR input, please use this wiring:
- * 4 IMPORTANTStart Strategy (enable)
  1.Switch on the supply voltage (L1-L2-L3)
  2.Switch on the auxiliary power
  3.Close the "Activate" contact to start operation.

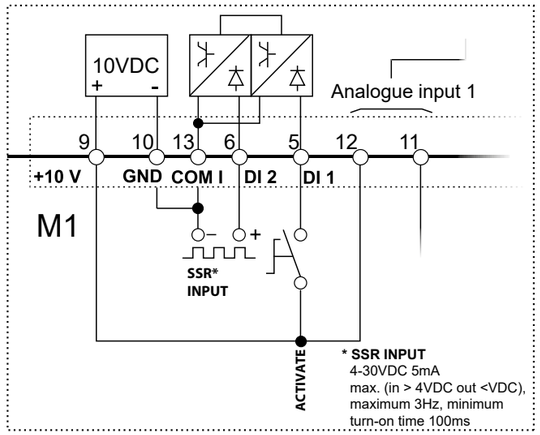


300 to 800 A



Note:

- * 1 The installation must be protected by a circuit breaker or fuse disconnector.The fuse must be in accordance with "branch circuit protection".For UL, all external fuses are suitable according to the "National Electrical Code" for ohmic loads with 125% load current nominal value to protect the external lines.
- * 2 The power supply for Relay C electronics must be synchronised with the load voltage.The required power supply for the electronics can be gauged from the order number.If this differs from the load voltage, use an external transformer as indicated.
- * 3 For an SSR input, please use this wiring:
- * 4 IMPORTANTStart Strategy (enable)
  1.Switch on the supply voltage (L1-L2-L3)
  2.Switch on the auxiliary power
  3.Close the "Activate" contact to start operation.



Two-phase versions

General

30 - 40 A

Material of cover and base:	V2 Polymer
Mounting:	DIN rail (thickness 1 mm max)
Utilisation category	AC-51 AC-55b
Protection	IP 20
Load	Load in delta connection, load in star connection
Supply voltage for the electronics, 10 VA max.	Transformer range 1 = 90 to 135 V (8 VA max.) Transformer range 2 = 180 to 265 V (8 VA max.) Transformer range 1 = 180 to 265 V (8 VA max.) Transformer range 2 = 342 to 528 V (8 VA max.) Transformer range 1 = 238 to 330 V (8 VA max.) Transformer range 2 = 540 to 759 V (8 VA max)
Relay output for the HB alarm (only with the HB option)	125 VAC 0.5 A

From 60 A:

Material of cover and base:	V2 Polymer
Utilisation category	AC-51 AC-55b
Protection	IP 20
Load	Load in delta connection, load in star connection
Supply voltage for the control electronics, 8 VA max. Order number:RC2 _ _ _- _1 ... mains voltage:100/120 V transformer range 90 to 135 V Order number:RC2 _ _ _- _2 ... mains voltage:200/208/220/230/240 V Transformer range 180 to 265 V Order number:RC2 _ _ _- _3 ... mains voltage:277 V Transformer range 180 to 265 V Order number:RC2 _ _ _- _5 ... mains voltage:380/400/415/440/480 V Transformer range 342 to 528 V Order number:RC2 _ _ _- _6 ... mains voltage:600 V Transformer range 238 to 330 V Order number:RC2 _ _ _ -_7 ...Mains voltage:690 V Transformer range 540 to 759 V	
Relay output for the HB alarm (only with the HB option)	125 VAC 0.5 A

Input

Analogue input V:	0 - 10 VDC Impedance 15 kΩ
Analogue input A:	4 - 20 mA Impedance 100 Ω
Potentiometer	10 kΩ min.
Digital input	4 - 30 VDC 5 mA max. (ON> 4 VDC OFF <1 VDC)

Output

Current	Load voltage range (Ue)	Repeatable peak blocking voltage Uimp:		Holding current	Max. peak current (one cycle)	Leakage current	Fuse I²T recommended value for 500 VAC	Frequency range	Power loss Thyristor + fuse	Isolation voltage (Ui)
(A)	(V)	(480 V)	(600 V)	(MArms)	(10 ms) (A)	(MArms)	tp = 10 ms	(Hz)	I = Inom (W)	(V)
30	24 - 600	1200	1600	250	360	15	525	47 - 70	76	2500
35	24 - 600	1200	1600	250	540	15	1260	47 - 70	88	2500
40	24 - 600	1200	1600	250	700	15	1260	47 - 70	100	2500
60	24 - 600	1200	1600	600	1900	15	10780	47 - 70	205	3000
90	24 - 600	1200	1600	600	1900	15	10780	47 - 70	290	3000
120	24 - 600	1200	1600	600	1900	15	14280	47 - 70	398	3000
150	24 - 600	1200	1600	300	5000	15	17500	47 - 70	409	3000
180	24 - 600	1200	1600	300	5000	15	30800	47 - 70	486	3000
210	24 - 600	1200	1600	300	5000	15	53900	47 - 70	598	3000
300	24 - 600	1200	1600	200	7800	15	73500	47 - 70	903	3000
400	24 - 600	1200	1600	200	7800	15	149000	47 - 70	1092	3000
450	24 - 600	1200	1600	200	7800	15	215600	47 - 70	1259	3000
500	24 - 600	1200	1600	200	8000	15	215600	47 - 70	1407	3000
600	24 - 600	1200	1600	1000	17800	15	294000	47 - 70	1528	3000
700	24 - 600	1200	1600	1000	17800	15	294000	47 - 70	1753	3000
800	24 - 600	1200	1600	1000	15000	15	246400	47 - 70	2281	2500

Fan specification

From 90 A:

230 VAC (standard) supply voltage — Power 32 W (16 W for each of the two fans)
115 VAC supply voltage (option) — Power 32 W (16 W for both fans)
24 VDC supply voltage (option) — Power 14 W (7 W for both fans)

Device type	Number of fans for CE	Number of fans for cULus LISTED
300A, 400A, 500A, 600A	Two fans 34 W (2 x 17 W)	Four fans 68 W (4 x 17 W)
450A, 700A	Four fans 68 W (4 x 17 W)	Four fans 68 W (4 x 17 W)
800 A	Four fans 68 W (4 x 17 W)	Four fans 68 W (4 x 17 W)

Environmental and installation conditions, derating curve

See single-phase versions (page 9)

Wiring instructions

The thyristor controller in some circumstances could be disrupted by interference from other devices or via the mains supply.For this reason, the following precautions should be taken:

- Coils of contactors, relays and other inductive loads must be equipped with a suitable RC filter.
- Use shielded bipolar cables for all input and output signals.
- Signal cables must not be routed near or parallel to the power cables.
- Local regulations for electrical installation must always be followed.

Only use copper cables or copper busbars rated for at least 75 ° C (90 ° C for 30 - 40A), which are for field wiring, line sections (AWG), line terminal type (ZMVV), and torques as shown in the tables

Line power - load cable and load rail dimensions are listed.

Power connections (recommended)

Type	Terminal type	Torque	Cable cross section	Max. terminal current	Wire ends UL-listed (ZMVV)
030 035 040	M5 screw	3.0 Nm	1.5 - 10 mm² (AWG 16 - 8)	40 A	Solid/Flexible Fork cable lug

Cable sizes of the control cables:0.5 mm² (AWG 4)
Temperature class 90°C or higher

Cable sizes for ground connection (recommended):6 mm² (AWG 4)
Temperature class 75°C or higher

Power connections (recommended)

Type	Terminal type	Torque	Cable cross section	Max. terminal current	Wire ends UL-listed (ZMVV)
060 090 120	M6 screw	8.0 Nm	16 mm² (AWG 5) 25 mm² (AWG 3) 35 mm² (AWG 2)	150 A	Fork cable lug Copper tube Crimp connections
150 180 210	M8 screw	16.0 Nm	50 mm² (AWG 0) 70 mm² (AWG 00) 90 mm² (AWG 000)	250 A	

Cable sizes of the control cables:0.5 mm² (AWG 18)
Temperature class 90°C or higher

Cable sizes for ground connection (recommended):6 mm² (AWG 18)
Temperature class 75°C or higher

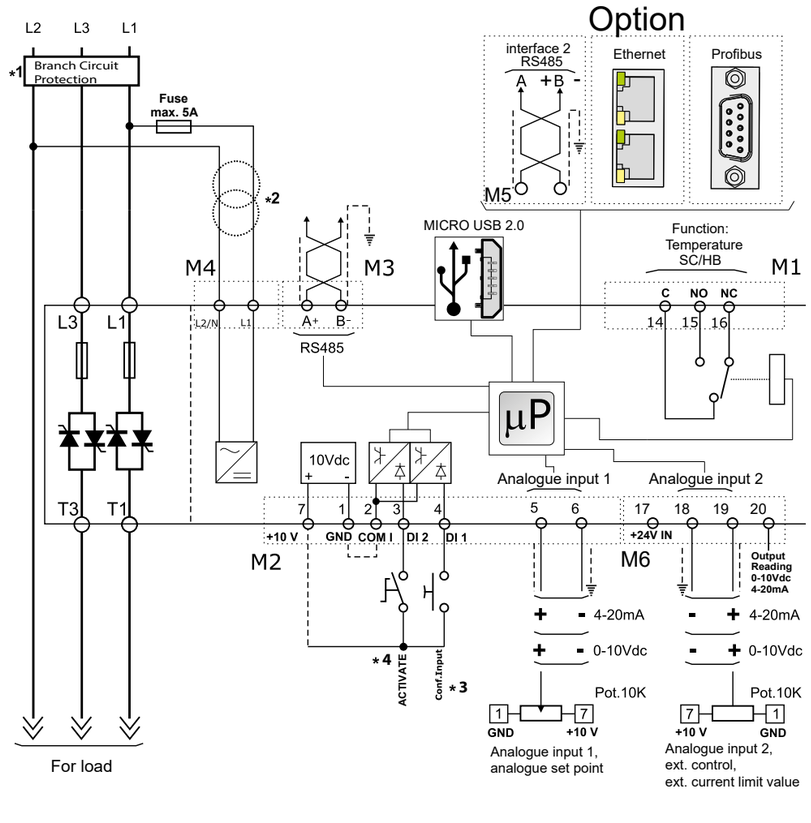
Current	Connection type	Torque (Nm)	Cables			Cable connection	Busbar (mm)
			AWG	mm²	kcmil		
300 A (S14)	Power wiring Busbar with an M10 screw	30.0 Nm	2 x 1/0	2 x 70	350	UL-listed (ZMVV) Fork cable lug Copper pipe Crimp connections	30 x 6 mm
400 A (S14)			2 x 3/0	2 x 95	600		30 x 6 mm
450 A (S14)			2 x 4/0	2 x 95	700		30 x 6 mm
500 A (S14)			-	2 x 150	2 x 250 900		60 x 4 mm
600 A (S14)			-	2 x 185	2 x 350 1500		60 x 5 mm
700 A (S14)			-	2 x 300	2 x 500		60 x 6 mm
800 A (S16)			-	2 x 300	2 x 500		60 x 6 mm

Recommended cable sizes of the control cables and ground connection

Current	Ground			Control lines	
	Cables		Screw	Cables	
	mm²	AWG		mm²	AWG
300 A (S14)	50	1	M8	0.50	18
400 A (S14)	50	1	M8	0.50	18
450 A (S14)	70	1/0	M8	0.50	18
500 A (S14)	70	1/0	M8	0.50	18
600 A (S14)	70	1/0	M8	0.50	18
700 A (S14)	70	1/0	M8	0.50	18
800 A (S16)	70	1/0	M8	0.50	18

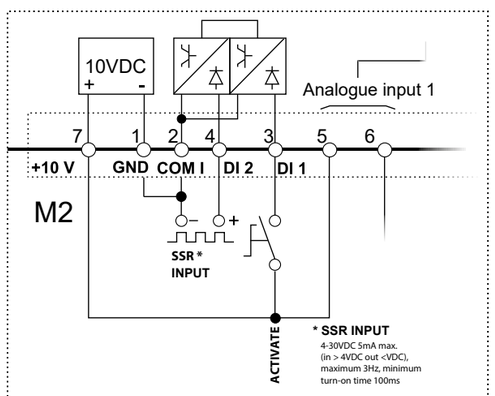
Connection diagram

30 to 40 A

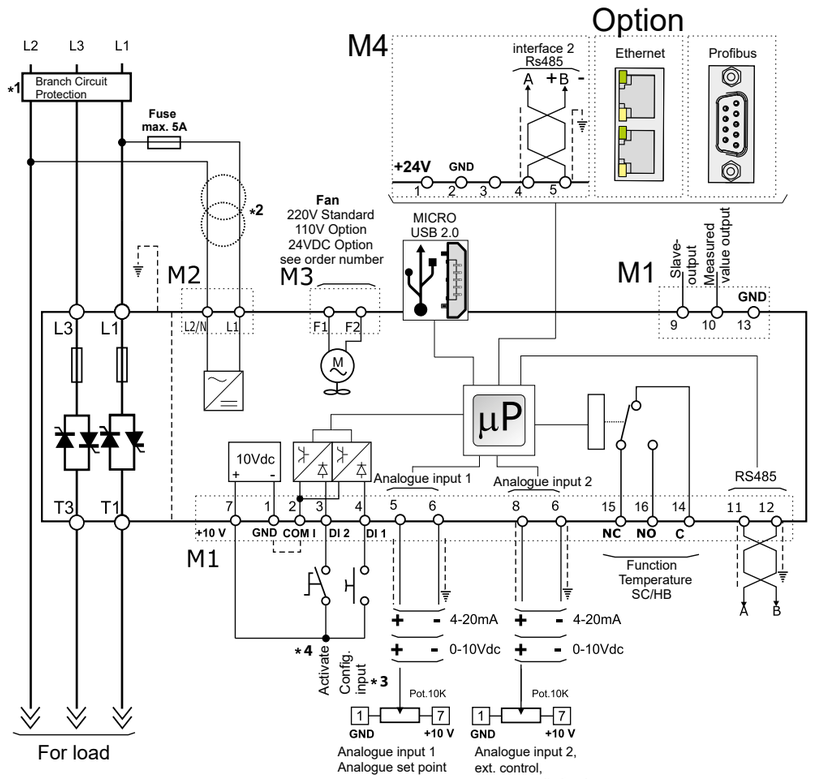


Note:

- * 1 The installation must be protected by a circuit breaker or fuse disconnector.The fuse must be in accordance with "branch circuit protection".For UL, all external fuses are suitable according to the "National Electrical Code" for ohmic loads with 125% load current nominal value to protect the external lines.
- * 2 The power supply for Relay C electronics must be synchronised with the load voltage.The required power supply for the electronics can be gauged from the order number.If this differs from the load voltage, use an external transformer as indicated.
- * 3 For a SSR input, please use the following connection diagram:
- * 4 IMPORTANTStart Strategy (enable)
  1.Switch on the supply voltage (L1-L2-L3)
  2.Switch on the auxiliary power
  3.Close the "Activate" contact to start operation.

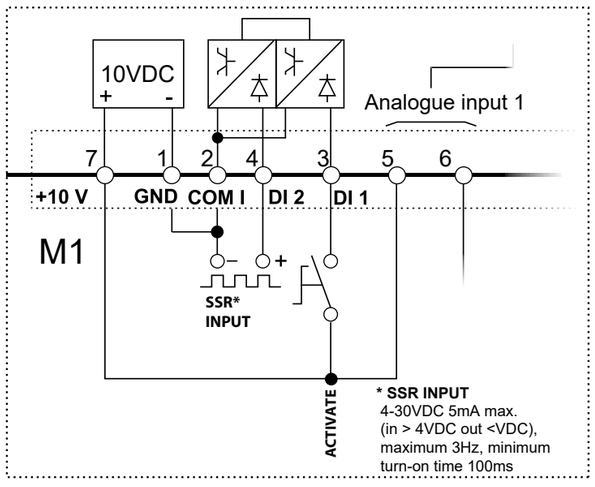


60 to 210 A

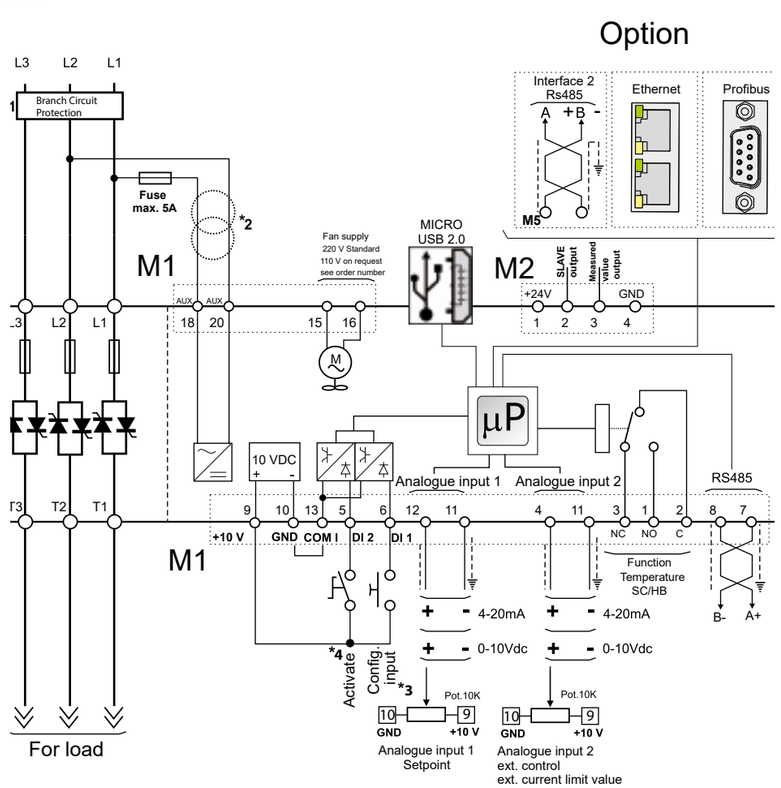


Note:

- * 1 The installation must be protected by a circuit breaker or fuse disconnector.The fuse must be in accordance with "branch circuit protection".For UL, all external fuses are suitable according to the "National Electrical Code" for ohmic loads with 125% load current nominal value to protect the external lines.
- * 2 The power supply for Relay C electronics must be synchronised with the load voltage.The required power supply for the electronics can be gauged from the order number.If this differs from the load voltage, use an external transformer as indicated.
- * 3 For a SSR input, please use the following connection diagram:
- * 4 IMPORTANTStart Strategy (enable)
  1.Switch on the supply voltage (L1-L2-L3)
  2.Switch on the auxiliary power
  3.Close the "Activate" contact to start operation.

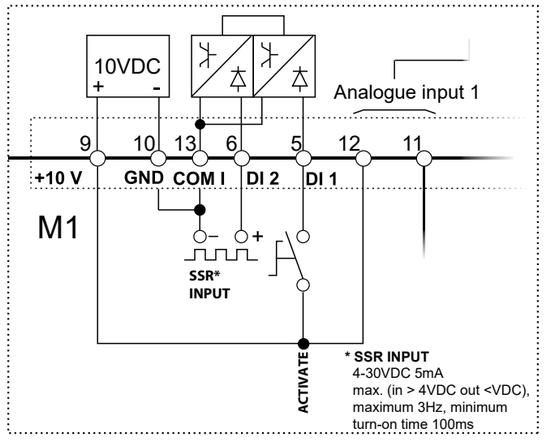


300 to 800 A



Note:

- * 1 The installation must be protected by a circuit breaker or fuse disconnector.The fuse must be in accordance with "branch circuit protection".For UL, all external fuses are suitable according to the "National Electrical Code" for ohmic loads with 125% load current nominal value to protect the external lines.
- * 2 The power supply for Relay C electronics must be synchronised with the load voltage.The required power supply for the electronics can be gauged from the order number.If this differs from the load voltage, use an external transformer as indicated.
- *3 The fuse for phase L2 is not available for the frame size 600-700A.
- * 4 For a SSR input, please use the following connection diagram:
- * 5 IMPORTANT! Start strategy (activate)1.Switch on the supply voltage (L1-L2-L3)
  2.Switch on the auxiliary power
  3.Close the "Activate" contact to start operation.



Three-phase versions

General

30 - 40 A

Material of cover and base:	V2 Polymer
Mounting:	DIN rail (thickness 1 mm max)
Utilisation category	AC-51 AC-55b
Protection	IP 20
Load	Load in delta connection, load in star connection
Supply voltage for the electronics	Transformer range 1 = 90 to 135 V (8 VA max.) Transformer range 2 = 180 to 265 V (8 VA max.) Transformer range 1 = 180 to 265 V (8 VA max.) Transformer range 2 = 342 to 528 V (8 VA max.) Transformer range 1 = 238 to 330 V (8 VA max.) Transformer range 2 = 540 to 759 V (8 VA max)
Relay output for the HB alarm (only with the HB option)	125 VAC 0.5 A

From 60 A:

Material of cover and base:	V2 Polymer
Utilisation category	AC-51 AC-55b
Protection	IP 20
Load	Load in delta connection, load in star connection
Supply voltage for the control electronics, 8 VA max. Order number:RC3 _ _ _- _1 - Mains voltage:100/120 V Transformer range 90 to 135 V Order number:RC3 _ _ _- _2 - Mains voltage:200/208/220/230/240 V Transformer range 180 to 265 V Order number:RC3 _ _ _- _3 - Mains voltage:277 V Transformer range 180 to 265 V Order number:RC3 _ _ _- _5 - Mains voltage:380/400/415/440/480 V Transformer range 342 to 528 V Order number:RC3 _ _ _- _6 - Mains voltage:600 V Transformer range 238 to 330 V Order number:RC3 _ _ _ -_7 -Mains voltage:690 V Transformer range 540 to 759 V	
Relay output for the HB alarm (only with the HB option)	125 VAC 0.5 A

Input

Analogue input V:	0 - 10 VDC Impedance 15 kΩ
Analogue input A:	4 - 20 mA Impedance 100 Ω
Potentiometer	10 kΩ min.
Digital input	4 - 30 VDC 5 mA max. (ON> 4 VDC OFF <1 VDC)

Output

Current	Load voltage range (Ue)	Repeatable peak blocking voltage Uimp:		Holding current	Max. peak current (one cycle)	Leakage current	Fuse I²T recommended value for 500 VAC	Frequency range	Power loss Thyristor + fuse	Isolation voltage (Ui)
(A)	(V)	(480 V)	(600 V)	(MArms)	(10 ms) (A)	(MArms)	tp = 10 ms	(Hz)	I = Inom (W)	(V)
30	24 - 600	1200	1600	250	360	15	525	47 - 70	114	2500
35	24 - 600	1200	1600	250	540	15	1260	47 - 70	135	2500
40	24 - 600	1200	1600	250	700	15	1260	47 - 70	150	2500
60	24 - 600	1200	1600	600	1900	15	10780	47 - 70	290	3000
90	24 - 600	1200	1600	600	1900	15	10780	47 - 70	580	3000
120	24 - 600	1200	1600	600	1900	15	14280	47 - 70	598	3000
150	24 - 600	1200	1600	300	5000	15	17500	47 - 70	594	3000
180	24 - 600	1200	1600	300	5000	15	30800	47 - 70	740	3000
210	24 - 600	1200	1600	300	5000	15	53900	47 - 70	898	3000
300	24 - 600	1200	1600	200	7800	15	73500	47 - 70	903	3000
400	24 - 600	1200	1600	200	7800	15	149000	47 - 70	1092	3000
450	24 - 600	1200	1600	200	7800	15	215600	47 - 70	1259	3000
500	24 - 600	1200	1600	200	8000	15	215600	47 - 70	1407	3000
600	24 - 600	1200	1600	1000	17800	15	294000	47 - 70	1528	3000
700	24 - 600	1200	1600	1000	17800	15	294000	47 - 70	1753	3000
800	24 - 600	1200	1600	1000	15000	15	246400	47 - 70	2281	2500

Fan specification

From 90 A:

230 VAC (standard) supply voltage — 48 W (16 W for each of the three fans) power
115 VAC supply voltage (option) — 42 W (14 W for each of the three fans) power
24 VDC supply voltage (option) — power 21 W (7 W for each of the three fans)

Device type	Number of fans for CE	Number of fans for cULus LISTED
450	Two fans 34 W (2 x 17 W)	Four fans 68 W (4 x 17 W)
300 A, 400 A, 500 A	Four fans 68 W (4 x 17 W)	Four fans 68 W (4 x 17 W)
600 A, 700 A, 800 A	Six fans 102 W (6 x 17 W)	Six fans 102 W (6 x 17 W)

Environmental and installation conditions, derating curve

See single-phase versions (page 9)

Wiring instructions

The thyristor controller in some circumstances could be disrupted by interference from other devices or via the mains supply.For this reason, the following precautions should be taken:

- Coils of contactors, relays and other inductive loads must be equipped with a suitable RC filter.
- Use shielded bipolar cables for all input and output signals.
- Signal cables must not be routed near or parallel to the power cables.
- Local regulations for electrical installation must always be followed.

Only use copper cables or copper busbars rated for at least 75 ° C (90 ° C for 30 - 40A), which are for field wiring, line sections (AWG), line terminal type (ZMVV), and torques as shown in the tables

Line power - load cable and load rail dimensions are listed.

Power connections (recommended)

Type	Terminal type	Torque	Cable cross section	Max. terminal current	Wire ends UL-listed (ZMVV)
030 035 040	M5 screw	3.0 Nm	1.5 - 10 mm² (AWG 16 - 8)	40 A	Solid/Flexible Fork cable lug

Cable sizes of the control cables:0.5 mm² (AWG 4)
Temperature class 90°C or higher

Cable sizes for ground connection (recommended):6 mm² (AWG 4)
Temperature class 75°C or higher

Power connections (recommended)

Type	Terminal type	Torque	Cable cross section	Max. terminal current	Wire ends UL-listed (ZMVV)
060 090 120	M6 screw	8.0 Nm	16 mm² (AWG 5) 25 mm² (AWG 3) 35 mm² (AWG 2)	150 A	Fork cable lug Copper tube Crimp connections
150 180 210	M8 screw	16.0 Nm	50 mm² (AWG 0) 70 mm² (AWG 00) 90 mm² (AWG 000)	250 A	

Cable sizes of the control cables:0.5 mm² (AWG 18)
90°C or higher

Cable sizes for ground connection (recommended):6 mm² (AWG 4)
25 mm² (AWG 4) up to 210 A
Temperature class 75°C or higher

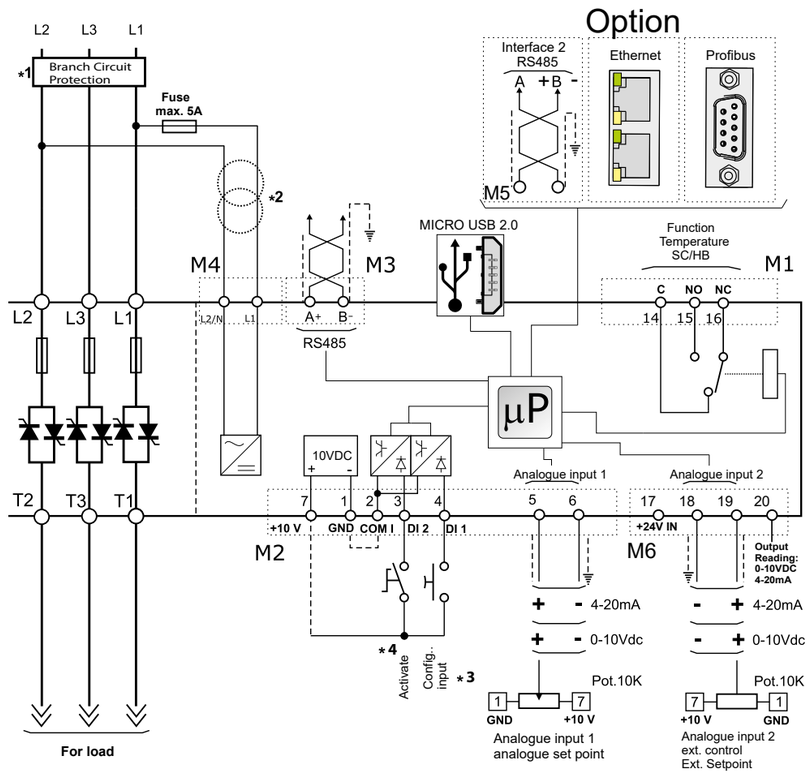
Current	Connection type	Torque (Nm)	Cables			Cable connection	Busbar (mm)
			AWG	mm²	kcmil		
300 A (S14)	Power wiring Busbar with an M10 screw	30.0 Nm	2 x 1/0	2 x 70	350	UL-listed (ZMVV) Fork cable lug Copper pipe Crimp connections	30 x 6 mm
400 A (S14)			2 x 3/0	2 x 95	600		30 x 6 mm
450 A (S14)			2 x 4/0	2 x 95	700		30 x 6 mm
500 A (S14)			-	2 x 150	2 x 250 900		60 x 4 mm
600 A (S14)			-	2 x 185	2 x 350 1500		60 x 5 mm
700 A (S14)			-	2 x 300	2 x 500		60 x 6 mm
800 A (S16)			-	2 x 300	2 x 500		60 x 6 mm

Recommended cable sizes of the control cables and ground connection

Current	Ground			Control lines	
	Cables		Screw	Cables	
	mm²	AWG		mm²	AWG
300 A (S14)	50	1	M8	0.50	18
400 A (S14)	50	1	M8	0.50	18
450 A (S14)	70	1/0	M8	0.50	18
500 A (S14)	70	1/0	M8	0.50	18
600 A (S14)	70	1/0	M8	0.50	18
700 A (S14)	70	1/0	M8	0.50	18
800 A (S16)	70	1/0	M8	0.50	18

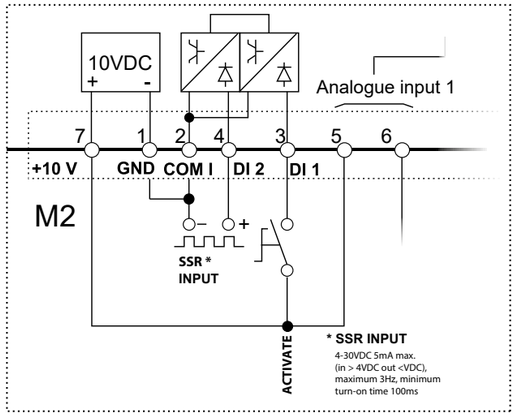
Connection diagram

30 to 40 A

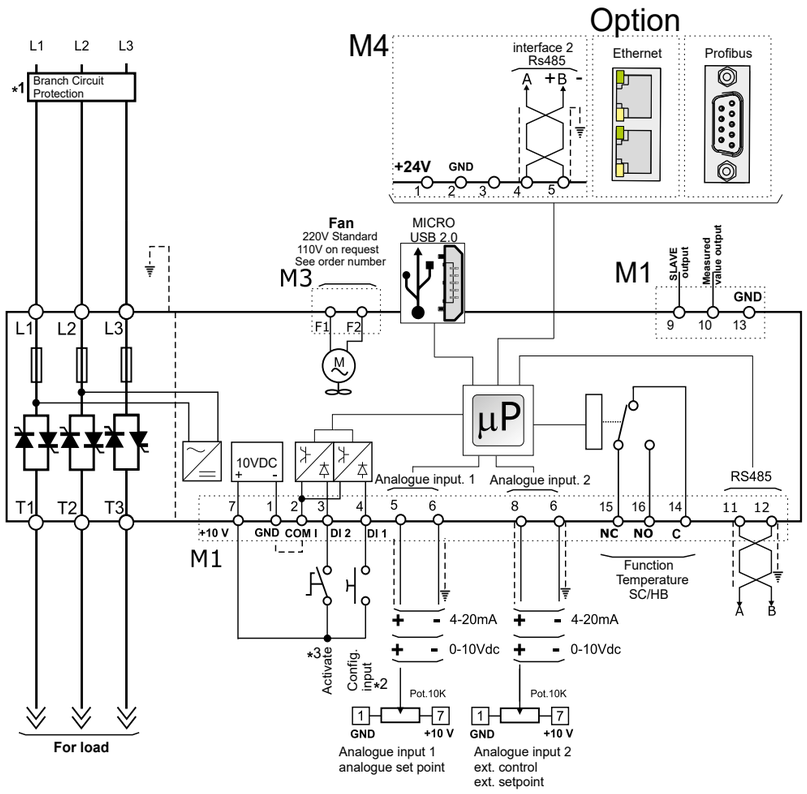


Note:

- * 1 The installation must be protected by a circuit breaker or fuse disconnector.The fuse must be in accordance with "branch circuit protection".For UL, all external fuses are suitable according to the "National Electrical Code" for ohmic loads with 125% load current nominal value to protect the external lines.
- * 2 The power supply for Relay C electronics must be synchronised with the load voltage.The required power supply for the electronics can be gauged from the order number.If this differs from the load voltage, use an external transformer as indicated.
- * 3 For an SSR-input, please use the following wiring diagram:
- * 4 IMPORTANTStart Strategy (enable)
  1.Switch on the supply voltage (L1-L2-L3)
  2.Switch on the auxiliary power
  3.Close the "Activate" contact to start operation.



60 to 210 A



Note:

- * 1 The installation must be protected by a circuit breaker or fuse disconnector.The fuse must be in accordance with "branch circuit protection".For UL, all external fuses are suitable according to the "National Electrical Code" for ohmic loads with 125% load current nominal value to protect the external lines.
- * 2 For an SSR-input please use the following circuit diagram:
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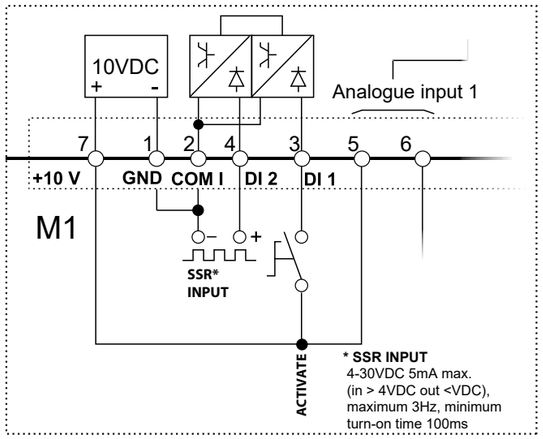
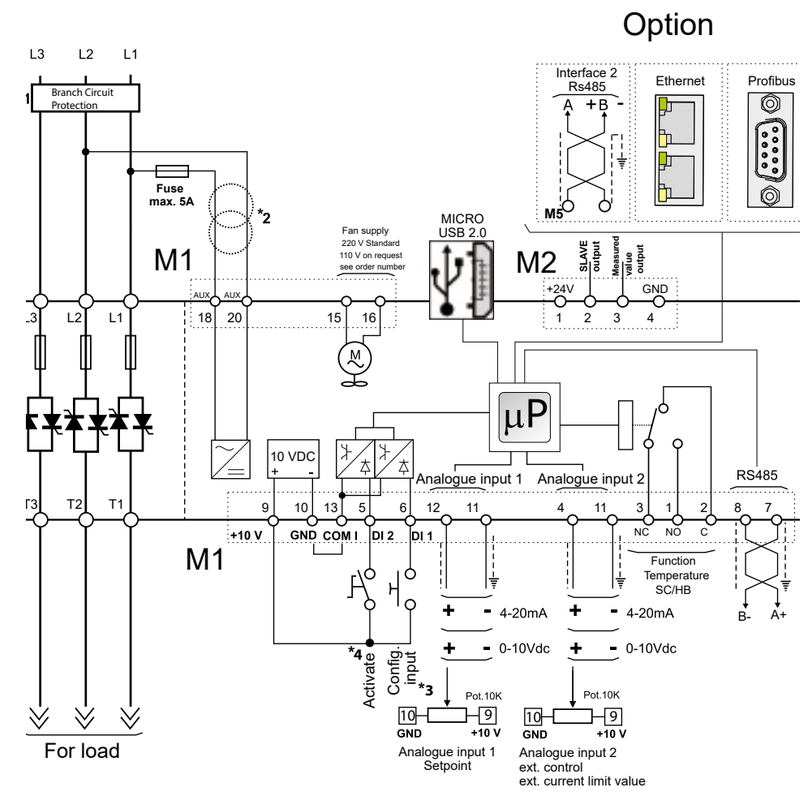
  3.Close the "Activate" contact to start operation.

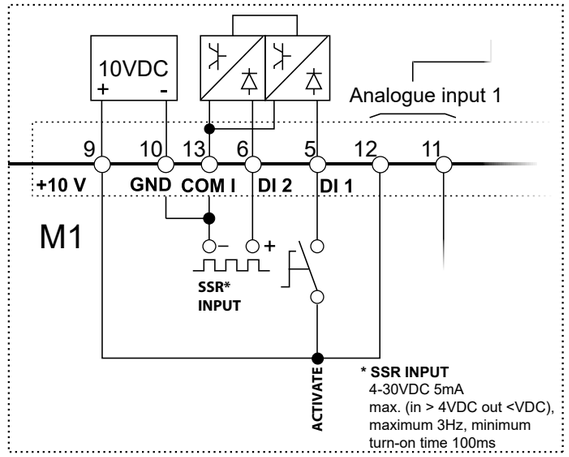


300 to 800 A



Note:

- * 1 The installation must be protected by a circuit breaker or fuse disconnector.The fuse must be in accordance with "branch circuit protection".For UL, all external fuses are suitable according to the "National Electrical Code" for ohmic loads with 125% load current nominal value to protect the external lines.
- * 2 The power supply for Relay C electronics must be synchronised with the load voltage.The required power supply for the electronics can be gauged from the order number.If this differs from the load voltage, use an external transformer as indicated.
- * 3 For an SSR-input, please use the following wiring diagram:
- * 4 IMPORTANTStart Strategy (enable)
  1.Switch on the supply voltage (L1-L2-L3)
  2.Switch on the auxiliary power
  3.Close the "Activate" contact to start operation.



Order information

Fan
- 0 Without a fan up to and including 75 A
- 1 110 V fan from 90 A
- 2 220 V fan from 90 A (standard version)

Supply voltage for electronics
- 1 90 - 135 VAC (100/120 VAC)
- 2 180 - 265 VAC (200/208/230/240 VAC)
- 3 238 - 330 VAC (277 VAC)
- 5 342 - 528 VAC (380/415/480 VAC)
- 6 540 - 759 VAC (600 VAC)
- 7 540 - 759 VAC (690 VAC)

Max. load current
- 030 30 A (1)
- 035 35 A (1)
- 040 40 A (1)
- 060 60 A (1)
- 075 75 A (1)
- 090 90 A
- 120 120 A
- 150 150 A
- 180 180A
- 210 210A
- 300 300A
- 400 400A
- 450 450A (1)
- 500 500A
- 600 600A
- 700 700A
- 800 800A (1)

Control mode
- 0 No control
- U Voltage regulation
- Q Voltage control U²
- I Current control
- A Current regulation I²
- W Power control

Default for load type
- 0 Normal resistance (5)
- 1 Infrared - short-wave (6)
- 2 MoSi2 heating element (7)
- 3 SiC heating element (1)
- 4 Transformer connected with normal resistance(2)(3)
- 5 Transformer connected to MoSi2 heating element (2)(3)
- 6 Transformer connected to SiC heating element(2)(3)
- 7 Transformer connected to UV lamp(2)(3)

RC1	090	4	1	V	D	0	0	0	0	2	1

Model
- 1 1-phase
- 2 2-phase
- 3 3-phase

Max. load voltage
- 4 480V
- 6 600V
- 7 690V

Input signal
- S SSR
- B 0 - 20 mA
- A 4 - 20 mA
- V 0 - 10 V
- K 10kΩ Pot

Operating mode
- C Single-cycle operation without soft start (2) (3)
- S Single-cycle linear soft start (2) (3)
- H Half-cycle operation without soft start (2) (3)
- L Half cycle linear soft start (2) (3)
- I Half-cycle soft start for infrared heaters (2) (3)
- B Burst-fire mode without a soft start
- J Burst-fire mode linear soft start (2)
- P Phase angle control without a soft start (2) (4)
- E Phase angle control linear soft start (2) (4)
- D Delayed trigger without a soft start (2) (4)
- T Delayed trigger linear softstart(2) (3)
- Z Zero cross switching without a soft start
- R Zero cross switching linear soft start (2)

Options
- 0 No options
- 1 Energy meter
- 2 Datalogger
- 3 Datalogger + energy meter
- 8 Heater current alarm
- 9 Heater current alarm + energy meter
- A Heater current alarm + datalogger
- B Heater current alarm + datalogger + energy meter
- G Current limit (2)
- H Current limit + energy meter (2)
- I Current limit + datalogger (2)
- J Current limit + datalogger + energy meter (2)
- O Current limit + heater current alarm(2)
- P Current limit + heater current alarm + energy meter (2)
- Q Current limitation + heater current alarm + datalogger (2)
- R Current limit + heater current alarm + datalogger + energy meter (2)

Approvals
- 0 CE
- L cUL + CE

Communication 1.+ #2 interface and measured value output
- 0 No. 1 Modbus RTU - no retransmission output
- 1 No. 1 Modbus RTU - retransmission output 4 - 20 mA
- 2 No. 1 Modbus RTU - retransmission output 0 - 10 V
- 3 No. 2 Modbus RTU - no retransmission output
- 4 No. 2 Modbus RTU - retransmission output 4 - 20 mA
- 5 No. 2 Modbus RTU - retransmission output 0 - 10 V
- 6 No. 1 Modbus RTU - No. 2 Profibus DP - no retransmission output
- 7 No. 1 Modbus RTU - No. 2 Profibus DP - retransmission output 4 - 20 mA
- 8 No. 1 Modbus RTU - No. 2 Profibus DP - retransmission output 0 - 10 V
- 9 No. 1 Modbus RTU - No. 2 Profinet - no retransmission output
- A No. 1 Modbus RTU - No. 2 Profinet - retransmission output 4 - 20 mA
- B No. 1 Modbus RTU - No. 2 Profinet - retransmission output 0 - 10 V
- C No. 1 Modbus RTU - No. 2 Modbus TCP - no retransmission output
- D No. 1 Modbus RTU - No. 2 Modbus TCP - retransmission output 4 - 20 mA
- E No. 1 Modbus RTU - No. 2 Modbus TCP - retransmission output 0 - 10 V

(1) Not available in all combinations
(2) Not relay-C 2-phase
(3) Not relay-C 3-phase
(4) Not relay-C 3-phase 30 A, 35 A and 40 A
(5) At 2-, 3-phase load in star connection
(6) For 2-, 3-phase load in star or delta connection
(7) At 2-, 3-phase load in delta connection

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