Sinexcel®

Power Quality

Static Var Generator (SVG)

active power factor correction

Advanced Static Var Generator (ASVG)

active power factor correction + harmonic mitigation

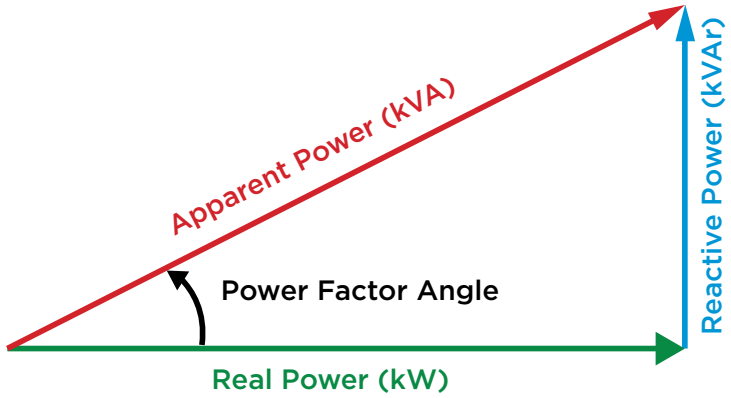
Wallmount
Cabinet Mount

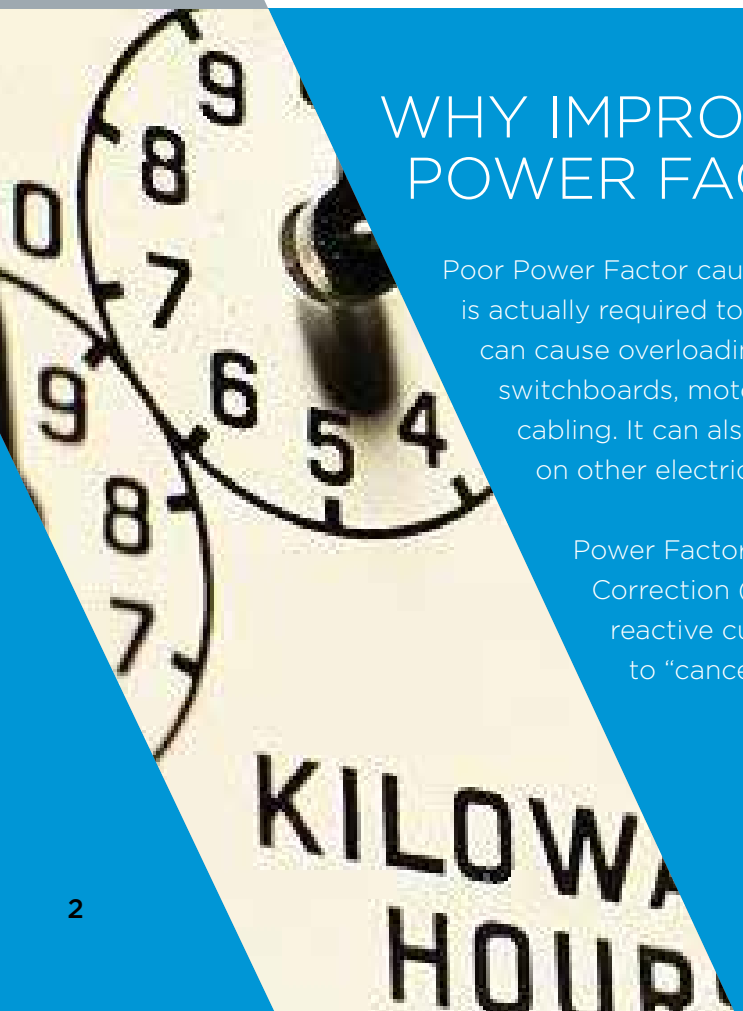
POWER ELECTRONICS®

INTRODUCTION TO POWER FACTOR

Displacement Power Factor is a measure of how effectively incoming power is used in your electrical system to convert current into output power, such as heat, light, or mechanical motion and is defined as the ratio of Real (working) power to Apparent (total) power.

- Real Power (kW) is the power that actually powers the equipment and performs useful, productive work. It is also called Actual Power, Active Power or Working Power.
- Reactive Power (kVAr) is the power required by some equipment (eg. transformers, motors and relays) to produce a magnetic field to enable real work to be done. It's necessary to operate certain equipment but you don't see any result for its use.
- Apparent Power (kVA) is the vector sum of Real Power (kW) and Reactive Power (kVAr) and is the total power supplied through the mains that is required to produce the relevant amount of real power for the load.

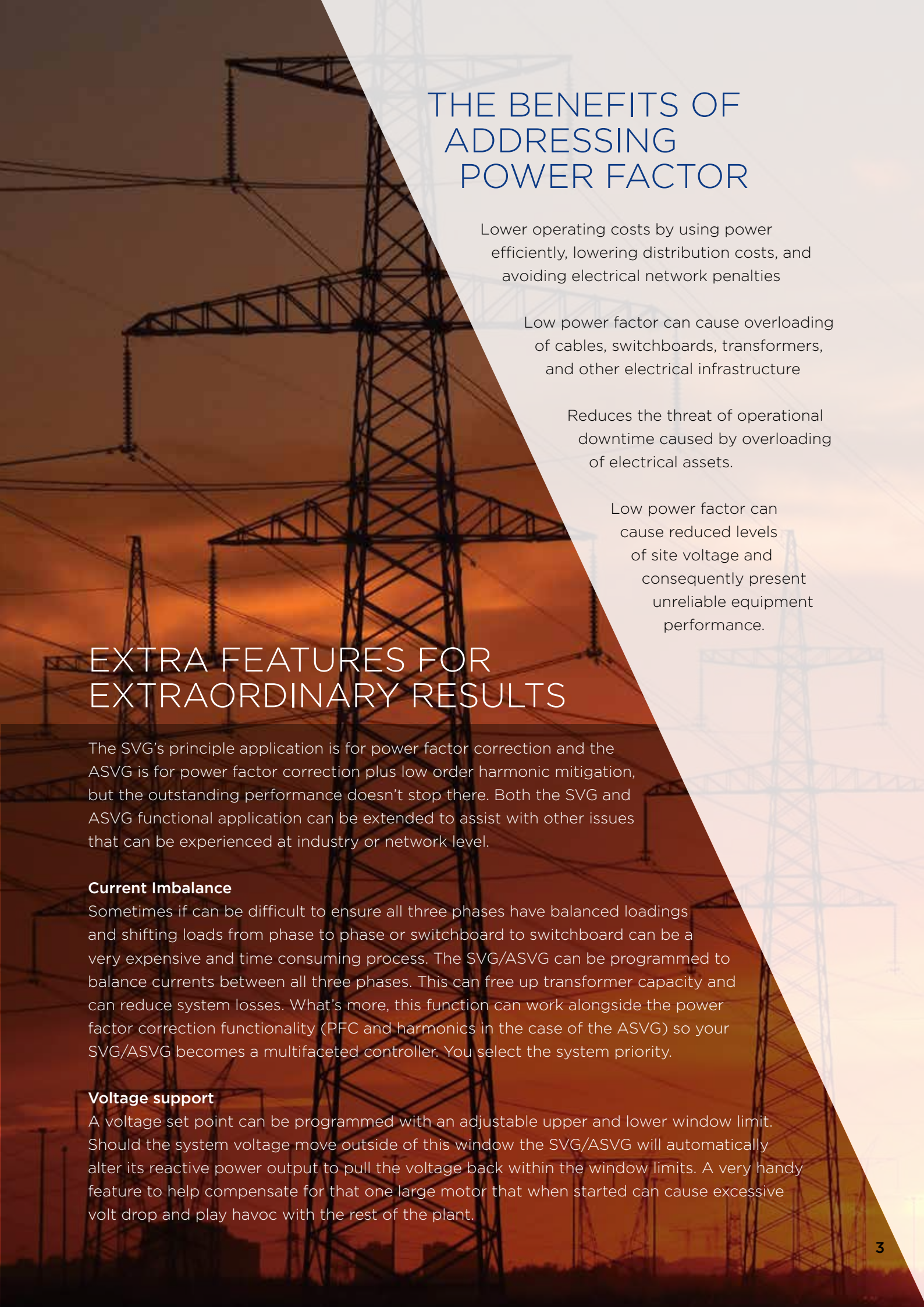




WHY IMPROVE MY POWER FACTOR?

Poor Power Factor causes more current to be drawn from the supply than is actually required to run the load efficiently. This additional current can cause overloading of the electrical network, supply transformers, switchboards, motor switching devices and protection equipment, and cabling. It can also cause excessive voltage drop which may impact on other electrical equipment.

Power Factor can be improved by installing Power Factor Correction (PFC) equipment. PFC equipment simply adds reactive current that is out of phase with the existing currents to "cancel" the poor Power Factor out.



THE BENEFITS OF ADDRESSING POWER FACTOR

Lower operating costs by using power efficiently, lowering distribution costs, and avoiding electrical network penalties

Low power factor can cause overloading of cables, switchboards, transformers, and other electrical infrastructure

Reduces the threat of operational downtime caused by overloading of electrical assets.

Low power factor can cause reduced levels of site voltage and consequently present unreliable equipment performance.

EXTRA FEATURES FOR EXTRAORDINARY RESULTS

The SVG's principle application is for power factor correction and the ASVG is for power factor correction plus low order harmonic mitigation, but the outstanding performance doesn't stop there. Both the SVG and ASVG functional application can be extended to assist with other issues that can be experienced at industry or network level.

Current Imbalance

Sometimes if can be difficult to ensure all three phases have balanced loadings and shifting loads from phase to phase or switchboard to switchboard can be a very expensive and time consuming process. The SVG/ASVG can be programmed to balance currents between all three phases. This can free up transformer capacity and can reduce system losses. What's more, this function can work alongside the power factor correction functionality (PFC and harmonics in the case of the ASVG) so your SVG/ASVG becomes a multifaceted controller. You select the system priority.

Voltage support

A voltage set point can be programmed with an adjustable upper and lower window limit. Should the system voltage move outside of this window the SVG/ASVG will automatically alter its reactive power output to pull the voltage back within the window limits. A very handy feature to help compensate for that one large motor that when started can cause excessive volt drop and play havoc with the rest of the plant.

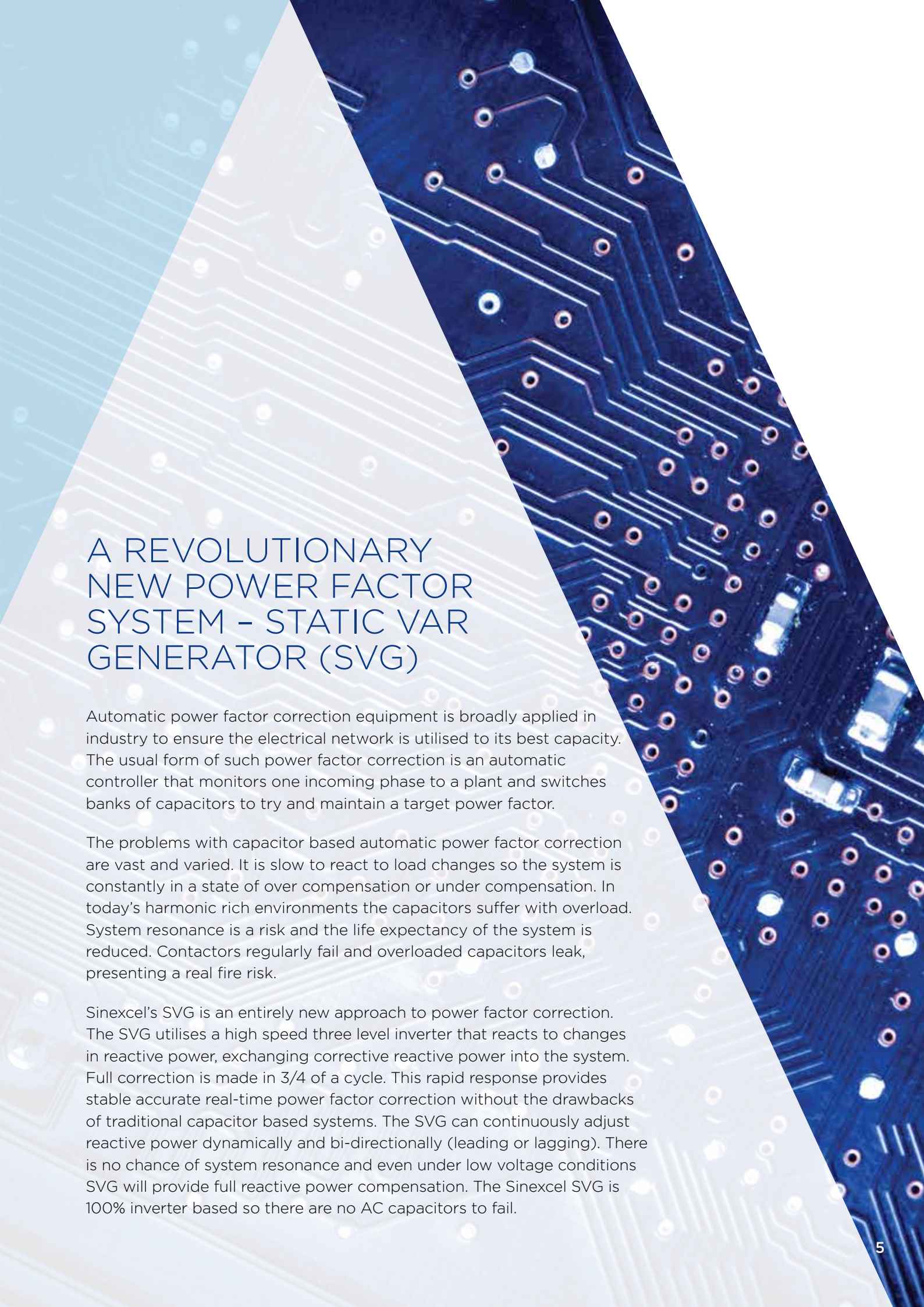
THE EVOLUTION OF POWER FACTOR CORRECTION

FIXED COMPENSATION

AUTOMATIC SWITCHING

THYRISTOR (PARTIALLY CONTROLLED)

IGBT (INTELLIGENT CONTROL)



A REVOLUTIONARY NEW POWER FACTOR SYSTEM – STATIC VAR GENERATOR (SVG)

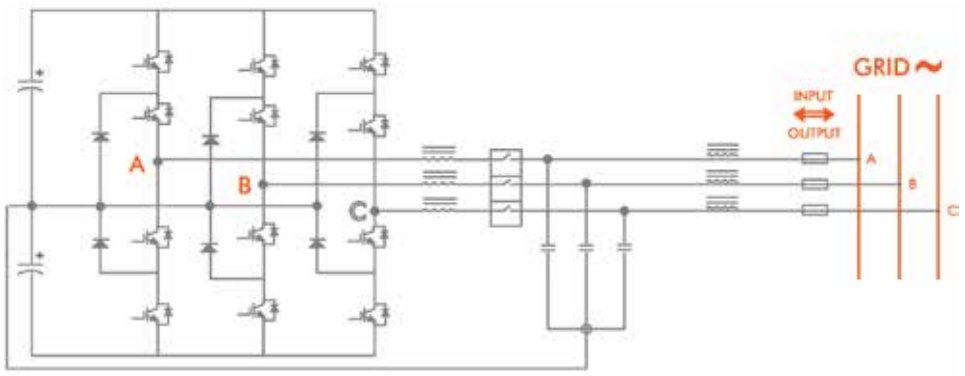
Automatic power factor correction equipment is broadly applied in industry to ensure the electrical network is utilised to its best capacity. The usual form of such power factor correction is an automatic controller that monitors one incoming phase to a plant and switches banks of capacitors to try and maintain a target power factor.

The problems with capacitor based automatic power factor correction are vast and varied. It is slow to react to load changes so the system is constantly in a state of over compensation or under compensation. In today's harmonic rich environments the capacitors suffer with overload. System resonance is a risk and the life expectancy of the system is reduced. Contactors regularly fail and overloaded capacitors leak, presenting a real fire risk.

Sinexcel's SVG is an entirely new approach to power factor correction. The SVG utilises a high speed three level inverter that reacts to changes in reactive power, exchanging corrective reactive power into the system. Full correction is made in 3/4 of a cycle. This rapid response provides stable accurate real-time power factor correction without the drawbacks of traditional capacitor based systems. The SVG can continuously adjust reactive power dynamically and bi-directionally (leading or lagging). There is no chance of system resonance and even under low voltage conditions SVG will provide full reactive power compensation. The Sinexcel SVG is 100% inverter based so there are no AC capacitors to fail.

SVG OPERATING PRINCIPAL

Load current is detected through external CTs and fed to the internal DSP and CPU where an Instantaneous Reactive Power algorithm separates the active power from the reactive power. A compensating reactive power requirement is dynamically and accurately calculated and sent to the IGBT control where a PWM signal is generated at a switching frequency of 20kHz. A compensating capacitive reactive power or inductive reactive power is controlled by the manipulation of the DC bus voltage in comparison to the AC line voltage. Thus a capacitive current or inductive current will flow, creating a reactive power exchange with the network.



Innovative three level inverter circuit

Sinexcel's innovative three level inverter is at the heart of every SVG. The modular three level inverter utilises 12 IGBTs so reduces switching loses and permits higher switching speeds. The need for small filter components results in an ultra-compact design with an improved waveform resulting in very low harmonic distortion and low levels of electromagnetic interference. The ultra-compact design permits a modular construction.

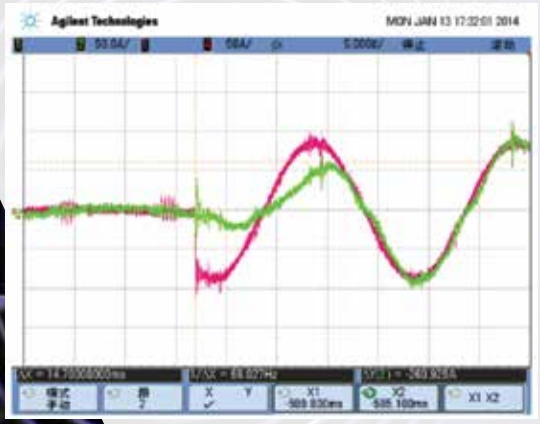
MODULAR DESIGNS ALLOWS FOR EASY EXPANSION

OUTSTANDING PERFORMANCE

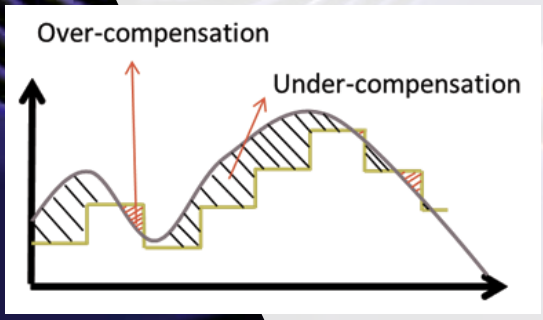
SVG provides real time response with constant correction to plant power factor. Transient free, virtually instantaneous response ensures high system stability.

- Reactive power compensation: Cos Φ = 1.00
- Continuous correction – step less control. SVG controls from 0 – rated kVAr as one continuous range. Think of it like a power factor "VSD".
- No over compensation or under compensation as experienced with capacitor switching systems.
- Individual correction on all three phases.
- Capacitive and Inductive compensation: -1 to +1. Something capacitor based systems can't do.
- 50µs response time with full correction in less than 15ms (3/4 of a cycle). Suitable for highly dynamic loads where the power factor fluctuates rapidly or in big steps e.g. saw mills, cranes, welders.
- Optimised sizing – installed capacity equals compensation capacity
- Simple wall mount for 50kVAr, 100kVAr and 200kVAr sizes.
- Rack mount options in 30/50/100/200kVAr sizes. One cabinet can accommodate up to 600kVAr utilising a combination of sizes.
- Increase your capacity as your plant grows. Simply add as many units in parallel as required. You can mix and match sizes to suit your application.

Dynamic step-less compensation



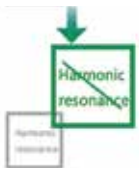
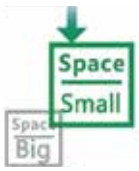
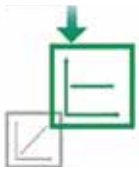
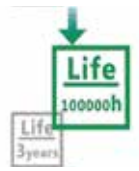
SVG <50us response time, <15ms full compensation



Traditional capacitor type PFC systems are slow to react to load changes. Their delay combined with stepped response means they are perpetually in a state of under-compensation or over-compensation

QUICK RESPONSE

THE PROS AND CONS OF A CONVENTIONAL CAPACITOR BASED SYSTEM VERSUS SVG

Capacitor based systems are based on "staging in" and "staging out" banks of fixed capacitance. This means the amount of correction is available only in multiples of the fixed banks resulting in over and under compensation.		The SVG uses inverter technology to inject an infinitely variable amount of corrective reactive power. This ensures the power factor is always at setpoint with no over or under correction.
Capacitor based systems are slow to respond. The power factor controller must be tuned to stop cycling of the "staging in" and "staging out" process. The delay is further increased by the time taken for the bank contactor to pull in.		The complete response time of the SVG is less than 15mS and the dynamic response time is less than 50uS. This makes the SVG perfect for sites with rapidly changing power factor.
Capacitor based systems can encounter resonance.		The SVG uses inverter technology so resonance is eliminated.
Conventional systems can only correct an inductive (lagging) load.		The SVG can correct both an inductive (lagging) or capacitive (leading) load.
Conventional systems are manufactured by collectively installing blocking chokes, capacitors, and switching contactors into an enclosure. This takes up a large amount of switchroom real estate.		The inverter technology used in the SVG is very compact and typically requires less mounting area than a conventional system.
The performance of power factor correction capacitors is greatly impacted by the grid voltage level. Low voltage on the grid results in poorer compensation performance from the capacitors.		The SVG performance is virtually unaffected by low grid voltage levels.
Capacitor based systems require frequent switching of the stages to achieve correction for changing power factor thus resulting in a shortened service life, in some cases as low as 3 years.		The SVG has low losses and needs little maintenance. The service life is expected to greater than 10 years.

FLEXIBLE CONTROL AND MONITORING

Easy to use, with displays on every unit providing all system information including grid voltage, compensating current, grid current, load current, grid pf, load pf, alarm code and operating status.

- Cabinet based systems come complete with 7” colour TFT touch screen so you can see exactly what is happening with your complete system. In addition to the information available on the standard unit display you can view individual module temperatures, THDv, THDi, voltage waveforms, harmonic spectrum.
- Optional alarm monitoring card allows SVG to be integrated into any plant control system (7” display only)
- RS485, RJ45 network port
- Modbus RTU, Modbus TCP/IP protocols supported

HMI ACTS AS A FULL POWER QUALITY METER

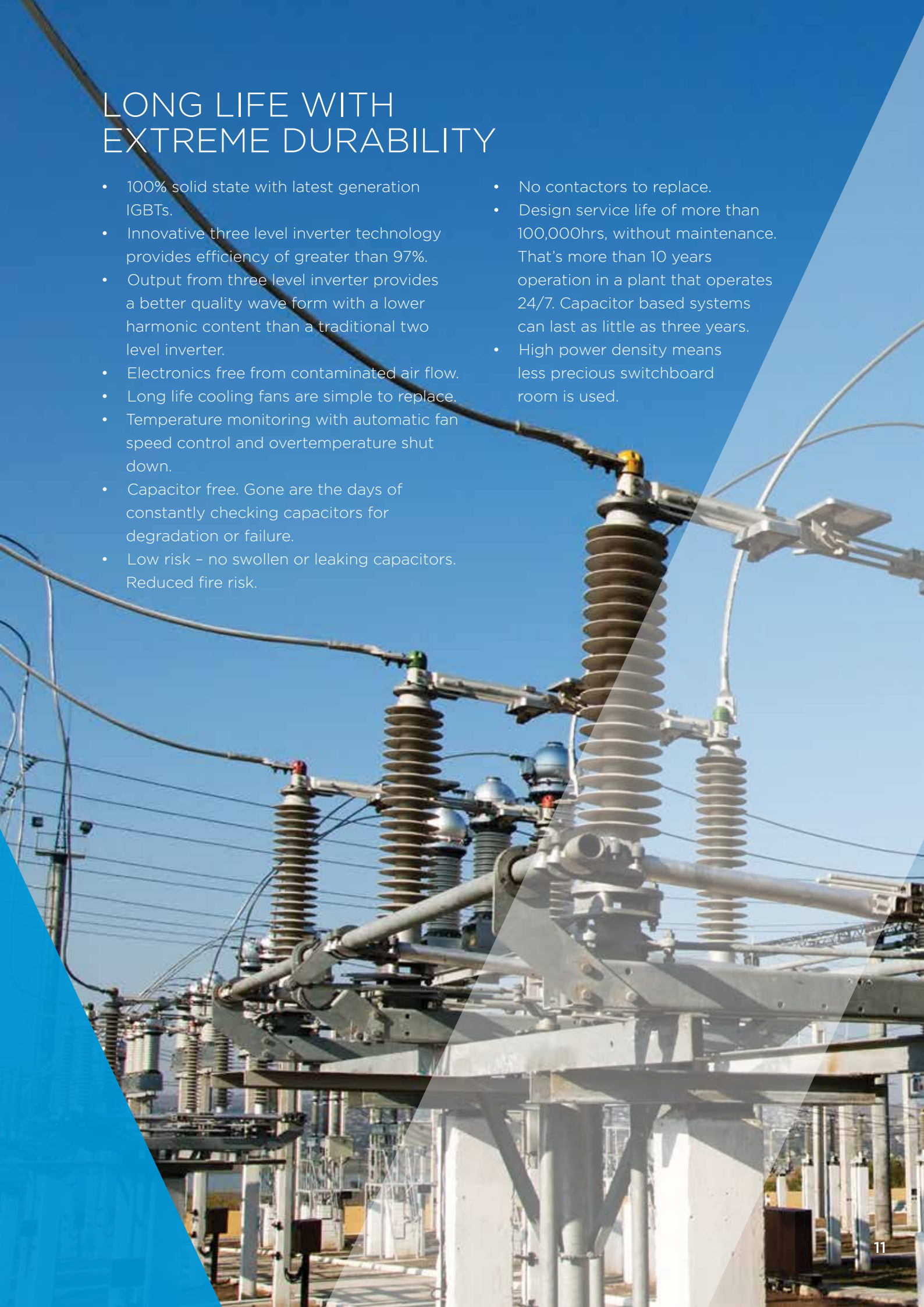
HIGH STABILITY AND NETWORK FRIENDLY

Unlike traditional capacitor based systems, the SVG does not negatively interact with your electrical system. Today's harmonically rich environments are tough on capacitor based systems with increased risks of resonance and capacitor failures:

- Unaffected by harmonic distortion and free from harmonic resonance
- Three phase unbalance compensation
- Unaffected by network voltage drop. Even under reduced network voltage levels full reactive current can be provided to meet working conditions. Operating voltage range of -40% to +20%
- There is no nasty transient voltage spikes caused by the switching of capacitors
- Overheating capacitors and harmonic reactors are a thing of the past.
- <3% THDi input harmonics won't pollute the network

LONG LIFE WITH EXTREME DURABILITY

- 100% solid state with latest generation IGBTs.
- Innovative three level inverter technology provides efficiency of greater than 97%.
- Output from three level inverter provides a better quality wave form with a lower harmonic content than a traditional two level inverter.
- Electronics free from contaminated air flow.
- Long life cooling fans are simple to replace.
- Temperature monitoring with automatic fan speed control and overtemperature shut down.
- Capacitor free. Gone are the days of constantly checking capacitors for degradation or failure.
- Low risk – no swollen or leaking capacitors. Reduced fire risk.
- No contactors to replace.
- Design service life of more than 100,000hrs, without maintenance. That's more than 10 years operation in a plant that operates 24/7. Capacitor based systems can last as little as three years.
- High power density means less precious switchboard room is used.



ADVANCED STATIC VAR GENERATOR – ASVG

Power Factor Correction and Harmonic Mitigation in One

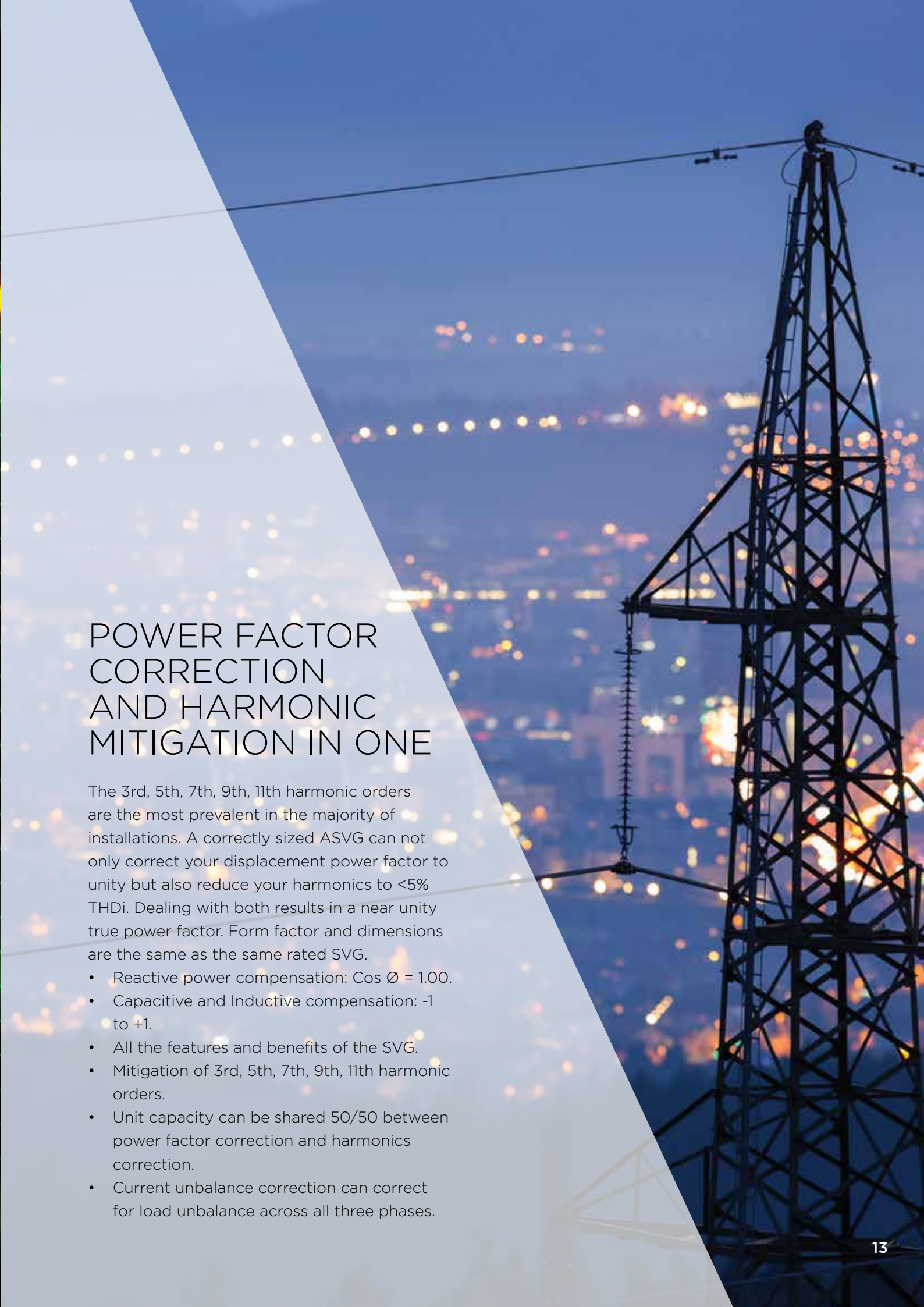
The Advanced Static Var Generator provides the same dynamic performance as the SVG with the added benefit of combining harmonic mitigation. Available in 50/100/200kVAr wall mount and 30/50/100/200kVAr cabinet mount modules.

Extend Your Power Factor Correction Performance

The requirement for power factor correction is the number one power quality issue faced by the vast majority of industrial and commercial installations. The second biggest and fastest growing power quality issue is harmonic distortion.

- Commercial installations will often have elevated 3rd harmonics owing to single phase non-linear loads such as computer switch mode power supplies, LED lighting, electronics lighting ballasts, inverter heat pumps.
- Add a computer data centre backed up by UPS containing a six pulse rectifier and 5th, 7th, 11th harmonics can be added into the mix
- Variable Speed Drives controlling air handler units within building HVAC systems can further elevate the 5th, 7th, 11th harmonics
- Industrial installations will often have high levels of variable speed drive loading as automation systems improve efficiencies and productivity. It is not uncommon to see very high levels of current harmonics and voltage harmonic distortion resulting from six pulse VSDs drawing predominantly 5th, 7th 11th harmonics.

Wouldn't it be great if you could address both power factor and harmonic mitigation in one cost effective unit. The Advanced Static Var Generator (ASVG) does just that.



POWER FACTOR CORRECTION AND HARMONIC MITIGATION IN ONE

The 3rd, 5th, 7th, 9th, 11th harmonic orders are the most prevalent in the majority of installations. A correctly sized ASVG can not only correct your displacement power factor to unity but also reduce your harmonics to <5% THDi. Dealing with both results in a near unity true power factor. Form factor and dimensions are the same as the same rated SVG.

- Reactive power compensation: Cos Ø = 1.00.
- Capacitive and Inductive compensation: -1 to +1.
- All the features and benefits of the SVG.
- Mitigation of 3rd, 5th, 7th, 9th, 11th harmonic orders.
- Unit capacity can be shared 50/50 between power factor correction and harmonics correction.
- Current unbalance correction can correct for load unbalance across all three phases.

TECHNICAL SPECIFICATIONS

ITEM	400V			
	SVG/ASVG 030	SVG/ASVG 050	SVG/ASVG 100	SVG/ASVG 200
System parameters				
Rated input line voltage	400V			
Input phase voltage range	228V - 456V			
Power grid frequency	50Hz/60Hz (range : 45Hz ~ 62.5Hz)			
Parallel operation	Unlimited			
Overall efficiency	>97%			
Power grid structure	3phase, 3wire/3phase, 4wire			
CT range	150/5 ~ 10,000/5			
Circuit topology	3-level			
Performance				
Single-module compensation capacity	30kVAr	50kVAr	100kVAr	200kVAr
Response time	<15ms			
Target power factor	Adjustable from -1 to +1			
Harmonics range (ASVG only)	3rd, 5th, 7th, 9th, 11th orders			
Cooling mode	Smart air cooling: 220L/sec		Smart air cooling: 405L/sec	Smart air cooling: 500L/sec
Noise level per module	<56dB		<65dB	<75dB
Communications and monitoring capabilities				
Communications ports	RS485, RJ45 (with optional PCB)			
Communications protocols	Modbus RTU, Modbus TCP/IP (with optional PCB)			
Alarm relay output	With optional PCB. Also connection to 7" HMI			
Module display	No monitor	LED or 2" for rack mount. 4.3" colour touch screen for wall mount		
Cabinet display	7" HMI colour touch screen			
Mechanical properties				
Mounting type	Rack or cabinet mount	Rack mount, cabinet mount, wall mount		
Cable entry	Rear entry for rack-mounted type; top entry for wall-mounted type; top or bottom entry for cabinet			
Module net weight	36kg		62kg	110kg
Colour	Natural aluminium-zinc alloy for rack and cabinet mount. Powder coated RAL7035 for wall mount			
Environmental conditions				
Altitude	1500 m. >1500m, 1% derating per 100m. 4000m max.			
Operating temperature	-10 ~ 40 °C			
Relative humidity	5% ~ 95%, non-condensing			
Protection grade	IP20			
Qualifications and standards				
Qualifications	CE ,ETL(UL508), BV, RCM (NZ)			
Standards compliance	AS/NZS 3820, EN 50178, IEC 61439-5 (cabinet), IEC 61000-6-4, IEC 61000-3-6			

POWER QUALITY SITE AUDIT AND SVG ENGINEERING SERVICES

For new installations our application team can assist with engineering an appropriate power quality solution to meet your system requirements. Alternatively, using our specialised measuring equipment, our technical support team can carry out an onsite audit to engineer a solution for your power factor needs. A report will be presented with recommendations on solutions. Please call Power Electronics to discuss your requirements with our technical support team.

DIMENSIONS

30kVAr Solutions

30kVAr Rack-Mounted SVG/ASVG
440W x 590D x 192H (mm)
Weight: 36kg

50kVAr Solutions

50kVAr Rack-Mounted SVG/ASVG
500W x 510D x 190H (mm)
Weight: 36kg

50kVAr Wall-Mounted SVG/ASVG
500W x 192D x 560H (mm)
Weight: 36kg

100kVAr Solutions

100kVAr Rack-Mounted SVG/ASVG
500W x 520D x 269H (mm)
Weight: 62kg

100kVAr Wall-Mounted SVG/ASVG
505W x 271D x 545H (mm)
Weight: 62kg

NOTE: Wall mount models are supplied with a top cover. Allow a further 150mm in height on 50kVAr model, 200mm on 100kVAr model and 300mm on 200kVAr model when using top cover.

200kVAr Solutions

200kVAr Rack-Mounted SVG/ASVG
500W x 690D x 370H (mm)
Weight: 110kg

200kVAr Wall-Mounted SVG/ASVG
590W x 370D x 692H (mm)
Weight: 110kg

Cabinets

We have a wide variety of cabinets to house the rack-mount SVG/ASVG modules. These cabinets can house a combination of modules up to a capacity of 600kVAr with options for top or bottom entry, rear or top airflow exhaust, inclusion of main switch or MCCB, bus coupling between cabinets and IP20 or IP54 design.

Please refer to our separate cabinet brochure for details.

Power Electronics NZ's power quality division represents the innovative Active Harmonic Filters and Static VAR Generators from international market leader Sinexcel. Sinexcel is the world's largest supplier of Active Harmonic Filters and Static Var Generators and leads the field in performance and design.

With an R&D centre of more than 180 people, and a manufacturing centre of more than 35,000 square meters, Sinexcel is a high-tech enterprise. It specializes in intelligent power quality technologies and concentrates on delivery of high quality products. Focused on customer support and service, Sinexcel is a great fit with Power Electronics New Zealand.

POWER ELECTRONICS®

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