

Electrification

LIVE TANK CIRCUIT BREAKERS FOR CONTROLLED SWITCHING

Digital-Native Circuit Breakers Available with SF₆ or SF₆-free Gas

Redefining Digital for High Voltage Primary Equipment

Integrating digital intelligence on primary equipment as close as possible to where signals originate, our Digital-Native High Voltage equipment portfolio is built with quality, precision, performance and reliability in mind. Our expertise in Digital Solutions for Power Transmission embedded in our latest hardware, software and security technologies is built to address the most demanding applications, from reactor and power transformer switching to the latest generation of digital substations. With each individual digital-native product being factory-tested as a complete integrated system, we are eliminating on-site troubleshooting operations and reducing commissioning time, delivering an asset ready to connect and operate from day one.

Our Best Solution for Controlled Switching

Our solution comprises:

- Our live tank circuit breakers with individual pole operation, a must-have for controlled switching performance. This ensures that each pole can be individually-controlled by CSD100 to reach optimal point-on-wave phase-by-phase.
- A Low-scattering mechanical drive combined with ultra-precise and long-term reliable light barrier sensor embedded in the mechanical drive, ensuring repeatability of controlled switching operations along the lifetime of the equipment.
- A digital circuit breaker low voltage control cubicle integrating our CSD100 controlled switching and monitoring solution, coupled with fast connectors between drives and cubicle that enable fast site-connection and capitalization of all factory troubleshooting and testing operations.
- Digital gas sensors installed on circuit breaker poles, and temperature sensor to measure ambient temperature, providing monitoring and operations timing compensation information to CSD100.
- Factory dry tests of the complete assembly for controlled and non-controlled operations, ensuring that site commissioning operations are limited to live tests, leaving troubleshooting and parametrization of CSD100 to factory.

The solution is fully standardized, ensuring no time is wasted during sourcing and engineering phases. It is available on our complete live tank circuit breaker range already compatible with controlled switching.



Advantages

- Faster commissioning
- Reduced supply chain complexity
- Improved delivery time
- Connection errors prevention
- Reduced erection and commissioning costs
- Simplified integration into the protection and control scheme through IEC 61850
- Improved flexibility

CSD100 Controlled Switching

Point-on-wave applications

- Shunt-reactors
- Capacitor banks and AC filters
- Power transformers
- Overhead lines including auto-reclose, compensated transmission cables

Circuit Breaker Monitoring

- Voltage dip, peak current, reignitions
- Gas monitoring incl. leak rate computation,
- Operations timing for all operations incl. travel curve
- Electric wear (I²t)

Data acquisition

- 40 kHz resolution, extensive storage capabilities (10,000+ records)

Advanced Communications

- PRP, HSR
- IEC 61850 MMS server Ed 2.1, PTP

Cybersecurity

- IEC 62443-4-2 certified
- Authentication, RBAC
- Security events logging, Syslog
- Network segregation, VLAN
- Host hardening, Software integrity



GE VERNOVA

Our Digital-Native Live Tank Solution

Improving AIS controlled switching

We designed our live tank circuit breakers for reactor, capacitor banks and power transformer switching to push the limits of the conventional approach of AIS controlled switching.

Compared to a conventional architecture in which CSD100 would be in the protection and control room of the substation, our digital-native approach enables significant improvements in terms of performance and commissioning.

When controlled switching is brought close to primary equipment, where signals are generated, our users can expect even more from their GE Vernova circuit breakers.

In terms of **performance**, first: by connecting to a robust and reliable light-barrier sensor, CSD100 can rely on a steady signal to determine the mechanical performance of the equipment, hence planning the next controlled switching operation with precision and a deeper knowledge of the circuit breaker it is connected to. Coupled with low-scattering drives, we provide one of the best products for controlled switching operations to our customers.

In terms of **site commissioning**: Extensive factory testing enables us to perform so called “dry tests” in our workshops located worldwide, providing a fully tested equipment. We trouble-shoot low voltage wiring, configure our control switching device, test the circuit breaker with and without CSD100 in the loop, for controlled and uncontrolled operations, and adjust our parameters to ensure that site activity is as limited as possible.



Factory testing of digital native live tank circuit breaker, 3 poles connected to the Low voltage cubicle directly configured and operated with CSD100.

Outcomes

Live tank circuit breakers for reactor, capacitor bank and power transformer switching bring



Simplified supply chain with streamlined procurement and more efficient logistics.



Improved engineering by speeding up design cycles.



Faster, more secure commissioning to connect and operate as efficiently as possible.



Operations repeatability and reliability, including monitoring data to enable predictive maintenance.

Digital Native Components

1

Digital-Native Mechanical Drive

Our Digital-Native mechanical drive is designed to enhance the performance of our controlled switching operations.

Ensuring low-scattering mechanical operations and benefitting from light-barrier sensing technology, it ensures that controlled switching operations are repeatable.

2

Low Voltage Control Cubicle

Our digital-native low voltage cubicle is designed to benefit as much as possible from factory-testing, ensuring that no surprises are left for site commissioning.

It therefore integrates CSD100 by design, as well as fast connectors that enable to capitalize from wiring troubleshooting operated during factory dry-tests, leaving site commissioning to a simple reconnection of the cubicle with its mechanical drives

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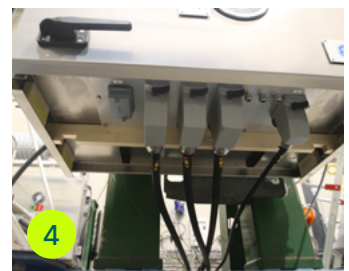
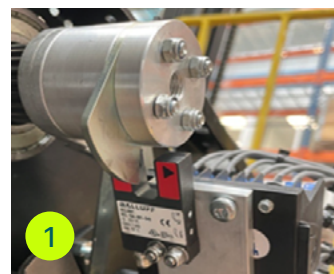
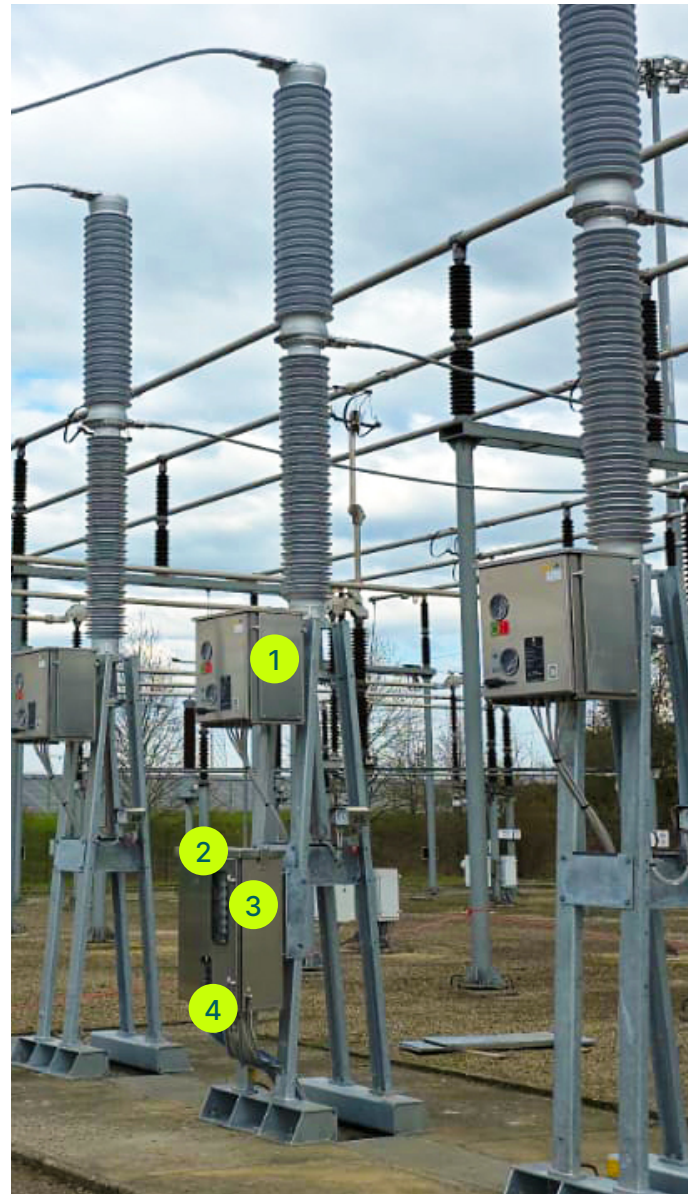
Improved reliability with Light Barrier Sensor

Controlled Switching operations do not only need a low scattering, i.e. a repeatable and predictable mechanical drive to operate with high precision and efficiency: the source of information used to compute the mechanical timing of the spring mechanism is of equal importance. Wear of conventional auxiliary contacts after years of operation can impact controlled switching targets, causing the need for another sensing technology dedicated to controlled switching performance. We chose light barrier technology capable to provide reliable and close to no-deviation feedback on the mechanical operation of the spring mechanism. When specific components of the spring mechanism cross the light barrier, the information is sent to CSD100, which computes the mechanical performance of the drive to ensure the next controlled switching target will be adjusted accordingly.

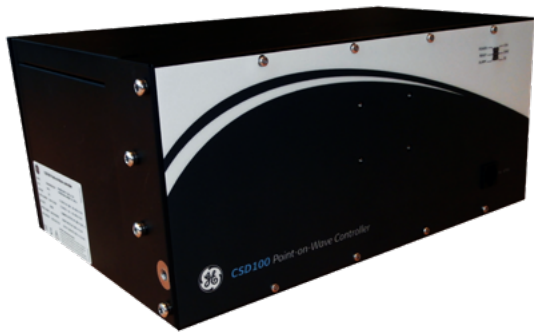
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CSD100 Controlled Switching and Circuit Breaker Monitoring Device

CSD100 is a very compact form-factor rack, available off-the-shelf, as an all-in-one box, with a versatile range of fully isolated inputs and outputs. A single hardware version integrating all controlled switching functionalities, monitoring features and communication capabilities is provided.



Zoom on CSD100



Safe Switching for Reactive Power Compensation

To accommodate daily load variations, Capacitor Banks and Shunt Reactors help stabilize and improve the power factor. Acting as reactive power generators, their switching needs to be controlled precisely to mitigate the related electrical transients. This limits damageable stress on the circuit breaker and the compensation load.

Silent Connection of Transformers to the Grid

Connecting and disconnecting intermittent power sources such as wind or solar farms, pumped storage, gas power plants or even interconnection transformers from the grid may generate switching transients.

These transients can cause electrical stresses on critical substation equipment, and can introduce power quality issues, such as high inrush currents and voltage dips in the system.

With active recording of voltage signals and other key electrical parameters during switching events, CSD100 automatically calculates residual magnetic flux in the transformer's core and automatically adjusts control operations. Matching source flux to transformer's residual flux (low-flux grading), minimizes inrush currents and voltage dips, and thereby improves power quality and extends transformer life.

Seamless Switching of Overhead Lines

Power generation sources are often located far from main consumption areas. As a result, large amounts of energy need to be transmitted over long distances. Random switching of no-load lines generates a traveling voltage wave which, when reflected from the open end of the line causes an over-voltage along the length of the line.

In auto-reclose situation, overvoltage is even larger because of the increased probability that a line has retained a trapped charge with opposite polarity.

CSD100 is the preferred solution to limit overvoltage during closing and auto-reclosing of line circuit-breakers. In auto-reclose situation, its capability to identify in real-time best close targets (three phases or single-phase auto-reclose) is unique. It can also be configured to eliminate current zero missing phenomena when energizing highly compensated lines and transmission cables.

The conventional approach of adding closing resistors to the circuit breaker, can be effectively replaced by the CSD100.

Automatic Reconfiguration

In many substation architectures, a single circuit breaker can switch different loads (e.g., one breaker-and-a-half scheme, ring scheme).

CSD100 provides multiple loads switching feature, allowing to use one single controller per circuit breaker whatever the substation architecture (layout with tie-circuit breaker) and whatever the operating mode.

The switching configuration is automatically selected from the positions of the substation switchgear (circuit breakers, disconnecting switches...).

Circuit Breaker Monitoring

With extensive data acquisition and storage capabilities, CSD100 allows for extensive monitoring and improved switching to protect equipment. Together with its digital communication abilities, CSD100 can be placed at the center of an Asset Performance Management (APM) strategy. High resolution records created upon each circuit breaker operation are available for the entire service life of the primary equipment, for controlled and uncontrolled operations.

Product Ratings

DESCRIPTION	VALUE
Dimensions	19" rack or local cubicle mounting Height: 3U, Depth: 250 mm
Weight	5.8 kg (12.8 lbs)
Operation temperature	-40 °C to +70 °C
Enclosure class	IP5x
Product safety	IEC 61010-1; IEC 60255-27
EMC compliance	IEC 61000-6-5; IEC 60255-26; EN 55032
Eco-design compliance	RoHS directive and REACH regulation
Power consumption	< 30 W
Switching time accuracy	< 10 µs
Transient data acquisition	10,000+ records, 40 kHz sampling rate
Universal Input/Output range	Voltage inputs up to 250 VAC Current inputs up to 20 A Binary inputs from 48 VDC to 250 VDC Control voltage up to 250 VDC

For more information, visit
gevernova.com/electrification