IGBT-based PFC solution

for Leading & Lagging PF Compensation

PF 0.99

Step-less PFC

STATIC VAR GENERATOR
LEADING & LAGGING PF COMPENSATION

Modern industrial, data center & commercial buildings require a new approach in addressing power factor. The presence of harmonics, rapid PF swing and dynamic reactive load are beyond the capability of conventional capacitor bank systems.

- **Current**
- **Voltage**
- **Compensation Current**

**RESISTIVE LOAD**

RESISTIVE LOAD such as filament lamp. In phasor diagram, load appears resistive when current and voltage are in phase.

**INDUCTIVE LOAD**

INDUCTIVE LOAD such as motor, compressor, relay and transformer.

1. **Current of inductors lags voltage**

   In phasor diagram, anticlockwise direction is set to be positive direction and U direction as the horizontal direction. Load appears inductive and resistive when I is within 0 to -90 degree.

   SVG generates capacitive current to neutralize inductive content of the load, achieving the performance for current and voltage phase congruency.

**CAPACITIVE LOAD**

CAPACITIVE LOAD such as capacitor bank

2. **Current of capacitors leads voltage**

   In phasor diagram, anticlockwise direction is set to be positive and U direction as the horizontal direction. Load appears capacitive and resistive when I is within 0 to 90 degree.

   SVG generates inductive current to neutralize capacitive content of the load, achieving the performance for current and voltage phase congruency.
**BENEFIT OF SVG**

- Suitable for use in Harmonics Loaded Network
- Avoid penalty for low PF by Utility Company
- Reduce electric energy loss
- Respond Dynamically to reactive power from Leading to Lagging condition
- Stepless compensation
- Fast response time 15ms to full compensation
Current Transformer (CT) detects the load current. Digital Signal Processor (DSP) has advanced logic control arithmetic, could analyse the current, divides the load current into active power and reactive power by using the instantaneous Reactive Power Algorithm, and calculates the reactive power change rate rapidly and accurately, then sends Pulse Width Modulation (PWM) signal to Insulated-gate Bipolar Transistor’s (IGBT) driver board to control IGBT on and off at average 20kHz frequency. Finally inductive or capacitive power compensation current is generated and injected to network, at the same time CT also detects the output current and forms a negative feedback to DSP. Then DSP proceeds the next logical control to achieve more accurate and stable system.
UNDERSTAND HOW SVG COMPENSATE REACTIVE POWER

1. **DC BUS CAPACITOR**
   DC bus capacitor, AC to DC rectifier storage

2. **IGBT**
   Controlled by DSP software algorithm, IGBT on-off timing section and length could control inverter to generate an accurate reactive power compensation current.

3. **INVERTER INDUCTION**
   IGBT Compensating inductive reactive power or capacitive reactive power by controlling inverter induction to generate a capacitive current or inductive current to achieve bidirectional reactive power compensation.

4. **LC FILTER CIRCUIT**
   Both are for filtering. The combination of LC filter circuit and high frequency inductor are called LCL filter circuit.

5. **HIGH FREQUENCY INDUCTOR**
KEY FEATURES AND BENEFITS

PFC PERFORMANCE

PFC performance 0.99

Stepless compensation without over-compensation and under-compensation, compensate specific capacity that system needs.

Full PFC process within 15ms and maintain at PF0.99 no matter how the system reactive power changes

Compensation with inductive reactive power and capacitive reactive power.

The voltage of the grid has little influence on SVG compensation capacity as SVG is a current source.

MAINTENANCE FREE, SAFE AND EASY TO USE

Could work under high THDv up to 15%, no capacitor explosion risk or harmonics resonance problem.

Minimal loss, maintenance-free

MTBF (mean time between failure) 100,000 hours

Advanced technology and easy to use with remote monitoring with EMS, BMS.

SPACE AND CAPACITY

Minimal footprint to save more than 70% space compared with cap bank.
# Specification 400V Network Type

## System Parameter

<table>
<thead>
<tr>
<th>Items</th>
<th>400V</th>
<th>480~690V (Large capacity)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sinexel SVG 030</td>
<td>Sinexel SVG 050</td>
<td>Sinexel SVG 100</td>
</tr>
<tr>
<td><strong>Rated Voltage</strong></td>
<td>400V</td>
<td>480V</td>
</tr>
<tr>
<td><strong>Voltage range</strong></td>
<td>228V~465V</td>
<td>384V~576V</td>
</tr>
<tr>
<td><strong>Rated frequency</strong></td>
<td>50/60Hz (range:45Hz~62Hz)</td>
<td>Unlimited</td>
</tr>
<tr>
<td><strong>Parallel operation</strong></td>
<td>Unlimited</td>
<td>3P3W/3P4W</td>
</tr>
<tr>
<td><strong>Overall Efficiency</strong></td>
<td>&gt;97%</td>
<td>&gt;99% (at 50% induction load)</td>
</tr>
<tr>
<td><strong>Distribution system</strong></td>
<td>3P3W/3P4W</td>
<td>3P3W</td>
</tr>
<tr>
<td><strong>CT ratio</strong></td>
<td>150/5~30,000/5</td>
<td>600/5~10,000/5</td>
</tr>
<tr>
<td><strong>Circuit topology</strong></td>
<td>3-Level</td>
<td>3-Level</td>
</tr>
</tbody>
</table>

## Performance Indicator

<table>
<thead>
<tr>
<th>Items</th>
<th>30kVar</th>
<th>50kVar</th>
<th>100kVar</th>
<th>200kVar</th>
<th>480/960/1440/1920/2400kVar</th>
<th>600/1200/1800/2400/3000kVar</th>
<th>690/1380/2070/2760/3450kVar</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Response time</strong></td>
<td>&lt;15ms</td>
<td>&lt;15ms</td>
<td>&lt;15ms</td>
<td>&lt;15ms</td>
<td>480/960/1440/1920/2400kVar</td>
<td>600/1200/1800/2400/3000kVar</td>
<td>690/1380/2070/2760/3450kVar</td>
</tr>
<tr>
<td><strong>Target power factor</strong></td>
<td>Adjustable from -1 to +1</td>
<td>Adjustable from -1 to +1</td>
<td>Adjustable from -1 to +1</td>
<td>Adjustable from -1 to +1</td>
<td>Adjustable from -1 to +1</td>
<td>Adjustable from -1 to +1</td>
<td>Adjustable from -1 to +1</td>
</tr>
<tr>
<td><strong>Cooling air requirement</strong></td>
<td>22L/sec</td>
<td>40L/sec</td>
<td>50L/sec</td>
<td>Smart air cooling: 3,000m³/h(1-4)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Noise level per module</strong></td>
<td>&lt;65 dB</td>
<td>&lt;75 dB</td>
<td>&lt;70 dB</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

## Communication & Monitoring Capability

<table>
<thead>
<tr>
<th>Communications ports</th>
<th>RS485, CAN (reserved), Ethernet port (RU45)</th>
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<tbody>
<tr>
<td>Communications protocols</td>
<td>MODBUS</td>
<td>MODBUS</td>
</tr>
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</table>

## Protection functions

- Abnormal voltage / frequency protection; Inverter short-circuit protection;
- Abnormal output current protection; Inverter over-loaded protection; Over-temperature protection etc.

## Alarm

Available

## Interfacing

- 4.3-inch touch screen monitor and optional 7-inch touch screen centralized monitor
- 7-inch touch screen centralized monitor

## Mechanical Properties

<table>
<thead>
<tr>
<th>Mounting type</th>
<th>Wall mount / Rack mount / Cabinet</th>
<th>Fixed cabinet</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cable entry mode</td>
<td>Rear entry for rack mount type</td>
<td>Top or bottom entry for cabinet</td>
</tr>
<tr>
<td>Dimension(W x D x H)</td>
<td>500<em>560</em>190(Rack mount)</td>
<td>500<em>520</em>269(Rack mount)</td>
</tr>
<tr>
<td></td>
<td>500<em>191</em>585(Wall mount)</td>
<td>500<em>286</em>557(Wall mount)</td>
</tr>
<tr>
<td></td>
<td>600<em>800</em>2200/1200<em>800</em>2200/1800<em>800</em>2200/2400<em>800</em>2200/3000<em>800</em>2200</td>
<td></td>
</tr>
<tr>
<td>Net weight</td>
<td>36kg</td>
<td>48kg</td>
</tr>
<tr>
<td>Color</td>
<td>RAL7035(gray)</td>
<td></td>
</tr>
</tbody>
</table>

## Environment Requirement

- Altitude: ≤1,500m; Between 1,500m to 4,000m, derating 1% every additional 100m
- Ambient temperature: -10°C~40°C (may derate capacity if ambient temperature exceeds 45°C)
- Relative humidity: 5%~95%, non-condensing
- Protection Class: IP20 (other IP degrees are customizable)

## Related Qualifications & Standards

- CE, cETLus
- CE
# SVG SPECIFICATION 480V / 690V / 600V

<table>
<thead>
<tr>
<th>Items</th>
<th>400V</th>
<th>480–690V</th>
</tr>
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<tbody>
<tr>
<td>Sinexcel SVG 35</td>
<td>Sinexcel SVG 30/40/50/80</td>
<td>Sinexcel SVG 40/50/80/100</td>
</tr>
</tbody>
</table>

## System Parameter

<table>
<thead>
<tr>
<th></th>
<th>208V</th>
<th>480V</th>
<th>600V</th>
<th>690V</th>
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<tr>
<td>Voltage range</td>
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<tr>
<th></th>
<th>35kVar</th>
<th>40/50/80/100kVar</th>
<th>40/50/80/120kVar</th>
</tr>
</thead>
<tbody>
<tr>
<td>Response time</td>
<td>&lt;15ms</td>
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## Protection functions

- Abnormal voltage/frequency protection
- Inverter short-circuit protection
- Abnormal output current protection
- Inverter over-loaded protection
- Over-temperature protection etc.

## Alarm

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## Interfacing

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<tr>
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<th>7-inch touch screen centralized monitor (Rack mount) and 4.3-inch touch screen monitor (Wall mount)</th>
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## Mechanical Properties

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<td>Cable entry mode</td>
<td>Top or bottom entry for cabinet</td>
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</table>

## Dimension(W x D x H)(mm³)

<table>
<thead>
<tr>
<th></th>
<th>500<em>675</em>250 (Rack mount)</th>
<th>500<em>250</em>723 (Wall mount)</th>
</tr>
</thead>
<tbody>
<tr>
<td>For 30/40kVar</td>
<td>500<em>540</em>180</td>
<td>500<em>184</em>627</td>
</tr>
<tr>
<td>For 50/80kVar</td>
<td>500<em>675</em>250</td>
<td>500<em>250</em>723</td>
</tr>
<tr>
<td>For 80/100kVar</td>
<td>500<em>675</em>250</td>
<td>(Wall mount)</td>
</tr>
<tr>
<td>For 80/120kVar</td>
<td>500<em>675</em>250</td>
<td>(Wall mount)</td>
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</table>

## Net weight

<table>
<thead>
<tr>
<th></th>
<th>40kg (30/40kVar)</th>
<th>40kg (40/50kVar)</th>
<th>40kg (40/50kVar)</th>
</tr>
</thead>
<tbody>
<tr>
<td>70kg (50/80kVar)</td>
<td>70kg (80/100kVar)</td>
<td>70kg (80/120kVar)</td>
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## Color

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## Environment Requirement

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<tr>
<td>Altitude</td>
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<tr>
<td>Ambient temperature</td>
<td>-20°C–40°C (may derate capacity if ambient temperature exceeds 45°C)</td>
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<tr>
<td>Relative humidity</td>
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<td>Protection Class</td>
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## Qualifications

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
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</table>
Flexible Cabinet

- Flexible dimension
  600*1000*2200mm
- Flexible capacity
- Flexible incoming connection
  Top / Bottom cable entrance
  Top / Bottom MCCB position
PLUG-IN TYPE CABINET

One plug-in type cabinet could hold five 100kVar modules to achieve 500kVar. The plug-in type cabinet has built-in module which can be easily removed and added.

The dimension of plug-in type cabinet: 600*800*2200mm.
Mun Hean SVG Project Reference

- Petrochina Bohai Oil Drilling, China
- LiaoYang Huitong Street Rolling, China
- State Grid of China – Jiangsu Province, China
- Shanghai Pufeng Harbour, China
- Far East Financial Centre, Admiralty, Hong Kong
- NTT Data Centre, Tseung Kwan O, Hong Kong
- China Unicom, Hong Kong
- Siu San Wan Sport Ground, Hong Kong
- Perodua Car Manufacturing Plant, Malaysia
- RongMao Cast Steel, Malaysia
- PTP Johor, Malaysia
- Plotting Yard at Botanic Gardens, Singapore
- Prima Flour Mill Factory, Singapore
- Seng Hong Warehouse, Singapore
- Mitrphol Sugar Mill Factory, Thailand
- TexHong Textile Factory, Vietnam
- Steel Factory, Philippines
- Hutchison Ports SITV, Vietnam
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