

ESL-10

ESL-20

ENERGY SAVING DEVICE

USER'S MANUAL

MAT503 May 2026

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May26	21.05.26	Chapter 7.6 amended

CONFORMITY DECLARATION

The Manufacturer,

**ORTEA SpA**

Via dei Chiosi, 21 20873 Cavenago Brianza (MB) – ITALY

Tel.: ++39 02 95917800

www.orteanext.com - ortea@ortea.com

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

DECLARES

that the products:

ENERGY SAVING DEVICES

identified with the name:

ESL-10; ESL-20 (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,

COMPLYwith 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

DECLARESthat 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 **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.orteanext.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 voltage stabilisers 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 an integral part of 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 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.*

1.3 REFERENCE

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 Part 1 and Part 2 (Low-voltage switchgear and controlgear assemblies) Harmonised Standard
- where applicable, CEI 0-21 (Technical reference standard for the connection of active and passive users to the low-voltage networks of electricity distribution companies)

 **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.*

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 saving valuable resources and preventing any potential negative effects on human health and the environment, which could otherwise arise from inappropriate waste handling.

In this respect, the following tables list the type of materials found in the equipment described in this manual.

Packaging

TYPE	MATERIAL	EWC CODE *	CODE EX 97/129/EC
Pallet, crate, cage	Wood	15 01 03	FOR 50
Box	Cardboard	15 01 01	PAP 20
Plastic protective film	Polyethylene	15 01 02	LDPE 4
Bubble wrap	Polyethylene	15 01 02	LDPE 4
Plastic strap	Polyethylene	15 01 02	PET 1
Polystyrene	Polistyrene	15 01 02	PS 6

Unit

PART/COMPONENT	MATERIAL	EWC CODE *
External panels, frame, supports, plates	Steel	17 04 05
Power & auxiliary transformers, voltage regulators, reactors	Magnetic parts	16 02 14
Electronic PCBs	Boards	16 02 16
Instruments, breakers, contactors, thermostats, relays, fuses	Non-dangerous removable components	16 02 16
Wire ducts, fans, protective screens	Plastic	15 01 02
Busbars	Aluminium	17 04 02
Power & auxiliary cables	Sleeved copper wires	17 04 11
Documentation	Paper	15 01 01

* = European Waste Catalogue

The product does not contain CFCs, HCFCs, asbestos, fuel, PCB, PCT, liquids or gaseous substances. 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 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. 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 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 slightly) 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 repair 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 communication	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 voltage stabiliser 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. 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 Service Dept.
- 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.

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

 **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 condition 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 Energy Saving devices, 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 de-rated.
- 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);
- Emergency bypass circuit
- Control electronic circuit

5.1 PROTECTIONS

PROTECTION	IN CASE OF	ACHIEVED THROUGH
Voltage reset to the minimum value	Black-out	Electrolytic capacitors or supercapacitor banks mounted on the control card
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. While the protection is active, the red alarm LED 'Safe ON' on the front panel is on.
Roof fans activation	T ambient > 35°C	Adjustable thermostat
Voltmeter lines and motor supplying circuits	Circuit overload	Fuses
Control card	Card overload	Two 5x20 10A delayed fuses
Roof fans relays	Card overload	Four 5x20 10A delayed fuses
Overvoltage	Lightning	Input Class I SPDs
Overvoltage	Transients & spikes	Output Class II SPDs

The intervention of any of the above mentioned protections (except for the fuses) is signalled by luminous and acoustic alarms. The latter is disabled by default and can be enabled by means of dipswitches).

5.2 REGULATOR OVERCURRENT PROTECTION

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.

5.3 EMERGENCY 'BYPASS'

The purpose of the circuit is to section off the regulating components yet maintaining the load supply.



DANGER The emergency bypass DOES NOT isolate the unit electrically.

	QS7	Push-button on the front panel. Its pression start a sequency that bring the unit into emergency bypass.
	HL1	Emergency bypass signal on the front panel showing that KM5 is closed (closed = ON; open = OFF)
	KM6	Contactur closing the primary circuit.
	KM5	Contactur short-circuiting the TM1 buck/boost transformer primary
	KM7	Contactur opening the VT regulator supply
	FU27	KM5 coil protection fuse
	FU25	KM6 coil protection fuse
	FU31	KM7 coil protection fuse

Status of components under normal operating conditions

COMPONENT	STATUS	POSITION
QS7	DISABLED	OFF
KM6	ENERGISED	ON
KM5	DE-ENERGISED	OFF
KM7	ENERGISED	ON
HL1	OFF	-

 **WARNING** During normal operation, switches QF3, QF4 and QF5 must be closed.

5.3.1 Procedure for activating "Emergency Bypass" mode

 **DANGER** Check that the input voltage is not at a dangerous level before starting the procedure. This procedure sets the output voltage (V_{out}) equal to the input voltage (V_{in}).

Circuit activation procedure

- Press the **QS7** button located on the outside of the door. Provided there are no faults with the motor and/or the electronic board, the carriages move into a position such that $V_{out} = V_{in}$.
- Contactors **KM6** opens, breaking the primary circuit of transformer TM1; contactor **KM5** closes (coil energised), causing lamp **HL1** and the "Safe ON" LED on the control panel to light up. Contactor **KM7** opens automatically, cutting the power supply to autotransformer VT.
- Check that $V_{out} = V_{in}$ (a small deviation of 1 to 3 volts is acceptable)

 **DANGER** In this configuration, both the load and the unit ARE ENERGISED.

Status of components during emergency bypass:

COMPONENT	STATUS	POSITION
QS7	ENABLED	ON
KM6	DE-ENERGISED	OFF
KM5	ENERGISED	ON
KM7	DE-ENERGISED	OFF
HL1	ON	-

5.3.2 Procedure for securing the unit's control compartment prior to carrying out maintenance work

 **WARNING** Ensure that the unit has been set to "Emergency Bypass" mode as described in section 5.3.1.

- Check that the status of the components is:

COMPONENT	STATUS	POSITION
QS7	ENABLED	ON
KM6	DE-ENERGISED	OFF
KM5	ENERGISED	ON
KM7	DE-ENERGISED	OFF
HL1	ON	-

- Open switches **QF3**, **QF4** and **QF5** to electrically isolate the control circuit (the order in which they are opened is not critical).
- Open the auxiliary disconnectors **QS10** and **QS11** fitted inside the enclosure housing the external control panel.

 **DANGER** Before carrying out any work, use a suitable test instrument to check that there is no voltage inside the control compartment.

- Check that:

TEST POINTS	VOLTAGE TO BE EXPECTED
Measure of voltage values on the VT power supplies (both phase-to-phase and phase-to-neutral).	0 V
Measure of voltage values on the circuits relating to the VT carriages.	0 V
Measure of voltage values relating to the VT auxiliary circuits.	0 V
Measure of other voltage values relating to other auxiliary circuits in the compartment (ventilation, etc.).	0 V

- The condition of the components will be as shown in the table below:

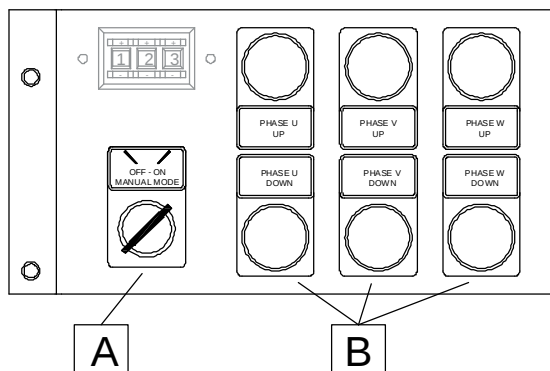
COMPONENT	STATUS	POSITION
QS7	ENABLED	ON
KM6	DE-ENERGISED	OFF
KM5	ENERGISED	ON
KM7	DE-ENERGISED	OFF
HL1	ON	-
QF3	OPEN	OFF
QF4	OPEN	OFF
QF5	OPEN	OFF
QS10	OPEN	OFF
QS11	OPEN	OFF

5.3.3 Return to regular operation after maintenance

Having carried out the necessary operations, follow the instructions below to resume normal operation:

Move the roller carriages to the central position (aligned with one another) by moving them manually or using the manual control buttons. By moving selector switch A to the ON position, the panel shown below allows you to increase or decrease the tension in each phase by pressing buttons B, thereby adjusting the position of the rollers.

⚠ WARNING Manual mode may only be used when the Emergency Bypass is active.



- Close the auxiliary disconnectors **QS10** and **QS11** fitted inside the enclosure corresponding to the control panel's location.
- Close all 3 circuit breakers **QF3**, **QF4** and **QF5** (the order in which they are closed is not critical).
- Only now** release the **QS7** button located on the outside of the door using the appropriate key.
- Contactor **KM7** closes (coil energised), contactor **KM5** opens (coil de-energised) and contactor **KM6** closes, causing the **HL1** lamp to switch off.
- Press the **Silencer** button on the control panel for a few seconds to switch off the red "Safe ON" LED.
- The unit returns to normal operation.
- Check that the components have assumed the status indicated in the table below:

COMPONENT	STATUS	POSITION
QS7	DISABLED	OFF
KM6	ENERGISED	ON
KM5	DE-ENERGISED	OFF
KM7	ENERGISED	ON
HL1	OFF	-
QF3	CLOSED	ON
QF4	CLOSED	ON
QF5	CLOSED	ON

5.4 REMOTE COMMUNICATION

5.4.1 Data Acquisition

Data collection is managed via the Kunbus RevPi DIO (Digital Input & Output) expansion module, which collects signals from the control board (alarms), the multimeters (electrical parameters) and the temperature sensor. This information is then transferred to the gateway for transmission to the cloud.

5.4.2 Data transmission to the XCloud platform

The unit is configured to send information regarding its operation and any alarms to the XCloud monitoring platform. A Kunbus RevPi Connect S gateway is located within the unit for data collection and transmission.

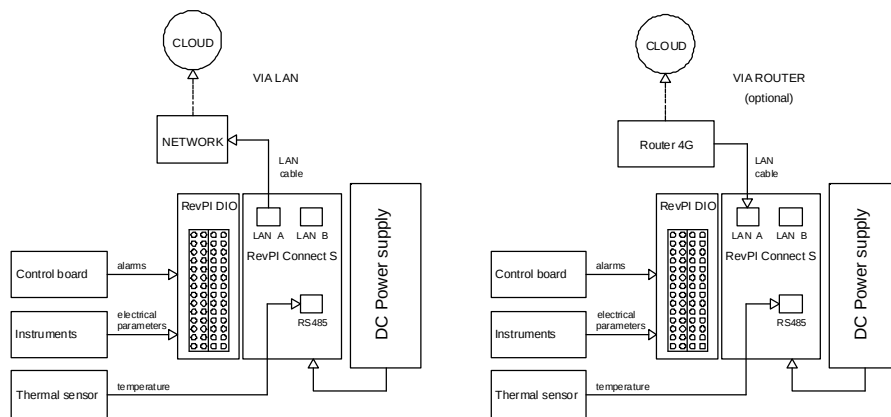


Data transmission can take place via one of the following methods:

- A physical connection via a LAN cable between the Gateway (LAN port A) and the customer's network. The network parameters must be configured in accordance with the procedure described below (section 7.6).

- Connection of a B810 Group P1348D5913 4G router (**optional**), equipped with a multi-provider SIM card, to the Gateway (LAN port A). This configuration allows the Customer's network to be bypassed and avoids the need to configure network parameters.

WARNING When the gateway is connected via a router, data transmission begins as soon as the stabiliser is powered up.



The parameters and alarms to be monitored are updated every 15 minutes.

5.5 USE OF THE ESL DEVICE IN THE PRESENCE OF ACTIVE LOADS (CEI 0-21)

The most common examples of active loads are photovoltaic systems and (more rarely) wind turbines.

Although functionality is generally required only in a bidirectional system, the issue involves two aspects:

- Functionality of the unit, regarding which, based on experience, it can be stated that the ESL device is capable of operating without problems in bidirectional systems
- Regulatory compliance, regarding which clarifications are required concerning the composition of the system and the positioning of the ESL device.

The relevant national standard is CEI 0-21 which, as the title suggests, sets out the "Technical reference standard for the connection of active and passive users to the low-voltage networks of electricity distribution companies" and plays a fundamental role for distributed generation systems connected to low-voltage networks (<1 kV).

At European level, the equivalent reference is provided by Standard EN 50549-1 (Requirements for generating plants to be connected in parallel with distribution networks Part 1: Connection to a LV distribution network - Generating plants up to and including Type B), which applies to LV systems (<1 kV). The nominal mains voltage for a single-phase AC line is 230V with a tolerance of $\pm 10\%$. A single-phase AC voltage within the range 207–253V is therefore considered to meet the standard's requirements.

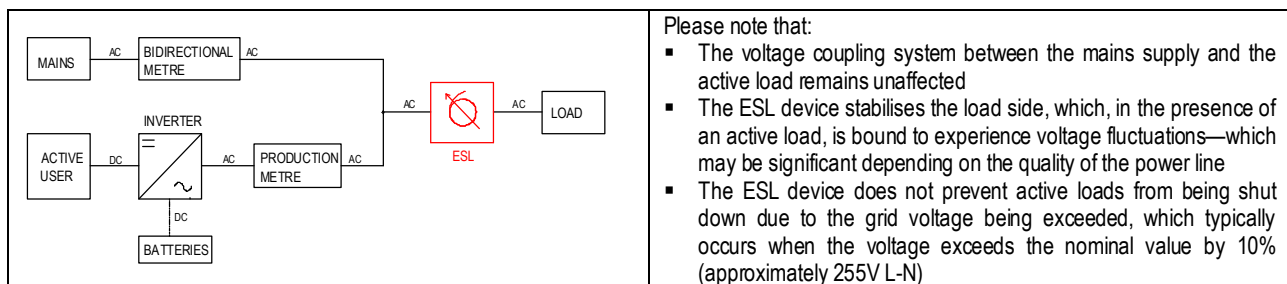
A grid overvoltage is therefore defined as a voltage exceeding 253V, a value which constitutes the trip threshold at which the inverters of active loads go into protection mode, halting energy production.

The CEI 0-21 standard prohibits the installation of devices that could prevent the protection mechanism from tripping in the event of overvoltages, i.e. the shutdown of the inverters. Two types of configurations can therefore be identified.

5.5.1 CONFIGURATION 1: ESL device on the consumer branch – Active consumer connected upstream

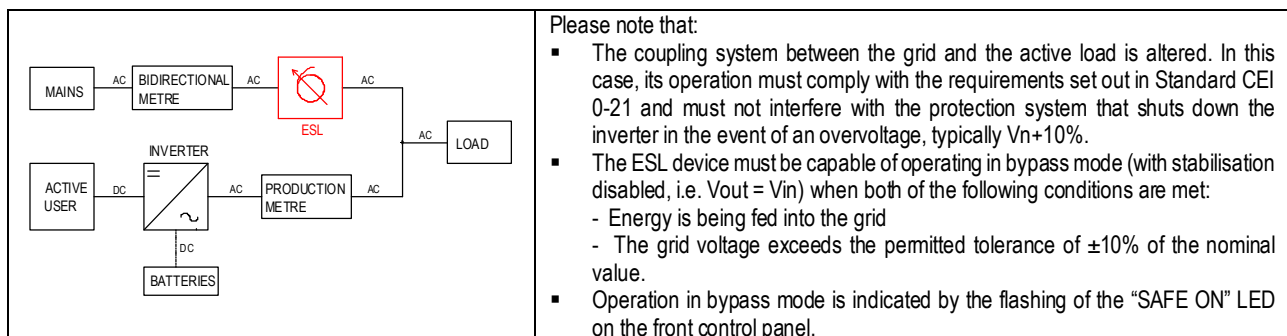
In this case, the ESL device performs its function regardless of the relationship between the mains supply and the active consumer, which operate in parallel.

The device detects an input voltage and operates on that. The load will be supplied with a stabilised voltage, which would not be the case if the equipment were not present.



5.5.2 CONFIGURATION 2: ESL device on the mains branch – Active load connected downstream

The device is connected downstream of the meter and operates in both directions.



This bypass system is implemented in the equipment at the software level and is made possible by a relay (connected to one of the measuring instruments) which authorises the switch to bypass mode.

6 ENERGY SAVING CALCULATION

6.1 INTRODUCTION

The control card manages and continuously adjusts 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.

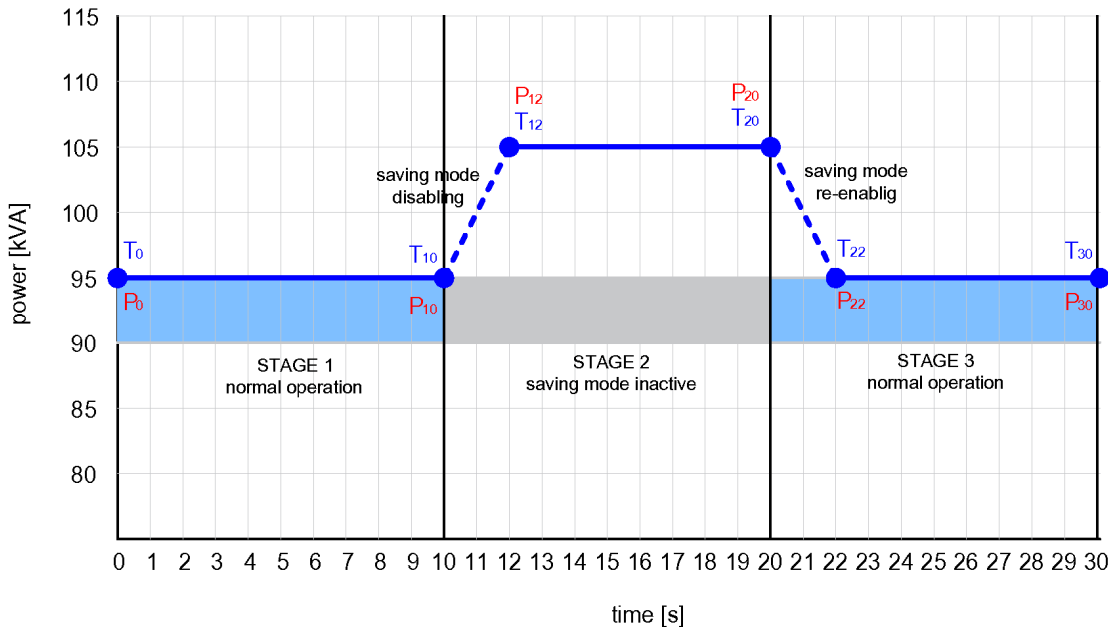
The data measured by the instrumentation on board and the generated energy saving are made available on the cloud platform XCloud, where they are always visible and downloadable by the User.

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:

$P_{\text{saving ON}} = \text{avg}(P_0, P_{10}, P_{22}, P_{30})$ average power measured when the saving mode is ON

$P_{\text{saving OFF}} = \text{avg}(P_{12}, P_{20})$ average power measured when the saving mode is OFF

The percentage energy saving can therefore be expressed as:

$$S_{\%} = 1 - \frac{P_{\text{saving ON}}}{P_{\text{saving OFF}}}$$

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).

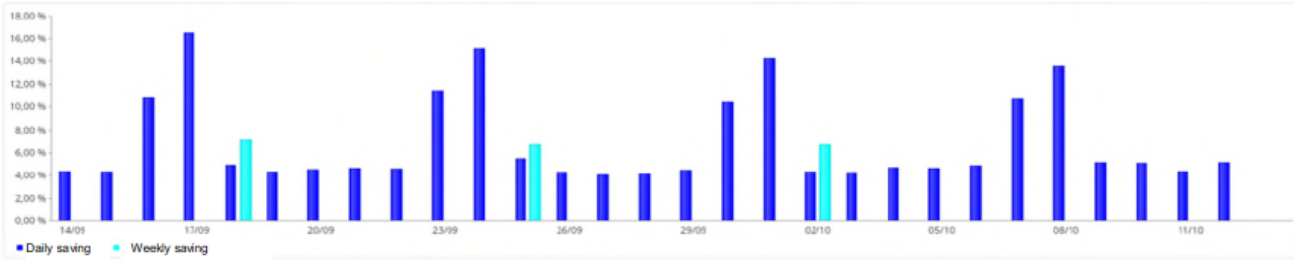
Once the S_% values are known, the aggregated parameters are determined: daily, weekly and cumulative saving, both percentage and absolute.

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

EnerCloud

ENERGY SAVING PARAMETERS



Daily saving
5,14 %
Thursday 12/10/2017

Daily saved kWh
357,72 kWh
Thursday 12/10/2017

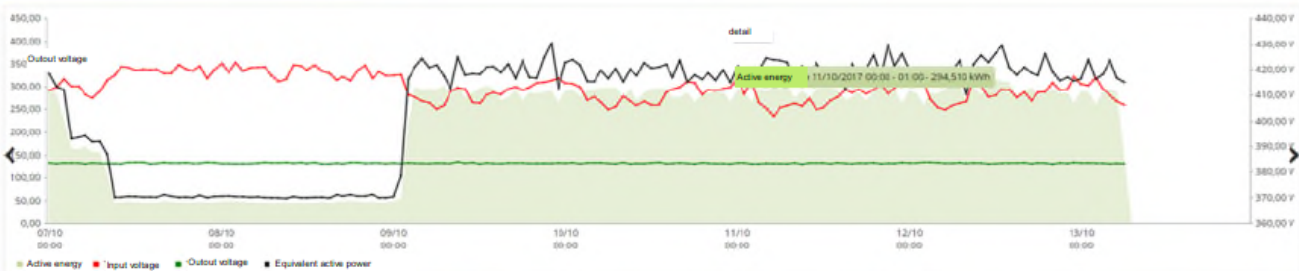
Daily saved €
57 €
Thursday 12/10/2017

Weekly saving
6,71 %
02/10/2017 - 08/10/2017

Weekly saved kWh
2.030,54 kWh
02/10/2017 - 08/10/2017

Weekly saved €
325 €
02/10/2017 - 08/10/2017

LAST WEEK'S MAINS PARAMETERS



Equivalent active power
289,44 kW
13/10/2017 06:21:24

Input voltage
402,67 V
13/10/2017 06:21:14

Output voltage
381,11 V
13/10/2017 06:21:24

7 INSTALLATION & COMMISSIONING

 **DANGER** DO NOT CONNECT IN PARALLEL TO EACH OTHER TWO OR MORE VOLTAGE STABILISERS 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 heat generated can be disposed of. Otherwise, +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 circulation. If there are ventilation filters in the housing, leave at least 500 mm of space to allow for cleaning and replacement

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 voltage stabiliser, 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.

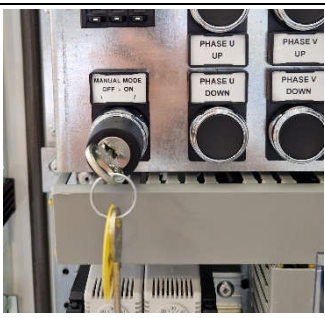
 **WARNING** *Be sure that phase and neutral wires are connected to the relevant terminals. Swapping the input connection with the output one could cause serious damage.*

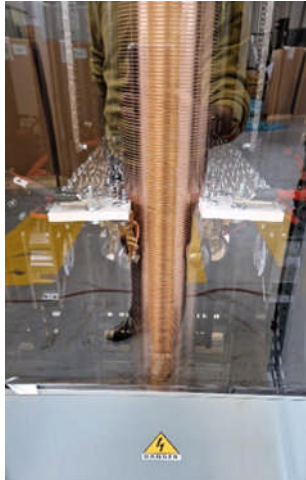
Check the tightness of the connections and carefully close the cabinet.

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.

Before energising the unit, check that the conditions listed below are met.

1	The QS7 emergency button must be deactivated (the button must NOT be pressed).	
2	The three internal switches (QF3 – QF4 – QF5) must be set to the ON (I) position. Note: The photo shown is for illustrative purposes only. The layout and type of switches may vary from case to case.	
3	The QS6 “Saving measurement” switch must be set to ON.	
4	The “Manual mode” selector switch must be set to OFF.	

5	The output voltage (phase-to-phase) must be set to 380V using the potentiometer.	
6	The roller carriages must be positioned halfway along the track (facing each other).	
7	Unless otherwise expressly requested, any input switches must be set to the OFF (O) position. Note: The photo shown is for illustrative purposes only. The type of switch may vary depending on the specific application.	

Check that the mains supply voltage complies with the equipment's rated specifications.

Supply the equipment with the rated voltage by closing any input circuit breakers on the unit. Consequently, the power circuit, auxiliary circuits and control board are thus powered.

After a short initialisation period (approximately 10 seconds) for the control board, the unit begins to operate.

7.5 SETTINGS



DANGER Dangerous voltage is present inside the energy saving device 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.

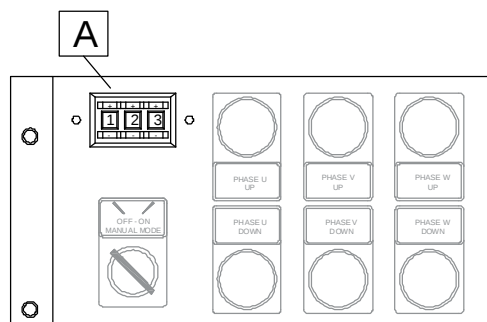
Note For a complete reset, the unit must have been switched off for at least five minutes.

7.5.1 Target voltage setting

In addition to software settings, the target voltage can be adjusted using potentiometer A on the panel provided for manual control of the rollers.



WARNING The "Manual mode" function must not be used to set the target voltage.



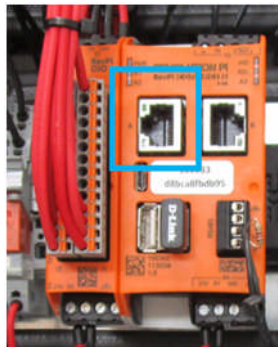
7.5.2 Dip switch setting

REF.	PARAMETRE	POSITION	DEFAULT	Adjustable by User
SW1 DIP1 SW1 DIP2	Factory setting	Depending on the nominal data	Depending on the nominal data	NO
SW1 DIP3	Factory setting	-	OFF	NO
SW1 DIP4	Acoustic signals disabling (Internal buzzer and siren)	ON = disabled OFF = signals enabled	OFF	NO
SW1 DIP5	Phase rotaion	ON = W-V-U OFF = U-V-W	OFF	YES
SW1 DIP6	Bypass input enabling in case of active load	ON = function enabled OFF = function disabled	OFF	NO
SW2 DIP7	Minimum regulation position. Enables the function that sets the voltage regulator to minimum position in case of a power cut.	ON = function enabled OFF = function disabled	ON	NO
SW2 DIP8	Minimum/maximum voltage alarms. Enables an alarm to be triggered if the output voltage remains outside the specified range for a set period of time.	ON = function enabled OFF = function disabled	ON	NO
SW2 DIP9	Factory setting	-	OFF	NO
SW2 DIP10	Automatic alarm reset after 180 seconds if no alarm is active	ON = function enabled OFF = function disabled	OFF	YES
SW2 DIP11	Factory setting	-	OFF	NO
SW2 DIP12	Factory setting	-	OFF	NO

7.6 CONNECTING THE GATEWAY TO THE NETWORK VIA ETHERNET CABLE

The following is a summary of the steps required to connect the gateway to the network in order to initiate data communication with the cloud.

- a) Connect an Ethernet cable between the gateway's 'LAN A' port and the LAN port provided by the customer:



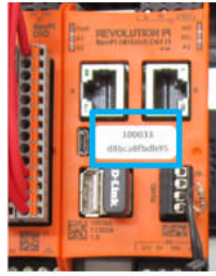
- b) Ask the company's IT manager for the static network settings relating to the Ethernet port to which the gateway is connected. The following settings are required:

- IP ADDRESS for the connection;
- SUBNET MASK;
- GATEWAY;
- DEFAULT DNS;
- ALTERNATIVE DNS;

Also ask the company's IT manager for the following permissions to allow data to be exported to the cloud:

Firewall not present	No permission required
Firewall present	The following requirements must be met: ▪ Outbound connection on TCP port 5672 (AMQP) for firmware updates ▪ Outbound connection on TCP port 443 enabled to the address https://iotto.onit.it to allow data to be sent to the XCloud monitoring platform. ▪ Outbound connection on UDP port 123 (NTP server) enabled for date and time synchronisation ▪ Outbound connection enabled to Google DNS for Internet connection testing

- c) Once the parameters listed above have been acquired, go to the unit (with the doors closed) with a laptop and enable the Wi-Fi connection. Once enabled, connect to the Wi-Fi network generated by the gateway. **This network will be named after the gateway number** [Example: 100006]. The password required for the connection will be the alphanumeric code shown on the gateway's nameplate.



- d) Once connected to the gateway's Wi-Fi network, open a web browser (e.g. Google Chrome) and enter the following address in the address bar at the top:

<http://10.0.0.1:8000/>

To access the gateway's network settings configurator, enter the following username and password:

Username: xcloud

Password: ()rt3A_30x

- e) Once logged in, the configuration screen will appear.
f) Uncheck the box next to 'DHCP' and enter the network parameters described in step b) into the relevant fields.

Configurator

Porta A:

DHCP TAG

CONNECTION IP STATIC ADDRESS

Dhcp
☒

CONNECTION SUBNET MASK

CONNECTION GATEWAY

Ip Address port A

Subnet Mask port A

Gateway port A

DNS 1

DNS 2

Ntp Server 1

CONNECTION DNS

CONNECTION ALTERNATIVE DNS

Ntp Server 2

Porta B:

- g) Once the settings described in step f) have been completed, scroll to the bottom of the page and click 'SAVE AND REBOOT'.
No further settings are required.
When all the steps listed above are done, data transmission to the cloud is active.

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.

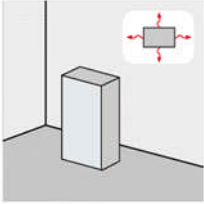
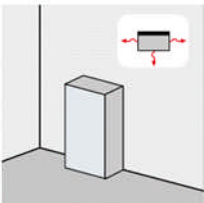
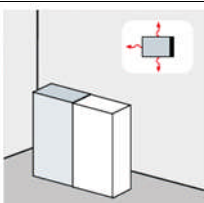
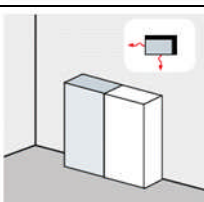
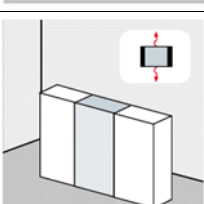
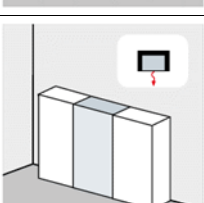
In order to ensure performance throughout its life, the unit must undergo simple but regular maintenance scheduling. The recommended frequency is 12 months, but the maintenance routine ought to be more frequent should it be required by other factors such as polluted environment or heavy duty cycle. Conforming 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.

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:

	4 clear sides Best configuration to perform maintenance. <i>Note. In outdoor installations, this is the only possible situation due to the presence of air inlet filters on all sides. Minimum required clearance is 600mm.</i>
	Front and sides clear. Maintenance possible (provided that the clearance be at least 800mm).
	Front, rear and 1 side clear. Maintenance possible if at least 800mm are available at the rear and the side.
	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).
	Front and rear clear. Maintenance possible (but potentially difficult) if at least 800mm are available at the rear.
	Only the front is clear. Maintenance impossible. The unit must be moved. Please contact the after-sale Service to agree on how to proceed.

8.3 MAINTENANCE ACTIVITIES

8.3.1 Generalities

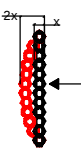
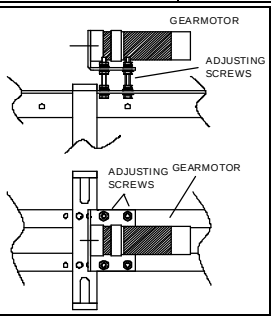
WHAT TO DO	HOW	WHY
Clean transformers and all electro-mechanical components removing dust, dirt and rust	Dry compressed air Dry cloths	Dust accumulation may limit the cooling air flow and cause overheating. Rust may compromise the dielectric properties of materials and components.
Check the correct tightening 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. Note:: the fans are controller by the ambient thermostat. 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.

8.3.3 Columnar voltage regulator

In a columnar regulator the copper track is wound helicoidally on a cylinder. The mobile contacts move vertically on the track thanks to a pinion and chain transmission.

WHAT TO DO	HOW	WHY
Clean the copper surface in case of clear oxidation or deposit of graphite dust.	Fine abrasive paper (120 type first and 240 type afterwards) Dry compressed air Dry clean cloth	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.
Clean and possibly lubricate the chain	Grease or spray for cogs and chains	Ensure the correct movement of transmission units and avoid interruption of the transmission or failure.
Check the chain tension.	 When manually applying force on the chain side, the displacement should be twice the thickness of chain.	
if necessary, adjust the chain tension.	 Lift or lower the plate supporting the gearmotor by means of the fixing bolts and nuts	The pulling chains tension must be such that there are no loosening or interruptions during the inversion of the rotating sense.
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. Replace any clearly defective guides.	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.

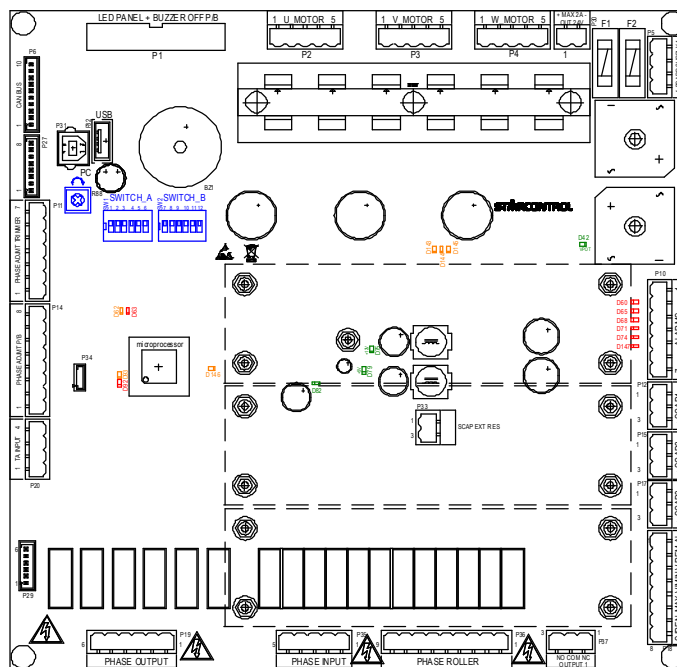
9 CONTROL CARD

The control card runs the voltage stabiliser 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. Firmware and operational parameters can be updated by means of a USB drive. The following components are connected to the control card:

- signalling card connected via a flat wire to P2 terminal on the control card;
- supercapacitor banks for adjusting to minimum voltage position in case of blackout (when fitted).

Note 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

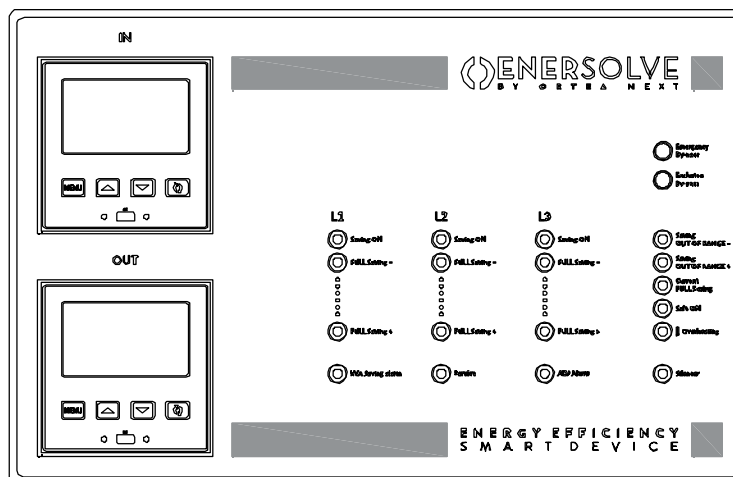
The card is provided with a phase-to-phase short-circuit alarm for each motor. Filtering devices operate in order to avoid unnecessary intervention. The resistance to a short-circuit depends on the nature of the phenomenon.

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	-

9.3 EXTERNAL CONTROL PANEL AND SIGNALLING CARD

The panel is the interface towards the user and provides with all the relevant readings and alarm signals. The card is mounted behind the control panel and is connected to the control card via a flat wire.



9.3.1 Input & Output digital multimetre

Reading of input and output electrical parameters.

9.3.2 L1-L2-L3 LEDs

DESCRIPTION	COLOUR	FUNCTION
SAVING ON	blinking green	Regular operation
FULL SAVING -	red	Minimum Saving reached
FULL SAVING +	red	Maximum Saving reached

9.3.3 Alarm LEDs

The alarm LEDs indicate a malfunctioning situation. Any abnormal condition generates an acoustic alarm as well. The alarm indications provided are listed in the table below (starting from the top one).

DESCRIPTION	FUNCTION
SAVING OUT OF RANGE -	Saving lower than minimum value
SAVING OUT OF RANGE +	Saving higher than maximum value
CURRENT FULL SAVING	Overload
SAFE ON	Bypass Saving
OVERHEATING	Internal overheating

The **Saving OUT OF RANGE** alarms on one or more phases are signalled also by the relevant phase control LED colour change from flashing green to fixed orange. A push-button for silencing the alarm is mounted underneath the alarm LEDs. In case of alarm, the relevant LED switches on and the buzzer and an internal siren start. By pressing the silencer for a few seconds, the audible alarms stop whilst the visible one stays on if the failure is permanent. The light reset takes place only when the alarm condition has stopped. Press the push-button for a few seconds in order to switch the LED off. The Dip-switch 4 (see the relevant table) on the control card allows for the audible alarms to be cut out. It is advisable to transfer the alarm signal to a manned position by means of the relevant terminals available in the auxiliary terminal block.

9.3.4 Additional LEDs

POSITION	FUNCTION
KVA SAVING ALARM	PFC system alarm (if available)
SERVICE	ON when the internal counter has reached the set threshold and maintenance is required
ADJ ALARM	ON if the temperature on the rollers is higher than 90°C (start of the regulator fans)
EMERGENCY BY-PASS	ON if the emergency bypass is active
EXCLUSION BY-PASS	ON if the exclusion bypass is active (if available)

9.4 SUPERCAPACITOR BANK

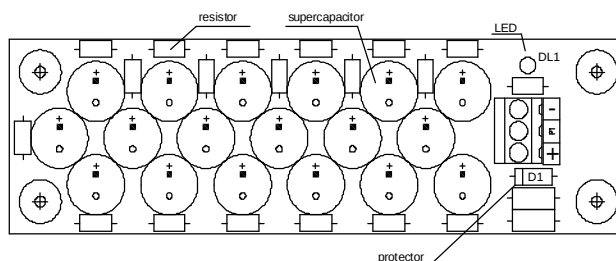
The bank is a reservoir of electric energy stored in supercapacitors (high capacity capacitors). The purpose is to supply each gearmotor in blackout condition, so that the voltage regulator can reach its minimum voltage position.

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 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.



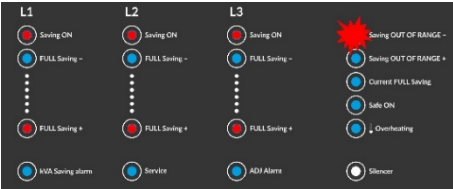
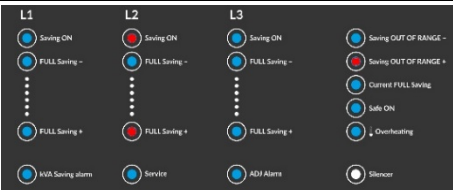
10 ALARMS & SERVICE

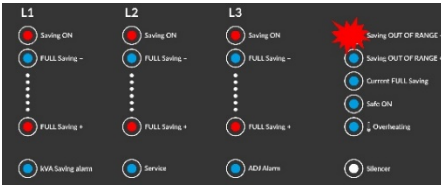
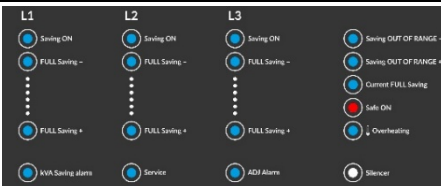
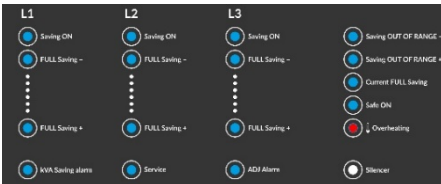
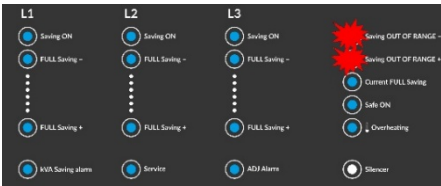
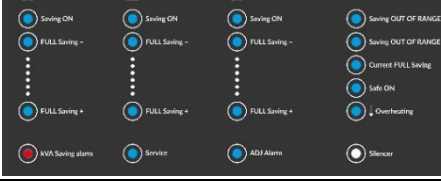
DANGER Access to the internal components must be granted only to qualified, trained personnel in charge of it. Any operation that might require the unit to be energised must be carried out in compliance with the habitual rules concerning personal safety and the use of adequate protective tools.

In case of 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, REM1 relay is connected to the P37 terminal block and REM2 relay is connected to the P18 terminal block.

ALARM INDICATION	ACTIVE RELAYS	ISSUE	POSSIBLE CAUSE	ACTIONS
	REM1 REM2	Roller overheating (ADJ alarm)	Overload on the regulator Failure of the thermal probe on the central roller of each roller group 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.
 SAVING OUT OF RANGE- LED RED SAVING ON LED RED FULL SAVING- LED RED	MIN-MAX REM1	Minimum voltage (saving out of range -)	V_{out} lower than V_{target} beyond the set tolerance (default 6%) Locked gearmotor	Check incoming voltage. Wait until the nominal condition is re-established. Switch the unit off and try to manually move the carriage and therefore the motor. If necessary, replace with a spare one.
 SAVING OUT OF RANGE- LED RED (AS CONSEQUENCE) SAVING ON LED RED	MIN-MAX REM1	Missing phase(s)	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.
 SAVING OUT OF RANGE- LED BLINKING RED ALL SAVING ON LED RED ALL FULL SAVING+ LED RED	MIN-MAX REM1	Maximum voltage (saving out of range +)	Same as for Minimum voltage but with V_{max} LED	Check incoming voltage. Wait until the nominal condition is re-established.
 SAVING OUT OF RANGE + LED RED SAVING ON LED RED FULL SAVING- LED RED	MIN-MAX REM1	Maximum current (current full saving)	I_{out} over set threshold (unit overload) Control card wrong reading (output instrument connector not tightened)	Adjust the load so that the unit is not overloaded. Check the output instrument ammeter connections.

ALARM INDICATION	ACTIVE RELAIS	ISSUE	POSSIBLE CAUSE	ACTIONS
 ALL SAVING ON LED BLINKING RED	MIN-MAX REM1	Input voltage signal failure	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.
 ALL SAVING ON LED RED SAVING OUT OF RANGE- LED BLINKING RED ALL FULL SAVING + LED RED	MIN-MAX REM1	Output voltage signal failure	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.
	REM1	Saving function off (safe on)	Overload in the voltage regulator circuit and intervention of the electronic protection $(V_{in} < V_{target} \Rightarrow V_{out} = V_{in}; V_{in} > V_{target} \Rightarrow V_{out} = V_{target})$	Investigate and eliminate the overload source.
	REM1 REM2	Internal overheating	Temperature measured around the card $> 65^{\circ}\text{C}$. The system operates in the same way as with the stabilisation off alarm	Check that the air circulation inside the enclosure is not hindered. If necessary, replace a defective fan following the procedure explained in the maintenance chapter.
 SAVING ON LED ORANGE	REM1 REM2	Locked garmotor	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.
 BOTH BLINKING	MIN-MAX REM1	Short-circuit on the garmotor	Damaged or faulty component. The alarm stops the regulation without trying to restart it.	Replace with a spare one..
	MIN-MAX REM1	Phase rotation error	Supplying system configuration The system operates in the same way as with the stabilisation off alarm	During installation, connect the card to a PC to check the alarm and adjust the relevant parametre
	N.A.	Service required	Set total working hours and/or motor movement threshold exceeded	During operation the issue is on the supplying line.
	N.A.	Power Factor Correction system alarm (if available)	- Insufficient reactive power - Plant current too low or too high - Plant voltage too low or too high - Internal overheating - Plant THDI% too high - Service required	Open the PFC section, register the alarm displayed by the reactive power controller and contact the Service Dept. If there is no alarm on the controller, check the status of the red LED on the TG1 device (blinking LED).

ALARM INDICATION	ACTIVE RELAIS	ISSUE	POSSIBLE CAUSE	ACTIONS
	n.a.	Bypass activation with active load connected	Generation towards the grid of voltage higher than the admitted tolerance	Wait until the nominal situation is restored

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

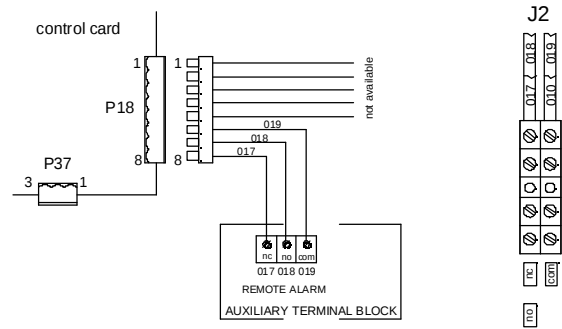
By connecting to the P37 terminal with a suitable connector, these alarm signal can be remoted separately.

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.



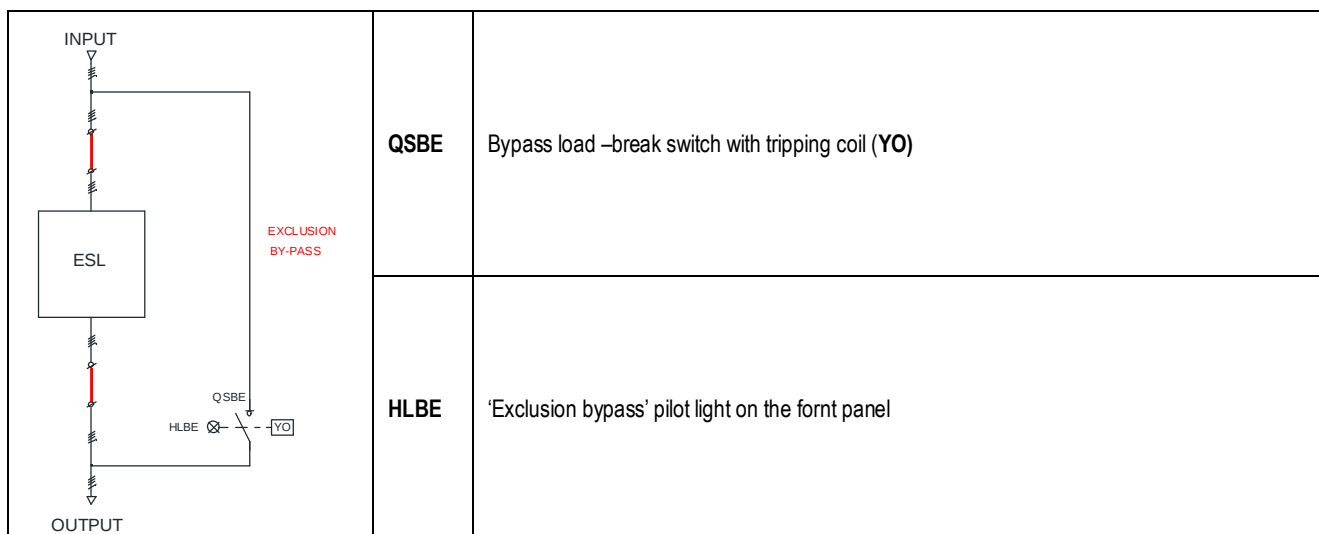
11 ACCESSORIES

11.1 EXCLUSION 'BYPASS'

WARNING Before operating the exclusion 'bypass', it is necessary to switch on the emergency 'bypass' as indicated in chapter 5.3.

DANGER The exclusion bypass **DOES NOT segregate completely the unit and DOERS NOT isolate it electrically**

If the unit is fitted with the exclusion bypass, by operating the relevant **QSBE** load-break switch a direct connection between the input and output terminals is performed, thus shifting the current on the bypass line and maintaining the unit energised. When the exclusion bypass is active, the relevant pilot light on the front panel is ON.



11.1.1 Regular operation

COMPONENT	STATUS	POSITION
QSBE	open	OFF
EMERGENCY 'BYPASS'	disabled	-
HLBE	off	

11.1.2 Circuit activation procedure

WARNING This procedure brings the output voltage (V_{out}) to be the same as the input one (V_{in}).

1. Activate the emergency bypass (chapter 5.3). This operation gives the tripping coil the consensus necessary to carry out the next step.
2. Activate the exclusion bypass by operating on the **QSBE** load-break switch. The **HLBE** pilot light switches on.

WARNING The activation can be performed only after the emergency 'bypass' has been activated.

DANGER In this configuration, both the load and the unit **ARE ENERGISED**.

COMPONENT	STATUS	POSITION
QSBE	closed	ON
emergency 'bypass'	enabled	-
HLBE	ON	

11.1.3 Return to regular operating mode

WARNING Follow the sequence below:

1. open the **QSBE** load-break switch.
2. disable the emergency bypass as indicated previously.

11.1.4 ESL unit complete disconnection

WARNING Run this activity only in case of damage to the buck/boost transformer.

The procedure allows for the complete disconnection of the ESL unit from the plant.

Below are the steps to follow:

1. Disconnect the plant in which the ESL is installed by opening the plant main circuit breaker.
2. Once the absence of voltage at the input and output terminals of the ESL unit has been checked, physically disconnect the wires or bars marked in red (3 input phases, 3 output phases and neutral).
3. Only after having performed the previous steps, energise the ESL unit by closing the plant main circuit breaker.
4. Operate the **QSBE** switch to supply the plant load.

11.2 AUTOMATIC POWER FACTOR CORRECTION SYSTEM

11.2.1 Introduction

The power factor correction unit with automatic step control is used for automatically holding the power factor of a system to a value as close as possible to 1, optimizing the saving performed by the energy saving device. Such automatic control is obtained via a sensitive and accurate electronic reactive power controller. The unit consists of capacitor banks, fitted with modular capacitors, which are automatically switched in or out by means of specific contactors for capacitive loads (type AC6b), traditional contactors if blocking reactors are included or solid-state contactors depending on the required capacitive reactive power.

The capacitors are provided with re-generable metallised plastic dielectric, discharge resistors and overpressure device.

11.2.2 Safety recommendations

In addition to the notes listed in the safety chapter, please also follow the rules below:

- **It is forbidden** to disconnect the PFC section when the capacitor banks are switched in.
- **It is forbidden** to perform repeated manoeuvres of the power factor correction banks without respecting the capacitor discharge times (as indicated also on the label positioned on the PFC section).
- **It is forbidden** to alter the unit without the Manufacturer's authorization.
- **It is forbidden** to operate or alter the system while the unit is energised.
- **It is forbidden** to interrupt the secondary of the current transformer while current is flowing through it.
- **It is forbidden** to operate in the presence of live parts with the door open.

11.2.3 Maintenance

The following notes are additional to the ones listed in the Maintenance chapter.

 **DANGER** 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.

11.2.3.1 Routine maintenance

Periodically check:

- Current drawn by the single steps in order to keep the operating conditions of the system always under control
- Auxiliary circuits fuses
- Capacitor banks fuses (fitted with signals)
- Operating temperature condition
- Electrical connections and mechanical fixtures tightness
- Contactors efficiency
- Presence of capacitors with tripped overpressure device (in this condition, restore immediately by installing new capacitors in order not to impair the efficiency of the entire system)

It is recommendable to keep a minimum stock of spare components in order to act quickly on the system.

Particularly important is the testing of the capacitors on units fitted with filters, where it is essential to check if the filter tuning frequency has altered over a certain period. Although the components used are highly reliable, it could be possible for a capacitor nearing the end of its working life, to cause tripping of its overpressure device. The consequent drop in capacity could cause a variation in the tuning frequency of the filter, thus producing hazardous overloads.

In order to ensure long-term protection against such possible phenomena, it is advisable to check the amount of current drawn by each step during the initial installation phase, after the first month of operation, then quarterly. Noticeable differences between subsequent measurements or any unbalance between the three phases are symptoms of a no longer reliable operation, which might require special maintenance.

11.2.3.2 Extraordinary maintenance

Carry out accurate maintenance when the unit requires it because it is subject to unusual and unexpected phenomena. A more accurate maintenance schedule should be drawn up taking into account the particular operating conditions. For example, a highly polluted environment (dust-laden or salty) could require more frequent cleaning of the filters.

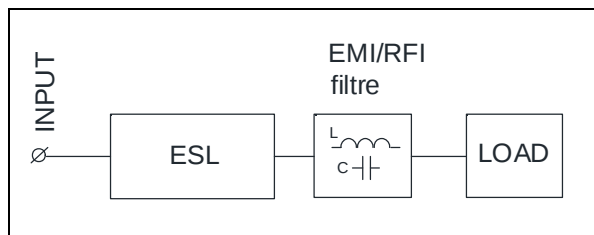
11.2.3.3 Replacement of components

Beyond replacing the individual faulty component, always establish the causes of the inefficiency.

- a) **Replacement of fuses.** Before replacing a fuse on the power circuit or the control circuits, eliminate the cause determining the event. Replace them with a type equivalent to the original ones.
- b) **Replacement of contactors.** The contactors working life is approximately 200,000 cycles and they should be replaced after such period has elapsed. When the assessment of the number of cycles is not possible, it is necessary to inspect the contacts and take the required steps. Replace them with a type equivalent to the original ones.
- c) **Replacement of capacitors.** Replace the capacitors with the same type of components, unless otherwise instructed by the Technical Service Department, after one of the following faults have occurred:
 - loss of insulating liquid
 - overpressure device tripped (detectable by the obvious deformation of the capacitor).
 - current drawn by the capacitor less than 10% of rated current at the rated voltage (only in the case of capacitor banks provided with blocking inductors).

11.3 EMI/RFI FILTER

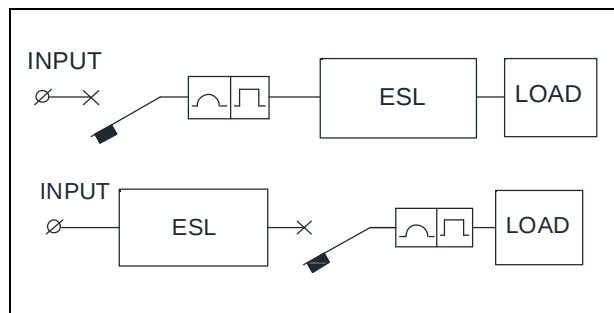
Device for the filtration of electromagnetic and radio-frequency interference aiming at providing the the load with cleaner output voltage.



11.4 INPUT AND/OR OUTPUT CIRCUIT BREAKER

Automatic circuit breaker with magnetic and thermal release to protect against overcurrent or short-circuit, respectively set to the maximum admitted input current and the output nominal one.

The circuit breaker can be fitted with own accessories, such as minimum voltage coil/release coil, re-set coil, motorised maneuver and so on.



11.5 4G/LTE ROUTER

The 4G/LTE 500 8D5913 router, manufactured by B810 Group (Digicom division), is a device developed for the industrial sector for remote control and monitoring. It is ideally suited for use in applications where it is necessary to interface with LAN and RS485 or RS232 serial devices and manage digital inputs/outputs, whilst efficiently transmitting data to the cloud.

For more detailed information, please refer to the relevant documentation provided.

12 TECHNICAL DATA

	ESL-10	ESL-20
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%	±20%
Input voltage range	Vout ±10%	Vout ±20%
Output voltage accuracy	±0,5%	
Frequency	50Hz o 60Hz (±5%)	
Admitted load variation	up to 100%	
Efficiency	>98%	
Cooling	natural ventilation (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 XCloud	
Installation	indoor	
Overvoltage protection	Input & output SPDs Voltage recovery via supercapacitors in case of black-out	
Bypass system	Automatic electronic 'Safe on' Single touch emergency	

ESL-10 Parameters referred to the nominal output voltage (400V)

TYPE	RATING [kVA]	MAX INPUT CURRENT [A]	OUTPUT CURRENT [A]	DIMENSIONS [mm]	WEIGHT [kg]
100-10	100	160	144	600x800x2200	560
160-10	160	257	231	600x800x2200	600
250-10	250	401	361	600x800x2200	660
315-10	315	505	455	1200x800x2000	800
400-10	400	642	577	1200x800x2000	850
500-10	500	802	722	1200x800x2200	970
630-10	630	1010	909	1200x1000x2200	1350
800-10	800	1283	1155	1200x1000x2200	1650
1000-10	1000	1604	1443	2400x1000x2200	2500
1250-10	1250	2005	1804	2400x1000x2200	2700
1600-10	1600	2566	2309	3000x1000x2200	2850
2000-10	2000	3208	2887	3600x1000x2100	3500
2500-10	2500	4009	3609	4200x1000x2300	5300
3200-10	3200	5132	4619	4200x1400x2300	6000

ESL-20 Parameters referred to the nominal output voltage (400V)

TYPE	RATING [kVA]	MAX INPUT CURRENT [A]	OUTPUT CURRENT [A]	DIMENSIONS [mm]	WEIGHT [kg]
100-20	100	180	144	600x800x2200	620
160-20	160	289	231	1200x800x2000	800
250-20	250	451	361	1200x800x2200	970
315-20	315	568	455	1200x1000x2200	1350
400-20	400	722	577	1200x1000x2200	1600
500-20	500	902	722	2400x1000x2200	2500
630-20	630	1137	909	2400x1000x2200	2700
800-20	800	1443	1155	3600x1000x2100	3000
1000-20	1000	1804	1443	3600x1000x2100	3600
1250-20	1250	2255	1804	4200x1000x2100	4500
1600-20	1600	2887	2309	4200x1400x2300	6000
2000-20	2000	3609	2887	4200x1400x2300	6300
2500-20	2500	4511	3609	4200x2000x2400	10200
3200-20	3200	5774	4619	4800x2000x2400	10400

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 in force regulations concerning 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), 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
CHECK (WHEN FITTED WITH A PFC SYSTEM)	h	ABSORBED CURRENT IN EACH STEP	SEMESTRALE
	j	FUSES STATUS	SEMESTRALE
	k	THERMAL SITUATION	SEMESTRALE
	l	CONTACTORS	SEMESTRALE
	m	CAPACITORS	SEMESTRALE

RECORD (TICK THE RELEVANT BOX)													DATE	SIGNATURE
a	b	c	d	e	f	g	h	j	k	l	m			

EXTRAORDINARY MAINTENANCE		
DESCRIPTION	DATE	SIGNATURE



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

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