**Static Var Generator (SVG)**

1. Specifications

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| Items | 400V Sinexcel SVG |
| Rated input | 228V~456V |
| Power grid frequency | 50/60Hz (45Hz~62.5Hz) |
| Parallel quantities | unlimited |
| Efficiency | ≥97% |
| Power grid structure | 3P3W/3P4W |
| Circuit Topology | 3-level |
| Reactive power compensation | Available |
| Unbalance compensation | Available |
| Operation mode | Reactive, Q+B, Auto-aging, B+Q, B, Constant reactive (Q: Reactive Power, B:Three Phases Unbalances); 6 combinations, set up priority of compensation for reactive power or three phase unbalances |
| Overall response time | <15ms |
| Target power factor | Adjustable from -1 to 1 |
| Switching frequency | No lower than 20kHz |
| Noise level | <65dB(for SVG 200 kvar module, ＜75dB) |
| Communications ports | RS485, Ethernet port |
| Communications protocols | Modbus, TCP/IP |
| Module display interface | 4.3-inch HMI (wall mount), 7-inch HMI (rack mount, with cabinet) |
| Protection functions | over-voltage protection, under-voltage protection, short-circuit protection,  inverter bridge inverse protection and so on |
| Monitoring alarm | Available |
| Fault alarm | Available |
| Mounting type | Wall-mounted/Rack-mounted/Cabinet |
| Altitude | ≤1500m; derating from 1500m~4500m |
| Ambient temperature | -10℃~40℃ |
| Relative humidity | Up to 95%, non-condensing |
| Protection class | IP20, higher protection class can be customized. |

1. Ratings
   1. SVG shall be able to connect in shunt to the main supply network and available to both 3-phase 3-wire and 3-phase 4-wire system. 3P3W or 3P4W could be set by software without changing any hardware. The neutral line of SVG shall have a current capacity three times of rated phase current.
   2. SVG shall operate with supply phase-phase voltage 228V to 456V directly without a step-up transformer. A third-party report shall be provided.
   3. SVG shall be designed to operate with a frequency of 45~62.5Hz.
   4. SVG shall be available as a standalone module with integrated control and HMI interface in one complete build unit.
   5. SVG shall be phase rotation insensitive. SVG shall detect phase rotation and align output accordingly.
   6. The heat loss shall not exceed 3% of the unit rating. A third-party report shall be provided.
   7. SVG shall be able to inject compensation current according to the information collected from current transformer. The current transform shall be able to install at both load side and supply side.
   8. SVG shall be available to be mounted directly on the wall or in an electrical panel.
   9. SVG shall be provided in NEMA Type 1 (IP20) enclosure.
   10. The maximum sound level shall not exceed 65dB at one meter under all operating conditions.
   11. Single SVG module capacity could be up to 200 kvar. SVG with different capacities can be freely connected in parallel.
   12. SVG is modular design, rack mount or wall mount type, could be installed in the cabinet. Single cabinet could install 600kvar SVG in maximum.
   13. AHF and SVG could be installed in one cabinet freely.
2. Functions
   1. The SVG shall use 3-level power electronics Insulated Gate Bipolar Transistor (IGBT) circuit topology to deliver its rated output as a current generator source, 3-level technology guarantee higher switching frequency with lower ripple current and closer to sinusoidal wave.
      1. The average switching frequency of IGBT circuit shall be 20kHz.
      2. The IGBT circuit shall be controlled by a set of Digital Signal Processor that continuously monitor the live current condition and calculate the required output compensation current wave-shape.
   2. The full response time of SVG shall be less than 15ms. Full response time is the time from current detection to complete reactive power compensation. A third-party report shall be provided.
   3. The SVG should have three algorithms, FFT, intelligent FFT and instantaneous reactive power algorithm.
   4. The user must be able to set the target power factor in a range from 1.0 inductive to 1.0 capacitive.
   5. Reactive power compensation shall be applicable under both leading and lagging phase condition.
   6. SVG shall be designed to compensate reactive power and three-phase unbalance at the same time. The user must be able to set whether the function of three-phase unbalance compensation is on.
   7. The function shall be validated with an independent third-party type test report.
   8. Multiple units of SVG module can be added to increase capacity without limit.
   9. SVG should have the energy saving function. User could set the working time, workday, also user could set the minimum limit load rate to save the energy.
3. Current Transformer
   1. Primary current ratings of the CT shall accord with full load current rating of the circuit on which installed.
   2. Secondary current ratings of the CT shall be 5 amperes.
   3. Current transformer ratio shall be selective on user’s requirements.
   4. Current transformers shall be rated for 50/60 Hz.
   5. Class 0.5 (or better) accuracy shall be provided.
   6. Both open-type and closed-type can be offered for easy installation.
   7. Closed loop control, SVG could only use one set of CT on grid side for normal operation.
4. Control Interface
   1. 4.3inch touch screen HMI shall be provided for user convenience.
   2. The SVG shall have dedicated Touch Screen HMI display to access all control to turn on/off and enter configuration settings.
   3. HMI shall support multiple color display to identify waveform of three phases.
   4. HMI shall be able to display multiple waveform on one page at the same time.
   5. The user must be able to select which waveform to display.
   6. HMI shall have a memory capacity for 500 operation logs. Operation logs shall not be deleted manually.
   7. HMI shall be able to display operation parameters as follows:
      1. Apparent power, both grid side and load side
      2. Reactive power, both grid side and load side
      3. Active power, both grid side and load side
      4. Cosφ, both grid side and load side
      5. Three phase line to neutral voltage
      6. Three phase line to line RMS current
      7. Neutral line RMS current
      8. THDv source side
      9. THDv load side
      10. THDi source side
      11. THDi load side
      12. Harmonic current spectrum
      13. Harmonic voltage spectrum
      14. IGBT temperature
      15. Power factor before and after compensation
   8. HMI shall provide external communication via cable connection. Modbus TCP/IP shall provide remote monitoring and control using RS485.
   9. 7-inch HMI can realize the electrical data recording and parameter setting, the recorded data can be exported through the U disk.
   10. 7-inch HMI has power analyze and PQ meter function. It could detect and display the grid current, load current, grid voltage, compensation current on the same page.
   11. 7-inch HMI should have the report function, user could output weekly report, monthly report and annual report to the USB disk.
   12. 7-inch HMI should have the data record function, user could choose to record data for the entire SVG system or for a single SVG module, user could also set the record interval time.
5. Safety Protections
   1. SVG shall automatically disconnect when the system is powered off and restart when the system recovers.
   2. SVG shall have the function of quick and complete fault self-check and automatically operate accordingly.
6. Compliance to Standards:
   1. IEEE519-1992: Recommended Practices and Requirements for Harmonic Control in Electrical Power Systems;
   2. GB 7251.1, GB/T 7251.8: Low-Voltage Switchgear and Control gear Assemblies--General Technology Requirement for Intelligent Assemblies;
   3. GB 15576-2008: The Specifications of Low-Voltage Reactive Power Steady Compensation Equipment;
   4. EMC: IEC61000-6-2: Electromagnetic Compatibility (EMC)-Part 6-2: Generic Standards-Immunity for Industrial Environments;
   5. EMC: IEC61000-6-4: Electromagnetic Compatibility (EMC) -- Part 6-4: Generic Standards -- Emission Standard for Industrial Environments (only for 50A model to pass);
   6. ESD: IEC61000-4-2: Electromagnetic Compatibility – Testing and Measurement Techniques – Electrostatic Discharge Immunity Test;
   7. RS: IEC61000-5-1: Electromagnetic Compatibility – Testing and Measurement Techniques – Radiated, Radiofrequency, Electromagnetic Field Radiation Immunity Test;
   8. EFT: IEC61000-4-4: Electromagnetic Compatibility – Testing and Measurement Techniques – Electrical Fast Transient/Burst Immunity Test;
   9. SURGE: IEC61000-4-5: Electromagnetic Compatibility – Testing and Measurement Techniques – Surge Immunity Test;
   10. DIP: IEC61000-5-9: Electromagnetic Compatibility – Testing and Measurement Techniques –Voltage Dips, Short Interruptions and Voltage Variations Immunity Test;
   11. CS: IEC61000-4-6: Electromagnetic Compatibility – Testing and Measurement Techniques – Immunity to Conducted Disturbances, Induced by Radio-Frequency Fields;
   12. IEC60068-2-6: Environment Testing Part 2-6: Tests -- Test Fc: Vibration (Sinusoidal);
   13. IEC60068-2-27: Environment Testing Part 2-27: Tests -- Test Ea and Guidance: Shock;
   14. EN 50178:1998: Electronic Equipment for Use in Power Installations;
   15. EN 61000-6-2:2005: Part 6-2: Generic standards – immunity for industrial environment；
   16. cUL/cETL（480V）
   17. CSA

1. Service Conditions

SVG shall be suitable for the following conditions:

* 1. Maximum Altitude: 1500m with derating at 1% for every additional 100m above.
  2. Ambient Temperature: The SVG shall operate continuously in an environment of -10°C to 40°C ambient temperature.
  3. Relative Humidity: to 95%, non-condensing