



ESL-5

ENERGY SAVING DEVICE

USER'S MANUAL

MAT504 June 2021

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CONFORMITY DECLARATION

The Manufacturer,



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under its own responsibility and in the person of its Legal Representative

DECLARES

that the products:

ENERGY SAVING DEVICES

identified with the name:

ESL-5 (p/n QLLxxxxxxxxxxxxx)

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 **ISO 9001:2015** Standards.

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 **OHSAS18001:2007 (in transition towards 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 energy saving devices 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 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 the present 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

⚠ 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 NOTES

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: the potential removal of the protections 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 or key-locked panels. In normal working conditions, the unit operates only with the enclosure 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.
- 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.
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.
FAILURE TO CARRY OUT MAINTENANCE	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 energy saving device 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. If changes are required, contact the Manufacturer or an authorised Service Centre.
- use of improper or 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.

⚠ 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	MAINTAINER	DANGER	CONSEQUENCE
	SAFETY SHOES	☼	☼	Bumping, tripping, slipping, crushing limbs	Bruises, abrasions, cuts, sprains, dislocations, fractures
	SAFETY GLOVES	☼	☼	Contact with sharp edges	Bruises, abrasions, cuts
	SAFETY DIELECTRIC GLOVES		☼	Contact with live parts when testing an energized unit	Electrocution
	HELMET		☼	Head injuries due to 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 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

The Energy Saving devices are designed to perform the following tasks:

- Energy quality improvement
- Optimization of the connected loads efficiency ensuring their best performance
- Achievement of energy saving by adjusting the output voltage
- Balance of the reactive energy transfer

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 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 habitually found because of converters, non-linear load, transients, and so on;
- regulation performed independently on each single phase (referring to the neutral, which must be available and connected);
- fully functioning with load charge variable from 0 to 100% and 100% phase unbalance.
- up to 30% harmonic content admitted on the load current. With higher percentage, nominal power must be derated.
- insensitivity to the load power factor
- absence of generation of noticeable harmonic distortions in the output voltage.

The main components are:

- Voltage regulation circuit (obtained via a three-phase 'buck/boost' transformer and a motorised three-phase autotransformer with continuously variable transformer ratio, also called voltage regulator);
- Control electronic circuit

5.1 PROTECTIONS

PROTECTION	IN CASE OF	ACHIEVED THROUGH
MOTOR ROTATION STOP	Motor overloaded	Control card
MOTOR ROTATION STOP	Motor short-circuit	Control card
OVERLOAD ON THE VOLTAGE REGULATOR	Excessive current flowing through the regulator	Control card
ROOF FANS ACTIVATION (IF PROVIDED)	T ambient > 35°C	Adjustable thermostat
VOLTMETER LINES AND MOTOR SUPPLYING CIRCUITS	Circuit overload	Fuses
CONTROL CARD PROTECTION	Card overload	Two 5x20 10A delayed fuses
ROOF FANS RELAYS	Card overload	Four 5x20 10A delayed fuses

The intervention of any of the above mentioned protections (except for the fuses) is signalled an acoustic alarm, disabled by default and re-settable via a dip-switch.

5.2 REGULATOR OVERCURRENT PROTECTION ('SAFE ON')

The protection is automatically controlled by the control card which intervenes when the regulator rollers are overcharged by a high current. When this situation is detected, the control card drives 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 ENERGY SAVING CALCULATION

6.1 INTRODUCTION

The control card manages and continuously adjust the energy flux in each supply phase, maintaining its level at the most suitable one for the plant and the supplied equipment.

The control card microprocessor detects, stores and transfers the values of the parameters defining unit and mains operation, amongst which in particular power, voltage and energy.

Said values are then made available for the determination of the generated energy saving.

The data measured by the instrumentation on board and the generated energy saving are made available on the cloud platform Enercloud, where they are always visible and downloadable by the User.

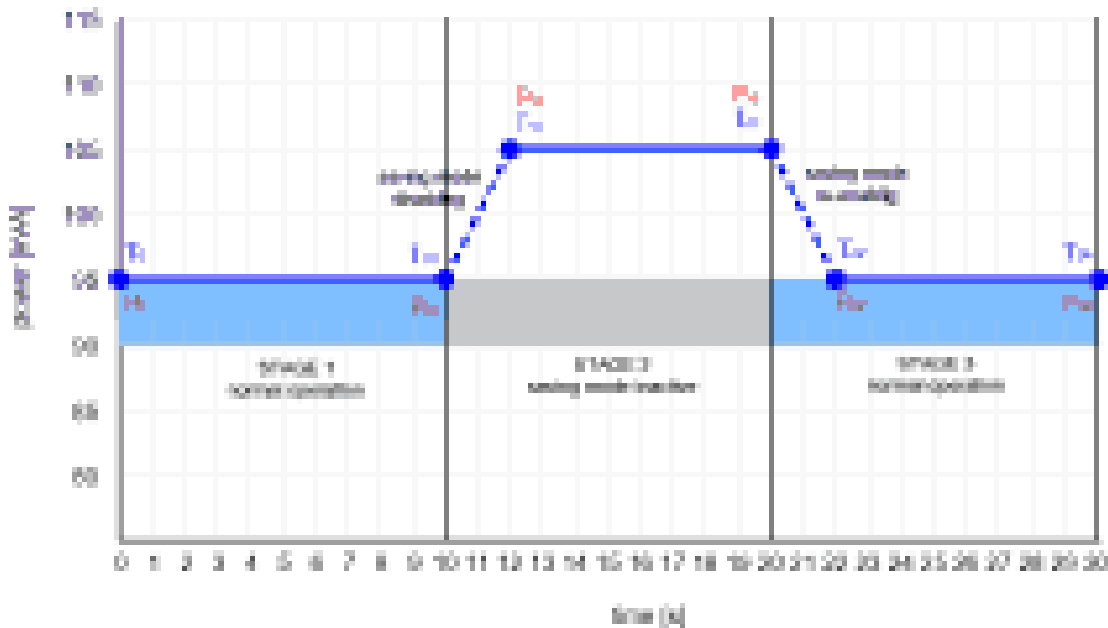
6.2 CALCULATION ALGORITHM

The unit's performance evaluation method provides with the instantaneous, daily and cumulative saving parameter ('S_%'). The algorithm is based on the International Performance Measurement and Verification Protocol ('IPMVP') and the ESPRO Protocol by ENEA as far as both the calculation of the instantaneous saving 'S_%' and the data sampling are concerned.

Every day is divided into 96 intervals, each of 15 minutes. During each interval a sampling routine (i.e. the measurement of the parameters) is performed.

The sampling routine lasts 30 seconds, during which the unit's operating status and the relevant electrical data are detected. There are three measurement stages:

STAGE	INTERVAL	UNIT BEHAVIOUR
1	initial 10 seconds (t ₀ - t ₁₀)	Normal operation (<i>saving mode enabled</i>)
2	central 10 seconds (t ₁₀ - t ₂₀)	The unit disables the saving mode and settles in a 'frozen' status as if it was not connected. This change takes place without any manoeuvring device such as switches or contactors.
3	final 10 seconds (t ₂₀ - t ₃₀)	Return to normal operation (<i>saving mode enabled</i>)



During the sampling procedure, voltage, active power and active energy are measured six times (t₀, t₁₀, t₁₂, t₂₀, t₂₂ and t₃₀ instants).

t₁₂ and t₂₂ measurements take into consideration the output voltage especially and their purpose is to highlight the unit's change of status, as they are taken 2 seconds after disabling and re-enabling the saving mode.

The comparison between the active power measured when the saving mode is ON (stages 1 and 3) and measured when the saving mode is OFF (stage 2) allows for the calculation of the associated saving S_%.

From the six instantaneous detected (P₀, P₁₀, P₁₂, P₂₀, P₂₂, P₃₀), the following is obtained:

P_{saving ON} = avg(P₀, P₁₀, P₂₂, P₃₀) average power measured when the saving mode is ON

P_{saving OFF} = avg(P₁₂, P₂₀) average power measured when the saving mode is OFF

The percentage energy saving can therefore be expressed as:

$$S_{\%} = 1 - \frac{P_{\text{savingON}}}{P_{\text{savingOFF}}}$$

All the calculated **S%** values are validated via control performed later:

- check that the measurement cycle did not take place at the same time as a plant change of status. (This circumstance is detected and identified as such by comparing the powers measured during the sampling cycle, as per ESPRO protocol);
- check that samplings occurred when the plant absorption is low are discarded. In that condition, measurement uncertainties might invalidate the **S%** value (as indicated in the ESPRO protocol, the criterion foresees minimum thresholds regarding the absorbed power).

Once the **S%** values are known, the aggregated parameters are determined: daily, weekly and cumulative saving, both percentage and absolute.

The root mean square of the **S%** values that were deemed valid in a day (according to the ESPRO validating criteria) is taken as daily saving.

The Enercloud platform publishes the daily and weekly savings and stores them up to 18 months.



7 INSTALLATION & COMMISSIONING

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

7.1 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 and leave 150-200mm clearance to allow for air circulation.

Check that anti fire devices are available in the area.

7.2 ACOUSTIC PRESSURE LEVEL

The unit does not constitute a significant noise source during normal operation. However, the unit has been designed in order to limit the equivalent continuous weighted acoustic pressure level (dBA). Indicatively, the value is within the 60 to 65 dBA range. It is also worth mentioning that very often the characteristics of the installation site and the presence of other machinery or noisy sources prevail on the noise produced by the unit.

7.3 ELECTRICAL CONNECTION

 **DANGER THE ENERGY SAVING DEVICE 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.**

7.3.1 Supply

The supplying line must comply with the nameplate technical data. The unit is not protected against short-circuit or overload. In compliance with the safety regulations in force, the installation should take place in a system fitted with:

- an interrupting device with capacity referred to the maximum input current upstream the unit
- an interrupting device with capacity referred to the output current downstream the unit

The above mentioned circuit breakers are not included in the standard unit, but they can be provided as optional accessories.

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 to allow the load to be fed directly from the mains in case the unit is switched off for maintenance or internal failure.

7.3.2 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]
$S \leq 16$	S
$16 < S \leq 35$	16
$35 < S \leq 400$	S/2
$400 < S \leq 800$	200
$S > 800$	S/4

Note If a not standardised cross-section is found when applying this data, choose the nearest larger one.

⚠ WARNING FOR THE CORRECT OPERATION OF A THREE-PHASE UNIT, 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.

7.4 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 and control card are energised.

7.5 SETTINGS

⚠ DANGER DANGEROUS VOLTAGE IS PRESENT INSIDE THE EQUIPMENT 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.

7.5.1 Dip switch

REF.	PARAMETRE	POSITION	DEFAULT
SWA DIP1 SWA 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=ON DIP2=OFF
SWA DIP4	Acoustic alarms disabling. Internal buzzer and external siren are cut off	ON = acoustic alarms off OFF = acoustic alarms on	ON
SWB DIP1	Minimum regulation enabling. Activates the voltage resetting to the minimum value in case of blackout (if fitted with supecapacitors)	ON = enabled OFF = disabled	ON
SWB DIP2	Min/max voltage alarm enabling. Enables the generation of an alarm in case the output voltage is out of range for at least 10s. The threshold is set via the R130 trimmer and a software parameter.	ON = enabled OFF = disabled	ON
SWB DIP4	Automatic reset of stored alarms. When enabled, the alarm reset occurs after 180s without any active alarm.	ON = enabled OFF = disabled	OFF

8 MAINTENANCE

8.1 FOREWORD

⚠ 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.

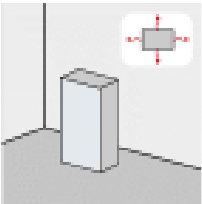
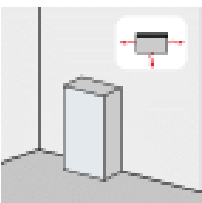
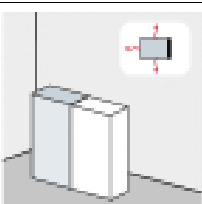
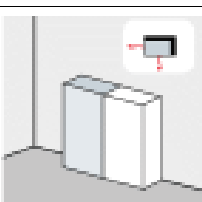
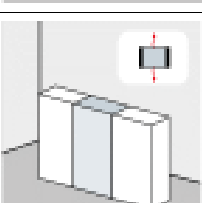
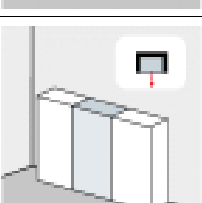
⚠ DANGER EVERY MAINTENANCE OPERATION MUST BE DONE WHILE THE UNIT IS DISCONNECTED FROM THE MAINS.

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:

8.2 CONDITIONS FOR MAINTENANCE

Maintenance activities can be performed only if clearances are ensured around the unit.

Beside the front (which is presumed to be clear), at least another side must be available. The possible configurations are:

	<p>4 clear sides Best configuration to perform maintenance.</p>
	<p>Front and sides clear. Maintenance possible (provided that the clearance be at least 800mm).</p>
	<p>Front, rear and 1 side clear. Maintenance possible if at least 800mm are available at the rear and the side.</p>
	<p>Front and 1 side clear. Maintenance possible provided that: 1. clearance at the side is at least 800mm 2. the internal configuration allows access from the clear sides. For more information, please contact the after-sale Service).</p>
	<p>Front and rear clear. Maintenance possible (but potentially difficult) if at least 800mm are available at the rear.</p>
	<p>Only the front is clear. Maintenance impossible. The unit must be moved. Please contact the after-sale Service to agree on how to proceed.</p>

8.3 MAINTENANCE ACTIVITIES

8.3.1 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.

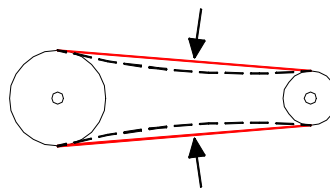
8.3.2 Roof fans

WHAT TO DO	HOW	WHY
Check that the airflow coming out from the turrets is regular. Keep clean the air outlets and the fans.	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 ambient thermostat. Before proceeding with the replacement, check the temperature threshold that determines the activation.	<ul style="list-style-type: none"> • 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.

8.3.3 Voltage regulator

In a toroidal regulator the copper track is wound on a toroidal core. The mobile contacts are fixed on an L-shaped support anchored to the regulator axis and move around the winding.

WHAT TO DO	HOW	WHY
Check that the regulator rollers are not broken, chipped, scratched or irregularly consumed (flat areas)	The rollers must rotate freely while their support moves along the winding. By moving the rollers slowly, check that their movement is smooth and uniform. The width of the contact surface must not be larger than the width of a turn of the winding.	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.
Check and if necessary adjust the belt tension (when applicable)	Loosen the screws that fix the motor supporting plate. The clamping holes allow for little adjusting movements. Move the plate to adjust the belt tension and tighten the screws back in position. A correct tension allows for a deflection towards the inside equal to 4 or 5 times the thickness of the belt.	If the belt is too tight there would be too much friction and therefore potential damage to the motor driving the pulley. If the belt is too loose it could fall off, thus interrupting the transmission chain and therefore the regulation



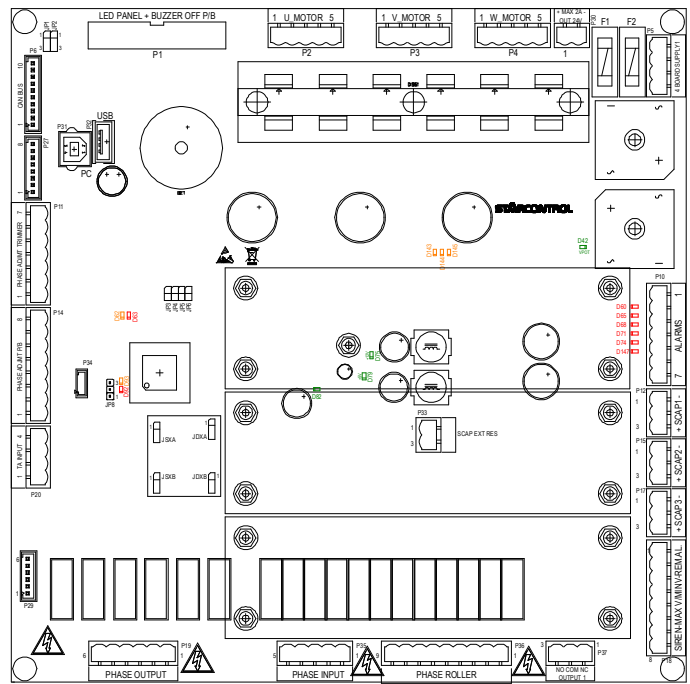
9 CONTROL CARD

The control card runs the unit by regulating each phase independently and also monitors the output currents and generates an alarm in case of overcurrent. Under normal working conditions, the output voltage is maintained stable with an accuracy equal to $\pm 0.5\%$ 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 a DSP microprocessor (DIGITAL SIGNAL PROCESSOR) that works as a *controlling* and *measuring CPU*. By means of this device, the card reads line voltage, settings, motor current and inputs and drives each motor directly by imposing direction and speed.

On the basis of the motor current, the card elaborates also the protections against overload and short-circuit for the motor itself.

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



9.1 PROTECTIONS

9.1.1 Motor stop or overload

The control estimates if the motor is overloaded or either the motor or the relevant kinematic mechanism is blocked. The thermal energy (i.e. the current) released is measured and if the value exceeds a set threshold, an alarm is generated.

9.1.2 Short-circuit

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

9.2 CONTROL CARD LEDs

REF.	COLOUR	PARAMETRE	ON	OFF	BLINKING
D62	yellow	CPU activity	CPU blocked	blocked CPU or absent SW	Status OK
D63	red	Active alarm signal	one or more active alarms	No active alarm	Startup status
D93	yellow	CPU programming	-	Normal status	-
D92	red	CPU programming	-	Normal status	-
D60	red	Spare 1 input	active	inactive	-
D65	red	Spare 2 input	active	inactive	-
D68	red	Current alarm input	active	inactive	-
D71	red	Temperature alarm input	active	inactive	-
D74	red	Fan alarm input	active	inactive	-
D147	red	Spare 3 input (NOT USED)	active	inactive	-
D143	yellow	Phase U motor current limitation intervention	Active limitation	Inactive limitation	-
D144	yellow	Phase V motor current limitation intervention	Active limitation	Inactive limitation	-
D145	yellow	Phase W motor current limitation intervention	Active limitation	Inactive limitation	-
D42	green	Card supply	28VDC present	28VDC absent	-
D75	green	+12VDC supply	12VDC present	12VDC absent	-
D79	green	+5VDC supply	5VDC present	5VDC absent	-
D82	green	+3,3VDC logic supply	Present	absent	-

10 ALARMS & SERVICE

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In case of anomalies 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.

10.1 ALARM SIGNALS

Note With reference to the table below, the REM1 relay is connected to the P37 terminal block and the REM2 relay is connected to the P18 terminal block.

ISSUE	ACTIVE RELAIS	POSSIBLE CAUSE	ACTIONS
ROLLER OVERHEATING	REM1 REM2	Overload on the regulator	Check column surface (colour). Investigate and eliminate the overload source.
		Failure of the thermal probe on the central roller of each roller group	Switch the unit off and check if the thermal probe connection is interrupted. Probes are connected in series.
		Presence of dirt or dust on the regulator surface (incorrect roller contact)	Switch the unit off and clean the regulator following the maintenance procedure.
MINIMUM VOLTAGE	MIN-MAX REM1	V_{out} lower than V_{target} beyond the set tolerance (default: 6%)	Check incoming voltage. Wait until the nominal condition is re-established.
		Locked gearmotor	Switch the unit off and try to manually move the carriage and therefore the motor. If necessary, replace with a spare one.
MISSING PHASE(S)	MIN-MAX REM1	Card signal defective (P30) or mains deficiency	The unit could be working correctly. Check the voltage parameters on the instruments and/or by measuring at the unit I/O terminals. Check that P30 terminal is correctly connected. If necessary replace the card with a spare one.
MAXIMUM VOLTAGE	MIN-MAX REM1	Same as for Minimum voltage but with V_{max} LED	Check incoming voltage. Wait until the nominal condition is re-established.
MAXIMUM CURRENT	MIN-MAX REM1	I_{out} over set threshold (unit overload)	Adjust the load so that the unit is not overloaded.
		Control card wrong reading (output instrument connector not tightened)	Check the output instrument ammeter connections.
INPUT VOLTAGE SIGNAL FAILURE	MIN-MAX REM1	Control card 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.
OUTPUT VOLTAGE SIGNAL FAILURE	MIN-MAX REM1	Control card 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.
SAVING FUNCTION OFF	REM1	Overload in the voltage regulator circuit and intervention of the electronic protection ($V_{in} < V_{target} \Leftrightarrow V_{out} = V_{in}$; $V_{in} > V_{target} \Leftrightarrow V_{out} = V_{target}$)	Investigate and eliminate the overload source.
INTERNAL OVERHEATING	REM1 REM2	Temperature measured around the card > 65°C. The system operates in the same way as with the saving off alarm	Check that the air circulation inside the enclosure is not hindered. If necessary, replace a defective fan following the procedure explained in the maintenance chapter.
LOCKED GEARMOTOR	REM1 REM2	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 manually move 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..

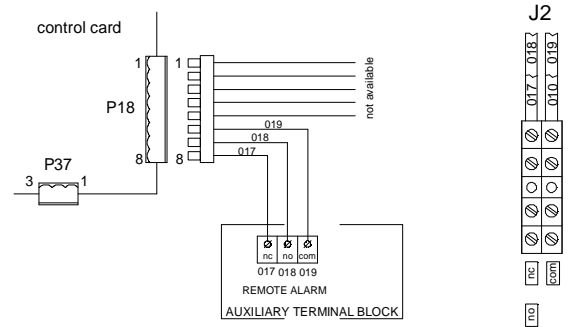
ISSUE	ACTIVE RELAIS	POSSIBLE CAUSE	ACTIONS
PHASE ROTATION ERROR	MIN-MAX REM1	Supplying system configuration The system operates in the same way as with the saving off alarm	During installation, connect the card to a PC to check the alarm and adjust the relevant parametre
			During operation the issue is on the supplying line.
SERVICE REQUIRED	N.A.	Set total working hours and/or motor movement threshold exceeded	Please contact the Service Dept.

10.2 ALARM SIGNAL TRANSFER

10.2.1 REM1 relay (terminal P18)

The alarm general 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 P18 terminal (wires 017, 018, 019). The output contacts are designed for 3Amps maximum current (at 230Vac 50Hz or 24Vdc). The contacts are isolated between each other.

Note The REM1 Remote Alarm relay on the control card activates when **at least one** of the alarm conditions listed in the table occurs. The remote signal could therefore indicate the presence of several simultaneous alarms.



10.2.2 REM2 relay (terminal P37)

The REM2 relay on the control card manages cumulatively four specific alarms already described for the REM1 relay:

- Gearmotor locked due to a short-circuit
- Gearmotor locked due to a mechanical issue
- Overheating on the regulator rollers
- Overheating inside the enclosure

By connecting to the P37 terminal with a suitable connector, these alarm signal can be remoted separately.

Note The REM2 Remote Alarm relay on the control card activates when **at least one** of the alarm conditions listed above occurs. The remote signal could therefore indicate the presence of several simultaneous alarms.

10.3 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.

11 ACCESSORIES ON REQUEST

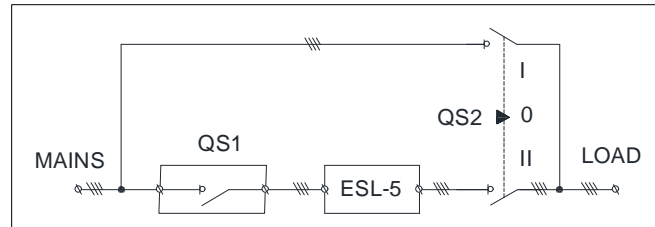
11.1 MANUAL BYPASS LINE

⚠ ACCESS TO THE INNER COMPONENTS FOR INSTALLATION, SETTING, INSPECTION AND MAINTENANCE MUST BE GRANTED ONLY TO QUALIFIED PERSONNEL IN CHARGE OF IT. ANY OPERATION THAT MIGHT INVOLVE THE UNIT TO BE ENERGISED MUST BE CARRIED OUT IN COMPLIANCE WITH THE ENFORCED REGULATIONS AND LEGISLATION CONCERNING PERSONAL SAFETY AND THE USE OF ADEQUATE PROTECTIVE TOOLS.

The by-pass circuit enables the unit to be segregated from the mains. The operator can therefore access the internal components safely and perform maintenance or repairing sessions without having to disconnect the load. For the duration of the bypass condition, the load is directly fed by the mains, hence the energy saving device functions are not operative. Depending on the nominal current, the bypass line can be hosted either in a dedicated cabinet beside the unit or inside the main cabinet. The passage through the switch '0' position, cause a short disconnection. The bypass line is obtained by means of:

- a load-break switch on the input line (QS1)
- a three-position (I-0-II) changeover interlocked switch on the output line (QS2)

This arrangement allows for different working possibilities:



QS2	QS1	STATUS
I open – II closed	closed	load supplied via the unit and bypass line open
I closed - (II open)	closed	load supplied via the bypass line. The unit is energised, but its output line is interrupted
I closed - II open	open	load supplied via the bypass line and unit not energised
0	open	load not supplied

12 TECHNICAL DATA

ENERGY PARAMETERS REGULATION	independently on each phase
ADJUSTABLE TARGET VOLTAGE	210V to 240V (L-N) 364V to 416V (L-L)
ADMITTED VARIATION OF ENERGY PARAMETERS	+10/-0%
INPUT VOLTAGE RANGE	Vout +10%
OUTPUT VOLTAGE ACCURACY	±0,5%
FREQUENCY	50Hz o 60Hz (±5%)
ADMITTED LOAD VARIATION	up to 100%
EFFICIENCY	> 98%
COOLING	natural ventilation (from 100kVA, aided by fans over 35°C)
AMBIENT TEMPERATURE	-25/+45°C
STORAGE TEMPERATURE	-25/+60°C
MAXIMUM RELATIVE HUMIDITY	<95% (not condensed)
MAXIMUM ADMITTED LOAD	200% 2min.
HARMONIC DISTORTION	none introduced
COLOUR	RAL 7035
PROTECTION DEGREE	IP 21
INSTRUMENTATION	cloud platform EnerCloud
INSTALLATION	indoor
BYPASS SYSTEM	automatic electronic safe on

ESL-5 Data referred to the nominal output voltage (400V)

TYPE	RATING [kVA]	MAX INPUT CURRENT [A]	OUTPUT CURRENT [A]	DIMENSIONS [mm]	WEIGHT [kg]
45-5	45	72	65	410 x 690 x 1140	160
63-5	63	101	91	410 x 690 x 1140	200
100-5	100	160	144	600 x 600 x 1600	315
125-5	125	200	180	600 x 600 x 1600	320
160-5	160	257	231	600 x 800 x 1600	425
200-5	200	321	289	600 x 800 x 1800	460
250-5	250	401	361	600 x 800 x 1800	520

MAINTENANCE LOG

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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), the maintenance frequency ought to be increased accordingly.

NOMINAL DATA			
TYPE	TYPE	TYPE	TYPE

ORDINARY MAINTENANCE			
CLEAN	a	GENERAL	ANNUALE
	b	VENTILATION AIR INLET	SEMESTRALE
CHECK	c	MECHANICAL FIXTURES	ANNUALE
	d	ELECTRICAL CONNECTIONS	ANNUALE
	e	FAN OPERATION	ANNUALE
	f	ROLLERS	ANNUALE
	g	BELT (WHEN APPLICABLE)	ANNUALE

RECORD (TICK THE RELEVANT BOX)								
a	b	c	d	e	f	g	DATE	SIGNATURE

EXTRAORDINARY MAINTENANCE		
DESCRIPTION	DATE	SIGNATURE

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