CD3000*E*-2PH

THYRISTOR UNIT

INDEX

1 Warnings

1.1 Important warning for safety

This chapter contain instruction about safety. The non observation of these warnings can cause serious accident and the loss of life of operator. Serious damages can be also caused to the thyristor unit and to the component system in which is included.
The installation must be done by qualified people.
In manual description are used following icons.

Hazard: This icon is present in all operative procedure where if non executed properly can cause serious accident and loss of life of the operator.

Attention: This icon is present in all operative procedure where if not executed can cause faults to the thyristor unit.

Thyristor units are used in power industrial equipment. When the thyristor unit is working there are on the unit the following voltages.
• Maximum main supply voltage on power terminals up to 600 V.
• Auxiliary supply 230-460Vac
• Fan voltage 230Vac 50/60Hz
Don't remove the cover which provides adequate protection against electric shock.
Don't use this thyristor units in aerospace and nuclear application.

Electric Shock Hazard (Risque the choque électrique)
When thyristor unit has been connected to main supply voltage and is switched off, before to touch it be secure that the unit is isolated and wait at least one minute to allow to discharge internal capacitors. Thus be secure that:
• access to thyristor unit is only permitted to specialised personnel;
• the authorised personnel must read this manual before to have access to the unit;
• the access to the units must be denied to unauthorised personnel.

Important warnings(attention)
Local regulations regarding electrical installation should be rigidly observed.
• Safety regulations must be rigidly observed.
• Don't bend components to maintain insulation distances.
• Protect the units from high temperature humidity and vibrations (see performances).
• Don't touch components to prevent electrostatic discharges on them.
• Verify that all rating are in line with real needs.
• If authorised personnel must measure voltage current etc. on units, take away rings and other jewels from fingers and hands.
• Authorised personnel working on thyristor unit under power supply voltage must work on insulated board. Be secure that board is not connected to earth.
This listing does not represent a complete enumeration of all necessary safety cautions.

Protection(protection)
CD3000E thyristor unit has an insulated cover to compliance to International specification IP20. To understand if IP20 protection is sufficient should be evaluated the installation place where the units are installed

Earth(terre)
CD3000E family has isolated heatsink. For safety connect the heatsink to earth to avoid shocks in case that circuit board or THYRISTOR lose insulation. Earth impedance should be correspondent to local earth regulation. Periodically the earth efficiency should be inspected.

Electronic supply (alimentation électronique)
CD3000E family electronic circuit should be supplied by dedicated voltage supply for all electronic circuit but not in parallel with contactor's coil, solenoids and other inductive or capacitive loads. It's recommended to use a shielded transformer.

Electromagnetic compatibility (compatibilité électromagnétique)
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)
All thyristor switching at high speed generate some radiofrequency disturbance. CD3000E serie compliance with EMC rules for CE mark. In many installations near electronic devices has not been noted problems. If radiofrequency devices at low frequency are used near the thyristor unit some precautions should be taken like line filters and shielded cables for input signal and for load cables.

NOTES

We reserves the right to apply modifications to the our products without any advice.

The thyristor unit must be mounted vertically and with no obstruction above and below to allow a good flow ventilation.
When mounted side by side leave a gap of 15 mm between the units.
Hot air of one thyristor unit must not invest the unit positioned above. The maximum cabinet temperature must not exceed 45°C.

A suitable electromechanical device must ensure that the unit can be electrically isolated from the incoming line supply.

2 Introduction

CD3000E is a three phase Thyristor unit designed to control resistive or inductive loads including three phase transformers.
The current range is from 25A to 700A and the voltage range is from 24 to 600 Volt.
The electronic control circuit of CD3000E is "full digital" and is based on a powerful microprocessor RISC Embedded 16 Bit with high performance.

2.1 Advantages compared with analog thyristor unit.

CD3000E-2PH is an universal thyristor unit and the same unit can work in different modes:
- Burst Firing
- Delayed triggering

On same unit can be used different fedd back that define the control mode.
- Voltage
- Power VxI

On same unit can be used different input
- Analog 4-20mA
- Analog 0-10V
- Potentiometer
- Communication RS485 that is a standard feature.

In addition CD3000E-2PH can be connected via RS485 to an Industrial Personal Computer.
On serial link are available many information like: voltage, current, power, load status and all the parameters for diagnostic and configuration. Tele service and clone facility is also available.
The advantages over the analog and non "Full digital" versions are flexibility and the possibility to implement special features without to change any Hardware.
Several strategies can be implemented and selected via the parameter on serial link.
All these features are not available on analog thyristor unit that use also small micro just to perform dedicated task (Ex. for Heater Break Alarm).
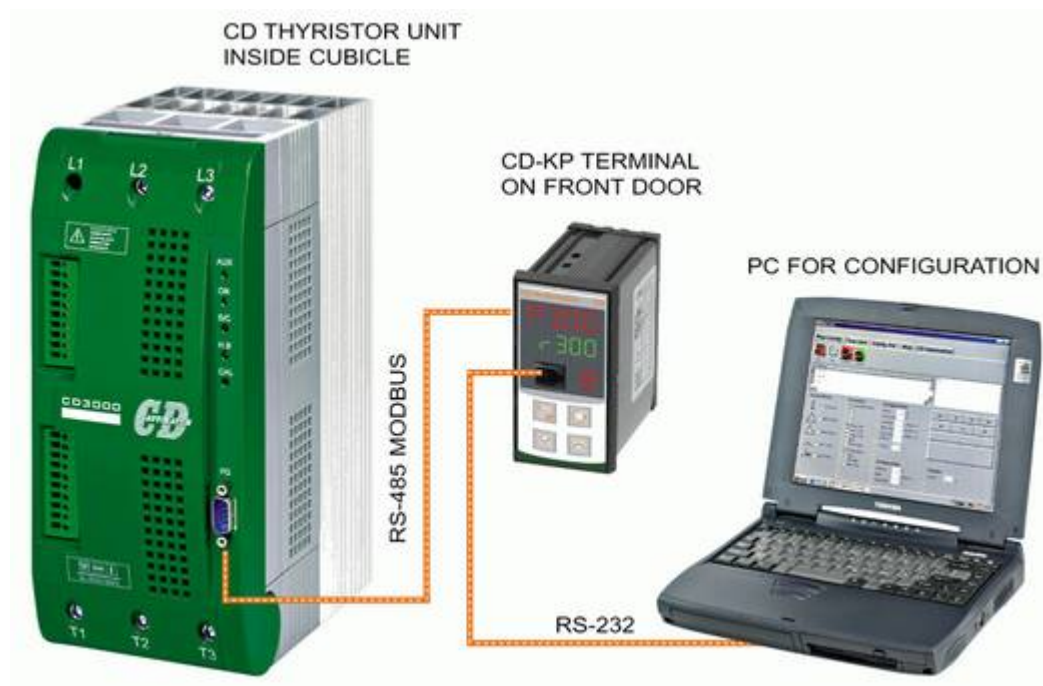
On CD Automation web-site is available, free of charge, the Configuration Software.
A cable with its built in converter and connector is available from CD Automation.
The configuration cable can be plugged into the PG connector of CD3000E-2PH,
or if a CD-KP is available it's possible to have the connection above indicated on front unit.
This solution allow to engineers to verify configuration without to go inside the cubicle where
there is high voltage and without to stop the plant.

2.2 CD-KP high lights

2.2.1 General description

- Local/remote facility

- Set point ramp up/down

- Scroll selection of:
  -Set point power
  -Power read out
  -Current
  -Voltage

- Display indication for:
  -Heater Break Alarm
  -SCR short circuit

- Retransmission (4-20mA or 0-10V selectable)
  of one of these parameters: power, current, voltage.

- Dimensions 48x96x92mm (WxHxD)

CD-KP is designed to give two access levels.
- First Level Access: the operator is able to view the power, current and voltage as well as set
  the power when the CD-KP is in Local Mode.
  At this level the password function is disabled to prevent accidental parameter changes by
  unauthorized personnel.
- Second level access: By connecting a PC to the RS232 port, located on the front of the CD-
  KP, it's possible to have access to all parameters of the CD Automation Thyristor Unit using
  the free downloadable Configuration Software.
  Configuration changes can be made interactively, without powering down the unit, removing
  the need to open the cabinet or to stop the process.

2.3 Clone facility using CD-EASY
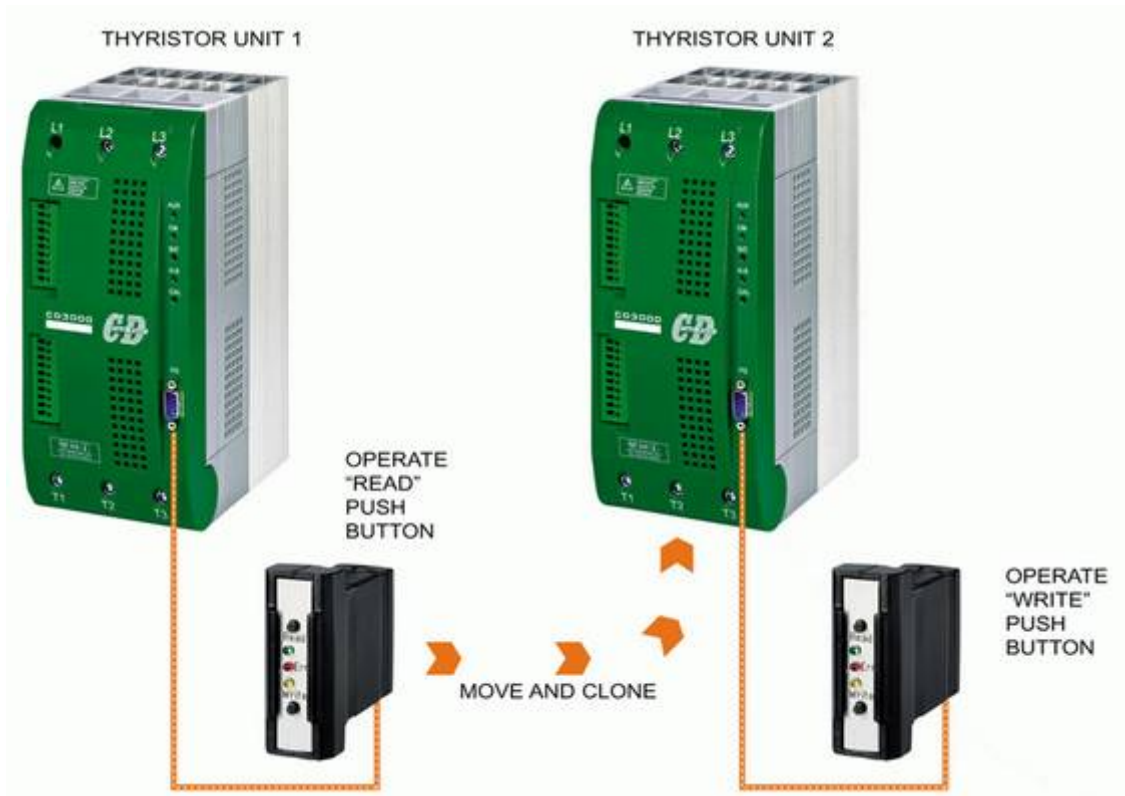
CD-EASY is a Memory Support used by maintenance personnel in the shop floor.
The Clone Facility makes it possible to copy the configuration of one Thyristor Unit and paste it into another in a matter of seconds. The CD-EASY can be loaded with the standard unit operating configuration and stored together with the system drawings in a convenient place, enabling unit reconfiguration within seconds if required.

For CD-KP and CD-EASY are available Maintenance Manuals on www.thinkthyristors.com.

2.4 Configurator
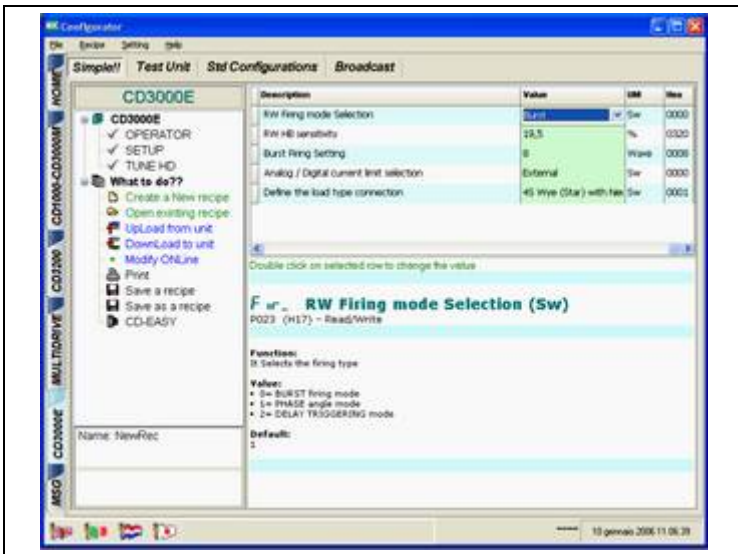
You can download the free software and the Configurator Manual from our web site. www.cdautomation.com

If the CD3000E code is in line with your requirement , providing that the Operating voltage and Load current are inside the code the CD3000E has been already configured in our Factory and you are ready to run. You need software tools only to modify the ordered configuration. Anyway we suggest to check the unit on the machine with the test section.
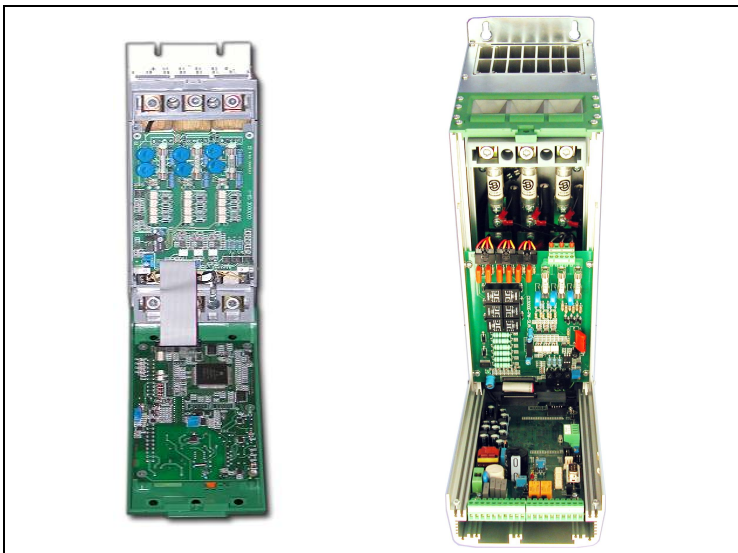
To install the software download it from the website, launch the installation program and follow the instruction on the screen. To configure the unit you can use the standard communication port RS485 on terminals blocks or use the programming Cable and plug it inside the PG connector. (see par.11.8)
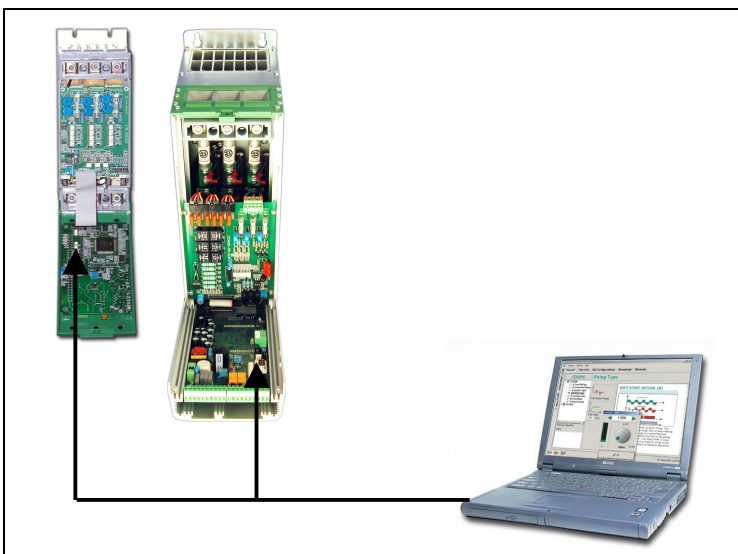
Connect the other side of the programming cable to the PC RS232(9PIN) serial port.

Set the PC serial port like the parameters P114 *boud* and P115 *Addr*

3 Quick Start

Attention: this procedure must be carried out by skilled people only.

If your CD3000E code is in line with what you really need, then the main configuration is already done by CD Automation and you just need to do the following steps:
1. Verify CD3000E's current sizing. Be sure that:
   - the load current is equal or less than the nominal one of CD3000E
   - the main voltage is equal or less than the nominal voltage of CD3000E
2. Verify the Product code
3. Verify the Installation
4. Verify the Wiring:
   - all auxiliary connections must be done in line with wirings on this manual
   - verify that there isn't a short circuit on the load
5. Supply the auxiliary voltage of the unit
6. Set the parameters P116 U_OP and P119 A_Lo using the software tool

P116 (H74)	U_OP	Operative Voltage	V	R/W

Function: It's necessary to specify the operative voltage
Min/Max: 24 ÷ 1000V
Default: 400
Note: CD3000E with voltage out of range 342V to 602V, needs hardware modifications, specify this in phase of ordination.

P119 (H77)	$A\-Lo$	Load nominal current	A	R/W

Function: It's necessary to specify the load current value at nominal voltage. This current and voltage value are necessary to be able to read the power in engineering units
Min/Max: 1 ÷ 100.0 Ampere (for size up to 100A)
                   1 ÷ 1000 Ampere (for size > 100A)
Default: Nominal CD3000E current value if load current has not been specified.

Example: I have bought CD3000E size 100 A with current feed back.
                   The load current at nominal voltage is 50 A.
                   0%   input signal =0 A
                   50%   input signal =50 A
                   100% input signal =100 A
                   As it's possible to see at 50% input signal the current output is already at Max value. From 50 to 100% of input signal there is no action on output.
                   To have a regulation from 0 to 100%, it's necessary to set parameter P119 $A\-Lo$= 50 Amp.
                   Set of this parameter is necessary also when there is a power feed-back

If your CD3000E code is NOT in line with what you really need, use the enclosed configurator software tool to set-up the unit. Install the software on your PC, select CD3000E and click on test unit changing what you need.

4 CD3000E Sizing

4.1.1 Star wiring with resistive load

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

V = Nominal voltage phase to phase
I = CD3000E Nominal current
P = Nominal power to the load
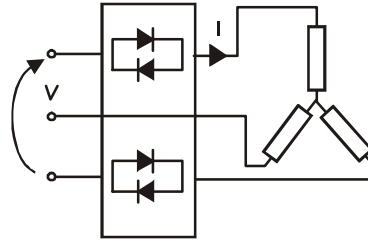
4.1.2 Star wiring with inductive load

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

V = Nominal voltage phase to phase
I = CD3000E Nominal current
P = Nominal power to the load
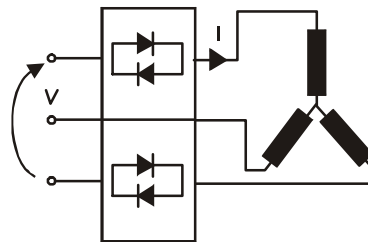
4.1.3 Delta wiring with resistive load

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

V = Nominal voltage phase to phase
I = CD3000E Nominal current
P = Nominal power to the load
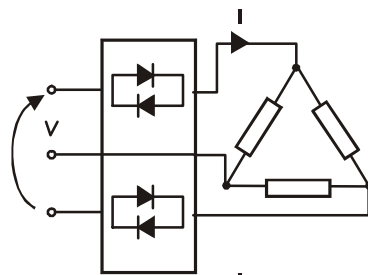
4.1.4 Delta wiring with inductive load

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

V = Nominal voltage phase to phase
I = CD3000E Nominal current
P = Nominal power to the load
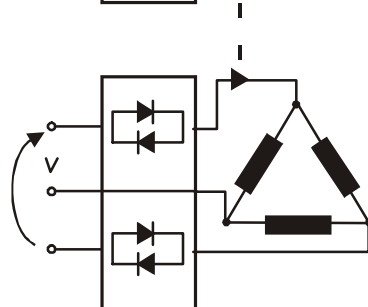
5 Installation and wiring information

5.1 Identification of the unit

Before to install the CD3000E unit examine for damages or deficiencies. If any is found, notify the carrier immediately. Check that the product features shown on CD3000E identification label corresponds to that ordered (see par.5.2)

An identification label provides all the information regarding the factory settings of the unit. This label is on the board inside the unit, as represented below:

Identification Label
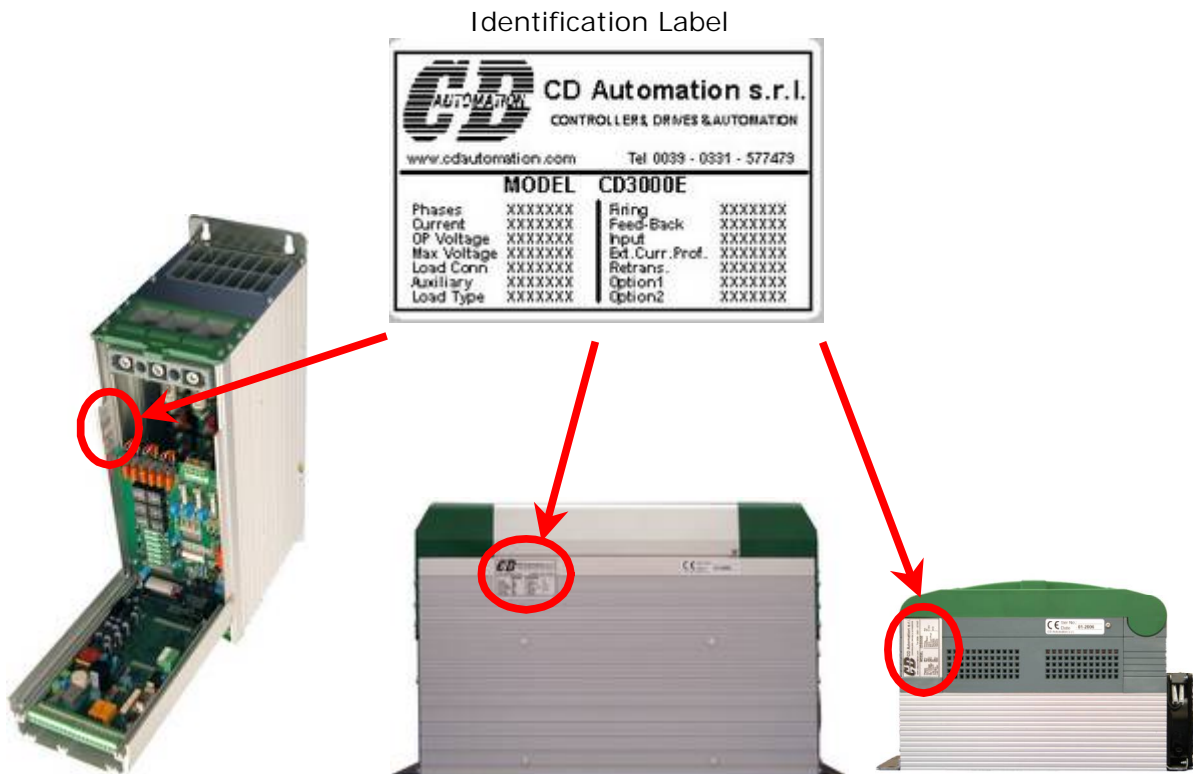
5.2 Ordering code

Model CD3000E-2PH

	1	2	3	4	5	6	7	8	9	10	11	12	13
CD3000E-2PH													
Ex: CD3000E-2PH	75A	50A	480V	300V	3D	230V	TRA	DT	V	0÷10V	None	W420	UL

1	Nominal CURRENT of CD3000E			
25A	75A	150A	400A	600A
35A	100A	200A	450A	700A
45A	125A	275A	500A	

2	Load Nominal CURRENT at operating Voltage
Specify this value used to configure the unit in CD Automation. If this is not specified must be configured by customer using software configurator	

3	Nominal VOLTAGE of CD3000E
480V	
600V	
The voltage on the identification label must be equal or more than operating voltage	

4	Load Voltage(incoming voltage supply)
Specify this value that will be used to configure the unit in CD Automation. If this is not specified must be configured by customer using software configurator	

5	Load Connection
3D	3 Wire Delta
3S	3 Wire Star

6	Auxiliary Voltage
110V	110Vac ±15% (this require special fan at 110v)
230V	230Vac ±15%

7	Load Type
RES	Normal resistance
TRA	Transformer
If the load is transformer that supply a normal resistive load write TRA+RES	

8	Firing
ZC	Zero crossing
BF_ _ _	Burst Firing, fill one number from 1 to 128 This number represents the number of cycles in ON condition at 50% of input signal
DT	Delay triggering (Can be used only with transformer coupled with normal resistance and not with cold resistance)

9	Feedback
V	Voltage
W	Power (VxI)

10	Input	
0÷10V	0÷10V 47KΩ
4÷20mA	4÷20mA 470Ω
POT	10KΩ potentiometer
Comm	RS485 link

11	External Current Profiler	
0÷10V	0÷10V 47KΩ
POT	10KΩ potentiometer
Comm	RS485 link
None	No secondary input

12	Retrasmission	
W010	0÷10V
W020	0÷20mA
W420	4÷20mA

13	Options	
CD-KP	External Keypad
CD-EASY	Clone facility & memory card
UL	UL Certification

6 Installation

CD3000E unit should be always mounted in vertical position to improve air cooling on heatsink. Maintain minimum distances in vertical and in horizontal as below represented. Don't install in proximity of hot elements and near units generating electromagnetic interferences.

When many units are mounted inside a cubicle provide air circulation as below represented. Sometimes it is necessary to provide a fan to have better air circulation.
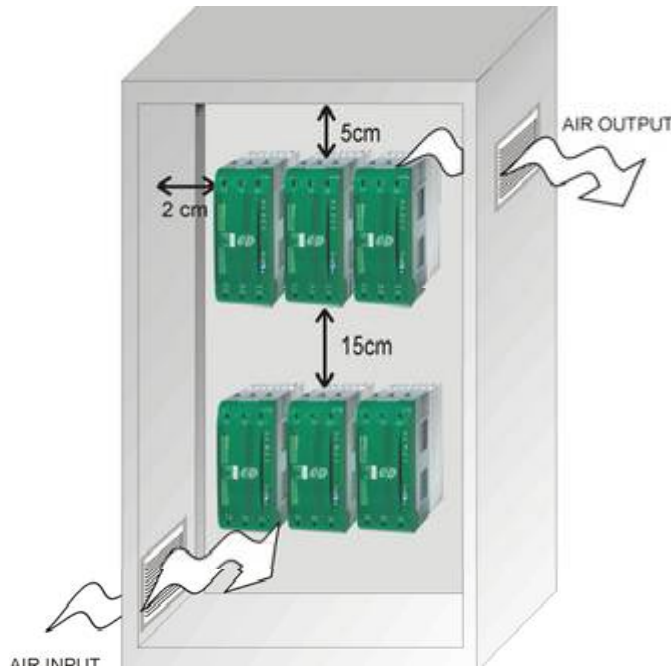
6.1 Environmental installation conditions

Ambient temperature	0-45°C at nominal current. Over 45°C use the derating curve (par.8.2)
Stocking 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

CD3000E 2PH 25-150A (S9)	CD3000E 2PH 200A (S10)	CD3000E 2PH 275A-700A (S14)
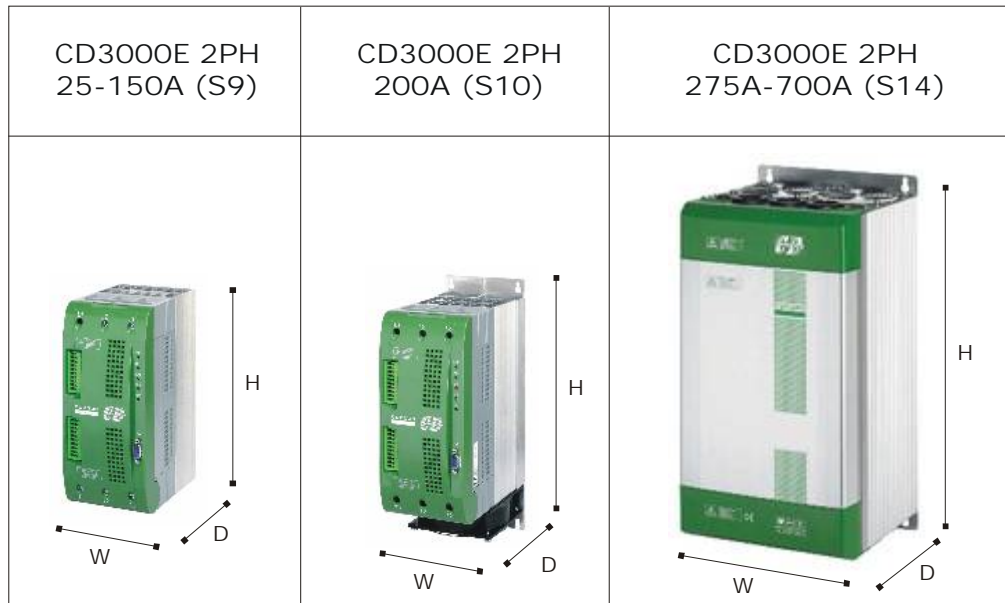
Size	W(mm)	H(mm)	D(mm)
25A (S9)	116	316	187
35A (S9)	116	316	187
45A (S9)	116	316	187
75A (S9)	116	316	187
100A (S9)	116	316	187
150A (S9)	116	316	187
200A (S10)	116	350	220
275A (S14)	262	520	270
400A (S14)	262	520	270
450A (S14)	262	520	270
500A (S14)	262	520	270
600A (S14)	262	520	270
700A (S14)	262	520	270

6.3 Fixing holes
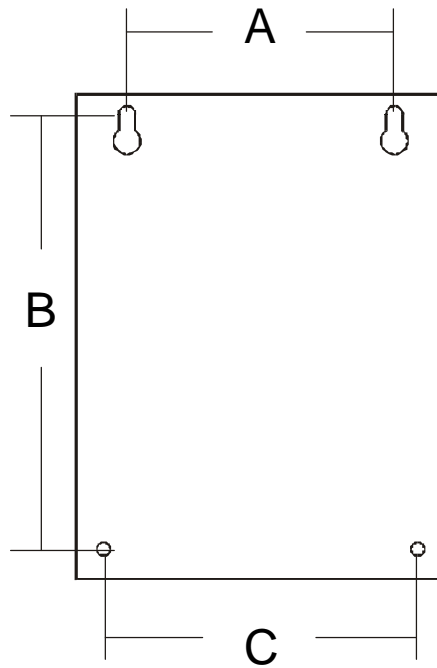
Size	A(mm)	B(mm)	C(mm)
25A (S9)	96	290	104
35A (S9)	96	290	104
45A (S9)	96	290	104
75A (S9)	96	290	104
100A (S9)	96	290	104
150A (S9)	96	290	104
200A (S10)	100	335	100
275A (S14)	222	495	222
400A (S14)	222	495	222
450A (S14)	222	495	222
500A (S14)	222	495	222
600A (S14)	222	495	222
700A (S14)	222	495	222

7 Wiring instructions

7.1 Removing the cover

For S9 and S10 size you must open the cover to configure the unit and to view the fuses

For S14 sizes, open the cover to wire, to configure the unit and to inspect the fuses & thyristors

*Warning: this procedure can be done just by specialized personnel
CD3000E unit has isolated heatsink. For safety connect the heatsink to hearth using its terminal with hearth symbol.*

CD3000E can be susceptible to airborne interferences from near equipment or from interferences on main supply, so a number of precautions must be taken.
- Contactors coils and chokes must have in parallel a RC filter and must be supplied with a different voltage line.
- All input/output signal must use screened bifilar wires.
- Signal input and output must not routing in same cable try and must not be parallel.
- Local regulations regarding electrical installation should be rigidly observed.

7.2 Power Terminals

⚠️ *Before to connect or disconnect, make sure that power cables and auxiliary wires are insulated from live voltage.*

Terminal	Description
L1	Line Input Phase 1
T1	Load Output Phase 1
L2	Line Input Phase 2
T2	Load Output Phase 2 – NOT controlled by the thyristor
L3	Line Input Phase 3
T3	Load Output Phase 3

S9 and S10 power connection	S14 power connection

7.3 Wiring details

Use 75°C copper (CU) conductor only, provided with the terminal type indicated below.

7.3.1 Power cable torque (suggested)

Current	Torque Lb-in (N-m)	Wire Range AWG / kcmill	Wire Terminal
25A, 35A, 45A, 75A, 100A, 125A, 150A, 200A	265 (30.0)	8 3/0	Polymeric Terminal Block M8
275A	505 (57.0)	2x1/0 300	Bus Bar Adapter M8
400A	505 (57.0)	2x3/0 600	Bus Bar Adapter M10
450A	505 (57.0)		Field wiring bus bar 30x6mm
500A	505 (57.0)		Field wiring bus bar 60x4mm
600A	505 (57.0)		Field wiring bus bar 60x5mm
700A	505 (57.0)		Field wiring bus bar 60x6mm

7.3.2 Power cable dimensions (suggested)

Current	Supply			Load		
	Cable		Screw	Cable		Screw
	mm^2	AWG	M	mm^2	AWG	M
25A	10	8	M8	10	8	M8
35A	10	8	M8	10	8	M8
45A	10	8	M8	10	8	M8
75A	25	4	M8	25	4	M8
100A	35	3	M8	35	3	M8
125A	50	1	M8	50	1	M8
150A	70	1/0	M8	70	1/0	M8
200A	95	3/0	M8	95	3/0	M8
275A	2 x 70	2 x 1/0	M8	2 x 70	2 x 1/0	M8
400A	2 x 95	2 x 3/0	M10	2 x 95	2 x 3/0	M10
450A	Bus Bar		30 x 6 mm	Bus Bar		30 x 6 mm
500A	Bus Bar		60 x 4 mm	Bus Bar		60 x 4 mm
600A	Bus Bar		60 x 5 mm	Bus Bar		60 x 5 mm
700A	Bus Bar		60 x 6 mm	Bus Bar		60 x 6 mm

7.3.3 Auxiliary cable dimensions (suggested)

Current	Auxiliary Supply			Earth		
	Cable			Cable		Screw
	mm^2	AWG		mm^2	AWG	M
25A	0,50	18		4	12	M6
35A	0,50	18		4	12	M6
45A	0,50	18		6	10	M6
75A	0,50	18		10	8	M6
100A	0,50	18		16	6	M6
125A	0,50	18		16	6	M6
150A	0,50	18		16	6	M6
275A	0,50	18		50	1	M8
400A	0,50	18		50	1	M8
450A	0,50	18		70	1/0	M8
500A	0,50	18		70	1/0	M8
600A	0,50	18		70	1/0	M8
700A	0,50	18		70	1/0	M8

7.4 Auxiliary connections, CD3000E MP BOARD

Terminal	Description	
1	Auxiliary supply voltage 93-265Vac (See order code)	
2	Auxiliary supply voltage 93-265Vac (See order code)	
3	N.C. not connected	
4	Supply Digital Input/Output +12Vdc (Max 20mA)	
5	Common Digital Output (0V)	
6	Output + 10V stabilized, 1mA max (Pot Supply)	
7	Common Analogue input and output	
8	+ Input command signal 4÷20mA, 0÷10V	
9	+ Input current limit profile 0÷10V	
10	Analogue output (Max 20mA Min 500Ω)	
11	RS485 B (size S9 and S10)	CONF relay contact (Max 300mA , 230V) (size S14)
12	RS485 A (size S9 and S10)	CONF relay contact (Max 300mA , 230V) (size S14)
13	RUN relay contact (Max 300mA , 230V)	
14	RUN relay contact (Max 300mA , 230V)	
15	NPN output 12Vdc 20mA max - Critical Alarm	
16	NPN output 12Vdc 20mA max - Programmable Output	
17	Reset alarm (Digital input1)	
18	Start Unit (Digital input2)	
19	Calibration Unit (Digital input3)	
20	Configurable input (Digital input4)	
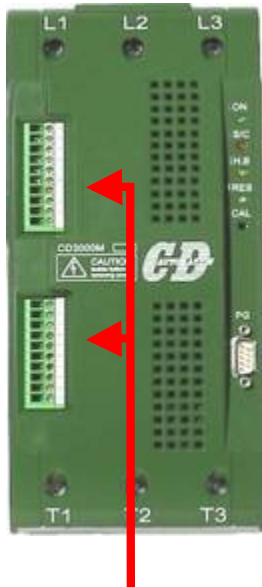
Auxiliary terminals

Auxiliary terminals

7.5 Diagram of control connection from 25 to 200A

Warning: this procedure can be done just by specialized personnel.

Size S9 and S10
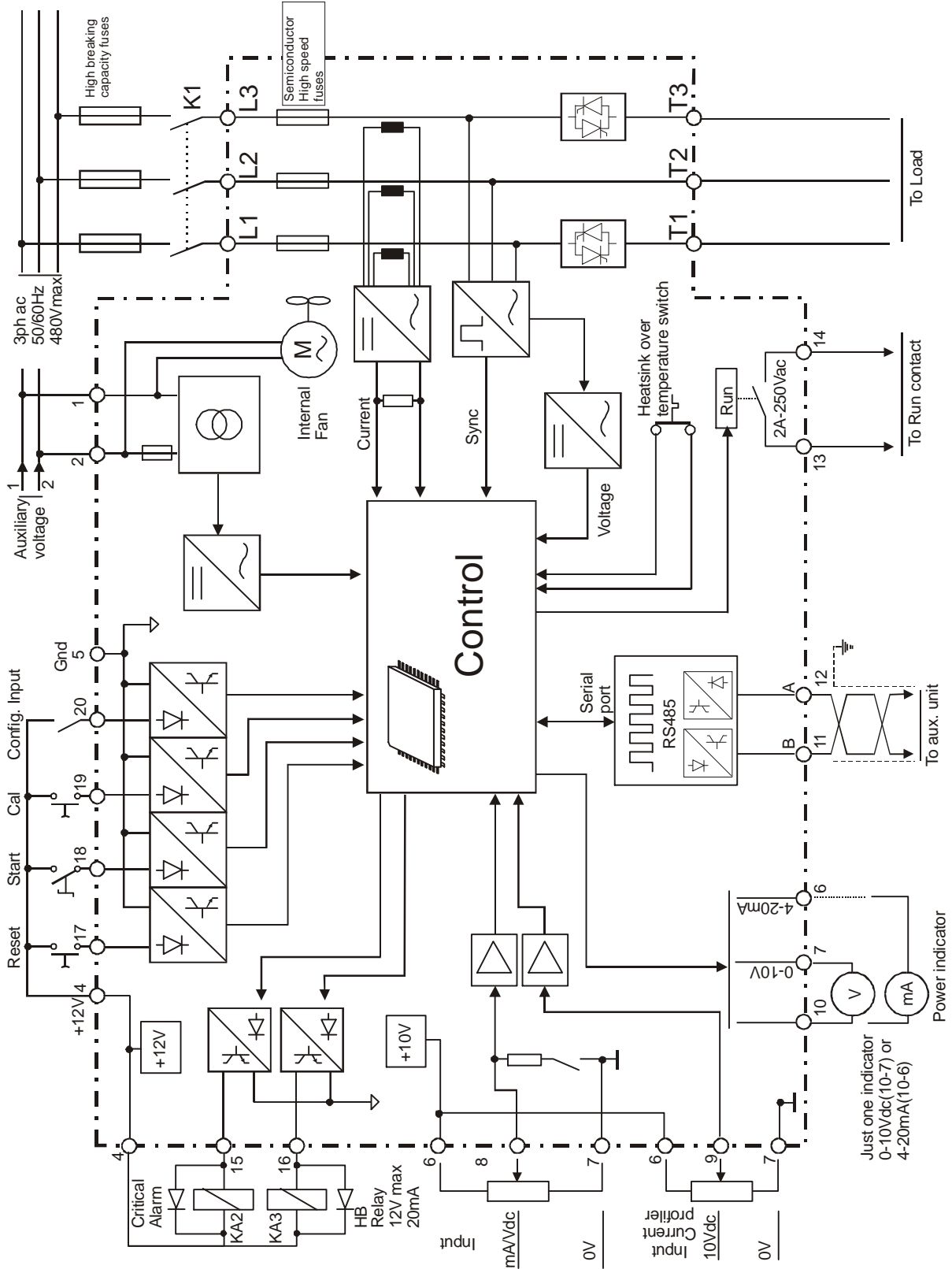
7.6 Diagram of control connection from 275 to 700A

Warning: this procedure can be done just by specialized personnel.

Size S14
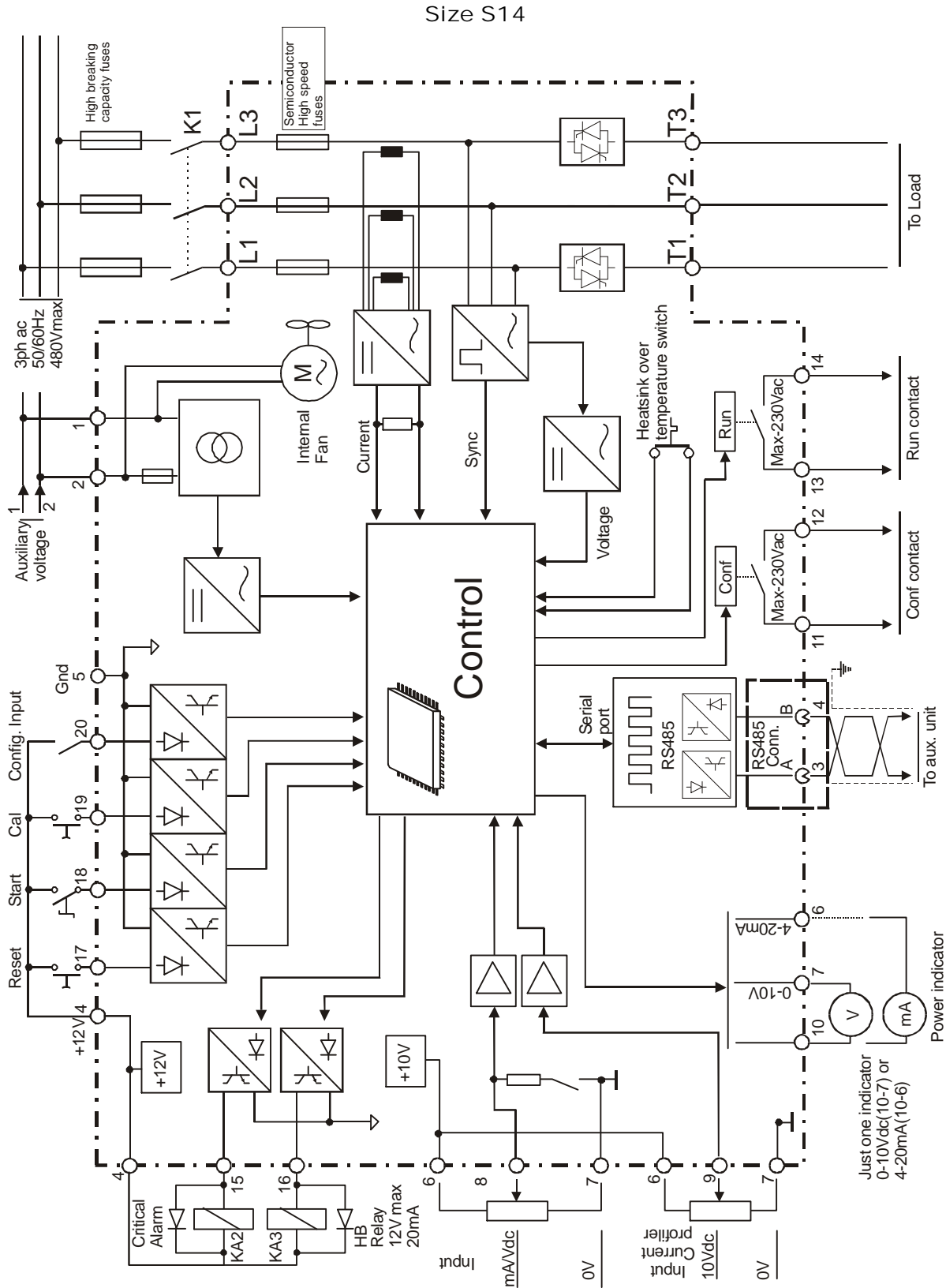
7.7 Wiring overview

In the figure below is represented the wiring for power and auxiliary cables of CD3000E
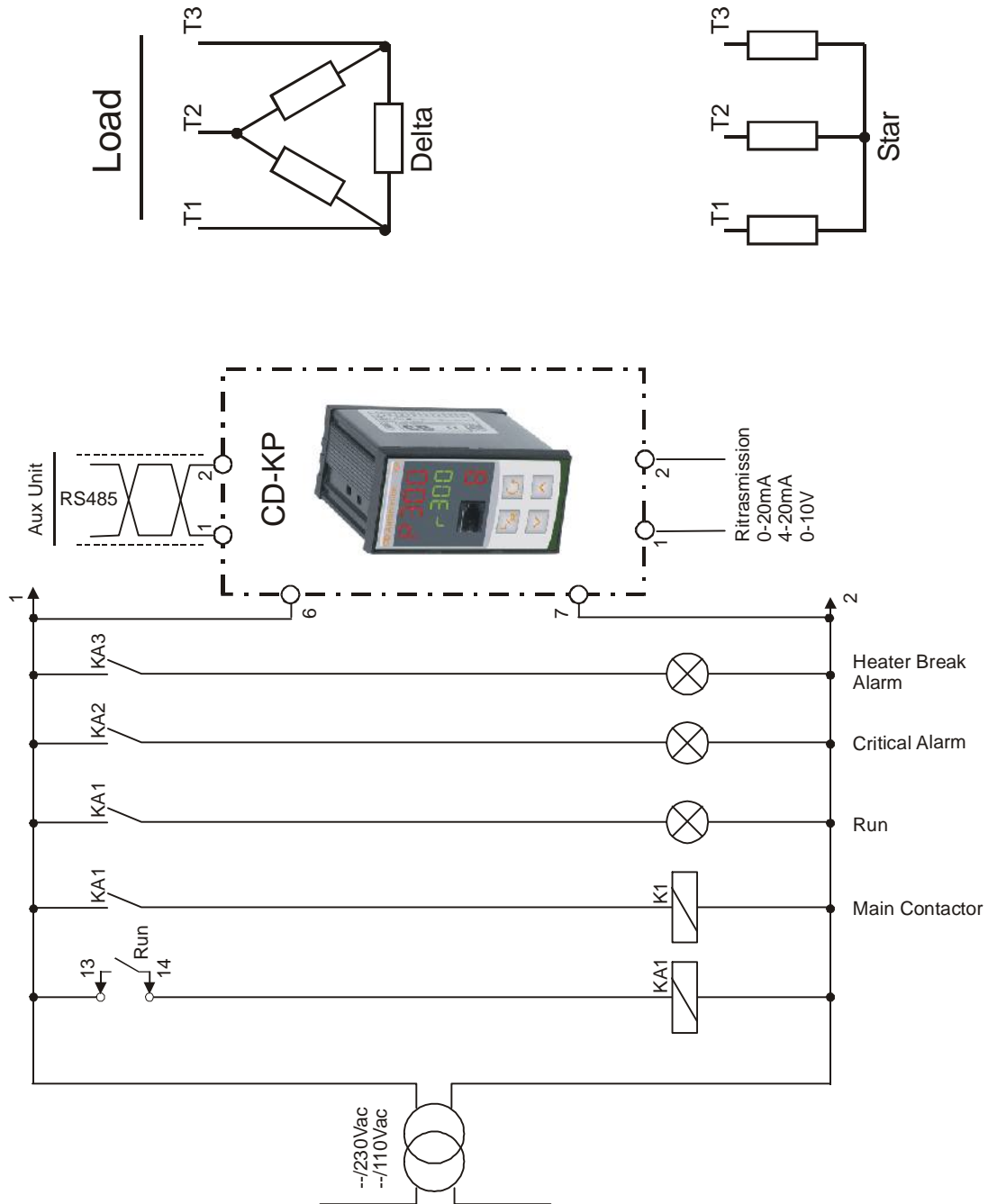
Before give the Start command (terminal 18) supply the auxiliary voltage to the terminals 1 and 2.
With the Start command the relay is activated and close his contact between the terminals 13 and 14. The CD3000E verifies the presence of the three phases and their rotation. If something is wrong, the CD3000E stops itself and open the relay contact.
The RUN relay must be used to energize the external main contactor K1.

8 Technical features

8.1 Power output features

Current	Voltage range	Ripetitive peak reverse voltage		Latching current	Max peak one cycle	Leakage current	I^{2}T value thyristor	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	500	15	1030	47÷70	60	2500
35A	330÷600	1600	1600	450	500	15	1030	47÷70	84	2500
45A	330÷600	1600	1600	450	1000	15	4750	47÷70	108	2500
75A	330÷600	1600	1600	450	1000	15	4750	47÷70	180	2500
100A	330÷600	1600	1600	450	1540	15	11300	47÷70	240	2500
125A	330÷600	1600	1600	450	2000	15	19100	47÷70	300	2500
150A	330÷600	1600	1600	300	4800	15	128000	47÷70	360	2500
200A	330÷600	1600	1600	300	4800	15	128000	47÷70	480	2500
275A	330÷600	1600	1600	300	4800	15	108000	47÷70	660	2500
400A	330÷600	1600	1600	200	7800	15	300000	47÷70	960	2500
450A	330÷600	1600	1600	200	8000	15	300000	47÷70	1080	2500
500A	330÷600	1600	1600	200	8000	15	306000	47÷70	1200	2500
600A	330÷600	1600	1600	1000	17800	15	1027000	47÷70	1440	2500
700A	330÷600	1600	1600	1000	17800	15	1027000	47÷70	1680	2500

8.2 Derating curve

$$I_{MAX} = I_{NOM} \times K$$
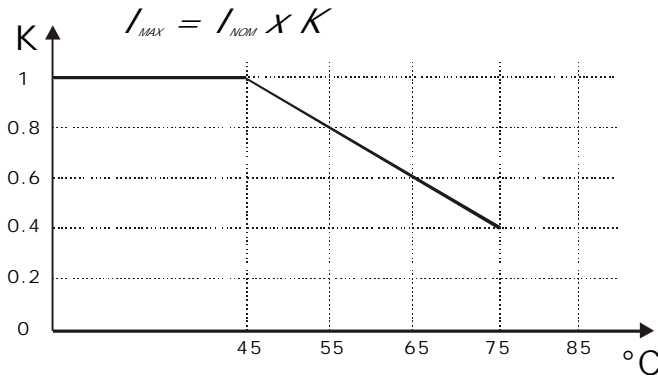
8.3 Cooling fans

The thyristor units are equipped with a cooling fan for currents > 45A. the supply votage is standard 240VAC ±15% 50/60Hz or optional 120VAC ±15% 50/60Hz.
The fan's power consumption is below listed:

Size	CE Number of fans	UL LISTED Number of fans
25A, 35A, 45A	No fan	One Fan - 14W
75A, 100A, 125A, 150, 200A	One Fans - 14W	One Fan - 14W
275A, 450A, 700A	Four Fans - 60W	Four Fans - 60W
400A, 500A, 600A	Two Fans - 30W	Four Fans - 60W

9 Led status and alarms

CD3000E has alarms and events grouped in 2 parameters on serial link (P001 AL_1, P002 AL_2).
Parameter P001 AL_1 shows alarms that stop the CD3000E.
Parameter P002 AL_2 shows events and alerts that does not stop the CD3000E.

9.1 LED Status Table

LED		STATUS	DESCRIPTION
Size From 25 to 200A	Size From 275 to 700A		
Aux	Run	○	Auxiliary supply is not connected
		●	Fault on the electronic board
		⊙ Flashing	Auxiliary supply is connected and board is OK
ON	All ON	○	NO alarm
		●	In Alarm
		⊙ Flashing	Critical Alarm
SC	SC	○	SCR OK
		●	SCR short circuit
HB	MB	○	Laod OK
		●	Load Fault
		⊙ Flashing	In current limit

○	= OFF
●	= ON
⊙	= Flashing

9.2 Critical alarms

These alarms are active after a START command in case of:
- Phase lost
- Incorrect phase rotation
- Over temperature on heatsink

When one of these alarms is active, the unit stops and must be reset before to start again. Via RS485 (MODBUS) it's possible also to discriminate witch type of alarm occurred.

9.2.1 Phase lost

This alarm is activated when one of the three phases R-S-T is lost and is a critical alarm that stops the CD3000E. The output "critical alarm" (terminal 15) will be actived (0Vdc) immediately and will stop the thyristor stack. When the problem is solved before to restart again use the reset command or use the RS485 communication command. To reset the unit.

<u>The "Phase lost" alarm can be activated by phase lost or fuse failure on CD3000E.</u>

9.2.2 Incorrect phase rotation

The system must have the phase rotation in clock wise.
If the sequence of the incoming voltage supply is not correct, the output "critical alarm" (terminal 15) will be actived (0Vdc) immediately and will stop the thyristor stack.
Invert phase S with phase T, reset the unit and start again. All these operations can also be done by the RS485 communication command.

NOTE: also in case of one phase lost could be activated the alarm of incorrect phase rotation.

9.2.3 Overtemperature on heatsink

The temperature on the heatsink is under the control of a thermic switch.
If the temperature is too high, it represents a critical alarm. The output "critical alarm" (terminal 15) will be actived (0Vdc) immediately and will stop the thyristor stack.

When the problem is solved, to start again the operator activates the reset command and start the unit. All these operations can also be done by the RS485 communication command.

9.3 Action to solve a critical alarm

<u>*If a critical alarm occurs during the first start-up:*</u>
- check the main line voltage between terminals L1-L2-L3
  if it's OK
- check the internal fuses
  if they are OK
- invert two phases (i.e.: invert phase S with phase T) and start again the unit.

<u>*If a critical alarm occurs during the normal working operation:*</u>
- check the main line voltage between terminals L1-L2-L3
  if it's OK
- check the internal fuses
  if they are OK
- check the heatsink temperature

The alarm type can be diagnosed via RS485

9.4 Events and alerts that don't stop CD3000E

The following events and alerts don't stop the unit:
- SCR Short Circuit (SC)
- Heater Break (HB)
- Unbalanced Load
- Current Limit active

When one of these alarms is active, the terminal 16 is at 0V.
The user can connect a PC to the unit via RS485 to discriminate the alarm type.

9.5 Current limit(see par.11.3.3)

To tune it proceed as below described.
-Disconnect from main supply voltage CD3000E
-Move the current limit potentiometer fully anti-clockwise
-Switch ON CD3000E again
-Set the input signal at 100% value
-Increase current limit potentiometer up to when the desired value of current is reached.
The current limit procedure is finished.

9.5.1 Current limit set

The current limit can be setted via digital mode (with RS485) or via analog input (with on board potentiometer or external reference).

P090 CL_i = 0   Current limit profiling with analog input (internal or external)
                 = 1   Current limit profiling in digital mode via RS485
P091 CL =   Set the max current from 0 to 100%.

If you choose to have the current limit profiling in digital mode via RS485, set the P090 CL_i parameter to 1

If you choose to have the current limit profiling with external analog input (via terminals 7-9) or internal potentiometer, set the P090 CL_i parameter to 0 and set properly the jumpers as showed in paragraph 11.3.3.

9.6 Heater break alarm and scr short circuit

The Heater Break Alarm is a circuit to diagnostic partial or total load failure.

- sensibility better than 20%;
- alarm stored in memory;
- current value of the three different phases
- this alarm is associated to digital output on terminal 16.

The Heater Break circuit to work properly must have at least an input of 25% of the nominal current.

If the "programmable alarm" digital output is set with "HB alarm" (P112 **do_2** = 1), when the LEDs HB or SC is lighted, this output goes to 0Vdc and its relay is energized.
All parameters may be adjusted via serial link using Thyristor Configurator.

9.6.1 Calibration

An automatic function sets the Heater Break Alarm.
The auto setting function can be activated using the digital input "Cal" (terminal 19) or via serial link.
The Heater Break procedure is performed in this way:

- The CD3000E gives the maximum voltage output
- The values of voltage and current are stored in memory
- After which CD3000E comes back to the initial situation

If the CD3000E is working and one of the load resistances fails the current drops below the current set point set automatically or with parameter P066 **Hb_S** and after a given delay the output alarm is activated.

9.6.2 Heater Break sensitivity (P066 **Hb_S**)

The Heater Break sensitivity is set in parameter P066 **Hb_S** in percentage.
The range goes from 0,0 to 100,0%.
The default value is 20%.
This means that if current drop is over 20% the alarm occurs.

10 Types of firing mode

Attention: this procedure must be carry out by skilled people only.

10.1 Burst firing

To configure Burst Firing via software configurator select P023 **F ɪr** and set it at 0. Burst Firing deliveres to the load a package of complete voltage supply cycles.
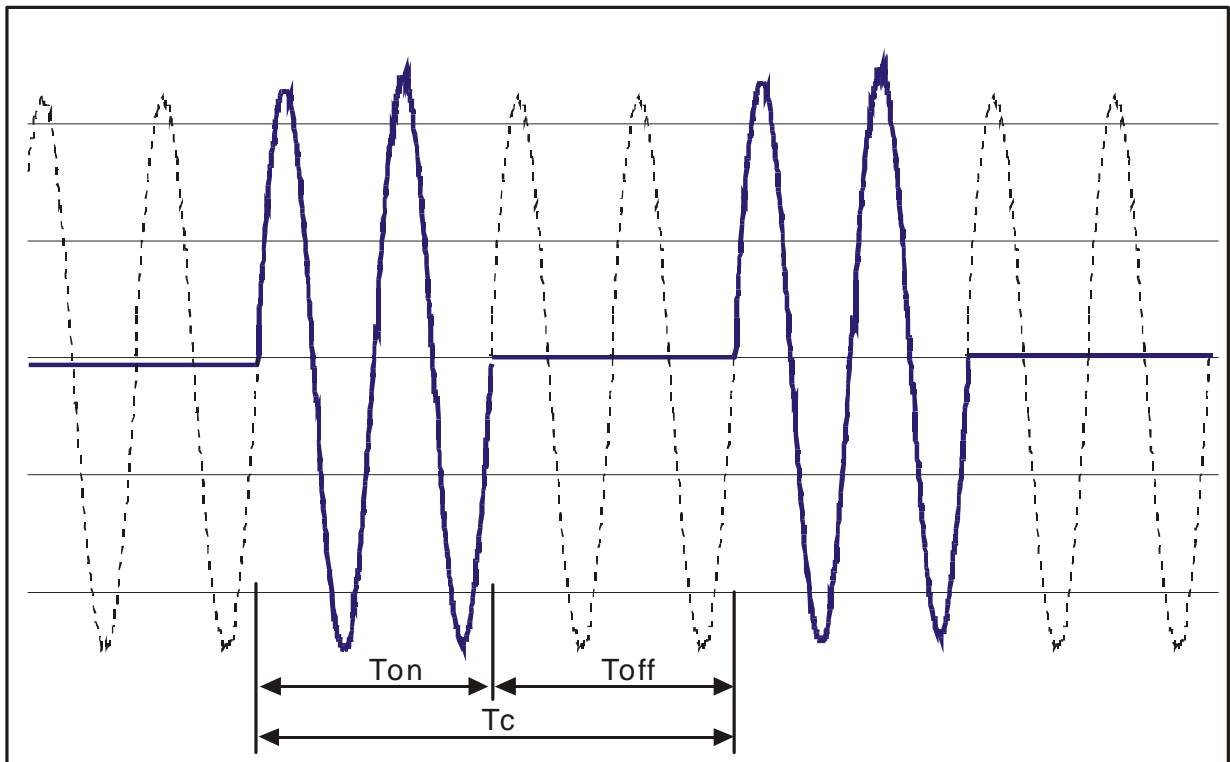
The number of complete periods is proportional to the input signal.
The power modulation is given by TC=T ON + T OFF.
This is a zero crossing firing that eliminates EMC interferences.
P083 **bF_n**   parameter gives the possibility to decide how many voltage periods the operator wants to have at 50% of input signal. This value is between 1 to 256 periods.
CD3000E becomes more or less fast depending on the set value.
When the value is 1, this type of firing is named Single Cycle.

10.2 Delay triggering (DT)

This firing mode is used to switch ON primary of transformer coupled with normal resistance on secondary. Don't connect cold resistance on secondary(superKanthal, Molybdenum, Platinum, Tungsten Quartz Lamp).
It's used to prevent inrush surge current when zero voltage switching is used.
To avoid to saturate transformer these precaution are taken.

When start push button is operated the first firing of the first block of voltage
periods is done in Phase Angle with Soft Start.
The first half cycle is positive and the last one is negative. In this mode we know where we are in the magnetization curve for the residual magnetism.
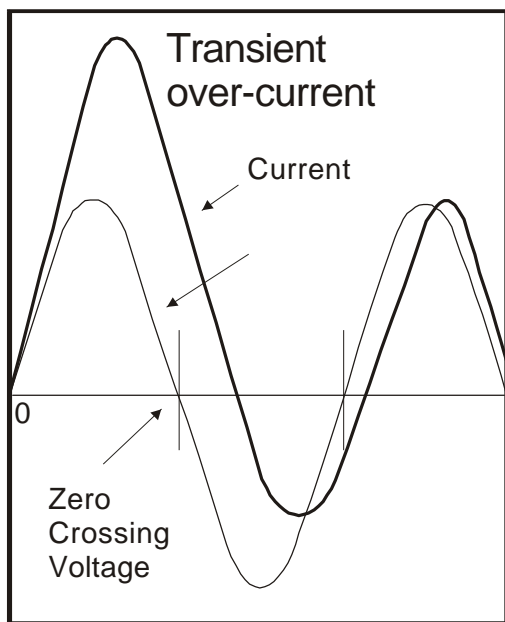
Fig.1
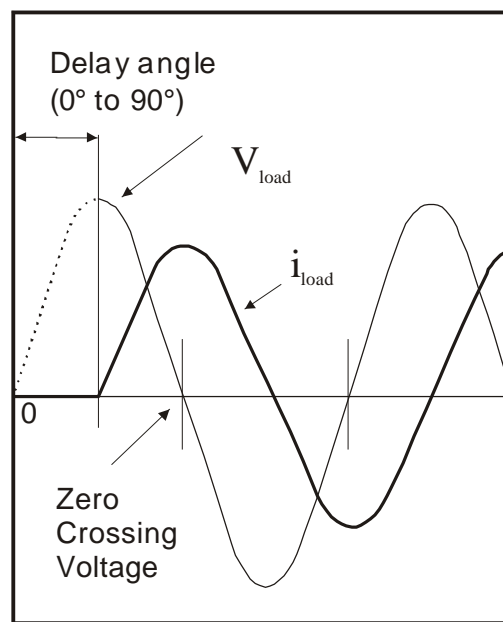
Fig.2

Starting from this moment CD3000E switch ON a complete whole supply cycles to
the transformer. Starting with positive and stopping with negative.
The first half positive cycle firing signal is given with a delay (Delay Triggering) to
avoid to generate transient over currents that can blow the fuses.
This delay is done on each phase.

The parameter that must be setted are:

P023 **F ir**   = 2   Select Delay Triggering Mode
P083 **bF_n**   =----   Burst Firing Setting. It define the number of complete cycles at 50% of power

demand. Default is 8 but can be setted up to 256.
P085 **dt**   =   This parameter set the delay of firing in millisecond. Default value setted at
4

millisecond. This value satisfy the majorities of applications.

Burst Firing without Delay   Burst with Delay Triggering
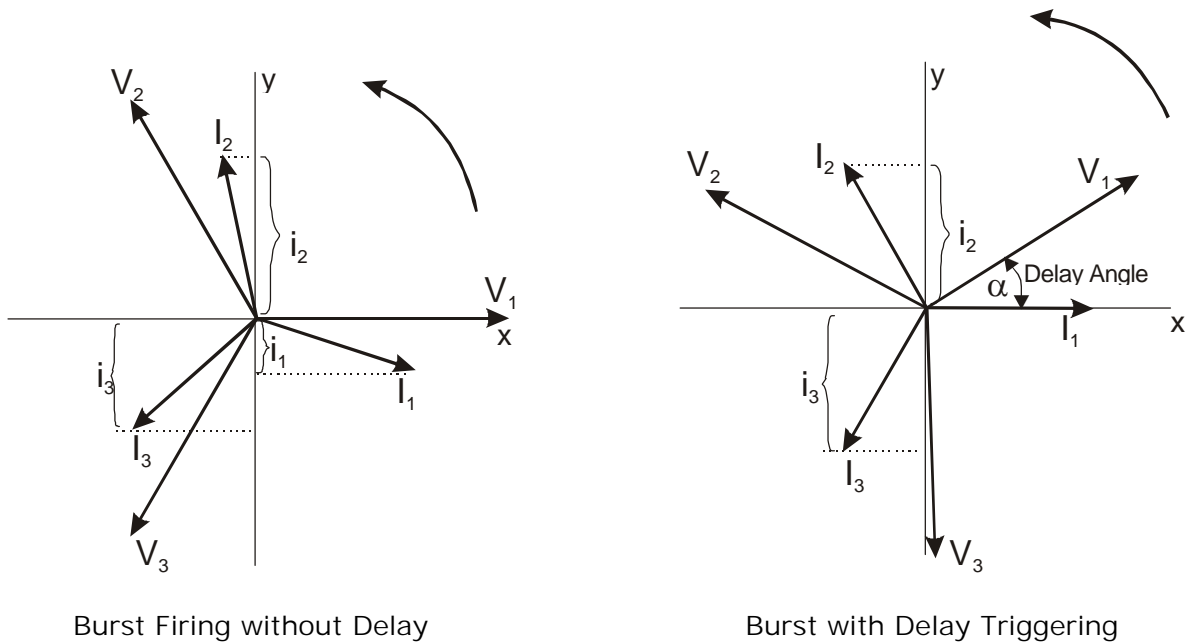
To better understand, the sinusoidal waveform represented at figure 2 are generate by vectors rotating anticlockwise.

All the electronic circuits use the zero voltage crossing as a reference. In Burst Firing without Delay when the V1 is zero (its projection on x axle) the unit switch ON.
In this case the instantaneous value of the current are i1, i2 and i3 and this status for magnetization curve can cause inrush currents that Blows Fuses.

If the thyristor are triggered with a delay up to when the instantaneous value of the current i1=0 like represented above the current status is i1=0   with i2 positive and i3 negative.
In this situation the fuses does not blow. The alfa angle define the delay to have i1=0 and this angle depend on cosy (power factor).

The suggested delay that is used in the most common application is 70°

10.3 Feed back (control mode)

Attention: this procedure must be carry out by skilled people only.

The feed-back defines the Control Mode.
It's possible to have:

V=   Voltage feed-back. The output voltage of CD3000E is proportional to input signal. This means that input signal becomes a voltage demand. This control mode compensate the voltage fluctuation of the incoming line supply.

W=   Power feed-back. The power output of CD3000E is proportional to input signal. This means that input signal becomes a power demand.
       The power remains constant also if voltage and load impedance change. This feed-back is used with silicon carbide elements that change its resistive value with temperature and with age.
       In addition are compensate also the voltage fluctuation of the incoming line supply.When the user chooses this feed-back, it's necessary to run the auto-calibration procedure by closing contacts 4-19.

11 Connection description

11.1 Electronic boards

To have access to the electronic boards the user must open the unit's cover(see par.7.1)

Warning: this procedure can be done just by specialized personnel.
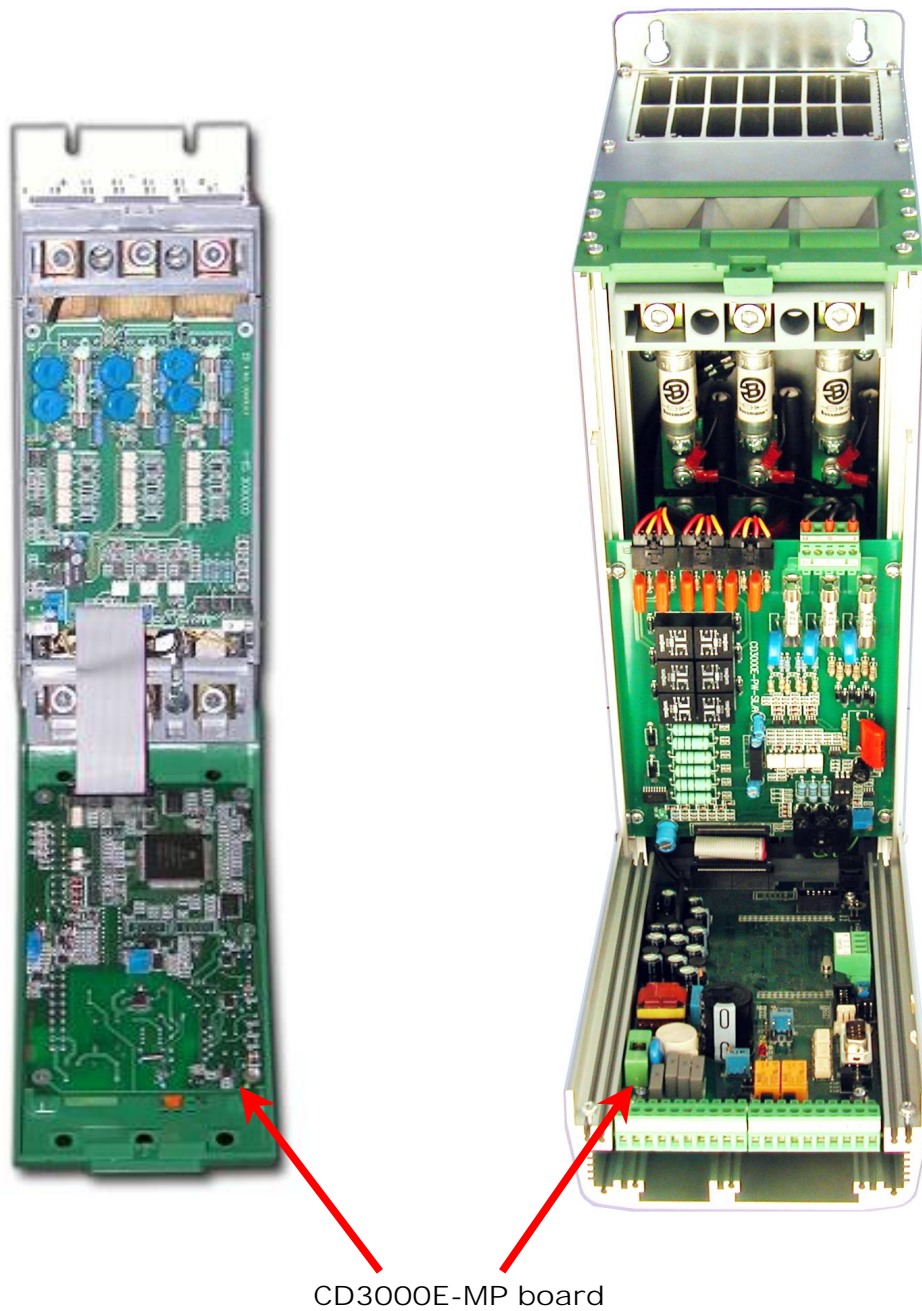
CD3000E-MP board

11.1.1 Jumper's position on CD3000E-MP board

The jumper's position changes in function of the CD3000E size.

The control board and the jumper's position on CD3000E from 25 to 200A	The control board and the jumper's position on CD3000E from 275 to 700A
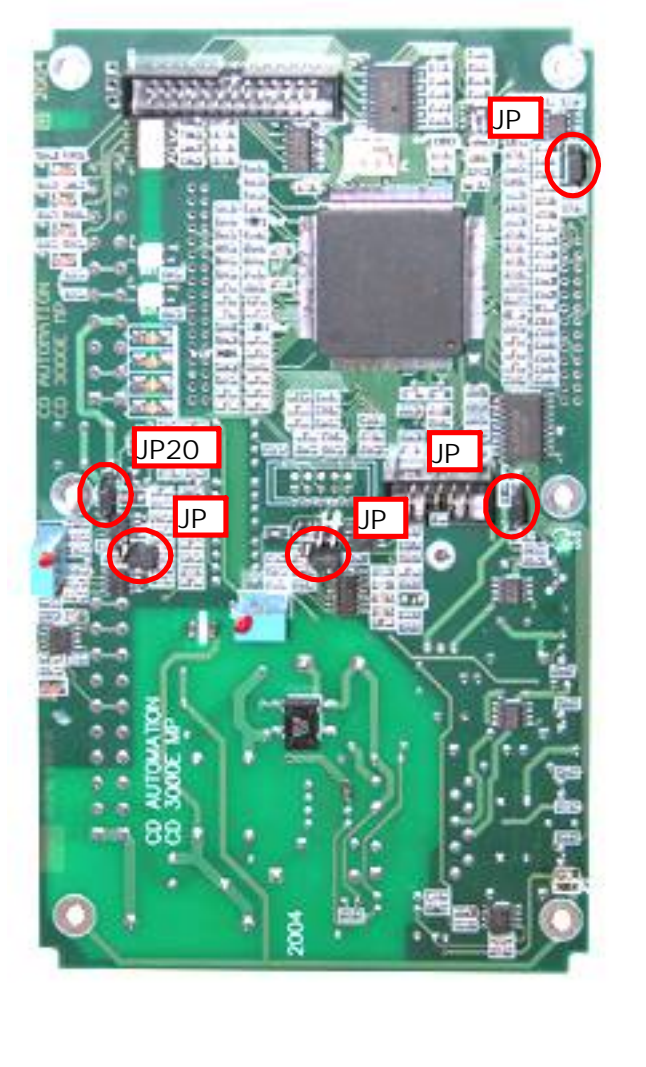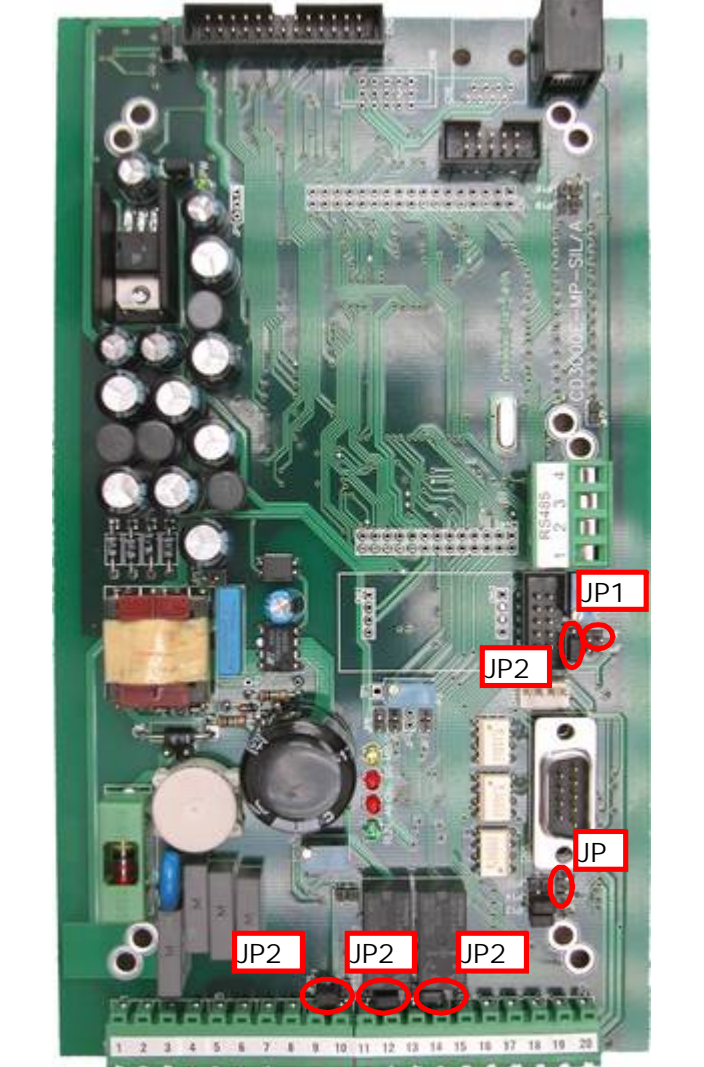
11.2 Auxiliary power supply connections

The auxiliary voltage supplies the electronic board and the fan, so check the nominal voltage on the label.

Terminal	Description
1	Auxiliary voltage supply 120/240V (for the electronic board and fans)
2	Auxiliary voltage supply 120/240V (for the electronic board and fans)

11.3 Analog inputs

CD3000E thyristor unit has an analogue input to drive the output power and a second analogue input that can be configured for external current profiling.

CD3000E units are delivered already configured in line with customer requirements that are defined in the complete product code.

The product code is written on the identification label.

Before to operate on CD3000E, make sure that the voltage and auxiliary voltage supply are not connected.

11.3.1 Main reference signal configuration (Terminal 8)

The main reference signal is already configured in line with customer requirements that are defined in the complete product code.The product code is written on the identification label. However, if you wish to change the input type (i.e. from 0÷10V to 4÷20mA) proceed as follows.

⚠️ *Warning: this procedure can be done just by specialized personnel.*

To configure the input type, set the jumper as below represented:

Type	Impedance	JP6
0÷10V	40KΩ	Open
POT(10KΩ min)	40KΩ min	Open
4÷20mA	500Ω	Close

Type	Impedance	JP8
0÷10V	40KΩ	Open
POT(10KΩ min)	40KΩ min	Open
4÷20mA	500Ω	Close

When operator finishes to configure the hardware setting he must do the input calibration procedure

11.3.2 Input calibration procedure

Warning: this procedure can be done just by specialized personnel.

This procedure is needed only if you change the input type

```
                    ┌─────────────────────┐
                    │     START TUNE      │
                    └─────────────────────┘
                    ┌─────────────────────┐
                    │ Auxiliary power supply│
                    │        OFF          │
                    └─────────────────────┘
                    ┌─────────────────────┐
                    │ Mantain Kay CAL pushed│      2sec.
                    │ and give the power supply│
                    └─────────────────────┘
                    ┌─────────────────────┐
                    │     Release key     │       ● S/C
                    │ when red and yellow │       ● H.B. / M.B.
                    │      led are ON     │
                    └─────────────────────┘
                    ┌─────────────────────┐
                    │  Yellow and red leds│       ☀ S/C
                    │     are flashing    │       ☀ H.B. / M.B.
                    └─────────────────────┘
                    ┌─────────────────────┐
                    │ Push again momentary│
                    │       CAL Key       │
                    └─────────────────────┘
                    ┌─────────────────────┐
                    │  Yellow led only is │       ○ S/C
                    │   flashing, apply   │       ☀ H.B. / M.B.
                    │    0 input Signal   │
                    │ I.E.: 0V for 0-10V  │       0% Signal
                    │    4mA for 4-20mA   │
                    └─────────────────────┘
                    ┌─────────────────────┐
                    │ Now press CAL Key again│
                    └─────────────────────┘
                    ┌─────────────────────┐
                    │   Red led only is   │       ☀ S/C
                    │   flashing, apply   │       ○ H.B. / M.B.
                    │ 10V for 0-10V input │
                    │         or          │       100% Signal
                    │ 20mA for 4-20mA input│
                    └─────────────────────┘
                    ┌─────────────────────┐
                    │ Now press CAL Key again│
                    └─────────────────────┘
                    ┌─────────────────────┐
                    │    Analog input     │       ✔
                    │      is tuned       │
                    └─────────────────────┘
                    ┌─────────────────────┐
                    │        END          │
                    │        TUNE         │
                    └─────────────────────┘
```

11.3.3 Secondary input (Terminal 9)

This analogue input 0-10V may be configured for External current limit profiling:

from 25 to 200A	from 275 to 700A

Type	P090 CL_ı	JP3
External current limit profiling	0	A-B

Type	P090 CL_ı	JP20
External current limit profiling	0	A-B

If you want to set the current limit via analog input with on board potentiometer, set the jumpers as showed below:

Tuning on CD3000E from 25 to 200A	Tuning on CD3000E from 275 to 700A

Type	P090 CL_ı	JP3	JP4
Internal current limit profiling	0	Open	Close

Type	P090 CL_ı	JP20	JP11
Internal current limit profiling	0	Open	Close

11.4 Analog outputs (Terminal 10)

Warning: this procedure can be done just by specialized personnel.

The thyristor unit is delivered configured and tuned in line with customer requirements. If it's necessary to change the configuration on site, proceed as below specified.

On CD3000E is available one analogue output 0÷10V (max 20mA) or 4÷20mA or 0÷20mA (500ohm) that represents the average power on the three phases.

from 25 to 200A				from 275 to 700A			

Type	P097 o4ΠA	JP2
0÷10V	0	A-B
0÷20mA	0	B-C
4÷20mA	1	B-C

Type	P097 o4ΠA	JP21
0÷10V	0	A-B
0÷20mA	0	B-C
4÷20mA	1	B-C
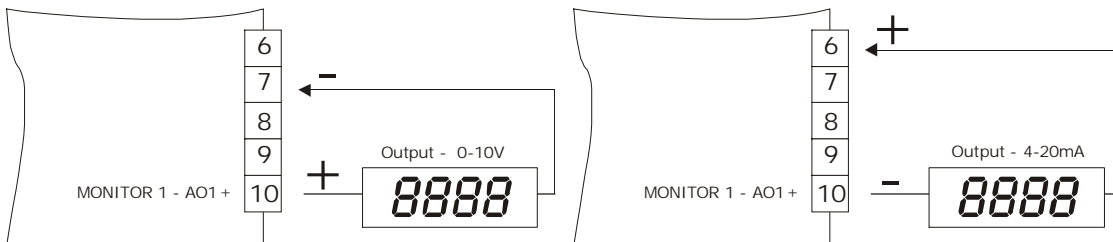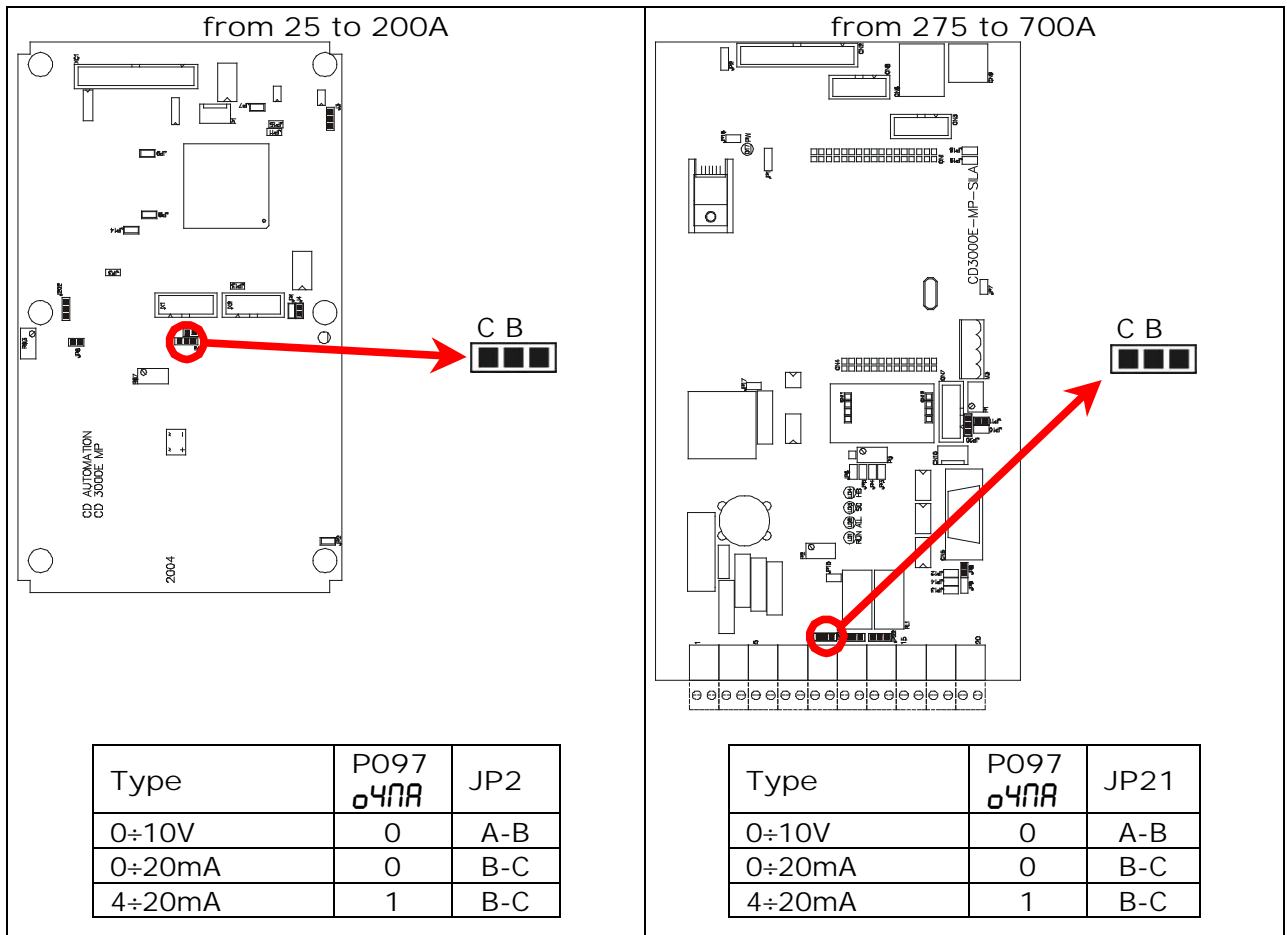
A digital filter is provided for discontinuous measures (i.e. BURST firing).
The parameter P104 *G_A1* is a number that we have to write and is equal to full scale value of indicator.
Example:
Power indicator full scale= 50KW
P104 *G_A1* = 50

11.5 Digital Input

CD3000E thyristor unit has 4 opto-isolated digital inputs.

11.5.1 Reset Alarm (Terminal 17 see par.7.4)

Use a free voltage instantaneous contact normally open (reset)
When an alarm occurs use reset to clear the alarm.
If the fault remains the alarm status come back.
If the fault has been overcome, the alarm does not appear again.

11.5.2 Start command (Terminal 18 see par.7.4)

Before give the Start command supply the auxiliary voltage to the terminals 1 and 2.
With the Start command the relay is activated and close his contact between the terminals 13 and 14. The CD3000E verifies the presence of the three phases and their rotation.
If something is wrong, the CD3000E stops itself and open the relay contact.

If all is OK and there is an input signal, the system will give an output following a ramp in line with the time setted in parameter P024 rP_u if ramp is used.

Opening run selector, the CD3000E will go to zero output following a ramp in line with the time setted in parameter P025 rP_d. Only when the output is equal to zero, the RUN relay is de-energized opening the contacts between terminals 13 and 14.

11.5.3 Cal Unit (Terminal 19 see par.7.4)

Use a free voltage momentary contact normally open.
To work in best conditions the unit needs a current calibration and heater break calibration.
This procedure starts by closing CAL or setting via RS485 using software configurator.

The calibration procedure is performed in this mode:

- The CD3000E gives the maximum voltage output
- The value of the voltage and current is stored in memory
- After which CD3000E comes back to the initial situation

This procedure is requested with new installation or when load is changed.
CAUTION: before to do this procedure set the nominal load current with the parameter P119 R_Lo

The CAL input is used also for the "Input calibration procedure" (see par. 11.3.2)

11.5.4 Configurable input (Terminal 20 see par.7.4)

Use a free voltage contact normally open (NO).
This digital input may be configured for one of following purposes:
* Additional Reset alarm status
* To switch On/off the unit maintaining the terminals 13-14 closed (unit in running)
* Feed-Back Selection (Ex. The unit start with V feed-back and revert to VxI when digital input is activated)
* Local/Remote set-point selection

The above functionality is done with parameter P103 $C\_d\,i$.

11.5.4.1 Alarm reset P103 $C\_d\,i$=0

When an alarm occurs use reset to clear the alarm.
If the fault remains the alarm status come back.
If the fault has been overcome, the alarm does not appear again.

11.5.4.2 On/off option P103 $C\_d\,i$=1

If the user gives this command (terminals 4-20 closed) the voltage output falls to zero also if the terminals 13-14 are closed (unit in run condition).
When the user opens the terminals 4-20, the power output goes to the set-point value.

11.5.4.3 Feed-Back Selection P103 $C\_d\,i$=2

If the user gives this command (terminals 4-20 closed) the unit works in V feed-back.
When the user removes the command (teminal 4-20 open), the unit works with the feed-back selected via configuration.

Example: With silicon Carbide elements to avoid to reach high voltage when element are cold CD3000E start with voltage feed back and switch to power feed-back when the heating elements are in temperature.

11.5.4.4 Local/Remote set-point selection P103 $C\_d\,i$=3

If the user gives this command (terminals 4-20 closed) the unit works in local set-point.
The local set-point can be setted via RS485 , CD-KP and software configurator.
When the user removes the command (terminals 4-20 open), the set-point is the input value
Applied on terminals 7–8

11.6 Digital output

CD3000E thyristor unit has 3 digital output (4 for size from 275 to 700A)to diagnose the thyristor status.

11.6.1 Run Relay (Terminals 13-14)

This is a free contact relay output. When the unit is in start mode the relay is energized. This contact may be NC or NO.

from 25 to 200A		from 275 to 700A	
Type	JP202	Type	JP22
NC	A-B	NC	A-B
NO	B-C *	NO	B-C *
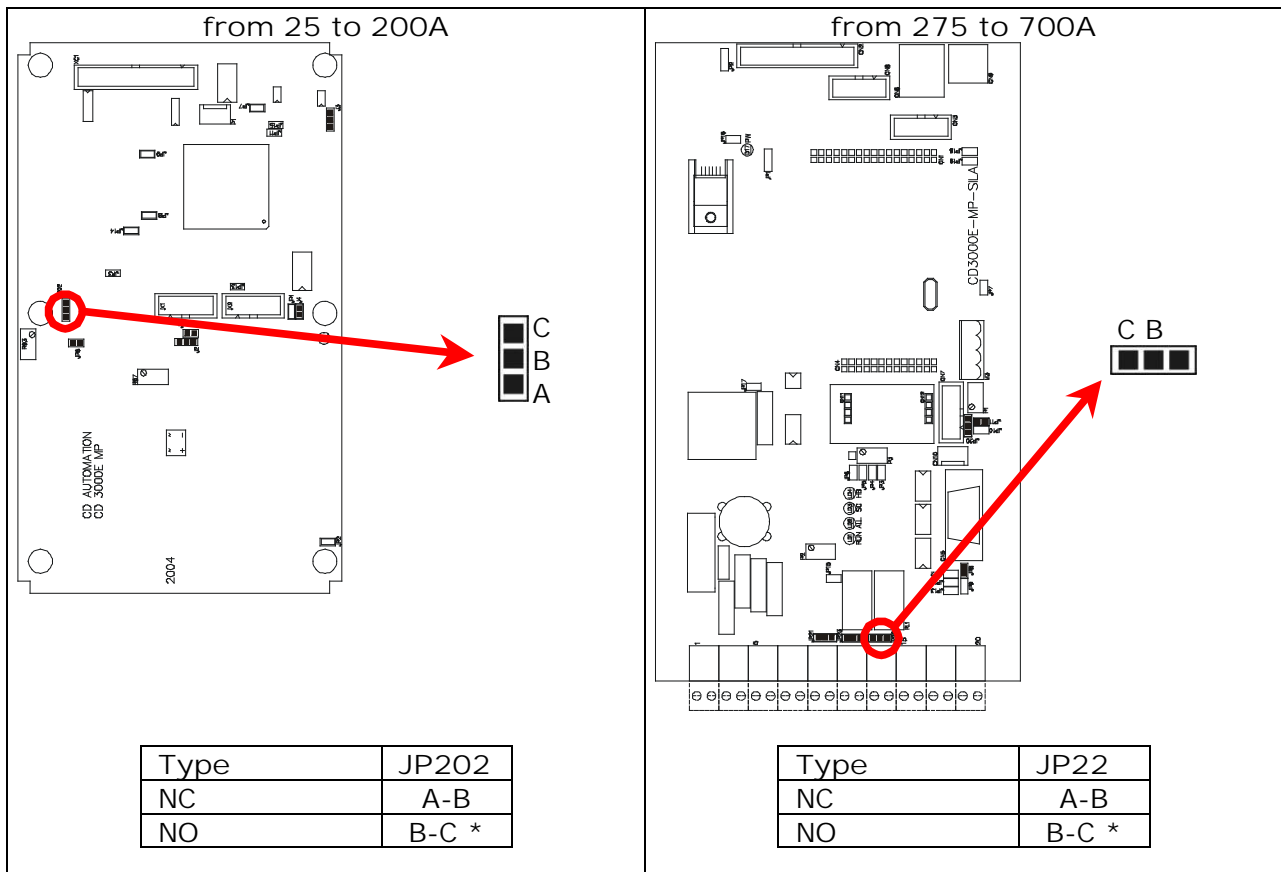
*This is the default configuration at which the wiring diagram are referred

The RUN relay must be used to energize an external main contactor.

11.6.2 Critical Alarm (Terminal 15)

This is a logic NPN 12Vdc (20mA max) output. When no alarm occurs the terminal output 15 is 12Vdc, when an alarm occurs this terminal is 0V. This output goes to zero volt if one if those alarms is active:

- Phase not found
- Incorrect phase rotation
- Over temperature on heatsink

When one of these alarms occurs, the unit stops. To reset the alarm use RESET. When the alarm is resetted, this output returns to 12Vdc.
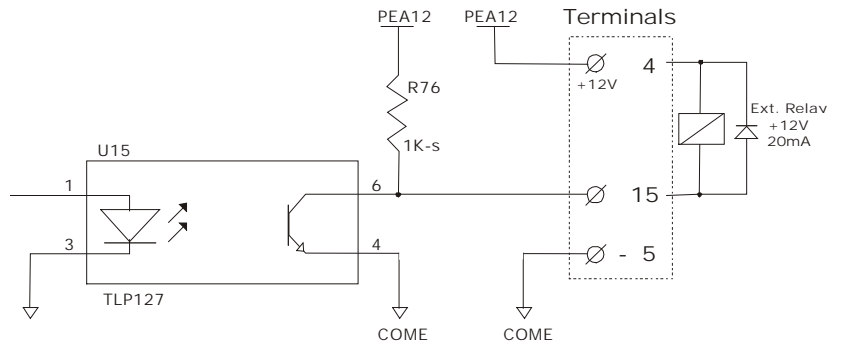
ATTENTION: to drive an inductive load (relay, coil, etc.) whit this output, be sure to use a free wheel diode in parallel to the coil.

11.6.3 Programmable Output (Terminal 16)

This is a logic NPN 12Vdc (20mA max) output. When no alarm occurs the terminal output 16 is 12Vdc, when an alarm occurs this terminal is 0V. This output goes to zero volt if one if these alarms is active:

- Thyristor Short circuit
  P112 do_2=0
- HB active
  P112 do_2=1
- Unbalanced load
  P112 do_2=2
- Current limit active
  P112 do_2=3
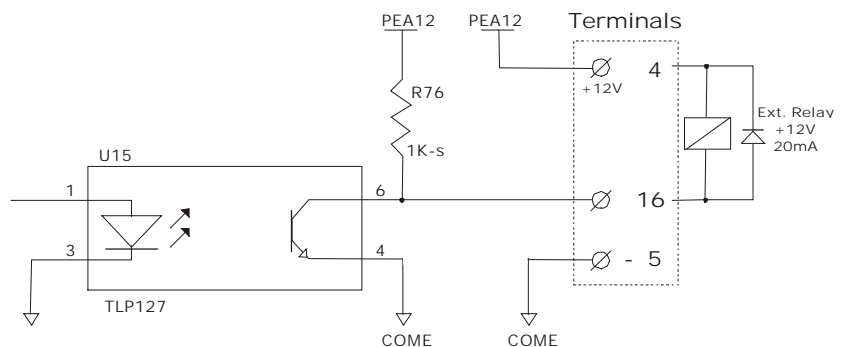
When one of the selected alarms occurs, the unit doesn't stop. To reset an alarm status use RESET. When the alarm is resetted, this output returns to 12Vdc.

ATTENTION: to drive an inductive load (relay, coil, etc.) with this output, be sure to use a free wheel diode in parallel to the coil.

11.6.4 Conf Relay (Terminals 11-12 only for size from 275 to 700A)

This is a free contact relay output. This contact may be NC or NO.

Type	JP23
NC	A-B
NO	B-C *
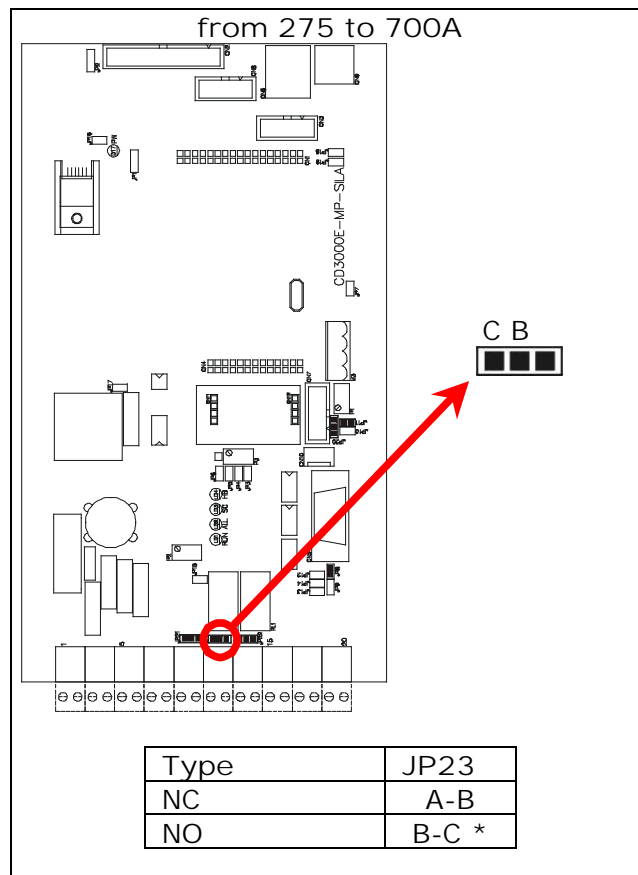
*This is the default configuration at which the wiring diagram are referred

The output may be configured for one of following purposes:
- Thyristor Short circuit
  P113 do_3=0
- HB active
  P113 do_3=1
- Unbalanced load
  P113 do_3=2
- Voltage Low
  P113 do_3=3

11.7 RS485 serial connection

The serial communication port is on terminal block and on 9 pin DIN connector.
On this port may be done a network up to 255 CD3000E.
On 9Pin DIN connector it's possible to use the CD-EASY facility (see par.2.3)

Terminal	Description
11	RS485 B
12	RS485 A

Terminal	Description
4	RS485 B
3	RS485 A
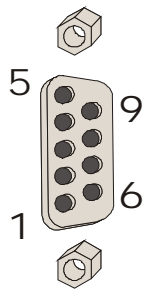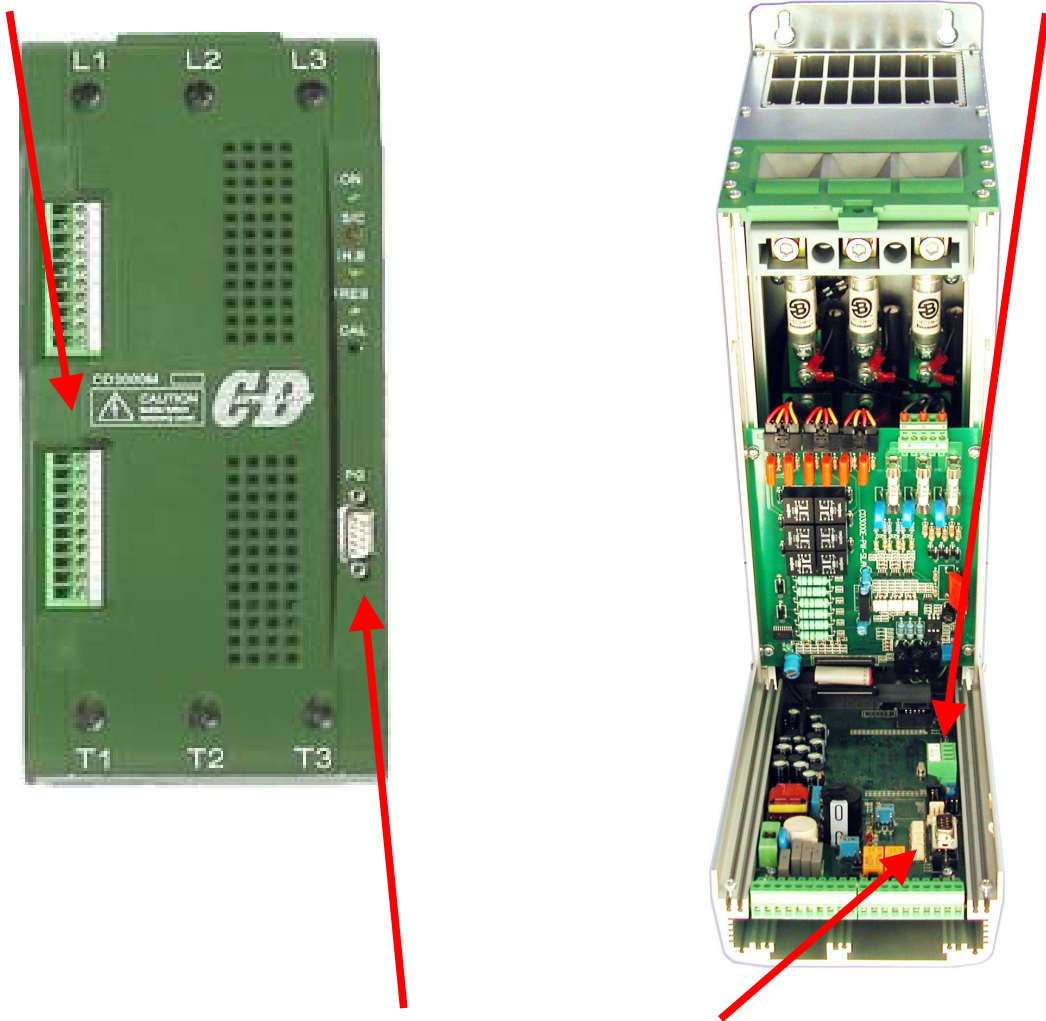
Pin 1	PMS5 (+5V)
Pin 2	GND 0V
Pin 3	GND 0V
Pin 4	Reserved (Rxd0)
Pin 5	GND 0V
Pin 6	RS485 A
Pin 7	RS485 B
Pin 8	nc
Pin 9	Reserved (Txd0)

11.8 PG Connector

The programmer port (PG) is used to configure the thyristor unit with the configuration software and with the programmer cable.

PG Connector
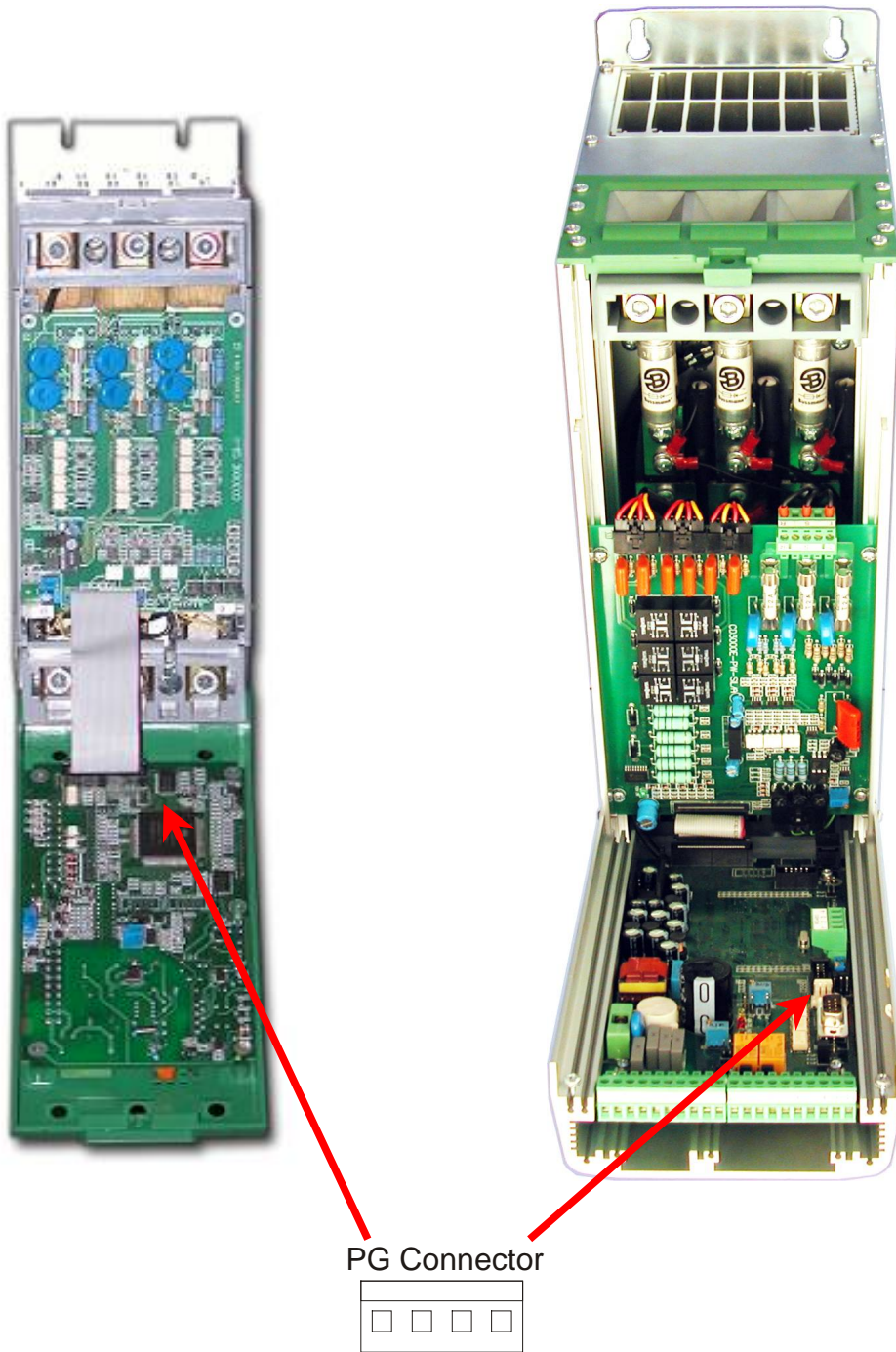
12 Fuses and Fuseholder

12.1 Fuses and Fuse Code

CD3000E unit must be protected by fuses against short circuit selecting the proper I²t that must be lower than the thyristor one. The same caution must be taken if Circuit Breaker is used. Remember that is very difficult to protect the thyristor if this choise is done.

WARNING!! USE SEMICONDUCTOR FUSES ONLY WITH proper I2t

SIZE	I²T (max) (A² sec.) THYRISTOR	Fuse CODE	I²T (max) (A² sec.) FUSE
25A	1030	FU50FE	600
35A	1030	FU63FE	750
45A	4750	FU80FE	1500
75A	4750	FU100FE	2800
100A	11300	FU160FEE	3700
125A	19100	FU200FEE	11400
150A	128000	FU250URB	52000
200A	128000	FU315URB	82000
275A	108000	FU315URB	82000
400A	300000	FU550FMM	215000
450A	300000	FU2x315FM	308000
500A	306000	FU2x315FM	308000
600A	1027000	FU2x450FMM	600000
700A	1027000	FU2x450FMM	600000

Other Fuses at your choice must have I^2t 20% less than thyristor's I^2t.

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

The user installation must be protect by electromagnetic circuit breaker or by fuse isolator.

The warranty of thyristor is null if no proper fuses are used. See tab above.

13 Parameters on software tools

13.1 Suggested recipe

13.1.1 ZC - Zero Crossing firing mode

Parameter	Name	Val	Description	UM	Mode
OPERATOR MENU					
P003 (H03)	L--r	0[2]	Local/remote Set-point selection		R/W
P004 (H04)	L_SP		Local Set-point value	%	R/W
P019 (H13)	OutN	100	Maximum Output	%	R/W
P024 (H18)	rP_u	0	Ramp up	Sec	R/W
P025 (H19)	rP_d	0	Ramp down	Sec	R/W
P116 (H74)	U_OP	Load V	Operative Voltage	V	R/W
P119 (H77)	A_Lo	Load I	Load Nominal Current	A	R/W

Parameter	Name	Val	Description	UM	Mode
SETUP MENU					
P023 (H17)	F ir	0[2]	Firing mode Selection		R/W
P066 (H42)	Hb_S	20	HB sensitivity	%	R/W
P070 (H46)	FEEd	1[2]	Feed back selection		R/W
P083 (H53)	bF_n	8[2]	Burst Firing Setting (available only with Burst Firing)	Cycles	R/W
P085 (H55)	dt	0[2]	delay triggering	°	R/W
P090 (H5A)	CL_ i	1[2]	Analog / Digital current limit selection		R/W
P091 (H5B)	CL	100,0[2]	Internal current limit value	%	R/W
P098 (H62)	LoAd	0=star 2=delta	Define the load type connection		R/W

[2] Default value

(shaded)	=modification it's not necessary
(unshaded)	=modification is necessary

13.1.2 BF - BURST firing mode

Parameter	Name	Val	Description	UM	Mode
OPERATOR MENU
P003 (H03)	L--r	0[2]	Local/remote Set-point selection		R/W
P004 (H04)	L_SP		Local Set-point value	%	R/W
P019 (H13)	OutN	100	Maximum Output	%	R/W
P024 (H18)	rP_u	0	Ramp up	Sec	R/W
P025 (H19)	rP_d	0	Ramp down	Sec	R/W
P116 (H74)	U_OP	Load V	Operative Voltage	V	R/W
P119 (H77)	A_Lo	Load I	Load Nominal Current	A	R/W

Parameter	Name	Val	Description	UM	Mode
SETUP MENU
P023 (H17)	F ir	0[2]	Firing mode Selection		R/W
P066 (H42)	Hb_S	20	HB sensitivity	%	R/W
P070 (H46)	FEEd	1[2]	Feed back selection		R/W
P083 (H53)	bF_n	8[2]	Burst Firing Setting (available only with Burst Firing)	Cycles	R/W
P085 (H55)	dt	0[2]	delay triggering	°	R/W
P090 (H5A)	CL_i	1[2]	Analog / Digital current limit selection		R/W
P091 (H5B)	CL	100,0[2]	Internal current limit value	%	R/W
P098 (H62)	LoAd	0=star 2=delta	Define the load type connection		R/W

[2] Default value

=modification it's not necessary

=modification is necessary

13.1.3 DT - Delay Triggering

OPERATOR MENU					
Parameter	Name	Val	Description	UM	Mode
P003 (H03)	L--r	0^2	Local/remote Set-point selection		R/W
P004 (H04)	L_SP		Local Set-point value	%	R/W
P019 (H13)	OutN	100	Maximum Output	%	R/W
P024 (H18)	rP_u	0	Ramp up	Sec	R/W
P025 (H19)	rP_d	0	Ramp down	Sec	R/W
P116 (H74)	U_OP	Load V	Operative Voltage	V	R/W
P119 (H77)	A_Lo	Load I	Load Nominal Current	A	R/W

SETUP MENU					
Parameter	Name	Val	Description	UM	Mode
P023 (H17)	F ir	2	Firing mode Selection		R/W
P066 (H42)	Hb_S	20	HB sensitivity	%	R/W
P070 (H46)	FEEd	1^2	Feed back selection		R/W
P083 (H53)	bF_n	8^2	Burst Firing Setting (available only with Burst Firing)	Cycles	R/W
P085 (H55)	dt	0 ÷ 100°	delay triggering	°	R/W
P090 (H5A)	CL_i	1^2	Analog / Digital current limit selection		R/W
P091 (H5B)	CL	$100,0^2$	Internal current limit value	%	R/W
P098 (H62)	LoAd	0=star 2=delta	Define the load type connection		R/W

^{2} Default value

	=modification it's not necessary
	=modification is necessary

14 Modbus communication

The CD3000E is equipped with two-wire RS485- serial communication.This means that communication can be between the CD3000E and a master device (e.g. a computer or terminal).

14.1 Physical requirements

Character Transmission
Data format is fixed to be one start bit, eight data bits, one stop bit and the parity none.

14.2 Modbus Rtu Protocol

The standard RS485 Communications use the industry standard MODBUS RTU protocol.
The following restrictions are imposed:

Baud rates will be 4800-9600-19200 Baud (Standard 19200).
Support for multi-parameter Write operations is limited to support of the Multi-Word Write Function (Number 16) but permits writing only one parameter per message.

The following MODBUS functions are supported:

Function	Function Number
Read Holding Registers (Read n Word)	03
Preset Multiple Registers (Write n Word)	16

14.3 Message formats

The first character of every message is the Controller address, in the range 1 - 255 and 0 for broadcast messages.
The second character is always the Function Number.
The contents of the remainder of the message depends upon this Function Number.
In most cases the Controller is required to reply to the message by echoing the address and Function Number.

Broadcast messages are supported at address 0 (to which the CD3000E responds by taking some action without sending back any reply).

Data is transmitted as eight-bit binary bytes with one start bit, one stop bit and parity checking set to none. A message is terminated simply by a delay of more than three character lengths at the Baud rate used; any character received after such a delay is considered to be the potential address at the start of a new message.

Since only the RTU form of the protocol is supported, each message is followed by a two-byte CRC 16 (a 16-bit cyclic redundancy checksum).
This checksum is calculated in accordance with a formula which involves recursive division of the data by a polynomial, with the input to each division being the remainder
of the results of the previous division.

The dividing polynomial is:
$2^{16} + 2^{15} + 2^2 + 1$(Hex 18005)

but this is modified in two ways:
• because the bit order is reversed, the binary pattern is also reversed, making the most significant bit (MSB) the right-most bit;
• only the remainder is of interest, the right-most (most significant) bit can be discarded.

Thus, the polynomial has the value Hex A001.

Bit order

Normal bit order

Most significant bit																	Least significant bit
	Most significant byte							Least significant Byte									

Reversed bit order

Least significant bit																	Most significant bit
	Least significant Byte							Most significant byte									
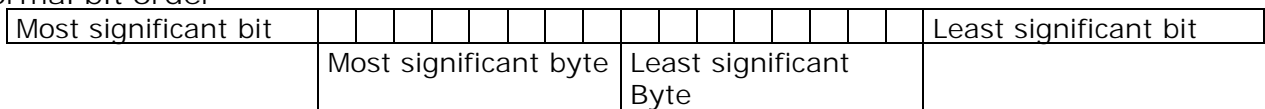
N.B.: Reversed order applies, so CRC16 returns Reversed bit order

CR— CRC error check data (1 word)
I   = Digits of calculation characters in command message
J   = Check on the number of times of CR calculation
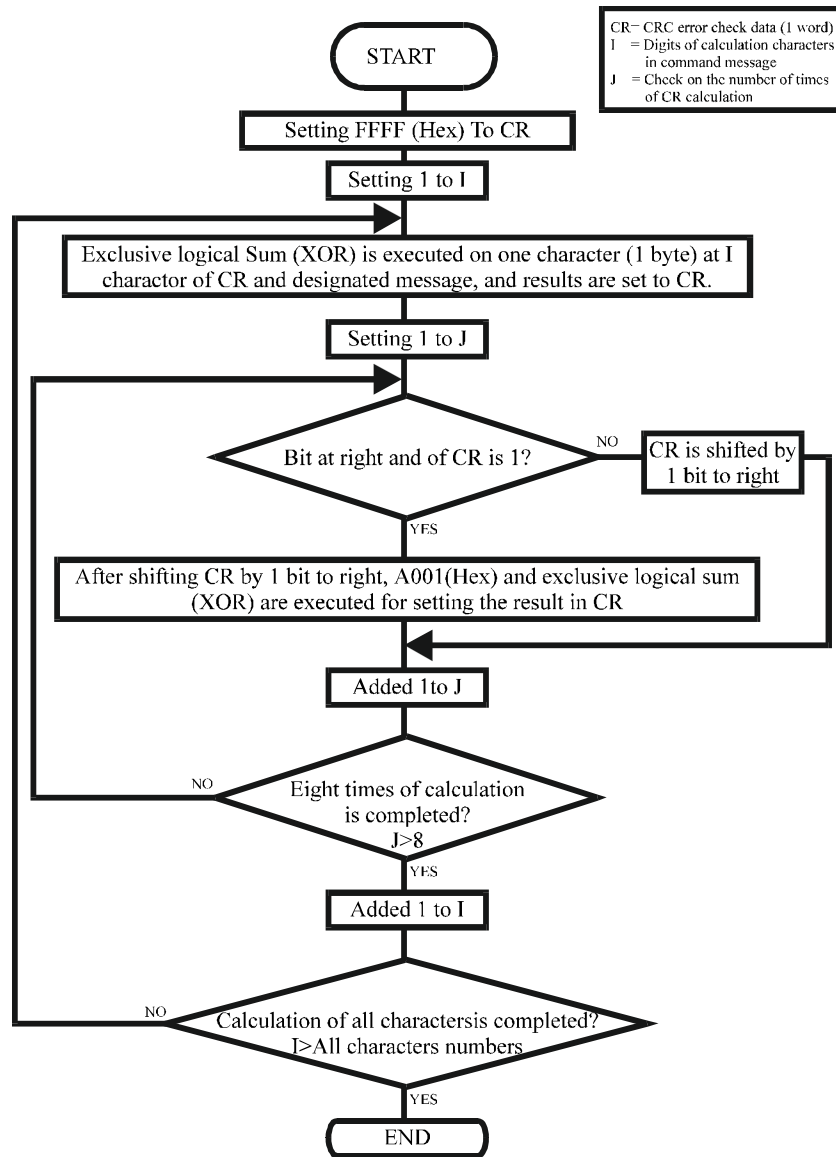
C Language CRC 16 Example

```
static short CRC16 (unsigned char *p_first,unsigned char *p_last)
{
        unsigned int crc=0xffff;
        short j;

        for (;p_first<=p_last;p_first++)
        {
                crc ^= *p_first;
                for(j=8;j>0;j--)
                {
                if(crc & 0x0001)
                        {
                        crc = crc >> 1;
                        crc ^= 0xA001;
                        }
                else
                        {
                        crc = crc >> 1;
                        }
                }
        }
  return (crc);
}
```

14.4 Read holding registers (read n words) – Function 03

The message sent to the unit to obtain the value of one or more registers comprises the following eight bytes:

Addr. Unit	Func.	Addr of 1° Word		N° of Word		CRC 16	
	3 3Hex	HI	LO	HI	LO	LO	HI

The normal reply will echo the first two characters of the message received followed by a single-byte data byte count (which will not include itself or the CRC).
For this message, the count value equals the number of parameter values read multiplied by two. Following the byte count, the specified number of parameter values are transmitted, followed by the CRC16 bytes:

Addr. unit	Func.	Cont.	1° Value			Last Value		CRC 16	
	3 3Hex		HI	LO		HI	LO	LO	HI

14.5 Preset multiple registers (write n words) - Function 16

This is an eleven-byte message. only one parameter may be written for each received message. The usual pre-amble is followed by the address of the parameter to be written, a two-byte word count (always set to 1), a single-byte byte count (always set to 2), the value to be written and the CRC16 bytes:

Addr. unit	Func.	Addr of 1° Word		N° of Word		Cont.	Valore		CRC 16	
	16 10Hex	HI	LO	0	1	2	HI	LO	LO	HI

The unit normally responds with the following eight-bit reply:

Addr. unit	Func.	N° of Word		N° Word		CRC 16	
	16 10Hex	HI	LO	0	1	LO	HI

14.6 Error and exception responses

If a received message contains a corrupted character (parity check failure, framing error etc.) or if the CRC16 check fails, or if the received message is otherwise syntactically flawed (e.g. byte count or word count is incorrect), the CD3000E will ignore that message.

If the received message is syntactically correct but nonetheless contains an illegal value, the thyristor will send a five-byte exception response as follows:

Addr. unit	Func.	N.Exception	CRC 16	
			LO	HI

The Function Number byte contains the function number contained in the message which caused the error,
with its top bit set (i.e. Function 3 becomes 0x83) and the Exception Number is on of the following codes:

Code	Name	Cause
1	ILLEGAL FUNCTION	Function number out of range
2	ILLEGAL DATA ADDRESS	Parameter ID out of range or not supported
3	ILLEGAL DATA VALUE	Attempt to write invalid data/required action not executed

NOTE: Writing a parameter value equal to its current value is a valid transaction; this will not cause an error response.

14.7 Modbus parameters

P001 (H01) RL_1 Status Code/Alarm   R
Function: This read only information gives following alarms that stop CD3000E
Value: 00 = NO Alarm
                 01 = Phase lost
                 02 = Wrong phase rotation
                 40 = Heatsink over temperature

P002 (H02) RL_2 Status Code/Alarm   R
Function: This read only information gives following alarms
Value: 00 = NO Alarm
                 x1 = Thyristor Failure
                 x2 = Heater Break failure
                 x4 = Unbalanced load

P003 (H03) $L\text{-}\text{-}r$ Local/remote Set-point selection   R/W
Function: Select if the command is remote (analog signal on terminals 7-8) or local
                 signal generated by parameter P004 L_SP
Value: 1 = local reference from parameter P004 L_SP
                 0 = remote reference from main analog input signal terminal 7-8
Default: 0
Note: The parameter is not memorized in EEPROM

P004 (H04) $L\text{-}SP$ Local Set-point value   %   R/W
Function: Local reference signal, active with P003 $L\text{-}\text{-}r$ = 1
Min/Max: 0 ÷ 100%
Default: 0
Note: The parameter is not memorized in EEPROM

P008 (H08) $r\text{-}SP$ Remote Set-point value   %   R
Function: This parameter reads in % the reference signal on input 1 (terminals 7-8)
Min/Max: 0 ÷ 100%
Example: Input   4 mA P008 r_SP = 0
                 Input 12 mA P008 r_SP = 50
                 Input 20 mA P008 r_SP = 100

P011 (H0B) $U\text{-}Ln$ Voltage supply   V   R
Function: This parameter reads the voltage of power supply
Value: from 0 to incoming voltage supply.
Example: 380 Volt

P019 (H13) $OutN$ Maximum output   %   R/W
Function: This parameter set in % maximum output voltage
Min/Max: 0 ÷ 100%

P023 (H17) $F\,ir$ Firing mode Selection   R/W
Function: It Selects the firing type
Value: 0= BURST firing mode
                 2= DELAY TRIGGERING mode
Default: 0

P024 (H18) $rP\text{-}u$ Ramp up   Sec   R/W
Function: This parameter sets ramp up time
Min/Max: 0 ÷ 1000 sec

Default: 2 sec

PO25 (H19) rP-d   Ramp down   Sec   R/W
Function: This parameter sets ramp down time
Min/Max: 0 ÷ 1000 sec
Default: 2 sec

PO31 (H1F) Uout   Average voltage output on the three phases   V   R
Function: This parameter show the Average voltage output on the three phases

PO32 (H20) Po   Average power output on the three phases   Kw   R
Function: This parameter show the Average power output on the three phases

PO33 (H21) A--r   Current rms value on phase R   A   R
Function: This parameter show the Current rms value on phase R

PO34 (H22) A--S   Current rms value on phase S   A   R
Function: This parameter show the Current rms value on phase S

PO35 (H23) A--t   Current rms value on phase T   A   R
Function: This parameter show the Current rms value on phase T

PO66 (H42) Hb_S   HB sensitivity   %   R/W
Function: This parameter set the drop of current over which the HB alarm became
                    active. This value is in percentage with reference to the nominal
                    resistance of the load.
Min/Max: 0,0 ÷ 100,0%
Default: 100,0
Example: Nominal current 100A P066 Hb_S=20 . This means that the Heather
                    Break Alarm became active when current goes below 80A

PO70 (H46) FEEd   Feed back selection   R/W
Function: It Selects the type of feed back on the main loop
Value: 1 = voltage feed back (rms value)
                    2 = power feed back VxI
Default: 1
Note: value of feed back are the average value on the three phase R, S, T

PO83 (H53) bF_n   Burst Firing Setting (available only with Burst Firing)   R/W
Function: It defines the number of voltage cycles in ON condition at 50% of power
                    demand
Min/Max: 0 ÷ 256 cycles
Default: 8

PO85 (H55) dt   Delay triggering   °   R/W
Function: This parameter set delay firing in °
Min/Max: 0 ÷ 100°
Default: 0

PO90 (H5A) CL_ı   Analog / Digital current limit selection   R/W
Function: This parameter select if the current limit of CD3000E is from Analog or
                    Digital signal. Digital is setted with parameter P091 CL
Value: 0 = Analog, current limit from main analog input (see par.9.5.1)
                    1 = Digital, current limit from parameter P091 CL
Default: 1
Note: Parameter is stored in memory

P091 (H5B)   CL   Internal current limit value   %   R/W
Function: With P090 CL-ı =1 The setted value correspond at Internal current
                        limit
Min/Max: 0,0 ÷ 100,0%
Default: 100,0

P097 (H61)   o4Π   Offset Analog Output   R/W
Function: This parameter is used to set the Analog Output (see par.11.4)
Value: 0 = 0 ÷ 10Vdc / 0 ÷ 20mA
                        1 = 4 ÷ 20mA
Default: 0

P098 (H62)   LOAd   Define the load type connection   R/W
Value: 0 = star connection without neutral
                        2 = delta connection
Default: 0

P103 (H67)   C-dı   Digital input configuration (terminal 20)   R/W
Function: It selects the function of digital input
Value: 0 = Reset
                        1 = ON/OFF unit
                        2 = Feed-back selection
                        3 = Local/Remote Set-point
Default: 1

P104 (H68)   G_A1   Analog Output Rescaling   %   R/W
Function: This parameter is used to adjust the full scale value
Min/Max: 0,0 ÷ 100,0%
Default: 100,0

P112 (H70)   do-2   Digital output 2 configuration   R/W
Function: It selects the signal to be connected on digital output 2
Value: 0 = Thyristor short circuit
                        1 = HB
                        2 = Unbalanced load
                        3 = Current limit
Default: 1

P113 (H71)   do-3   Digital output 3 config. (For size from 275 to   R/W
                        700A)
Function: It selects the signal to be connected on digital output 3
Value: 0 = Thyristor short circuit
                        1 = HB
                        2 = Unbalanced load
                        3 = Voltage Low
Default: 0

P114 (H72)   bAud   Baud Rate on serial port   R/W
Function: It selects the baud rate of RS232
Value: 0 = 4800
                        1 = 9600
                        2 = 19200
Default: 2

P115 (H73) **Addr**   Address number   R/W
Function: It identifies the drive number on communication master/slave.
Value: 1 = Drive 1
                       2 = Drive 2
                       ...
                       127 = Drive 127
Default: 1

P116 (H74) **U_OP**   Operative Voltage   V   R/W
Function: It's necessary to specify the operative voltage
Min/Max: 24 ÷ 1000V
Default: 400
Note: CD3000E with voltage out of range 342V to 602V, needs hardware
                       modifications, specify this in phase of ordination.

P119 (H77) **A-Lo**   Load nominal current   A   R/W
Function: It's necessary to specify the load current value at nominal voltage. This
                       current and voltage value are necessary to be able to read the power in
                       engineering units
Min/Max: 1 ÷ 100.0 Ampere (for size up to 100A)
                       1 ÷ 1000 Ampere (for size > 100A)
Default: Nominal CD3000E current value if load current has not been specified.

Example: I have bought CD3000E size 100 A with current feed back.
                       The load current at nominal voltage is 50 A.
                       0%   input signal =0 A
                       50%   input signal =50 A
                       100% input signal =100 A
                       As it's possible to see at 50% input signal the current output is already
                       at Max value. From 50 to 100% of input signal there is no action on
                       output.
                       To have a regulation from 0 to 100%, it's necessary to set parameter
                       P119 **A-Lo**= 50 Amp.
                       Set of this parameter is necessary also when there is a power feed-back

15 Maintenance

15.1 Fans

The thyristor unit with forced ventilation uses fans that rotate permanently when the unit is supplied. In case of accidental fan failure, there is an over heating temperature on heatsink. 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 heatsink 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.

15.2 Servicing

In order to have correct cooling, the user must clean the heatsink and the protective grill of the fans. The frequence of this servicing depends on environmental pollution.
Also check periodically if the screw for the power cables and safety earth are tightened correctly.

15.3 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 refer.
- Use a rugged packaging to ship the unit.

15.4 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.

16 Note

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