RXPE
RONGXIN XINGYE 荣信兴业

RXPE XINGYE STATIC VAR COMPENSATOR SVC

【RXPE】SZ002123

Liaoning Rongxin Xingye Power Technology Co., Ltd
version **R17.07**

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企业简介 Company introduction

Cooperation and Innovation

Liaoning Rongxin Xingye Power Technology Co., Ltd is a national key high-tech enterprise and a Chinese listed company (stock code: 002123), which is engaged in MV high power electronic device R&D, design and manufacture, series products meet requirements from power generation, transmission and distribution to the terminal load, provide solutions on improving power quality, optimizing the control and saving energy, etc.

RXPE is a leading supplier of power electronic equipments in China, the products are widely used in electricity, metallurgy, coal, nonferrous metals, electrics railway, wind power generation, petrochemical, shipping and other areas, users are all over China, The products have been exported to E.U countries like Germany, Italy, Turkey; Asian countries like Oman, India, Vietnam, Thailand, African countries like Algeria, Nigeria, Ethiopia, Egypt, south American countries like Ecuador, Peru, Brazil etc.

RXPE has passed the German TUV certification, EU CE-LVD certification, ISO9001, ISO14001, OHSAS18001 and other international certifications, products are in full compliance with international standards.

RXPE owns one of the top R&D team and the advanced power electronics test base, owns 66KV/10000kVA high-voltage substation, high-voltage frequency conversion Full-load Test Center, which meets the needs of inspection from simulation (RTDS) to the full-load experimental process. RXPE has strong capability of independent innovation and possesses nearly 40 patents and 10 software copyrights and has performed 23 significant scientific research projects and formulated two national standards.

RXPE will consistently devote to innovations on technologies and products of power key areas, and contribute to creating values for customers and sustainable social development.

Owning patented heat pipe cooling technology

Leading total capacity of SVC in China

Pass the German TUV certification, EU CE-LVD certification

Owning MV full load testing center

Possessing most SVC patents in China

Pass IS9001 Professional certification

Main drafter of SVC national standard

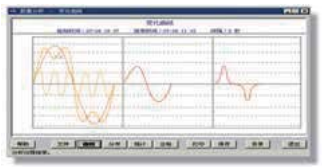
SVC are in full compliance with international standards

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 and more modern nonlinear loads are connected to the grid, the power quality has been seriously affected. Such loads introduced big impact to the connected power grid and resulted power
quality problemsas follows.

- ◆ 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 and grid voltage distortion which may lead to :
  - ● 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 and making which easily breakdown.
  - ● Reduce production efficiency of electric arc furnace (EAF) and increase loss.
  - ● Disturbing communication signals.
- ◆ Lead to 3-phase unbalance and negative sequence current which cause vibration of motor rotors.

Typical Reactive and Active Curves of
4 Housing Rolling Mill



Voltage Distortion Caused by 5th Harmonic

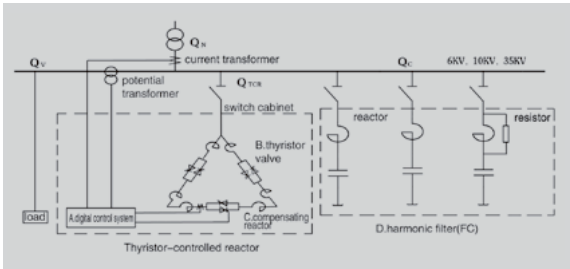
SVC is the best solution

SVC is widely used for stabling system voltage, eliminating the reactive impact, filtering harmonics and balancing the three phase grids.

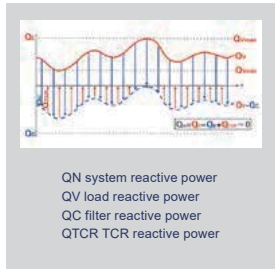
SVC Operating Principle

SVC is connected to the system as the follow Fig. Capacitors provide fixed capacitive reactive power QC. Compensations provide inductive reactive power which is decided by the current through itself, capacitive reactive power and inductive reactive power can offset. Only if QN=Qv(system needs)-QC+QTCR=constant(or 0), the power factor is a constant and there will be no voltage fluctuation. The key is to control the triggering angle of the thyristors prospectively to obtain the needed currents through the compensation reactors. The thyristor converter and control system can realize the functions by comparing the reactive value combined by reactive current and voltage values collecting from bus bar with the setting constant one, the triggering angle is gotten by calculation above and so is the needed current by triggering angle device.

For asymmetrical load adjust single phase, eliminate negative sequence current and balance the three phase grid in accordance with steinmetz theory.

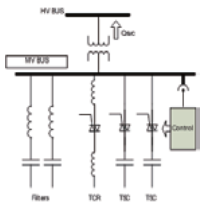


SVC single line diagram



QN system reactive power
QV load reactive power
QC filter reactive power
QTCR TCR reactive power

SVC schematic diagram



In case if big amount of reactive power is required on the grid but normally the SVC should be operated at zero Mvar output, a so-called thyristor switched capacitor (TSC) branch can be introduced to low down the active loss of the SVC. Theoretically, a TSC can be considered as a fixed capacitor bank that is switched on and off by thyristor valves instead of normal circuit breakers.

RXPE SVC Applications
——Power Generation, Power Transmission and Distribution

Long Distance Power Transmission

SVC is able to improve transmission and distribution performance of the power system remarkably. SVC should be installed at one or several proper points in the grid in order to achieve the following purposes:

- Stabilize voltage of a weak system
- Reduce the transmission losses
- Enhance transmission capability and make existing grid most efficient
- Improve transient stability
- Increase the resistance in the small interference
- Enhance the voltage control and stability
- Mitigate the power oscillation

Substations(10kV~1000kV)

RXPE SVC system is able to compensate capacitive and inductive reactive power rapidly and accurately. It can effectively improve the grid stability and make the grid safely ride-through during possible system faults. SVC is composed of TCR branches, fixed capacitor banks, and some times TSC branches (thyristor switched capacitors). This requires the minimum investment which is the most effective way to improve the system stability of the power transmission grids.

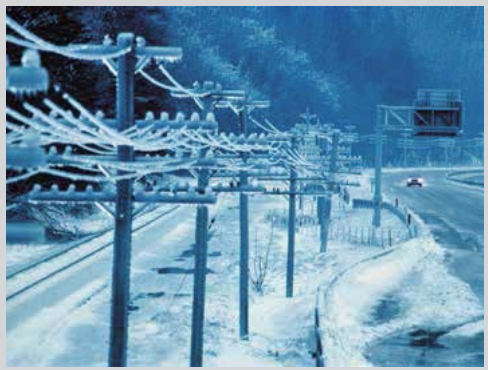
Mitigate sub-synchronous resonance

Long distance and high capacity transmission can be realized with series compensation, but sub-synchronous resonance is also produced which may damage the generators even break down the grid.

In order to solve such problems,RXPE has developed a so-called sub-synchronous resonance dynamic stabilizer,the control system of which can control TCR (thyristor controlled reactor) in SVC system and modulate a reversed wave to mitigate the harmful sub-synchronous resonance current in the power grid.

Ice melting

The main working principle of melting ice based on SVC: High DC current which passes transmission leading wire is gotten by rectification, the DC current is much higher than normal working current which heats the leading wire, so as to melt the ice, snow and rime.



RXPE SVC Applications
——Metallurgy, Nonferrous Metal Manufacturing

Rolling Mill

Reactive impact generated by the rolling mills and other industrial symmetric loads may cause the following effects to the grid:

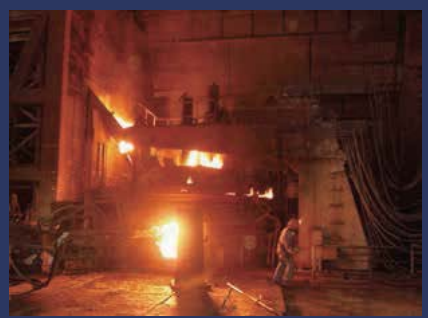
- The voltage drop and fluctuation, which may result in malfunction of electric equipment and reduce the productive efficiency.
- Low power factor
- The harmful high-order harmonic waves in the driving devices, typically 5th, 7th, 11th, 13th and side-frequencies, which will cause serious voltage distortion.

RXPE 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 which causes a series of negativariae effects

The response time of RXPE 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 ultraharmonics and increase the power factor by providing capacitive reactive power to the system.



RXPE SVC Applications
——Electric Railway, Wind Power and Solar Power etc.

Electric Railway / Subway

The power motor is fed by single phase which causes the serious three phase unbalance , low power factor and negative sequence current.
Three phase grid is balanced and power factor is improved by filter with the quick single phase compensation function of SVC.

Wind Power

The shunt running of wind power influences the power quality, safety and stability of grid, the main influences are:

- Low power factor
- Voltage fluctuation
- Add harmonic to grid

RXPE SVC can solve above problems perfectly

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 SVC can solve above problems perfectly.

RXPE SVC Structure

A) Digital Control System

The digital control system is the cabinet structure which is used for calculating real time reactive power and controlling reactive power value by controlling the triggering angle of thyristors.

Indoor installed.

B) Thyristor Valves

TCR / TSC valves.
Heat pipe natural cooling or water cooling.
Receiving signals from control system and Generating corresponding reactive compensation currents by adjusting the triggering angle of the thyristors.

Indoor installed.

C) Air-core Reactors

Air core reactors, twin winding (TCR), and natural cooling.

While the current through thyristor flows the compensation reactor, the needed inductive reactive power is generated, which is for balancing the system reactive power and stabilizing the bus bar voltage and power factor.

Outdoor installed.

D) Capacitor Banks

Used in harmonic filter branches, mechanical switched capacitor banks or TSC capacitor banks.

Capacitor banks are often used together with damping / tuning reactors or resistor (for high pass channel) to achieve various functionalities.

Outdoor installed.

A harmonic filter branch is composed of reactors, capacitors and sometimes resistors. And a certain number of filter channels can be formed according to the need of different system, the different channel is used for filtering the corresponding harmonics respectively.

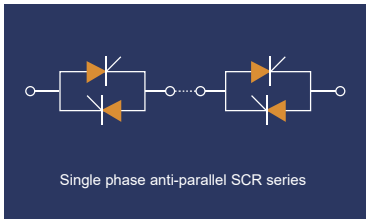
- Structure: Air core reactor, double winding, natural cooling. The power capacitors are shelf architecture and natural cooling.
- Function: Eliminating ultraharmonics, providing capacitive power to system and increasing power factor.
- Connection: Each filtering channel is connected to the bus bar through MV switchover cabinet or directly.

Highly Reliable Thyristor Valves

Technology feature

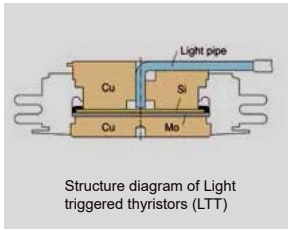
Based on large power SCR (thyristor) series converting technology and heat pipe natural cooling technology or water cooling technology.

- Both ETT (Electric Triggered Thyristors) and LTT (Light Triggered Thyristors) thyristors are available.
- Effective natural cooling SCR, simple structure and maintenance free.
- Closed circulating water cooling system(optional).
- Standard shelf structure, easy for installation and maintenance.
- Reasonable redundancy of SCR ensures stable running of SVCs.
- Thyristor valve can be connected to 1kV ~ 69kV system directly or higher voltage i.e. 110kV ~ 1000kV via transformers.

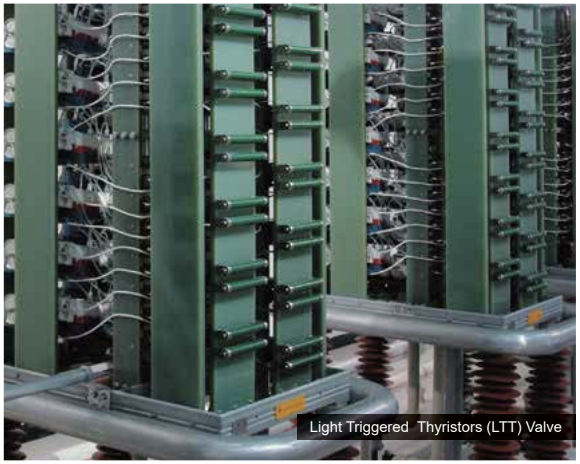


Single phase anti-parallel SCR series

Light triggered thyristors(LTT)



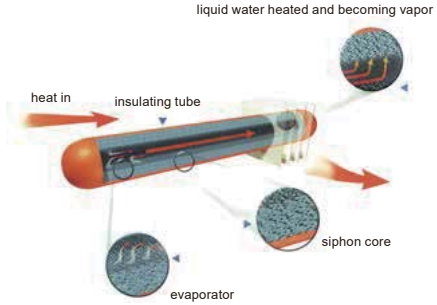
Structure diagram of Light triggered thyristors (LTT)



Light Triggered Thyristors (LTT) Valve

Heat pipe 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. The system structure is simple and free of maintenance without noise.



Water cooling system

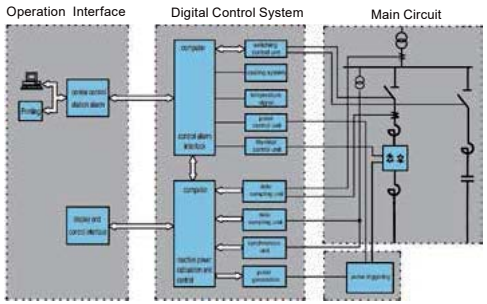
Water cooling system is a compact and high efficiency cooling method, which is normally used in bigger thyristor valves comparing with the heat pipe cooling method. There are two alternative external cooling methods, water/water type with existing external water loops or water/air type with extra cooling fans.

Advanced Digital Control System

Technical Characteristics

The digital control system adopts standard modules with the following function:

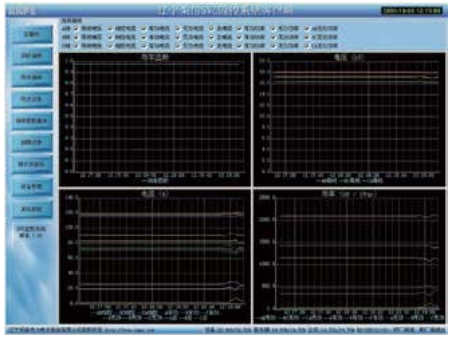
- Reactive power control
- Single phase adjusting
- Response time is less than 10ms
- Self-diagnosis and real-time monitoring and control
- Communication
- Function and components selected on demand



SVC control system diagram

Remote Monitoring System (Optional)

Remote monitoring system is a full-digital service platform composed of client side, transmission , center side. The remote monitoring system adopts the most advanced digital communication and transmission technology and sends the real time operating data and images of RXPE product continually from site to RXPE global monitoring center, RXPE can supply customer the active service at any time.



Special MV Full Load Test System is the Base of Quality

- Test voltage: 6kV, 10kV, 27.5kV, 35kV, 66kV
- Test capacity: 10000kVA
- All kinds of SVC special tests
- 72-hour continuous test and commissioning
- Shorten the commissioning time on site
- Vastly improve the reliability of the equipment

The Best Solution Offered by RXPE

Integrated project

- System design
- SVC equipment manufacture
- Equipment design, civil work design
- Installation guide
- Commissioning and running
- Training
- Supplying of spares
- Maintenance and repairing
- Remote monitoring

Serialized and Standardized Products

Though continuous research and practices, RXPE SVC has become a serialized and standardized products. The complete product types and advanced technology ensure the high quality, construction period, low cost and best after-sale service, which make RXPE SVC the excellent solution with best value-cost ratio.

Item	Specifications
Grid voltage (kV)	1 ~ 69kV or higher voltage with transformers
TCR/TSC capacity (Mvar)	Each single branch 1 ~ 300Mvar
Thyristor valves	Shelf structure, easy to replace thyristors
Valves cooling method	Water cooling / Heat pipe natural cooling
Control system	Fully programable digital control system
Control modes	- Industry applications: p.f. control, var control, open loop + close loop control. - Utility applications: constant voltage control, susceptance control etc with slow susceptance regulation and gain supervision & optimization functions.
Regulating range	-100% ~ +100%
Regulating mode	Single-phase / Three-phase control
Response time	≤10ms
Life time	≥30 years

Service Process

Analysis of Load Process

System Study
- Confirm the installation position
- System research
- Site

System Design
- SVC configuration
- Harmonic Suppression
- Equipment capacity
- Valuation on loss & cost

Control & Protection
- C&P configuration
- Control function
- Response time

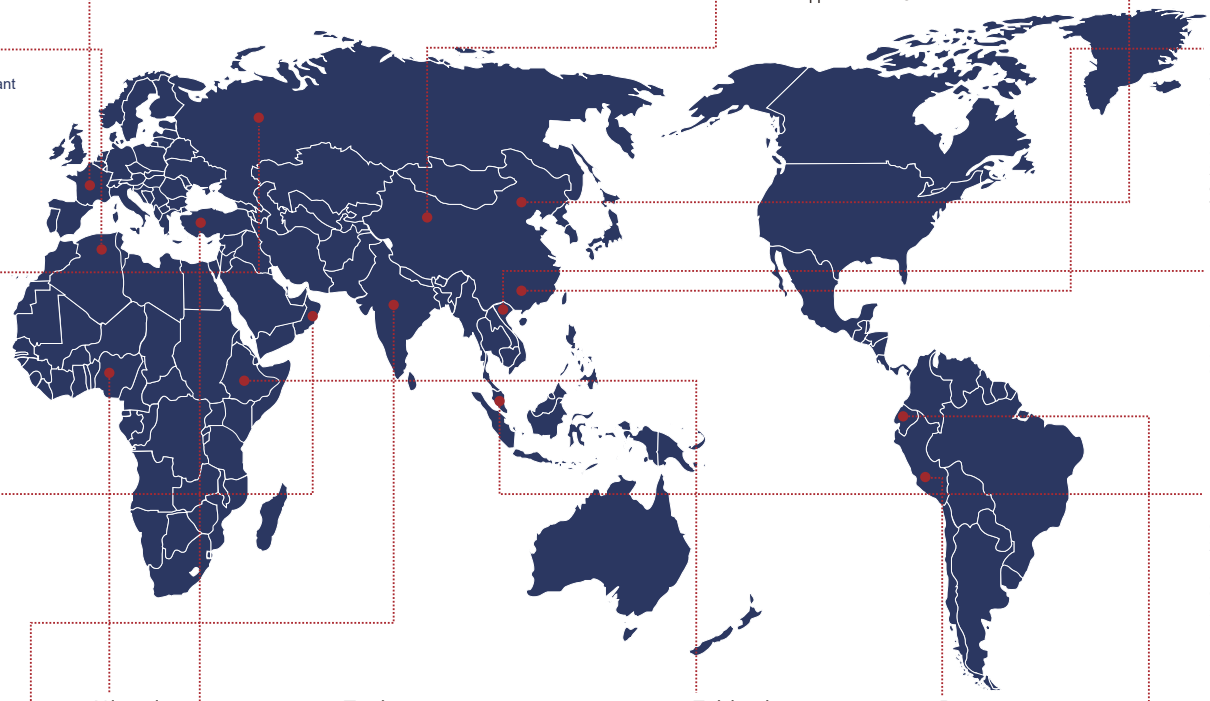
Hardware Design
- SVC equipment design
- Engineering design

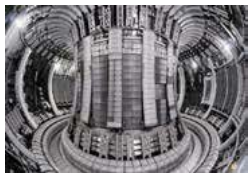
Product Manufacture
- Manufacture
- Factory test

Installation & Commissioning
- Installation Supervision
- Commissioning
- PAC

After-sales Service & Training
- Training
- Warranty
- Maintenance
- System Upgrade
- Remote Monitoring
- Spare Parts Services

1500 Sets
Of SVCs
All Over The World





France
ITER Nuclear Fusion Testing Lab SVC, 2015(ongoing)

SVC for Nuclear Fusion "Tokamak Reactor" Power Impact Compensation, 69kV/3*250Mvar

Algeria
Tosyali Iron & Steel Plant SVC, 2011

SVC for EAF & LF Compensation, 34.5kV/140Mvar

Russia
STAV Company SVC, 2012

SVC for Steel Factory Compensation, 34.5kV/75Mvar

Oman
Shadeed Iron & Steel Plant SVC, 2008

SVC for EAF & LF Compensation, 33kV/180Mvar

India
Usha Martin Company SVC, 2008

SVC for EAF & LF Compensation, 33kV/140Mvar

Nigeria
Dong Group SVC, 2007

SVC for Cold Rolling Mill Compensation, 11kV/15Mvar

Turkey
CELIK Steel Plant SVC, 2007

SVC for Hot Rolling Mill Compensation, 34.5kV/36Mvar

Ethiopia
ADAMA/NAZRET Wind Farm SVC, 2011

SVC for Wind Farm Integration Support, 33kV/12Mvar

Peru
Minera Chinalco Peru S.A. Toromocho Project, 2011

Harmonic Filters for Aluminum Production Plant, 34.5kV/20sets

China
Baiyinxi Electric Railway Traction Substation SVC, 2002

SVC for Electric Railway Power Impact and Three-phase Unbalance Compensation, 27.5kV/7.2Mvar, the first SVC for electric railway applications in China.

China
Donganshan 220kV Substation SVC, 2009

SVC for Regional Grid Voltage Stablization, 220kV/66kV/140Mvar, Based on LTT (Light Triggered Thyristor) Technology.

China
Wuzhou 500kV Substation SVC, 2009

SVC for Regional Grid Voltage Stablization, 220kV/66kV/140Mvar, Based on LTT (Light Triggered Thyristor) Technology.

Vietnam
Pomina Iron & Steel Plant SVC, 2012

SVC for EAF & LF Compensation, 33kV/130Mvar

Malaysia
OM Sarawak Plant SVC, 2014

SVC for Ore Furnaces Compensation, 35kV/4*90Mvar

Ecuador
CELEC EP 500kV Chorrillos Substation SVC, 2014

SVC for Long Distance Power Transmission Support, 230kV/30kV/-30~+120Mvar