Substation Automation Products

Line distance protection REL670/650
Relion® 670 and 650 series

Power and productivity
for a better world™

For maximum reliability of your power system

REL670 and REL650 line distance protection IEDs (Intelligent Electronic Device) offer extensive protection application opportunities for overhead lines and cables, or combinations of overhead lines and cables. They feature full scheme distance protection with selective single-phase and three-phase tripping and autoreclosing with synchronizing and synchrocheck, power swing detection and a wide range of scheme communication logics. The IEDs with five zone distance protection for phase-to-phase and phase-to-earth faults enable you to protect transmission and sub-transmission lines and cables in impedance or solidly earthed networks. The IEDs are also equipped with residual overcurrent protection functions and a wide range of scheme communication logics that enable detection and fault clearance of high resistive earth faults.

REL670 – maximum flexibility and performance

The REL670 IEDs provide versatile protection, monitoring and control functionality with maximum flexibility and performance optimized for transmission and sub-transmission overhead lines and cables. The powerful IED provides distance protection for double circuit, parallel operating and series compensated lines. This, together with flexible and expandable hardware, allows the IED to meet your specific requirements. As a result, you can benefit from applications with multiple algorithms and comprehensive bay control functionality, including synchronizing, synchrocheck, dead line detection and autoreclosing.

Furthermore, REL670 IEDs are able to protect and control several objects, for instance a combination of a line and a shunt reactor with a single IED. As a result, this IED increases both the reliability and profitability of your entire power system.

The REL670 IEDs provide both customized and pre-configured protection solutions. The pre-configured IEDs are equipped with complete functionality adapted for four different configuration alternatives: single pole breaker or multi-breaker arrangements with single or three-phase tripping. If needed, they can be adapted to meet your power system's specific requirements. With the customized REL670 IEDs you have the freedom to completely adapt the functionality according to your needs.

REL650 – ease of use from ready-to-use solutions

REL650 offers optimum 'off-the-shelf', ready-made application solutions for protection of single breaker connected power lines and cables. The type-tested variants are delivered equipped and configured with complete protection functionality, and with default parameters for easy handling of products – from ordering, engineering and commissioning to reliable operation.

The 650 series IEDs introduce a number of innovations, such as a significantly reduced number of parameter settings and extended IED HMI functionality including 15 dynamic three-color-indication LEDs per page, on up to three pages, and configurable push-button shortcuts for different actions. In the 650 series IEDs, most basic parameters are set before delivery from the factory. You only need to set the parameters specific to your application. The parameters related to line distance protection are mostly set as primary ohms, which significantly reduce the need to re-calculate the current and voltage values. This allows the IEDs to be quickly taken into operation. The application manual includes setting examples to support the protection engineer.

Extensive protection for lines and cables

REL670 and REL650 provide protection of power lines and cables with high sensitivity and low CT requirements. Measurements and setting of all five zones with several setting groups are realized completely independently to ensure high reliability. The distance protection function is available with both quadrilateral and mho impedance characteristics. This enables coordination with existing distance protection schemes in any power network.

The distance protection is further enhanced with load encroachment adaption, which increases the ability to detect high resistive faults on heavily loaded lines. This is especially useful in sub-transmission networks where high line load needs to be allowed while high resistive faults need to be detected and cleared. The unique load current compensation in zone one prevents over-reaching during resistive faults and high power transfer on the line. Furthermore, an integrated power swing detection function prevents unwanted operation during power system oscillations caused by disconnection of parallel lines, heavy loads or tripping of large generators.

Versatile overcurrent functions provide additional back-up protection. The thermal overload protection will trip the line in overload situations to prevent more severe fault consequences.

Breaker failure protection allows high-speed back-up tripping of surrounding breakers and re-tripping of the own breaker, for instance to avoid operational mistakes during testing. This function is essential in substations that require local back-up protection. The distance directional earth fault overcurrent and directional negative sequence overcurrent functions can communicate with the remote end in any communication scheme.

The autoreclosing functionality increases operation security and is an effective way to restore the network after arcing faults. In REL670 and REL650, autoreclosing can be made using synchrocheck to eliminate the risk of unwanted reclosing during unfavorable circumstances.

In addition to the wide range of overcurrent protection functions, REL670 and REL650 provide a negative sequence overcurrent protection. This function detects all unsymmetrical faults with or without earth connection. It features high sensitivity, which enables detection of faults with a low fault

Designed for IEC 61850

current. The negative sequence overcurrent protection can also be used as directional. This facilitates the coordination with protection for other objects.

The multi-stage negative sequence overcurrent protection can serve as back-up protection for most faults. It can also serve as the main protection for earth faults and other unsymmetrical faults in radial applications.

REL670 IEDs can also provide additional logic in direct transfer trip schemes to minimize the risk of unwanted operation caused by a false signal in protection communication. Several different protection functions can be used as local criteria when configuring the logic for a specific application.

Integrated protection and control

REL670 and REL650 IEDs are designed for IEC 61850, implementing all the aspects of this standard and thus ensuring open, future-proof and flexible system architectures, with state-of-the art performance. Their performance meets comprehensive communication tasks, for example, GOOSE messaging for horizontal communication. These IEDs provide you with wide application flexibility, which makes them an excellent choice for both new and retrofit installations.

The advanced interlocking functionality of REL670 allows you to avoid dangerous or damaging switchgear operations and to ensure personnel safety. REL670 performs secure bay- and station-wide interlocking using an easy-to-use reservation functionality. This prevents simultaneous operation of disconnectors and earthing switches and ensures that the interlocking information is correct at the time of operation. The control is based on the select-before-operate principle to ensure secure operation and to avoid human mistakes.

The integrated HMI of REL670 and REL650 provide you with a quick overview of the status of the line and service values as well as instant access to important data, such as settings. Using a library of symbols, you can easily configure the graphical display to correspond to your needs and to your substation. The built-in disturbance and event recorders provide you with valuable data for post-fault analysis and corrective actions to increase the security of your power system.

Furthermore, the HMI of REL670 allows secure and quick local control for stand-alone applications and provides back-up control for substation automation systems, when control functionality is integrated in the IED. The two-position versatile switch and the 32-position selector switch functions in REL670/650 enable you to easily manage switching operations via an icon on the IED HMI. The versatile switch function allows you to directly change, for instance, the autorecloser function from

On to Off, or vice versa, without changing the configuration. The function also presents an indication of the selected position.

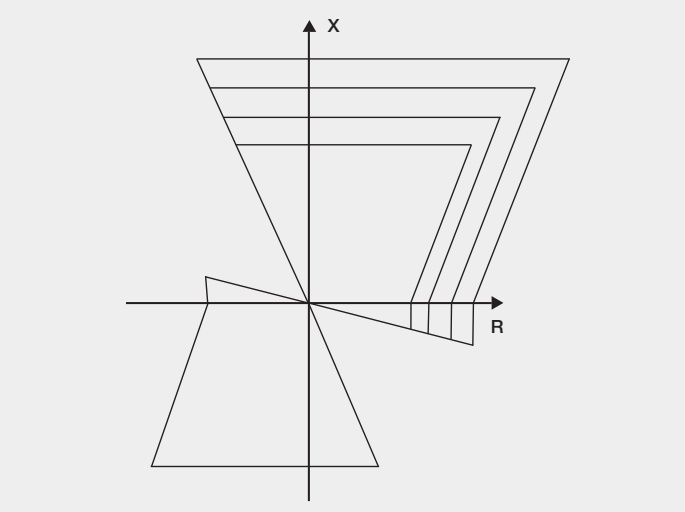
The selector switch can replace an external mechanical selector switch and allows you to directly select the position you desire, for instance, to change the autorecloser mode between 1-pole, 3-pole or 1- and 3-pole modes in REL670/650. In addition to the IED HMI, these switch functions can be operated from a remote system.

Fast and efficient system integration

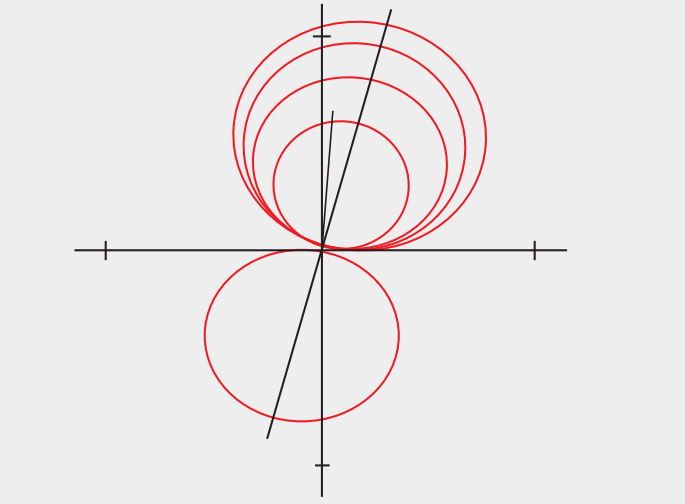
The IEC 61850 compliant REL670/650 IEDs utilize ABB's unique connectivity package concept, which simplifies the system engineering and reduces the risks of errors in system integration. A connectivity package contains a complete description of the specific IED, consisting of data signals, parameters, addresses and IED documentation. The signal data is configured automatically based on the information provided by the connectivity package to efficiently integrate the IEDs in ABB's MicroSCADA Pro automation system.

Relion® 670 series IEDs support IEC 62439 standard redundant communications on the station bus as per IEC 61850 standard. The solution from ABB utilizes the IEC 62439-3 standardized Parallel Redundancy Protocol (PRP). PRP improves the communication system reliability and features a unique capability of zero seconds' recovery time in case of communication failures. This means that there will be no interruption in communication

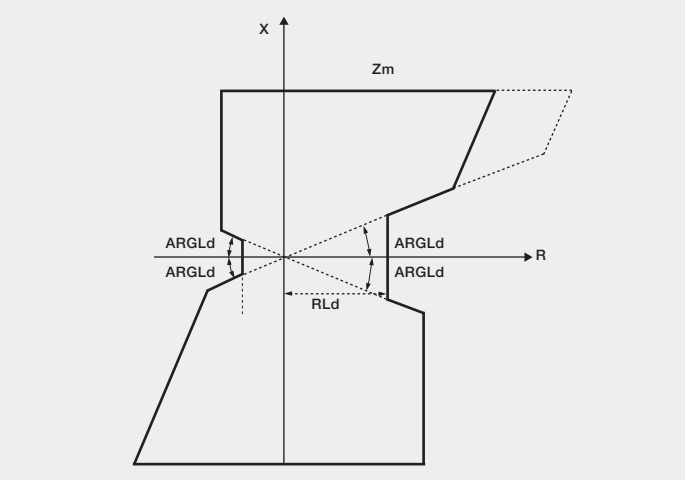
Application examples



REL670/650 IEDs provide distance protection with quadrilateral characteristic.



REL670/650 IEDs provide distance protection with mho characteristic.



The load encroachment function allows the efficient detection of high resistive faults without interfering with the load impedance.

if one link fails as the other link instantaneously takes over the communication. As a result, there is no data lost when communication failures have occurred.

The supervision of communication links provides real-time status information about both communication links individually. If a failure occurs, an alarm is sent to the IED HMI and the substation automation system. This also allows for maintenance of the station bus while it is in operation. Thus, redundant communication further improves personnel safety and ensures that the necessary information about the system is available for operators in all situations.

Relion 670 series IEDs can also support synchronized sampled measured value communication over the process bus using IEC 61850-9-2 LE which replaces conventional wiring between the process and the secondary system. This enables new design of substations. For example, utilization of sensor technology eliminates problems caused by, for instance, CT saturation and EMC influence. Furthermore, extensions and maintenance of substations can be completed more efficiently as fiber-optic cables are used instead of copper wires.

670 series IEDs allow you to mix conventional wiring and fiber-optic communication with IEC 61850-9-2 LE in a single IED. This way you can shift from conventional wiring for analog data to fiber-optic-based communication for synchronized sampled measured values step by step.

Relion® – Complete confidence

Line distance protection REL670/650 IEDs belong to the Relion® protection and control product family. The Relion product family offers the widest range of products for the protection, control, measurement and supervision of power systems. To ensure interoperable and future-proof solutions, Relion products have been designed to implement the core values of the IEC 61850 standard. With ABB's leading-edge technology, global application knowledge and experienced support network, you can be completely confident that your system performs reliably – in any situation.

REL670 Technology summary:

Features
- Fully IEC 61850 compliant
- Protection, monitoring and control integrated in one IED
- Extensive self-supervision including analog channels
- Six independent parameter setting groups
- Large HMI for visualization of single line diagrams
- Ethernet interface for fast and easy communication with PC
- Signal matrix for easy configuration of binary and analog signals
- User management and authority handling

Pre-configured solutions
- Pre-configured and type-tested solutions including default settings for:
  - Single breaker with selective single- or three-phase tripping
  - Multi-breaker with selective single- or three-phase tripping
  - 1 1/2 circuit breaker arrangements with selective single- or three-phase tripping
  - Solidly or high impedance earthed systems

Most important protection functions
- Distance protection
  - 5 zone full-scheme high-speed line distance protection with quadri-lateral or Mho characteristics, and with scheme communication logic and load encroachment discrimination
  - Selective phase selection and automatic switch on to fault logic
  - Current reversal and weak end infeed logic
  - Power swing detection and blocking
  - Phase preference logic
  - Pole slip protection
- High impedance differential protection for tee-feeders
- Current
  - Instantaneous phase overcurrent protection
  - Instantaneous residual overcurrent protection
  - Four step phase overcurrent protection with definite and inverse time characteristics
  - Four step residual directional overcurrent protection with definite and inverse time characteristics
  - Four step directional negative sequence overcurrent protection
  - Directional residual overcurrent protection with scheme communication logic
  - Sensitive directional earth-fault protection
  - Broken conductor check
  - Thermal overload protection
  - Breaker failure protection
  - Stub protection
  - Pole discordance protection
- Power functions
  - Directional under- and over power protection
- Voltage
  - Two step phase- and residual overvoltage protection with definite and inverse time characteristics
  - Two step undervoltage protection with definite and inverse time characteristics
  - Overexcitation
  - Loss of voltage check
- Power system supervision
  - Loss of voltage check configured based on undervoltage protection
  - Dead line detection included in fuse failure supervision and switch on to fault logic
- Secondary system supervision
  - Fuse failure supervision
  - Current circuit supervision
- Frequency functions
  - Under- and overfrequency protection
  - Rate-of-change frequency protection
- Multi-purpose function
  - General current and voltage protection

Logic
- Tripping logic
- Trip matrix logic
- Configurable logic blocks

Monitoring
- Disturbance recorder
  - 100 disturbances
  - 40 analog channels (30 physical and 10 derived)
  - 96 binary channels
- Event list for 1000 events
- Disturbance report
- Event and trip value recorders
- Fault locator
- Event counters
- Supervision of AC and mA input quantities
- Small and large HMI in local language
- LED indications with 6 red and 9 yellow LEDs

Metering
- U, I, P, Q, S, f, and cosφ
- Differential voltage per zone
- AC input quantities with accuracy better than 0.5%
- Inputs for mA measuring
- Energy metering function for energy statistics
- Pulse counting support for energy metering

Control functions
- Apparatus control for 8 or 15 apparatus
- Ready to use interlocking modules for different switchgear arrangements
- Several alternatives for reservation functionality
- Synchronizing, synchrocheck and energizing check
- Autorecloser
- Versatile switch with two positions
- Selector switch with up to 32 positions

Communication
- IEC 61850-8-1 including GOOSE messaging
- IEC 61850-9-2 LE Process bus
- Individually supervised redundant station bus with zero seconds' recovery time
- IEC 60870-5-103 serial communication
- DNP 3.0 slave protocol
- LON
- SPA
- Remote end communication for transfer of 192 binary signals

Setting, configuration and disturbance handling
- Protection and control IED manager PCM600

Hardware
- 1/1 x 19", 3/4 x 19" or 1/2 x 19" 6U height case selected according to the number of required I/O modules
- Power supply modules from 24 to 250 V DC ± 20%
- TRM module with measurement transformers
- ADM module
- Up to 14 I/O modules in 1/1 x 19" case
- Binary input module, 30 mA and 50 mA, with 16 inputs
- Binary output module with 24 outputs
- Static binary output module with 12 outputs (6 static)
- Binary input/output module, 30 mA and 50 mA, with 8 inputs and 12 outputs
- mA input module with 6 transducer channels
- Accurate time-synchronization through GTM, GPS time module, SNTP, DNP 3.0, or IRIG-B-module
- Remote end data communication modules for C37.94, X21 and G.703/G.703E1
- COMBITEST test switch module

Technical details are available in the REL670 Product Guide.

REL650 Technology summary:

Features
- Fully IEC 61850 compliant
- Protection and monitoring integrated in one IED
- Extensive self-supervision including analog channels
- Four independent parameter setting groups
- Large HMI for visualization of single line diagrams and on-line measurements
- Integrated or detachable HMI with 1-5 m cable for flexible panel mounting
- Ethernet interface for fast and easy communication with PC
- Accurate time-synchronization via SNTP, DNP 3.0, IEC 60870-5-103 and IRIG-B serial interface
- Signal matrix for easy configuration of binary and analog signals
- User management and authority handling

Configured solutions
- Single breaker with single-phase tripping
- Single breaker with three-phase tripping
- Solid or high impedance earthed systems (single breaker)

Most important protection functions
- Distance protection
  - 5 zone full-scheme high-speed line distance protection with quadrilateral or Mho characteristics, and with scheme communication logic and load encroachment discrimination
  - Selective phase selection and automatic switch on to fault logic
  - Current reversal and weak end infeed logic
  - Power swing detection and blocking
  - Phase preference logic
- Current
  - Instantaneous phase overcurrent protection
  - Instantaneous residual overcurrent protection
  - Four step directional phase overcurrent protection with definite and inverse time characteristics
  - Four step residual directional overcurrent protection with definite and inverse time characteristics
  - Two step negative sequence based directional overcurrent protection
  - Directional residual overcurrent protection with scheme communication logic
  - Sensitive directional earth-fault protection
  - Two step undercurrent protection
  - Broken conductor check
  - Thermal overload protection
  - Breaker failure protection
  - Stub protection
  - Pole discordance protection
- Power functions
  - Directional under- and over power protection
- Voltage
  - Two step phase- and residual overvoltage protection with definite and inverse time characteristics
  - Two step undervoltage protection with definite and inverse time characteristics
  - Loss of voltage check
- Frequency protection
  - Under- and overfrequency protection
  - Rate-of-change frequency protection
- Power system supervision
  - Loss of voltage check configured based on undervoltage protection
  - Dead line detection included in fuse failure supervision and switch on to fault logic
- Secondary system supervision
  - Current circuit supervision
  - Fuse failure supervision
  - Breaker close/trip circuit monitoring

Control functions
- Selective single-phase and three-phase autorecloser
- Synchronizing, synchrocheck and energizing check
- Selectable operator place allocation
- Versatile switch with two positions
- Selector switch with up to 32 positions

Logic
- Tripping logic
- Trip matrix logic
- Configurable logic blocks

Monitoring
- Disturbance recorder
  - 100 disturbances
  - 40 analog channels (30 physical and 10 derived)
  - 96 binary channels
- Event list for 1000 events
- Disturbance report
- Event and trip value recorders
- Fault locator
- Event counters
- Supervision of AC input quantities
- Insulation gas monitoring function
- Insulation liquid monitoring function
- Circuit breaker condition monitoring
- Station battery supervision
- Indication of up to 135 binary signals via 15 three-color-state indication LEDs on up to three pages

Measurements
- U, I, P, Q, S, f, and cosφ
- AC input quantities with accuracy better than 0.5%

Metering
- Energy metering function for energy statistics
- Pulse counting support for energy metering

Communication
- IEC 61850-8-1 including GOOSE messaging
- DNP 3.0 slave protocol
- IEC 60870-5-103 serial communication

Setting, configuration and disturbance handling
- Protection and control IED manager PCM600

Hardware
- 1/2 x 19” 6U height case
- 10 analog inputs (5 CT and 5 VT inputs)
- Universal 1A/5A CT inputs
- Communication and processor module with 14 inputs
- Binary input/output module with 9 inputs and 9 outputs
- Possibility to add two optional binary input/output modules
- Power supply modules from 48 to 250 V DC or 100 to 240 V AC with 9 outputs, 3 of which with trip circuit supervision

Technical details are available in the REL650 Product Guide.

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