REC 501
Remote Monitoring and Control Unit

Technical Reference Manual

ABB

REC 501
Remote Monitoring and Control Unit

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General

Safety Instructions

- Dangerous voltages can occur on the connectors, even though the auxiliary voltage is disconnected.

- National and local electrical safety regulations must always be followed.

- The frame of the Remote Monitoring and Control unit has to be solidly earthed.

- Only a competent electrician is allowed to maintain and repair the electrical installation.

Introduction

The REC 501 Remote Monitoring and Control unit is part of the PYRAMID® Substation Automation system. It is used in the Distribution Automation application segment of the Panorama concept. The PYRAMID® Substation Automation system includes a complete range of protective relays, feeder terminals, control units, annunciator units, Substation Monitoring Systems (SMS) and Substation Control Systems (SCS). The modern technology applied in the unit adds to the flexibility of the system. This manual includes instructions for mounting and use of the remote monitoring and control unit REC 501.

The REC 501 monitoring and control unit for medium voltage networks is used for condition monitoring, supervision and automation of Ring Main Units (RMUs), disconnectors and other secondary substation equipment.

Depending on the needs of the customer and the area of application, the REC 501 unit is used as a control unit in many types of applications. Some typical applications are illustrated below.

In the application illustrated in Fig. 1 the REC 501 unit is used for controlling and monitoring an RMU. The REC unit is located in the enclosure together with the basic components. The enclosure is fitted directly to the RMU. This assembly includes an enclosure, a REC 501 unit (1) with an optional modem (2), a radio telephone (3), two 12 V sealed lead acid batteries (4), local control push-buttons (5), a local / remote switch (5), miniature circuit-breakers (5), contactor logic (5) and the RMU (6).

The optional modem allows communication via radios, leased lines or a public telephone line. Other means of communication are explained in the chapter "Communication and protocols".

The contactor logic (5) is required when the current exceeds the values specified for the output relays. The circuitry consists of control push-buttons and miniature circuit-breakers. It connects the REC 501 unit with the motor operating device or the control solenoid.

Two of the five inputs can be used for pulse counting purposes. Due to that the energy or power values measured by the electromechanical meters (7) can be transferred via the REC 501 unit to the network control system.

The auxiliary voltage for the REC 501 unit is supplied from an auxiliary voltage transformer or from the low voltage side of the distribution transformer.
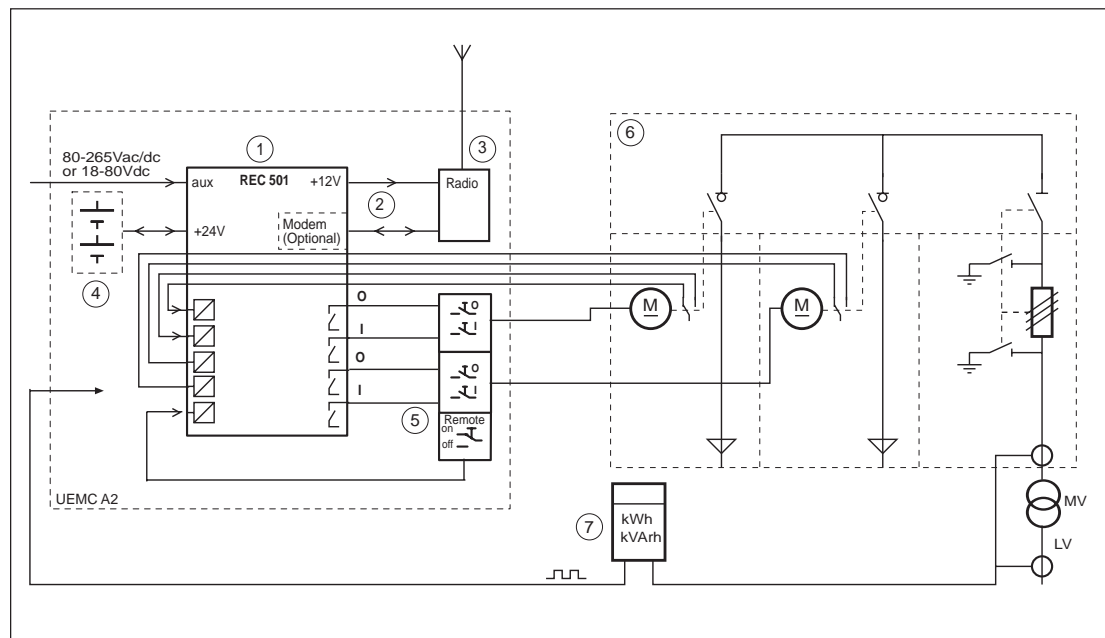
Fig. 1. A REC 501 unit used for remote control of a Ring Main Unit.

Figure 2 shows an application in which the REC 501 unit controls and monitors a disconnector remotely. The disconnector has an integrated motor operating device. The enclosure can be mounted on a wall or in a pole. Local regulations should always be followed. The same components as in the previous example are used. In addition, a heating element (7) and a distribu-tion transformer or an auxiliary voltage trans-former (8) are used. One of the output relays can be used for controlling the heating element. Refer to chapter "Heating" for more informa-tion. The REC 501 unit is supplied from the MV network via the MV / LV auxiliary voltage transformer.
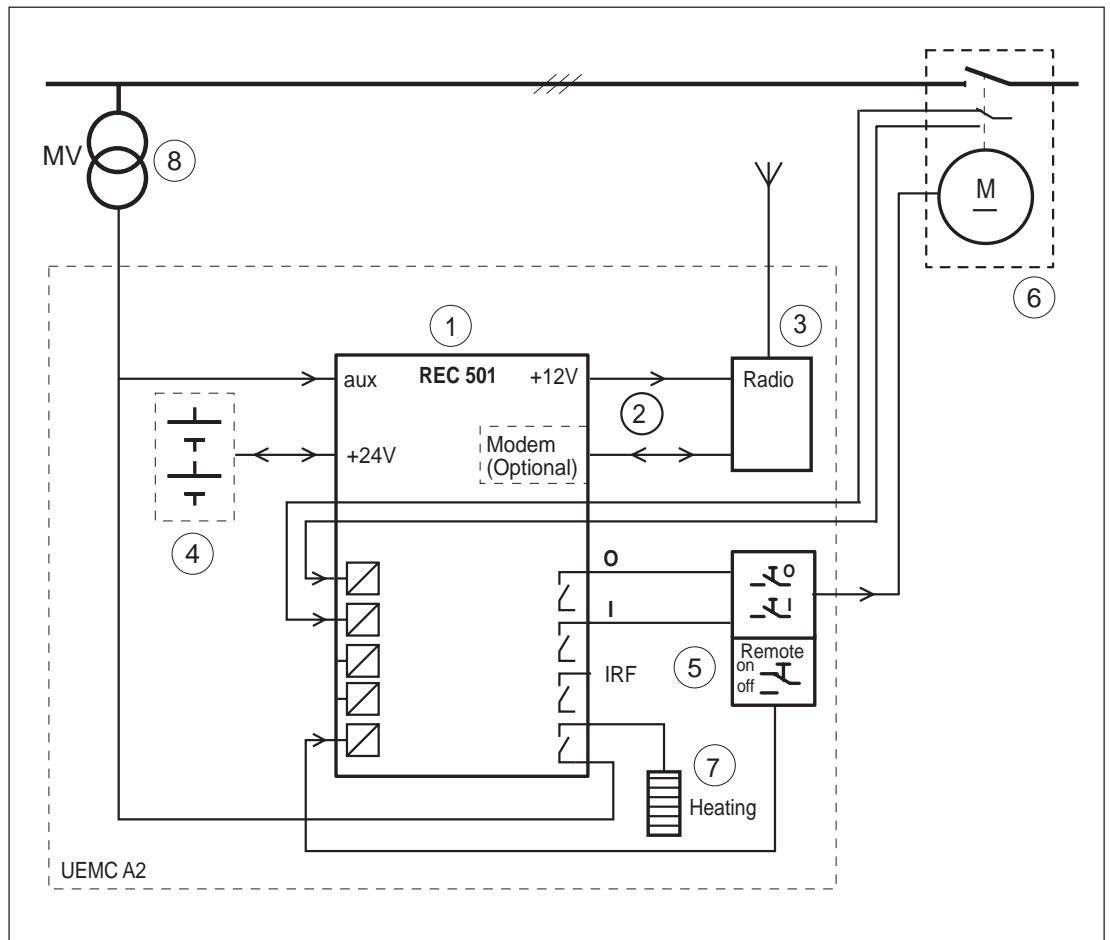
Fig. 2. A REC 501 unit used for remote control of a disconnector. The motor operating device is fitted to the disconnector.

In the application illustrated in Fig. 3 the REC 501 unit controls and monitors a disconnector remotely. The enclosure contains the motor operating device for the disconnector, as well as the REC 501 unit. The enclosure can be mounted, for instance, on a wall or in a pole. Local regulations and the instructions of the manufacturer of the disconnector and the motor operating device should always be followed.

Fig. 3. A REC 501 unit used for the remote control of a disconnector. The motor operating device is placed in the same enclosure as the other equipment.

Figure 4 shows a complete Distribution Terminal Unit DTU 111. The enclosure UEMC-A2 contains a REC 501 unit and all the components needed for the automation of RMUs, disconnectors and switches.
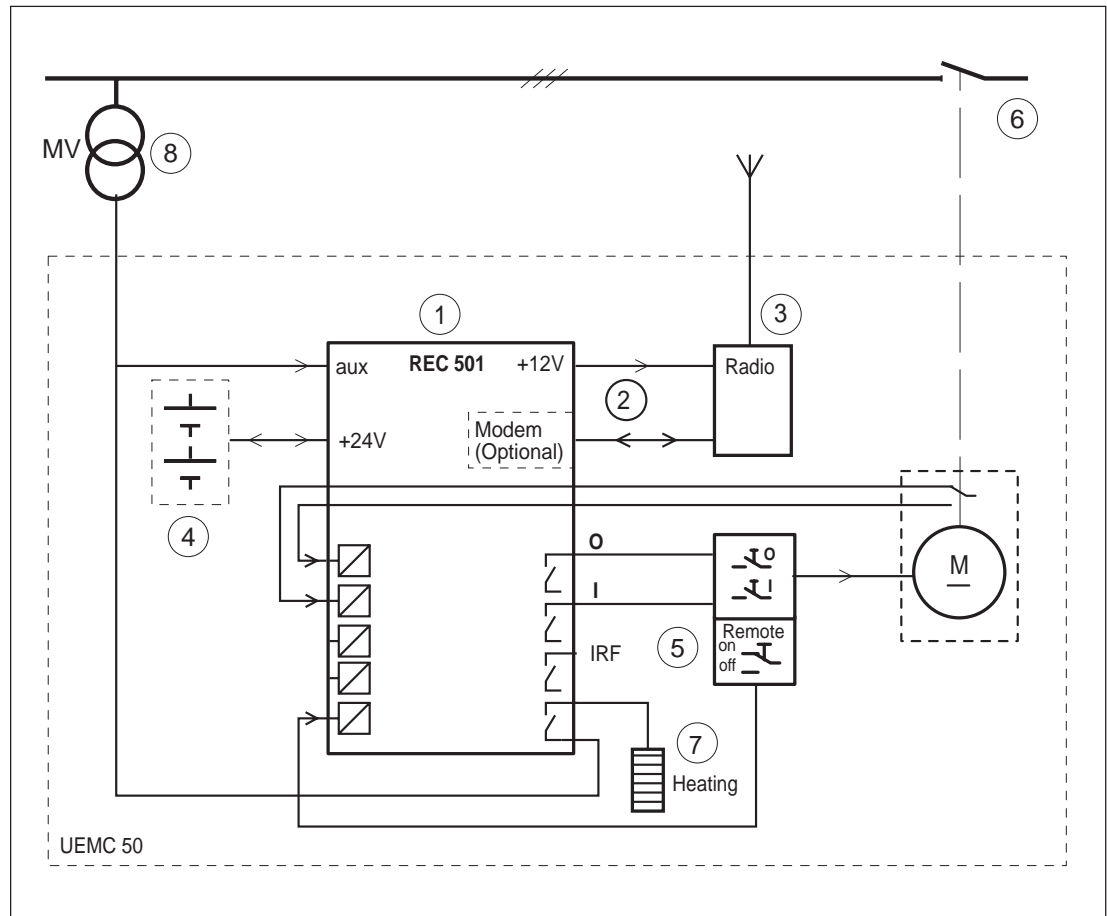

Fig. 4. A DTU 111 including a REC 501 unit mounted in a UEMC-A2 enclosure.

| Communication and protocols | The REC 501 unit offers the following means of communication between a secondary substation or substation and a network control system: | The protocols available for communication towards a network control system as SPIDER MicroSCADA or equivalent SCADA systems are: |

The REC 501 unit offers the following means of communication between a secondary substation or substation and a network control system:
• Leased lines or public telephone lines
• Fixed lines
• Conventional radio telephones
• Portable NMT telephones with adapter
• RS232 serial cable
• Other RS 232 compatible communication devices, e.g.:
  - radio modems
  - external modems
  - DLC modem
  - portable GSM telephones with adapter

For more information on communication and applications refer to chapter "Communication application".

The protocols available for communication towards a network control system as SPIDER MicroSCADA or equivalent SCADA systems are:
• SPA
• LON with LON adapter
• ANSI X3.28 HD
• RP 570
• IEC 870-5-101
• MODBUS
• DNP 3.0
• Other protocols can be developed on request

The REC 501 unit always includes a SPA protocol. In addition, one of the other protocols mentioned above can be integrated into the unit. The required network control protocol has to be specified in the order. The development of communication protocols is an ongoing process. Information on protocols is available from the local ABB customer centre.

Order information

Two separate order numbers are used for ordering the REC 501 unit. The order number for the hardware specifies the auxiliary supply voltage of the unit and the order number for the software specifies the network control protocol used for the communication with a network control system. Possible optional parts and accessories also have to be specified in the order.

Hardware order numbers:
REC 501, 1MRS090020-AA, U_{aux} = 80 ... 265 V ac / dc, surface mounting
REC 501, 1MRS090021-AA, U_{aux} = 80 ... 265 V ac / dc, flush mounting
REC 501, 1MRS090020-CA, U_{aux} = 18 ... 80 V dc, surface mounting
REC 501, 1MRS090021-CA, U_{aux} = 18 ... 80 V dc, flush mounting

Software order numbers: Protocols:
1MRS118006   ANSI X3.28 HD
1MRS118007   RP570
1MRS118008   IEC 870-5-101
1MRS118009   MODBUS
1MRS118010   DNP 3.0

Optional parts and accessories:
Programming cable   1MRS120500
RS232 cable, 15 m   1MRS120507
Plug-in modem module   1MRS119000 *)
Plug-in adapter module with RS 485
and plastic fibre cable interfaces   1MRS050248
Plug-in adapter module with RS 485
and glass fibre cable interfaces   1MRS050249
LON/SPA adapter   SPA-ZC 100-BB/MM
Cable for LON/SPA adapter   1MRS120502

*) Note ! The country of destination should be specified in the order of the modem board.

Example:

Description	Order
1. Quantity, type designation and auxiliary voltage	15 REC 501 units, U_{aux} = 110 Vdc
2. Hardware order number	1MRS090020-AA
3. Software order number	1MRS118007, RP570
4. Options	15 Modem modules 1MRS119000
5. Accessories	5 Programming cables 1MRS120500

Design

Design and case

A basic REC 501 unit consists of a processor - power supply / charger board (PSC), a mother board and an optional plug-in modem or an optional adapter board. The PSC board includes a processor, switch mode power supply with a temperature-compensated battery charger, five inputs, four outputs and an RS232 serial interface. The inputs and outputs are galvanically isolated from the internal electronics. The wide range of I/O operating voltages make the REC 501 unit suitable for many different applications.

The mother board located inside the case connects the signals and supply voltages from the PSC board to the optional plug-in modem or the optional adapter board.

The REC 501 remote monitoring and control unit is fitted into a closed box of the common ABB look. The box is 145 mm wide, 265 mm (6U) high and 250 mm deep and it includes two card places for E2 size printed circuit boards.

The degree of protection of the REC 501 unit, including terminals and front cover, is IP 20. To increase the degree of protection, the REC 501 unit can be placed in the same enclosure as the batteries, contactor logic and communication devices.

Connection diagram
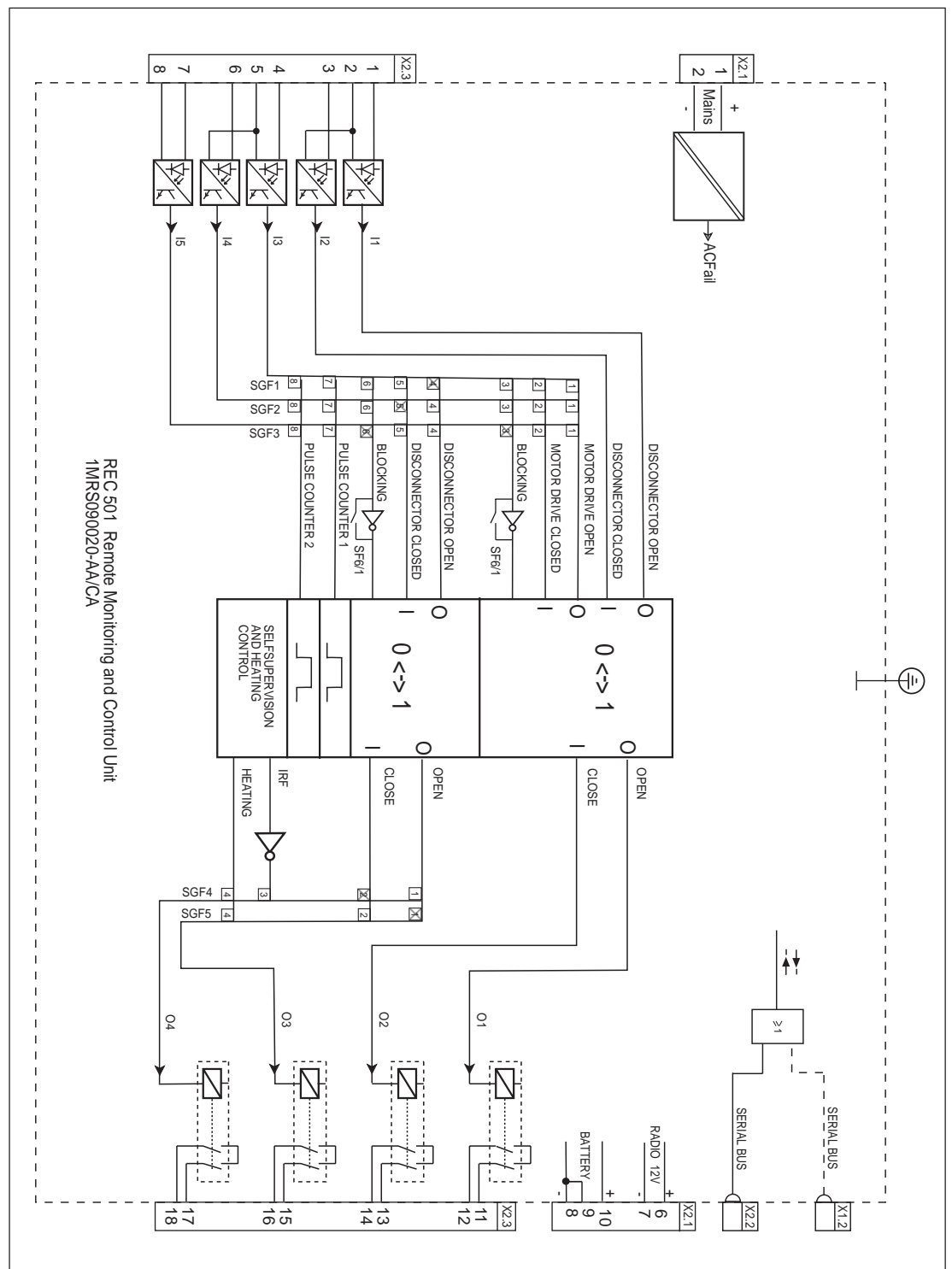
Fig. 5. Connection diagram.

Abbreviations of signal names:

I1, I2, I3, I4 and I5   Inputs
SGF   Switchgroups for selection of functions
O1, O2, O3 and O4   Outputs
IRF   Internal relay fault
Heating   Control of heating
Radio 12V   12 Vdc supply for external communication device
Battery   Supply from batteries and battery charger

The settings and functions of the SGF switches are explained in the chapter "Functions".

Terminals
and earthing

The screw terminals and the 9-pole D-connector are located on the front / rear (surface / flush mounting) of the unit.

The terminals are identified by a number, e.g. X2.1. See Fig. 6 "Connectors on the front plate of the REC 501". The numbering starts from the top.

As the terminal connectors are detachable, wiring can be made in advance. One wire of 0.2 - 2.5 mm^2 or two wires of 0.2- 1.0 mm^2 can be connected to each screw terminal.

The REC 501 unit has to be solidly earthed by connecting the shortest possible 2.5 mm^2 copper wire to the separate earth screw terminal.

The communication cable is to be connected to the 9-pole D-connector, the RJ12 telephone connector (X1.1), or screw terminals (X1.3), when the optional modem module is used. The RS485 communication cable is connected to the 9-pole D-connector (X1.1) or the optical cables to the connectors (X1.2 and X1.3) using the optional adapter module. The communication cable is connected to connector X2.2 on the PSC board using an external telephone modem or DLC modem

Two serial interfaces are available for the communication with the REC 501 unit. The RS232 interface (X2.2) located at the front edge of the PSC board is normally used for changing the settings of the unit and for the communication with a network control system, a radio modem, an external modem or a portable GSM. The programming tool is used for changing the parameters.

When the optional plug-in modem is used, an RS232 interface (X1.2) will be available at the edge of the modem module. This port is normally used for altering the settings of the modem. More information, including applications of the optional plug-in modem module, is given in the chapter "Communication applications" and in the user manual of the modem board (1MRS750577-MUM).

When the optional plug-in adapter is used an RS485 interface (X1.2) or two fibre-optic connectors (X1.2 and X1.3) will be available at the edge of the adapter module. These interfaces are normally used for the communication over RS485 or fibre-optic cables inside substation.

Terminals on the PSC 3 and PSC 4 boards:

Terminal group	Contact interval	Function
X2.1	1-2	Auxiliary supply voltage. The positive lead (+) of the dc supply is connected to contact 1.
X2.1	3, 4, 5	Not connected.
X2.1	6-7	12 Vdc supply to an external radio or another device. The positive lead (+) of the dc supply is connected to contact 6.
X2.1	8, 9	- 24 Vdc, battery charger and supply.
X2.1	10	+ 24 Vdc, battery charger and supply.
X2.2	1	FREEZE. To be connected to ground during configuration. 9-pole D-connector. The pin order is illustrated in "Serial communication"
X2.2	2	RXD
X2.2	3	TXD
X2.2	4	Not connected.
X2.2	5	GND
X2.2	6	Not connected.
X2.2	7	RTS
X2.2	8	CTS
X2.2	9	+5 V, 280 mA, supply for the external communication adapter.

Terminal group	Contact interval	Function
X2.3	1	Input I1, 18...265 Vdc or 80...265 Vac.
X2.3	2	Common contact for input 1 and input 2.
X2.3	3	Input I2, 18...265 Vdc or 80...265 Vac.
X2.3	4	Input I3 or pulse counter input, 18...265 Vdc or 80...265 Vac.
X2.3	5	Common contact for input 3 and input 4.
X2.3	6	Input I4 or pulse counter input, 18...265 Vdc or 80...265 Vac.
X2.3	7-8	Input I5 or pulse counter input, 18...265 Vdc or 80...265 Vac.
X2.3	9, 10	Not connected.
X2.3	11-12	Output O1 for opening object 1
X2.3	13-14	Output O2 for closing object 1
X2.3	15-16	Output O3 for opening object 2 or for controlling a heater element
X2.3	17-18	Output O4 for closing object 2, IRF, or for controlling a heater element

Terminals on the optional plug-in adapter module:

Terminal group	Contact interval	Function
X1.1	1	DATA A
X1.1	2	DATA B
X1.1	3	RTS A
X1.1	4	RTS B
X1.1	5	Not connected.
X1.1	6	Not connected.
X1.1	7	GND
X1.1	8	+5 V, 280 mA, supply for the external communication adapter.
X1.1	9	Not connected.
X1.2		Tx to fibre-optic cable.
X1.3		Rx to fibre-optic cable.

The pin order on the front side of the female connectors X1.1, X1.2 and X2.2 is shown in Fig. 6. Information about the other connectors of the optional modem board is found in the modem's user manual 1MRS750577-MUM.

Connector X1.2 on the optional modem module		Connector X1.1 on the optional adapter module		Connector X2.2 on the PSC3 / PSC4 module	
Pin	Signal	Pin	Signal	Pin	Signal
1	DCD	1	DATA A	1	FREEZE
2	RXD	2	DATA B	2	RXD
3	TXD	3	RTS A	3	TXD
4	DTR	4	RTS B	4	
5	GND	5		5	GND
6	DSR	6		6	
7	RTS	7	GND	7	RTS
8	CTS	8	+5V	8	CTS
9	RI	9		9	+5V

Fig. 6. D-connectors.

Connecting pin 1 of connector X2.2 (FREEZE) to earth brings the REC 501 unit into to the programming mode. The optional cable 1MRS 120500 is used for programming. In the programming mode, the REC 501 unit is forced to use the SPA communication protocol and certain special communication parameters described in "Enforced communication parameters". In this way, the unit is easily parameterized.
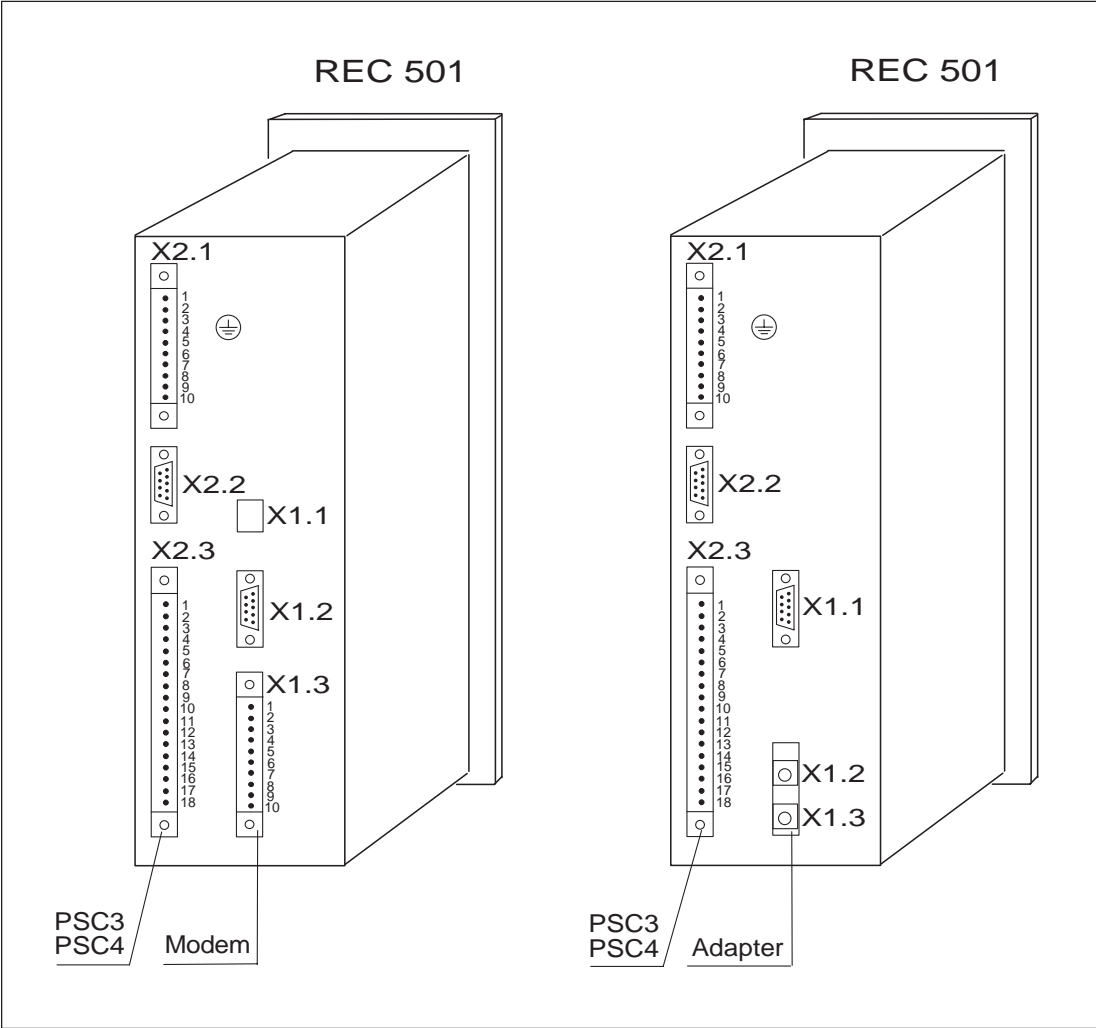
Fig. 7. Connectors of the REC 501.

Wiring has to be done according to the block diagram presented in the chapter "Wiring". For safety reasons all the screw terminals, connectors for serial communication and modem connectors are protected by a cover, which can be opened and removed for wiring.

Auxiliary supply voltage	The auxiliary voltage for the REC 501 unit has to be in the range 18...80 Vdc or 80...265 Vac/dc. The required auxiliary voltage range has to be mentioned in the order, see "Ordering information". When possible, the unit should be supplied by an auxiliary supply voltage of the substation. Otherwise, in secondary substation applications, a small MV auxiliary voltage transformer is recommended to be used for the supply of the unit. National and local electrical safety regulations must always be followed, when the unit is connected to the electrical network. The auxiliary supply input is protected by a 2 A fuse F1. The location of the fuse is shown in the chapter "Trouble-shooting".
Power supply	The switch mode dc/dc power supply of the REC 501 unit includes a temperature-compensated battery charger. The power supply provides voltages for the internal electronics and an external communication device, e.g. a radio telephone. The temperature-compensated battery charger monitors the input voltage and measures temperature and battery voltage. Furthermore, the charger incorporates functions for battery load test and deep discharge protection. The 12 Vdc output voltage is used to supply, for instance, a radio telephone. The maximum peak output current is 7 A. This is sufficient for most of a conventional radio telephones or radio links.
Battery charger	Power backup for the station can be arranged by connecting 24 V (2 x 12 V) sealed lead acid batteries to the REC 501 unit. The batteries supply the REC 501 unit and the communication device during a mains failure. The batteries are charged by the REC 501 unit. Thus the communication between the unit and the network control centre is operating in any situation. The charger secures an appropriate charging voltage in different environmental conditions. The batteries are protected against too high or too low charging voltages. The rated charging voltage is 27.6 Vdc at @ 20°C. The temperature range for compensation is -40...+60°C. The charger regulates the charging voltage for the batteries according to the temperature as illustrated in Fig. 8. "Charging voltage versus temperature".
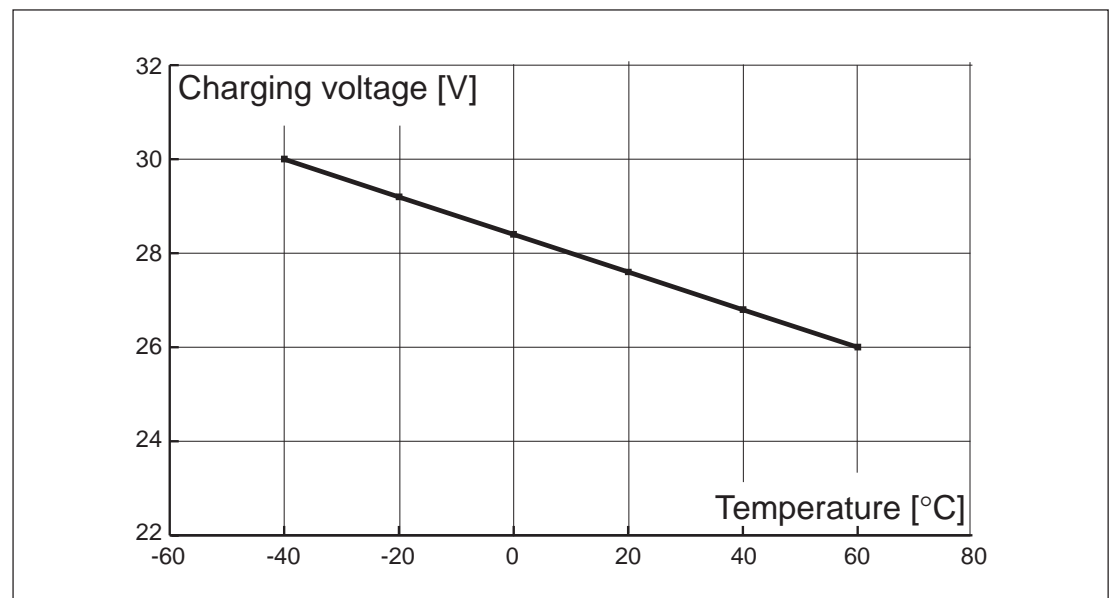
Fig. 8. Charging voltage versus temperature.

The charger protects the batteries against deep-discharge during long periods of outages. It switches the power supply to stand-by mode as soon as the battery voltage drops below 19 V (2 x 9.5 V). The power supply is switched on again, when the auxiliary voltage returns.

The voltage of the batteries may vary in the range of 19...32 V.

The output of the battery charger is protected by a 6 A fuse F2. The location of the fuse is illustrated in chapter "Trouble-shooting".

Batteries

Two 12 V external maintenance-free sealed lead-acid batteries secure the operation of the REC 501 unit during a mains failure. To achieve the required voltage level of +24 V the batteries are connected in series.

Depending on the application and the maximum operate time required, batteries of 15 Ah or 38 Ah are normally used. Tests performed show an operation time of about 36 hours for a 15 Ah battery and 72 hours for a 38 Ah battery at an ambient temperature of +20 °C. The average consumption of the communication device during the test was 200 mA. A low temperature reduces the capacity and the operate time of the batteries. The approximate maximum operate time can be estimated as shown in Fig. 9 below.
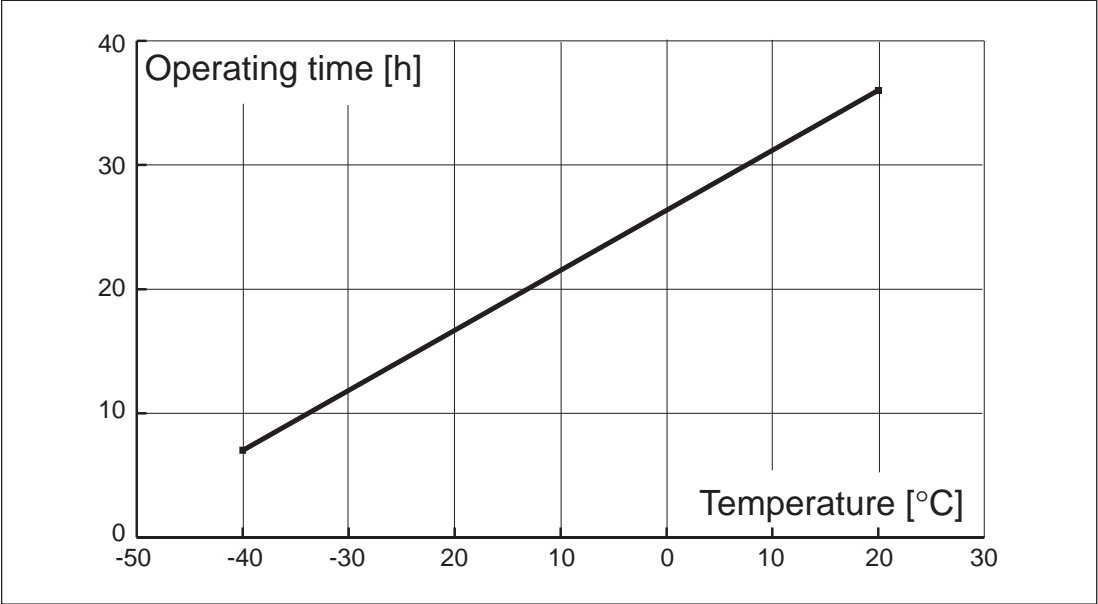
Fig. 9. Operating time versus temperature with 15 Ah batteries.

Sealed lead-acid batteries, e.g. Yuasa's NP 15-12, NP 38-12 or equivalent are recommended to be used.

Battery type	voltage	capacity	weight	dimensions
YUA NP 15-12	12 V	15 Ah	5.0 kg	181 x 76 x 167 mm
YUA NP 38-12	12 V	38 Ah	13.8 kg	197 x 165 x 170 mm

A current limiter should be used when the capacity of the battery is less than 7 Ah. The current limiter is to be connected between the charger output (connector X2.1, pin 10) and the + pole of the battery. This ensures that the charging current does not exceed the specified maximum limit of about 0.6 A if the batteries have a capacity of 2 Ah. The circuit diagram of the current limiter, with component values, is shown in Fig. 10.

Fig. 10. Circuit diagram current limiter.

Configuration tools

The REC 501 unit is easily configured using the setting emulator software, SMS 010 tool, CAP 5xx configuration and programming tool, terminal emulators with 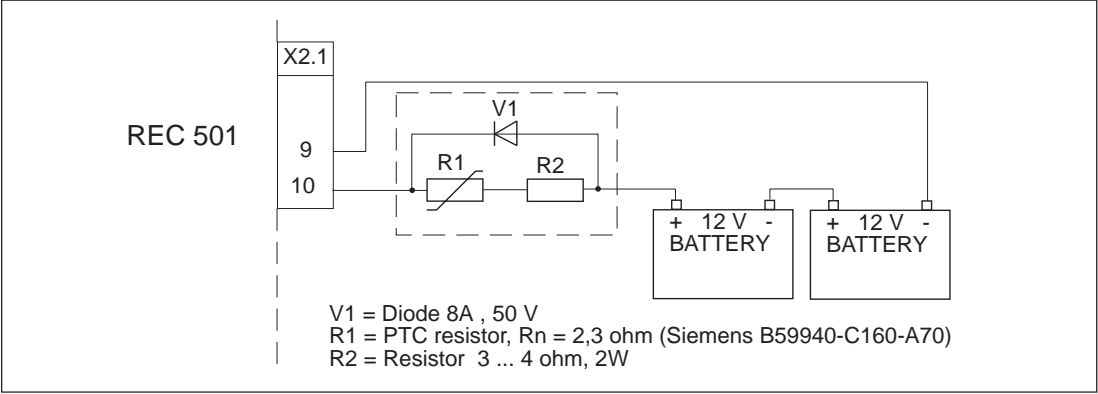SPA parameters and, remotely, via MicroSCADA. The parameters can be set off-line on the tool and downloaded over a communication port. The menu structure of the programming tools is similar to the menu structure of the REC 501 unit. More information on the programming tools is obtained from the manuals.

Information about parameters and settings to be used for configuring the REC 501 unit in different applications is given in "Function description" and "SPA communication".

Functions

Control operations

The REC 501 unit is capable of controlling two objects, e.g. circuit breakers and disconnectors, and handling the status information of the objects. Alternatively, one object with separate status information from the motor drive and the circuit breaker itself, can be operated. In this case, the control logic automatically recognizes the position of the motor drive and that of the circuit breaker. If an attempt is made to operate towards closed or open position, while the status information is in conflict, the unit performs a close-before-open or open-before-close sequence.

Should the status information of the motor drive or the circuit breaker show an undefined position, the close-before-open or the open-before-close sequences will not be performed, just the close or open command selected .

SGF switchgroups

The software switchgroups SGF1...SGF6 are used for selecting the functions required for different applications. The switchgroups SGF1... SGF3 connect digital inputs to input signals, while the switchgroups SGF4...SGF5 connect output signals to output relays.

Note! Several input signals can be connected to one digital input, provided the functions of the input signals can be combined. The tables below show the default settings of the switches and the checksums of the corresponding parameters. See also the block diagram in chapter "Terminal and block diagram".

Switchgroup SGF1

Switchgroup SGF1 is used for connecting digital input I3 to the process signals

Switch	Function	Checksum value	Default
SGF1/1	I3 connected to actuator* open signal	1	0
SGF1/2	I3 connected to actuator* closed signal	2	0
SGF1/3	I3 connected for blocking of object 1	4	0
SGF1/4	I3 connected to object 2 open signal	8	1
SGF1/5	I3 connected to object 2 close signal	16	0
SGF1/6	I3 connected for blocking object 2	32	0
SGF1/7	I3 connected to pulse counter 1	64	0
SGF1/8	I3 connected to pulse counter 2	128	0
SGF1 default checksum, parameter S4			8

* The actuator may be a motor operating device or a solenoid

Switchgroup SGF2

Switchgroup SGF2 is used for connecting digital input I4 to the process signals

Switch	Function	Checksum value	Default
SGF2/1	I4 connected to actuator* open signal	1	0
SGF2/2	I4 connected to actuator* closed signal	2	0
SGF2/3	I4 connected for blocking object 1	4	0
SGF2/4	I4 connected to object 2 open signal	8	0
SGF2/5	I4 connected to object 2 close signal	16	1
SGF2/6	I4 connected for blocking object 2	32	0
SGF2/7	I4 connected to pulse counter 1	64	0
SGF2/8	I4 connected to pulse counter 2	128	0
SGF2 default checksum, parameter S5			16

* The actuator may be a motor operating device or a solenoid

Switchgroup SGF3

Switchgroup SGF3 is used for connecting digital input I5 to the process signals

Switch	Function	Checksum value	Default
SGF3/1	I5 connected to actuator* open signal	1	0
SGF3/2	I5 connected to actuator* closed signal	2	0
SGF3/3	I5 connected for blocking object 1	4	1
SGF3/4	I5 connected to object 2 open signal	8	0
SGF3/5	I5 connected to object 2 close signal	16	0
SGF3/6	I5 connected for blocking object 2	32	1
SGF3/7	I5 connected to pulse counter 1	64	0
SGF3/8	I5 connected to pulse counter 2	128	0
SGF3 default checksum, parameter S6			36

* The actuator may be a motor operating device or a solenoid.

Switchgroup SGF4

Switchgroup SGF4 is used for connecting output relay O4 to the process signals

Switch	Function	Checksum value	Default
SGF4/1	O4 connected to open output signal of object 2	1	0
SGF4/2	O4 connected to close output signal of object 2	2	1
SGF4/3	O4 connected to IRF signal *	4	0
SGF4/4	O4 connected to heating output	8	0
SGF4/5	Reserved for future use	16	0
SGF4/6	Reserved for future use	32	0
SGF4/7	Reserved for future use	64	0
SGF4/8	Reserved for future use	128	0
SGF4 default checksum, parameter S7			2

* The function of the Internal Relay Fault IRF is described in the chapter "Self-supervision".

Switchgroup SGF5 | Switchgroup SGF5 is used for connecting output relay O3 to the process signals

Switch	Function	Checksum value	Default
SGF5/1	O3 connected to open output signal of object 2	1	1
SGF5/2	O3 connected to close output signal of object 2	2	0
SGF5/3	Reserved for future use	4	0
SGF5/4	O3 connected to heating output	8	0
SGF5/5	Reserved for future use	16	0
SGF5/6	Reserved for future use	32	0
SGF5/7	Reserved for future use	64	0
SGF5/8	Reserved for future use	128	0
	SGF5 default checksum, parameter S8		1

Switchgroup SGF6

Switch	Function	Checksum value	Default
SGF6/1	Select logical level for the blocking inputs When SGF6/1=1, the operation of the object controls is blocked by a logical 0 on the blocking inputs When SGF6/1=0, the operation of the object controls is blocked by a logical 1 on the blocking inputs	1 1	0 0
SGF6/2	Reserved for future use	2	0
SGF6/3	Reserved for future use	4	0
SGF6/4	Reserved for future use	8	0
SGF6/5	Reserved for future use	16	0
SGF6/6	Reserved for future use	32	0
SGF6/7	Reserved for future use	64	0
SGF6/8	Reserved for future use	128	0
	SGF6 default checksum, parameter S9		0

Analogue measurements	The REC 501 unit measures the battery voltage and the ambient temperature. The temperature measurement is calibrated to measure the ambient temperature of the REC 501 unit mounted in an enclosure. The value measured is read via the serial bus. Furthermore, the temperature measurement is used to compensate the charging voltage of the batteries and for activating/deactivating heating in cold environments.	The battery voltage measured is received as two values: the minimum battery voltage and the battery charging voltage. The values are read from the network control centre over the serial bus. The minimum battery voltage indicates the lowest voltage measured during a battery test or during the operation of an object. The battery charging voltage indicates the present voltage on the pole of the batteries. The minimum battery voltage can be reset via the serial bus.
Heating	The outputs O3 or O4 are intended for the control of external heating resistors. The heating control is based on the environmental temperature. Heating is needed if the REC 501 unit is installed in a separate enclosure outdoors, where the ambient temperature may be below -10...0°C. Heating is also required when the enviroment is very damp and dehumidifying is needing.	The output to be used is selected with the switches SGF5/4 or SGF4/4. Parameter S3 is used for selecting the temperature for the heater in the range -25...+15°C. The hysteresis of heating is stable within 4 °C. The heating will be switched on when the temperature falls below the heating limit programmed. When the temperature reaches the heating point added with the hysteresis, heating is switched off.
Pulse counters	Two pulse counters are available for power or energy measurement. The inputs count the number of pulses from the output of the electromechanical meter during a specified time period. The maximum pulse frequency is 25 Hz. The pulse ratio at maximum input frequency must be 50 / 50. Any of the inputs I3, I4 or I5 may be used for pulse counting. The inputs are selected with the switchgroup SGF1...SGF3. Counting is triggered at the positive edge of the input signal. The output values are the intermediate counter readings and the period counter readings. The counters are synchronized with the internal clock of the REC 501 unit. The counting periods end at midnight and counting starts immediately after power-up.	until midnight with an even amount of intermediate counting periods of 6 minutes. The first counting time period, on the other hand, will be 28 minutes. Event E19 or E20 is generated and the counter value together with the time stamp is read from parameters V20 and V21. The next counting time will be 60 minutes. When new period counter values are received, the previous values are transferred to new parameters. The latest values are always stored in the parameters V20 and V21.

Two pulse counters are available for power or energy measurement. The inputs count the number of pulses from the output of the electromechanical meter during a specified time period. The maximum pulse frequency is 25 Hz. The pulse ratio at maximum input frequency must be 50 / 50. Any of the inputs I3, I4 or I5 may be used for pulse counting. The inputs are selected with the switchgroup SGF1...SGF3. Counting is triggered at the positive edge of the input signal. The output values are the intermediate counter readings and the period counter readings. The counters are synchronized with the internal clock of the REC 501 unit. The counting periods end at midnight and counting starts immediately after power-up.

The intermediate counting time, for example, is set to 6 minutes and the period counting time is set to 60 minutes. After power-up, the clock is set to 22.32. Then the first intermediate counting time will be 4 minutes, until event E17 or E18 is given. The value can be read with parameter V11. The counting sequence proceeds until midnight with an even amount of intermediate counting periods of 6 minutes. The first counting time period, on the other hand, will be 28 minutes. Event E19 or E20 is generated and the counter value together with the time stamp is read from parameters V20 and V21. The next counting time will be 60 minutes. When new period counter values are received, the previous values are transferred to new parameters. The latest values are always stored in the parameters V20 and V21.

Both the intermediate counting and the period pulse counting can be selected as cumulative or wrap around counter readings. Readings will be increased once a counting period elapses, whereas a wrap around reading will be reset after a counting period has ended. A counter reading from a period is always valid until the next period has elapsed.

The accurary of the pulse counter is ±1 pulse. The accurary of the counting periods depends on amount of the clock synchronizing pulses.

Self supervision	The REC 501 unit is provided with an internal self-supervision system including a normal microprosessor watchdog function, checksum verification of the memory contents and hardware supervision. A permanent fault detected inside the unit, will be indicated by a blinking green LED indicator. At the same time as a fault is detected the unit delivers a fault signal to the self-supervision output relay of the control unit. If the communication is operating after an internal fault has been detected, a fault indication message is transferred to the Network Control System via the selected protocol. Otherwise parameter V169 can be used for reading the fault code.	The LED indicator has three different functions:

The LED indicator has three different functions:
1. Steady light (ON state)
   - the LED is lit when the unit is OK
   - the CPU is in normal service, no internal faults, etc.
   - auxiliary voltage is available to the unit
2. Blinking light (frequency of 2 Hz)
   - an internal relay fault (IRF) has been detected
3. Dark LED (OFF state)
   - there is no auxiliary voltage supply to the unit
   - if the auxiliary voltage supply is ON the LED still being dark, a fault in the internal electronics may be the reason

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Condition monitoring

The condition of the batteries is secured by a periodic condition monitoring test. The test is based on ten second load tests and is performed twice an hour and always after power-up of the unit. During the battery load test, the voltage of the power supply charger is reduced to 20 V. This causes the electronics and communication to load the batteries. The automatic functions of the unit measure the battery voltage continuously also during the condition monitoring test. The minimum value of the voltage will be recorded in the memory.

The condition and lifetime of the batteries can be estimated on the basis of the minimum values recorded. If the battery voltage drops to 22 V during testing, the unit generates an event. This indicates that the lifetime of the batteries is ending or that an internal fault has occured in the battery. In both cases the battery must be changed.

Regular reinitialization is used for monitoring the condition of the optional plug-in modem and the external modem. The REC 501 unit reinitializes the modem even though there has been no successful communication within a certain period of time.

The number of operations of the disconnectors, circuit breakers and other devices to be controlled are recorded by two operation counters. The values of the operation counters are read locally from the unit or over the remote control system using parameter V5. The operation counters facilitate condition monitoring of equipment and indicate the need for maintenance.

Monitoring of the pressure of SF6 gas-insulated primary equipment is arranged by wiring the pressure sensor contact to one input of the unit. This information can be obtained from the network control system.

Communication applications

RS 232 serial cable

The RS232 serial cable is used for the communication with the Network Control system at distances shorter than 15 m. The cable is connected from the connector X2.2 of the REC 501 unit to the RS232 interface of the Network Control System. The pin connection is illustrated in Fig. 10. "Pin connection of the RS 232 cable" The type designation of the cable is 1MRS120507.
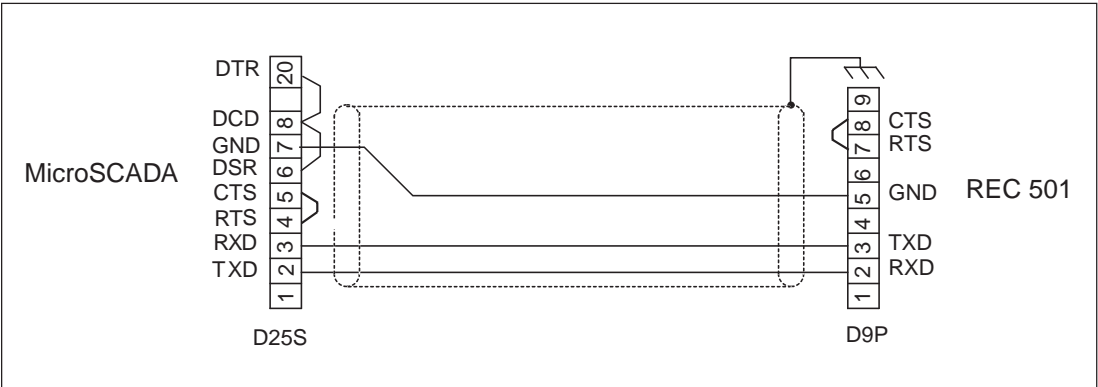

Fig. 10. Pin connection of the RS 232 cable.

Communication using the optional plug-in modem

The optional plug-in modem board 1MRS 119000 can be placed inside the REC 501 unit. It is designed for severe environmental conditions, as is the situation of most non-heated secondary substations. The modem can be used in a wide temperature range.

The modem allows many different means of communication:
- public telephone line with pulse or tone dialling
- leased lines with 2 or 4 wires
- fixed line with 2 or 4 wires
- radio telephone with radio keying

The data transfer rate of this modem may be as high as 14400 bps (V.32bis). If a radio link is used, the maximum data rate depends on the type of radio.
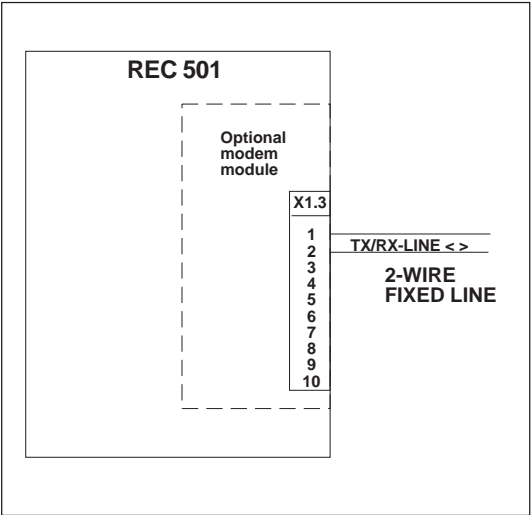

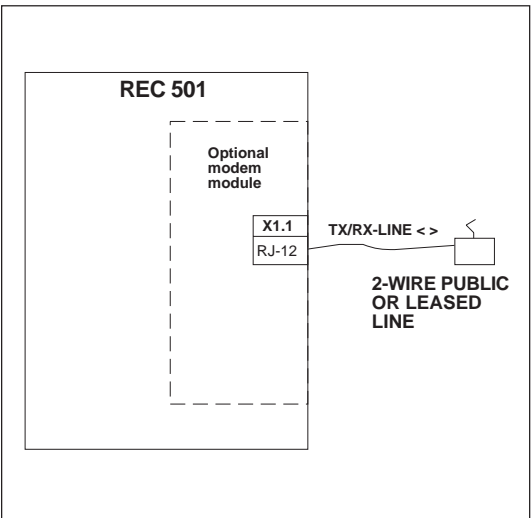Fig. 11. Two-wire connection to fixed line

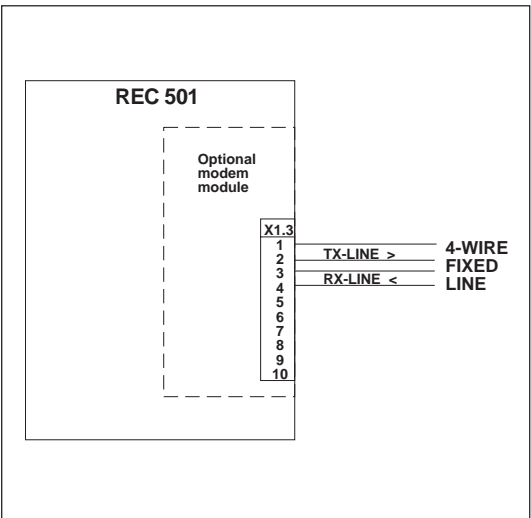Fig. 12. Two-wire connection to public or leased line.

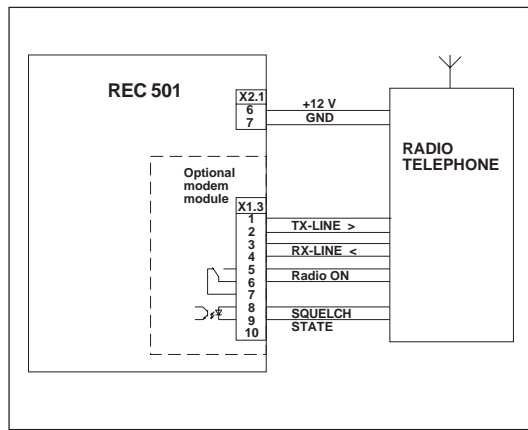Fig. 13. Four-wire connection to fixed line
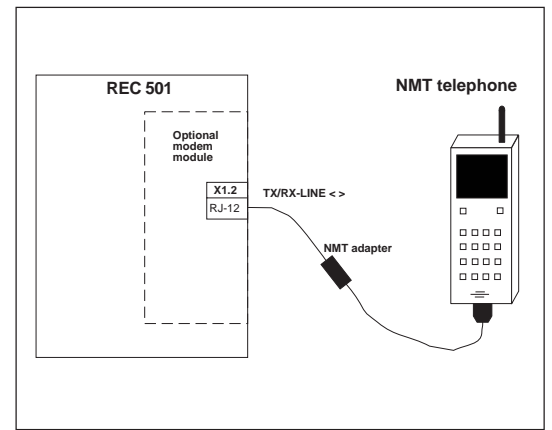
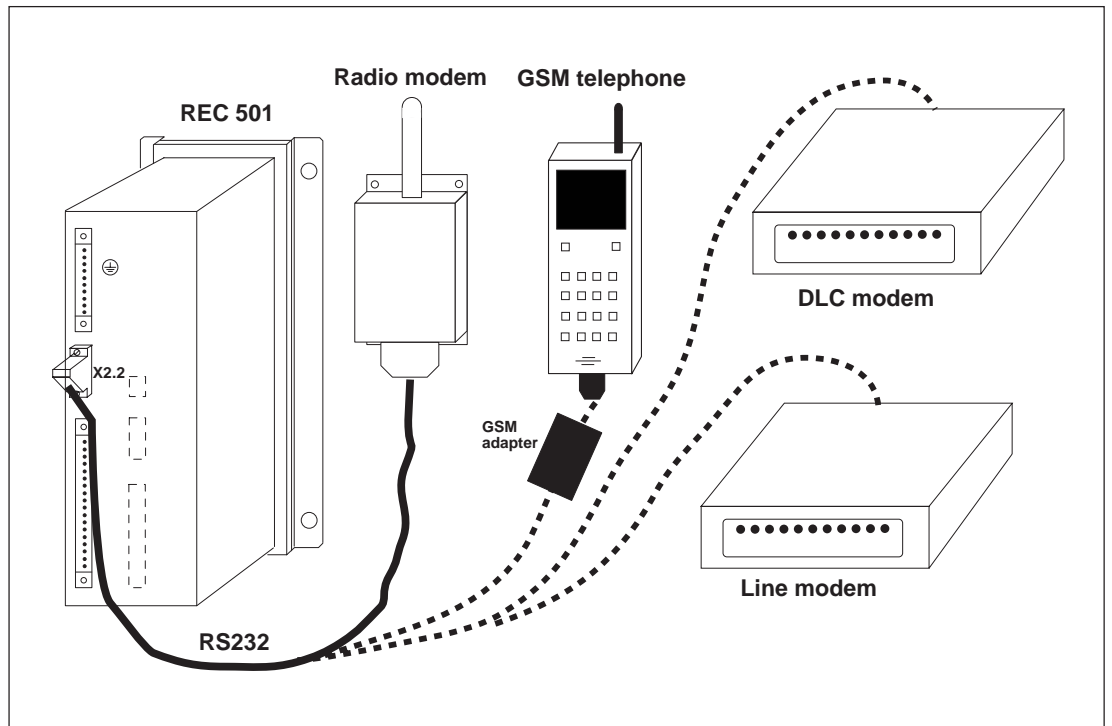Fig. 14. Radio telephone connection

Fig. 15. NMT connection

Fig. 16. External communication devices

More information about the optional plug-in modem is found in the modem's user manual 1MRS750577-MUM.

The 12 Vdc voltage supply to the external communication devices can be obtained from the connector X1.3, pins 6-7, of the REC 501 unit. See Fig. 6 or the table in chapter "Terminals and earthing".

Communication using the optional plug-in adapter

The optional plug-in adapter module 1MRS 050248 or 1MRS050249 can be placed inside the REC 501 unit. The plug-in adapter consists of an RS485 interface and an interface for fibre-optic cables. This module is normally used inside the substation for the communication between the REC 501 unit and the master unit or the network control system over the RS485 interface or plastic / glass fibre-optic cables.

The plug-in adapter modules types are:
- module with RS 485 and plastic fibre cable interfaces: 1MRS050248
- module with RS 485 and glass fibre cable interfaces: 1MRS050249.

The pin connections of the connectors of the plug-in module are described in the chapter "Terminals and earthing".

Setting of the DIP switches on the adapter board:

Switch S1	Function	Setting
1	Data line terminal resistance	0 = not connected 1 = connected
2, 3	Data line pull-up and pull-down resistances	0 = not connected 1 = connected
4	RTS line terminal resistance	0 = not connected 1 = connected
5, 6	RTS line pull-up and pull-down resistances	0 = not connected 1 = connected
7	Control of RTS line	0 = adapter acts as a slave 1 = adapter acts as a master
8	Function of optical interface	0 = echo off 1 = echo on

Switch S1	Function	Setting
1, 2	Communication protocol with RS 485 connection. (Must be selected because of handshaking signals)	01 = SPA 10 = Other e.g. ANSI, RP570…
3	SPA communication speed	0 = 9600 bps 1 = 4800 bps

S2 switches 4…8 are reserved for the future use.

Technical data	Mechanical dimensions	width 145 mm, height 265 mm, depth 250 mm	

Power Supply

1MRS09002x-AA	U_n = 110/120/220/ 240 Vac
	U_n = 110/125/220 Vdc
	Operating range 80...265 Vac/dc
1MRS09002x-CA	U_n = 24/36/48/60 Vdc
	Operating range 18...80 Vdc

Temperature-compensated battery charger
- rated voltage	27,6 Vdc, @ 20°C
- output power	15 W
- temperature compensation	-0,04 V/°C
Supply for radios	
- with batteries	12 Vdc, 7 A peak
- without batteries	12 Vdc, 1 A peak
Nominal power consumption	20 W
- with optional plug-in modem	22 W
- with optional plug-in adapter	21 W
Burden of auxiliary supply under different operating conditions	~10 / ~100W
Ripple in dc auxiliary voltage	Max. 12% of the DC value
Interruption in auxiliary dc voltage	
- without reseting	$\geq$50 ms @ 110V and $\geq$100ms @ 200V
Internal over temperature indication	78°C (75...83°C)

Binary Inputs

5 binary inputs
Operating range	18...265 Vdc (24/48/60/110/220 Vdc)
	80...265 Vac (110/120/220/240 Vac)
Current drain	~ 2...25 mA
Power consumption	< 0.8 W

Pulse counter inputs
- 3 of the 5 inputs can be programmed as pulse inputs
- max. frequency of counters at pulse ratio 50/50	0...25 Hz
- counting range	0...999999 pulses

Binary Outputs

4 outputs
Rated voltage	250 V ac/dc
- continuous carry	5 A
- make and carry for 0.5 s	30 A
- make and carry for 3 s	15 A
- breaking capacity for dc, when the control circuit time-constant L/R <40 ms, at 48/110/220 Vdc	
- control circuit voltage	5A/3A/1A
- contact material	$AgCdO_2$

Rated Frequency fn = 50/60 Hz

Degree of protection of the relay

Surface-mounted, flush mounted and rack mounted unit	IP 20
Unit fitted in an eclosure of a Distribution Terminal Unit DTU 111 or DTU 115	IP 55

Environmental tests

Specified service temperature range	+10...+55°C
- with external heating	-40...+ 55°C
Transport and storage temperature range	-40...+70°C
Degree of protection, IEC 529	IP 20 (IP 55)

Dry heat test, According to the IEC 68-2-2 (BS 2011 : Part 2.1 B)
Dry cold test, According to the IEC 68-2-1 (BS 2011 : Part 2.1 A)
Damp heat test, cyclic, According to the IEC 68-2-30 (BS 2011 : Part 2.1 Db)
Storage temperature tests, Accordance with the IEC 68-2-48.

Electromagnetic Compatibility tests

IEC 1000-x
IEC 255-22-1...4
EN 50082-2
EN 55011
EN 50081-2

EMC immunity test level requirements take into consideration of demands in the generic standard EN 50082-2 and IEC standards 255-22-1,2,3&4.

1 Mhz burst disturbance test
- according to the standard
  IEC 255-22-1, Class III
  - common mode   2.5 kV
  - differential mode   1.0 kV

Electrostatic discharge test
- according to the standard   6 kV for contact discharge
  IEC 1000-4-2, Class III   8 kV for air discharge.

Radio frequency electromagnetic field disturbance test
- according to the standards   f = 80 ... 1000 MHz
  IEC 255-22-3 and IEC 1000-4-3   E = 10 V/m (rms)

Radio frequency disturbance test
- according to the standard   10 V, f = 150 kHz ... 80 Mhz
  IEC 1000-4-6

Fast transient disturbance test
- according to the standards
  IEC 255-22-4 and IEC 1000-4-4
  - AC/DC-ports   test voltage = 4 kV
  - contacts   test voltage = 2 kV

Surge immunity test
- according to the standard IEC 1000-4-5
  - AC/DC-ports   test voltage = 4 kV (common mode)
                                   test voltage = 2 kV (diff. mode)
  - I/O ports   test voltage = 2 kV (common mode)
                                   test voltage = 1 kV (diff. mode)
  - battery charger and radio supply   test voltage = 0,5 kV (common mode)
                                   test voltage = 0,5 kV (diff. mode)

Electromagnetic emission tests
- test is performed according to standard EN 55011 class A
- emission level is specified in standard EN 50081-2 (industrial environment)

Mains terminal disturbance voltage (Conducted RF-emission)
- emission level allowed in the standard EN 50081-2 is applied for REC 501

Electromagnetic radiation disturbance
- emission level allowed in the standard EN 50081-2 is for REC501.

CE-approval	Comply with EMC Directive 89/336/EEC and with LV Directive 73/23/EEC

Insulation tests

Dielectric tests
- the insulation tests is performed in accordance with the IEC 60-2 (BS 932: Part 2) and IEC 255-5 (BS 5992 : Part 3).
- test data: test voltage 2 kV, 50 Hz, 1 min.

Impulse voltage test
- an impulse voltage test according IEC 255-5, with 5 kV unipolar impulses, wave form 1,2/50 ms, source energy 0.5 Joule.

Insulation resistance measurements
- the insulation resistance is measured according to the IEC standard 255-5.
- isolation resistance ≥100 MΩ 500 Vdc.

Mechanical Tests

Mechanical tests acc. to IEC-standards:
Vibration tests (sinusoidal), acc. IEC 255-21-1 class I
Shock and bump test, acc. IEC 255-21-2 class I
Seismic tests, acc IEC 255-21-3 class I

Data communication

Interface, connector X2.2
- RS-232 connection
- SPA or other communication protocol bus, selectable
- data transfer rate for the SPA bus is 4800/9600 bps
- data transfer rate for the other communication protocol is 300/600/1200/4800/9600/14400 bps
- serial communication cable, 1MRS120500
  - serial communication parameters:
    - SPA protocol in use
    - number of data bits, 7
    - number of stop bits, 1
    - parity, even
    - baudrate, 9.6 kilobauds as a default

Connectors with optional plug-in modem module:
Interface connector X1.1
- RJ-12 connector for public telephone line
Interface connector X1.2
- RS-232 connector
- configuration with PC and any terminal software by using AT-Hayes commands
Interface connector X1.3
- screw terminal connector for radio and leased lines
- radio's transmitter keying
- supply voltages to the radio device

Connectors with optional plug-in communication adapter module:
Interface connector X1.1
- RS-485 connection
Interface connector X1.2 and X1.3
- fiber optic interface
  - for plastic fibre cable, 1MRS050248
  - for glass fibre cable, 1MRS050249

Configuration and Paramatrization tools	SMS 010 tool CAP 5xx, Configuration and Programming tool Any termial emulator with SPA parameters
Event recording	All events are registered: Reason, Time, Date 30 lates events are recorded
Control functions	1...2 pcs disconnectors or equivalent objects Heating resistor
Condition monitoring	Batteries Modem unit Disconnector(s) Pressure of SF6 gas
Measurements	Temperature of the enclosure -40...+60ºC, ±3℃ Battery voltage 15...35 Vdc, ±3%
Communication protocols	SPA bus protocol ANSI X3.28 HD, Refer to Protocol Description 1MRS750750-MUM EN RP570, Refer to Protocol Description 1MRS750751-MUM EN IEC 870-5-101, Refer to Protocol Description 1MRS750779-MUM EN MODBUS, Refer to Protocol Description 1MRS750780-MUM EN DNP 3.0, Refer to Protocol Description 1MRS750781-MUM EN
Self supervision	Automatic test sequences - RAMs - ROMs - EEPROMs - I/Os - Output relay coils
Additional general data	Weight of the unit 3,1 kg - 3,3 kg with optional plug-in communication adapter - 3,5 kg with optional plug-in modem
Applicable manuals	Technical Reference Manual 1MRS750568-MUM EN Optional plug-in modem: - operator's Manual 1MRS750577-MUM EN - engineering manual 1MRS750720-MUM EN Protocol Descriptions: - ANSI X3.28 HD 1MRS750750-MUM EN - RP570 1MRS750751-MUM EN - IEC 870-5-101 1MRS750779-MUM EN - MODBUS 1MRS750780-MUM EN - DNP 3.0 1MRS750781-MUM EN

The REC 501 unit can be surface-mounted or flush-mounted. Figures 17 and 18 show the dimensions of the cases and the space needed for surface mounting and flush mounting.
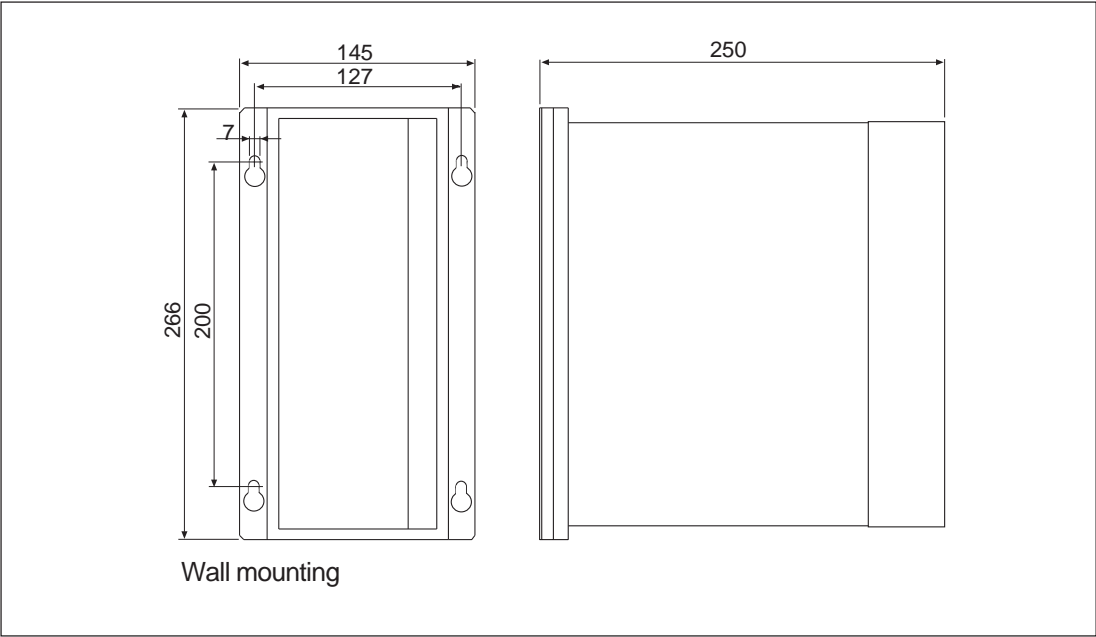
Wall mounting

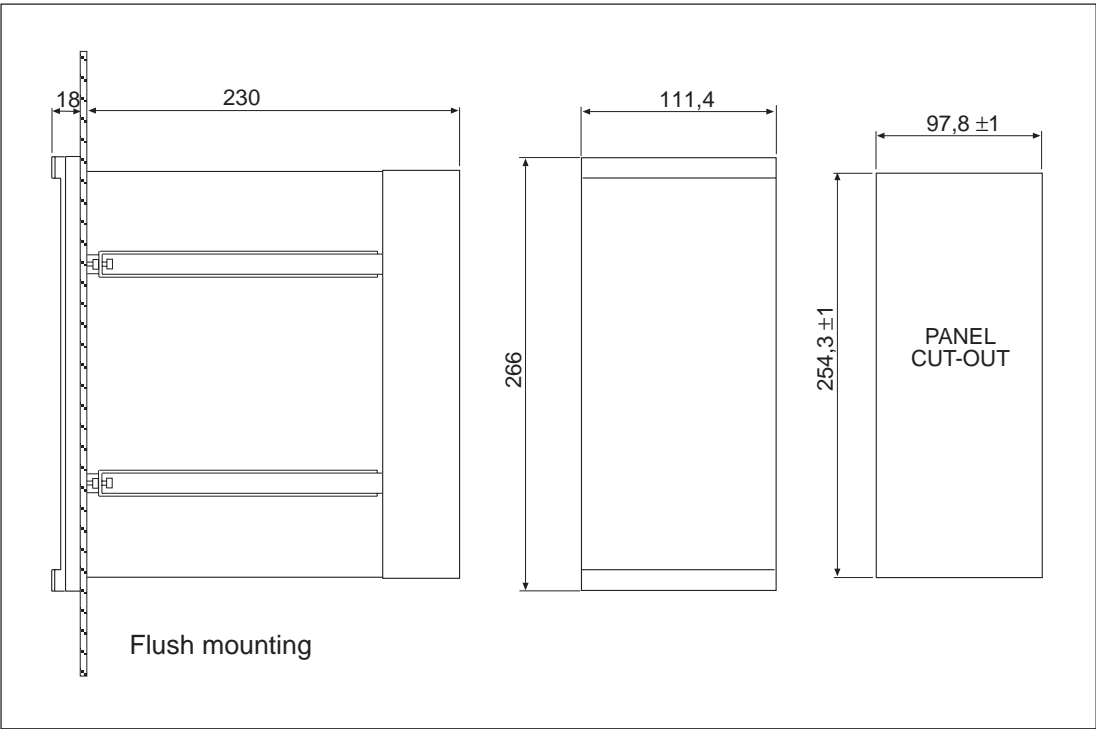Fig. 17. Surface mounting case.

Flush mounting

Fig. 18. Flush mounting case.

Auxiliary supply, digital inputs and output relay voltages	Before connecting the auxiliary voltage and input / output voltages, it should be checked that the operative voltage is in the range specified in technical data. The auxiliary voltage range is	marked on the unit. The input voltage range is invariably 18...80 Vdc or 80...265 Vac/dc. The maximum voltage to be used on the outputs is 250 Vac/dc.
Wiring	The wiring has to be made in accordance with the requirements for the specific application, and by connecting the unit as described in the	chapters "Connection diagram" and "Terminals and earthing". National and local safety regulations must always be followed.
Configuration of the unit	The connection of the application must be checked before configuring and programming the REC 501 unit. The input and output configuration and the settings for different applications are explained in chapter "Function description". The address for the REC 501 unit can be a SPA address and a station address. The SPA address is needed when the unit is used as a SPA slave together with other SPA devices, e.g. for the control of switches in the station. In this case it	is not necessary to program the station address. The SPA address can be programmed locally or remotely using parameter V200. The station address is required when the REC 501 unit is used for the remote control of a secondary substation using one of the network control protocols. Then the SPA address required for local or remote programming of the unit must be programmed as well. The parameter V210 can be used for programming.
Testing after installation	After installation the unit should be tested with the settings used in normal service. If necessary, a more comprehensive test can be done.	The tests are usually performed as secondary tests. Then the REC 501 unit is disconnected from the primary equipment. The input and output circuits are recommended to be checked separately.
Configuration example	Various configurations of the REC 501 application with different kinds of protocols are de-	scribed at the end of chapters where the protocol used is explained.

Maintenance and testing

When used under the conditions mentioned in the section "Technical data", the REC 501 unit is practically maintenance-free because it includes no parts or components subjected to abnormal physical or electrical wear.

When the environmental conditions differ from those specified, as to temperature and humidity, or when the atmosphere around the unit contains chemically active gases or dust, the unit should be visually inspected in association with the functional testing of the I/Os. The visual inspection should focus on the following things:

- Signs of mechanical damage to the case and terminals of the unit
- Dust inside the case; remove carefully with compressed air
- Signs of corrosion on terminals, case or inside the unit

In the event of malfunction or, if the operating values considerably differ from those specified, the REC 501 unit should be given a proper overhaul. Minor measures can be taken by the customer but any major repair involving the electronics has to be made by the manufacturer. Please contact the manufacturer or his nearest representative for further information about checking, overhaul and testing of the unit.

Note!
The remote monitoring and control unit REC 501 is a measuring instrument and should be handled with care and protected against moisture and mechanical stress, especially during transport.

Trouble-shooting

General

In the event of malfunction of the REC 501 unit, the items listed in the table below should be checked:

Disturbances	Possible reasons	Corrective actions
The control signal does not reach the object to be controlled	Internal SGF software switches are incorrectly programmed.	Check the SGF settings of the unit by using the programming tool.
	The possible remote/local control switch is in the local position and blocks remote control.	Turn the switch into remote position.
	The m.c.b. of the actuator has tripped.	Switch the m.c.b. to ON position and check that there is no short circuit.
	The disconnector/switch is externally locked or there are some other problems with these.	Check the situation in the station and, remove the locking, if possible.
	Problems with the contactor logic of the controlled object.	Check the contactor logic circuits.
No connection to the REC 501 of a secondary substation	Station supply voltage is missing, m.c.b. of the batteries has tripped or is in OFF position.	Switch the m.c.b. to ON position and check that there is no short circuits.
	Incorrect settings of REC 501.	Check and change the setting, e.g. communication speed, parity, addresses, other communication parameters, and check the trouble-shooting instructions in the modem manual.
	Failure in communication device or electronics.	Check the communication device and the connection.
Station to be controlled without auxiliary supply	Interruption in electricity supply.	Wait until electricity returns.
	M.c.b. of the unit supply is tripped or in OFF position.	Switch the m.c.b. to ON position and check that there is no short circuits.
	The fuse F1 on the PSC board is defect.	Switch off the auxiliary supply of the REC 501. Remove the connector terminal. Check the personal ESD protection, open the front plate of the unit and remove the PSC board. Check the position of fuse F1 in Fig. 19. Exchange the fuse. Always use the recommended fuse size and type. Replace all the parts in their original places and switch on the supply. Note ! Local electrical safety regulations must always be followed !
No connection after a control operation.	Batteries are too empty or the lifetime is ending.	Wait until the internal charger has charged the batteries or exchange them.

Disturbances	Possible reasons	Corrective actions
Battery failure information to Network control system.	Fuse F2 (8 A) on the PSC board is defect.	Switch off the auxiliary supply of the REC 501. Remove the connector terminal. Check the personal ESD protection, open the front plate of the unit and remove the PSC board. Check the position of the fuse F2 in Fig. 19. Exchange the fuse. Always use the recommended fuse size. Replace all parts in their original places and switch on the supply. Note ! Local electrical safety regulations must always be followed !
	Batteries are discharged or the lifetime of the battery is ended.	Wait until the internal charger charges the batteries or exchange the batteries.
No connection to the REC 501 and the green indication LED on the front is blinking at 2 Hz frequency.	The self-supervision of the unit has indicated an internal software or hardware fault.	Switch OFF and ON the auxiliary supply. Check if the fault disappears. If not, read the internal fault code parameter V169 using the programming tool. Contact the local ABB Service for repair. Always state the fault code.
No connection to the REC 501 and the green indication LED on the front is dark.	No power supply from auxiliary voltage or batteries.	Check the supplies and the m.c.b. Check the position of the fuses F1 and F2 in Fig. 19
	If the supplies are OK and there are still problems with the communication of the unit.	Switch OFF and ON the auxiliary supply. If the fault persists, contact the local ABB Service for repair. Always state the fault code.

In most fault situations it is recommended to visit the substation to check the situation.
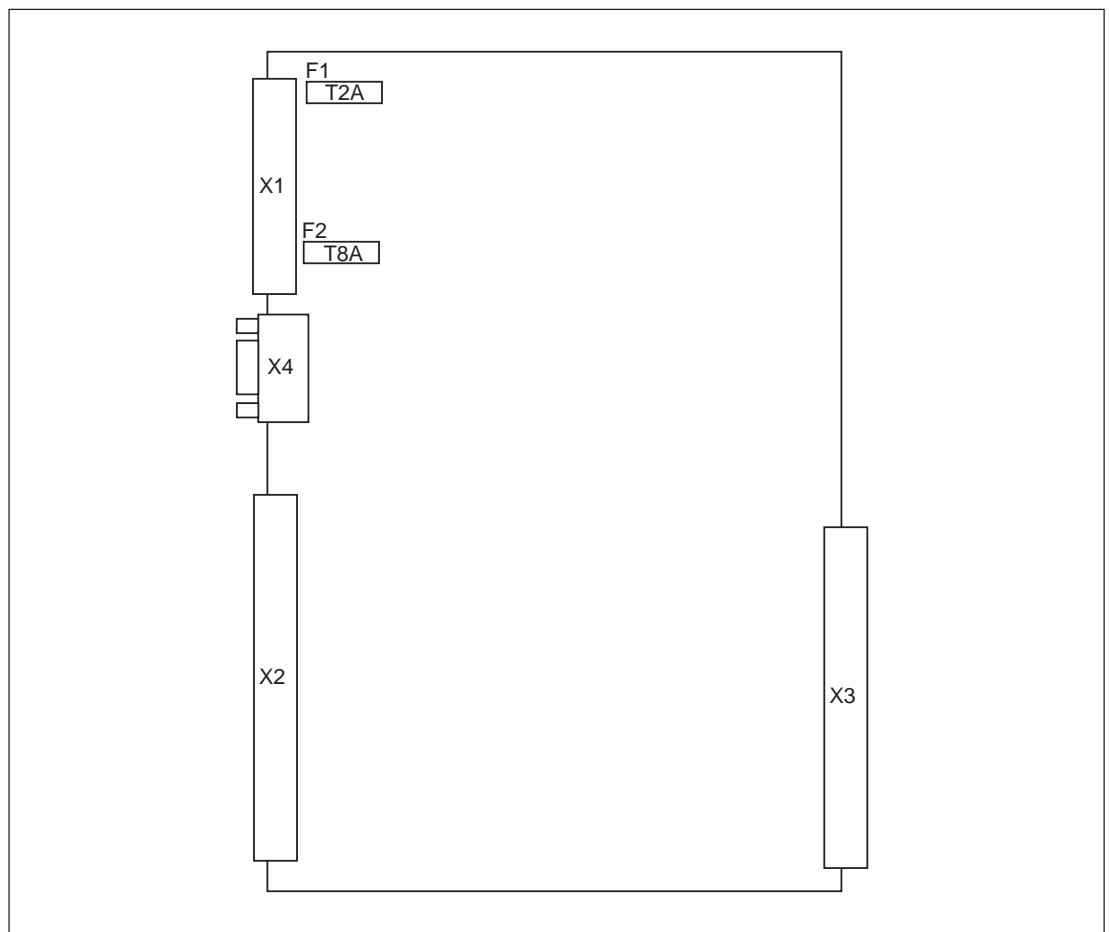
Fig. 19. Fuses F1 and F2 on the PSC board.

Fault codes

The REC 501 unit is provided with auto-diagnostics which continuously supervises the function of the microprosessor, its program execution and the electronics.

When the self-supervision system has detected a permanent fault in the unit, the green IRF LED on the front panel starts blinking. All controls of the outputs of the unit are automatically disabled and the unit generates a fault code that indicates the nature of the fault.

Fault code	Fault description
4	Faulty output relay.
20	Unknown software reset performed.
22	Tasking error.
30	Faulty program memory (ROM).
50	Faulty program memory (RAM).
51	EEPROM CRC error.
52	Counter write error.

Modem

Regular initialization is made to check the condition of the optional plug-in modem and the external modem. The REC 501 unit reinitializes the modem even though there is no successful communication within a certain programmed period.

If the internal or external modem does not start operating or it stops, check that the initializa-

tion string parameter V221 to the modem is correct. The reinitialization parameter is described in chapter "Communication parameters". Should the initialization string be correct, read the trouble-shooting instructions in the concerned modem manual. For the optional plug-in modem use manual 1MRS750577-MUM.

Communication parameters

Enforced programming parameters

The programming cable forces the REC 501 unit into the programming mode by earthing the freeze pin of connector X2.2. This action does not change the parameters visibly, it only changes them internally. After removing the programming cable all the parameters entered will be valid. This operation facilitates the parameterization of the unit.

Data	Parameter	Enforced values
Unit's SPA address	V200	1
Data transfer rate	V201	9.6 kBd
Parity	V230	even
Data bits	V231	7 data bits

Remote Communication Parameters

Data	Channel	Parameter	Data direction	Values	Default
Selection of active protocol (not valid at parameterization)	0	V202	R,W	0 = SPA protocol 1 = remote protocol	0
Station address	0	V210	R,W	0...255	255
Data transfer rate of the remote protocol*	0	V211	R,W	0.3; 0.6; 1.2; 4.8; 9.6 or 14.4 kBd	1.2
CTS delay	0	V213	R, W	0…255 = 0…2550 ms	3
RTS keep up delay	0	V214	R, W	0…255 = 0…2550 ms	1

* Note!
Selection of the data transfer rate for the SPA communication is described in chapter "Control parameters".

Modem Communication Parameters

Data	Channel	Parameter	Data direction	Values	Default
Connection mode	0	V220	R,W	0 = 2/4-wire leased line 1 = switched line	0
Initialization string for the modem	0	V221	R,W	40 ASCII characters	empty
Dialling string for the modem	0	V222	R,W	20 ASCII characters	empty
Hang-up string for the modem	0	V223	R,W	20 ASCII characters	empty
Modem diagnostic interval	0	V224	R,W	0 - 255 min	0 min

Note!
Communication parameters based on certain protocols are explained at the end of the protocol description in question.

**SPA
communication**

Input events

Code	Channel	Event	Number representing the event	Default mask value
E1	0	Input I1 activated	1	0
E2	0	Input I1 deactivated	2	0
E3	0	Input I2 activated	4	0
E4	0	Input I2 deactivated	8	0
E5	0	Input I3 activated	16	0
E6	0	Input I3 deactivated	32	0
E7	0	Input I4 activated	64	0
E8	0	Input I4 deactivated	128	0
		Event mask V155 for inputs		0

Code	Channel	Event	Number representing the event	Default mask value
E9	0	Input I5 activated	1	1
E10	0	Input I5 deactivated	2	1
E11	0	Battery voltage low	4	1
E12	0	Battery voltage normal	8	1
E13	0	Power supply overheated	16	1
E14	0	Power supply temperature normal	32	1
E15	0	Auxiliary supply disconnected	64	1
E16	0	Auxiliary supply reconnected	128	1
		Event mask V156 for inputs		255

Code	Channel	Event	Number representing the event	Default mask value
E17	0	Intermediate counter 1, value received	1	0
E18	0	Intermediate counter 2, value received	2	0
E19	0	Period counter 1, value received	4	0
E20	0	Period counter 2, value received	8	0
		Event mask V157 for counters		0

Output events

Code	Channel	Event	Number representing the event	Default mask value
E30	0	Output O1 activated	1	0
E31	0	Output O1 deactivated	2	0
E32	0	Output O2 activated	4	0
E33	0	Output O2 deactivated	8	0
E34	0	Output O3 activated	16	0
E35	0	Output O3 deactivated	32	0
E36	0	Output O4 activated	64	0
E37	0	Output O4 deactivated	128	0
Event mask V158 for outputs				0

Open/close events

Code	Channel	Event	Number representing the event	Default mask value
E40	1...2	Change in status: xx $\rightarrow$ 10 (open)	1	1
E41	1...2	Change in status: xx $\rightarrow$ 01 (close)	2	1
E42	1...2	Change in status: xx $\rightarrow$ 11 (undefined)	4	1
E43	1...2	Change in status: xx $\rightarrow$ 00 (undefined)	8	1
E44	1...2	Open command executed	16	1
E45	1...2	Close command executed	32	1
Event mask V159 for open/close events				63

General events

Code	Channel	Event	Number representing the event	Default mask value
E50	0	Restart of microcontroller	*	-
E51	0	Overflow of event buffer	*	-

Explanations:
0   not included in event reporting
1   included in event reporting
*   no code number
-   cannot be programmed

The REC 501 unit has an event fuffer. The size of the buffer is 30 latest event.

The overflow of event buffer E51 is caused during too long communication breaks. This E51 and other general events has to be acquit by reseting the status of the unit, as described in the document "SPA-BUS COMMUNICA-TION PROTOCOL", 34 SPACOM 2 EN.

Input parameters

Data	Channel	Parameter	Data direction	Values
Temperature inside enclosure	0	I1	R	-40...+60 °C
Battery charging voltage	0	I2	R	24.0...30.0 V dc
Object status	1...2	I3	R	0 = undefined (inputs 00) 1 = closed 2 = open 3 = undefined (inputs 11)
Input X2 (1/2)	0	I4	R	0 = not active 1 = active
Input X2 (3/2)	0	I5	R	0 = not active 1 = active
Input X2 (4/5)	0	I6	R	0 = not active 1 = active
Input X2 (6/5)	0	I7	R	0 = not active 1 = active
Input X2 (7/8)	0	I8	R	0 = not active 1 = active
Power supply temperature	0	I9	R	0 = normal 1 = overheated
Auxiliary supply	0	I10	R	0 = connected 1 = disconnected
Battery voltage at testing	0	I11	R	0 = normal 1 = low
Heating	0	I12	R	0 = not active 1 = active
Closed status of an object	1...2	I13	R	0 = not closed 1 = closed
Open status of an object	1...2	I14	R	0 = not open 1 = open

Output parameters

Data	Channel	Parameter	Data direction	Values
Output1	0	O1	R	0 = not active 1 = active
Output2	0	O2	R	0 = not active 1 = active
Output3	0	O3	R	0 = not active 1 = active
Output4	0	O4	R	0 = not active 1 = active
Output1	0	O11	R,W	0 = not active 1 = active
Output2	0	O12	R,W	0 = not active 1 = active
Output3	0	O13	R,W	0 = not active 1 = active
Output4	0	O14	R,W	0 = not active 1 = active
Enable output relay test	0	O21	R,W	0 = not enabled 1 = enabled

Setting parameters

Data	Channel	Parameter	Data direction	Values	Default
Open pulse length	1...2	S1	R,W	0.05...100.0 s	0.50 s
Close pulse length	1...2	S2	R,W	0.05...100.0 s	0.50 s
Heating limit	0	S3	R,W	-25...+15°	+10°
Switchgroup SGF1	0	S4	R,W	0...255	8
Switchgroup SGF2	0	S5	R,W	0...255	16
Switchgroup SGF3	0	S6	R,W	0...255	36
Switchgroup SGF4	0	S7	R,W	0,1,2,4,8	2
Switchgroup SGF5	0	S8	R,W	0,1,2,4,8	1
Switchgroup SGF6	0	S9	R,W	0...255	0
Intermediate pulse counting time (generates events E17 and E18)	1...2	S10	R,W	1...60 min	10
Period pulse counting time (generates events E19 and E20)	1...2	S11	R,W	30...60 min	60
Cumulative or wrap-around pulse counting	1...2	S12	R,W	0 = wrap-around after the specified time	
				1 = cumulative	0

Commands and recorded value

Data	Channel	Parameter	Data direction	Values	Default
Open select (secured operation)	1...2	V1	R,W	0 = not selected	0
				1 = selected	
Close select (secured operation)	1...2	V2	R,W	0 = not selected	0
				1 = selected	
Execute selected open/close operation	1...2	V3	W	1 = execute	-
Cancel selected open/close operation	1...2	V4	W	1 = cancel	-
C/O-operation counter (Stored every 3 hours)	1...2	V5	R,W	0...10000	0
Minimum battery voltage	0	V6	R	0.0...28.0	28.0
Reset minimum battery voltage	0	V7	W	1 = reset	-
Activate battery test	0	V8	W	1 = Battery testing	-
Reset pulse counter values	1...2	V9	W	1 = reset	-
Intermediate counter value	1...2	V11	R	0...999 999	-
Period counter values	1...2	V20 V22 V24 : V138	R	0...999 999	-
Time stamps for the storage of registers V20, V22, V24 ... V138	1...2	V21 V23 V25 : V139	R	DD HH.MM	-

Control parameters

Data	Channel	Parameter	Data direction	Values	Default
Event mask for inputs (1 enable 0 disable)	0	V155	R,W	0...255	0
Event mask for inputs	0	V156	R,W	0...255	255
Event mask for counters	0	V157	R,W	0...15	0
Event mask for outputs	0	V158	R,W	0...255	0
Event mask for open/close	1...2	V159	R,W	0...63	63
Activate self-supervision	0	V165	R,W	1 = self-supervision output activated 0 = normal	
Format EEPROM	0	V167	W	2 = format	-
Internal fault code	0	V169	R	1...255	-
Unit's SPA address code	0	V200	R,W	1...255	1
SPA data transfer rate	0	V201	R,W	4.8 or 9.6 kBd	9.6 kBd
Program version of the PSC3/PSC4 unit	0	V205	R	1MRS1180xxx	-
Program version of the MOD module	0	V206	R	xxxxxxx	-
Type designation of the unit	0	F	R	REC 501	
Reading of event register	0	L	R	Time, channel number and event code	
Re-reading of event register	0	B	R	Time, channel number and event code	
Reading of unit status information	0	C	R	0 = normal state 1 = unit been subject to automatic reset 2 = overflow of event register 3 = events 1 and 2 together	
Resetting of unit status	0	C	W	0 = reset	
Time	0	T	R,W	0.000...59.999 s	
Date and time	0	D	R,W	YY-MM-DD HH.MM;SS.mss	

Configuration example	This chapter gives an example of how to set different parameters when:
	- the unit communicates using the SPA protocol
	- one input is used for a pulse counter by counting periods of 1 hour
	- one object is controlled
	- local remote switch is used
	- heating control is used
	- IRF output is used

At least the following parameters have to be set:
• Functional parameters
  S5= 64   Input 4 is programmed for pulse counter 1
  S8= 8   Output 3 is programmed for heating control
  S7= 4   Output 4 is programmed for IRF output
  1S11= 60 Counting time set to 60 minutes
• Event mask
  V157= 4   Event masks programmed to correspond to the need of counter 1.
  2V159= 0 Event masks programmed to correspond to the need of counter 1.

All others parameters settings can be left as defaults.

ABB