DISCOVERY

THREE-PHASE LINE CONDITIONER

USER'S HANDBOOK
MAT 127T August 2021

CONFORMITY DECLARATION 3

1 INTRODUCTION 4
1.1 Information property 4
1.2 Reference Normative 4
1.3 Definitions 4
2 ENVIRONMENTAL NOTE 4
3 HEALTH & SAFETY 5
3.1 Notes for the operator 5
3.2 Notes for maintenance 5
3.3 Behaviour 5
3.4 Personal Protective Equipment (PPE) 6
4 HANDLING 7
4.1 Packaging 7
4.2 Reception 7
4.3 Storage 7
4.4 Moving the unit 7
5 DESCRIPTION 8
5.1 Main components and working principle 8
5.2 Protections 8
6 INSTALLATION & COMMISSIONING 10
6.1 Site choice 10
6.2 Accessibility 10
6.3 Electrical connection 10
6.4 Start-up 11
6.5 Settings 11
7 MAINTENANCE 12
7.1 Generalities 12
7.2 Roof fans 12
7.3 Voltage regulator 12
8 CONTROL CARD 14
8.1 Control card LEDs 14
8.2 Control card terminals 15
8.3 Protections 15
8.4 PC board management 15
8.5 Supercapacitor bank 17
8.6 Bodyguard CPU 18
8.7 External panel 18
9 TOUCHSCREEN USER INTERFACE 18
9.1 Start page 18
9.2 Monitor page 18
9.3 Voltage page 20
9.4 Current page 20
9.5 Power page 21
9.6 Alarm page 21
9.7 Service page 22
9.8 Setup/Info page 22
9.9 Touchscreen card 24
10 MODBUS® TCP/IP communication protocol 25
10.1 MODBUS® TCP protocol 25
10.2 MODBUS® functions 25
10.3 Error table 27
10.4 Limits 27
10.5 List of the exported informations 27
11 ALARMS & SERVICE 30
11.1 Alarm signal 30
11.2 Alarms availability 33
11.3 Service 33

MAINTENANCE LOG 34

Annexed:

DATA SHEET
SCHEMATICS

CONFORMITY DECLARATION

The Manufacturer,

ORTEA SpA
Via dei Chiosi, 21 20873 Cavenago Brianza (MB) – ITALY
Tel.: ++39 02 95917800 Fax: ++39 02 95917801
www.ortea.com - ortea@ortea.com

under its own responsibility

DECLARES

that the products:

3-PHASE LINE CONDITIONER

identified with the name:

DISCOVERY (code SDxxxxxxxxxxxxx)

provided that they are installed, maintained and used for the purpose for which they have been designed and built according to good professional practice and in conformity with the Manufacturer's instructions,

COMPLY

with the requirements contained in the CE EUROPEAN DIRECTIVES:

- **2014/30/EU** (**EMC DIRECTIVE**)
- **2014/35/EU** (**LOW VOLTAGE DIRECTIVE**)
- **2011/65/EU** (**ROHS RECAST**)

as complying with the relevant parts of the Harmonised Standards:

- **EN 61439-1** (LOW-VOLTAGE SWITCHGEAR AND CONTROLGEAR ASSEMBLIES. PART 1: GENERAL RULES)
- **EN 61439-2** (LOW-VOLTAGE SWITCHGEAR AND CONTROLGEAR ASSEMBLIES. PART 2: POWER SWITCHGEAR AND CONTROLGEAR ASSEMBLIES

The Manufacturer also

DECLARES

that the units are built with suitable quality components and that the manufacturing process is constantly verified in accordance with the Quality Control Plans which the Company applies in compliance with the **ISO9001:2015** Standard.
The Company's commitment towards environmental issues and safety at work matters is guaranteed by the certification of the Management System according to the ISO14001:2015 and **ISO45001:2018** Standards.

The General Sales Conditions, which include the warranty terms, can be downloaded either via the QR code or from the website www.next.ortea.com

1 INTRODUCTION

This Manual contains the information necessary to ensure correct operation of the unit, efficient maintenance program, avoidance of incorrect use and safety for the personnel involved with the unit performance. The units described in this manual must be used exclusively for the purpose for which they have been designed and manufactured. Installation must be done according to the instructions provided with this handbook. Any other use has to be considered as inappropriate and therefore dangerous. The Manufacturer shall not to be held liable for any damage to people and belongings due to incorrect use or installation. In case of doubt and for any other necessity, please contact the nearest authorised Service Centre. This Manual is as an integral part to the unit and the instructions therein must be carefully followed. File this manual and all the attached documentation for further consultation in a place available and known to the user and the maintenance personnel and keep it for the entire life of the unit.

1.1 INFORMATION PROPERTY

This Manual (including any attached document) is covered by copyright and the Manufacturer maintains all the reserved rights. It is compulsory to inform the Manufacturer's Head Office and ask for authorisation before proceeding with any release or reproduction. The Manufacturer shall not be held liable or responsible in any way for unauthorised copies, alterations or additions to the text or to the illustrated parts of this document. Any modification involving company logo, certification symbols, names and official data is strictly forbidden. In order to obtain better performance, the product described in this handbook can be altered at any date and without prior notice.

1.2 REFERENCE NORMATIVE

The units described in this Manual are designed and built in compliance with:

- 2014/35/EU (Low Voltage European Directive)
- 2014/30/EU (Electromagnetic Compatibility European Directive)
- applicable parts of the EN61439-1/-2 (Low-voltage switchgear and controlgear assemblies) Harmonised Standard

Furthermore, the Manufacturer's Managing System is compliant and duly approved according to:

- ISO9001:2015 (Quality)
- ISO14001:2015 (Environmental issues)
- ISO45001:2018 (Health & Safety at work)

⚠ ***WARNING*** *INFORMATION AND INSTRUCTIONS PROVIDED BY THIS MANUAL ADD TO AND NEITHER REPLACE NOR AMEND ANY STANDARDS, REGULATIONS, DECREES, DIRECTIVES OR LAWS CONCERNING ENVIRONMENTAL AND SAFETY AT WORK AWARENESS ENFORCED BOTH INTERNATIONALLY AND IN THE COUNTRY OF INSTALLATION.*

1.3 DEFINITIONS

⚠ ***WARNING*** *MESSAGE RELEVANT TO POTENTIALLY HAZARDOUS SITUATIONS WHICH MIGHT INDUCE MINOR INJURIES IF IGNORED OR NEGLECTED. THE SAME SIGNAL CAN BE USED TO HIGHLIGHT HAZARDS WHICH MIGHT CAUSE DAMAGE TO THE UNIT OR TO POINT OUT IMPORTANT INFORMATION.*

⚠ ***DANGER*** ***MESSAGE RELEVANT TO POSSIBLE OR PROBABLE HAZARDOUS SITUATIONS WHICH MIGHT INDUCE SERIOUS OR EVEN FATAL HARM IF IGNORED OR NEGLECTED.***

Note *Additional information to better understand the unit operation.*

2 ENVIRONMENTAL NOTE

Note *Units weighing more than 2000kg do not enter the scope of the 2012/19/EU WEEE Directive (Waste of Electric and Electronic Equipment) as they can be identified as large fixed industrial equipment. Nevertheless, although they do not bear the relevant symbol on their nameplates, it is recommendable to follow the Directive's guidelines concerning a responsible disposal at the end of their working life.*

With reference to the 2012/19/EU WEEE Directive (Waste of electric and electronic equipment), please be aware that the products described in this manual have been produced after August 13th 2015. When applicable, the WEEE symbol (beside) on the product label and / or accompanying documents means that used electrical and electronic equipment must not be mixed with general household or municipal waste. At the end of their useful life, these products must be disposed of via suitable channels. Please refer to the current legislation in force in the Country of installation. Professional users in the European Union must contact their dealer or supplier for further information. The symbol is only valid in the European Union (EU). For disposal in countries outside of the European Union please contact the local authorities or dealer and ask for the correct method of disposal. Disposing of this product correctly will help save valuable resources and prevent any potential negative effects on human health and the environment, which could otherwise arise from inappropriate waste handling. The product does not contain CFCs, HCFCs, asbestos, fuel, PCB, PCT, liquids or gaseous substances. Please recycle the packaging materials (cardboard and/or wood). At the end of the service, before disposing of the unit, remove the nameplate and make the appliance unusable by cutting the internal connections.

3 HEALTH & SAFETY

3.1 NOTES FOR THE OPERATOR

⚠ ***DANGER*** *THE VOLTAGE INSIDE THE EQUIPMENT IS DANGEROUS. ACCESS TO THE COMPONENTS FOR INSTALLATION, SETTING, INSPECTION AND MAINTENANCE MUST BE GRANTED ONLY TO QUALIFIED PERSONNEL IN CHARGE OF IT AND INFORMED OF THE RELEVANT RISKS. BEFORE STARTING ANY OPERATION, DISCONNECT THE UNIT FROM THE MAINS.*

The following safety general instructions are based on experience and common sense, but cannot describe or foresee all the possible situations. Basic safety procedures must be continuously applied and known by whoever operates on the unit. In order to ensure full knowledge of properties and characteristics of the unit, this Manual must be read and comprehended by those who supervise, maintain and run the unit.

- Check that the unit is always properly earthed.
- Warn anybody who might be in the vicinity before energizing the unit.
- Always operate in good lighting.
- Do not allow unauthorized personnel to operate on the unit for no reason whatsoever.
- Always use suitable safety means such as isolating tools and footboards, isolating gloves, etc.
- *never* operate the unit without the provided protections against accidental contact, unless specifically indicated in the maintenance instructions in this Manual. However, controls and maintenance routines that require the protections to be removed shall be under the User's full responsibility.
- Do not climb on top of the enclosure.
- Do not accumulate goods around or above the enclosure.

The unit is housed in an enclosure with screwed in panels. In normal working conditions, the unit must operate only when the enclosure is completely closed and cannot be accessed without opening the cubicle with specific means. The protection against direct contact is therefore inherently obtained. Any anomaly or alarm indication must be promptly signaled.

3.2 NOTES FOR MAINTENANCE

⚠ ***DANGER*** *BEFORE ANY MAINTENANCE OR REPAIRING ROUTINE, DISCONNECT THE UNIT BY OPENING THE UPSTREAM GENERAL BREAKER AND LOCK IT WITH A PADLOCK, THE KEYS OF WHICH MUST BE KEPT BY THE MAINTENANCE SUPERVISOR UNTIL THE END OF THE PROCEDURE.*

- Do not perform maintenance while the unit is working. Only setting or checking operations through the provided instrumentation are allowed.
- Whenever possible, do not use hands instead of suitable tools to work on the unit.
- Do not use bars, cables, plates or internal components as support or handhold.
- Check that mechanical and electrical connections are properly tightened at the end of the maintenance routine.
- Do not remove, alter or damage nameplates, warnings of any identification tags or labels.
- Before re-energising, always restore the protection that might have been removed for maintenance.

In case of doubts on the operational features or on the necessary maintenance procedures, please contact the Manufacturer or an authorised Service Centre.

Tampering on the unit relieves the Manufacturer from any responsibilities and makes the User solely responsible towards the competent bodies concerning accident prevention. The Manufacturer disclaims all responsibility for:

- failure to follow the specified instructions
- modification (even slight) performed on the unit resulting in altering its operational features
- failure to comply with the health and safety at work measures
- use of not original spare parts (unless specifically authorized by the Manufacturer)

During maintenance and repairing procedures, the enclosure is likely to be open. Consequently, some residual dangers persist, due to the impossibility of eliminating the sources as implicit in the working procedures.

DANGER	INDICATIONS
CRUSHING	Handling the unit must be done exclusively by means of the tools described in the relevant chapter. Handling and lifting operations must be carried out by skilled and trained personnel only.
ELECTROCUTION	During normal working operation, the danger does not exist. Carry out maintenance routines only after having disconnected the unit. Should it be necessary to test an energized unit, segregate the area so that only skilled personnel can operate, still in compliance with all the health and safety requirements set forth by the Rules and Regulations enforced in the Country of installation.
FIRE	Open the upstream interrupting device and use CO_2 fire extinguishers. Do not use water to extinguish fire.
HUMAN ERROR	Installation, start-up, setting, inspection, maintenance and repairing operations must be carried out by skilled, qualified and authorized personnel only, informed of the relevant risks. Read this Manual carefully and thoroughly before operating on the unit. Altering its configuration or replacing one or more of its parts without the Manufacturer's authorization is strictly forbidden.
MAINTENANCE NOT CARRIED OUT	Carry out the maintenance routine as prescribed in this Manual. The Manufacturer shall not be held liable in any way for damage to people and belongings caused by failure in performing maintenance on the unit.
LACK OF INFORMATION	While carrying out the maintenance routine, ensure that the unit cannot be energised without the maintainer's awareness. To this purpose, padlock the upstream interrupting device and affix warning signs.

3.3 BEHAVIOUR

The personnel dealing with the unit shall operate strictly in conformity with the requirements set forth by the health and safety at work Rules and Regulations enforced in the Country of installation. Provided that everything is carried out according to the instructions in this Manual, the unit is designed in order to work and be maintained without risks for people or the environment. The line conditioner is an automatic equipment that does not require maneuvering or command drives. However, personnel dealing with it must be aware of its characteristics, functioning features, signals and alarm indications, maintenance routines and troubleshooting procedures. The full comprehension of this Manual is therefore critical.

⚠ ***DANGER*** *TAMPERING AND/OR UNAUTHORISED REPLACEMENT OF ONE OR MORE COMPONENTS, USING ACCESSORIES, TOOLS OR MATERIAL NOT RECOMMENDED AND/OR NOT APPROVED BY THE MANUFACTURER MIGHT BE DANGEROUS AND CAUSE ACCIDENTS. SAID ACTIONS RELIEVE THE MANUFACTURER FROM ANY CIVIL AND/OR PENAL RESPONSIBILITIES.*

3.3.1 Correct behaviour

The User is protected against the risks related to the unit operation. The correct use allows for fully and safely exploiting its performance and can be obtained by:

- following the instructions provided by this use and maintenance Manual
- paying attention to the provided warnings and danger indications
- respecting the recommended maintenance frequency and keeping a record of the performed interventions
- disconnecting the unit in case of inspection, maintenance or repairing routines
- using suitable PPEs (Personal Protective Equipment) when dealing with the unit
- promptly informing the supervisor about operating anomalies (suspected malfunctioning, incorrect operation or failure; excessive noise; etc.) and if necessary putting the unit out of order.

3.3.2 Incorrect behaviour

Any use that contrasts with what stated above and any of the operations listed below can be defined as 'incorrect':

- arbitrary alteration of the working parameters. In case changes are required, please contact the Manufacturer or an authorized Service Centre
- use of improper of unsuitable energy sources
- unit operated by insufficiently trained personnel
- failure to comply with the maintenance instructions or incorrect maintenance
- use of unsuitable or unauthorized not original spare parts
- alteration of the safety devices and/or unit tampering
- performance of inspection, maintenance or repairing routines without disconnecting the unit

⚠ ***WARNING*** *THE MANUFACTURER SHALL NOT BE HELD LIABLE DUE TO ANY DAMAGE TO PEOPLE AND BELONGINGS ARISING FROM INCORRECT USE AS ABOVE DEFINED.*

The microprocessor-based control system detects data and anomalies, generating several alarms displayed by means of the LEDs on the external control panel. The alarms are generally accompanied by an acoustic signal.

⚠ ***WARNING*** *EXCLUDING OR BYPASSING IN ANY WAY THE ALARMS IS STRICTLY FORBIDDEN. THE MANUFACTURER DISCLAIMS ALL RESPONSIBILITY ON THE UNIT SAFETY IN CASE OF FAILURE TO RESPECT SAID BAN.*

3.4 PERSONAL PROTECTIVE EQUIPMENT (PPE)

While dealing with the unit, the user must have and use suitable PPEs, in conformity with the safety requirements enforced in the Country of installation and with the relevant European Directives (89/656/EEC and 89/686/EEC). The Manufacturer strongly recommends dressing suitably, avoiding clothes that might be caught up, wide sleeves, synthetic material, scarves and ties. Necklaces, bracelets, metallic wristwatches and similar object should also be avoided. In the table below, the recommended PPEs are listed:

		USER	MAINT.	DANGER	CONSEQUENCE
	SAFETY SHOES	✹	✹	Bumping, tripping, slipping, crushing limbs	Bruises, abrasions, cuts, sprains, dislocations, fractures
	SAFETY GLOVES	✹	✹	Contact with sharp surfaces or edges	Bruises, abrasions, cuts
	SAFETY DIELECTRIC GLOVES		✹	Contact with live parts when testing an energized unit	Electrocution
	HELMET		✹	Bumps to the head in the presence of suspended loads or work inside the enclosure	Bruises, abrasions, cuts, concussion, fractures
	VISOR/GLASSES		✹	Contact with liquids and projectile	Eye injury, eyesight loss or limitation
	ANTI-ARC VISOR		✹	Contact with projectile and radiation from electric arc	Eye injury, eyesight loss or limitation
	ANTI-DUST MASK		✹	Particulate and/or dust inhalation	Respiratory disorders

⚠ ***WARNING*** *A VISITOR CAN APPROACH A WORKING UNIT ONLY IF THE LATTER IS COMPLETELY CLOSED. SHOULD THE INTERNAL COMPONENTS BE SHOWN, REGARDLESS OF THE PROTECTION AGAINST ACCIDENTAL CONTACT, THE UNIT WILL HAVE TO BE SWITCHED OFF. OTHERWISE, THE VISITOR SHALL BE MAINTAINED AT A SAFETY DISTANCE BY MEANS OF PHYSICAL BARRIERS.*

4 HANDLING

4.1 PACKAGING

The units can be packaged either in cardboard boxes strapped to a pallet and wound in plastic film or in a wooden crate with seaworthy vacuum bag. Each unit is provided with a label indicating nominal data, consignee data and purchasing order details. The package bears the usual pictograms (☂; 🍷; ⇅) and, in case of wooden crate, the indication of the lifting points for chains or fork-lift trucks. With cardboard box packaging, anti-shock and anti-tilting indicators are also affixed.

4.2 RECEPTION

At reception, check the integrity of the packaging and the absence of evident damage occurred during transport. If the unit does not require immediate installation, store it with its original packaging. Once the good condition of the delivery has been established, unpack the unit and check it. In the unlikely event of damage, notify the Manufacturer in writing immediately.

4.3 STORAGE

Should the unit be stored, ensure that it is kept sheltered from rain or snow, excessive humidity, adverse climatic conditions (atmospheric pollution, saline atmosphere, parasites, etc.) at a temperature between -5°C and 40°C.

4.4 MOVING THE UNIT

⚠ ***WARNING*** *THE UNIT MUST BE KEPT IN VERTICAL POSITION, AS INDICATED ON THE PACKAGING. LAYING IT DOWN INTO A HORIZONTAL POSITION MIGHT SERIOUSLY DAMAGE THE INTERNAL COMPONENTS, ALTER THE MECHANICAL STABILITY AND COMPROMISE THE FUNCTIONALITY.*

Unloading and moving operations are under the User's responsibility. Take the utmost care in order to avoid damage to whoever might be around the unit, to the unit itself and to belongings or other equipment on the installation site.
Unloading and moving operations can be performed via cranes fitted with chains or lifting brackets or fork-lift trucks
The lifting devices must be suitable to the unit weight, in good conditions and regularly checked and maintained.
If required by the weight distribution inside the cabinet, the lifting points are highlighted by means of stickers (black arrow on yellow field).

⚠ ***DANGER*** ***HANDLING OPERATIONS MUST BE CARRIED OUT ONLY BY AUTHORISED, SUITABLY TRAINED PERSONNEL PROVIDED WITH THE NECESSARY PERSONAL PROTECTIVE EQUIPMENT (PPE). ALWAYS OPERATE IN CONFORMITY WITH THE SAFETY AT WORK RULES AND REGULATIONS ENFORCED IN THE COUNTRY OF INSTALLATION AND WITH THE INSTRUCTION MANUALS OF THE TOOLS USED. THE MANUFACTURER SHALL NOT BE HELD LIABLE FOR ANY DAMAGE THAT MIGHT OCCUR TO PEOPLE OR BELONGINGS DUE TO FAILURE IN COMPLYING WITH WHAT STATED ABOVE DURING UNLOADING AND MOVING OPERATIONS.***

5 DESCRIPTION

Please refer to the attached Data Sheet for a complete list of the technical characteristics. The present handbook deals only with the standard units. If optional devices such as breakers, by-pass switch, etc. are provided, please refer to the attached relevant technical sheets. The units, designed and built in compliance with the European Directives concerning CE marking (Low Voltage Directive and Electromagnetic Compatibility Directive), can be used in both A and B environments according to EN61439-1/2 and are supposed to be connected between mains and user.
The line conditioner is essentially a voltage stabiliser fed via a three-phase isolating transformer and fitted with additional protective devices. The input transformer (the rating of which is based on the line conditioner maximum input current) isolates from the mains and creates a steady neutral wire. The main features are:
The main features are:

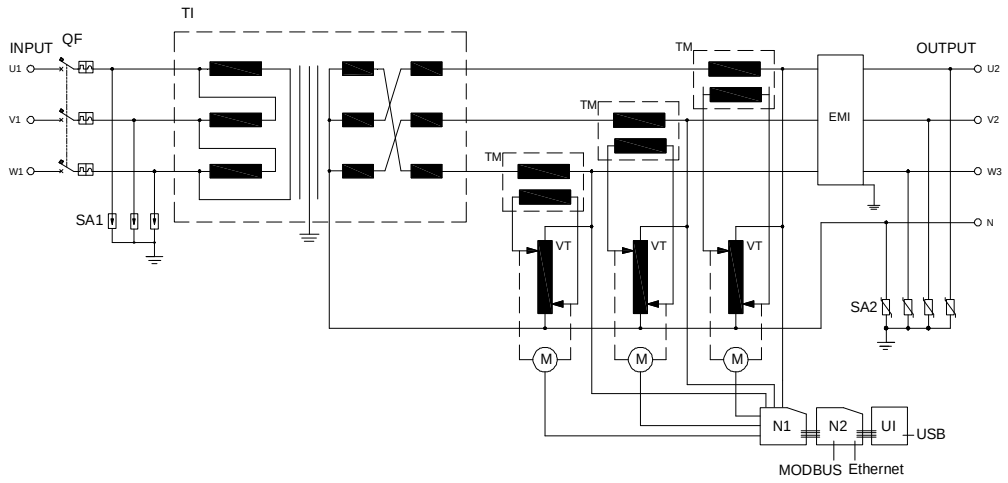
- use with asymmetrical input supply and single-phase loads or unbalanced three-phase loads;
- operation based on the 'rms voltage' and not on the average one. This type of control can supply the load a correctly stabilised voltage even with non-sinusoidal waves, frequently found in habitual applications and caused by the presence of (for example) converters, non-linear loads, transients, etc.
- regulation performed independently on each single phase (referring to the neutral, which must be available and connected;
- fully operational with load charge variable from 0 to 100% and 100% phase unbalance.
- up to 30% load current harmonic content admitted. With higher percentage, the nominal power must be de-rated.
- insensitivity to the load power factor
- absence of generation of noticeable harmonic distortions in the output voltage.

5.1 MAIN COMPONENTS AND WORKING PRINCIPLE

The main components are:

- three-phase 'buck/boost' transformer
- motorised three-phase autotransformer (or 3 single-phase ones) with continuously variable transformer ratio (voltage regulator)
- electronic control board running the system in terms of regulation, measurement and alarm management
- electronic board managing touchscreen and remote communication;
- Dzn0 three-phase input isolating transformer

A representation of the system is shown in the sketch below. The control circuit compares the output voltage value to the adjusted one. When the percentage variation is too high, the control drives the voltage regulator gearmotor. By doing so the regulator rollers change their position thus varying the voltage drawn and supplied to the buck/boost transformer primary winding. Being the secondary voltage of the buck/boost transformer in phase or in opposition to the supply, the voltage drawn from the regulator is added or subtracted to the mains voltage, thus compensating its variations.



QF	Input circuit breaker	N1	Control card
SA1	class I SPD	N2	Touchscreen card
TI	Input Dz_n0 isolating transformer	UI	User Interface
TM	Buck/boost transformer	EMI	EMI/RFI filter
VT	Voltage regulator	SA2	class II SPD
M	DC motor		

The remote communication is managed by the touchscreen card. Provided that the unit is connected to an Ethernet network, the interface screenshots can be reproduced remotely with a VNC software. The communication can also be established via a MODBUS® TCP/IP protocol (see the relevant chapter) in order to manage the information available.

5.2 PROTECTIONS

PROTECTION	IN CASE OF	ACHIEVED THROUGH
VOLTAGE RESET TO THE MINIMUM VALUE	Black-out	Supercapacitor banks on the control card
MOTOR ROTATION STOP	Motor overloaded	Control card
MOTOR ROTATION STOP	Motor short-circuit	Control card

PROTECTION	IN CASE OF	ACHIEVED THROUGH
OVERLOAD ON THE VOLTAGE REGULATOR	Excessive current through the regulator	Control card. While the protection is active, the alarm 'Stabilisation off' on the front panel is on.
1ST SET OF ROOF FANS ACTIVATION	$T1_{ambient}$ > 35°C (example)	Thresholds set via PC or UI
2ND SET OF ROOF FANS ACTIVATION (IF ANY)	$T2_{ambient}$ > 40°C (example)	
3RD SET OF ROOF FANS ACTIVATION (IF ANY)	$T3_{ambient}$ > 45° C (example)	
4TH SET OF ROOF FANS ACTIVATION (IF ANY)	$T4_{ambient}$ > 50° C (example)	
MOTOR SUPPLY	Circuit overload	Fuses
CONTROL CARD PROTECTION	Board overload	Two 5x20 10A delayed fuses
FAN RELAYS ON THE CONTROL CARD	Board overload	Four 5x20 10A delayed fuses
OVERVOLTAGE	Lightning	Input Class I SPDs
OVERVOLTAGE	Transients & spikes	Output Class II SPDs
SHORT-CIRCUIT & OVERLOAD	Short-circuit on the mains	Input automatic circuit breaker
ELECTRICAL NOISE AND RADIO INTERFERENCE	Line disturbance	EMI/RFI filter

The intervention of any of the above mentioned protections (except for fuses) is signalled by luminous and acoustic alarms. One or more lamps are installed inside the enclosure and switch on when the door supporting the control panel is open.

5.2.1 Regulator overcurrent protection

The protection is automatically controlled by the control card, which intervenes when the regulator rollers are overcharged by a high current by driving the regulator rollers to a safe position.
If the input voltage is lower than the target output voltage, the latter coincides with the input voltage. If the input voltage is higher than the target output voltage, the latter coincides with the target voltage. When the alarm condition stops, the unit goes back automatically to the regular working mode.
In case of control card failure, the regulator rollers are driven to the minimum output voltage position. The output voltage shall be decreased (in relation to the input voltage) of the maximum percentage allowed for by the nominal data.

6 INSTALLATION & COMMISSIONING

⚠ ***DANGER DO NOT** CONNECT IN PARALLEL TO EACH OTHER TWO OR MORE UNITS OUTPUT LINES.*

6.1 SITE CHOICE

The installation site must comply with the basic requirements listed below:

- unless otherwise agreed upon, the ambient temperature must fall in the -25/+45°C range
- unless otherwise agreed upon, the maximum installation altitude is 1000mt a.s.l.
- the floor or surface must be flat and able to withstand the unit's weight;
- the installation room dimensions and the airing system must ensure that the generated heat can be disposed of. Otherwise, a cooling systems must be arranged;
- the lighting system must be suitable for normal operating and maintenance routines;
- the ground circuit must comply with the relevant applicable rules and regulations;

If not previously arranged during the contracting phases, the unit must not be commissioned in case of:

- corrosive, explosive or flammable atmosphere;
- presence of conductive dust in the environment;
- proximity to radiation sources;
- possibility of floods.

Avoid direct heat and contact with liquid, flammable or corrosive materials. Do not clog the cabinet air outlets.
Check that anti fire devices are available in the area.

6.2 ACCESSIBILITY

The distances indicated are only indicative and suggested to allow for easy access in case of maintenance or repair.

Recommended space at the front:	800 - 1000mm
Recommended space at the rear:	300mm (800mm advisable for inspection and maintenance)
Recommended space at the sides:	800mm
Access to input/output terminals:	front
Access to cabinet fans:	roof inner side

6.3 ELECTRICAL CONNECTION

⚠ ***DANGER** THE LINE CONDITIONER IS NOT AND MUST NOT BE USED AS A PROTECTING DEVICE FOR NEITHER THE PLANT NOR THE LOADS. THE ELECTRICAL CONNECTION MUST BE CARRIED OUT BY TRAINED AND QUALIFIED PERSONNEL, AWARE OF THE INVOLVED RISKS. ALWAYS USE SUITABLE TOOLS AND PERSONAL PROTECTIVE EQUIPMENT (PPE). THE OPERATIONS MUST BE CARRIED OUT IN CONFORMITY WITH THE RULES AND REGULATIONS ENFORCED IN THE COUNTRY OF INSTALLATION.*

6.3.1 Supply

The supplying line must comply with the technical data specified in the nameplate. The unit is protected against short-circuit or overload.

Note *The installation of a co-ordinated upstream and/or downstream differential circuit breaker may be done under the site manager's responsibility.* ***Said differential circuit breakers are not included in the unit***

Note *If the load supply continuity is of paramount importance, it is advisable to install a by-pass circuit in order to allow for the load to be fed directly from the mains in case the unit is switched off for maintenance or internal failure.*

Note *If the load is thought to be sensitive to voltages outside the rated tolerance, the addition of an over/undervoltage protection system able to disconnect the load in said conditions is strongly recommended.*

6.3.2 Connections

Note *The cross-section value of the cables/bars for the connection to mains and load falls entirely under the installer's responsibility. The Manufacturer shall not be held liable for any damage that might occur to people or belongings due to an incorrect choice.*

Open the cubicle and locate main parts and connection points. Remove the accidental contact protections. Prepare the connection cables/bars with regard to the current values and make them go through the openings prepared on purpose.
The very first operation is to connect the earth wire to the terminal identified by PE, GRD or ⏚.

⚠ ***DANGER** THE EARTH CONDUCTOR MUST NEVER BE ELECTRICALLY INTERRUPTED NEITHER INSIDE NOR OUTSIDE THE UNIT.*

The earth wire cross-section must be chosen in conformity to the regulations in force. Therefore, depending on the phase cable cross-section, the earth wire cross-section should respect the values in the table below:

PHASE CABLE CROSS-SECTION S [sqmm]	EARTH WIRE MIN CROSS-SECTION [sqmm]
S ≤ 16	S
16 < S ≤ 35	16
35 < S ≤ 400	S/2
400 < S ≤ 800	200
S > 800	S/4

Note *If the application of this data determines a not standardised cross-section, the nearest larger one should be chosen.*

⚠ ***WARNING** FOR THE CORRECT OPERATION OF A THREE-PHASE LINE CONDITIONER, THE NEUTRAL WIRE MUST BE AVAILABLE AND CONNECTED TO THE RELEVANT TERMINALS.*

Connect the unit to mains and load, trying to avoid kinks and accidental contact between the cables and the electric components. Make the connections respecting the indications written on the terminations.

⚠ ***WARNING** BE SURE THAT PHASE AND NEUTRAL WIRES ARE CONNECTED TO THE RELEVANT TERMINALS. SWAPPING THE INPUT CONNECTION WITH THE OUTPUT ONE COULD CAUSE SERIOUS DAMAGE.*

Check the tightness of the connections and carefully close the cabinet.

6.4 START-UP

Before starting-up, it is recommendable to check whether haulage and long permanence in a warehouse might have affected the unit. If clear signs of dust, dirt or rust can be detected, follow the instruction given in the Maintenance chapter concerning how to clean the components. Supply the rated voltage. Power circuit, auxiliary circuits, control card and touchscreen are energised. Once the touchscreen software has started, input and output values can be read: check that they comply with the rated ones. The equipment is now ready for use. Connect the load and check that the output voltage regulation is steady and that the circulating current does not exceed the rated value.

6.5 SETTINGS

⚠ ***DANGER*** *DANGEROUS VOLTAGE CAN BE FOUND INSIDE THE UNIT AND THE CONTROL CARD. FOR THIS REASON, ONLY TRAINED AND QUALIFIED PERSONNEL AWARE OF THE INVOLVED RISKS MUST PERFORM THE DESCRIBED SETTINGS. SETTING OPERATION MUST BE PERFORMED ONLY IF STRICTLY NECESSARY. SUITABLE TOOLS AND PROTECTIVE MEANS MUST BE USED WHEN PERFORMING THE DESCRIBED ACTIVITIES. READ THIS HANDBOOK COMPLETELY BEFORE STARTING ANY INTERVENTION ON THE UNIT OR THE CONTROL CARD.*

Note *For a complete reset, the unit must have been switched off for at least five minutes.*

6.5.1 Trimmers

The trimmers are set during the testing session and it is strongly recommended NOT to alter such settings. In case of doubt, please refer to an authorised Service Centre.

6.5.2 Dip switches

REF.	PARAMETRE	POSITION	DEFAULT
SW1 DIP1 SW1 DIP2	Selection of the voltage to be stabilised. If the voltage is set via software, the dip-switched are disabled	DIP1 DIP2 TARGET Vac OFF OFF 210 ON OFF 220 OFF ON 230 ON ON 240	DIP1=OFF DIP2=ON
SW1 DIP3	Enabling of each motor regulation by means of external potentiometers. The full-scale value is set with the software	ON = enabled OFF = disabled	OFF
SW1 DIP4	Acoustic alarms disabling. Internal buzzer and external siren are cut off	ON = acoustic alarms off OFF = acoustic alarms on	OFF
SW1 DIP5 SW1 DIP6	Roller saving function regulation	DIP5 DIP6 behaviour OFF OFF Fast regulation with more movements ON OFF Fast intermediate OFF ON Slow intermediate ON ON Slow regulation with fewer movements	OFF
SW2 DIP1	Minimum regulation enabling. Activates the voltage resetting to the minimum value in case of blackout	ON = enabled OFF = disabled	ON
SW2 DIP2	Min/max voltage alarm enabling. Enables the generation of an alarm in case the output voltage is out of range for at least 10 seconds. The threshold is set with the trimmer R130 and with a software parameter.	ON = enabled OFF = disabled	ON
SW2 DIP4	Automatic alarm reset after 180 seconds without any active alarm	ON = enabled OFF = disabled	OFF

7 MAINTENANCE

⚠ ***DANGER*** *ACCESS TO THE INTERNAL COMPONENTS FOR INSTALLATION, SETTING, INSPECTION AND MAINTENANCE MUST BE GRANTED ONLY TO QUALIFIED PERSONNEL IN CHARGE OF IT AND INFORMED OF THE RELEVANT RISKS. ANY INTERVENTION MUST BE CARRIED OUT IN COMPLIANCE WITH THE HABITUAL RULES ON PERSONAL SAFETY AND USE OF ADEQUATE PROTECTIVE TOOLS.*

In order to ensure the performance throughout its life, the unit must undergo a simple but regular maintenance scheduling. The recommended frequency Is 12 months, but the maintenance routine ought to be more frequent should it be required by other factors such as polluted environment or heavy duty cycle. Conforming to the recommended maintenance program ensures the correct functioning, thus preventing potentially dangerous failures.

⚠ ***DANGER*** *EVERY MAINTENANCE OPERATION MUST BE DONE WHILE THE UNIT IS DISCONNECTED FROM THE MAINS.*

Before proceeding with the maintenance routine, check that the upstream interrupting device (disconnecting switch or circuit breaker) is open. Put on the unit a sign indicating the 'out of order' condition. Be sure that only the personnel necessary to the maintenance operations is dealing with the unit. The tables below resume the maintenance program:

7.1 GENERALITIES

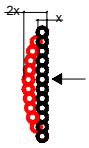
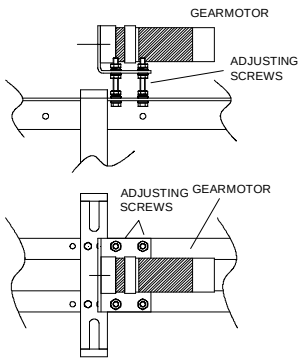
WHAT TO DO	HOW	WHY
Clean transformers and all electro-mechanical components removing dust, dirt and rust	Dry compressed air Dry cloths	Dust accumulation may limit the cooling air flow and cause overheating. Rust may compromise the dielectric properties of materials and components.
Check the correct tightening of the transmission units connections	Tightening tools DO NOT use lubricants for the regulator contacts	Transmission units improperly connected may cause irregular operating and abnormal wear and tear of components
Check that the electrical connections are tight	Tightening tools	Improper electrical connections may cause localised overheating and consequent major failure of the unit
Clean the air inlets at the base of the enclosure	Dry compressed air	Dust accumulation may limit the cooling air flow and cause overheating.

7.2 ROOF FANS

WHAT TO DO	HOW	WHY
Check that the airflow coming out from the turrets is regular. Keep the air outlets and the fans clean.	Dry compressed air Dry cloths	Dust accumulation may limit the cooling air flow and cause overheating.
If necessary, replace defective fans. WARNING. The fans are controller by the control card. Before proceeding with the replacement, check the temperature threshold that determines the activation.	• disconnect the fan plug; • unscrew and remove the turret from the cabinet roof; • replace the defective fan with an original spare one; • connect the fan plug; • re-position the turret on the roof	Failure of one or more fans may compromise the air circulation inside the enclosure.

7.3 VOLTAGE REGULATOR

The mobile contacts (rollers) move vertically on the track thanks to a pinion and chain transmission.

<table>
<tr><th>WHAT TO DO</th><th colspan="2">HOW</th><th>WHY</th></tr>
<tr><td>Clean the copper surface in case of clear oxidation or deposit of graphite dust.</td><td colspan="2">Fine abrasive paper (120 type first and 240 type afterwards)
Dry compressed air
Dry clean cloth</td><td>The presence of residual material or oxide on the copper where the rollers run may cause deterioration of the rollers themselves and overheating.
The phenomenon is self-supplied so as time goes by, the regulator may suffer major failure.</td></tr>
<tr><td>Clean and possibly lubricate the chain</td><td colspan="2">Grease or spray for cogs and chains</td><td>Ensure the correct movement of transmission units and avoid interruption of the transmission or failure.</td></tr>
<tr><td>Check the chain tension.</td><td> 
</td><td>When manually applying force on the chain side, the displacement should be twice the thickness of chain.</td><td rowspan="2">The pulling chains tension must be such that there are no loosening or interruptions during the inversion of the rotating sense.</td></tr>
<tr><td>If necessary, adjust the chain tension.</td><td> 
</td><td>Lift or lower the plate supporting the gearmotor by means of the fixing bolts and nuts</td></tr>
</table>

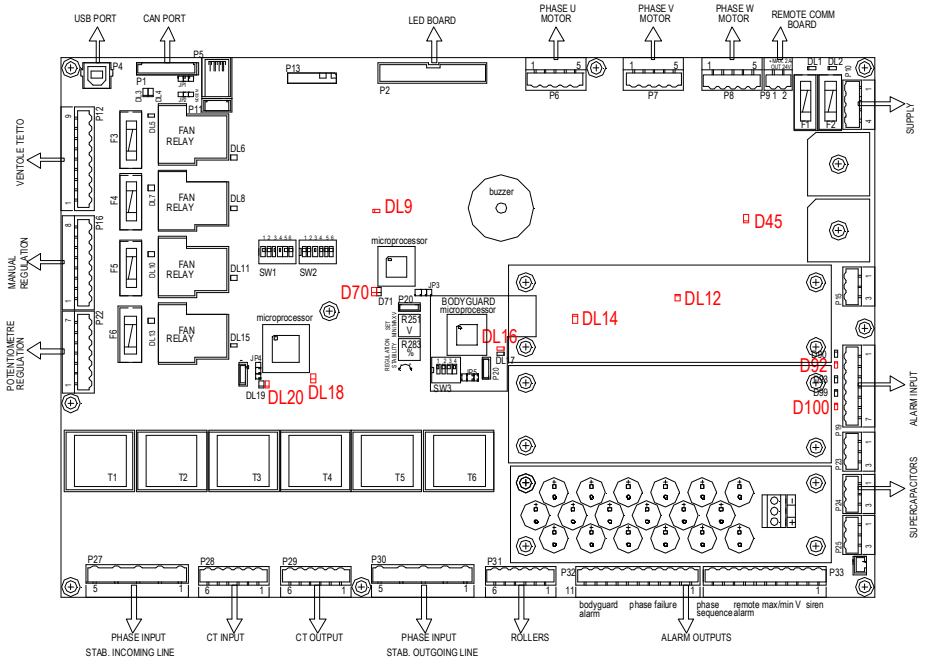
WHAT TO DO	HOW	WHY
Check the roller support condition	Lift the roller and check the following points: • uniformity of the force necessary to lift the rollers • continuity and regularity of the movement • uniformity of the contact pressure when the rollers are placed back on the regulator column. If it is necessary to replace the support, please contact the Service Dept.	The pressure exercised on the column is critical for the contact to be efficient. If this is not ensured, the current distribution among the rollers is incorrect. Such condition may cause localized overheating and major failure on the regulator.
Check the rollers status.	Lift the roller support and check the roller surface status. They must roll freely while the carriages move and their surfaces must not show any scratches, rubs or flat areas. If it is necessary to replace the rollers, please contact the Service Dept.	Stop of the roller rotation and surface irregularities cause incorrect contact with the copper winding. This determines the circulation of local eddy currents and quick overheating of the area. The phenomenon is self-supplied so as time goes by, the regulator may suffer major failure.

8 CONTROL CARD

The control card runs the unit by regulating each phase independently, monitoring the output currents and generating an alarm in case of overcurrent. Under normal working conditions, the output voltage is maintained stable with an accuracy equal to ±0.5% in relation to the rated voltage. The control is performed totally through a software that digitalises all the parameters (full digital control). The card is fitted with two DSP microprocessors (DIGITAL SIGNAL PROCESSOR), one that works as *controlling CPU* and the other as *measuring CPU*. By means of these devices, the board reads line voltage, settings, motor current and inputs and drives directly each motor by imposing direction and speed. On the basis of the motor current, the board elaborates also the protections against overload and short-circuit for the motor itself. The control card controls also the activation of the roof fans. A third DSP microprocessor (called *bodyguard CPU*) works as supervisor of the output voltage by detecting and signalling abnormal situations. The input and output voltage inputs are electrically separated by means of isolating transformers mounted on the board. The following components are connected to the control card:

- touchscreen card managing the interactive display and the remote communication;
- three supercapacitor boards for adjusting to minimum voltage position in case of blackout.

Due to the presence of miniaturised components and possibility of micro-fractures, the card must not be bent.



8.1 CONTROL CARD LEDS

REF.	COLOUR	PARAMETRE	ON	OFF	BLINKING
DL1	red	F1 fuse	Blown fuse	Fuse OK	-
DL2	red	F2 fuse	Blown fuse	Fuse OK	-
DL3	red	USB – status TX	Comm. blocked	Comm. blocked or absent	TX comm.. on
DL4	red	USB – status RX	Comm. blocked	Comm. blocked or absent	RX comm. on
DL5	red	F3 fuse (FAN 4)	Blown fuse	Fuse OK	-
DL6	yellow	Drive FAN 4	FAN 4 ON	FAN 4 OFF	-
DL7	red	F4 fuse (FAN 3)	Blown fuse	Fuse OK	-
DL8	yellow	Drive FAN 4	FAN 4 ON	FAN 4 OFF	-
DL9	green	modem supply (+5Vdc)	enabled	disabled	-
DL10	red	F5 fuse (FAN 2)	Blown fuse	Fuse OK K	-
DL11	yellow	Drive FAN 2	FAN 2 ON	FAN 2 OFF	-
DL12	green	Logic supply (+12Vdc)	enabled	disabled	-
DL13	red	F6 fuse (FAN 1)	Blown fuse	Fuse OK	-
DL14	green	Logic supply (+5Vdc)	enabled	disabled	-
DL15	yellow	Drive FAN 1	FAN 1 ON	FAN 1 OFF	-
DL16	yellow	CPU3 status (bodyguard)	CPU blocked	CPU blocked or absent SW	status OK
DL17	red	CPU3 status (bodyguard)	alarm	regular operation	status OK at start-up
DL18	green	Logic supply (+3,3Vdc)	enabled	disabled	-
DL19	red	CPU2 status (measure)	alarm	regular operation	status OK at start-up
DL20	yellow	CPU2 status (measure)	CPU blocked	CPU blocked or absent SW	status OK
D45	green	Board supply (22Vac)	enabled	disabled	-
D70	yellow	CPU1 status (control)	CPU blocked	CPU blocked or absent SW	status OK
D71	red	CPU1 status (control)	alarm	regular operation	status OK at start-up
D90	red	Test bench input bypass	alarm	regular operation	-
D92	red	probes overheating input	regular operation	alarm	-
D93	red	current alarm input	alarm	regular operation	-
D99	red	Temperature alarm input	alarm	regular operation	-
D100	red	Fan alarm input	regular operation	alarm	-

Note *The highlighted LEDs are ON when the board is working correctly.*

8.2 CONTROL CARD TERMINALS

REF.	TYPE	DESCRIPTION
P1	6-pole male	CAN bus
P2	34-pole male flat	Panel interface
P4	USB	USB
P5	RJ11	Modem supply
P6	5-pole screw term. block	Motor U
P7	5-pole screw term. block	Motor V
P8	5-pole screw term. block	Motor W
P9	2-pole screw term. block	Communication board supply
P10	4-pole screw term. block	Control card supply
P11	4-pole male	RS232 modem serial
P12	9-pole screw term. block	Fan output
P13	Strip 9x2F	Modem interface
P16	8-pole male	Manual phase regulation
P18	6-pole male	CPU1 programming
P19	7-pole screw term. block	Alarm inputs
P20	6-pole male	CPU3 programming
P21	6-pole male	CPU2 programming
P22	7-pole screw term. block	Phase regulation potentiometres
P23	3-pole screw term. block	supercapacitors
P24	3-pole screw term. block	supercapacitors
P25	3-pole screw term. block	supercapacitors
P27	5-pole screw term. block	Input voltage – dangerous voltage
P28	6-pole screw term. block	Current input
P29	6-pole screw term. block	Current output
P30	5-pole screw term. block	Output voltage – dangerous voltage
P31	6-pole screw term. block	Current on each column
P32	11-pole screw term. block	Alarm outputs
P33	11-pole screw term. block	Alarm outputs

8.3 PROTECTIONS

8.3.1 Motor stop or overload

The control estimates whether the motor is either in overload condition or blocked. The thermal energy (i.e. the current) released in a certain time is measured and if the value exceeds a set threshold, an alarm is generated.

8.3.2 Short-circuit

The board is provided with a phase-to-phase short-circuit alarm for each motor. Filtering devices operate in order to avoid unnecessary intervention. The board's resistance to a short-circuit depends on the nature of the phenomenon.

8.4 PC BOARD MANAGEMENT

In order to access the menu that runs the system, create a serial connection between the board and a PC and start a communication program such as, for example, Hyper-Terminal®. This program is part of the standard Windows® package and can be launched with the sequence:

START → ACCESSORIES → COMMUNICATION.

When using the program for the first time, the connection file must be created. Type in a file name (for example, 'STAB') in the dialog window that appears at the beginning. Under the voice 'Connect', choose the serial port to be used (for example, COM1)) and press OK. Now set the following parameters:

- Bit per second: 115200
- Data Bit: 8
- Parity: none
- Stop Bit: 1
- Flux control: Xon/Xoff

Press OK and save the connection file (choose 'Save' from the 'File' menu). Once the file has been created, every time the program is initiated press the space bar, choose 'Open' from the 'File' menu and choose the 'STAB' file. On the PC screen, the window shown below appears:

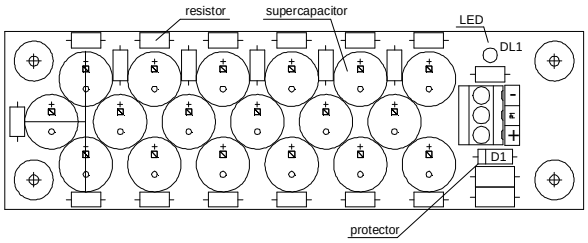
```
-  LINE CONDITIONER -

1- TARGET  (0)
2- MAINTENANCE
3- FAN TEST

5- ALARMS
6- INFO 1
7- INFO 2
```

KEY	DESCRIPTION	DISPLAY
1	Selection of the target output voltage to be reached and stabilised. If the target is nil, the control board will use the values set by means of the dipswitches DIPSW1 and DIPSW2 (see the dip-switch table later in this manual). The choice of a new target requires to be confirmed.	**- LINE CONDITIONER –** **1- TARGET (0)** **2- MAINTENANCE** **3- FAN TEST** **5- ALARMS** **6- INFO 1** **7- INFO 2** **New value TARGET (0) > 235** and then: **New Target 235 - Do you want to use it? (y/n)**
2	Display of the maintenance status. For each type of maintenance, the menu shows three counters: ▪ total working hours ▪ number of hours from last performed maintenance *setup value (within brackets)*	**- MAINTENANCE -** **WORKING HOURS MOTOR U: 150 - 25 MAINT.(250))** **WORKING HOURS MOTOR V: 155 - 30 MAINT.(250)** **WORKING HOURS MOTOR W: 147 - 22 MAINT.(250)** **POWER ON HOURS : 185 - 45 MAINT.(10000)** **X- EXIT**
3	Programming of the start of roof fans and overheating alarm. There are four temperature thresholds to be set (in increasing sequence). When the temperature reaches threshold T1, the first fan is activated and so on when the other thresholds are trespassed. When the temperature goes beyond the alarm threshold, the alarm is generated. Before an event can be cancelled, a three degree hysteresis must be taken into account. In the following example, the fan is started when the temperature goes beyond 35°C. The same fan will be stopped only when the temperature decreases to 32°C.	**- FAN SETUP -** **1- TEMPERATURE T1 (35)** **2- TEMPERATURE T2 (40)** **3- TEMPERATURE T3 (45)** **4 - TEMPERATURE T4 (50)** **A- TEMPERATURE ALARM (60)** **X- EXIT**
5	Display of the active alarms with a brief description. The alarm messages currently managed are shown beside. In addition, the status of the maintenance to be performed is shown by means of a hexadecimal parameter.	**"Max current"** **"Phase U short curr."** **"Phase V short curr."** **"Phase W short curr."** **"By pass"** **"Phase U Vout min"** **"Phase V Vout min"** **"Phase W Vout min"** **"Fan off"** **"Phase U Vout max"** **"Phase V Vout max"** **"Phase W Vout max"** **"Overheating sonde"** **"Phase U blocco"** **"Phase V blocco"** **"Phase W blocco"** **“Overheating inter"** **...**
6	Display of system information. NB: the voltage value is multiplied by 100. For example, 23500 reads as 235.00V	**- AUTOMATIC - T 21.80 (0C17)** **- phase voltage U -** **VIn 21923 Iin 0034** **VTRGT 23500 Irol 0007** **Vout 23514 Iout 0003** **MaxCnt Over 16 - Short 16** **MOVING SEC.661** **- phase voltage V -** **VIn 21907 Iin 0034** **VTRGT 23500 Irol 0007** **Vout 23490 Iout 0002** **MaxCnt Over 9 - Short 9** **MOVING SEC.688** **- phase voltage W -** **VIn 21915 Iin 0035** **VTRGT 23500 Irol 0008** **Vout 23522 Iout 0002** **MaxCnt Over 11 - Short 11** **MOVING SEC.621** **- MAINTENANCE -** **SEC.661** **SEC.688** **SEC.621** **SEC.9293** **- MSTE949 -** **SW 01.03** **Status 0021**

KEY	DESCRIPTION	DISPLAY
7	Display of system information. NB: the voltage value is multiplied by 100. For example, 23500 reads as 235.00V	- Phase-voltage U - V.POWER-FAIL 8000 - (reset 8320) V.BLACKOUT 10000 - (reset 10400) V.PH.LOSS 15000 - (reset 15600) V.MIN 22090 - (reset 22560) V.MAX 24910 - 25380 - 25850 - 26320 - 26790 - 27260 - (reset 24440) ERR I -872 Kp 50 - Phase-voltage V - V.POWER-FAIL 8000 - (reset 8320) V.BLACKOUT 10000 - (reset 10400) V.PH.LOSS 15000 - (reset 15600) V.MIN 22090 - (reset 22560) V.MAX 24910 - 25380 - 25850 - 26320 - 26790 - 27260 - (reset 24440) ERR I -312 Kp 50 - Phase-voltage W - V.POWER-FAIL 8000 - (reset 8320) V.BLACKOUT 10000 - (reset 10400) V.PH.LOSS 15000 - (reset 15600) V.MIN 22090 - (reset 22560) V.MAX 24910 - 25380 - 25850 - 26320 - 26790 - 27260 - (reset 24440) ERR I -41 Kp 50 - Parameter Current - PH 0 MAX Current 4000 limits (4400 A - 60 s.)(4800 A - 30 s.)(5200 A - 10 s.) reset(3960 A - 20 s.) PH 1 MAX Current 4000 limits (4400 A - 60 s.)(4800 A - 30 s.)(5200 A - 10 s.) reset(3960 A - 20 s.) PH 2 MAX Current 4000 limits (4400 A - 60 s.)(4800 A - 30 s.)(5200 A - 10 s.) reset(3960 A - 20 s.) - Parameter Current ROLLER - PH 0 MAX Current ROL. 700 limits (770 A - 10 s.)(840 A - 30 s.)(910 A - 10 s.) reset(693 A - 10 s.) PH 1 MAX Current ROL. 700 limits (770 A - 10 s.)(840 A - 30 s.)(910 A - 10 s.) reset(693 A - 10 s.) PH 2 MAX Current ROL. 700 limits (770 A - 10 s.)(840 A - 30 s.)(910 A - 10 s.) reset(693 A - 10 s.)

8.5 SUPERCAPACITOR BANK

The bank is a reservoir of electric energy stored in supercapacitors (high capacity capacitors). The purpose is to supply each gearmotor in blackout condition, so that the voltage regulator can reach its minimum voltage position.

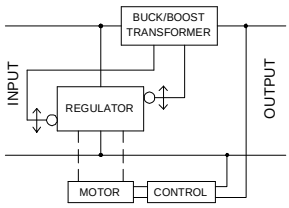


⚠ ***WARNING*** *THE VOLTAGE AVAILABLE ON THE BANK IS NOT DANGEROUS. HOWEVER, BECAUSE OF ITS FUNCTION, THE CARD STORES ELECTRIC ENERGY AND MIGHT STAY CHARGED EVEN AFTER HAVING BEEN DISCONNECTED FOR A FEW MINUTES. DO NOT SHORT-CIRCUIT THE CARD AND DO NOT POSITION CONDUCTIVE AND/OR METALLIC OBJECTS IN THE VICINITY.*

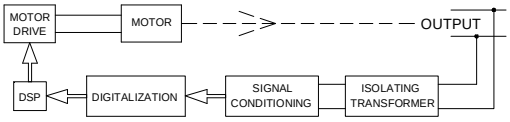
Any residual voltage can be easily detected by means of the LED mounted on the card: when the green LED is on, the capacitors are charged and voltage is available.
Some resistors might be hot. The bank can be regarded as discharged after five minutes from disconnection.
A varistor surge arrestor intervenes in case of overvoltage.

8.6 BODYGUARD CPU

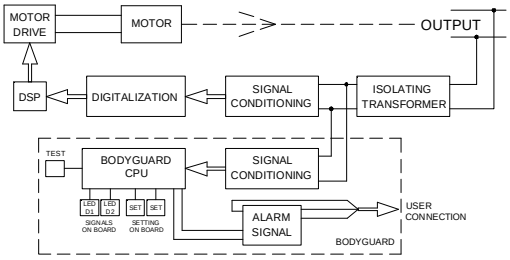
Generally speaking, the unit must be able to alter the input voltage in order to ensure the output nominal voltage. How the voltage needs to be changed is decided automatically by the control system on the basis of the input voltage.
In case of malfunctioning, the output voltage could increase or decrease even considerably and therefore create problems for the load.
The control system is designed to be extremely reliable. Nevertheless, an additional supervisor on the output voltage has been introduced to ensure that an unlikely malfunctioning condition would not be dangerous. Said supervisor (called 'Bodyguard' microprocessor) is almost entirely redundant and checks that the output voltage is correct, i.e. maintained within the nominal range, allowing for a given tolerance.
In case of abnormal output voltage, the system generates a signal that can be dealt with by the user in order to activate an alarm or a protection.



single phase regulating chain

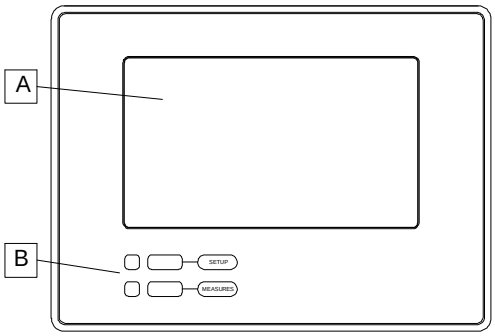


single phase regulating chain
from an electronic point of view



solution with supervising microprocessor

8.7 EXTERNAL PANEL



8.7.1 A – 10" touch display

The interactive display provides with information on the electrical parameters and on the status of the unit.
It also shows alarm conditions and event history.

8.7.2 B –USB ports

Used to update the control card software (SETUP) and download the stored data (MEASURES).

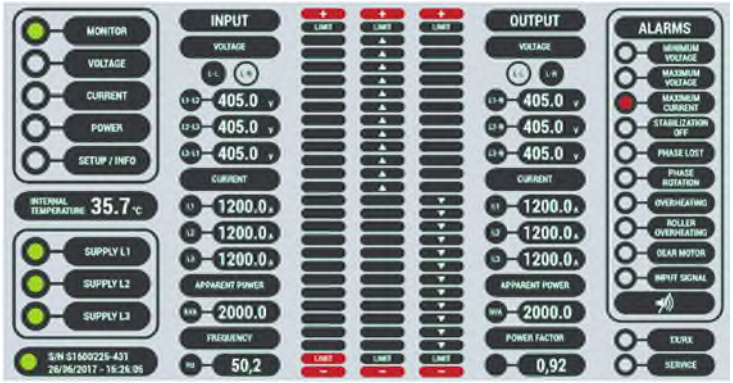
9 TOUCHSCREEN USER INTERFACE

9.1 START PAGE

The page, showing company logo and type of unit, appears after a set loading time (approximately ten seconds). After five seconds, the screen moves automatically to the MONITOR page, set in English by default. After 1 minute, a screen saver reducing the display brightness is activated (it can be de-activated by touching any part of the screen). The interface language can be chosen in the SETUP INFO page (currently, English, French, Italian and Spanish are available).

9.2 MONITOR PAGE

The page shows the status of the unit. The sidebars remain visible in every page.



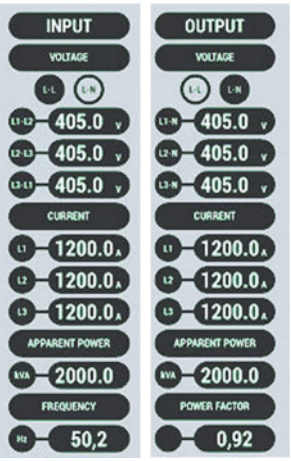
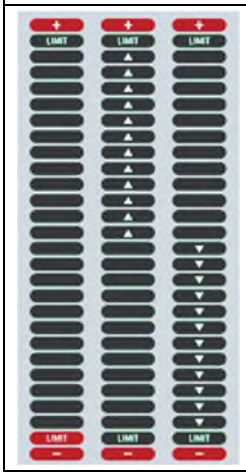
9.2.1 Left-hand sidebar

	Touch the keys to surf to the desired page. When one of the pages is selected, the relevant circle on the left turns green.
	Indication of temperature inside the unit.
	Supply status. If the circle is blinking green, everything is alright. In case of alarm, one or more of the circles turns blinking red.
	Unit serial number, date and time. If the circle on the left is green, the CAN-BUS connection between control card and display is alright.

9.2.2 Right-hand sidebar

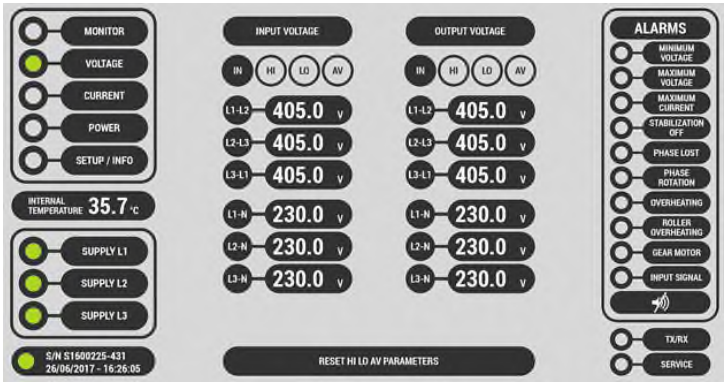
	Summary of the available alarm indications. Touch the keys to surf to the desired page. When an alarm is inactive, the relevant circle on the left is grey. Should it become active, the circle turns red and the buzzer/siren starts. By touching the active alarm key, the screen shifts to the ALARM page without switching off the buzzer/siren. By touching the SILENCER key, the card buzzer and the siren are switched off and the screen shifts to the ALARM page.
	The TX/RX circle turns red when a PC is connected to the control card. When the SERVICE circle turns red, by touching the key the screen moves to the SERVICE page.

9.2.3 Centre

	*Input and output parametres* Display of the parametres at the unit input and ouput. It is possible to choose between phase-to-phase (L-L) and phase-to-neutral (L-N) voltage by touching the relevant key. The voltage indication changes according to the choice. The active choice is the one with white writing on a dark field.
	*Virtual operating mode* An arrow indicates in which direction the regulator is compensating (increase voltage or decrease voltage). If the regulation reaches the limit (top or bottom), the relevant icon turns red.

9.3 VOLTAGE PAGE

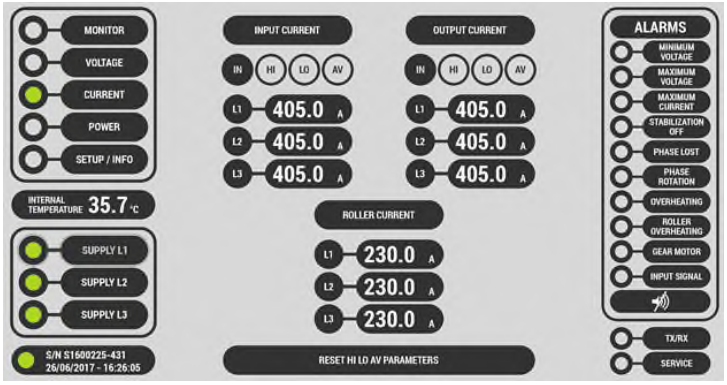
The page shows the details on input and output phase-to-phase and phase-to-neutral voltage.



	Keys for the selection of the type of value to display IN instantaneous voltage HI maximum voltage in a set time interval LO minimum voltage in a set time interval AV average voltage in a set time interval The selected option is the one with the dark field.
	Key to reset the detection time interval for HI, LO and AV. The window below appears to confirm the reset operation. 

9.4 CURRENT PAGE

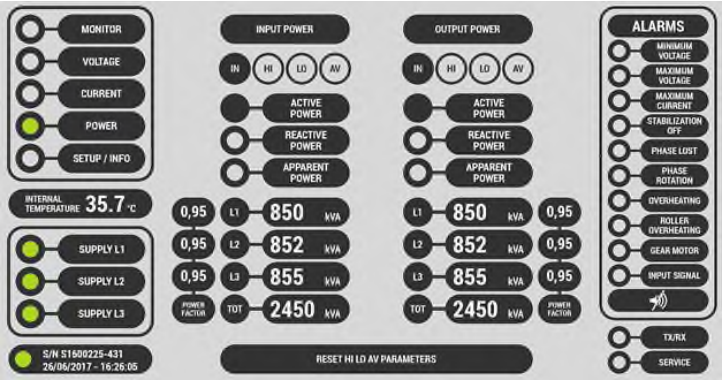
The page shows the details on input, output and roller current.



	Keys for the selection of the type of value to display IN instantaneous current HI maximum current in a set time interval LO minimum current in a set time interval AV average current in a set time interval The selected option is the one with the dark field.
	Key to reset the detection time interval for HI, LO and AV. The window below appears to confirm the reset operation. 

9.5 POWER PAGE

The page shows the details on input and output power.

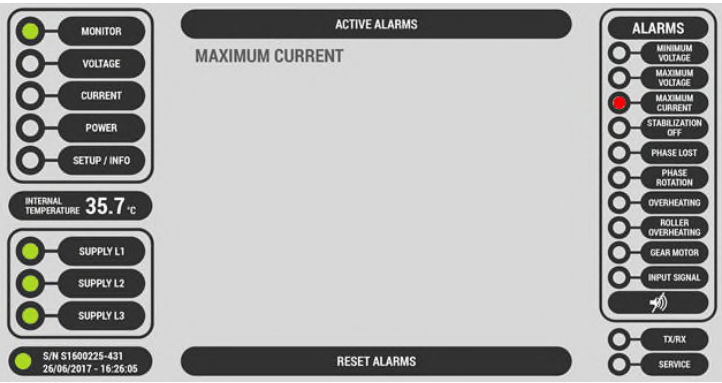


Select the desired power (active power [kW], reactive power [kvar], apparent power [kVA]) with the relevant key for input and output. The chosen option circle turns green and the indication below those key will be updated accordingly.
Beside each phase power indication, the power factor relevant to that phase is also shown.

	Keys for the selection of the type of value to display IN instantaneous power HI maximum power in a set time interval LO minimum power in a set time interval AV average power in a set time interval The selected option circle is the one with the dark field.
	Key to reset the detection time interval for HI, LO and AV. The window below appears to confirm the reset operation. 

9.6 ALARM PAGE

The page shows the details relevant to the active alarm(s).

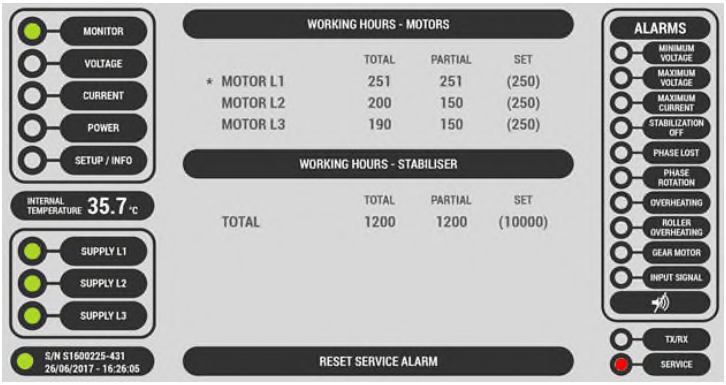


The possible situations are:

	*Still active alarm* The type of alarm is indicated in the main window. By touching the RESET ALARMS key at the bottom, the alarm cannot be reset and the indication in the sidebar stays red. Both the card buzzer and the siren start again (if previously silenced with the relevant SILENCER key).
	*Alarm not active anymore* The main window is empty, but the red sign in the sidebar is still on. The card buzzer is also still active (unless previously silenced with the relevant SILENCER key together with the siren). The unit siren is off, as it automatically switches off when the alarm condition ceases to be. In order to eliminate the red sign and (if active) the card buzzer sound, touch the RESET ALARMS key at the bottom of the page.

9.7 SERVICE PAGE

The Service page can be accessed by touching the SERVICE key in the right-hand sidebar even if there is no alarm indication. The page shows the details relevant to the working hour number for both the unit and each phase motor.

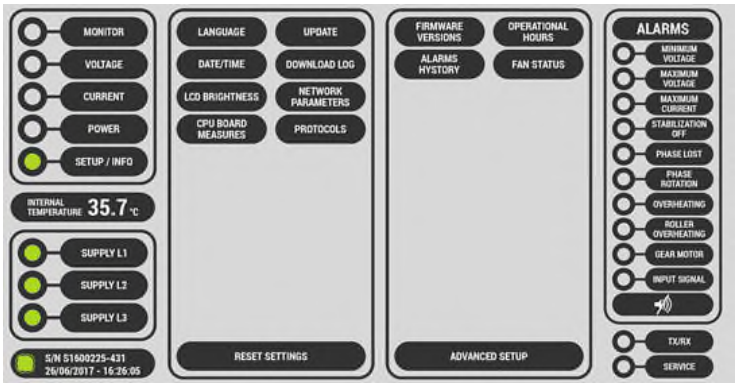


The SERVICE alarm is active when the number of working hours (PARTIAL) of either the motors or the unit exceeds the set value, indicated in brackets. In this situation, the relevant circle is red ant the card buzzer is active (but not the siren). Touch the SILENCER key to stop the card buzzer. The resetting of the alarm (and therefore the elimination of the red sign) is restricted to authorized Service Personnel by means of a password.

9.8 SETUP/INFO PAGE

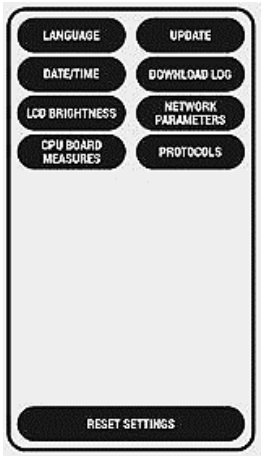
The page provides with the possibility of:

- Setting some basic parametres
- Visualizing some information on the unit.



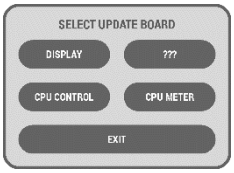
9.8.1 Setup

The left-hand side of the main windows shows the parameters that can be setup

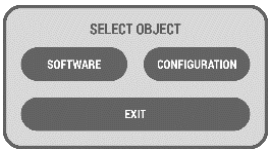


	LANGUAGE Touch the LANGUAGE key to select the desired language.
	DATE/TIME Touch the DATE/TIME key to open the window for typing date and time. At the end, touch ENTER to confirm or EXIT to abandon the procedure.
	LCD CONTRAST Touch the LCD CONTRAST key to open the window for adjusting the screen brightness. Touch + or – to increase or decrease the brightness and once the desired level has been reached, touch ENTER to confirm or EXIT to abandon the procedure.

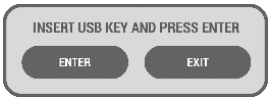
CPU BOARD MEASURES
Touch the CPU BOARD MEASURES key to open the window showing the electrical parametres available on the board.
Touch EXIT to abandon the procedure

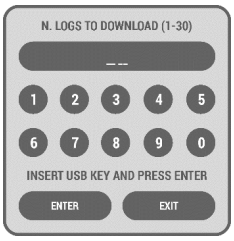


UPDATE
Touch the UPDATE key to open the window for selecting what needs updating. Touch EXIT to abandon the procedure. Once the choice has been made, the updating options appear. Touch the key relevant to the desired one or EXIT to abandon the procedure.

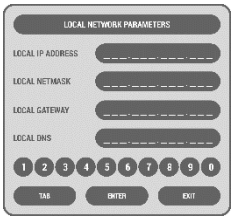


The window requesting the USB drive appears. Touch ENTER to confirm the new data or EXIT to abandon the procedure.

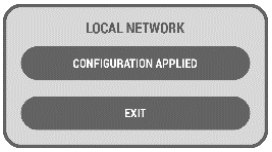


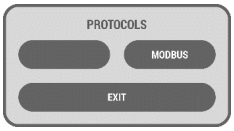


DOWNLOAD LOG
Touch the DOWNLOAD LOG key to open the window for downloading the log files. Use the keypad to communicate how many logs must be downloaded. Touch ENTER to confirm the new data or EXIT to abandon the procedure. When the downloading procedure is finished, the window for removing the USB drive appears. Touch EXIT to complete the procedure.

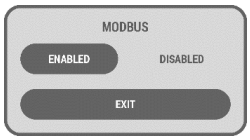


NETWORK PARAMETRES
Touch the NETWORK PARAMETERS key to open the window for inserting the communication parametres. Touch EXIT to abandon the procedure.
By touching LOCAL, the relevant windows appears: Use the numeric keys to digit the codes, ENTER to confirm and EXIT to abandon the procedure. At the end of the procedure, the confirmation windows appears.





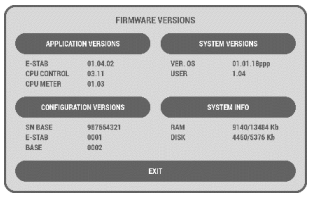
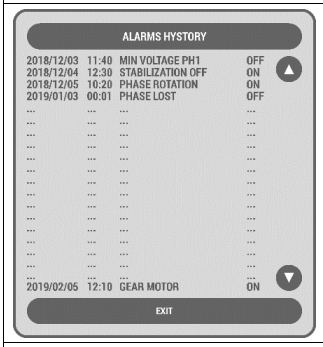
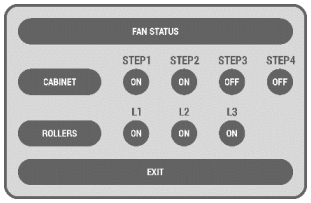
PROTOCOL
Touch the PROTOCOLS key to enable/disable the available communication protocols (at the moment, only MODBUS). Touch EXIT to abandon the procedure.



RESET SETTINGS
Touch the RESET SETTINGS key to go back to the factory default.
A request for confirmation appears.

9.8.2 Information

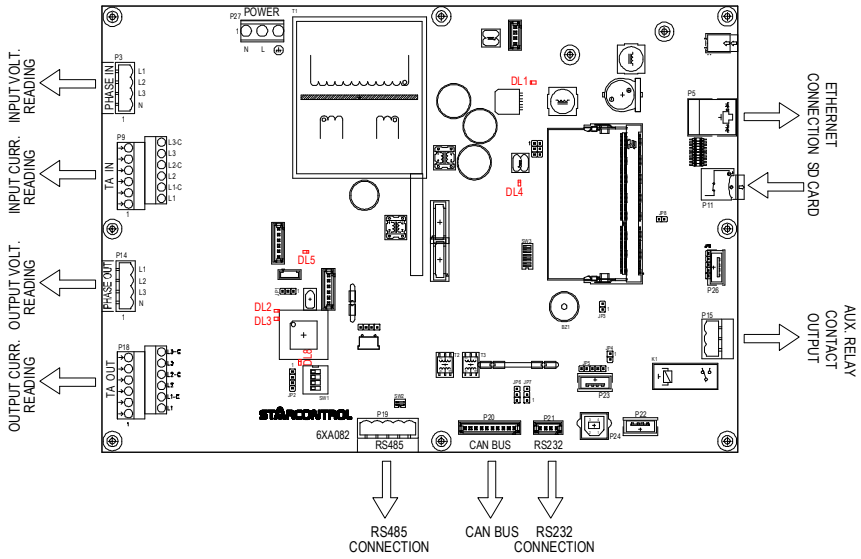
The right-hand side of the main windows shows the information that can be displayed. The activities offered by the ADVANCED SETUP key at the bottom are restricted to authorized Service Centre personnel via a password.

<table>
<tr>
<td rowspan="5"> 
</td>
<td> 
</td>
<td>FIRMWARE VERSIONS
Touch the FIRMWARE VERSIONS key to see the different installed software versions.</td>
</tr>
<tr>
<td> 
</td>
<td>ALARMS HISTORY
Touch the ALARMS HISTORY key to read the list of the alarm events.
Touch EXIT to abandon the procedure.</td>
</tr>
<tr>
<td> 
</td>
<td>OPERATIONAL HOURS
Touch the OPERATIONAL HOURS key to read the number of working hours.
Touch EXIT to abandon the procedure.</td>
</tr>
<tr>
<td> 
</td>
<td>FAN STATUS
Touch the FAN STATUS key to read which fans are active.
Touch EXIT to abandon the procedure</td>
</tr>
<tr>
<td> 
</td>
<td>ADVANCED SETUP
The key grants access (through password) to further and more complex setting procedures that are restricted to authorized Service Personnel.</td>
</tr>
</table>

9.9 TOUCHSCREEN CARD

9.9.1 Description

The card receives input and output data, alarms and status information from the main control card and transfers them to the touchscreen display. The card also manages the remote communication by means of an Ethernet port and the availability of MODBUS TCP/IP protocol.



9.9.2 LED meaning

REF.	COLOUR	PARAMETER	ON	OFF	FLASHING
DL1	Green	+5V CPU LCD	POWER OK	POWER KO	-
DL2	Red	Measure CPU alarm signal	OK	KO	Alarm
DL3	Yellow	Measure CPU OK			Normal
DL4	Green	+3.3V CPU LCD	POWER OK	POWER KO	-
DL5	Yellow	+3.3V Measure CPU	POWER OK	POWER KO	-
DL8	Green	Communication eith CPU LCD	KO	KO	Normal-

9.9.3 Terminals

REF.	TYPE	DESCRIPTION	SCREEN PRINTING
P3	4-pole term. 5mm	Input voltage reading – DANGEROUS VOLTAGE	PHASE IN
P5	8-pole, 90° RJ45 connector	Ethernet connection	-
P9	Double-line 12-pole term. 5mm	Input current reading	TA IN
P11	SD card connector	SD memory card	-
P14	4-pole term. P=5mm	Output voltage reading – DANGEROUS VOLTAGE	PHASE OUT
P15	3-pole term. P=5mm	Auxiliary relay contact output	-
P18	Double-line 12-pole term. 5mm	Output current reading	TA OUT
P19	5-pole term. 5mm	RS485 connection	RS485
P20	10-pole MODU2 term.	CAN BUS connection	CAN BUS
P21	4-pole MODU2 term.	RS232 connection	RS232
P27	3-pole term. 7.5mm	Card supply	POWER

10 MODBUS® TCP/IP communication protocol

⚠ ***WARNING*** *THE MODBUS® COMMUNICATION PROTOCOL IS AVAILABLE IF THE UNIT IS FITTED WITH:*
- *REMOTE COMMUNICATION CARD SOFTWARE VERSION NOT OLDER THAN 01.05.00*
- *CONTROL CPU SOFTWARE VERSION NOT OLDER THAN 04.00*

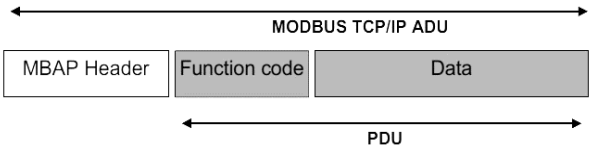
NO INTERFACE IS PROVIDED TO MANAGE THE DATA COMMUNICATION.

The basic MODBUS® server functions are:
- waiting for a MODBUS® request on 502 TCP port;
- treating this request;
- providing with a MODBUS® response on the basis of the device context.

The supported MODBUS® data is:
- Input register (read only information): word 16 bit size
- Holding register (read information): word 16 bit

The communication is based on a simple package called Protocol Data Unit (PDU). There are three types of PDU:
- *Request PDU*. consisting of a code specifying a function (Function Code, 1 byte) and function specific data (Function Data, varying number of bytes)
- *Response PDU*, consisting of the function code corresponding to the request (Function Code, 1 byte) and response specific data (Response Data, varying number of bytes)
- *Exception Response PDU*, consisting of the function code corresponding to the request + 0x80 (128), (Error Code, 1 byte) and a code specifying the exception (Exception Code, 1 byte)

This package is enclosed in a message called ADU (Application Data Unit):



A MODBUS® TCP/IP ADU message is therefore a PDU package with a dedicated header called MBAP (MODBUS® Application Protocol header).

10.1 MODBUS® TCP PROTOCOL

The communication message has the following structure:

Transaction ID (16 bit)	Protocol ID (16 bit)	Length (16 bit)	Address (8 bit)	Function (8 bit)	Data (N x 8 bit)

1. *Transaction ID* it is an identifier replied from the server and it is used to trace the server response (it could be a random or progressive 16 bit value)
2. *Protocol ID* fixed to 0
3. *Length* number of following bytes
4. *Address* board adderss (1 to 254). Not used.
5. *Function* code of the function that must be executed by the server.
6. *Data* field containing the data sent to the server or received from the server in response to a query

10.2 MODBUS® FUNCTIONS

The available functions are:
03h = Read holding register Allows to read the board setup information (see table below)
04h = Read input register Allows to read board and measure instrument information
For instance, in order to read the value of the Target voltage, which resides at board address 24 (18 Hex), the message is the following:

00h	00h	00h	00h	00h	06h	01h	04h	00h	18h	00h	01h

where:
00 00 = Transaction ID
00 00 = Protocol ID
00 06 = Length
01 = server address (unused)
04 = MODBUS® function 'Read input register'
00 18 = Address of the required register (Target voltage)
00 01 = Number of registers to be read starting from the required one

The board answer is the following:

00h	00h	00h	00h	00h	05h	01h	04h	02h	00h	C8h

where:
00 00 = Transaction ID (identical to the request Transaction ID)
00 00 = Protocol ID
00 05 = Length
01 = board address (unused; it is only an echo of the request)
04 = Function requested by the client
02 = Number of bytes of the response sent
00 C8 = Hex value of the Target voltage (200 V)

10.2.1 Function 03h: Read Holding Register

The MODBUS® function 03 allows for one or more consecutive setup information from the server memory to be read. Up to 9 consecutive addresses can be read. The address of each measure is listed in a tables further on.
If the measure address is not included in the table or the number of requested measures exceeds 9, the board will return an error code (see error table)

client query example:

MSB Transaction ID	00h
LSB Transaction ID	00h
MSB Protocol ID	00h
LSB Protocol ID	00h
MSB Length	00h
LSB Length	06h
1B server address	01h
1B Function	03h
MSB address	00h
LSB address	00h
MSB register number	00h
LSB register number	08h

In the above example, the server is requested for 8 consecutive registers beginning with address 00h.
Registers from 0 to 7 will then be returned.

server response:

MSB Transaction ID	00h
LSB Transaction ID	00h
MSB Protocol ID	00h
LSB Protocol ID	00h
MSB Length	00h
LSB Length	13h
1B server address	01h
1B Function	03h
1B Byte number	10h
MSB register 00h	00h
LSB register 00h	00h
----------	----
MSB register 07h	00h
LSB register 07h	00h

The response always includes the server address, the function code requested by the client and the contents of the requested registers.

10.2.2 Function 04h : Read Input Register

The MODBUS® function 04 allows one or more consecutive measures from the server memory to be read. Up to 125 consecutive addresses can be read. The address of each measure is listed in a tables further on.
If the measure address is not included in the table or the number of requested measures exceeds 125, the board will return an error code (see error table)

client query example:

MSB Transaction ID	00h
LSB Transaction ID	00h
MSB Protocol ID	00h
LSB Protocol ID	00h
MSB Length	00h
LSB Length	06h
server address	01h
Function	04h
MSB address	00h

LSB address	18h
MSB register number	00h
LSB register number	08h

In the above example the server is requested for 8 consecutive registers beginning with address 24 (18h).
Registers from 24 to 31 will then be returned.

server response:

MSB Transaction ID	00h
LSB Transaction ID	00h
MSB Protocol ID	00h
LSB Protocol ID	00h
MSB Length	00h
LSB Length	13h
server address	01h
Function	04h
Byte number	10h
MSB register 18h	00h
LSB register 18h	00h
----------	-------
MSB register 1Fh	00h
LSB register 1Fh	00h

The response always includes the server address, the function code requested by the client and the contents of the requested registers.

10.3 ERROR TABLE

If an error occurs, the server responds with an error code. Below an example with the response to a read of multiple registers.

MSB Transaction ID	00h
LSB Transaction ID	00h
MSB Protocol ID	00h
LSB Protocol ID	00h
MSB Length	00h
LSB Length	03h
1B server address	01h
1B Function	90h
1B Exception Code	02h

The function is alway 80h + code of the function requested by the client (10h in this case).
The following table shows the exception codes returned in case of invalid queries.

01h	Invalid function
02h	Invalid register address
03h	Parameter value out of bounds

10.4 LIMITS

This server accepts only 2 clients connection at the same time.

10.5 LIST OF THE EXPORTED INFORMATIONS

READ: Holding registers (03H)

ADD.	WORDS	DESCRIPTION	FORMAT	UNIT
0	1	Output Target	Int16	Volt (ex. 230v)
1	1	Reset alarms command	Int16	Any value to reset
2	1	Reset service LED command	Int16	Any value to reset
3	1	Fan start-up temperature setup (step 1)	Int16	C°/100
4	1	Fan start-up temperature setup (step 2)	Int16	(ex.4000 if 40°)
5	1	Fan start-up temperature setup (step 3)	Int16	C°/100
6	1	Fan start-up temperature setup (step 4)	Int16	(ex.4000 if 40°)
7	1	Overheating alarm temperature setup	Int16	C°/100
8	1	Phase rotation setup	Int16	0/1

READ : Input registers for information on the control board (04H)

ADD.	WORDS	DESCRIPTION	FORMAT	UNIT
0	15	Serial number	(*) String char [30]	Hex –Ascii
15	5	Current date	String char [10] – MM/DD/YY	Hex –Ascii
20	4	Current time	String char [8] – HH:MM:SS	Hex –Ascii
24	1	Target voltage	Int16	Volt (ex.230)
25	1	Temperature	Int16	C°/100 (ex.4000 if 40°)
26	2	Phase U motor service hours	(**)Int32	Sec.
28	2	Phase V motor service hours	Int32	Sec.
30	2	Phase W motor service hours	Int32	Sec.
32	2	Phases service hours	Int32	Sec.
34	2	Phase U motor service partial ours	(**)Int32	Sec.
36	2	Phase V motor service partial ours	Int32	Sec.
38	2	Phase W motor service partial ours	Int32	Sec.
40	2	Phases service partial hours	Int32	Sec.
42	2	Alarms	(***)Int32 – bit field	
44	1	Phase U (ph-n) input voltage	Int16	Volt (ex. 230V)
45	1	Phase V (ph-n) input voltage	Int16	Volt (ex. 230V)
46	1	Phase W (ph-n) input voltage	Int16	Volt (ex. 230V)
47	1	Phase U (ph-n) input current	Int16	A (ex 35A)
48	1	Phase V (ph-n) input current	Int16	A (ex 35A)
49	1	Phase W (ph-n) input current	Int16	A (ex 35A)
50	1	Phase U (ph-n) output voltage	Int16	Volt (ex. 230V)
51	1	Phase V (ph-n) output voltage	Int16	Volt (ex. 230V)

ADD.	WORDS	DESCRIPTION	FORMAT	UNIT
52	1	Phase W (ph-n) output voltage	Int16	Volt (ex. 230V)
53	1	Phase U (ph-n) output current	Int16	A (ex 35A)
54	1	Phase V (ph-n) output current	Int16	A (ex 35A)
55	1	Phase W (ph-n) output current	Int16	A (ex 35A)
56	1	Phase U roller current	Int16	A (ex 7A)
57	1	Phase V roller current	Int16	A (ex 7A)
58	1	Phase W roller current	Int16	A (ex 7A)

(*) String format: the string value is formatted with 2 chars for every word: the first into the high address and the second into the low. For example, the string "CATS" coded with 0x43 0x41 0x54 0x53 will be formatted into 2 words as follows:

Word 1	Add 0 – high value	'C'	Hex 43
	Add 0 – low value	'A'	Hex 41
Word 2	Add 1 – high value	'T'	Hex 54
	Add 1 – low value	'S'	Hex 53

(**) Int32 format: double word formatted with 2 words, being the high value into the first word. For example, the double value 12345678 Hex will be formatted into 2 words as follows:

Word 1	Hex 1234
Word 2	Hex 5678

(***) Int32 bit field special case. It is formatted as described in (**), but the bit value is as follows:

Bit0	"MAX Current"
Bit1	"By PASS" – Stabilisation OFF
Bit2	"Overheating"
Bit3	"Overheating roller"
Bit4	"Phase U short curr." – Regulator Motor
Bit5	"Phase U Vout min"
Bit6	"Phase U Vout max"
Bit7	"Phase U locked" – Regulator Motor
Bit8	"Phase V short curr." – Regulator Motor
Bit9	"Phase V Vout min"
Bit10	"Phase V Vout max"
Bit11	"Phase V locked" – Regulator Motor
Bit12	"Phase W short curr." – Regulator Motor
Bit13	"Phase W Vout min"
Bit14	"Phase W Vout max"
Bit15	"Phase W locked" – Regulator Motor
Bit16	"Overheating internal"
Bit17	"Phase U MAX curr."
Bit18	"Phase V MAX curr."
Bit19	"Phase W MAX curr."
Bit20	"CPU MSTE949"
Bit21	"CPU BODY949"
Bit22	"PHASE LOST"
Bit23	"PHASE SEQUENCE"
Bit24	"WRONG FACT.CALIB."
Bit25	"WRONG USER CALIB."
Bit26	"INPUT PHASE LOST"
Bit27..31	Reserved for future use

READ : Input registers for information on the measure instrument (04H)

ADDRESS	WORDS	DESCRIPTION	FORMAT	UNIT
100	2	phase U (ph-n) input voltage	Int32	V (ex.230v)
102	2	phase V (ph-n) input voltage	Int32	V (ex.230v)
104	2	phase W (ph-n) input voltage	Int32	V (ex.230v)
106	2	phase U (ph-n) input LOW voltage	Int32	V (ex.230v)
108	2	phase V (ph-n) input LOW voltage	Int32	V (ex.230v)
110	2	phase W (ph-n) input LOW voltage	Int32	V (ex.230v)
112	2	phase U (ph-n) input HIGH voltage	Int32	V (ex.230v)
114	2	phase V (ph-n) input HIGH voltage	Int32	V (ex.230v)
116	2	phase W (ph-n) input HIGH voltage	Int32	V (ex.230v)
118	2	phase U Input current	Int32	A/100 (ex 3500 if 35A)
120	2	phase V Input current	Int32	A/100 (ex 3500 if 35A)
122	2	phase W Input current	Int32	A/100 (ex 3500 if 35A)
124	2	Input total active power	Int32	W
126	2	Input total reactive power	Int32	var
128	2	Input total apparent power	Int32	VA
130	2	phase U (ph-n) output voltage	Int32	V (ex.230v)
132	2	phase V (ph-n) output voltage	Int32	V (ex.230v)
134	2	phase W (ph-n) output voltage	Int32	V (ex.230v)
136	2	phase U (ph-n) output LOW voltage	Int32	V (ex.230v)
138	2	phase V (ph-n) output LOW voltage	Int32	V (ex.230v)
140	2	phase W (ph-n) output LOW voltage	Int32	V (ex.230v)
142	2	phase U (ph-n) output HIGH voltage	Int32	V (ex.230v)
144	2	phase V (ph-n) output HIGH voltage	Int32	V (ex.230v)
146	2	phase W (ph-n) output HIGH voltage	Int32	V (ex.230v)
148	2	phase U output current	Int32	A/100 (ex 3500 if 35A)
150	2	phase V output current	Int32	A/100 (ex 3500 if 35A)
152	2	phase W output current	Int32	A/100 (ex 3500 if 35A)
154	2	phase U output high current	Int32	A/100 (ex 3500 if 35A)
156	2	phase V output high current	Int32	A/100 (ex 3500 if 35A)

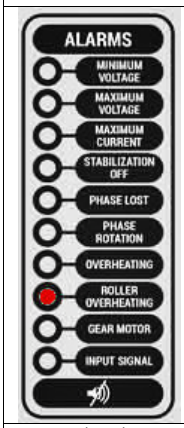
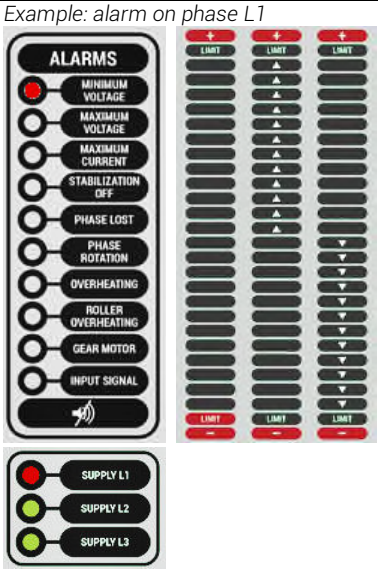
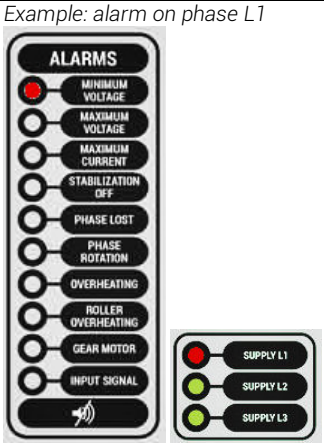
ADDRESS	WORDS	DESCRIPTION	FORMAT	UNIT
158	2	phase W output high current	Int32	A/100 (ex 3500 if 35A)
160	2	Output total active power	Int32	W
162	2	Output total reactive power	Int32	var
164	2	Output total apparent power	Int32	VA
166	2	phase U output active power	Int32	W
168	2	phase U output reactive power	Int32	var
170	2	phase U output apparent power	Int32	VA
172	2	phase V output active power	Int32	W
174	2	phase V output reactive power	Int32	var
176	2	phase V output apparent power	Int32	VA
178	2	phase W output active power	Int32	W
180	2	phase W output reactive power	Int32	var
182	2	phase W output apparent power	Int32	VA
184	2	phase U output power factor	Int32	(ex. 99 if cos 0,99)
186	2	phase V output power factor	Int32	(ex. 99 if cos 0,99)
188	2	phase W output power factor	Int32	(ex. 99 if cos 0,99)
190	2	Output frequency	Int32	Hz/10 (ex. 500 if 50 Hz)

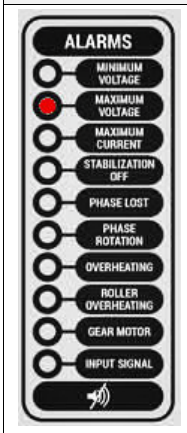
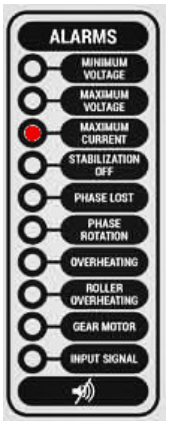
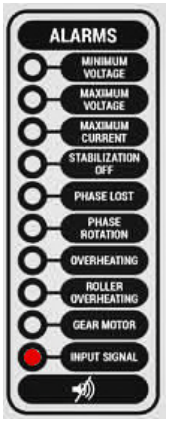
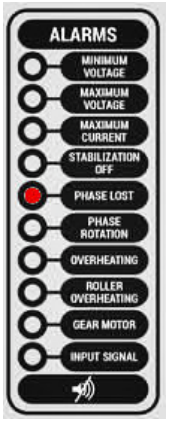
11 ALARMS & SERVICE

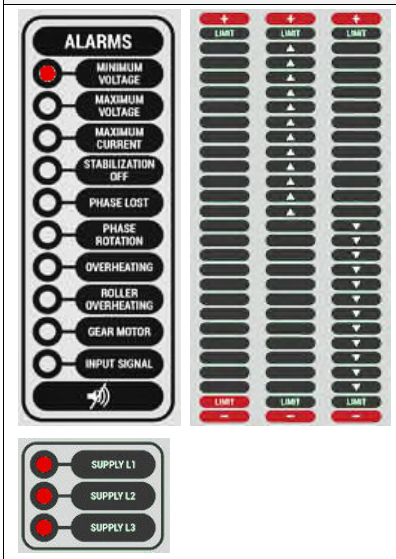
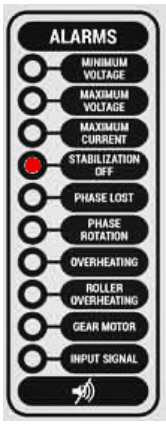
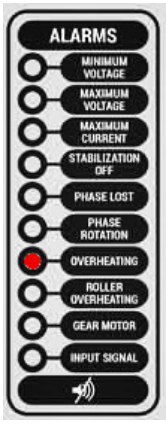
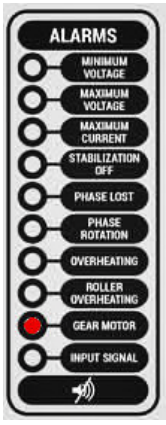
⚠ ***DANGER*** *ACCESS TO THE INTERNAL COMPONENTS MUST BE GRANTED ONLY TO QUALIFIED, TRAINED PERSONNEL IN CHARGE OF IT. ANY OPERATION THAT MIGHT REQUIRE THE UNIT TO BE ENERGISED MUST BE CARRIED OUT IN COMPLIANCE WITH THE HABITUAL RULES CONCERNING PERSONAL SAFETY AND THE USE OF ADEQUATE PROTECTIVE TOOLS.*

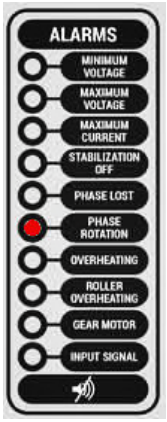
In case of anomaly or failure of any component, check that all the instructions given in this manual have been followed. Interventions must be requested out promptly as soon as the issue arises in order to avoid an aggravation of the problem and the involvement of other components. Touching the icon of the active alarm will open the Alarm Page on the User Interface.

11.1 ALARM SIGNAL

ALARM	ISSUE	POSSIBLE CAUSE	ACTIONS
Blank instrument display	NO READINGS	- Damaged or defective instrument - Fuse intervention	- Replace with spare instrument - Check the supply. Replace the blown fuse with an equivalent one
	ROLLER OVERHEATING	- Overload - Thermal probe failure - Presence of dirt or dust on the regulator surface (incorrect roller contact)	- Check column surface (colour). Investigate and eliminate the overload source - Switch the unit off and check if the thermal probe connection is interrupted. Probes are connected in series. - Switch the unit off and clean the regulator following the maintenance procedure.
Example: alarm on phase L1 	MINIMUM VOLTAGE	V_{out} over 6% below V_{target}	Check incoming voltage. Wait until the nominal condition is re-established.
Example: alarm on phase L1 		Gearmotor not rotating	Switch the unit off and try to move manually the carriage and therefore the motor. If necessary, replace with a spare one.

ALARM	ISSUE	POSSIBLE CAUSE	ACTIONS
	MAXIMUM VOLTAGE	Same as for Minimum voltage but with V_{max} LED	Check incoming voltage. Wait until the nominal condition is re-established.
	MAXIMUM CURRENT	- Iout over set threshold (unit overload) - Control board wrong reading (output instrument connector not tightened)	- Adjust the load so that the unit is not oveloaded. - Check the output instrument connections
	INPUT VOLTAGE SIGNAL FAILURE	Control board issue (terminal P27) or circuit fuses (if present)	Check that P27 terminal is correctly connected and that no fuse has blown. If necessary, replace the card with a spare one.
	PHASE FAILURE	Board signal defective (P30) or mains deficiency (in which case, the input voltage signal failure alarm switches on as well)	The unit could be working correctly. Check the voltage parameters and/or measure them at the unit I/O terminals. Check that P30 terminal is correctly connected. If necessary, replace the card with a spare one.

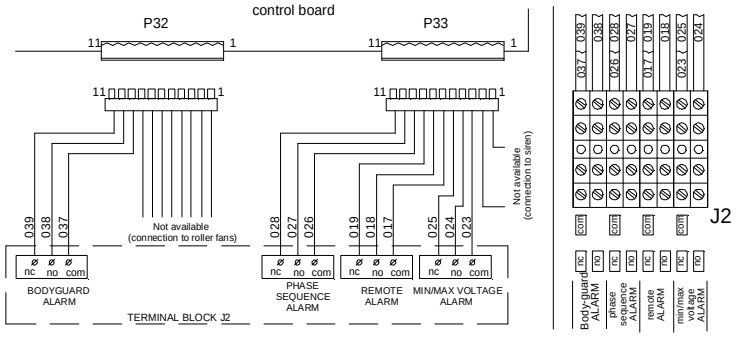
ALARM	ISSUE	POSSIBLE CAUSE	ACTIONS
	OUTPUT VOLTAGE SIGNAL FAILURE	Control board issue (terminal P30) or circuit fuses (if present)	Check that P30 terminal is correctly connected and that no fuse has blown. If necessary, replace the card with a spare one.
	STABILISATION OFF	Overload in the voltage regulator circuit (and likely on the whole unit) with intervention of the automatic protection ($V_{in} < V_{target}$ ⇨ $V_{out} = V_{in}$; $V_{in} > V_{target}$ ⇨ $V_{out} = V_{target}$)	Investigate and eliminate the overload source.
	OVERHEATING	Temperature measured around the board > 65°C. The system operates in the same way as with the stabilisation off alarm	Check that the air circulation inside the enclosure is not hindered by obstructed air inlet or defective roof fans. If necessary, replace a defective fan following the procedure explained in the maintenance chapter.
	LOCKED GEARMOTOR	Damaged or faulty component. For 13 mins, the system tries to restart the motor (with the LED temporarily turning green). Beyond that time, the alarm stops the regulation.	Switch the unit off and try to move manually the carriage and therefore the motor. If necessary, replace with a spare one.
	SHORT-CIRCUIT ON THE GEARMOTOR	Damaged or faulty component. The alarm stops the regulation without trying to restart it.	Replace with a spare one.

ALARM	ISSUE	POSSIBLE CAUSE	ACTIONS
	PHASE ROTATION ERROR	Supplying system configuration The system operates in the same way as with the stabilisation off alarm	Connect the board to a PC to check the alarm and adjust the relevant parameter.

11.2 ALARMS AVAILABILITY

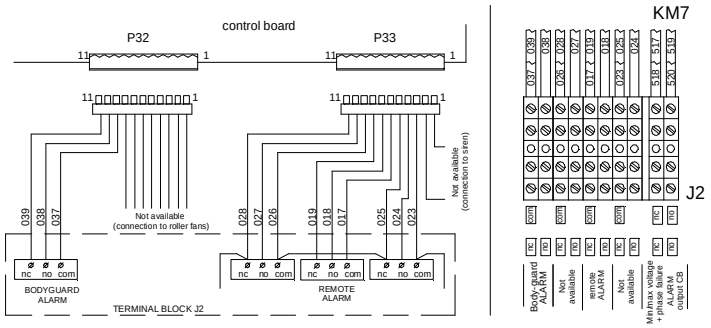
The alarm signal can be transferred to a remote position via the terminals included in the J2 auxiliary terminal block mounted below the electronic control card, to which is connected by means of the P33 terminal. The output contacts are designed for 3Amps maximum current (at 230Vac 50Hz or 24Vdc). The contacts are isolated between each other.

Note *The Remote Alarm relay on the control card switches when at least one alarm condition occurs (for example, output voltage in any of the phases higher than the maximum value, voltage in any of the phases lower than the minimum value, maximum current alarm, etc.).*



Standard unit

Note *If the unit is fitted with a 3xMCCBs bypass kit, the terminals dedicated to 'Phase sequence alarm' (wires 026, 027, 028) and 'Min/max voltage alarm' (wires 023, 024, 025) are not available. However, the alarms are made available on additional terminals in the J2 auxiliary terminal block. (see picture below).*



Unit with 3xMCCB bypass line

11.3 SERVICE

For any queries (including the request for spare parts) please contact the nearest authorised Service facility or the Manufacturer's Service Dept. always mentioning:

- **Type and factory code of the unit**
- **Serial number**
- **Purchasing Order or Invoice Number.**

MAINTENANCE LOG

⚠ ***DANGER*** ***ACCESS TO THE INTERNAL COMPONENTS FOR INSTALLATION, SETTING, INSPECTION AND MAINTENANCE MUST BE GRANTED ONLY TO QUALIFIED PERSONNEL IN CHARGE OF IT AND INFORMED OF THE RELEVANT RISKS. ANY INTERVENTION MUST BE CARRIED OUT IN COMPLIANCE WITH THE HABITUAL RULES ON PERSONAL SAFETY AND USE OF ADEQUATE PROTECTIVE TOOLS.***

For a description of the maintenance procedures and frequency, please refer to the relevant Section in the User's Manual. In case of abnormal situations (such as polluting or aggressive environment, heavy duty cycle, etc.) the maintenance frequency ought to be increased accordingly.

NOMINAL DATA			
TYPE	CODE	SERIAL NUMBER	RATING

ORDINARY MAINTENANCE		
CLEANLINESS	1	GENERAL
	2	VENTILATION AIR INLET
CHECK	3	MECHANICAL FIXTURES
	4	ELECTRICAL CONNECTIONS
	5	FAN OPERATION
	6	VOLTAGE REGULATOR COPPER SURFACE STATUS
	7	VOLTAGE REGULATOR ROLLER SURFACE STATUS
	8	ROLLER SUPPORT STATUS
	9	VOLTAGE REGULATOR CHAIN & VERTICAL GUIDES

RECORD (TICK THE RELEVANT BOX)											
1	2	3	4	5	6	7	8	9	COMPANY	DATE	SIGNATURE

EXTRAORDINARY MAINTENANCE			
DESCRIPTION	COMPANY	DATE	SIGNATURE

ORTEA SpA
Via dei Chiosi, 21
20873 Cavenago Brianza – Milan – ITALY
Tel.: ++39 02 95917800
www.ortea.com - ortea@ortea.com