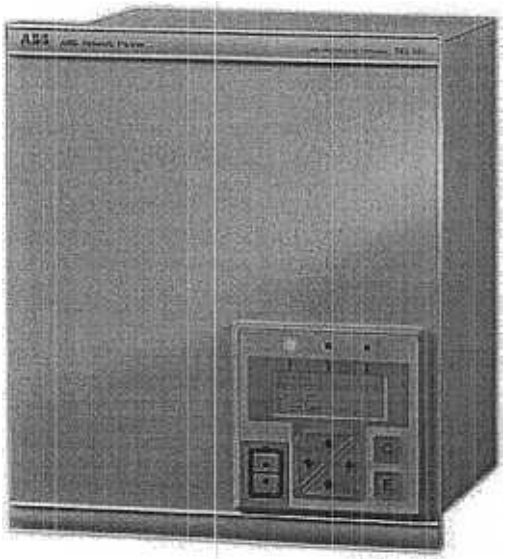
ABB Network Partner

REL 551 * 1.2
Line differential protection terminal

1MRK 506 005-BEN

November 1997
Changed since October 1997
Data subject to change without notice



(SE 95 02 13)

Features

- Phase segregated line differential protection
- Current differential measurement evaluating both magnitude and phase angle
- Master/master design
- Settable through current stabilization
- Current transformer saturation detector increasing the degree of stabilization
- Operation time typically 28 ms
- CT Supervision function
- Digital communication
- Continuous compensation of transmission delay, enabling use of route switched communication network
- MUX-ed 56/64 kbit/s channels complying to CCITT and EIA standards can be used
- Built in communication for dedicated opto fibres up to 30 km
- Additional communication options for dedicated opto fibres up to 120 km
- Short range modem for optical communication to multiplexer up to 5 km.
- Built in modem for communication over twisted pair cable up to 4 km.
- Galvanic interface for connection to multiplexer.
- Direct intertrip function within the digital communication channel
- Communication channel supervision
- Numerical filtering and measuring techniques ensuring correct performance during transient condition
- Versatile man machine communication from the front of the protection and two optional built-in serial ports
- Extensive self supervision with fault diagnostics
- The following optional functions are available:
  - Independent time overcurrent protection
  - Single-phase tripping
  - Non-directional earth fault current protection
  - Three or single pole autoreclosing
  - Breaker failure protection
  - Event reports from the last ten disturbances with up to 150 time tagged events for each disturbance
  - Disturbance recorder with up to 5 analogue and 48 binary signals

Application

NOTE! The line differential function in protection of version 1.1 and 1.2 are not compatible! The communication protocol differs!

REL 551 is a line protection terminal for HV transmission systems and a part of the PYRAMID system. The different parts of the PYRAMID system are available as stand alone units or as building blocks in a complete Station Monitoring System (SMS), Station Control System (SCS) and/or Relay Testing System (RTS).

Current differential protections require a comparison of the currents entering and leaving a protected zone. A dependable communication facility is needed to allow information exchange between the relays at the line terminals.

Pilot wire schemes have been the most commonly used differential protection of transmission lines and feeders. To minimize the number of metallic circuits, summation principles were used to produce a single-phase relaying signal from three-phase line currents. This however caused different sensitivity for different fault types. The principle does not perform adequately for certain types of fault. Failure of operation for some internal faults and maloperations for some external faults can occur.

When dedicated pilot circuits are not available, communication channels have to be used in privately owned communication networks or rented from telecommunication companies. However, with the extensive use of electronic repeating and multiplexing equipment in modern telecommunication systems, direct signalling of power frequency signals is becoming less feasible. There is a need therefore for a new generation of current differential relays suitable for longer line application and designed to follow the trends in the telecommunication industry towards digital communication.

The new digital current differential relay, type REL 551, offers phase selective true differential protection for transmission and sub-transmission lines. The relay is an all digital, multi- microprocessor based design for use with modern digital communication systems, also multiplexed and route switch. Since data can easily be mixed and carried within a digital message, all three phase current signals are transmitted over the same communication channel. Currents are compared on a per phase basis, obviating the problem of current summation approach.

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, utilizing 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. Also included in the message are information for supervision, CT saturation detection, synchronization of terminals, direct transfer trip etc.

The differential measurement is stabilized phase by phase with the current scalar sum, see Fig.1. The degree of stabilization is settable.

To minimize the requirements on the current transformer all currents are individually supervised by CT-saturation detectors. In case of CT-saturation the degree of stabilization is increased in the affected phase, see Fig.1.

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

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

The communication can be either dedicated opto fibres or 56/64 kbit/s multiplexed communication links. With dedicated opto fibres of single-mode type, communication distances up to 120 km can be covered.

The connection to multiplexer can either be galvanic (<100 m distance) and with connection according to CCITT or EIA standard or via a short fibre optic link to an optical-to-electrical converter with connection according to CCITT standard G.703, codirectional, 64 kbit/s.
A direct inter trip is transmitted between the terminals in the common telegram. This intertrip is activated through a separate input and has a separate output.

A built in CT-supervision function provides both an alarm signal and block signal. The block signal is intended for blocking of the line differential function. The CT-supervision function is based on comparison between the zero sequence current calculated from the phase currents and a reference current. The reference current is taken from the zero sequence current from another core. This core can either be of measuring transformer type or a relay type.

The REL 551 can communicate with REL 561. When the voltage based options in REL 561 only is required in one of the line terminals REL 551 can be installed in the other terminal.

The REL 551 terminal can however only perform three pole tripping.

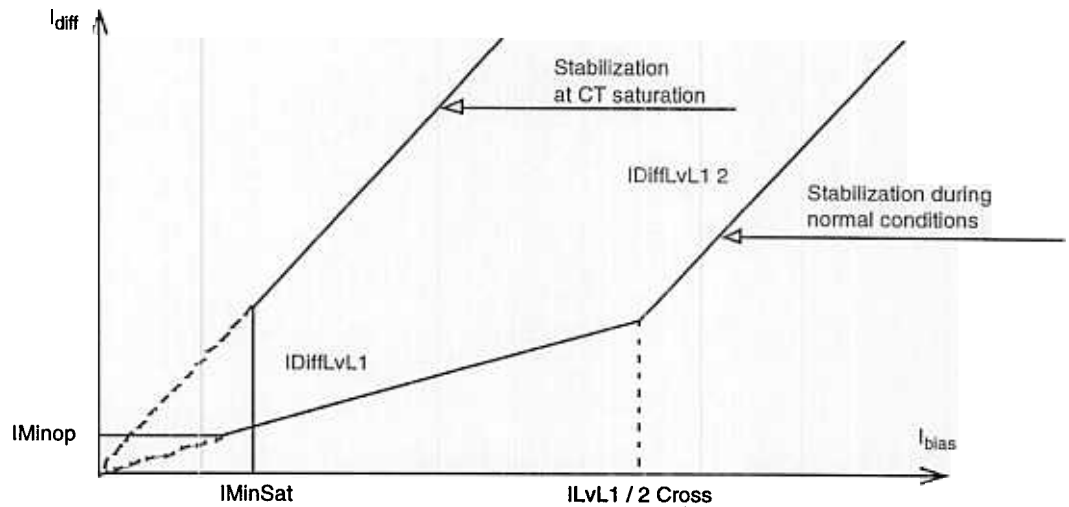


Fig. 1 Stabilization characteristic

A high set instantaneous phase overcurrent function is included.

Four independent groups of setting parameters are available within the REL 551. The user can change an active group 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). Change of active setting group is possible also by the activation of binary inputs.

Actual values of all binary input signals and internal logical signals are available on each of the two local MMI possibilities. All binary inputs and outputs can be set to 1 or 0.

Optional function
Independent time overcurrent protection measuring phase and residual current.

Non-directional ground fault current protection functions are available to detect high resistive ground faults.

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

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

The reclosing function can be selected to perform single-phase and/or three phase reclosing from eight single shot to multiple shot reclosing programs. The three-phase autoreclose open time can be selected to give either high speed autoreclosing or delayed autoreclosing.

The reclaim time and duration of the closing pulse are settable.

Optional breaker failure protection is available measuring the current through the line circuit breaker. The current measuring principle is stabilized against the dc-transient that can cause unwanted operation at saturated current transformers.

The operating values of the three current measuring elements are settable within a wide range. The time measurement is individual for each phase. Two independent timers are available, T1 for a repeated tripping of the "own" circuit breaker and T2 for the busbar trip.

Any of the REL 561 internal tripping functions can start the breaker failure protection. The breaker failure function can also be started phase by phase externally.

An event recording function is available presenting in a logical order, starting and tripping signals that have appeared during each of the last ten recorded disturbances. Up to 150 time tagged events for each of the last ten recorded disturbances are stored. Time synchronization is possible, by means of external minute pulses connected to an binary input as well as through the optionally built in communication ports for remote communication.

Optional disturbance recorder with high performances is one of the building blocks within the REL 551. It can memorize up to 4 analogue and 48 binary signals (binary input signals or internal signals) that are available within the terminal. Typical recording time is 10 seconds. Any of the recorded analogue and binary signals can be programmed to start a recording. All analogue and digital signals are programmable to start the recording at high or low values.

The disturbance recorder option can be selected as a disturbance recorder with extended memory.

The time is provided by an internal clock that can be externally synchronized. Pre-fault time, post fault time and limit time are settable in wide ranges.

Collection of disturbance records is possible locally by means of a PC used for the local man machine communication as well as remotely within the SMS. A disturbance evaluator, PC based, program type REVAL that operates under MS Windows, is also available.

Optional remote serial communication

One or two serial communication ports are optionally available with the REL 551. They are installed independently on the back of the REL 551. The remote communication with a REL 551 is using optical fibres to eliminate influence of the electromagnetic interferences. This remote communication makes the REL 551 a part of a SMS and/or SCS system. The SMS and SCS systems enable the operator in a control centre as well as a relay engineer in the office to read information from the terminal and also to change an active setting group as well as 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 the relay engineer to communicate with the REL 551 (through a telephone network), read information from the relay on a PC screen and store it on PC files. Complete information on the last ten disturbances is available as well as 150 time tagged events.

The operator in a control room and/or control centre has similar possibilities, when one communication port is connected to the SPA-bus within the SCS system.

Collection of the disturbance record files is possible remotely within the substation monitoring system (SMS) by using SMS-BASE. Evaluation of the disturbance records is possible by means of the REVAL PC based evaluator program.

Design

The REL 551 line protection terminal is provided in a closed case having a common ABB look that is 224 mm wide and 6U (267 mm) high. A mother board is mounted behind the front plate of the terminal. All modules are of a plug-in type and removable. Screw connection terminals are mounted at the rear of the terminal for connections to external circuits. Optional optical connectors of type SPA-ZC21 for communication within SCS and SMS are located at the rear.

Optical or electrical connection for the differential protection function is located at the rear.

The REL 551 consists of the following units:

- Transformer module with *four* current inputs.
- A/D converter module for 4 analogue signals sampled 2000 times/s.
- Central processing module performing all the REL 551 measuring functions.
- Power supply module with a regulated DC/DC converter that supplying all static circuits. The supply unit also contains binary input and output.
- Man machine interface module, installed on the front of the REL 551, serves as a local communication facility between the user and the equipment.

The following hardware modules are available optionally to the basic version of REL 551:

- One additional input/output modules.
- One or two serial communication interface modules of type SPA-ZC21 for connection of REL 561 terminal to SCS and SMS system.

The measuring technique used in REL 551 protection terminal is based on numerical methods. The measuring digital signal processors operate with numerical signals derived from the analogue to digital converter.

The self supervision function operates continuously and includes:

- normal microprocessor watch-dog function
- checking of digitized measuring signals
- checksum verification of PROM contents
- checksum verification on all signal communications
- Read-Write-Read-Write cycling of the memory cells and internal registers

Totally four analogue input quantities are processed in the transformer module:

- the three phase currents
- residual current ($3I_0$) in the protected line

The analogue signals are low pass filtered before they are converted from analogue to numerical values. The numerical values are then transferred into serial form and fed to the measuring processors by the aid of a separate digital signal processor.

The measurement in REL 551 is performed by a number of digital signal processors (DSP) performing different measuring functions. The DSPs are connected to a serial data bus from the analogue to digital converter. Thus REL 551 is of multiprocessor design where the calculation for the measurement is divided into different DSPs for different functions.

The optional functions are basically performed in optional DSPs.

The results from the DSPs are coordinated in a 32-bit micro processor that also controls the CAN-bus communication with the binary I/O modules.

The optical or galvanic port for the differential protection digital communication is performed in a separate communication module. Different

modules are used for optical and galvanic communication.

The power supply module has a regulated DC/DC converter that provides stabilized auxiliary voltage to all static circuits within the REL 561.

The MMI module has a common ABB look and is installed on the front of REL 551. The MMI module is used for the local communication with the personnel on site. The most important MMI functions are:

- settings: Four groups of setting parameters are settable and readable in a self explanatory structured menu. Different parameters are separately changeable within the different setting groups. Selection of an active setting group is also possible
- information handling: The most important information on the last ten disturbances including the time of disturbance, its duration together with starting and tripping signals are stored in REL 551 and available any time through the MMI unit. Information about the actual line current
- the same is valid for the status of all important internal logical signals as well as input and output signals.
- fault tracing: Faulty part in the REL 551 and the differential protection communication, detected by the built-in continuous self supervision, will be presented by codes on the MMI
- testing: Test of functions and wiring during commissioning, and other types of testing, is possible by setting any of the input and output logical signals to the logical value 1 or 0. Complete signalling, tripping and logical circuits within the line bay can be tested in this way.

A PC can be connected through an optical connector on the front of the built-in MMI module. By this a disturbance free local communication with the personal computer is achieved. The use of a personal computer simplifies the communication with the REL 551 and adds functionality, that due to the lack of space is not available on the built-in MMI module:

- up to 150 time tagged events are available for each of the last ten recorded disturbances
- disturbance records are available for collection by a personal computer and a corresponding software.

Optional modules
The differential protection optical module in REL 551 can without any additional units communicate over dedicated fibres up to 30 km. When greater distances have to be covered the optional FOX 20 system from ABB Netcom Ltd. Switzerland is available.

The FOX 20 is used as a repeater for longer distances than 30 km. The optical unit in REL 551 is optically connected to a FOX 20 unit that sends the signals on the dedicated fibres. With this configuration it is possible to cover distances up to 120 km with single mode fibres.

The FOX 20 unit can also operate as a multiplexer in which case a number of 64 kbit/s data channels and a RS232 channel can be transmitted in parallel with the differential communication.

The differential protection can directly galvanically (max. distance 100 m) be connected to a multiplexer. The build in interface can support the CCITT standard v.35/36 co-directional or contra-directional and X.21 64 kbit/s and EIA RS-530/422 co-directional or contra-directional 56 kbit/s.

The CCITT G.703 can be connected over an external converter V.35 contra-directional to G.703 that can be delivered on request.

When the distance between the differential protection and the multiplexer is to great for a direct galvanic connection a short range optical modem 21-15X is used. The distance can be up to 5 km and the optical/galvanic converter 21-15X can directly support the CCITT standard v.35/36 co-directional or contra-directional as well as X.21 and G.703.

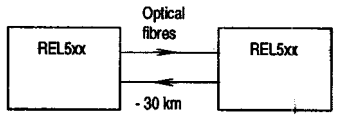
The differential protection can with built in modem communicate galvanically over twisted pair cable (max. distance 4 km).

One additional binary input/output unit can be added. All binary inputs are freely programmable to any of the built-in functions including the event and disturbance recording. Also the internally generated binary signals in REL 551 are freely programmable to the event and disturbance recording function

SMS and SCS communication
One or two serial interface modules of type SPA-ZC21 for remote communication enables the REL 551 terminal to be a part in an SCS and/or SMS system. These modules are optional and located at the rear of REL 551.

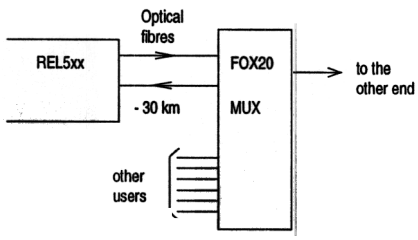
Two optical loops can be built up, one independent of another, each of them with different competencies regarding monitoring and setting the functions in REL 551 terminal. Plastic fibres can be used up to a length of 30 meters. Glass fibres can be used up a length of 500 meters.

An optical loop can be used for remote communication within the substation control system SCS 200. The loop is normally closed within the bay and/or connected to a bay computer. This enables communication with the REL 551 through the station bus from the operator's work place and also from a control centre.



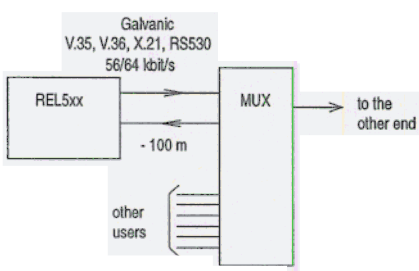
(X80039-2.2)

Dedicated link, fibre optical connection



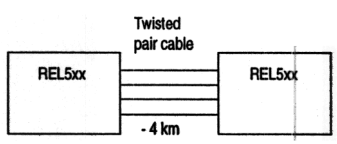
(X80039-2_5)

Multiplexed link, fibre optical connection



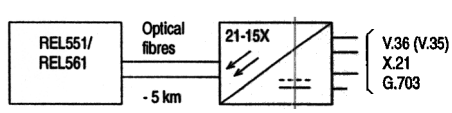
(X80039-2_6)

Multiplexed link, galvanic connection



(X80039-2_4)

Dedicated link, short range galvanic modem



(X80039-2_7)

Multiplexed link, short range fibre optical connection

Fig. 2 Communication alternative

The second optical communication loop can be, for example, built up on station level. It can include different numerical relays of the PYRAMID range with remote communication possibilities. The optical loop is closed by an opto/electrical converter with a RS 232-C connector on its output. Connection to a personal computer can then be performed directly (if the computer is located in the substation) or by a telephone modem through a telephone network with CCITT characteristics. Instead of the optical loop, a star connection can be used. In this case a port expander is necessary as a gateway from the different protection terminals to the PC (telephone modem).

Remote communication with REL 551 enables operation in the same way as when operating it locally by means of the local MMI. The following additional functions or limitations are present with the remote communication facilities:

- up to 150 time tagged events for each of the last ten disturbances stored in the REL 551 memory with 1 ms resolution can be presented locally or remotely within the SMS system.
- the REL 551 internal clock can be synchronized with a station clock and other equipment in the station either through the SCS optical communication loop or through the input for minute pulses.
- selection of access levels to monitoring and setting possibilities within the REL 551 is only possible through the local MMI.

Technical data

Table 1: Energizing quantities, rated values and limits

Quantity	Rated value	Nominal range
Current	I_r = 1 or 5 A	(0,2-30) x I_r
Operative range	(0,2-4) × I_r cont.	(0,2-15) x I_r for line differential function
	(0,2-100) × I_r for 1 s *)	
Burden	< 0,25 VA at I_r	
Frequency	f_r = 50/60 Hz	± 5 %
Auxiliary dc voltage EL	U_r = (48/60) V	± 20 %
	U_r = (110/125) V	± 20 %
	U_r = (220/250) V	± 20 %
power consumption		
basic terminal	≤ 14 W	
each I/O-board	≤ 1 W	
Comm board	≤ 2 W	
each output relay	≤ 0,1 W	
Binary input circuits		
dc voltage RL	U_r = (24/30) V	± 20 %
	U_r = (48/60) V	± 20 %
	U_r = (110/125) V	± 20 %
	U_r = (220/250) V	± 20 %
power consumption		
U_r = (24/30)V	max. 0,05 W/input	
U_r = (48/60)V	max. 0,1 W/input	
U_r = (110/125)V	max. 0,2 W/input	
U_r = (220/250)V	max. 0,4 W/input	
Ambient temperature	20° C	-5° C to +55° C
	max. 2 %	max. 12 %
	(10-90) %	(10-90) %

*) max. 350 A for 1 s when COMBIFLEX test switch included together with the product

Table 2: Influencing factors, Permissible 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	< 50 ms	< 50 ms
correct function	0 - ∞	0 - ∞
restart time	< 45 s	< 45 s

Table 3: Electromagnetic compatibility tests

Test	Type test values	Reference standards
1 MHz burst disturbance	2,5 kV	IEC 255-22-1, Class III
For short range galvanic modem	2,5kV	IEC 255-22-1, Class III
For galvanic interface *)		
- differential mode	1 kV	Class II
- common mode	0,5 kV	Class II
Electrostatic discharge	8 kV	IEC 255-22-2, Class III
For short range galvanic modem	8 kV	IEC 255-22-2, Class III
For galvanic interface *)	-	
Fast transient disturbance	4 kV	IEC 255-22-4, Class IV
For short range galvanic modem	4 kV	IEC 255-22-4, Class IV
For galvanic interface *)	1 kV	Class II, level 2
Radiated electromagnetic field disturbance	10 V/m, (25-1000) MHz	IEC 255-22-3, Class III Draft IEEE/ANSI C37.90.2

*) Applicable for the differential communication module and FOX6Plus only, for the following standards:
- V.36/V11 Co-directional according to CCITT
- V.36/V11 Contra-directional according to CCITT
- X21/X27 according to CCITT
- RS530/RS422 Co-directional according to EIA
- RS 530/RS422 Contra-directional according to EIA
- G.703 according to CCITT

Table 4: Insulation tests (reference standard: IEC 255-5)

Test	Type test values
Dielectric test	2,0 kV ac, 1 min
For short range galvanic modem	2,5 kV ac, 1 min
For galvanic interface *)	1,0 kV ac, 1 min
Impulse voltage test	
For short range galvanic modem	5 kV, 1,2/50 µs, 0,5 J
For galvanic interface *)	1 kV, 1,2/50 µs, 0,5 J
For other circuits	5 kV, 1,2/50 µs, 0,5 J
Insulation resistance	>100 MΩ at 500 V dc

*) Applicable for the differential communication module and FOX6Plus only, see comments under table 3.

Table 5: Mechanical tests

Test	Type test values	Reference standards
Vibration	Class I	IEC 255-21-1
Shock and bump	Class I	IEC 255-21-2
Seismic	Class I	IEC 255-21-3

Table 6: Contact data (reference standard: IEC 255)

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<40 ms	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

Table 7: Additional General Data

Weight approx.	8,5 kg
Dimensions width height depth	 223,7 mm 267 mm 245 mm
Storage temperature	-40° C to +70° C

Table 8: Event recording

Function	Value
Time tagging resolution	1 ms
Event buffering capacity	
Max. number of events/disturbance report	150
Max. number of disturbance reports	10
Time tagging error with synchronisation once/1s	± 1,5 ms
Time tagging error with synchronisation once/10s	± 1,5 ms
Time tagging error with synchronisation once/60s (minute pulse synchronisation)	± 1,5 ms
Time tagging error without synchronisation	± 3 ms/min

Table 9: Remote serial communication

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/no
Remote changed of settings allowed	yes/no
Connectors and optical fibres	glass or plastic

Table 10: Disturbance recorder

Function	Setting range
Number of binary signals	0 - 48
Number of analogue signals	0 - 4
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 %
Pre-fault time	(50 - 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
Function	**Value**
Current channels dynamic range without dc offset with full dc offset resolution	 (0,01-110) x I_r (0,01-60) x I_r 0,5 % of I_r
Total recording time with 10 analogue and 48 binary signals *) recorded	typical 15 s maximum 40 s with extended memory
Built-in calendar	for 30 years with leap years

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

Table 11: CT supervision

Function	Setting range
Operating current I>	(5 - 100)% of I_r in steps of 1%

Table 12: Differential protection

Function	Setting range
Current scaling (CTFactor)	(0,4-1,0) in steps of 0,01
Minimum operate current (IMinOp) Slope 1 (IDiffLvl1) Slope 2 (IDiffLvl2) Slope 1/Slope 2 intersection (ILvl1/2Cross) Slope at saturation Saturation min current (IMinSat)	(20-150) % of (CTFactor x I_r) in steps of 1 % (20-150) % of I_{bias} in steps of 1 % (30-150) % of I_{bias} in steps of 1 % (100-1000) % of (CTFactor x I_r) in steps of 1 % 1,60 x I_{bias} (100-1000) % of (CTFactor x I_r) in steps of 1 %
Function	**Value**
Operate time I_{diff} > 2 x I_{bias} and I_{diff} > 4 x IMinOp	 Typical 28 ms
Reset time at I_{diff} = 0	max 55 ms
Transfer trip operating time	max 35 ms
Data communication between the terminals transmission type data transfer rate	 synchronous 56 or 64 kbit/s For G.703 only 64 kbit/s

Table 13: Communication for differential protection

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 Line interface Connector Isolation	max 4 km Balanced symmetrical three-state current loop 5-pin divisible connector with screew connection Galvanic isolation through optocouplers and isolating DC/DC-converter	
Optical interface Terminal dedicated fibre Terminal - FOX 6 PLUS (G.703)		
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
Short range fibre optical modem		
Transmission distance Optical fibre Optical connectors Optical budget	max 5 km 1300 nm, multimode fibre ST 15dB	

Table 14: Instantaneous overcurrent protection

	Setting range	**Operate time**
Operate current	(50-2000) % of I_r in steps of 1 %	-
Dynamic overreach at $\tau < 100$ ms	-	-
Minimum operate time at $I > 10 \times I_{set}$		max 15 ms

Table 15: Overcurrent protection

Function	**Setting range**
Operating current phase measuring elements residual measuring elements	 (10-400) % of I_r in steps of 1 % (10-150) % of I_r in steps of 1 %
Dynamic overreach at $\tau < 100$ ms	-
Time delay phase current measuring el. residual current measuring el.	 (0-25) s in steps of 0,01s (0-25) s in steps of 0,01s

Table 16: Autoreclosing - Three-phase

Function	Setting range
Number of autoreclosing shots	1 - 4
Number of autoreclosing programs	4
Autoreclosing open time: shot 1 - t1 shot 2 - t2 shot 3 - t3 shot 4 - t4	 (0,2-60) s in steps of 0,01 s (1,0-300) s in steps of 1 s (1,0-300) s in steps of 1 s (1,0-300) s in steps of 1 s
Reclaim time - tReclaim	(10-300) s in steps of 1 s
Inhibit reclosing, reset time -tInhibit	(5-30) s in steps of 1 s
Duration of reclosing pulse - tPulse	(0,1-1,0) s in steps of 0,01 s
SC/DC time limit - tSync	(0,5-10,0) s in steps of 0,1 s
Breaker closed before start - tCB	5 s
Resetting of "AR Started" after reclosing - tTrip	(0,2-1,0) s in steps of 0,1 s

Table 17: Autoreclosing - Single- and/or three-phase

Function	Setting range
Number of autoreclosing shots	1 - 4
Number of autoreclosing programs	8
Auto-reclosing open time: 1-phase shot 1 - t1s 3-phase shot 1 - t1 3-phase shot 2 - t2 3-phase shot 3 - t3 3-phase shot 4 - t4	 (0,2-5,0) s in steps of 0,01 s (0,2-60) s in steps of 0,01 s (1,0-300) s in steps of 1 s (1,0-300) s in steps of 1 s (1,0-300) s in steps of 1 s
Reclaim time - tReclaim	(10-300) s in steps of 1 s
Inhibit reclosing, reset time -tInhibit	(5-30) s in steps of 1 s
Duration of reclosing pulse - tPulse	(0,1-1,0) s in steps of 0,01 s
SC/DL time limit - tSync	(0,5-10,0) s in steps of 0,1 s
Breaker closed before start - tCB	5 s
Resetting of "AR Started" after reclosing - tTrip	(0,2-1,0) s in steps of 0,1 s

Table 18: Non-directional earth-fault overcurrent protection

Function	Setting range	Accuracy
Basic current for inverse time delay $3I_0$	(5-300) % of I_r in steps of 1%	
Independent time delay	(0-6,0) s in steps of 0,01 s	± 0,5 % ± 10 ms
Normal inverse characteristic	k = (0,05-1,1) in steps of 0,01	IEC 255-3 class 5 ± 60 ms
Very inverse characteristic	k = (0,05-1,1) in steps of 0,01	IEC 255-3 class 7,5 ± 60 ms
Extremely inverse characteristic	k = (0,05-1,1) in steps of 0,01	IEC 255-3 class 7,5 ± 60 ms
Logarithmic characteristic $t = 5,8 - 1,35 \times ln\frac{I}{3I_0}$		± 5 % of t at I = (1,3-29) x $3I_0$
tMin for dependent characteristic	(0,05-6,0) s in steps of 0,01 s	
Min. operate current for dependent characteristic IMin	(100-400) % of $3I_0$ in steps of 1 %	
Operating time	**Value**	
Resetting time	< 70 ms	

Table 19: Breaker failure protection

Function	Setting range
Operating current (one measuring element per phase)	(10-200) % of I_r in steps of 1 %
Retrip time delay t1	(0-150) ms in steps of 1 ms
Back-up trip time delay t2	(50-400) ms in steps of 1 ms
	Value
Trip operate time	max 18 ms
Operate time for current detection	max 10 ms

Ordering

The basic version of REL 551 is a phase segregated line differential protection terminal for three-phase tripping. High set instantaneous overcurrent protection are also included.

Ordering Number: 1MRK 000 480-AA **Quantity:** ☐

Basic data:

Frequency, f_r	50/60 Hz
Ac voltage, U_r	100/110/115/120 V
Dc voltage, EL	48/60/110/125/220/250 V

Basic data to specify:

Rated current, I_r	☐ 1A	☐ 5A		
Interface dc voltage, RL 1	☐ 24/30 V	☐ 48/60 V	☐ 110/125 V	☐ 220/250 V

Communication modules:
(one and only one alternative must be selected. Optical fibre or electrical cables are not included.)

V.35/36 co-directional galvanic interface	☐ 1MRK 000 185-AA
V.35/36 contra-directional galvanic interface	☐ 1MRK 000 185-BA
X.21 galvanic interface	☐ 1MRK 000 185-CA
RS 530/422 co-directional galvanic interface	☐ 1MRK 000 185-DA
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

Options:

One additional I/O module with 8 binary inputs and 12 signalling output relays
Interface dc voltage, RL2:

☐ 24/30 V	☐ 48/60 V	☐ 110/125 V	☐ 220/250 V
1MRK 000 173-GA	1MRK 000 173-AB	1MRK 000 173-BB	1MRK 000 173-CB

Autoreclosing (only one alternative can be selected):

Three-phase	☐ 1MRK 000 482-AA
Single- and/or three-phase	☐ 1MRK 001 380-AA
Single-phase tripping	☐ 1MRK 000 438-AA
Earth-fault overcurrent protection – non-directional	☐ 1MRK 000 482-BA
Event recorder	☐ 1MRK 000 482-CA
Independent time overcurrent	☐ 1MRK 000 482-DA
Breaker failure protection	☐ 1MRK 000 482-EA
Remote communication (SMS/SCS)	☐ 1MRK 000 482-FA

Disturbance recorder (only one alternative can be selected):

Disturbance recorder	☐ 1MRK 000 482-GA
Disturbance recorder with extended memory	☐ 1MRK 001 377-AA
On line control function (10 signals)	☐ 1MRK 000 482-HA
Simulation logic	☐ 1MRK 000 482-KA

Bus connection unit for remote communication, type SPA-ZC21 (one for each port if used)

Transmitter	Receiver	Quantity:	
Plastic	Plastic	1 ☐ 2 ☐	1MRK 000 194-AA
Plastic	Glass	1 ☐ 2 ☐	1MRK 000 194-BA
Glass	Plastic	1 ☐ 2 ☐	1MRK 000 194-CA
Glass	Glass	1 ☐ 2 ☐	1MRK 000 194-DA

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

☐ Internal earthing ☐ External earthing

On/Off switch for the auxiliary dc-supply ☐ RK795 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
No mounting details	☐

Accessories:

User's Guide for REL 551 * 1.2	**Quantity:** ☐	1MRK 506 005-UEN
Front connection cable for PC (Opto/9-pol D-sub)	**Quantity:** ☐	1MKC 950 001-1
Fibre optic repeater and multiplexer (FOX 20) available from ABB Netcom		
Fibre optic and G 703 converter (FOX 6 PLUS)		
V36 to G 703 converter *)	**Quantity:** ☐	1MRK 001 295-AA
Optical/electric converter for short range optical moden (dc-supply 48-110 V)		
V.35/V.36	**Quantity:** ☐	1MRK 001 295-CA
X.21/G.703	**Quantity:** ☐	1MRK 001 295-DA
SMS-BASE, version 2.0, Basic program for SMS and PC front connection	**Quantity:** ☐	RS 881 007-AA
SM/REL 551 SMS Program module for REL 551 * 1.2	**Quantity:** ☐	1MRK 000 314-FB
RECOM Disturbance collection program, version 1.3	**Quantity:** ☐	1MRK 000 077-DB
REVAL Disturbance evaluation program, english version	**Quantity:** ☐	1MRK 000 078-AA
CAP 531 - Graphical configuration tool	**Quantity:** ☐	1MRK 000 876-KA
CAP/REL 551, CAP program module for REL 551 * 1.2 [1]	**Quantity:** ☐	1MRK 000 876-DA

[1] SMS-BASE and SM/REL 551 is required

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

Country: End user:

Station name: Voltage level: kV

Available only for V35/36 Contra-mode.
(For dc-supply 110-250 V an extra dc/dc converter type RXTUG 22H is needed, see 1MRK 513 001-BEN).

References

Series RE 500 Mechanical design and mounting accessories	1MRK 514 003-BEN
SPA-ZC 21	34 SPACOM 22 EN1 A
User's Guide REL 551 * 1.2	1MRK 506 005-UEN
Reference List REL 551	1MRK 506 005-REN
SMS 010	1MRK 511 014-BEN
CAP 531	1MRK 511 034-BEN