Protect^{IT} Transformer protection terminal

RET 521*2.5

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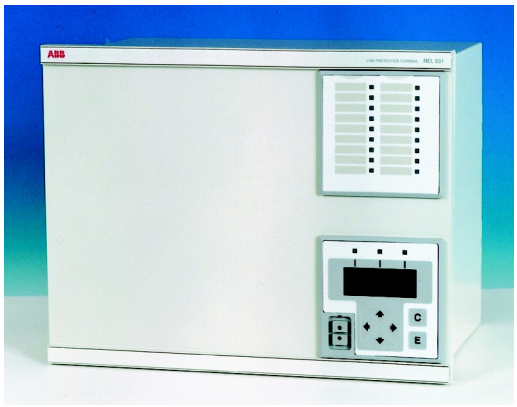


Industrial^{IT} enabled

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 variants 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-winding variant up to 4 three-phase CT groups and for three-winding variant up to 5 three-phase 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
  - Tap changer position adaptation for increased sensitivity
  - 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
- Versatile time overcurrent- or over/under-voltage protection. Inverse and definite time characteristics for low set overcurrent and definite characteristics for other functions. Can be connected as phase, earth, positive, negative and zero sequence functions for necessary back-up protection. The overcurrent function can be made directional and/or voltage/current controlled/restrained. Twelve protection modules are available. Each of them can be configured to any side of the transformer
- Restricted earth fault protection for each transformer winding, based on the low impedance principle and also provided with a directional feature and adaptive 2nd harmonic restraining.
- 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

Features (cont'd)

- 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
- Single or three-phase definite time undervoltage 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. Three protection modules are available
- High precision over and under frequency protection
- Voltage regulation for single transformer or up to 8 parallel transformers with on load tap changer, hot stand-by transformer control is included
- Programmable logic with inputs and outputs, AND-, OR-, INV-, 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 self monitoring 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. Local language available as option
- 18 LEDs for extended indication capabilities
- 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.

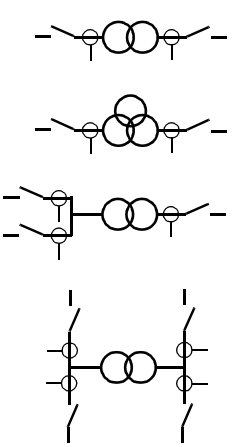
Flexibility is provided to cover for different applications in form of transformer size, vector groups, system neutral earthing and extension of protection functions according to the user's preference. The selection of functionality from the modular hardware and software is made according to the requirements 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.

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

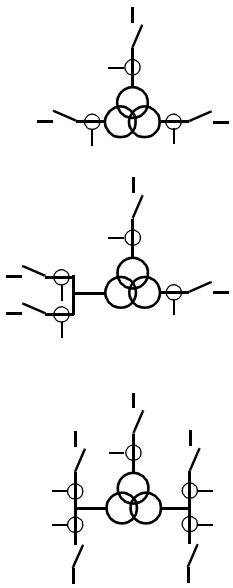


Fig. 1 CT group arrangement for differential protection and other protections

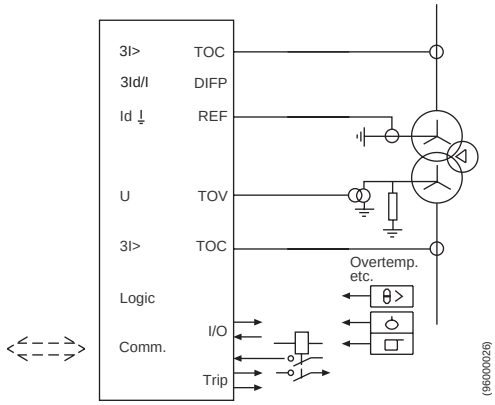


Fig. 2 An application example

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 adaptation for CT ratio matching and vector group compensation, which allows connection directly to Y-connected main CTs. Zero sequence current elimination is made internally, but can alternatively 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 it can alternatively 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.

Application (cont'd)

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 definite time or inverse time characteristic, and the higher level can be selected with definite time 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.

General function protection, GF
Twelve units of General Function Protection can be included. Each of them can be configured to any side of the transformer. The protection module is recommended as a general backup protection with many application areas due to flexible measuring and setting possibilities. The built-in overcurrent protection feature has two settable current levels, the lower level with definite time or inverse time characteristic, and the higher level with definite time characteristic. The over and under voltage feature have definite time characteristics. The overcurrent protection can be made directional with selectable voltage polarising quantity and can be additionally voltage and/or current controlled/restrained. 2nd harmonic restraining is available as well. At too low polarising voltage the overcurrent feature can be blocked or made non directional independently on both levels.

GF suits applications with underimpedance and voltage controlled overcurrent solutions. As well GF can be utilised for negative or positive sequence current solutions. Generator applications such as loss of field, inadvertent energizing, stator overload, fuse failure and open phase detection are just a few of many possible arrangements.

Service values for measured current and voltage 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 definite time or inverse time characteristic, and the higher level can be selected with definite time 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 $3U_o$ 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.

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.

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 lockout 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 definite time delay. The low stage can alternatively have an inverse time delay.

Service value for highest 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.

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 definite time delay.

Service value for lowest voltage is 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.

Frequency function protection, FRF
Three units of high precision under and over frequency function can be included. The frequency function shall be configured to the frequency measurement function block FRME for supply of frequency value. Both over and underfrequency functions are provided with definite time delay.

Service value for frequency is 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. A built-in power measuring function can be used to create selectivity with other equipment influencing on the system voltage. 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.

Application (cont'd)

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 parallel operating transformers, i.e. at the busbar or at the feeder ends. The voltage regulation is based on minimising the circulating current or the reverse reactance method. LON communication is used between terminals (for minimising circulating current method) 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. The voltage control function for parallel transformers exists in two versions one where maximum four transformers can be included in the station topology and another one where up to eight transformers can be included in the station topology

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 overtemperature 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.

Configurable logic
Configurable 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.

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 32 on page 28. These configurations are often covering more functionality than needed but can easily be changed from a connected PC with the CAP 540 terminal toolbox.

- 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 22.
- 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 page 24.
- 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 rat-

ing. 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 seconds. 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 540, 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).

Local language
It is possible to order and use one local language besides the english language for the text menus, shown on the front HMI panel.

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 an 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.
- Front LED-HMI panel. There are eighteen three color light-emitting diodes (LEDs), which can light up or flash on the LED display. The main purpose is to present on site an immediate visual information such as protection indications or alarm signals. Each LED is configured with the CAP 540 terminal toolbox.

Technical data

Table 1: Energising quantities, rated values and limits

Quantity	Rated value	Nominal range	Operative range
Current Burden	I_r = 1 A or 5 A < 0,25 VA at I_r	(0,2-30) x I_r (0,2-4) x I_r continuously	(0,03 - 100) x I_r 100 x I_r for 1 s*
AC voltage Ph-Ph** Burden	U_r = 100/110/115/120 V < 0,2 VA at U_r	80-120% of U_r	1,5 x U_r continuously 2,5 x U_r for 1 s
Frequency	f_r = 50/60 Hz	±2,5 Hz	±5 Hz
Frequency with extended range	f_r = 50/60 Hz	(0,7-1,2) x f_r	(0,65-1,25) x f_r
Auxiliary DC voltage EL power consumption (Terminal equipped with all IO- modules) Auxiliary DC power in-rush	EL = 24 - 60 V EL = 90 - 250 V < 35 W 220 VDC, <30 A, 0,1 ms 110 VDC, <15 A, 0,1 ms 48 VDC, <15 A, 0,1 ms 24 VDC, <10 A, 0,1 ms	±20% ±20%	±20% ±20%
Binary input /output module DC voltage RL power consumption each I/O module each output relay power dissipation RL24 = 24/30 V RL48 = 48/60 V RL110 = 110/125 V RL220 = 220/250 V	 RL24 = 24/30 V RL48 = 48/60 V RL110 = 110/125 V RL220= 220/250 V ≤ 1 W ≤ 0,15 W max. 0,05 W/input max. 0,1 W/input max. 0,2 W/input max. 0,4 W/input	 ±20% ±20% ±20% ±20%	 ±20% ±20% ±20% ±20%
Binary input module DC voltage RL power consumption each input module power dissipation RL24 = 24/30 V RL48 = 48/60 V RL110 = 110/125 V RL220 = 220/250 V	 RL24 = 24/30 V RL48 = 48/60 V RL110 = 110/125 V RL220 = 220/250 V ≤0,5 W max. 0,05 W/input max. 0,1 W/input max. 0,2 W/input max. 0,4 W/input	 ±20% ±20% ±20% ±20%	 ±20% ±20% ±20% ±20%
Binary output module power consumption each output module each output relay	 ≤ 1 W ≤ 0,25 W		

Table 1: Energising quantities, rated values and limits

Quantity	Rated value	Nominal range	Operative range
mA input module input range input resistance power consumption each mA module each mA input	 ±20 mA R_{in} = 194 ohm ≤4 W ≤0,1W		
Ambient temperature	20°C	-10°C to +55°C	
Ripple in dc auxiliary voltage	max. 2%	max. 12%	Full wave rectified
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	Influence
Ambient temperature	-10 °C to +55 °C	0,01%/ °C
Frequency dependence (without extended frequency range)	f_r ± 2,5 Hz for 50 Hz f_r ± 3,0 Hz for 60 Hz	± 3,0 %
Frequency dependence (with extended frequency range)	(0,7-1,2) x f_r	± 2,0 %
Harmonic frequency dependence (10, 20 and 50% content)	2:nd 3:rd and 5:th harmonic of I_r	± 1,0 %
Auxiliary DC voltage	(24-60) Vdc ±20 % (110-250) Vdc ±20 %	0,01 % / %
Ripple in auxiliary DC voltage	12 % of EL	0,01 % / %
Interruption in auxiliary DC voltage without resetting correct function	(24-60) Vdc ±20 % (110-250) Vdc ±20 %	 < 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	 8 kV, air discharge 6 kV, contact discharge	IEC 60255-22-2, Class III
Fast transient disturbance	4 kV	IEC 60255-22-4, Class A
Surge immunity test	1-2 kV, 1,2/50 µs, high energy	IEC 60255-22-5
Power frequency immunity test	100-300 V, 50 Hz	IEC 60255-22-7, Class A
Power frequency magnetic field test	1000 A/m, 3 sec.	IEC 61000-4-8, Class V
Radiated electromagnetic field disturbance	10 V/m, (80-1000) MHz	IEC 60255-22-3
Radiated electromagnetic field disturbance	10 V/m, (80-1000) MHz, (1,4-2,0)GHz	IEC 61000-4-3, Class 3
Radiated electromagnetic field disturbance	10 V/m, 27, 80, 150, 450, 900 MHz	IEEE/ANSI C37.90.2
Conducted electromagnetic field disturbance	10 V (0,15-80) MHz	IEC 60255-22-6

Technical data (cont'd)

Table 4: Electromagnetic compatibility (EMC), emission tests

Test	Type test values	Reference standards
Electromagnetic emission, radiated	30-1000 MHz	IEC 60255-25
Electromagnetic emission, conducted	0,15 - 30 MHz	IEC 60255-25

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 µs, 0,5 J	IEC 60255-5
Insulation resistance	> 100 Mohm at 500 V dc	IEC 60255-5

Table 6: CE-mark

Test	Reference standards
Immunity	EN 61000-6-2
Emissivity	EN 61000-6-4
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 60255-23)

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, cosφ > 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^2 2 x 1 mm^2	10 A	30 A
Current connectors	250 V AC	4 mm^2	20 A	500 A
Fiber connectors LON, SPA	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	9600, 19200, 38400, 57600 or 115200 Bd
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 Bd
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

Technical data (cont'd)

Table 14: Event recording

Function	Value
Time tagging resolution	1 ms
Event buffering capacity Max. number of events/ disturbance report Max. number of disturbance reports Time tagging error with synchronisation using LON and minute pulse Time tagging error without synchronisation	 150 10 ± 1 ms typical ± 10ms/hour

Table 15: Service values for input quantities

Function	Nominal range
Frequency	(0,7 -1,2) x fr acc ± 2 mHz at three phase connection acc ± 50 mHz at single phase connection
Current	(0,1 - 4,0) x Ir
Voltage	(0,1 - 1,5) x Ur
Angles	0,0 - 359,9 degrees

Table 16: Disturbance recorder, DR

Function	Setting range
Number of binary inputs	48
Number of analog inputs	10
Sampling rate	1 kHz or 1,2 kHz for 50 and 60 Hz respectively
Recording bandwidth	(5-500) Hz or (6-600) Hz fixed
Over triggering	(0,00-50,00) x rated value (U_r or I_r)
Under triggering	(0,00-2,00) x rated value (U_r or I_r)
Pre-fault time	(10-300) ms in steps of 10 ms
Post fault time	(100-3000) ms in steps of 100 ms
Limit time	(500-4000) ms in steps of 100 ms
Number of recorded disturbances	Max. 10 disturbances
Function	**Value**
Voltage channels dynamic range resolution accuracy at rated frequency f_r $U \leq U_r$ $U > U_r$	 (0,01-2,0) x U_r at 100 V sec. 0,1% of U_r ≤1% of U_r ≤1% of U

Table 16: Disturbance recorder, DR

Current channels dynamic range without DC offset with full DC offset resolution accuracy at rated frequency f_r $I \leq I_r$ $I > I_r$	 (0,01-85) x I_r (0,01-40) x I_r ≤0,25% of I_r ≤1% of I_r ≤1% of I (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, DIFP

Function	Parameter	Value or Range
Current bias	CharactNo	Selectable characteristics
Inrush Stabilisation setting	StabByOption	Wave form and second harmonic selections
Inrush restraint	I2/I1ratio	5-25%

Technical data (cont'd)

Table 19: Transformer differential protection, DIFP

Function	Parameter	Value or Range
Overexcitation restraint	I5/I1ratio	10-50%
Basic diff. current, % of object Ir	Idmin	10-50%
High, non-restraint diff. current, % of object Ir	Idunre	200-2500%
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_r at diff. current I = 10 x I_r at diff. current I = 2 x Idunre		 34 ms, typically 30 ms, typically 20 ms, typically
Reset time		Typical 15 ms

Table 20: Three-phase time overcurrent protection, TOC

Function	Parameter	Value or Range
Level 1 Operate current, % of object Ir or user defined Ir Time characteristics	 IsetLow CurveType	 10-500% DEF, NI, VI, EI, LI
Definite time setting	tDefLow	0,00- 300,00 s
Inverse time characteristics $t=(k \times T)/[(I/Is1)^{\alpha} -1]$ Is1 = IsetLow		Acc. to IEC 60255-3 Normal inverse, Type A: T=0,14, α=0,02 Very inverse, Type B: T=13,5, α=1,0 Extremely inverse, Type C: T=80,0, α= 2,0 Long time inverse: T=120,0, α=1,0
Time multiplier Definite minimum time	k tMin	0,05-1,10 0,05-1,00 s
High set current, % of object Ir or user defined Ir Time setting	IsetHigh tDefHigh	10-2000% 0,00-300,00 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		< 5 %

Table 21: General function protection, GF

Function	Parameter	Value or Range
Measuring Current Input	CurrentInput	L1, L2, L3, PS, NS, 3ZS, MAX, MIN, UNB, L1L2, L2L3, L3L1 MAX2, MIN2
Rated current for user defined side, in A	IrUserDef	1 -99999 A
Measuring Voltage Input	VoltageInput	L1, L2, L3, PS, -NS, -3ZS, MAX, MIN, UNB, L1L2, L2L3, L3L1 MAX2, MIN2
Rated voltage for user defined side, in kV	UrUserDef	0,1 - 999,9 kV
Start current, lowset in % of Ir	IsetLow	2 - 5000 % of Ir
Definite delay lowset in sec.	tDefLow	0,00 - 300,00 s
Minimum operating time in sec.	tMin	0,05 - 200,00 s
$t_{op} = k \times \left[\frac{A}{\left(\frac{I}{I_{pickup}} \right)^{P} - C} + B \right]$ t_{op} = operate time I_{pickup} = actual pickup current with restrain influence Time multiplier for inverse time lowset stage	k	0,05 - 999,00
Constant A of inverse time curve, lowset stage	A	0,0000 - 999,0000
Constant B of inverse time curve, lowset stage	B	0,0000 - 99,0000
Constant C of inverse time curve, lowset stage	C	0,0000 - 1,0000
Constant P of inverse time curve, lowset stage	P	0,0001 - 4,0000
Reset time const. in ms for inverse time	tReset	0,00 - 600,00 s
2nd Harmonic restrains	2harLow 2harHigh	0 = Off, 1 = On 0 = Off, 1 = On
Second to first harmonic ratio in %	I2/I1ratio	5 - 100 %
Start current, highset in % of Ir	IsetHigh	2 - 5000 % of Ir
Definite delay highset in sec.	tDefHigh	0,00 - 300,00 s
Restraining Current Input	RestrCurr	PS, NS, 3ZS and MAX,
Restrain coefficient	RestrCoeff	0,00 - 5,00
Start overvoltage in % of Ur	UsetOver	3,0 - 200,0 % of Ur
Start undervoltage in % of Ur	UsetUnder	3,0 - 200,0 % of Ur
Definite delay overvoltage function in sec.	tDefOver	0,00 - 300,00 s
Definite delay undervoltage function in sec.	tDefUnder	0,00 - 300,00 s
Direction for trip, lowset.	DirectionLow	NonDir, Forward and Reverse
Direction for trip, highset.	DirectionHigh	NonDir, Forward and Reverse
Relay Characteristic Angle in deg.	rca	-180 to +180 deg
Relay Operate Angle in deg.	roa	1 to 120 deg

Technical data (cont'd)

Table 21: General function protection, GF

Function	Parameter	Value or Range
Directional operation principle lowset	DirPrincLow	0 = I&U, 1 = I · cos φ & U
Directional operation principle highset	DirPrincHigh	0 = I&U, 1 = I · cos φ & U
Minimum Voltage Operation for directional feature	UminOper	1,0 - 200,0 % of Ur
Action low pol. voltage, lowset.	UActionLow	NonDir and Block
Action low pol. voltage, highset.	UActionHigh	NonDir and Block
Voltage level for restrained feature in % of Ur	ULevel	1,0 - 200,0 % of Ur
Factor giving lower level voltage for restraining	UFactor	0,03 - 0,99
Factor giving lower level of lowset current for restraining	IFactorLow	0,03 - 5,00
Factor giving lower level of highset current for restraining	IFactorHigh	0,03 - 5,00
Resetting ratio overcurrent Resetting ratio overvoltage Resetting ratio undervoltage		> 0,95 > 0,99 < 1,01
Operate time current measurement IEC curves (parameters set acc to IEC standard defined parameters) Definite time setting		 Class 5 and 0/+30 ms ±0,5% of setting 0/+30 ms
Operate time voltage measurement Definite time setting		 ±0,5% of setting 0/+30 ms
Reset time current and/or voltage measurement		 Typical 25 ms
Transient overreach due to DC offset in current for current measurement L/R<100ms		 < 5 %

Table 22: Earth-fault time current protection, TEF

Function	Parameter	Value or Range
Level 1 Operate current, % of object Ir or user defined Ir Time characteristics	 IsetLow CurveType	 3 - 500% Definite (independent) Inverse (dependent)
Definite time setting	tDefLow	0,00 - 300,00 s
Inverse time characteristics $t=(k \times T)/[(I/Is1)^{\alpha} -1]$ Is1 = IsetLow Time multiplier Definite minimum time	 k tMin	Acc. to IEC 60255-3 Normal inverse, Type A: T=0,14, α=0,02 Very inverse, Type B: T=13,5, α=1,0 Extremely inverse, Type C: T=80,0, α=2,0 Long time inverse: T=120,0, α=1,0 0,05 - 1,10 0,05 - 1,00 s
Logarithmic inverse (RXIDG) $t= 5,8-1,35 \times \ln(I/Ib)$ Ib = IsetLow Min current Istart x IsetLow Definite min. time	 Istart tLog	 1,0 - 4,0 0,03 - 10,00 s

Table 22: Earth-fault time current protection, TEF

Function	Parameter	Value or Range
High set current, % of object Ir or user defined Ir Time setting	 IsetHigh tDefHigh	 20-2000% 0,00-300,00 s
2nd harmonic restrain	2harLow 2harHigh	Off/On Off/On
Second to first harmonic ratio	I2/I1ratio	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		< 5%

Table 23: Restricted earth-fault protection, REF

Function	Parameter	Value or Range
Basic diff. current, % of object Ir	Idmin	5-50%
Directional characteristic	rca (fixed) roa	180° ±60° to ±90°
Operate time at 2 × Id		Typical 25 ms
Reset time		Typical 25 ms

Table 24: Thermal overload protection, THOL

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 $(Itr)^2$	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
1:st alarm level, in % of heat content trip value $(Itr)^2$	Alarm1	50-99%
2:nd alarm level, in % of heat content trip value $(Itr)^2$	Alarm2	50-99%
Reset level for lock-out, in % of heat content trip value $(Itr)^2$	ResetLockOut	10-95%
Operate time		±5% of set time

Technical data (cont'd)

Table 25: Single-/Three-phase time overvoltage protection, TOV

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	0,00-300,00 s
Inverse time characteristic $t=(k \times T)/[(U/Us1)^{\alpha} -1]$ Us1 = UsetLow Time multiplier Definite minimum time	 k tMin	Very Inverse: T=13,5, α=1,0 0,05-1,10 0,05-1,00 s
High set voltage, % of object Ur Time setting	UsetHigh tDefHigh	5,0-200,0% 0,00-300,00 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 26: Neutral time voltage protection

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

Table 27: Single-/Three-phase time undervoltage protection, TUV

Function	Parameter	Value or Range
Operate voltage, % of object Ur	UsetLow UsetHigh	5,0-130,0% 5,0-130,0%
Time setting	tDefLow tDefHigh	0,00-300,00 s 0,00-300,00 s
Resetting ratio		< 1,01
Operate time Definite time setting		 ±0,5% of setting 0/+40 ms
Reset time		Typical 35 ms

Table 28: Overexcitation protection, OVEX

Function	Parameter	Value or Range
Emax continous no-load	Emaxcont	1,00-1,50 p.u.
Emax when time according to delay tMin takes over	Emax	1,20-1,80 p.u.
Minimum time delay when over excitation >Emax	tMin	0,50-30,00 s
Maximum time delay for over excitation	tMax	10-120 min

Table 28: Overexcitation protection, OVEX

Function	Parameter	Value or Range
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	Tcool	1 - 120 min
Time delay for alarm	tAlarm	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 29: Frequency function protection, FRF

Function	Parameter	Value or Range
Start frequency for over frequency Protection	FrsetOver	30,000 - 75,000 Hz
Definite delay over frequency Protection	tDefOver	0,00 - 300,00 s
Reset time factor for over frequency Protection.	kResetOver	0,1 - 1000,0
Start frequency for under frequency Protection	FrsetUnder	30,000 - 75,000 Hz
Definite delay under frequency Protection	tDefUnder	0,00 - 300,00 s
Reset time factor for under frequency Protection.	kResetUnder	0,1 - 1000,0
Accuracy	at three phase connection	± 2 mHz
Resetting ratio		1,00
Operate time at 10 Hz/sec frequency change Definite time setting		 ±0,5% of setting 250 - 375 ms
Reset time		Typical 300 - 400 ms

Table 30: Voltage control function, VCTR

Function	Parameter	Value or Range
Voltage control set voltage, % of Ur2*	Uset	85,0 - 120,0% acc < 0,5 % of U_r
Set voltage deadband, % of Ur2	Udeadband	0,5 - 9,0%
Set inner deadband, % of Ur2	UdeadbandInner	0,1 - 9,0 %
Upper limit busbar voltage, % of Ur2	Umax	80 - 180% acc < 0,5 % of U_r
Lower limit busbar voltage, % of Ur2	Umin	70 - 120% acc < 0,5 % of U_r
Fast step down function activation	FSDMode	Off, Auto, AutoMan
Time characteristic for Time 1 (first command)	t1Use	Const Inverse

Technical data (cont'd)

Table 30: Voltage control function, VCTR

Function	Parameter	Value or Range
Time delay for first command	t1	1-300 s
Time characteristic for Time 2 (consecutive command)	t2Use	Const Inverse
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 4,0%
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 Setting 0 is for special configuration of auto block feature	LowVoltTap	0 and 1-64
Tap changer high limit position Setting 0 is for special configuration of auto block feature	HighVoltTap	0 and 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
Operate level for Active Power in forward direction of Power monitoring function	Pforw	-9999.99-9999.99 MW
Operate level for Active Power in reverse direction of Power monitoring function	Prev	-9999.99-9999.99 MW
Operate level for Reactive Power in forward direction of Power monitoring function	Qforw	-9999.99-9999.99 MVAr
Operate level for Reactive Power in reverse direction of Power monitoring function	Qrev	-9999.99-9999.99 MVAr
Power monitoring function time delay	tPower	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	NoOpWindow	3-30
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 31: Additional voltage control function parameters for operation of parallel power transformers, VCTR4 or VCTR8

Parallel operation	OperatonPAR	Off/On
Parallel transformer reactance reduced to secondary side (for each transformer T_x)	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	1,0-60,0 s

Terminal diagrams

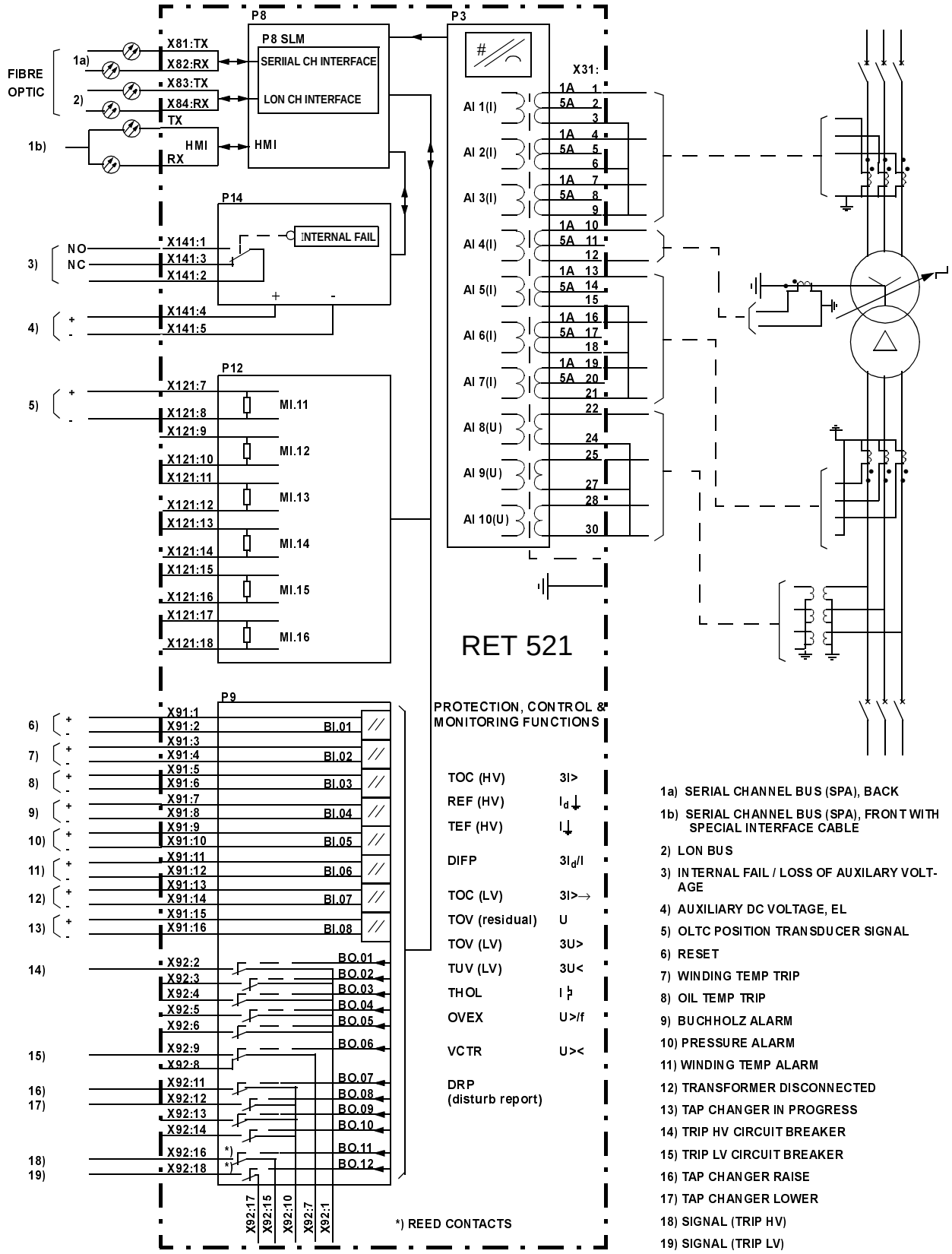
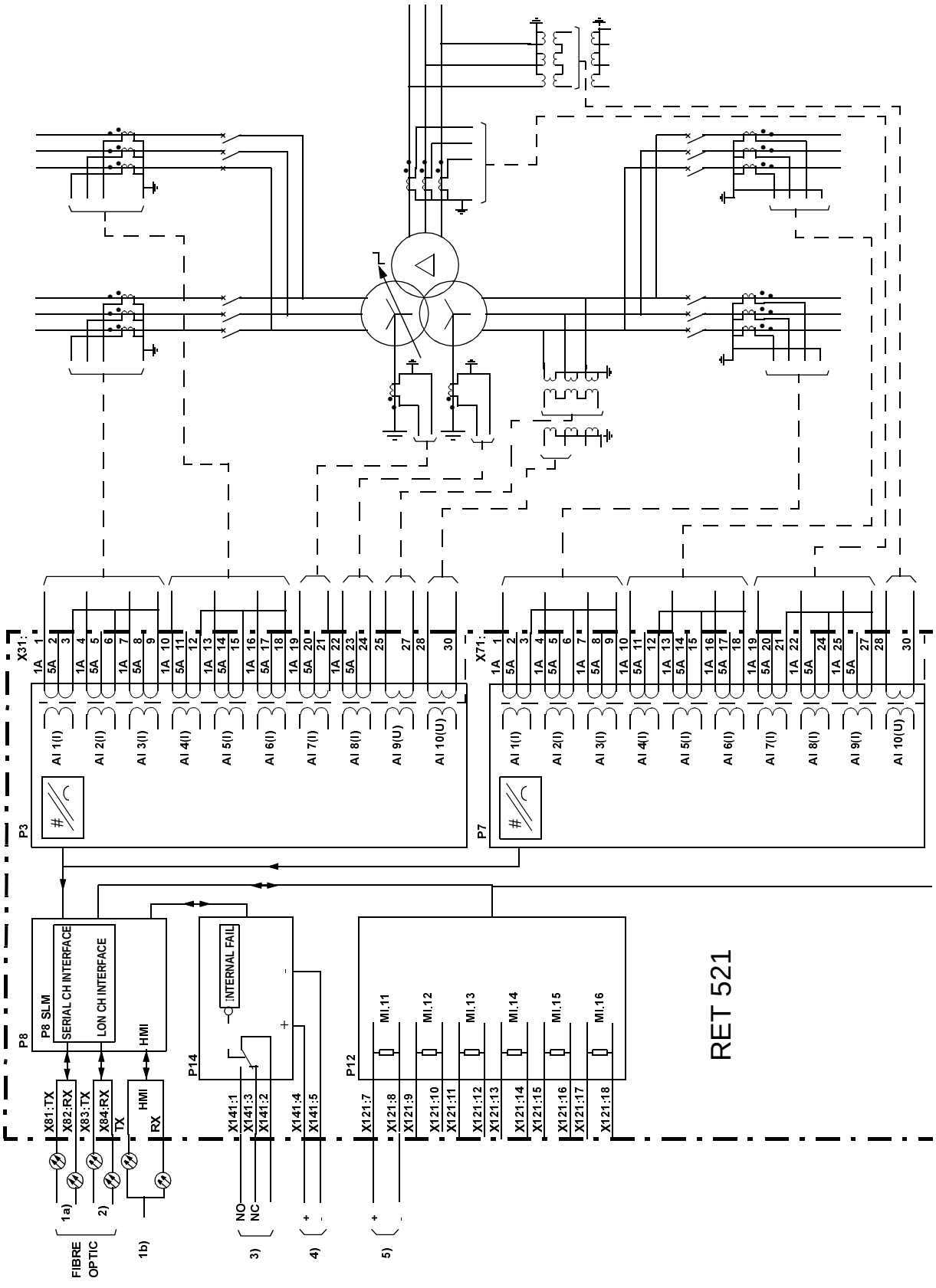


Fig. 3 2 Winding Transformer Protection Terminal Diagram acc to configuration alternative 1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X71:
P3
P7
P8
P8 SLM
SERIAL CH INTERFACE
LON CH INTERFACE
HMI
P14
INTERNAL FAIL
P12
RET 521
X81:TX
X82:RX
X83:TX
X84:RX
TX
RX
FIBRE OPTIC
1a)
2)
1b)
NO
NC
3)
4)
5)

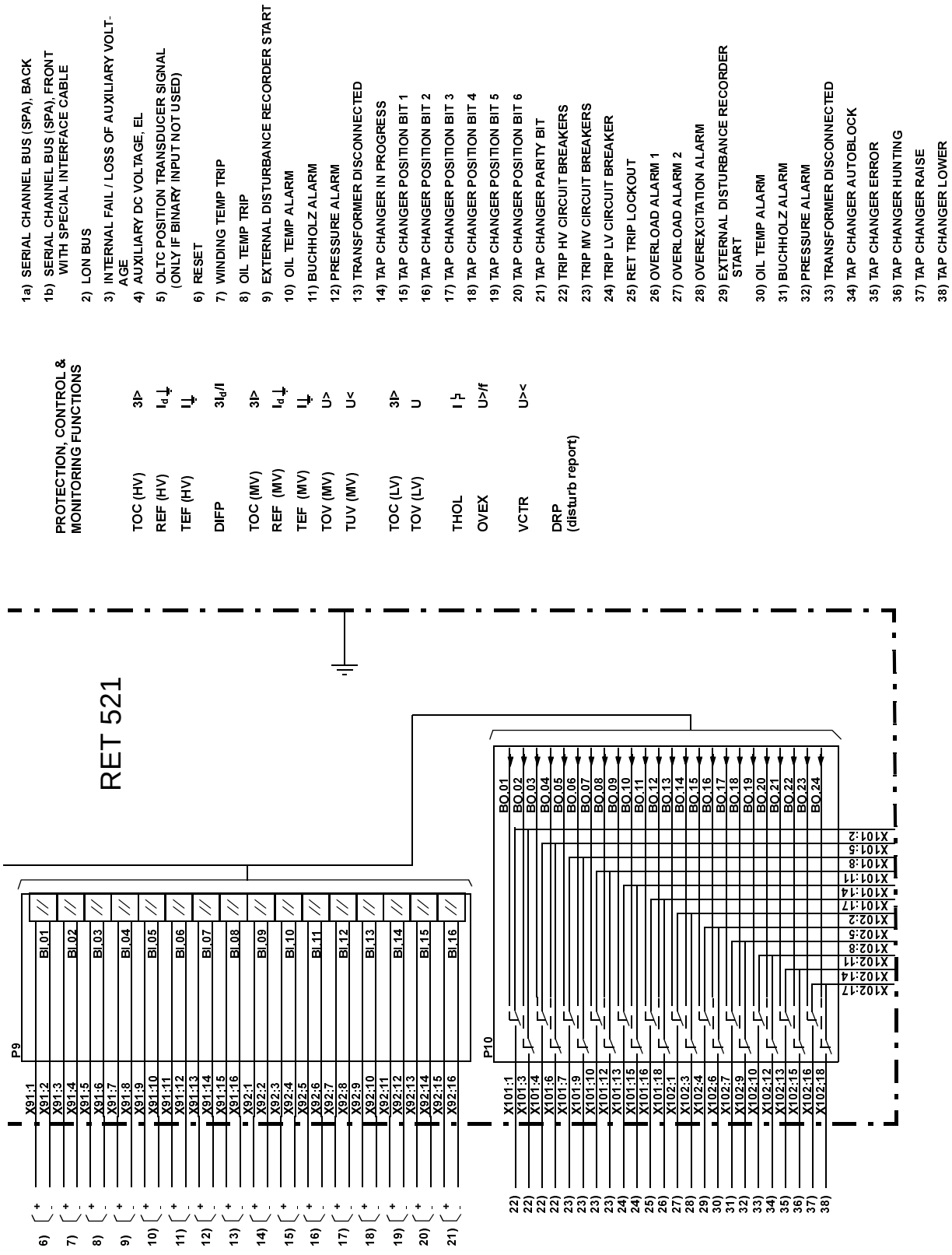

Fig. 4 3 Winding Transformer Terminal Diagram acc to configuration alternative no 5

Ordering

RET 521 terminals 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 basic modules
Casing with connection board and front HMI panel, 3/4 of 6U 19 inch

Numerical module (processor board)

Auxiliary power supply module

Software basic functions
Frequency measurement function, FRME

Service value reading, SVR

Event recording and trip value recording (in disturbance report), ER

Custom logic programming (40 AND, 40 OR, 20 inverters, 25 timers, 20 pulse timers, 10 SR-gates and 3 MOVE blocks), CL1

Trip logic, 12 blocks, TL

Binary converter, BC

Event function (single and double indications), EV

Command function (single and multiple), CD and CM

Ordering Number: 1MRK 001 530-AE **Quantity:** ☐

Basic data:

Nominal frequency:	50/60 Hz
Rated VT input voltage (across each individual input)	100/√3, 110/√3, 115/√3, 120/√3, 100, 110, 115, 120 V
Rated CT input current	1/5 A
Auxiliary dc voltage EL	90-250 V or 24-60 V

Ordering (cont'd)

Basic data to be specified

Select with "X" mark required protection and control functions.

Transformer terminal	Available options			
Max one option can be chosen	Two winding, 2w		Three winding, 3w	
Transformer terminal		1MRK 001 534-SB		1MRK 001 534-TB

RET 521 Protection and control optional functions

Transformer differential protection	Available options			
Max one option can be chosen	Two winding, 2wDIFP		Three winding, 3wDIFP	
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, TOCx		Directional, TOCxdir	
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

General function protection	Available options	
General function three instances, GF01...GF03 called 3GF		1MRK 001 534-YA
General function six instances, GF01...GF06 called 6GF		1MRK 001 534-YB
General function twelve instances, GF01...GF12 called 12GF		1MRK 001 534-YC

Earth fault time current protection	Available options			
Max three options totally and only one per TEFx can be chosen	Non-Directional, TEFx		Directional, TEFxdir	
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

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

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

Frequency function protection	Available options	
Frequency function protection three instances, FRF1....FRF3 called 3FRF		1MRK 001 534-ZA

Voltage control (On-load tap changer control)

Rule: Max one option can be chosen.

Rule: VCTR4 or VCTR8 needs LON communication port on the RET 521 terminal.

	Available options	
Voltage control, single transformer, VCTR		1MRK 001 534-LD
Voltage control, maximum four parallel trasformers, VCTR4		1MRK 001 534-MD
Voltage control, maximum eight parallel trasformers, VCTR8		1MRK 001 534-ME

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

Second HMI language Max one option can be chosen	Available options	
2nd HMI language, german, HMI-de		1MRK 002 099-AA
2nd HMI language, russian, HMI-ru		1MRK 002 099-BA
2nd HMI language, french, HMI-fr		1MRK 002 099-CA
2nd HMI language, spanish, HMI-es		1MRK 002 099-DA
2nd HMI language, italian, HMI-it		1MRK 002 099-EA
Customer specific language	Contact your local ABB representative for availability	

Ordering (cont'd)

RET 521 Hardware 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 540 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 32: 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 Basic Hardware Components

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

PSM Module
Auxiliary dc voltage

24-60 V dc	☐ 1MRK 002 239-AA
90-250 V dc	☐ 1MRK 002 239-BA

RET 521 Optional Hardware Components

LED HMI

18 LED indication module	☐ 1MRK 000 008-DA

Rule: Only one type of AIM (standard compression or ringlug) in the same terminal

Standard compression type terminals

Analog Input Module, AIM	Available options for Analogue Input Module		
	7I + 3U 1MRK 001 162-AC	8I + 2U 1MRK 001 162-BC	9I + 1U 1MRK 001 162-CC
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

AIM with ringlug terminal connection
Please observe, ringlugs are not approved for the EU market since requirements for CE-marking are not fulfilled

Analog Input Module, AIM	Available options for Analogue Input Module		
	7I + 3U 1MRK 001 162-GA	8I + 2U 1MRK 001 162-HA	9I + 1U 1MRK 001 162-KA
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

Binary Input/Output & mA module	Available options for Input/Output Module			
	BIM 1MRK000508-xx	BOM 1MRK000614-AB	IOM 1MRK000173-xx	MIM 1MRK000284-AB
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

Ordering (cont'd)

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 kit for 3/4 of 19” terminal casing	☐		1MRK 000 020-BA
19” rack mounting kit (applicable for terminal together with test switch)	☐		1MRK 000 020-CA
19” rack mounting for second test switch case		☐	1MRK 000 020-BE
Wall mounting (applicable for terminal and for test switch)	☐	☐	1MRK 000 020-DA
Flush mounting (applicable for terminal and for test switch)	☐	☐	1MRK 000 020-Y
Flush mounting with IP54 (applicable for terminal only)	☐		1MKC 980 001-2

Front connection cable

Front connection cable between LCD-HMI and PC for terminal handling (Opto/9-pole D-sub connectors)	Quantity:	☐ 1MKC 950 001-2

Manuals

One User Documentation CD-ROM with all 500 series manuals is always delivered with each terminal.

Rule: Specify the number of printed manual requested.

User Documentation CD-ROM RET 521 *2.5	Quantity:	☐ 1MRK 002 270-AA
Operator´s manual	Quantity:	☐ 1MRK 504 039-UEN
Technical reference manual	Quantity:	☐ 1MRK 504 036-UEN
Installation and commissioning manual	Quantity:	☐ 1MRK 504 038-UEN
Application manual	Quantity:	☐ 1MRK 504 037-UEN

Customer feedback

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

Related documents

Technical overview brochure	
CAP 540*1.2, terminal tool box	1MRK 511 112-BEN
Accessories for REx 5xx*2.3	1MRK 514 009-BEN
COMBITEST Test system	1MRK 512 001-BEN
Auxiliary relays	1MRK 508 015-BEN

Sample Specification

Numerical transformer protection and control terminal must have continuous self monitoring and analogue/digital conversion of all measured input quantities. The terminal shall be suitable for protection, control and monitoring of two- or three-winding transformers, auto-transformers, shunt reactors, and generator-transformer block units. The terminal shall be also suitable for applications with multi-breaker arrangements with up to five restraint CT inputs. The numerical transformer terminal shall be designed to operate correctly over a wide frequency range to accommodate for system frequency variations during generator start-up or shut-down.

The differential protection function shall be provided with adaptive 2nd harmonic and waveblock restraint features to avoid tripping at magnetizing inrush and 5th harmonic restraint to avoid tripping at overexcitation. The differential protection shall have a settable restraint characteristic and be provided with an adaptive differential feature for multi-breaker arrangements. The differential function shall be stable for external faults followed by heavy CT saturation and recovery inrush. Tap-changer position indication shall be used to provide maximum sensitivity for the differential protection. A high-set unrestrained differential current protection must be included.

Low impedance, restricted earth-fault protection functions shall be available as complimentary protection against winding to ground faults. Function shall include directional criteria for extra security.

Underimpedance protection functionality for phase to phase and/or phase to ground faults shall be available as backup protection for transformer and connected power network.

Versatile phase, ground, positive, negative and zero sequence overcurrent and/or over and undervoltage protection functions shall be available for necessary backup protection for power transformer and connected power system. It shall be possible to use the overcurrent functions as directional and/or voltage controlled or restrained. A thermal overload protection, an overexcitation protection and over/under frequency protection functions shall be available as well. Voltage regulation for a single transformer or up to eight 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.

Front mounted 18 LED-HMI annunciator panel shall be available. Freely configurable, multi color light-emitting diodes with steady or flashing indication shall be used for easy and immediate visual indication about internal protection function operation or abnormal operating status of the protected object.

Manufacturer

ABB Automation Technology Products AB
Substation Automation
SE-721 59 Västerås
Sweden
Telephone: +46 (0) 21 34 20 00
Facsimile: +46 (0) 21 14 69 18
Internet: www.abb.com/substationautomation