USER'S MANUAL
Rev. 10/2014

REVO E-3PH BASIC
THYRISTOR UNIT

00004

from 25A to 600A

CD Automation S.r.l.
Via Picasso 34/36 - 20025 – Legnano (MI) – ITALY
Tel +39 0331 577479 – Fax +39 0331 579479
E-Mail: info@cdautomation.com - WEB: www.cdautomation.com

SUMMARY

1 Important warnings for safety 6

2 Introduction 8

2.1 Advantages compared with analog thyristor unit 8
2.2 Software Configurator 9

3 Quick Start 10

4 REVO E Sizing 11

5 Identification and Order Code 12

5.1 Identification of the unit 12
5.2 Order Code 13

6 Installation 14

6.1 Environmental installation conditions 14
6.2 Dimensions and Fixing holes 15
6.3 Removing the cover 16

7 Wiring instructions 17

7.1 Wiring details 17
7.2 Power Terminals 19
7.3 Command Terminals Size S09 20
7.4 Diagram of control connection Size S09 21
7.5 Command Terminals Size S11/S13/S14 22
7.6 Diagram of control connection Size S11/S13/S14 23

8 Power output features 24

8.1 Derating curve 24
8.2 Cooling fans 24

9 Led status and Alarms 25

9.1 LED Status Table 25
9.2 Critical Alarms 26
9.3 Not Critical Alarm 27
9.4 Calibration Procedure 27

10 Firing type 28

10.1 Single Cycle (SC) 28
10.2 Burst Firing (BF) 30
10.3 Phase Angle (PA) 32

10.4 Delay Triggering (DT) 34
10.5 Feed-back type 36

11 Connection description 37

11.1 Access to the Electronic boards 37
11.2 Supply the Electronic Board 37
11.3 Analog Inputs 38
11.4 Analog Outputs 39
11.5 Digital Input 40
11.6 Digital Output 41
11.7 PG Connector 42

12 Internal Fuse 43

12.1 Fuse Code 43

13 Maintenance 44

13.1 Fans 44
13.2 Maintenance 44
13.3 Repairing procedure 44
13.4 Warranty condition 44

1 Important warnings for safety

This chapter contains important information for the safety. The not observance of these instructions may result in serious personal injury or death and can cause serious damages to the Thyristor unit and to the components system included.
The installation should be performed by qualified persons.

The Thyristor unit are integral part of industrial equipments. When it is supply, the Thyristor unit is subject to dangerous tensions.

- Don't remove the protection Cover.
- Don't use these unit in aerospace applications and/ or nuclear.

The nominal current corresponds to use at temperature not superior to 45°C.

- The Thyristor unit must be mounted in vertical position and without obstruction above and below to allow a good flow ventilation.
- The hot air of one thyristor unit must not invest the unit positioned above.
- For side by side placed leave a space of 15mm between the unit.

A suitable device must ensure that the unit can be electrically isolated from the supply, this allows the qualified people to work in safety.

Protection (Protection, Protezione)
The unit have IP20 protection rating as defined by the specific international. Is necessary consider the place of installation.

Earth (Terre, Messa a terra)
For safety, the Thyristor unit with isolated heat-sink must be connected to earth.
Earth impedance should be correspondent to local earth regulation. Periodically the earth efficiency should be inspected.

Electronic supply (Alimentation électronique, Alimentazione elettronica)
The electronic circuit of the Thyristor unit must be supplied by dedicated voltage for all electronic circuits and not in parallel with coil contactors, solenoids and other.
It's recommended to use a shielded transformer.

Electric Shock Hazard (Risque de choque électrique, Rischi di scosse elettriche)
When the Thyristor unit is energized, after the power supply is shut off, wait least a minute for allow the discharge of the internal capacitors where there is a dangerous tension. Before working, make sure that:

- Only authorized personnel must perform maintenance, inspection, and replacement operations.
- The authorized personnel must read this manual before to have access to the unit.
- Unqualified People don't perform jobs on the same unit or in the immediate vicinities.

Important warnings (Attention, Avvertenze importanti)
During the operations with units under tension, local regulations regarding electrical installation should be rigidly observed:

- Respect the internal safety rules.
- Don't bend components to maintain insulation distances.
- Protect the units from high temperature humidity and vibrations.
- Don't touch components to prevent electrostatic discharges on them.
- Verify that the size is in line with real needs.
- To measure voltage current etc. on unit, remove rings and other jewels from fingers and hands.
- Authorized personnel that work on thyristor unit under power supply voltage must be on insulated board

This listing does not represent a complete enumeration of all necessary safety cautions.

Electromagnetic compatibility
(Compatibilità électromagnétique, Compatibilità elettromagnetica)
Our thyristor units have an excellent immunity to electromagnetic interferences if all suggestions contained in this manual are respected. In respect to a good Engineering practice, all inductive loads like solenoids contactor coils should have a filter in parallel.

Emissions (Emission, Emissioni)
All solid-state power controllers emit a certain amount of radio-frequency energy because of the fast switching of the power devices.
The CD Automation's Thyristor unit are in accord with the EMC norms, CE mark.
In most installations, near by electronic systems will experience no difficulty with interference. If very sensitive electronic measuring equipment or low-frequency radio receivers are to be used near the unit, some special precautions may be required. These may include the installation of a line supply filter and the use of screened (shielded) output cable to the load.

Note

Warning: This icon is present in all the operational procedures where the Improper operation may result in serious personal injury or death

Caution: This icon is present in all the operational procedures where the Improper operation can cause damage for the Thyristor unit.

CD Automation reserves the right to modify the own products and this manual without any advise.

c UL us LISTED

CE

2 Introduction

A thyristor unit is semiconductor device which acts as a switch formed by two thyristors in ant parallel. To switch on the alternating current the input signal will be on and the thyristor will switch off at first Zero Crossing voltage with no input signal.
The benefits of thyristor units compared with elettromechanical contactors are numerouses: no moving parts, no maintenance and capacity to switch very fast. Thyristors are the only solution to control transformers and special loads that change resistance with temperature and with age.

2.1 Advantages compared with analog thyristor unit

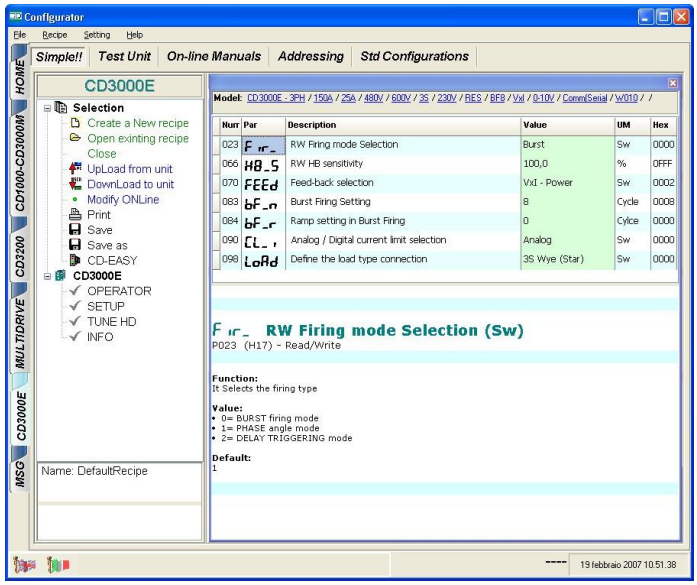
REVO E is an universal Thyristor unit, designed to control resistive or inductive loads including three phase transformers. The electronic circuit is completely digital and is based on a powerful microprocessor with high performance that allow the use in different ways:

- Single cycle
- Burst Firing with soft start
- Delayed triggering
- Phase Angle with soft start

On same unit can be used different feed back that define the control mode:
- Voltage
- Current
- Power VxI
- External 0÷10Vdc

On same unit can be used different input:
- 4÷20mA
- 0÷10Vdc
- Potentiometer 10KΩ
- SSR

2.2 Software Configurator



The software configuration is free and is possible download it from our site: www.cdautomation.com

If the Order Code is in line with requirement, then REVO E has been already configured in Factory and it's ready to use.
You need the software only to modify the ordered configuration. Anyway we suggest to check the unit on the machine with the "Test unit" section.

For install the software, launch the program and follow the instructions on the screen.

To connect the unit at the PC, it's necessary use the USB\TTL converter connected between the unit and the USB port of the PC.

USB\TTL converter need a driver to work properly, you can find it from our site.

Is available a full programmer kit composed by

- USB\TTL converter,
- Two cable
- Thyristor configurator software

USB driver.

3 Quick Start

Caution: *this procedure must be performed only by qualified persons.*

If the Order Code of the Thyristor unit is in line with what you really need, then REVO E has been already configured in Factory and you just need to do the following steps:

1. Verify the REVO E Sizing. Making sure that:
   - The load current is equal or less than the MAX current of REVO E.
   - The load voltage is equal or less than the MAX voltage of REVO E.

   (see par. 4)

2. Verify the Order Code
   (see par. 5.2)

3. Verify the Installation
   (see par. 6)

4. Verify the Diagram of control connection:
   - All auxiliary connections must be done in line with wirings on this manual.
   - Verify that there isn't a short circuit on the load.

   (see par. 7.4)

5. Supply the Electronic boards
   (see Order Code)

6. If not specified in the Order Code:
   - Set the Load Voltage in the parameter P116 U_OP.
   - Set the Load Current in the parameter P119 A_Lo.

7. With Burst Firing (BF) or Heater Break Alarm (HB)
   make the Calibration procedure
   (see par. 9.4)

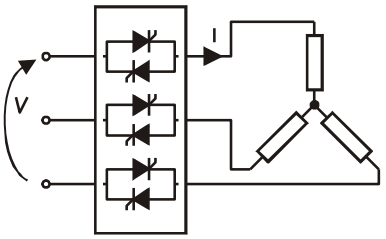
The REVO E Thyristor unit is ready to start.

4 REVO E Sizing

4.1.1 Star wiring with resistive load

$$I = \frac{P}{1{,}73V}$$

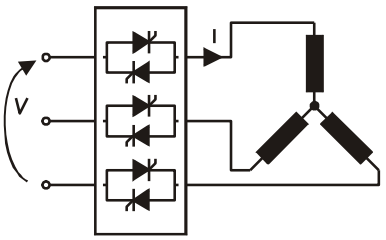
V = Nominal voltage phase to phase
I = Nominal current of the load
P = Nominal power of the load



4.1.2 Star wiring with inductive load

$$I = \frac{P}{1{,}73V\cos\phi}$$

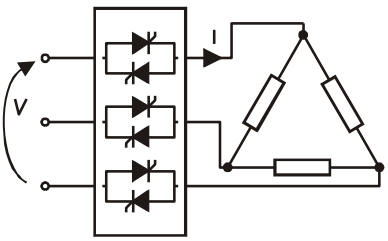
V = Nominal voltage phase to phase
I = Nominal current of the load
P = Nominal power of the load



4.1.3 Delta wiring with resistive load

$$I = \frac{P}{1{,}73V}$$

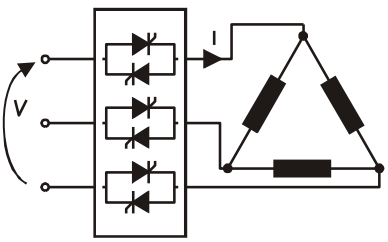
V = Nominal voltage phase to phase
I = Nominal current of the load
P = Nominal power of the load



4.1.4 Delta wiring with inductive load

$$I = \frac{P}{1{,}73V\cos\phi}$$

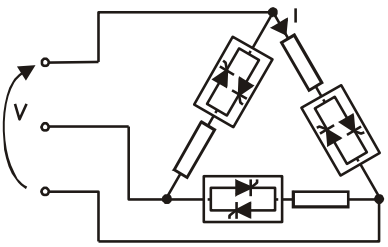
V = Nominal voltage phase to phase
I = Nominal current of the load
P = Nominal power of the load



4.1.5 Open Delta wiring with resistive load

$$I = \frac{P}{3V}$$

V = Nominal voltage phase to phase
I = Nominal current of the load
P = Nominal power of the load



5 Identification and Order Code

5.1 Identification of the unit

Caution: *Before to install, make sure that the Thyristor unit have not damages. If the product has a fault, please contact the dealer from which you purchased the product.*

The identification's label give all the information regarding the factory settings of the Thyristor unit, this label is on the unit, like represented in figure.
Verify that the product is the same thing as ordered (see par. 5.2).

5.2 Order Code

ORDERING CODES CD3000E 3PH - BASIC

Note 1

	1	2	3	4	5	6		7	8	9	10	11	12	13	14	15	16
CD3000E 3PH Basic	R	E	B	_	_	_	-	_	_	_	_	_	_	_	_	_	_

4, 5, 6 Current

Description code	Numeric code
25A	0 2 5
35A	0 3 5
45A	0 4 5
75A	0 7 5
100A	1 0 0
125A	1 2 5
150A	1 5 0
225A	2 2 5
300A	3 0 0
350A	3 5 0
400A	4 0 0
450A	4 5 0
500A	5 0 0

7 Max Voltage

Description code	Numeric code
480V	4
600V	6

8 Aux. Voltage supply

Description code	Numeric code
110V	1
230V	2

9 Input

Description code	Numeric code
0:10V	V
4:20mA	A
10KPot	K
RS485	R

10 Firing

Description code	Numeric code
Soft Start + Phase Angle S+PA	E

11 Control Mode

Description code	Numeric code
Open Loop	0
Voltage Feed Back V	U

12 Option

Description code	Numeric code
Control Mode Retransmission 4:20mA	A
Control Mode Retransmission 0:10V	V

13 Fan Voltage

Description code	Numeric code
Fan Voltage equal to Aux. Voltage	3

14 Approvals

Description code	Numeric code
CE EMC For European Market	0
cUL For American Market	L

15 Manual

Description code	Numeric code
None	0
Italian Manual	1
English Manual	2
German Manual	3
French Manual	4

16 Load type/Connection

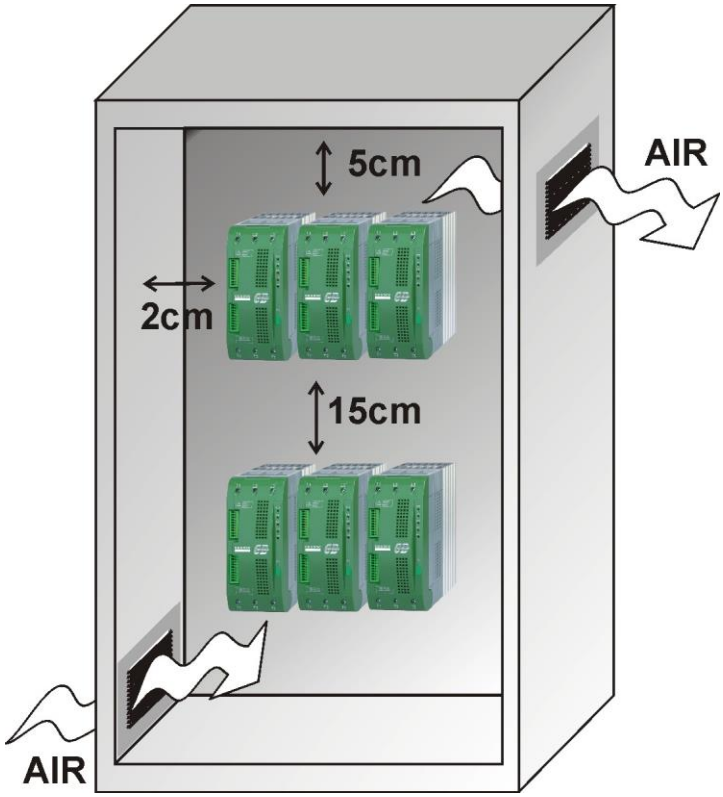
Description code	Numeric code
Resistive Load/ Delta Connection	1
Resistive Load/ Star Connection	2
Resistive Load/ Star Connection + Neutral	7

Note (1): **After 16th digit write current and voltage of load inside brackets Ex. (190A-400V). Required if units are to be tuned to load.**

6 Installation

Caution: *Don't install near the hot elements or near the units that could give electromagnetic interferences.*

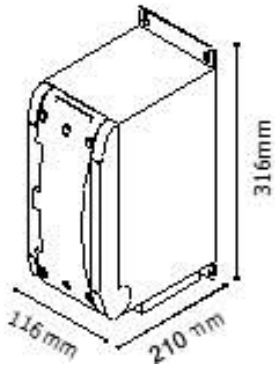
The REVO E Thyristor unit must be always mounted in vertical position to improve air cooling on heat-sink. Maintain the minimum distances in vertical and in horizontal as represented.
When more unit has mounted inside the cabinet maintain the air circulation like represented in figure.
Sometimes is necessary installing a fan to have better air circulation.



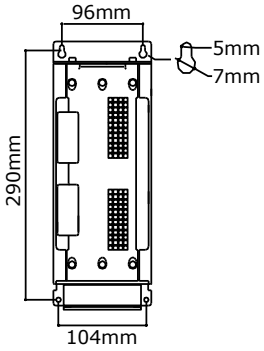
6.1 Environmental installation conditions

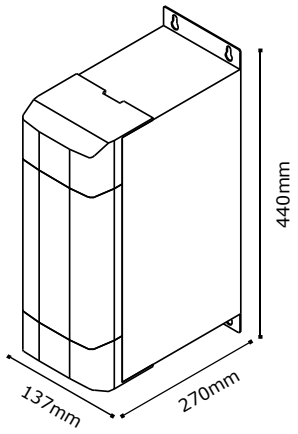
Ambient temperature	0-40°C at nominal current. Over 40°C use the derating curve (see par. 8.1)
Storage temperature	-25°C to 70°C
Installation place	Don't install at direct sun light, where there are conductive dust, corrosive gas, vibration or water and also in salty environmental.
Altitude	Up to 1000 meter over sea level. For higher altitude reduce the nominal current of 2% for each 100m over 1000m
Humidity	From 5 to 95% without condense and ice

6.2 Dimensions and Fixing holes

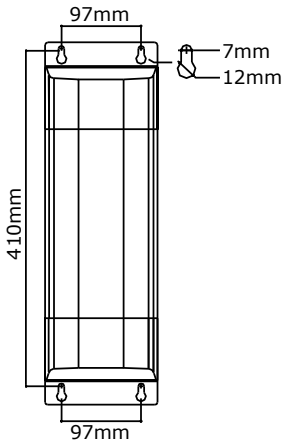


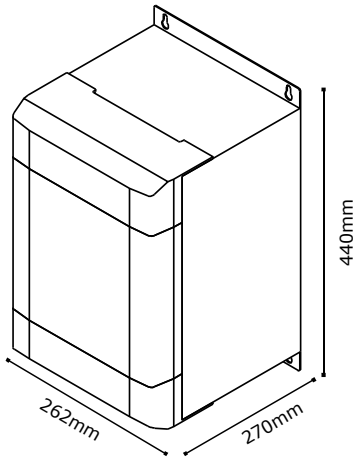
Size S09
(25A÷75A)
Weight 5kg



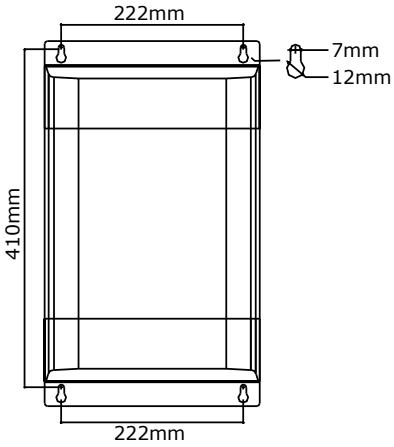


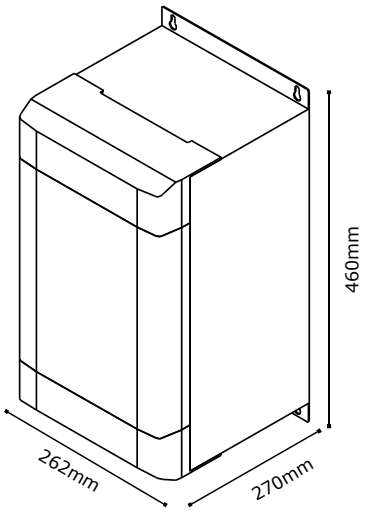
Size S11
(100A÷150A)
Weight 10,5kg



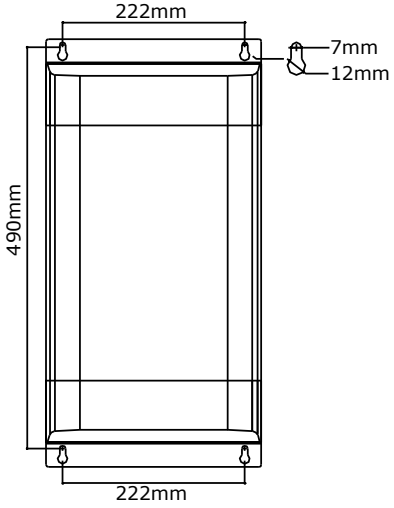


Size S13
(225A)
Weight 18kg





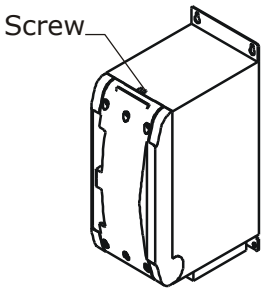
Size S14
(300A÷600A)
Weight 22,5kg



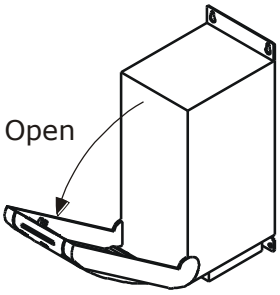
6.3 Removing the cover

Size S09

Remove the screw, if present

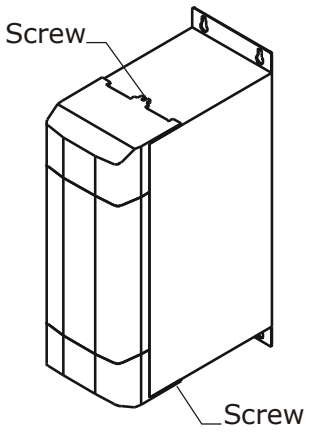


Open the unit

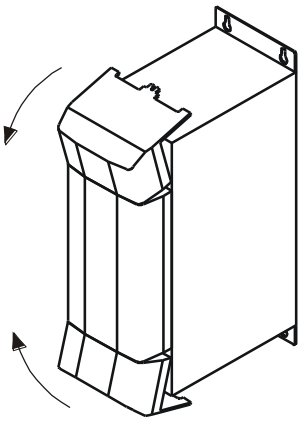


Size S11

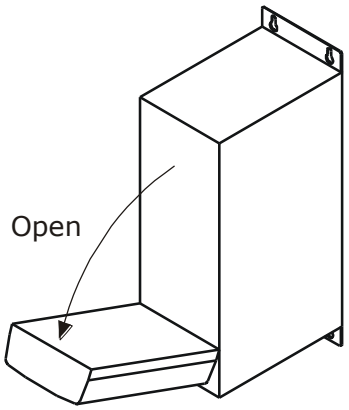
Remove the screw, if present



Remove the plastic cover

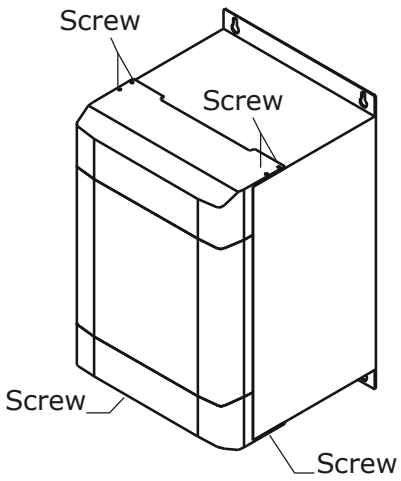


Open the unit

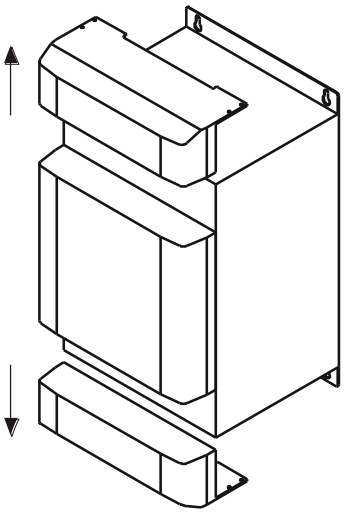


Size S13/S14

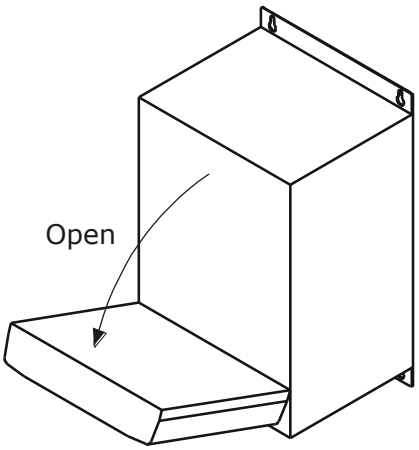
Remove the screw



Remove the plastic cover



Open the unit



7 Wiring instructions

Caution: *this procedure must be performed only by qualified persons.*

The Thyristor unit could be susceptible to interferences lost by near equipments or by the power supply, for this reason in accord to the fundamental practices rules is opportune take some precautions:

- The electronic circuit of the Thyristor unit must be supplied from a dedicated voltage and not with inductive or capacitive loads. We recommend the use of a screened transformer.
- The coil contactor, the relays and other inductive loads must be equipped with opportune RC filter.
- Use shielded bipolar cables for all the input and output signals.
- The signal cables must not be near and parallel to the power cables.
- Local regulations regarding electrical installation should be rigidly observed.

For safety connect the heat-sink to the earth with his terminal.

7.1 Wiring details

Use copper cables and wires rated for use at 75°C only.

7.1.1 Power cable torque (suggested)

Current	Connector Type	Torque Lb-in (N-m)	Wire Range AWG / kcmil	Wire Terminal
25A÷225A	Terminal Block M8	265 (30.0)	8 4/0	Copper wire Compact (Solid) Stranded
300A	Bus Bar with M8 screw	505 (57.0)	2x1/0 350	UL Listed (ZMVV) Copper Tube Crimp. Lug
350A÷400A	Bus Bar with M10 screw	505 (57.0)	2x3/0 600	UL Listed (ZMVV) Copper Tube Crimp. Lug
450A	Bus Bar with M10 screw	505 (57.0)	Bus Bar 30x6mm	
500A÷600A	Bus Bar with M10 screw	505 (57.0)	Bus Bar 60x4mm	

7.1.2 Power cable dimensions (suggested)

Current	Power Supply Cable		Load Cable (Output)		Earth	
	mm²	AWG	mm²	AWG	mm²	AWG
25A (S09)	10	8	10	8	4	12
35A (S09)	10	8	10	8	6	10
45A (S09)	10	8	10	8	6	10
75A (S09)	25	4	25	4	10	8
100A (S11)	35	3	35	3	16	6
125A (S11)	50	1	50	1	16	6
150A (S11)	70	1/0	70	1/0	16	6
225A (S13)	120	4/0	120	4/0	25	4
300A (S14)	2 x 70	2 x 1/0	2 x 70	2 x 1/0	50	1
350A (S14)	2 x 95	2 x 3/0	2 x 95	2 x 3/0	50	1
400A (S14)	2 x 95	2 x 3/0	2 x 95	2 x 3/0	50	1
450A (S14)	Bus Bar 30 x 6 mm		Bus Bar 30 x 6 mm		70	1/0
500A (S14)	Bus Bar 60 x 4 mm		Bus Bar 60 x 4 mm		70	1/0
600A (S14)	Bus Bar 60 x 4 mm		Bus Bar 60 x 4 mm		70	1/0

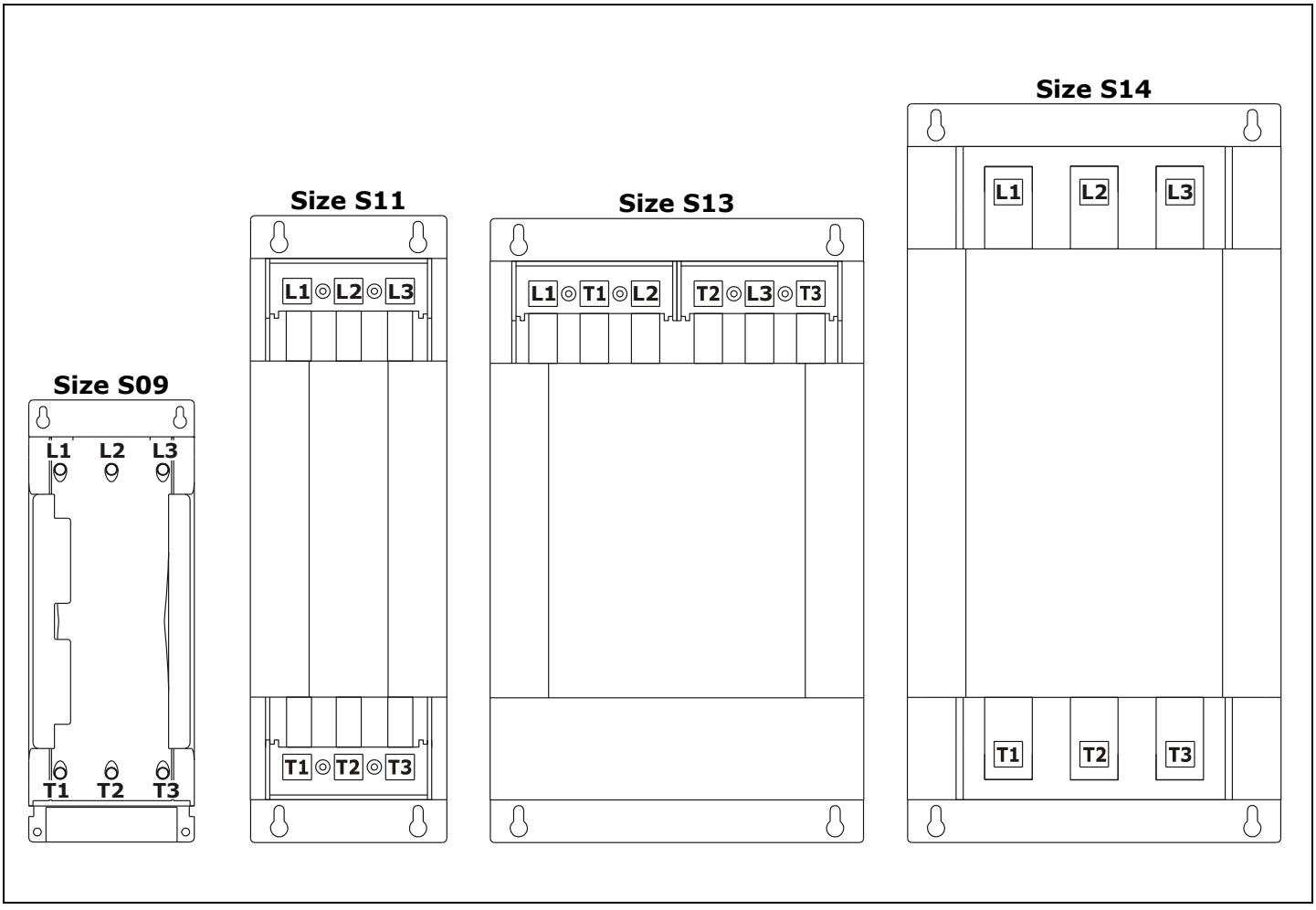
7.1.3 Cable dimensions of the Command Terminals

Maximum connection capacity for all size: 1.5 mm2 (14 AWG)

7.2 Power Terminals

Warning: *Before connecting or disconnecting the unit check that power and control cables are isolated from voltage sources.*

Terminal	Description
L1	Line Input Phase 1
L2	Line Input Phase 2
L3	Line Input Phase 3
T1	Load Output Phase 1
T2	Load Output Phase 2
T3	Load Output Phase 3



7.3 Command Terminals Size S09

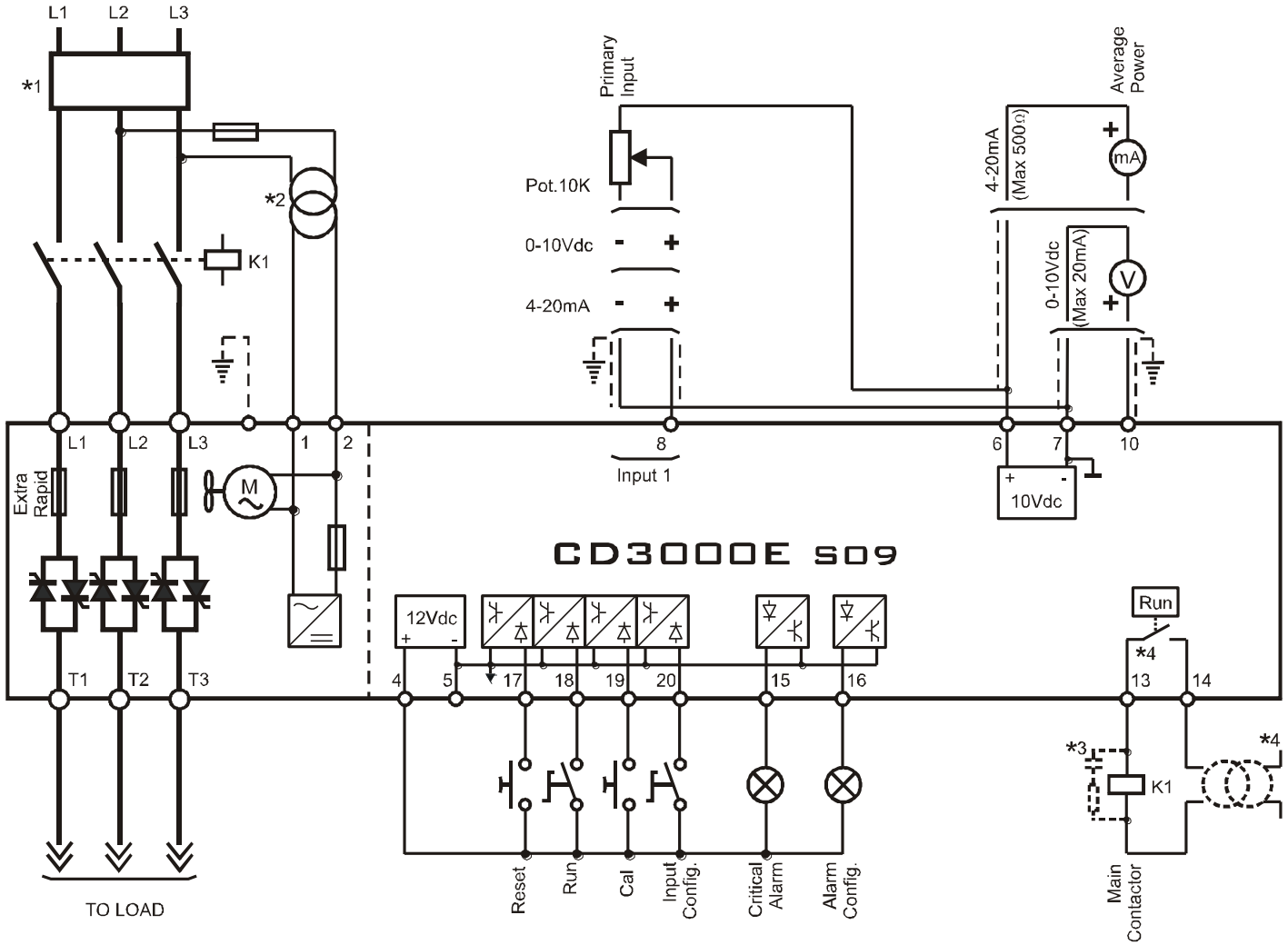
Warning: *Before connecting or disconnecting the unit check that power and control cables are isolated from voltage sources.*

Terminal	Description
1	Voltage Supply for Electronic Boards (See par. 11.2)
2	Voltage Supply for Electronic Boards (See par. 11.2)
3	Not used
4	Isolated output +12Vdc MAX 20mA
5	GND for Digital Input
6	Output +10Vdc MAX 5mA
7	GND for Analogue Input
8	(+)Analogue Input 1: Primary (See par. 11.3)
9	Not used
10	Analogue Output 1: Power (See par. 11.4)
11	Not used
12	Not used
13	Output relay: Run (Max 500mA, 125Vac)
14	Common of the contact relay: Run
15	NPN Output 1: Critical Alarm (12Vdc max 20mA)
16	NPN Output 2: Configurable (12Vdc max 20mA)
17	Digital Input: Reset Alarm
18	Digital Input: Start/Stop
19	Digital Input: Calibration
20	Digital Input: Configurable

(See par. 11)

7.4 Diagram of control connection Size S09

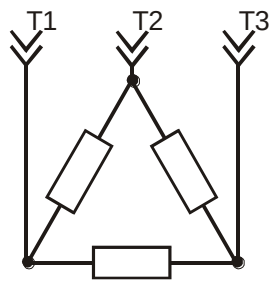
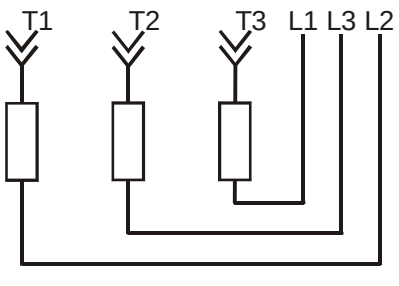
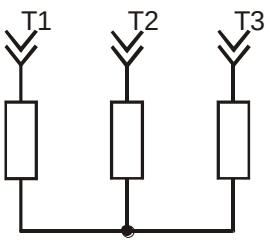
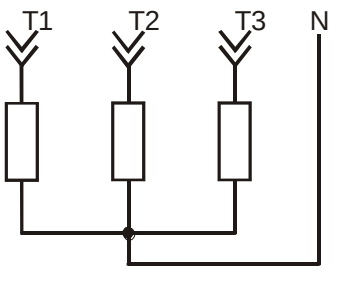
Caution: *this procedure must be performed only by qualified persons.*



NOTE:

- *1 *The user installation must be protecting by electromagnetic circuit breaker or by fuse isolator.*
- *2 *Use an appropriate external transformer based on the voltage supply of the electronic board (see the identification label)*
- *3 *The coil contactor, the relays and other inductive loads must be equipped with opportune RC filter.*
- *4 *Before give the Start command supply the auxiliary voltage.*

Load Type

			
Delta	Open Delta	Star	Star + Neutral

7.5 Command Terminals Size S11/S13/S14

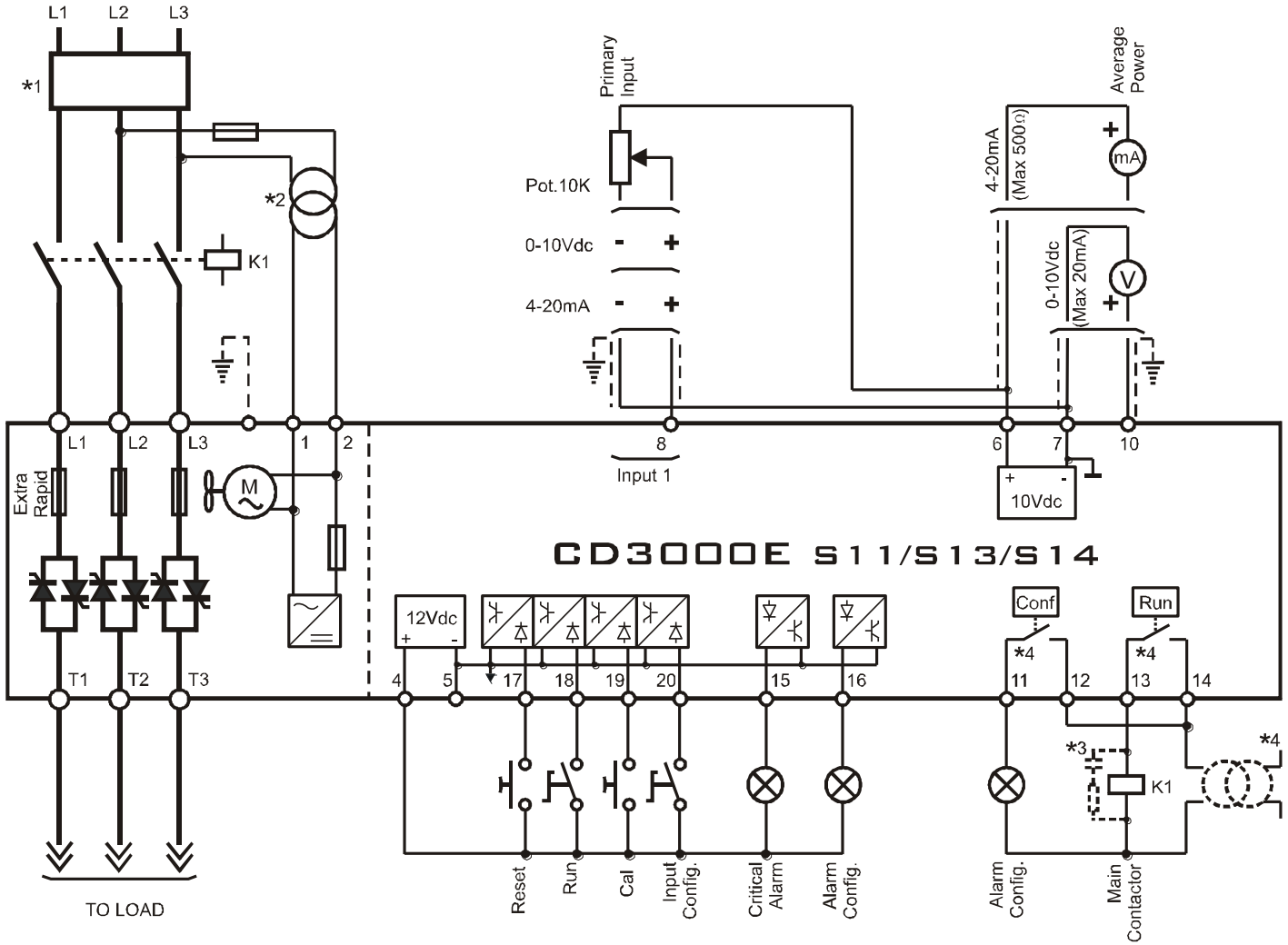
Warning: *Before connecting or disconnecting the unit check that power and control cables are isolated from voltage sources.*

Terminal	Description
1	Voltage Supply for Electronic Boards (See par. 11.2)
2	Voltage Supply for Electronic Boards (See par. 11.2)
3	Not used
4	Isolated output +12Vdc MAX 20mA
5	GND for Digital Input
6	Output +10Vdc MAX 5mA
7	GND for Analogue Input
8	(+)Analogue Input 1: Primary (See par. 11.3)
9	Not used
10	Analogue Output 1: Power (See par. 11.4)
11	Output relay: Conf (Max 500mA, 125Vac)
12	Common of the contact relay: Conf
13	Output relay: Run (Max 500mA, 125Vac)
14	Common of the contact relay: Run
15	NPN Output 1: Critical Alarm (12Vdc max 20mA)
16	NPN Output 2: Configurable (12Vdc max 20mA)
17	Digital Input: Reset Alarm
18	Digital Input: Start/Stop
19	Digital Input: Calibration
20	Digital Input: Configurable

(See par. 11)

7.6 Diagram of control connection Size S11/S13/S14

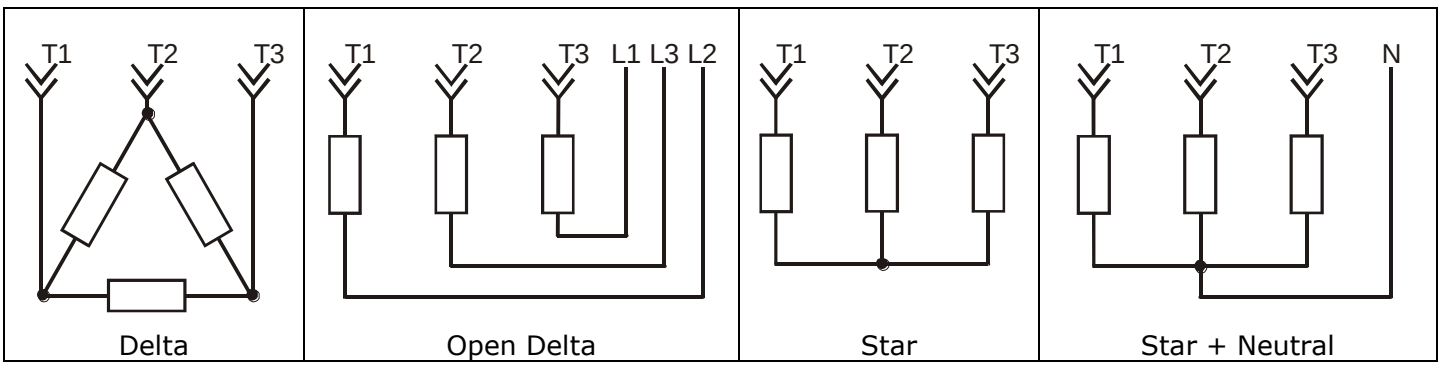
Caution: *this procedure must be performed only by qualified persons.*



NOTE:

- *1 *The user installation must be protecting by electromagnetic circuit breaker or by fuse isolator.*
- *2 *Use an appropriate external transformer based on the voltage supply of the electronic board (see the identification label)*
- *3 *The coil contactor, the relays and other inductive loads must be equipped with opportune RC filter.*
- *4 *Before give the Start command supply the auxiliary voltage.*

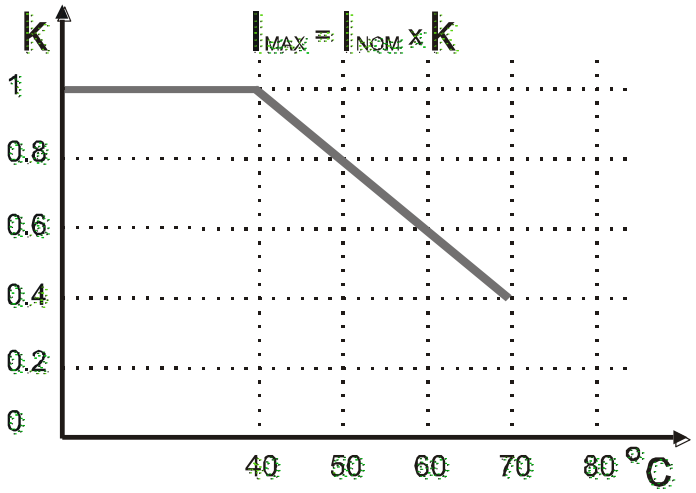
Load Type



8 Power output features

Current	Voltage range	Repetitive peak reverse voltage		Latching current	Max peak one cycle	Leakage current	I^2T value max	Frequency range	Power loss	Isolation Voltage
(A)	(V)	(480V)	(600V)	(mAeff)	(10msec.) (A)	(mAeff)	tp=10msec	(Hz)	I=Inom (W)	Vac
25A	330÷600	1600	1600	450	1900	15	18050	47÷70	65	3000
35A	330÷600	1600	1600	450	1900	15	18100	47÷70	126	3000
45A	330÷600	1600	1600	450	1900	15	18200	47÷70	162	3000
75A	330÷600	1600	1600	450	1900	15	18400	47÷70	270	3000
100A	330÷600	1600	1600	450	1900	15	18600	47÷70	360	3000
125A	330÷600	1600	1600	450	1900	15	19100	47÷70	450	3000
150A	330÷600	1600	1600	450	5000	15	108000	47÷70	540	3000
225A	330÷600	1600	1600	300	5000	15	109000	47÷70	810	3000
300A	330÷600	1600	1600	300	5000	15	125000	47÷70	1080	3000
350A	330÷600	1600	1600	200	7900	15	300000	47÷70	1260	3000
400A	330÷600	1600	1600	200	8000	15	306000	47÷70	1440	3000
450A	330÷600	1600	1600	1000	15000	15	1027000	47÷70	1620	2500
500A	330÷600	1600	1600	1000	15000	15	1027000	47÷70	1800	2500
600A	330÷600	1600	1600	1000	15000	15	1027000	47÷70	2160	2500

8.1 Derating curve



8.2 Cooling fans

The REVO thyristor unit is equipped with a cooling fans. The supply votage is the same of the electronic board (see par. 11.2). The fan's power consumption is below listed:

Size	CE Number of fans	cULus LISTED Number of fans
25A ÷ 150A	One Fan - 17W	One Fan - 17W
225A	Two Fans - 30W	Two Fans - 30W
350A, 450A	Two Fans - 30W	Four Fan - 60W
300A, 400A, 500A ,600A	Four Fan - 60W	Four Fan - 60W

9 Led status and Alarms

9.1 LED Status Table

On the Electronic board there are LED that indicates the state of the Electronic cards:

LED For All size	STATUS	DESCRIPTION
AUX	○	The power supply is not connected or fault on the electronic board
	●	Fault on the electronic board
	☀	Electronic board is OK
All ON	○	No alarm
	●	In Alarm
		Critical Alarm
SC	○	SCR OK
	●	SCR short circuit
HB	○	Laod OK
	●	Load Fault
	☀	Current limit active
	○	= OFF
	●	= ON
	☀	= Lampeggiante

9.2 Critical Alarms

When a critical alarm is active, it stops the REVO E thyristor unit and activates the relative digital output (terminal 15).
The parameter P001 AL_1 allows to visualize the state of these alarms

9.2.1 Phase loss

This critical alarm is active when one of the three phases R-S-T is loss. The phase loss could be also activated by an interrupted fuse.
For restart the thyristor unit, check the presence of the line voltage on the power terminals L1, L2, L3 and check the state of the internal fuses, When the problem is solved before to restart is necessary use the digital input: "Reset Alarm" (see par. 11.5).

9.2.2 External Alarm

This critical alarm is active when the Digital input 4 is configured like "External Alarm" and is activated.
For restart the thyristor unit, you must disarm the external alarm. When the problem is solved before to restart is necessary use the digital input: "Reset Alarm" (see par. 11.5).

9.2.3 Heat-sink Over temperature

This critical alarm is active when the thermal switch mounted on the heat-sink is activated.
For restart the thyristor unit, you must wait that the heat-sink returns at the safety temperature. When the problem is solved before to restart is necessary use the digital input: "Reset Alarm"
(see par. 11.5).
If this alarm becomes active, check if the indications described in the "par. 6" of this manual are respected.

Caution: *this procedure must be performed only by qualified persons.*

9.3 Not Critical Alarm

The Not Critical Alarm, doesn't stop the REVO E thyristor unit, but is possible to associate an digital output at these alarms (see par. 11.6).
The parameter P002 AL_2 allows to visualize the state of these alarms

9.3.1 SCR Short Circuit

This alarm is active when REVO E read the output current in absence of the input signal. This is possible if there are a short circuit on the thyristor or if there are a wrong wiring of the load.
When the problem is solved is necessary use the digital input: "Reset Alarm" (see par. 11.5).

9.3.2 Unbalanced Load

This alarm is active when one of the three load current (read on the terminals T1, T2, T3) differs from the others more than 30%.
The unbalanced alarm could be active also if there are a wrong wiring of the load.
When the problem is solved is necessary use the digital input: "Reset Alarm" (see par. 11.5).

9.3.3 Heater Break alarm (HB)

This alarm is active when the load current decrease under the threshold set on the parameter P066 Hb_S
The Heater Break alarm could be active also if there are a wrong wiring of the load.
When the problem is solved is necessary use the digital input: "Reset Alarm" (see par. 11.5).
The Heater Break alarm to work properly must have an input signal more then 25% of the nominal current value.

Caution: *In the first start, and each time that the load is replaced, it's necessary make the Calibration procedure.*

9.4 Calibration Procedure

The Calibration procedure is an automatic procedure that save in memory the three different values of load current (for each phase)
This procedure is necessary if you use the Burst Firing (BF) or if you use the Heater Break Alarm.
To make the Calibration procedure follow these steps:

- Give the power supply and start the thyristor unit (see par. 11.5).
- Activate the digital input: "Cal" (terminal 19).
- The REVO E thyristor unit give the maximum output voltage.
- After a few seconds the values of voltage and current are stored in memory.
- The REVO E thyristor unit returns to the initial situation.
- Stop the thyristor unit.

The Calibration procedure is done.

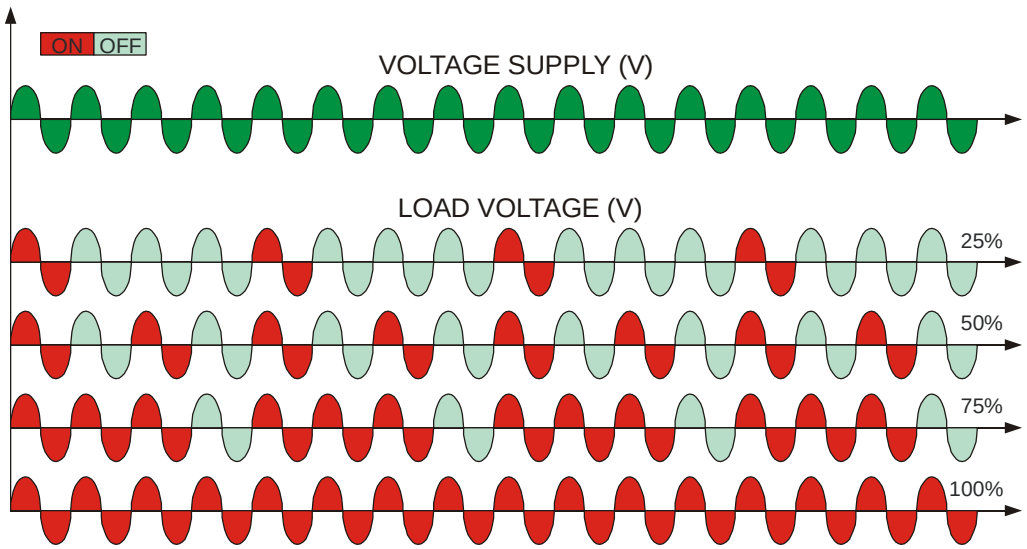
10 Firing type

Choose an correct firing type allows to optimize the thyristor unit for the installed load.
The firing type has already configured in line with customer requirements that are defined in the Order Code. The Order Code is written on the identification label.
However, if you wish to change the firing type you can use the software configurator or the Control Panel (see par. 0).

Caution: *this procedure must be performed only by qualified persons.*

10.1 Single Cycle (SC)

Single Cycle it's the faster zero crossing switching method in relationship of the power demand from a temperature regulator or from an external signal.
With input signal at 25% the output is one cycle ON and three cycles OFF
With input signal at 50% the output is one cycle ON and one cycle OFF
With input signal at 75% the output is three cycles ON and one cycle OFF
With input signal at 76% the output is the same of 75% but for each ON cycle the microprocessor divides 76/75, and when the sum of rests is one, the unit does one more cycle ON. For this firing is necessary to have analog input.
The Single Cycle is used to control the loads with low inertia or for infrared lamps to short wave.



10.1.1 Suggested recipe for Single Cycle

The firing type has already configured in line with customer requirements that are defined in the Order Code. The Order Code is written on the identification label.
However, if you wish to change the firing type you can use the software configurator or the Control Panel (see par. 0).

Caution: *this procedure must be performed only by qualified persons.*

OPERATOR MENU					
Parameter	**Name**	**Value**	**Description**	**UM**	**Mode**
P003 (H03)	L--r	0	Setpoint selection Analog/Digital		R/W
P004 (H04)	L_SP		Digital Setpoint value	%	R/W
P019 (H13)	OutN	100	Maximum Output	%	R/W
P024 (H18)	rP_u	0	Setpoint Ramp Up	Sec	R/W
P025 (H19)	rP_d	0	Setpoint Ramp Down	Sec	R/W
P116 (H74)	U_OP	V Load	Operative load voltage	V	R/W
P119 (H77)	A_Lo	I Load	Load nominal current	A	R/W

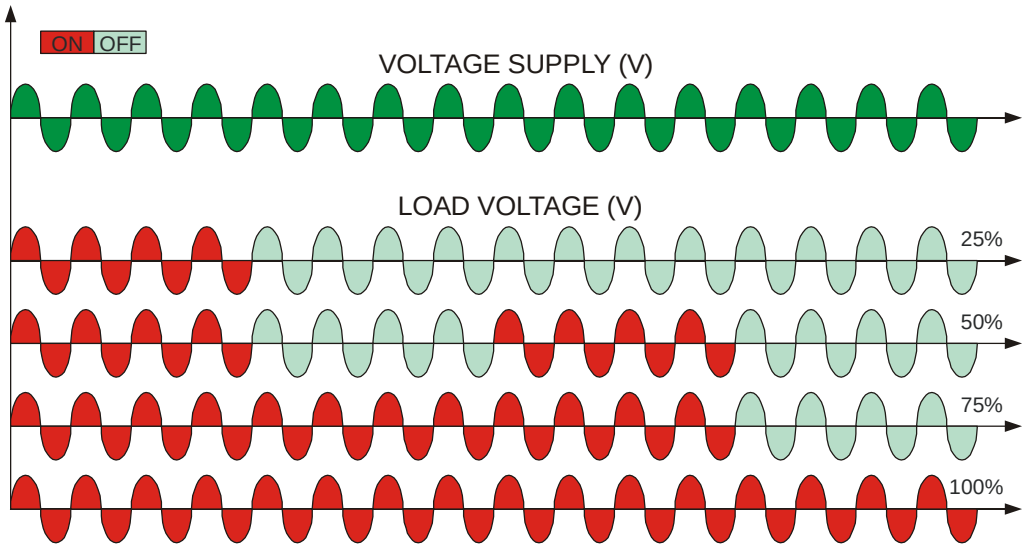
SETUP MENU					
Parameter	**Name**	**Value**	**Description**	**UM**	**Mode**
P023 (H17)	F ir	0	Firing Type		R/W
P066 (H42)	Hb_S	20	HB sensitivity	%	R/W
P070 (H46)	FEEd	1	Feed back selection		R/W
P083 (H53)	bF_n	1	Burst Firing Cycles (Not used in Phase Angle)	Cycles	R/W
P084 (H54)	bF_r	0	Ramp Cycles of Burst (Not used in Phase Angle)	Cycles	R/W
P085 (H55)	dt	0	Delay triggering	°	R/W
P090 (H5A)	CL_ı	1	Limit current Analog/Digital		R/W
P091 (H5B)	CL	0÷100,0☐	Digital Limit current value	%	R/W
P098 (H62)	LoAd	0÷3	Define the load type connection: 0=star 1=star+N 2=delta 3=open delta		R/W

	= modification is not necessary
	= modification is necessary

☐ If the current limit is not used set this value to 100,0%

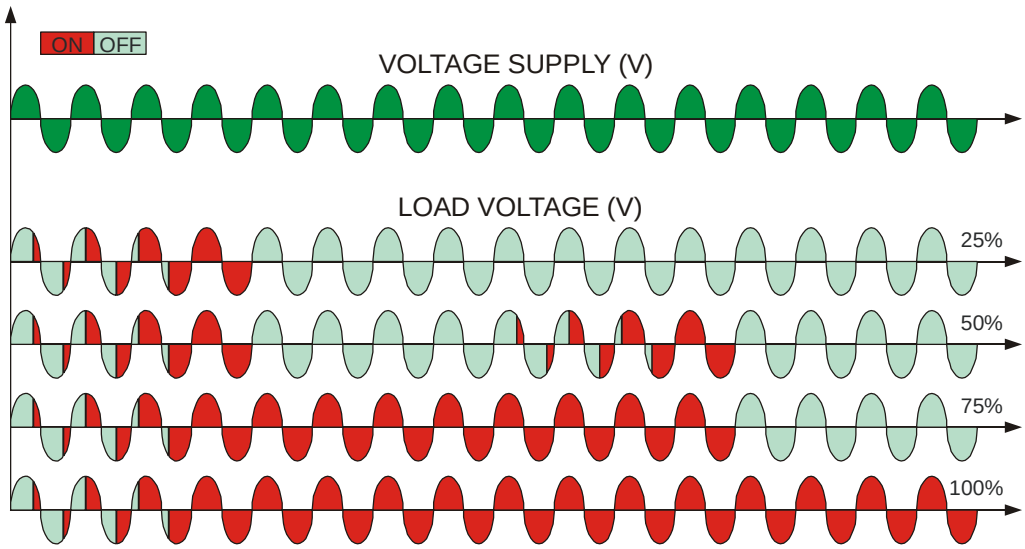
10.2 Burst Firing (BF)

The Burst Firing is similar to the Single Cycle, but consecutive cycles ON are selectable between 2 and 255, with input signal equal at 50%.
Burst Firing is a method zero crossing that it reduces the electromagnetic interferences because the thyristor switches at zero voltage crossing.
The example show the Burst Firing with Burst cycles: P083 bF_n =4



10.2.1 Soft Start with Burst Firing (S+BF)

This is an additional function to the Burst Firing. The unit start in phase angle mode with a ramp starting from zero up to the full tension in the cycles number set in the parameter P084 bF_r.
When the ramp is over, the thyristor unit will stay in conduction at full voltage up to the end of cycles of burst. The S+BF firing is used to control small inductive loads to avoid inrush surge current and to reduce the electromagnetic interferences.
The example show the firing with Burst cycles: P083 bF_n =4 and ramp cycles: P084 bF_r =3



10.2.2 Suggested recipe for Burst Firing

The firing type has already configured in line with customer requirements that are defined in the Order Code. The Order Code is written on the identification label.
However, if you wish to change the firing type you can use the software configurator or the Control Panel (see par. 0).

Caution: *this procedure must be performed only by qualified persons.*

OPERATOR MENU					
Parameter	**Name**	**Value**	**Description**	**UM**	**Mode**
P003 (H03)	L--r	0	Setpoint selection Analog/Digital		R/W
P004 (H04)	L_SP		Digital Setpoint value	%	R/W
P019 (H13)	OutN	100	Maximum Output	%	R/W
P024 (H18)	rP_u	0	Setpoint Ramp Up	Sec	R/W
P025 (H19)	rP_d	0	Setpoint Ramp Down	Sec	R/W
P116 (H74)	U_OP	V Load	Operative load voltage	V	R/W
P119 (H77)	A_Lo	I Load	Load nominal current	A	R/W

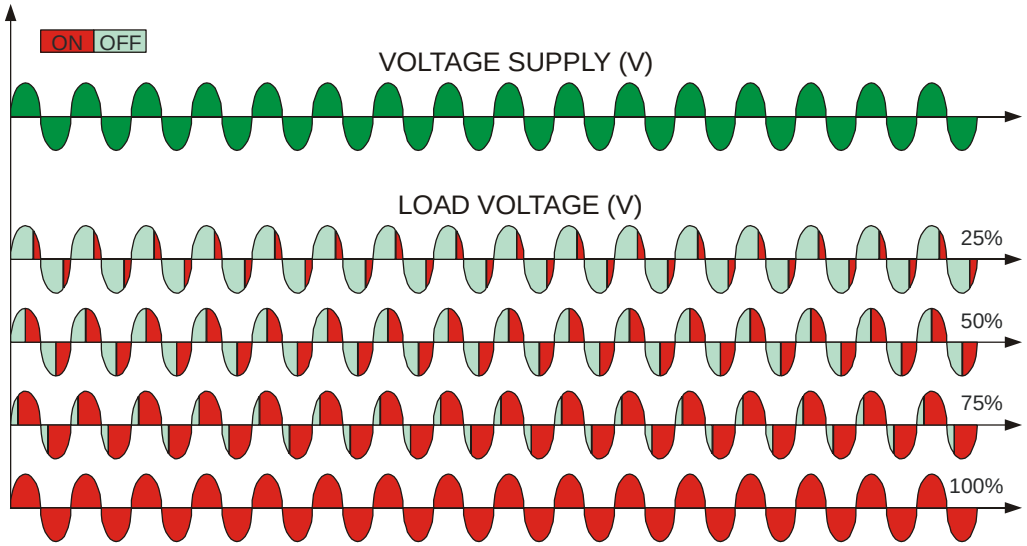
SETUP MENU					
Parameter	**Name**	**Value**	**Description**	**UM**	**Mode**
P023 (H17)	F ir	0	Firing Type		R/W
P066 (H42)	Hb_S	20	HB sensitivity	%	R/W
P070 (H46)	FEEd	1	Feed back selection		R/W
P083 (H53)	bF_n	8	Burst Firing Cycles (Not used in Phase Angle)	Cycles	R/W
P084 (H54)	bF_r	<P083 bF_n [2]	Ramp Cycles of Burst (Not used in Phase Angle)	Cycles	R/W
P085 (H55)	dt	0	Delay triggering	°	R/W
P090 (H5A)	CL_ i	1	Limit current Analog/Digital		R/W
P091 (H5B)	CL	0÷100,0□	Digital Limit current value	%	R/W
P098 (H62)	LoAd	0÷3	Define the load type connection: 0=star 1=star+N 2=delta 3=open delta		R/W

	= modification is not necessary
	= modification is necessary

□ If the current limit is not used set this value to 100,0%.
[2] If don't use the ramp soft start (S+BF) set this value to 0.

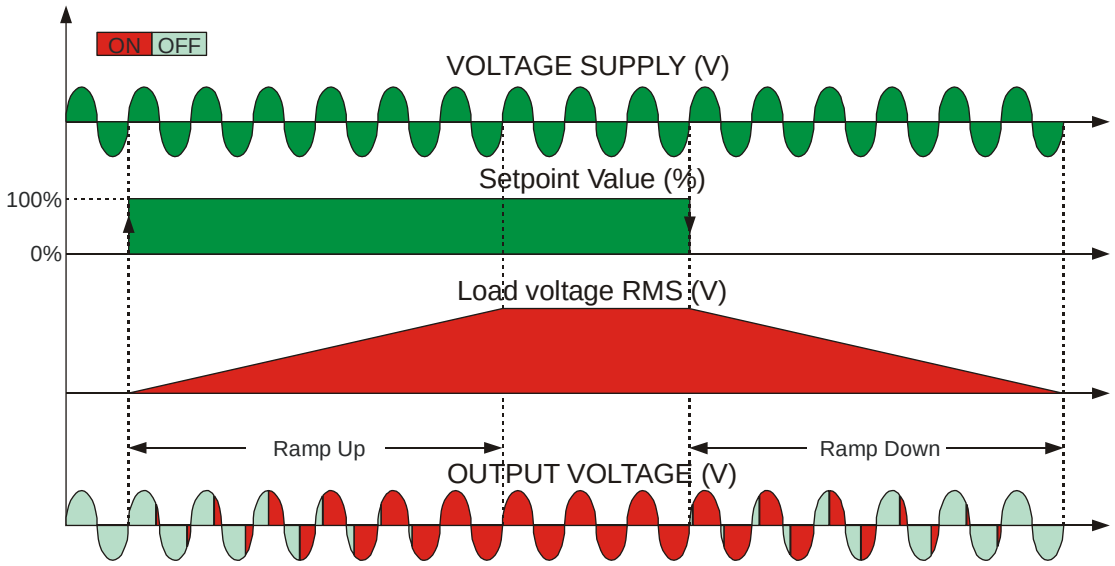
10.3 Phase Angle (PA)

The Phase Angle firing allow the control of the power on the load, for this firing the thyristor can be in conduction only for a part of the voltage cycle.
This part of the voltage cycle is adjustable in function of the input signal from 0 at 100%.
The PA firing is normally used for control the inductive loads, and is also possible control a primary of transformer coupled with the cold resistances like: Superkanthal, Molybdenum, Platinum, Tungsten or Quartz Lamp. The only disadvantage with phase angle is the possible generation of interferences that however can be reduced with opportune filters.



10.3.1 Soft Start with Phase Angle (S+PA)

This is an additional function to the Phase Angle. The firing angle of the thyristor increase or decrease up to the final setpoint value.
The Soft start ramp is an important feature to reduce the inrush current with transformers during the during the cycle of magnetization or with cold resistance that are near to the short circuit when they are supplied.
Setpoint Ramp Up : P024 rP_u
Setpoint Ramp Down: P025 rP_d



10.3.2 Suggested recipe for Phase Angle

The firing type has already configured in line with customer requirements that are defined in the Order Code. The Order Code is written on the identification label.
However, if you wish to change the firing type you can use the software configurator or the Control Panel (see par. 0).

Caution: *this procedure must be performed only by qualified persons.*

OPERATOR MENU					
Parameter	**Name**	**Value**	**Description**	**UM**	**Mode**
P003 (H03)	L--r	0	Setpoint selection Analog/Digital		R/W
P004 (H04)	L_SP		Digital Setpoint value	%	R/W
P019 (H13)	OutN	100	Maximum Output	%	R/W
P024 (H18)	rP_u	0÷1000²	Setpoint Ramp Up	Sec	R/W
P025 (H19)	rP_d	0÷1000²	Setpoint Ramp Down	Sec	R/W
P116 (H74)	U_OP	V Load	Operative load voltage	V	R/W
P119 (H77)	A_Lo	I Load	Load nominal current	A	R/W

SETUP MENU					
Parameter	**Name**	**Value**	**Description**	**UM**	**Mode**
P023 (H17)	F ir	1	Firing Type		R/W
P066 (H42)	Hb_S	20	HB sensitivity	%	R/W
P070 (H46)	FEEd	1	Feed back selection		R/W
P083 (H53)	bF_n		Burst Firing Cycles (Not used in Phase Angle)	Cycles	R/W
P084 (H54)	bF_r		Ramp Cycles of Burst (Not used in Phase Angle)	Cycles	R/W
P085 (H55)	dt	0	Delay triggering	°	R/W
P090 (H5A)	CL_ı	1	Limit current Analog/Digital		R/W
P091 (H5B)	CL	0÷100,0☐	Digital Limit current value	%	R/W
P098 (H62)	LoAd	0÷3	Define the load type connection: 0=star 1=star+N 2=delta 3=open delta		R/W

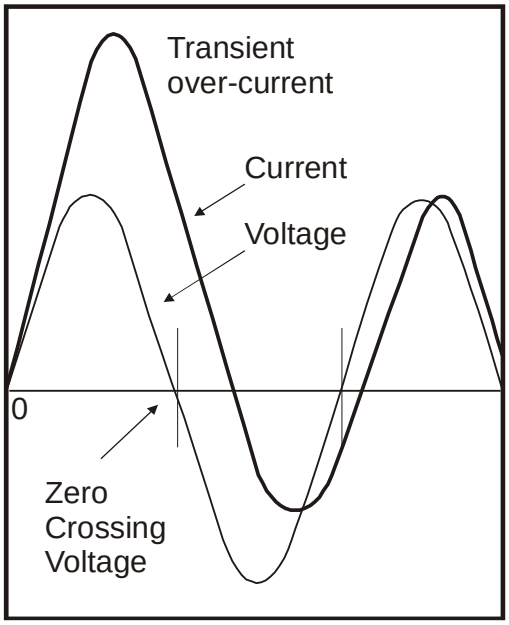
	= modification is not necessary
	= modification is necessary

☐ If the current limit is not used set this value to 100,0%.
² If don't use the ramp soft start (S+PA) set this value to 0.

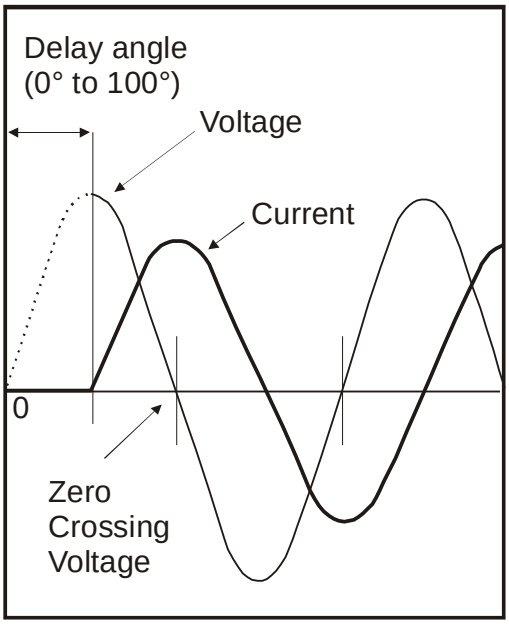
10.4 Delay Triggering (DT)

The Delay Triggering firing is used the control a primary of transformer coupled with the normal resistances on the secondary (N.B. don't connect cold resistances on the secondary like: Superkanthal, Molybdenum, Platinum, Tungsten, Quartz Lamp).
For an inductive load (ex transformer), switching the thyristors at zero crossing can generates transient over currents that can blow the fuses, to avoid this problem you must use the Delay Triggering. This firing delay the first half cycle of Burst for an angle from 0 to 100° relative to the zero, besides all the first burst start with soft start ramp to reduce the inrush current during the cycle of magnetization.

Without Delay Triggering

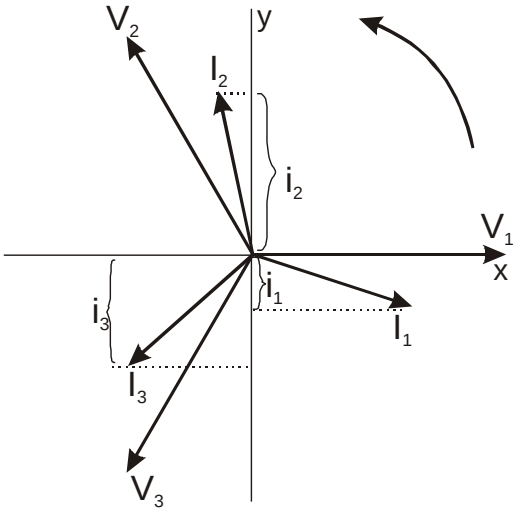


With Delay Triggering

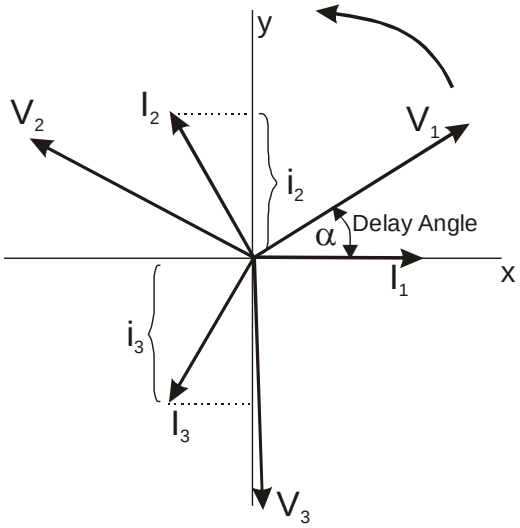


For understand the Delay Triggering firing, we have represented the waves generate by vectors that rotates in counterclockwise:

Without Delay Triggering



With Delay Triggering



Without delay at zero crossing when V1 is to zero (projected on the X axis) the unit switch On.
In this case the instantaneous value of the currents are i1, i2 and i3 and this condition, for the curve of magnetization, could generate transient over currents that can blow the fuses.
With Delay Triggering the firing of the thyristor are triggered with a delay until the instantaneous value of the curret i1=0, i2 positive and i3 negative like represented.
In this case the risk of transient over currents is reduced and the fuses don't blow.
The angle alpha is the delay to have i1=0 and this angle depends on the power factor.
The delay angle suggest for most applications is 80°

10.4.1 Suggested recipe for Delay Triggering

The firing type has already configured in line with customer requirements that are defined in the Order Code. The Order Code is written on the identification label.
However, if you wish to change the firing type you can use the software configurator or the Control Panel (see par. 0).

Caution: *this procedure must be performed only by qualified persons.*

OPERATOR MENU					
Parameter	**Name**	**Value**	**Description**	**UM**	**Mode**
P003 (H03)	L--r	0	Setpoint selection Analog/Digital		R/W
P004 (H04)	L_SP		Digital Setpoint value	%	R/W
P019 (H13)	OutN	100	Maximum Output	%	R/W
P024 (H18)	rP_u	0÷1000[2]	Setpoint Ramp Up	Sec	R/W
P025 (H19)	rP_d	0÷1000[2]	Setpoint Ramp Down	Sec	R/W
P116 (H74)	U_OP	V Load	Operative load voltage	V	R/W
P119 (H77)	A_Lo	I Load	Load nominal current	A	R/W

SETUP MENU					
Parameter	**Name**	**Value**	**Description**	**UM**	**Mode**
P023 (H17)	F ir	2	Firing Type		R/W
P066 (H42)	Hb_S	20	HB sensitivity	%	R/W
P070 (H46)	FEEd	1	Feed back selection		R/W
P083 (H53)	bF_n	8	Burst Firing Cycles (Not used in Phase Angle)	Cycles	R/W
P084 (H54)	bF_r	0	Ramp Cycles of Burst (Not used in Phase Angle)	Cycles	R/W
P085 (H55)	dt	0÷100[3]	Delay triggering	°	R/W
P090 (H5A)	CL_ı	1	Limit current Analog/Digital		R/W
P091 (H5B)	CL	0÷100,0☐	Digital Limit current value	%	R/W
P098 (H62)	LoAd	0÷3	Define the load type connection: 0=star 1=star+N 2=delta 3=open delta		R/W

	= modification is not necessary
	= modification is necessary

☐ If the current limit is not used set this value to 100,0%.
[2] If don't use the setpoint ramp set this value to 0.
[3] The delay angle suggest for most applications is 80°

10.5 Feed-back type

The Feed-back type has already configured in line with customer requirements that are defined in the Order Code. The Order Code is written on the identification label.
However, if you wish to change the Feed-back type you can use the software configurator or the Control Panel (see par. 0).

Caution: *this procedure must be performed only by qualified persons.*

The Feed-back type is defined by the parameter P070 FEEd
If the configurable digital input has set like Feed-Back Selection (see par. 11.5), it's possible to change the select Feed-Back with the Voltage Feed-Back (V) simply activating the input.
The feed-back defines the Control Mode. It's possible to have:

- V=Voltage feed-back.
  The input signal is proportional to the output voltage. This means that input signal becomes a voltage demand. This control mode compensates the voltage fluctuation of the incoming line supply.

- I=Current feed-back.
  The input signal is proportional to the current output. This means that input signal becomes a current demand. This control mode maintain the current also if the load impedance changes.

- W=Power feed-back.
  The input signal is proportional to the power output. This means that input signal becomes a power demand. The power remains constant also if voltage and load impedance change. This control mode is used with silicon carbide elements that change its resistive value with temperature and with age. In addition it compensates the voltage fluctuation of the incoming line supply.

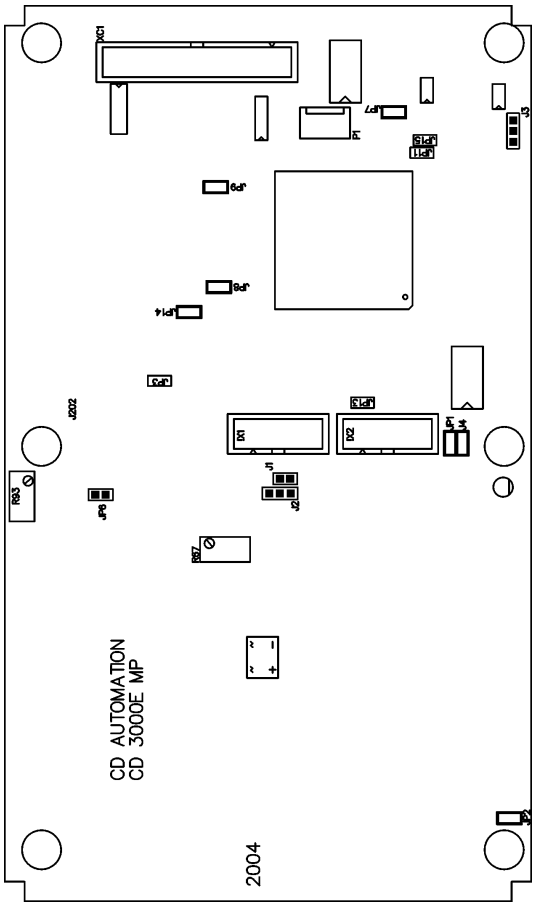
11 Connection description

11.1 Access to the Electronic boards

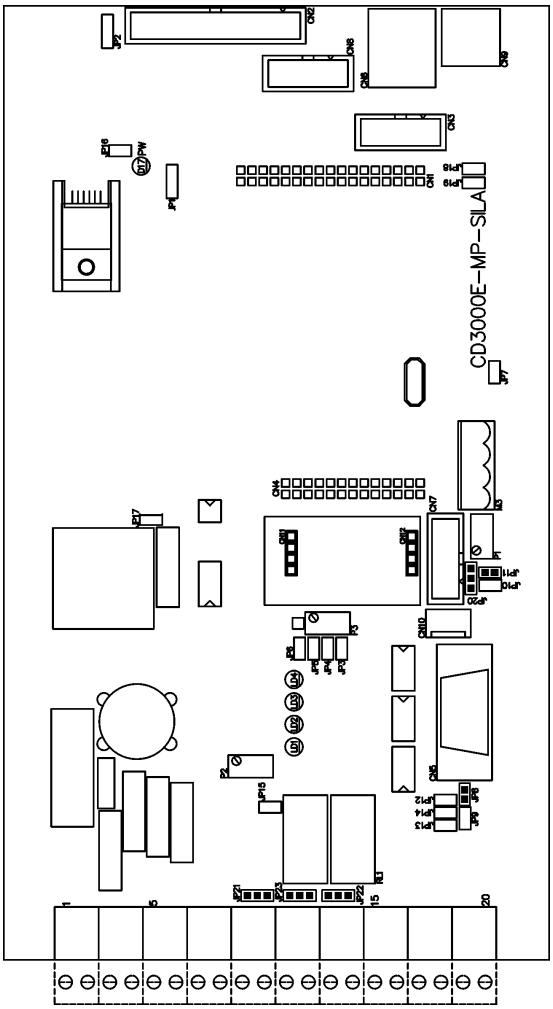
To have access to the electronic boards the user must removing the unit's cover (see par.6.3)

Warning: *Before operate, be sure that power and control cables are isolated from voltage sources*

Size S09



Size S11/S13/S14



11.2 Supply the Electronic Board

The REVO E thyristor unit, to work, requires a voltage supply for the electronic boards. This voltage is used also to supply the internal fans.
The consumption is 20VA max, at this you must add the consumption of the internal fans (see par. 8.2).
The voltage supply for the electronic boards is configured in line with customer requirements that are defined in the Order Code. The Order Code is written on the identification label.

Warning: *Before connecting or disconnecting the unit check that power and control cables are isolated from voltage sources.*

Terminal	Description
1	Voltage Supply for Electronic Boards
2	Voltage Supply for Electronic Boards

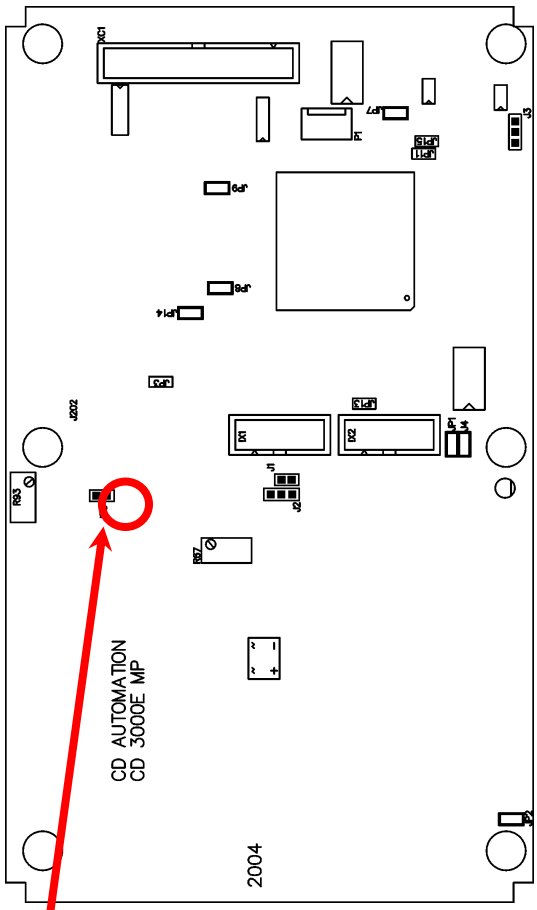
11.3 Analog Inputs

The REVO E thyristor unit has 2 configurable analog inputs (0÷10V, 4÷20mA, ecc):
The primary input for the analog setpoint, the secondary input for the Current Profiler or Ext. Feed-Back.

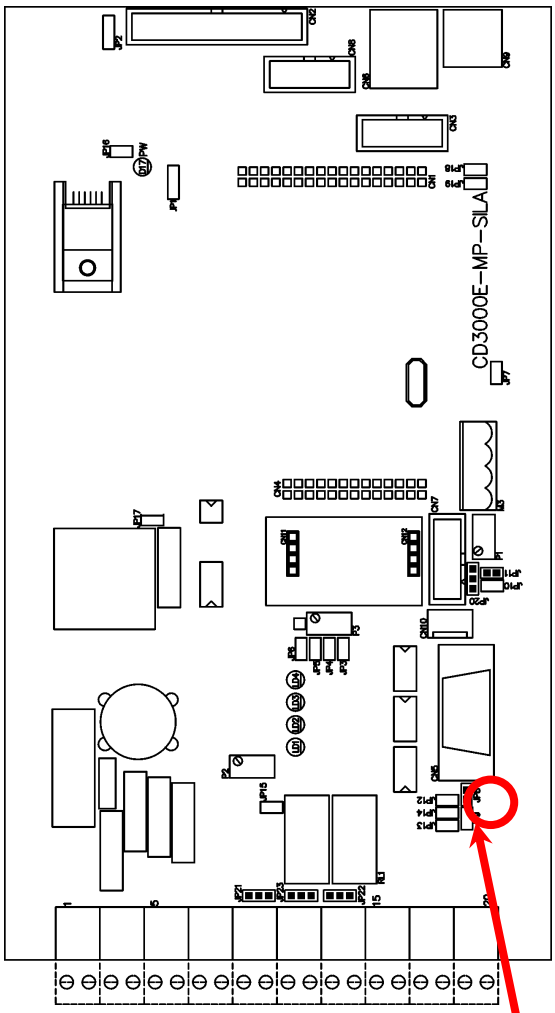
11.3.1 Primary Input (Terminals 8 and 7)

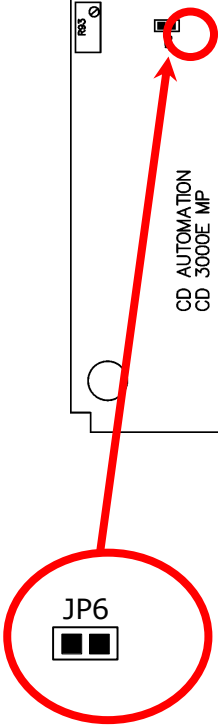
The primary input is already configured in line with customer requirements that are defined in the Order Code. The Order Code is written on the identification label.
However, if you wish to change the primary input (ex. from 0÷10V to 4÷20mA) proceed as follows:

Size S09

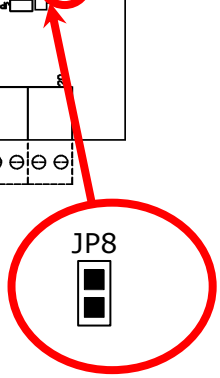


Size S11/S13/S14





Type	Input features		Jumper
0÷10V (default)	Impedance	40KΩ	Open
POT	Impedance	10KΩ min	Open
4÷20mA	Impedance	500Ω	Close



Primary Input calibration procedure
When you change the hardware setting is necessary make the Input calibration procedure.
To make the Input calibration procedure follow these steps:

- Give the power supply.
- With Control Panel go in the Hardware menu (P000 PASS = 5)
- Set the input signal to the min value (ex. 0V for 0÷10V or 4mA for 4÷20mA)
- Set the parameter P057 LAI = 1
- Press ENTER key
- Set the input signal to the max value (ex.10V for 0÷10V or 20mA for 4÷20mA)
- Set the parameter P058 HAI = 1
- Press ENTER key

The Input calibration procedure is done.

11.4 Analog Outputs

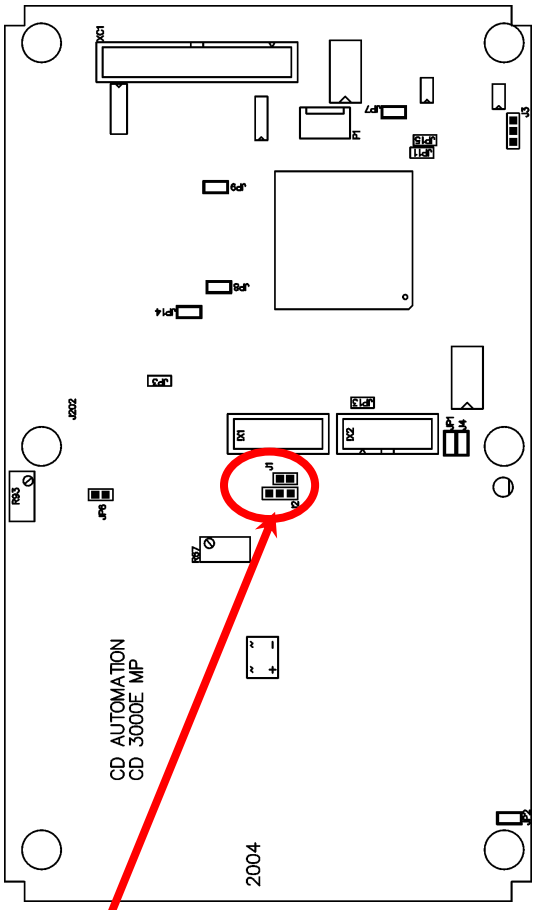
The REVO E thyristor unit have 1 analog output (0÷10V, 4÷20mA, ecc).
The output is for retransmitting the average power on the three phases.

11.4.1 Output 1: Average Power (Terminals 10 and 6 or 10 and 7)

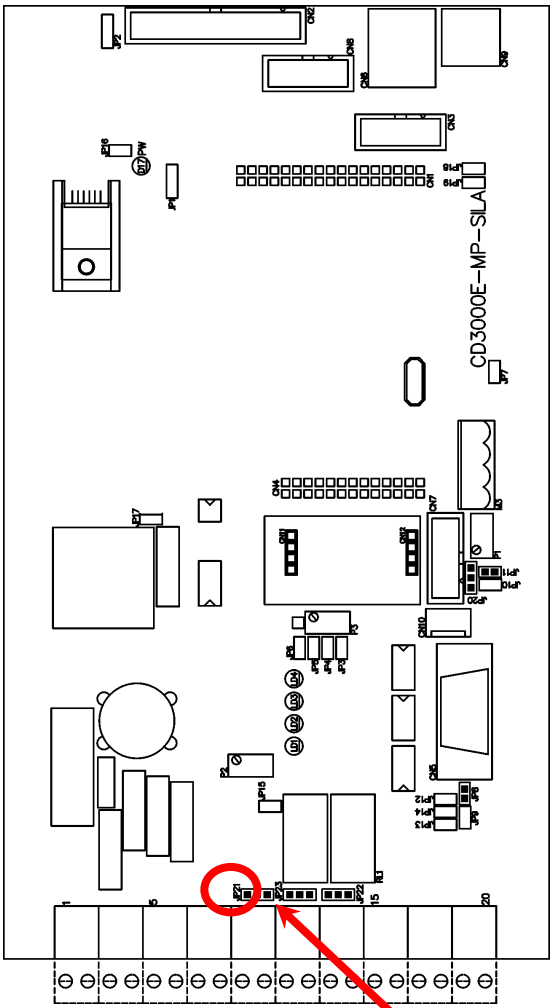
The average power output is already configured in line with customer requirements that are defined in the Order Code. The Order Code is written on the identification label.
However, if you wish to change the average power output (ex. from 0÷10V to 4÷20mA) proceed as follows:

Caution: *this procedure must be performed only by qualified persons*

Size S09



Size S11/S13/S14



JP2
C B A

Type	Output features	P097 oUnA	Jumper
0÷10V (default)	20mA Max	0	A-B
0÷20mA	500Ω Max	0	B-C
4÷20mA	500Ω Max	1	B-C

JP21
C B A

Setting the Output Value
The parameter P104 G_AI allows to set the full scale value to have the maximum output, for example if you use an indicator with full scale 50Kw set the parameter P104 G_AI = 50.

11.5 Digital Input

The REVO E thyristor unit has 4 digital inputs opto-isolated to 12Vdc.
You can activate the inputs with the internal supply (see par. 7.4) or with an external source for example the PLC.

11.5.1 Reset alarm (Terminal 17)

The Reset Alarm is used for restore the unit after an alarm occurs.
Before using this input you must resolve the fault or the alarm status come back.

11.5.2 Start/Stop (Terminal 18)

This is the start command of the REVO E thyristor unit and active the relative digital output (terminal 13 and 14) connected to the main contactor, if no alarm occurs, the REVO E thyristor unit give an output proportional at the input signal.
If you Remove the Start command the REVO E thyristor unit will be stopped and the output will return at zero following the ramp. When the ramp is over the Run contact will be reopened and the main contactor goes down.

11.5.3 Calibration (Terminal 19)

The Calibration input activates the Calibration procedure that is necessary if you use the Burst Firing (BF) or the Heater break alarm (see par. 9.4).

11.5.4 Configurable Input (Terminal 20)

This digital input is configured by the parameter P103 C_d , and could perform different functions:

- Additional Reset Alarm:
  This function is the same of the Reset Alarm command.
- Setpoint zero:
  This function forces the output at zero maintaining the Run contact closed.
- Feed-Back Selection:
  With this function, when you active the input, the feed-back setted in the parameter P070 FEEd change in Voltage Feed-Back (V).
- Analog/Digital Setpoint:
  With this function, when you active the input, the setpoint reference change from Analog input to Digital value, setted in the parameter P004 L_SP
- External Alarm:
  With this function the thyristor unit, to work, must not have this digital input active.
  When the unit is in Run and you active the External Alarm, the unit will be stopped and the output goes at zero without follow the ramp. The Run contact at the terminals 13 and 14 will be immediately reopened and the main contactor goes down. The External Alarm activates also the Critical Alarm digital output.

11.6 Digital Output

The REVO E thyristor unit has 2 digital output (1 for size S09) with relay contact (Max 500mA, 125Vac) and 2 digital output with logic NPN 12Vdc (20ma Max).

11.6.1 Configurable Relay (Terminals 11 and 12 not available for size S09)

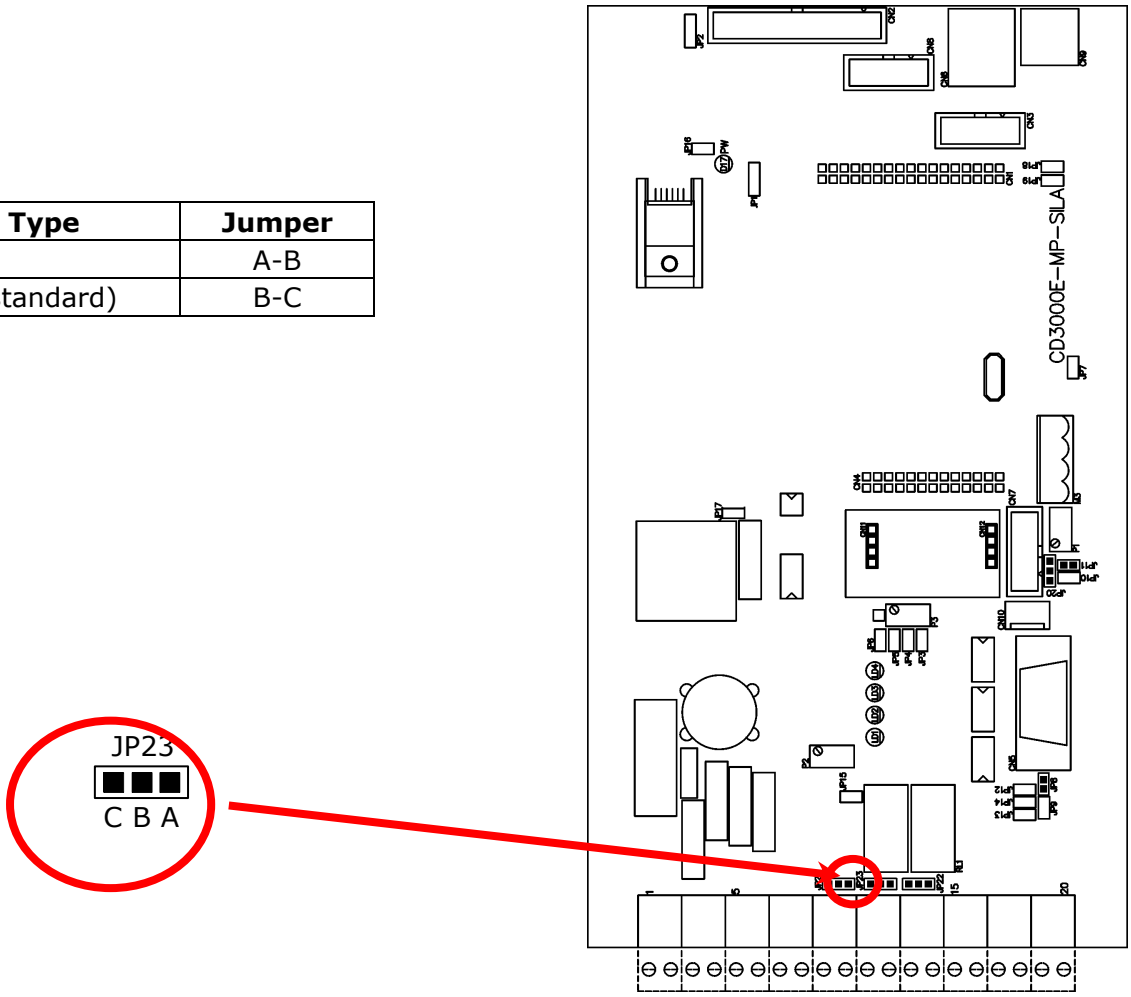
This digital output can be configured in order to activate itself after that one of these alarms occors:

- SCR in short circuit
- Unbalanced Load
- Heater Break Alarm (HB)
- Low Voltage

The parameter for configurate the output is the P113 do_3 The standard contact used for this output is normally open (NO),but is possible change the contact type:

Type	Jumper
NC	A-B
NO (standard)	B-C

Size S11/S13/S14



11.6.2 Run Relay (Terminals 13 and 14)

This digital output is used to control the main contactor, when the thyristor unit is in run the output is active and the contact is closed.

11.6.3 Critical Alarm (Terminal 15)

This digital output is active when a critical alarm occurs (see par. 9.2).

11.6.4 Configurable Relay Digital Output (Terminal 16)

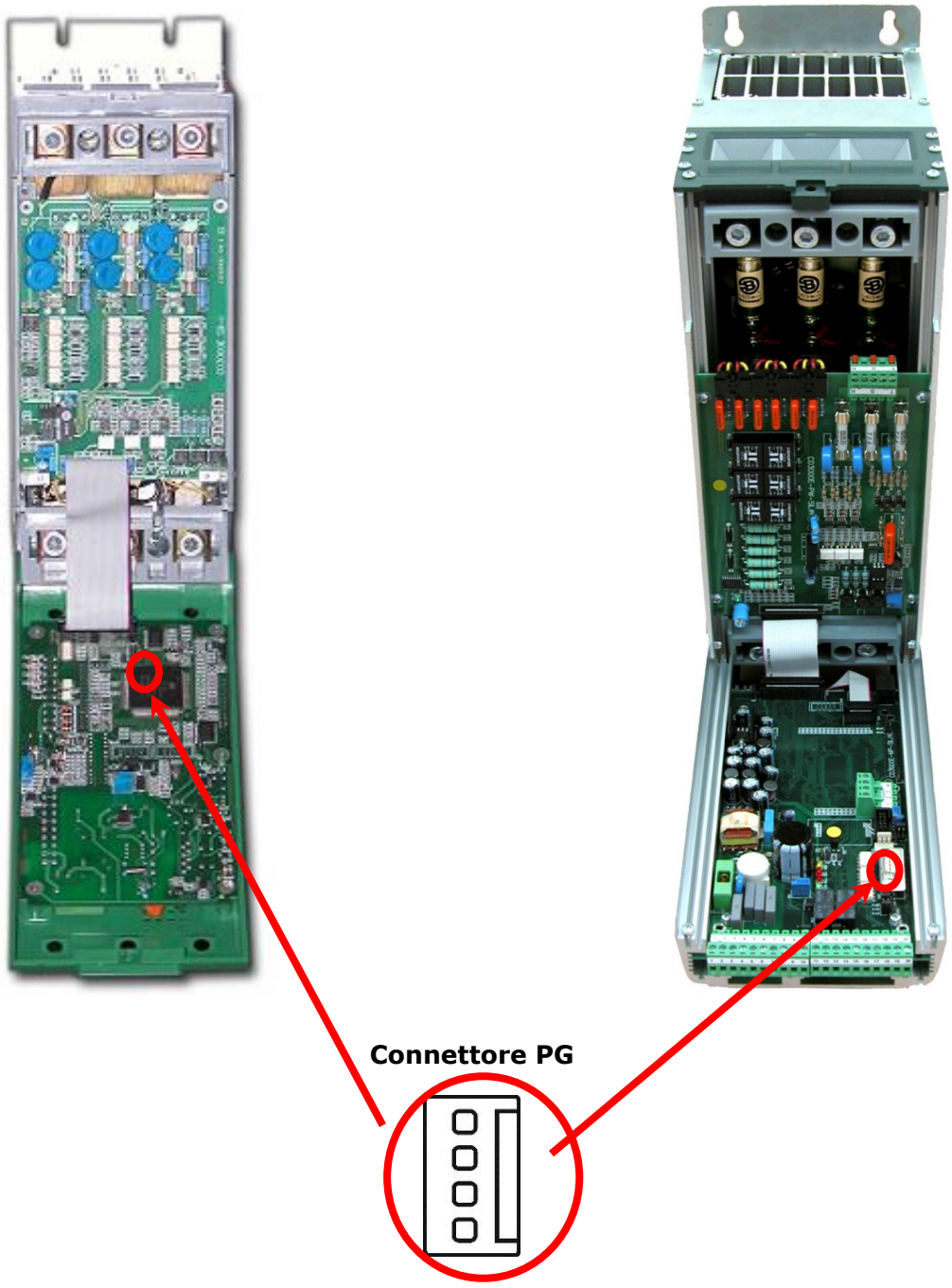
This digital output can be configured in order to activate itself after that one of these alarms occors:

- SCR in short circuit
- Unbalanced Load
- Heater Break Alarm (HB)

The parameter for configurate the output is the P112 do_2 .

11.7 PG Connector

The PG Connector is used to configure the thyristor unit with the configuration software and with the programming cable.
The programming cable is not included.



12 Internal Fuse

The REVO E thyristor unit have internal fuse extrarapid at low I^2t for the thyristor protection of against the short-circuits.
The fuse must have I^2t lower than the thyristor one (I^2t max)

Caution: *USE ONLY EXTRARAPID FUSE WITH APPROPRIATE I^2T*

12.1 Fuse Code

Size	200 kARMS Symmetrical A.I.C.				Qty
	Fuse CODE	Current (A RMS)	I^2T (A^2sec)	Vac	
25A (S09)	2x50 073 06.100	2 x 100	10540	660	3
35A (S09)	2x50 073 06.100	2 x 100	10540	660	3
45A (S09)	2x50 073 06.100	2 x 100	10540	660	3
75A (S09)	2x50 073 06.100	2 x 100	10540	660	3
100A (S11)	20 282 20.180	180	16320	660	3
125A (S11)	20 282 20.180	180	16320	660	3
150A (S11)	20 282 20.250	250	35200	660	3
225A (S13)	20 559 20.315	315	61600	660	3
300A (S14)	FU450FMM	450	84000	660	3
350A (S14)	FU550FMM	550	193500	660	3
400A (S14)	FU550FMM	550	193500	660	3
450A (S14)	FU700FMM	700	378000	660	3
500A (S14)	FU700FMM	700	378000	660	3
600A (S14)	FU700FMM	700	378000	660	3

Caution: *The Fuses must have I^2t 20% less than thyristor's I^2t.*

Caution: *High speed fuses are used only for the thyristor protection and can not be used to protect the installation.*

Caution: *The warranty of thyristor is null if no proper fuses are used. See tab.*

Warning: *The user installation must be protected by electromagnetic circuit breaker or by fuse isolator.*

13 Maintenance

13.1 Fans

The thyristor unit with forced ventilation uses fans that rotate permanently when the unit is supplied. In case of fan failure, the heat-sink can be reach high temperature. In this case to give protection to thyristor there is a thermal switch properly setted. The function of this switch is to open the input signal until the heat-sink temperature falls below the setted value. This means that also with input signal in ON condition the unit is switched OFF and the system can not work at full power. For this reason is important to control periodically the fans status checking that are rotating.

13.2 Maintenance

For maintain a correct cooling, the consumer must clean the heat-sink and the protective grate of the fans. The frequency of these operations depends on the atmospheric local pollution.
Check also that the screw of the power terminals and earth terminals are shut correctly
(see Diagram of control connection).

13.3 Repairing procedure

- Phone to CD Automation.
- Explain to Service Engineer the problem because sometimes it can be solved with a phone call. If this is not possible, ship the unit to CD Automation or to your distributor.
- Write a fault description and give the name of your personnel to which refers.
- Use a rugged packaging to ship the unit.

13.4 Warranty condition

CD Automation gives a 12 months warranty to its products. The warranty is limited to repairing and parts substitution in our factory and does exclude products not properly used and fuses.
Warranty does not include products with serial numbers deleted. The faulty product should be shipped to CD Automation at customer's cost and our Service will evaluate if product is under warranty terms.
Substituted parts remain of CD Automation property.