Product brochure

Gas-insulated Switchgear Type ELK-14
The modular system for GIS, 300 kV
ABB switchgear systems offer maximum flexibility
Than we draw on experience to meet the needs of tomorrow

ABB’s SF6 gas-insulated switchgear technology has been proving its worth, day in and day out, for years. In applications all over the world. It owes its leading international position to a string of significant advantages: system security, reliable performance, economical use and an extremely long service life, even under the toughest conditions.

Apart from its many classical qualities, the ELK-14 series boasts several very advanced features. With compact architecture and fewer components, for example, it requires far less space than previous systems. Its use simplifies operations and cuts costs from the moment you start using it. And goes on doing so. ABB’s GIS systems are designed for future upgrading because both main circuits and control & protection are totally modular. Which means you can expand and adapt them when you need to. Simply and efficiently. We call it systematized flexibility.

Ideally suited for voltages up to 300 kV, the modular ELK-14 system combines innovation with tried-and-tested qualities: the features that have given ABB GIS systems their international reputation.

**Safety**
The combined disconnector/earthing switch guarantees maximum operational safety.

**Reliability**
All live parts are enclosed and effectively protect the insulation system against negative external influences. The amount of moving parts and number of drives are reduced to a minimum.

**Availability**
A sophisticated partitioning divides the system into separate, gas-tight gas compartments, which will limit the impact on other modules to a minimum and therefore ensures a 100% service continuity during maintenance and repair work. World-wide service organization, together with a mature spare parts concept, assures shortest downtime for maintenance and repair.

**Long-life cycle periods**
Top-quality materials and workmanship guarantee maximum life with a minimum of service and maintenance.

**Compactness**
The ELK-14 modular system is so well designed that it requires much less space, which shows especially in cities and metropolitan areas its advantages.

**Flexibility**
The system’s modular architecture permits individual solutions that can be adapted to changing needs at any time.

**Economy**
Use of aluminium enclosures reduces the weight of the system, cutting the cost of foundations, load-bearing components and reduction of variants.

**Efficiency**
Prefabrication of subassemblies and stringent quality control at our own factory simplify final installation and commissioning.

**Environmentally friendly**
Significant reduction in number of flanges and seals, as well as a small compact design lead to a low environmental impact.
World-wide success
GIS ELK-14

<table>
<thead>
<tr>
<th>Country</th>
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In the early stage of gas-insulated switchgear (GIS) in this voltage level, ABB introduced one of the world’s first 245 kV GIS ELK-1 in 1969. The low centre of gravity using a horizontal single-break puffer circuit-breaker, optimal characteristics in seismic areas could be achieved. Meanwhile the circuit-breaker with one to four interrupting chambers is implemented in different applications up to 1100 kV and 80 kA. Over the years, ABB was continuously faced with changing market demands and further steps in technology. Together with continuous requests in more compact products due to increasing costs for land in megacities.

Thus, ABB introduced a successor product for ELK-1 called ELK-14 in 1993, applying latest perceptions in GIS technology and service experiences, together with adaptations of the product to the increasing demands of latest IEC standards, the most compact GIS with horizontal arrangement of the circuit-breaker could be created for voltage range up to 300 kV and short-circuit ratings up to 63 kA. Changing standards and further market development towards higher competitiveness result in a standardisation process to minimize complex installation variants. Any different switching variants can be simply and transparently realised from tried and tested standard modules.

During the latest improvements of ABB’s ELK-14, a great deal of emphasis was placed on excellent accessibility of all items of equipment requiring operator attention in spite of the compact design and space-saving arrangement. The installation can therefore be readily accommodated in smaller buildings.

A Product Certificate for the entire product ELK-14 signed by independent authority assures: Conformity of all type-tests with standards, conformity with the design and construction, conformity of routine testing and conformity of all internal manufacturing processes according the certified quality management system.
ELK-14 switchgear in 1½-breaker arrangement
The ELK-14 switchgear system from ABB
Clear-cut advantages and outstanding qualities

From ABB’s decades of experience a highly standardized modular system was developed, which is characterized by the fact that a wide variety of technical requirements can be met with a small number of modules.

Greater performance with fewer components, this counts for both, the primary equipment and control & protection. That makes ABB’s ELK-14 so revolutionary: Since it requires less space, it drastically cuts your construction costs and saves your operating costs at the same time.

Maximum system security with a minimum of maintenance. Another quality feature of the environment-friendly ELK-14 system. And because it is modular, it can be extended or adapted at any time to meet your present and future requirements.

High-performance circuit-breakers
Enhanced performance and lower maintenance – that is the simple principle behind ABB’s high-voltage circuit-breakers. Designed for maximum efficiency with quality in mind.

Save disconnectors and earthing switches
Even the disconnectors and earthing switches prove ABB’s pioneering technology in terms of construction and design as well as system safety.

Reliable current and voltage transformers
The current and voltage transformers are as efficient as they are economical, and leave nothing to be desired in terms of service life. This is also true for the latest generation of NCITs (non-conventional instrument transformers).

Versatile connecting elements
A collection of terminals and connecting elements in various shapes and sizes enables the substations to be adapted to virtually any customers requirement.

Innovative control & protection technology
ABB’s forward-looking control & protection technology is fully integrated and completely open, which makes it more adaptable and simplifies operation.

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<table>
<thead>
<tr>
<th>Modules</th>
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<tbody>
<tr>
<td>Circuit-breakers</td>
</tr>
<tr>
<td>Disconnectors and earthing switches</td>
</tr>
<tr>
<td>Voltage and current transformers</td>
</tr>
<tr>
<td>Connecting elements</td>
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<tr>
<td>Control &amp; protection</td>
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</tbody>
</table>
1 Circuit-breaker | 2 Disconnectors/earthing switches | 3 Voltage transformer and fast-acting earthing switch | 4 Connecting elements | 5 Control & protection
ABB high-voltage circuit-breaker
For solid, improved performance and less maintenance

The circuit-breaker
Over the years, the circuit-breaker, using SF₆-gas for insulation and arc-quenching purposes, has been continuously developed and improved. Extensive operating experiences as well as continuous research and development activities are the basis when anticipating future market requirements.

Features
- Reliable making and breaking capacity for heavy load and short-circuit currents
- Easy access to active parts for inspection and overhaul
- Low noise level
- Separate contact system for continuous current and current interruption
- High dielectric withstand in open and closed position
- Single-phase auto-reclosing
- Compact spring operating mechanism
- Continuous self-supervision of energy transmission system
- Type tested according latest IEC and ANSI standards
- Maintenance-free design

Breaker Design
Each circuit-breaker in the ELK-14 GIS comprises three single-phase metal-enclosed breaker poles. Each pole consists of the operating mechanism, the interrupter column with one interrupting chamber and the enclosure with the basic support structure. In case of an overhaul, the interrupter column can easily be removed from the enclosure.

The circuit-breaker is a single-pressure type and works on the latest arc-quenching technology. During an interruption, a compression piston in the chamber generates the SF₆-gas pressure required to extinguish the arc between the contacts.
Circuit-breaker operating mechanism

Each pole of the circuit-breaker is equipped with a spring operating mechanism. The mechanism combines the non-wearing properties of a hydraulic system with the robustness of mechanical spring operating mechanisms. Spring operating mechanisms are used for ABB’s entire GIS portfolio, from 72.5 kV to 1’100 kV and for various other applications in AIS, PASS and DTB. ABB has supplied more than 65,000 spring operating mechanisms of this type.

The components of the operating mechanism
- Charging system
- Energy storage with disk spring stack
- Three independent actuator pistons and control valves
- Auxiliary switches and position indicators

A hydraulic energy control system is integrated within a compact, sealed block that does not require any external piping. All components are easily accessible for maintenance and repair.

Charging
A pump moves oil from the low-pressure oil reservoir to the high-pressure side of the energy storage piston and compresses the disk spring stack. A micro switch stops the pump when the disk spring stack is fully charged.

Close operation
A magnetically operated change-over valve initiates the close operation and connects the high pressure side of the energy-storage piston to the actuator piston. Both sides of the actuator piston are connected to the high-pressure reservoir. Due to the different areas of both surfaces of the actuator piston, the circuit-breaker closes and is retained in a closed position.

Open operation
The trip coil operates the change over valve and connects the actuator piston to the low pressure reservoir. The circuit-breaker opens and is retained in an open position by the pressure difference.
Disconnectors and earthing switches
Safe and reliable due to proven and tested technology

The disconnector/earthing switch
The disconnector/earthing switch combines two functions – a disconnector and a maintenance earthing switch – in one common enclosure, sharing one common operating mechanism.

The disconnector/earthing switch is based on a modular design. It has identical active parts for all variants and incorporates an insulating gap for the disconnector and one for the earthing switch. Variable arrangement of the active parts allows up to eight different configurations. This ensures the highest degree of flexibility with the lowest number of different parts.

The operating mechanism is of modular design. The modular design enables rapid replacement of complete modules, thus ensuring greater service friendliness and excellent access for maintenance and repair.

Features
- Reliable SF₆-gas insulation across the isolation distance
- Reliable switching capacity for small capacitive currents and bus-transfer currents
- High capacity for carrying rated and short-circuit currents
- Space-saving combination of disconnector and earthing switch
- Mechanical interlocking between disconnector and earthing switch
- Insulated earth connection allows measurements without opening gas compartment
- Manual operation by hand crank possible
- Reliable 3-pole operating mechanism
- One drive only for both functions
- Location of drive unit outside SF₆-gas compartment
- Separated mechanically coupled position indicator for each function
- Viewing port for checking position and condition of contacts
- Fully type-tested for conformity to latest IEC and ANSI standards

The fast-acting earthing switch
The fast-acting earthing switch is used to earth insulated sections of the installation to protect personnel during overhaul and assembly work. But it is also employed for earthing capacitance (cables, transmission lines, etc.). The earthing switch can be mounted at any position by using a linear connection element, thus ensuring the greatest flexibility in switchgear layout.

The controlled “Open”-operation results from a slow linear contact motion directly driven by an electric motor, which is located in one of the outer phases and connects the other phases by rotating shafts. This enables optimal switching movement during contact opening.

The fast “Close”-operation is spring-actuated. After a closing command, the electric motor and the rotating shafts will compress the spring of a phase. After reaching the required state of charge, they are automatically released until the next closing command is activated.

Features
- Reliable earthing of main circuit
- High short-circuit current carrying capacity in closed position
- High short-circuit current making capability
- Insulated operating mechanism
- Capable of switching induced capacitive and inductive currents
- Fast linear contact motion by spring-loaded drive for “Close”-operation
- Manual operation by hand crank possible
- Location of drive unit outside the SF₆-gas
- Position indicator mechanically coupled to the moving contact
- Viewing ports for checking position and condition of contacts
- Safety elements such as padlocks can be provided
- Fully type-tested for conformity to latest IEC and ANSI standards
Voltage and current transformers
Maximum safety, practicality and high reliability

The voltage transformer
Used for system protection or revenue metering, ABB’s powerful transformers offer years of trouble-free service. Even for heavy-duty applications. They are based on the electromagnetic transformer principle, where primary and secondary windings are galvanically separated from one another.
The single-pole inductive voltage transformers are connected to the switchgear with a standardised connecting flange and a partition insulator. The primary winding is wound on top of the core and the secondary windings. The latter are connected to the terminals in the external terminal box through a gas-tight multiple bushing.

Features
- Utilisation of SF$_6$-gas as insulating medium, together with plastic foil in the windings
- High secondary output and accuracy
- Ratio and number of secondary windings according to actual GIS plant requirements
- Effective damping of very fast transients, transmitted to the secondary side
- Rectangular type core of low loss magnetic sheets
- No ferroresonance possible in absence of circuit-breaker grading capacitors
- Horizontal or vertical mounting possible
- Separate gas volume with density monitoring
- Over-pressure relief device provided
- Secondary fuses on request
- Maintenance-free

The current transformer
The ring core current transformers concentrically enclose the primary conductor. The core support is provided by the pressure-proof enclosure, which is insulated from the basic flange to prevent the return current from passing through the cores.

Features
- Simple ring-core type windings integrated in the main current path
- SF$_6$-gas as main insulation according to ABB’s well-proved-GIS technique
- Secondary windings on ring-cores, located outside of the SF$_6$-gas compartment and mechanically protected
- Efficient damping of the very fast transients transmitted to the secondary side
- Any accuracy class defined by international standards is possible
- Maintenance-free

The non-conventional instrument transformer (NCIT)
NCITs replace the conventional voltage and current transformers. The NCIT uses two redundant Rogowski Coils to measure the current value. The primary voltage is measured by a capacitive voltage divider composed of two cylindrical electrodes, the conductor and the enclosure. The measured values are digitally processed by the “Secondary Converters” and sent to the “Merging Unit”. From there the data is routed through a standardized, optical connection to the protection, measurement and control devices.

Features
- High bandwidth, high accuracy and linearity, high reliability
- SF$_6$ insulated unit with excellent long term stability and long service life
- No saturation or ferroresonance effects
- Standardised digital interfaces according to IEC 61850-9-2
- Configurable voltage and current ratings (for protection, control and measurement applications and energy metering)
- Integrated self supervision
- Maintenance-free
The connecting elements
Switching systems need to be as varied as the purposes for which they are intended. That is why ABB supplies connecting elements in all shapes and sizes: cross-shaped and T-elements, as well as simple straight sections, are the links that join up individual GIS components.

Compensators of various types allow for heat expansion, vibrations during operation and tolerances in the lengths of specific components. Moreover, lateral dismantling units guarantee hassle-free assembly and dismantling.

The terminal connections
ABB’s GIS range includes the connecting elements for peripherals such as the \( \text{SF}_6 \)-air bushings, the enclosures for the cable terminations and the enclosures for the transformer terminals.

The transformer termination
The transformer connection enables transformers to be connected directly to the switchgear using bellows.

Features
- Effective compensation of vibrations
- Connection between the \( \text{SF}_6 \) switchgear and the transformer
- Isolation of the \( \text{SF}_6 \) switchgear from the transformer for testing possible
- Interface according IEC 61639
- Maintenance-free
The cable termination
Cable connections, which are part of the cable manufacturer’s scope of supply, consist typically of an epoxy resin barrier insulator and can be either of dry type or of fluid-filled type.

Features
- Interface according IEC 62271-209
- The GIS and the high-voltage cable can be galvanically separated and the high-voltage tests can be carried out independently
- Removable link easily accessible
- Flange available to attach a test bushing
- Easy mounting of the cable at any rotation angle
- Maintenance-free

The SF₆-air bushing
The SF₆-air bushings are available in two different versions: with classical porcelain insulators or in the standard version, with fibre-reinforced resin insulators with silicon sheds.

Features
- High creepage current resistivity
- Self-cleaning silicon sheds
- Single pressure SF₆-gas insulation
- Explosion and vandal-proof
- Resistivity against sandstorms
- All fitting positions possible
- Low weight
- Maintenance-free
ABB’s proven local control concept
Operational benefits based on experience and innovation

The local control cubicle

The local control cubicle (LCC) includes all required functions for control and supervision of a GIS bay and provides safe access to the secondary circuits. The portfolio of local control solutions contains a modern and a conventional control concept.

The modern concept is based on ABB’s intelligent bay control unit REC670 for remote and local control. Optionally a bay control mimic can be provided for emergency control of the complete bay. The modern solution is rich in functionality and can simply be integrated in a substation automation system according to IEC 61850.

The conventional local control solution is based on contactor logic in combination with a bay control mimic for local control. A hardwired parallel interface provides the data for the remote control system.

The local control cubicle can be installed in space optimizing manner integrated to the GIS, right in front of each feeder. Also detached installation is possible, usually opposite the circuit-breaker drives.

A wide range of functionality assures safe and reliable operation of the substation:

Basic functions
- Save local control of all motorized equipment
- Operation mode selectable by key switch (local/remote/emergency/off as well as normal operation or interlock bypass)
- Interface for remote control and protection, either hardwired or optionally through IEC 61850 station bus
- Feeder and station interlocking, depending on the position of all high-voltage apparatus as well as the various blocking conditions
- Command inhibition (eg, crank-handle insertion)
- Circuit-breaker supervision, including gas density, position indication, operation counters, pole discrepancy and monitoring of the operating mechanism
- Gas density supervision of the entire switchgear
- Measurement visualization and alarm indication

Function possibilities of modern local control cubicles

While all basic control functions including synchrocheck are usually integrated in the modern control solution. A wide range of additional functions can be configured if requested:
- Remote communication to station automation system, eg, through IEC 61850
- Horizontal communication between control and/or protection IEDs; applying IEC 61850 GOOSE messages
- Auto-reclosure as well as back-up or main protection functions can be integrated in the IED
- Optional integration of dedicated protection or monitoring devices inside the LCC
Local control cubicles
Innovative, intelligent and flexible, creative, economical and ecologically safe: these are the outstanding features of the successful ELK-14. As it is well thought-out as it is mature, it can be used for virtually any application.

All ABB GIS comply with or exceed the latest international standards (IEC/ANSI) and have been type tested in independent laboratories. Our certified design and manufacturing processes guarantees the highest quality of our products.

Site testing according to IEC/ANSI standards and ABB quality assurance procedures include leakage checks on flanges, instrument transformer tests, control and monitoring functions, resistance measurements and a high-voltage test. Site installation can be carried out by ABB, but also by personnel from your own company under the guidance of a certified ABB supervisor. ABB University offers training courses for every aspect of GIS installation, operation and maintenance.

ABB’s metal-enclosed gas-insulated switchgear requires minimal maintenance in service. In normal operational conditions, more than 25 years fault-free operation is assured with periodic visual checks, after which time a first full inspection is recommended. ABB Service provides competent 24/7 worldwide support in case of failures.
Section of a 1½-breaker arrangement
Main technical data
GIS ELK-14

GIS ELK-14 double busbar bay

- Circuit-breakers
- Disconnector and earthing switches
- Voltage and current transformers
- Connecting elements
- Control & protection
### Main data

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<tr>
<th>Specification</th>
<th>Value</th>
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<tr>
<td>Power-frequency withstand voltage, 1 min. (kV)</td>
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<tr>
<td>Power-frequency withstand voltage, 1 min. across open contacts (kV)</td>
<td>530</td>
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<tr>
<td>Lightning impulse withstand voltage (kV)</td>
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<td>Lightning impulse withstand voltage across open contacts (kV)</td>
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<td>Switching impulse withstand voltage (kV)</td>
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<td>Switching impulse withstand voltage across open contacts (kV)</td>
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<td>Rated frequency (Hz)</td>
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<td>Rated continuous current (A)</td>
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<td>Rated short-time withstand current (kA)</td>
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<td>Rated withstand impulse current (kA)</td>
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### Circuit-breaker

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<td>Rated making current, peak value (kA)</td>
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<td>Rated breaking time (ms)</td>
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<td>Rated closing time (ms)</td>
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<td>Reclosing time (ms)</td>
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<td>Rated operating sequence</td>
<td>O - 0.3s - CO - 1min or CO - 15s - CO</td>
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<td>High-speed auto-reclosing</td>
<td>single- and three-phase</td>
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### Disconnecter & earthing switch

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<td>Capacitive current switching capability (mA)</td>
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<td>Bus transfer current switching capability (A/V)</td>
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<td>Opening/closing time (s)</td>
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### Fast-acting earthing switch

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<td>- Current (A)</td>
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<tr>
<td>Capacitive currents (kV)</td>
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<td>- Current (A)</td>
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<td>Motor running time (s)</td>
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### Voltage transformer

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<td>Rated output power (VA)</td>
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<td>Rated voltage factor</td>
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### Current transformer

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<td>Cores for metering</td>
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<tr>
<td>Cores for protection (transient performance optional)</td>
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### SF₆-air bushing

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<tbody>
<tr>
<td>Continuous bending load (N)</td>
<td>2500</td>
</tr>
<tr>
<td>Test bending load (N)</td>
<td>5000</td>
</tr>
<tr>
<td>Creepage distance (mm/kV)</td>
<td>20, 25, 31</td>
</tr>
</tbody>
</table>
ABB’s ELK solutions offer
Improved performance, more practically - at a fraction of cost

Switching systems require an exceptionally high degree of safety

Indoor switching systems are designed to minimize space to claim

Protected installations especially when exposed to particular dirty, polluted or corrosive environments (e.g. coastline locations, deserts or industrial zones)

Extension of conventional outdoor substations with limited space
In underground switching systems for hydro-electric and pump-storage power stations

Upgrading the voltage level of existing conventional substations without the need for more space

Hybrid solutions combining dead tank and live tank components to reduce dimensions