Instruction Manual code MANU.470S

Rev.11
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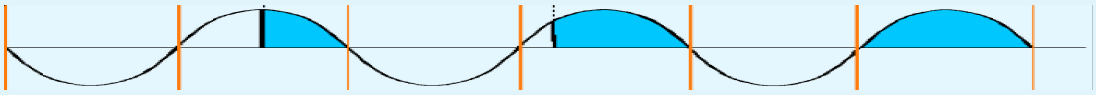
MULTIFUNCTION THREE PHASE DRIVES

470 SERIES



SOFT-STARTER

STATIC SWITCH

POWER/ENERGY REGULATOR

VOLTAGE REGULATOR

CE

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Description of the Manual

Three-phase 470 series drive have been created with 4 programmable features (see Chapt. 2 DRIVE FUNCTION SELECTION):
- SOFT-STARTER: to start/slow down three-hase asynchronous motors.
- STATIC SWITCH: to statically command three-phase loads in alternative to electro-mechanical contactors, by ZERO CROSSING antijamming managing.
- POWER/ENERGY REGULATOR: to control the temperature in ovens with electric resistances by wave- train regulation in ZERO CROSSING.
- VOLTAGE REGULATOR to control voltage/current on Rowan High slip motors and in general on feeders voltage/current adjustable; the voltage is adjusted by the PHASE PARTIALIZATION technique.
For this reason, this manual is divided into the following parts:
- Chapt. 1-2-3-4 gives instructions common to all functions.
- Chapt. 5-6-7-8-9 describe **SOFT-STARTER** function (see Chapt. 1 and 5 for a quick start-up of the function).
- Chapt. 10 describes technical characteristics common to the following functions:
STATIC SWITCH, **POWER/ENERGY REGULATOR, VOLTAGE REGULATOR.**
Chapt. 11 describes the **STATIC SWITCH function.**
Chapt. 12 describes the **POWER/ENERGY REGULATOR.**
Chapt. 13 describes the **VOLTAGE REGULATOR.**

ATTENTION! Before starting, select the function needed by reading chapt. 2 - "DRIVE FUNCTION SELECTION"

ROWAN ELETTRONICA s.r.l. declines all responsibility for any imprecisions in this manual due to printing and/or copy errors. Moreover it can make changes any variations it may deem necessary to improve the products under its sole discretion and without notice.
The data and characteristics provided in this manual have a maximum tolerance of ±10%, unless otherwise indicated. The diagrams are mere guidelines and should be adapted to the specific needs of the user.

Compatibility of the manual with the firmware 470S version

IThis manual is updated to the **firmware 4.01**. The firmware version can be read through the DISPLAYS menu on the keypad, see FIRMWARE VERSION variable.

General safety instructions

Before installing , wiring or any other operation on the actuator, carefully read this manual to ensure that the correct operations are made and all related safety measures are taken.

It is strictly forbidden to use the 470 actuators in any way other than for the operations indicated in this manual.

This instruction manual addresses **qualified technicians** who know the standards to respect in the installation and operation of the actuator, in compliance with safety regulations and the protection of this type of equipment.
The actuator and its load can create hazardous situations for the safety of objects and individuals, the user and installer must comply with statutory regulations.

This actuar presents a a current lekeage to ground (<1mA), so DO NOT supply it without connecting the PE terminal to ground first.

The drive doesn't have any SIL ability (Safety Integrity Level) as per standard IEC/EN61508, so drive contacts cannot be considered a valid method for a safety stop; in certain programming or actuator fault conditions, its shut down may not mean that the motor will stop immediately. Only an electromechanical cut-off of the actuator from the power supply, made by following IEC/EN61508 standards, will safely cut-off any motor command.
In the same way, in case of SOFT-STARTER function, the shaft stopped detector cannot be considered valid to carry out operations in total safety (SIL ability).

Installation of the actuator in risky zones, containing flammable substances or combustible vapour or dust, can cause fire or explosion. The 470 actuators must be installed away from such zones.
In all events prevent water or other fluids from penetrating the interior of the appliance.
Do not carry out dielectric rigidity tests on parts of the drive.

Warranty

The product warranty is provided ex works Rowan E.; Terms and conditions are specified on the Sales Conditions that can be requested to the Commercial Dept. or downloaded from our web site: www.rowan.it

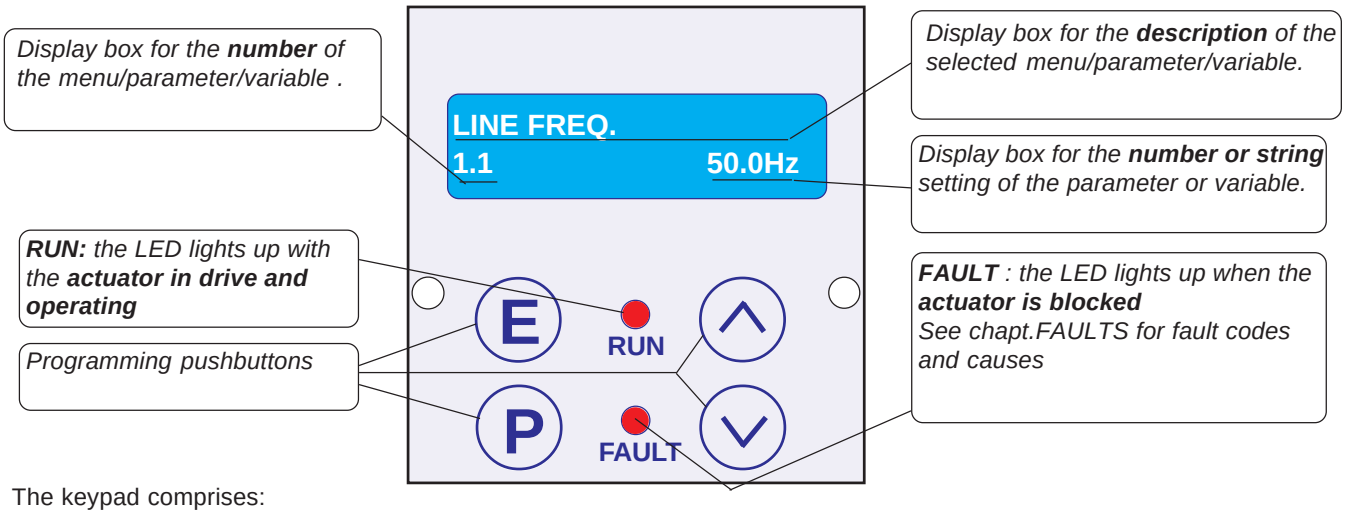
Instructions for all functions

Instructions for SOFTSTARTER function

Instructions for: STATIC SWITCH, POWER/ENERGY REGULATOR, VOLTAGE REGULATOR functions

General overview of the keypad

The keypad is used to modify the operating parameters (stored on an eeprom) and view parameters and measurements during processing. The serial connection allows the keypad can be remote connected to the panel of a control switchbox, at a maximum distance of 25 meters.
On request, Rowan Elettronica can supply the keypad remote connection lead.



The keypad comprises:

- A backlit alphanumerical display with 2x16 characters .
- Four pushbuttons with pressed feeling.
- Two LED's signalling drive (RUN) and fault block (FAULT).

Button descriptions

E **ESCAPE** returns to the start menu or a higher level and saves the settings.

P **PROGRAM**, enters the submenus and the parameter change mode with sequential digit selection for number settings.

UP, scrolls the variables FORWARD and increases the number setting selected by PROGRAM button.

DOWN, scrolls the variables BACKWARD and reduces the number setting selected by PROGRAM.

Parameter modification procedure

For example, SOFTSTART function, to modify the parameter **1.2 MOTOR In** under the **1. BASIC DATA** menu :
> Press P to view the 1. BASIC DATA menu
> Press P to view the first parameter in the 1.BASIC DATA menu, the 1.1 LINE FREQ parameter.
> Press UP to select par.1.2 MOTOR In.
> Press P to enter the modify parameter mode:
the display box with the rightmost digit of the setting will start blinking to indicate that it is now possible to modify it by the UP and DOWN buttons.
> Press UP to increase and DOWN to decrease the setting.
> To modify the other digits just press P briefly, every time it is pressed the next digit to the left is selected, until it reaches the leftmost and then returns to the rightmost and so forth.
> If the parameter can be both positive or negative, the sign is shown after the leftmost digit; to change it press P until it is selected and then use UP to set **+** and DOWN to set **-**
> To memorise the new setting press ESCAPE (the selection will stop blinking).
> To return to the initial menu (DISPLAY STATUS) press ESCAPE again. To modify parameters with string selections use exactly the same procedure, in this case UP and DOWN will select the strings available instead of numbers.

Caution! → **The keypad does not have its own memory to store the parameters**

The C470 series device can be applied in 4 ways (functions) that can be selected by parameter **100.1 APPLICATIONS**. They are:
- SOFT-STARTER: to starting/slowing down of three-phase asyncronous motors.
- STATIC SWITCH: to statically command three-phase loads in alternative to the use of electromechanical contactors, by the ZERO CROSSING feature (against interferences).
- POWER/ENERGY REGULATOR: to control the ovens (electric resistance type) temperature by the wave -trains regulation (by the ZERO CROSSING).
- VOLTAGE REGULATOR: to control voltage/current of high slip Rowan motors and feeder units in general that can be regulated under voltage/current; the voltage is regulated by the PHASE-PARTIALIZATION technic.

The default function is SOFT-STARTER

Description of the 100 menù parameters

WARNING! The 100. menu includes critical parameters affecting the regulator's basic functions; always pay utmost attention when setting them.
To access the 100. parameter programming screens, variables must be DISPLAYED. Pressing the ESCAPE button for 5 seconds gives access to the first parameter programming screen:

APPLICATIONS 100.1 SOFTSTART	***Par.100.1. It selects the function type***

Setting range: SOFTSTART, 3AC_REG, 3AC_0CROSS, 3AC_ON/OFF
SOFTSTART = SOFTSTART function , starter/decelerator for three-phase asynchronous motors.
3AC_REG = VOLTAGE REGULATOR function , phase cutting voltage regulator.
3AC_0CROSS = POWER/ENERGY REGULATOR function, zero crossing wave train regulator.
3AC_ON/OFF = STATIC SWITCH function, zero crossing command.

RESET FAULT EN 100.2 NO	***Par.100.2. It enables fault reset by a new run command (forward/backward for SOFTSTARTER function)***

Setting range: NO, YES.

PARAM BLOCK 100.3 NO	***Par.100.3. It allows to lock the access to keypad parameters***

Setting range: NO, YES
If it is set to YES, with par.**100.5 = DEFAULT**, the system will prevent access to all parameters (except for menu 100).
If it is set to YES, with par.**100.5 = OPERATOR**, the system will prevent access to all parameters (except for menu 100 and menu 1). BASIC DATA OPER.

SCR CONTROL TYPE 100.4 2.	***Par.100.4. It select the SCR control technique***

This parameter is not enabled on STATIC SWITCH and POWER/ENERGY REGULATOR functions.
Setting field: from 1 to 3 for the SOFTSTARTER function, 1 for the VOLTAGE REGULATOR function
1 = OPEN LOOP control (suggested with "disturbed" supply line)
2 = OPEN LOOP control combined + FEEDBACKED control from voltage on SCR (must be used when starting a loadless motor)
3 = for softstarter applied on network locking of a **threephase generator** (see chap.9 OPERATING MODES)

MENU OPERATOR 100.5 DEFAULT	***Par.100.5. It configures the keypad parameter access methods***

This parameter is enabled for the *VOLTAGE REGULATOR function only.*
Setting range: DEFAULT, OPERATOR
DEFAULT= Menu **1. BASIC DATA** standard
OPERATOR = The **1.BASIC DATA** menu is replaced by menu **1. BASIC DATA OPER.**, which can be customised with the OPERATOR type setting parameters.
For a description of menu **1. BASIC DATA OPER.** see the paragraph at the chapt.13:
"**Customising keypad settings with OPERATOR parameters**".

LINEARIZATION 100.6 YES.	***Par.100.6. Linearization of the SCR control signal***

This parameter is enabled for the *VOLTAGE REGULATOR function only.*
Setting range: NO, YES
NO = The control signal is directly proportional to the SCR fire angle.
YES = The control signal is linearized so that it is directly proportional to the RMS U1 V1 W output regulated voltage (maximum accuracy with resistive load).

Description of the actuator blocked status with faults list

The actuator faults are signalled by the FAULT LED lighting up in **continuous** on the keypad and the RUN LED turns off ; in this case all output relays are disactivated and consequently, in the SOFTSTART function, the FORWARD, REVERSE, FAST (return to SLOW) and BYPASS relay switches.
With the default settings, to know the cause of the block, just use the arrow buttons to select the monitor variable **LAST FAULT.** This variable views the **fault number** associated with the cause of the block as described in the **FAULT LIST** table below.

There are two ways of resetting the blocked status of the actuator:
1) shut off and (after a pause) restore the logic power at terminals 39 and 41.
2) with the logic powered, disactivate and then activate the FORWARD or REVERSE drive command. To use this option set **par.100.2 RESET FAULT EN = YES**.

N° FAULT	FAULTS LIST
1	**MOTOR OVERLOAD**
	Fault enabled on SOFT-STARTER function only and par. 3.1 ENABLE CLASS10 = YES. **It is present after a long motor overload.**
2	**MOTOR UNDERLOAD**
	Fault enabled on SOFT-STARTER function only **It is present at the end of Start-up if the motor current is lower than the value set on par. 3.2 % UNDERLOAD during the time set on par. 3.3 t UNDERLOAD.**
3	**OUTPUT SHORT CIRCUIT**
	Short-circuit on U1 V1 W1 output terminals.
4	**SCR MODULE SHORT CIRCUIT**
	Fault enabled on STATIC SWITCH and POWER/ENERGY REGULATOR functions only **At least one internal SCR module is in short-circuit.**
7	**SCR OVERTEMPERATURE**
	Over-temperature on SCR modules cooler device; intervention by thermic probe opening.
10	**DRIVE OVERLOAD**
	Drive overload; on SOFT-STARTER function, this fault can be caused by too long or too frequent and close start-ups.
11	**MOTOR PTC OVER TEMPERATURE**
	Fault enabled on STATIC SWITCH, POWER/ENERGY REGULATOR and VOLTAGE REGULATOR functions only with par. 3.4 MOTOR PTC ENABLE= YES **It is present when the PTC probe installed in the motor (and connected to the drive terminals 27- 32) has detected an over-temperature.**
12	**REGULATOR OVERLOAD**
	Fault enabled on VOLTAGE REGULATOR function only and par. 2.8 OVERLOAD ENABLE = YES. **It is present when the current gets over the limit set on par. 2.9 OVERLOAD for the time set on par. 2.10 OVERLOAD TIME.**
13	**ANOMALY ON POWER LINE**
	Imbalance or lack of power on the phases of the power line terminals R1 S1 T1.

Descrizione parametri del menù FAULT HISTORY

If the device is turned-off after a fault event, the **LAST FAULT** variable is zeroed; in this case, to know the cause of the arrest, enter the **FAULT HISTORY menu,** select the **FAULT1** variable to see the most recent Fault number until variable **FAULT5** (the less recent one). To erase the latest 5 fault list, set **par. RESET HIS FAULT=NO** (the setting automatically comes back to YES).
The FAULT HISTORY menu got different numerical orders basing on the function:
- SOFT-STARTER function > **menu 11.**
- STATIC SWITCH and POWER/ENERGY REGULATOR functions > **menu 3.**
- VOLTAGE REGULATOR function> **menu 7.**

For example, on SOFTSTARTER function, the menu will be as follows:

Description of 11. FAULT HISTORY menu parameters

FAULT HISTORY
11.

View the last 5 FAULTS in chronological order and a parameter to completely reset the history

FAULT 1
11.1 ***0.***

Var.11.1. View the most recent FAULT number

Setting options: 0 - 13.

FAULT 2
11.2 ***0.***

Var.11.2. View the second FAULT number

Setting options: 0 - 13.

FAULT 3
11.3 ***0.***

Var.11.3. View the third FAULT number

Setting options: 0 - 13.

FAULT 4
11.4 ***0.***

Var.11.4. View the fourth FAULT numer

Setting options: 0 - 13.

FAULT 5
11.5 ***0.***

Var.11.5. View the fifth (the oldest) FAULT number

Setting options: 0 - 13.

RESET HIST FAULT
11.6 ***NO.***

Par.11.6. Reset the 5 FAULT history

Setting options: NO, YES
YES: the faults are reset and the setting then automatically returns to NO.

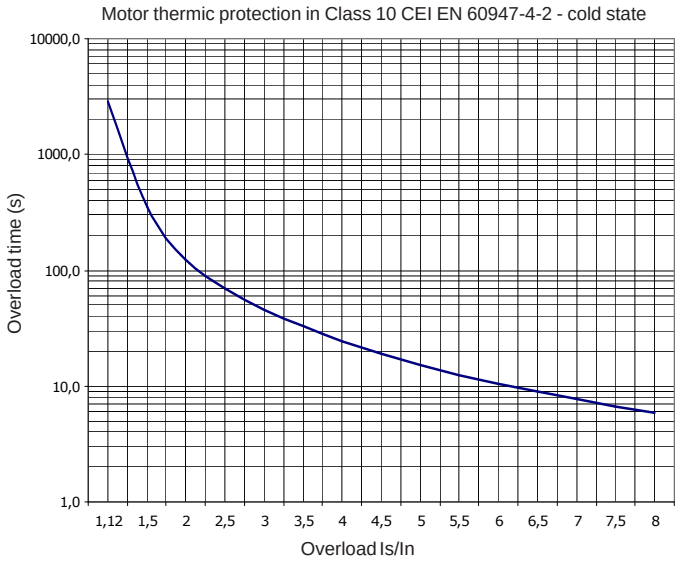
Other possible cases of mulfunctioning and remedies

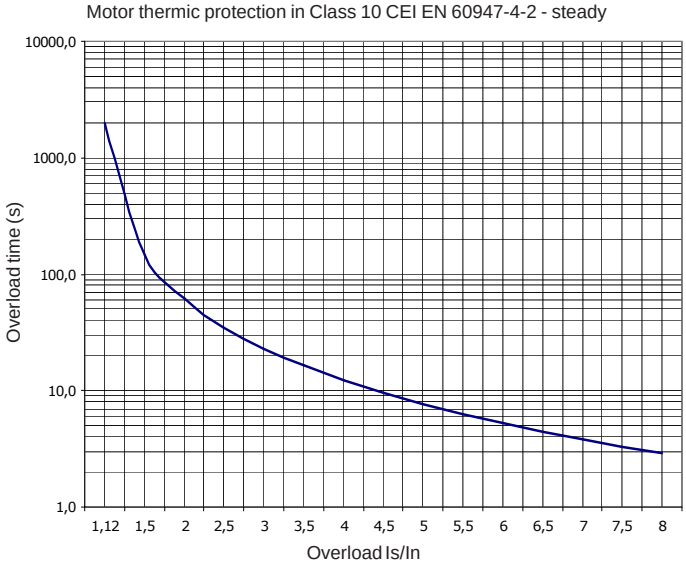
1) On SOFT-STARTER function, during a loadless starting, you hear strong bumps on the motor at full speed.
RIMEDY: to start a loadless motor, it is necessary to use SCR control technique, by setting par.100.4 SCR CONTROL TYPE = 2.

2) The supply line R1 S1 T1 is very disturbed and the voltage on the load (terminals U1 V1 W1) is irregular.
RIMEDY: use SCR control technique, by setting par. 100.4 SCR CONTROL TYPE = 1.

FAULT1 "MOTOR OVERLOAD" description (on SOFT-STARTER function only)

With par. 3.1 ENABLE CLASS 10 to YES you will enable the motor protection as specified by regulations for Class 10. Class 10 provides times and overloads for cold and warm motor, above which Fault 1 steps in .
The curves with the times / overloads are below:

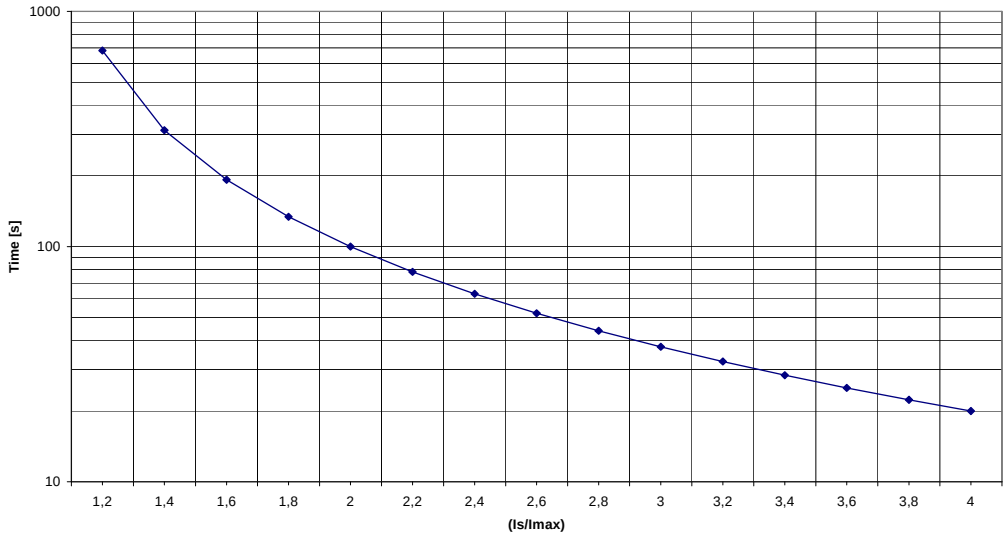




Is is the starting current, **In** is the rated motor current set in par. 1.2 or in par. 5.1 (if you selected the second speed).
Is / In = ratio between starting current and rated motor current.
The softstarter internally simulate the motor winding heating basing on the absorbed current during a certain time (i^2t motor). If beside **IxI MOTOR** you read "Cold", the motor is cold and when starting (or with overloadings) consider the "cold" times of the curve. If beside **IxI MOTOR** you read "Warm", the motor is considered hot and when starting (or with overloadings) consider the "warm" times of the curve.
At starting, to obtain the times shown by the curves it is necessary that **IxI MOTOR** is 0%, otherwise times will be lower.
To bring the variable **IxI MOTOR** from 100% to 0%, you need 15 minutes; this is the maximum time to be wait after the starting in order to obtain the maximum times allowed by the Class 10 curves.

FAULT10 "MOTOR OVERLOAD" description

Fault 10 protects the drive against overloading, the maximum rated current (**Imax**) in continuous service corresponds to the maximum setting limit of the parameters par. 1.2 or 5.1.
The soft starters are designed to withstand cold start with inrush currents (**Is**) corresponding to 4 times the current maximum permissible continuous service for 20s.
Consequently, the response times of FAULT10 are shown in the chart below:



However, if **IxI DRIVE** exceeds 0% and starts to increase, we enter the area of intervention FAULT10.
If, after an overload , the current decreases under the threshold value, the variable starts to decrease and from 100% to 0% it takes about 5min and 30s. After a starting, if scr are still hot, next startings will have shorter admitted times depending on the **IxI DRIVE** residual content and on the thermic simulation by scr junction.

Description of modbus RTU serial transmission

The MODBUS RTU protocol establishes asynchronous communication between a MASTER device (e.g. plc, pc, etc.) and several SLAVE devices (in this case the 470 series actuators) connected by an RS485 interface
HALF-DUPLEX (i.e. simultaneous transmission and reception is not possible) with a 2-wire connection.
Only the master can query the slaves that can only respond; each character of the message is composed as follows: ***1 start bit , 8 bits for the data, 1 bit for the parity, 1 or 2 stop bits***
In 470 series actuators the type of parity and number of stop bits can be programmed together with the transmission speed at the following baudrates: ***9600, 19200, 38400, 57600, 76800, 115200.***
For every correct write or read message del master , a slave response messagge is provided.
The integrity of data exchanged between master and slave is verified by the CRC16 algorhythm.
If the slave verifies an incorrect CRC and cancels the response messagge to the master.
The master/slave message contains the univocal address of the slave being queried, from **1** to **100**
The master/slave message contains the FUNCTION CODE required of the slave .
The modbus protocol offers several functions but in the 470 series only the following are available:
- *READ 1 OR MORE WORDS (maximum 20)* *(FUNCTION CODE=03H)*
- *WRITE 1 OR MORE WORDS (maximum 20)* *(FUNCTION CODE=10H)*

If the master sends the slave a message with incorrect instructions , the protocol provides a slave response containing an error code(MODBUS EXCEPTION CODE).
The 470 series actuators are programmed to communicate to the master the following error codes:
- *ILLEGAL FUNCTION* *(Modbus exception code=01H)*
- *ILLEGAL DATA ADDRESS* *(Modbus exception code=02H)*
- *ILLEGAL DATA VALUE* *(Modbus exception code=03H)*

More detailed information on the modbus standard can be obtained from http://www.modbus.org

Serial Communication Parameter Description

All parameters of this setting are on the **SERIAL COMUNICAT menu.**
All functions have the same menu but with a different numerical order:
- SOFT-STARTER function > **menu 10.**
- STATIC SWITCH and POWER/ENERGY REGULATOR functions > **menu 2.**
- VOLTAGE REGULATOR function> **menu 6.**

For example, on SOFTSTARTER function, the menu will be as follows:

SERIAL COMUNICAT 10.	***The parameters for managing the modbus serial communication***
ADDRESS 10.1 3.	***Par.10.1. Actuator serial address***

Setting range: 0 - 100.

BAUD RATE 10.2 9600.	***Par.10.2. Transmission rate in bps.***

Setting options: 9600, 19200, 38400, 57600, 76800, 115200.

PARITY 10.3 NONE	***Par.10.3. Disable or enable parity control on single characters.***

Setting options: NONE, EVEN, ODD.
NONE = disable character parity control.
EVEN = enable EVEN character parity control.
ODD = enable ODD character parity control.

BIT STOP 10.4 1.	***Par.10.4. Set the number of stop bits for each character.***

Setting options:1, 2.

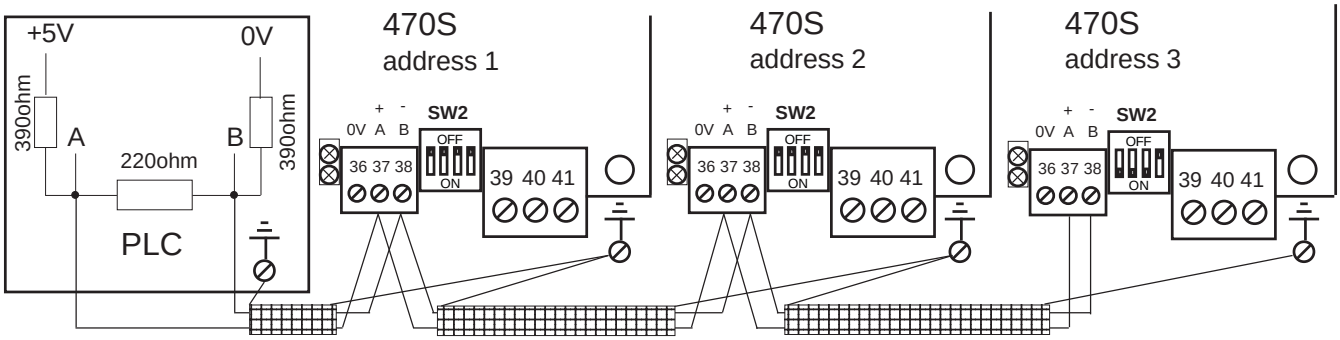
ENABLE FAST MODB 10.5 NO.	***Par.10.5. Enable fast serial communication , with minimum delay between modbus messages***

Setting options: NO, YES

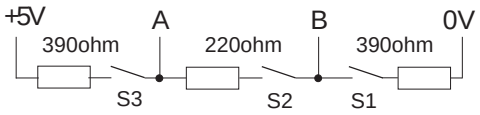
The modbus address (ID MODBUS) specified in the tables with the full parameter list into the descriptions of functions ;
the parameters values with this address are written in the **RAM** memory and are not saved when the actuator is shut off.
To make the actuator save the setting permanently in the internal **EEPROM** just add 10000 to the addess in the tables.
E.G.: to save on EEPROM a setting of **par.1.2 MOTOR** In the address to enter in the write message (10H function) will be **10001** (1001+10000).

Instructions for the serial connection and transmission monitoring

Typical serial wiring diagram for 3x 470 series of plc commanded actuators:

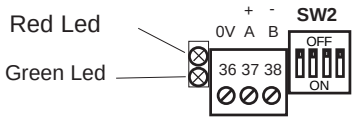


The components of the serial bus must be connected in daisy-chain as shown in the example.
The first and last component of the bus must end the seriale line with the resistive network illustrated below, which are built into the 470 actuator and setting to ON SW2 micro-switches1,2,3 (the micro4 setting is irrelevant) that are accessible on the outside next to the bus signal terminal block.



In the above wiring example there will thus be the Plc (first in the line) and the 470S address 3 (last in line), both ending with the characteristic resistive network. The default settings of SW2 micro-switches 1,2,3 are closed and IF 3 actuators are required on the same serial bus, SW2 micro-switches 1,2,3 can be left closed.
Wherever possible, the common 0V connection between master and slaves avoids hazardous voltage differences between the serial bus components and generally improves EMI immunity (terminal 36, 0V)
Recommendations for the wiring connections :
Maximum connection distance 1200m.
Use screened cable with 2 twisted wires having a 120ohm characteristic impedence.
Connect the cable screen to every node nodo on an ample earthing system.
Wherever possible use screened cables for the motor connections, at least apply ferrite rings .
Avoid passing the motor or braking resistance cables in parallel with the serial connection cable, and if this is not possible, leave a space of at least 200mm.
If the serial cable has to pass over the motor or braking resistance or any other power cable that may generate interference, attempt to make sure a 90° intersect angle is kept.
In particularly disturbed environments , the installation of a ferrite ring in the ingoing and outgoing connecting cables of the A B serial connection improves EMI immunity.

The serial transmission status can be verified by the LED's next to the serail connection terminal block of the actuator:

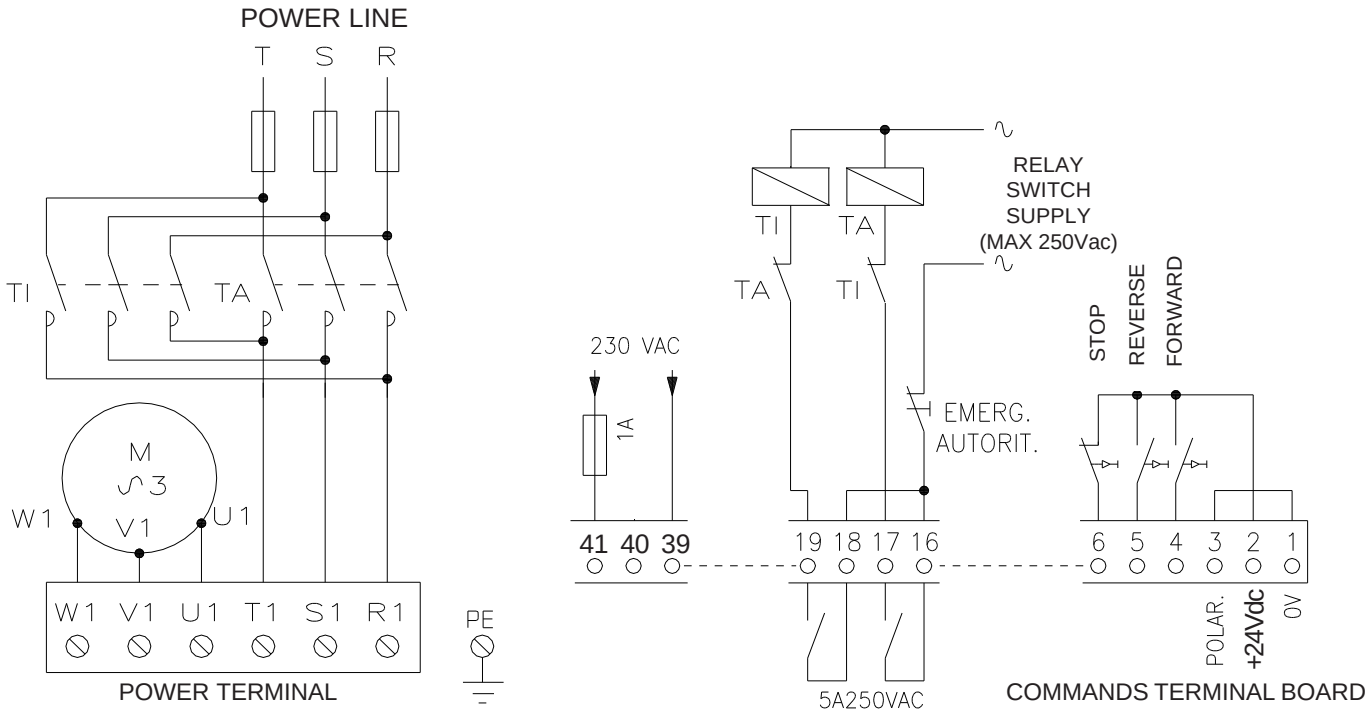


Green LED = lights up for 2 seconds for every valid message received.
Red LED = lights up for 2 seconds for every transmission error counted in **var.8 COUNT ERRORS COM**.

The following codes of the last 2 errors are viewed in **variable LAST TWO ERR COM** :
01 = The master requested a modbus function not supported by the slave; the slave gives the response message with "MODBUS EXCEPTION CODE" = 1 (ILLEGAL FUNCTION).
02 = the master wants to write/read a parameter with unauthorised address; the slave responds with the message "MODBUS EXCEPTION CODE" = 2 (ILLEGAL DATA ADDRESS).
03 = the master attempts to write a parameter with an off-range setting; the slave responds with the message "MODBUS EXCEPTION CODE" = 3 (ILLEGAL DATA VALUE).
19 = Bad checksum, the message is not interpreted.

Typical wiring diagram and rapid installation of the soft-starter

The soft-start should be connected as shown in the wiring diagram below (example of a 3-wire connection) with the following recommendations:
- To mount the soft-start inside a switchbox consult chapt.7
- Use GL type fuses, for their size consult the tables in chapt.6 according to the actuator code.
- If only one direction of rotation is required just connect only one relay switch (unless the braking is used as described in chapt.9); the pc board commands the external relay switches with max 5A/250VAC contacts, for greater loads an external power relay is necessary.



PARAMETER SETTINGS

- **Before setting any parameters, read chapt.1 with the keypad instructions.**

When the power supply is connected the keypad display will always go in "DISPLAY" mode and give the last monitor variable selected before being shut off .
To make the rapid installation easier, the basic parameters required to start the motor are accessible in the first menu level, proceed as follows:
- Press P to select the **1. BASIC DATA** menu**.**
- Press P to enter **1.BASIC DATA** and program the following parameters, selecting them with UP :
- par. **1.1 LINE FREQUENCY** > enter the supply **line frequency**.
- par. **1.2 MOTOR In** > enter the **rated current of the motor** to start.
- par. **1.3 ACC RAMP** > enter the **time in seconds of the voltage acceleration ramp** that has to be applied to the motor so as to obtain the soft starting. ***Attention: this parameter setting does not corresponds to the real motor acceleration ramp, this is a voltage ramp to be set to the minimum necessary value, to avoid mechanical shock or pipe hammering on pumps. We suggest not to get over 5 secs.***
- par. **1.4 ACC/DEC Imax** > enter the **maximum start current** as a % of the rated current at **par. 1.2 MOTOR In ;** begin with the default setting (400%) and then modify it according to the real limitation requirements. In all cases the maximum current must allow the motor start-up in greatest load conditions, leaving a margin to avoid stalling.
- par. **1.5 STARTING Vmax** > enter the **start platform voltage** as a % of the supply line voltage; begin with the default setting (60%) and then modify it to obtain a prompt start, but without jerking the mechanics (the higher the platform voltage, the earlier the start).
- The basic parameter settings for the rapid installation are complete.

START-UP
- To begin the start-up, press briefly FORWARD or REVERSE and to stop press STOP.
- To avoid the FORWARD/REVERSE commands being self-primed do not connect the STOP command.

END OF RAPID INSTALLATION

For more details on all the other soft-starter functions consult chapt.9 OPERATION MODES

Technical characteristics on the SOFT-STARTER function

- CE product
- Three phase power supply can have 2 ranges:
  > 170 - 510 Vac / 45Hz ÷ 65Hz (230/400Vac line)
  > 300 - 760 Vac / 45Hz ÷ 65Hz (690Vac line).
- Separate supply for logic + ventilation command (where mounted) 170 - 250 Vac / 45Hz - 65Hz
- Maximum admitted supply line distortion: 10%.
- A range of actuators for 3-wire and 6-wire connections (see CURRENTS AND POWERS tables)
- Balanced voltage regulation on all three phases through SCR power modules (1 on each phase). Regulated voltage on motor from zero until the line voltage with limitation of the starting maximum current.
- All soft-starters can support a start-ups with 4 times the rated current for 20 seconds every 5 minutes (300sec.), except for the 470S/9 accepting 3 times the rated current only.
  To the maximum limit of the setting on the starting current (400%), it is allowed an acceleration 4,6 times the rated current for 16 seconds (see description parameters 1.4 and 5.3).
- Thermal image control on motor and actuator to avoid overheating during impulse drive .
- Current control on two supply phases by CT.
- Input and output commands fully isolated from the high tension network.
- Keypad parameter programming and monitoring by backlit display with 2 rows of 16 digits, remote connection
- Commanded and fully programmable by RS485 MODBUS RTU serial connection.

- FUNCTIONS:
> Basic start function by voltage acceleration ramp with maximum current limitation.
> Kick start function to overcome shutdown friction.
> Voltage deceleration ramp(e.g. useful for avoiding pipe hammering during pump stops).
> Counter current braking for inertial loads without the aid of external braking modules.
> Dual polarity motor commands, with automatic selection of speed change relay switches.
> External start current regulation by potentiometer or 0 - 10Vdc signal.
> Automatic command of external BYPASS relay switch for soft-start in continuous duty.
> Motor shaft stopped detection with output contact consensus.

ACTUATOR SAFETIES
> Thermal image overload.
> Output phases short circuit.
> Supply phases unbalance
> SCR module overheating.

MOTOR PROTECTIONS
> Second thermal image overload class 10 to CEI EN 60497-4-2
> Current threshold underload
> Overheating by PTC sensor 250 ohm at 25°C (DIN 44081) mounted on motor (max 3 in series)

- Input/output command connections on blade terminal block .
- Standard version in aluminium housing with IP20 protection rating, aluminium lid.
- Ambient air temperature limits: -5°C +40°C.
- Dissipater air temperature limits: -5°C +70°C.
- Storage temperature: -25 °C +70 °C.
- Condensated free relative humidity : 5% - 95%
- Maximum elevation 1000 m. on sea level (over this, reduce the load of the 1% every 100 m.)

- Conformity to standards: BT 2006/95/CE (LOW VOLTAGE) and EMC 2004/108/CE (ELECTROMAGNETIC COMPATIBILITY) for industrial environment as per CEI EN60947-4-2 standard.

ATTENTION: this device has been created in A Class (CEI EN 60947-4-2 e 4-3). The usage in domestic enviroments could cause radio disturbances; in this case it is recommended to use additional protections.

If it is necessary to respect limits for domestic environment, please contact the Rowan Elettronica technical department.

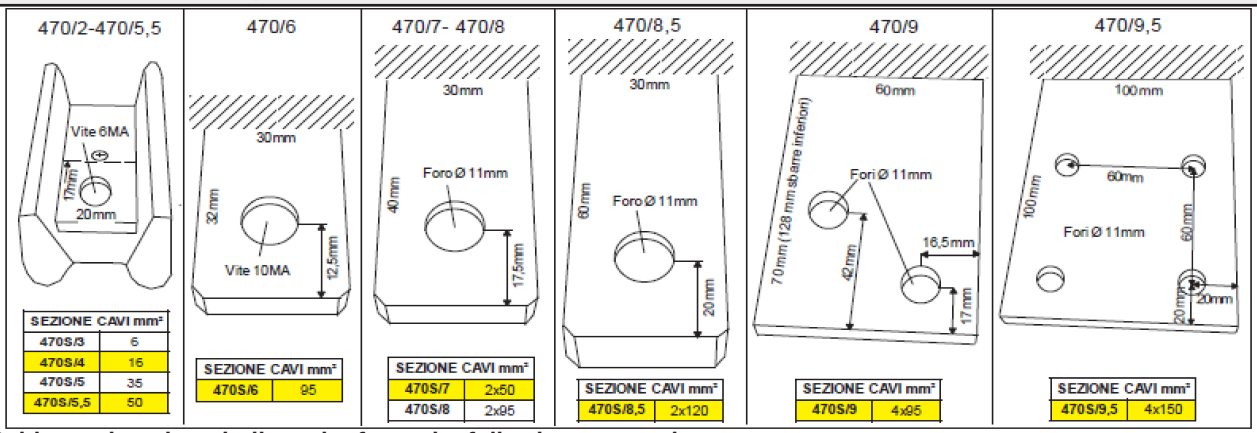
SOFT-STARTER electrical characteristics tables

CURRENTS and POWERS at 3 WIRE CONNECTION														
POWER CODES	NOMINAL CURRENT SETTING FIELD		MAXIMUM CURRENT TO START DECELERATION	MAXIMUM POWER 690VAC SUPPLY		MAXIMUM POWER 400VAC SUPPLY		MAXIMUM POWER 230VAC SUPPLY		SUGGESTED gG/gL TYPE FUSES	THERMIC PROBE	POWER OF THE SEPARATE SUPPLY (TERMINALS 39-41)	POWER DISSIPATED OF MODULES POWER AT IMAX	INTERNAL VENTILATION
	I MIN	I MAX												
	A	A	A	HP	kW	HP	kW	HP	kW	A		W	W	
470S/3	12	40	160	50	37	25	19	14,5	11	80	YES	20	110	NO
470S/4	18	60	240	74	55	40	30	23	17	100	YES	50	190	YES
470S/5	30	100	400	120	90	70	55	40	32	200	YES	50	270	YES
470S/5,5	40	130	520	160	120	102	75	60	43	200	YES	50	360	YES
* 470S/6	60	200	600	255	190	150	110	86	63	400	YES	50	580	YES
470S/7	105	300	1200	400	300	250	180	145	105	630	YES	50	980	YES
470S/8	150	400	1600	536	400	340	250	196	144	800	YES	50	1210	YES
470S/8,5	190	560	2240	750	560	428	320	248	185	1000	YES	100	1570	YES
* 470S/9	250	850	2550	1150	850	680	500	390	280	1600	YES	170	2500	YES
470S/9,5	380	1150	4600	1474	1100	1020	750	590	433	2000	YES	170	3500	YES

CURRENTS and POWERS at 6 WIRE CONNECTION											
POWER CODES	NOMINAL CURRENT SETTING FIELD		MAXIMUM CURRENT TO START DECELERATION	MAXIMUM POWER 400VAC SUPPLY		MAXIMUM POWER 230VAC SUPPLY		SUGGESTED gG/gL TYPE FUSES	THERMIC PROBE	POWER OF THE SEPARATE SUPPLY (TERMINALS 39-41)	POWER DISSIPATED OF MODULES POWER AT IMAX	INTERNAL VENTILATION
	I MIN	I MAX										
	A	A	A	HP	kW	HP	kW	A		W	W	
470S/3	20	70	280	40	30	25	19	160	YES	20	110	NO
470S/4	30	105	420	70	50	40	30	200	YES	50	190	YES
470S/5	50	175	700	120	95	70	55	400	YES	50	270	YES
470S/5,5	69	225	900	176	132	103	76	400	YES	50	360	YES
* 470S/6	105	345	1035	260	190	150	110	800	YES	50	580	YES
470S/7	180	520	2080	430	320	250	183	1000	YES	50	980	YES
470S/8	260	690	2760	590	430	340	250	1500	YES	50	1210	YES
470S/8,5	330	970	3880	737	550	428	320	2000	YES	100	1570	YES
* 470S/9	430	1470	4400	1170	860	675	485	2500	YES	170	2500	YES
470S/9,5	740	1990	7950	1700	1270	1000	760	3000	YES	170	3500	YES

*** On soft-starters 470S / 6 and /9, the starting current, permitted for 20s, is limited to 3 times the maximum rated current of the drive and not to 4 times as on the other sizes.**

Power fixing terminals and minimum sections for connetction cables



*** Cable sections here indicated refer to the following connections:**
- For line cables and motor when 3 wire connected.
- For motor cables only when 6 wire connected; for the line, oversize of 1.73 times.

Notes on the choice of soft-starter

1) The power that can be applied to the soft-starter, provided in the tables, refers to the rated power of the asynchronous motor as provided on its ID plate.
2) All soft-starters (C470S/6 and C470S/9 excluded) can support **4 times** the start-up of the rated current of the field of calibration (**IMAX,**see tables) **for maximum 20 seconds every 5 minutes (300sec.)**; To the maximum setting limit of the starting current **(400%)**, **a start of 4,6 times the rated current is allowed for 16 seconds** (see description on parameters 1.4 and 5.3). Over this current the soft-start is blocked by **fault10**.
If longer or repeated starts are required in a period of 5 minutes (300 seconds), the soft-start size has to be determined by recalculating the IMAX by the following equation:

$$\text{IMAX (A)} = \frac{\text{Isurge}}{\sqrt{1 + \frac{300}{\text{Tavv} \times \text{Navv}}}}$$

Isurge = maximum start/deceleration current (A)
Tavv = start time at Isurge (sec)
Navv = number of starts every 5 minutes (300sec.)

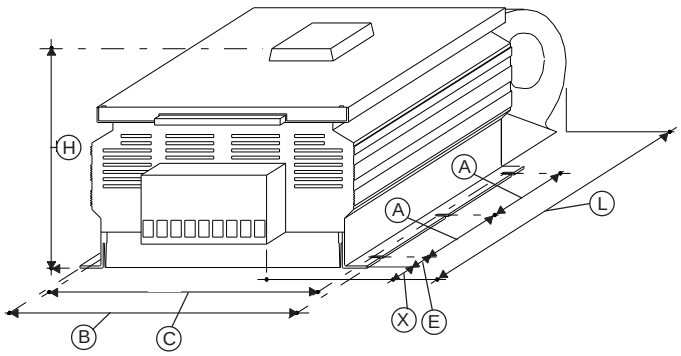
After this calculation, you also need to verify that the Isurge is lower than the MAXIMUM STARTING and DECELERATION CURRENT allowed by the soft-starter (see tables CURRENTS and POWERS at 3 AND 6 WIRE CONNECTION). If this value is not lower, you shall choose the bigger size allowing the requested surge.
E.G.: Tavv = **60sec** , Isurge = **840A, One starting every 4 minutes** -> Navv=5min/4min= **1,25**

$$\text{IMAX (A)} = \frac{840}{\sqrt{1 + \frac{300}{60 \times 1{,}25}}} = 312\text{A}$$

In this example a soft-start with IMAX just over 312A and a maximum starting current at 840A will be selected; so with a 400Vac the supply line and 3-wire connection, the soft-start to use is 470S/8 (IMAX=400A and Isurge=1600A)

Note: The soft-starter power must never be less that the rated power of the motor

Dimensions

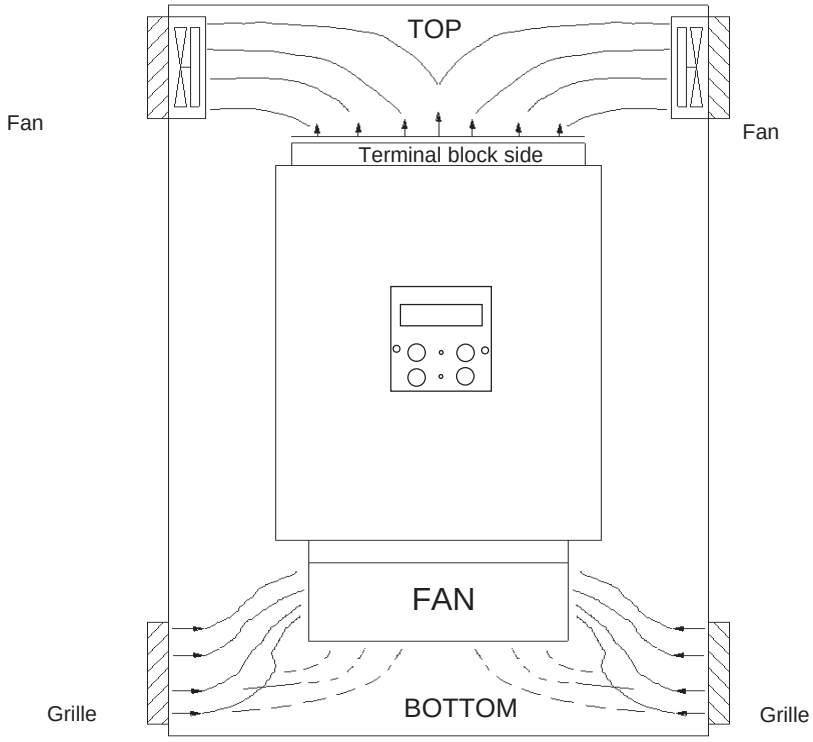


Anchor holes for:
-4MA bolts (470/3 - 470/5,5)
-5MA bolts (470/6 - 470/9,5)

CODE	H	B	L	A*	C	E	X	Kg
470/3	180	265	315	200x1	255	40	25	6.5
470/4	180	265	360	200x1	255	40	25	7.5
470/5 e /5,5	180	265	460	200x1	255	75	25	9
470/6	290	280	560	233x1	265	65	65	15
470/7	300	380	570	330x1	355	60	70	30
470/8	300	380	570	330x1	355	60	70	30
470/8.5	300	480	700	360x1	465	110	60	55
470/9	350	680	915	220x3	658	85	130	80
470/9,5	435	942	973	150x5	926	100	100	170

* The number of A distances depends on the number of anchor holes.

Typical position of a soft-start in a switchbox



For a correct cooling, install the actuator as above, accounting for the following recommendations:
- Make sure that the installation environment is within the ambient conditions provided in chapt.6 (temperature - humidity - protection rating).
- Install it in the area of the switchbox designated for the power components avoiding proximity to low voltage analog and digital circuit boards (e.g. opposite side of sheet metal).
- Favour maximum cooling airflow, avoiding to stack actuators and leaving at least 100mm space over and under each actuator and at least 50mm each side.
- Avoid excess vibration and knocks.

The actuators in the 470S series operate correctly with temperatures on their housing and inside the switchbox between -5°C and +40°C; higher or lower temperatures can give rise to malfunctions; it is best to position the circuit boards away from head sources and ventilate the switchbox in high ambient temperatures; if the environment is saturated with corrosive gas (e.g. tanneries/dye shops) the cooling air must be supplied from outside or a BYPASS made or fit the switchbox with airconditioning.

Instructions for the cabling system and electromagnetic compatibility

This actuator presents a a current leakage to ground (<1mA), so DO NOT supply it without connecting the PE terminal to ground first.

To best things to do to limit disturbances induced by the connecting cables:
- Avoid passing connection cables of the command terminal block in the same conduit as the power cables.
- Connect potentiometers, DC signals with screened cable and connect the end of each screen independently to the common earthing point of the switchbox.
- Avoid earth rings.

470S series actuators, used as soft-starters, are temporary regulation devices designed for an industrial environment as per CEI EN60947-4-2 standard that, after the start-up of the motor, return to the emission limits conducted on the supply line without the addition of filtering elements. If it is necessary to respect the limits for a domestic environment contact the Rowan E. Technical Dept.

Description of the power terminal block

R1 S1 T1 Three-phase line voltage for 2 ranges with absolute limits:
170Vac ÷ 510Vac (**lines 230/400/440Vac**), 300Vac ÷ 760Vac (**line 690Vac**).
Standard line frequency 50Hz / 60Hz (min 45Hz - max 65Hz).

PE ⏚ Earth connection.

U1 V1 W1 Partialised variable three phase voltage output for commanding an asynchronous motor.
Maximum voltage on supply line at start-up end.

When choosing the connection cables of the power terminal board, see the table ***"Power fixing terminals and minimum sections for connection cables"*** on Chapt.6.

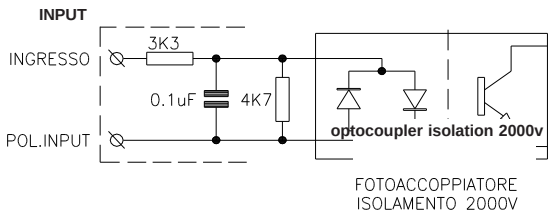
Description of the command terminal block

DIGITAL INPUT DESCRIPTIONS:

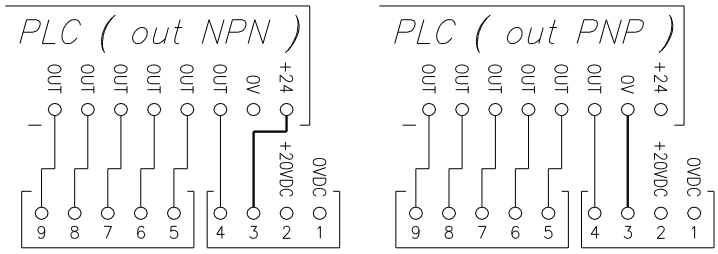
1 = **0VDC**	COMMON NEGATIVE
2 = **+24 VDC**	SUPPLY FOR ACTIVATING INPUTS BY CONTACTS max 500mA
3 = **COMMON DIGITAL INPUT**	INPUT POLARISATION
4 = **DIGITAL INPUT1**	TG FORWARD ROTATION COMMAND INPUT
5 = **DIGITAL INPUT2**	TG REVERSE ROTATION COMMAND INPUT
6 = **DIGITAL INPUT3**	STOP BY BRAKING OR VOLTAGE DECELERATION INPUT
7 = **DIGITAL INPUT4**	FAST MODE SELECT FOR DUAL POLARITY MOTORS INPUT
8 = **DIGITAL INPUT5**	NOT USED
9 = **DIGITAL INPUT6**	AUXILIARY INPUT.

DIGITAL INPUT CHARACTERISTICS:
> Input resistance = 3Kohm
> Minimum voltage for input activation 5Vdc
> Maximum voltage 30Vdc

Internal wiring diagram for digital inputs



Typical connection of digital inputs with external logics (PLC type)



CONTACT OUTPUT DESCRIPTIONS
Max contact load 5A/250Vac

10 = NO
11 = C
12 = NC

R1 ***SHUNT CONTACT ON EMERGENCY RELAY CONTACT:***
It activates with the soft-start powered and no faults, disactivates with a fault

13 = NO
14 = C
15 = NC

R2 ***MOTOR SHAFT STOPPED DETECTOR CONTACT (N.B. do not use for safety)***

16 = NO
17 = C

R3 ***FORWARD RELAY SWITCH COMMAND CONTACT***

18 = NO
19 = C

R4 ***REVERSE RELAY SWITCH COMMAND CONTACT***

20 = NO
21 = C
22 = NC

R5 ***SHUNT CONTACT ON SLOW/FAST SELECT RELAY SWITCHES FOR DUAL POLARITY MOTORS***

23 = NO
24 = C

R6 ***AUXILIARY CONTACT***

25 = NO
26 = C

R7 ***CLOSE CONTACT ON START-UP END(FOR TG BYPASS COMMAND)***

ANALOG REFERENCES

27 = **0VDC** COMMON NEGATIVE
28 = **+10VDC** Potentiometer supply voltage for external regulation of start-up (Imax = 10mA)
29 = **ANALOG INPUT 1** Input for external start-up current regulation 0Vdc (min) - 10Vdc (max).

27-32 = **Input for max 3 PTC sensors** 250 ohm/25°C, connected in series for motor overload safety;
for the safety to be active set **SW1 micro-switch 4 to ON** and **par.3.4 MOTOR PTC ENABLE = YES.**

33 = **ANALOG INPUT3** NOT USED
34 = **ANALOG INPUT4** NOT USED
35 = **0VDC** COMMON NEGATIVE

ANALOG OUTPUTS

30 = **ANALOG OUTPUT1** Proportional signal of voltage frequency regenerated by the motor max 5mA :
0VDC = 0Hz, +/- 9,5 Vdc = a 50Hz o 60Hz (depends on par.1.1 LINE FREQ.).
31 = **ANALOG OUTPUT2** Proportional signal of motor absorption max 5mA:
0VDC = 0A, +9,5 Vdc = Absolute maximum start-up current of actuator.

SERIAL CONNECTION

36 = **0VDC-SER** RS485 serial common negative
37 = **A +** RS485 channel positive
38 = **B -** RS485 channel negative

SEPARATE SUPPLY LINE

39 = **VAC**
40 = **NOP** LOGIC AND FAN SUPPLY: MIN 170VAC \ MAX 250VAC..... MIN 45Hz /MAX65HZ.
41 = **VAC** POWER: MIN 20W / MAX 150W dependent on fans mounted; see table chapt.6 under "POWER OF THE SEPARATE SUPPLY (TERMINALS 39-41)", size the supply transformer according to the actuator size.

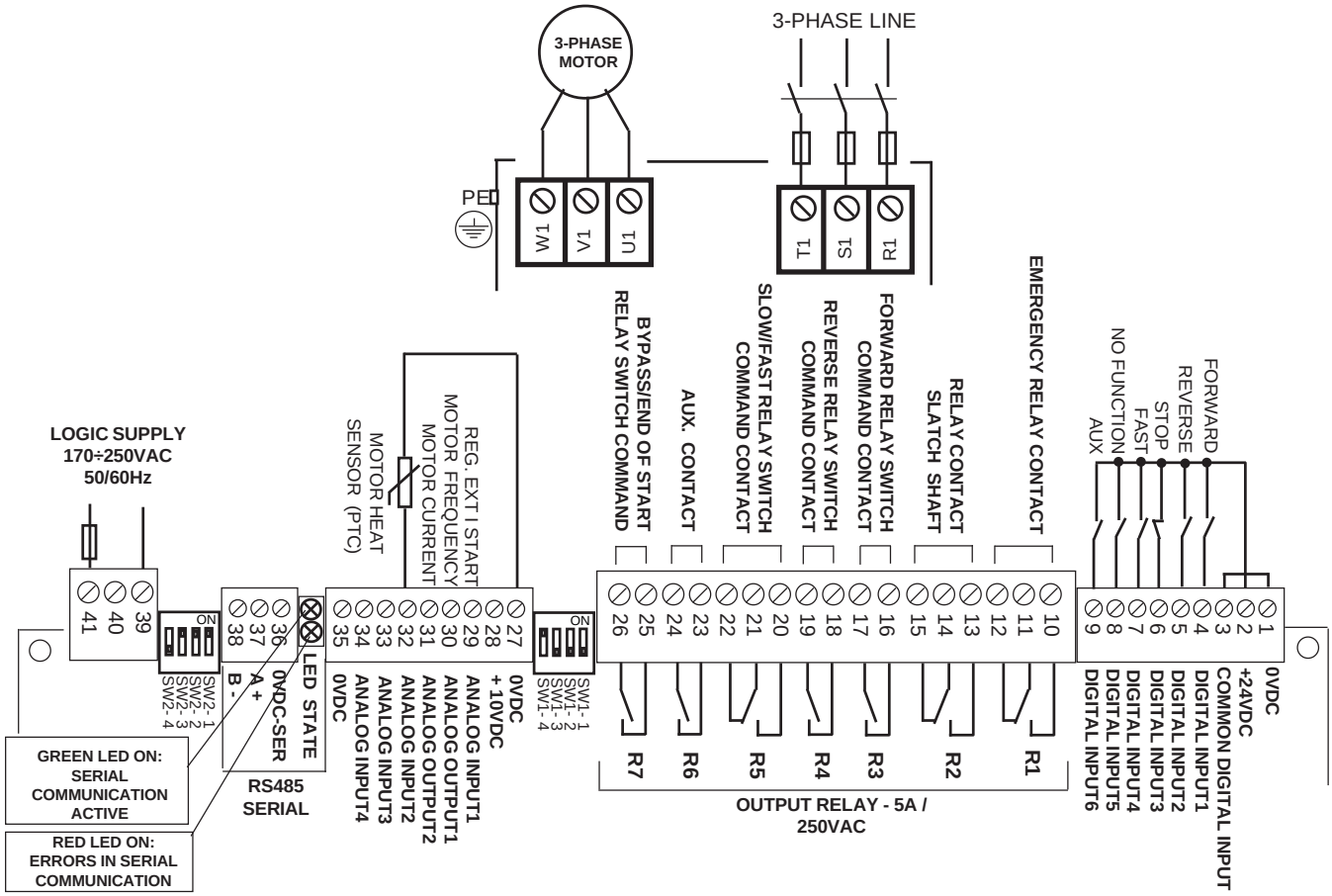
COMMAND TERMINAL BOARD CONNECTION CABLE SECTION

Connectors from 1 to 9 and from 27 to 38: min. 0,22mm² - max 1,5mm². Connectors from 10 to 26 and from 39 to 41: min 0,22mm² - max 2,5mm²

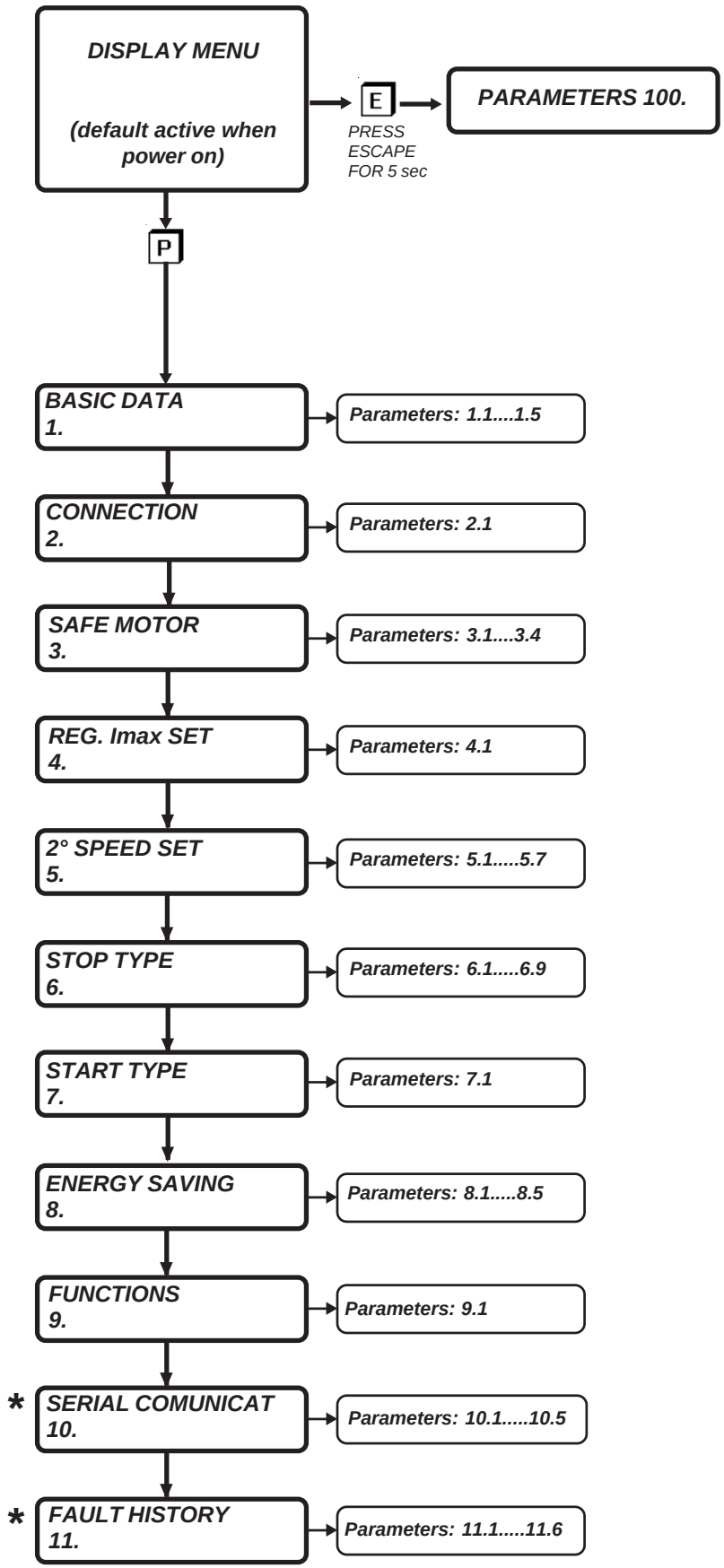
MICRO-SWITCH FUNCTIONS

SW1 : For the SOFT-STARTER function maintain the default setting **OFF** = SW1-1, SW1-2, SW1-3 and **ON** = SW1-4
SW2 : Micro-switches SW2-1, SW1-2, SW1-3, activate the resistive termination on the serial line; the default setting is ON, so with the termination active. SW2-4 is not used.

General wiring diagram



Keypad menu map of SOFT-STARTER functions



* MENUS COMMON TO ALL APPLICATIONS BUT WITH DIFFERENT ORDER NUMBER

Full parameter list

PARAMETER		SETTING FIELD (modbus values into brackets)	DEFAULT SETTING	ID MODBUS (decimal)
1. BASIC DATA				
1.1	LINE FREQ.	da 45.0Hz a 65.0Hz	50.0 Hz	1000
1.2	MOTOR In	it depends on the size		1001
1.3	ACC. RAMP	da 1.0s a 600.0s	2.0s	1002
1.4	ACC/DEC Imax	da 0% a 700% Inom	400 %	1003
1.5	STARTING Vmax	da 0% a 100% Vlinea	60 %	1004
2. CONNECTION				
2.1	CONNECTION TYPE	3WIRES (**0**) 6 WIRES (**1**)	3WIRES	1005
3. SAFE MOTOR				
3.1	ENABLE CLASS 10	NO (**0**) YES (**1**)	YES	1006
3.2	% UNDERLOAD	da 0% a 100% Inom	0%	1007
3.3	t UNDERLOAD	da 0.0s a 180.0s	15.0s	1008
3.4	MOTOR PTC ENABLE	NO (**0**) YES (**1**)	NO	1009
4. REG. Imax SET				
4.1	REG. Imax SET	INT (**0**) EXT (**1**)	INT	1010
5. 2nd SPEED SET				
5.1	In 2nd SPEED	it depends on the size		1011
5.2	ACC RAMP 2 SPEED	from 1.0s to 120.0 s	2.0s	1012
5.3	Imax 2nd SPEED	from 100% to 700% Inom	400 %	1013
5.4	Vmax START 2nd	from 0% to 100% Vlinea	80 %	1014
5.5	V2>V1 RAMP	from 1.0s to 10.0 s	3.0s	1015
5.6	Vmax START V2>V1	from 0% to 100% Vlinea	50 %	1016
5.7	ENAB. 2nd TO 1st	NO (**0**) YES (**1**)	NO	1017
6. STOP TYPE				
6.1	STOP TYPE	DEC (**0**) BRAKE (**1**)	DEC	1018
6.2	DEC. RAMP	from 0.0s to 120.0s	0.15s	1019
6.3	VLINE STOP DEC	from 10% to 100% Vlinea	10%	1020
6.4	MOTOR STOP FREQ	from 2.0Hz to 10.0Hz	3.0 Hz	1021
6.5	DC BRAKE TIME	from 0.1s to 5.0s	3.0 sec	1022
6.6	1 AC BRAKE LEVEL	from 1% to 400% Inom	250%	1072
6.7	1 AC BRAKE DURAT	from 0.000s to 10.000s	5.000s	1073
6.8	AC BRAKE LEVEL	from 1% to 400% Inom	200%	1023
6.9	AC BRAKE DURAT	from 0.000s to 10.000s	1.000s	1074
6.10	BRAKE DELAY	from 0.01s to 5.00 sec	3.00 sec	1024
7. START TYPE				
7.1	KICK START TIME	from 0.0s to 2.0s	0.0s	1025
8. ENERGY SAVING				
8.1	SAVE ENERGY	NO (0) YES (1)	NO	1112
8.2	MIN% SCR COND.	da 65% a 100% Vlinea	65%	1113
8.3	VOLTAGE ACC RAMP	from 0.1s to 20.0s	0.1 sec	1114
8.4	VOLTAGE DEC RAMP	from 1.0s to 50.0s	5.0 sec	1115
8.5	cosPHI THRESHOLD	from 0.20s to 0.80s	0.40	1116
9. FUNCTIONS				
9.1 FUNCTION TYPE		from 0 to 1	0	1026
10. SERIAL COMUNICAT				
10.1	ADDRESS	from 0 to 100	3	1027
10.2	BAUD RATE	9600 (**0**) 19200 (**1**) 38400 (**2**) 57600 (**3**) 76800 (**4**) 115200 (**5**)	9600	1028
10.3	PARITY	NONE (**0**) EVEN (**1**) ODD (**2**)	NONE	1029
10.4	BIT STOP	from 1 to 2	1	1030
10.5	ENABLE FAST MODB	NO (**0**),YES (**1**)	NO	1031
11. FAULT HISTORY				
11.1	FAULT1	display from 0 to 13		518
11.2	FAULT2	display from 0 to 13		519
11.3	FAULT3	display from 0 to 13		520
11.4	FAULT4	display from 0 to 13		521
11.5	FAULT5	display from 0 to 13		522
11.6	RESET HIST FAULT	N0 (**0**) YES (**1**)	N0	1033
PARAMETERS 100.				
100.1	APPLICATIONS	SOFTSTART (**0**) 3AC_REG (**1**) 3AC_0CROSS (**2**) 3AC_ON/OFF (**3**)	SOFTSTARTER	1032
100.2	RESET FAULT EN	NO (**0**),YES (**1**)	NO	1034
100.3	PARAM BLOCK	NO (**0**),YES (**1**)	NO	1035
100.4	SCR CONTROL TYPE	from 1 to 3	2	1036

Display menu list

DISPLAYS	RANGE min-max	ID MODBUS
Ixl MOTOR	0% - 700%	500
Ixl DRIVE	0% - 700%	523
LAST FAULT	0 - 13	501
SCR CONDUCTION	0% - 100%	502
MOTOR CURRENT	0A - 10000A	503
SET I MAX	0A - 10000A	504
MOTOR FREQUENCY	0.0Hz - 60.0Hz	505
TA1 TA2	0A - 10000A 0A - 10000A	506 507
cos phi	0.00 - 1.00	527
LAST TWO ERR COM	0 - 9999	514
COUNT ERR COM	0 - 32000	515
FIRMWARE VERSION	0.00 a 9.99	517
HARDWARE VERSION	0.00 a 300.00	524
CONFIG. VERSION	0 a 99	525

Modbus input/output commands

WORD for INPUTS CONTROL (ID MODBUS = 1075)	
bit 0	**FORWARD** (OR logic - terminal 4)
bit 1	**REVERSE** (OR logic - terminal 5)
bit 2	**STOP** (OR logic - terminal 6)
bit 3	**FAST** (OR logic - terminal 7)
bit 4	**INPUT 5** (OR logic - terminal 8 but NO FUNCTION)
bit 5	**INPUT AUX** (OR logic - terminal 9)
bit 6 *	Force output **EMERGENCY**
bit 7 *	Force output **SHAFT LATCH**
bit 8 *	Force output **FORWARD**
bit 9 *	Force output **REVERSE**
bit 10 *	Force output **FAST**
bit 11 *	Force output **AUX**
bit 12 *	Force output **BYPASS**
bit 13 *	Force outputs : 0=**NO** 1=**YES**
bit 14 *	FAULT1 and FAULT10 intervention: 0=ENABLE 1=DISABLED
bit 15	NO FUNCTION

*** WARNING! these bits are functions for the factory only therefore, in normal operation, if these words are handled in serial transmission, must always be kept at 0.**

Read modbus inputs/output status

WORD for OUTPUTS/INPUTS READING (ID MODBUS = 516)	
bit 0	**OUT EMERGENCY**
bit 1	**OUT SHAFT LATCH**
bit 2	**OUT FORWARD TG COMMAND**
bit 3	**OUT REVERSE TG COMMAND**
bit 4	**OUT FAST TG COMMAND**
bit 5	**OUT AUX**
bit 6	**OUT BYPASS/END START UP**
bit 7	NO FUNCTION
bit 8	**INPUT FORWARD**
bit 9	**INPUT REVERSE**
bit 10	**INPUT STOP**
bit 11	**INPUT FAST**
bit 12	**DIGIT INPUT 5 (no function)**
bit 13	**AUX INPUT**
bit 14	NO FUNCTION
bit 15	NO FUNCTION

Description of DISPLAY menu

All displays monitoring the soft-starter status

IxI MOTOR "Cold" 0.%	***Percentage motor overload***

Display range: 0.% - 700.%.
This variable shows the calculation of i2t of current absorbed in overload by the motor, it gives information related to the energy that the motor is absorbing and thus, indirectly, to its heating. It is considered overloaded when the current gets over 105% of the rated current of the motor (par. 1.2 MOTOR_In or 5.1 2nd SPEED).
If the motor protection in Class 10 is enabled by par. 3.1 ENABLE CLASS 10, the FAULT 1 steps up when exceeding the threshold of 100%.
If, after an overload , the current decreases under the threshold value, the variable starts to decrease and it takes about 15min for getting the **IxI MOTOR** from 100% to 0%; this is the maximum time to be wait after the starting in order to obtain the maximum times allowed by the Class 10 curves. Besides the **IxI MOTOR,** you can read "Cold" or "Warm" when considering the motor cold or warm.

IxI DRIVE 0.%	***Percentage overload of the soft-start***

Display range: 0. - 100.%.
If this variable exceeds 100%, we enter the area of FAULT10 intervention.
This variable shows the calculation of 'I2t current input / output from the overloaded soft-start, it gives information related to the energy that the soft-start is absorbing and thus, indirectly, to its heating. If the current does not get over the overload threshold, the variable stands at 0%.
If, after an overload , the current decreases under the threshold value, the variable starts to decrease and it takes about 5min and 30s. for getting from 100% to 0%.

LAST FAULT 0	***Last soft-starter block number***

Display range: 0. - 13.
This variable views the ID number of the type of fault if the soft-start is blocked with the "FAULT" LED lighting up on the keypad. The types of fault are listed in chapt.3
The variable is resetted after the logic power is shut off, so to know the history of the last 5 faults the parameters in the 11. FAULT HISTORY menu have to be accessed.

SCR CONDUCTION 0.%	***% of SCR conduction***

Display range: 0. - 100%.
This variable views the conduction state of the diodes under control (SCR) that partialise the voltage on the motor; the reading is given as a % of the duration of the semiwave applied to the diode under control:
0% = diodes not conducting > voltage at motor =0Vac.
100% = diodes conducting for the entire semiwave > voltage at motor = line voltage at terminals R1 S1 T1.

MOTOR CURRENT 0.0A	***Maximun absorbed RMS current of motor and supply line***

Display range: 0 - 10000A.
This variable views the absorbed current of the motor, which also corresponds to the line current at terminals R1 S1 T1 of the soft-start; the measurement is made on two supply phases.

SET I MAX 0.0A	***Actual setting of maximum start/deceleration current***

Display range: 0 - 10000A.

MOTOR FREQUENCY 0.0Hz	***Frequency at motor terminals.***

Display range: 0.0 - 60.0Hz.

TA1 50.0A *TA2 50.0A*	***Real RMS current monitoring measured on each current transformer inside the regulator.***

TA1 =current measured by current transformer TA1.
Display range: 0 - 10000A.
TA2 = current measured by current transformer TA2.
Display range: 0 - 10000A.

cos phi 0.80	*Actual motor Cosphi (working by par.100.4 SCR CONTROL TYPE=2 only) useful for the function "ENERGY SAVING"*

Dysplay range: 0.00 - 1.00.

LAST TWO ERR COM XXYY.	*Containing the last 2 errors on serial communication. YY= number of the last error, XX= number of the previous error.*

Dysplay range: 0. - 9999.
Numbers are reset every time the drive is turned on.
To know the kind of error described by these numbers, see chapt.4 SERIAL COMMUNICATION.

COUNT COM ERRORS 0.	*Serial communication error counter.*

Display range: 0. - 32000.
The counter is reset to zero every time the actuator is powered.

FIRMWARE VERSION 4.01	*Actuator firmware version number*

Display range: 0.00 - 9.99.

HARDWARE VERSION 0.00	*Number of the drive hardware version*

Display range: 0.00 - 300.00.

CONFIG. VERSION 0.	*Number of the drive configuration version*

Display range: 0 : 99.

Description of 1. BASIC DATA menu parameters

BASIC DATA 1.	*Basic parameters for a standard configuration of the soft-start (see chapt.5 RAPID INSTALLATION)*

LINE FREQ. 1.1 50.0Hz	*Par.1.1. Frequency of the three phase supply line at terminals R1, S1, T1*

Setting range: 45.0 - 65.0 Hz.
Impostare 50.0Hz o 60.0Hz a seconda della linea di alimentazione.

MOTOR In 1.2 6.0A	*Par.1.2. Rated line current of the three phase asynchronous motor connected to terminals U1, V1, W1 (both 3 and 6 wire)*

Setting range: dependant on the soft-start power size . **CAUTION!** Sizes from 470/3 to 470/6 view the currents with a decimal after the decimal point, while from 470/7 to 470/9.5 there is no decimal point.

ACC. RAMP 1.3 10.0s	*Par.1.3. Time of voltage acceleration ramp on motor during start-up*

Setting range: 1.0 - 600.0 seconds.
Set to obtain the required soft-start .
The effective motor **speed** ramp will depend on the load.

ACC/DEC Imax 1.4 400.%	*Par.1.4. Maximum motor start current*

Setting range: 100 - 700% (reduced to 400% at max actuator limits)
Set the **max motor surge current** as a **%** of the rated current at par. 1.2 ; this setting must allow the motor to start-up in the time set at parameter 1.3.
CAUTION! When setting parameter = 400%, the current set on par.1.2 MOTOR In is internally increased of 15%, allowing the starting at higher current; in this case the maximum starting time is reduced from 20sec to 16 sec.
In the setting range from 100% to 399% there is again the corresponding to the rated current set on par.1.2

STARTING Vmax 1.5 50.%	*Par.1.5. Instant supply voltage to motor at start -up as a % of the line voltage (VL)*

Setting range: 0 - 100%.
This setting must be raised until the motor no longer delays its start-up with respect to the start command; on the other hand, unduly high settings of the platform voltage cancel the effect of the soft-start.

Description of 2. CONNECTION menu parameter

CONNECTION 2.	*Parameters that establish the type of motor connection*
CONNECTION TYPE 2.1 3WIRES	*Par.2.1. Select the motor connection: 3-WIREor 6-WIRE*

Setting range: 3WIRES, 6WIRES
3WIRES = 3 wire connection.
6WIRES = 6 wire connection (see chapt.9)

Description of 3. SAFE MOTOR menu parameters

SAFE MOTOR 3.	*Parameters for managing the motor load protection*
ENABLE CLASS 10 3.1 YES	*Par.3.1. Enable the motor temp prot in Class 10 to CEI EN 60947-4-2*

Setting options: NO, YES.
NO: the actuator does not control the motor overload; in this case it is suggested using an external current thermic relay or to enable the motor overheating control by the ptc thermic probe (see **par. 3.4 MOTOR PTC ENABLE**).
YES: the actuator calculates the protection level basing on the bends in Class 10 indicated below, with differentiated intervention depending on the motor state, cold or steady. The safety activation blocks the actuator by FAULT 1(see chapt.3 FAULTS).

% UNDERLOAD 3.2 0%	*Par.3.2. Motor underload as a % of the set rated current of the motor*

Setting range: 0 - 100%
The setting refers to the active rated current of the motor, see at par. 1.2 or at par. 5.1 if the speed 2 has been selected.
The underload control is active at the end of the start-upramp; in this state, if the motor current is lower than the % set at par.3.1, after the time set at par.3.3, the soft-start is blocked by FAULT 2 (see chapt.3 FAULTS).
ATTENTION! To de-activate the control, if bypass is used for example, set 0%

t UNDERLOAD 3.3 15.0s	*Par.3.3. Trip delay for the motor underload safety*

Setting range: 0.0 - 180.0 seconds.

MOTOR PTC ENABLE 3.4 NO	*Par.3.4. Enable the PTC temperature sensor control in the motor*

Setting options: NO,YES.
NO = Disable the PTC temperature sensor control in the motor .
YES = Enable the PTC temperature sensor control for the motor connected to terminals 27-32.
The PTC sensor input is provided for the connection of up to 3 sensors in series for an overall resistence of 750ohm; if the overall resistance exceeds approx. 3Kohm, the soft-start is blocked by FAULT 11.

Description of 4. REG. Imax SET menu parameters

REG. Imax SET 4.	*Parameters establishing the type of motor connection*
REG. Imax SET 4.1 INT	*Par.4.1. Select the start current regulation mode*

Setting options: INT, EXT
INT = Internal regulation by setting par. 1.4 **ACC/DEC Imax** (or par.5.3 **Imax 2nd SPEED** if speed 2 has been selected).
EXT = External regulation by potentiometer or 0 /+10Vdc analog signal connected to input 29; the description of this mode is at chapt.9.

Description of 5. 2nd SPEED SET menu parameters

2nd SPEED SET
5.

Parameters for managing start-up in speed 2 (FAST) with dual speed motors. Speed 1 (SLOW) is managed under 1.BASIC DATA menu

In 2nd SPEED
5.1 6.0A

Par.5.1. Rated motor current referred to speed 2 (FAST)

Setting range: dependent on the soft-start power size .

ACC. RAMP 2 SPEED
5.2 10.0s

Par.5.2. Voltage acceleration ramp on motor in passage from SLOW to FAST

Setting range: 1.0 - 120.0 seconds.
Set a time so that the start-up in FAST follows with the required ramp.
The effective **speed** ramp of the motor until maximum speed is reached will depend on the load and cannot be to long otherwise the actuator will be blocked by fault 10 (see chapt.3 FAULTS).

Imax 2nd SPEED
5.3 400%In

Par.5.3. Maximum start current of motor in FAST

Setting range: 100 - 700% (reduced to 400% at max actuator limit)
Set the **max motor surge current** as a **%** of the rated current at par.5.1; this setting must nevertheless allow the completion of the motor start-up in FAST in the time set at parameter 5.2.

ATTENTION! when setting par. = 400% the current set into par.5.1 In 2nd SPEED is internally increased of 15%, so to allow the starting at a higher current; in this case, the maximum starting time is reduced from 20sec to 16 sec.
On the setting range from 100% to 399% there is again the conformity to the rated current set into par.5.1.

Vmax START 2nd
5.4 50%VL

Par.5.4. Instant supply voltage on motor as a % of the line voltage at the passage to FAST.

Setting range: 0 - 100%
Set to guarantee continuity in the start-up after reaching SLOW, without drops in speed.

V2>V1 RAMP
5.5 3.0s

Par.5.5. Voltage acceleration ramp on motor in the passage from FAST to SLOW

Setting range: 1.0 - 10.0 seconds
Set a time so that the passage from FAST to SLOW is done with the intended ramp.

Vmax START V2>V1
5.6 50%VL

Par.5.6. Instant supply voltage to motor as a % of the line voltage (VL), at the passage from FAST to SLOW

Setting range: 0 - 100%VL.
Set so the motor brake is anticipated in the passage from FAST to SLOW, but without jerks on the mechanics.

ENABLE 2nd TO 1st
5.7 YES

Par.5.7. Enable the passage from speed 2° to 1° in dual polarity motors

Setting options: NO, YES
The setting is valid in both MANUAL and AUTOMATIC.
NO = During rotation in FACT (speed 2), if the FAST command is disabled the change from fast to slow will not be performed; moreover in this case if the drive (FORWARD o REVERSE) is disabled the voltage to the motor is cut off without a stop procedure, with the relay switches instantly diengaging .
YES = During rotation in FAST (speed 2), if the FAST command is disabled the FAST to SLOW with braking procedure is performed, the same as occurs if the drive is shut off (FORWARD or REVERSE).

See also "DUAL SPEED MOTOR COMMANDS" at chapt.9 OPERATING MODES.

Description of 6. STOP TYPE menu parameters

STOP TYPE 6. — *The parameters for managing motor stops*

STOP TYPE 6.1 DEC — ***Par.6.1. Select motor STOP mode***

Setting options: DEC, BRAKE
DEC = stop with voltage deceleration ramp
BRAKE = stop by braking (for high inertia loads).

DEC RAMP 6.2 1.0s — ***Par.6.2. Voltage deceleration ramp on motor after a 0 type STOP command***

Setting range: 0.0 - 120.0 seconds.
Set 0.0s to disengage motor instantly.

VLINE STOP DEC 6.3 10% — ***Par.6.3. Minimum setting of voltage on motor, below which the drive relay switch trips automatically during the deceleration ramp (STOP TYPE= DEC).***

Setting range: 10% - 100%
The line voltage as a percentage measured at terminals R1, S1, T1.

MOTOR STOP FREQ 6.4 5.0Hz — ***Par.6.4. Minimum motor speed , below which the final direct current impulse braking begins (STOP TYPE= BRAKE).***

Setting range: 2.0 - 10.0Hz.
The braking end speed is given in Hz so to obtain the motor speed in rpm refer to the motor ID plate data.
E.G.: a 4 pole motor having 1450rpm at 50Hz, with parameter 6.5=5.0Hz, the braking end will be at around 145rpm.

DC BRAKE TIME 6.5 1.0s — ***Par.6.5. Direct current final braking impulse time, when complete the braking cycle ends, disengaging the motor drive relay switch (STOP TYPE= BRAKE).***

Setting range: 0.1 - 5.0 seconds.

1AC BRAKE LEVEL 6.6 30% — ***Par.6.6. First AC braking current impulse level (STOP TYPE= BRAKE).***

Setting range: 1 - 400% of the rated current of the motor set at par.1.2 MOTOR In.

1AC BRAKE DURAT 6.7 1.000s — ***Par.6.7. AC first braking impulse time (STOP TYPE= BRAKE).***

Setting range: 0.000 - 10.000 seconds.

AC BRAKE LEVEL 6.8 100% — ***Par.6.8. AC braking current impulse levels after the first, until the stop speed set at par.6.4 MOTOR STOP FREQUENCY (STOP TYPE= BRAKE).***

Setting range : 1 - 400% of the rated current of the motor set at par.1.2 MOTOR In.

AC BRAKE DURAT 6.9 1.000s — ***Par.6.9. Length of AC braking current impulses after the first, until the stop speed set at par.6.4 MOTOR STOP FREQUENCY (STOP TYPE= BRAKE).***

Setting range: 0.010 - 10.000 seconds.
N.B. When the motor drops below a frequency of 15Hz, the duration of the impulses is halved.

BRAKE DELAY 6.10 3.00s — ***Par.6.10. First ac braking current impulse delay time (STOP TYPE= BRAKE).***

Setting range: 0.01 - 5.00 sec.

Description of 7. START TYPE menu parameters

START TYPE 7. — *The parameters for managing the motor start phase*

KICK START TIME 7.1 0.0s — ***Par.7.1. Time of voltage impulse on motor without ramp at start command.***

Setting range: 0.0sec - 2.0sec
The impulse voltage level is the same as the voltage supply value on terminals R1,S1,T1.
It is used to un-lock the mechanical transmission from the static frictions; when the impulse finishes, the voltage ramp starts from the platform value set on **par.1.5 STARTING Vmax** until reaching the line supply voltage.

Description of 8. ENERGY SAVING menu parameters

ENERGY SAVING 8.	Parameters managing the energy saving function

SAVE ENERGY 8.1 NO	Par.8.1. Enabling the energy saving function

Setting range: NO, YES.
NO = Function disabled
YES = Function enabled

MIN% SCR COND. 8.2 65%	Par.8.2. Minimum motor voltage on energy saving function

Setting range: from 65% to 100% of the three-phase supply voltage.

VOLTAGE ACC RAMP 8.3 0.1s	Par.8.3. Acceleration ramp on voltage set in energy saving function

Setting range: from 0.1s to 20.0s.

VOLTAGE DEC RAMP 8.4 5.0s	Par.8.4. Deceleration ramp on voltage set in energy saving function

Setting range: from 1.0s to 50.0s.

cosPHI THRESHOLD 8.5 0.40	Par.8.5. Intervention threshold on cosPHI in energy saving function

Setting range: from 0.20 to 0.80.

"ENERGY SAVING" FUNCTION DESCRIPTION
ATTENTION! Before using this function set par.100.4 SCR CONTROL TYPE=2
The function must be enabled by par.8.1 SAVE ENERGY = YES.
When the **"cos phi"**, also shown on DISPLAYS MENU, goes under the threshold set on par.8.5, the motor voltage is reduced by the ramp of par.8.4 until the minimum set on par.8.2.
When, by a load raising, the **cos phi** is getting over the threshold set on par.8.5, the motor voltage is raised at 100% by the ramp of par.8.4.
The ENERGY SAVING function is particularly indicated when the motor is working without load for long times; it stands to reason that the cosphi threshold set on par. 8.5 must alway be **over** the cosphi of the loadless motor, otherwise the energy saving function will not be enabled; for this reason, before enabling the function, verify the **"cos phi"** visualization with loadless motor in order to set par.8.5 correctly.

Description of 9. FUNCTIONS menu parameters

FUNCTIONS 9.	The parameters for managing the special motor control functions

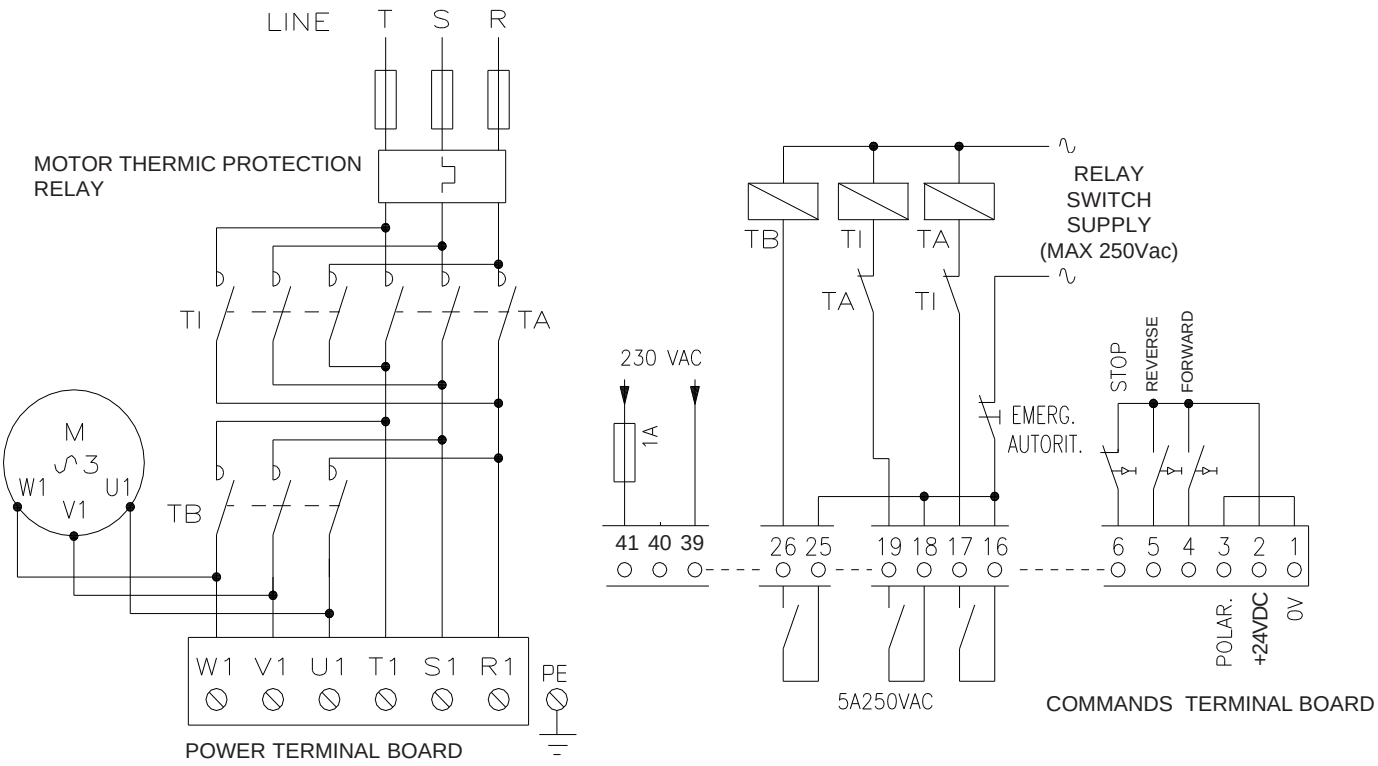
FUNCTION TYPE 9.1 0.	Par.9.1. Select type of function

Setting options: 0, 1.
0 = standard soft -start function.
1 = as for 0 but with the following differences in operation:
With theFORWARD or REVERSE drive command , the auxiliary output related to relay R6 is activated to command the motor brake release ; the brake released status is detected by a sensor connected to auxiliary input DIGITAL INPUT6 (terminal 9), when the sensor is ON and therefor the brake is released , the start-up begins.
When the drive command is disactivated the normal stop procedure is performed , when the drive relay switches are disengaged power to the R6 relay is cut off with the brake engaging.

Soft-starter bypass at the end of start-up

TYPICAL USE : when the soft-starter is installed in aggressive environments (e.g. dye shops, tanneries etc.), with low start-up rates and it is best to avoid switchbox ventilation from outside.
OPERATING PRINCIPLE:
The bypass relay switch of the soft-starter (TB) activates at the **end of the start-up** (in both slow and fast).
The start-up is considered ended when the motor reaches the full line voltage and the absorbed current drops under 112 % of the rated current set at par.1.2 MOTOR In.
If the start-up does not end, the motor and actuator thermal image controls will finish blocking the soft-start by FAULT1 or FAULT10 (see chapt.3)
The bypass is instantly disengaged in the following cases:
- when the drive is shut off (forward or reverse);
-in the passage from slow > fast and fast > slow
- when the soft-start is blocked
CAUTION! When the soft-starter is in bypass, all controls on the motor absorption are excluded related to parameters **3.1 ENABLE CLASS 10** and **3.2 %UNDERLOAD** and the variables **var.1 AVERAGE IxI**, **var.4 MOTOR CURRENT**, **var.6 TA1-TA2**.
To avoid fault 2 coming up, par. 3.2 % UNDERLOAD must be set to 0 (default setting).
In case of bypass, it is therefore necessary to protect the motor by one of the following operations:
- connect the PTC sensor of the motor to terminals 27-32, activating the control by setting **par.3.4MOTOR PTC ENABLE=YES**
- install an external current overload sensor as shown in the wiring diagram below.
If not using the bypass, you can overlook the PTC sensor.

TYPICAL WIRING WITH BYPASS AT END OF START-UP



6-wire connection

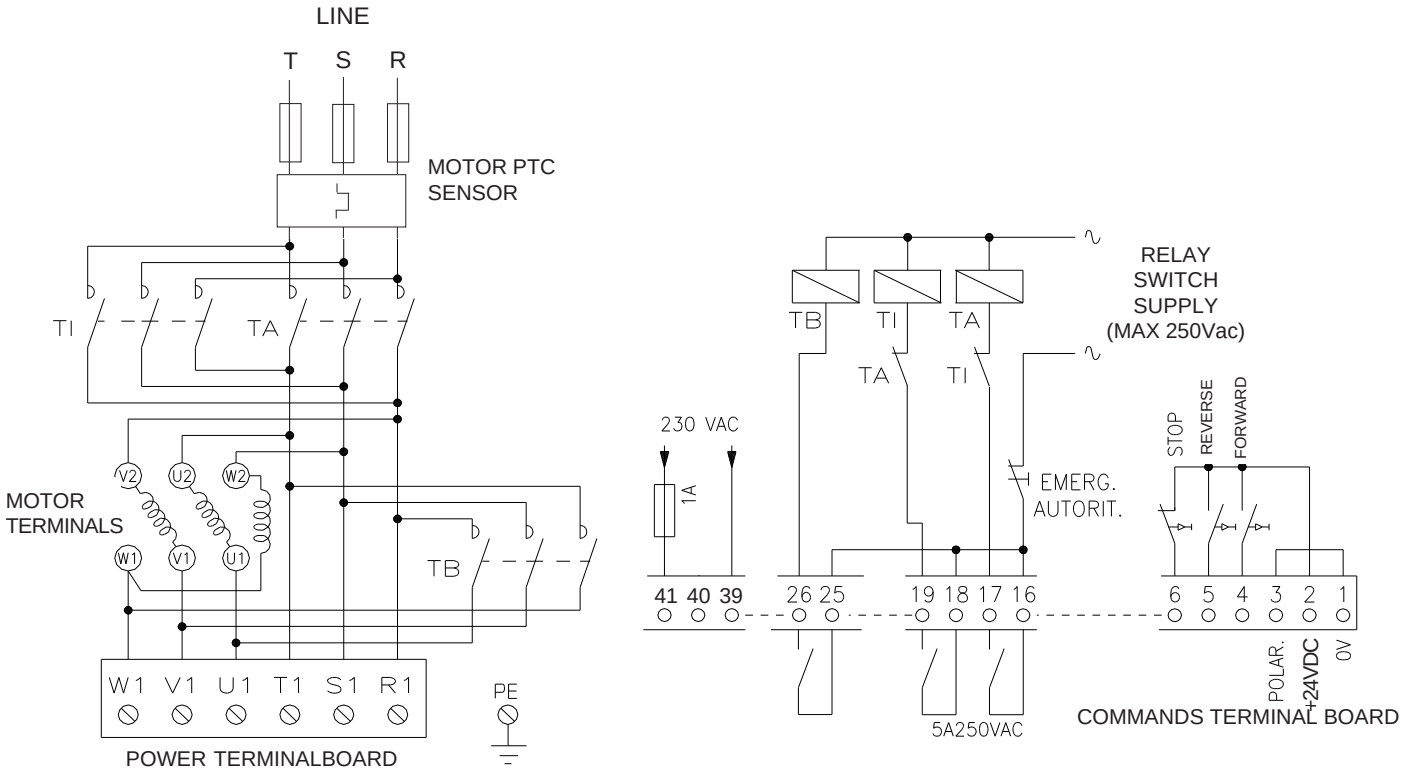
TYPICAL USE:
When the soft-starter is replacing an old star/delta starter ; in all cases where the supply voltage enables a delta connection on the motor .

OPERATING PRINCIPLE:
The 6-wire connection enables the use, with equal motor power, of a soft-start with 1.73 times less power than would be needed for the 3-wire connection; this naturally means a reduction in costs and dimensions, especially at high powers (see CURRENTS AND POWERS table at chapt.6); on the other hand greater attention must be paid in the motor connections since the start and end of the windings must be connected according to the wiring diagram, otherwise you risk damaging the soft-start.

TO ENABLE OPERATION OF A MOTOR WITH A 6-WIRE CONNECTION :
- First enter the parameters by the keypad as described in chapt.5 RAPID INSTALLATION.
- At **par.1.2 MOTOR In** set the rated current of the motor referred to the **delta connection.**
- Set **par.2.1 CONNECTION TYPE = 6 WIRES.**

ATTENTION! When using the bypass, motor thermal protections are not working (see example SOFT-STARTER BYPASS AT THE END OF START-UP on page 28).
If not using the bypass, you can overlook the PTC sensor.

COMPLETE WIRING DIAGRAM WITH INVERSION AND BYPASS AT END OF START-UP

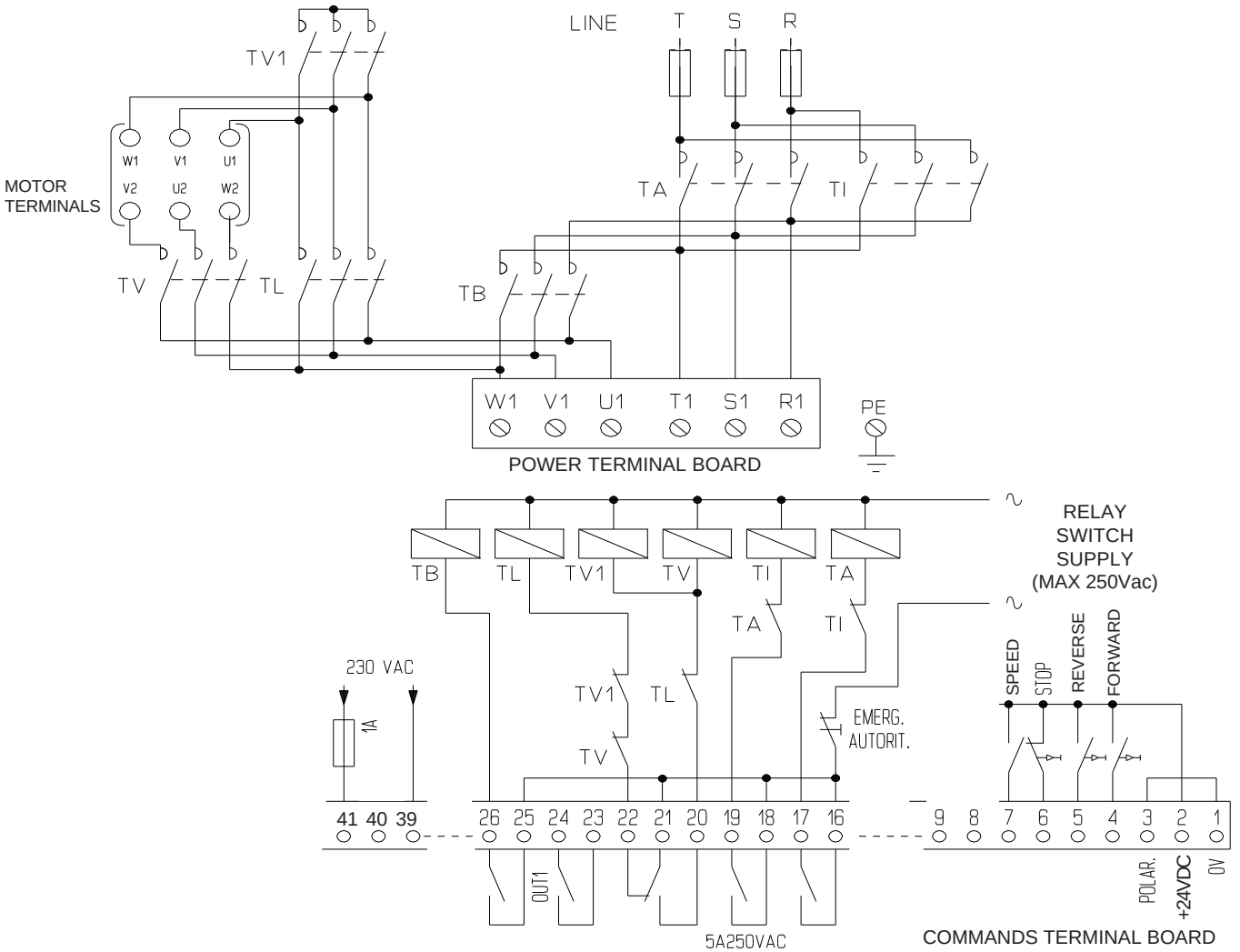


Dual speed motor command

OPERATING PRINCIPLE:
The TL relay switch must engage the SLOW speed;,while relay switches TV and TV1 the FAST speed; TB=BYPASS (if necessary, only).
To set the parameters for a **SLOW** speed start-up carry out the rapid installation described in chapt. 5
In this case, **par. 1.2 MOTOR In** has to be set with the rated current on the motor ID plate, referred to the slow winding.
The parameters for setting the start-up in **FAST** are grouped in the **5. 2nd SPEED SET** menu:
- At **par. 5.1 In 2nd SPEED** set the rated current on the motor ID plate referred to the fast winding.
- At **par. 5.2 ACC RAMP 2 SPEED** set the required voltage ramp for FAST to avoid mechanical jerks in the speed change.
- At **par. 5.3 Imax 2nd SPEED** set the maximum surge current for the FAST so that at full load the motor is able to complete the start-up.
- At **par. 5.4 Vmax START 2nd** set the start platform voltage for FAST; enter a setting that will not create speed drops at full load during the passage from SLOW to FAST.
- At **par. 5.5 V2>V1 RAMP** set the voltage deceleration ramp in the passage from FAST to SLOW to avoid sharp slow downs.
- At **par. 5.6 Vmax START V2>V1** set the platform voltage during the return to SLOW from FAST

par.5.7 ENAB. 2nd TO 1st = YES, (default setting) gives the operating sequence :
When giving a FORWARD or REVERSE command, even if the FAST input is already activated, the soft-start automatically esegue firt the start-up in SLOW and then afterwards in FAST, at the end of the start-up the bypass activates.
When the driveis shut off, the motor first enters SLOW with the ramp set at par. 5.5 and then starts the stop in DECELERATION or in BRAKING depending on the setting at par.6.1 STOP TYPE.
If **par.5.7 ENAB. 2nd TO 1st = NO** is set, the following special function is obtained:
During rotation in FAST (SPEED 2) and the FAST command is disabled, the speed change to SLOW is not performed; moreover in this case if the drive (FORWARD or REVERSE) disactivates the voltage to the motor is cut off without a stop procedure, with the relay switches instantly disengaging.
ATTENTION! When using the bypass, motor thermal protections are not working (see example SOFT-STARTER BYPASS AT THE END OF START-UP on page 28).

COMPLETE WIRING DIAGRAM WITH SPEED CHANGE, INVERSION AND BYPASS AT THE END OF START-UP

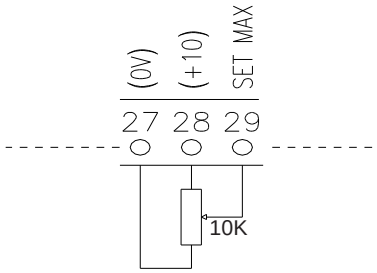


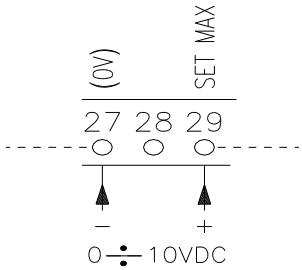
External regulation of the maximum start-up current

TYPICAL USE:
When external regulation is necessary, by potentiometer or analog signal, on the maximum start-up torque of the motor according to the type of load applied (e.g. start-up of diamond wire cutters with various types of marble or drums with strong load variations for treating dry or wet material).

OPERATING PRINCIPLE:
To enable the external current regulation set **par.4.1 REG. Imax SET = EXT**
The field of regulation :
With analog signal at input 29 = 0Vdc :
- with the FAST input disactivated the maximum permitted current is set at **par. 1.2 MOTOR In**
- with the FAST input activated the maximum permitted current is set at **par. 5.1 In 2nd SPEED**

With analog signal at input 29 = +10Vdc:
- with the FAST input disactivated the maximum permitted current is set at **par. 1.4 ACC/DEC Imax**
- with the FAST input activated the maximum permitted current is set at **par. 5.3 Imax 2nd SPEED**





Kick Start

TYPICAL USE:
conveyor belt start-up with high shutdown friction.

WIRING DIAGRAMS: all wiring diagrams in this manual.

OPERATING PRINCIPLE:
At the start drive, to unblock the mechanical transmission from shutdown friction, the motor is powered without a voltage ramp, by default equal to the voltage at terminals R1 S1 T1 for the time set at **par. 7.1 KICK START TIME;** at the end of this overvoltage impulse the normal voltage ramp will start as preset at **par. 1.3 ACC. RAMP.**
To cancel the KICK START function, set par. 7.1 KICK START TIME=0,0s

Motor stop modes

VOLTAGE DECELERATION RAMP

TYPICAL USE:
To command pumps with ramp stop to avoid hammering of the water column on the piping.

WIRING DIAGRAMS: all the wiring diagrams provided in this manual.

OPERATING PRINCIPLE:
To enable the deceleration set **par. 6.1 STOP TYPE = DEC** (default setting).
In this case, at the STOP, the voltage on the motor decreases by the ramp set at **par.6.2 DEC RAMP**; when the voltage drops below the setting at **par.6.3 VLINE STOP DEC,** the FORWARD or REVERSE drive relay switch disengages automatically .
If **par.6.2 DEC RAMP = 0,0s** is set at the STOP, the drive relay switch instantly disengages.

COUNTER CURRENT BRAKING

TYPICAL USE: to command rapid braking in motors that drive large inertia loads (e.g. flywheels).

WIRING DIAGRAMS:
All the wiring diagrams provided in this manual , but it is essential that the wiring diagram is complete (3 and 6 wire) with **both FORWARD and REVERSE relay switches**, even if only one direction of rotation is needed (the reverse relay switch is needed for the countercurrent braking).

OPERATING PRINCIPLE:
To enable counter current braking set **par. 6.1 STOP TYPE = BRAKE**
In this case at the STOP the supply relay switch is staccato and the reverse drive relay switch is automatically activated; after the time set at **par. 6.9 BRAKE DELAY,** the **counter current impulse braking cycle** starts and ends only when the motor slows to below the speed set at **par. 6.4 MOTOR STOP FREQ.**
At this stage, to block the motor an impulse of direct current is injected for the time set at **par. 6.5 DC BRAKE TIME** after which the stop cycle ends and the drive relay switch disengages automatically .
The **counter current impulse braking cycle** has the following sequence:
A first counter current impulse is given with the intensity set at **par. 6.6 1AC BRAKE LEVEL** and for the time set at **par. 6.7 1AC BRAKE DURAT**; this first braking impulse slows down the motor towards the stop speed (with an ample higher margin) so a single continuous impulse will obtain most of the motor deceleration.
After the first impulse, the real speed of the motor is measured:
- **if the speed is lower** than **par. 6.4 MOTOR STOP FREQ** a direct current impulse is applied to the motor for the time set at **par. 6.5 DC BRAKE TIME** and the stop cycle ends.
- if the speed is higher than **par. 6.4 MOTOR STOP FREQ** other impulses are given to "approach" the stop speed at the an intensity set at **par. 6.8 AC BRAKE LEVEL** and for a time set at **par. 6.9 AC BRAKE DURAT**; these braking impulses are given to reach **precisely** the stop speed set at **par. 6.4 MOTOR STOP FREQ,** therefore the intensity and time must be set accordingly.

CAUTION !
- An unduly high counter current impulse may make the motor rotate in the opposite direction before being stopped with the injection of direct current , therefore the settings of parameters **6.6 1AC BRAKE LEVEL**, **6.7 1AC BRAKE DURAT, 6.8 AC BRAKE LEVEL**, **6.9 AC BRAKE DURAT** must be adapted if a lower load is on the motor.
-The DC braking is somewhat noisy so it is advisable to set **par. 6.5 DC BRAKE TIME** with just sufficient braking time to stop the motor shaft; if the motor has a brake the DC braking can be cancelled by setting **par. 6.5 DC BRAKE TIME** to 0.1 seconds, in this case the brake has to be supplied separately and only activated after a delay of at least 2 seconds from when both disengage.

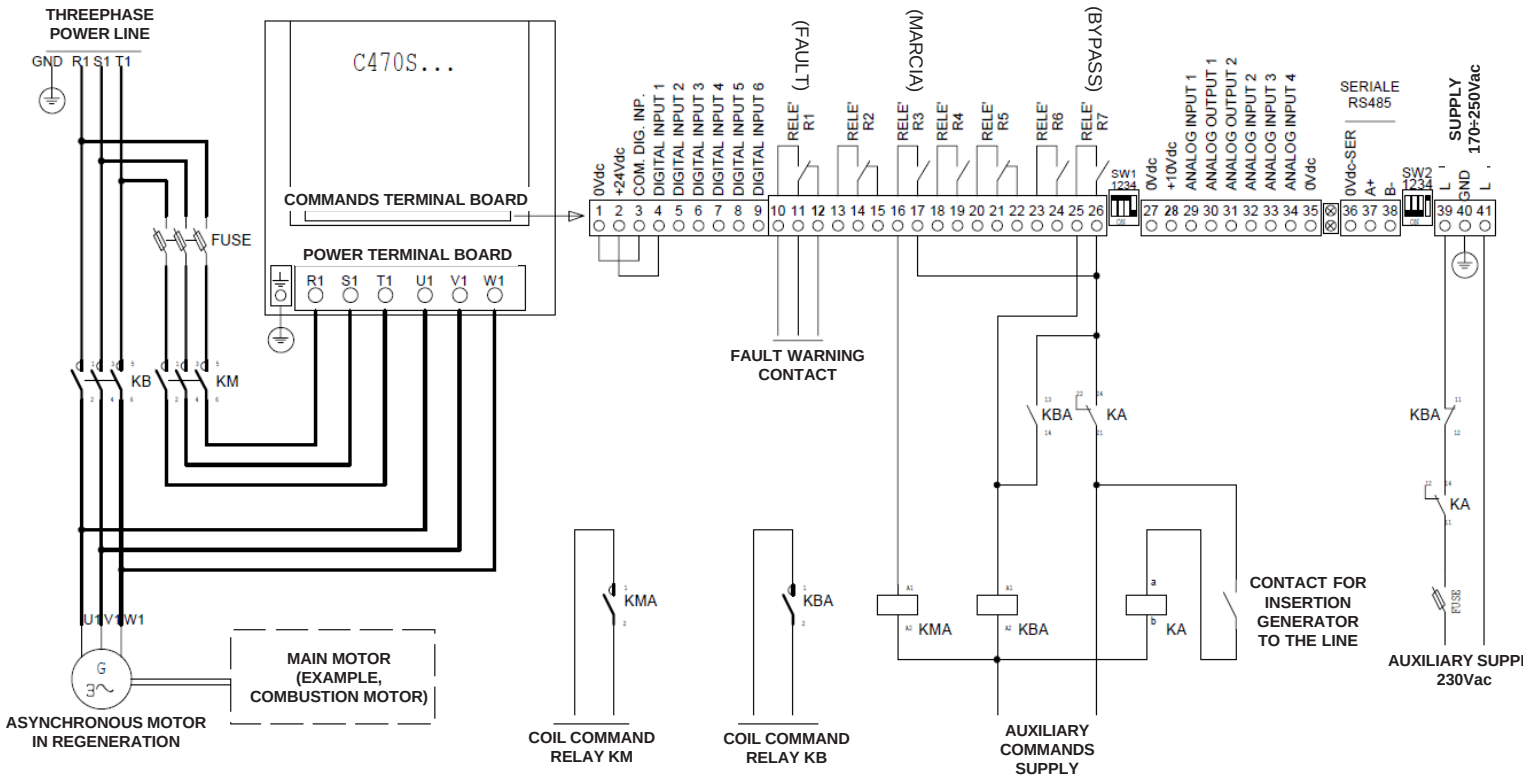
Soft-starter for locking of a generator to the line

TYPICAL USE:
Insertion to the line of a three-phase asynchronous machine in regeneration.

WORKING PRINCIPLE (following the diagram below):
First of all take insuration that the cyclic sense of the three-phase triad and the rotational sense of the Main Motor are correctly working; to do so, get a partial starting by the soft-starter to the asynchronous machine as like as a motor (few seconds at poor current sufficient to see the rotor sense of direction); the rotational sense of the machine has to correspond to the sense of the Main Motor, if not, it is sufficient to revert the connection of the line phases to the soft-starter.
Before locking the line, the asynchronous machine must be taken, by the Main Motor, next (but lower) to the speed of synchronism, so that it is sufficient to use the only magnetization current; at this point, by turning on **permanently** the CONTACT FOR INSERTION GENERATOR TO THE LINE, the **KM Contacter** will close to start the locking to the line in ramp. During this phase, the Main Motor must not take the machine over the synchronism speed. At the end of the locking, the bypass **KB Contacter** is automatically turned-on and the machine is automatically connected the the supply line. The **KM Contacter** is de-activated and the soft-starter logic is disconnected.
At this point, the Main Motor will get the machine over the synchronism speed to work as like as generator.
To repeat the cycle, turn-off and then turn-on again the command CONTACT FOR INSERTION GENERATOR TO THE LINE.
The KB Contacter can be of AC category, dimensioned on the generator current.
The KM Contacter can be of AC1 category, dimensioned on the magnetization current, basing on the fact that it is used during the line locking-phase only; the range will be lower than **KB**.

Example for choosing the soft-starter and setting the most important parameters:
- Generator with 1500A rated current
- Current limitation during the locking to the line at the 37% of the rated value (**Iavv** = 550A), assuming a 500A (33% of In) magnetizing current. You will use a soft-starter with a maximum current a bit over the needed starting current, allowing the use of a soft-starter with rated current much lower the generator one, reducing considerably the plant expenses.

To choose the right soft-starter and protection fuses see Chapt.6 table "CURRENTS and POWERS at 3 WIRE CONNECTION"; in this case, use a 470S/6 with max starting current 600A, next to the 550A required.
Parameter setting:
To use the soft-starter for the line locking, set par.**1.2 MOTOR In** to value **Iavv / 4** and par.**1.4 ACC/DEC Imax** = **400%**; in this case par.**1.2 MOTOR In** will be 550A divided to 4 , so 138A.
Other parameters to be set before the starting:
- par.**100.4 SCR CONTROL TYPE** = 2
- par.**1.1 LINE FREQUENCY** > put the **supply line frequency** value.
- par.**1.3 ACC RAMP** > put the **time (seconds) of the voltage accelaration ramp** that you need to give the motor to achieve the line locking.
- par.**1.5 STARTING Vmax** = 30%
- par.**3.1 ENABLE CLASS 10** = NO



Technical characteristics common to the following functions: STATIC SWITCH POWER/ENERGY REGULATOR VOLTAGE REGULATOR

- CE product
- Three phase power supply can have 2 ranges:
  > absolute limits: 170 - 510 Vac / 45Hz ÷ 65Hz (230/400Vac line)
  > absolute limits: 300 - 760 Vac / 45Hz ÷ 65Hz (690Vac line).
- Separate power supply for command logic + ventilation command (where mounted) 170 - 250 Vac / 45Hz - 65Hz
- Maximum admitted supply line distortion: 10%.
- Range of actuators for 3-wire and 6-wire connections (see CURRENTS AND POWERS tables)
- Regolazione di tensione simmetrica su tutte e 3 le fasi mediante moduli di potenza a SCR (1 per ogni fase).
- Operation in continuous duty up to 112% of rated regulator current.
- Current control on two phases of the supply line by the current transformer.
- Input and output commands fully isolated from the high voltage system.
- Parameter setting and monitoring by keypad with 2 row,16 digit backlit display with remote connection.
- Command and full parameter setting by RS485 MODBUS RTU serial connection.

AVAILABLE FUNCTIONS:

> **STATIC SWITCH** ZERO CROSSING (see chapt.11); the drive can be commanded as a simple three-phase static switch by DIGITAL INPUT1; the switching to ON is always made when crossing zero voltage of each phase in order to avoid disturbance and distortion on three-phase supply line.

> **POWER/ENERGY REGULATOR** ZERO CROSSING (see chapt.12); the drive works as a wave train energy regulator (at integral period) with the modulation directly proportional to an analog command signal. Even in this case the start of the wave packages is synchronized with the crossing of zero to avoid disturbance and distortion on the three-phase supply line.

> **VOLTAGE REGULATOR** AT PHASE PARTIALIZATION (see chapt.13); in this case the regulated output voltage is obtained controlling the firing angle of the alternate voltage to the SCR ends.
By this technique, it is possible to realise feeder devices and controls for alternate AC or DC motors.

ACTUATOR PROTECTIONS:

> Overloaded exceeding 112% of the regulator rated current.
> Output phase short-circuit.
> Supply line phase unbalance
> SCR module overheating.

- Extractable Input/output command connection terminal board.
- Standard version in aluminium housing with IP20 protection rating and aluminium lid.
- Ambient air temperature limits: -5°C +40°C.
- Dissipater air temperature limits: -5°C +70°C.
- Storage temperature: -25 °C +70 °C.
- Condensate free relative humidity : 5% - 95%

- Conformity to directives:
BT 2006/95/CE (LOW VOLTAGE) and EMC 2004/108/CE (ELECTROMAGNETIC COMPATIBILITY) for industrial environments following the CEI EN 60947-4-3.
ATTENTION: When using the "**VOLTAGE REGULATOR"** function, the conformity is guaranteed by the use of an EMC filter as described on the paragraph "Electromagnetic Compatibility".

ATTENTION: this product has been designed as Class A device (CEI EN 60947-4-2 e 4-3). If used in domestic environment, it can cause radio-interferences; in this case additional filtering precautions will be necessary (contact the Rowan Elettronica Technical Dept. for more information).

Electrical characteristics tables

CHARACTERISTICS FOR 3 WIRE CONNECTION

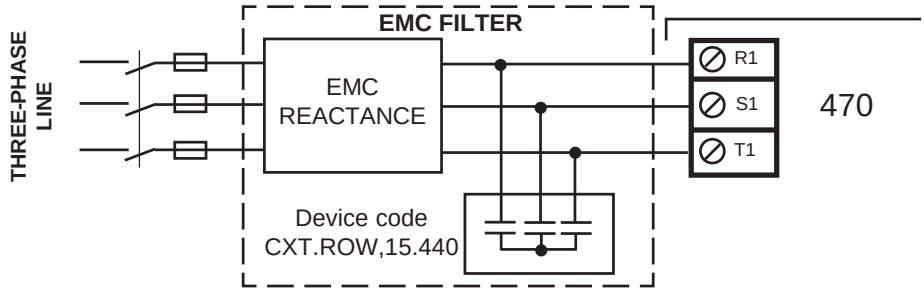
POWER CODES	NOMINAL CURRENT	NOMINAL POWER line 230Vac resistive load	NOMINAL POWER line 400Vac resistive load	SUGGESTED gG/gL TYPE FUSES	THERMIC PROBE	POWER OF THE SEPARATE SUPPLY (TERMINALS 39-41)	POWER DISSIPATED OF MODULES POWER at IMAX	INTERNAL VENTILATION	REACTANCE EMC
	A	kW	kW	A		W	W		
470S/3	40	15,9	27,7	50	YES	20	110	NO	RZT.50A.0,56
470S/4	60	23,9	41,5	80	YES	50	190	YES	RZT.72A.0,39
470S/5	100	39,8	69,2	125	YES	50	270	YES	RZT.106A.0,26
470S/5,5	130	51,7	90,0	160	YES	50	360	YES	RZT.165A.0,16
470S/6	200	79,6	138	250	YES	50	580	YES	RZT.245A.0,11
470S/7	300	119	208	350	YES	50	980	YES	RZT.370A.0,074
470S/8	400	159	277	500	YES	50	1210	YES	RZT.460A.0,059
470S/8,5	560	223	387	630	YES	100	1570	YES	RZT.550A.0,049
470S/9	850	338	588	1000	YES	170	2500	YES	ask Technical Dept.
470S/9,5	1150	458	796	1600	YES	170	3500	YES	ask Technical Dept.

CHARACTERISTICS FOR 6 WIRE CONNECTION

POWER CODES	NOMINAL CURRENT	NOMINAL POWER line 230Vac resistive load	NOMINAL POWER line 400Vac resistive load	SUGGESTED GL TYPE RAPID FUSES	THERMIC PROBE	POWER OF THE SEPARATE SUPPLY (TERMINALS 39-41)	POWER DISSIPATED OF MODULES POWER at IMAX	INTERNAL VENTILATION	REACTANCE EMC
	A	kW	kW	A		W	W		
470S/3	70	27,9	48,4	80	YES	20	110	NO	RZT.72A.0,39
470S/4	105	41,8	72,7	125	YES	50	190	YES	RZT.106A.0,26
470S/5	175	69,7	121	200	YES	50	270	YES	RZT.245A.0,11
470S/5,5	225	89,6	156	300	YES	50	360	YES	RZT.245A.0,11
470S/6	345	137	239	400	YES	50	580	YES	RZT.370A.0,074
470S/7	520	207	360	630	YES	50	980	YES	RZT.550A.0,049
470S/8	690	275	477	800	YES	50	1210	YES	ask Technical Dept.
470S/8,5	970	386	671	1250	YES	100	1570	YES	ask Technical Dept
470S/9	1470	585	1017	2000	YES	170	2500	YES	ask Technical Dept
470S/9,5	1990	792	1377	2500	YES	170	3500	YES	ask Technical Dept

Electromagnetic Compatibility

When you use the "**VOLTAGE REGULATOR**" function, the conformity to the EMC 2004/108/CE standard (ELECTROMAGNETIC COMPATIBILITY) in industrial environment following the CEI EN 60947-4-3, is guaranteed by the use of an EMC filter including a three-phase **REACTANCE** (see previous tables CHARACTERISTICS for 3 and 6 WIRE CONNECTION) and the device code **CXT.ROW0.15.440** connected as in the following example:

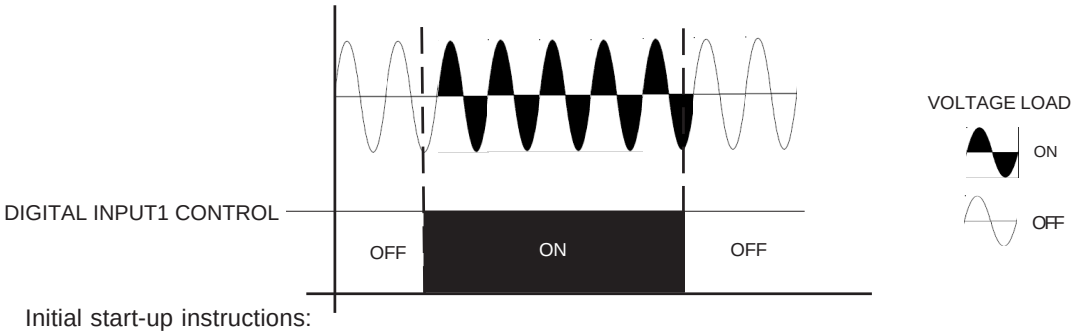


The C470S gives a leakage current toward ground (<1mA) so, connect the PE terminal to ground BEFORE supplying the device. In all cases, to avoid induced disturbances on connection cables:

- Avoid the passing of cables for connection to the command terminal board in the same wireway of the power ones.
- Connect potentiometers and DC signals with screened cable and connect each end of the screen singularly to the point of the cabinet common ground and avoiding so, ground loops.

Description of static switch operation

In this function mode the 470 actuator can be commanded as a simple three phase static switch by the DIGITAL INPUT1 drive input. It is switched to ON always when passing zero voltage of each phase to avoid disturbance and distortion on the three phase supply line as shown in the graph below. A typical application is the temperature control of electric ovens by pulse output thermoregulator.



Initial start-up instructions:

1) Follow the wiring diagram below. The installation is explained in chapt.7 of the SOFTSTART function.

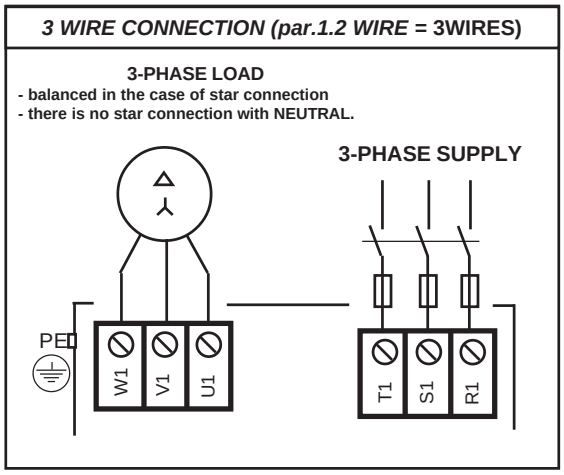
2) Enable the function by setting **par.100.1 APPLICATIONS = 3AC_ON/OFF.** (to enter menu 100. press E for 5 seconds).

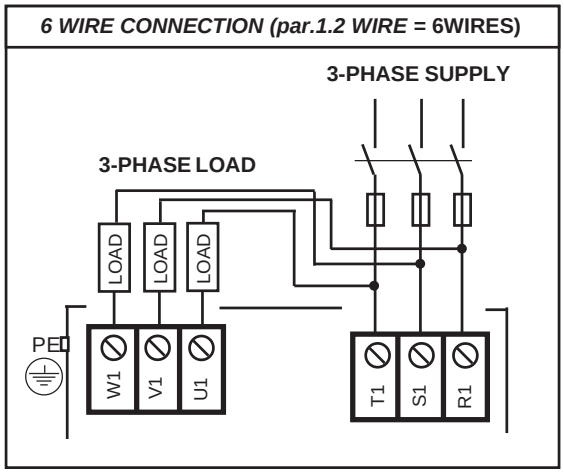
3) Set par.1.1 LINE FREQ. according to the three phase supply line frequency.

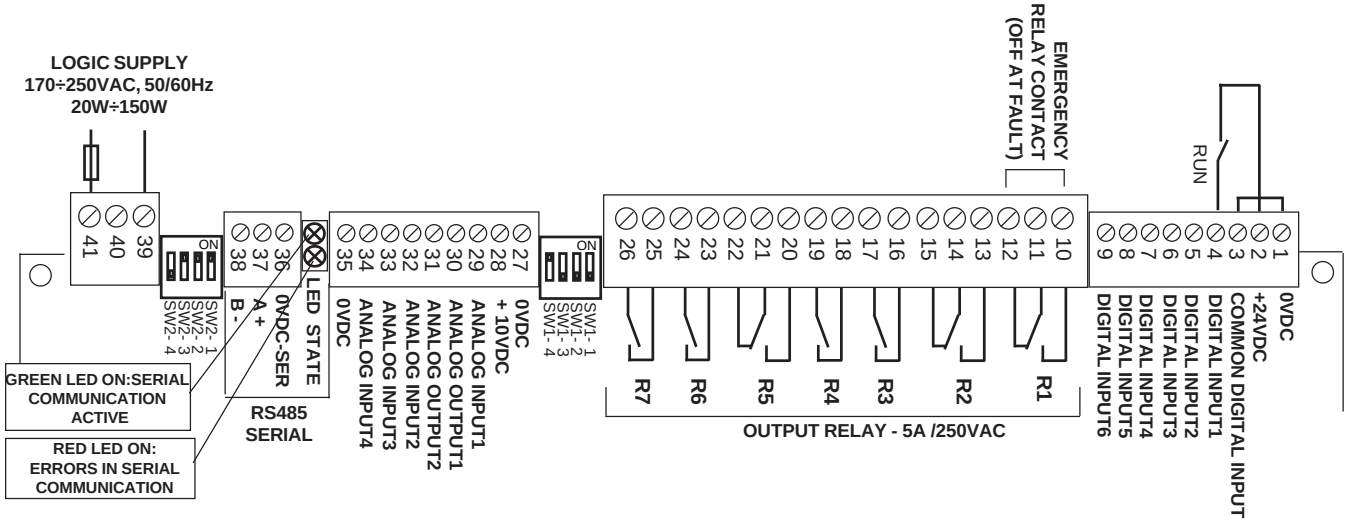
4) Set par.1.2 WIRE according to the type of load connection.

5) Activate the DRIVE command to give the full power to the load

Wiring diagram







Power terminal box description

R1 S1 T1 Three-phase line voltage for 2 ranges with absolute limits:
170Vac ÷ 510Vac (**lines 230/400/440Vac**), 300Vac ÷ 760Vac (**line 690Vac**).
Standard line frequency 50Hz / 60Hz (min 45Hz - max 65Hz).

PE ⏚ Connection to earth.

U1 V1 W1 Three-phase output as supply voltage commutated zero crossing.

Command terminal box description

DIGITAL INPUT DESCRIPTION:

1 = **0VDC**	COMMON NEGATIVE
2 = **+24 VDC**	POWER SUPPLY FOR INPUT ACTIVATION BY CONTACT max 500mA
3 = **COMMON DIGITAL INPUT**	INPUT POLARISATION
4 = **DIGITAL INPUT1**	REGULATOR RUNNING INPUT
5,6,7,8,9 **= DIGITAL INPUT 2,3,4,5,6**	NO FUNCTION

DIGITAL INPUT CHARACTERISTICS:
> PNP connection (term. COMMON at 0Vdc)
> NPN connection (term. COMMON at max 30Vdc)
> Input resistance = 3Kohm
> Minimum voltage for 5Vdc input activation

CONTACT OUTPUT DESCRIPTION
Contact max load 5A/250Vac

10 = NO
11 = C
12 = NC
R1 ***EMERGENCY RELAY CHANGE-OVER CONTACT:***
It gets energised when the regulator is powered and there are no active faults; it gets de-energised if there are any faults

R2, R3, R4, R5, R6, R7 NO FUNCTION

ANALOGUE REFERENCE DESCRIPTION

27 = **0VDC**	COMMON NEGATIVE
28 = **+10VDC**	Set potentiometer supply voltage max load = 10mA.
29,32,33,34 = **ANALOG INPUT**	NO FUNCTION
35 = **0VDC**	COMMON NEGATIVE

ANALOGUE OUTPUT DESCRIPTION
30, 31 = **ANALOG OUTPUT,** NO FUNCTION

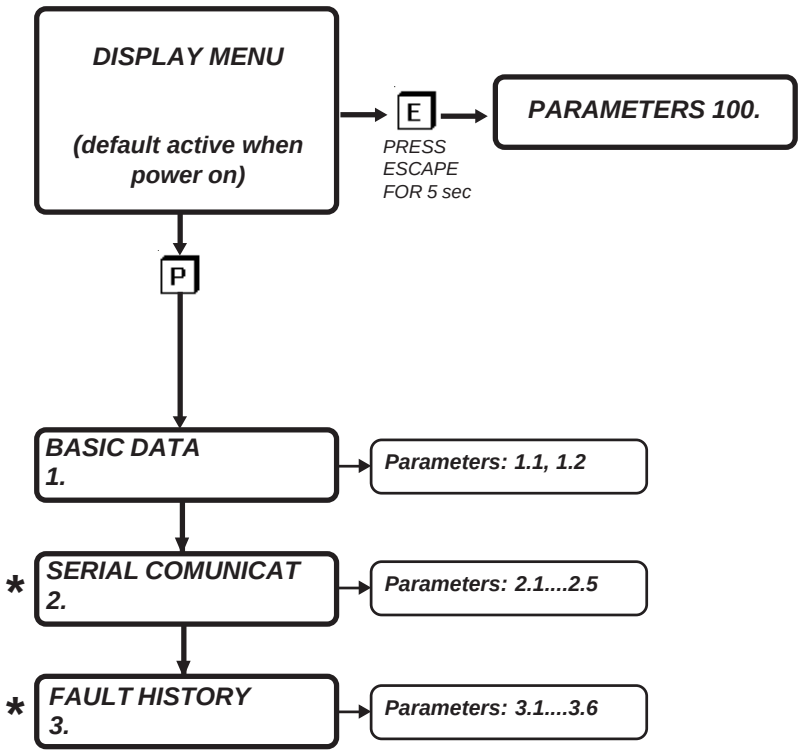
SERIAL CONNECTION

36 = **0VDC-SER**	Common negative serial RS485
37 = **A +**	Positive channel RS485
38 = **B -**	Negative channel RS485

SEPARATE SUPPLY LINE

39 = **VAC**	LOGIC AND FAN SUPPLY: MIN 170VAC \ MAX 250VAC..... MIN 45Hz /MAX65HZ.
40 = **NOP**	POWER: MIN 20W / MAX 150W dependent on fans mounted; see table chapt.10 under "POWER OF THE
41 = **VAC**	SEPARATE SUPPLY (TERMINALS 39-41)", size the supply transformer according to the actuator size.

Keypad menu map of STATIC SWITCH function



* MENUS COMMON TO ALL APPLICATIONS BUT WITH DIFFERENT ORDER NUMBER

Full parameter list

PARAMETER		SETTING RANGE (modbus values in brackets)	DEFAULT SETTING	ID MODBUS (decimal)
1. BASIC DATA				
1.1	LINE FREQ.	da 45.0Hz a 65.0Hz	50.0 Hz	1000
1.2	WIRE	3WIRES (**0**) 6 WIRES (**1**)	3WIRES	1005
2. SERIAL COMUNICAT				
2.1	ADDRESS	da 0 a 100	3	1027
2.2	BAUD RATE	9600 (**0**) 19200 (**1**) 38400 (**2**) 57600 (**3**) 76800 (**4**) 115200 (**5**)	115200	1028
2.3	PARITY	NONE (**0**) EVEN (**1**) ODD (**2**)	NONE	1029
2.4	BIT STOP	da 1 a 2	1	1030
2.5	ENABLE FAST MODB	NO (**0**),YES (**1**)	NO	1031
3. FAULT HISTORY				
3.1	FAULT1	display from 0 to 13		518
3.2	FAULT2	display from 0 to 13		519
3.3	FAULT3	display from 0 to 13		520
3.4	FAULT4	display from 0 to 13		521
3.5	FAULT5	display from 0 to 13		522
3.6	RESET HIST FAULT	N0 (**0**) YES (**1**)	N0	1033
PARAMETRI 100.				
100.1	APPLICATIONS	SOFTSTART (**0**) NONE (**1**) 3AC_0CROSS (**2**) 3AC_ON/OFF (**3**)	SOFTSTART	1032
100.2	RESET FAULT EN	NO (**0**),YES (**1**)	NO	1034
100.3	PARAM BLOCK	NO (**0**),YES (**1**)	NO	1035

Display menu list

DISPLAYS	RANGE min-max	ID MODBUS
Pout SET	0% - 100%	526
LOAD CURRENT	0A - 10000A	503
TA1 TA2	0A - 10000A 0A - 10000A	506 507
Ixl DRIVE	0% - 700%	500
LAST FAULT	0 - 13	501
LAST TWO ERR COM	0 - 9999	514
COUNT ERR COM	0 - 32000	515
FIRMWARE VERSION	0.00 a 9.99	517
HARDWARE VERSION	0.00 a 300.00	524
CONFIG. VERSION	0 a 99	525

Modbus input/output commands

WORD for INPUTS CONTROL (ID MODBUS = 1075)	
bit 0	**RUN** (OR logic - terminal 4)
bit 1...bit 15	NO FUNCTION

Read modbus inputs/output status

WORD for OUTPUTS/INPUTS READING (ID MODBUS = 516)	
bit 0	**OUT EMERGENCY**
bit 1....bit15	NO FUNCTION

Description of DISPLAY menu

It contains all the displays for monitoring the regulator status

Pout SET 0.% — ***Preset Power applied to the load***

Display range: 0.% -100.%.

LOAD CURRENT 0.0A — ***Maximun RMS current absorbed by load and power supply line***

Display range: 0 - 10000A.

This variable displays the current absorbed by the load, which also corresponds to the maximum line current at the regulator terminals R1 S1 T1.

The reading is made on 2 line phases, taking the highest of TA1 and TA2, the built-in current transformers.

TA1 50.0A
TA2 50.0A — ***Real RMS currents measured at each current transformer in the regulator.***

TA1 =current measured by the TA1 current transformer .
Display range: 0 - 10000A.
TA2 = current measured by the TA2 current transformer.
Display range: 0 - 10000A.

Ixl DRIVE 0.% — ***Regulator overload as a percentage %***

Display range: 0. - 100.%.
When it gets over 100%, FAULT 10 turns on.
This variable takes back to the **i²t** formula about the regulator **overload a**bsorbed/supplied current; it gives information about the overload energy absorbed by the regulator and, indirectly, to its heating.
If the current don't get over the load threshold, the variable keeps at 0%.
If, after an overload, the current decreases under the threshold value, the variable start to decrease; from 100% to 0% it takes 5min and 30s.

LAST FAULT 0	*Last regulator fault number*

Display range: 0. - 13.

This variable views the number identifying the type of fault stopping the regulator with the “FAULT” signal lighting up on the keypad. To know the fault types consult chapt.3This variable resets after a cut-out in the logic power supply, so to see the last 5 faults access the parameters in the 3. FAULT HISTORY menu.

LAST TWO ERR COM XXYY.	*Numbers related to the last 2 errors in the serial communication. YY=last error number, XX=penultimate error number.*

Display range: 0. - 9999.
The numbers are zeroed every time the actuator is powered .
To know the types of errors associated with these numbers, consult chapt.4 SERIAL COMMUNICATION.

COUNT ERRORS COM 0.	*Serial communication error counter.*

Display range: 0. - 32000.
The counter is zeroed every time the actuator is powered.

FIRMWARE VERSION 4.02	*Regulator firmware version number*

Display range: 0.00 - 9.99.
This manual is up-dated to the firmware 4.02 version.

HARDWARE VERSION 0.00	*Regulator hardware version number*

Display range: 0.00 - 300.00.

CONFIG. VERSION 0.	*Regulator configuration parameters version number*

Display range: 0 : 99.

Description of 1. BASIC DATA menu parameters

BASIC DATA 1.	*Basic parameters for the start up of the regulator*

LINE FREQ. 1.1 50.0Hz	*Par.1.1. Three-phase supply line frequency at terminals R1, S1, T1*

Setting range: 45.0 - 65.0 Hz
Set 50.0Hz or 60.0Hz basing on the supply line.

CONNECTION TYPE 1.2 3WIRES	*Par.1.2. Select 3-WIRE or 6-WIRE load connection*

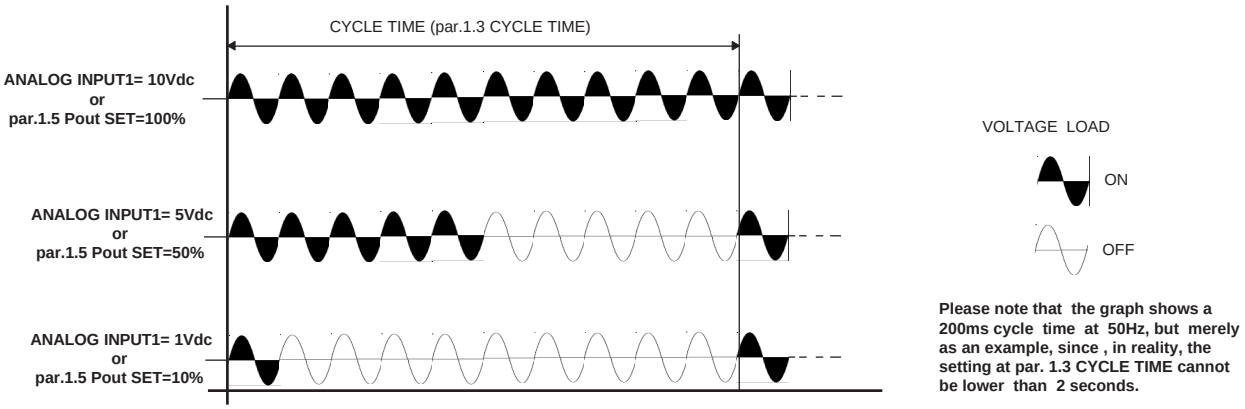
Setting range: 3WIRES, 6WIRES
3WIRES = 3 wire connection.
6WIRES = 6 wire connection

Description of power/energy regulator operation

In this function the 470 appliance is used as a wave train **energy** regulator. In fact in this case the **electric power** on the load is applied for whole period intervals, dependent on a programmable cycle **time** (par.1.3 CYCLE TIME) and on the power setting. The switching to ON always passes zero voltage of each phase (ZERO CROSSING) to avoid disturbance and distortion on the three phase supply line as shown in the graph below.

Since the electric heating element temperature is proportional to the absorbed energy, with this function the 470 actuator is specifically designated to the control of electric ovens.

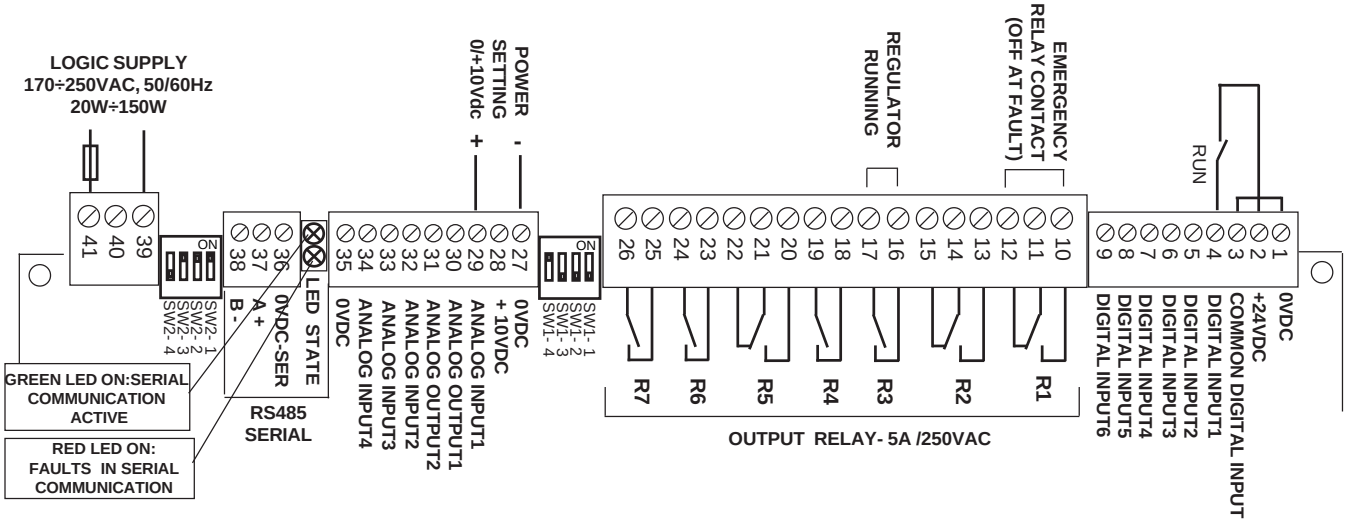
The power level applied in the cycle time can be controlled in 2 ways selected with par. 1.5:
- Par. 1.5 Pout SET SOURCE = OPERATOR, the power setting is established by par.1.4 Pout SET
- Par. 1.5 Pout SET SOURCE = AIN SET, the power setting is established by a 0/10Vdc analog signal connected to ANALOG INPUT1



Please note that the graph shows a 200ms cycle time at 50Hz, but merely as an example, since , in reality, the setting at par. 1.3 CYCLE TIME cannot be lower than 2 seconds.

Initial start-up instructions:
1) Follow the wiring diagram shown below. The mechanical installation is explained at chapter 7 of the SOFTSTART function .
2) Enable the function by setting the **par.100.1 APPLICATIONS = 3AC_0CROSS**. (to enter menu 100. press **E** for 5 seconds).
3) Set the **par.1.1 LINE FREQ**. according to the three-phase supply line frequency.
4) Set the **par.1.2 WIRE** according to the type of load connection.
5) Set the required cycle time based on the thermal inertia of the heating load at **par.1.3 CYCLE TIME**
6) If a 0/10Vdc analog signal is used to modulate the power, as shown in the diagram, set :
par. **1.5 Pout SET SOURCE = AIN SET**
7) Activate the RUN command to give power to the load according to the analog signal value.

Command terminal block wiring diagram (power connection such as STATIC SWITCH in chapt.11)



Power terminal box description

R1 S1 T1 Three-phase line voltage for 2 ranges with absolute limits:
170Vac ÷ 510Vac (**lines 230/400/440Vac**), 300Vac ÷ 760Vac (**line 690Vac**).
Standard line frequency 50Hz / 60Hz (min 45Hz - max 65Hz).

PE ⏚ Earth connection.

U1 V1 W1 Three-phase output as supply voltage commutated zero crossing.

Command terminal box description

DIGITAL INPUT DESCRIPTION:

1 = **0VDC**	COMMON NEGATIVE
2 = **+24 VDC**	POWER SUPPLY FOR INPUT ACTIVATION BY CONTACT max 500mA
3 = **COMMON DIGITAL INPUT**	INPUT POLARISATION
4 = **DIGITAL INPUT1**	REGULATOR RUNNING INPUT
5,6,7,8,9 **= DIGITAL INPUT 2,3,4,5,6**	NO FUNCTION

DIGITAL INPUT CHARACTERISTICS:
> PNP connection (term. COMMON at 0Vdc)
> NPN connection (term. COMMON at max 30Vdc)
> Input resistance = 3Kohm
> Minimum voltage for 5Vdc input activation

CONTACT OUTPUT DESCRIPTION
Contact max load 5A/250Vac

10 = NO
11 = C
12 = NC

R1 ***EMERGENCY RELAY CHANGE-OVER CONTACT:***
It gets energised when the regulator is powered and there are no active faults; it gets de-energised if there are faults.

16 = C
17 = NO

R3 ***RUN RELAY CONTACT:***
It gets energised when the regulator is powered (RUN led is ON), it gets de-energised when RUN is OFF and if there are faults.

R2, R4, R5, R6, R7 NO FUNCTION

ANALOGUE REFERENCE DESCRIPTION

27 = **0VDC**	COMMON NEGATIVE
28 = **+10VDC**	Set potentiometer supply voltage max load = 10mA.
29 = **ANALOG INPUT1**	Power regulation: 0Vdc = 0 power, +10Vdc = maximun power.
32,33,34 = **ANALOG INPUT 2,3,4**	NO FUNCTION
35 = **0VDC**	COMMON NEGATIVE

ANALOGUE OUTPUT DESCRIPTION
30, 31 = **ANALOG OUTPUT,** NO FUNCTION

SERIAL CONNECTION

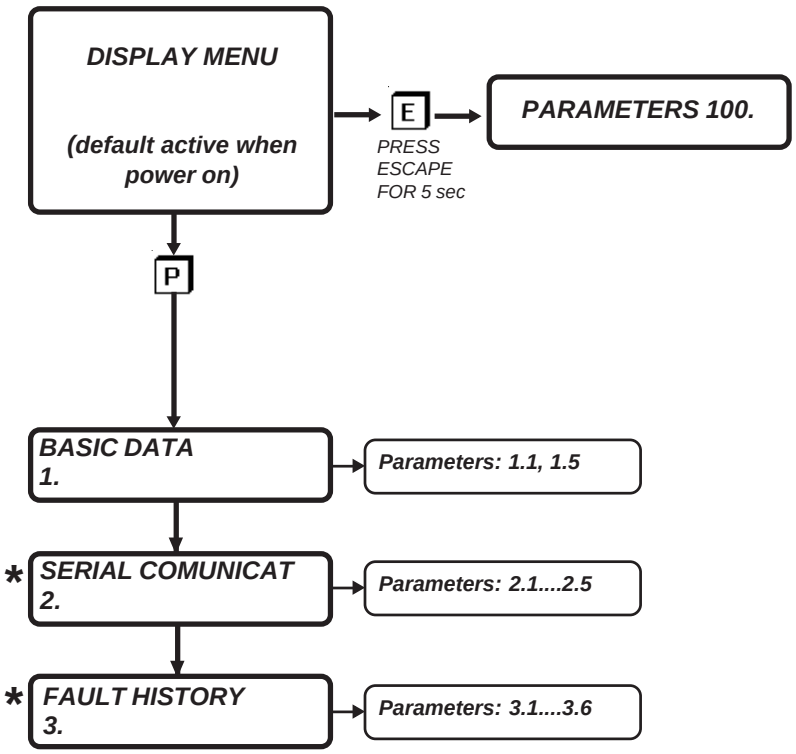
36 = **0VDC-SER**	Common negative serial RS485
37 = **A +**	Positive channel RS485
38 = **B -**	Negative channel RS485

SEPARATE SUPPLY LINE

39 = **VAC**
40 = **NOP**
41 = **VAC**

LOGIC AND FAN SUPPLY: MIN 170VAC \ MAX 250VAC..... MIN 45Hz /MAX65HZ.
POWER: MIN 20W / MAX 150W dependent on fans mounted; see table chapt.10 under "POWER OF THE SEPARATE SUPPLY (TERMINALS 39-41)", size the supply transformer according to the actuator size.

Position of keypad menus in the POWER/ENERGY function



* MENUS COMMON TO ALL APPLICATIONS BUT WITH DIFFERENT ORDER NUMBER

Full parameter list

PARAMETER		SETTING RANGE (modbus values in brackets)	DEFAULT SETTING	ID MODBUS (decimal)
1. BASIC DATA				
1.1	LINE FREQ.	da 45.0Hz a 65.0Hz	50.0 Hz	1000
1.2	WIRE	3WIRES (**0**) 6 WIRES (**1**)	3WIRES	1005
1.3	CYCLE TIME	da 2s a 60s	2 s	1101
1.4	Pout SET	da 0% a 100%	100 %	1102
1.5	Pout SET SOURCE	AIN SET (**0**) OPERATOR (**1**)	AIN SET	1103
2. SERIAL COMUNICAT				
2.1	ADDRESS	da 0 a 100	3	1027
2.2	BAUD RATE	9600 (**0**) 19200 (**1**) 38400 (**2**) 57600 (**3**) 76800 (**4**) 115200 (**5**)	115200	1028
2.3	PARITY	NONE (**0**) EVEN (**1**) ODD (**2**)	NONE	1029
2.4	BIT STOP	da 1 a 2	1	1030
2.5	ENABLE FAST MODB	NO (**0**),YES (**1**)	NO	1031
3. FAULT HISTORY				
3.1	FAULT1	display from 0 to 13		518
3.2	FAULT2	display from 0 to 13		519
3.3	FAULT3	display from 0 to 13		520
3.4	FAULT4	display from 0 to 13		521
3.5	FAULT5	display from 0 to 13		522
3.6	RESET HIST FAULT	N0 (**0**) YES (**1**)	N0	1033
PARAMETERS 100.				
100.1	APPLICATIONS	SOFTSTART (**0**) NONE (**1**) 3AC_0CROSS (**2**) 3AC_ON/OFF (**3**)	SOFTSTART	1032
100.2	RESET FAULT EN	NO (**0**),YES (**1**)	NO	1034
100.3	PARAM BLOCK	NO (**0**),YES (**1**)	NO	1035

Display menu list

DISPLAYS	RANGE min-max	ID MODBUS
Pout SET	0% - 100%	526
LOAD CURRENT	0A - 10000A	503
TA1 TA2	0A - 10000A 0A - 10000A	506 507
IxI DRIVE	0% - 700%	500
LAST FAULT	0 - 13	501
LAST TWO ERR COM	0 - 9999	514
COUNT ERR COM	0 - 32000	515
FIRMWARE VERSION	0.00 a 9.99	517
HARDWARE VERSION	0.00 a 300.00	524
CONFIG. VERSION	0 a 99	525

Modbus input/output commands

WORD for INPUTS CONTROL (ID MODBUS = 1075)	
bit 0	**RUN** (OR logic - terminal 4)
bit 1...bit 15	NO FUNCTION

Read modbus inputs/output status

WORD for OUTPUTS/INPUTS READING (ID MODBUS = 516)	
bit 0	**OUT EMERGENCY**
bit 1.	NO FUNCTION
bit 2	**OUT REGULATOR RUNNING**
bit3...bit15	NO FUNCTION

Description of DISPLAY menu

It contains all the displays for monitoring the regulator status

Pout SET *0.%*

Preset Power applied to the load

Display range: 0.% -100.%.

LOAD CURRENT *0.0A*

Ma ximun RMS current absorbed by load and power supply line

Display range: 0 - 10000A.

This variable displays the current absorbed by the load, which also corresponds to the maximum line current at the regulator terminals R1 S1 T1.

The reading is made on 2 line phases, taking the highest of TA1 and TA2, the built-in current transformers.

TA1 *50.0A*
TA2 *50.0A*

Real RMS currents measured at each current transformer in the regulator.

TA1 =current measured by the TA1 current transformer .
Display range: 0 - 10000A.
TA2 = current measured by the TA2 current transformer.
Display range: 0 - 10000A.

IxI DRIVE *0.%*

Regulator overload as a percentage %

Display range: 0. - 100.%.
When it gets over 100%, FAULT 10 turns on.
This variable takes back to the **i²t** formula about the regulator **overload a**bsorbed/supplied current; it gives information about the overload energy absorbed by the regulator and, indirectly, to its heating.
If the current don't get over the load threshold, the variable keeps at 0%.
If, after an overload, the current decreases under the threshold value, the variable start to decrease; from 100% to 0% it takes 5min and 30s.

LAST FAULT 0	*Last regulator fault number*

Display range: 0. - 13.

This variable views the number identifying the type of fault stopping the regulator with the “FAULT” signal lighting up on the keypad. To know the fault types consult chapt.3This variable resets after a cut-out in the logic power supply, so to see the last 5 faults access the parameters in the 3. FAULT HISTORY menu.

LAST TWO ERR COM XXYY.	*Numbers related to the last 2 errors in the serial communication. YY=last error number, XX=penultimate error number.*

Display range: 0. - 9999.
The numbers are zeroed every time the actuator is powered .
To know the types of errors associated with these numbers, consult chapt.4 SERIAL COMMUNICATION.

COUNT ERRORS COM 0.	*Serial communication error counter.*

Display range: 0. - 32000.
The counter is zeroed every time the actuator is powered.

FIRMWARE VERSION 4.01	*Regulator firmware version number*

Display range: 0.00 - 9.99.

HARDWARE VERSION 0.00	*Regulator hardware version number*

Display range: 0.00 - 300.00.

CONFIG. VERSION 0.	*Regulator configuration parameters version number*

Display range: 0 : 99.

Description of 1. BASIC DATA menu parameters

BASIC DATA 1.	*Basic parameters for a standard configuration of the regulator*

LINE FREQ. 1.1 50.0Hz	*Par.1.1. Three-phase supply line frequency at terminals R1, S1, T1*

Setting range: 45.0 - 65.0 Hz
Set 50.0Hz or 60.0Hz basing on the supply line.

CONNECTION TYPE 1.2 3WIRES	*Par.1.2. Select 3-WIRE or 6-WIRE load connection*

Setting range: 3WIRES, 6WIRES
3WIRES = 3 wire connection.
6WIRES = 6 wire connection

CYCLE TIME 1.3 2s	*Par.1.3. Cycle time for wave train regulation*

Setting range: 2s - 60s.
See description of POWER/ENERGY REGULATOR function at the beginning of this chapter.

Pout SET 1.4 100%	*Para.1.4. It manually sets the value of the power transferred on every wave train cycle*

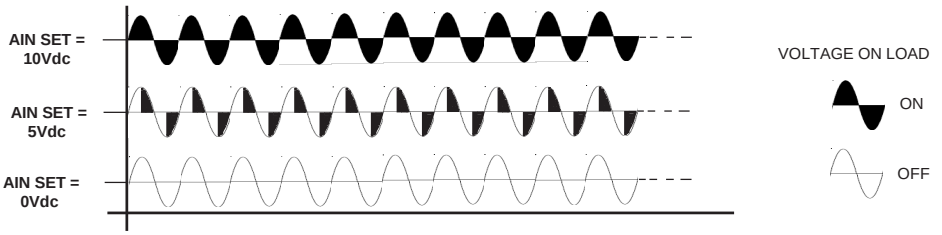
Setting range: 0% to 100%.
The setting is enabled by setting par.1.5 Pout SET SOURCE=OPERATOR.

Pout SET SOURCE 1.5 AIN SET	*Par.1.5. It selects the setting mode for the power transferred on every wave train cycle*

Setting range: OPERATOR, AIN SET
OPERATOR = power set through par.1.4 Pout SET
AIN SET= power set through the 0/10Vdc analogue signal connected to the ANALOG INPUT1 input.

Description of the operation as phase cut regulator

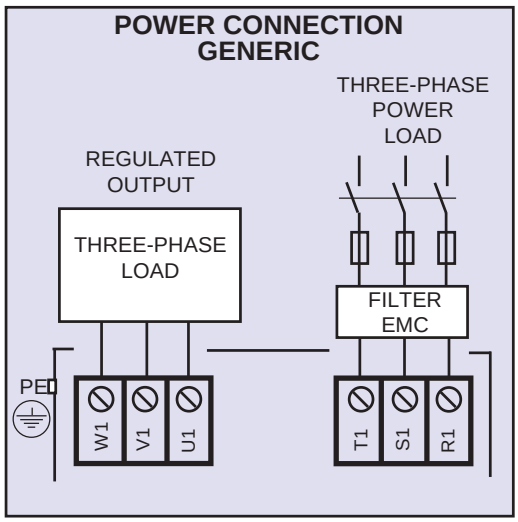
The function is enabled by setting par.**100.1 APPLICATIONS = 3AC_REG**; in this case the regulated output voltage to the 470 drive is obtained by controlling the fire angle of alternating voltage at the SCR ends. This control technique (see figure) allows to regulate the output voltage from 0V to the value of the supply voltage with a great resolution (for example compared with the ZERO CROSSING REGULATOR).

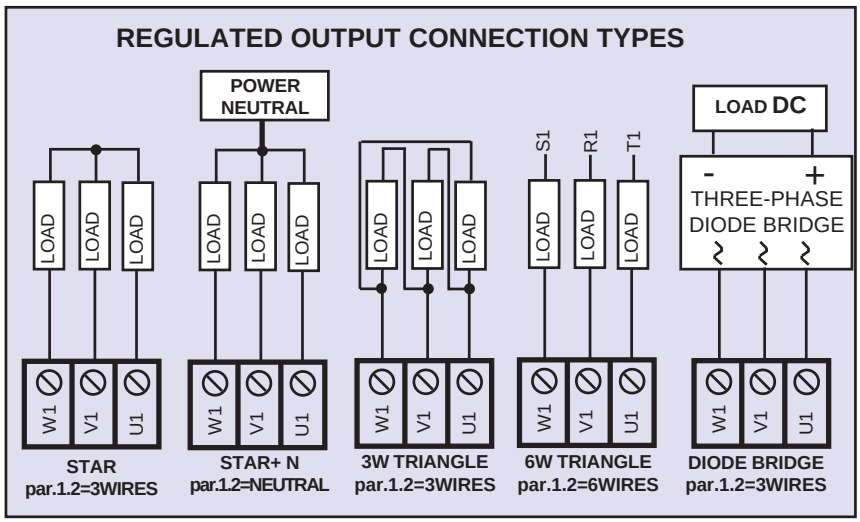


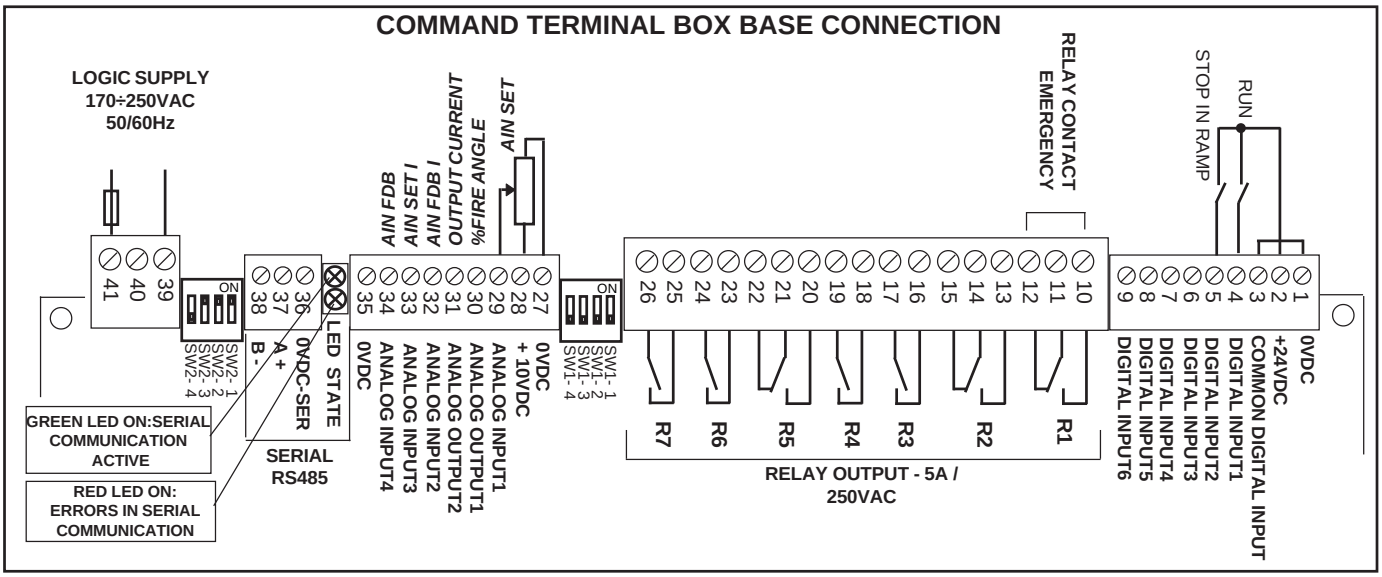
The function's applications, therefore, include for example:
- controls for asynchronous high-slip motors manufactured by Rowan Elettronica.
- controls for fan units equipped with three-phase asynchronous motors whose unit power doesn't exceed 1HP.
- speed/torque controls for unidirectional DC motors through the external connection of a three-phase diode bridge.
- variable voltage and current DC power supplies, through the external connection of a three-phase diode bridge with or without transformer, for miscellaneous applications (electroplating baths, electromagnetic brakes, earth disconnection, etc.).

The three-phase load can be connected as shown below and can only be **unbalanced** in the following cases: STAR +N (**WARNING!** the neutral must be of power type), 3W TRIANGLE, 6W TRIANGLE.
WARNING! The intended load type ranges between **resistive** and **inductive**; when the load is strongly inductive (like in case of no-load transformers), you need to set par.**1.9 INDUCTIVE LOAD =YES**, to prevent strong irregularities.
When the function is enabled through the par.**100.1=3AC_REG**, the regulator is set by default for open loop voltage regulation, through the potentiometer connected to the ANALOG INPUT1 (AIN SET) input according to the base diagram shown below.
WARNING! ***The RUN command can NOT be issued if the R1-S1-T1 line is off. It shall be issued after or simultaneously to the Line switch-on (e.g.: auxiliary contact "NO" of the Line counter, or 220Vac power supply simultaneous to the one to the Line).***

CONNECTION DIAGRAMS







Power terminal box description

R1 S 1 T1 Supply frequency ranging between 45Hz and 65Hz (standard frequencies 50Hz-60Hz)
Three-phase supply voltage designed for 2 ranges:
170Vac - 510Vac (**230/400Vac lines**), 300Vac - 760Vac (**690Vac line**)

PE ⏚ Connection to earth.

U1 V 1 W1 Cut variable voltage three-phase output (see REGULATED OUTPUT CONNECTION TYPES on the previous page), maximum value as supply voltage.

Command terminal box description

DIGITAL INPUT DESCRIPTION:

1 = **0VDC**	COMMON NEGATIVE
2 = **+24 VDC**	POWER SUPPLY FOR INPUT ACTIVATION BY CONTACT max 500mA
3 = **COMMON DIGITAL INPUT**	INPUT POLARISATION
4 = **DIGITAL INPUT1**	REGULATOR RUNNING INPUT
5 = **DIGITAL INPUT2**	ACTIVE SET POINT STOP IN RAMP INPUT
6,7,8,9 **= DIGITAL INPUT 3,4,5,6**	NO FUNCTION

DIGITAL INPUT CHARACTERISTICS:
> PNP connection (term. COMMON at 0Vdc)
> NPN connection (term. COMMON at max 30Vdc)
> Input resistance = 3Kohm
> Minimum voltage for 5Vdc input activation

CONTACT OUTPUT DESCRIPTION
Contact max load 5A/250Vac

10 = NO
11 = C
12 = NC

R1 ***EMERGENCY RELAY CHANGE-OVER CONTACT:***
It gets energised when the regulator is powered and there are no active faults; it gets de-energised if there are any faults

16 = C
17 = NO

R3 ***RUN RELAY CONTACT:***
It gets energised when the regulator is powered (RUN led is ON), it gets de-energised when RUN is OFF and if there are faults.

R2,R4, R5, R6, R7 NO FUNCTION

ANALOGUE REFERENCE DESCRIPTION

27 = **0VDC**	COMMON NEGATIVE
28 = **+10VDC**	Set potentiometer supply voltage max load = 10mA.
29 = **ANALOG INPUT1**	**(AIN SET)** 0/+10Vdc multifunction analogue input. By default it is the output voltage set in open loop configuration. In case of closed loop regulator it is coupled with the feedback input **(AINFDB)**
32 = **ANALOG INPUT2**	**(AIN FDB I)** Current feedback analogue input: -with the microswitches SW1 (1-2-3-4OFF) +/-10Vdc or 7Vac 50Hz-60Hz -with the microswitches SW1 (1-2-3 ON, 4OFF) it is pre-set for a TA 4Vac/0.2A (load 22ohm). WARNING! By default the SW1-4 microswitch is ON; if you use this input turn it back to OFF
33 = **ANALOG INPUT3**	**(AIN SET I)** Analogue input for the 0/+10Vdc output current set In the closed current loop regulator it is coupled with the feedback input **(AINFDB I)**
34 = **ANALOG INPUT4**	**(AIN FDB)** Multifunction feedback analogue input +/-10Vdc or 7Vac 50Hz-60Hz
35 = **0VDC**	COMMON NEGATIVE

ANALOGUE OUTPUT DESCRIPTION

30 = **ANALOG OUTPUT1**	SCR DRIVING %, +10Vdc = 100% 0Vdc = 0%
31 = **ANALOG OUTPUT2**	The signal is proportional to load absorption at the output U1 V1 W1 max 5mA: 0VDC = 0A, +9,5 Vdc = Maximum absolute starting current of the drive (see CURRENTS AND POWERS tables in chap.6 for the SOFTSTART function).

SERIAL CONNECTION

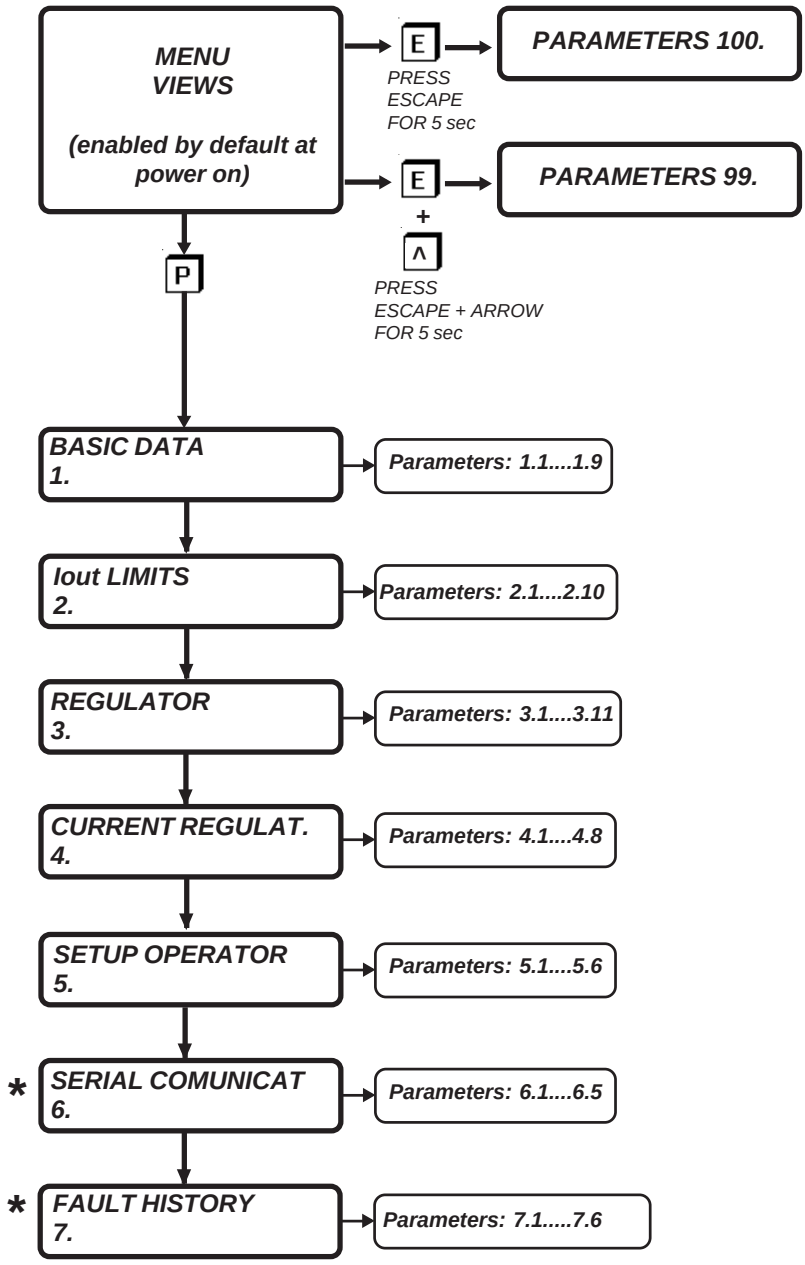
36 = **0VDC-SER**	Common negative serial RS485
37 = **A +**	Positive channel RS485
38 = **B -**	Negative channel RS485

SEPARATE SUPPLY LINE

39 = **VAC**
40 = **NOP**
41 = **VAC**

LOGIC AND FAN SUPPLY: MIN 170VAC \ MAX 250VAC..... MIN 45Hz /MAX65HZ.
POWER: MIN 20W / MAX 150W dependent on fans mounted; see table chapt.10 under "POWER OF THE SEPARATE SUPPLY (TERMINALS 39-41)", size the supply transformer according to the actuator size.

Position of keypad menus in the VOLTAGE REGULATOR function



* MENUS COMMON TO ALL APPLICATIONS BUT WITH DIFFERENT ORDER NUMBER

PARAMETER		SETTING FIELD (modbus limits under brackets)	DEFAULT SETTING	ID MODBUS
1. BASIC DATA				
1.1	LINE FREQUENCY	from 45.0Hz to 65.0Hz	50.0 Hz	1000
1.2	WIRE	3WIRES (0) 6 WIRES (1) NEUTRAL (2)	3WIRES	1005
1.3	Vout min	from 0.0% to 100.0%	0.0%	1037
1.4	Vout MAX	from 0.0% to 100.0%	100.0%	1038
1.5	Vout ACC RAMP	from 0.0 sec to 600.0sec	10.0sec	1039
1.6	Vout DEC RAMP	from 0.0 sec to 600.0sec	10.0sec	1040
1.7	SETTING +DISPLAYING			
Vout SET (setting)		from par.1.3 Vout MIN to par.1.4 Vout MAX	0.0%	1041
Iout (displaying)		from 0.0A to 10000.0A		509
1.8	Vout SET SOURCE	from 0 to 4	0.	1042
1.9	INDUCTIVE LOAD	NO (0),YES (1)	NO	1110
2. Iout LIMITS				
2.1	Iout MIN	from 0.0A to fabric par.	0.0	1043
2.2	Iout MAX	from 0.0A to fabric par.	depending on size	1044
2.3	Iout RAMP	from 0.1 sec to 600.0sec	0.1sec	1045
2.4	SETTING +DISPLAYING			
SET OPER. (setting)		from par.2.1 Iout MIN to par.2.2 Iout MAX	depending on size	1046
Iout (displaying)		from 0.0A a 10000.0A		509
2.5	Iout SET SOURCE	AIN_SET_I (0), OPERATOR(1)	OPERATOR	1047
2.6	Iout REG KP	from 0 to 100.	20	1048
2.7	Iout REG KI	from 0 to 100.	20	1049
2.8	OVERLOAD ENABLE	NO (0),YES (1)	NO	1050
2.9	OVERLOAD	from 0.1A to fabric par	depending on size	1051
2.10	OVERLOAD TIME	from 0.0sec to 180.0sec.	10.0sec	1052
3. REGULATOR				
3.1	FEEDBACK MAX	from 0.0 to 3000.0	3000.0	1053
3.2	SET MAX	from 0.0 to 3000.0	3000.0	1054
3.3	SET MIN	from 0.0 to par.3.2	0.0	1055
3.4	SET RAMP	from 0.1 sec to 600.0sec	10.0 sec	1056
3.5	SETTING +DISPLAYING			
SET (setting		from par.3.3 SET MIN to par.3.2 SET MAX	0.0	1057
FDB (displaying)		from 0.0 to 10000.0		510
3.6	SET SOURCE	AIN_SET (0), OPERATOR(1)	AIN_SET	1058
3.7	KP	from 0 to 100.	30	1059
3.8	KI	from 0 to 100.	10	1060
3.9	% FEEDFORWARD	from 0% to 100%	0	1061
3.10	MAX OUT REG	from 0% to 100%	100	1062
3.11	PI OUT INVERSION	NO (0),YES (1)	NO	1117
4. CURRENT REGULAT.				
4.1	FEEDBACK I MAX	from 0.0A to 10000.0A	3000.0	1063
4.2	SET I MAX	from 0.0A to 10000.0A	3000.0	1064
4.3	SET I MIN	from 0.0A to par.4.2	0.0	1065
4.4	SET I RAMP	from 0.1 sec to 600.0sec	10.0 sec	1066
4.5	SETTING +DISPLAYING			
SET I (setting)		from par.4.3 SET I MIN to par.4.2 SET I MAX	0.0	1067
FDB I (displaying)		from 0.0A to 10000.0A		511
4.6	SET I SOURCE	AIN_SET I (0), OPERATOR(1)	AIN_SET I	1068
4.7	KP CURRENT	from 0 to 100.	20	1069
4.8	KI CURRENT	from 0 to 100.	10	1070
5. SETUP OPERATOR				
5.1	MAX ACTIVE SET	from 1 to 5	4	1071
5.2	OPERATOR SET 1	1.7(0), 2.4(1), 3.5(2), 4.5(4)	1.7	1105
5.3	OPERATOR SET 2	1.7(0), 2.4(1), 3.5(2), 4.5(4)	2.4	1106
5.4	OPERATOR SET 3	1.7(0), 2.4(1), 3.5(2), 4.5(4)	3.5	1107
5.5	OPERATOR SET 4	1.7(0), 2.4(1), 3.5(2), 4.5(4)	4.5	1108
5.6	OPERATOR SET 5	1.7(0), 2.4(1), 3.5(2), 4.5(4)	4.5	1109

PARAMETER		SETTING FIELD (modbus limits under brackets)	DEFAULT SETTING	ID MODBUS
6. SERIAL COM UNICAT				
6.1	ADDRESS	da 1 a 20	3	1027
6.2	BAUD RATE	1200(0), 2400 (1), 4800(2), 9600(3), 19200(4), 38400(5), 57600(6), 76800(7), 115200(8)	9600	1028
6.3	PARITY	NONE(0), EVEN(1), ODD(2)	NONE	1029
6.4	BIT STOP	da 1 a 2	1	1030
6.5	ENABLE FAST MODB	NO (0),YES (1)	NO	1031
7. FAULT HISTORY				
7.1	FAULT1	displaying from 0 to 13		518
7.2	FAULT2	displaying from 0 to 13		519
7.3	FAULT3	displaying from 0 to 13		520
7.4	FAULT4	displaying from 0 to 13		521
7.5	FAULT5	displaying from 0 to 13		522
7.6	RESET HIST. FAULT	N0 (**0**) YES (**1**)	N0	1033
PARAMETERS 100.				
100.1	APPLICATIONS	SOFTSTART (**0**) 3AC_REG (**1**) 3AC_0CROSS (**2**) 3AC_ON/OFF (**3**)	SOFTSTART	1032
100.2	RESET FAULT EN	NO (**0**),YES (**1**)	NO	1034
100.3	PARAM. BLOCK	NO (**0**),YES (**1**)	NO	1035
100.4	SCR CONTROL TYPE	from 1 to 3	1	1036
100.5	MENU' OPERATOR	DEFAULT(0), BLOCK(1)	DEFAULT	1099
100.6	LINEARIZATION	NO (0),YES (1)	NO	1100

List of views with Modbus address

DISPLAYING	RANGE min-max (modbus limits under brackets)	ID MODBUS
1. DOUBLE DISPLAYING		
Vout SET	0.0% - 100.0%	528
Cond. SCR	0.0% - 100.0%	532
2. DOUBLE DISPLAYING		
SET CUR	from 0.0A to 3000.0A	529
Iout	from 0.0A to 3000.0A	509
3. DOUBLE DISPLAYING		
SET GEN.	from 0.0 to 3000.0	530
FDB	from 0.0 to 3000.0	510
4. DOUBLE DISPLAYING		
SET I	from 0.0A to 3000.0A	531
FDB I	from 0.0A to 3000.0A	511
5. DOUBLE DISPLAYING		
TA1	0.0A - 3000.0A	506
TA2	0.0A - 3000.0A	507
6. I x I DRIVE	0% - 100%	523
7. LAST FAULT	from 0 to 100	501
8. LAST TWO ERR COM	from 0 to 9999	514
9. COUNT ERRORS COM	from 0 to 32000	515
10. FIRMWARE VERSION	from 0.0 to 99.9	517
11. HARDWARE VERSION	from 0.00 to 300.00	524
12. CONFIG. VERSION	from 0 to 99	525

Input control from Modbus

WORD for INPUTS CONTROL (ID MODBUS = 1075)	
bit 0	**RUN** (ANDlogic, command term.4)
bit 1	**STOP IN RAMP** (OR logic, command term.5)
bit 2 - bit 15	NO FUNCTION

Output status reading from Modbus

WORD for OUTPUTS STATE (ID MODBUS = 516)	
bit 0	**EMERGENCY**
bit 1 - bit 15	NO FUNCTION

VIEW menu description

It includes all the views allowing to monitor the status of the three/phase regulator

Vout SET	100.0%
Cond. SCR	0.0%

Var.1. It includes the views referring to the regulator output voltage and to the fire angle

Vout SET = regulator output voltage pre-set in % with reference to the supply line value.
Display range: 0.0% to 100.0%.
0.0% = load voltage 0Vac; 100.0% = load voltage equal to the line voltage at the R1 S1 T1 terminals.
WARNING! The value corresponds to the actual output voltage only in case of resistive load.
Cond. SCR = active set of the SCR driving % angle when running is ON.
Display range: 0.0% to 100.0%.

SET CUR.	3000.0A
Iout	0.0A

Var.2. It includes the views referring to the control of the regulator output current

SET CUR. = active set of the regulator output current limitation at the U1 V1 W1 terminals.
Iout = line current of the load connected to the U1 V1 W1 3 WIRE terminals; 1.73 times the phase current in case of 6 wire connection. Display field ranging between 0.0A and 3000.0A. It also indicates the current absorbed by the regulator supply line. **The displayed value corresponds to the highest one measured by the amperometric transformers TA1 and TA2, and multiplied by 1.73 in case of 6 WIRE connection.**

SET GEN.	3000.0
FDB	0.0

Var.3. It includes the views referring to the control set and feedback parameters GENERIC P/I

SET GEN = set of the GENERIC P/I REGULATOR.
Display field ranging between 0.0 and 3000.0
FDB = actual value of the feedback signal applied to the GENERIC P/I REGULATOR.
Display field ranging between 0.0 and 3000.0

SET I	3000.0A
FDB I	0.0A

Var.4. It includes the views referring to the control set and feedback parameters CURRENT P/I

SET I = set of the CURRENT P/I regulator.
Display field ranging between 0.0A and 3000.0A
FDB I = actual value of the feedback signal applied to the CURRENT P/I regulator.
Display field ranging between 0.0A and 3000.0A

TA1	50.0A
TA2	50.0A

Var.5. It includes the monitoring of the actual currents measured by each individual amperometric transformer, inside the regulator.

TA1 =current measured by the TA1 amperometric transformer. Display field ranging between 0.0A and 3000.0A.
TA2 =current measured by the TA1 amperometric transformer. Display field ranging between 0.0A and 3000.0A.

IxI DRIVE	0.%

Var.6. Regulator % overload percentage

Display field ranging between 0% and 100%.
When it exceeds 100% FAULT 10 is triggered.
This variable displays the calculation of the i^2t of the current absorbed/delivered on **overload** by the regulator; it provides an information about the energy the regulator is absorbing on overload and thus, indirectly, about its heating. If the current doesn't exceed the overload threshold the variable stays at 0%.
If after an overload the current drops below the threshold value the variable begins to decrease; it takes 5min and 30s to go from 100% to 0%.

LAST FAULT	0

Var.7. Number of the last regulator stop

Display field ranging between 0. and 13.
This variable displays the number identifying the fault type if the soft-start is stopped and the "FAULT" warning lamp lights up on the keypad.
This variable is reset after power supply to the logic is cut off; as a consequence, to get the history data about the last 5 faults you need to access the parameters of menu 7. FAULT HISTORY

LAST TWO ERR COM XXYY.	***Var.8. It holds the number associated with the last 2 serial communication errors. YY=last error number, XX=previous error number.***

Display field ranging between 0. and 9999.
Numbers are reset every time the drive is switched on.

COUNT ERRORS COM 0.	***Var.9. Counter of the amount of serial communication errors.***

Display field ranging between 0. and 32000.
The counter is reset every time the drive is switched on.

FIRMWARE VERSION 3.02	***Var.10. Number of the drive firmware version***

Display field ranging between 0.00 and 9.99.

HARDWARE VERSION 0.00	***Var.11. Number of the drive hardware version***

Display field ranging between 0.00 and 300.00.

CONFIG. VERSION 0.	***Var.12. Drive configuration parameter version number***

Display field ranging between 0 and 99.

Description of menu 1. parameters BASIC DATA

BASIC DATA
1.

It contains the basic parameters for the start/up of the drive in its base application as an OPEN LOOP VOLTAGE REGULATOR.

LINE FREQ. 1.1 50.0Hz

Par.1.1. Frequency of the three/phase power supply line at R1, S1, T1 terminals

Setting range: 45.0Hz to 65.0Hz.
Impostare 50.0Hz o 60.0Hz a seconda della linea di alimentazione.

WIRE 1.2 3WIRE

Par.1.2. Load connection selection: 3 WIRES, 6 WIRES or star with NEUTRAL

Setting range: 3 WIRES, 6WIRES, NEUTRAL
3WIRES = 3-wire connection.
6WIRES = 6-wire connection.
NEUTRAL=star connection with neutral.

Vout min 1.3 0.0%

Par.1.3. MINIMUM limit of the regulation range for the regulator's output cut voltage at U1 V1 W1 terminals

Setting range: 0.0% to 100.0%.
The limit is expressed as a % and refers to the direct control of SCR driving determining the regulator's output voltage.
0.0% = load voltage 0Vac; 100.0% = load voltage equal to the line voltage at the R1 S1 T1 terminals.
WARNING! this limit is always enabled, even in case of closed loop controls.

Vout MAX 1.4 100.0.%

Par.1.4. MAXIMUM limit of the regulation range for the regulator's output cut voltage at U1 V1 W1 terminals

Setting range: 0.0% to 100.0%.
The limit is expressed as a % and refers to the direct control of SCR driving determining the regulator's output voltage.
0.0% = load voltage 0Vac; 100.0% = load voltage equal to the line voltage at the R1 S1 T1 terminals.
WARNING! this limit is always enabled, even in case of closed loop controls.

Vout ACC RAMP 1.5 1.0sec

Par.1.5. Acceleration ramp on the cut voltage set

Setting range: 0.0 sec to 600.0sec

Vout DEC RAMP 1.6 1.0sec

Par.1.6. Deceleration ramp on the cut voltage set

Setting range: 0.0 sec to 600.0sec.

Vout SET 0.0%
Iout 0.0A

Par.1.7. Manual cut voltage setting through the keypad, with displaying of the regulator output current

Vout SET = set of the SCR driving % determining the regulator output current.
Setting range from par.1.3 Vout MIN to par.1.4 Vout MAX. It is an **OPERATOR type** parameter.
0.0% = load voltage 0Vac; 100.0% = load voltage equal to the line voltage at the R1 S1 T1 terminals.
Iout = line current of the load connected to the U1 V1 W1 3 WIRE terminals; 1.73 times the phase current in case of 6 wire connection. **Display** field ranging between 0.0A and 3000.0A.

Vout SET SOURCE 1.8 0.

Par.1.8. Selection of the cut voltage regulation source.

Setting range: 0. to 4.
0 = regulation from the analogue signal connected to term.29 AIN SET (open-loop voltage regulator).
1 = regulation through the OPERATOR parameter 1.7 Vout OPERAT. SET (open-loop voltage regulator).
2 = regulation through the output of the BASE P/I regulator (see the example for the closed-loop voltage regulator).
3 = regulation through the output of the CURRENT P/I regulator (see the example for the closed-loop current regulator).
4 = regulation through the output of the BASE P/I regulator, limited by the CURRENT P/I regulator (see the example for the closed-loop voltage/current regulator).

INDUCTIVE LOAD 1.9 NO

Par.1.9. Load type selection

Setting range: NO, YES.
NO = Mainly resistive load
YES= Mainly inductive load

Description of menu 2. parameters Iout LIMITS

Iout LIMITS 2.	*It contains the parameters managing the limits on the regulator's U1 V1 W1 output CURRENT , also displayed in var.2 (Iout) and read by the internal TA as true RMS.*

Iout MIN 2.1 0.0A	***Par.2.1. MINIMUM limit of the output current regulation range.***

Setting range: 0.0A to the value of par.2.2 Iout MAX.

Iout MAX 2.2 0.0A	***Par.2.2. MAXIMUM limit of the output current regulation range.***

Setting range: 0.0A to the maximum limit designed for the drive.

Iout RAMP 2.3 0.0sec	***Par.2.3. Acceleration/deceleration ramp on the output current set.***

Setting range: 0.1 sec to 600.0sec

SET OPER. 12.0A Iout 0.0A	***Par.2.4. Manual output current setting through the keypad, with displaying of the present current value.***

SET OPER = set of the regulator's output current limitation at the U1 V1 W1 terminals.
Setting range: from par.2.1 Iout MIN to par.2.2 Iout MAX
It is an **OPERATOR type** parameter.
Iout = line current of the load connected to the U1 V1 W1 3 WIRE terminals; 1.73 times the phase current in case of 6 wire connection. Display field ranging between 0.0A and 10000.0A
It also indicates the current absorbed by the regulator supply line

Iout SET SOURCE 2.5 OPERATOR.	***Par.2.5. Selection of the output current regulation source.***

Setting range: AIN_SET_I, OPERATOR.
AIN_SET_I = regulation from the analogue signal connected to term.33 AIN SET I
OPERATOR = regulation through the OPERATOR parameter 2.4 SET OPER.
WARNING! If par. 1.8 Vout SET SOURCE = 3 or 4, the setting is automatically forced to OPERATOR.

Iout REG KP 2.6 10.	***Par.2.6. Proportional gain of the P/I regulator for output current control. The current feedback is drawn from the drive internal TA***

Setting range: 0 to 100.
The proportional part regulation is saturated at a minimum of 0% Vout and at a maximum of 100%Vout.

Iout REG KI 2.7 10.	***Par.2.7. Integral gain of the P/I regulator for output current control. The current feedback is drawn from the drive internal TA.***

Setting range: 0 to 100.
The integral part regulation is saturated at a minimum of 0% Vout up to 100%Vout.

OVERLOAD ENABLE 2.8 NO.	***Par.2.8. It enables the triggering of FAULT 12 for load protection.***

Setting range: NO, YES

OVERLOAD 2.9 12.0A.	***Par.2.9. FAULT 12 triggering level***

Setting range: 0.1A to the maximum limit designed for the drive.

OVERLOAD TIME 2.10 15.0sec.	***Par.2.10. FAULT 12 triggering delay***

Setting range: 0.0sec to 180.0sec.

Description of menu 3. parameters REGULATOR

REGULATOR	
3.	

It contains parameters managing the "GENERIC P/I" regulator, normally used to feedback the actual voltage on the load in case of DC power supplies.
It might be used to ensure that other factors associated with the output voltage, like SPEED, TEMPERATURE, etc., remain constant.

FEEDBACK MAX	
3.1	100.0

Par.3.1. Value displayed in var.3 in FDB, with the analogue signal connected to term.32 AIN FDB at full scale

Setting range: 0 to 3000.0.
The feedback signal is expressed as true RMS.

SET MAX	
3.2	100.0

Par.3.2. MAXIMUM limit of the SET GEN. regulation range

Setting range: 0 to 3000.0
It is also the value displayed in var.3 in SET GEN, with the analogue signal connected to term.29 AIN SET at full scale

SET MIN	
3.3	0.0

Par.3.3. MINIMUM limit of the SET GEN. regulation range

Setting range: 0.0 to the value set in par.3.2 SET MAX.

SET RAMP	
3.4	10.0sec

Par.3.4. Acceleration/deceleration ramp on the SET GEN.

Setting range: 0.1 sec to 600.0sec

SET GEN.	0.0
FDB	0.0

Par.3.5. Manual setting of the SET GEN. through the keyboard and displaying of the current feedback value (FDB)

SET GEN. = active set of the GENERIC P/I regulator.
Setting range: from par.3.3 SET MIN to par.3.2 SET MAX. It is an **OPERATOR type** parameter.
FDB = actual value of the feedback signal applied to the GENERIC P/I REGULATOR.
Display **field** ranging between 0.0 and 3000.0

SET SOURCE	
3.6	OPERATOR.

Par.3.6. Selection of the SET GEN. regulation source.

Setting range: AIN_SET, OPERATOR.
AIN_SET = regulation from the analogue signal connected to term.29 AIN SET
OPERATOR = regulation through the OPERATOR parameter 3.5 SET

KP	
3.7	10.

Par.3.7. Proportional gain of the GENERIC P/I regulator

Setting range: 0 to 100.

The proportional part regulation is saturated at a min. of 0% Vout and at the max. set in par.3.10 MAX OUT REG

KI	
3.8	10.

Par.3.8. Integral gain of the GENERIC P/I regulator

Setting range: 0 to 100.
The integral part regulation is saturated at a min. of 0% Vout and at the max. set in par.3.10 MAX OUT REG

% FEEDFORWARD	
3.9	0.%

Par.3.9. % of the SET summed to the regulator's output

Setting range: 0% to 100%.
With par. 3.11 PI OUT INVERSION = NO, the summed value is directly proportional to the SET GEN.
With par. 3.11 PI OUT INVERSION = NO, the summed value is inversely proportional to the SET GEN.

MAX OUT REG	
3.10	100.%

Par.3.10. Maximum saturation in % Vout of the GENERIC P/I regulator output

Setting range: 0% to 100% of the value set in par.1.4 Vout MAX.

PI OUT INVERSION	
3.11	NO.

Par.3.11. It selects the GENERIC P/I regulation direction

Setting range: NO,YES
NO = with SET GEN. >FDB the voltage on the load increases; for example control of heating resistances with feedback from temperature probe.
YES = with SET GEN. >FDB the voltage on the load decreases; for example control of cooling fan motors with feedback from temperature probe.

Description of menu 4. parameters CURRENT REGULAT.

CURRENT REGULAT.
4.

It contains the parameters managing the "CURRENT P/I" regulator, specifically used to feedback the actual current on the load as in case of DC power supplies.

FEEDBACK I MAX
4.1 10.0A

Par.4.1. Value displayed in var.4 in FDB I, with the analogue signal connected to term.34 AIN FDB I at full scale

Setting range: 0.0A to 3000.0A
The feedback signal is expressed as true RMS.

SET I MAX
4.2 10.0A

Par.4.2. MAXIMUM limit of the CURRENT SET regulation range

Setting range: 0.0A to 3000.0A
It is also the value displayed in var.4 in SET I, with the analogue signal connected to term.33 AIN SET I at full scale.

SET I MIN
4.3 0.0A

Par.4.3. MINIMUM limit of the CURRENT SET regulation range

Setting range: 0.0A to the value set in par.4.2 SET MAX.

SET I RAMP
4.4 1.0sec

Par.4.4. Acceleration/deceleration ramp on the CURRENT SET

Setting range: 0.0 sec to 600.0sec

SET I 0.0A
FDB I 0.0A

Par.4.5. Manual setting of the current SET through the keyboard and displaying of the current feedback value

SET I = active set of the CURRENT P/I regulator.
Setting range: from par.4.3 SET I MIN to par.4.2 SET I MAX. It is an **OPERATOR type** parameter.
FDB I = actual value of the feedback signal applied to the CURRENT P/I regulator.
Display field ranging between 0.0A and 3000.0A

SET I SOURCE
4.6 OPERATOR.

Par.4.6. Selection of the CURRENT SET regulation source.

Setting range: AIN_SET_I, OPERATOR.
AIN_SET_I = regulation from the analogue signal connected to term.33 AIN SET I
OPERATOR = regulation through the OPERATOR parameter 4.5 SET I

KP CURRENT
4.7 10.

Par.4.7. Proportional gain of the CURRENT P/I regulator

Setting range: 0 to 100.
The proportional part regulation is saturated at a minimum of 0% Vout and at a maximum of 100%Vout.

KI CURRENT
4.8 10.

Par.4.8. Integral gain of the CURRENT P/I regulator

Setting range: 0 to 100.
The integral part regulation is saturated at a minimum of 0% Vout up to 100%Vout.

Description of menu 5. parameters SETUP OPERATOR

SETUP OPERATOR
5.

It allows the parameters allowing to select the settings which can be activated in menu 1. BASIC DATA OPER. (see description of par.100.5 MENU OPERATOR

MAX ACTIVE SET
5.1 **1.**

Par.5.1. It sets the maximum number of parameters which can be activated in menu 1. BASIC DATA OPER.

Setting range: 0 to 5

OPERATOR SET1
5.2 **9.2.1.**

Par.5.2. It selects the order number of the parameter to be included as 1st setting

Setting range: 1.7, 2.4, 3.5, 4.5
1.7 = selects par. 1.7 with the setting " **SET OPER.** " (and the " **Iout** " display).
2.4 = selects par. 2.4 with the setting " **Vout SET** " (and the " **Iout** " display).
3.5 = selects par. 3.5 with the setting " **SET** " (and the " **FDB** " display).
4.5 = selects par. 4.5 with the setting " **SET I** " (and the " **FDB I** " display).

OPERATOR SET2
5.3 **9.2.1.**

Par.5.3. It selects the order number of the parameter to be included as 2nd setting

Setting range: 1.7, 2.4, 3.5, 4.5 (as for par.5.2).

OPERATOR SET3
5.4 **9.2.1.**

Par.5.4. It selects the order number of the parameter to be included as 3rd setting

Setting range: 1.7, 2.4, 3.5, 4.5 (as for par.5.2).

OPERATOR SET4
5.5 **9.2.1.**

Par.5.5. It selects the order number of the parameter to be included as 4th setting

Setting range: 1.7, 2.4, 3.5, 4.5 (as for par.5.2).

OPERATOR SET5
5.6 **9.2.1.**

Par.5.6. It selects the order number of the parameter to be included as 5th setting

Setting range: 1.7, 2.4, 3.5, 4.5 (as for par.5.2).

Customising keypad settings with OPERATOR parameters

When remoting the keypad to allow it to be used as a continuous setting terminal, it may be useful to allow the operator to immediately access a menu (**1. BASIC DATA OPER.**) only including the parameters he needs, preventing access to all the other ones. To enable this option you need to perform the following operations:
- set par. **100.3 PARAM BLOCK = YES**
- set par. **100.5 MENU OPERATOR = YES**
- set the parameters of menu **5. SETUP OPERATOR** to select the available OPERATOR parameters to be included in menu **1. BASIC DATA OPER.** in the desired sequence.

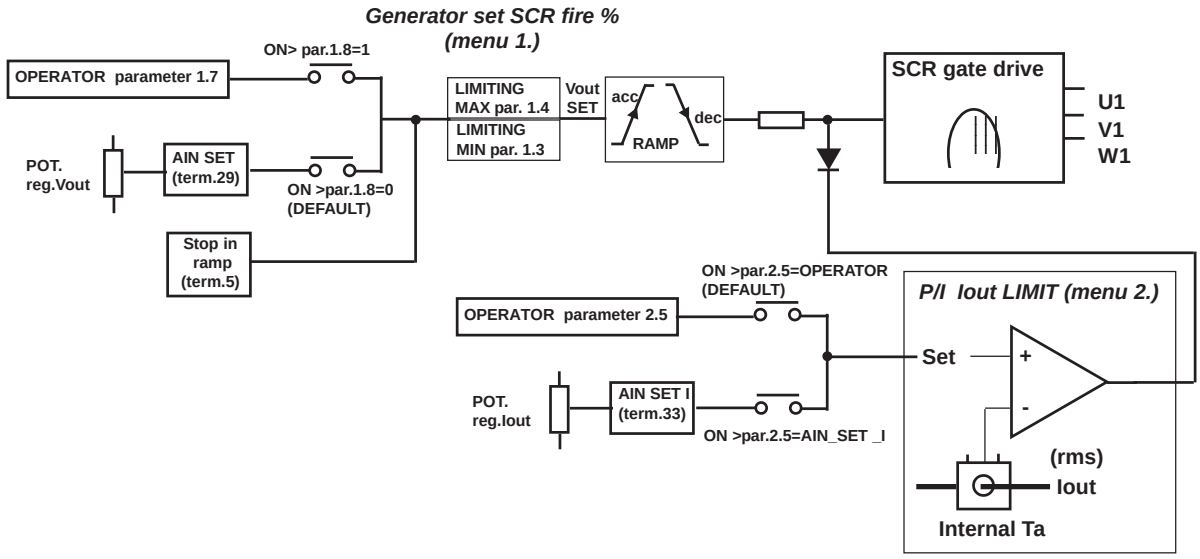
After performing the settings, the operator will just have to press the P button to access the menu with the desired parameters, thus skipping the menu complexity.

Standard setting and block diagrams of the voltage regulator functions

Par.**1.8 Vout SET SOURCE** allows to select the different regulator operating modes, described in the block diagrams below. When enabling the drive as phase cut regulator (access menu 100. by pressing the E button for 5 seconds and set par.**100.1=3AC_REG)**, the regulator is set by default (par.**1.8=0**) for open-loop voltage regulation, through the potentiometer to be connected to the ANALOG INPUT1 (AIN SET) input. All the parameters to be set are included in menu **1. BASIC DATA**; among them, par.**1.1 LINE FREQUENCY** and par.**1.2 WIRE** are critical for operation.
Per l'installazione meccanica fare riferimento al Cap.7 della funzione SOFT-START.

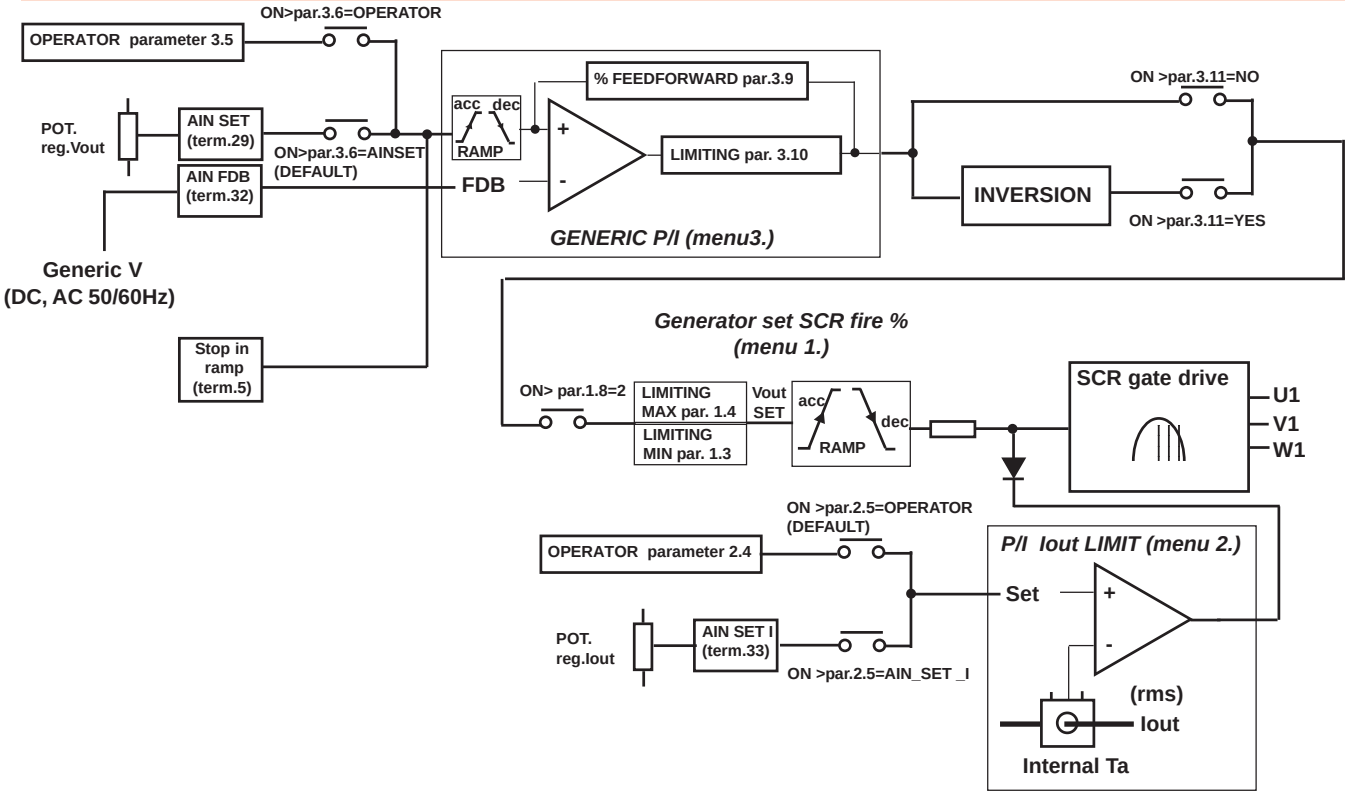
Block diagram of the open-loop voltage regulator (default function)
Case par.1.8 Vout SET SOURCE = 0(default), 1

Sample usage: voltage regulator for Rowan high slip motors in alquist function.



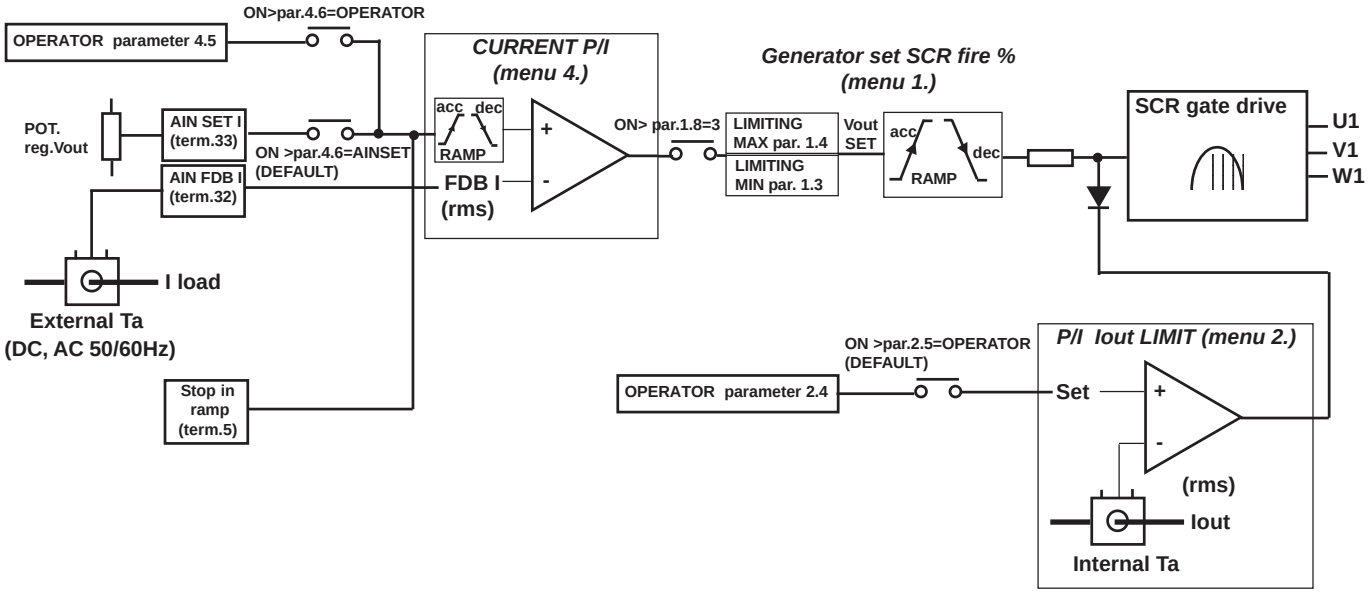
Block diagram of the closed-loop VOLTAGE regulator (GENERIC)
Case par.1.8 Vout SET SOURCE = 2

Sample usage: speed regulator for Rowan high slip motors with feedback from tachometer generator



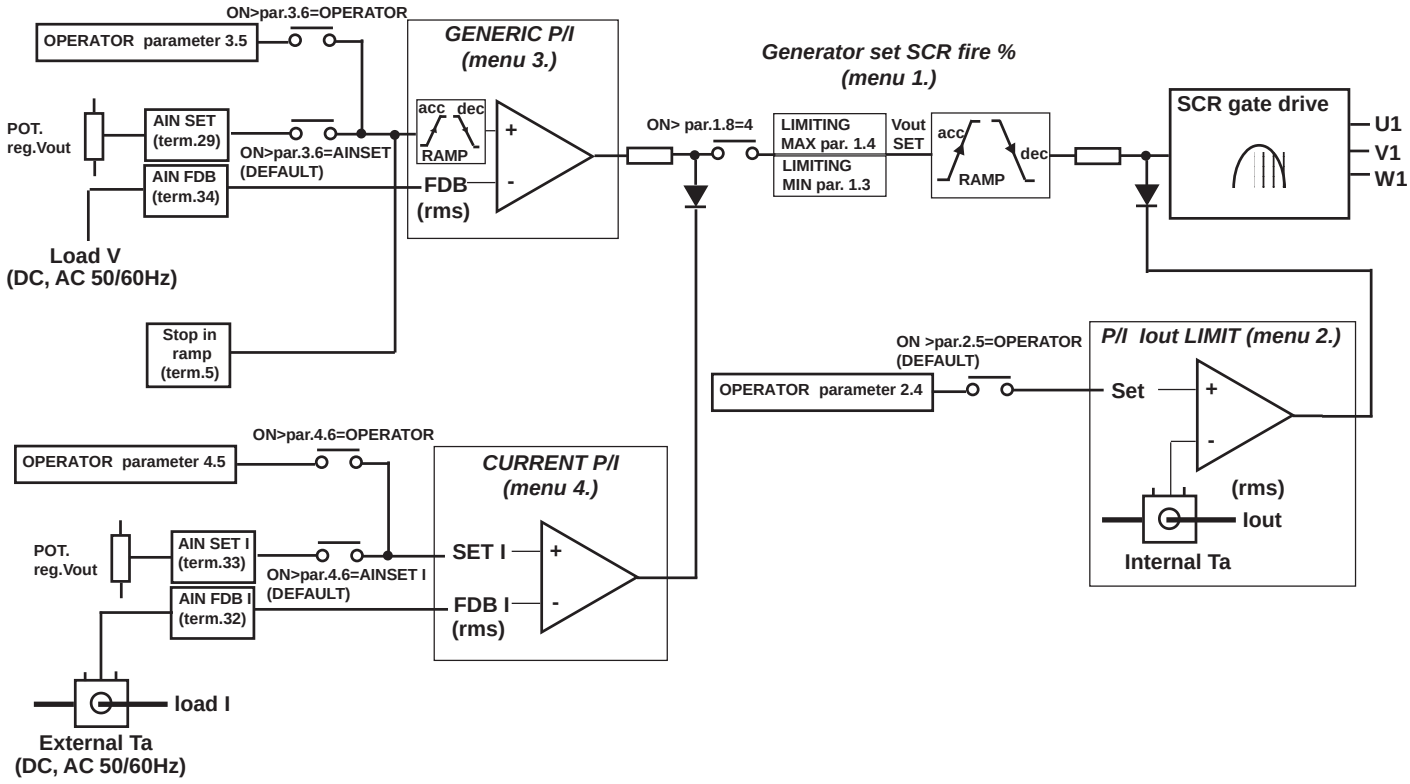
Block diagram for closed-loop CURRENT regulator
Case par.1.8 Vout SET SOURCE = 3

Sample usage: Controlled current DC power supply (through the insertion of a three-phase bridge rectifier between the U1 V1 W1 output and the load)



Block diagram for closed-loop VOLTAGE and CURRENT regulator
Case par.1.8 Vout SET SOURCE = 4

Sample usage: Stabilised voltage and controlled current DC power supply or speed/torque regulator for DC motors with feedback from tachometer generator for speed and from external TA for torque (always through the insertion of a three-phase bridge rectifier between the U1 V1 W1 output and the load)



Order Code Construction

Code : **C470 X / 1 . A . G . P XX**

S = standard

HARDWARE RELEASE

CUSTOM VERSION

P= CUSTOM REGULATOR
XX = CUSTOMISATION CODE.
In the standard versions
these 3 letters are omitted.

ACTUATOR POWER SIZE

3 - 4 - 5 - 5,5 - 6 - 7 - 8 - 8,5 - 9 - 9,5

SUPPLY VOLTAGE (50/60Hz)

G = Power: 170÷510 VAC - Logic: 170÷250 VAC
V = Power: 300÷760 VAC - Logic: 170÷250 VAC

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