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VOLTAGE SAGS ARE THE MOST COMMON CAUSE OF EQUIPMENT MALFUNCTIONS IN AUTOMATED INDUSTRY

OXYGEN SAG COMPENSATOR

VOLTAGE IS NEVER PERFECT

Modern industry is becoming more automated and the **sensitivity** of processes to **power quality events** is increasing.
It is generally recognized that quality is an important aspect of the electricity service. Not only low prices are important, also high-quality matters to customers.
Price and **quality** are often **complementary** aspects; together they define the value that customers derive from consuming electricity.
In practice the **voltage is never perfect**.

60%

POWER QUALITY COSTS ARE CONSEQUENCE OF VOLTAGE SAGs

If the quality of electricity supplied to the plants drops below a certain level, equipment no longer works properly and customers are likely to experience problems.
Sensitive industry sectors may incur a **Power Quality cost** up to **4% of their turnover**, with about **60% of those costs caused by voltage SAGs** and short interruptions.
The cost of a voltage SAG is usually lower than the cost of an interruption, either short or long, but SAGs are much more frequent.
An interruption will affect all (unprotected) services, SAGs may affect only those that are most sensitive.

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THE RIGHT SOLUTION

Many businesses require voltage or power conditioning rather than battery back-up power, provided by UPS system. In those cases where back-up power is unnecessary, a voltage conditioner provides superior protection and additional power quality functions, such as protecting against over/under voltage, voltage fluctuations, SAGs.
Moreover protecting a whole plant by UPS, which can guarantee SAGs immunity, may be very costly, due to battery and maintenance costs.
The right solution is the sag compensator.

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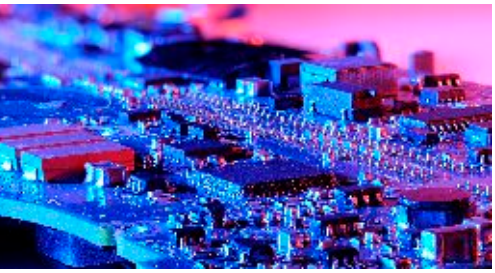
APPLICATIONS

Voltage SAGs and interruptions disturb many types of device connected to the network.
They are the most frequent cause of power quality problems.

The most sensitive applications are:



ELECTRONICS INDUSTRY
Sensitive machinery, semiconductor.

FOOD & BEVERAGE
High speed bottling, packaging lines.

CONTINUOUS PRODUCTION LINES
Printing, steelworks, paper mills, petrochemicals, fibre and film, automotive.

MEDICAL
Sensitive medical equipment, Hospitals.

PHARMACEUTICAL
Climatization.

COMPUTER EQUIPMENT
Data processing centres, banks, telecommunication.

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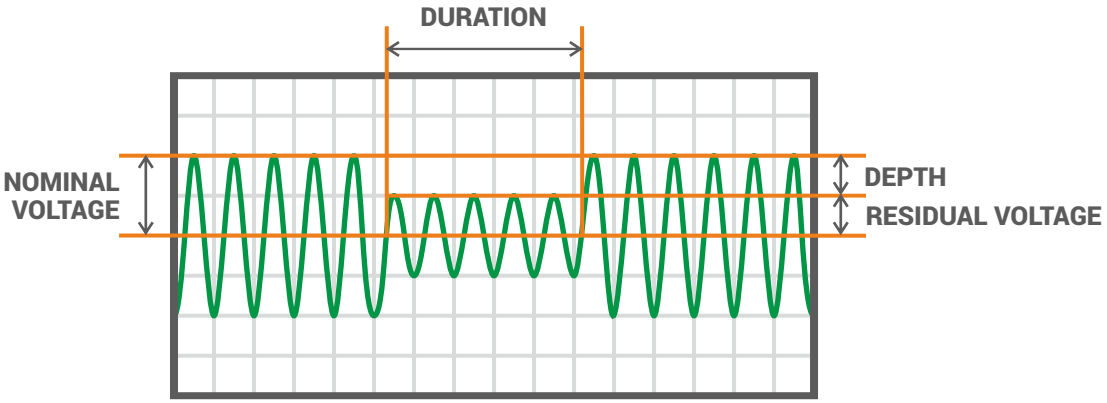
WHAT ARE VOLTAGE SAGs?

A voltage SAG is a temporary reduction of the Voltage RMS below a specific threshold at an electrical supply line point.

SAG STARTS WHEN VOLTAGE GOES LOWER THAN 90% OF NOMINAL VALUE AND ENDS WHEN VOLTAGE RESUME ABOVE 90%

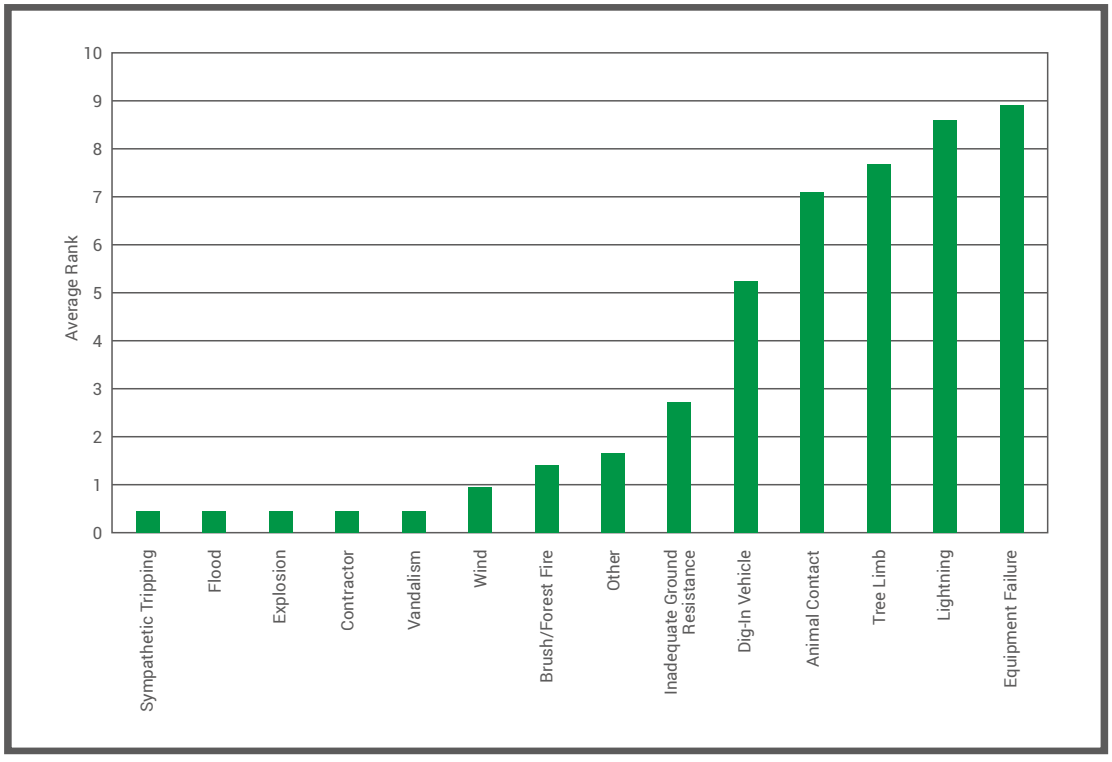


Generally voltage SAG happens when the residual voltage decreases between 10 and 90 percent of nominal voltage for one-half cycle to one minute. Voltage SAG duration is considered within 10ms up to 1min. The great deal of Voltage SAG have a duration lower than 1 second and a residual voltage higher than 40% of the rated value.

VOLTAGE SAGs CAUSES

Voltage SAGs are generally caused by faults in the public network or in the installations of network users, in some cases by transient overloads due to the starting of large motors or the insertion of large loads.

SAGs ARE IMPREVEDIBLE AND RANDOM



Voltage SAG causes, source EPRI, Electric Power Research Institute.

Motor drives, including variable speed drives, are particularly susceptible.
Data processing and control equipment is also very sensitive to voltage SAGs and can suffer from data loss and extended downtime.

WHERE DO THE VOLTAGE SAGs COME FROM?

- The voltage SAG propagates from the higher voltage levels to the lower ones, the load is often connected to a voltage level lower than the point of failure.
- Faults in the network cause deep voltage SAGs if they occur near loads.
- According to an Italian CESI study, the incidence of voltage SAGs is much greater in the case of an aerial MV network than with underground cables.

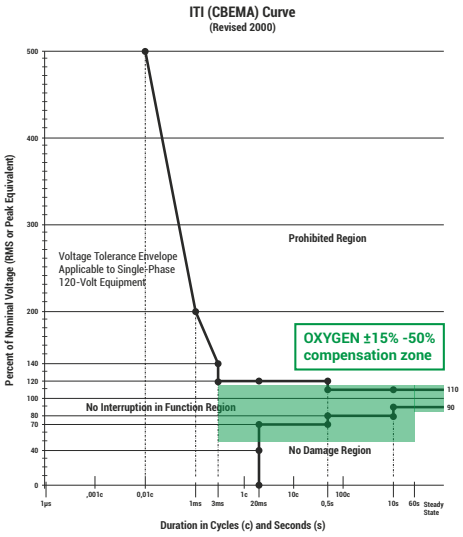
RELEVANCE OF VOLTAGE SAGs

The more modern the equipment is and the more electronics is required, the more serious are the problems caused through voltage SAG. With the increasing number of regenerative energy sources, energy sags, fluctuations and frequency deviations also increase.
Example of costs due to voltage SAGs:

- Costs for unproductive personnel due to the sudden termination of the production cycle.
- Costs for raw materials and production lost.
- Costs for damages and/or malfunctions of machineries (repairs to them, temporary hire of new ones).
- Penalties caused by contractual shortcomings.
- Sanctions for damage to the environment.
- Increase in general insurance costs.

VOLTAGE SAG COST IS NORMALLY LOWER THAN A VOLTAGE SUPPLY INTERRUPTION ONE, BUT THE FIRST IS BY FAR MORE FREQUENT

IMMUNITY OF EQUIPMENT TO DISTURBANCES COMING FROM THE NETWORK



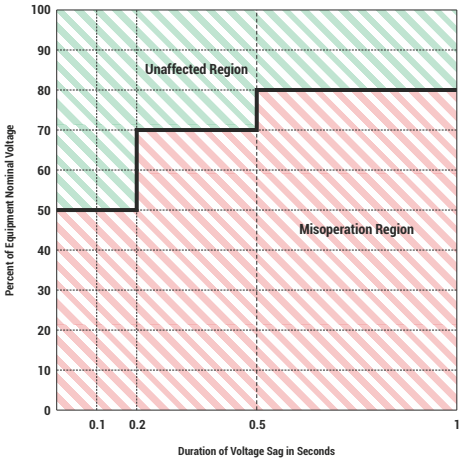
TROUBLES COME:

LOWER THAN 90% OF NOMINAL VOLTAGE AND STARTING FROM 10 sec

ABOVE 110% OF NOMINAL VOLTAGE AND STARTING FROM 0.5 sec

(CBEMA)

Temporary increase of RMS voltage at a point of electrical supply line and above a specific threshold.
Curve developed by ITIC (Information Technology Industry Council) and CBEMA (Computer and Business Equipment Manufacturers' Association) allows to understand the capabilities and limitations of computers and business equipment and their voltage stability requirements.



THE EQUIPMENT MUST BE ABLE TO CONTINUOUSLY OPERATE WITHOUT INTERRUPTION DURING CONDITIONS IDENTIFIED IN THE AREA ABOVE THE DEFINED SOLID BLACK LINE

SEMI, the industry association for the semiconductor industry, has developed the SEMI F47 voltage SAG immunity standard.
SEMI F47 is important because semiconductor plants require high levels of POWER QUALITY due to the sensitivity of equipment and process controls.
They must tolerate sags to 50% of equipment nominal voltage for duration of up to 200ms, sags to 70% for up to 0.5 seconds, and sags to 80% for up to 1.0 second.

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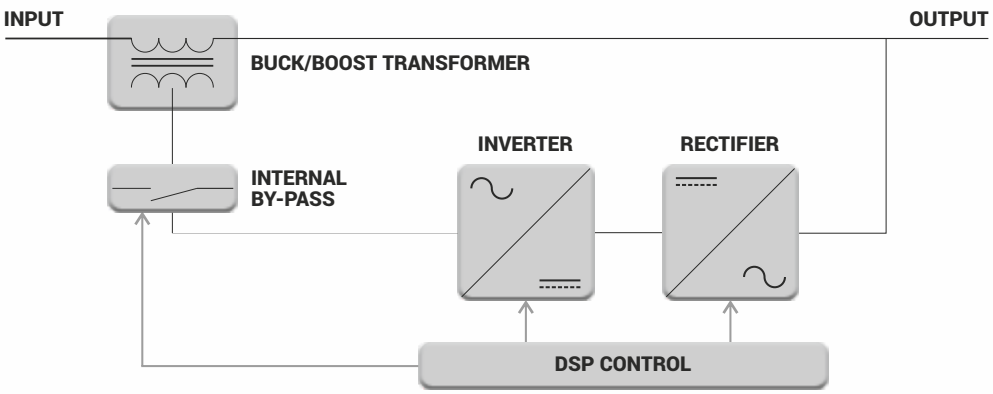
Oxygen, thanks to a suitable sizing of the power components and a remarkable response speed (<3 milliseconds) is able to face lowering (SAG) of the grid voltage of a maximum duration of one minute. The energy required is taken directly from the network.
Current models are able to cover network downing up to 50% of the nominal value (-50%).
The **voltage compensation** on the buck/boost primary winding is performed by **IGBT** static switches controlled by a microcontroller. The microcontroller system monitors the output voltage and determines the opening or closing of the IGBT contacts ensuring the best regulation.
The use of the **double conversion technology** guarantees the insulation from the disturbances and the distortions of the network and, together with the help provided by the electrolytic capacitors, makes it possible to build machines for high power loads.
This SAG Compensator can operate with a **load variation range** for each phase **from 0 to 100%**, it is **not affected** by the **power factor** of the load and it can work with or without the neutral wire.
Oxygen can operate with different input and, consequently, output voltage (380V or 415V) from the nominal one (400V).

The **main components** are:

- **IGBT** microcontroller-based electronic control boards running the system in terms of regulation and alarm management. They compare the output voltage value to the set one: if a difference is detected, they generate the compensation necessary to bring back the output voltage to the nominal value (provided that said difference falls in the working range).
- **Conversion units** (AC/DC rectifier and DC/AC inverter):
  Rectifier: it converts the phase to neutral voltage of the AC mains into DC voltage by means of a fully-controlled IGBT bridge. The rectifier is sized in order to supply the inverter at full load.
  Inverter: it converts the DC voltage coming from the rectifier into AC voltage, stabilised in amplitude. The inverter uses the same IGBT technology as the rectifier.
- **Internal by-pass** static switch enabling load supply in case of fault condition.
- **Buck/boost transformer** adding or subtracting the voltage necessary to compensate for the mains fluctuation.
- **Touch display**.

The user interface is created using a multilingual «touch panel» (10"); through the selection menu, it is possible to display electrical values and set the operating parameters.
It is also possible to communicate with the electronic component via the **RS485 serial bus** using the **Modbus RTU** protocol.
The standard cabinet is metallic with RAL9005 color and IP21 protection degree.

Working principle of OXYGEN



KEY BENEFITS

Protection from the most common Power Quality problem.
Voltage SAGs are the most common cause of equipment malfunctions in automated industry. SAGs correction up to -50% for 1 min.

Economical solution: no maintenance and operation costs.
No battery energy storage required. Efficiency >98%.

Compared to a UPS, Oxygen solution is specific for voltage SAGs with considerable benefits in terms of:

- Reduced cost
- Less maintenance
- Smaller footprint and occupied space
- No specific climate room or air conditioning required

KEY FEATURES

HIGH EFFICIENCY
>98% at nominal power.

INDUSTRIAL DESIGN
Designed for standard industrial loads with admitted overload as of 150% for 1 minute (at nominal input voltage).

MODULAR CONSTRUCTION
Fast & Easy maintenance.

WITHOUT ENERGY STORAGE
Minimum maintenance and increased reliability.

SAG CORRECTION UP TO -50% WITH CONTINUOUS ±10%, ±15% ONLINE REGULATION
Correction in less than 3 millisecs.

INTERNAL BY-PASS
Internal by-pass static switch enabling load supply in case of fault condition.

CONNECTIVITY
Modbus RTU.

MULTILINGUAL TOUCH SCREEN INTERFACE
Easy to understand with simple user controls, events log.

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RANGE

Type	Input variation range	Rated Power	Input Voltage range	Max input current (peak)	Output voltage ±0.5%	Rated output current	Efficiency	Correction time	Cabinet dimensions*	Weight*
	[%]	[kVA]	[V]	[A]	[V]	[A]	[%]	[ms]	[WxDxH]	[kg]
Input voltage compensation: **±10%** continuous / **-40%** for 1 minute (100% nominal output voltage)										
200-10-40	±10(-40%)	200	360-440	321(481)	400	289	>98	<3	1200x800x2000	800
250-10-40	±10(-40%)	250	360-440	401(601)	400	361	>98	<3	1200x800x2000	900
320-10-40	±10(-40%)	320	360-440	513(770)	400	462	>98	<3	1200x800x2000	1150
400-10-40	±10(-40%)	400	360-440	642(962)	400	577	>98	<3	1200x1000x2200	1200
500-10-40	±10(-40%)	500	360-440	802(1203)	400	722	>98	<3	1200x1000x2200	1400
630-10-40	±10(-40%)	630	360-440	1010(1516)	400	909	>98	<3	2600x1000x2200	1600
800-10-40	±10(-40%)	800	360-440	1283(1925)	400	1155	>98	<3	2600x1000x2200	1800
1000-10-40	±10(-40%)	1000	360-440	1604(2406)	400	1443	>98	<3	4200x1000x2200	2100
1250-10-40	±10(-40%)	1250	360-440	2005(3007)	400	1804	>98	<3	4200x1000x2200	2300
1600-10-40	±10(-40%)	1600	360-440	2566(3849)	400	2309	>98	<3	4800x1400x2400	3200
2000-10-40	±10(-40%)	2000	360-440	3208(4811)	400	2887	>98	<3	4800x1400x2400	3600
2500-10-40	±10(-40%)	2500	360-440	4009(6014)	400	3609	>98	<3	4800x1400x2400	4000
3200-10-40**	±10(-40%)	3200	360-440	5132(7698)	400	4619	>98	<3	4800x1400x2400	5000

The values listed in the table are referred to 400V nominal voltage

* Size and Weight may change

** Available only for 480V / 60Hz

Input voltage compensation: **±15%** continuous / **-50%** for 1 minute (100% nominal output voltage)										
200-15-50	±15(-50%)	200	340-460	340(577)	400	289	>98	<3	1200x800x2000	1150
250-15-50	±15(-50%)	250	340-460	425(722)	400	361	>98	<3	1200x1000x2200	1200
320-15-50	±15(-50%)	320	340-460	543(924)	400	462	>98	<3	1200x1000x2200	1400
400-15-50	±15(-50%)	400	340-460	679(1155)	400	577	>98	<3	2600x1400x2200	1600
500-15-50	±15(-50%)	500	340-460	849(1443)	400	722	>98	<3	2600x1400x2200	1800
630-15-50	±15(-50%)	630	340-460	1070(1819)	400	909	>98	<3	2600x1400x2200	1900
800-15-50	±15(-50%)	800	340-460	1359(2309)	400	1155	>98	<3	4200x1000x2200	2300
1000-15-50	±15(-50%)	1000	340-460	1698(2887)	400	1443	>98	<3	4800x1400x2400	3200
1250-15-50	±15(-50%)	1250	340-460	2123(3609)	400	1804	>98	<3	4800x1400x2400	3600
1600-15-50	±15(-50%)	1600	340-460	2717(4619)	400	2309	>98	<3	4800x1400x2400	4000
2000-15-50**	±15(-50%)	2000	340-460	3396(5774)	400	2887	>98	<3	4800x1400x2400	5000

The values listed in the table are referred to 400V nominal voltage

* Size and Weight may change

** Available only for 480V-460V / 60Hz

Optional

Input automatic circuit breaker
Short circuit output protection
Manual maintenance by-pass
Input isolating transformer
EMI/RFI filters

TECHNICAL FEATURES

INPUT			
Available nominal voltage*	380-400-415V (440-460-480V 60Hz only)		
Maximum supply voltage	Max continuous voltage +10%		
Supply Frequency	50Hz ±5% or 60Hz ±5%		
Power system	3 phases + N (no neutral wire on request)		
OUTPUT			
Voltage	The same of input nominal voltage (output voltage can be adjusted)		
Admitted load variation	Up to 100%		
Admitted load imbalance	50%		
Admitted overload	150% for 1 minute (at nominal input voltage)		
PERFORMANCE			
Efficiency	>98%		
SAG correction response	<3 millisecs		
Output voltage accuracy	±0.5%		
SAG correction accuracy	±4%		
Continuous regulation range	Oxygen 10-40: ±10%, Oxygen 15-50: ±15%		
SAG correction capability	*Input*	*Output*	*Time*
Oxygen 10-40	-40%	100%	1 minute
	-50%	90%	45 seconds
	-60%	80%	36 seconds
Oxygen 15-50	-50%	100%	1 minute
	-60%	90%	45 seconds
INTERNAL BY-PASS			
Capacity	150% of model rating		
Mode of operation	Thyristor switch		
BUCK/BOOST TRANSFORMER			
Type	Dry transformer		
Frequency	50Hz or 60Hz		
ENVIRONMENT			
Operating temperature range	0°C to 40°C (32°F to 104°F)		
Operating altitude	<1000m without derating		
Inverter cooling	Forced Ventilation		
Transformer cooling	Natural convection		
Max relative humidity	<95% (non-condensing)		
Pollution degree rating	2		
ENCLOSURE			
Protection degree	IP21 (other on request)		
Material	Electro-galvanized steel		
Finish	Standard epoxy-polyester powder coating textured finish		
Colour	RAL 9005		
Enclosure access	Hinged doors with key lock		

* Output voltage can be adjusted by choosing **one** of the indicated values. Such choice sets the new nominal value as a reference for all the stabiliser parameters.

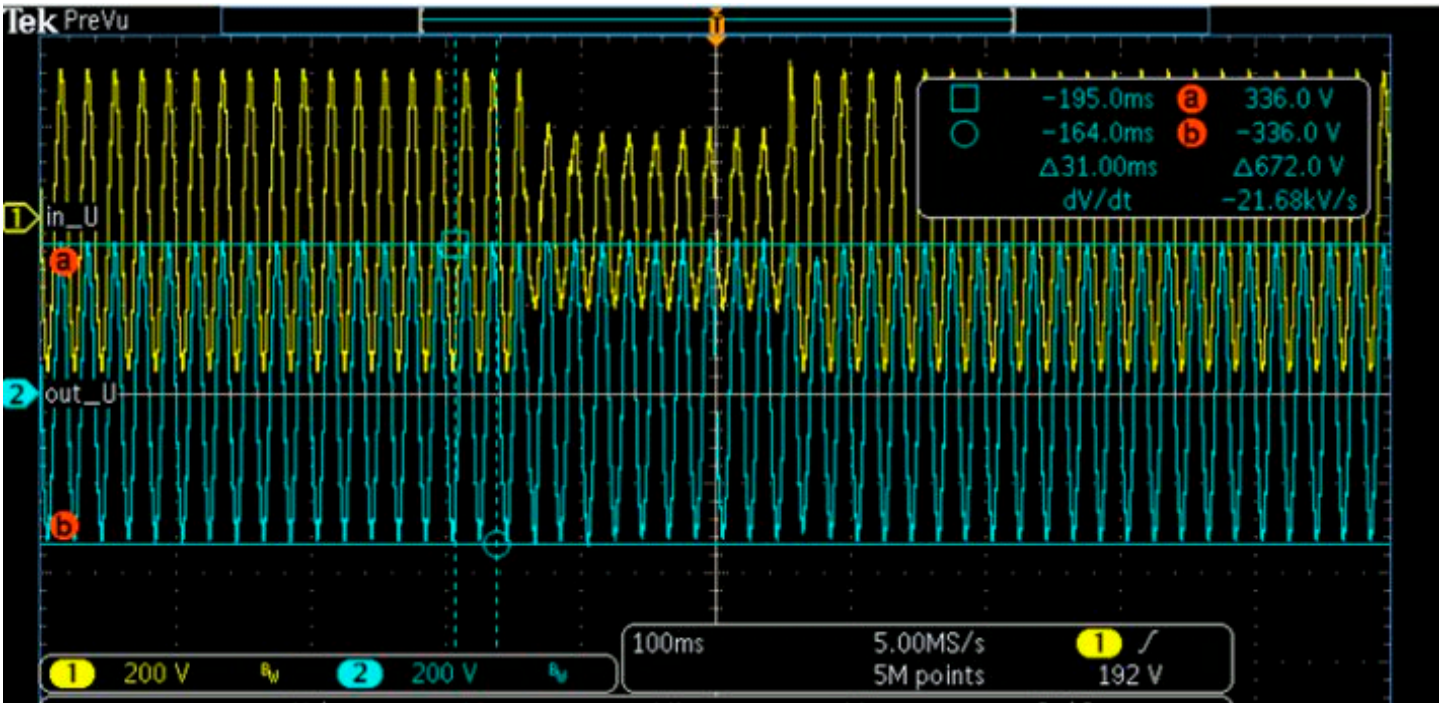
SERVICE	
Diagnostics	Non-volatile event & log

USER INTERFACE	
User interface	10" color touch panel, multilingual
Touch panel	Full parameters control, system & voltage event log
Remote duplication	On request by dedicated software connected to the same network (Ethernet)
Communication	Modbus RTU (Modbus TCP on request)

POWER QUALITY EVENT MONITOR	
Events recorded	Voltage SAG
Events detection	Input voltage
SAG threshold	Continuous (under minimum voltage)

STANDARDS & CERTIFICATIONS	
Quality	ISO9001
Environmental	ISO14001
Health & Safety	OHSAS18001
Marking	CE
Performance	IEC 61439-1/2

APPLICATION EXAMPLE



Yellow: without Oxygen | Sag compensator
Blue: with Oxygen | Sag compensator

For more information visit **www.voltagesag.ortea.com**

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IMPROVE YOUR POWER QUALITY

Companies are more and more sensitive to Power Quality issues because they can cause troubles and damages to equipments.

Our Power Quality solutions:

VOLTAGE STABILISERS
SAG COMPENSATOR
DRY-TYPE TRANSFORMERS
VOLTAGE OPTIMISERS
PFC SYSTEMS
ACTIVE HARMONIC FILTERS

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ORTEA SpA
Via dei Chiosi, 21
20873 Cavenago di Brianza MB | ITALY
tel. +39 02 95 917 800

www.ortea.com
sales@ ortea.com