Phasor Measurement Terminal

RES 521*1.0

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Data subject to change without notice

Features

- Time tagged AC phasors, positive sequence voltages and currents as real and imaginary quantities, for local or remote applications
- Frequency and rate of change of frequency
- Data transfer rate is selectable to 1 per cycle, 1 per 2 cycles, or 1 per 4 cycles. A specific anti-aliasing filter has been designed for each transfer rate, to capture an optimum of the power system dynamics
- Selectable time tagging principle: beginning, center or end of reporting interval
- Synchronized sampling of terminals in different substations, by the use of GPS-based time signals
- Time tagging accuracy down to 1 µs
- Highly accurate voltage and current measurement
- Highly accurate phase angle calculation
- 6 analog current inputs, and 3 analog voltage inputs
- Optionally additional 6 analog current inputs, and 3 analog voltage inputs
- Two settable pick-up levels for frequency, two settable pick-up levels for rate of change of frequency, two settable undervoltage pick-up levels, and four settable overcurrent pick-up levels are available
- One normally open output contacts each for abnormal frequency, rate of change of frequency, undervoltage and overcurrent pick-up
- One normally open output contact for loss of GPS alarm. One normally open output contact for streaming data failure
- Common change over output contact for loss of dc and internal self-monitoring.
- Seven binary inputs can be freely connected to the IEEE 1344 synchrophasor data format. One binary input is also used for blocking of triggers
- Remote communication port 10/100 Base Tx for TCP/IP/UDP and streaming data in IEEE 1344 or PC37.118 synchrophasor format
- Optionally additional optical remote communication ports 100 Base Fx on a PMC module with ST glass fibre connectors for TCP/IP/UDP and streaming data in IEEE 1344 or PC37.118 synchrophasor format
- Front-mounted menu-driven display for displaying positive sequence voltage and current measurements as amplitude and phase angle. The angle reference is selectable to any phasor or the GPS time reference
- Continuous self-monitoring and diagnostics
- Protective relay technology and EMC noise suppression
- Available for 19 inch rack mounting in a panel, surface or flush mounting
- Hardware options:
  - Separate Combitest test switch for reliable and safe testing
  - On/Off switch for dc supply
  - Mounting details for IP40 and IP54
  - Ring lug terminals
- Industrial IT Enabled

Application

There are a number of applications for phasor measurements, such as:

- Continuous logging for detailed off-line post contingency analysis; e.g., WAMS (Wide Area Measurement System) applications
- Improved state estimation for SCADA (Supervisory Control And Data Acquisition), EMS (Energy Management System), system wide protection and emergency control applications
- Power system damping functions, based on system wide phase angle measurements
- Loss of synchronism mitigation, based on voltage phase angle measurements at critical nodes

The increased utilization of electric power systems is of major concern to most utilities and grid operators today. Advanced control and supervision systems will allow the operation of the power system closer to its thermal limits (increase of power flow) without violating reliability constraints. Introduction of the Phasor Measurement Terminal RES 521, is the first step towards more efficient and reliable network operation.

A number of RES 521, connected in a star configuration to a data concentrator, make sure that relevant phasor data are available for off-line studies and post-fault analysis. Each RES 521 has typically 9 or18 analog input channels for voltages and currents. Each RES 521 is continuously sending data to the data concentrator at a selectable speed of up to 50/60 times per second. The data concentrator then stores these data in a circular buffer with a capacity of about one week. Based on these stored data, extensive off-line studies and post-fault analyses can be performed.

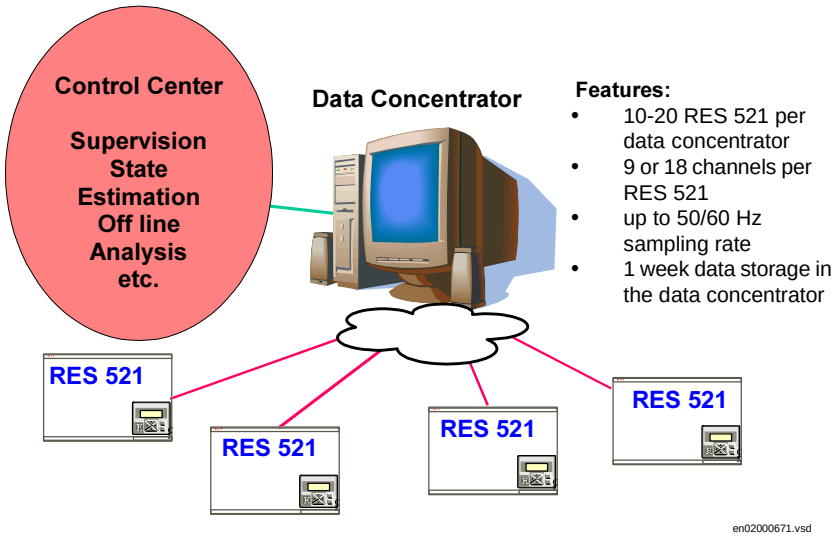


Fig. 1 Data concentrator connection to RES 521

By the introduction of RES 521, power network state estimation can be done in nearly real-time, overcoming the inaccuracy and delays of traditional SCADA-based schemes. The presently available EMS model can thus be complemented with phasors and angles measured in real-time, enhancing the power system load transfer calculations.

Design

The physical design of Phasor Measurement Terminal RES 521 is in line with the products in the RE. 500-series. It is housed in a painted sheet steel enclosure suitable for different mounting application by use of particular mounting accessories. Wire connections are made at the rear side at terminals of compression type tightened by a screw. Ring lug terminals are available as an option. Wires and optionally fiber-optic cables for data communication are also connected at the rear side. On the front is an HMI-panel. Behind the front panel, there is an interconnection board and a motherboard to which printed board assemblies (PBAs) are plugged in from the rear side. The input modules for analog AC quantities are fixed mounted, and the connection terminal for these circuits is also fixed mounted. The connection terminals for the DC contact circuits are of the multipole detachable type, facilitating disconnection for exchange of PBAs.

The built in GPS clock module decodes time information received from the global positioning system and provides a time reference with an accuracy better than 1µs. The module is mounted on the communication interface module.

The following modules are included in the RES 521 Phasor Measurement Terminal:

- Analog input module with galvanic separation and adaptation of the AC signals. The module contains 7 current transformers of which 6 are used, and 3 voltage transformers. The analog input module also contains an analog to digital converter, which provides the necessary conversion, and some filtering. One module is included and one more module can be optionally included.
- Processor module with data processing for phasor measurement and other functions, as well as communication, via 10/100 Base Tx for IEEE 1344 or PC37.118. The processor module can be optionally provided with a fiber-optic 100 Base FX Ethernet communications module.
- Power supply module with DC/DC converter for the electronic circuits.
- 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. Each BI is directly connected to the IEEE 1344 protocol, and the phasor time stamp provides the BI time tag. 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 a reed relay in parallel with the standard relay, to be used for fast signalling, with one normally open contact. The BOs are used for function level pick-up indication.
- Front HMI panel. There are three light-emitting diodes (LEDs) for RES 521; Ready (green), Time Synchronism warning (yellow), and Loss of GPS or Bad Time Quality (red), one LCD display with 4 lines of 16 characters each, a six button key pad, and a fiber-optic connector socket intended for future PC connection.

Functionality summary

On the Analog Input Module (AIM), the 50/60 Hz AC voltage/current is sampled, and A/D-converted at a frequency of 36 kHz for each channel. These quantities are then processed through a Digital Fourier Filter (DFF).

From the voltage/current signal, the fundamental is derived as a phasor quantity; i.e., as a magnitude and a phase angle, where the phase angle reference is obtained from the GPS satellites. Based on the three corresponding phase-phasors, the positive sequence real and imaginary quantities are derived, as RMS values.

The power system frequency is obtained, from a three-phase voltage quantity.

Binary inputs are forwarded directly to the data buffer.

The RES 521 local WAMS-database update rate is given by a parameter (1/4, 1/2, or 1/1) of nominal power system frequency (50/60 Hz). The data are then streamed to the Data Concentrator.

Phasor quantities are exported to a SCADA system or a Data Concentrator, using the IEEE 1344 or PC37.118 Synchrophasor format. The communication output is Ethernet (optical or galvanic), with a TCP/IP stack running socket for data transfer. The GPS data stream includes a GPS synch bit.

A calibration table is used to improve the AIM (Analog Input Module) voltage and current measuring accuracy. The calibration is made at the factory and during RES 521 commissioning.

Each phasor quantity is time tagged with an accuracy of ±1µs. Normally, the time tag refers to the AIM terminals, but it is adjustable and can, for example, refer to the high voltage measuring point.

The signals from the AIM transformer board are filtered with a bandwidth of 10 kHz on two ranges for each channel and converted with a resolution of 12 bits. The results from the conversion on the two ranges are combined into a single 24 bit word and filtered in two cascaded decimation filters programmed into a digital signal processor (DSP). The numerical filters are of finite impulse response type, giving a linear phase response and appropriate anti-aliasing with a cut-off at 2300 Hz and 500 Hz respectively.

Functionality

Detailed descriptions of the function blocks:

A/D conversion, filtering, etc.
The Analog Input Module measures analog signals of currents and voltages of Ir=1A / 5A and Ur=63V. The signal is separated in two parts. The separation is done to get a wider dynamic range of resolution. The two parts of each signal are then filtered by anti-aliasing filters with a cut-off frequency of 10 kHz before the signals are sampled with the A/Ds. The signals are over-sampled with A/Ds with a frequency of 36 kHz. The signals are then filtered by fourier filters in the software before they are sent on the Compact PCI-bus at the rate of 1 kHz for 50 Hz systems or 1.2 kHz for 60 Hz systems.

The fourier filters can operate with adaptive filter window or fixed filter window. This feature is settable. A range of adaptive filter operation around rated frequency can also be set.

Bandpass filters are implemented to suit the data transfer rates of 1 per cycle, 1 per 2 cycles, and 1 per 4 cycles.

Calibration
The RES 521 provides three separate kinds of calibration to compensate amplitude and phase angle of the measured phasor (voltage or current). The calibration parameters are settable by the HMI. If the user does not change the parameters, the default values are automatically chosen. The three calibrations are:

- Internal calibration due to inaccuracy of terminal transformers - factory made
- External calibration due to inaccuracy of instrument transformers - made at commission
- System calibration due to different phase angle in two power systems, e.g. due to Y/D power transformers - made at commission.

Seven setting points in percent of rated current or voltage forms eight class intervals in order to compensate the analog input signals. Linear interpolation is used in all class intervals. The first and the last calibration points are used for values outside the intervals.

Voltage and current phasors
The phasors are measured with the GPS as a time/angle reference. The incoming current or voltage sample values are multiplied with reference values for the real and the imaginary part separately and stored in circular buffers containing 32 elements.

RMS values
The rms values of voltages and currents are derived based on the fundamental frequency component.

Positive sequence components
Symmetrical positive sequence components of current and voltage are available in RES 521.

Frequency 3-phase based
The frequency module uses the real and the imaginary part of the selected input channel (positive sequence voltage), from a fixed (at rated frequency) DFT, to measure the system frequency.

Rate of change of frequency
The rate of change of frequency is derived as $\Delta f / \Delta t$, where Δt corresponds to the selected data transfer rate. The time derivative is updated with a frequency of up to 50/60 Hz.

Greater Than / Less Than
The trigger functions for abnormal frequency and abnormal rate of change of frequency, comprise a maximum setting, a minimum setting and a settable time delay. The trigger functions for undervoltage comprise a minimum setting, and a time delay, for each of the two voltage phasors. The trigger functions for overcurrent comprise a maximum setting, and a time delay for each of the four current phasors. If a threshold level is reached the "start" output is activated, if then the time delay runs out, with the measured quantity still over/under the threshold, the corresponding binary output is activated. The threshold functions are updated with a frequency of up to 50/60 Hz. Binary normally open outputs for frequency, rate of change of frequency, undervoltage and overcurrent are activated by the threshold functions.

Data Format

To ensure that measurements are made and communicated in a consistent manner, the IEEE Standard for Synchrophasors for Power Systems (1344-1995) or PC37.118 are both simultaneously available on two different communication port sockets.

Communication

Time tagged phasor quantities, sequence quantities, system quantities as well as binary signals can be sent to a SCADA system or to a Data Concentrator at a deterministic speed of up to 50/60 Hz for each quantity.

Communication Protocol for Data Concentrator and SCADA systems

- TCP/IP/UDP

- Ethernet

Configuration and Tools

The configuration for the connection of the analog inputs, the binary inputs/outputs, the logical circuits and the monitoring and measuring function modules is fixed.

Parameter settings

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

The ratios of the instrument transformers are entered in the terminal setting and configuration menus. All settings are made in primary quantities, such as V, A, wherever applicable. Most timers are set in seconds.

Settings can be changed from the front Human-Machine-Interface (HMI).

Indications, events and service values
Operation indications and time tagged events are available by the front HMI or from another location over a data communication system. Actual input quantity voltage and current values, frequency and rate of change of frequency service values can also be read from the terminal HMI.

Technical data

Table 1: Energizing 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 / ±3,0 Hz	±5,0 / ±6,0 Hz
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 (8) /output (12) module DC voltage RL power consumption each I/O board each output relay 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%
Ambient temperature	20°C	-10°C to +55°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 or ph-earth voltage may be directly connected across the analog voltage inputs

Table 2: Influencing factors, Permissible influence

Dependence on variations in	Within nominal range	Influence
Ambient temperature	-10 °C to +55°C	0.01%/ °C
Auxiliary DC voltage	(110-250) Vdc ±20%	0.01% / %
Ripple in auxiliary DC voltage	12% of EL	0.01% / %
Interruption in auxiliary DC voltage without resetting no unwanted function	(24-60) Vdc ±20% (110-250) Vdc ±20%	 < 50 ms 0 - ∞

Technical data (cont'd)

Table 3: Electromagnetic compatibility (EMC), immunity tests[1)]

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 61255-22-5 (Draft)
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 (25-1000) MHz	IEC 61000-4-3 IEEE/ANSI C37.90.2
Radiated electromagnetic field disturbance GSM	10 V/m, 1,4-2,0 GHz, 900 MHz, 1890 MHz	EN 61000-4-3
Conducted electromagnetic field disturbance	10 V/m (0,15-80) MHz	IEC 61000-4-6, level 3

1)The galvanic ethernet communication port (RJ-45) follows the IEEE Standard 802.3^{TM}-2002 physical specification in Part 3.

Table 4: Electromagnetic compatibility (EMC), emission tests[1)]

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

1)The galvanic ethernet communication port (RJ-45) follows the IEEE Standard 802.3^{TM}-2002 physical specification in Part 3.

Table 5: Insulation tests[1)]

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

1)The galvanic ethernet communication port (RJ-45) follows the IEEE Standard 802.3^{TM}-2002 physical specification in Part 3.

Table 6: CE-mark

Test	Reference standards
Immunity	EN 50082-2
Emissivity	EN 50081-2
Low voltage directive[1)]	EN 50178

1)The ring-lug option does not fully comply with 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, 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 wire cross section area	Maximum load continuous	Maximum load 1 s
Binary input/output module voltage compression type of screw connection	250 V AC	2,5 mm^2 2 x 1 mm^2	10 A	30 A
Analog input module voltage/current compression type of screw connection	250 V AC	4 mm^2	20 A	500 A
Voltage Ring Lugs	250 V AC	5.3 mm^2	10 A	30 A
Current Ring Lugs	250 V AC	5.3 mm^2	20 A	500 A
Fiber connectors	Glass: Bayonet ST Plastic: Snap in Simplex Latching			

Technical data (cont'd)

Table 10: Additional general data

Weight approximate	**<18 kg**
Dimensions Width Height Depth	 448 mm 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: GPS Antenna and cable

Function	**Value**
Max antenna cable attenuation	26 dB at 1.6 GHz
Antenna cable impedance	50 Ohms
Lightning protection	Must be provided externally

Table 12: Accuracy

Specification	**Value**
Receiver accuracy	±1 µs relative UTC

Table 13: Service values for input quantities displayed on the built in HMI

Function	**Nominal range**	**Accuracy**
Frequency	(0.7 -1.2) x fr	± 5 mHz at three phase connection
Rate of change of frequency	5 Hz/s	
Current	(0.1 - 4.0) x Ir	± 0.1 %
Voltage	(0.1 - 1.5) x Ur	± 0.1 %
Angles	0.0° - 359.9°	± 0.1°

Table 14: triggFreq

Quantity	Parameter	Range and step
Enable under-frequency trigger.	enableUnder	0,1 with step 1
Enable over-frequency trigger.	enableOver	0,1 with step 1
Limit under-frequency trigger, in Hz.	limitUnder	30.000-75.000 with step 0.001
Limit over-frequency trigger, in Hz.	limitOver	30.000-75.000 with step 0.001
Pick-up time delay under-frequency trigger, in ms.	tDelayUnder	100-999999 with step 1
Pick-up time delay over-frequency trigger, in ms.	tDelayOver	100-999999 with step 1
Relative value for hysteresis, in % of the limit.[1)]	hystRel	0.0-100.0 with step 0.1
Absolute value for hysteresis, in Hz.[2)]	hystAbs	0.000-100.000 with step 0.001

1)Hysteresis set as % of the limit, e.g. setting 10 means 10% of the limit.
2)Hysteresis set as an addition value to the limit.

Table 15: triggDFreq

Quantity	Parameter	Range and step
Enable rate of change of under-frequency trigger.	enableUnder	0,1 with step 1
Enable rate of change of over-frequency trigger.	enableOver	0,1 with step 1
Limit rate of change of under-frequency trigger, in Hz/s	limitUnder	-100.000-0.000 with step 0.001
Limit rate of change of over-frequency trigger, in Hz/s	limitOver	0.000-100.000 with step 0.001
Pick-up time rate of change of delay under-frequency trigger, in ms.	tDelayUnder	100-999999 with step 1
Pick-up time delay rate of change of over-frequency trigger, in ms.	tDelayOver	100-999999 with step 1
Relative value for hysteresis, in % of the limit.[1)]	hystRel	0.0-100.0 with step 0.1
Absolute value for hysteresis, in Hz/s.[2)]	hystAbs	0.000-100.000 with step 0.001

1)Hysteresis set as % of the limit, e.g. setting 10 means 10% of the limit.
2)Hysteresis set as an addition value to the limit.

Table 16: triggOC4ch

Quantity	Parameter	Range and step
Enable over-current trigger phasor 1.	enableCh1	0,1 with step 1
Enable over-current trigger phasor 2.	enableCh2	0,1 with step 1
Enable over-current trigger phasor 3.	enableCh3	0,1 with step 1
Enable over-current trigger phasor 4.	enableCh4	0,1 with step 1
Limit over-current trigger, in A phasor 1.	limitCh1	0-50000 with step 1
Limit over-current trigger, in A phasor 2.	limitCh2	0-50000 with step 1
Limit over-current trigger, in A phasor 3.	limitCh3	0-50000 with step 1
Limit over-current trigger, in A phasor 4.	limitCh4	0-50000 with step 1

Table 16: triggOC4ch

Quantity	Parameter	Range and step
Pick-up time delay over-current trigger, in ms phasor 1.	tDelayCh1	100-999999 with step 1
Pick-up time delay over-current trigger, in ms phasor 2.	tDelayCh2	100-999999 with step 1
Pick-up time delay over-current trigger, in ms phasor 3.	tDelayCh3	100-999999 with step 1
Pick-up time delay over-current trigger, in ms phasor 4.	tDelayCh4	100-999999 with step 1
Relative value for hysteresis, in % of the limit.[1)]	hystRel	0.0-100.0 with step 0.1
Absolute value for hysteresis, in A.[2)]	hystAbs	0-50000 with step 1

1)Hysteresis set as % of the limit, e.g. setting 10 means 10% of the limit.
2)Hysteresis set as an addition value to the limit.

Table 17: triggUV2ch

Quantity under voltage	Parameter	Range and step
Enable under-voltage trigger phasor 1.	enableCh	0,1 with step 1
Enable under-voltage trigger phasor 2.	enableCh2	0,1 with step 1
Limit under-voltage trigger, in V phasor 1.	limitCh1	0-1000000 with step 1
Limit under-voltage trigger, in V phasor 2.	limitCh2	0-1000000 with step 1
Pick-up time delay under-voltage trigger, in ms phasor 1.	tDelayCh1	100-999999 with step 1
Pick-up time delay under-voltage trigger, in ms phasor 2.	tDelayCh2	100-999999 with step 1
Relative value for hysteresis,in % of the limit.[1)]	hystRel	0.0-100.0 with step 0.1
Absolute value for hysteresis, in V.[2)]	hystAbs	0-1000000 with step 1

1)Hysteresis set as % of the limit, e.g. setting 10 means 10% of the limit.
2)Hysteresis set as an addition value to the limit.

Table 18: Synchronizing signals (GPS)

Function	Accuracy
GPS	± 0.5 µs

Table 19: Sampling/Storing/Sending Rate for Phasors and System Quantities

Function	Setting
Transfer rate	once per cycle, once per 2 cycles, once per 4 cycles

Table 20: Startup performance

Condition	Value
Time to reliable time reference with antenna in new position or after power loss longer than 1 month	less than 30 minutes
Time to reliable time reference after a power loss longer than 48 hours	less than 15 minutes
Time to reliable time reference after a power loss shorter than 48 hours	less than 5 minutes

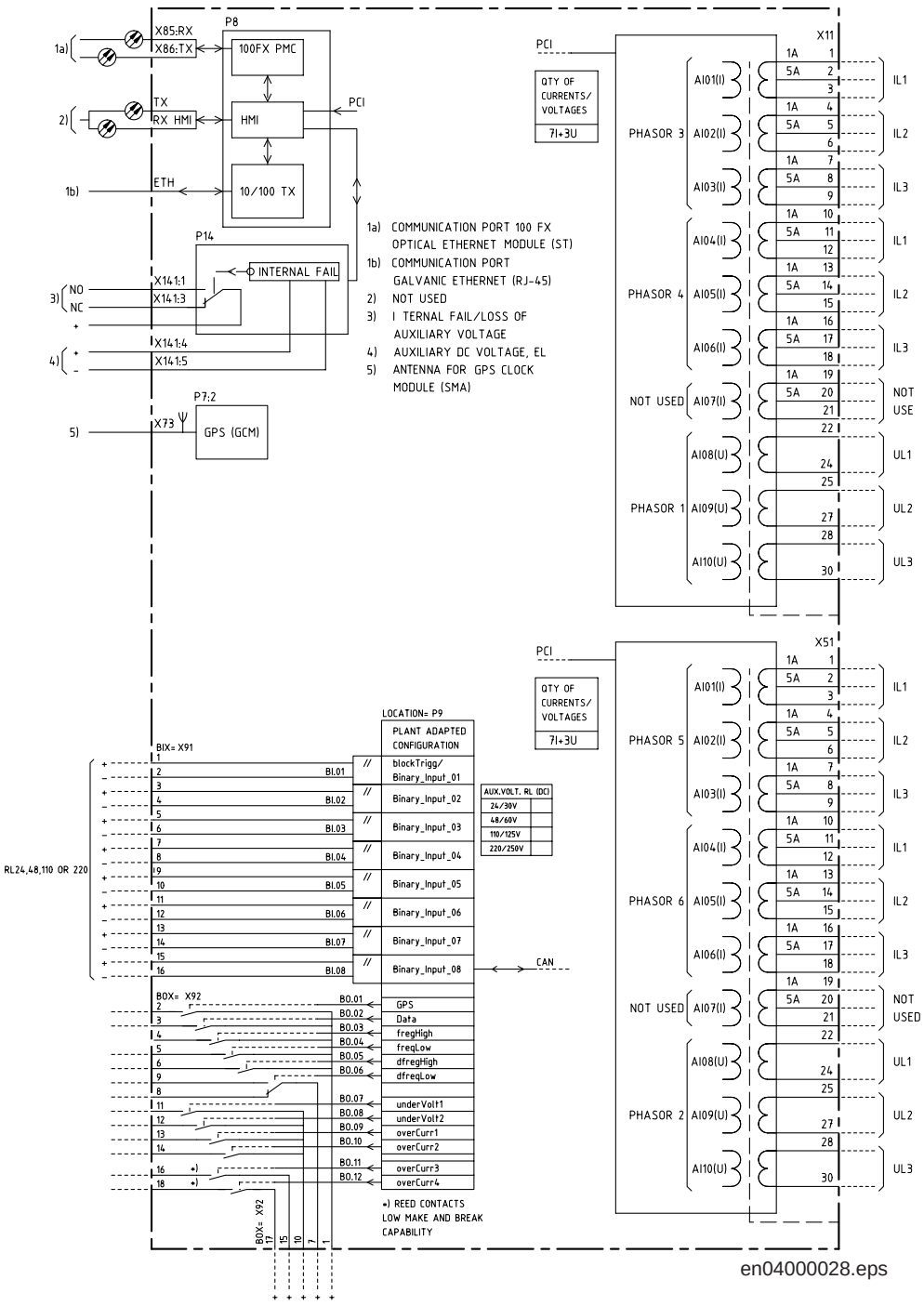
Table 21: Optical Ethernet

Function	Value
Applicable standard	IEEE 802.3u 100BASE-FX
Communication speed	100/200 Mbps for half/full-duplex
Connectors	ST RX/TX Style connectors
Cable	62.5/125 µm multi-mode fiber optic cable up to 2 km (glass)
Optical wavelength	1270-1380 µm
LED Indicators	Link Active, Receive Data, 100 Mbps, Transmit Data

Table 22: Galvanic Ethernet

Function	Value
Applicable standards	IEEE802.3 10BASE-T IEEE802.3u 100BASE-TX
Communication speed	10/20 Mbps for half/full-duplex 100/200 Mbps for half/full-duplex
Connector	RJ-45
Cable	10BASE-T 2-Pair UTP Cat. 3, 4, 5 up to 100m 100BASE-TX 2-Pair UTP Cat 5 up to 100m

Terminal diagrams



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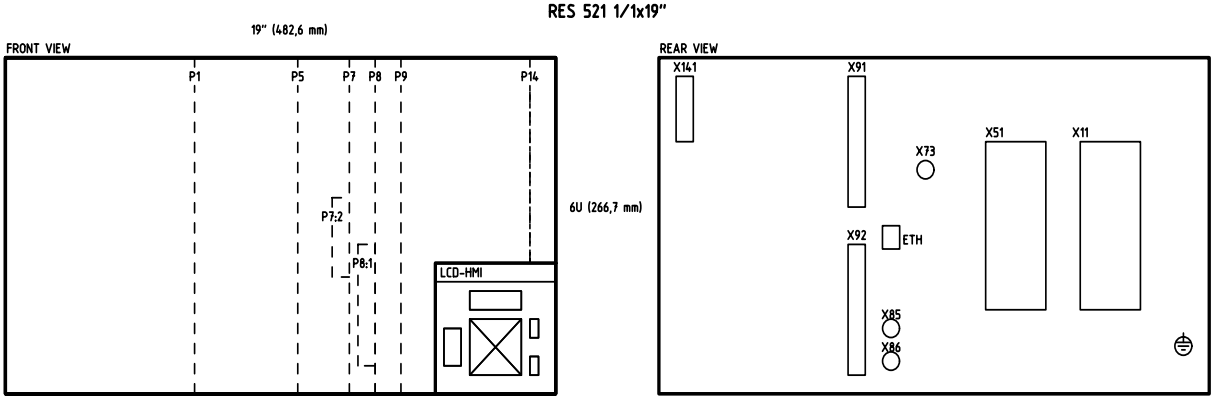

ANALOGUE INPUT MODULE						
LOCATION	QTY OF CURRENTS/VOLTAGES			RATED FREQUENCY,fr	RATED VOLTAGE,Ur	RATED CURRENT,Ir
	7I+3U	8I+2U	9I+1U			
P1	X			50Hz / 60Hz	100,100/$\sqrt{3}$,110,110/$\sqrt{3}$ 115,115/$\sqrt{3}$,120,120/$\sqrt{3}$	1A / 5A RECONNECTABLE
P5						

LOCATION	BINARY IN/OUT MODULE			
	AUXILIARY VOLTAGE (DC)			
	RL24	RL48	RL110	RL220
	24/30V	48/60V	110/125V	220/250V
P9				

DESIGNATION CORRESPONDING TO CASING		
MODULE	FRONT	REAR
AIM	P1	X11
AIM	P5	X51
CIM	P7	-
GCM	P7:2	X73
NUM	P8	-
OEM	P8:1	X85-86
IOM	P9	X91,92
PSM	P14	X141

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Ordering

Guidelines

The analog transformer input modules (type AIM) are configured to the application with a maximum of 6 input transformers for current and 3 input transformers for voltage for each analog input module; a maximum of 2 analog input modules can be included. The basic versions occupy 1/1 of a 6U 19” rack. Totally, 1 rack position is intended for I/O boards in the 1/1 rack. The RES 521 Phasor Measurement Terminal contains hardware always needed as well as the software functions. The hardware in the terminal is fixed, except for the optional second AIM module and the auxiliary dc voltage level of the power supply module.

Product specification

Ordering Number **Quantity** ☐ 1MRK 002 056-BA

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	24-60 V or 90-250 V (to be selected below)

Hardware

In the tables below the hardware requirements for RES 521 have been listed. If the hardware is ordered according to the tables, also the corresponding configuration will be downloaded in the terminal.

PSM Module
Auxiliary dc voltage
Available options for Power Supply Module

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

AIM Module
with standard connection compression screw 7I + 3U[1)]
Note:Select the required type of module per slot location. Make sure that the same type of AIM is selected for slots P1 and P5

Analog Input Module 1 (Located in Slot P1)	☐ 1MRK 001 162-AD
Analog Input Module 2 (Located in Slot P5) Optional addition	☐ 1MRK 001 162-AD

AIM Module
with ring-lugs screw connection 7I + 3U[1)2)]
Note:Select the required type of module per slot location. Make sure that the same type of AIM is selected for slots P1 and P5

Analog Input Module 1 (Located in Slot P1)	☐ 1MRK 001 162-DA
Analog Input Module 2 (Located in Slot P5) Optional addition	☐ 1MRK 001 162-DA

1)7I + 3U = Seven CT Inputs (of which six are used) and Three VT Inputs
2)Ring-lug option does not fully comply with EN 50178

IOM Module

Available rated voltages for optocouplers Inputs on IOM Module

Rule:One IOM card must be chosen for position 9.
Select the rated voltage for optocouplers inputs in the IOM type of module

24/30 V dc	☐ 1MRK 000 173-GB
48/60 V dc	☐ 1MRK 000 173-AC
110/125 V dc	☐ 1MRK 000 173-BC
220/250 V dc	☐ 1MRK 000 173-CC

Communication PMC

Rear communication via optical fiber on 100 Base Fx Optional addition	☐ 1MRK 002 058-AA

Mechanical options

First test switch

COMBITEST test switch module RTXP 24 for the first AIM	☐ 1MRK 000 371-EA

Second test switch

COMBITEST test switch module RTXP 24 for the second AIM	☐ 1MRK 000 371-EB

NOTE!
The test switches have internal star point connection of each of the three-phase CT groups per AIM. Each analog input module AIM is connected to its own test switch module so two test switches are needed if two analog input modules are used.
Each RTXP 24 test switch module will be mounted in a separate RHGS 6 case with window door.
The terminal is reconnectable and can at any time be altered between 1 or 5 A.

DC-supply

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

Mounting details

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

	Phasor Measurement Terminal	**One test switch case**	**Two test switch case**
19” rack	☐ 1MRK 000 020-CA	☐ 1MRK 000 020-BE	☐ 1MRK 000 020-BB
Wall mounting (applicable for terminal and for test switch)	☐ 1MRK 000 020-DA	☐ 1MRK 000 020-DA	☐ 1MRK 000 020-DA
Flush mounting (applicable for terminal and for test switch)	☐ 1MRK 000 020-Y	☐ 1MRK 000 020-Y	☐ 1MRK 000 020-Y
Flush mounting with IP54 (Only available for flush mounted terminals)	☐ 1MRC 980 001-2	☐ 1MRC 980 001-2	☐ 1MRC 980 001-2
No mounting details	☐		

GPS Antenna

GPS Antenna	☐ 1MKC 690 002-2
Antenna cable (L=40m)	☐ 1MRK 001 665-BA
Set of antenna mounting details	☐ 1MRK 001 641-AA

Manuals

One CD with all 500 series manuals is always delivered with each terminal

Rule: Specify the number of extra CD´s requested Quantity ☐ 1MRK 002 241-AA

Rule: Specify, the number of printed manuals requested

Technical reference manual Quantity: ☐ 1MRK 511 115-UEN

Reference Information

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

Country: End user:

Substation name: Voltage level(s): [kV]

Application:

References

Series RE 500 mechanical packaging and connection	1MRK 510 010-BEN
COMBITEST Test system	1MRK 512 001-BEN
Inform^{IT} PSG810/PSG830	1KHA - 000 803 - SEN - 500 - 2.03

Manufacturer

ABB Automation Technologies 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