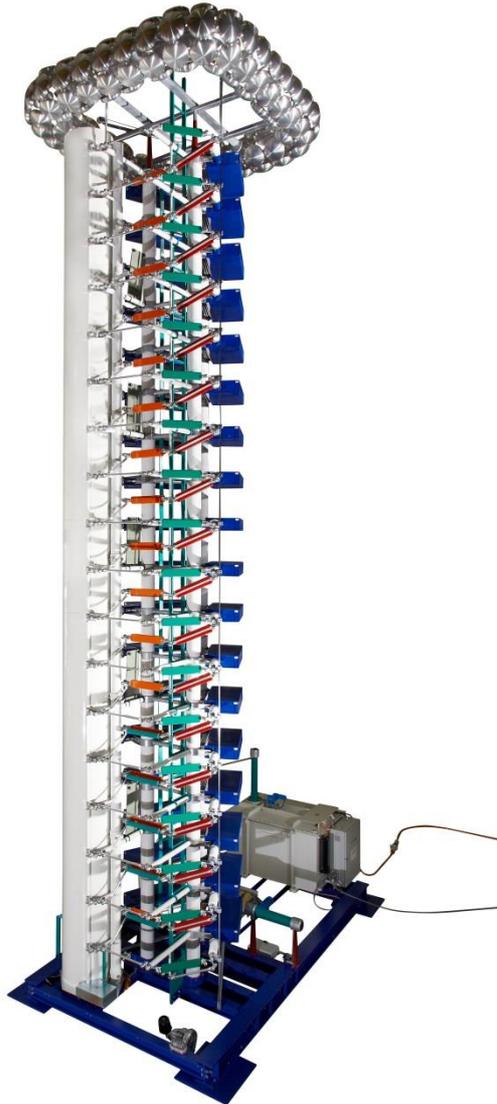


# SGVA

Impulse Voltage Test System, 200 – 10'000 kV / 10 – 1'500 kJ



3600 kV Impulse Voltage Generator

## APPLICATION

SGVA impulse test systems can be used to generate impulse voltages simulating lightning strokes and switching surges. The total charging voltage ranges from 200 kV to 10'000 kV with a per-stage energy of 10 to 30 kJ. This wide range permits optimum capacity selection for any test assignment. The system has all our experience acquired, in building Impulse Generators since 1932, behind it.

Applications covered include testing according to IEC, ANSI/IEEE as well as other national standards.

A number of optional additional circuits and components can be included to optimise the impulse test system for tests on:

- Shunt reactors
- Power transformers
- Instrument transformers
- Cables (type tests)
- Arresters (impulse current tests)
- Insulators
- Bushings
- GIS and air-insulated breakers

in the factory or on-site. For the latter tests, the SGVA system can be mounted in modules on a trailer or installed in an air-conditioned weather-resistant tower for permanent outdoor operation.

Our generators withstand **earthquakes** and strong winds due to extreme engineering design and our outdoor systems are also protected against fire & lightnings.

## BENEFITS

### Quality

The electronic measurement and control components are designed and manufactured in-house. Our many years of experience in dealing with electromagnetic compatibility of electronic devices in high voltage test bays provide the requisite expertise and a trouble-free operation and a long service life are thereby ensured.

### Safety of Operation

The grounding device with two grounding strips and two grounding switches guarantees safe operation. The controls provide clear alarm messages and guide the user through the operations.



Motorized safety earthing system

### Grounding system

Two earthing switches at the first stage, two motorised earth strips system and one earth rod help ground the generator.

### Protection of Test Objects and Test Systems

The test system is shut down in case of over-voltage, over-current or fast voltage transients.

### Ease of Operation with Modern Control System

The generator controls are very comfortable and flexible, safety features are implemented in the hardware too, independent of software. All components of the control system are EMC tested.



Controls GC 257

## Main features of the SGV system are:

- Sophisticated, strong and flexible design (experience has proven that our 30 stage generator (6 MV) can withstand strong earthquakes several times).
- Total charging voltage from 200 kV up to 10'000 kV.
- Energy for stage ranges from 10 kJ to 30 kJ.
- Computerized and microprocessor based control system.
- Equipped with resistors for lightning and switching impulse voltages.
- Unique protective grounding device, the fastest available on the market.
- Ingenious extensions of load range (Glaninger Circuit, Overshoot Compensation, Special Resistor sets for transformer, cable or GIS testing).
- Short reconfiguration times by utilizing built in internal ladder, internal platforms, handy plug-in resistors and connections, special resistor support and resistor compartments on every stage.
- Series resistors can be interchanged with one another as can be the parallel resistors. Different values of a resistor type can be used.
- Encapsulated spark gaps with filtered air-flow.
- Different kind of base frames available.
- Liquid insulation in the impulse capacitors is made of castor oil (no PCB's) making sense ecologically.
- Feedback loop between measuring system and control allows the determination of the efficiency and to work with test voltages instead of charging voltages
- Top electrodes adjustable according to customers' impulse test requirements.
- SGVA is not only technically competent, but also aesthetically pleasing and complements the quality image of the customer's facilities

### Extension Possibility

The impulse generator can be extended for the generation of higher peak values (by adding of some stages) or for the generation of other wave shapes (by adding resistors and or other external circuits). Load range can also be extended by adding the Glaninger circuit or the Overshoot Compensation device.

### Immunity to Electromagnetic Interference

The SGVA test system is designed especially for minimizing the influence of interference fields to ensure correct functioning of the controls and measuring instruments. The measurement signal from the high voltage divider is in the range of 100 V to 1'600 V in order to ensure a high signal to noise ratio.

## THEORY

SGV generators are based on MARX multiplier circuits.

The impulse test system operates under a control system which charges the impulse generator through the charging unit. This is achieved as the stages in the impulse generator are connected in parallel via the charging resistors. Charging time and charging voltage can be selected by the operator.

Once the selected charging voltage has been reached, a trigger pulse initiates firing of the first spark-gap of the impulse generator. The resulting over-voltage triggers the successive stages. As all the spark-gaps fire, the stages which are in series now, multiply the charging voltage to reach the test voltage.

An impulse voltage divider reduces the impulse voltage to a value that the measuring and recording instruments can use.

The major impulse circuit elements such as capacitors and resistors are arranged in an optimum manner to simultaneously satisfy the two major requirements viz. smallest possible internal inductance and operating convenience.

## OPERATING RANGE

The minimum output voltage is 20 kV positive and negative. This is obtained with only one stage operating. The other stages are shorted or connected in parallel. The maximum output voltage is between 85% and 95% of the total charging voltage, depending on the load and the waveform. Details about the load range and output voltages are given in our offers/quotes.

## COMPONENTS OF THE IMPULSE TEST SYSTEM

The test system comprises the following main components:

- Impulse Generator stack
- Charging Rectifier
- Impulse Voltage Divider
- Control System
- Measuring System

## ACCESSORIES

- Air cushion systems
- Top electrodes
- Shunts
- Termination resistors
- Chopping Gaps
- Additional circuits for transformer testing
- Additional circuits for Impulse Current generation
- Internal series overshoot circuit
- Matching and isolating transformers
- Weather proof enclosures

## IMPULSE GENERATOR STACK

### Support frame

Epoxy resin tubes glued to a welded steel frame carries sets of two impulse capacitors in a V-shaped configuration as well as the resistor holders. Fibreglass guy wires increase stability in generators with more than 22 stages. The design is so good that even our 30 stage generators have withstood earthquakes several times over.

### Operating platforms

At every third stage a folding platform is mounted. All operations like resistor change, parallel connection of stages, implementation of Glaninger circuit or Overshoot Compensation can be performed from this platform (not only from the internal ladder).



Internal view of ladder and platform

### Internal ladder

An internal ladder in the stack made of insulating material makes it possible to reach the operating platforms.

### Impulse capacitors

Each impulse capacitor consists of flat elements built into a steel housing and impregnated with castor oil. The housing walls are flexible so that the impregnating oil can expand. Two 100 kV impulse capacitors are positioned in a V-arrangement in each stage. Castor oil insulation offers optimal ecological safety (no PCB's).

### Resistors

They are the wave shaping elements and wire-wound for high stability and linearity and are epoxy cast for high impulse loads. Each resistor value has a specific colour for easy identification. These resistors have a plug-in connection for quick and easy reconfiguration. The basic system includes a set of resistors for lightning and switching impulse voltages according to IEC 60060-1.

All resistors are distributed among the stages within the generator in easily accessed compartments.

The resistors are completely internal to the generator and ensure very low inductance. Multiple series- and parallel connections enable the combination of resistors for additional values.

**Encapsulated spark gaps**

The spark gaps of the generator type SGV consists of copper spheres with 250 mm diameter. Tungsten sintered metal inserts reduce burn-off. Fiber glass chimney protects the spark gaps from dust. Precision translatory gears are used to adjust gap distance. The gap drive motor is automatically controlled from the control unit.

**Top electrodes**

The use of top electrodes makes it possible to raise preliminary discharge voltage to very high values. Several models of top electrodes, made of aluminium toroids or made of discs (Polycon design) are available

**CHARGING RECTIFIER LGR 200**

The charging rectifier type LGR 200 is used to charge the impulse capacitors with stage voltages up to 200 kV and is located on the base frame

- Compact & rugged design.
- Short circuit protected.
- Automatic motor-driven polarity reversal.
- Powerful - 60mA or 200 mA



**DAMPED CAPACITIVE VOLTAGE DIVIDERS**

Multiple options exist. Please refer catalogues of

- CR
- CS
- CZ

CR 4800-300



**CONTROLS**

Two systems differing in sophistication and technical specification are available. Please refer to individual Control System's catalogues

- ❖ Competitive and well established GC 223
  - Standalone desk top unit
  - EMC shielded and proof tested
- ❖ Fully computerised GC 257, operating under Windows.
  - Sophisticated sequence programs
  - User-friendly software equipped with a flat screen colour monitor

**Safety and Protection Functions**

The control unit has a connection for a safety circuit and is equipped with a connection for warning lights.

**IMPULSE ANALYSING SYSTEMS**

- ❖ **HiAS® 744**
  - A multi-channel capable precision digital impulse analyzing system of the highest performance class.
  - 11 / 16 bit real vertical resolution at 250 MS/s
  - Automatic evaluation of all common impulse shapes and their parameters
  - Fiber Optic Communication to control room with galvanic separation

Please refer individual catalogue of HiAS 744



**OPTIONS**

**Shunts**

Haefely shunts can be used for the measurement of impulse currents. They consist of a metal cylinder with coupling flanges and coaxial measuring connector. Different models are available depending on the application

**Chopping Gaps**

❖ **KFS Series**

- Simple Straightforward Sphere Gaps useful for measurement, calibration as well as chopping.
- Available in Vertical-Motorized and Horizontal-Manual versions
- Voltage rating ranges from 150kV to 750 kV



❖ **MAFS Series**

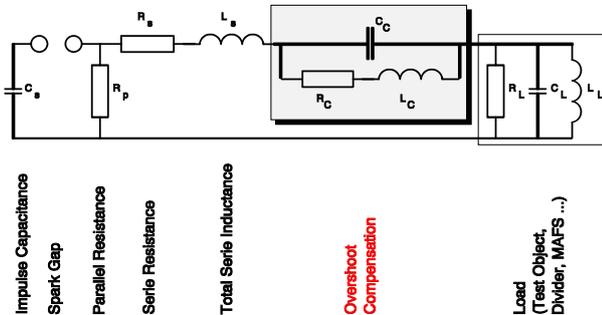
- Original and Patented by Haefely
- Used for front and tail chopping
- Voltage rating ranges from 600 kV to 3600 kV

Please refer individual catalogues for more details.

**Overshoot Compensation**

An overshoot compensation circuit can be used to test very high capacitive loads according to the standard impulse shapes and is designed as an add-on circuit which can be integrated in each stage of the impulse voltage generator type V.

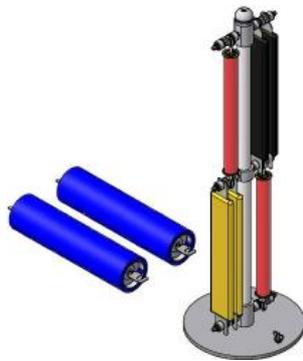
*Impulse Voltage Generator with HAEFELY patented overshoot compensation (equivalent single stage circuit)*



**Glaninger Circuit.**

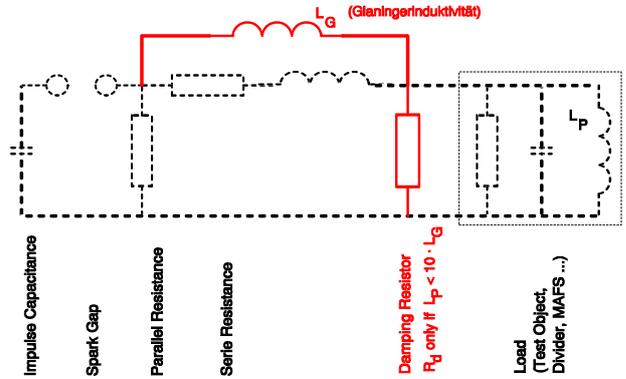
For testing low voltage windings of transformers, an additional circuit is available as an option. This external circuit permits the testing of very low inductive loads.

The Glaninger circuit presupposes the existence of the tail resistor set SGV RP.



This circuit is built into the first (respectively ground) and/or second stage of the generator. The stages are connected in parallel (1s2p) or parallel/series (2s2p).

*Glaninger Circuit*



**Impulse Current generation**

Only additional resistors and wave shaping inductances are necessary for generating impulse currents with an impulse voltage generator. Exponential impulse currents acc. IEC 60099-4 can be generated on test objects having very high residual voltages.



Impulse current testing arrangement for MV arresters

**Protective cylinder for outdoor operation**

For outdoor operation, the standard indoor generator is enclosed in an air-conditioned weather-resistant tower.

Modifications to generator aren't necessary. Internal lighting and fire protection system are provided. Our design is also resistant to natural lightnings.



## TECHNICAL SERVICES

A high level of customer service is essential in view of the complexity of high voltage test systems and the high reliability demanded by the customer.

The full warranty of the impulse voltage test system is conditional on the performance of the following Haefely services:

- Expert installation and on-site testing of the system
- Training of the operating personnel
- Maintenance of the test system throughout its service life, but for a period of at least 10 years (other than computers)
- Availability of spare parts

## TRAINING OF OPERATING PERSONNEL

After acceptance testing, the client's personnel assigned to operate the impulse voltage test system will be trained. Installation and operator training is conducted by our customer-service personnel and will be adapted to suit the particular test facility and test specimen. This is an important contribution to reliable operation of the test system.

## 10 YEARS MAINTENANCE GUARANTEE

Because of the high degree of vertical integration with respect to high-voltage components and electronic equipment, Haefely is virtually independent of the product policies of suppliers. A large stock of replacement parts is held for maintenance purposes. This makes it possible for Haefely to ensure the maintenance for 10 years (other than computers)

## OTHER SERVICE OPTIONS

### ON-SITE CALIBRATION SERVICE

Simple and unified calibration methods which apply to complete measuring systems give high-voltage test equipment manufacturers, users and customers the assurance of comparable quality requirements and tests involving such equipment.

Haefely Test performs following services on-site or in our works:

- Calibration of divider
- Calibration of measuring device
- Calibration of entire system

### MAINTENANCE AGREEMENT

Haefely Test offers a maintenance agreement tailored to the customer's special needs. In this way, the value of the test system can be preserved over a long period of time.

Further services are offered for support in integration tasks or during operation

## OFFICES:

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HAEFELY HIPOTRONICS has a policy of continuous product improvement. Therefore we reserve the right to change design and specification without notice.