

Voltage Protection and Control REU615 Standard Configuration B

Numerical voltage control in medium voltage networks

The relay is intended for automatic voltage regulation of power transformers with a motor-driven on-load tap-changer.

Mechanical and construction details

- The relay shall have compact dimensions not exceeding 4U in height. The depth of the relay shall, without any additional raising frame, not exceed 160 mm when flush mounted so as not to foul with other equipment mounted inside the cabinet. The weight of the relay must not exceed 5 kgs to permit use of optimized sheet metal thickness in construction of panels.
- The relay shall support flush, semi-flush, rack and wall mounting options.
- As flush mounted, the relay shall meet the IP54 ingress protection requirements on the front side and IP20 on the rear side and connection terminals.
- To facilitate quick unit replacement, the relay design shall be of draw-out. It shall be possible to quickly replace a faulty unit with a spare without disturbing the majority of the wiring. The mean time to repair (MTTR) shall be less than 30 minutes.
- To prevent unauthorized detachment of the relay plug-in unit, the relay shall be provided with an integrated seal.
- The relay shall have a graphical display with at least 7 rows of characters and up to 20 characters per row.

Protection and control functions

- The relay shall include manual and automatic voltage regulation (90V) of power transformers with a motor-driven on-load tap-changer. The voltage regulator function shall have the following features:
 - Parallel operation of up to four power transformers
 - Parallel operation modes according to master-follower, minimizing circulating current and negative reactance principles
 - Support for necessary data exchange between relays using IEC 61850-8-1 GOOSE messaging when power transformers are running in parallel
 - Line drop compensation for both single power transformers and transformers running in parallel
 - Out-of-step supervision for followers in the master-follower mode
 - Possibility to apply reduced set-point voltage setting in case of a temporary power shortage within the supplying network
 - Both definite time (DT) and inverse definite minimum time (IDMT)- based time delay modes for the tap-changer step-timer. This allows either a fixed time delay or an inverse time delay, based on the difference between the measured and the target voltage level, to be applied for the step-timer.
 - Fast lowering feature that is activated when a specific set voltage value is exceeded due to large load rejection. In this case, the voltage regulator drives the on-load tap-changer to reach the desired LV-side voltage as fast as possible.
 - Blocking of the operation in an overcurrent situation
 - Blocking of the operation in case the measured voltage is too low to be regulated by the tap-changer
 - Supervision of the tap-changer response to the given control command and issuing of an alarm if the performance is not within the set performance limits

- The relay shall have three-stage overvoltage (59) and undervoltage (27) protection with both definite time (DT) and inverse definite minimum time (IDMT) characteristics. The protection functions shall operate based on one, two, or three-phase measurement mode according to application requirements, and the mode shall be individually settable for each protection stage.
- The protection functions (59) and (27) shall measure either the phase-to-phase or phase-to-earth voltages. The selection shall be software-based and individually settable for each stage.
- The reset ratio of the (59) and (27) protection functions shall be adjustable by setting the relative hysteresis parameter value between 1 and 5% individually for each stage. The adjustable reset ratio shall enable the coordination of the protection function resetting and the operation of the on-load tap-changer, ie whether the protection function shall be reset as a result of a tap transition.
- It shall be possible to block the operation of the undervoltage protection when the voltage drops below a set value. The value shall be individually settable for each stage.
- The relay shall have three-stage (low-set, high-set and instantaneous) non-directional overcurrent protection (50/51) with definite time (DT) and inverse definite minimum time (IDMT) characteristics, supporting both IEC and ANSI/IEEE operating curves.
- The relay shall include three-phase thermal overload protection (49T) and shall protect the transformer mainly from short-time overloads. The protection shall be able to utilize either one or two time constants, which shall be selectable.

Inputs and outputs

- The relay shall have 8 binary inputs and 10 binary outputs and all of them freely configurable. Optionally, it shall be possible to extend the amount up to 14 binary inputs and 13 binary outputs.
- To enable direct tripping of the circuit breaker, the relay must have 2 double-pole power output relays with integrated trip-circuit supervision (TCS). The two power output relays shall be rated to make and carry 30 A for 0.5 s with a breaking capacity of ≥ 1 A (L/R < 40 ms).
- The threshold voltage of the relay's binary inputs shall be settable to 16...176 V DC.
- The binary inputs of the relay shall, when energized, utilize a higher inrush current to facilitate the breaking of possible dirt or sulfide from the surface of the activating contact.

- The relay shall have inputs for tap-changer position monitoring and indication. The following three signal options shall be supported:
 - mA-input (0-10 mA, 0-20 mA and 4-20 mA)
 - Resistor chain input (range up to 2000 ohms)
 - Up to 6 bit BCD code via binary inputs
- Optionally, the relay shall include inputs for detecting temperature using resistance temperature detector (RTD) sensors. At least 2 inputs shall be required to measure transformer oil and ambient temperatures. The relay shall support the commonly used sensor types Pt100, Pt250, Ni100, Ni120, Ni250 and Cu10 with 2-wire or 3-wire connection with common ground.
- The phase-current inputs of the relay shall be rated 1/5 A. The selection of 1 A or 5 A shall be software-based.
- The phase-voltage inputs of the relay shall support a rated voltage range from 60 V AC to 210 V AC. The selection shall be software-based.

Measurements, alarms and reporting

- The relay shall have three-phase current and voltage measurement (fundamental or RMS-based as selectable options) with an accuracy of $\pm 0.5\%$ and zero, negative and positive-sequence voltage measurement with an accuracy of $\pm 1\%$ within the range of ± 2 Hz of the nominal frequency.
- To collect sequence-of-events (SoE) information, the relay must include a non-volatile memory with a capacity of storing at least 1024 event codes with associated time stamps.
- The relay must support the storage of at least 128 fault records in the relay's non-volatile memory.
- The fault record values must at least include phase currents, phase voltages, zero, negative and positive-sequence currents and voltages, and the active setting group.
- The relay shall have a disturbance recorder supporting a sampling frequency of 32 samples per cycle and featuring up to 12 analog and 64 binary signal channels.
- The relay's disturbance recorder shall support not less than 6 three-second recordings at 32 samples per cycle for 12 analog channels and 64 binary channels.
- The relays shall support up to 100 disturbance recordings.
- The relay must have a load profile recorder for phase currents and voltages supporting up to 12 selectable load quantities and more than 1 year of recording length. The load profile recorder output shall be in COMTRADE format.

Communication

- The relay must support IEC 61850 Edition 1 and Edition 2.
- The relay must support, besides IEC 61850, simultaneous communication using one of the following communication protocols: Modbus® (RTU-ASCII/TCP), IEC 60870-5-103 or DNP3 (serial/TCP).
- The relay must have an Ethernet port (RJ45) on the front for local parametrization and data retrieval.
- The relay shall support up to five IEC 61850 (MMS) clients simultaneously.
- The relay must have two fiber-optic Ethernet ports with HSR and PRP-1.
- The relay shall have a third Ethernet port for providing connectivity of any other Ethernet device to an IEC 61850 station bus inside a switchgear bay.
- The relay must support IEC 61850 GOOSE messaging and meet the performance requirements for tripping applications (<10 ms) as defined by the IEC 61850 standard.
- The relay shall support subscribing analog values using IEC 61850 GOOSE messaging.
- The relay must support IEEE 1588 v2 for high-accuracy time synchronization (< 4 μs) in Ethernet-based applications. The relay shall also support the SNTP (Simple Network Time Protocol) and IRIG-B (Inter-Range Instrumentation Group - Time Code Format B) time synchronization methods.
- The relay must support IEC 61850-9-2LE with IEEE 1588 v2 for accurate time synchronization

Engineering and configurability

- The relay must have 6 independent settings groups for the relevant protection settings (start value and operate time). It must be possible to change protection setting values from one setting group to another in less than 20 ms from the binary input activation.
- The relay must have a web browser-based human-machine interface (WHMI) with secured communication (TLS) and shall provide the following functions:
 - Programmable LEDs and event lists
 - System supervision
 - Parameter settings
 - Measurement display
 - Disturbance records
 - Phasor diagram
 - Single-line diagram (SLD)
 - Importing and exporting of parameters
- When a protection function is disabled or removed from the configuration, neither the relay nor the configuration tool shall show the function-related settings.
- The relay HMI and configuration tool shall have multilingual support.
- The relay HMI and configuration tool shall support both IEC and ANSI protection function codes.
- The relay shall have at least 11 freely configurable and programmable two-color LEDs.
- The relay must have at least 10 user-configurable local HMI views including measurements and SLDs.
- The relay shall have a graphical configuration tool for the complete relay application including multi-level logic programming support, timers and flip-flops.
- The relay configuration tool must include online visualization of the relay application state.
- It must be possible to keep the relay configuration tool up-to-date using an online update functionality.
- The relay configuration tool shall support viewing of relay events, fault records and visualization of disturbance recordings.
- The relay configuration tool must include the complete relay documentation including operation and technical details.
- The relay configuration tool must include functionality for comparing the archived configuration to the configuration in the relay.
- The relay configuration tool must allow configuration of IEC 61850 vertical and horizontal communication including GOOSE and sampled values.
- The relay configuration tool must support importing and exporting of valid IEC 61850 files (ICD, CID, SCD, IID).
- The relay configuration tool must be compatible with earlier relay versions.

Type tests and other compliance requirements

- The relay shall have an operating temperature range of -25 ... +55 °C and transport/storage temperature range of -40...+85 °C.
- The relay must fulfill the mechanical test requirements according to IEC 60255-21-1, -2 and -3, Class 2 for vibration, shock, bump and seismic compliance.
- The relay's maximum DC auxiliary power consumption shall be less than 20 W (all inputs activated and over the full supply range).
- The relay must have an IEC 61850 Edition 2 certificate from an accredited Level A testing laboratory.
- The relay must fulfill the electromagnetic compatibility (EMC) test requirements according to IEC 60255-26.
- The relay must be tested according to the requirements of the IEC or an equivalent standard.

Additional information

For more information, please contact your local ABB representative or visit our website at:

www.abb.com/substationautomation

www.abb.com/mediumvoltage