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1 General

The REB 551 breaker terminal is the basic unit for sub-transmission and transmission line breaker related applications and forms a part of a PANORAMA station automation system. The PANORAMA station automation concept includes a complete range of single function units and multifunctional terminals, Substation Monitoring System (SMS) and Substation Control System (SCS). The units in the PANORAMA concept are available as stand-alone relays/terminals or as building blocks in a total power network management system.

2 Features

Protection functionality such as:

- breaker failure protection
- pole discordance protection
- fuse failure and current transformer circuit supervision
- fast interbay communication of binary signals
- single- or multi-pole tripping.

Control;

- command control
- autoreclosing and synchro-check with phasing and energising check.

Monitoring;

- event recorder
- disturbance recorder
- trip value recorder
- status indication of all input and internal binary signals
- presentation of measured mean values of line current and voltage with accuracy up to ±0.25%
- presentation of measured mean value of active power with accuracy up to ±0.5%
- presentation of measured mean values of reactive power and frequency

Metering;

- pulse counter logic.

Remote-end data communication;

- multiplexed, dedicated fibre or galvanic channel
- allows for remote end binary signal transfer
- communication channel supervision.

Serial communication;

- SPA control or monitoring, alternatively IEC 870-5-103 port monitoring
- LON port (control).

General features such as;

- Extensive configuration possibilities by use of internal logical gates, timers and user configurable connections between different functions, binary inputs and outputs
- Several input/output module options including measuring mA input module (for transducers)
- Extensive software toolbox for monitoring, evaluation and user configuration of the terminal
- Flexible software and hardware
- Selected processor design guarantees high availability together with excellent possibilities for extensive combination of different functions without prolonging the operation time
- Numerical filtering and measuring techniques ensuring correct performance during transient conditions
- Versatile local human machine interface (HMI), front panel operated
- Various local HMI language options
- Extensive self-supervision with fault diagnostics.

1 Basic functions

1.1 Setting groups

1.1.1 Application

Different system operating conditions require different settings of protection functions. The REx 5xx series terminals have basically four sets of independent setting groups built-in, which contains all setting parameters for all protection-, control- and monitoring functions. The user can change the active setting group at any time locally by means of the local HMI or from a personal computer, remotely from a station control or station monitoring system as well as by activation of the corresponding functional inputs to the GRP function block. Adaptive changing of the active setting group is possible by using GRP together with other functions available.

1.1.2 Design

The GRP function block has four functional inputs, each corresponding to one of the setting groups stored within the terminal. Activation of any of these inputs changes the active setting group. Four functional output signals are available for configuration purposes, so that continuous information on active setting group is available.

1.2 Time synchronisation

1.2.1 Application

The terminal has an internal clock, which can be synchronised by means of a minute pulse through a binary input or via the station bus communication.

1.3 Local human machine interface

1.3.1 Application

The human machine interface, HMI, serves as an presentation and input unit, displaying in a logical order starting and tripping signals that have appeared during each of the last ten recorded disturbances.

Furthermore, the HMI is capable of presenting values such as measured current, voltage, power (active and reactive) and frequency, as well as displaying the logical state of binary inputs and internal logical signals.

1.4 Monitoring of AC analogue measurements

1.4.1 Application

This function provides three phase or single phase values of voltage and current. At three phase measurement, the values of active power, reactive power, frequency and the RMS voltage and current for each phase can be calculated. Alarm limits can be set and used as triggers, i.e. to generate trip signals.

The software functions to support presentation of measured values are always present in the terminal. In order to retrieve actual values, however, the terminal must be equipped with the appropriate hardware measuring module(s).

1.5 Monitoring of DC analogue measurements

1.5.1 Application

Many devices used in process control uses low currents, usually in the range 4-20 mA or 0-20 mA to represent low frequency, near dc signals. The terminal can be equipped with analogue inputs for such signals, function blocks MI11-MI66, in the mA range. Alarm limits can be set and used as triggers, i.e. to generate trip signals.

The software functions to support presentation of measured values are always present in the terminal. In order to retrieve actual values, however, the terminal must be equipped with the appropriate hardware measuring module(s).

1.6 Self-supervision with internal event recorder

1.6.1 Application

The self-supervision function operates continuously and includes:

- normal microprocessor watchdog function
- checking of digitised measuring signals
- checksum verification of program memory contents
- checksum verification of communication signals
- memory and register read/write check.

The self-supervision status can be monitored from the local HMI or via a SMS or SCS system.

When an internal fault has occured, you can retrieve extensive information about the fault from the list of internal events available in the terminal from either a station control or a station monitoring system. A time-tagged list with the date and time of the last 40 internal events is available.

1.7 Configurable logic

1.7.1 Application

The terminal contains a number of user configurable logic function blocks, such as timers, AND/OR/INV gates and flip-flops. In the basic unit, 40 timers, nearly 150 gates and 5 S/R flip-flops are available.

By ordering the additional configurable logic option, the number of available elements can be expanded with additional 40 timers and almost 460 gates.

1.8 Dead line detection

Note: The dead line detection function is only available together with the automatic switch onto fault function, the weak end infeed detection function and the fuse failure function.

1.8.1 Application

Different protection, control and monitoring functions require for their proper operation information on the condition of a protected element, such as power lines, etc.The dead line detection function, DLD, detects the conditions of a protected element, whether or not it is connected to the rest of the power system.

1.8.2 Design

The function continuously measures all three phase currents and phase voltages of a protected power line. The line is declared as dead (nonenergised) if all three measured currents and voltages fall below the preset values for more than 200 ms. The function operates on a phase-segregated basis, if single-pole trip logic has been selected for a particular terminal.

2 Current, phase wise

2.1 Pole discordance protection

2.1.1 Application

Breaker pole position discordance can occur on the operation of a breaker with independent operating gears for the three poles. The reason may be an interruption in the closing or trip coil circuit, or a mechanical failure resulting in a stuck breaker pole. A discordance caused by one pole failing to close or open can be tolerated for a limited time, for instance during a single-phase trip-reclose cycle.

2.1.2 Design

The operation of the pole discordance protection, PD, is based on checking the position of the breaker auxiliary contacts. Three parallel normally-open contacts in series with three normally-closed contacts in parallel of the respective breaker poles form a condition of pole discordance, connected to a binary input dedicated for the purpose. In addition, there is a parallel detection criterion based on comparision of currents in the breaker poles. This function is enabled for just a few seconds after close or trip commands to the breaker in order to avoid unwanted operation in unsymmetrical load conditions.

2.2 Breaker failure protection

2.2.1 Application

The breaker failure protection, BFP, provides backup protection in case of failure of the breaker to trip and clear the fault as requested by the object protection. It is obtained by checking that fault current persists after a brief time from the operation of the object protection.

2.2.2 Design

The breaker failure protection is initiated by the trip commands from the protection functions, either internal to the terminal or from external commands through binary inputs. The start can be single-phase or three-phase.

The operating values of the three current measuring elements are settable within a wide setting range. The measuring is stabilised against the dc-transient that can cause unwanted operation at saturated current transformers and correct breaker operation. Time measurement is individual for each phase. Two independent timers are available, T1 for repeated tripping of “own” breaker and T2 which operates trip logic for adjacent breakers.

3 Power system supervision

3.1 Loss of voltage check

3.1.1 Application

The loss of voltage check, LOV, is suitable for use in networks with an automatic restoration function. The LOV function initiates a three-pole tripping of a circuit breaker, if all three phase voltages fall below the set value for longer than 7 seconds. The operation of the function is supervised by the fuse-failure function and the information about the closed position of an associated circuit breaker.

3.2 Overload supervision

3.2.1 Application

The overload protection, OVLD, prevents excessive loading of power lines. Its operation is based on the measurement of the maximum phase current and its duration. The operating current and the operating time are settable in a wide range.

4 Secondary system supervision

4.1 Current circuit supervision

4.1.1 Application

Faulty information about current flows in a protected element might influence the security or dependability of a complete protection system. The current circuit supervision function, CTSU, as built in REx 5xx terminals, detects different faults in current secondary circuits and influence the operation of corresponding main protection functions.

4.1.2 Design

The function compares the $3I_0$ secondary currents from two different sets of current instrument transformers or different cores of the same instrument transformer. The function issues an output signal when the difference is greater than the set value. The signal can be configured to block different protection functions or initiate the alarm.

4.2 Fuse failure supervision

4.2.1 Application

The fuse failure supervision, FUSE, continuously supervises the ac voltage circuits between the voltage instrument transformers and the terminal. Different output signals can be used to block, in the case of faults in the ac voltage secondary circuits, the operation of the breaker protection and other voltage-dependent functions, such as the synchro-check function.

The function block can be ordered in one of two functional modes, zero sequence protection recommended in directly or low impedance earthed systems, or negative sequence protection, recommended in isolated or high impedance earthed systems.

4.2.2 Design

The function continuously measures the zero sequence or the negative sequence voltage and current in three-phase ac voltage circuits. It operates if the measured zero and/or negative-sequence voltage increases over the preset operating value, and if the measured zero and/or negative-sequence current remains below the preset operating value.

Two function output signals are available. The first depends directly on the voltage and current measurement. The second depends on the operation of the dead line detection function, to prevent unwanted operation of the breaker protection if the line has been deenergised and energised under fuse failure conditions. A special function input serves the connection to the auxiliary contact of a miniature circuit breaker, MCB (if used), to secure correct operation of the function on simultaneous interruption of all three measured phase voltages.

5 Control

5.1 Command control

5.1.1 Application

The terminals may be provided with 16 output functions that can be controlled either from a substation automation system or from the local human-machine interface, HMI (see “Local human machine interface” on page 7 for details). The output functions can be used, for example, to control high voltage apparatuses in switchyards. For local control functions, the local HMI can also be used. Together with the configuration logic circuits, the user can govern pulses or steady output signals for control purposes within the terminal or via binary outputs.

5.2 Synchro- and energising check

5.2.1 Application

The synchro-check function, SYNX, is used for controlled interconnection of a line in an already interconnected network. When used, the function gives an enable signal on satisfactory voltage conditions across the breaker that is to be closed. The synchro-check function measures the voltages on the busbar side and the line side. It operates and permits closing of the circuit-breaker when the set conditions are met, with respect to the voltage difference (U_{Diff}), the phase angle difference ($Phase_{Diff}$), and the frequency difference ($Freq_{Diff}$).

The energising condition can be set to allow energising in one, or the other, or both directions, e.g. live busbar and dead line. It is possible to have different energising settings for a manual close command and an autoreclose command.

5.2.2 Design

The synchro-check for double busbar arrangements includes the voltage selection function. From the auxiliary contacts of the breakers and disconnectors, the terminal can select the right voltage for the synchronism and energising function. The function is also designed to allow manual closing when both sides of the breaker are dead.

5.3 Phasing

Note: This function is only available together with the synchro-check and energising check described in the previuos section.

5.3.1 Application

Phasing of network breakers is to be performed, together with synchro-check, when two asynchronous systems are going to be connected in order to avoid stress on the network and its components. The phasing function compensates for measured slip frequency as well as the circuit-breaker closing delay.

5.3.2 Design

The phasing function can be included with synchro-check function, it cannot be purchased separately. The phasing function is used when the difference in frequency is larger than the set value for synchro-check.

5.4 Autoreclosing

5.4.1 Application

The four blocks of the autoreclosing function, AR01-AR04, can be selected to perform single-, two- and/or three-phase reclosing from eight single-shot or multi-shot reclosing programs. The three-phase autoreclose open time can be selected to give either high speed autoreclosing or delayed autoreclosing. Three-phase autoreclosing can be performed with or without the use of the synchronism check or energising function.

5.4.2 Design

The autoreclosing function cooperates with the line protection functions, the trip function, the circuit breaker and the synchro-check function. It can also be influenced by other protection functions through binary input signals.The autoreclosing is a logical function built up by logical elements.

6 Logic

6.1 Trip logic

6.1.1 Application

The trip logic function, TRIP, is basically used for single and/or multi-pole tripping.

It operates in single-pole trip mode for single phase faults, in two-pole operating mode for two-phase faults (with or without earth) and in three-pole tripping mode for three-phase faults. It is also possible to achieve three-pole tripping for one- and/or two-phase faults.

The function is applicable for all terminals which have built-in phase selection functionality and is used in applications where single-pole tripping is required for single-phase faults due to system stability reasons. The two-pole operating mode can be used on double-circuit parallel operating lines.

6.1.2 Design

Special functional inputs are provided for the initiation of a single-, two- and three-pole tripping command. Decision to initiate outgoing trip signals in different phases depends on a presence of corresponding phase selective signals on specially provided functional inputs. Additional logic circuits secure a three-pole final trip command in the absence of the required phase selection signals.

The function is equipped with logic circuits, which secure correct operation on evolving faults as well as after the reclosing on persistent faults. Special function inputs are provided to override the internal conditions and initiate an instantaneous three-pole trip command. These inputs could be initiated by different external functions, such as station breaker failure protection, transfer trip from the remote end line terminal, etc.

6.2 Communication channel test logic

6.2.1 Application

Many applications in secondary systems require testing of some functionality with confirmed information about the result of the test. The communication channel test logic, CCHT, perform testing of communication (power line carrier) channels in applications, where it is not possible to monitor them continuously by some other means.

6.2.2 Design

The logic initiates sending of an impulse (carrier send signal), which starts the operation of different external functions, and checks the feedback from the external function. It reports the successful or unsuccessful response on the initiated test. It is also possible to abort the test with an external signal, which overrules all internal process.

6.3 Binary signal transfer to remote end

6.3.1 Application

The binary signal transfer function, RTC, is mainly used for sending communication scheme related signals, trip and/or other binary signals required at the remote end. Up to 32 freely selectable binary signals are packed and transmitted serially using any of the available communication alternatives, see “Remote end data communication” on page 17.

6.4 Binary signal interbay communication

6.4.1 Application

Up to 80 function blocks, CM01-CM80, can be used to recieve data transmitted over the system-wide LON bus from other REx 5xx terminals, using one or several event function blocks (EV01-EV44) to send the data. The number of events possible to communicate depends on the configuration of each terminal connected to the LON bus.

One function block can be used for high speed data transfers, remaining blocks for lower speed transfers.

6.5 Serial communication

6.5.1 Application

For remote control, one or two optional optical serial interfaces, one using SPA or IEC 870-5-103 protocol, and one using LON protocol, enables the terminal to be part of a Substation Control System, SCS, and/or Substation Monitoring System, SMS. The interface connectors are located at the rear of the terminal.

The interfaces can be configured independent of each other, each with different functionalities regarding monitoring and setting of the terminal functions. Plastic fibres can be used up to a distance of 30 meters (90 feet), glass fibres for distances up to 500 meters (1500 feet).

The respective interface is used as follows:

Table 1: Serial communication usage

	Station control	Station monitoring
SPA	Yes	Yes
IEC 870-5-103	No	Yes
LON	Yes	Yes[1]

1. The LON bus can be used for monitoring as a part of the station HMI (microSCADA) functions

The LON bus is solely used for station control. It can interconnect several different numerical relays/terminals from the PANORAMA range with remote communication possibilities. Direct connection to a personal computer (PC) is possible by equipping the PC with a LON bus interface, or by a phone modem through a phone network with CCITT characteristics if the PC is placed on a remote location.

6.6 Remote end data communication

6.6.1 Application

In order to quickly and reliably communicate important data while maintaining a quick response to events occuring on the remote end of a protected line, dedicated high speed serial links are used. In order to support multiple units, multiplexed links are available. Serial links can either be using optical fibres (short to long distances and/or high isolation) or galvanic connections (short distance).

The fibre optical module can communicate without additional units over dedicated fibres up to around 30 km. When greater distances are required to be covered, an external FOX 20 system, available from ABB Network Partner Ltd. (Switzerland), can be used. The FOX 20 works as a repeater in this case and is optically connected, sending the signals on dedicated fibres. With this configuration it is possible to cover distances up to 120 km on single-mode fibres. The FOX 20 can also operate as a multiplexer, in which case a number of 64 kbit/s data channels and RS 232 channel can be transmitted in parallel.

Direct galvanic connection to a multiplexer can be done up to a distance of 100 m. The built-in interface in these modules can support the CCITT standard V.35/36 contradirectional, X.21 64 kbit/s and EIA RS 530/422 contradirectional 56 kbit/s communication modes. V.35/36 and RS 530/422 codirectional communication modes can be supplied upon request.

The CCITT G.703 can be connected over an optional RS 530/422 contradirectional to G.703 converter. The distance between the terminal and the converter is limited to 10 meters.

Direct galvanic communication over twisted pair cable for distances up to 4 km can be done using the short range galvanic modem.

When the distance is too long for direct galvanic connection, a short-range optical modem is used. The distance can be up to 5 km and the optical/galvanic converter can directly support CCITT standard V.35/36 contra-directional as well as X.21 and G.703 communication modes.

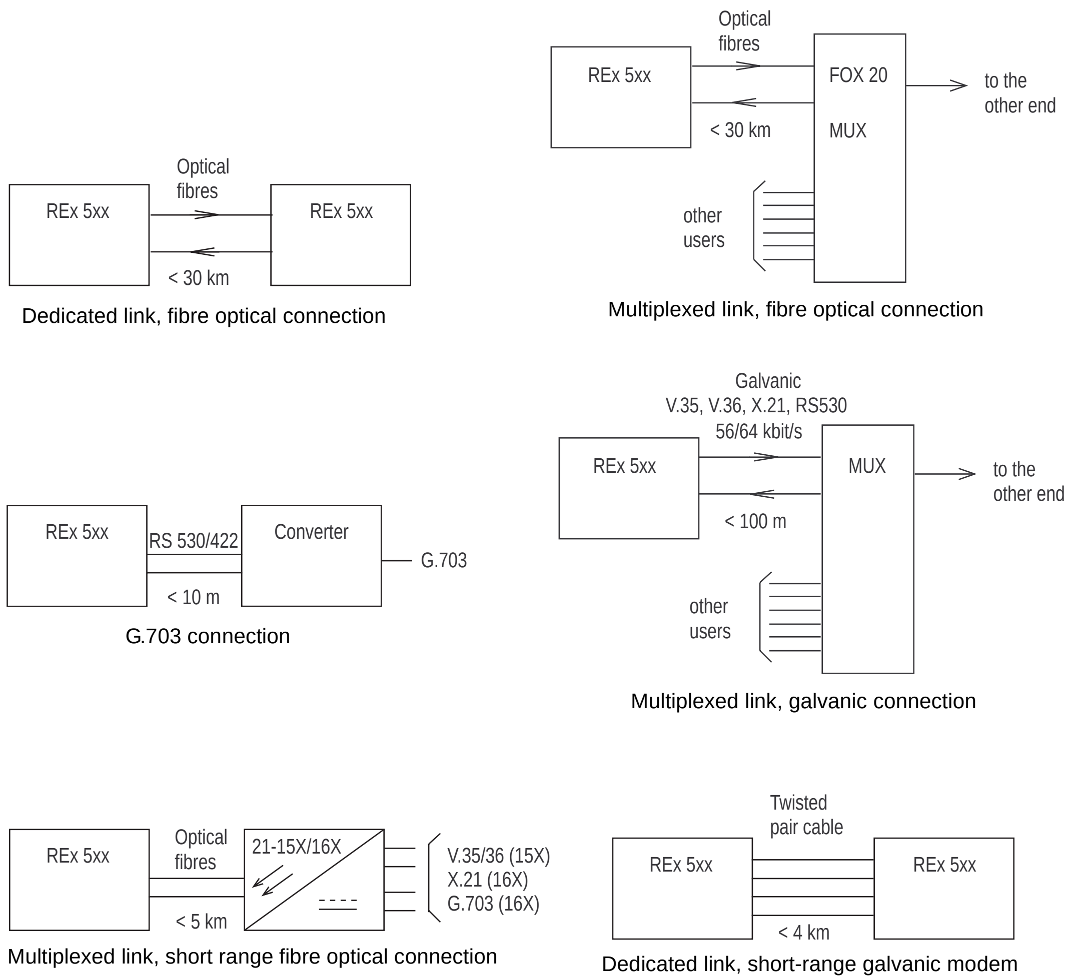

Figure 1: Communication alternatives

7 Monitoring

7.1 Disturbance recorder

7.1.1 Application

The disturbance recording function, DREP, is an important part of a station monitoring system, which enables the evaluation of different events within the power system. This high-performance disturbance recorder can memorise up to 10 analogue channels and 48 binary signals (internal signals to the terminal and/or external signals connected to the binary inputs of the terminal). Any of the recorded analogue channels and binary signals can be programmed to start a recording.

Furthermore, analogue channels are programmable for start of DR at over- and under-functions and the binary signals can start recording on transition from a logical 0 to a logical 1 and vice versa. Prefault, postfault and limit time can be set in wide ranges. Collection of disturbance records is possible locally as well as remotely. Evaluation of disturbances can be done in the REVAL software, separately purchased.

7.2 Event recorder

7.2.1 Application

An event recording function, EVR, is available. It presents in a logical order, starting and tripping signals that have occured in the terminal. Up to 150 time-tagged events for each of the last 10 recorded disturbances are stored. For handling of internal events, such as setting changes, see “Self-supervision with internal event recorder” on page 8.

7.3 Trip value recorder

7.3.1 Application

Information on the actual primary and secondary phasors of the voltages and currents are available in the trip value recorder, TRVAL. The prefault and fault values of the applicable voltages and currents are recorded with their phase relations for the last 10 disturbances.

7.4 Increased measuring accuracy

7.4.1 Application

Measuring accuracy for voltage and current can be increased to ±0.25%, and to ±0.5% for active power, by ordering a software calibration specifically for the measuring devices to be used, i.e. the five current and voltage transformers connected to the terminal.

8 Metering

8.1 Pulse counter logic

8.1.1 Application

The pulse counter function counts externally generated binary pulses, for instance pulses coming from an external energy meter, for calculation of energy consumption values. The pulses are captured by the binary input module and then read by the pulse counter function. The number of pulses in the counter is then reported via LON to the station control system or read via SPA from the station monitoring system as a service value.

1 Requirements

1.1 General

The operation of a protection measuring function is influenced by distortion, and measures need to be taken in the protection to handle this phenomenon. One source of distortion is current transformer saturation. In this protection terminal, measures are taken to allow for a certain amount of CT saturation with maintained correct operation. This protection terminal can allow relatively heavy current transformer saturation.

Protection functions are also affected by transients caused by capacitive voltage transformers (CVTs) but as this protection terminal has a very effective filter for these transients, the operation is hardly affected at all.

1.2 Voltage transformers

Magnetic or capacitive voltage transformers can be used.

Capacitive voltage transformers (CTVs) should fulfil the requirements according to IEC 186A, Section 20, regarding transients. According to the standard, at a primary voltage drop down to zero, the secondary voltage should drop to less than 10% of the peak pre-fault value before the short circuit within one cycle.

The protection terminal has an effective filter for this transient, which gives secure and correct operation with CVTs.

1.3 Current transformers

1.3.1 Classification

Current transformers should be of type TPX or TPY with an accuracy class of 5P or better. The characteristic of the linearised current transformer type TPZ is not well defined as far as the phase angle error is concerned, and we therefore recommend contacting ABB Network Partner AB to confirm that the type in question can be used.

The current transformer ratio should be selected so that the current to the protection is higher than the minimum operating value for all faults that are to be detected. The minimum operating current is 10% of the nominal current.

1.3.2 Conditions

The requirements are a result of investigations performed in our network simulator. The tests have been carried out with an analogue current transformer model with a settable core area, core length, air gap and number of primary and secondary turns. The setting of the current transformer model was representative for current transformers of type TPX and TPY. The results are not valid for TPZ.

All testing was made without any remanence flux in the current transformer core. The requirements below are therefore fully valid for a core with no remanence flux. It is difficult to give general recommendations for additional margins for remanence flux. They depend on the reliability and economy requirements.

When current transformers of type TPY are used, practically no additional margin is needed due to the anti-remanence air gap.

For current transformers of type TPX, the small probability of a fully asymmetrical fault, together with maximum remanence flux in the same direction as the flux generated by the fault, has to be kept in mind at the decision of an additional margin. Fully asymmetrical fault current will be achieved when the fault occurs at zero voltage (0°). Investigations have proved that 95% of the faults in the network will occur when the voltage is between 40° and 90°.

1.3.3 Fault current

The current transformer requirements are based on the maximum fault current for faults in different positions. Maximum fault current will occur for three-phase faults or single-phase-to-earth faults. The current for a single phase-to-earth fault will exceed the current for a three-phase fault when the zero sequence impedance in the total fault loop is less than the positive sequence impedance.

When calculating the current transformer requirements, maximum fault current should be used and therefore both fault types have to be considered.

1.3.4 Calculating transformer requirements

The current transformer secondary limiting emf (E_{2max}) should meet the requirements below:

$$E_{2max} > \frac{I_{kmax} \cdot I_{sn}}{I_{pn}} \cdot 1.5 \cdot \left(R_{CT} + R_L + \frac{0.25}{I_R^2} \right) \qquad \text{(Equation 1)}$$

I_{kmax}	Maximum primary fundamental frequency current for forward and reverse faults
I_{pn}	Primary nominal CT current
I_{sn}	Secondary nominal CT current
I_R	Protection terminal nominal current
R_{CT}	CT secondary winding resistance
R_L	CT secondary cable resistance and additional load

1.4 Serial communication

1.4.1 SPA

The optical fibres that are supplied by ABB Network Partner AB fulfil all the requirements for the communication in the station. Both plastic fibres and glass fibres can be used. For distances up to 30 m, plastic fibres and for distances up to 500 m, glass fibres are suitable. Glass and plastic fibres can be mixed in the same loop. The transmitter and reciever connectors at the bus connection unit has to be of corresponding types, i.e. glass or plastic connector. See also table 2 on page 24.

For communication on longer distances, telephone modems are used. The modems must be Hayes-compatible ones using “AT” commands with automatic answering (AA) capability. The telephone network must comply with the CCITT standards.

For connection of the optical fibre loop to a PC or a telephone modem, an opto/electrical converter is required. The converter uses RS–232C and it has a D25 connector on the electrical side. The converter is supplied by ABB Network Partner AB.

1.4.2 LON

The protection terminal can be used in a substation control system (SCS). For that purpose, connect the LON communication link to a LON Star Coupler via optical fibres. The optical fibres are either glass or plastic with the following specification:

Table 1: Cable connection requirements for LON bus connection

	Glass fibre	**Plastic fibre**
Cable connector	ST-connector	Snap-in connector
Cable diameter	62.5/125 µm	1 mm
Max. cable length	1000 m	30 m

A PC can be used as a station HMI. The PC must be equipped with a communication card for LON (e.g. Echelon PCLTA card). Control functions in the station HMI that is used with REC 561 are available as the High-voltage MicroLibrary (HVLib) functions, which is a library of standard application functions and images for the application engineering in S.P.I.D.E.R. MicroSCADA ver. 8.4 or later.

To configure the nodes in a SCS, the LON Network Tool is needed.

1.4.3 IEC 870–5–103

As an alternative to SPA communication, the terminals can use the IEC 870–5–103 standard protocol for protection functions. The terminals communicate with a primary station level system. In IEC terminology a primary station is a master and a secondary station is a slave. The communication is based on a point to point principle, where the terminal is a slave. The master must have a program that can interpret the

IEC 870–5–103 communication messages. The IEC communication link is connected via optical fibres. The optical fibres are either glass or plastic with the following specification:

Table 2: Cable connection requirements for SPA/IEC connection

	Glass fibre	**Plastic fibre**
Cable connector	ST connector	Snap-in connector
Cable diameter	62.5/125 µm	1 mm
Max. cable length	500 m	30 m

For more detailed requirements refer to the IEC 870–5–103 standard.

1.5 Personal computer for human machine interfacing

The PC shall comply with the following requirements:

- 100% IBM compatible running with DOS 5.0 or higher
- 640 kb RAM or more (at least 450 kb available)
- VGA screen and floppy disk drive 3 1/2” (1,44 Mb)
- 3 Mb disk space required for the HMI program SM/REx 500 with SMS-BASE for communication to the front port
- Additional disk space required depends on the application, see *Buyers Guide for Rex 5xx*, requirements for SMS 010
- one serial port (COM) available.

1 Introduction

All setting values are related to the rated voltage or current of the terminal, in order to simplify tables. However, in section 6, where functions are described, setting values are related to the base voltage or current, in order to increase flexibility at system design. See the section “Terminal identification” for details concerning base values and their definition.

2 General data

2.1 AC measuring accuracy (DA01-DA15)

Note: The actual number of available function blocks may be less than the number referenced, depending on ordered options.

Function	Setting range	Accuracy
Frequency	(0.95-1.05) x f_r	± 0.2 Hz
Voltage (RMS)	(0.1-1.5) x U_r	± 2.5 % of U_r, at $U \le U_r$ ± 2.5 % of U, at $U > U_r$
Current (RMS)	(0.2-4) x I_r	± 2.5 % of I_r, at $I \le I_r$ ± 2.5 % of I, at $I > I_r$
Active power *) Reactive power *)	at $\|\cos \varphi\| \ge 0.9$ at $\|\cos \varphi\| \le 0.8$	± 5 % ± 7.5 %

*) Measured at U_r and 20 % of I_r

2.2 DC (mA) measuring accuracy (MI11-MI66)

Note: The actual number of available function blocks may be less than the number referenced, depending on ordered options.

Function	Setting range	Accuracy
mA measuring function	± 5, ± 10, ± 20 mA 0-5, 0-10, 0-20, 4-20 mA	± 0.1 % of set value
Max current of transducer to input, I_Max	(-25 to +25) mA in steps of 0.01	
Min current of transducer to input, I_Min	(-25 to +25) mA in steps of 0.01	
High alarm level for input, HiAlarm	(-25 to +25) mA in steps of 0.01	
High warning level for input, HiWarn	(-25 to +25) mA in steps of 0.01	
Low warning level for input, LowWarn	(-25 to +25) mA in steps of 0.01	
Low alarm level for input, LowAlarm	(-25 to +25) mA in steps of 0.01	
Alarm hysteresis for input, Hysteresis	(0 - 20) mA in steps of 1	
Amplitude dead band for input, DeadBand	(0 - 20) mA in steps of 1	
Integrating dead band for input, IDeadB	(0 - 1000) mA in steps of 0.01	

2.3 Configurable logic

Timers			
Function	**Number**	**Setting range**	**Accuracy**
Timer, TM	10	(0-60) s in steps of 1 ms	± 0.5 % ± 10 ms
Long timer, TL	10	(0-90000) s in steps of 0.1 s	± 0.5 % ± 10 ms
Pulse timer, TP	10	(0-60) s in steps of 1 ms	± 0.5 % ± 10 ms
Pulse long timer, TQ	10	(0-90000) s in steps of 0.1 s	± 0.5 % ± 10 ms
Logic			
Function	**Number**	**Description**	
AND	30	4 inputs (1 inverted),2 outputs (inverted and non-inverted)	
OR	60	6 inputs, 2 outputs (inverted and non-inverted)	
XOR	39	2 inputs, 2 outputs (inverted and non-inverted)	
INV	20		
SR	5	2 inputs, 2 outputs (inverted and non-inverted)	

2.3.1 Additional configurable logic

Timers			
Function	**Number**	**Setting range**	**Accuracy**
Pulse timer, TP	40	(0-60) s in steps of 1 ms	± 0.5 % ± 10 ms
Logic			
Function	**Number**	**Description**	
AND	239	4 inputs (1 inverted),2 outputs (inverted and non-inverted)	
OR	159	6 inputs, 2 outputs (inverted and non-inverted)	
INV	59		

2.4 Contact data

Function or quantity	Trip and Signal relays	Fast signal relays
Max system voltage	250 V ac, dc	250 V ac, dc
Test voltage across open contact, 1 min	1000 V rms	800 V dc
Current carrying capacity continuous 1 s	 8 A 10 A	 8 A 10 A
Making capacity at inductive load with L/R>10 ms 0.2 s 1.0 s	 30 A 10 A	 0.4 A 0.4 A
Breaking capacity for ac, cos φ>0.4	250 V/8.0 A	250 V/8.0 A
Breaking capacity for dc with L/R<40ms	48 V/1 A 110 V/0.4 A 220 V/0.2 A 250 V/0.15 A	48 V/1 A 110 V/0.4 A 220 V/0.2 A 250 V/0.15 A
Maximum capacitive load	-	10 nF

2.5 Energising quantities

Quantity	Rated value	Nominal range
Current	I_r = 1 or 5 A	(0.2-30) x I_r
	I_r = 1 or 5 A for I_5	
Operation range	(0.004-100) × I_r	
Permissive overload	4 × I_r cont.	
	100 × I_r for 1 s $^{*)}$	
Burden	< 0.25 VA at I_r	
Ac voltage Ph-Ph	U_r = 100/110/115/120 V	(80-120) % of U_r
	U_r = 200/220/230/240 V	
Operation range	(0.001-1.5) x U_r	
Permissive overload	1.5 × U_r cont.	
	2.5 × U_r for 1 s	
Burden	< 0.2 VA at U_r	
Frequency	f_r = 50/60 Hz	± 5 %
Auxiliary dc voltage EL	EL = (48-250) V	± 20 %
power consumption		
basic terminal	≤ 16 W	
each output relay	≤ 0.15 W	
power dissipation		
RL24 = (24/30)V	max. 0.05 W/input	
RL48 = (48/60)V	max. 0.1 W/input	
RL110 = (110/125)V	max. 0.2 W/input	
RL220 = (220/250)V	max. 0.4 W/input	
Binary input/output module		
dc voltage RL	RL24 = (24/30) V	± 20 %
	RL48 = (48/60) V	± 20 %
	RL110 = (110/125) V	± 20 %
	RL220 = (220/250) V	± 20 %
power consumption		
each I/O-module	≤ 1.0 W	
each output relay	≤ 0.15 W	
power dissipation		
RL24 = (24/30)V	max. 0.05 W/input	
RL48 = (48/60)V	max. 0.1 W/input	
RL110 = (110/125)V	max. 0.2 W/input	
RL220 = (220/250)V	max. 0.4 W/input	
Binary input module		
dc voltage RL	RL24 = (24/30) V	± 20 %
	RL48 = (48/60) V	± 20 %
	RL110 = (110/125) V	± 20 %
	RL220 = (220/250) V	± 20 %
power consumption		
each input module	≤ 0.5 W	
power dissipation		
RL24 = (24/30)V	max. 0.05 W/input	
RL48 = (48/60)V	max. 0.1 W/input	
RL110 = (110/125)V	max. 0.2 W/input	
RL220 = (220/250)V	max. 0.4 W/input	
Binary output module		
power consumption		
each output module	≤ 1.0W	
each output relay	≤ 0.25 W	
mA input module		
input range	± 20 mA	
input resistance	R_{in} = 194 Ω	
power consumption		
each mA-module	≤ 4 W	
each mA-input	≤ 0.1 W	

Quantity	Rated value	Nominal range
Ambient temperature	20 °C	-5 °C to +55 °C
Ripple in dc auxiliary voltage	max. 2 %	max. 12 %
Relative humidity	(10-90) %	(10-90) %

*) max. 350 A for 1 s when COMBIFLEX test switch included together with the product $I^2t = 10$ kAs

2.6 Environmental influence

Dependence on:	Within nominal range	Within operative range
Ambient temperature	0.01 % / °C	Correct function
Ripple in auxiliary dc voltage	Negligible	Correct function
Interruption in auxiliary dc voltage without resetting correct function restart time	 < 50 ms 0 - ∞ < 100 s	 < 50 ms 0 - ∞ < 100 s

2.7 Electromagnetic compatability

Test	Type test values	Reference standards
1 MHz burst disturbance For short-range galvanic modem For galvanic interface *) - common mode - differential mode	2.5 kV 2.5 kV 1 kV 0.5 kV	IEC 60255-22-1, Class III IEC 60255-22-1, Class III Class II Class II
Electrostatic discharge For short-range galvanic modem For galvanic interface *)	8 kV 8 kV -	IEC 60255-22-2, Class III IEC 60255-22-2, Class III
Fast transient disturbance For short-range galvanic modem For galvanic interface *)	4 kV 4 kV 1 kV	IEC 60255-22-4, Class IV IEC 60255-22-4, Class IV Class II, level 2
Radiated electromagnetic field disturbance	10 V/m, (25-1000) MHz	IEC 60255-22-3, Class III IEEE/ANSI C37.90.2

*) For FOX6Plus the following modes are not applicable:
- V.36/V11 Co-directional according to CCITT
- RS530/RS422 Co-directional according to EIA

2.8 Insulation

Test	Type test values
Dielectric test For short-range galvanic modem For galvanic interface *)	2.0 kV ac, 1 min 2.5 kV ac, 1 min 1.0 kV ac, 1 min
Impulse voltage test For short-range galvanic modem For galvanic interface *) For other circuits	 5 kV, 1.2/50 µs, 0.5 J 1 kV, 1.2/50 µs, 0.5 J 5 kV, 1.2/50 µs, 0.5 J
Insulation resistance	>100 MΩ at 500 V dc

Reference standard:IEC 60255–5

2.9 Vibration

Test	According to	Reference standards
Vibration	Class I	IEC 60255-21-1
Shock and bump	Class I	IEC 60255-21-2
Seismic	Class I	IEC 60255-21-3

2.10 CE compliance

Test	According to
Immunity	EN 50082-2
Emissivity	EN 50081-2
Low voltage directive	EN 50178

2.11 Size and weight

Weight approx.	1/2 of 19" rack: ≤ 8.5 kg 3/4 of 19" rack: ≤ 11 kg
Dimensions width height depth	 1/2 of 19" rack: 223.7 mm 3/4 of 19" rack: 336 mm 267 mm 245 mm
Storage temperature	-40 °C to +70 °C

2.12 Dead line detection (DLD)

Function	Setting range	Accuracy
Automatic check of dead line condition operate phase voltage operate phase current	 (10-100) % of U_r in steps of 1% (5-100) % of I_r in steps of 1%	 ± 2.5 % of U_r ± 2.5 % of I_r

3 Current, phase wise

3.1 Pole discordance (PD)

Function	Setting range	Accuracy
Operate current	10% of I_r	± 2.5 % of I_r
Time delay	(0-60) s in steps of 1 ms	± 0.5 % ± 10 ms
Auxiliary-contact-based function - time delay	(0-60) s in steps of 1 ms	± 0.5 % ± 10 ms

3.2 Breaker faílure protection (BFP)

Function	Setting range	Accuracy
Operate current (one measuring element per phase)	(5-200) % of I_r in steps of 1 %	± 2.5 % of I_r, at $I \leq I_r$ ± 2.5 % of I, at $I > I_r$
Retrip time delay t1	(0-60) s in steps of 1 ms	± 0.5 % ± 10 ms
Back-up trip time delay t2	(0-60) s in steps of 1 ms	± 0.5 % ± 10 ms
	Value	
Trip operate time	max 18 ms	
Operate time for current detection	max 10 ms	

4 Power system supervision

4.1 Loss of voltage check (LOV)

Function	Setting range	Accuracy
Operate voltage U<	(10-100) % of U_r in steps of 1%	± 2.5 % of U_r

4.2 Overload supervision (OVLD)

Function	Setting range	Accuracy
Operate current I>	(20-300) % of I_r in steps of 1 %	± 2.5 % of I_r, at $I \le I_r$
Time delay	(0-60) s in steps of 1 ms	± 2.5 % of I, at $I > I_r$ ± 0.5 % ± 10 ms

5 Secondary system supervision

5.1 Current circuit supervision (CTSU)

Function	Setting range	Accuracy
Operate current I>	(5 - 100)% of I_r in steps of 1%	± 2.5 % of I_r

5.2 Fuse failure supervision (FUSE)

Function	Setting range	Accuracy
Zero-sequence quantities: operate voltage $3U_0$ operate current $3I_0$	 (10 - 50)% of U_r in steps of 1% (10 - 50)% of I_r in steps of 1%	 ± 2.5 % of U_r ± 2.5 % of I_r
Negative-sequence quantities: operate voltage $3U_2$ operate current $3I_2$	 (10 - 50)% of U_r in steps of 1% (10 - 50)% of I_r in steps of 1%	 ± 2.5 % of U_r ± 2.5 % of I_r

6 Control

6.1 Syncro- and energising check (SYN1-SYN4)

Note: The technical data includes data for the phasing function, which cannot be present without the syncro-check function.

Function	Setting range	Accuracy
Synchro check frequency difference limit, FreqDiff voltage difference limit, UDiff phase difference limit, PhaseDiff	 (50-300) mHz in steps of 10 mHz (5-50) % of U_r in steps of 1 % (5-75)° in steps of 1°	 ≤ 20 mHz ± 2.5 % of U_r ± 2°
Energising voltage level high, UHigh voltage level low, ULow auto-energising period, tAutoEnerg manual energising period, tManEnerg	 (50-120)% of U_r in steps of 1% (10-100) % of U_r in steps of 1% 0-60) s in steps of 1 ms (0-60) s in steps of 1 ms	 ± 2.5 % of U_r ± 2.5 % of U_r ± 0.5 % ± 10 ms ± 0.5 % ± 10 ms
Phasing slip frequency, FreqDiffSynch breaker closing pulse duration, tPulse breaker closing time, tBreaker	 (50-500) mHz in steps of 10mHz (0-60) s in steps of 1ms (0-60) s in steps of 1ms	 ≤ 20 mHz ± 0.5 % ± 10 ms ± 0.5 % ± 10 ms
Phase shift φ_{line} - φ_{bus} Voltage ratio U_{bus}/U_{line}	(0-360)° in steps of 5° (0.20-5.00) in steps of 0.01	
Operate time	**Value**	
For synchro check function For energising check function	typical 190 ms typical 80 ms	

6.2 Autoreclosing (AR01-AR04)

Function	Setting range	Accuracy
Number of autoreclosing shots	1 - 4	
Number of autoreclosing programs	8	
Auto-reclosing open time: shot 1 - t1 1ph shot 1 - t1 2ph shot 1 - t1 3ph shot 2 - t2 3ph shot 3 - t3 3ph shot 4 - t4 3ph	 (0-60) s in steps of 1 ms (0-60) s in steps of 1 ms (0-60) s in steps of 1 ms (0-9000) s in steps of 0.1 s (0-9000) s in steps of 0.1 s (0-9000) s in steps of 0.1 s	 ± 0.5 % ±10 ms ± 0.5 % ±10 ms ± 0.5 % ±10 ms ± 0.5 % ±10 ms ± 0.5 % ±10 ms ± 0.5 % ±10 ms
Reclaim time - tReclaim	(0-9000) s in steps of 0.1 s	± 0.5 % ±10 ms
Inhibit reclosing, reset time -tInhibit	(0-60) s in steps of 1 ms	± 0.5 % ±10 ms
Duration of reclosing pulse - tPulse	(0-60) s in steps of 1 ms	± 0.5 % ±10 ms
Synchro-check/Dead line time limit - tSync	(0-9000) s in steps of 0.1 s	± 0.5 % ±10 ms
Breaker closed before start - tCB	5 s	± 0.5 % ±10 ms
Resetting of “AR Started“ after reclosing - tTrip	(0-60) s in steps of 1 ms	± 0.5 % ±10 ms
Wait for Master release - tWait	(0-9000) s in steps of 0.1 s	± 0.5 % ± 10 ms

7 Logic

7.1 Trip logic(TRIP)

Function	Setting range	Accuracy
Tripping action	1/3-ph, 1/2/3-ph	

7.2 Communication channel test logic (CCHT)

Function	Setting range	Accuracy
Time interval for automatic start of testing cycle, tStart	(0-90000) s in steps of 0.1 s	± 0.5 % ± 10 ms
Time interval available for successful test of an external function, tWait	(0-90000) s in steps of 0.1 s	± 0.5 % ± 10 ms
Minimum time interval for repeated tests of an external function, tCh	(0-90000) s in steps of 0.1 s	± 0.5 % ± 10 ms
Duration of CCHT-CS functional output signal, tCS	(0-90000) s in steps of 0.1 s	± 0.5 % ± 10 ms
Duration of a CCHT-CHOK functional output signal, tChOK	(0-90000) s in steps of 0.1 s	± 0.5 % ± 10 ms
Duration of an inhibit condition after the CCHT-BLOCK input signal resets, tInh	(0-90000) s in steps of 0.1 s	± 0.5 % ± 10 ms

7.3 Binary signal transfer to remote end (RTC)

Note: The RTC function uses internal logic signals and/or a binary I/O module as a data source, and remote end data communication links for communication with remote end terminal(s). See “Introduction” on page 25 for specifications of the binary I/O module, and “Remote end data communication” on page 36 for specifications of the remote end data communication links.

7.4 Binary signal interbay communication (CM01-CM80)

Note: The CM01-CM80 function blocks uses internal logic signals and/or binary I/O modules as a data source, and the LON protocol based communication bus for communication with other terminals and/or a station control system. See “Introduction” on page 25 for specifications of the binary I/O module, and the following section for serial communication specifications. The actual number of available function blocks may be less than the number referenced, depending on ordered options.

7.5 Serial communication

Table 1: SPA protocol

Function	Value
Protocol	SPA
Communication speed	300, 1200, 2400, 4800, 9600, 19200 or 38400 bit/s
Slave number	1 to 899
Remote change of active group allowed	yes/no
Remote changed of settings allowed	yes/no
Connectors and optical fibres	glass or plastic

Table 2: LON protocol

Function	Value
Protocol	LON
Communication speed	1.25 Mbit/s
Connectors and optical fibres	glass or plastic

Table 3: IEC 870-5-103 protocol

Function	Value
Protocol	IEC 870-5-103
Communication speed	9600, 19200 bit/s
Connectors and optical fibres	glass or plastic

Table 4: Front panel connection

Function	Value
Protocol	SPA
Communication speed	300, 1200, 2400, 4800 or 9600 bit/s
Slave number	1 to 899
Remote change of active group allowed	yes
Remote changed of settings allowed	yes
Connectors	special electric/optic cable

7.6 Remote end data communication

Function	Value	
Data communication between the terminals transmission type data transfer rate	 synchronous 56 or 64 kbit/s, For G.703 only 64 kbit/s	
Galvanic interface	**Connection**	
Interface type	V.36/V11 Co-directional V.36/V11 Contra-directional X.21/X27 RS530/RS422 Co-directional RS530/RS422 Contra-directional G.703	According to CCITT According to CCITT According to CCITT According to EIA According to EIA According to CCITT
Connector type	D-sub 15 or 25 pins (G.703 screw)	
Short-range galvanic modem		
Range Cable Line interface Connector Isolation	max 4 km Twisted pair, minimum 2 pairs Balanced symmetrical three-state current loop 5-pin divisible connector with screew connection Galvanic isolation through optocouplers and isolating DC/DC-converter	
Optical interface		
Type of fibre	**Graded-index multimode 50/125μm**	**Single mode 9/125 μm**
Optical connector Wave length Optical transmitter injected power Optical receiver sensitivity Transmission distance	Type FC, e.g. Diamond HFC-13 1300 nm LED -16 dBm PIN diode -40 dBm max 20 km	Type FC-PC, e.g. Diamond HPC-10 1300 nm LED -21 dBm PIN diode -40 dBm max 30 km
Interface type	ABB FOX specific protocol	
Short-range fibre optical modem		
Transmission distance Optical fibre Optical connectors Optical budget Interface type	max 5 km 1300 nm, multimode fibre ST 15dB Fiberdata specific protocol	

8 Monitoring

8.1 Disturbance recorder (DREP)

Function	Setting range
Number of binary signals	0 - 48
Number of analogue signals	0 - 10
Sampling rate	2 kHz
Recording bandwidth	(5-250) Hz
Overcurrent triggering	(0 - 5000) % of I_r in steps of 1 %
Undercurrent triggering	(0 - 200) % of I_r in steps of 1 %
Overvoltage triggering	(0 - 200) % of U_r in steps of 1 % at 100 V sec
Undervoltage triggering	(0 - 110) % of U_r in steps of 1 %
Pre-fault time	(10 - 300) ms in steps of 10 ms
Post fault time	(100 - 3000) ms in steps of 100 ms
Limit time	(500 - 4000) ms in steps of 100 ms
Number of recorded disturbances	Max 10 disturbances
Total recording time with 10 analogue and 48 binary signals *) recorded	maximum 40 s
Voltage channels dynamic range resolution accuracy at rated frequency f_r $U \leq U_r$ $U > U_r$	 (0.01-2.0) x U_r at 100 V sec. 0.1 % of U_r ± 2.5 % of U_r ± 2.5 % of U
Current channels dynamic range without dc offset with full dc offset resolution accuracy at rated frequency f_r $I \leq I_r$ $I > I_r$	 (0.01-110) x I_r (0.01-60) x I_r 0.5 % of I_r ± 2.5 % of I_r ± 2.5 % of I
Built-in calendar	for 30 years with leap years

*) The amount of harmonics can affect the maximum storage time

8.2 Event recorder (EVR)

Function	Value
Time tagging resolution Event buffering capacity Max. number of events/disturbance report Max. number of disturbance reports Time tagging error with synchronisation once/1s Time tagging error with synchronisation once/10s Time tagging error with synchronisation once/60s (minute pulse synchronisation) Time tagging error without synchronisation	1 ms 150 10 ± 1.5 ms ± 1.5 ms ± 1.5 ms ± 3 ms/min

8.3 Increased measuring accuracy

Function	Setting range	Accuracy
Frequency	(0.95-1.05) x f_r	± 0.2 Hz
Voltage (RMS)	(0.8-1.2) x U_r	± 0.25 % of U_r, at $U \leq U_r$ ± 0.25 % of U, at $U > U_r$
Current (RMS)	(0.2-2) x I_r	± 0.25 % of I_r, at $I \leq I_r$ ± 0.25 % of I, at $I > I_r$
Active power *)	at $\lvert\cos\varphi\rvert \geq 0.9$ $0.8 \times U_r < U < 1.2 \times U_r$ $0.2 \times I_r < I < 2 \times I_r$	± 0.5 % of P_r, at $P \leq P_r$ *) ± 0.5 % of P, at $P > P_r$ *)

*) P_r active power at $U = U_r$, $I = I_r$ and $\lvert\cos\varphi\rvert = 1$

9 Metering

9.1 Pulse counter

Function	Setting range	Accuracy
Cycle time for pulse counter	(0.5-60) min in steps of 30 s	± 0.1 % of set value

1 Ordering

The basic version of REB 551 is a breaker protection terminal with breaker failure, current based pole discordance protection and synchrocheck. System supervision functions and event recorder are also included in the basic version.

Basic functions

Self-supervision with internal event recorder

Real-time clock with external time synchronisation

Four groups of setting parameters

Local Human Machine Interface (HMI)

Configurable logic

Service value reading

Monitoring of ac analogue measurements

Monitoring of dc analogue measurements

Ordering Number: 1MRK 002 498-AA **Quantity:** ☐

Includes basic functions and the selected functions and hardware options below

Basic data:

Frequency, f_r	50/60 Hz
Dc voltage, EL	48/60/110/125/220/250 V

Basic data to specify:

Ac inputs

1 A, 110 V	☐ 1MRK 000 157-MA
5 A, 110 V	☐ 1MRK 000 157-NA
1 A, 220 V	☐ 1MRK 000 157-VA
5 A, 220 V	☐ 1MRK 000 157-WA

Interface dc voltage

24/30 V	☐ 1MRK 000 179-EA
48/60 V	☐ 1MRK 000 179-AB
110/125 V	☐ 1MRK 000 179-BB
220/250 V	☐ 1MRK 000 179-CB

Factory configurations

Standard configuration, single or two pole tripping **Quantity:** ☐

Customer-specific configuration **Quantity:** ☐

Functions;

■ = function always included

Current, phase wise

Pole discordance protection (current and contact based)	■ 1MRK 001 456-PA
Breaker failure protection	■ 1MRK 001 458-AA

Power system supervision

Loss of voltage check	■ 1MRK 001 457-VA
Overload supervision	■ 1MRK 001 457-FA

Secondary system supervision

Current circuit supervision (current-based)	■ 1MRK 001 457-XA
Fuse failure supervision (Negative sequence)	☐ 1MRK 001 457-YA
Fuse failure supervision (Zero sequence)	■ 1MRK 001 457-ZA

Control

Note: Only one alternative for Command control, Synch-check and Autorecloser can be selected respectively.

Command control (16 signals)	☐ 1MRK 001 458-EA
Synchro-check and energising-check, single CB	■ 1MRK 001 458-GA
Synchro-check and energising-check, double CB	☐ 1MRK 001 458-FA
Synchro-check and energising-check, 1½ breaker arrangement (per breaker)	☐ 1MRK 001 458-HA
Note: This function requires binary inputs/outputs	
Synchro-check with phasing and energising-check, single CB	☐ 1MRK 001 458-KA
Synchro-check with phasing and energising-check, double CB	☐ 1MRK 001 457-HA
Autorecloser logic, 1 and/or 3 phase, single CB	☐ 1MRK 001 458-LA
Autorecloser logic, 1 and/or 3 phase, double CB	☐ 1MRK 001 457-KA
Autorecloser logic, 3 phase, single CB	☐ 1MRK 001 458-MA
Autorecloser logic, 3 phase, double CB	☐ 1MRK 001 457-LA

Logic

Single or two pole tripping logic	■ 1MRK 001 458-XA
Additional configurable logic	☐ 1MRK 001 457-MA
Communication channel test logic	☐ 1MRK 001 459-NA
Binary signal transfer to remote end *Note: See Communication module alternatives for selecting a comm. module*	☐ 1MRK 001 458-ZA
Binary signal interbay communication, high speed (protection application)	☐ 1MRK 001 455-RA

Monitoring

Disturbance recorder, 40 s	☐ 1MRK 001 458-NA
Event recorder	■ 1MRK 001 459-KA
Trip value recorder	☐ 1MRK 001 458-SA
Increased measuring accuracy for U, I, P, Q	☐ 1MRK 000 597-PA

Metering

Pulse counter logic	☐ 1MRK 001 458-TA

Hardware options;

Casing

Case size	3/4 x 19" (max. 8 I/O) 1MRK 000 151-GA ☐ Standard	1/2 x 19" (max. 3 I/O) 1MRK 000 151-FA ☐ Optional
Combined binary input/output and output modules (max)	4	3
mA input module (max)	3	1

Note: The communication module option, if selected, occupies one I/O position

I/O modules

8 modules are available in the 3/4 x 19" case and 3 modules are available in the 1/2 x 19" case.

	Interface DC voltage	**Quantity**	**Ordering number**
Binary input module (16 inputs)	24/30 V		1MRK 000 508-DA
	48/60 V		1MRK 000 508-AA
	110/125 V		1MRK 000 508-BA
	220/250 V		1MRK 000 508-CA
Binary input/output module (8 inputs and 12 outputs)	24/30 V		1MRK 000 173-GA
	48/60 V		1MRK 000 173-AB
	110/125 V		1MRK 000 173-BB
	220/250 V		1MRK 000 173-CB
Binary output module (24 single outputs or 12 command outputs)			1MRK 000 614-AA
mA input module (6 channels)			1MRK 000 284-AA

Remote end data communication module alternatives
Note: Applicable only when function Binary signal transfer to remote end is selected.
Only one alternative can be selected. Optical fibre or electrical wire is not included.

V.35/V.36 contra-directional galvanic interface ☐ 1MRK 000 185-BA

X.21 galvanic interface ☐ 1MRK 000 185-CA

RS 530/422 contra-directional galvanic interface ☐ 1MRK 000 185-EA

Fibre optical modem ☐ 1MRK 000 195-AA

Short range galvanic modem ☐ 1MRK 001 370-AA

Short range fibre optical modem ☐ 1MRK 001 370-BA

V.35/V.36 and RS 530/422 co-directional galvanic interfaces ☐ On Request

Serial communication modules

Serial communication for SMS and SCS; (one alternative per port)

SMS, port SPA/IEC 870-5-103 (location X13)

Plastic/Plastic ☐ 1MRK 000 168-FA

Glass/Glass ☐ 1MRK 000 168-DA

SCS, port LON (location X15)

Plastic/Plastic ☐ 1MRK 000 168-EA

Glass/Glass ☐ 1MRK 000 168-DA

Engineering facilities

HMI language

Second language besides English

German	☐ 1MRK 001 459-AA
Russian	☐ 1MRK 001 459-BA
French	☐ 1MRK 001 459-CA
Spanish	☐ 1MRK 001 459-DA
Italian	☐ 1MRK 001 459-EA

Customer-specific ordering

Customer-specific order number ☐

Combiflex

COMBITEST test switch module RTXP 24 mounted with the terminal in RHGS6 case with window door ☐ 1MRK 000 371-CA

☐ Internal earthing RK 926 215-BB ☐ External earthing RK 926 215-BC

On/Off switch for the dc supply ☐ RK 795 017-AA

Mounting details with IP40 degree of protection from the front:

19" rack	☐ 1MRK 000 020-BR
Wall mounting	☐ 1MRK 000 020-DA
Flush mounting	☐ 1MRK 000 020-Y
additional for IP54 (protection terminal only)	☐ 1MKC 980 001-2
Semi-flush mounting	☐ 1MRK 000 020-BS
additional for IP54 (protection terminal only)	☐ 1MKC 980 001-2

Accessories:

User documentation

Technical reference manual, REB 551 **Quantity:** ☐ 1MRK 606 008-UEN

Combiflex

Key switch (for locked Settings) **Quantity:** ☐ 1MRK 000 611-A

Resistor unit for creation of 3Uo voltage (RXTMA 1) **Quantity:** ☐ 1MRK 000 486-AA

Communication (remote terminal communication)

Interface converter (dc voltage 48 V)

RS 530/422 contra-directional to G.703 co-directional converter [1)] **Quantity:** ☐ 1MRK 001 295-AA

Optical/electrical converters for short-range optical modems (dc voltage 48-110 V)

V.35/V.36 **Quantity:** ☐ 1MRK 001 295-CA

X.21/G.703 / RS 530 **Quantity:** ☐ 1MRK 001 295-DA

Fibre optic repeater and multiplexer (FOX 20)[2)] available from ABB Network Partner Ltd (Turgi, Switzerland)

1) For dc-supply 110-250 V an extra dc/dc converter type RXTUG 22H is needed, see 1MRK 513 001-BEN.
2) Compatible with Fibre optical modem according to 1MRK 000 195-AA.

Configuration and monitoring tools

Front connection cable for PC (Opto/9-pol D-sub)	**Quantity:**	1MKC 950 001-1
CAP 531, Graphical configuration tool (IEC 1131-3)	**Quantity:**	1MRK 000 876-KB
CAP/REx 500, CAP software module	**Quantity:**	1MRK 000 876-PA
LNT 505, LON configuration tool	**Quantity:**	1MRS 151 400
SLDT, LON configuration module REx 500 available on our website: www.abb.se/net		1MRK 001 700-4
SMS-BASE, Basic program for all SMS applications	**Quantity:**	RS 881 007-AA
SM/REx 500, SMS software module	**Quantity:**	1MRK 000 314-MA
REPORT, program for event and alarm handling in SMS	**Quantity:**	RS 881 011-AA
RECOM Disturbance collection program	**Quantity:**	1MRK 000 077-DC
REVAL Disturbance evaluation program, English version	**Quantity:**	1MRK 000 078-AB

MicroSCADA tools

LIB 520, MicroSCADA engineering tool	**Quantity:**	On request

For our reference and statistics we would be pleased to be provided with the following application data:

Country: End user:

Station name: Voltage level: kV