What is the PropSava

and

Question and Answers

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1508 Eastern Tower |Yihai Square Commercial Building | North Chuang Ye Road| Nanshan District | Shenzhen | 518054 | China | **Telephone:+86 755 2664 7764**|
Fax: +86 755 2664 8864 | Registered Office Address: | 803, Futura Plaza, 111 How Ming Street, Kwun Tong, Hong Kong. TEL: (852) 3583 9190. FAX: (852) 2341 1414
|web: www.vanguardspower.com |

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What is the PropSava?

Background:

Vanguards Power (Hong Kong) Limited PropSava is based upon a design of a contactless voltage regulator from 10KVA to 600KVA and electro-servo voltage regulator from 60KVA – 3,000 KVA *(definition: A voltage regulator is an electrical regulator designed to automatically maintain a constant voltage level)*

We refer to the PropSava as a Power Optimisation System because the main purpose of the software we have designed that controls the voltage regulator is to optimise *(definition: [verb] modify to achieve maximum efficiency)* the output voltage from the main supply to electrical equipment.

Voltage regulation is not new. Devices for regulating voltage have existed since man started trying to harness the power of electricity. The basic principles of high current voltage regulators are also not new since all systems use various types of transformers to change the value of the voltage supply to the required output level. The main difference between different types of voltage regulators are:

1. They are able to regulate incoming voltage that is over and under the required output requirement – many transformer types only regulate over voltage and therefore do not provide stable voltage for those users who suffer from under voltage supply.
2. The control mechanism and systems used that measures and effects change of the incoming voltage to achieve the desired output voltage – mechanical, electro-mechanical and electronic
3. The speed of the control mechanism and system – response time in seconds.
4. The serviceability of the device – service and maintenance intervals.
5. The range of output voltage that can be maintained - + or – X Volts.
6. The length of service life – how many years the device is designed to operate.
7. Cost
8. Warranty.

PropSava Single Phase Load Sizes:

The single phase systems are designed for 230V and 120V systems. The 230V units are available as 5, 12, 18, 23, 30, 40 and 60KVA; and the 120V units as 2, 5, 9 and 12KVA.

Voltage output on the 230V units are regulated to 220V +/- 1% with an 'optimum switch' that instantly changes the output voltage to 210V.

Voltage output on the 120V units are regulated to 110V+/- 1% with an 'optimum switch' that instantly changes the output voltage to 105V.

PropSava 3 Phase Load Sizes:

The three phase systems are designed for 400V input voltage +/-10% (360 – 440V) supplies with output across the phase of 380V (single Phase of 220V) and load sizes from 10KVA to 600KVA using our Contactless SCR System and 60KVA to 3,500KVA for our Electro-Servo system.

Benefits of the PropSava:

Both the single and three Phase PropSava provide the following benefits:

1. Reduce KWH electricity costs and carbon emissions by up to 17%, (depended on incoming voltage and equipment conditions)

2. Reduce reactive power, improve power factor and suppress harmful harmonics (subject to assessment of KVAR and installation of an additional harmonic filter).

3. Increase the lifecycle of the electrical equipment and reduce the maintenance costs.

4. Protect electrical equipment from transients (spikes and surges).

5. 10 year guarantee and a 25-40 year life cycle.

6. No maintenance on contactless system – 5 year, 1 hourly inspection on electro-servo systems.

PropSava Technology:

Contactless System:

Control & Management:

The PropSava is a pure linear contactless system based upon electromagnetic induction principle. This system is used in our single and three phase systems. The contactless system is managed and controlled by our newly developed computer chip and software system. The computer chip controlled system and software is the key to the consistent efficiency of our contactless voltage regulator; making some 8 million calculations per second. This extremely fast measuring of all data allows the PropSava to rapidly identify, measure, and implement the necessary control changes to ensure that the outgoing voltage is maintained at the pre-set limits within 0.042 seconds – 42 milliseconds.

SCR:

To ensure that the PropSava voltage control system keeps up with the speed of the onboard computer chip system and software, we have used the latest German manufactured silicon controlled rectifiers (SCR). SCR's have no wear out mechanism related to number of switching operations so much higher switching rates can be used bringing higher speed, smoother power delivery and flexibility.

Electro-Servo System:

For most applications our Electro – Servo Systems have proved to be a very reliable and cost-efficient, being able to accommodate an input voltage swing of in excess of 40% whilst still delivering accuracy on the output. Comprising a transformer having its secondary winding connected between the mains supply and the load, the primary voltage is automatically controlled through a motor driven variable transformer.

Electro - Servo Systems do contain moving parts with only a low-level of ongoing maintenance required; being deliverable by universally readily available skill sets.

SCR Power Optimisation System

Advantages	Disadvantages
High speed of response to voltage changes – 0.042 seconds	Less price competitive when compared to Electronic Servo design
Output voltage accuracy 1.5 %.	Should not be used where large and unexpected loads are possible such as welding plants and large ovens.
No Moving parts – virtually Maintenance free	
Efficiency 96% at full load below 50KVA and 98% plus above 50KVA	
Not Frequency dependent	
Output voltage does not collapse on overload or severe input voltage drop	
Low output waveform distortion	
Unaffected by load or power factor changes	
Will attenuate voltage spikes if required	

Electro-Servo Power Optimisation System

Advantages	Disadvantages
Unaffected by load or power factor changes and more resilient to frequent large loads than SCR - such as welding etc.	Moving parts requiring maintenance such as annual inspection of servo-motor chain drive and 5 yearly replacements of carbon brushes.
Reasonable speed of response to voltage changes.	Lower speed of response (1 – 1.5 seconds compared to solid state designs such as Contactless Systems.
Competitively priced	Size & Weight larger than Contactless System.
Efficiency 96% at full load below 50KVA and 98% above 50KVA	
Negligible output waveform distortion	
Not Frequency dependent	
Will attenuate voltage spikes if required	
Endurable, with long life expectancy	

General Specifications of PropSava 3 Phase SCR System:

Power Optimisation/Regulation:		Digital control contactless compensated regulation, three phase regulated separately
Input	**Voltage:**	400V (360 – 440V)
	Variance Range:	± 10%
	Frequency:	47Hz ~ 63Hz
	Power Factor:	0.95 ~ 1
Output	**Voltage:**	380V or customer specified
	Regulated range:	± 1.5%
	Frequency:	As input
	Range of Load PF:	0.8 ~ 1
Efficiency		≥98.8% (Full Load)
Waveform distortion:		≤0.1%
Response time:		≤40mS
Insulation Resistance:		≥2MΩ
Insulation strength:		No damage at 2000V 1 Minutes
Display:		Multifunctional LED display shows input/output Voltage, current. Protection state.
Protection function:		Auto/Manual Bypass, Over/under voltage, Over load, Short circuit, Phase Drop, Wrong Phase, Alarm/Silence at Bypass.
Surge Protection:		IEC class II surge protection. Nominal discharge surge current is 20KA
Overload ability:		150% for 10 second
Noise:		≤ 45dB
Cooling:		Fan
Size:		Manufactured to Load/size specification
Input/output Connection:		Terminal plate
Environment	**Temperature**	-10ºC ~ 45ºC
	Humidity	0~95% (No freezing point)

Surge Protection System:

All PropSava single and 3 Phase Power Optimisation Systems have a surge arrestor fitted as standard. This is not a luxury but an absolute necessity to protect not only the PropSava but also the entire site/properties electrical equipment. Surges are short-duration peak voltages – i.e. transient voltages – existing for only milliseconds; but can measure thousands of volts.

These surges are caused by:

1. Direct lightning strikes
2. Indirect lightning strikes within a distance of some kilometres
3. Switching operations in the power supply system
4. Faults due to switching operations within the installation

In the commercial sector, lightning or power surges cause 45% of electrical equipment damage. Overall, 28 out of 100 cases of damage to electronic equipment are caused by surges. Surges are by far the most frequent cause of damage and that is why surge arrestors are fitted as standard.

Surge Protection System Specifications - Standard:

PropSava-3 phase Standard Surge Arrestor installed V 20-C/3+NPE-385 technical data:

Surge Controller surge arrester Description	V 20-C/3+NPE-385
Maximum continuous operating voltage Uc_{AC} (max. permitted operating voltage) Uc_{DC}	385 V~ 505 V-
LPZ	1 → 2
Requirement class to VDE 0675, Part 6 (Draft 11.89) A1, A2 to IEC 61643-1	C, Class II
Tested to:	IEC 61643-1, pr EN 61643-1, E DIN VDE 0675-6:1989-11 and Part 6/A1
Nominal discharge current of the upper part In (8/20)	20KA
Max. Discharge current per block Imax (8/20) Surge Controller V 20-C/3...	110 kA
Maximum discharge current of the upper part Imax (8/20)	40 kA
Voltage protection level at 1 kA (8/20) Up at 5 kA (8/20) Up at In Up	≤1.2 kV ≤1.5 kV ≤1.8 kV
Response time tA	<25 ns
Short-circuit withstand strength 25 kA with max. upstream fuse	125 A gL/gG
Connection cross-section	2.5-35 mm2 (single and multi stranded); 2.5-25 mm2 (fine-stranded with core end sleeves)
Mounting	Snap-fitting on 35 mm top-hat rail to DIN EN 50 022
IP Code	IP20
Temperature range ϑ	-40 °Cto+80 °C

Surge Protection System Specifications - Optional:

PropSava-3 phase Optional Surge Arrestor type V 25-B+C/3+NPE-385 technical data:

Surge Controller surge arrester Description	V 25-B+C/3+NPE-385
Maximum continuous operating voltage Uc_{AC} (max. permitted operating voltage) Uc_{DC}	385 V~ 505 V-
LPZ	0 → 2
Requirement class to VDE 0675, Part 6 (Draft 11.89) A1, A2 to IEC 61643-1	B+C Class I+II
Tested to:	IEC 61643-1, pr EN 61643-1, E DIN VDE 0675-6:1989-11 and Part 6/A1
Nominal discharge current of the upper part In (8/20)	50KA
Max. discharge current per block Imax (8/20) Surge Controller V 20-C/3...	 150 kA
Maximum discharge current of the upper part Imax (8/20)	100 kA
Voltage protection level at 1 kA (8/20) Up at 5 kA (8/20) Up at In Up	 ≤1.0 kV ≤1.2 kV ≤1.5 kV
Response time tA	<25 ns
Short-circuit withstand strength 25 kA with max. upstream fuse	160 A gl/gG
Connection cross-section	2.5-35 mm2 (single and multi-stranded); 2.5-25 mm2 (fine-stranded with core end sleeves)
Mounting	Snap-fitting on 35 mm top-hat rail to DIN EN 50 022
IP Code	IP20
Temperature range ϑ	-40 °Cto+80 °C

Overall Build objectives of the PropSava:

- PropSava single and 3 Phase Voltage Optimisers:
- Fast response time.
- Maximum possible efficiency at full load.
- High efficiency, high standard and extensive safety range of industrial grade components.
- The ability to sustain severe temperature, humidity, vibration and dirty environments.
- Transformer windings are of high quality enamelled copper wire.
- Low output noise and extremely RFI radiated noise.
- Fast response to input and output changes.
- Inexpensive.
- No maintenance.
- Reliable.
- Manual bypass function
- Automatic bypass function
- Surge protection
- Input and output isolated

Questions and Answers about the PropSava Voltage Optimisers.

Why Optimise Voltage?

Most electrical equipment used is manufactured to European standards, designed for 220V and will operate effectively down to 200V. By forcing appliances to operate at a higher voltage leads to significantly higher energy consumption, increased heat losses and a reduced life span.

"A 230V linear appliance used on a 240V supply will take 4.3% more current and will consume almost 9% more energy." (Electricians Guide 16th Edition BS7671).

It is estimated that 70% of sites in Europe are operating at too high a voltage and could benefit from voltage optimisation.

The table below compares the behaviour of 3 phase 5 H.P. motor at different voltages:

INPUT VOLTAGE	CURRENT	KVA	PF
400	7.5 A	5.2	0.8
425	11% More	18% More	0.7
435	19% More	28% More	0.6
445	265 more	38% More	0.57

The table below compares the behaviour of a single phase 60 watt lamp at different voltages:

VOLTAGE	CURRENT	WATTS	LUMINOUS INTENSITY	LIFE IN HOURS
230	0.26	60 W	710	1000
240	0.27	65 W-8.3% More	820	575
250	0.28	70.6-17.6% More	943	338
260	0.29	75.4-25.6% More	1073	200
270	0.31	83.4-39% More	1213	100

Where is the PropSava installed?

The PropSava is a device that is installed in series with the main breaker in a property's electrical room between the meter and distribution panel. It is available in a range of sizes to match a properties system requirement. Subject to site and survey, the installation of the units can be carried out in a few hours.

Does the PropSava require any maintenance?

The Contactless Systems of the PropSava do not require any scheduled maintenance. The Electro-Servo Systems require 1 and 5 yearly inspections that take about 1 hour.

Is the PropSava suitable for single-phase supply sites?

Yes, we have a PropSava version for single and 3 phase supply.

Where was the PropSava developed and where is it built?

The technology was developed in the UK and Germany by specialist engineers in the field of transformer and control management systems in 2005. The systems are currently assembled in China and over 37,000 units have been deployed through Asia since 2006. PropSava® Systems are used in virtually all forms of properties and buildings: telecoms, factories, offices, petrol stations, department stores, residential apartment blocks, and leisure industry – anywhere that needs to save power, costs and electrical equipment from premature failure.

How many PropSava Systems have been installed?

The systems are currently assembled in China and over 37,000 units have been deployed through Asia since 2006. We have now designed systems for Western & Eastern Europe, North & South America and Australasia and these are being launched now. There are planned test sites being set-up in the UK, Australia and Chile in August 2009, with further installations being planned for South Australia, Germany and Greece in November 2009.

What is the Warranty period for a PropSava?

The unit itself is guaranteed for 10 years – 5 years parts and labour and 5 years parts, with an expected lifetime of 25-40 years.

For what types of electrical equipment will the PropSava provide savings?

The PropSava® technology is suitable for almost all types of site. To date, the greatest savings have been achieved on facilities with large lighting and office equipment loads, including motors, refrigeration and air-conditioning. Longer operating hours (high 'load factor') will maximise the savings made.

Is the PropSava a system made up of several components?

The **PropSava** is a single unit that addresses various power quality improvements and extends the life of electrical equipment in a facility.

What size of building is the PropSava suitable for?

The **PropSava** is an energy saving device for domestic and light-commercial single phase sites and commercial and industrial 3-phase sites, with units up to around 5,320 Amps (3,500 KVA). The actual model size will depend on the property's electrical load profile, the size of the main breaker and electrical room configuration.

How is the PropSava sized in relation to the existing power demand in the building and would future expansion be accounted for?

The size of the **PropSava** installed at your site depends on your incoming power supply and a survey of your existing equipment load. We will recommend a PropSava load size equal to 20% more than the equipment total load. This ensures that your electrical infrastructure will meet future expansion needs of your business; and that poor Harmonics and low Power Factor will be improved by the additional capacity of the PropSava.

Can we install multiple PropSava Systems in one site?

We would always recommend that one System with the capacity to meet all the needs of the site is considered as the optimum choice. This is to reduce installation costs and increase the efficiency of balancing the output load for the overall electrical system.

Is the PropSava legally accepted by the power suppliers/generators?

The PropSava improves the existing power distributed from the power suppliers/generators and does not in any way affect their operations or their supply.

Do the harmonics of my site need to be analysed before I install a PropSava?

You do not have to analyse the current harmonic state of your site prior to the installation of the PropSava; but we do recommend it. Many companies who fit competitive types of Voltage Regulators suggest you need not to as their system will correct harmonic interference and increase Power Factor readings. These companies employ a 'shotgun' approach or 'one size fits all' by fitting a standard set of capacitors to cure some of the common problems associated with bad harmonics. If all installations had exactly the same equipment and numbers; and they were all receiving the same quality of power then this approach would work effectively. However, this is basically impossible and not an effective way of curing these problems. No two sites are the same.

We recommend calculating the harmonics on your site and we would then manufacture either an Active or Passive set of filters to correct the problems which in turn could increase the Power Factor. This is the only correct way to provide an effective solution.

What is the effect of over-voltage on AC motors?

Supplying voltage over the design voltage of a motor will not increase motor torque or performance. The various problems associated with over voltage are as follows:

- Iron losses will always be higher in motors that are experiencing over voltage.
- In some cases, the motor draws excessive current and attempts to magnetise the iron core above its design capacity. This can lead to saturation of the iron core, above which additional losses are incurred due to eddy currents. These losses increase disproportionately with the rise in voltage over the design voltage.
- The drawing of excessive current will cause copper losses.
- Iron and copper energy losses are released as heat.
- As a motor is put under additional stress, its lifetime will decrease.
- Small motors are more sensitive to over-voltage than large motors.

The effects of over-voltage are felt particularly on motors which are lightly loaded. In reality, all motors are specified with a frame size that is large enough for the maximum load it will ever experience, with an additional margin. So in effect all motors on real sites are lightly loaded, and there is always an opportunity to make savings by bringing the voltage down to a more appropriate level.

It should be noted that reducing the voltage slightly below the optimal operating point barely impacts on the efficiency. A typical motor will operate at near full efficiency down to 200V, without deviation from normal performance. The reduction in voltage will not affect the speed of the motor as this is a function of the frequency of the electricity and the number of poles on the motor. By keeping the voltage within the statutory band, no reduction in torque will be observed.

What is the effect of the PropSava on an AC motor?

Motors will provide especially good savings when a **PropSava** is installed, they can be found inside refrigeration equipment and air conditioning as well as their more obvious applications.

Following a **PropSava** installation, the stress and losses on motors will be reduced so they operate closer to their nameplate rating whilst maintaining constant power output at the drive shaft. This will reduce maintenance costs for the lifetime of the motor. Through the more efficient operation of the motors, there will also be a reduction in the amount of reactive power (KVAR) consumed which will improve the Power Factor.

Along with over-voltage, the **PropSava** will also help to address phase imbalance and total harmonic distortion (THD); both these problems can lead to excessive vibration of the motor causing faster wear and tear on the bearings.

For savings energy on motors, how does the PropSava compare to a Variable Speed Drive (VSD)?

Installing a PropSav**a** to optimise the power supply to common motors (HVAC etc) can deliver better energy savings than a Variable Speed Drive installation: as well as optimising the voltage it will act to balance the three phase voltage (which dramatically improves efficiency), reduce reactive power and improve power factor. Savings from voltage optimisation on AC motors depend on the extent to which over-voltage and phase imbalance are currently a problem, but we would expect savings in the region of up to 17% for an average supply voltage.

For specialist applications, a VSD may well deliver higher savings on an individual motor, but the aggregated benefits of having a PropSava optimise the entire site's load at source are considerable. Some sites already have VSDs installed on various motors: the PropSava will give further energy savings on these as well as improving the reliability of the VSD itself. However, the level of savings achieved is likely to be lower than average, as we cannot 'double account' for the savings already delivered by the VSD.

What is the effect of the PropSava on motors with inverter drives or variable speed drives?

As with AC motors, the PropSava will reduce the stress on VSDs or inverter drives by delivering an optimised voltage. There will be no effect on speed or torque of the motor as it is buffered by the inverter. The life span of these types of drive will be shortened considerably if the supply voltage is too high, and many sites report the need to replace such drives frequently. By correcting this, the PropSava will reduce replacement costs. VSDs and inverter drives are also notorious for generating harmonics, which can damage sensitive equipment.

What is the effect of the PropSava on systems that are protected by a UPS (Uninterruptible Power Supply)?

Rotary UPS systems will benefit significantly from the phase voltage balancing effect of the PropSava, which will allow them to work more efficiently. As many UPS devices act to correct over-voltage themselves, supplying them with the correct voltage through a PropSava will mean that they will not have to operate in this mode routinely, allowing more efficient day-to-day operation. The PropSava replicates other functions of some UPS systems, by protecting against transients up to 25kV, filtering harmonics and balancing phase voltages. This may mean that a UPS is not required for a particular application, or a less expensive UPS can be specified.

How does the PropSava affect different types of lighting?

Lighting loads tend to be switched on for a large proportion of the time, so savings on lighting equipment are very valuable. Incandescent lighting is particularly susceptible to losses at high voltages, and by bringing the voltage to the correct level savings can be delivered with no discernible drop in light levels. The lifetime of bulbs can also be extended markedly: "A 230V bulb used at 240V will achieve only 55% of its rated life." (IEE Electricians Guide)

The efficiency of any type of lighting will be improved by bringing it to the correct voltage, including systems with resistive or reactive ballasts. Fluorescent lighting is much more efficient that incandescent lighting, but nevertheless will run even more efficiently when supplied with the correct voltage. Optimisation with a PropSava will never take the voltage to a level where the light fails to strike, as the voltage will not drop below the statutory minimum.

Some types of lighting control system for high-frequency lighting carry out voltage optimisation electronically anyway, so the savings on these will be lower than simple lighting systems. Optimising with a PropSava would reduce the need for such controllers, as lighting load would be considerably more efficient. Lighting controllers and HF ballasts are also responsible for generating high levels of harmonic distortion.

Does the PropSava cause lights to dim?

Optimising the voltage will not cause lights to dim; lighting levels will be maintained within their original design specification. Remember that the PropSava is bringing the voltage from an 'over-voltage' to the correct, design optimum voltage ,so as a result the lighting output will be at the designed level, and the efficiency and longevity of the lighting system will be maximised. We have never had a report of a discernible drop in lumen output following a **PropSava** installation.

Is there any conflict with backup generators?

The **PropSava** will optimise the mains supply to a building, so will be installed upstream of the LV distribution. It should not therefore affect or be affected by any backup generators that may be installed, as these will only come on stream if the incoming power supply fails. The only real consideration is the threshold at which the backup generators come on. They are often triggered by a drop in the supply voltage, so it is possible that if their control panels are not adjusted they will try to come on once the site is re-energised after the PropSava installation, as they will interpret the new lower supply voltage as a sign of an imminent failure. This can be avoided very simply by adjusting the nominal voltage level on the generators' panels to 220V before re-energising the site.

IEE guidelines specify that volt-drop across a site should be no more than 4%. Does this have any bearing on the PropSava?

The optimisation setting on the PropSava is specified according to the voltage at the most distant electrical point from the incoming supply, so that we can take volt-drop across the site into account. Minimum site voltages will be around the statutory minimum level of 216V when the PropSava is installed, but mostly higher than this.

The IEE 17th Edition says that voltage must be 230+/-10%, and your voltage will always be well within this range. PropSava is adjusting the supply voltage, so does not affect the volt drop across the site itself, so if volt drop is currently 4% of 242V, it will simply become 4% of the new (lower) voltage.

What are the environmental benefits of the PropSava?

Many businesses around the world can expect to come under increasing pressure to reduce their own carbon footprint, which will involve addressing inefficiencies in their processes and equipment. Over-voltage and poor power quality are under-publicised causes of these inefficiencies, and by rectifying them, the PropSava can lead to emissions reductions of up to 17%.

Given that we estimate that up to 70% of businesses suffer from over-voltage and would save energy by installing a PropSava, the contribution towards the carbon-cutting effort over the coming decades will be substantial.

By adopting the technology, you can be confident that your business has taken a significant step towards meeting its environmental obligations. In addition, a PropSava prolongs the operating life of electrical equipment, reducing non-recyclable waste.

What are the energy savings from a PropSava?

The average optimisation level of a PropSava is 8%, this typically produces energy consumption (KWH) savings of 13%. However, as the supply voltage does vary site to site and from country to country; with each site having different power consumption, savings can be seen between 8 - 17% on around 70% of sites.

If my transformer has already been tapped down as far as practicable; will the PropSava give me any further savings?

Yes, but in this case the savings will be towards the lower end of the possible range, e.g. 2% - 2.5% for a 5% tap 60 down. If the 5% tap had been taken through a PropSava the saving would have been approximately 8% as compared to less than 2.5%.

What is the average return on investment from a PropSava?

The return on investment is typically 25 – 100% based purely on energy savings. This will depend on the optimisation setting of the PropSava, the mixture of equipment running on the site, the 'load factor' and energy unit cost.

$$\text{Load factor} = \frac{\text{Average demand}}{\text{Maximum demand}} \text{ (as a \%)}$$

The load factor will be higher if a site operates over long hours and has a continuous base load demanding power. A higher load factor will allow the capital costs of the unit to be recouped at a faster rate, increasing the ROI. Maintenance cost savings of appliances will also be achieved, which can further reduce the ROI period. There are no associated maintenance costs with the Contactless System itself as it has no moving parts.