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1 INTRODUCTION - REL 551

The REL 551 line protection terminal which is a part of the PYRAMID system is basically a line differential protection for MV and HV lines. The PYRAMID system includes a complete range of complex object terminals, a functional substation monitoring, and a substation control system. The blocks in PYRAMID are available as stand-alone protection units or as building blocks in a complete Station Monitoring System (SMS), Substation Control System (SCS) and/or Relay Testing System (RTS).

1.1 Basic function

The basic function in the REL 551 is a current differential protection of master/master type, evaluating each phase current separately at both ends, utilising both the current amplitude and phase angle (segregated vector comparison).

All currents are Fourier filtered, in order to extract the sine and cosine components. The six components, two per phase, are included in a message that is transmitted every 5 ms to the remote terminal over a synchronous 56/64 kbit/s data channel. The message also includes information for supervision, CT saturation detection, synchronisation of terminals, direct transfer trip etc.

The differential measurement is stabilised phase by phase by the current scalar sum, see Fig. 1. The degree of stabilisation is settable.

To minimise the requirements on the current transformer, all currents are individually supervised by CT-saturation detectors. In case of CT-saturation the degree of stabilisation is increased, see Fig. 1.

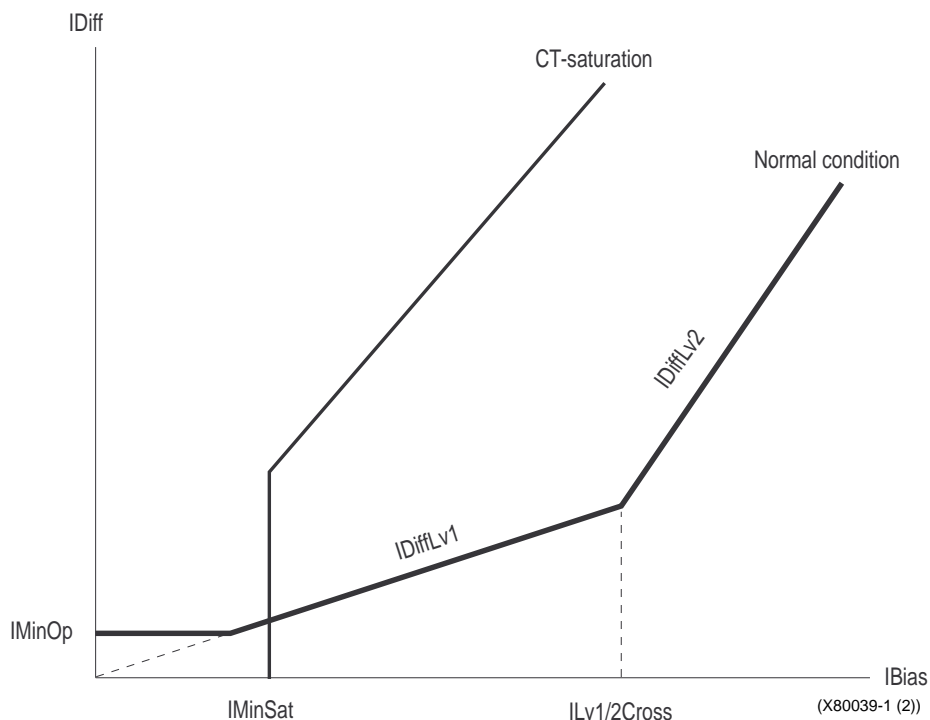


Fig. 1 Stabilisation characteristic.

The communication delay is continuously measured, and automatically compensated for in the differential measurement. This enables the REL 551 to use a communication network with automatic route switching (public digital networks usually have this function).

The communication message is checked for errors and at the detection of erroneous information, the message is excluded from the evaluation. For tripping, two or three accepted message out of four are required. This provides a very high security against false tripping due to transmission disturbances

1.2 Communication alternatives

Following communication alternatives exists:

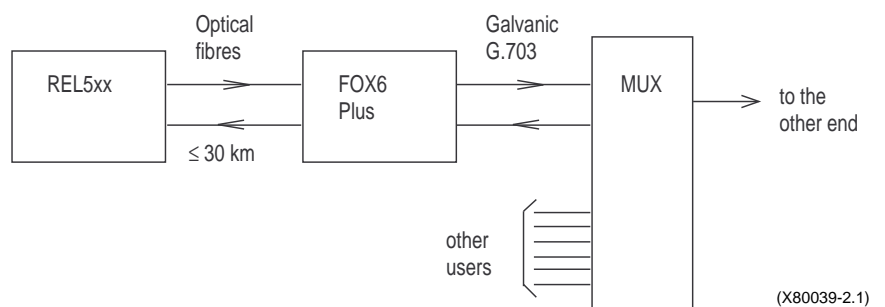


Fig. 2 Multiplexed link, fibre optical-galvanic connection



Fig. 3 Dedicated link, fibre optical connection

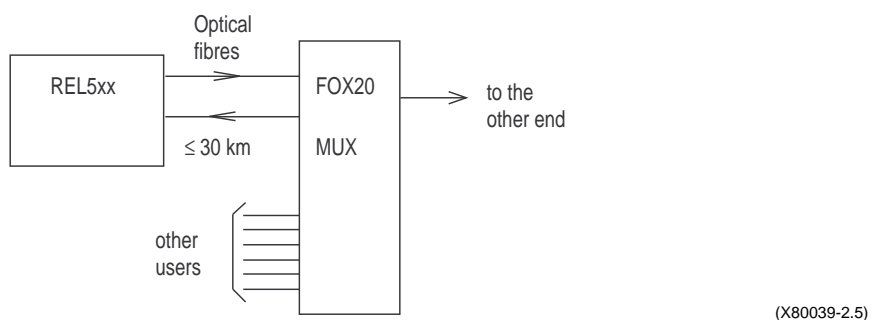
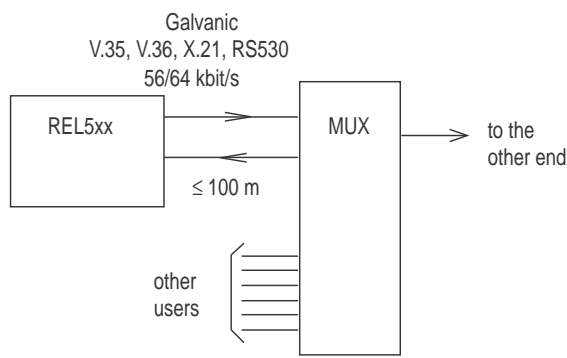
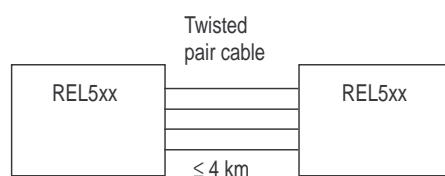


Fig. 4 Multiplexed link, fibre optical connection



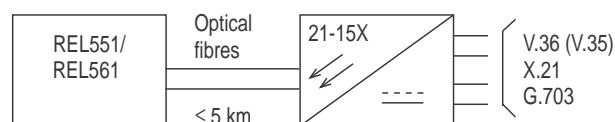
(X80039-2.6)

Fig. 5 Multiplexed link, galvanic connection



(X80039-2.4)

Fig. 6 Dedicated link, short range galvanic modem



(X80039-2.7)

Fig. 7 Multi link, short range fibre optical connection

A direct intertrip can be transmitted between the terminals in the common message. This intertrip is activated through a separate input, and has a separate trip output.

The protection is only designed for three-pole tripping.

An instantaneous overcurrent function is included.

A built in CT Supervision function provides both an alarm signal and a block signal.

Four independent groups of setting parameters are available within the REL 551. The user can change between active groups as well as any parameter within them locally, with the aid of the man-machine communication unit, or by means of a personal computer (PC). Changing between active setting groups is also possible by activating four binary inputs.

1.3 Optional functions

Note! The REL 551 is only designed for three-pole tripping, although some of the included and optional functions are utilising phase segregated measurement giving phase oriented trip signals. The tripping logic however is only capable of three-pole tripping.

1.3.1 Overload protection

A time delayed phase overcurrent function may be included.

1.3.2 Single-phase tripping

Single-phase tripping of the circuit breaker for single-phase-to-earth faults is possible with the aid of a separate single-phase tripping logic.

1.3.3 Earth-fault overcurrent protection

A non-directional earth-fault current protection function is available for a maximum sensitivity to detect high resistive earth-faults.

Independent and dependent time delay with normal, very, extremely and logarithmic inverse time characteristics can be set. The trip can be second harmonic restrained to enable very low settings without the risk of unwanted tripping at transformer energization.

1.3.4 Autoreclosing

Two different options are available for the autoreclosing function:

- programmable three-phase multi-shot autoreclosing
- programmable single and/or three-phase multi-shot autoreclosing.

Dead times for the single-phase and three-phase autoreclosing are settable, independent of each other, in a wide range. The same is also valid for the reclaim time and duration of a breaker closing impulse. Extensive information on the operation of a reclosing function is available to the user at any time.

1.3.5 Breaker failure protection

The optional breaker failure protection measures the current flowing through the line circuit breaker. The current measurement takes care of the dc transient in the secondary current, following a successful breaker operation in case of a saturated current transformer.

Two timers, independent of each other are available: timer t1 for repeated tripping of the line circuit breaker, and timer t2, which can operate a separate output relay for connection to the breaker failure tripping logic for the entire busbar system.

Any of the internal tripping functions will start the operation of the breaker failure protection. It is also possible to program a corresponding binary input for external start of the breaker failure protection.

1.3.6 Event recorder

Up to 150 time-tagged events, for each of the last ten recorded disturbances, are available via the PC connection on the front and SMS or SCS ports. Time synchronisation is possible by means of minute pulses wired to a separate binary input, as well as via the optionally built-in communication ports for remote communication.

1.3.7 Disturbance recorder

The disturbance recording function is an important part of a station monitoring system, which enables the evaluation of different events within the power system.

The optional, high performance, disturbance recorder is one of the building blocks within the REL 551. It can record up to 4 analogue and 48 binary signals (input binary signals or internal signals). The typical total recording time is 10 seconds (will depend on the number of analogue and digital signals and the number of disturbances recorded).

Any of the recorded analogue and binary signals are programmable to start the recording. Furthermore, analogue signals are programmable for overfunctions and underfunctions, and binary signals can start recording with a transition from a logical 0 to a logical 1 or vice versa.

The time base is synchronised with an internal clock and, via the synchronising facilities, further on to the system. Pre-fault, post-fault and time limit are settable in wide ranges.

Disturbance records can be collected locally by means of a PC used for local man-machine communication, as well as remotely within the SMS. A disturbance evaluating PC-based program of type REVAL, operating in MS Windows, is also available.

1.3.8 Optional input/output facilities

The basic version of REL 551 comprises four binary inputs and five output relay contacts. One of them is a normally open contact, used for the signalization of a continuous self-supervision function, built into REL 551.

One additional I/O module with 8 binary inputs and 12 output relay contacts (two of them high speed reed contacts) is available as options. All the binary inputs are freely programmable to any of the built-in functions for maximum flexibility. All the REL 551 internal logical signals can control one or more of the output relays.

All the output relays are programmable to follow either the logical values of the corresponding signals or to be equal to logical 1 or logical 0. This enables testing of the functions and signals within the protected line bay as well as within the terminal itself.

1.3.9 Optional remote serial communication

Optionally, one or two serial communication ports are available with the REL 551. They are installed independently of each other on the back plane of the terminal. Remote communication with REL 551 uses optical fibres to eliminate the influence of electromagnetic interference.

This enables the REL 551 to be a part of the SMS and/or the SCS at the same time. This means that both the operator in the control room and the relay engineer in the office have the possibility of reading information from the terminal or even changing between active setting groups, as well as changing different values of the setting parameters within the setting groups.

The software program SMS-BASE with SM/REL 551, installed in a personal computer, enables communication with the REL 551 (either direct or through a telephone network), reading information from the relay on a PC screen, and storing it in PC files.

The operator in the control room and/or control centre has similar possibilities when a communication port is connected to the SPA-bus within the SCS. Communication within the SCS enables time synchronisation of the REL 551 with other equipment in the substation. Similar functionality is also possible when it is connected to the SMS only.

Disturbance records can be collected remotely within the station monitoring system (SMS) by using the SMS-BASE with RECOM. An evaluation of the disturbance records is feasible by means of the REVAL PC-based evaluation program.