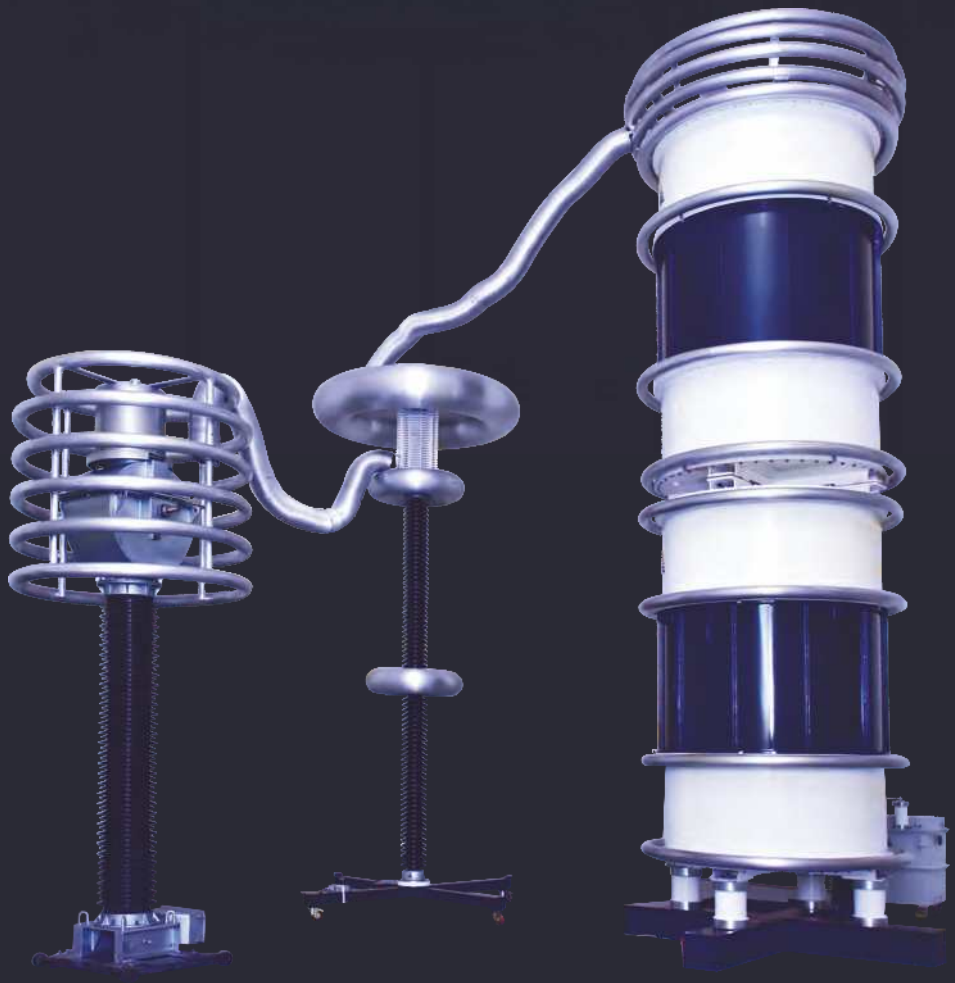
KVTEK
DEFINING QUALITY

HV AC SERIES
RESONANT TEST SYSTEMS

HIGH VOLTAGE TEST
& MEASURING SOLUTIONS
FOR MULTIPLE APPLICATIONS



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RS SERIES

HV AC SERIES RESONANT TEST SYSTEMS

Modular Type

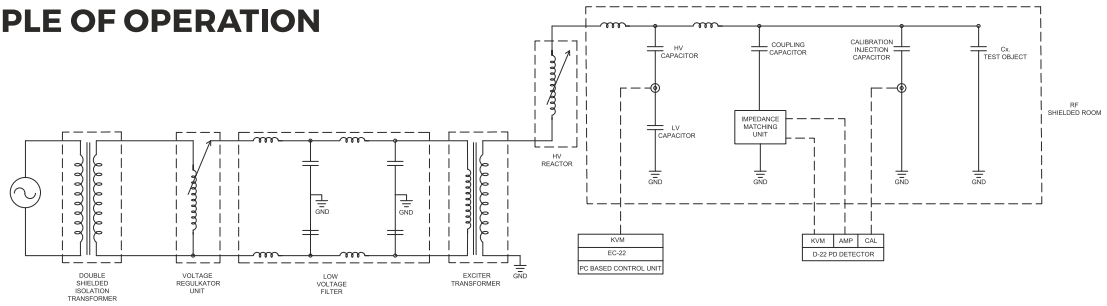
INTRODUCTION

The **Variable Inductance** Series Resonant Test Systems are specially designed for high voltage testing of capacitive test objects such as Power Cables, Generators, Bushings, Capacitors, Power Transformers, Instrument Transformers and SF6 gas insulated equipment. With option of supplying variable frequency, variable voltage static frequency converter instead of voltage regulator for PT testing at test voltage higher than rated voltage & higher frequency without saturating its core is also possible.

These Systems are available in two designs : Modular Design & Tank Type Design. Modular Series Resonant Test is designated as (RSX-YM) & Tank Type Series Resonant Test Set is designated as (RSX-YT) where X stands for output voltage rating in KV and Y stands for power rating in KVA. For applications like PT Testing to avoid core saturation this system can be supplied with variable frequency option as well.

Modular Series Resonant Test Set is typically used for voltages higher than 200kV and Tank Type design is used for all voltages up to 350 kV. In Tank type design it is possible to have multiple taps which are not possible in Modular design. Modular test set can be stacked one upon the other to generate as high as 1600 kV.

PRINCIPLE OF OPERATION



Series Resonant Test System consists of a Voltage Regulator, Exciter Transformer, HV Variable Reactor and the capacitive test object as basic essential accessories to generate high voltage. The voltage regulator is connected to the mains through a main power circuit breaker. This component supplies a variable voltage to the exciter transformer which permits the output voltage to be adjusted to the proper value for the test.

The exciter transformer supplies the necessary power to the high voltage circuit consisting of the HV variable inductance reactor and the test object. The exciter transformer also provides galvanic isolation between the mains connected primary and the high voltage circuit in the secondary. These transformers are designed with shielding to further isolate line conducted electrical noise from the output circuit.

The HV variable reactor is the heart of the resonant circuit. (This device is designed with means to adjust its inductance to precisely compensate for the capacitance in the high voltage circuit thereby tuning the system to resonance.) This variation in inductance is accomplished by varying the mutual inductance of the reactor by adjusting air gap between the two parts of reactor core. The length of the air gap is adjusted by motor driven mechanism controlled from the control panel through Laptop or PC.

The capacitive load represents the combined effects of the test object, voltage divider, filter capacitors (if used) and stray capacitance due to the test set up. A capacitive load is required for proper operation of the system in the series resonant mode.

FEATURES & BENEFITS

- Very low (real) input power is required for large output (reactive) power.
- The output voltage has suppressed harmonic level due to its natural filtration ability of the resonant circuit.
- In the event of a fault in test object, the system de-tunes itself and the power follow from the mains is eliminated, thus limiting damage to the fault.
- The system is operated in a controlled resonant condition so accidental resonant cannot occur.
- Lower test equipment cost for system rated 250 KVA and above.
- Reduced operational costs because of the substantially reduced input KVA required.
- Lower installation cost for the power service because the load is at unity power factor.

MAIN COMPONENTS OF THE SYSTEMS

- Double Shielded Isolation Transformer.
- Voltage Regulator Unit or Static Frequency Convertor.
- Low Voltage Filter.
- Exciter Transformer.
- High Voltage Reactor.
- HV Filter/Voltage Divider.
- Control Unit.

HIGH VOLTAGE VARIABLE REACTOR

High Voltage Variable Reactor is the most significant part of the system.

HV reactor and test object constitute series resonant circuit. HV reactor is made of high quality silicon steel, precision ball bearing pole to vary the mutual inductance of the reactor by adjusting air gap between the two parts of core. Its significant features are low loss, high Q value, and low PD level.

FEATURES & BENEFITS

- Drive mechanism provides 20:1 tuning range restricted to the linear portion of the tuning curve.
- Rugged reactor drive screws with heavy duty threads, located on the axis of the electromagnetic force between core segments, much superior in terms of reliability, minimum backlash and size compared to off axis drives which try to control forces through a large moment arm.
- Low reactor core flux density design to control electro-magnetic force between core segments, reduce core loss and audible noise.
- Low audible noise level < 80 dB.
- Coil manufacturing and processing techniques applied to the complete winding, from coil to outer layer shield. These techniques eliminate internal voids in the coil structure and guarantee low PD levels.
- Cellulose covered wire used for the coil winding enhances inter turn steady state and transient voltage withstand levels thus ensuring a void free winding structure.
- Continuously variable drive speed from 15 to 150 seconds for full range of inductance adjustment.
- Electromagnetic brake to hold reactor position.
- Torque limiter design for safety.

EXCITER TRANSFORMER

The Exciter Transformer is designed to set up the mains voltage and supply the real power required by the test system. An exciter transformer also provides galvanic isolation and electrostatic shielding of the high voltage test circuit from the mains.

The Exciter Transformer is housed in a separate grounded steel or FRP oil filled tank depending on the rating of the system. The winding in the exciter transformer is shielded to reduce electrical noise coupling through the transformer. The secondary winding is provided with full kVA taps.

DOUBLE SHIELDED ISOLATION TRANSFORMER

The Double Shielded Isolation Transformer provides a galvanic isolation from the mains supply. Each transformer is provided with two electrostatic shields, one over the primary and one before the secondary. Between the shield is a low capacitance insulation system designed to reduce the coupling of high frequency noise between the local mains and the test power for the resonant system.

The double shielded isolation transformers are mounted in oil filled steel tanks and are fitted with air bushings for connections. The electrostatic shields are also brought out insulated terminals to allow the optimum grounding and noise reduction configuration to be made at the time of installation.

LOW VOLTAGE FILTER

The Low Voltage Filter made from the combination of inductors and capacitors is designed to attenuate the mains noise by 20 to 30 dB level. All systems are supplied with low voltage filter to be connected between the output of the voltage regulator and the input of exciter transformer. Filters are mounted within the voltage regulator cubicle or are mounted in a separate metal enclosure, depending upon its rating. All the filters are matched to the frequency band of 30 - 1000 KHz ratings of voltage regulator.

VOLTAGE REGULATOR

Voltage Regulator supplies 0-415V variable output voltage to excitation transformer. It characterizes lower voltage waveform distortion, lower loss of power and high efficiency. Its function includes motor driven, zero voltage output start, and limit switches.

The voltage regulator is located in a steel enclosure which includes the main power circuit breaker, the main power contactor, plus the safety and protective relays to control the system. Also included in the voltage regulator section are the low power isolation transformers for supplying the power to control systems and accessories.

STATIC FREQUENCY CONVERTER

For application such as PT Testing where high frequency and high voltage testing is required to eliminate the possibility of core saturation, Static Frequency converter will replace the voltage regulator. SFC duly fitted with sine filter and high frequency noise filter will provide variable voltage and variable frequency to the exciter transformer.

Note: Either Voltage Regulator or Static Frequency Converter is required. No application will require both together.

EC-22 LAPTOP BASED DIGITAL CONTROLLER

- Switching ON/OFF High Voltage Contactor.
- Manual or automatic variation of the output high voltage with variable speed control.
- If supplied with SFC instead of voltage regulator it allows selection of output frequency to a preset value.
- Automatic raise of the output voltage to a pre-defined value with pre-defined speed.
- Timers with STOP switch for automatic switching off high voltage at pre-selected time period.
- Over voltage and over current protection with alarm indicator.
- Multiple test sequence can be programmed (Optional feature).
- Test voltage vs. time can be displayed in graphical form.
- Display of all alarms and warnings.
- Report Generation Software.
- Printing the report or saving the report is optionally selectable.

HV FILTER / VOLTAGE DIVIDER

High voltage filters are recommended when the resonant set is to be used for partial discharge testing. The high voltage capacitors and inductors are used in these filters. They are specially designed and manufactured for the rigorous flash over and low PD requirement testing. These components are designed to be partial discharge-free and are produced in a number of different form factors to suit the requirements of the system in which they are to be installed. In addition to providing attenuation of conducted noise or any radiated noise that enters the system before the filter, the filter often acts as a basic capacitive load for operating the resonant test set. This is particularly useful during set-up, training or for trouble shooting. The filters are supplied in a multi-stage or single stage series inductance & shunt capacitance configurations depending on the degree of filtering required and the voltage and current ratings. The output stage of the multistage designs also functions as a voltage divider and power separation filter for driving commercial partial discharge detectors. A PD/KV impedance matching unit is installed in this stage to supply signals to the System Kilovolt Meter, Arc Detector, Phase Synchronizer, and Partial Discharge Detector.

COMPARISON

Convential HV AC Transformer

- High KVA source required.
- Distortion on line appears at load.
- High fault current Capability.
- Over Voltage at output may be problem after flash over.
- Suitable for any load power factor.
- Overload rating possible.

Series Resonant System

- Input requirements approx. 2% of output rating.
- Negligible distortion of voltage wave form.
- Inherently current limiting.
- No over voltage problem after flash over.
- Requires predominantly capacitive load.
- Cannot be overload.

Parallel Resonant System

- Input requirements approx. 2% of output rating.
- Distortion present on Line appears at load.
- Power follow current available from HV Transformer.
- Over Voltage at output may be problem after flash over.
- Requires predominantly capacitive load for full Output but may also be used on very light loads which are not capacitive.
- Over Load rating Possible.

KVTEK Power Systems Pvt. Ltd.

(An ISO 9001:2015, ISO 14001:2015, ISO 45001:2018 Certified Company)

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