

White Paper

Why Sinewave Dimming

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Everything is Possible™

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Why Sinewave Dimming?

Purpose of this paper

The purpose of this paper is to introduce some of the key benefits of using Variable Sinewave Technology (VST), developed by State Automation for the advantage to our customers.

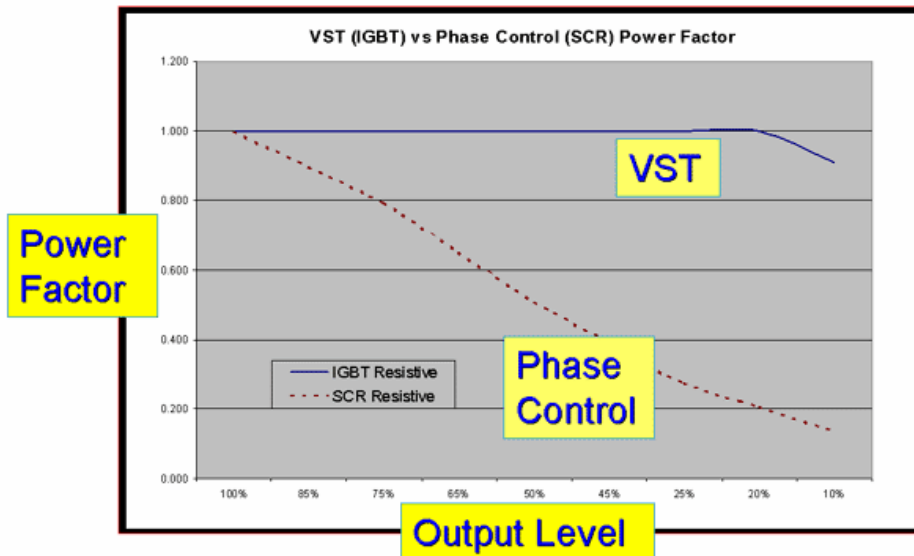
What is Variable Sinewave Technology?

VST, the revolutionary technology, developed and patented by State Automation providing Sinewave dimming of the mains supply voltage. Specifically developed to work with all lighting loads- resistive and reactive -VST has been incorporated into State Automation's **Solution^{Sine}** range of dimmer products and is now in service in Theatrical and Architectural venues.

1. "Efficient Power Transfer"

Power factor is a measure of how the current is being used to transmit power. It is a number between zero and 1, with 1 indicating perfect power factor. When a load draws current that differs from the sinusoidal waveform provided by the utility, the power factor is less than 1. Poor power factor causes inefficiency in the delivery of electricity to the end-user, requiring more energy to compensate for losses on the line.

For example, a load with a power factor of .5 will require twice as much current as a load with a power factor of 1.



Many power utilities already charge a penalty if the power-factor gets below a certain value.

The **Solution^{Sine}** dimmers offer an excellent alternative to the purchase of expensive power-factor correction equipment.

Benefits of VST

- Excellent power factor
- Lower power tariffs
- Lower power bill
- Lower operating expenses

2. "Minimising Harmonics"

Harmonics are a distortion of the utility- supplied waveform and are caused by "non-linear" loads. Even a linear load such as an incandescent lamp becomes a non-linear load when dimmed via a conventional phase controlled dimmer. The ultra-cycle switching of mains supply causes harmonics of the fundamental frequency to be generated. High harmonics increase line losses and VST, decrease the utilities equipment lifetime.

Harmonic currents in the Neutral of a dimmer system can be larger than the fundamental current in the Active supply line. Hence in 3 phase dimmer installations, the size of the neutral cable is typically at least the size of the supply phase cable and often larger. To cater for these higher neutral currents the system designer will often over-specify the whole supply system so that the active cable size matches the larger needed neutral size. Where installations are not oversized they are typically derated to 70% capacity to allow for the harmonic currents. "

Benefits of VST

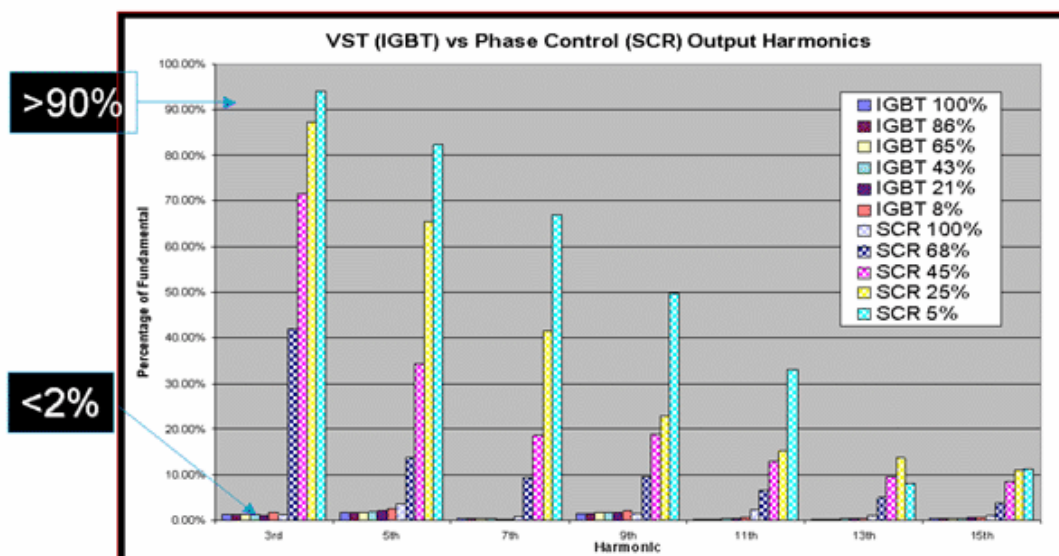
- Reduced capital outlay
 - Reduced Neutral cable size
 - Reduced overall feed cable size
 - Reduced power supply transformer size
- Lower maintenance costs
 - Reduced risk of damage to supply transformers and electrical distribution components
 - Reduced risk of expensive repairs or loss of revenue through long lead time repairs

3 "Improving Power quality"

While power supply is generally regular and reliable, deviations from the regular "sinusoidal" wave, both on the utility side and on the customer side, result in poor power quality. Poor power quality can have adverse effects on sensitive equipment and cause inefficiencies in higher power equipment. Power companies and regulatory authorities are working towards standards that restrict more and more the allowable levels of harmonic distortion permissible. Harmonic distortion refers to the difference between the shape of the current wave drawn by a device, and the shape of the voltage wave supplied to that device. Total Harmonic Distortion (THD) measures the degree to which the input is distorted, and is the relative value of all the harmonics combined, as a percentage of the fundamental current.

Benefits of VST

- Use the same supply for Audio/Computers and Lighting
- Less expensive power reticulation
- Lower capital outlay



4 Short of power? "Use the existing supply"

Often the existing lighting supply is capable of supplying the new demand, but the cabling and transformers have been de-rated to allow for high neutral current present when dimming using phase control. The introduction of **Solution^{Sine}** dimmers will allow the load to be increased to normal cable ratings.

Benefits of VST

- Increase in utilisation of existing plant
- Savings on plant upgrade costs

5. "Increasing Lamp Life"

Phase control dimmers present a chopped waveform to the lamp filament which is effectively switching the lamp on and off 100 times per second with a fast rising current. This waveform causes the filament to physically move and therefore add mechanical stress.

The sinewave output from the **Solution^{Sine}** dimmer eliminates this stress

Benefits of VST

- Reduced Stress on filaments
- Increased Lamp Life
- Lower operations costs

6 "Dimming existing fluorescent and HID lamps "

Lighting levels in working and public areas are often higher than required to meet regulations or functionality. Even if the existing fixtures are non-dimmable, they will operate at a lower voltage -and hence operate at lower current. The **Solution^{Sine}** dimmer acts as a variable transformer and comfortably provides a true sinewave to the fixture at a lower voltage, regardless of the reactance of the fitting.

Benefits of VST

- No fixture replacement costs
- No capital outlay for fixtures
- Lower power usage
- Lower operating costs

8 "Reducing Venue Noise Figure "

Many venues are looking for good noise figures. Lamp filaments vibrate and emit a buzzing sound when dimmed by phase controlled dimmers. Transformers and specialist ballasts also vibrate and add to the noise figure of the venue. VST virtually eliminates these sources of noise.

Benefits of VST

- Effectively eliminate filament sing and transformer buzz
- Lower venue noise figure
- Improved venue specification
- Improved appeal to customers
- Increase in business and/or higher charge rates
- Increase in revenue

8 "Overload and Short circuit protection"

They say that short circuits can mostly be avoided through proper maintenance and good work practice, but we all know that is not really the case. We have all suffered damage to cabling and the electronic switching devices through overload or short circuit.

With the VST, "Short circuits are detected in a few nanoseconds". The channel is simply disabled by the internal microprocessor. When disabled a dual pole relay disconnects both the Active and Neutral connections and the faulty circuit is 100% isolated from the electronics. The **Solution^{Sine}** dimmer is virtually indestructible from a load fault.

Benefits of VST

- Avoid costly repair/replacement of damaged Electronics equipment
- Faster recovery time
- Lower maintenance costs
- No nuisance circuit breaker tripping
- Lower operation costs

9 Load Compatibility

Many lighting loads are not purely resistive as they have inductive ballasts or capacitors installed to correct the power factor. These loads are not compatible with phase controlled dimmers. The **Solution^{Sine}** dimmer will comfortably dim both inductive and capacitive loads.

For example: HID lamps with non-electronic ballasts.

Typical characteristics of dimmed HID lamps;

Lamp Type	Dimmed Voltage Level	Light output below 100%
Mercury Vapour	175Vac	<50% lumens
Metal Halide	180Vac	<70% lumens

10 False tripping of safety switches (RCD's or GFI's)

Phase controlled dimmers emit large amounts of high frequency noise. At these higher frequencies the capacitance of the cabling is significant and allows the high frequencies to leak to ground. Depending on the installation and the cable lengths, this current leakage can be sufficient to trip the safety devices. The **Solution^{Sine}** dimmer operates reliably with its own in-built 30mA RCD and will operate with individual 6mA GFI's (Ground Fault Interrupter) on each channel output with cable lengths up to 600 metres.

11 Reducing Stress -on mains supply transformers and distribution elements

When large installations of phase controlled dimmers are dimmed at the same level, huge harmonic currents are produced in the supply cabling which can cause the transformers and bussing systems to mechanically vibrate in an excessive and sometimes dangerous way.

Operationally this is avoided by not dimming all the loads at the same level at the same time. Regardless there are many stories of this vibration being experienced in venues. VST eliminates this problem.

12 Powering audio, the control room and dimmers off the same mains supply

Traditionally, Phase controlled dimmers are incompatible with audio electronics and enormous effort and cost is expended to keep them apart. Customers either suffer a cost penalty or risk performance problems if the supplies are not segregated. With **Solution^{Sine}** dimmers, the audio and control equipment can be run from the same supply feeds.

Operationally the Variable Sinewave technology delivers ideal performance, completely hassle free dimming and a suite of features never before available in conventional phase controlled dimmers.

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