



**IREM** *Ecostab*

*IT'S TIME TO SAVE*

*Automatic Voltage optimisers*

# Ecotab automatic voltage optimisers

**Save up to 40%  
of energy**

The dwindling fossil fuel reserves, the need to reduce carbon dioxide emissions and lower availability of financial resources has spurred energy production from renewable sources and strongly boosted the development of technology for optimising (limiting) electricity consumption.

**Ecotab automatic voltage optimisers** are one of the solutions offered by new technologies to users.

These devices comply with the requirements of IEC 60038 for electric equipment operating tolerances and supply an operating voltage which minimises consumption without impairing performance or reducing reliability.

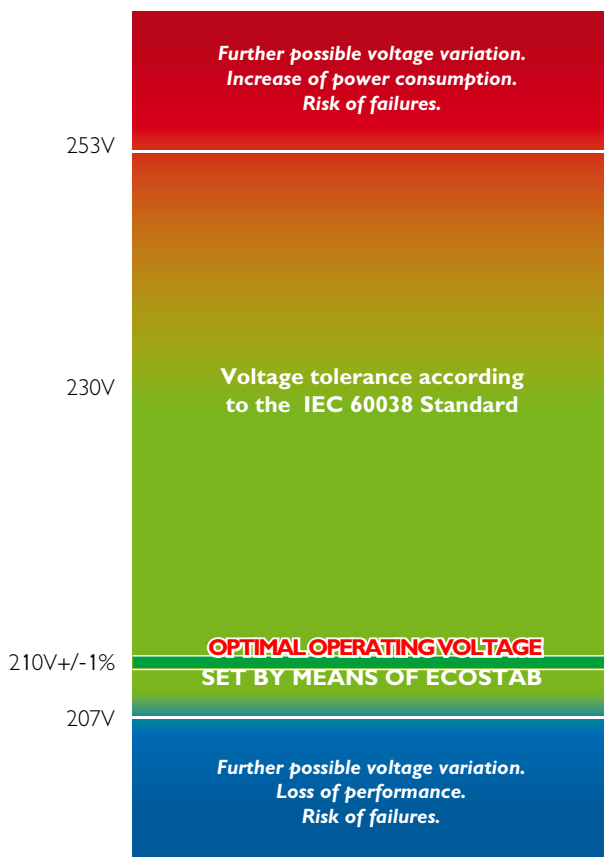
IEC 60038 establishes that the electric equipment must be able to work correctly at an input voltage within  $\pm 10\%$  of the nominal value, that is from 253V to 207V for single-phase devices and from 440V to 360V for three-phase devices.

This is an essential feature for all electric devices because energy producers establish that the supplied voltage may vary within these limits contractually.

As a consequence, if a load is supplied at a value close to the lower operating tolerance limit (-10%) also when the mains voltage assumes the higher value established by contract (+10%), the difference between 253V and 207V in absolute terms is 18%.

This power supply difference allows to:

- obtain a significant saving of energy;
- extend the working life of electric equipment. *Ecotab* voltage optimisers prevent devices from being powered at higher values than the rated voltage. For example, it is a known fact that the life of sodium bulbs is reduced by 50% when they are powered at a voltage 10% higher than their rated value;
- secure a significant reduction of carbon dioxide emissions. This corresponds to approximately 630 g for every saved kWh of energy.



By means of potentiometers the **OPTIMAL OPERATING VOLTAGE** can be set according to the peculiar features of the connected loads. The minimum stabilised voltage is 207V.



**Ecostab automatic voltage optimisers** deliver a stabilised voltage which can be set to the minimum tolerance established in IEC 60038, i.e. -10% (207V). This value is guaranteed also in presence of significant mains voltage variations. Interestingly, these devices are also excellent mains voltage stabilisers.

- **Standard single-phase models** can deliver a variable voltage from 230V to 207V with input voltage comprised in the 207-253V range.
- **Standard three-phase models** can deliver a variable voltage from 360/207V to 400/230V with input voltage comprised between 360/207V and 440/253V.

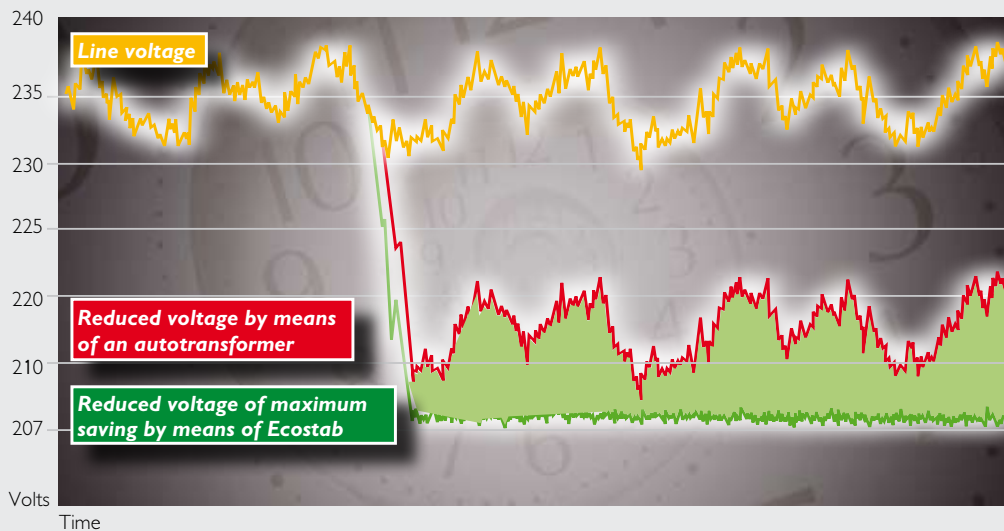
Models capable of broader input voltage variations may be built on demand. These may be needed because voltage may sometimes exceed the 10% tolerance specified in the supply contract.

Automatic voltage stabilisation is a key function that sets *Ecostab* voltage optimisers apart from simple autotransformers, which also reduce voltage but cannot guarantee certain savings due to the continuous voltage variations of the mains.

In order to prevent the delivered voltage from dropping excessively low as a consequence of mains fluctuations, autotransformers can never provide maximum savings.

The following diagram shows three different power supply possibilities with average absorbed power and saving for an electric motor.

The area included between the red and the green lines represents the maximum saving achievable by *Ecostab* compared to the autotransformer economisers.



Voltage supplye	Average voltage V	Average power kW	Saving kW	Saving %
<b>Line voltage</b>	234	159	0	0
<b>Reduced voltage by means of an autotransformer</b>	217	146	13	8.2
<b>Reduced voltage by means of Ecostab</b>	<b>207</b>	<b>139</b>	<b>20</b>	<b>12.6</b>

## Applications



There are many applications of *Ecostab* voltage optimisers. Consequently, in order to assess whether the return on investment is sufficiently rapid, the electric loads must be analysed to determine which percentage may be defined as "voltage sensitive", i.e. which electric devices have an energy consumption which changes by varying the input voltage. The higher the voltage sensitive load absorption percentage, the higher the potential savings.

**INVERTER-CONTROLLED MOTORS.** These are not very sensitive to voltage variations and consequently the use of a voltage optimiser does not permit energy saving.

**ASYNCHRONOUS MOTORS** very frequently allow significant energy saving, particularly motors with power lower than 20 kW. Motors are nearly always overdimensioned with respect to real needs and often do not work at full load. These recurrent conditions cause significant loss of efficiency and makes the use of voltage optimisers particularly convenient. Asynchronous motors are frequently used in residential and industrial applications. The most important are: cooling, ventilation and air conditioning systems, pumps, compressors, conveyors, elevators, petrol stations, shopping centres, hotels, medical centres, sports centres, swimming pools, offices, venues, car parks, warehouses, logistic centres, tunnels, exhibition halls and airports.

The efficiency of synchronous motors with power higher than 20 kW is close to 95% when working with a load equal to 70-90% of their maximum power and are not very sensitive to power voltage variations.

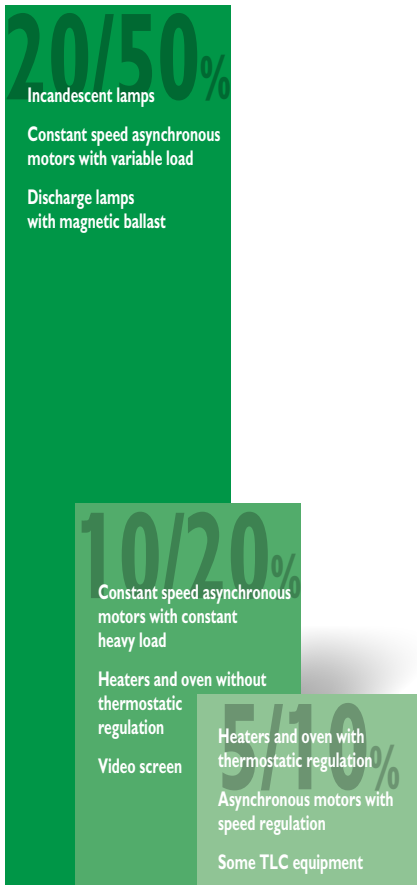
**ELECTRONIC EQUIPMENT.** Small devices, such as computers, office machines and telecommunication systems, are generally equipped with switching power supplies and using voltage optimisers will not determine significant energy saving.

**FILAMENT, FLUORESCENT and DISCHARGE LAMPS.** (sodium, mercury, metal iodide bulbs equipped with magnetic reactor) emit a light flow which is proportional to the supply voltage. Consequently, using an voltage optimiser allows to save providing a reduction of brightness is acceptable. Furthermore, voltage optimisers extend their working life because the stabilisation function prevents powering at a voltage higher than the rated value, this being a condition which causes early ageing. Using a voltage optimiser does not allow to save energy when the lamps are equipped with electronic reactors.

**LED LAMPS.** No advantages derive from the use of voltage optimisers because the lamps are equipped with devices which supply constant power.

**PRODUCTION LINES.** All the electric loads present on the line must be analysed to determine whether the use of a voltage optimiser is convenient or not. For instance, controllers, which are low-power electronic devices and are not sensitive to power voltage variations, may be present on lines along with motors and heating systems, for which a voltage optimiser may be advantageously used.

## Saving and return on investment



There are many factors which contribute to saving energy and reduce the payback period:

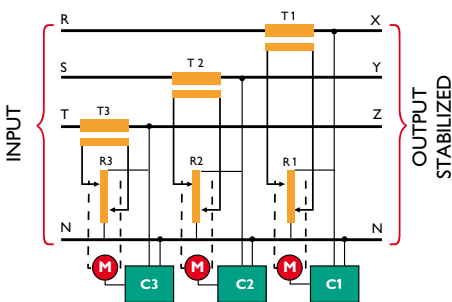
- Mains voltage** which is not always close to rated value. Voltage is usually higher late at night: 10% higher than the rated value is a common condition. This level is often exceeded when the user is located near an electric substation. Saving increases to approximately 20% when the voltage exceeds 10% of the rated value.
- Type of powered device.** Some devices allow higher saving than others and some electric devices do not provide any significant saving at all.
- Device use.** The best results are obtained by using *Ecostab* in connection to motors with stall torque often lower than the maximum deliverable torque.
- Overall consumption of devices powered by the voltage optimiser.** The higher the power of the *Ecostab* voltage optimiser, the shorter its payback period.

Since not all the appliances and loads ensure the same saving, a careful analysis on their use is necessary to predict potential saving.

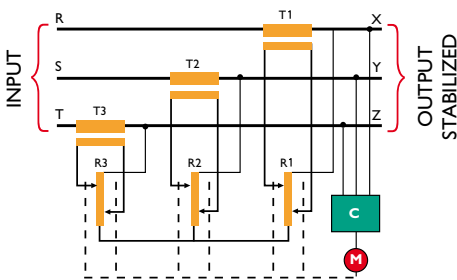
Sometimes, it may be advantageous to limit the use of *Ecostab* voltage optimisers to some devices to optimise the investment.

The cost of the voltage optimiser will be usually paid off by the saved energy in a period ranging from two to five years.

## Operating principle



with independent regulation of the phases



with regulation on the average of the phases

An electronic control circuit detects the voltage delivered by the voltage optimiser and compares it to a reference voltage. If the difference between the output voltage and the reference voltage exceeds the preset tolerance limits, an error signal is generated; this signal may be either negative or positive according to whether the output voltage is lower or higher than the preset value. This signal activates the servomotor which moves the mobile contacts (electrographite rollers / brushes) of the variable autotransformer thus changing the transformation ratio in order to supply the additive or subtractive voltage needed to restore the value within the predetermined limits to the primary winding of the series transformer. The root-mean-square value (RMS) of the output voltage is stabilised and consequently not affected by possible harmonic distortions present in the input mains. This regulation system has the advantage of not having mobile contacts in series to the power supply line.

## General features



IP21 model  
Figure D



IP21 model  
Figure E



IP54  
outdoor model



IP54  
indoor model



**Range.** Voltage optimisers are available in power range from 15 to 2600 kVA.

- Single-phase 100-110-115-120-127-200-220-230-240-265-277V.
- Single-phase with input 240V and output 230V.
- Three-phase 208-220-230-240-380-400-415-440-460-480-500V.
- Three-phase with input 415V and output 400V.
- Frequency: 50 or 60 Hz.



**Accuracy.** *Ecostab* voltage optimisers secure the true RMS voltage value with an accuracy ranging from  $\pm 0.5\%$  to  $\pm 1.5\%$  according to the model also in presence of high harmonic distortions of the mains.



**Regulation speed.** An innovative control circuit combines an extremely fast regulation speed, from 11 to 33 ms/V according to the model, with the structural reliability of the electrodynamic system.



**Overload capacity.** This is a peculiarity of the *Ecostab* electrodynamic regulation system. These devices can withstand overloads up to ten times the rated power for ten milliseconds, five times the rated power for six seconds or twice the rated power for one minute without damage.



**Efficiency.** Efficiency varies from 96% for smaller power models to 98% for larger devices at full load.



**Power factor and load variation insensitivity.** The adopted operating principle ensures that the accuracy and the regulation speed features of *Ecostab* voltage optimisers remain unaltered under any load condition (full load or no load, with inductive or capacitive loads).



**Frequency variation insensitivity.** The control circuit works correctly also with mains frequency variations up to  $\pm 5\%$ .



**Harmonic distortions.** The high quality and correct use of materials ensure that the harmonic distortion is always maintained within 0.2% in any operating condition.



**Impedance.** The installation of an *Ecostab* voltage optimiser in a pre-existing system does not require a new calculation of the protections because the internal impedance of the optimiser, varying from 0.52 to 0.015 Ohm, does not significantly affect the line impedance.



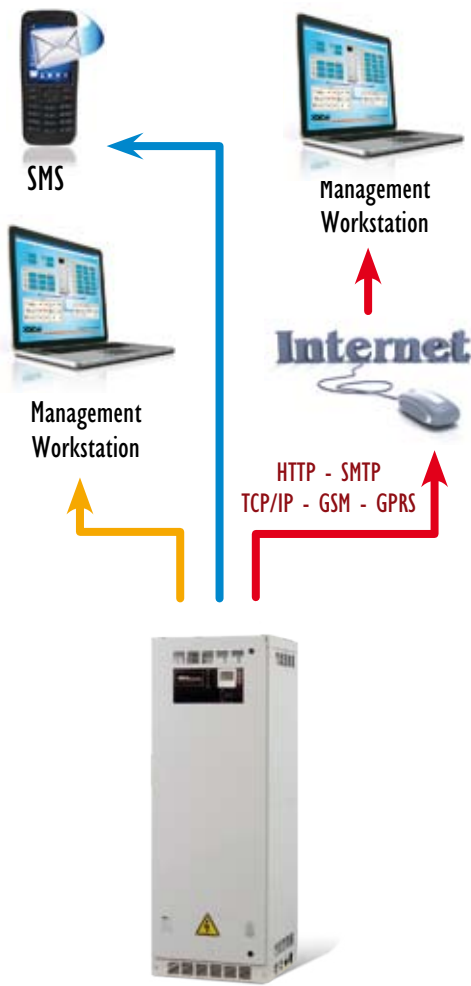
**Operating temperature.** *Ecostab* voltage optimisers are designed to work correctly at a maximum ambient temperature of 40°C in the most demanding conditions: continuous operation, full load and minimum input voltage. Models suitable for operation at temperatures higher than 40°C are manufactured on request.



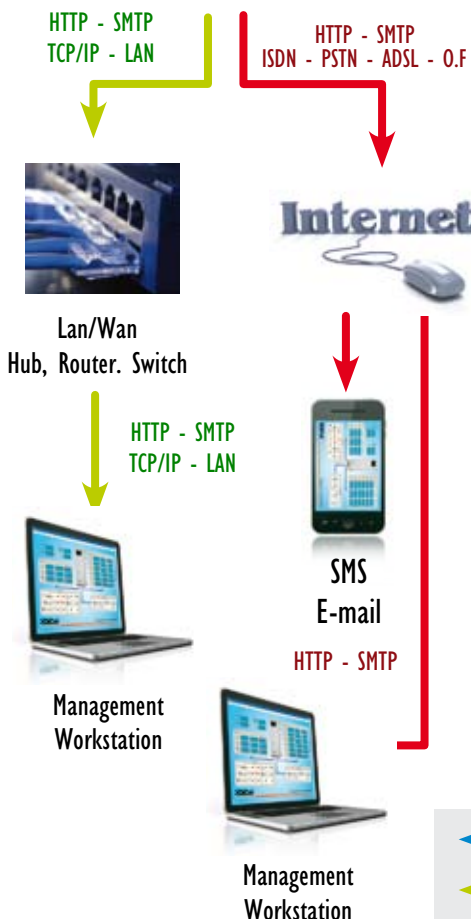
**Degree of protection.** According to the ambient conditions, the safety requirements and the installation site, *Ecostab* voltage optimisers are available in 4 versions with the following protection degree: IP00, IP21, IP54 INDOOR and IP54 OUTDOOR.



**Reliability.** *Ecostab* voltage optimisers use the same technology and the same components as *Ministab* and *Sterostab* voltage stabilisers, products that IREM has been manufacturing for over 50 years (over 430,000 units have been produced until today). The



Voltage optimiser equipped with POWER METER



MTBF exceeding 500,000 hours is the result of IREM continuous improvement in technical aspects and production process.

**Cooling system.** *Ecostab* voltage optimisers are cooled in different manner according to the type of casing and the ambient conditions by means of:

- natural convection
- fans
- air conditioning

**Installation.** It is rather quick and easy. The voltage optimiser is installed after the energy counter and before the electric users.

**Standard fittings:** Digital network analyser / energy meter, pilot lamps, potentiometer, alarm indication and dry contacts for connection to an external device for protection against: overload, over/under voltage, phase failure/reversed phase sequence.

**Special versions.** *Ecostab* voltage optimisers can be equipped on demand with special fittings in separate cabinet, like e.g.: maintenance by-pass, thermal magnetic circuit breakers, insulating transformer, surge suppressors, lightning arresters, harmonic filters.

**Remote control.** *Ecostab* voltage optimisers can be equipped with a special optional monitoring system POWER METER permitting the remote control via ETHERNET, INTERNET, GSM/GPRS. The following electric and physical parameters are detected: frequency, active power, reactive power, apparent power, distorting power, three-phase equivalent current, line current, power factor, active, reactive and inductive energy, harmonics, temperature, humidity, switch and contactor state. By using the POWER MANAGEMENT software installed on a non-dedicated PC, detected values can be managed and statistics can be obtained on a daily, weekly, monthly and yearly basis with various viewing, data processing, cost calculation and energy saving possibilities.

**Compliance with standards.** *Ecostab* voltage optimisers comply with the following Directives:

- Electro Magnetic Compatibility 2004/18/EC and following amendments.
- Low Voltage Electrical Equipment 2006/95/EC and following amendments.

# IREM. Experience and Quality

IREM is a leading company in the manufacture of electromechanical and electronic equipment for the control of the mains power in the following sectors:

- powering of discharge lamps for professional applications;
- protection of electric users against line disturbances;
- luminous flux regulation in lighting plants;
- power generation by micro hydroelectric plants.



Since its foundation in 1947, IREM has gained wide recognition due to the reliability and innovative content of its high-tech products. A reliable company deserving the Oscar-ward. In 1992, in Los Angeles, **Mario Celso** - founder of IREM - was granted the "Scientific-Technical Award" by the Academy of Motion Picture Arts and Sciences.

Two production plants, a philosophy based on "quality upgrading" as the company's primary concern and direct export exceeding 70% of the global turnover are a warranty of continuity and development.

Experience, quality and professional skill: these are the factors that permitted IREM to achieve in 1993 the certification of its quality system in compliance with **UNI EN ISO 9001** standard, a further confirmation of IREM commitment to constant improvement to ensure the maximum satisfaction of the customer and its capacity to guarantee:

- a constant quality standard
- precision and repeatability of all working processes
- dropping of acceptance control at the customer's plant
- identification and traceability of a product through the years.

In year 2000, IREM obtained the certification of its environment management system according to **UNI EN ISO 14001** standard. This certification is a firm demonstration of the company's will to protect the environment not just through its products, but also via precise patterns of behaviour.



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