Railway systems

REL 517 Line Protection Terminal

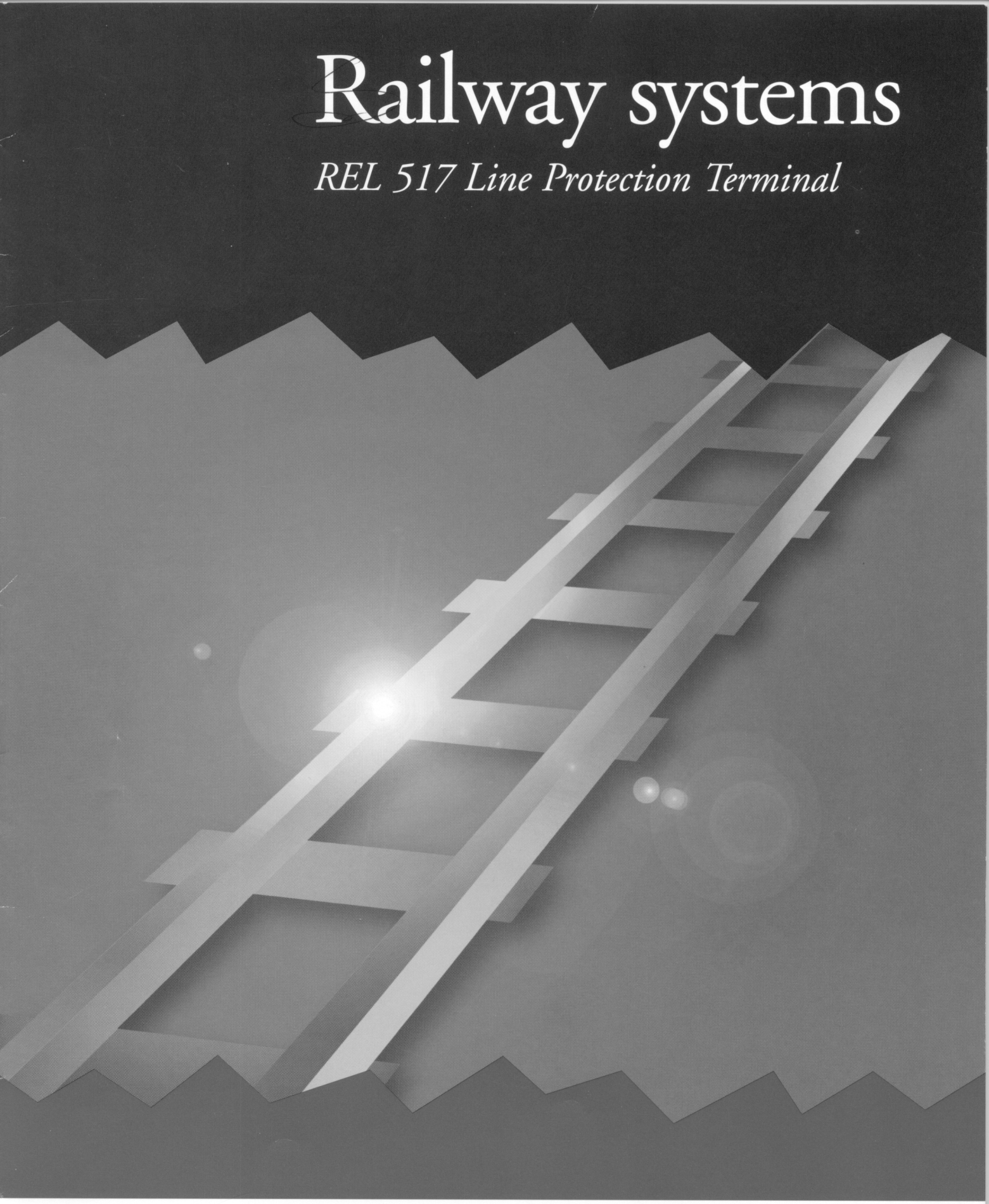
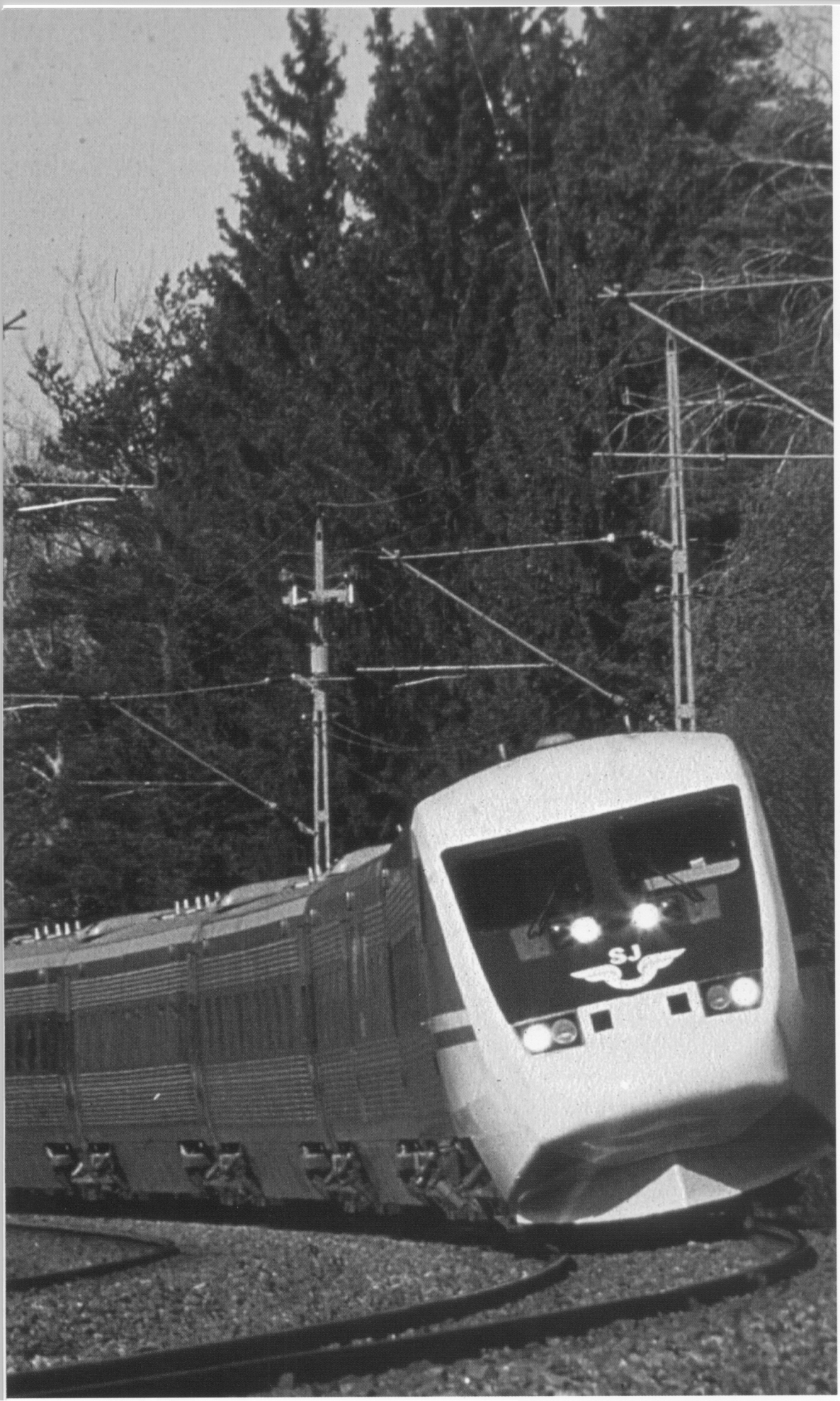


ABB Network Partner

ABB



Feeders and contact lines for railway systems are more exposed to electrical faults than other parts of the power supply system. Digital protective devices for 16 2/3 Hz satisfy the stringent requirements placed on effective protection of such systems.

The principal features of the latest generation of protective devices include rapid and selective fault clearing, correct auto-reclosing, facilities for accurate fault location and event and disturbance recording — all of which are essential functions for limiting the consequences of faults in transmission and contact lines.

A new approach to protection of railway feeders and contact lines

At the limits of capacity

The basic and most important function in line protection is always the clearing of power system faults, whereby the faulty section is disconnected from the network.

In many cases, transmission systems for railway networks operate at the limits of their technical capacity. A fault in an important part can have severe consequences for the system as a whole if the total fault clearing time is too long. Top priority is given to reducing the risk of loss of stability, and in this context, the minimum operating time for a protection device is a vital piece of data. However, the maximum possible operating time and the breaker operating time are the most important items of information and are in fact the only relevant consideration when discussing system stability when faults arise.

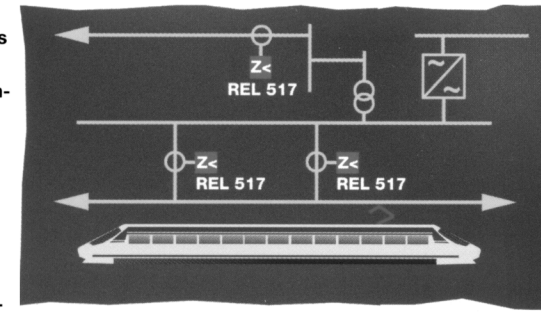
Increased risk of interference

The demands imposed on protective devices for 16 2/3 Hz feeders and contact overhead lines in railway systems are determined by the characteristics of the power unit, locomotive or railcar drive system, and by the characteristics and operation of the power supply, for example whether dealing with static or moving converters. New types of high-speed train and more powerful tractive units may cause excessive current peaks. Due to reinforcement and meshing of the railway network, short-circuit currents also increase. Both circumstances, unacceptable high-load currents and high short-circuit currents, must be detected promptly and cut out of the network to prevent damage to the overhead lines or, in a worst-case scenario, burning of these lines. Such quick detection and prompt action helps reduce the amount of line disruption and its duration. Digital protection satisfies the stringent requirements placed on effective protection of railway networks.

A multitude of protection systems

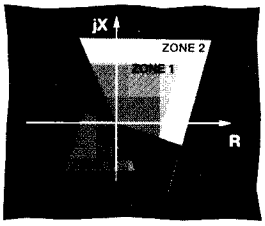
The 500 Series line protection system has established a new concept in protection of 50 and 60 Hz power systems by offering a variety of protection configurations. They can be combined with fibre-optic sensors to achieve maximum performance with minimum compromise in different network and line configurations.

Expanding the 500 Series, ABB Network Partner AB now offers a new line protection terminal, the REL 517, for protection of railway transmission and contact lines. The REL 517 is the result of the vast knowledge gained in the development of the current 500 Series products and the past decade's experience from the manufacture of railway transmission line protection systems.



The railway power supply system includes two types of power lines:
- contact lines (single-conductor system)
- supply lines (single and two-conductor system)
REL 517 can protect both types at system voltages from 10 to 130 (300) kV, and is applicable for both overhead lines and underground cables.

Functionality for all contact and supply lines



The characteristic of the distance protection system's zones. Each zone can be selected at will — forwards, reverse or non-directional.

Distance protection

The main protection facility in REL 517 is a full scheme distance protection device featuring three impedance measuring zones with quadrilateral characteristic. The settings for each zone are fixed entirely independently with regard to:

- reactive and resistive reach
- earth return compensation factor
- directionality of all zones

Scheme communication logic is available for the distance protection device. The logic is user-programmable to permit applications for permissible overreach and underreach schemes as well as blocking schemes.

Sudden current change

In railway systems it is sometimes difficult to distinguish between a fault and an accelerating train. In both cases the impedance might enter into the time-delayed zones. The difference between the two can be distinguished by the sudden current change function which operates for faults but not for loads caused by the train.

Thermal overload

To prevent the line from being overheated, a thermal overload function can be included. Since the maximum allowable load – and therefore also the line's absolute temperature – is a function of ambient temperature, it is possible to compensate for this.

Earth fault overcurrent protection

The directional or non-directional earth fault overcurrent protection system operates as a complementary function to distance protection. The earth fault overcurrent protection is available with definite or inverse time delay. Measurements in forward and reverse direction are evaluated separately. Communication schemes independent of the distance protection are integrated. Current measurement can be stabilised by a second harmonic component.

Auto-reclosing

A multishot auto-reclosing system with up to four programmable shots and six different reclosing programs is available.

Fault locator

The highly accurate fault locator is based on a well-proven algorithm which has long been used in 50 and 60 Hz systems. Phasors of line currents and voltages are recorded for prefault and fault conditions for the last three disturbances. These phasors can be read both locally and remotely.

Event recording

A complete set of signals for the last three disturbances is stored in the internal memory. Up to 150 time-tagged events are available for each recorded disturbance, with a time resolution of 1 ms.

Service values

Service values of current, voltage, active and reactive power and frequency are available as well as all actual binary input values and all internal logical signals.

Disturbance recorder

A minimum 10 s of total recording time is available for up to 5 analogue and 20 binary signals. The memory is retained even if the auxiliary voltage is disconnected. The evaluating software, REVAL, operates under MS Windows.

Remote communication

REL 517 can communicate with SCS (Substation Control Systems) and/or SMS (Substation Monitoring Systems) via one or two communication ports. Communication is based on the SPA or LON communication protocol. It may be used for remote monitoring purposes, including setting and reading of all available parameters.

Setting groups

Four independent groups of setting parameters are available to adapt the protection system to changes in network conditions. The active setting group can be selected with the aid of a man-machine communication unit, a personal computer (PC) or binary inputs.

Functionality

The structure of REL 517 is based on the multi–processor principle, where options are added in separate signal processors. As a result, the number of options included does not affect the operating time of the protection function. All options are handled by dedicated signal processors which execute in parallel with the distance measurement processors.

All binary inputs are freely programmable for different functions. The binary outputs are also freely programmable so that any internal binary signal can be connected to any output relay.

Each binary input and internal logical signal can also be programmed to logical 0 or 1. This feature makes it possible to test functions within the terminal and in the protected bay. The current service values for all binary inputs and internal logical signals are available locally and remotely.

Time synchronization of the internal clock is possible by means of communication via the Substation Control System or the Substation Monitoring System, or by hard-wired minute pulse synchronization via the binary input.

Hardware characteristics

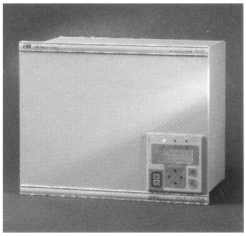
REL 517 is built into a case measuring 3/4 of a 19" rack width and 6U height. Electrical connections are made by screw terminals at the rear.

A COMBITEST test switch is available on request. The basic version has twelve output contacts and eight binary inputs. Additional binary inputs and output contacts are available.

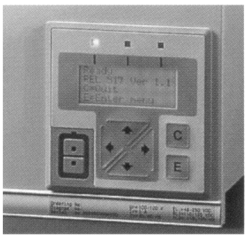
Local Man–Machine–Interface

REL 517 has a built in man-machine-interface (MMI) unit common to all functions with a four-line LCD and three LEDs. The information is presented in a functionally structured menu tree. A separate optical front connection for a PC is included. The information in the PC is the same as that obtained via the Substation Control System or the Substation Monitoring System.

Platform related functions	
Self supervision and self diagnostic	■
External time synchronization	■
Four groups of setting parameters	■
Disturbance overview	■
Local Man-Machine-Interface (MMI)	
(also by means of PC)	■
Customer configuration possibilities	■
Remote communication within the SMS	□
Remote communication within the SCS	□
Additional I/O units	□
Distance protection	
Three distance protection zones	■
Sudden change in current	□
Automatic switch onto fault logic	□
Local acceleration logic	□
Scheme communication logic	□
Earth fault protection for solidly earthed networks	
Non-directional earth fault	
overcurrent protection	□
Directional earth fault overcurrent protection	□
Directional earth fault overcurrent protection	
with scheme communication	□
Additional protection functions	
Breaker failure protection	□
Thermal overload protection	□
Overcurrent protection — time delayed	□
Instantaneous overcurrent protection	□
Under-voltage and over-voltage protection	□
Fuse failure supervision	□
Automatic and control functions	
Change of active setting group	
via binary inputs	■
Restricted setting via local MMI unit	■
Multishot auto-reclosing	□
Monitoring functions	
Mean values of measured quantities	■
Service values of all internal digital signals	■
Fault locator with current and voltage phasors	□
Event recorder	□
Disturbance recorder	□
basic function	■
optional function	□



REL 517
Line Protection Terminal for Railway Feeders and Contact Lines



Built-in man-machine-interface (MMI) unit for REL 517.

The right information at the right time

The intelligent substation

The communication philosophy in the intelligent substation is of paramount importance in providing the right information to the right person at the right time, and in a reliable way. For this reason the terminals in the 500 series can be equipped with two remote communication ports which operate independently of each other, offering simultaneous communication with both the Substation Control System and the Substation Monitoring System.

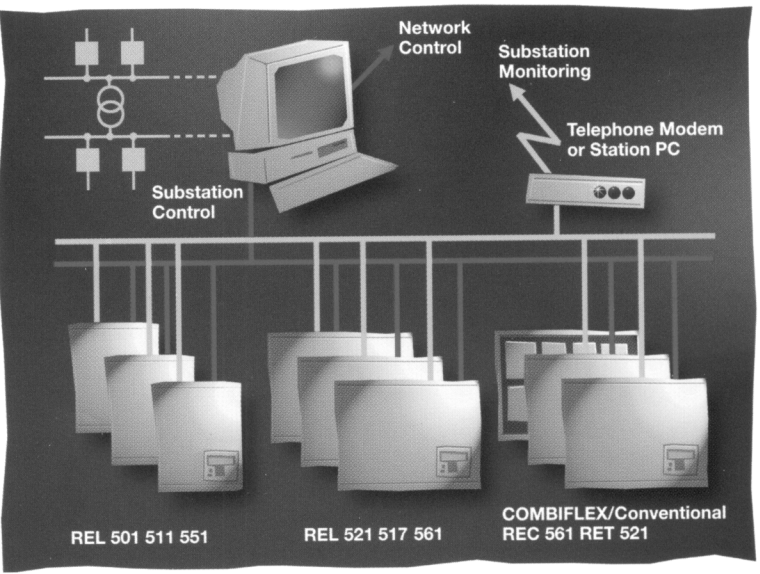
The Substation Control and Substation Monitoring systems enable both operating personnel in their control centres and relay engineers in their offices to read information from the terminal and change active setting groups as well as individual setting parameters within the setting groups.

A software program installed in a personal computer enables the relay engineer to communicate with the protection system via the telephone network, read information from the relay on a PC screen, and store such information in PC files. Complete information covering the last ten disturbances is available as well as 150 time-tagged events.

Operators in their control rooms and/or control centres have similar functions at their command, when one communication port is connected to the SPA (or LON) bus within the SCS system. Information from the terminals can provide an instant overview of the protection system and the process, revealing data such as instantaneous current, voltage, power – both active and reactive – and frequency readouts.

It is possible to access the disturbance record files remotely and download them via the substation monitoring system (SMS) by using SMSBASE. Evaluation of the disturbance records is possible by means of a PC-based evaluator program.

All communication is performed by means of fibre-optic cables in order not to jeopardise the performance of the protection terminals, because after all, protection is the major issue.



Coordinated communication, that is to say sub-station control systems (SCS) or substation monitoring systems (SMS) allied to local MMI, complement each other to take care of different needs within the PYRAMID structure. All communication takes place via fibre-optics so as to avoid jeopardising the function of the protection terminals.

Technical data
REL 517

General data, REL 517

Rated current/voltage/frequency	1 or 5 A/110 V/ 16 2/3 Hz
Rated auxiliary dc voltage ER	48/60V, 110/125V, 220/250V
Dimensions: width/height/depth	336 mm/ 265.9 mm/ 245.1 mm

Distance protection

Number of zones	3
Directionality of zones	adjustable forward, reverse or non-directional
Impedance setting range of zones	
in X direction	(0.1-150) ohm
in R direction	(0.1-150) ohm independent for Ph–E and Ph–Ph
Time delays for measuring zone elements	(0–10) s
Static accuracy/max. dynamic overreach	±5%/ 5%
Typical operate time	60 ms
Scheme communication logic	user programmable

High set instantaneous overcurrent protection

Setting range of operate current	(1–20) Ir
Static accuracy/dynamic overreach	±5%/ max 25%
Minimum operate time	13 ms

Measuring accuracy for mean service values of

measured current, voltage, active power	<2%
reactive power/ frequency	< 6%/ < 0.1 Hz

Options

Earth fault protection, directional or non-directional

Setting range of basic current/ accuracy	(5–300)% I_r / ±5% I_{set}
Adjustable time delay characteristics	independent, normal inverse, very inverse, extremely inverse, logarithmic
Min. operate current/ time for dependent channel	(100–400)% of basic current/ (0.05–6.0) s

Fault locator

Typical accuracy	better than ±5% of set length

Disturbance recorder

Number of analogue/binary channels	3 to 5/20
Minimum memory capacity	10 disturbances or 10 s
Triggering channels	any binary input, any analog input (over or under-function), manual

Auto–reclosing

Number of programmable shots	max. 4
Number of auto–reclosing programs	6
Auto–recloser open time shot 1/ shot 2–4	(0.2–60) s/(1–300) s
Reclaim time	(10–300) s

Breaker failure protection

Current setting range/accuracy	(0 1–2.0) I_r /±10%
Setting range of time delay measuring elements	(0.15 – 1.00) s

Remote communication

1 or 2 ports, SPA protocol, 300–9600 bit/s

Information about other ABB Network Partner AB products mentioned in this brochure can be obtained in our catalogue. Please contact us if you would like a copy.

Railway systems

REL 517 Line Protection Terminal

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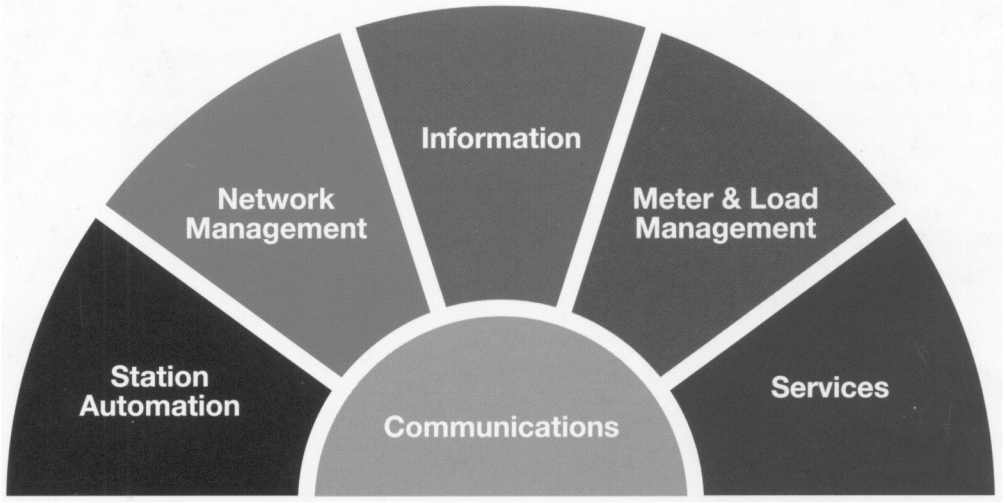

Panorama is the ABB solution for efficient and reliable management of power networks.

Panorama stands for an open view in all directions, utilizing innovative information technology.

Panorama enables the user to always be in perfect control of the power process, from generation to consumption.

Panorama is the complete concept for today and for the future, from ABB Network Partner.

Panorama

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