SVC

STATIC VAR COMPENSATOR

www.rxpe.com
Rongxin Power Electronic Co., Ltd. (RXPE) is one of the biggest SVC manufacturers in the world. RXPE enjoys a 12-year manufacturing history with installed capacity of 18,000MVar, the largest total capacity globally.

So far, RXPE’s SVC systems have been widely used not only in China, but also in Vietnam, Thailand, Burma, etc.

RXPE’s SVC systems are widely used in the fields of rolling mills, EAF, coal, heavy machinery, electric railway and power systems. RXPE has made a great contribution towards the improvement of electric energy and energy-saving for the power distribution system.

RXPE is a specialized SVC manufacturer with strong designing and manufacturing abilities, providing customers with high quality products at very competitive price. 100% parts and finished products are thoroughly tested for each order. The company’s technical strength and efficient service enable RXPE to provide the world-class SVC solution, greatest value for customers, thorough testing, shortest response time, best service and full technical support. As a remarkable success, there have never been serious faults in RXPE’s SVC equipments which have been proven to have top quality by existing deployment.
Quality Problems of Power in Existing Electric Network

Power quality is generally indicated by stability, symmetry and current wave characteristics and so on. As more modern nonlinear loads are connected to the grid, the power quality has been seriously affected. The mass application of various power electronic devices and the frequent fluctuation of the loads are main sources of the disturbance which results in many negative impacts to the grid:

- Low power factor, high power loss, high productive cost and low productive efficiency.
- Resulting in reactive power impact, voltage dropping and voltage flicker of the grid. In some cases even causing the driving and protection equipments’ malfunction or shutdown.
- Causing harmonic currents which may lead to:
  - Grid voltage distortion.
  - Faults of protective and automatic equipments.
  - The amplification of resonance and harmonic currents of the capacitors, which may lead to the capacitors’ overload or over-voltage or burning.
  - Increasing loss of transformers which will result in heat increase of the transformer.
  - Heat increase of the electrical equipments, the instability of motor and even burning of the motor.
  - Acceleration of insulation deterioration of electrical equipments.
  - Reduction of efficiency of the electric arc furnace (EAF) and increment of losses.
  - Disturbing communication signals.
- 3-phase unbalance which causes negative-sequence current which causes vibration of motor rotors.

Typical Reactive and Active Curves of 4 Housing Rolling Mill Voltage Distortion Caused by 5th Harmonic
SVC of TCR type

SVC is connected to the system as the follows Fig. Capacitors provide fixed capacitive reactive power. TCR provides inductive reactive power which is decided by the current through the TCR. The system must try to satisfy the equation:

\[ Q_N = Q_v - Q_{QC} + Q_{TCR} = 0 \]

so that the power factor is a constant and there will be no fluctuation of the voltage.

The most important is to control the pass angle of the thyristors prospectively to obtain the needed currents in order to provide the needed reactive power.

The control system adopts the currents and voltage of the system and calculates the reactive power which will be compared with the preset value (may be 0). According to the result, the control system works out the triggering angle of the thyristors and triggers them at this angle.

Rongxin’s SVC has the ability of single phase regulation based on the theory of Steinmets which makes Rongxin’s SVC excellent in distinguishing the negative frequency currents.

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**Working Principle of SVC**

- \( Q_N \) total reactive power of system
- \( Q_v \) reactive power of load
- \( Q_{QC} \) reactive power of filter
- \( Q_{TCR} \) reactive power of TCR

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**Fig: SVC Single Phase System Diagram**
Quality Problems of Power in Existing Electric Network

**Rolling Mill**
Reactive shocks generated by the rolling mills and other industrial symmetric loads may cause the following effects to the grid:

- The voltage drop and fluctuation, which may result in malfunction of electric equipment and reduce the productive efficiency
- Low power factor
- The harmful high-order harmonic waves in the driving devices, typically 5th, 7th, 11th, 13th and side-frequencies, which will cause serious voltage distortion. RXPE's SVC system can solve those problems perfectly. It ensures the stability of the bus bar voltage, reduces the harmonic currents substantially and makes the power factor close to 1.

**Electric Arc Furnace (EAF)**
The electric arc furnace is a typical non-linear load, causing a series of negative effects:

- Serious unbalance of the grid and negative-sequence currents.
- Harmonic currents which cause the voltage distortion.
- Serious voltage flickers.
- Low power factor.

The best way to solve the problems mentioned above is to install SVC with rapid response time. Based on the instant reactive power theory, the response time of RXPE's SVC is less than 10ms, which can meet the strict technical demand, offer reactive current rapidly to the EAF and stabilize the bus bar voltage, increase the output of metallurgical active power, improve the productive efficiency and mitigate the flickers substantially. Single phase compensating function of RXPE SVC can eliminate the three-phase unbalance. Furthermore, the filter devices can mitigate the harmful harmonic currents and increase the power factor by providing capacitive reactive power to the system.

**Secondary Substation**
In the local grid, the stepped switching capacitor banks are used to compensate the system reactive power and increase the power factor. But they are only able to provide the capacitive reactive power, and unable to realize rapid and accurate adjustment according to the load variation. So sometimes they provide much more reactive power than the grid really needs, which will result in over voltage of the bus bar and damage the electric equipment and destroy system stability. RXPE's SVC system is able to compensate with capacitive and inductive reactive power rapidly and accurately. It solves the problems of reactive feedback effectively. In addition, when a new SVC system is installed, the existing fixed capacitor banks can be utilized by adding a TCR, which requires the minimum investment. It is the most effective way to improve the power quality of the local grid.
Long Distance Power Transmission
The grid tends to have larger capacity and longer distance. At the same time, power loss becomes higher than ever, which needs the transmission system to be more effective. It has been comprehensively demonstrated all over the world that SVC is able to improve transmission and distribution performance of the power system remarkably. The SVC should be installed at one or several proper points in the grid in order to maintain a balanced voltage under different conditions and achieve the following purposes:
- Stabilize voltage of a weak system
- Reduce the transmission losses
- Enhance transmission capability and make existing grid more efficient
- Improve transient stability
- Increase the resistance in the small interference
- Improve system damping
- Enhance the voltage control and stability
- Mitigate the power oscillation

Electric Railway Traction Substation
While protecting the environment, the electric locomotive also causes serious pollution to the grid. As the power supply of the electric locomotive is through the single phase, the load not only causes serious unbalance and lowers the power factor but also generates negative-sequence currents. Currently, the only way to solve the problem is to install SVC system at proper locations along the railway. The SVC is able to balance the three-phase by means of single-phase compensating and to increase the power factor through filters. RXPE's SVC is capable of solving this problem perfectly at minimum cost.

Hoists and Other Heavy Industrial Loads
The hoists and other heavy industrial loads may cause the following effects to the grid.
- The voltage drop and fluctuation
- Low power factor
- The harmful high-order harmonic currents
RXPE's SVC can solve above problems perfectly.
The Modules of RXPE’s SVC

A  Digital Control System
- The digital control system is a cabinet structure which is used to calculate reactive power value in real-time and control reactive power value by regulating the triggering angle of thyristors.
- Indoor installed

B  Thyristor Valves
- LTT or ETT
- Heat pipe natural cooling or water cooling
- Receiving signals from control system.
- Generating corresponding reactive compensating currents by modulating the triggering angle of the thyristors.
- Indoor installed

C  Compensation Reactors
- Air core reactors and high voltage AC capacitors (harmonic filters) used together with the thyristor valves. Reactors generate inductive reactive power and capacitors generate capacitive reactive power.
- Outdoor installed
Harmonic Filters

- A filter channel is made of three parts: reactor, capacitor and resistor. According to the system’s need, certain number of filtering channels will be formed in this way and every filter channel is for corresponding harmonic respectively.

- Structure:
  - Air core reactor, double winding, natural cooling.
  - The electrical capacitors are shelf architecture and natural cooling.

- Function:
  - Eliminates harmonic currents of the system, provides capacitive power to system and increases power factor.

- Connection:
  - Each filtering channel is connected to the bus-bar through HV switching cabinet or directly.

- Outdoor installed
Highly Reliable Thyristor Valves

Based on large power thyristor series technology and heat pipe natural cooling technology or water cooling technology.

- Light-triggered-thyristor (LTT) or Electrical-triggered-thyristor (ETT).
- Effective heat pipe natural cooling or water cooling TCR with simple structure and non-maintenance.
- Standard shelf structure is easy to be installed
- Reasonable thyristor redundancy ensures stability.
- Able to be connected to bus bar of different voltage class such as 6KV, 10KV, 27KV and 35KV.

Single phase anti-parallel thyristor valve
LTT technology is the best in the world

Light Triggered Thyristors (LTT)

The Structure of Light Triggered Thyristor (LTT)

Power Unit of Light Triggered Thyristor (LTT)

Heat pipe natural cooling system

Heat pipes of RXPE are bi-directional and totally-enclosed which are able to absorb heat from the thyristors directly to cool them. There is no movable component so the system is simple and free of maintenance and it has low noise.

Water cooling system

1. heat exchanger and air cooling system
2. valves
3. main cycle water pump
4. thyristor
5. water tank
6. water supplying pump
7. ion exchanger
8. expansion tank
9. nitrogen gas cylinder
10. temperature sensor
11. pressure sensor
12. flow sensor
13. conductivity sensor
14. water level sensor
SVC
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The digital control system are made of standard modules with the following function:
- Reactive power control, voltage regulating, etc.
- Response time is less than 10ms
- Communication
- Single-phase control
- Self-diagnosis and real-time monitoring and control
- Function and components can be selected on demand
SVC HV Test System is the Guarantee of SVC Quality

- Test voltage: 6KV, 10KV, 27KV, 35KV and 66KV
- Test capacity: 10000KVA
- All kinds of SVC special tests
- 72-hour continuous test and commissioning
- Shorten the debugging time in the working field
- Greatly improve the reliability of the equipment
SVC  STATIC VAR COMPENSATOR

We offer the best solution of SVC

Integrated project
• System design
• SVC equipment manufacture
• Equipment design, civil design
• Installation guide
• Debugging and Commissioning
• Training
• Supplying of backup components
• Maintenance and repairing
• Remote monitoring

1. transformer
2. HV switchers
3. reactors of TCR
4. filter reactors
5. filter capacitors
6. thyristor valves
7. valve control cabinet
8. protection cabinet
9. control cabinet
10. power supply cabinet
11. control room

ISO9001    GB    IEEE    IEC

Analysis of the Load Flow
• Determination of the installation site
• System capacity
• Background harmonic test

System Plan
• SVC design
• Harmonic quenching
• Equipment capacity
• Valuation on loss and cost

System Design
• Control & protection design
• Control function
• Response time

Control & Protection Design
Serialised and Standardized Products

Through continuous research and practices, RXPE’s SVC has become a series of standardised products. The complete product types and advanced technology ensure the high quality, long life, low cost and best after-sale service, which make RXPE’s SVC the excellent solution with best value-cost ratio.

<table>
<thead>
<tr>
<th>Grid voltage (KV)</th>
<th>6</th>
<th>10</th>
<th>27</th>
<th>35</th>
</tr>
</thead>
<tbody>
<tr>
<td>TCR rated power (Mvar)</td>
<td>2-200</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Thyristor valves</td>
<td>Shelf structure</td>
<td></td>
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<tr>
<td>Valves cooling mode</td>
<td>Heat pipe natural cooling or water cooling</td>
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<td></td>
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<tr>
<td>Control system</td>
<td>Digital control system</td>
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<td></td>
</tr>
<tr>
<td>Control mode</td>
<td>Reactive power, voltage, etc</td>
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</tr>
<tr>
<td>Regulating range</td>
<td>-100%~+100%</td>
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<tr>
<td>Regulating mode</td>
<td>Single-phase control</td>
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<tr>
<td>Response time</td>
<td>&lt;10ms</td>
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<td>Noise level</td>
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<td>Supply voltage</td>
<td>380V+15%</td>
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<tr>
<td>Service life</td>
<td>&gt;20 years</td>
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</tbody>
</table>
The first set of SVC used in local grid in China was designed and manufactured by RXPE (Shanxi 110kV power network, China 2002)

The first set of SVC used in electric railway system in China was designed and manufactured by RXPE (Shanxi 110kV power network, China 2002)

The first self-cooling SVC applied in power system in China (Haikou Xiuying 110kV substation, China, 2001)

SVC for EAF+LRF which will be used in Burma for a turn-key project contracted by Danieli, Italy (33kV, 45Mvar, Burma, 2006)

The largest SVC in Vietnam was designed and manufactured by RXPE (22kV, 85Mvar, Vanloi Company, Vietnam 2006)

The first made-in-China digital control SVC was designed and manufactured by RXPE

The first SVC based on LTT power unit in China (Tangshan Qianan No.1 Rolling Mill, 2007)

The first natural cooling SVC was designed and manufactured by RXPE

The first SVC used for DC-EAF in China (100Mvar, Suzhou Iron & Steel Co., Ltd. 2000)

Chinese first TCR+TSC type SVC used in power system was designed and manufactured by RXPE (70Mvar, Hainan 220kV network, China 2006)
Apart from SVC, we also provide the following products:

- Power filter (6KV, 10KV, 35KV)
- Medium-voltage converter (6KV, 10KV)
- Low-voltage converter (660V, 1140V)
- Medium-voltage soft starter (6KV, 10KV)