



(SE960158)

## Features

- Multiple function transformer protection terminal in a compact design
- Numerical microprocessor design with advanced facilities
- Suitable for power transformers, generator-transformer blocks and reactors
- Variants:
  - Two-winding transformer application
  - Three-winding transformer application
  - Both with multi-breaker arrangement connections possibilities
- No interposing Current Transformers required
- Application flexibility through generous setting and configuration facilities
- Extended frequency range by frequency tracking and filter adaptation
- Function modular and type tested software
- Transformer differential protection
  - for two- and three-winding transformers with 2, 3 or more CT groups
  - Through-fault stability by settable current bias characteristics
  - Enhanced through-fault stability for multi-breaker arrangements
  - Inrush restraint with two selectable combinations of waveform and 2nd harmonic methods. Settable crossblocking between phases
- Overexcitation restraint with 5th harmonic
- Internal CT ratio and vector group adaptation
- Settable zero sequence current elimination
- Three-phase time overcurrent protection with inverse and definite time characteristics. Three protection modules are available. Each of them can be configured to any side of the transformer. Directionality as option
- Restricted earth fault protection for each transformer winding, based on the low impedance principle and also provided with a directional feature
- Earth fault time current protection with inverse and definite time characteristics. Three protection modules are available. Each of them can be configured to any side of the transformer. 2nd harmonic restraining can be chosen if required. Directionality as option
- Single or three-phase definite time or inverse time overvoltage protection for selectable transformer sides. This overvoltage protection is also suitable to apply as neutral voltage protection. Six protection modules are available

## Features (cont'd)

- Single or three-phase definite time under-voltage protection for selectable transformer sides. Three protection modules are available
- Overexcitation protection based on V/Hz measurement with IEEE inverse time or transformer adapted characteristic
- Thermal overload protection
- Voltage regulation for single transformer or parallel transformers with on load tap changer
- Programmable logic with inputs and outputs, And-, Or-gates, SR-gates, timers and trip logic for trip and/or indication of external protection features (Buchholz, temperature, etc.)
- Display of service values
- Display of event records
- Continuous selfmonitoring and diagnostics
- Disturbance recording and data storage for presentation on PC
- Front mounted menu driven display with key pad and front port connector for PC
- Remote data communication with 2 ports for station control and station monitoring systems
- Available for 19 inch rack mounting in a panel, surface or flush mounting
- Hardware options:
  - Up to four input/output modules for binary inputs and output contacts, and mA analog inputs
  - One or two analog input modules
  - Separate Combitest test switch for reliable and safe testing
  - On/Off switch for dc supply
  - Mounting details for IP 40 and IP 54

## Application

The numerical transformer terminal RET 521 is designed for fast and selective protection and control of two- and three-winding transformers, auto-transformers, generator-transformer blocks and shunt reactors.

The RET 521 has low requirements on the main Current Transformers and no interposing CTs are necessary.

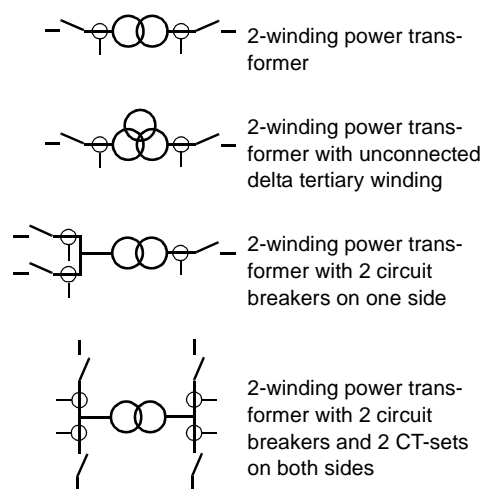
Flexibility is provided to cover for different applications in form of transformer size, vector groups, system neutral earthing and extension of protection functions according to the user's preference. The selection of functionality from the modular hardware and software is made according to the requirements for selectivity and reliability in accordance to the user's preference. Big and important transformers such as generator-transformer blocks or large network transformers can use two RET 521 and include the modular protection software selectively to obtain redundancy.

Smaller transformers and shunt reactors can include the modular software in one RET 521 and can also use the programmable logic to provide trip or indication for external protections (e.g. Buchholz). Thus providing a very compact design for protection and control.

The RET 521 includes setting adaptation to power transformer rating and instrument transformer ratios to allow protection settings in percent (%), of the power transformer rating, thus facilitating the protection settings to an optimum.

The RET 521 can be supplied for 2-winding applications or 3-winding applications as indicated below in Fig. 1.

### 2-winding applications



**3-winding applications**

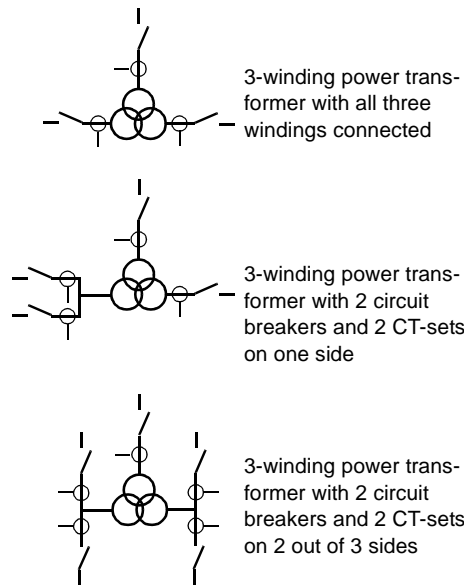


Fig. 1 CT group arrangement for differential protection and other protections

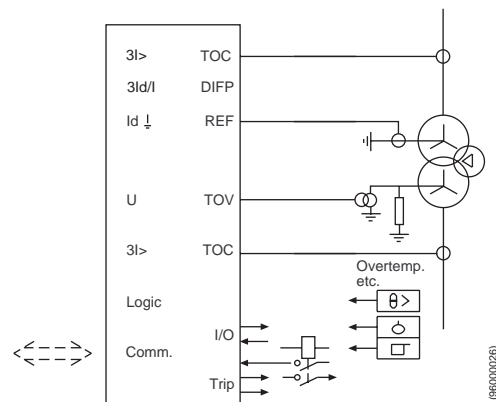


Fig. 2 An application example

**Transformer differential protection, DIFP**

The differential protection function is one of the most important function for fast and selective protection of transformers. The RET 521 is provided with internal settable adaptation for CT ratio matching and vector groups, which allows connection directly to Y-connected main CTs. Zero sequence current elimination is made internally, but the option can be turned off. All current inputs are provided with restraint features, making the RET

521 suitable for multibreaker arrangements. The setting facilities cover for application of the differential protection to power transformers with or without tap changer, a shunt reactor or a local feeder within the station, and for multi-breaker arrangements. An adaptive differential feature is included for through-faults. By introducing the tap changer position to RET 521, the differential protection pick-up can be set to optimum sensitivity covering low level internal fault currents.

Stabilisation is included to avoid differential protection tripping for inrush currents and for overexcitation. Stabilisation is also included for system recovery inrush and CT saturation for external faults. Crossblocking between phases is normally used, but the option can be turned off.

A fast high set unrestrained differential current protection is also included for high speed tripping at high internal fault currents.

Service values for differential currents, bias current and tap position are available.

**Three-phase time overcurrent protection, TOC**

Three units of three-phase overcurrent protections can be included. Each of them can be configured to any side of the transformer. The overcurrent protection is recommended as a backup protection for transformer faults or network faults. The overcurrent protection is provided with two settable current levels. The lower level can be selected with independent or inverse time characteristic, and the higher level can be selected with independent characteristic only. Both levels have separate blocking inputs. The higher level of the overcurrent protection can be used as a blocking type of busbar protection for the low voltage side with a short time delay. Low voltage side distribution feeder protection start functions are then connected to this blocking input.

The three-phase overcurrent protection can be added with directional features individually for each stage using healthy phase polarising by selection at ordering. At too low polarising voltage the overcurrent function can be blocked or made non directional independently on both levels.

Service value for highest current is available.

## Application (cont'd)

**Restricted earth fault protection, REF**

Three units of restricted earth fault protections can be included in RET 521. REF is an instantaneous earth current differential protection for solidly or low impedance earthed systems. It can be applied for each low impedance earthed transformer winding. The protection is a stabilised low impedance type and is unaffected by inrush currents or external faults. The protection is also stabilised against CT saturation. A directional feature is included in the protection.

Service values for differential current and bias current are available.

**Earth fault time current protection, TEF**

Three units of earth fault time current protections can be included. They can be applied for each transformer winding. The earth fault protection is recommended as a backup protection for transformer faults or network faults. The earth fault protection is provided with two settable current levels. The lower level can be selected with independent or inverse time characteristic, and the higher level can be selected with independent characteristic only. Both levels can also be provided with a 2nd harmonic restraint for inrush currents. The earth fault protection can be connected to a neutral CT or to summated phase currents. The earth fault protection can be added with a directional feature using  $3U_0$  polarising by selection at ordering. At too low polarising voltage the directional earth fault function will be blocked.

Service values for residual current and residual voltage are available.

**Single-/Three-phase time overvoltage protection, TOV**

Six units of single-/three-phase time overvoltage protections can be included. The overvoltage protection can be applied on any transformer side, if VT inputs are provided. It has got parallel outputs for both single-phase measurement and three-phase measurement. The overvoltage protection is recommended as backup for sustained system overvoltages. The overvoltage protection is provided with two settable voltage levels, and both levels are provided with independent time delay. The low stage can alternatively have an inverse time delay.

Service value for highest voltage is available.

**Single-/Three-phase time undervoltage protection, TUV**

Three units of single-/three-phase time undervoltage protections can be included. The undervoltage protection can be applied on any transformer side, if VT inputs are provided. It has got parallel outputs for both single-phase measurement and three-phase measurement. The undervoltage protection is recommended as backup for sustained system undervoltages. The undervoltage protection is provided with two settable voltage levels, and both levels are provided with independent time delay.

Service value for lowest voltage is available.

**Neutral time voltage protection, TOV**

The above described single-/three-phase overvoltage protection is designed to be suitable also as neutral overvoltage protection. The overvoltage protection measures the fundamental frequency component and is therefore insensitive for 3rd and higher harmonics. When used as a neutral overvoltage protection it is typically connected to a VT in the neutral of the transformer or to an open delta connection of the secondary of a three-phase set of VTs. As a neutral overvoltage protection it is normally used in high impedance earthed systems, and is given a longer time delay than the feeder earth fault protections.

**Thermal overload protection, THOL**

The three-phase thermal overload protection can be included in RET 521 and protects the transformer windings against thermal stresses. The thermal protection can be applied to one selected transformer winding. The thermal protection is provided with two different thermal constants. The thermal protection is provided with two independently set levels for alarm and tripping.

Service value for measured current, thermal status, time-to-trip and time-to-reset of lock-out are available.

**Overexcitation protection (V/Hz), OVEX**

The overexcitation protection can be included in RET 521 and can be configured to any side of the power transformer. However the side with the voltage regulation taps shall be avoided. The overexcitation protection can be configured to either three-phase to earth voltages or to one phase-to-phase voltage. The overexcitation protection is based on voltage/frequency (V/Hz) measurement. The IEEE trip time inverse characteristic can be set to follow the transformer characteristic and a

cooling time memory is included. The trip time characteristic is also provided with definite minimum and maximum times.

As an alternative a transformer adapted time delay characteristic can be used for close adaptation to the transformer capability characteristic.

Separate trip and alarm outputs are included.

Service values for relative excitation status voltage/frequency, thermal status and time-to-trip are available.

#### **Voltage control for single transformer, VCTR**

The voltage control function can be included in RET 521 and is used to maintain a constant user preset voltage at the low voltage side of the transformer, i.e. at the busbar or at the feeder ends. Constant voltage is obtained by controlling the tap changer position by raise and lower commands. The delay for the regulating command can be of inverse or independent type. Blocking is included for overcurrent and undervoltage, power system emergencies and tap changer end positions. Line drop compensation is included. A load shedding based on voltage reduction is also included. Number of tap changer operations can be recorded for determining the service intervals. Remote or local command possibilities are included. Alarms from the tap changer auxiliary equipment (binary contacts) can be connected to the voltage control function. The tap changer position can be monitored by mA-input or by binary inputs to the voltage control function.

Service values for busbar voltage, compensated voltage, actual set voltage, load voltage adjustment, tap changer position, contact life calculation and no of operation counter are available

#### **Voltage control for parallel transformer, VCTR**

The voltage control function for parallel transformers can be included in RET 521 and is used to maintain a constant user preset voltage at the low voltage side of up to four parallel operating transformers, i.e. at the busbar or at the feeder ends. The voltage regulation is based on minimising the circulating current method. LON communication is used between terminals to get information about adjacent transformer currents, voltages and settings. The regulation can be made to use the mean value of the voltages and settings of

the terminals controlling a group of parallel transformers. Another feature is that a hot stand-by transformer also can be automatically controlled and be prepared to momentarily be switched into a parallel group.

The voltage control function for parallel transformers also includes the single transformer control module with the same functionality as described in previous point.

Service values as above but also for circulating current and mean values of bus voltages and settings in a parallel group are available.

#### **Input trip matrix**

External contacts, e.g. from transformer over-temperature devices and Buchholz gas detector, can be connected via Binary Inputs. Logic can be arranged for alarm, event logging and tripping. For redundancy reasons it is recommended to route tripping from the Buchholz or overpressure device in parallel to RET 521.

#### **Tripping matrix**

The tripping commands are configured to trip logic blocks, which then are configured to the tripping output relays. Each trip logic block has 16 inputs to an or gate. Up to 12 trip logic blocks can be used.

#### **Additional logic**

Additional logic elements in the form of 40 AND-gates, 40 OR-gates, 20 inverters, 25 timers, 20 pulse elements and 10 SR-gates are available and can be combined by the user to suit particular requirements.

Optional BI/BO modules can be added to get more BI and BO interfaces, while observing that the maximum number of board places is four.

#### **Configuration**

Six example configurations for the connection of the analog inputs, the binary inputs/outputs, the logical circuits and the protection modules, the control modules and the monitoring modules are available and used as shown in table 30 on page 25. These configurations are often covering more functionality than needed but can easily be changed from a connected PC with the CAP 535 configuration and programming tool package.

- Alternative 1 is primarily used for two winding power transformers with one side high ohmic earthed as in the example shown in fig 3 on page 19.

## Application (cont'd)

- Alternative 2 is primarily used for two winding power transformers with both sides low ohmic earthed
- Alternative 3 is primarily used for two winding power transformers with multi-breaker system on one side.
- Alternative 4 is primarily used for three winding power transformers with possibility for multi-breaker system on one side.
- Alternative 5 is primarily used for three winding power transformers with multi-breaker systems on two sides as in the example shown in fig 4 on pages 20 and 21.
- Alternative 6 is primarily used for three winding power transformers with a protection system not using more than 9 currents and 1 voltage (only one analog input module used).

**Parameter settings**

RET 521 has wide setting facilities to ensure application flexibility. Factory default settings are chosen to indicate typical setting values or choices. The settings are organised as general settings and settings for each separate function.

The main data (ratings) of the protected transformer and ratios of the instrument transformers are entered in the terminal setting and configuration menus. Most of the setting parameters of the particular functions can then be made as per unit (p.u.) or percent (%) values related to the power transformer rating. For some protections there also exist a possibility to define the rated value in the setting menu to another value than the power transformer rating. Most timers are set in sec-

onds. There is a possibility to enter one to four complete groups of settings. It is then an easy operation to switch between these groups locally or by external control.

Settings can be changed from the front Human-Machine-Interface (HMI), or by a portable personal computer (PC), with a parameter setting program (PST) included in CAP 535, connected to a fibre-optic connector socket at the front, or from another location over a data communication system.

**Indications, events and service values**

Operation indications and time-tagged events are available by the front HMI and a connected PC, or from another location over a data communication system. Actual input quantity values, load, differential current and other service values can also be read from the terminal.

**Disturbance recording**

Sampled data from a disturbance, like a tripping operation, can be stored and made available for oscillographic presentation and evaluation on a front connected PC or from another location over a data communication system, to which the disturbance files are transferred. This function stores continuously sampled data in a cyclic buffer. At selectable trigger conditions the data are stored, so that both prefault and fault data are saved.

**Data communication**

Two remote communication ports for SPA and LON can be included. They enable cooperation with a station monitoring system (SMS) including a remotely located PC, and a station control system (SCS).

**Design**

The physical design of terminal RET 521 is in line with the products in the RE. 500-series. It is housed in painted sheet steel enclosure suitable for different mounting by use of particular mounting accessories. Wire connections are made at the rear side at terminals of compression type tightened by a screw. Fibre optic wires for data communication are also connected at the rear side. On the front is a HMI-panel and socket with an optic interface to a specific cable for a portable PC.

Behind the front there is an interconnection board, a motherboard, to which printed board assemblies (PBAs) are plugged in from the rear side. The input module for analog AC quantities is fixed mounted and the connection terminal for these circuits are also fixed mounted. The connection terminals for the DC contact circuits are of the multipole detachable type so as to facilitate disconnection for exchange of PBAs.

The following modules can be included in the RET521 terminal:

- Analog input module with galvanic separation and adaptation of the AC signals. To suit different applications there are three variants with different number of current and voltage signals. The analog input module also contains an analog to digital converter (A/D-converter) which provides the necessary conversion and some filtering.
- Processor modules with data processing for the protection as well as other functions and communication. As an option two communication interfaces can be added for connection to a station monitoring system (SMS) including a remotely located PC and a station control system (SCS).
- Power supply module with DC/DC converter for the electronic circuits.
- One choice of binary in/out interface is a combined binary input/output module, IOM, with 8 binary inputs and 12 output relay contacts. The BIs have isolation by optocouplers and are intended for external contacts. 10 BOs are each made by one printed circuit board type of relay (PCB mounted relay) which has one normally open contact. 2 BOs have also got one reed relay in parallel with the standard relay to be used for fast signalling with one normally open contact.
- Another possibility of binary in/out interface is to use a separate binary input module, BIM, with 16 binary inputs and a separate binary output module, BOM, with 24 output relay contacts. The BIs and BOs are essentially of similar design as for the combined module, IOM.
- Additional binary in/out modules of the three above types are available if needed.
- A mA-analog input board with 6 channels 0-20 mA (4-20 mA) is also available.
- Front HMI panel. There are three light-emitting diodes (LEDs), one LCD display with 4 lines times 16 characters and there is a six button key pad and a fibre-optic connector socket, for connection to the serial port of a portable PC by means of a special interface cable.

Technical data

Table 1: Energising quantities, rated values and limits

Quantity	Rated value	Nominal range	Operative range
Current Burden	$I_r = 1 \text{ A or } 5 \text{ A}$ < 0,25 VA at $I_r$	$(0,2-30) \times I_r$ $(0,2-4) \times I_r$ continuously	$(0,03 - 100 \times I_r)$ $100 \times I_r$ for 1 s*
AC voltage Ph-Ph** Burden	$U_r = 100/110/115/120 \text{ V}$ < 0,2 VA at $U_r$	80-120% of $U_r$	$1,5 \times U_r$ continuously $2,5 \times U_r$ for 10 s
Frequency	$f_r = 50/60 \text{ Hz}$	$\pm 2,5 \text{ Hz}$	$\pm 5 \text{ Hz}$
Frequency with increased range	$f_r = 50/60 \text{ Hz}$	$(0,7-1,2) \times f_r \text{ Hz}$	$(0,65-1,25) \times f_r \text{ Hz}$
Auxiliary DC voltage EL  Power consumption Basic terminal (2 AIM, 1 BOM, 1 BIM, 1 IOM and 1 MIM) and no activated relay outputs Auxiliary DC power in-rush	EL = 110/125 V EL = 220/250 V  < 35 W  110 VDC, <15 A, 0,1 ms 220 VDC, <30 A, 0,1 ms	$\pm 20\%$ $\pm 20\%$	$\pm 20\%$ $\pm 20\%$
Binary input (8) /output (12) module DC voltage RL  power consumption each I/O board each output relay RL = 24/30 V RL = 48/60 V RL = 110/125 V RL = 220/250 V	RL = 24/30 V RL = 48/60 V URL = 110/125 V RL = 220/250 V  $\leq 1 \text{ W}$ $\leq 0,15 \text{ W}$ max. 0,05 W/input max. 0,1 W/input max. 0,2 W/input max. 0,4 W/input	$\pm 20\%$ $\pm 20\%$ $\pm 20\%$ $\pm 20\%$	$\pm 20\%$ $\pm 20\%$ $\pm 20\%$ $\pm 20\%$
Binary input(16) module DC voltage  power consumption each I/O board RL = 24/30 V RL = 48/60 V RL = 110/125 V RL = 220/250 V	RL = 24/30 V RL = 48/60 V RL = 110/125 V RL = 220/250 V  $\leq 0,5 \text{ W}$ max. 0,05 W/input max. 0,1 W/input max. 0,2 W/input max. 0,4 W/input	$\pm 20\%$ $\pm 20\%$ $\pm 20\%$ $\pm 20\%$	$\pm 20\%$ $\pm 20\%$ $\pm 20\%$ $\pm 20\%$
Binary output (24/12) module power consumption each output board each output relay	$\leq 1 \text{ W}$ $\leq 0,25 \text{ W}$		
mA input module input range input resistance  power consumption each mA module each mA input channel	$\pm 20 \text{ mA}$ $R_{in} = 194 \text{ ohm}$  $\leq 4 \text{ W}$ $\leq 0,1 \text{ W}$		
Ambient temperature	20°C	-5°C to +55°C	
Ripple in dc auxiliary voltage	max. 2%	max. 12%	Full wave rectified

**Table 1: Energising quantities, rated values and limits**

Quantity	Rated value	Nominal range	Operative range
Relative humidity	10-90%	10-90%	0-95%

\* Max 350 A for 1 s when COMBIFLEX test switch is used

\*\* Ph-ph voltage may also be directly connected across the analog voltage inputs

**Table 2: Influencing factors, Permissible influence**

Dependence on	Within nominal range	Within operative range
Ambient temperature	0,01%/1°C	Correct function
Frequency dependence (without extended frequency range)	fr ± 2,5 Hz for 50 Hz fr ± 2,5 Hz for 60 Hz	± 3,0 %
Frequency dependence (with extended frequency range)	(0,7-1,2) x fr	± 2,0 %
Harmonic frequency dependence (10, 20 and 50% content)	2:nd 3:rd and 5:th harmonic of fr	± 1,0 %
Ripple in auxiliary DC voltage	negligible	Correct function
Interruption in auxiliary DC voltage without resetting no unwanted function	< 50 ms 0 - ∞	< 50 ms 0 - ∞

**Table 3: Electromagnetic compatibility (EMC), immunity tests**

Test	Type test values	Reference standards
1 MHz burst disturbance	2,5 kV	IEC 60255-22-1, Class III
Electrostatic discharge Direct application Indirect application	8 kV, air discharge 6 kV, contact discharge 6 kV, contact discharge	IEC 60255-22-2, Class III IEC 61000-4-2, Class III
Fast transient disturbance	4 kV	IEC 60255-22-4, Class IV
Surge immunity test	1-2 kV, 1,2/50 µs, high energy	IEC 61000-4-5, Class III
Radiated electromagnetic field disturbance	10 V/m, 26-1000 MHz	IEC 61000-4-3, level 3
Radiated electromagnetic field disturbance GSM	10 V/m, 900 MHz	ENV 50204
Conducted electromagnetic field disturbance	10 V/m, 0,15-80 MHz	IEC 61000-4-6, level 3

**Table 4: Electromagnetic compatibility (EMC), emission tests**

Test	Type test values	Reference standards
Electromagnetic emission radiated	30-1000 MHz, class A	EN 55011
Electromagnetic emission conducted	0,15 - 30 MHz, class A	EN 55081-2

Technical data (cont'd)

**Table 5: Insulation tests**

Test	Type test values	Reference standards
Dielectric test	2,0 kV ac 1 min	IEC 60255-5
Impulse voltage test	5 kV, 1,2/50 $\mu$ s, 0,5 J	IEC 60255-5
Insulation resistance	> 100 Mohm at 500 V dc	IEC 60255-5

**Table 6: CE-mark**

Test	Type test values	Reference standards
Immunity		EN 50082-2
Emissivity		EN 50081-2
Low voltage directive		EN 50178

**Table 7: Mechanical tests**

Test	Type test values	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

**Table 8: Contact data (reference standard: IEC 60255)**

Function or quantity	Trip- and signal relays	Fast signal relays (parallel reed relay)
Max. system voltage	250 V ac, dc	250 V ac, dc
Test voltage across open contact, 1 min	1,0 kV 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, $\cos\phi > 0,4$	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 9: Connection system**

Connector type	Rated voltage	Maximum square area	Maximum load continuous	Maximum load 1 s
Voltage connectors	250 V AC	2,5 mm <sup>2</sup> 2 x 1 mm <sup>2</sup>	10 A	30 A
Current connectors	250 V AC	4 mm <sup>2</sup>	20 A	500 A
Fiber connectors	Glass: Bayonet ST Plastic: Snap in Simplex Latching			

**Table 10: Additional general data**

Weight approximate	10 kg
Dimensions Width Height Depth	336 mm (3/4 of 19") 6U = 267 mm 245 mm
Water and dust protection level	Front IP 40 ( IP 54 with sealing strip ) Sides IP 30 Back IP 20
Storage temperature	-40°C to +70°C

**Table 11: Front communication**

Function	Value
Protocol	SPA
Communication speed	300, 1200, 2400, 4800, 9600, 19200 or 38400 baud
Slave number	1 to 899
Connectors	special electric/optic cable

**Table 12: Serial communication (SPA)**

Function	Value
Protocol	SPA
Communication speed	300, 1200, 2400, 4800, 9600, 19200 or 38400 baud
Slave number	1 to 899
Connectors and optical fibres	glass or plastic

**Table 13: Serial communication (LON)**

Function	Value
Protocol	LON
Communication speed	1,25 Mbit/s
Connectors and optical fibres	glass or plastic



**Table 16: Disturbance recorder**

Current channels dynamic range without DC offset with full DC offset resolution accuracy at rated frequency $f_r$ $I < I_r$ $I > I_r$	$(0,01-85) \times I_r$ $(0,01-40) \times I_r$ $\leq 0,5\% \text{ of } I_r$ $\leq 1\% \text{ of } I_r$ $\leq 1\% \text{ of } I \text{ (current value)}$
Total recording time with 10 analog and 48 digital signals recorder	maximum 40 s
Built-in calendar	For 30 years including leap years

**Table 17: Transformer (object) data**

Quantity	Parameter	Value or Range
Rated power 2 winding	Sr	0,1-9999,9 MVA
Rated power 3 winding primary wind	Sr1	0,1-9999,9 MVA
Rated power 3 winding secondary wind	Sr2	0,1-9999,9 MVA
Rated power 3 winding tertiary wind	Sr3	0,1-9999,9 MVA
Rated current primary winding in A	Ir1	1-99999 A
Rated current secondary winding in A	Ir2	1-99999 A
Rated current tertiary winding in A	Ir3	1-99999 A
Rated voltage primary winding in kV	Ur1	1,0-999,9 kV
Rated voltage secondary winding in kV	Ur2	1,0-999,9 kV
Rated voltage tertiary winding in kV	Ur3	1,0-999,9 kV
Vector group compensation (For different groups, Yy0, Yd1, Dy11.. etc.)	VectorGrp2WV	1-24
Vector group compensation (For different groups, Yy0d1.. etc.)	VectorGrp3WV	1-288

**Table 18: Transformer terminal configuration**

Quantity	Parameter	Value or Range
Used input tap for CT on AIM card in A	InputCTTap	Input 1A / Input 5A
Rated CT primary current in A	CTprim	1-99999
Rated CT secondary current in A	CTsec	1-5 (step 1)
Current transformer earthing, Towards power transformer/Towards bus	CTstarpoint	ToObject, FromObject
Rated VT primary voltage in kV	VTprim	0,1-999,9
Rated VT secondary voltage in V	VTsec	1-999

**Table 19: Transformer differential protection**

Function	Parameter	Value or Range
Current bias	CharactNo	Selectable characteristics
Inrush Stabilisation setting	StabByOption	Wave form and second harmonic selections
Inrush restraint	I2/I1ratio	10-25%
Overexcitation restraint	I5/I1ratio	10-50%

Technical data (cont'd)

**Table 19: Transformer differential protection**

Function	Parameter	Value or Range
Basic diff. current, % of object I <sub>r</sub>	Idmin	10-50%
High, non-restraint diff. current, % of object I <sub>r</sub>	Idunre	500-2500%
Zero Sequence Current Subtraction	ZSCSub	Off/On
Operation crossblocking	CrossBlock	Off/On
Number of taps	NoOfTaps	1 - 64
Rated tap	RatedTap	1 - 64
Voltage for minimum tap (tap1) in kV	MinTapVoltage	0,1 - 999,9
Voltage for maximum tap in kV	MaxTapVoltage	0,1 - 999,9
Operate time at diff. current I = 2 x I <sub>r</sub> at diff. current I = 10 x I <sub>r</sub> at diff. current I = 2 x Idunre		33 ms, typically 30 ms, typically 20 ms, typically
Reset time		Typical 15 ms

**Table 20: Three-phase time overcurrent protection**

Function	Parameter	Value or Range
Level 1 Operate current, % of object I <sub>r</sub> or user defined I <sub>r</sub> Time characteristics	IsetLow CurveType	10-500% DEF, NI, VI, EI, LI
Definite time setting	tDefLow	0,03- 240,00 s
Inverse time characteristics $t=(k \times T)/[(I/I_s1)^e - 1]$ I <sub>s1</sub> = IsetLow  Time multiplier Definite minimum time	k tMin	Acc. to IEC 60255-3 Normal inverse, Type A Very inverse, Type B Extremely inverse, Type C Long time inverse 0,05-1,10 0,05-1,00 s
High set current, % of object I <sub>r</sub> or user defined I <sub>r</sub> Time setting	IsetHigh tDefHigh	10-2000% 0,03-5,00 s
Selection of nondirectional, forward or reverse direction for lowset	DirectionLow	NonDir, Forward, Reverse
Selection of nondirectional forward or reverse direction for highset	DirectionHigh	NonDir, Forward, Reverse
Relay Characteristic Angle in degrees	rca	-50 to -20 degrees
Relay Operate Angle in degrees	roa	±60 to ±90 degrees
Resetting ratio		> 0,95
Operate time IEC curves Definite time setting		Class 5 and -0/+40 ms ±0,5% of setting -0/+40 ms
Reset time		Typical 35 ms
Transient overreach for DC offset L/R<100ms		< 10%

Table 21: Restricted earth-fault protection

Function	Parameter	Value or Range
Basic diff. current, % of object I <sub>r</sub>	I <sub>dmin</sub>	5-50%
Directional characteristic	rca (fixed) roa	180° ±60° to ±90°
Operate time at 2 × I <sub>d</sub>		30 ms, typically
Reset time		Typical 25 ms

Table 22: Earth-fault time current protection

Function	Parameter	Value or Range
Level 1 Operate current, % of object I <sub>r</sub> or user defined I <sub>r</sub> Time characteristics	I <sub>setLow</sub> CurveType	3-500% Definite (independent) Inverse (dependent)
Definite time setting	tDefLow	0,03-240,00 s
Inverse time characteristics $t = (k \times T) / [(I/I_{s1})^e - 1]$ I <sub>s1</sub> = I <sub>setLow</sub>  Time multiplier Definite minimum time	k tMin	Acc. to IEC 60255-3 Normal inverse, Type A Very inverse, Type B Extremely inverse, Type C Long time inverse 0,05-1,10 0,05-1,00 s
Logarithmic inverse (RXIDG) $t = 5,8-1,35 \times \ln(I/I_b)$ I <sub>b</sub> = I <sub>setLow</sub> Min current I <sub>start</sub> × I <sub>setLow</sub> Definite min. time	I <sub>start</sub> tLog	1,0 -4,0 0,03-10,00 s
High set current, % of object I <sub>r</sub> or user defined I <sub>r</sub> Time setting	I <sub>setHigh</sub> tDefHigh	20-2000% 0,03-10,00 s
2nd harmonic restrain	2harLow 2harHigh	Off/On Off/On
Second to first harmonic ratio	I <sub>2</sub> /I <sub>1</sub> ratio	10-25%
Relay characteristic angle in degrees	rca	0 to 90 degrees
Relay operate angle in degrees	roa	±60 to ±90 degrees
Selection of nondirectional, forward or reverse direction for lowset	DirectionLow	NonDir, Forward, Reverse
Selection of nondirectional forward or reverse direction for highset	DirectionHigh	NonDir, Forward, Reverse
Resetting ratio		> 0,95
Operate time IEC curves Definite time setting		Class 5 and -0/+40ms ±0,5% of setting -0/+40ms
Reset time		Typical 35 ms
Transient overreach for DC offset L/R < 100ms		< 10%

Technical data (cont'd)

**Table 23: Single-/Three-phase time overvoltage protection**

Function	Parameter	Value or Range
Operate voltage, % of object Ur Time characteristics	UsetLow CurveType	5,0-200,0% Definite (Independent) Very Inverse (Dependent)
Definite time setting	tDefLow	0,03-120,00 s
Inverse time characteristic $t=(k \times T)/[(U/U_{s1})^e - 1]$ Us1 = UsetLow		Very Inverse
Time multiplier	k	0,05-1,10
Definite minimum time	tMin	0,05-1,00 s
High set voltage, % of object Ur Time setting	UsetHigh tDefHigh	5,0-200,0% 0,03-60,00 s
Resetting ratio		> 0,99
Operate time IEC curves Definite time setting		Class 5 and -0/+40ms ±0,5% of setting -0/+40ms
Reset time		Typical 35 ms

**Table 24: Single-/Three-phase time undervoltage protection**

Function	Parameter	Value or Range
Operate voltage, % of object Ur	UsetLow UsetHigh	5,0-130,0% 5,0-130,0%
Time setting	tDefLow tDefHigh	0,03-120,00 s 0,03-120,00 s
Resetting ratio		< 1,01
Operate time Definite time setting		±0,5% of setting -0/+40 ms
Reset time		Typical 35 ms

**Table 25: Neutral time voltage protection**

Function	Parameter	Value or Range
The Time Overvoltage Protection is used for this application		

**Table 26: Thermal overload protection**

Function	Parameter	Value or Range
Normal base current, in % of object Ir	Ib1	30-250%
Based current used with true COOLING input signal, in % of Ir	Ib2	30-250%
Thermal overload steady state trip current in % of Ibx	Itr	50-250%
Initial heat content in % of heat content trip value (Itr) <sup>2</sup>	Thetalnit	0-95%
Normal time constant, in min, used with Ib1	TimeConstant1	1-500 min
Time constant, in min, used with Ib2	TimeConstant2	1-500 min

Table 26: Thermal overload protection

Function	Parameter	Value or Range
1:st alarm level, in % of heat content trip value $(I_{tr})^2$	Alarm1	50-99%
2:nd alarm level, in % of heat content trip value $(I_{tr})^2$	Alarm2	50-99%
Reset level for lock-out, in % of heat content trip value $(I_{tr})^2$	ResetLockOut	10-95%
Operate time		±5% of set time

Table 27: Overexcitation protection

Function	Parameter	Value or Range
E <sub>max</sub> continuous no-load	E <sub>max</sub> cont	1,00-1,50 p.u.
E <sub>max</sub> when time according to delay t <sub>Min</sub> takes over	E <sub>max</sub>	1,20-1,80 p.u.
Minimum time delay when over excitation >E <sub>max</sub>	t <sub>Min</sub>	0,50-30,00 s
Maximum time delay for over excitation	t <sub>Max</sub>	10-120 min
IEEE time characteristics $t = (k \times 0.18) / [M - 1]^2$ M = overexcitation		
Time multiplier for inverse time functions	k	1-60
Transformer cooling time constant	T <sub>cool</sub>	1-120 min
Time delay for alarm	t <sub>Alarm</sub>	0-120 s
Time value in sec. for Time 1	t1	0-7200 s
Time value in sec. for Time 2	t2	0-7200 s
Time value in sec. for Time 3	t3	0-7200 s
Time value in sec. for Time 4	t4	0-7200 s
Time value in sec. for Time 5	t5	0-7200 s
Time value in sec. for Time 6	t6	0-7200 s
Operate time		±5% of setting -0/+40 ms

Table 28: Voltage control function

Function	Parameter	Value or Range
Voltage control set voltage, % of U <sub>r2</sub> *	U <sub>set</sub>	85,0-120,0% acc < 0,5 % of U <sub>r</sub>
Set voltage deadband, % of U <sub>r2</sub>	U <sub>deadband</sub>	0,5-9,0%
Set inner deadband, % of U <sub>r2</sub>	U <sub>deadbandInner</sub>	0,1-9,0 %
Upper limit busbar voltage	U <sub>max</sub>	100-130% acc < 0,5 % of U <sub>r</sub>
Lower limit busbar voltage	U <sub>min</sub>	70-95% acc < 0,5 % of U <sub>r</sub>
Fast step down function activation	FSDMode	Off, Auto, AutoMan
Time characteristic for Time 1 (first command)	t1Use	Const Inverse
Time delay for first command	t1	1-300 s
Time characteristic for Time 2 (consecutive command)	t2Use	Const Inverse

Technical data (cont'd)

**Table 28: Voltage control function**

Function	Parameter	Value or Range
Time delay for consecutive command	t2	1-300 s
Minimum operating time in sec	tMin	1,0-30,0 s
Operation line voltage drop compensation	OperationLDC	Off/On
Regulation for capacitive load	OperCapaLDC	Off/On
Line resistance, primary values	Rline	0,0-150,0 ohm
Line reactance, primary values	Xline	-150,0 to 150,0 ohm
Constant load voltage adjust factor 1	LVAConst1	-9,0 to 9,0%
Constant load voltage adjust factor 2	LVAConst2	-9,0 to 9,0%
Constant load voltage adjust factor 3	LVAConst3	-9,0 to 9,0%
Constant load voltage adjust factor 4	LVAConst4	-9,0 to 9,0%
Load current dependent automatic voltage reduction factor	VRAuto	-4,0 to 0,0%
Undervoltage blocking, % of Ur2	Ublock	50-90%
Operation OLTC reversed action blocking	OperationRA	Off/On
Power system emergency blocking time	tRevAct	30-360 s
Tap changer low limit position	LowVoltTap	1-64
Tap changer high limit position	HighVoltTap	1-64
Overcurrent blocking, % of object Ir1	Iblock	0-250%
Output pulse duration	tPulseDur	0,5-5,0 s
Tap changer constant timeout time	tTCTimeout	1-60 s
Hunting detection alarm, max operation/day	DayHuntDetect	0-100
Hunting detection alarm, max operation/hour	HourHuntDetect	0-30
Time sliding window hunting detection	tHuntDetect	1-120 min
Hunting detection alarm, max operation/wind	NoOpindow	0-30
Contact life counter factor	CLFactor	1,0 -3,0
Initial value tap changer life counter	InitCLCounter	0-9999999
External MMI operation priority mode	ExtMMIPrio	Priority/No Priority
Total block of the voltage control function	TotalBlock	Off/On
Automatic mode block of the voltage control	AutoBlock	Off/On

\*) Rated secondary side power transformer voltage set in menu Transformer data

**Table 29: Additional voltage control parameters for parallel power transformers**

Parallel operation	OperatonPAR	Off/On
Parallel transformer reactance reduced to secondary side (for each transformer T <sub>x</sub> )	Tx Xr2	0,1-20,0 ohm
Parallel control compensation factor	Comp	0-2000%
Operation circulation current block function	OperationCC	Off/On
Circulating current block limit (primary value)	CircCurrLimit	0,0-20000,0 A
Circulating current delay time	tCircCurrent	1- 300 s
Operation common setpoint for parallell op	OperUsetPar	Off/On
Operation simultaneous tapping prohibited	OperSimtap	Off/On
Operation homing function	OperHoming	Off/On
VTmismatch	VTmismatch	0,5-10,0 %
VTmismatch time	tVTmismatch	1,0-10,0 s

Terminal diagrams

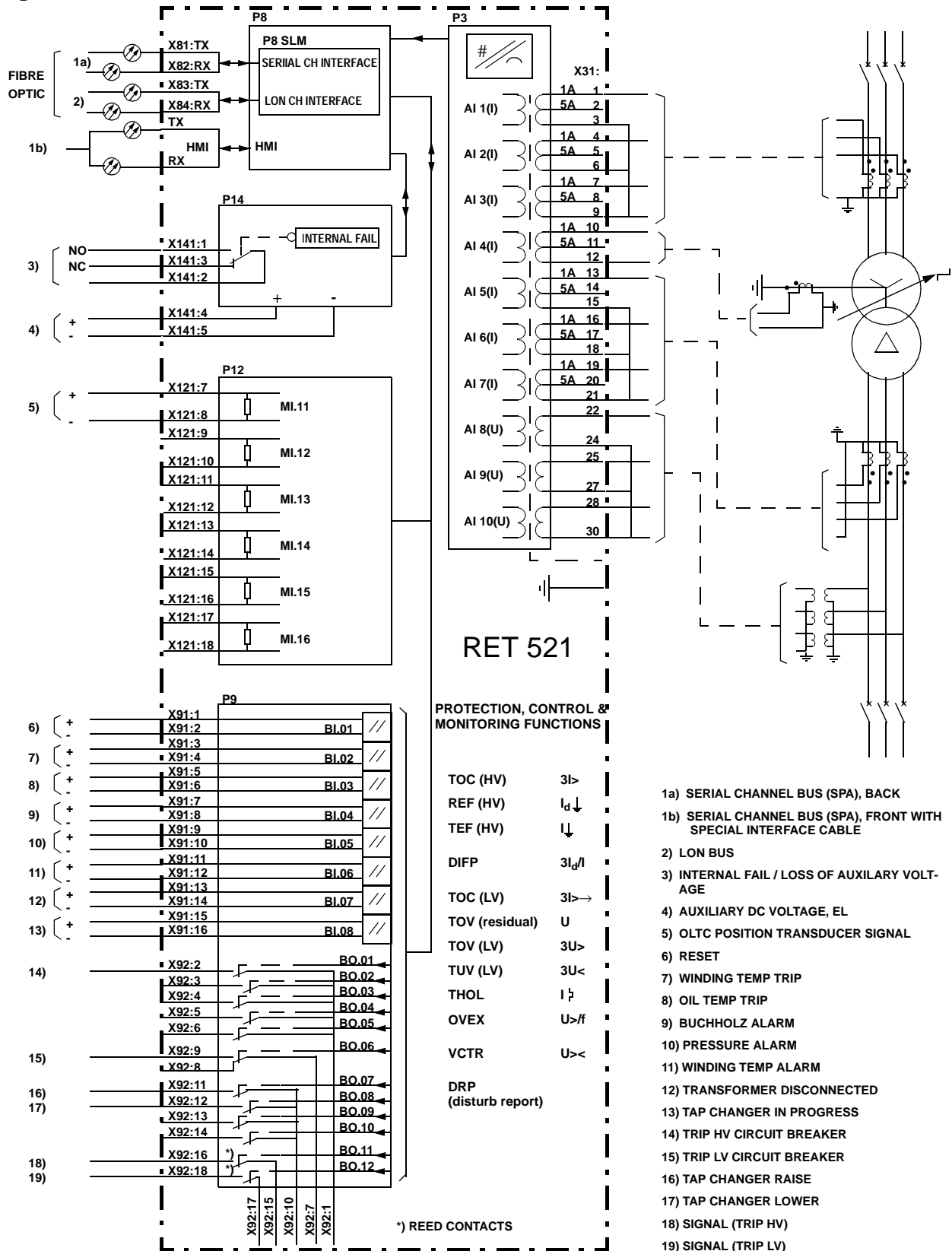
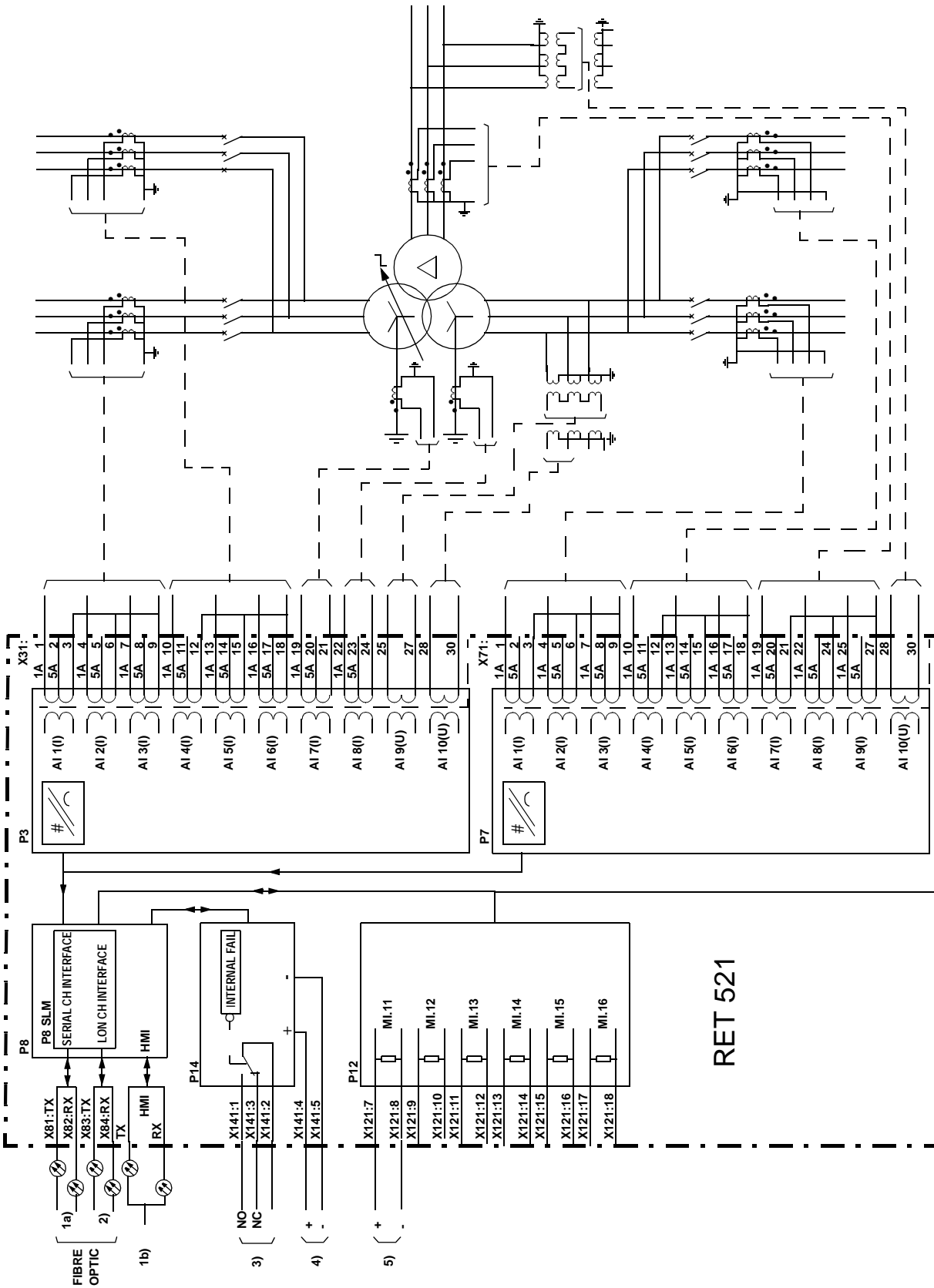


Fig. 3 2 Winding Transformer Protection Terminal Diagram acc to configuration alternative 1



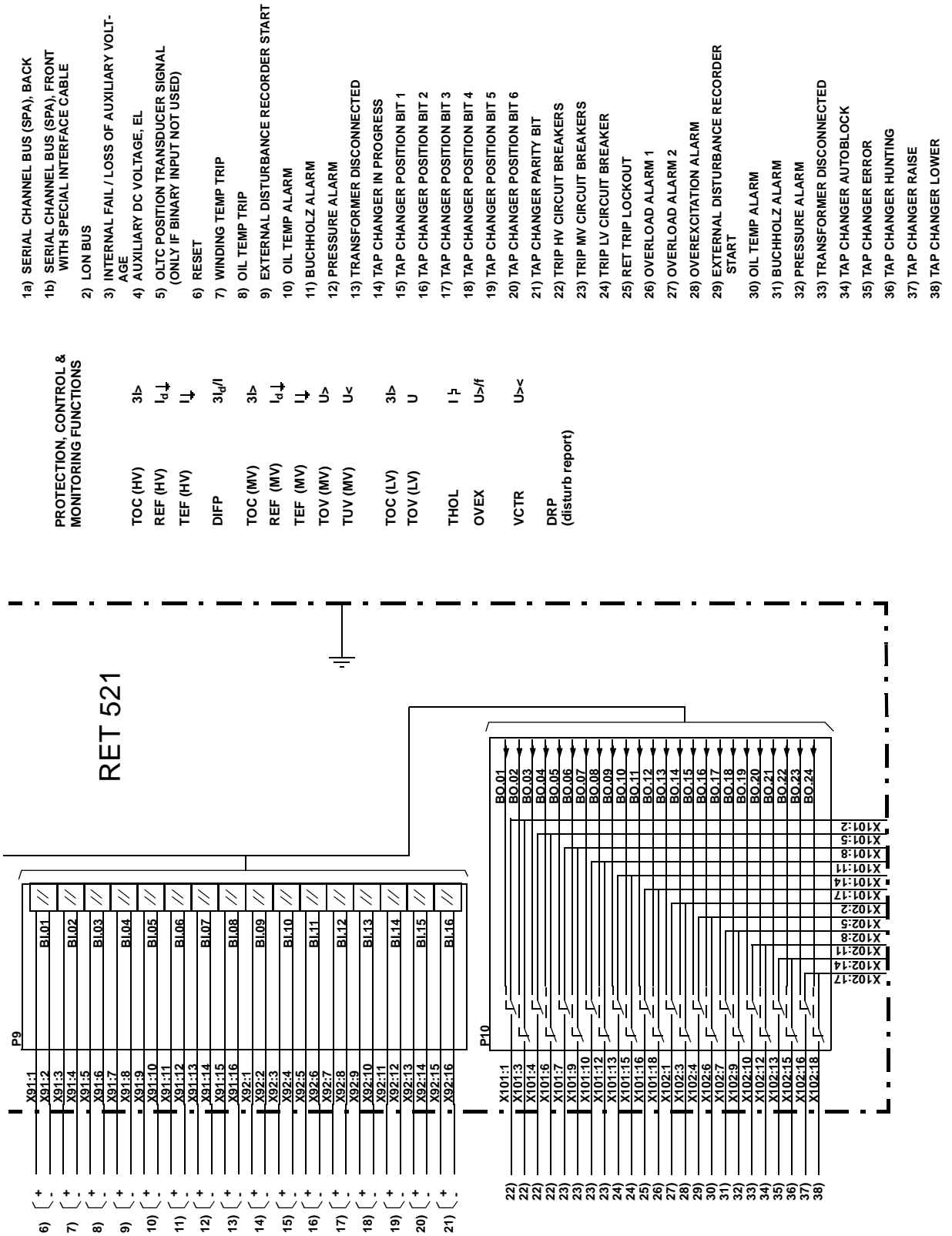


Fig. 4 3 winding Transformer Terminal Diagram acc to configuration alternative no 5

## Ordering

RET 521 are intended for two-winding transformer or three-winding transformer applications. The analog transformer input modules type AIM can be configured to the application with maximum 10 input transformers for each analog input module, maximum 2 analog input modules can be included. The basic versions occupy 3/4 of a 6U 19 inch rack. Totally 4 rack positions are intended for I/O boards in the 3/4 rack. One optional test switch type RTXP 24 can be fitted in the same 19 inch rack together with the protection terminal. If two test switches are needed the second one has to be placed in an other rack.

The base terminal contains hardware always needed and some basic software functions. The hardware in the terminal will be customised by additional choices according to the alternatives below.

Protection and control functions can be added to the terminal while observing the need and limitations for the number of input transformers and also the need and limitations for the number of I/O boards.

### Hardware base modules

Casing with connection board and front HMI panel, 3/4 of 6U 19 inch

Numerical module (processor board)

Auxiliary power supply module

### Software base functions

Frequency measurement function (FRME)

Service value reading

Event recording and trip value recording (in disturbance report)

Custom logic programming (40 AND, 40 OR, 20 inverters, 25 timers, 20 pulse timers, 10 SR-gates and 3 MOVE blocks)

Trip logic, 12 blocks

Binary converter

Event function (single and double indications)

Command function (single and multiple)

**Ordering Number:** 1MRK 001 530-AC

**Quantity:**

**Basic data:**

Nominal frequency: 50/60 Hz  
 Rated VT input voltage (across each individual input) 100/ $\sqrt{3}$ , 110/ $\sqrt{3}$ , 115/ $\sqrt{3}$ , 120/ $\sqrt{3}$ , 100, 110, 115, 120 V  
 Rated CT input current 1/5 A  
 Auxiliary dc voltage EL 110-250 V

**Basic data to be specified**

**RET 521 Protection and control functions**

Select with “X” mark required protection and control functions.

Transformer terminal*)	Available options	
Max one option can be chosen	Two winding	Three winding
Transformer terminal	1MRK 001 534-SB	1MRK 001 534-TB

\*) Needs only to be filled in when no transformer differential protection is ordered in next table  
 If transformer differential protection is ordered in next table the type of transformer terminal will automatically be chosen from that information.

Transformer differential protection	Available options	
Max one option can be chosen	Two winding	Three winding
Transformer differential protection, DIFP	1MRK 001 534-NC	1MRK 001 534-PC

Three-phase time overcurrent protection	Available options	
Max three options totally and only one per TOCx can be chosen	Non-Directional	Directional
First time overcurrent protection, TOC1	1MRK 001 538-AA	1MRK 001 538-DA
Second time overcurrent protection, TOC2	1MRK 001 538-BA	1MRK 001 538-EA
Third time overcurrent protection, TOC3	1MRK 001 538-CA	1MRK 001 538-FA

Restricted earth fault protection	Available options	
First restricted earth fault protection, REF1		1MRK 001 538-GA
Second restricted earth fault protection, REF2		1MRK 001 538-HA
Third restricted earth fault protection, REF3		1MRK 001 538-KA

**Ordering (cont'd)**

Earth fault time current protection Max three options totally and only one per TEFx can be chosen	Available options			
	Non-Directional		Directional	
First earth fault time current protection, TEF1		1MRK 001 538-LA		1MRK 001 538-PA
Second earth fault time current protection, TEF2		1MRK 001 538-MA		1MRK 001 538-RA
Third earth fault time current protection, TEF3		1MRK 001 538-NA		1MRK 001 538-SA

Thermal overload protection	Available options	
Thermal overload protection, THOL		1MRK 001 534-GA

Single-/Three-phase overvoltage protection or neutral time voltage protection	Available options	
First time overvoltage protection, TOV1		1MRK 001 538-TA
Second time overvoltage protection, TOV2		1MRK 001 538-UA
Third time overvoltage protection, TOV3		1MRK 001 538-VA
Fourth time overvoltage protection, TOV4		1MRK 001 538-XA
Fifth time overvoltage protection, TOV5		1MRK 001 538-YA
Sixth time overvoltage protection, TOV6		1MRK 001 538-ZA

Single-/Three-phase time undervoltage protection	Available options	
First time undervoltage protection, TUV1		1MRK 001 534-UA
Second time undervoltage protection, TUV2		1MRK 001 534-VA
Third time undervoltage protection, TUV3		1MRK 001 534-XA

Overexcitation protection	Available options	
Overexcitation protection, OVEX		1MRK 001 534-HC

Voltage control (On-load tap changer control) Max one option can be chosen	Available options			
	Single		Parallel(*)	
Voltage control, VCTR		1MRK 001 534-LC		1MRK 001 534-MC

(\*) Requires rear LON communication port on the RET terminal

Disturbance recorder	Available options	
Disturbance recorder DR		1MRK 001 534-KC

**RET 521 Configuration**

In the table below the hardware requirements for some general applications have been suggested. If the hardware is ordered according to that table also the corresponding example configuration will be downloaded in the delivered terminal. The six example configurations are available as templates in the configuration tool. The example configurations often cover more functionality than required in a specific case. Since all example configurations are available the necessary changes for a specific application will be easy to implement by using examples from the other configuration templates. The configuration tool CAP 535 have to be used to do the changes.

If the hardware required is different from the alternatives in the table below no example configuration is downloaded but the user can easily change one of the example configurations in CAP or built his own configuration to fit his application. The hardware configuration is always downloaded in the delivered terminal.

If the user require to have a specific configuration made and downloaded in the delivered terminal by ABB this can be ordered as well.

**Table 30: Configuration examples**

Configuration alternative	One AIM 7I+3U in position	Two AIM 7I+3U in positions	One AIM 8I+2U in position	One AIM 9I+1U in position	One Binary In module in position	One Binary Out module in position	One Binary In/ Out module in position	One mA input module in position	Intended for transformer with
Example 1	P3						P9		2 windings
Example 2			P3				P9	P12	2 windings
Example 3				P3	P9	P10		P12	2 windings
Example 4		P3 and P7			P9	P10			3 windings
Example 5			P3	P7	P9	P10			3 windings
Example 6				P3	P9	P10		P12	3 windings

**RET 521 Hardware Components**

Select with “X” mark in tables below the required type of module per slot location

Analog Input Module	Available options for Analogue Input Module		
	7I + 3U 1MRK 001 162-AA	8I + 2U 1MRK 001 162-BA	9I + 1U 1MRK 001 162-CA
Analog Input Module 1 (Located in Slot P3)			
Analog Input Module 2 (Located in Slot P7)			

7I+3U = Seven CT Inputs and Three VT Inputs

8I+2U = Eight CT Inputs and Two VT Inputs

9I+1U = Nine CT Inputs and One VT Inputs

(cont'd)

Binary Input/Output & mA module	Available options for Input/Output Module			
	BIM 1MRK000508-xx	BOM 1MRK000614-AB	IOM 1MRK000173-xx	MIM 1MRK000284-AA
Input/Output Module 1 (Located in Slot P9)				
Input/Output Module 2 (Located in Slot P10)				
Input/Output Module 3 (Located in Slot P11)				
Input/Output Module 4 (Located in Slot P12)				

BIM = 16 Optocoupler Inputs. Please specify rated voltage of optocoupler inputs below

BOM = 24 Contact Outputs

IOM = 12 Contact Outputs and 8 Optocoupler Inputs. Please specify rated voltage of optoc. inputs below

MIM = 6 analog (i.e. mA) inputs, always located in Slot P12

Please specify with “X” mark rated voltage for optocoupler inputs only for slots in which you have chosen BIM or IOM type of module

	Available rated Voltages for Optocoupler Inputs on BIM & IOM Modules			
	24/30 V dc for BIM xx =DB for IOM xx =GB	48/60 V dc for BIM xx =AB for IOM xx =AC	110/125 V dc for BIM xx =BB for IOM xx =BC	220/250 V dc for BIM xx = CB for IOM xx = CC
Input/Output Module 1 (Located in Slot P9)				
Input/Output Module 2 (Located in Slot P10)				
Input/Output Module 3 (Located in Slot P11)				
Input/Output Module 4 (Located in Slot P12)				

Communication ports	Available Options		
	SPA = Plastic LON = Plastic 1MRK 001 608-AA	SPA = Plastic LON = Glass 1MRK 001 608-BA	SPA = Glass LON = Glass 1MRK 001 608-CA
Rear communication via SPA & LON bus			

## Mechanical options:

### Test switch

COMBITEST test switch module RTXP

1MRK 000 371-EA

Current circuits connected for rated current

1A

5A

On/Off switch for the dc-supply

RK 795 017-AA

### NOTE!

The test switches have internal star point connection of three-phase CT groups

Each analogue input module AIM is connected to its own test switch module so two test switches are needed if two analogue input modules are used.

The first test switch module RTXP 24 will be mounted with the transformer protection terminal in RHGS 6 case with window door forming a full 19 inch case.

The second test switch module RTXP 24 (if needed) will be mounted in a separate RHGS 6 case with window door.

Test switch module RTXP24 for AIM2 mounted in RHGS6 Case

1MRK 000 371-EB

Rated current (1 or 5 A) to be specified for the connection between test switch and terminal.

The terminal is reconnectable and can at any time be altered between 1 or 5 A, but the terminal will be delivered with all current channels connected to either 1 A or to 5 A.

### Mounting details

Mounting details with IP40 degree of protection from the front for protection terminal case and if needed the extra test switch case for a second test switch module:

	Protection terminal	Second test switch case	
19" rack mounting of 3/4 of 19" terminal casing	<input type="checkbox"/>		1MRK 000 020-BA
19" rack mounting (applicable for terminal together with test switch)	<input type="checkbox"/>		1MRK 000 020-CA
19" rack mounting for second test switch case		<input type="checkbox"/>	1MRK 000 020-BE
Wall mounting (applicable for terminal and for test switch)	<input type="checkbox"/>	<input type="checkbox"/>	1MRK 000 020-DA
Flush mounting (applicable for terminal and for test switch)	<input type="checkbox"/>	<input type="checkbox"/>	1MRK 000 020-Y
Flush mounting with IP54 (applicable for terminal only)	<input type="checkbox"/>		1MKC 980 001-2

### Manuals

One copy of the Application manual, the Installation and Commissioning manual, the Operator's manual and the Technical reference manual are always included for each terminal.

*Rule: Specify the number of extra manual requested.*

Installation and commissioning manual

Quantity:

1MRK 504 017-UEN

Operator's manual

Quantity:

1MRK 504 015-UEN

Technical reference manual

Quantity:

1MRK 504 016-UEN

Application manual

Quantity:

1MRK 504 021-UEN

## Related documents

### Technical Overview brochure

CAP 535\*1.1

1MRK 511 086-BEN

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

Transformer Rated Power:

MVA

## Sample Specification

Numerical transformer terminal type RET 521 with continuous selfmonitoring and analogue/digital conversion of all input quantities. The terminal shall be suitable for protection, control and monitoring of two- or three-winding transformers, auto-transformers, reactors, and generator-transformer block units and also for applications with multi-breaker arrangements. The numerical transformer terminal shall be designed to operate correctly over a wide frequency range to accommodate for system frequency variations and block generator start-up.

The differential protection function shall be provided with 2nd harmonic restraint to avoid tripping at magnetizing inrush and 5th harmonic restraint to avoid tripping at overexcitation. Recovery inrush and CT saturation shall not influence the differential function. The differential protection shall have a settable restraint characteristic and be provided with an adaptive differential feature for multi-breaker arrangements. The differential protection shall be stable in case of high through-faults also in multi-breaker arrangements. Tap-changer position indication must be used to provide maximum sensitivity for the differential protection. A high-set unrestrained differential current protection shall be included.

Three-phase time overcurrent protections, restricted earth-fault protections, second harmonic restrained time earth-fault current pro-

tections, three-phase under- and over-voltage protections and neutral voltage protections shall be available for selectable windings. A thermal overload protection and an overexcitation protection shall be included.

Voltage regulation for single transformer or parallel transformers with On-Load-Tap-Changer shall be included in the numerical transformer terminal.

The terminal shall be provided with a programmable logic for trip and indications and configuration of the included protection, control and monitoring functions, and the basic structure shall be modular for binary inputs and binary outputs to facilitate user adaptation. A mA transducer input module shall be possible to add.

The terminal shall be provided with a front mounted menu driven human-machine-interface and a front port optical connector for a personal computer. Service value display of voltage, currents, frequency, event recording with 150 events and 10 recordings, and disturbance recording with 10 analogue signals and 48 digital signals for 40 s, and local data storage shall be included. Communication with the terminal shall be provided with two ports for LON and SPA in the rear for station control and station monitoring purpose.

## References

Series RE 500 mechanical packaging and connection	1MRK 510 010-BEN
COMBITEST Test system	1MRK 512 001-BEN
Auxiliary relays	1MRK 508 015-BEN

## Manufacturer

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