

INSTALLATION AND OPERATION MANUAL



code **85383A** / Edition **02 - 12/04**

GENERAL PRESENTATION

The "WATTCOR W312" thyristor power controllers are designed to control:

- standard resistive loads with a low temperature coefficient
- short-wave infrared heaters
- inductive loads, transformer primaries

They can be used in the following cases:

- **Single-phase:** connection of the load and the unit between 2 phases or between one phase and Neutral.
- **Three-phase:** use of three W312, open delta or star with neutral connected.

This model is designed on the basis of a common architecture, whose dimensions are defined by the eight different current load specifications for an ambient temperature of 50°C.

The power circuit has been designed to operate under a wide range of voltage. The working voltage can vary from a minimum of 24Vac to a maximum of 660Vac (Max. range 20....725Vac).

The phase angle firing device ensures accurate control of the power and fast switching.

A logic input can be used to inhibit the power output, where necessary, notwithstanding the presence of the command signal.

The LED indicators on the front indicate:

- the presence of the electronics auxiliary supply voltage;
- the conduction status of the unit.

The operating principle is phase angle firing:

The load power control is performed by slicing the individual half-waves.

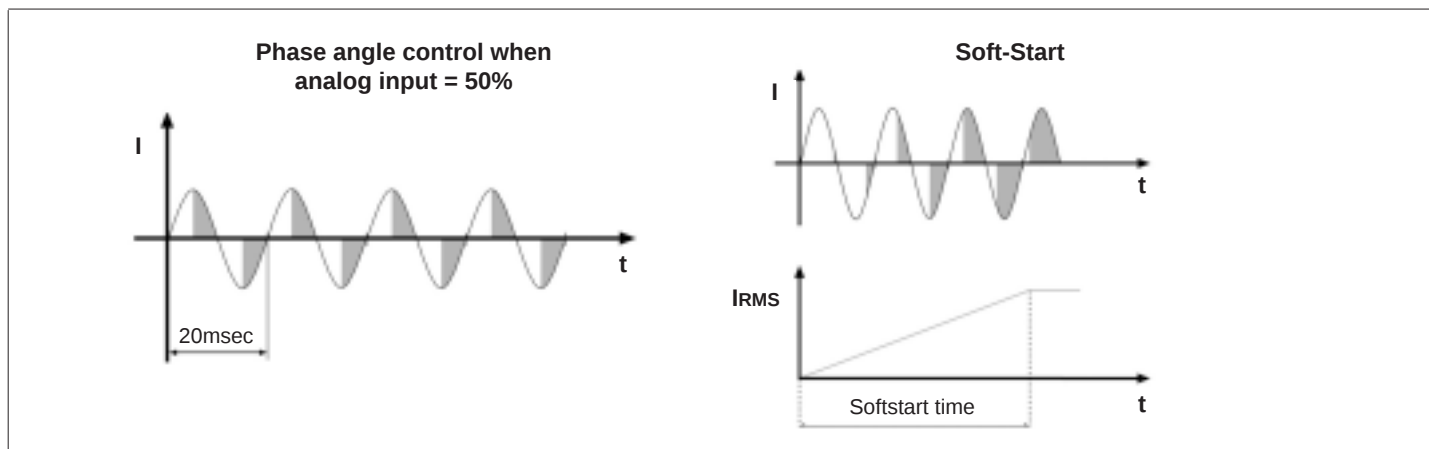
The conduction angle varies in proportion to the analog control signal so that power can be adjusted from 0 to 100%.

The voltage control signal (0...5V or 0...10V) or current control signal (0/4...20mA) is normally supplied by a temperature controller or directly from a potentiometer (manual control). A soft start function is also available.

In this case the conduction angle varies from zero up to the value corresponding to the control input in a set time.

This function is indispensable with resistive loads having low resistance when cold (tungsten, molybdenum disilicide, kanthal super).

A voltage of 5 Vdc is available to supply an external potentiometer for the manual control of the instrument.



ORDER CODE

MODEL	
	W312

NOMINAL CURRENT	
25Aac	25
40Aac	40
75Aac	75
100Aac	100
150Aac **	150

NOMINAL VOLTAGE	
660Vac	660

AUXILIARY SUPPLY	
2	230Vac. 50Hz (•)
3	400Vac. 50Hz (•)

INPUT TYPE	
2	0-10 Vdc standard *

** With cooling fan
(nominal voltage 230Vac)

(•) 60Hz on request

- * analog input type selectable by dip switches:
- 0-5Vdc and potentiometer
 - 0-10Vdc (standard)
 - 0-20mA
 - 4-20mA

Kindly contact GEFRA for information on available codes.

ELECTRICAL CABINET - COOLING

The power controllers must be assembled in a closed cabinet, protected from dust, humidity and any corrosive factors. The ambient temperature of the cabinet must not exceed 50°C.

Each WATTCOR dissipates a power approximately defined by the equation:

$$W = 1.2 \times I$$

W = dissipated power in Watts

I = current in Amperes controlled by the power controller

The power controllers with capacity from 25 to 100A are cooled by natural convection. To ensure this occurs, the cooling fins must absolutely be in a vertical position.

The model 150A includes an integrated fan which in the installation must be below the heatsink.

A thermal safety switch is available to activate an alarm or inhibit conduction in case of overheating of the heatsink (broken fan....). The thermal switch opens when the temperature is near 100°C; closing hysteresis is approximately 35°C.

The frequent intervention of this safety device indicates that ventilation is insufficient.

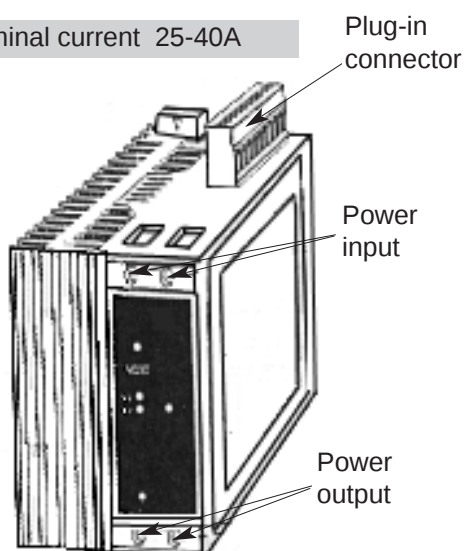
Where this is so it is essential to verify the temperature and aeration of the cabin.



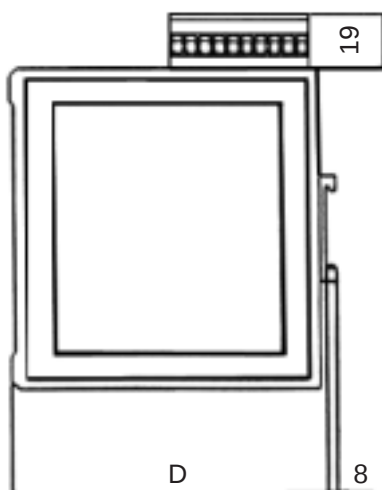
The heatsink can reach a high temperature. Even if electrically insulated, any contact must be avoided during operation. Even with the electrical panel off the thermal inertia of the heatsink must be kept in mind.

DIMENSIONS

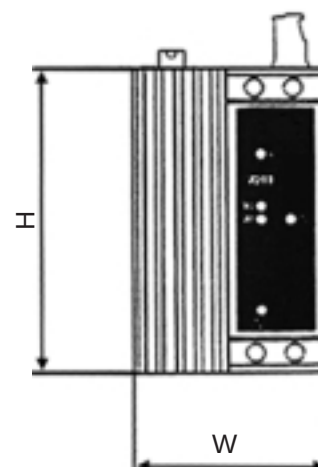
Nominal current 25-40A



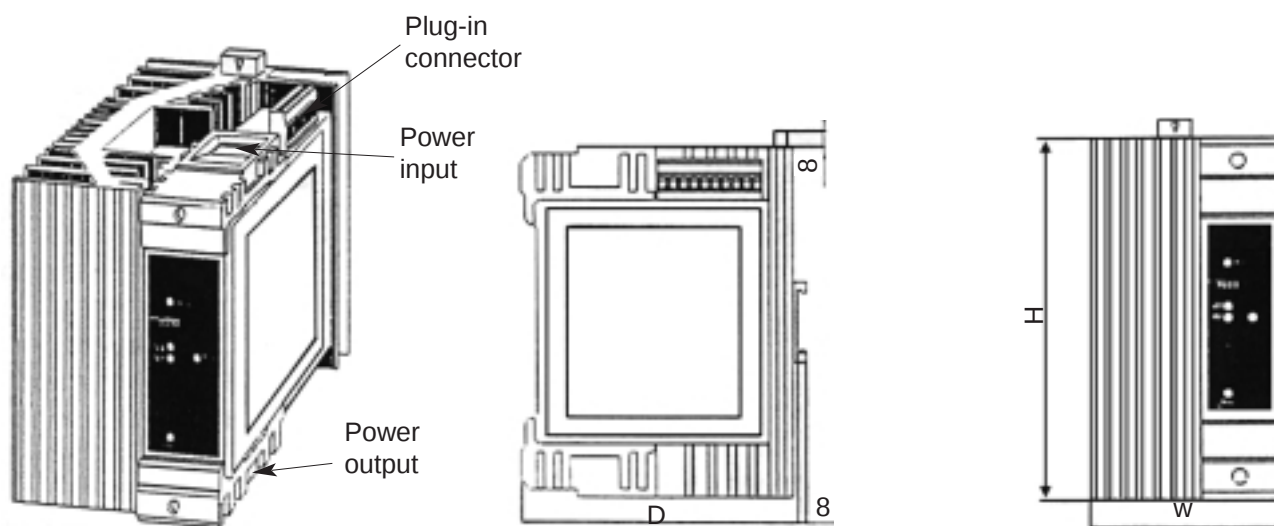
Side view



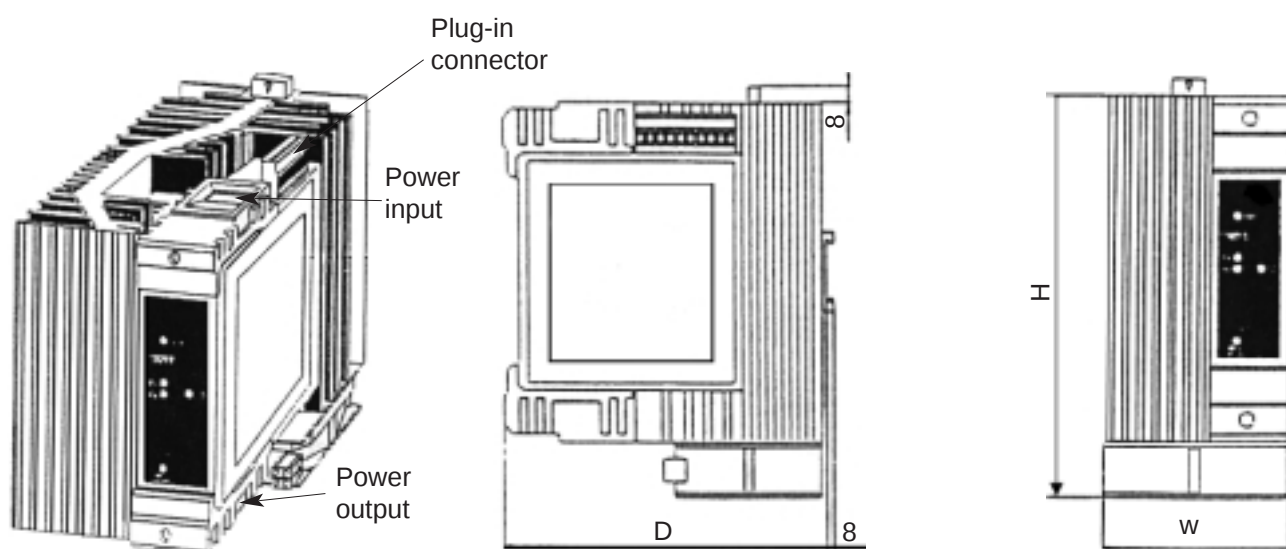
Front view



Nominal current 75-100



Nominal current 150A



Dimensions in mm and average weight of the models (ref. Nominal Current)

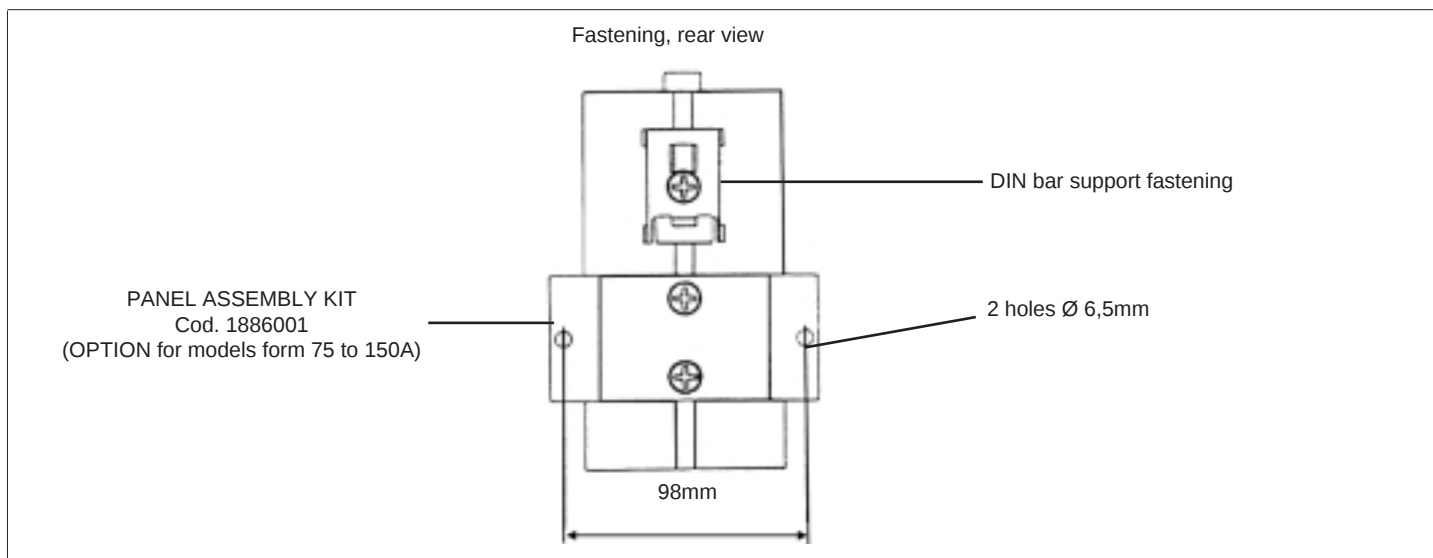
CAPACITY AMPERES	WIDTH W	HEIGHT H	DEPTH D	WEIGHT Kg.
25	66	130	105	0.8
40	83	130	120	1.2
75	83	175	125	1.7
100	83	175	160	2.3
150	83	215	160	2.7

ASSEMBLY - FASTENING

To ensure correct cooling, the minimum horizontal distance to be respected between the power controllers must be 20mm. Where there is overlapping, assemble the power units in a quincuncial layout and leave sufficient vertical space (approximately 100 mm) to facilitate the connections.

• THE DEVICES CAN BE FASTENED:

- normally on DIN RAIL. For sizes from 75 to 150A it is advisable to assemble a second bar to be used as a support, to prevent the anchor bar from bending under the unit's weight.
- On a panel, using a fixing plate supplied as an option and available only for models 75A, 100A and 150A.



CONNECTIONS

• GENERAL PRECAUTIONS

The power controllers are not sectioning or insulating devices.

In order to guarantee functional safety, it is advisable to:

- install a general power supply switch-off system which ensures the insulation between the device and the network.
- Connect the heatsink of the power controllers from 25 to 150 A to earth before carrying out all other connections, and before disconnecting it or carrying out any intervention on the unit.

Assemble a protection device suitable for the installation features (automatic switch, fuses, ...)

The ultra rapid fuses usually proposed as an option only provide protection for the thyristors of the unit and do not ensure complete protection of the instrument.



The heatsink can reach a high temperature. Any type of contact must be avoided, even accidental, between the dissipater and the electric connection cables.

The installation and wiring must be carried out in full compliance with the standards in force. Special care must be taken to keep the power cables separate from the control cables along their entire length. The control signals connection must be done with shielded cables where the shield is earthed to a single point, preferably on the side of the origin of the signal.

• CONNECTION TERMINAL BOARD

The CAGE power terminals of the unit allow the use of cables with/without crimped terminals.

For 25 and 40A power controllers it is possible to connect in input the two phases or one phase and one neutral. In this case the inner crossing connection between input 1 and output 3 is used.



It is essential to respect the correct locking torque and choose the cable section which is most suitable for the capacity used, in order to avoid dangerous overheating of the unit.

Rating A	Terminal capacity mm ²	Tightening torque Nm
25 - 40	from 1,5 to 16 (16 to 6 AWG)	from 1,2 to 1,4
75 - 100 - 150	from 20 to 70 (5 to 00 AWG)	from 6 to 7

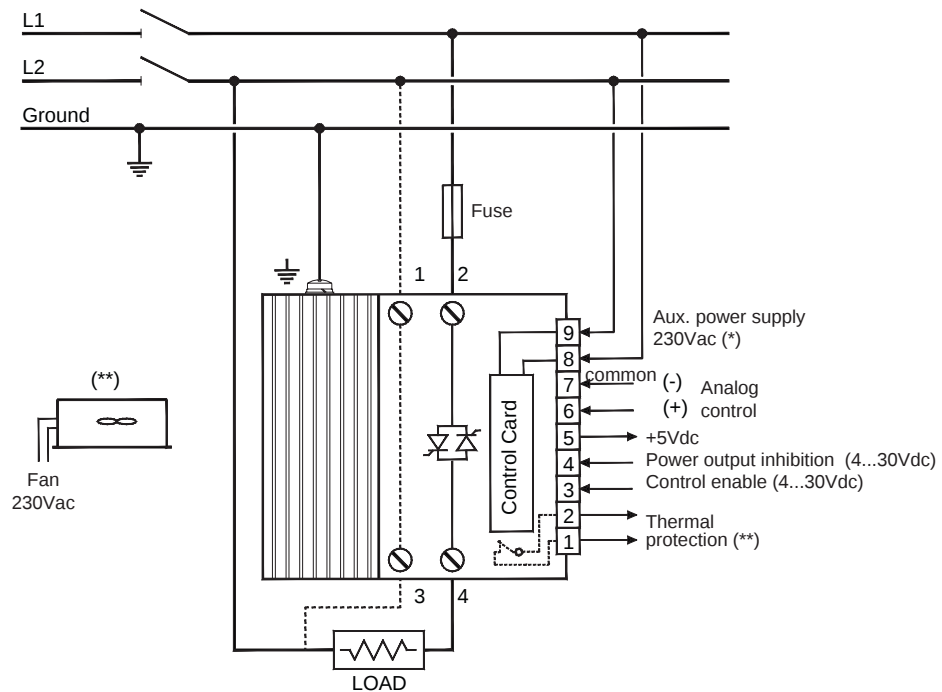
The command and inhibition signals, thermal safety switch, electronics supply are grouped on a black plug-in connector which allows the use of cables with a cross section $\leq 1.5 \text{ mm}^2$.

The fan include with 150A models is connected to a 230Vac power supply by means of a specific connector.

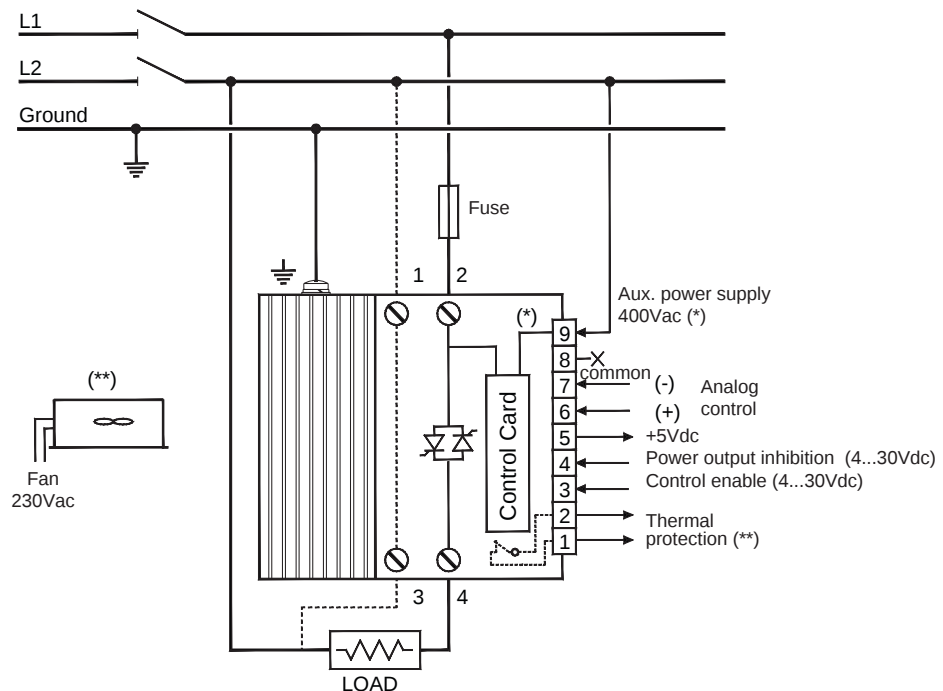
W312 WIRING DIAGRAMS

SINGLE-PHASE LOAD CONTROL

Models with 230 VAC auxiliary power supply: code W312 ... 020



Models with auxiliary power supply >230 VAC (for ex.: code W312...030, auxiliary power supply 400 Vac).



---- On 25A and 40A models, direct connection with terminals 1-3 is available for connecting one of the phases to the load, as an alternative to outside connection.

(*) Auxiliary power supply for control board (indicated in code and on label): must be in phase (synchronized) with the voltage applied to the load.
If not directly available, use an external auxiliary transformer.

IMPORTANT

On models with auxiliary power supply >230 VAC, one phase of the power supply for the control board is already connected internally. Therefore, terminal 8 is not used and must not be connected.

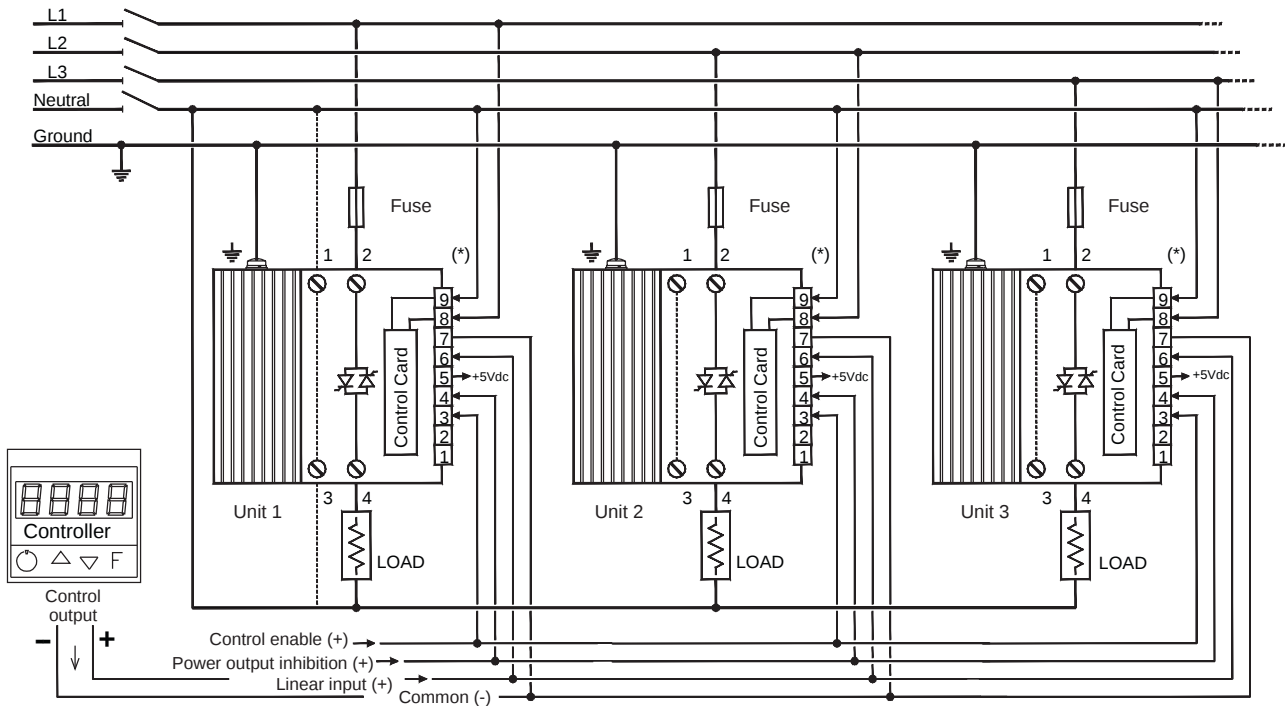
(**) 150A mod. only

CONTROL OF THREE-PHASE LOADS WITH THREE WATTCORS OPERATING IN SINGLE PHASE

Example 1 - Star connection with neutral.

Line voltage 400 VAC. 3 units W312 25A (or 40A).

Analog control (linear signal). Auxiliary power supply 230 Vac (W312 - □ □ □ - 660 - □ - 020)



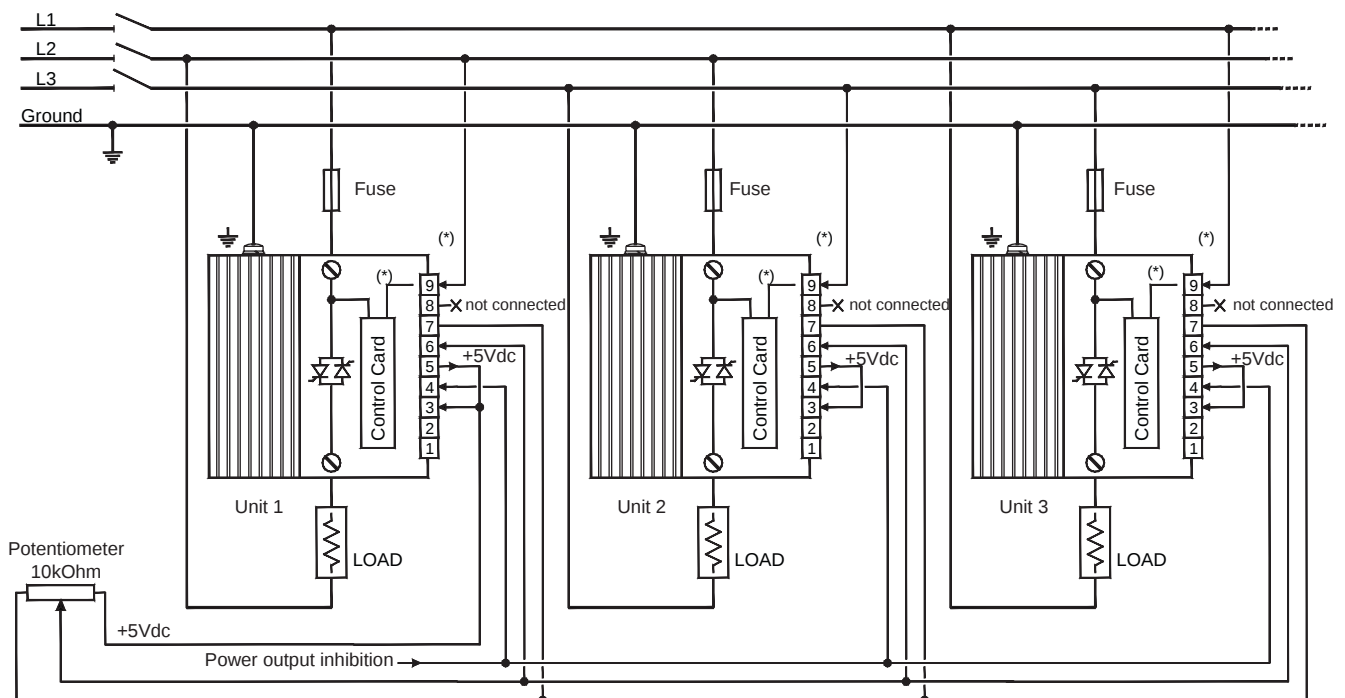
---- On 25A and 40A models, direct connection with terminals 1-3 is available for connecting one of the phases to the load, as an alternative to outside connection.

(*) Auxiliary power supply 230 VAC + 10%-20%-50Hz for control board (indicated in code and on label): must be in phase (synchronized) with the voltage applied to the load. If not directly available, use an external auxiliary transformer.

Example 2 - Open delta connection.

Line voltage 400 VAC. 3 units W312 75A (or 100A).

Potentiometer control. Auxiliary power supply 400 Vac (W312 - □ □ □ - 660 - □ - 030)



(*) Auxiliary power supply 400 VAC + 10%-20%-50Hz for control board (indicated in code and on label): must be in phase (synchronized) with the voltage applied to the load.

IMPORTANT

On models with auxiliary power supply >230 VAC, one phase of the power supply for the control board is already connected internally. Therefore, terminal 8 is not used and must not be connected.

CONTROL SIGNALS

W312 units have the following control inputs available:

- analog input in current or voltage that allows to set the desired power output (0..10V standard, 0...5V / 0...20mA / 4...20mA selectable by dip-switch).

The analog input (0...5V) can also be used for control via potentiometer ($R=10k\Omega$).

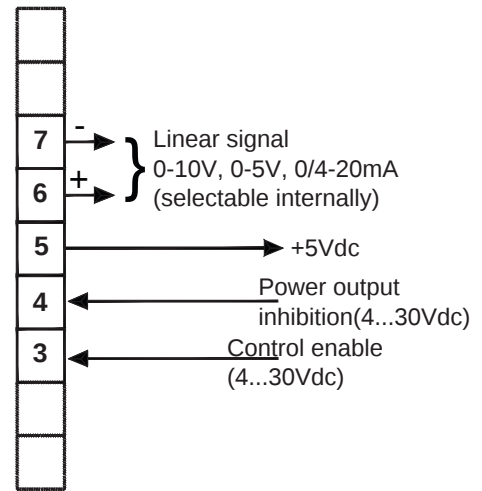
- logic input that enables the control.

If not used, must be connected to terminal 5 (+5Vdc) .

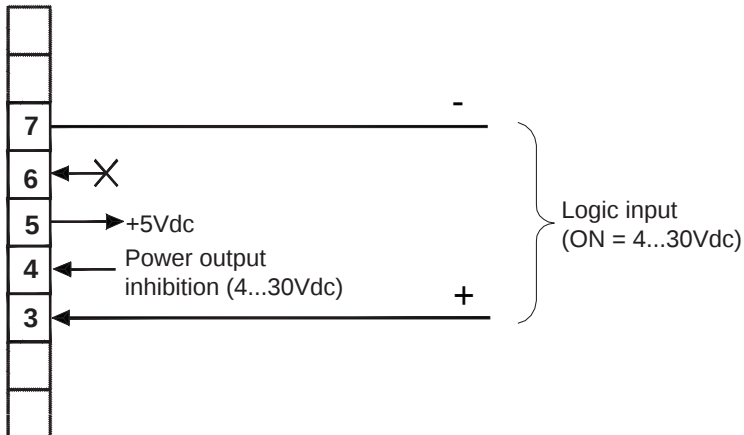
- inhibition logic input that locks the power output when the unit is active, whatever the control signal level may be.

Enable/inhibit controls are active with voltage in the 4...30 VDC range, and can also be operated by means of potential-free contacts connected between terminals 3-5 and 4-5, respectively.

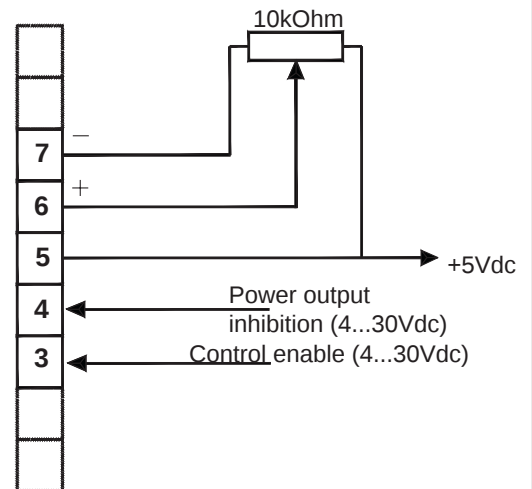
Analog control



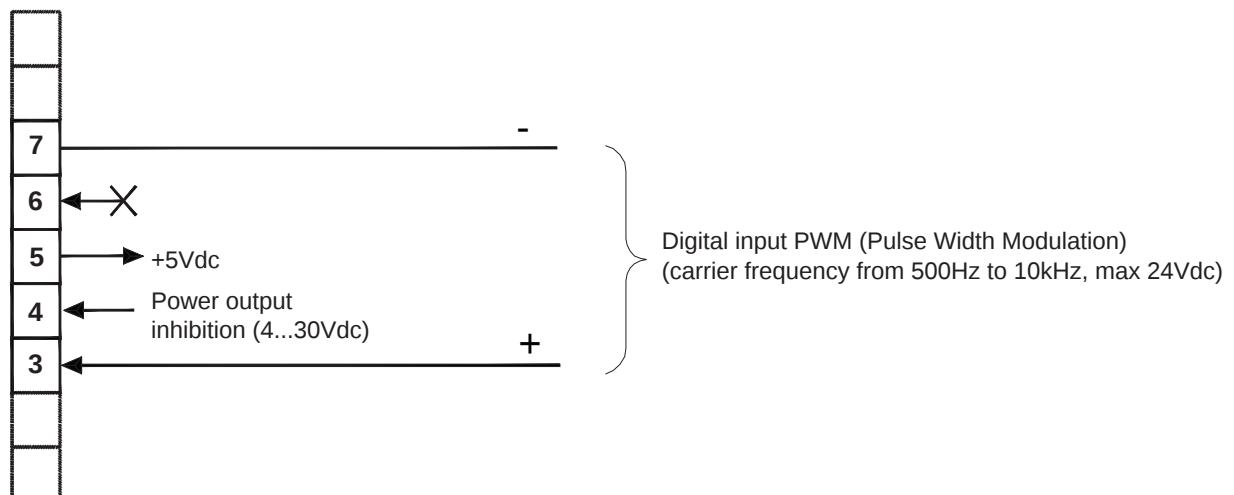
Logic control (ON/OFF)



Potentiometer control



Digital control (PWM)



POWER CONNECTIONS

25A and 40A models have a pair of input terminals to connect the line (24...660 VAC) and a pair of output terminals to connect the load.

The solid state relay (two SCRs in antiparallel) is connected internally to terminals 2-4.

Terminals 1-3 are connected directly inside the unit. This connection can also be made externally.

75A, 100A, 150A models have a single input terminal to connect a single phase and an output terminal to connect the load. The solid state relay (two SCRs in antiparallel) is connected internally to these terminals.

The other phase must be connected to the load externally.

PROTECTIVE EARTH CONNECTION

All models must be grounded by connection to the protective earth terminal.

AUXILIARY POWER SUPPLY

The auxiliary power supply for the W312 must be in phase with the voltage applied to the load.

The auxiliary power supply voltage is indicated in the code and on the product label.

- On models with 230 VAC auxiliary power supply, the auxiliary voltage is applied to terminals 8 and 9.
- On models with auxiliary power supply > 230 VAC, one phase is already connected internally to the power input. The user must connect the other phase to terminal 9 of the plug-in connector (terminal 8 is not used).

Use an external transformer if the load power supply and the auxiliary power supply required by the W312 have a different voltage. The auxiliary voltage applied must always be the voltage indicated in the code and on the product label (auxiliary power supply).

FAN POWER SUPPLY (150A model only)

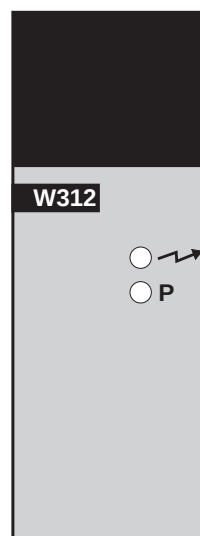
The W312 150A has a built-in cooling fan.

The fan is powered at 230 VAC. The connection is made to the terminal board on the fan, independent of the board for the control signals.

SIGNALING

The green LED P indicates the command status:
- if on: thyristor conduction
- if off: thyristor inhibition.

The green LED  signals the presence of the auxiliary supply voltage.



OPERATING MODES

W312 units offer the following control modes selectable by dip-switches:

- **analog control** (dip switch GC4=OFF): the solid state power unit transfers to the load a % of power proportional to the analog input signal (terminals 6-7).

The set power is supplied / interrupted by activating / deactivating the logic signal at terminal 3.

The type of analog signal (standard 0...10V) can be selected by the internal dip switches SW1-SW2-SW3-SW4 (see chart)

By enabling the "Soft-start at power-on" function (dip switch GC2=ON), when the auxiliary power supply is switched on (with logic signal present at terminal 3) the set power is reached gradually after a fixed time of about 40 sec.

By enabling the "Control variation gradient" function (dip switch GC4=ON) setpoint variations can be made more gradually; for example, a set point variation from 0 to 100% is performed on the load with a ramp of about 2.2 sec.

- **logic control** (dip switch GC4=ON, SW1=ON, SW2=OFF, SW3=ON, SW4=OFF): the solid state power unit transfers 100% of power to the load.

The power is supplied / interrupted by activating / deactivating the logic signal at terminal 3.

For this function, terminal 6 (analog input) must not be connected.

By enabling the "Soft-start at power-on" function (dip switch GC2=ON), when the auxiliary power supply is switched on (with logic signal present at terminal 3) the power is reached gradually after a fixed time of about 40 sec.

By enabling the "Control variation gradient" function (dip switch GC4=ON) the switching phase can be made more gradually; for example, passage from 0 to 100% of power takes place with a ramp of about 2.2 sec.

If GC3 and GC4 are both enabled, the 2.2 sec. (approx.) ramp is also executed when the logic control is deactivated.

- **PWM control** (dip switch GC4=ON, GC3 = ON, SW1 = ON, SW2 = OFF, SW3 = ON, SW4 = OFF). In logic control mode, you can send a PWM type digital signal (Pulse Width Modulation) to terminal 3.

The power controller transfers to the load a % of power proportional to the ratio between the "ON time" and the "OFF time" within the cycle; this function lets you set a power set point by means of digital signal (for ex., from PLC or controller with PWM output) with carrier frequency from 500 Hz to 10kHz, logic level Lo<0.6V, Hi>2.5V (max 24 VDC).

Example: with digital signal at 1 kHz and tON=50%, you have 50% of power output.

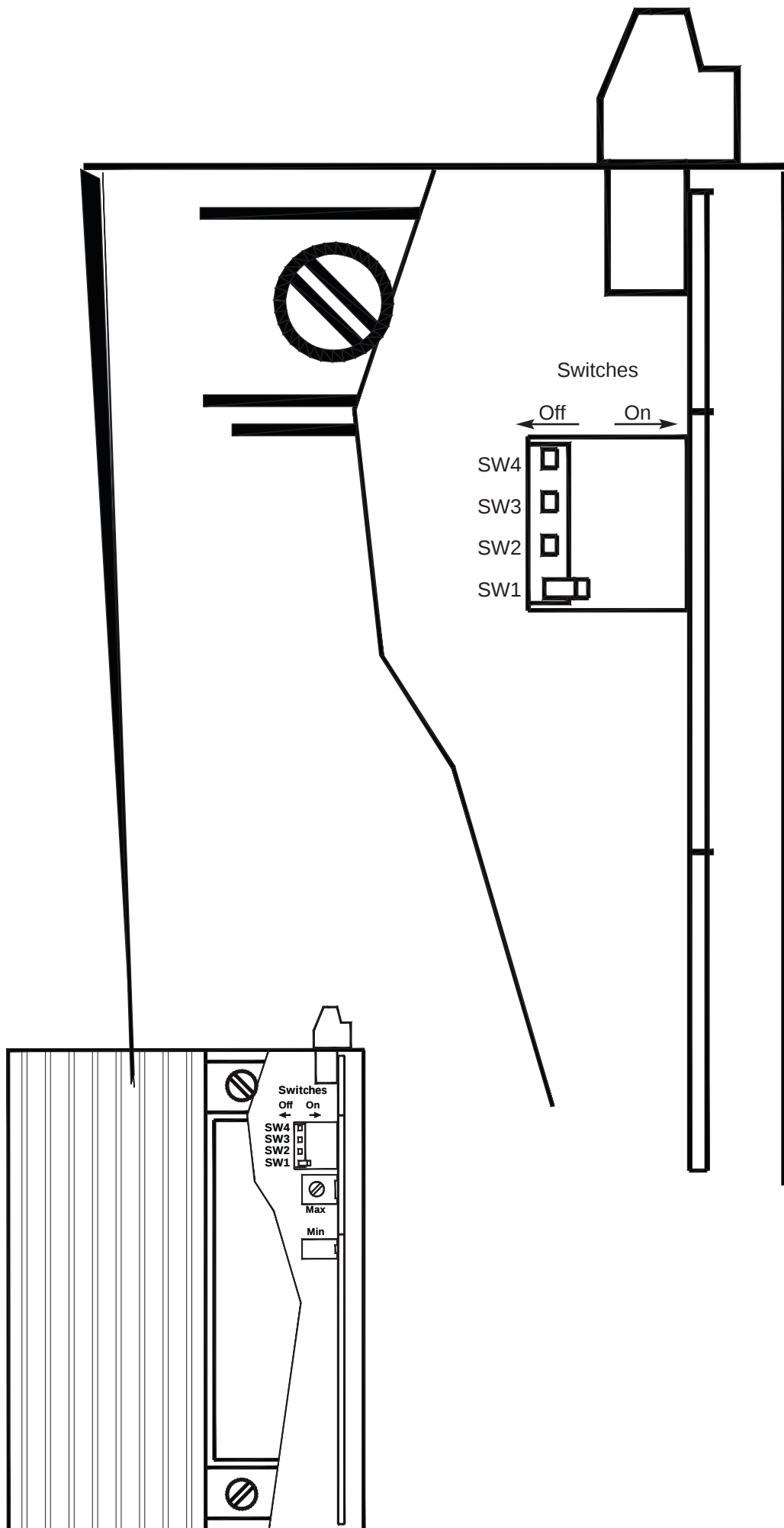
IDENTIFICATION OF THE DIP-SWITCHES

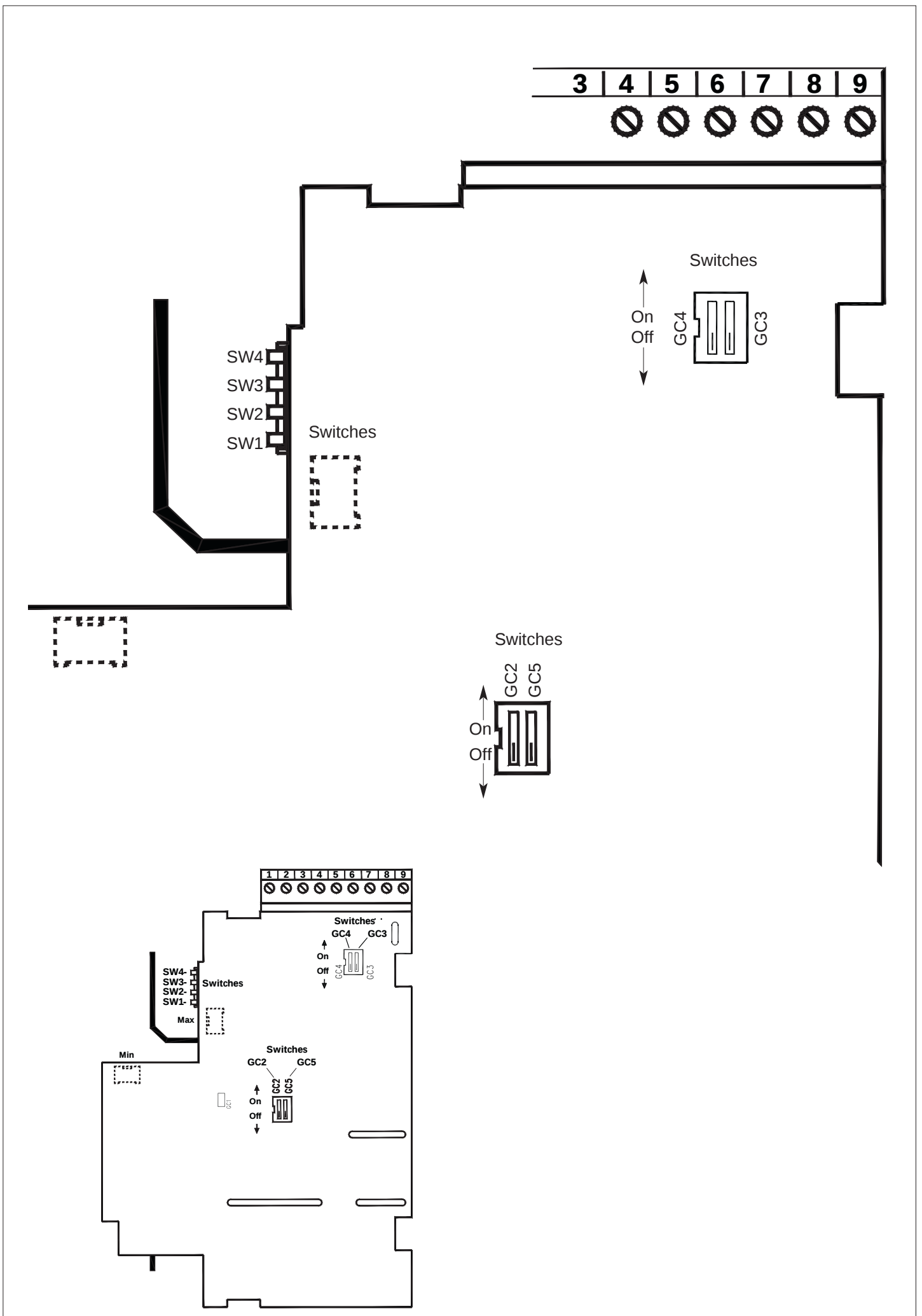
Control type and operating mode are selected by internal dip-switches SW1...4 and GC2...5.

To access them, remove the side cover (insert a screwdriver into the slots).



CUT POWER TO THE ELECTRICAL CONTROL PANEL BEFORE REMOVING THE COVER





DIP-SWITCH SETTINGS

		GC3	GC4	GC2	GC5	SW1	SW2	SW3	SW4
		logic control deactivation ramp	logic/ analog control	control variation gradient	soft-start at switch-on of the auxiliary power supply	Type of analog signal			
analog control	0...10V	OFF	OFF	OFF		ON	OFF	OFF	OFF
	0...5V	OFF	OFF	OFF		ON	OFF	ON	OFF
	potentiometer	OFF	OFF	OFF		ON	OFF	ON	OFF
	0...20mA	OFF	OFF	OFF		ON	OFF	ON	ON
	4...20mA	OFF	OFF	OFF		OFF	ON	ON	ON
analog control with variation gradient	0...10V	OFF	OFF	ON		ON	OFF	OFF	OFF
	0...5V	OFF	OFF	ON		ON	OFF	ON	OFF
	potentiometer	OFF	OFF	ON		ON	OFF	ON	OFF
	0...20mA	OFF	OFF	ON		ON	OFF	ON	ON
	4...20mA	OFF	OFF	ON		OFF	ON	ON	ON
logic control	no ramps	OFF	ON	OFF		ON	OFF	ON	OFF
	with 2 sec activ. ramp	OFF	ON	ON		ON	OFF	ON	OFF
	with 2 sec activ./deactiv. ramp	ON	ON	ON		ON	OFF	ON	OFF
PWM control	carrier frequency 500Hz..10kHz	ON	ON	-		ON	OFF	ON	OFF
soft-start at power-on	enabled				ON				
	disabled				OFF				
default (factory setting)	= analog control 0-10V	OFF	OFF	OFF	OFF	ON	OFF	OFF	OFF

- indifferent

TECHNICAL SPECIFICATIONS

POWER LINE VOLTAGE

MODEL		RANGE OF USE		
		Minimum	Rated	Maximum
W312	Nominal Voltage - Vac	20	660	725
	Frequency - Hz	47	50 (•)	53

NOMINAL CURRENT

The capacities are specified at an ambient temperature of 50°C. Typical dissipation: 1.2 Watt per ampère

Model	I minimum	I minimum with Amb.Temp. 20°C	I maximum with Amb.Temp. 50°C	I ² t at 10ms	Dissipation at I nominal
	Ampere	Ampere	Ampere	A ² S	Watt
25A	1	30	25	1800	30
40A	2	50	40	11200	50
75A	2	85	75	14450	90
100A	3	120	100	151000	120
150A	3	200	150	151000	180

(•) 60Hz on request

CONTROL SIGNALS

Model	Signal		Value in V or in mA			Absorbed current (mA)		Input impedance (K Ω)
	Type	Level	Minimum	Nominal	Maximum	Value	Condition	
W312	Logic input	0 (non active).	0	0	1	0,25	5 Vdc	27K Ω <5V
		1 (active)	1,9	5	30			100K Ω <5V
	Analog control in current	0-20mA	0mA		20mA			Internal Shunt
		4-20mA	4mA		20mA			250 Ω
	Analog control in voltage	0-5Vdc	0V		5V			35K Ω
		0-10Vdc	0V		10V			70K Ω
	Inhibition logic input	0 (non active).	0	0	1			27K Ω <5V
		1 (active)	4	5	30	0,1	5Vdc	100K Ω <5V

AUXILIARY POWER SUPPLIES

For the electronics of the WATTCOR W312: - 230V or 400V $\pm$ 10%(see order code) 50Hz (•),
5VA in phase with the voltage applied to the load

For the cooling fan (model 150A) : - 230V, 50/60Hz, 14VA

OPERATIVE CONDITIONS

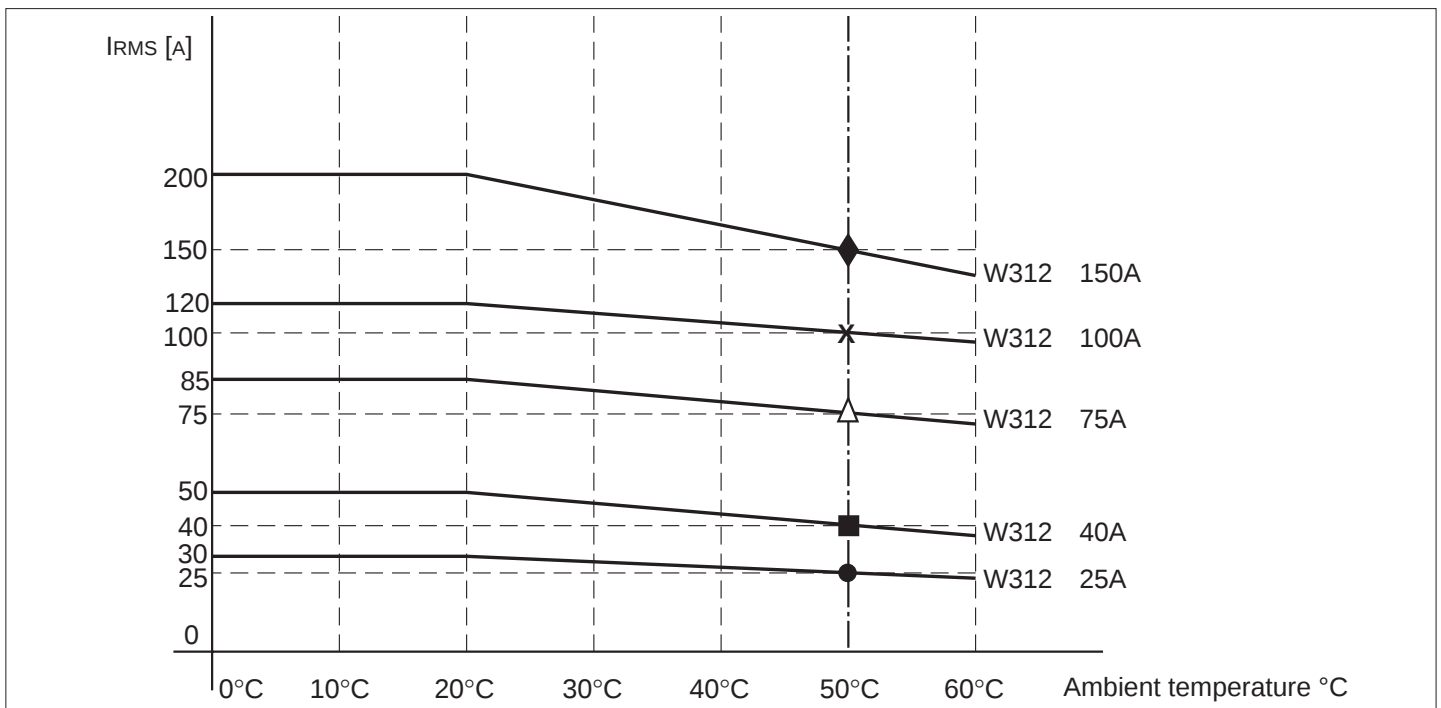
- Operating temperature : -5...+60°C
- Storage temperature : -20...+70°C
- Relative humidity : from 10 ... 90% without condensation
- Non dusty, non explosive, non corrosive atmosphere.

SAFETY

- Insulation voltage 3750Vac between the command electronics and the controlled power.
- Internal protection from overvoltage and dV/dt by means of varistors and RC systems.
- Insulated heatsink.
- Thermal switch for model 150A: opening of the contact at 100°C, closing hysteresis 35°C.
- IP20 degree of protection.
- Self-extinguishing casing UL 94 VO.

(•) 60Hz on request

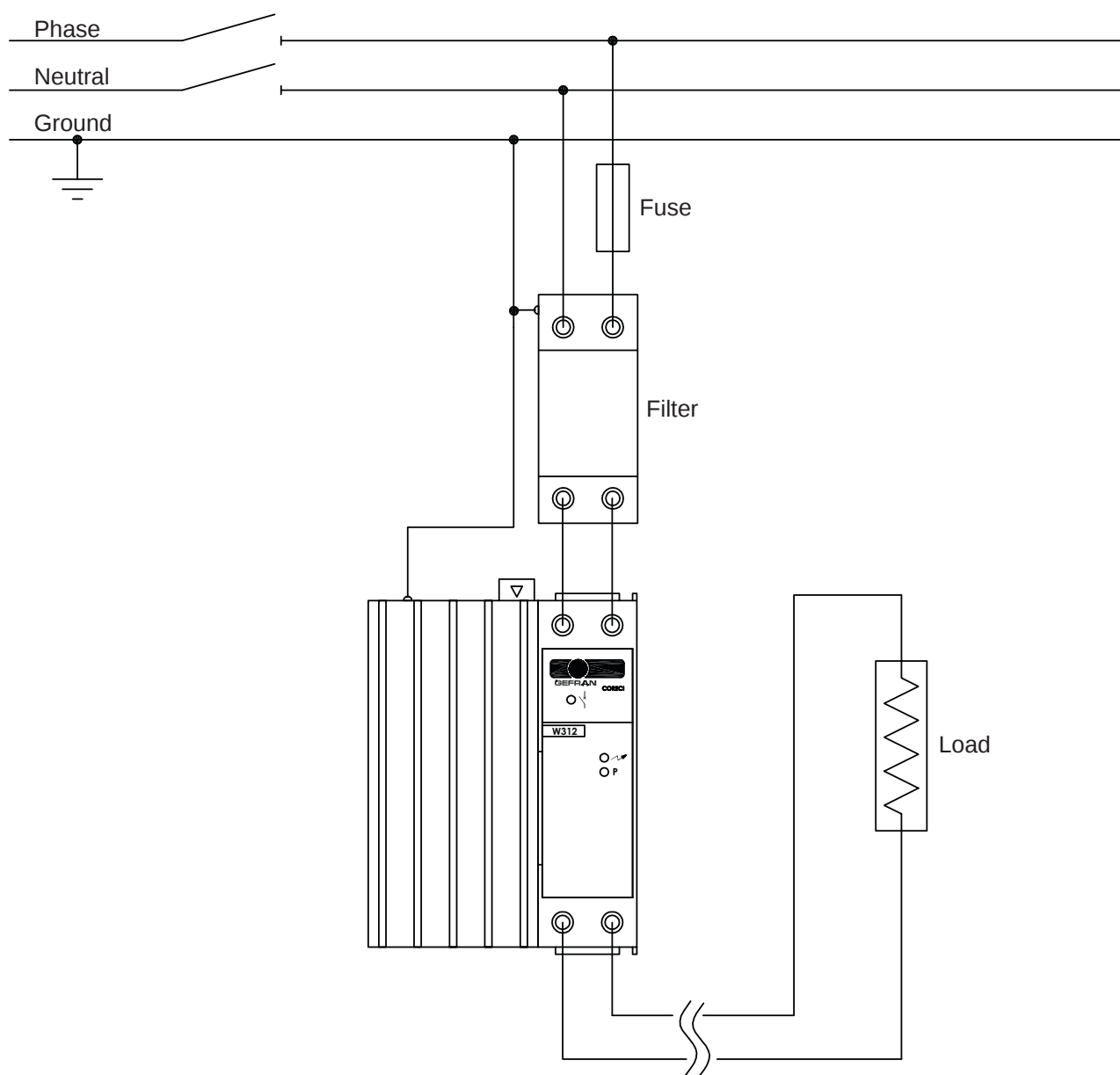
DISSIPATION CURVES



INSTALLATION NOTES

The need of a filter in order to reduce the conducted emissions , during the firing of the Thyristors at a certain phase angle, depends on the specific application. In fact the level depends on the layout of the machine and the load typology.

Therefore it is suggested to check the level of the emissions of the machine in order to define how to reduce them. Following is the schematic for a typical filter connection.



It is important to connect the filter as close as possible to the power controller.

A filter with the following characteristics is suggested

Voltage	Voltage of the load
Current	Max current on the load
Operating frequency	50/60Hz
Common mode	>35dB@100KHz >60 dB da 150KHz a 1.5MHz
Differential mode	>50dB@100KHz >60 dB da 150KHz a 1.5MHz

Some filters tested in single phase applications:

Model	Load 230V	Load 400V
W312 25A	ICAR FL140.30.00	ICAR FL140.30.00 H
W312 40A	ICAR FL140.50.00	ICAR FL140.50.00 H
W312 75A	ICAR FL140.80.00	ICAR FL140.80.00 H
W312 100A	ICAR FL140.120.00	ICAR FL140.120.00 H
W312 150A	ICAR FL140.250.00	ICAR FL140.250.00 H

ACCESSORIES

ULTRA RAPID FUSES and FUSES CAPACITY

The W312 power controller does not have an integrated fuse.

Separate fuses and fuse holders are proposed as accessories (see table below).



The ultra rapid fuses are exclusively intended for the protection of the thyristors of the WATTCOR. In no case should these replace the device line protections. In order for the manufacturer's guarantee to be valid, it is obligatory to use the fuses indicated below for each type of WATTCOR. Where the load generates significant transitory excess currents (short wave infrared elements), it is necessary to consult GEFAN.

FUSEHOLDER FASTENING

- On symmetrical DIN bar for PF 22x58 (WATTCOR 25-40 and 75A).
- On panel by means of two screws diam. 6 mm with horizontal space between centres of 19mm for PF 27x60 (WATTCOR 100 and 150A).

FUSES AND FUSEHOLDERS CODES

Model	Pt Max. recommended for the fuse	Ultra Rapid Fuse Manufacturer/ Model mm		Fuse order number Code	Fuse holder order number Code Dimensions
W312-25A-660V	1800	22x58	^{50A} FWP50A22F Bussmann	FUS-050	PF-22x58 H139 x L36 x P86
W312-40A-660V	11200	22x58	^{63A} FWP63A22F Bussmann	FUS-063	PF-22x58 H139 x L36 x P86
W312-75A-660V	14450	22x58	^{100A} FWP100A22F Bussmann	FUS-100	PF-22x58 H139 x L36 x P86
W312-100A-660V	151000	27x60	^{250A} TO76308 Ferraz	FUS-250	PF-27x60 H150 x L39 x P107
W312-150A-660V	151000	27x60	^{250A} TO76308 Ferraz	FUS-250	PF-27x60 H150 x L39 x P107



WARNING: this symbol indicates danger.

Read the following warnings before installing, connecting or using the device:

- follow instructions precisely when connecting the device.
- always use cables that are suitable for the voltage and current levels indicated in the technical specifications.
- In applications with risk of damage to persons, machines or materials, you **MUST** install auxiliary alarm devices.
- Power controllers are designed to assure a switching function that does not include protection of the load line or of devices connected to it. The customer must provide all necessary safety and protection devices in conformity to current electrical standards and regulations. It is advisable to verify frequently that the alarm device is functional even during the normal operation of the equipment.
- DO NOT operate the device in rooms with dangerous (flammable or explosive) atmosphere.
- During continuous operation, the heat sink can reach up to 100°C, and stays at a high temperature even after the device is turned off due to thermal inertia; therefore, DO NOT touch it and avoid contact with electrical wires.
- do not work on the power part without first disconnecting electrical power to the panel.
- do not remove the cover when the device is powered!

Installation: category II, pollution degree 3, double insulation

- correctly ground the device using the specific terminal.
- power supply lines must be separated from device input and output lines; always check that the supply voltage matches the voltage indicated on the device label.
- avoid dust, humidity, corrosive gases and heat sources.
- respect the installation distances between one device and another (to allow for dissipation of generated heat).
- respect the indicated dissipation curves

Maintenance: at regular intervals, check operation of the cooling fans and clean all air ventilation filters.

- repairs must be done out only by trained and specialized personnel. Cut power to the device before accessing internal parts.
- do not clean the box with solvents derived from hydrocarbons (trichloroethylene, gasoline, etc.). Using such solvents will compromise the device's mechanical reliability. Use a clean cloth moistened with ethyl alcohol or water to clean external parts in plastic.

Service: GEFran has a service department. The warranty excludes defects caused by any use not conforming to these instructions.

GEFRAN spa reserves the right to make aesthetic or functional changes at any time and without notice.



In conformity to ECC 89/336/CEE and 73/23/CEE with reference to standards:

CEI-EN 61000-6-2 (immunity in industrial environment)- **EN 61010-1** (safety)