

Builder's guide

500 series



About this manual

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Chapter	Page
Chapter 1 Introduction	1
Introduction to the Builder's guide	2
Intended audience	2
Acronyms and abbreviations	2
Trademarks	2
Revision notes	2
Chapter 2 Terminal dimensions and mounting alternatives	3
Terminal sizes.....	4
Mounting alternatives.....	5
Flush mounting, single case	5
Semi flush mounting, single case	6
Wall mounting.....	6
Two 500 terminals side-by-side	7
A 500 terminal side-by-side with a RHGS case.....	8
Mounting methods and mounting details	9
Mounting the terminal	9
Flush mounting	10
Semi-flush mounting (only single case)	12
19" Panel (rack) mounting	15
Wall mounting.....	17
Side-by-side rack mounting	19
Side-by-side flush mounting	23
Chapter 3 Terminals with a test switch module.....	27
Test switches	28
Example of a typical test switch module with a test switch.....	29
DC-switch	31
Test-plug handle.....	31
Test switch modules for REL-, REB-, and REC 5xx	33
Test switch modules for RET 521.....	35
Test switch modules for RED 521	36
Secondary testing.....	37
Test switch for 4U 19" rack mounting	37
Chapter 4 Terminal connectors	41
Connectors on the terminal.....	42
Location of the connectors on rear side for REL-, REB-, REC 5xx ...	44
1/2 of 19" case	44
3/4 of 19" case	46

1/1 of 19" case	48
Modules	51
Location of the connectors on rear side of RET 521.....	53
Modules	54
Location of the connectors on rear side for RED 521	56
Modules	58
 Chapter 5 Electrical connections	59
Making the electrical connections	60
Connection to protective earth.....	60
Make the electrical connections.....	60
Connection of the CT circuits, X11	60
Connectors for voltage-, binary input- and output signals	61
Identification of the labels on the relays and relay assemblies	65
 Chapter 6 Installation of the optical cables in terminals and cubicles	67
Installing the optical fibres	68
Configuring the 56/64 kbit data communication modules	69
Configuring the fibre optical modem	69
Configuring the short range fibre optical modem	71
Configuring the short range galvanic modem	75
Configure the interface modules for V.36, X.21 and RS530	76
Configuring the interface modules for G.703 co-directional.....	77
Fault tracing	78
Configuring the transceiver 21-15xx	82
Configuring the transceiver 21-16xx	85
 Chapter 7 Making the screen connection	89
Screen connections	90
Installing.....	90
 Chapter 8 Installation of optical cables	91
SPA/IEC.....	92
LON	93
Technical data	94
 Chapter 9 Data communication modules	95
Data communication modules.....	96
Technical data	97

Chapter 10 Mounting in cubicles 99

Requirements	100
Degrees of protection	100
Environmental aspects	101
Earthquake protection	102
Power losses	102
Ambient temperature	104
Earth connection.....	110
Electro static discharge.....	112
Examples of mounting in cubicles	113
Examples of terminal blocks and cables.....	117
Terminal blocks	117
Cables	117

Chapter 11 Cubicle layouts..... 119

Example 1.....	120
Example 2.....	121
Example 3.....	122
Example 4.....	123
Example 5.....	124
Example 6.....	125
Example 7.....	126
Example 8.....	127
Example 9.....	128

Chapter 1 Introduction

About this chapter

This chapter is an introduction to the Builder's guide

1 Introduction to the Builder's guide

1.1 Intended audience

This guide is intended for system integrators.

1.2 Acronyms and abbreviations

GPS	Global Positioning System
HMI	Human Machine Interface is the front panel of a terminal.
HSI	Human System Interface is the control system of a station.
IEC	International Electrotechnical Commission
LAG	LON Application Guideline
LON	Local Operating Network
OLE	Object Linking and Embedding
OPC	OLE for Process Control
PST	Parameter Setting Tool
SA	Substation Automation
SMS	Substation Monitoring System
SPA	Strömberg Protection Aquisition, Communication Protocol
SVT	Settings Visualization Tool
TCP/IP	Transmission Control Protocol/Internet Protocol

1.3 Trademarks

All trademarks reside within their respective owner.

1.4 Revision notes

Revision	Description
A	Updates in current chapters. New chapters: chapter 13-19.

Chapter 2 Terminal dimensions and mounting alternatives

About this chapter

This chapter describes terminal dimensions and mounting alternatives

1

Terminal sizes

Three different case sizes are available for the 500 series terminals.



Figure 1: 1/2 of 19" 6U case, 3/4 of 19" 6U case and 1/1 of 19" 6U case.

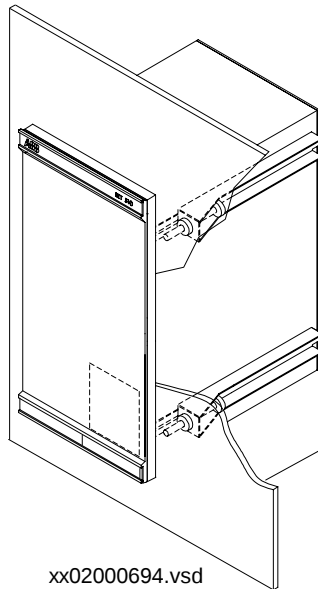
2

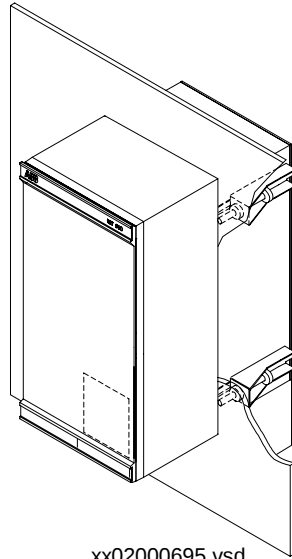
Mounting alternatives

The RE 500 cases can be mounted in several different ways, they can also be combined with, for example, RHGS cases in the same assembly.

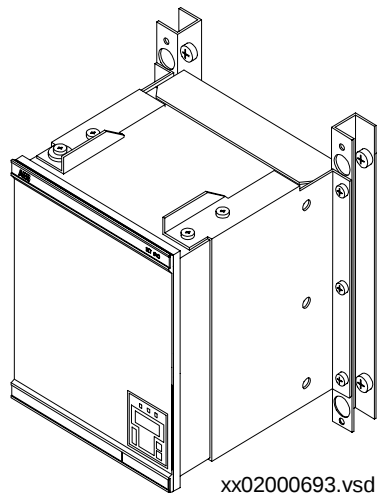
2.1

Flush mounting, single case



2.2**Semi flush mounting, single case**

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2.3**Wall mounting**

xx02000693.vsd

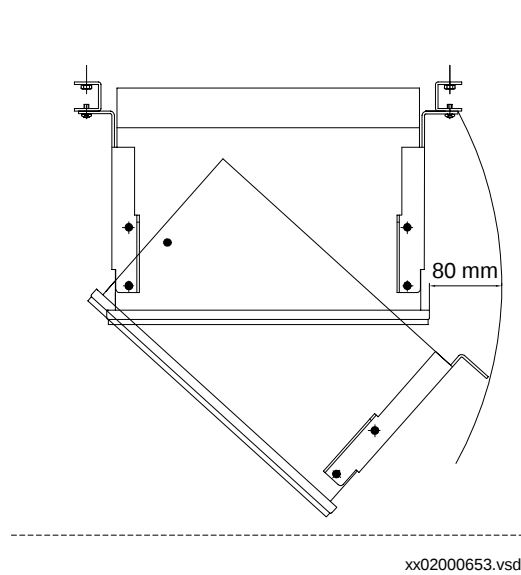
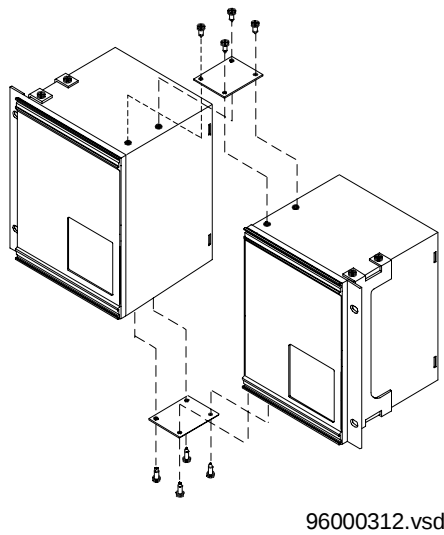


Figure 2: Required free space, 80 mm.

2.4

Two 500 terminals side-by-side



2.5

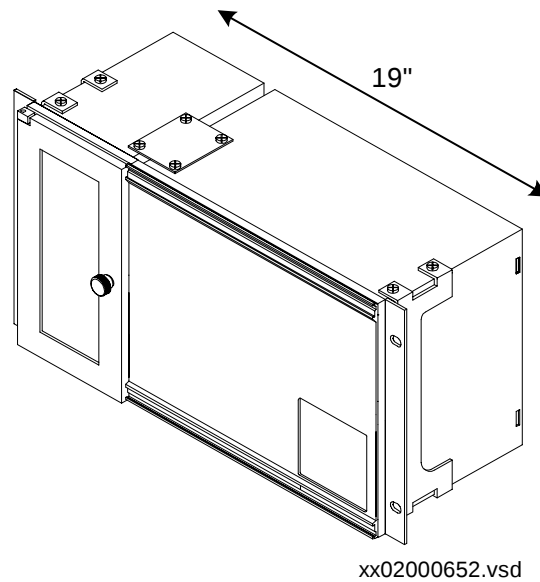
A 500 terminal side-by-side with a RHGS case

Figure 3: A 1/4 of 19" RHGS 6 case, mounted to a 3/4 of 19" 6U case.

3 Mounting methods and mounting details

3.1 Mounting the terminal

Most of the REx 5xx terminals can be rack, flush, semi-flush or wall mounted with the use of different mounting kits. An additional box of type RHGS can be mounted to one side of a 1/2 or 3/4 terminal. The 19-inch 1/1 wide terminal cannot be semi-flush mounted because the mounting distance frame will cover the ventilation openings at the top and bottom.

A suitable mounting kit is available. Mounting kits include instruction sheets and all parts needed including screws. The following mounting kits are available:

- 19-inch rack mounting kits, 1/2, 3/4 and 1/1 terminal width variants.
- Side-by-side mounting kit.
- Flush mounting kit.
- Semi-flush mounting kit.
- Wall mounting kit.

Note! Ordering information

Note that the mounting kits and details are not automatically included when you order the terminal. They are available as options on the ordering sheet. Simply order desired details there.

Note! Ordering information

When ordering the relay terminal, both the case type and the type of mounting shall be marked with a cross (X) on the ordering sheet. Our ordering system then takes the ordered case/s and size into consideration, and generates the accurate mounting details with the ordered relay terminal. This Builder's Guide will also describe the ordering number for each case size and each mounting kit. This enables you to order these details e.g. as spare-parts.

Torx screw

Generally, all the screws included in delivered mounting kits are of Torx type and a screwdriver of same type is needed (Tx10, Tx15, Tx20 and Tx25).

3.2**Flush mounting**

All terminal sizes, 1/2, 3/4 and 1/1 of 19" and RHGS 6 cases, can be flush mounted. Only a single case can be mounted in each cut-out on the cubicle panel, see A in figure 4. IP54 class is not possible when mounting two cases side-by-side in one cut-out.

Mounting kit details

Consisting of:

- 4 fasteners and fixing screws, see B in figure 4
- sealing strip, see C in figure 4
- an instruction sheet

Optional sealing strip

- an additional sealing strip, to achieve IP54 class

The sealing strip is mounted between the front and the case frame.

Note! Ordering information

To achieve IP54 class protection, an additional sealing must be ordered when ordering the relay terminal. The ordering number for this option is 1MKC 980 001-2. It is factory mounted.

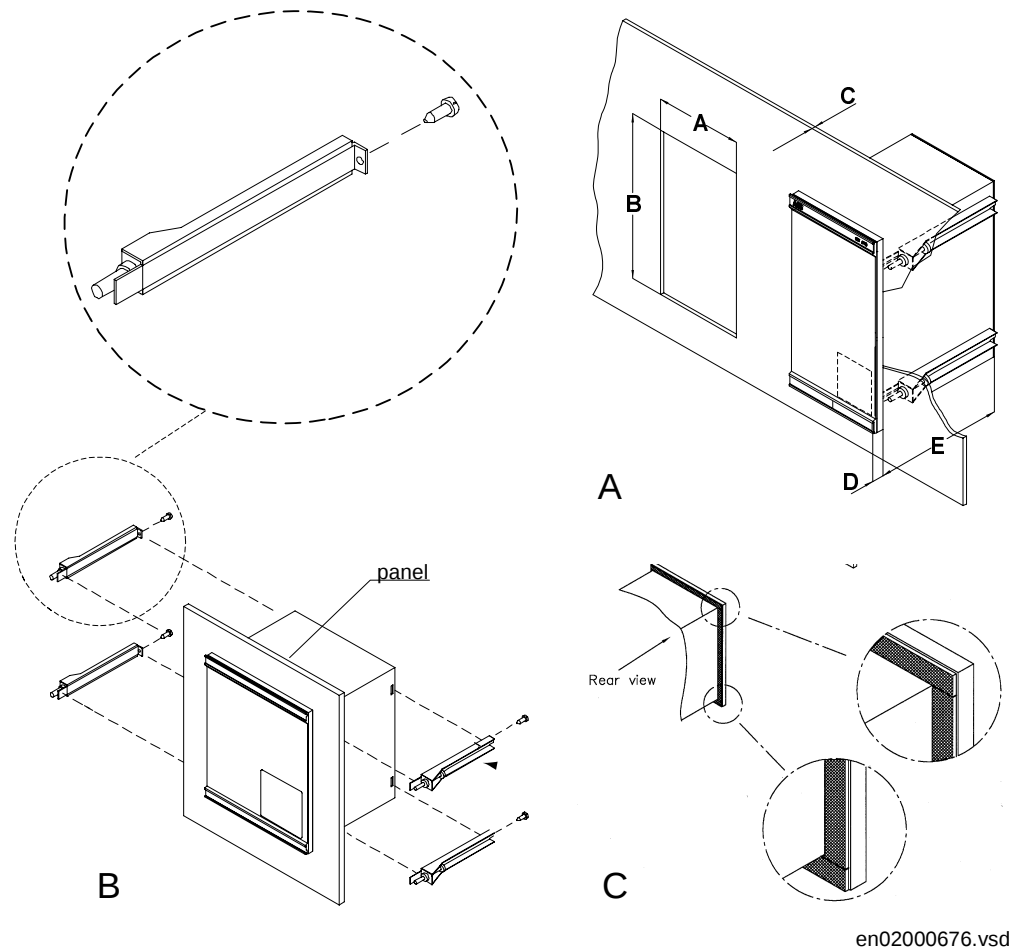


Figure 4: Flush mounting details and dimensions.

Table 1: Cut-out dimensions for flush mounting, see A

Single case size	A +/- 1	B +/- 1
6U x 1/2 of 19"	210.1 mm	254.3 mm
6U x 3/4 of 19"	322.4 mm	254.3 mm
6U x 1/1 of 19"	434.7 mm	254.3 mm

Table 2: Rest of dimensions, see A

Number	Description
C	4-10 mm
D	16.5 mm
E	187.5 mm without protective cover and 228.6 mm with protective cover

Table 3: Ordering a flush mounting kit

Ordering number
1MRK 000 020-Y

Table 4: Ordering an additional sealing strip, to obtain IP54 class

Ordering number
1MKC 980 001-2

3.3

Semi-flush mounting (only single case)

All terminal sizes, 1/2, 3/4 and 1/1 of 19" cases can be semi-flush mounted (not ventilated cases) i.e. it extends 89,8 mm from the panel, compared to flush mounting.

Mounting kit details

Consisting of:

- 4 fasteners and fixing screws, [see \(1\) at figure 5](#)
- sealing strip for both sides of the distance frame, [see \(3\) and \(4\) at figure 5](#)
- distance frame, [see \(2\) at figure 5](#)
- an assembling instruction

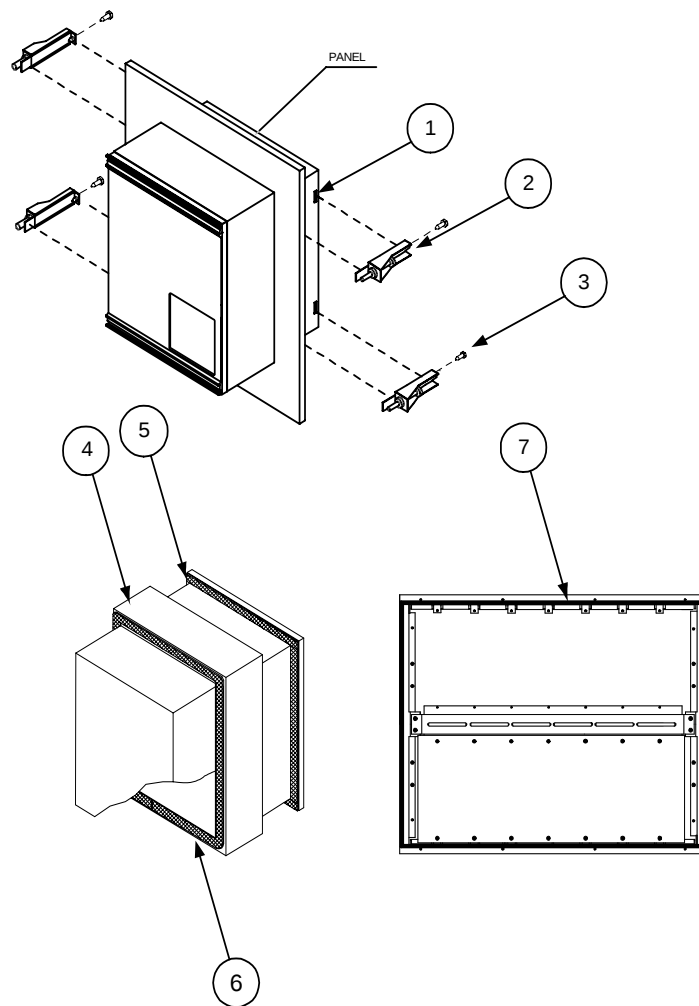
Optional sealing strip

- an additional sealing strip, to achieve IP54 class

The sealing strip is mounted between the front and the case frame.

Note! Ordering information

To achieve IP54 class protection, an additional sealing must be ordered when ordering the relay terminal. The ordering number for this option is 1MKC 980 001-2. It is factory mounted.



xx02000685.vsd

Figure 5: Semi-flush mounting details.

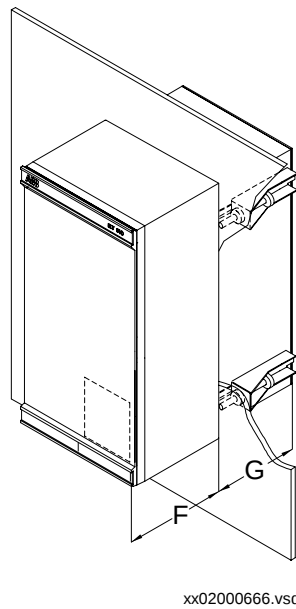


Figure 6: Semi-flush mounting dimensions.

Table 5: Semi-flush mounting dimensions

Number	Dimensions
F	106.5 mm
G	97.6 mm without protective cover and 138.6 mm with protective cover

Table 6: Ordering a semi-flush mounting kit

Ordering number
1MRK 000 020-BS

Table 7: Distance frame ordering numbers when ordering a separate distance frame

Case size	Ordering number
6U x 1/2 of 19"	1MRK 000 020-AM
6U x 3/4 of 19"	1MRK 000 020-AL
6U x 1/1 of 19"	1MRK 000 020-AK

3.4

19" Panel (rack) mounting

All terminal sizes, 1/2, 3/4 and 1/1 of 19" case , can be mounted in a standard 19" cubicle (rack), by using a correctly dimensioned mounting kit.

Mounting kit details

Consisting of:

- 2 rack flanges, which are reversible, either to the left or right side of the cubicle, see (1a) and (1b) at figure 7
- 8 fastening screws, see (2) at figure 7

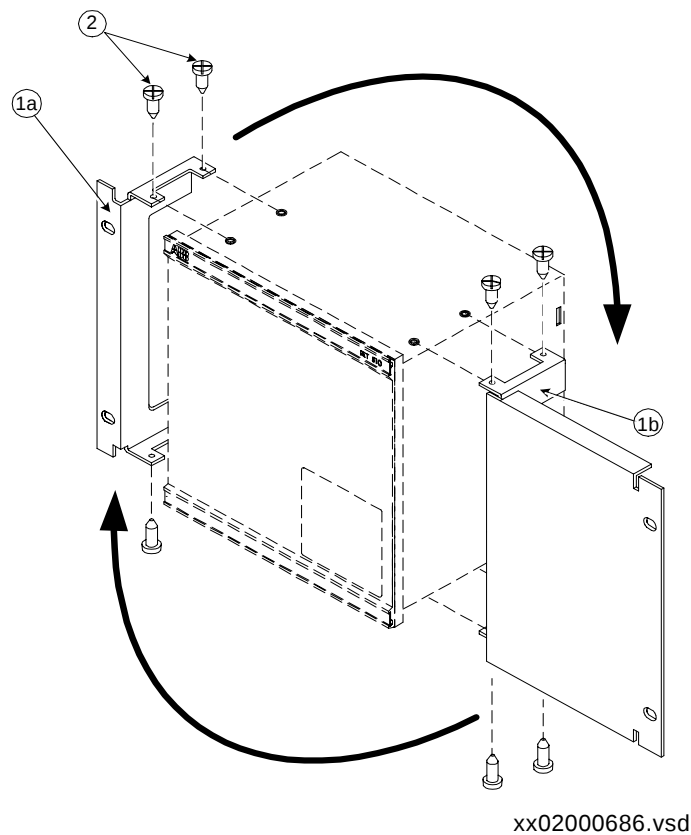


Figure 7: Panel mounting, the flanges are reversible.

Table 8: Ordering a mounting detail kit when ordering a terminal

Ordering number	Consist
1MRK 000 020-BR	When ordering a terminal, the accurate size of parts; 1a and 1b are automatically delivered.

Table 9: Ordering a separate mounting detail kit

Case size	Ordering number	Consist
1/2 of 19"	1MRK 000 020-BB	1a + suitable size of 1b
3/4 of 19"	1MRK 000 020-BA	1a+ suitable size of 1b
1/1 of 19"	1MRK 000 020-CA	2 x 1a

3.5

Wall mounting

All terminal sizes, 1/2, 3/4 and 1/1 of 19", can be wall mounted. It is possible to mount the terminal on a panel or in a cubicle.

Mounting kit details

Consisting of:

- 2 mounting bars, see (4) in figure 8
- 2 terminal brackets, see (6) in figure 8
- 8 screws, see (2) in figure 8
- 4 bushings, see (1) in figure 8
- 6 screws, see (5) in figure 8
- 4 screws, see (3) in figure 8

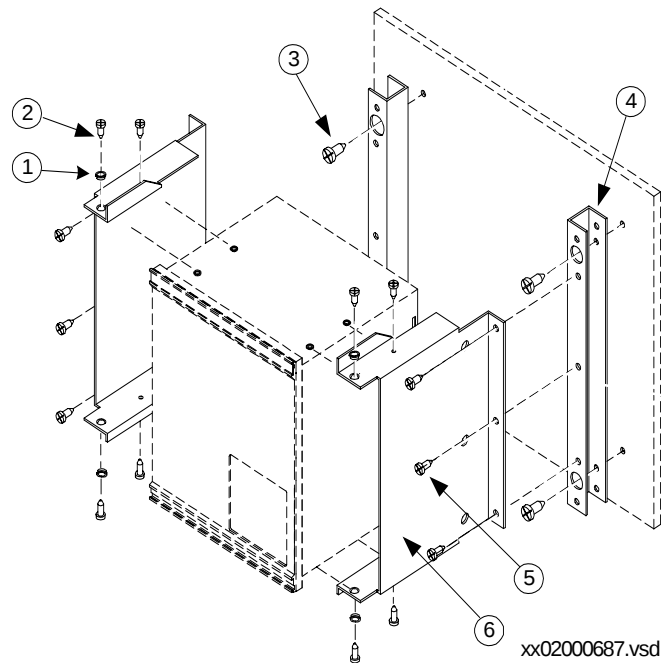


Figure 8: Wall mounting details.

Protection cover

See figure 9, the terminal has been equipped with a rear protection cover (1), which is recommended for this type of assembly.

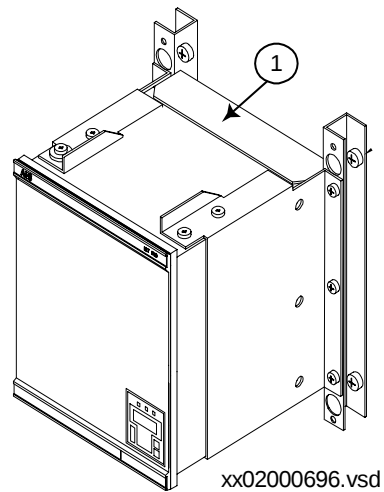


Figure 9: Protection cover.

How to reach the connectors on the rear side of the terminal

See figure 10

To access the rear side of the terminal, a free space of 80 mm is required on the side that opens.

- (1) dismount the inner screws, upper and lower on one side.
- (2) dismount all three fixing screws, on the opposite side, from wall support.

The terminal can now be turned out for access to the connectors, after removing any rear protection.

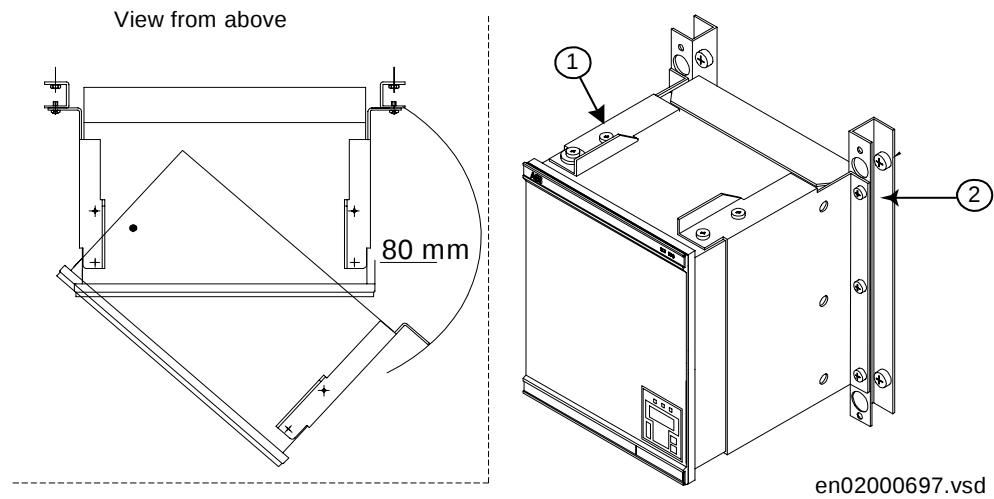


Figure 10: How to reach the connectors on the rear side of the terminal

Table 10: Ordering a wall mounting detail kit

Ordering number
1MRK 000 020-DA

3.6

Side-by-side rack mounting

Terminal sizes, 1/2, 3/4 and RHGS cases, can be mounted side-by-side with a maximum size of 19". When ordering a terminal, 1/2 or 3/4 of 19" size together with a RTXP 24 test switch, the test switch will be delivered mounted in an RHGS 6 case, and mounted alongside the terminal. Order the correct type of mounting kit according to the requirements of your application.

Mounting kit details

Consisting of:

- 2 fixing plates, [see \(1\) in figure 11](#)
- 8 fixing screws, [see \(2\) in figure 11](#)
- 2 mounting brackets, [see \(3\) in figure 11](#)
- an assembly instruction sheet

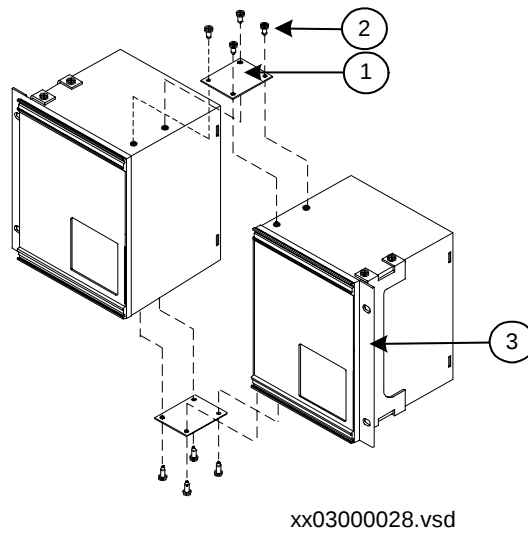


Figure 11: Side-by-side rack mounting details.

A 500 series terminal mounted with a RHGS 6 case

A 500 series terminal 3/4 of 19" mounted with a RHGS 6 case, [see figure 12](#). The RHGS 6 case can be used for mounting a test switch of type RTXP 24. It also has enough space for a terminal base of RX 2 type for mounting a DC-switch or two trip relays of one seat size.

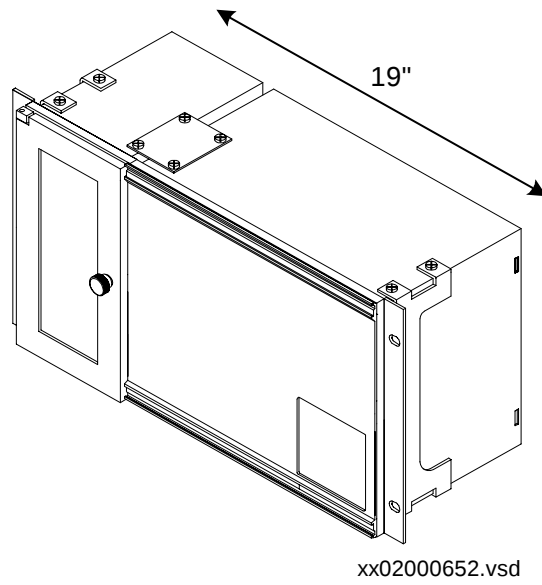


Figure 12: A 500 series terminal mounted with a RHGS 6 case.

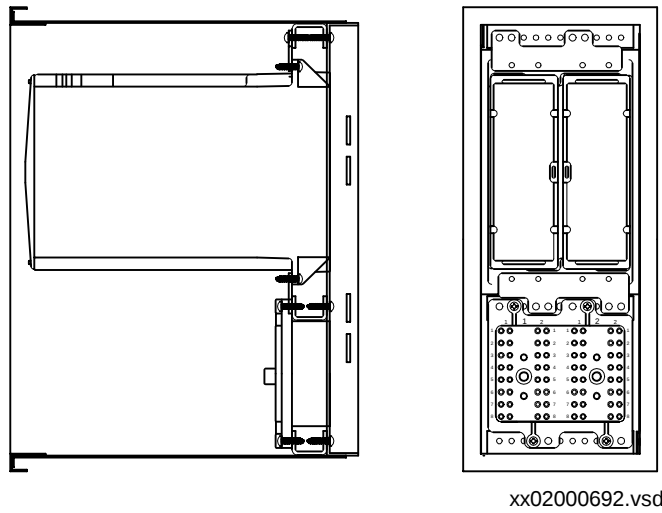
An example of content in the RHGS 6 case


Figure 13: Example of content in a RHGS 6 case

Note! Ordering information

Separately ordered mounting detail kit, for side-by-side mounted 500 series terminals, or 500 series terminals together with RHGS cases, must be chosen according to the maximum size of 1/1 of 19"

Table 11: Ordering a separate side-by-side mounting detail kit

Ordering number	Description
1MRK 000 020-Z	2 fixing plates, 8 fixing screws and assembly instruction

Table 12: Ordering a separate side-by-side rack mounting detail kit

Case size	Ordering number Mounting brackets	Ordering number Side-by-side mounting kit
1/2 of 19"	1MRK 000 020-BB	1MRK 000 020-Z
3/4 of 19"	1MRK 000 020-BA	1MRK 000 020-Z
1/1 of 19"	1MRK 000 020-CA	1MRK 000 020-Z

Table 13: Ordering a side-by-side rack mounting detail kit with a terminal

Ordering number	Description
1MRK 000 020-BR	The correct size rack will be delivered.

3.7

Side-by-side flush mounting

Side-by-side mounted cases should not be installed as flush mounting. If your application demands this type of installation, it can be done by using the side-by-side mounting details kit, in a panel cut-out, with a maximum size of 19". See figure 14.

Mounting detail kit

Consisting of:

- 2 fixing plates
- 8 fixing screws
- 2 mounting angles
- an assembling instruction

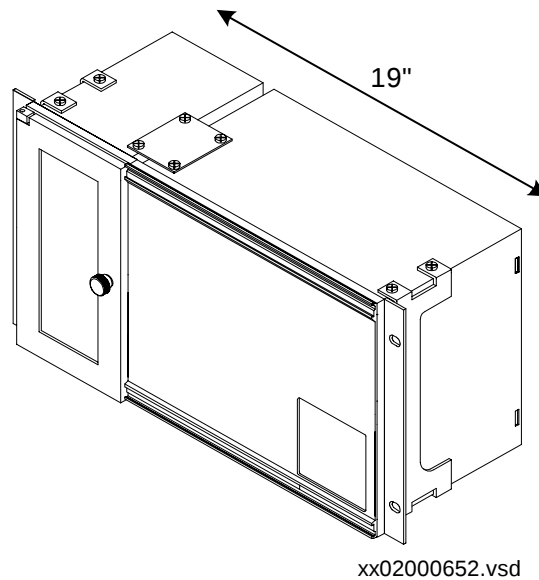


Figure 14: Side-by-side flush mounting.

Dimensions

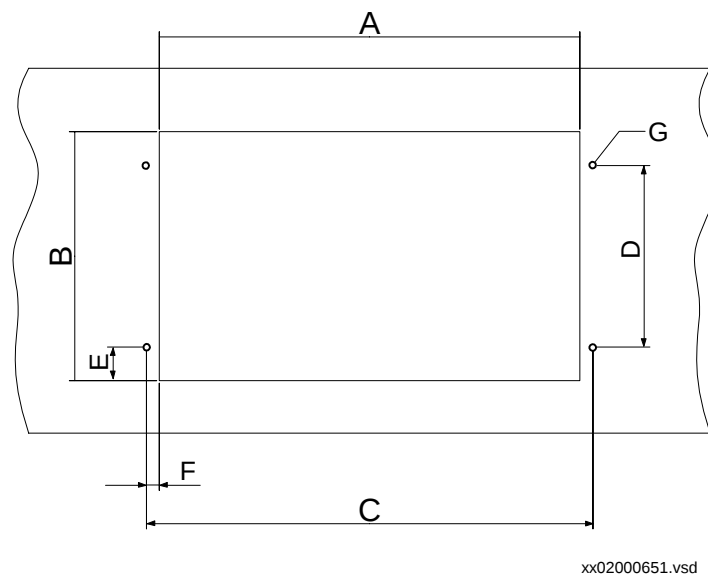


Figure 15: Case dimensions.

Case size	A	B	C	D	E	F	G
6U x 1/2 of 19"	214.0	259.3	240.4	190.5	34.4	13.2	diam. 6.4
6U x 3/4 of 19"	326.7	259.3	352.8	190.5	34.4	13.2	
6U x 1/1 of 19"	438.7	259.3	465.1	190.5	34.4	13.2	

Note! Ordering information

With side-by-side flush mounting installation, only IP class 20 can be achieved. To achieve IP class 54 we recommend case-by-case flush mounting, See section, flush mounting.

Table 14: Ordering a separate side-by-side mounting detail kit

Ordering number	Description
1MRK 000 020-CA + 1MRK 000 020-Z	Mounting brackets and side-by-side mounting kit (2 fixing plates, 8 fixing screws and an instruction sheet)

Chapter 3 Terminals with a test switch module

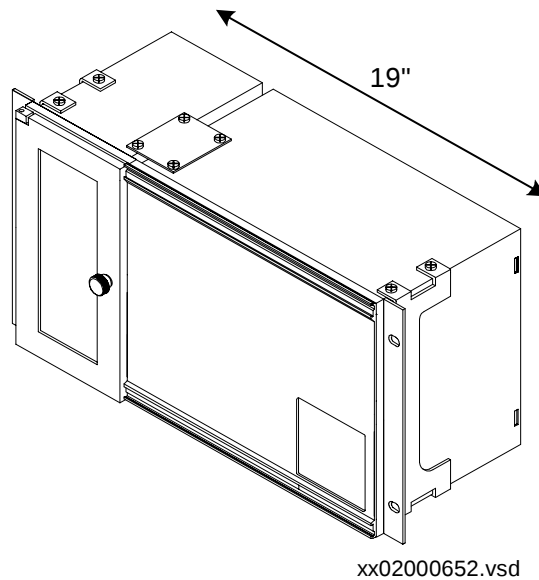
About this chapter

This chapter describes different test switch modules.

1

Test switches

When ordering a 500 series 19" rack mounted terminal of 1/2 and 3/4 size with a RTXP 24 test switch, the terminal will be delivered with a test switch module mounted side-by-side and wired to the terminal. When ordering a terminal with 1/1, the test switch will be delivered separately. Order the correct type of mounting kit, according to the requirements of your application.



Consisting of:

- a RHGS case including a RTXP 24 test switch
- and no other options are selected, an empty two-seat COMBIFLEX terminal base RX 2 is mounted in the lower part of the module.

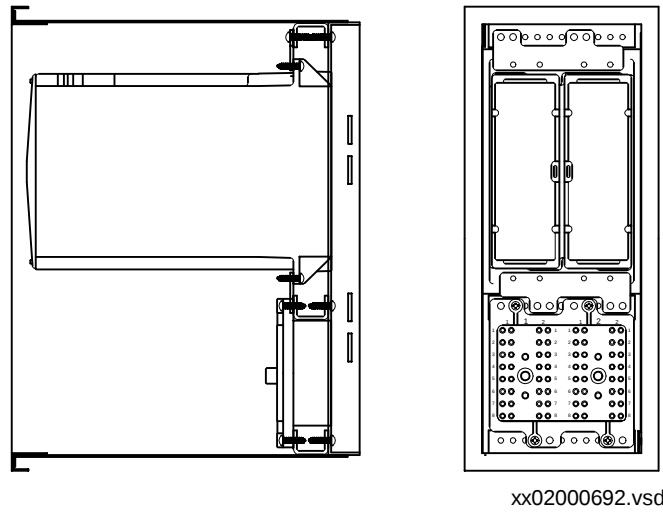


Figure 16: The test switch module with a RTXP 24 and an empty RX 2 terminal base mounted.

1.1

Example of a typical test switch module with a test switch

Example; A test switch module with a test switch RTXP 24 and RX 2 terminal base with a DC-switch mounted as an option, [see figure 17](#).

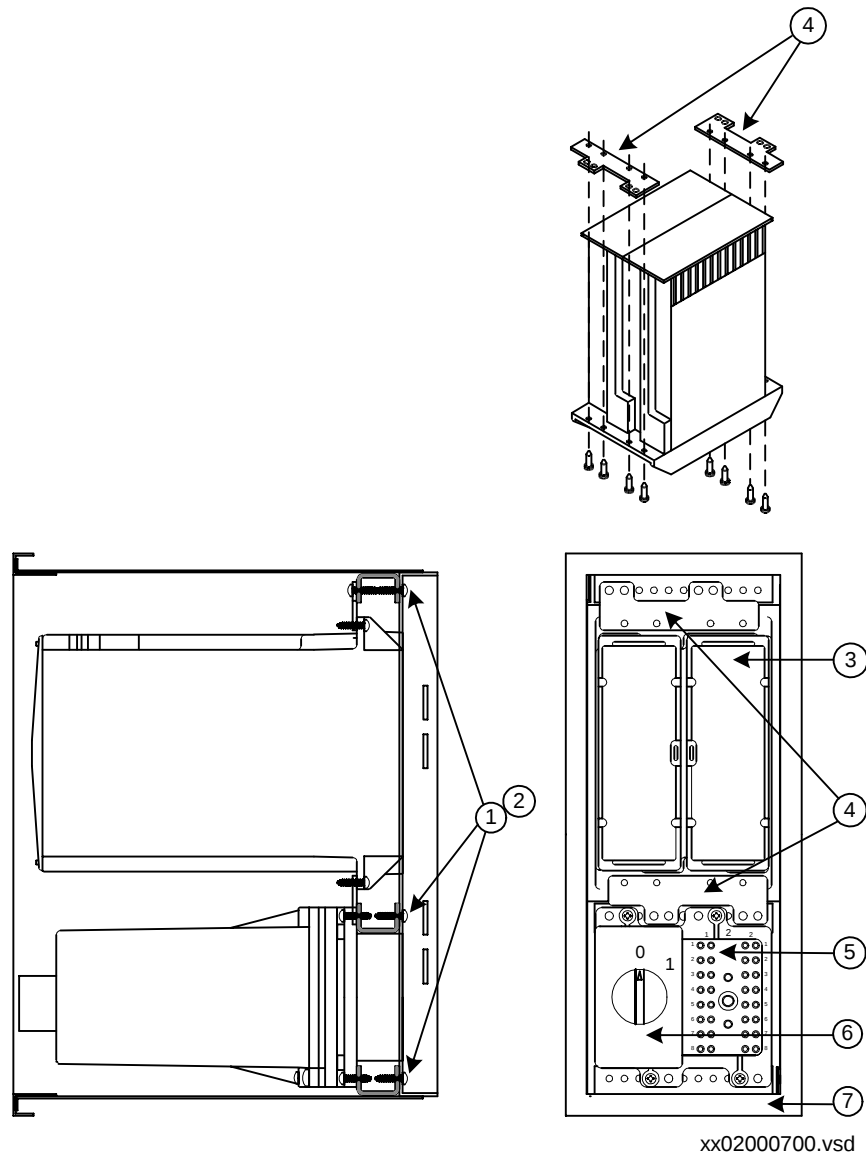


Figure 17: Example of a typical test switch module with a test switch.

Number	Description
1	3 apparatus bars 12C, Ordering no: 2175 323-1
2	9 ADA 637-12 screws
3	RTXP 24 test switch

Number	Description
4	Mounting plate kit for RTXP 24, Ordering no: 1MRK 000 020-BT
5	Terminal base RX 2
6	DC-switch
7	RHGS 6 case

Note! Ordering information

The ordering number is visible on the right half of the front cover on the RTXP 24 test switch.

1.2**DC-switch**

As an option a DC-switch can be selected for this module and occupy one seat of the two-seat RX 2 terminal base.

If your application does not have any use for the DC-switch, the RX 2 terminal base can with advantage be used for tripping relays and eliminate the cost of an additional rack.

Table 15: Ordering a DC-switch

Ordering number
RK 795 017-AA

1.3**Test-plug handle**

The test switch RTXP 24 makes it possible to test relays in a fail-safe way. Inserting test-plug handle RTXH 24 into the test switch automatically prepares for testing in proper sequence. Blocked trip circuits, short circuited CT's, opened voltage circuits make the relay terminal available for secondary injection testing.



xx02000699.vsd

Figure 18: Test-plug handle RTXH 24



xx02000698.vsd

Figure 19: Test switch RTXP 24

2

Test switch modules for REL-, REB-, and REC 5xx

REL, REB and REC provide you with a test switch module. There are two alternatives, which depend on the use of internal or external earthing.

See (1) at [figure 20](#) and [figure 21](#), RTXP is equipped with a signal contact located on the top, right-hand housing. This contact is for the signalling of test in progress which is very important, especially during the test of differential protections. The contact is wired with two 10 A terminal sockets.

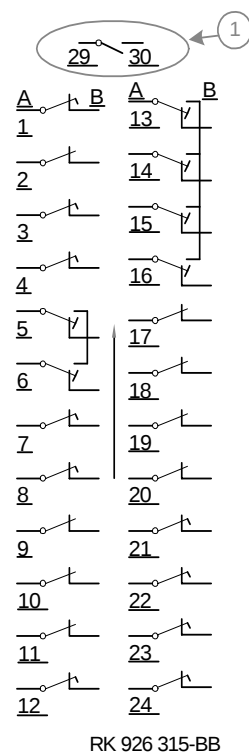


Figure 20: Internal earthing

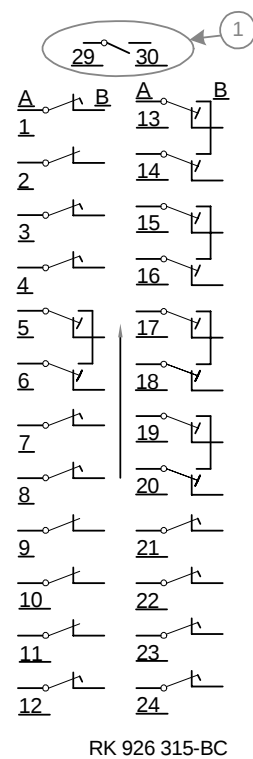


Figure 21: External earthing

Table 16: Ordering a test switch for REL 5xx, REB 5xx or REC 5xx

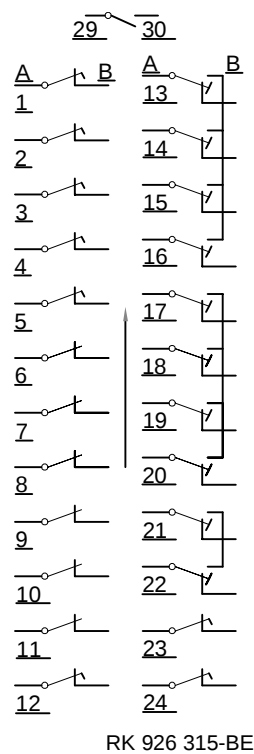
Ordering number	Description
1MRK 000 371-CA	Test switch module RTXP 24 in a RHGS case. The ordering system will generate the correct switch, according to your choice of internal- or external earthing.

3

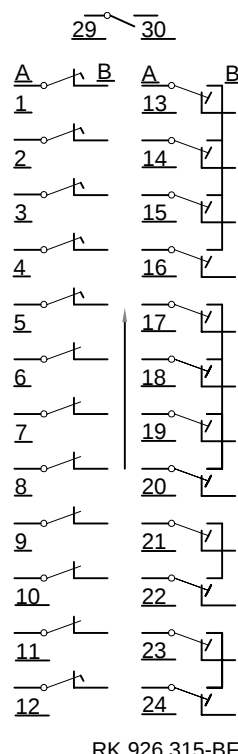
Test switch modules for RET 521

One test switch is required for each Analog input module (AIM). As the RET 521 is 3/4 of a 19" case, the first test switch is mounted alongside the terminal. The second test switch is delivered separately, with a set of leads and must be connected by the user in accordance with the circuit diagram of each terminal. The conductors are dimensioned for connection to the adjacent rack. The test switches for RET 521 always have internal star point earthing.

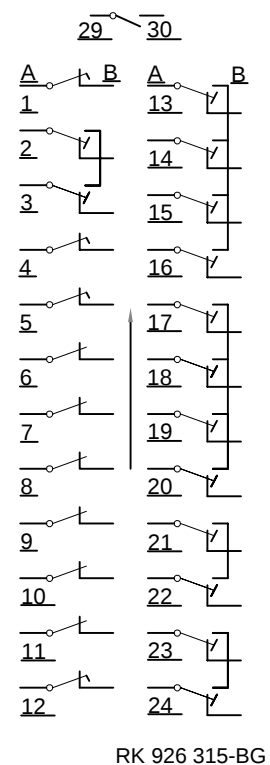
The contact configuration in the test switch in accordance to AIM



For AIM 7I + 3U



For AIM 8I + 2U



For AIM 9I + 1U

4 Test switch modules for RED 521

One test switch is required for each analog input module (AIM). As the RED 521 terminal case is 19" the test switch will always be delivered separately. The test switches for RED 521 have always an external earth (star point) connection of three-phase CT groups, see figure 22. There are two alternatives for the choice of test switch modules.

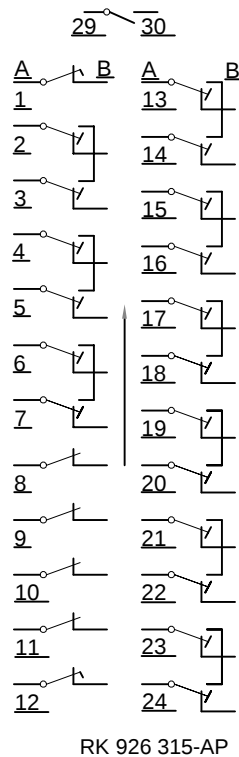


Figure 22: With external earthing

Table 17: Ordering a test switch for RED 521

Ordering number	Description
1MRK 000 371-EA	For the first AIM module. Test switch module RTXP 24 in a RHGS case. Provides a DC-switch as an available option.
1MRK 000 371-EB	For the second AIM module. Test switch module RTXP 24 in a RHGS case. DC-switch is not a possible option.

4.1

Secondary testing

In many cases more than three CT circuits are connected to one RED 521. In these cases more than one test switch type RTXP 24 shall be used. This imposes some requirements on the overall circuit design in order to allow secure secondary testing of the bus differential relay under through-load conditions. Only one test handle can be inserted at a time, which may cause current unbalance to the RED 521 and possible unwanted operation. To prevent this, the following two actions can be taken:

1. If external trip relays are used, connect the trip signal from RED 521 in series with all RTXP 24 test switches. This will insure that the trip signal will be detected regardless which test handle is first inserted.

2. If for any reason, solution one is not possible, then the manually operated “Enable/Disable” selector switch can be included in the bus differential circuit, which in “Disable” position energizes the “BLOCK” input of RED 521. Then testing can be carried out in the following sequence:

- Put switch in “Disable” position
- Insert ALL test handles
- Open trip paths for all breakers
- Put switch in “Enable” position
- Perform secondary tests on RED 521
- Put switch in “Disable” position
- Close trip paths for all breakers
- Withdraw ALL test handles
- Make sure RED 521 is balanced by reading Id & Iin service values on the front HMI
Put switch in “Enable” position

In order to check that the bus differential relay is not disabled by mistake, wire output contact “BLOCKED” to RTU or SCADA system in order to monitor RED 521 status.

4.2

Test switch for 4U 19” rack mounting

If your cubicle application consists of more than one RED 521 and hence needs more than one test switch, that are required for each terminal, it can be advantageous to mount four test switches in a 4U 19” rack by using the mounting plate kit instead, than to mount each one in its own RHGS 6 case. A distance of min. 1C (7mm) is required between each test switch in order to allow for the opening of the cover locks, [see figure 23](#) and [figure 24](#).

An example of RED 521 cubicle application

3 RED 521 with the following functions. Two single-phase differential zones (i.e. ZA & ZB), ZA/ ZB bus interconnection, open CT detection, service values reading and event list.

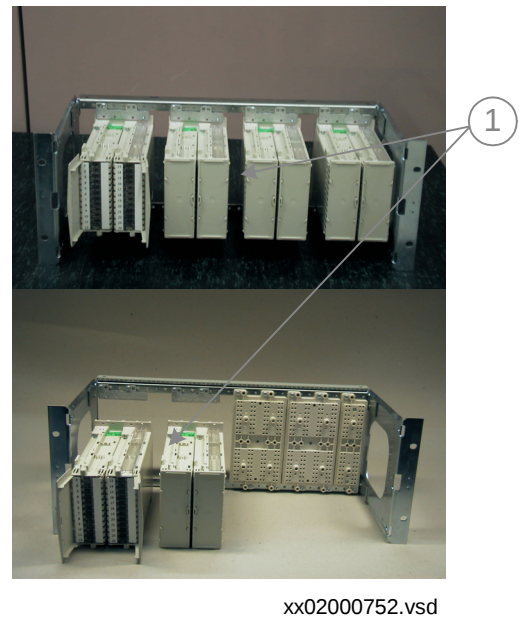
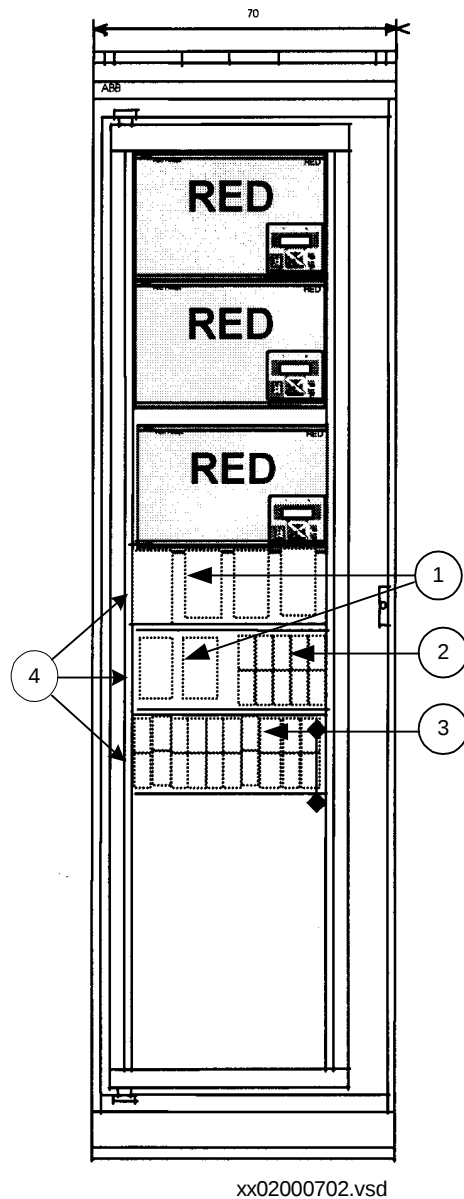


Figure 24: 6 RTXP 24 test switches.

Figure 23: Example of cubicle configuration

Number	Description	Ordering number
1	6 RTXP 24	1MRK 000 315-AP
	6 mounting kits	1MRK 000 020-BT
2	1 RX2H terminal base	5619 625-A
	7 RX 4 terminal bases	5619 625-A
	9 RXMS 1	RK 216 063-xx tripping relays
3	3 DC-switches (option)	RK 795 017-AA, 1MRK 001 602-xx
	18 RXMD 1	1MRK 001 602-xx
	Isolator replica relays for 16 feeders (a and b contacts per each isolator is required)	
4	3 4U 19" racks , with window	5284 1935-D or 1MRK 000 137-RA

Chapter 4 Terminal connectors

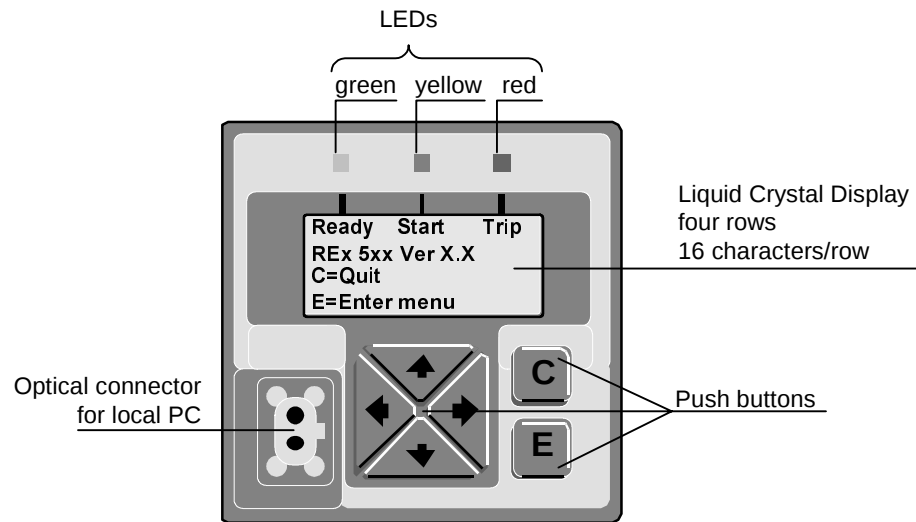
About this chapter

This chapter describes how to connect the terminal to a computer.

1

Connectors on the terminal

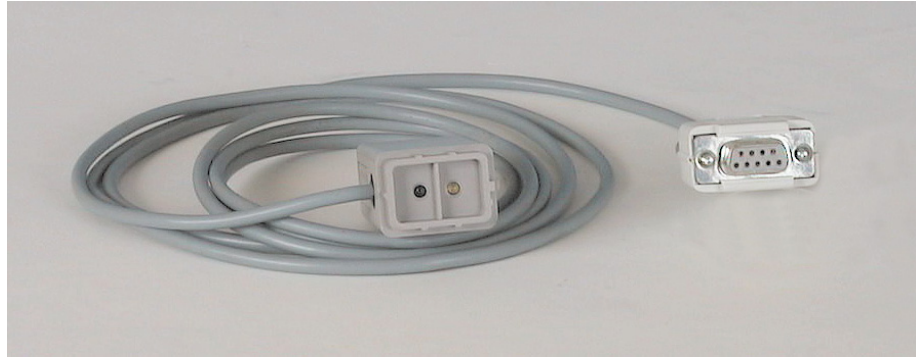
There are communication ports on the front and rear sides of the terminal. On the front of the terminal on the HMI module, an optical/electrical connector to the PC COM-port is available, [see figure 25](#).



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Figure 25: Optical/electrical connector.

A special front connection cable, opto/9 pole D-sub, [see figure 26](#), is to be used to connect a PC COM-port to the optical contact on the left side of HMI. The cable includes an optical contact, an opto/electrical converter and a shielded electrical cable with a standard 9-pole D-sub contact. This cable ensures a disturbance free and safe communication with the relay terminal.



xx03000027.vsd

*Figure 26: Opto/9 pole cable.***Table 18: Ordering a opto cable**

Ordering number	Description
1MKC 950 001-2	Opto/9pole D-sub cable



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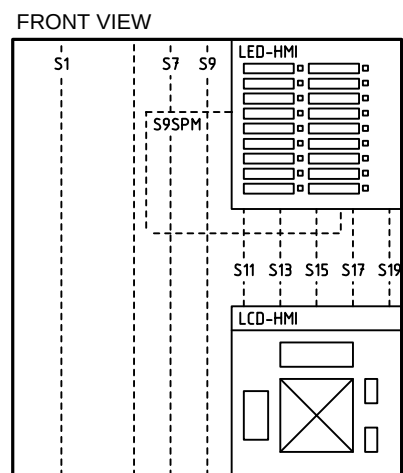
Figure 27: A terminal connected to a PC.

2 Location of the connectors on rear side for REL-, REB-, REC 5xx

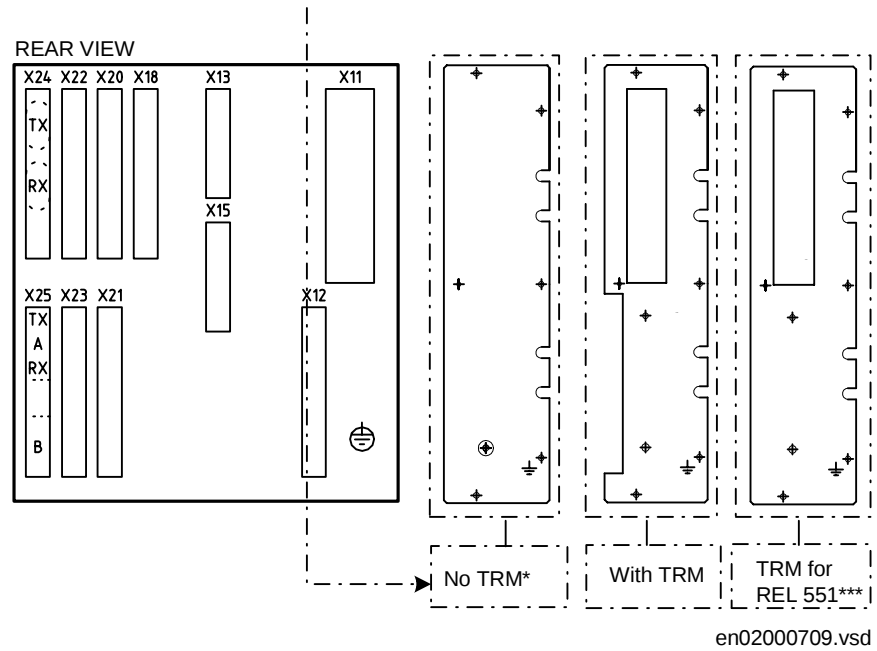
2.1 1/2 of 19" case

The quantity and designation of connectors depends on the type and size of the terminal. The rear cover-plates are prepared with space for the maximum number of HW options for each case size and a factory mounted cover plate covers the unused cutouts.

Designations of modules and connectors on 1/2 of 19" case



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* TRM =Transformer module

*** No voltage transformers

Table 19: Designation corresponding to casing 1/2 of 19" casing

Module	Front	Rear
Transformer Module (1)	S1	X11, X12
Analog/Digital conversion Module (1)	S7	-
Main Processing Module	S9	X13, X15
Power Supply Module	S13	X18
(2)	S15	X20, X21
(2)	S17	X22, X23
(3)	S19	X24, X25

Options

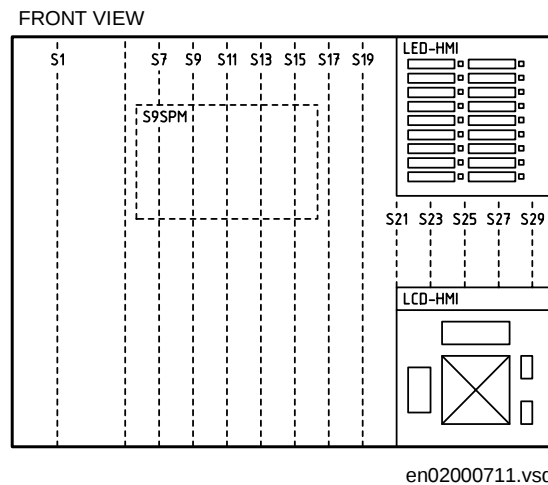
- (1) TRM and ADM
- (2) BIM, BOM, IOM and/or MIM
- (3) BIM, BOM, IOM, MIM or DCM

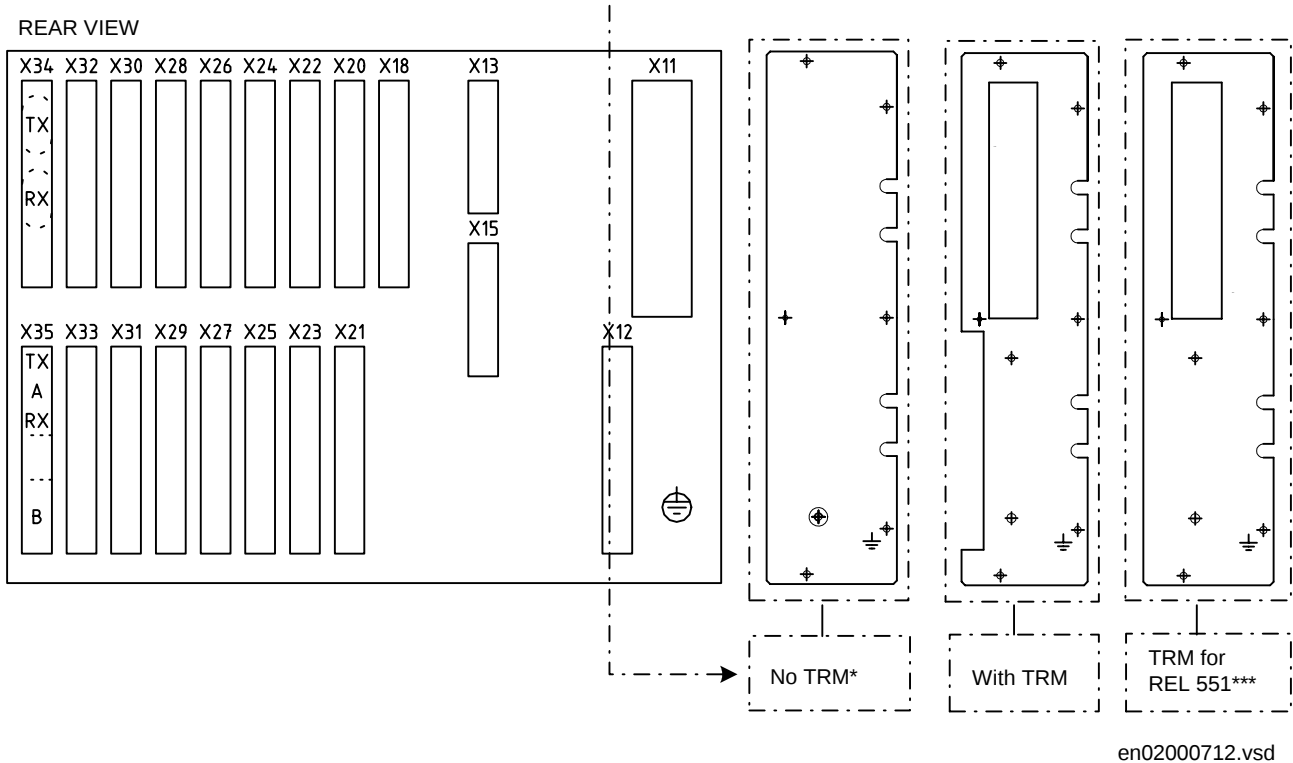
2.2

3/4 of 19" case

The quantity and designation of connectors depends on the type and size of the terminal.
The rear cover-plates have space for the maximum number of HW options for each case size and a factory mounted cover plate for unused cutouts.

Designation of modules and connectors on a 19" 3/4 size case





* TRM = Transformer module

*** No voltage transformers

Table 20: Designation corresponding to casing 3/4 of 19" case

Module	Front	Rear
Transformer module (1)	S1	X11, X12
Analog/Digital conversion Modl. (1)	S7	-
Main Processing Module	S9	X13, X15
Power Supply Module	S13	X18
(2)	S15	X20, X21
(2)	S17	X22, X23

Module	Front	Rear
(2)	S19	X24, X25
(2)	S21	X26, X27
(2)	S23	X28, X29
(2)	S25	X30, X31
(2)	S27	X32, X33
(3)	S29	X34, X35

Options

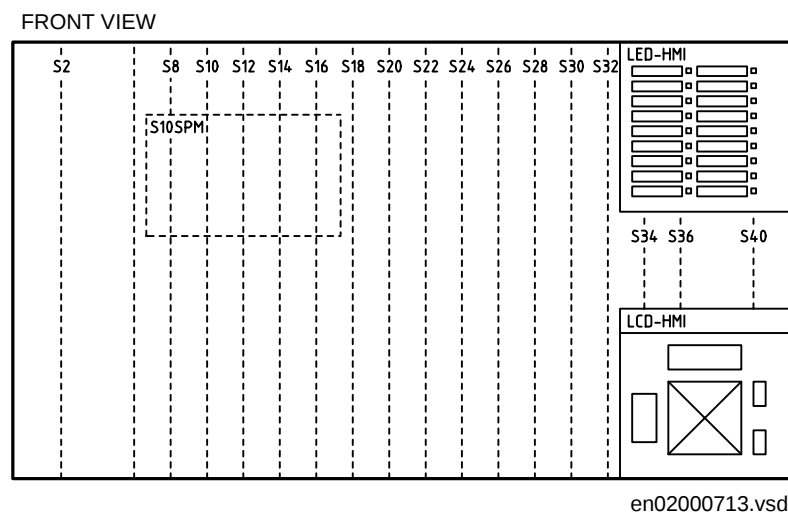
- (1) TRM and ADM
- (2) BIM, BOM, IOM and/or MIM
- (3) BIM, BOM, IOM, MIM or DCM

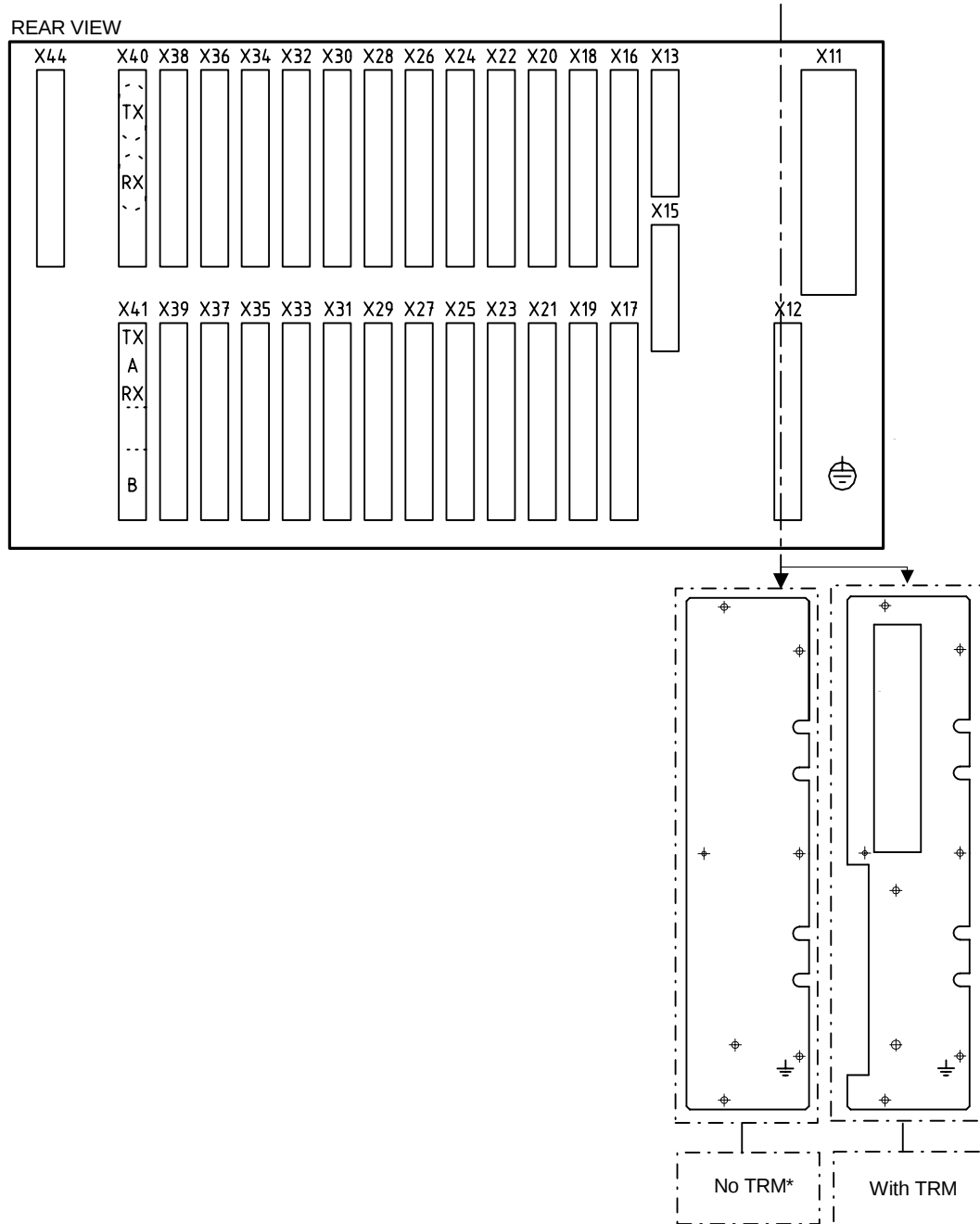
2.3

1/1 of 19" case

The quantity and designation of connectors depends on the type and size of the terminal.
The rear cover-plates have space for the maximum number of HW options for each case size and a factory installed cover plate on unused cutouts.

Designation of modules and connectors on 19" full size (1/1) case





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* TRM = Transformer module

Table 21: Designation corresponding to casing 1/1 of 19" case

Module	Front	Rear
Transformer Module (1) TRM	S2	X11, X12
Analog/Digital conversion Module, (1) ADM	S8	-
Main Processing Module, MPM	S10	X13, X15
(2)	S12	X16, X17
(2)	S14	X18, X19
(2)	S16	X20, X21
(2)	S18	X22, X23
(2)	S20	X24, X25
(2)	S22	X26, X27
(2)	S24	X28, X29
(2)	S26	X30, X31
(2)	S28	X32, X33
(2)	S30	X34, X35
(2)	S32	X36, X37
(2)	S34	X38, X39
(3)	S36	X40, X41
Power Supply Module, PSM	S40	X44

Options

- (1) TRM and ADM
- (2) BIM, BOM, IOM and/or MIM
- (3) BIM, BOM, IOM, MIM or DCM

2.4

Modules

Table 22: Basic modules, always included

Module	Description
Backplane module	Carries all internal signals between modules in a terminal. The size of the module depends on the size of the case. 1/1x19": 13 slots available for I/O. 3/4x19": 8 slots available for I/O. 1/2x19": 3 slots available for I/O.
Power supply module (PSM)	Including a regulated DC/DC converter that supplies auxiliary voltage to all static circuits. - For case size 1/2x19" and 3/4x19" a version with four binary inputs and five binary outputs is used. One of the five outputs is reserved for the internal fail alarm. - For case size 1/1x19" a version without binary I/O:s and increased output power is used. An internal failure alarm output is available.
Main processing module (MPM)	Module for overall application control. All information is processed or passed through this module, such as configuration, settings and communication.
Human machine interface (LCD-HMI)	The module consists of LED:s, a LCD, push buttons and an optical connector for a front connected PC

Table 23: Application specific modules

Module	Description
Milliampere input module (MIM)	Analog input module with 6 independent, galvanically separated channels.
Binary input module (BIM)	Module with 16 optically isolated binary inputs
Binary output module (BOM)	Module with 24 single outputs or 12 double-pole command outputs including supervision function
Binary I/O module (IOM)	Module with 8 optically isolated binary inputs, 10 outputs and 2 fast signalling outputs.

Module	Description
Data communication modules (DCMs)	Modules used for digital communication to remote terminal.
Transformer input module (TRM)	Used for galvanic separation of voltage and/or current process signals and the internal circuitry.
A/D conversion module (ADM)	Used for analog to digital conversion of analog process signals galvanically separated by the TRM.
Serial communication modules (SCM)	Used for SPA/LON/IEC communication
LED module (LED-HMI)	Module with 18 user configurable LEDs for indication purposes

3

Location of the connectors on rear side of RET 521

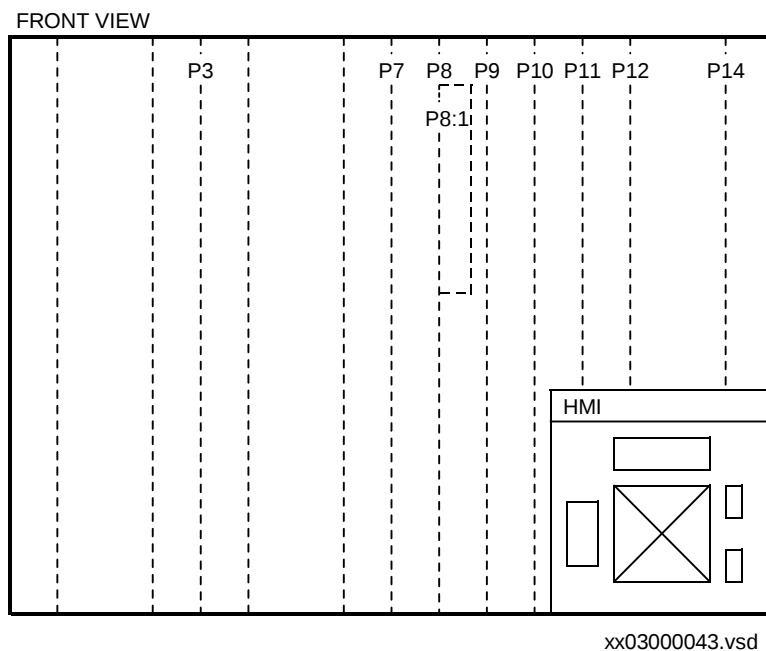


Table 24: Designation corresponding to 1/1 of 19" casing

Module	Location	Rear
Analog input module 1, AIM1	P3	X31
Analog input module 2, AIM2	P7	X71
Numerical module	P8	X81 - X84
Optical communication module	P8:1	
(1)	P9	X91, X92
(1)	P10	X101, X102
(1)	P11	X111, X112
(2)	P12	X121, X122
Power supply module	P14	X141

Options

- (1) BIM, BOM, IOM
- (2) BIM, BOM, IOM, MIM

3.1

Modules

Table 25: Basic modules, always included

Module	Description
Backplane module	Carries all internal signals between modules in a terminal.
Numerical module (NUM)	Fits into the specific system slot in the backplane. The module may carry a mezzanine card, according to the PMC standard.
Power supply module (PSM)	DC/DC converter that supports the electronics. Supervision of all voltages is implemented. The module includes one relay output for the "internal failure" signal.
Human machine interface (LCD-HMI)	The module consists of LEDs, a LCD, push buttons and an optical connector for a front connected PC

Table 26: Application specific modules

Module	Description
Analog input module (AIM)	Used for analog to digital conversion of analog processing signals galvanically separated from the internal circuits.
Serial channel and LON channel module (SLM)	Used for analog to digital conversion of analog processing signals galvanically separated from the internal circuits
Binary input module (BIM)	Module with 16 optically isolated binary inputs
Binary output module (BOM)	Module with 24 single outputs or 12 double-pole command outputs including supervision function
Input and output module (IOM)	Module with 8 optically isolated binary inputs, 10 outputs and 2 fast signalling outputs
Milliampere input module (MIM)	Analog input module with 6 independent, galvanically separated channels

4 **Location of the connectors on rear side for
RED 521**

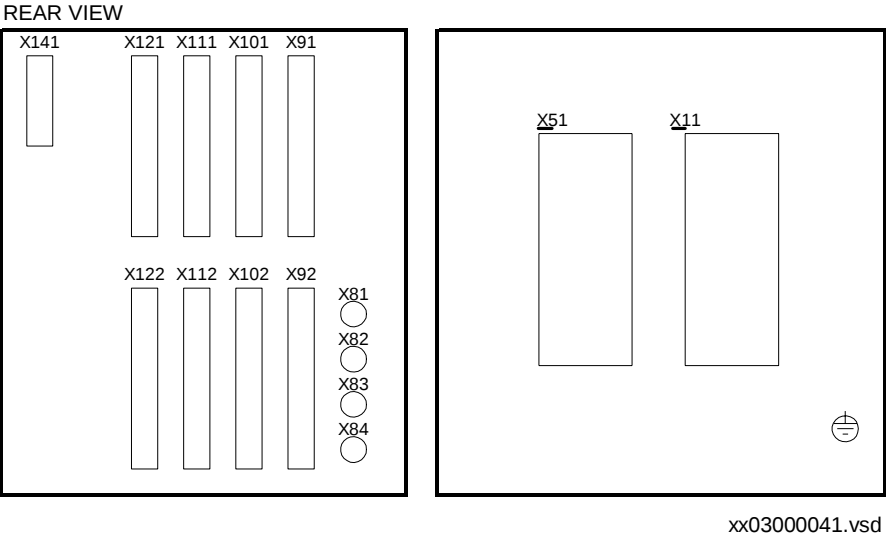
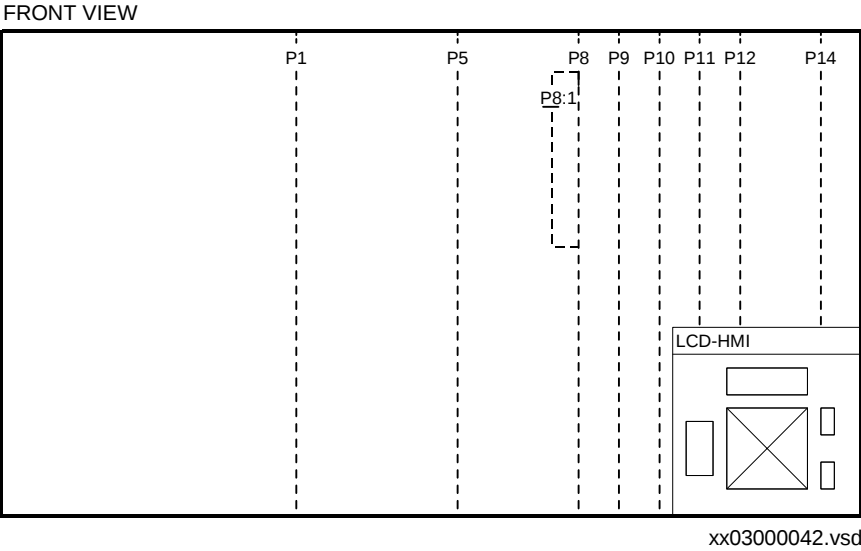


Table 27: Connectors and associated printed board assemblies for three-phase RED terminal

Module	Location	Rear
Analog input module 1 (CT1 to CT3)	P1	X11
Analog input module 2 (CT4 to CT6)*	P5	X51
Optical communication module	P8	X81-X84
Binary input module (general inputs and zone selection inputs for CT1 to CT6)	P9	X91/X92
Empty (not used)	P10	X101/X102
Empty (not used)	P11	X111/X112
Binary output module (trip outputs, open CT outputs etc.)	P12	X121/X122
DC/DC converter module	P14	X141

*) only available for 6-bay version

Table 28: Connectors and associated printed board assemblies for one-phase RED 521 terminal

Module	Location	Rear
Analog input module 1(CT1 to CT9)	P1	X11
Analog input module 2 (CT10 to CT18)*	P5	X51
Optical communication module	P8	X81-X84
Binary input module (general inputs and zone selection inputs for CT1 and CT2)	P9	X91/X92
Binary input module (zone selection inputs for CT3 to CT10)	P10	X101/X102
Binary input module * (zone selection inputs for CT11 to CT18)	P11	X111/X112
Binary output module (ZA and ZB trip outputs, open CT outputs etc.)	P12	X121/X122
DC/DC converter module	P14	X141

* only available for 18-bay version

4.1

Modules

Table 29: Basic modules, always included

Module	Description
Backplane module	Carries all internal signals between modules in a terminal.
Analog input module (AIM)	Used for analog to digital conversion of analog processing signals galvanically separated from the internal circuits.
Numerical module (NUM)	Fits into the specific system slot in the backplane. The module may carry a mezzanine card, according to the PMC standard.
Power supply module (PSM)	DC/DC converter that support the electronics. The module can provide up to 50W. Supervision of all voltages is implemented. The module includes one relay output for the "internal failure" signal.
Human machine interface (LCD-HMI)	The module consists of LEDs, an LCD, push buttons and an optical connector for a front connected PC.

Table 30: Application specific modules

Module	Description
Analog input module (AIM)	Used for analog to digital conversion of analog processing signals, galvanically separated from the internal circuits.
Serial channel and LON channel module (SLM)	Used for analog to digital conversion of analog processing signals, galvanically separated from the internal circuits.
Binary input module (BIM)	Module with 16 optically isolated binary inputs
Binary output module (BOM)	Module with 24 single outputs or 12 double-pole command outputs including supervision function.

Chapter 5 Electrical connections

About this chapter

This chapter describes the electrical connections

1 Making the electrical connections

1.1 Connection to protective earth

When, for example, a terminal is mounted in a cubicle, it shall be connected to protective earth with a green/yellow conductor with a cross section area of at least 2.5 mm^2 (AWG 12). The connection shall be made from the terminals earthing screw (on the rear side) to the cubicles frame with a conductor $<10 \text{ cm}$ long or as short as possible, see figure 28.

The cubicle frame must be connected to a copper earthed bar or equivalent, with a conductor that must have cross section of at least 4 mm^2 and as short as possible. The copper bar should preferably run along a row of cubicles.

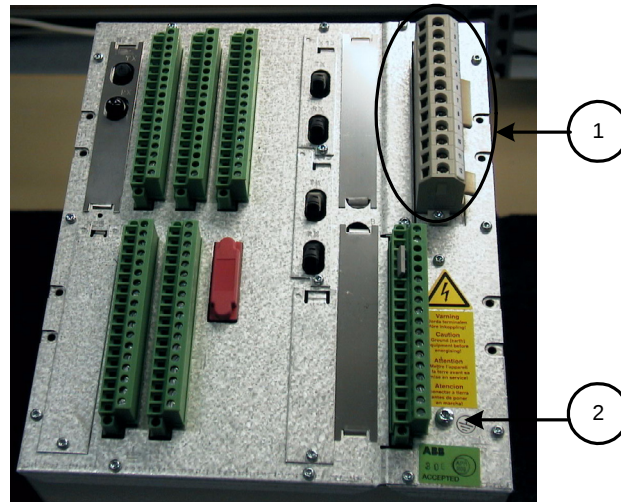
1.2 Make the electrical connections

The wiring from the cubicle terminals to the 500 relay terminal, must be made in accordance with the established guidelines for this type of equipment (see Installation guide 1MRK 500 005-MEN, chapter 3, “wiring of relay assemblies). The wires from binary inputs and outputs and the auxiliary supply must be routed separately from the current transformer cables between the cubicle terminals and the relay terminal.

1.3 Connection of the CT circuits, X11

CT's are to be connected to the 12-pole Weidmuller type DFK 6/12 connector known as “feed-through” terminal blocks for conductors with cross section areas:

- Use a solid conductor between $2.5 - 6.0 \text{ mm}^2$ (AWG 14-10)
- Use a stranded conductor between $2.5 - 4.0 \text{ mm}^2$ (AWG 14-12)



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Figure 28: 12-pole connector and the earthing screw.

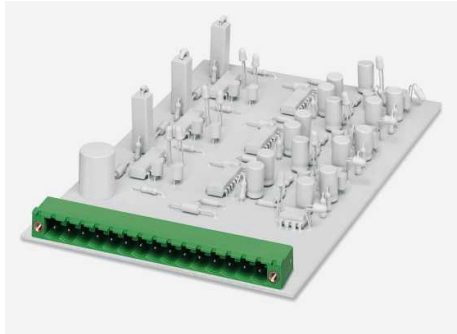
Number	Description
1	Weidmuller 12-pole connector, DFK 6/12
2	Earthing screw

1.4

Connectors for voltage-, binary input- and output signals

The connectors are of Phoenix COMBICON type.

The 18-pole male connectors are soldered to the module circuit boards, [see figure 29](#).



xx02000741.vsd

Figure 29: 18-pole male, Phoenix 17 76 66 3.

The 18-pole female connectors are included in the delivery. The removable plug-in connectors are a screw joint type and designed to be connected with flexible or rigid wire with cross section area from 0.5 to max 2.5 mm² (AWG 24 - 12). The wiring to the female connector should be made before plugging into the male connector, [see figure 30](#).



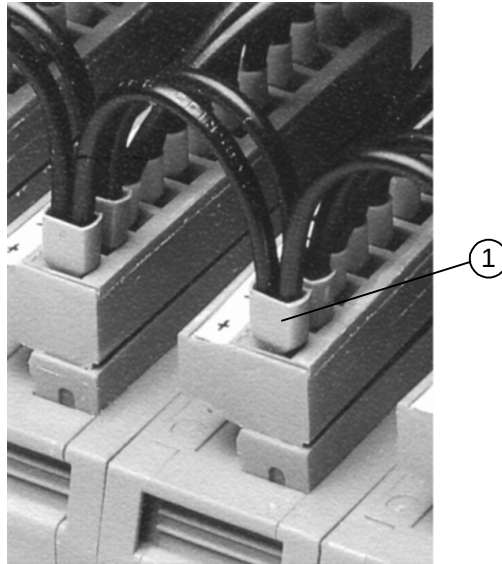
xx02000742.vsd

Figure 30: 18-pole female, Phoenix 18 42 67 8.

Table 31: Ordering a 18-pole female

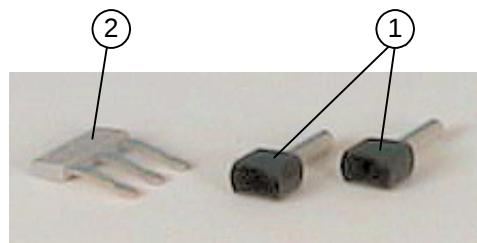
Ordering number	Description
1MKC 860 001-2	ABB Part number for Phoenix 18-pole female

If two conductors of cross section 1.5 mm are connected to the same terminal additional ferrules must be used. We recommend use of Phoenix ferrules AL-Twin2, 1.5-8 BK. Bridge connectors are used for jump terminal points in a femal connector. We recommend use of the Phoenix crimping tool ZA3, for crimping.



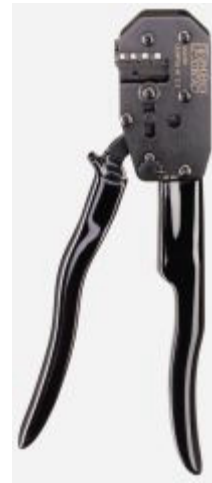
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Figure 31: (1) Phoenix ferrules AL-Twin2, 1.5-8 BK, 32 00 82 3.



xx0100051.vsd

Figure 32: (1) Phoenix ferrules AL-Twin2, 1.5-8 BK, 32 00 82 3. (2) Bridge connectors.



xx02000744.vsd

Figure 33: Phoenix crimping tool
12 06 36 6

Table 32: Ordering ferrules

Number	Ordering number	Description
1	1MKC 840 003-4	ABB part number for Phoenix ferrules

Table 33: Ordering bridge connectors

Number	Ordering number	Description
2	1MKC 840 002-1	2 terminals, 8 mm division
2	1MKC 840 002-4	3 terminals, 5.8 mm division
2	1MKC 840 002-3	4 terminals, 8 mm division

1.5

Identification of the labels on the relays and relay assemblies



Connection point for protective earth



Indicates that a wrist ESD-bracelet shall be used when touching the terminal and when modules are to be exchanged or inserted



Informes that the equipment must be connected to protective earth before being energized



Warning label placed on all apparatuses/products, which are used on voltages exceeding 50V ac/75V dc and where the degree of protection against ingress is lower than IP 20



Caution label. This part of the manual should be carefully read

Chapter 6 Installation of the optical cables in terminals and cubicles

About this chapter

This chapter describes the installation of the optical cables in terminals and cubicle and how to configure modems and transceivers.

1

Installing the optical fibres

Connectors are generally color coded; connect blue or dark grey cable connectors to blue or dark grey (receive) back-side connectors. Connect black or grey cable connectors to black or grey (transmit) back-side connectors.

**Caution!**

The fibre optical cables are very sensitive to handling. Do not bend too sharply. The minimum curvature radius is 15 cm for the plastic fibre cables and 25 cm for the glass fibre cables. If cable straps are used to fix the cables, apply with loose fit.

Always hold the connector, never the cable, when connecting or disconnecting optical fibres. Do not twist, pull or bend the fibre. Invisible damage may increase fibre attenuation thus making communication impossible.

**Note!**

Please, strictly follow the instructions from the manufacturer for each type of optical cables/connectors.

2 Configuring the 56/64 kbit data communication modules

2.1 Configuring the fibre optical modem

Two different levels of optical output power can be set on the HMI under:

Configuration/TerminalCom/RemTermCom/OptoPower

For the optical module, the optical output power has to be set according to the attenuation of the fibre optic link.

For multimode fibres:

- If the attenuation is less than 6 dB, use Low power setting
- If the attenuation is higher than 10 dB, use High power setting
- If the attenuation is between 6 and 10 dB, use either High or Low power setting

For single-mode fibres:

- If the attenuation is higher than 5 dB, use High power setting
- If the attenuation is between 0 and 5 dB, use either High or Low power setting

For optimal operation, the optical communication modules in both terminals must be synchronized. To achieve this, one terminal acts as a Master and the other as a Slave. This is set under:

Configuration/TerminalCom/RemTermCom/CommSync



Note!

This is an additional setting and should not be mixed up with the Master-Slave setting for the differential protection function.

When communicating with FOX 515 Plus, the setting should be Master for version 2.0 and higher. Slave for version 1.1 and 1.2.

When operating back-to-back over dedicated fibres the setting shall be Master on one terminal and Slave on the other.

2.1.1

Calculation of optical power budget

Refer to [table 34](#) and [table 35](#) for maximum distance in a back-to-back application

Table 34: Input data for calculation of optical power budget

	General data	Attenuation
Type of optical Tx/Rx-module	0	
Bit rate	64 kbit/s	
Transmission code	MCMI	
Optical fibre	Single mode	
Optical connector	FC-PC	
Optical wavelength	1300 nm	
Spectral bandwidth	30.0 nm	
Transmitter Tx	LED	
Optical min output power (S)		-22 dBm
Receiver Rx	Pin Diode	
Sensitivity for BER 0 10 ¹⁰ (R)		-38 dBm
Available power budget		-16 dB

Table 35: Examples of optical power budget calculation

Terminal equipment		Example 1	Example 2
Available power budget (S_R)		16 dB	16 dB
Equipment margin		Included	Included
Type of optical connectors	FC-PC for single mode		
Terminal box			
Patch panel connectors	FC-PC for single mode	0	0
Connectors for S-R	0.5 dB each	Included	Included
Total available optical power		16 dB	16 dB
Optical cable			
Type of optical fibre	Single mode 1300 nm		
Fibre attenuation (installed)		0.22 dB/km	0.34 dB/km
Splice attenuation	0.08 dB per splice		

Terminal equipment		Example 1	Example 2
Av. cable length between splices	3.0 km		
Average number of splices	0.33 splice/km	0.027 dB/km	0.027 dB/km
Number of repair splices	0.10 splice/km	0.008 dB/km	0.008 dB/km
Fibre margin		0.010 dB/km	0.010dB/km
Total fibre attenuation per km		0.265 dB/km	0.385 dB/km
Maximum optical transmission distance		60 km	41 km

2.2

Configuring the short range fibre optical modem

No setting is available for the short range fibre optical modem on the HMI. There are however some settings that can be made on a DIP-switch located behind the cover around the fibre optic connectors at the back of the terminal according to [figure 34](#). After the fibres have been disconnected, if attached, the cover plate can be removed by pulling the middle of the cover plate.



Note!

If handled carefully the cover plate can be removed with the fibres attached.

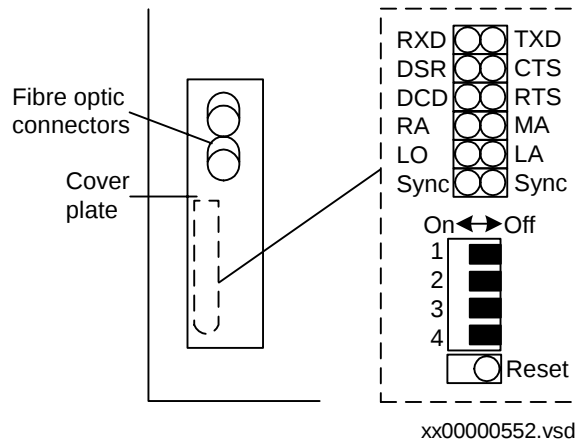


Figure 34: Setting and indications for the short range optical modem

Switch 3 and 4 are used to set the source of timing. The function is according to the setting of timing signal, [table 36](#). When using the modem for optical point-to-point transmission, one modem should be set for locally created timing and the other for timing recovered from the received signal. When the modems are communicating with a transceiver 21-15X or 16X the modems shall be set for timing recovered from received optical signal, see setting of timing signal.



Note!

After any change of settings, the modem has to be reset by the Reset button located below the DIP-switch.

Table 36: Setting of the timing signal

Switch no.		Function
3	4	
OFF	OFF	Timing created by the modem
OFF	ON	Timing recovered from received optical signal
ON	OFF	Timing created by the MPM module
ON	ON	No timing, the data transmission will not work

There are also some jumpers on the circuit board that have to be correctly set. One, S4 according to [figure 36](#), is for changing the functionality between article number 1MRK 001 370-BA delivered with version 1.1, 1.2 and 2.0.(marked 1MRK001471-BA) and 1MRK 001 370-DA delivered with version 2.3 and higher (marked 1MRK001471-DA). The difference between these two is that the transmitted and received signals are inverted in relation to one another.

When a terminal of version 1.1, 1.2 or 2.0 is to communicate with a terminal of version 2.3 or higher it is necessary that the jumper is changed to 1 MRK 001 370-BA in the version 2.3 terminal. This is because older versions of this module lack the capacity to set article number, they are set in 1 MRK 001 370-BA. If both terminals however include modules with capacity to change article number it actually doesn't matter which article number is used as long as the same number is used in both terminals.

The other jumper is S3 and must be in the position indicated in [figure 36](#). If it is in the top position the communication will not work. (In top position the transmit clock is supposed to be created in the CPU on the MPM module which is not possible). On JTAG/ISP there shall be no jumpers inserted.



Note!

When using the set up in [figure 35](#) only at one end and for example a direct G.703 connection at the other end a short range fibre optical modem according to 1MRK 001 370-DA must be used.

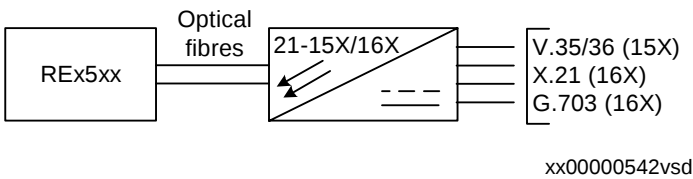
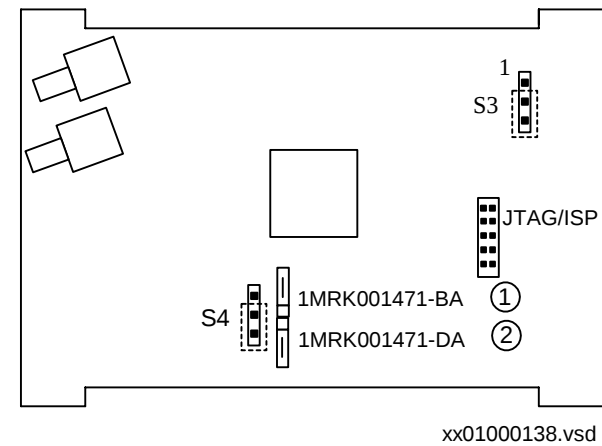


Figure 35: Multiplexed link, short range fibre optical connection



1	Delivered with version 1.1, 1.2 and 2.0
2	Delivered with version 2.3 or higher

Figure 36: Jumper location on short range optical modem

The jumpers are accessible after the modem has been pulled out. This is done by first removing all green 18-pin connectors at the back, then remove all screws holding the back plate. After the back plate has been removed the modem can be pulled out.



Note!

Pull out the modem only and not the whole double size Euro-card. After the jumper settings have been changed put everything back in reverse order.



Note!

All electronics are sensitive to electrostatic discharge. Proper action must be taken at the work place to avoid electrostatic discharge! Disconnect DC.

There are LEDs for supervision of the communication channel that can be seen when the cover around the fibre optic connectors is removed. These LED's are found above the DIP-switches. The function of the LED's is explained in table [37](#).

Table 37: Indications

LED	Color	Explanation
RTS	Yellow	Request to send
CTS	Yellow	Clear to send
DSR	Yellow	Data communication correct
DCD	Yellow	Detection of carrier signal
TXD	Yellow	Transmitted data
RXD	Yellow	Received data
RA	Red	Remotely detected problem with link
MA	Red	Memory function for problem with link
LO	Green	Link operation correctly
LA	Red	Locally detected problem with link
Sync	Green	Used when synchronization is selected

2.3

Configuring the short range galvanic modem

No setting is available for the short range galvanic modem on the HMI. There are however some settings that can be made on the DIP-switch located behind the cover around the line connector at the back of the terminal as shown in [figure 37](#). After the connector has been disconnected, if attached, the cover plate can be removed by pulling the middle of the cover plate. No settings are located on the circuit board.

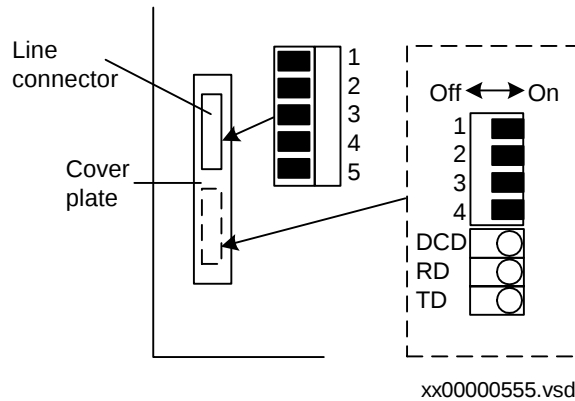


Figure 37: Setting and indications for short range galvanic modem

Only switch 1 and 2 are used on the DIP-switch. The function is dependant on the setting of the timing signal, see [table 38](#). In normal operation switch 1 is set in ON position at one end of the communication channel and switch 2 is set ON at the other end. The rest of the switches are set to OFF.

Table 38: Setting of timing signal

Switch no.		Function
1	2	
OFF	OFF	Unpredictable, normally locally created timing
OFF	ON	Timing recovered from received signal
ON	OFF	Locally created timing
ON	ON	Timing recovered from received signal

There are also LEDs for the supervision of the communication channel that can be seen when the cover around the fibre optic connectors is removed. These LED's are found below the DIP-switch. The function of the LED's is explained in [table 39](#).

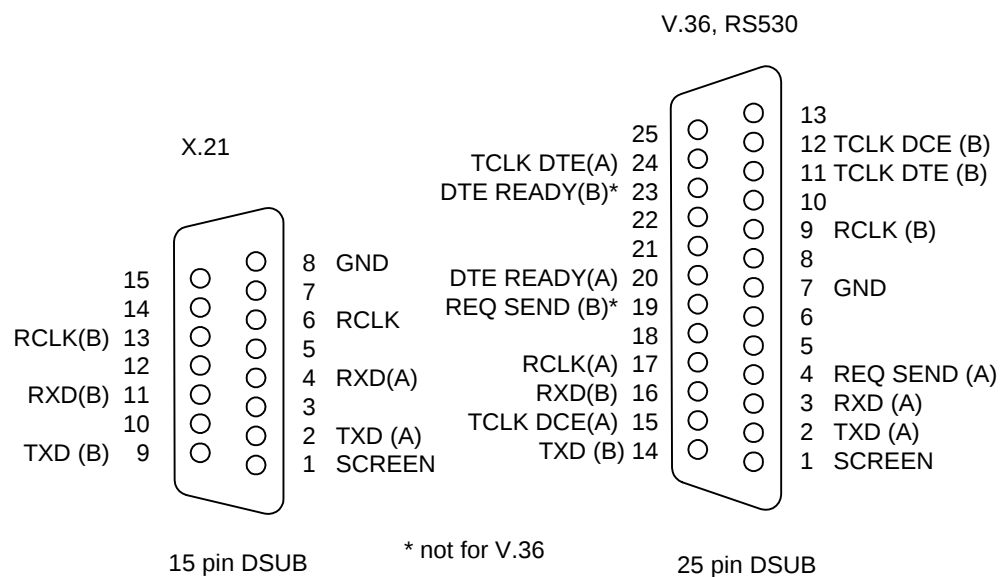
Table 39: Indications

LED	Explanation
DCD	Detection of carrier signal
TD	Transmitted data
RD	Received data

2.4

Configure the interface modules for V.36, X.21 and RS530

The connector for X.21 is a 15 pin DSUB according to the X.21 standard. For RS530 the connector is a 25 pin DSUB according to the RS530 standard. The same 25 pin DSUB is also used for the V.36 connection contrary to the 37 pin DSUB listed in the standard. The pin lay-out is shown in [figure 38](#) and pin designations are explained in [table 38](#).



xx00000544.vsd

Figure 38: DSUB connectors

Table 40: DSUB connector explanation

Designation	Explanation
A	Designations of terminals according to ITU (CCITT), EIA etc.
B	Designations of terminals according to ITU (CCITT), EIA etc.
DCE	Data communication equipment (= multiplexer, etc.)
DTE	Data terminal equipment (= protection)
DTE READY	Data terminal ready (follows auxiliary voltage)
GND	Earth (reference for signals)
RCLK	Receiver signal timing
REQ SEND	Request to send (follows auxiliary voltage)
RXD	Received data
SCREEN	Connection of cable screen
TCLK DCE	Transmitter signal timing from DCE
TCLK DTE	Transmitter signal timing from DTE
TXD	Transmitter data

For the co-directional operation the transmission rate of the transmitted signal must be set. This setting, 56 or 64 kbit/s, is done on the HMI under:

Configuration/TerminalCom/RemTermCom/BitRate

For X.21 and contra-directional operation no settings are available.

For the signals used by the protection, the communication module for V.36 also fulfils the older recommendation for V.35.

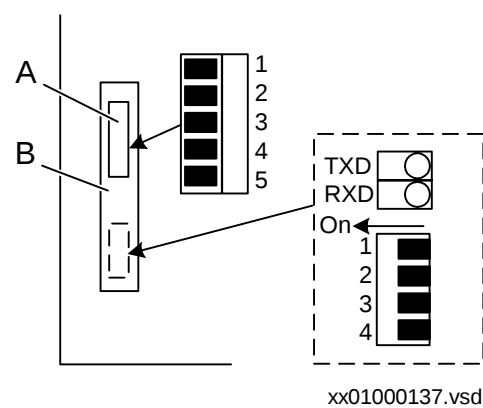
2.5

Configuring the interface modules for G.703 co-directional

No setting is available for the G.703 modem on the HMI. There are however some settings that can be made on a DIP-switch located behind the cover around the line connector at the back of the terminal according to [figure 39](#). After the connector has been disconnected, if attached, the cover plate can be removed just by pulling at the middle of the cover plate. No settings are located on the circuit board.

Only switch 1 is used on the DIP-switch. In the ON position, transmission timing is generated internally in the modem. In the OFF position, transmission timing is generated by the received G.703 signal. Normally the OFF position shall be used when the terminal is connected to a multiplexer or other communication equipment. If used in back to back operation switch 1 is set in ON position at one end and in OFF position at the other end. The rest of the switches shall be set to OFF.

There are also LEDs for supervision of the communication channel that can be seen when the cover around the fibre optic connectors is removed. These LED's are located below the DIP-switch. The function of the LED's is explained in [table 41](#).



A	Line connector
B	Cover plate

Figure 39: G.703 modem, indications and settings

Table 41: Indications

LED	Explanation
TD	Transmitted data
RD	Received data

2.6

Fault tracing

Procedure

1. Check that the settings are correct.

2. Check that the optical budget is correct.
3. COMFAIL occurs for the following reasons:

The COMFAIL signal will be triggered when there is a problem in the communication link between the two terminals, depending on type of 56/64 modem. Also, normal actions such as a change of setting, switch off of remote terminal during maintenance etc., can cause COMFAIL.

Comfail function

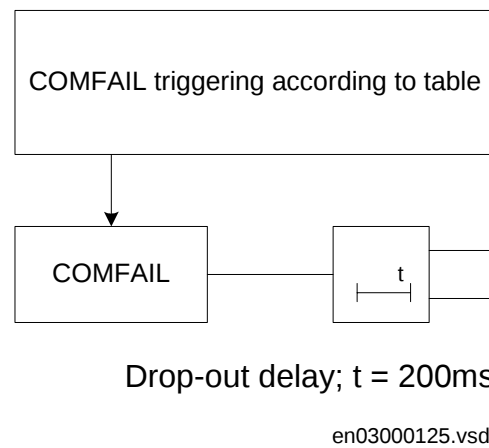


Figure 40: Comfail triggering.

The 200 ms alarm dropout delay is, for example, required as hysteresis for terminals with reserve overcurrent, REL 551 or distance reserve function REL 561, if the differential function is blocked by communication delays and interruptions etc.

The communication failure signal, COMFAIL, depends on the following internal signals (variables) in each terminal for REx 5xx. [Table 42](#) shows a summary with additional explanations below.

Table 42: Summary

No.	COMFAIL triggering	COMFAIL triggering time (Drop-out delay 200 ms)	Remark
1	Transmit error	≥ 50 ms	Messages can not be sent
2	Receive error	≥ 100 ms	No valid messages received
3	Block differential protection	0 ms	Block of the differential protection due to setting changes etc.
4	Remote terminal COMFAIL	0 ms	COMFAIL from the remote terminal. For error no 1, 2, 3, and no 5, 6, 7, 8, 9, 10 the COMFAIL is sent in the second consecutive message (within 10 ms)
5	Time synchronization error	≥ 2 s	Problems in the synchronization of internal differential clock in the differential protection. The clock refers to the synchronized counters 0-39999 μ s in each terminal. The clock is independent of the real time clock in the terminal.
6	Differential clock drift	> 0 ms	Unacceptable drift of the internal differential clock in the slave terminal compared to the internal differential clock in the master terminal (slave- master - slave)
7	Communication channel loop delay - instantaneous	0 ms	Checks if the loop time (slave - master - slave) in the differential communication channel 31 ms
8	Communication channel loop delay - time delayed	≥ 2 s	Checks if the loop time (local - remote-local) in the differential communication channel 24 ms
9	Abnormal clock deviation	0 ms	Internal differential clock deviation (slave- master - slave)
10	Data flow Only in version *2.3	0 ms	Long time between attempts to send messages and adjustment of the real time terminal clock . The terminal clock is the real time clock in the terminal for time tagging of events etc.

Explanation of contents in column 2 of table 42

1. Transmit errors are due to that the terminal cannot send messages via the telecommunication channel (PCM). The line differential function initiates the sending of one message every 5 ms. If this command can not be executed for 10 consecutive times ($= 10 \times 5 \text{ ms}$) due to blocked, missing or unsynchronized communication channel, COMFAIL is triggered. For non-consecutive interruptions, an integration algorithm is used that prolongs the COMFAIL triggering time.
2. Receive errors occur when no expected messages are received. The line differential function expects to receive one message every 5 ms. If this does not occur 10 consecutive times ($= 10 \times 5 \text{ ms}$), COMFAIL is triggered. For non-consecutive interruptions, an integration algorithm is used that prolongs the COMFAIL triggering time.
3. Block differential protection. Block of differential protection occurs during change of settings or setting group.
4. Remote terminal COMFAIL. For error No 1, 2, 3 and No 5, 6, 7, 8, 9, 10 the COMFAIL is sent in the second consecutive message (within 10 ms). Thus, some short interruptions can be recorded only in one terminal. The communication channel must be in operation to be able to receive this signal.
5. Time synchronization error refers to synchronization check and is only performed by the terminal set as Slave for the internal differential clocks synchronization. If 50 time synchronization messages (included with every 8 line differential function message) are not correctly received ($= 8 \times 5 \text{ ms} \times 50 = 2000 \text{ ms}$), COMFAIL will be triggered. If more than 750 synchronization messages are not correctly received, a re-synchronization of the internal differential clock will be made. For non-consecutive interruptions, an integration algorithm prolongs the COMFAIL triggering time.
6. Differential Clock drift refers to a difference $> 50 \text{ ms}$ between the internal differential clocks in the differential protection in the terminal set as Slave and the one set as Master for synchronization of the internal differential clock. The COMFAIL triggering time depends on a number of factors from a drift compensation algorithm. This check is normally not activated unless the communication channel has been lost for a long time.
7. Communication channel loop delay-instantaneous is checked every 40 ms (at each synchronization message). If the communication channel loop (Slave-Master-Slave) delay is more than 31ms for one message, COMFAIL is triggered instantaneously. This check is done in the terminal set as Slave for the internal differential clock by a comparison with the real time clock in the terminal at sending and receiving of a looped message.
8. Communication channel loop delay-time delayed checks if the communication channel delay for transmitted and received signal is $> 24 \text{ ms}$ (Local-Remote-Local). The check is performed every 40 ms (at each synchronization message) by comparing the real time clock time at sending and receiving of a looped message. COMFAIL is triggered after 50 consecutive messages with excessive loop time.

COMFAIL triggering time = 2000 ms (= 50x40 ms). For non-consecutive messages with excessive loop time, an integration algorithm is used that prolongs the COMFAIL triggering.

9. Abnormal clock deviation checks if the synchronization in the Slave of the internal differential clocks in the differential protection have an abnormal deviation, (Slave-Master-Slave). COMFAIL is triggered instantaneously, but will probably only occur after long interruptions in the communication channel. However, the start or re synchronization procedure can also activate COMFAIL due to this function.
10. Data flow checks if the time between initiations of the sending messages from the line differential function is longer than 20 ms, using the real time clock for the check. This check will also trigger the COMFAIL if the external time synchronization of the real time clock by minute pulse or SPA/LON from Station Clock or GPS, adjusts the terminal clock forward > 15 ms. The COMFAIL triggering is instantaneous. The channel interruption measurements for short, medium and long interruptions, presented on the HMI are based on measurements of timing from the real time clock which are made independently in each terminal. These measurements are also independent from the internal differential clock. The measurements presented on the front HMI are not connected to COMFAIL or by indications of channel delay exceeding 12 ms, since the delay is not a channel interrupt, the channel is still working.

2.7

Configuring the transceiver 21-15xx

Follow the instructions, for setting of jumpers, given in the document delivered with the transceiver.

Here follow some recommendations on settings and connections when operating together with protection systems from ABB. In the following the transceiver is regarded as a DTE (although it is actually designed as a DCE) and is supposed to be connected to communication equipment that acts as a DCE.

For synchronous communication a DCE always has to output timing signals (TC and RC) and one input timing signal (TTC). For the DTE the opposite is valid. All clocks in a synchronous network have the same timing and provided the phase is set correctly they also have the same phase. This means that only one clock signal has to be used between the transceiver and the communication as shown in the cases below.

2.7.1

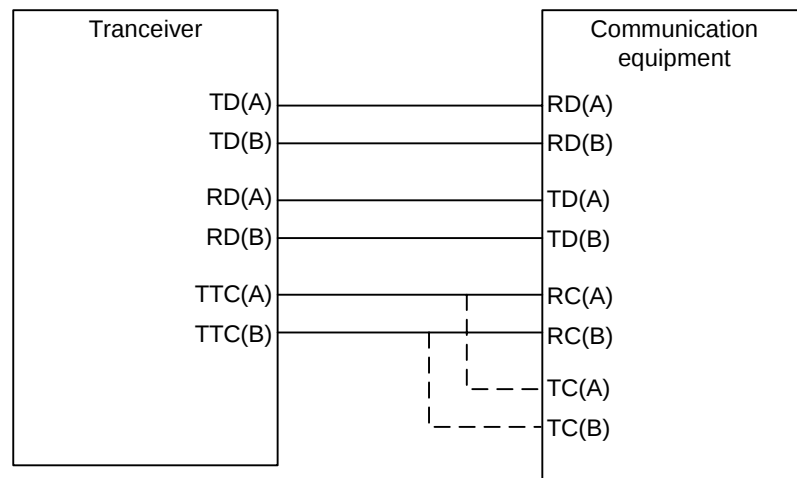
Co-directional operation

The connection is made according to [table 43](#).

Table 43: Connections

Transceiver								
		Pin No.						
		V.35		V.36		Comm. eq.		
Signal	No	A	B	A	B	Signal	No	Direction
TD	103	P	S	4	22	RD	104	Comm. eq. -> Transceiver
RD	104	R	T	6	24	TD	103	Transceiver -> Comm. eq.
TTC	113	U	W	17	35	RC	115	Comm. eq. -> Transceiver

Figure 41 shows the connection. If needed for proper operation of the communication equipment a connection can be made between the RC and TC. Both TD and RD are controlled from TTC.



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Figure 41: Connection between transceiver and communication equipment

The transceiver is set according to table 44.

Table 44: Settings

Switch, jumper	Setting	Gives
S1	Middle position	V.35
S1	Bottom position	V.36
S2	9	64 kbit/s
S3	Middle position	External clock
S4	Has no influence on operation	---

2.7.2

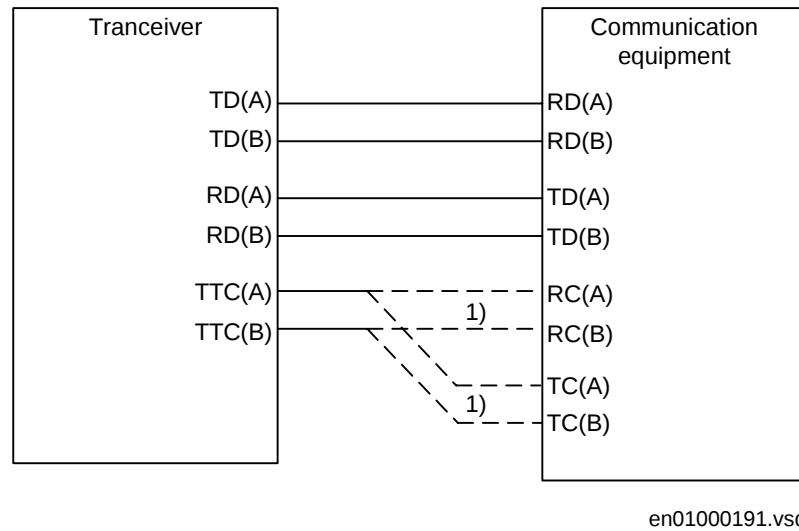
Contra-directional operation

Connected according to [table 45](#).

Table 45: Connections

Transceiver								
		Pin No.						
		V.35		V.36		Comm. eq.		
Signal	No	A	B	A	B	Signal	No	Direction
TD	103	P	S	4	22	RD	104	Comm. eq -> Transceiver
RD	104	R	T	6	24	TD	103	Transceiver -> Comm. eq.
TTC	113	U	W	17	35	¹⁾	¹⁾	Comm. eq. -> Transceiver
¹⁾ Either RC - 115 or TC - 114 can be used.								

[Figure 42](#) shows the connection. In this case the connection to TTC can be made either from RC or TC but not from both. Both TD and RD are controlled from TTC.



where:

1 is the selection between either RC or TC

Figure 42: Connection between transceiver and communication equipment

Setting of transceiver is done according to [table 46](#).

Table 46: Settings

Switch, jumper	Setting	Gives
S1	Middle position	V.35
S1	Bottom position	V.36
S2	9	64 kbit/s
S3	Middle position	External clock
S4	Has no influence on operation	---

2.8

Configuring the transceiver 21-16xx

For setting jumpers, follow the instructions in the document delivered with the transceiver.

Here follow some recommendations on settings and connections when using protection systems from ABB. In the following, the transceiver is regarded as a DTE and is supposed to be connected to communication equipment that acts as a DCE.

2.8.1

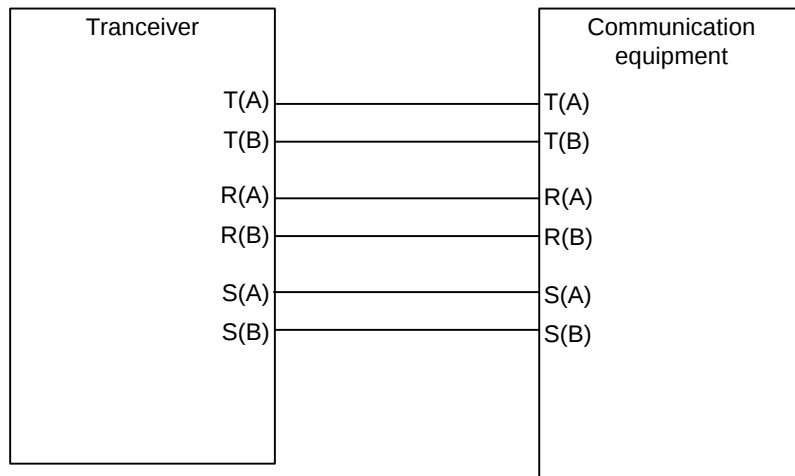
X.21 operation

The connection is made according to [table 47](#).

Table 47: Connections

Transceiver			Comm. eq.	
	Pin No.			
Signal	A	B	Signal	Direction
T	2	9	T	Comm. eq -> Transceiver
R	4	11	R	Transceiver -> Comm. eq.
S	6	13	S	Comm. eq. -> Transceiver

[Figure 43](#) shows the connection.



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Figure 43: Connection between transceiver and communication equipment

Set transceiver according to [table 48](#).

Table 48: Settings

Switch, jumper	Setting	Gives
S2, S3, S4, S15, S16	Jumpers downwards	DTE
S6	Second position from bottom	X.21
S11	9	64 kbit/s
S14	Jumper at middle position	External clock
S13	Has no influence on operation	---

2.8.2

G.703 co-directional operation

Connect according to [table 49](#).

Table 49: Connections

Transceiver		Comm. eq.	
Signal	Pin ¹⁾	Signal	Direction
TX	1/2	RX	Comm. eq -> Transceiver
RX	3/4	TX	Transceiver -> Comm. eq.
¹⁾ RJ-45 connector. Numbered from left the connection points will be this number			

If a screen is available in the cable it is connected to Protection Ground (pin 9 on the transceiver) at one or both ends.

[Figure 44](#) shows the connection. Note that the signal directions are according to DCE operation for both transceiver and communication equipment.

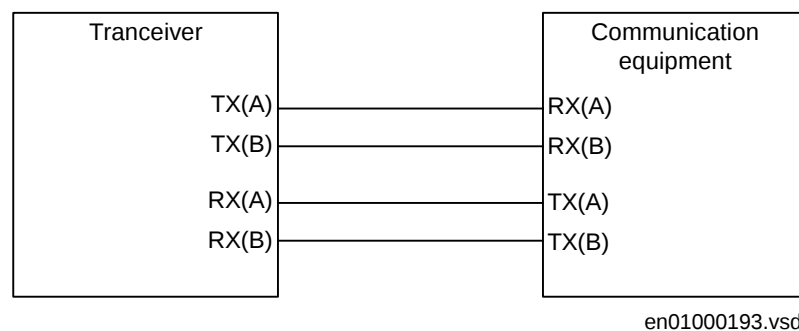


Figure 44: Connection between Transceiver and Communication equipment

Set transceiver according to [table 50](#).

Table 50: Settings

Switch, jumper	Setting
S5	G.703 co - con, balanced Nx64 kbps
S6	Co-directional
S7	Has no influence on operation
S8	Has no influence on operation
S9	Has no influence on operation
S11	9 (64 kbit/s)
S14 timing source	External clock
S14 sync	No jumper
S13	Has no influence on operation

Chapter 7 Making the screen connection

About this chapter

This chapter describes how to connect the screen cables.

1 Screen connections

1.1 Installing

When using screened cable, always make sure that the screens are earthed and connected according to established engineering methods.

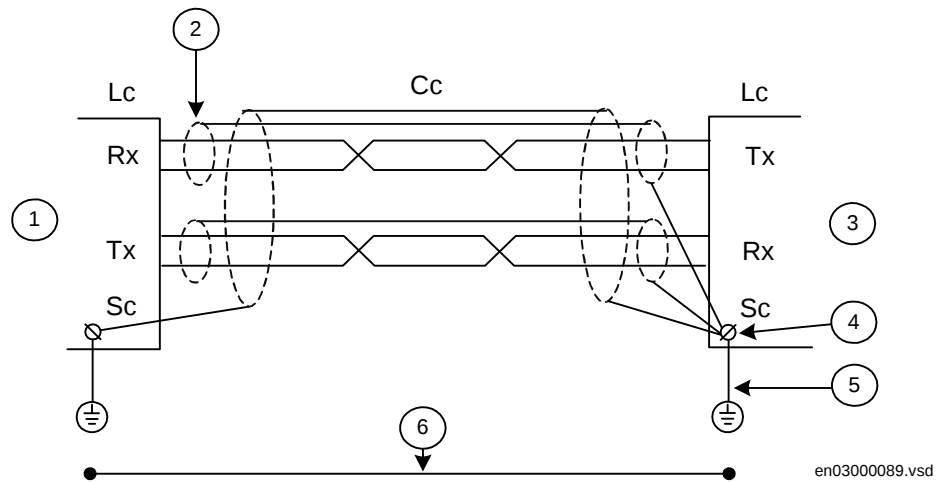


Figure 45: Communication cable installation.

Number	Description
1	Relay terminal
2	Use insulation tape for the inner shield to prevent contact with the protective earth
3	External equipment
4	Protective earth screw
5	Make sure that cases are properly earthed, with as short as possible connection, to e.g. earthed cubicle frame
6	G 703 <10 m between earth points V36 / V11, X21 / X27 <100 m between earth points

Chapter 8 Installation of optical cables

About this chapter

This chapter describes the connection of optical cables.

1

SPA/IEC

The serial communication module for SPA/IEC is placed in a slot at the rear of the main processing module. One of the following connection options is available for serial communication:

- two plastic fibre cables; (Rx, Tx) or
- two glass fibre cables; (Rx, Tx) or
- galvanic RS485

The type of connection is chosen when ordering the terminal.

**Note!**

Pay special attention to the instructions concerning the handling, connection, etc. of the optical fibre cables.

2

LON

The serial communication module for LON is placed in a slot at the rear of the Main processing module. One of the following options is available for serial communication:

- two plastic fibre cables; (Rx, Tx) or
- two glass fibre cables; (Rx, Tx)

The type of connection is chosen when ordering the terminal.

The incoming optical fibre is connected to the Rx receiver input and the outgoing optical fibre to the Tx transmitter output.

**Note!**

Pay special attention to the instructions concerning the handling, connection, etc. of the optical fibre cables.

3

Technical data

Table 51: Optical fibre connection requirements for SPA/IEC

	Glass fibre	Plastic fibre
Cable connector	ST connector	HFBR, Snap-in connector
Fibre diameter	62.5/125 µm 50/125 µm	1 mm
Max. cable length	1000 m	25 m

Table 52: RS485 connection requirements for SPA/IEC

Cable connector	Phoenix, MSTB 2.5/6-ST-5.08 1757051
Cable dimension	SSTP according to EIA Standard RS485
Max. cable length	100 m

Table 53: LON optical fibre connector

Communication	Fibre connection
LON	Plastic, HFBR, snap-in connector
	ST, glass, bayonet

Chapter 9 Data communication modules

About this chapter

This chapter describes the data communication modules.

1

Data communication modules

The remote terminal communication modules can be used either for differential line protection applications or for binary signal transfer of up to 32 signals in both directions between, for example, distance protections. The following hardware modules are available:

- V35/36 contra-directional and co-directional
- X.21
- RS530/422 contra-directional and co-directional
- G.703
- Short-range galvanic module
- Fibre optical communication module
- Short-range fibre optical module

The galvanic data communication modules according to V35/36 DCM-V36 contra, DCM-V36 co, X.21 DCM-X21, RS530/422 DCM-RS 530 contra, DCM-RS 530 co can be used for galvanic short range communication covering distances up to 100 m in low noise environments. Only contra-directional operation is recommended for best system performance. These modules are designed for 64 kbit/s operation but can also be used at 56 kbit/s.

The galvanic data communication module DCM-G.703 according to G.703 is not recommended for distances above 10 m. Special attention must be paid to avoid problems due to noise interference. This module is designed only for 64 kbit/s operation.

The short-range galvanic module DCM-SGM can be used for communication over galvanic pilot wires and can operate over distances of up to 3 km depending on pilot wire cable. Twisted-pair or double-shielded cable is recommended.

The fibre optical communication module DCM-FOM can be used both with multi-mode and single-mode fibres. The communication distance can typically be 40-60 km for single mode fibre and typically 15-20 km for multi-mode fibre, and even further with high quality fibre. This interface can also be used for direct connection with communication equipment of type FOX 512/515 from ABB.

The short-range fibre optical module DCM-SFOM can only be used with multi-mode fibre. The communication distance is normally 3 to 5 km. This module can also be used for direct connection to optical/electrical communication converters of type 21-15xx and 21-16xx from FIBERDATA

1.1

Technical data

Table 54: DCM - Galvanic data communication module

Interface type	According to standard	Connector type
V.36/V11 Co-directional (on request)	ITU (CCITT)	D-sub 25 pins
V.36/V11 Contra-directional	ITU (CCITT)	D-sub 25 pins
X.21/X27	ITU (CCITT)	D-sub 15 pins
RS 530/RS422 Co-directional (on request)	EIA	D-sub 25 pins
RS 530/RS422 Contra-directional	EIA	D-sub 25 pins
G.703 Co-directional	ITU (CCITT)	Screw
Function	Value	
Data transmission	synchronous, full duplex	
Transmission type	56 or 64 kbit/s	
	For G703 only 64 kbit/s	

Table 55: DCM-SGM - Short-range galvanic module

Data transmission	Synchronous, full duplex
Transmission rate	64 kbit/s (256 kBaud; code transparent)
Clock source	Internal or derived from received signal
Range	< 3 km
Line interface	Balanced symmetrical three-state current loop (4 wires)
Connector	5-pin connector with screw connection
Insulation	2,5 kV 1 min. Opto couplers and insulating DC/DC-converter
	15 kV with additional insulating transformer

Table 56: DCM-FOM - Fibre optical communication module

Optical interface		
Type of fibre	Graded-index multimode 50/125µm or 62,5/125µm	Single mode 9/125 µm
Wave length	1300 nm	1300 nm
Optical transmitter injected power	LED -17 dBm	LED -22 dBm
Optical receiver sensitivity	PIN diode -38 dBm	PIN diode -38 dBm
Optical budget	21 dB	16 dB
Transmission distance	typical 15-20 km ^{a)}	typical 40-60 km ^{a)}
Optical connector	Type FC-PC	Type FC-PC
Protocol	ABB specific	ABB specific
Data transmission	Synchronous, full duplex	Synchronous, full duplex
Transmission rate	64 kbit/s	64 kbit/s
Clock source	Internal or derived from received signal	Internal or derived from received signal
^{a)} depending on optical budget calculation, see example in Application manual for REC 561		

Table 57: DCM-SFOM - Short-range fibre optical module

Data transmission	Synchronous, full duplex
Transmission rate	64 kbit/s
Clock source	Internal or derived from received signal
Optical fibre	Graded-index multimode 50/125µm or 62,5/125µm
Wave length	850 nm
Optical connectors	ST
Optical budget	15 dB
Transmission distance	typically 3-5 km ^{a)}
Protocol	FIBERDATA specific
Optical connector	Type ST
^{a)} depending on optical budget calculation, see example in Application manual for REC 561	

Chapter 10 Mounting in cubicles

About this chapter

This chapter describes the mounting of units in cubicles.

1 Requirements

The cubicle’s design shall take into account all the electrical and environmental demands arising from the location of the cubicle.

The cubicle should be designed according to the international standard publication IEC 439-1 and to other IEC publications referring to this standard.

The degree of ingress protection provided by the cubicle should correspond to those in IEC 60 529.

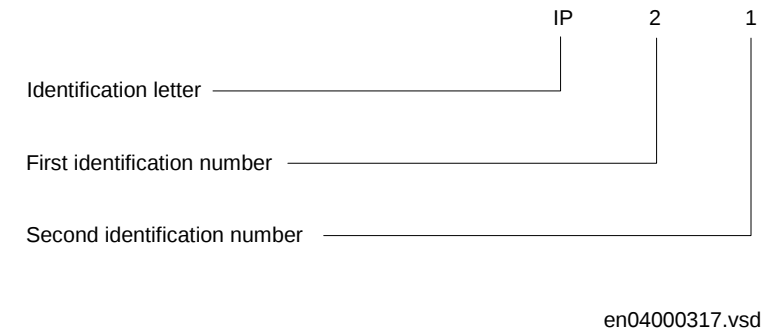
The earthquake protection of the cubicle should follow the standard, IEEE 693 draft 5.

1.1 Degrees of protection

The IEC 60 529 describes standard degrees of protection provided by enclosures (IP code) that a product is designed to provide when properly installed.

Identification examples using the IP code

The explanation of the Alpha-numeric IP code system can be illustrated as shown in figure 46.



- where:
- 2 Protected against ingress of solid objects greater than 12 mm in diameter
 - 1 Protected against ingress of dripping water

Figure 46: Explanation of the Alpha-numeric IP code system

Using the IP code according IEC 60 529, the degrees of protection of the equipment are IP21, IP41, IP43 or IP54. The IP code components are described in [table 58](#).

Table 58: IP code and its meaning for the protection of the equipment

Component	Figures	Description
First identificaion number	2	Protected against ingress of solid objects greater than 12 mm in diameter
	4	Protected against ingress of solid objects greater than 1 mm in diameter
	5	Protected against dust
Second identification number	1	Protected against ingress of dripping water
	3	Protected against ingress of spraying water
	4	Protected against ingress of splashing water

1.2

Environmental aspects

The cubicle can be equipped with thermostat ([figure 47](#)) controlled heating elements ([figure 48](#)) to prevent condensation. Normal cubicles are designed and fitted for indoor use in a dry environment or at a reasonable humidity and air pollution level.



Figure 47: Cubicle thermostat



Figure 48: Cubicle heating element

1.3

Earthquake protection

The standard IEEE 693 draft 5 states recommended practice for seismic design of sub-stations. The cubicle should be able to sustain a maximum ground acceleration (ZPA) equivalent to 0.5g in areas with a high risk for seismic shocks.

1.4

Power losses

The temperature rises in a cabinet due to the power losses from the equipment housed in it. It also depends on the cabinet's degree of protection (airtightness). Self-ventilated cooling is also highly dependent on the type of equipment involved and its location in the cabinet.

Equipment placed to ensure free air circulation around a heat source can be expected to emit more heat for the same increase in temperature than equipment which is not so well situated. Expected power losses at certain permissible temperature rises can also only be given as guidelines as shown in [figure 49](#), [figure 50](#) and [figure 51](#).

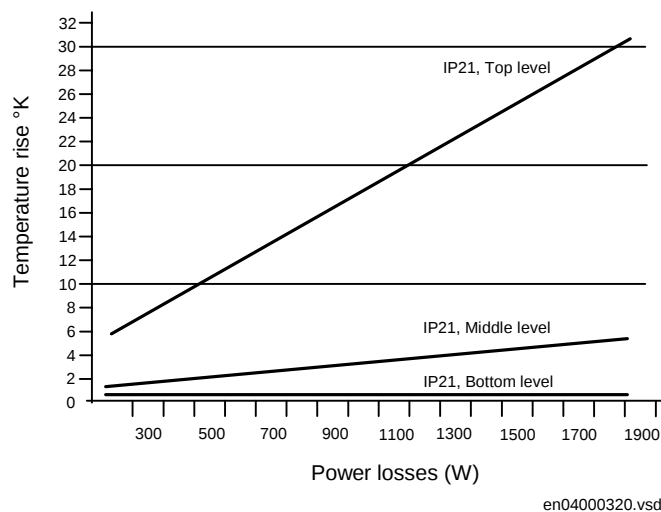


Figure 49: Temperature rise, IP 21 (ventilated door and rear panel, both at the top and on the bottom)

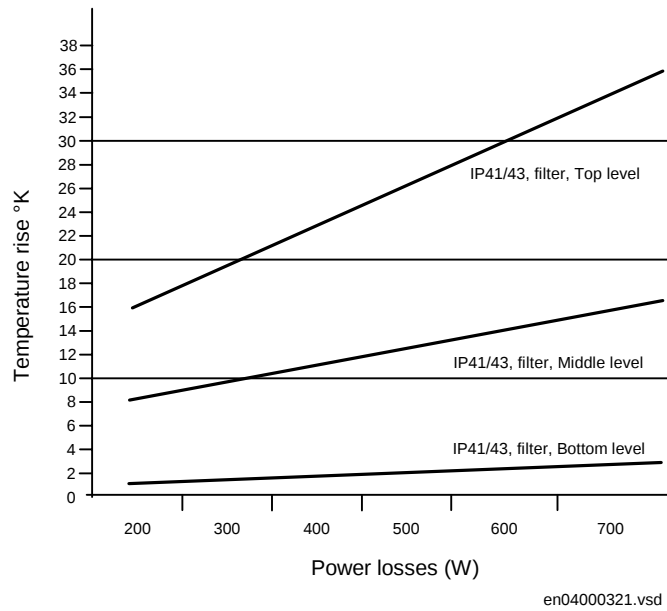


Figure 50: Temperature rise, IP41/43 (ventilated door and rear panel with dust filter, both at the top and on the bottom)

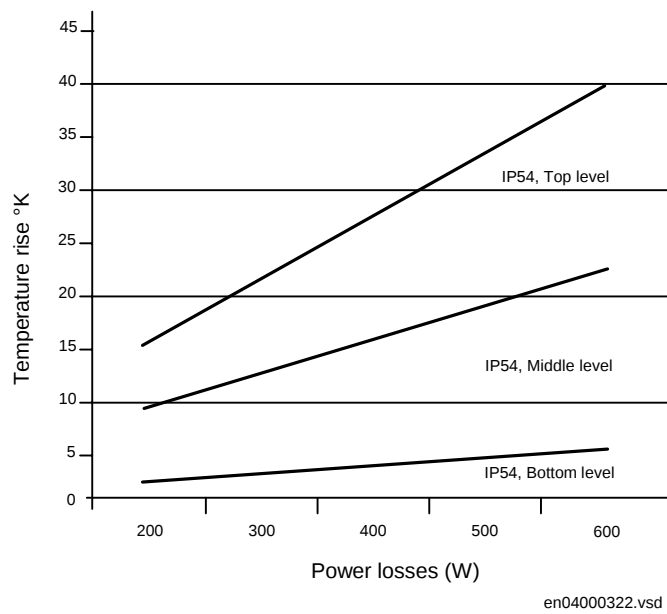


Figure 51: Temperature rise, IP54 (sealed cubicle)

1.5 Ambient temperature

1.5.1 Maximum permissible ambient temperature

The relays are designed for a maximum ambient temperature of 55°C at rated voltage.

The permissible ambient temperature stated for a relay refers to the average temperature surrounding the relay itself and not the temperature in the control room, where the relay's cubicle or panel is located.

If a relay is mounted in a cubicle, case or other sealed enclosure, consideration must be given to the increase in temperature, resulting from the power losses in the equipment.

1.5.2 Permissible temperature increase

The maximum permissible ambient temperature for relays mounted in a case or cubicle is, in reality, less than the specified 55°C due to temperature rises in the case and cubicle.

The temperature rise must be considered when designing control rooms. The temperature rise for the room ambient temperature compared to the relay ambient temperature could as high as 15°C if the maximum permissible power losses given in [table 60](#) are applicable.

The actual power losses will generally be less than the maximum permissible values and the temperature rise will be less than 15°C. With the maximum permissible room ambient temperature corresponding to +55°C, the permissible relay ambient temperature could be +40°C.

If the room temperature is higher, it is necessary to keep the increase less than 15°C. This can be achieved either by mounting the equipment in several cubicles or cases in order to reduce the supplied power losses per cubicle or case, or by improving cooling through increased natural ventilation or by forced ventilation using a fan.

The total power losses of the relays incorporated in a case or cubicle are usually too low to cause a 15°C temperature increase. However, there are two situations when it may be necessary to observe the total power losses and to rearrange the relaying equipment. It may then also be necessary to reduce the total losses per frame or cubicle.

The first situation is when the auxiliary voltage supply is 220 or 250 V dc for several voltage or current measuring relays (2-3 pcs) with a fairly high power consumption, positioned in the same equipment frame or in equipment frames mounted close to each other. It is not possible to fill all positions in a cubicle or a rack or otherwise to pack the above relays too closely and still stay within the 15°C rise in the air surrounding the relay.

The second situation concerns auxiliary relays. There is a limitation to the numbers of continuously energized auxiliary relays that may be included in a RHGS or RHGX case or equipment frame and still stay within the 15°C rise limit. For example in an application of *continuously energized* interposing relays. It is the temperature rise rather than the physical space which may limit the number of relays in a case or frame.

1.5.3

Permissible power losses

Concerning permissible relay power losses in cases of type RHGS or RHGX, consideration must be given to how the case is mounted when defining the permissible power losses.

Example: When a case is flush-mounted at the front of a cubicle

1. Take the calculated temperature increase within the case
2. Add the temperature increase of the air in the cubicle
3. Calculate the total temperature increase in the case in relation to room temperature

Relaying equipment in cubicle

Table 60 states the recommended values of permissible power losses of relaying equipment mounted in the D-plane (hinged frame or front plane) and the B-plane (rear mounting plane).



Note!

It is recommended to mount only transformers, resistors and similar apparatuses in the B-plan. It is not recommended to mount relays in the B-plane, as the air circulation is minimal.

1.5.4

Temperature rise

A calculation of the temperature rise within an RHGS or RHGX case mounted in a cubicle is shown in [equation 1](#).

$$\Theta_{\text{relay}} = K_H + P_H + K_S + P_S$$

(Equation 1)

Where:

Θ_{relay} is the increase of the ambient temperature of the relay

K_H is the RHGS or RGHX case thermal resistance

P_H is the total power loss of the relay in the case

K_S is the thermal resistance of the cubicle (for the cubicles according to [table 60](#))

P_S is the total power loss in the cubicle

Table 59: Permissible power losses for 15°C temperature increase in RHGS and RHGX cases

Case typ	°C/W (K_H)	W
RHGS 6	2.50	6
RHGS	1.50	10
RHGS	0.90	17
RHGX	2.50	6
RHGX	1.80	8
RHGX	1.40	11
RHGX	0.90	17
RHGX	0.65	23

Table 60: Permissible power losses in a cubicle type (ABB VHS200, 700mm) for maximum 15°C temperature increase in the relay ambient

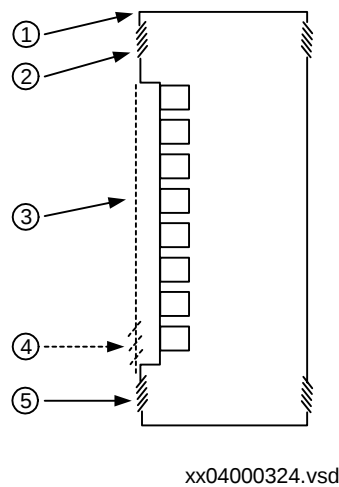
Cubicle location	Code	Cubicle design	Permissible power losses				Thermal resistance of the cubicle
			Equipment frames above and underneath ¹⁾	Equipment frames with 4U space between each frame ²⁾	Totally in cubicle		K _S
			W/4U-equipment frame		W/cubicle	Example of cubicle location	°C/W
Freestanding Cubicle	A1	Sealed cubicle	17	28	170	170 W	0.09
	A2	Tropical design ³⁾					
	A3	Ventilated design ⁵⁾	25	40	250	170 W	0.06
Mounted on the side of one cubicle with approx. the same power losses ⁴⁾	B1	Sealed cubicle	13	21	130	130 W	0.12
	B2	Tropical design ³⁾				130 W	
	B3	Ventilated design ⁵⁾	22	35	220	220 W 220W	0.07
Several cubicles located in a row with maximum permissible power losses	C1	Sealed cubicle	11	17	110	130 W 110 W	0.14
	C2	Tropical design ³⁾				110 W 130 W	
	C3	Ventilated design ³⁾	20	30	200	220 W 200 W 220 W	0.08

¹⁾ Refers to several similar equipment frames with regard to power losses and with the power distributed over the whole equipment frame.

- 2) Also applicable to equipment frames mounted close to each other if every alternate equipment frame has a low continuous power loss (approximately 5 W). It is desirable to mount the equipment frames in the cubicles with maximum possible space between them, to ensure the best possible heat dissipation.
- 3) The heater should be disconnected by a thermostat set for maximum 45°C.
- 4) Also applicable to locations where the cubicle is located back-to-back or close to a wall (with a distance of approximately 50 mm between the back of the cubicle and the wall).
- 5) Self-ventilated design according to [figure 52](#).

1.5.5

Self-ventilated design of the cubicle



Where:

- 1 is raised roof. The roof plate is raised 20 mm to provide an outlet for heated air.
- 2 is trim plate with vents that provides an outlet for heated air.
- 3 is protective door with vents, when required.
- 4 are door vents.
- 5 is kick plate with vents that provides cool air for the rear mounting plane.

Figure 52: Self ventilated design of the cubicle

Table 60 is applicable for convection in sealed or self-ventilated cubicles with a design according to figure 52. When the power losses are approximately evenly distributed in the equipment frames, the temperature increase should not exceed 15°C.

Sources of maximum heat loss, such as power supplies for static relays and continuously energized auxiliary relays, should preferably not be located too close to each other. They should be located with the maximum possible spacing, to ensure the lowest possible temperature in the surrounding air.

The equipment frames containing relays with the highest power losses should preferably be positioned as far down as possible in the cubicle.

The temperature increase should be calculated when designing the layout of relaying equipment. This is done by adding the power losses at rated voltage for all the relays in the cubicle that are simultaneously energized including auxiliary relays, and comparing the calculated values with those in table 60. Normally, it is sufficient to calculate with only the power losses of the auxiliary voltage supply for the static and numerical relays and thus to ignore the losses of signal circuits.

The power losses in table 60 shall be calculated based on the losses at 110% of rated voltage, as obtained from the technical data tables (refer to the Buyer's Guide for the respective relay type). The temperature rise of 15°C has, however, been based on the relays operating at their maximum permissive voltage. For relays operating at their rated voltage the permitted losses in table 60 will result in a temperature rise less than that specified.

2

Earth connection

All units in the cubicle shall be earthed through the cubicle framework. All units must be well fixed and the screws tightened correctly.

Equipment with a connector (possibly a screw) for protected earth shall be connected to the earthing bar in the cubicle with a green/yellow cable. The minimum cross section area of the conductor shall be selected according to the maximum power supply or a minimum cross section area of 1.5 mm^2 .



Figure 53: *Equipment label, marking the connection point for protective earth*

For a cubicle with a hinged frame, the frame shall be earthed to the cubicle frame with two green/yellow wires, each with a minimum cross section area of 6 mm^2 . One of the wires shall be mounted at the top and the other to the bottom of the cubicle.



Figure 54: *Earth cable*

A vertical earthing bar (see [figure 55](#)), size $10 \times 3 \text{ mm}$, or a horizontal earthing bar (see [figure 56](#)), size $30 \times 10 \text{ mm}$, shall be installed in the base of the cubicle.

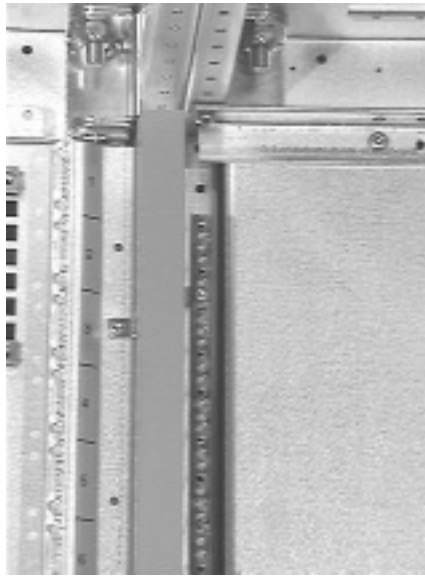


Figure 55: Vertical earthing bar

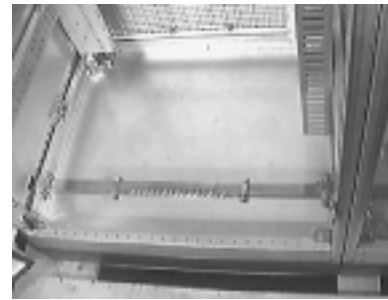


Figure 56: Horizontal earthing bar

When two or more cubicles are mounted side-by side, the earthing bars shall be joined together with joining pieces, see [figure 57](#). The earthing bar is then connected to an earth grid, or equivalent, in the plant.

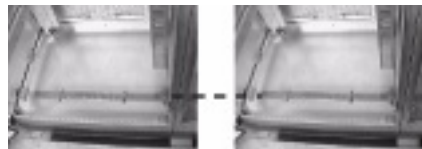


Figure 57: Cubicles mounted side-by-side with horizontal earthing bars

3 Electro static discharge

When working in a cubicle, a wrist ESD bracelet connected to protective earth shall always be used in order to minimize the risk of ESD damage to the equipment.

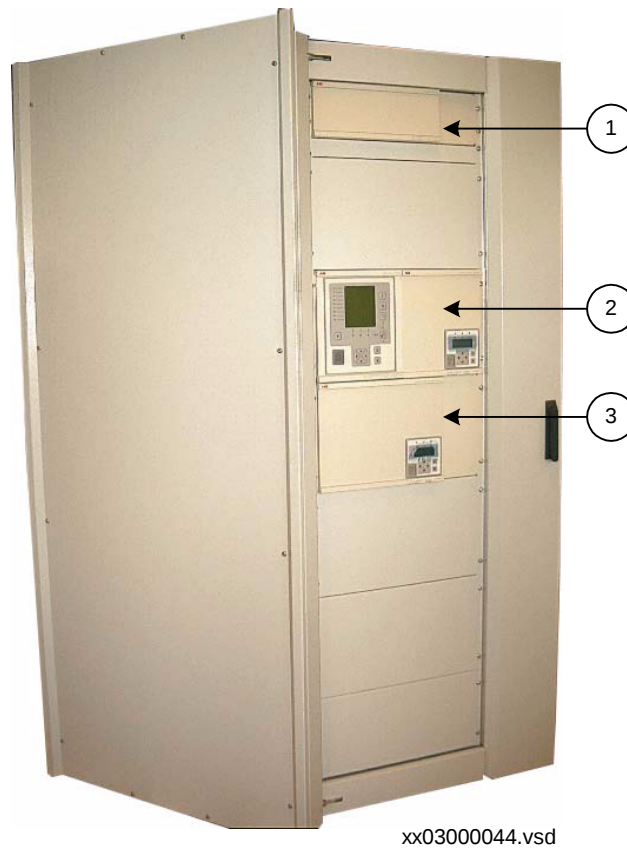
The end-user of the cubicle has to be aware that the cubicle contains ESD sensitive equipment. A warning label is therefor attached to the cubicle before delivery, see [figure 58](#).



Figure 58: ESD label with written explanation

4

Examples of mounting in cubicles

*Figure 59: Mounting into cubicle.*

Number	Description
1	A star-coupler, RER xxx, with 19" mounting
2	A 1/2 of 19" 500 series terminal joined together with a REF 5xx terminal from ABB Finland
3	A 3/4 of 19" 500 series terminal



Figure 60: Front view of two 3/4 of 19" terminals, mounted with mounting details for 19" rack mounting

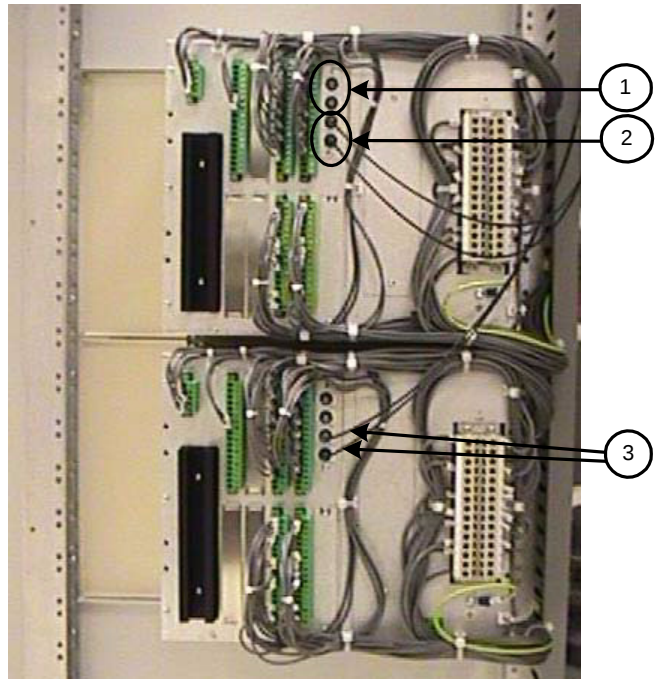


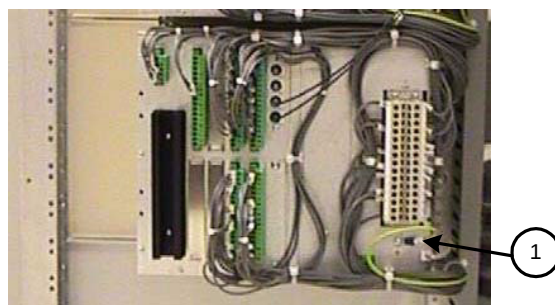
Figure 61: Rear view of two 3/4 of 19" terminals.

Number	Description
1	SPA connectors, IEC 60870-5-103
2	LON connectors
3	LON communication



Figure 62: Terminal cabinet.

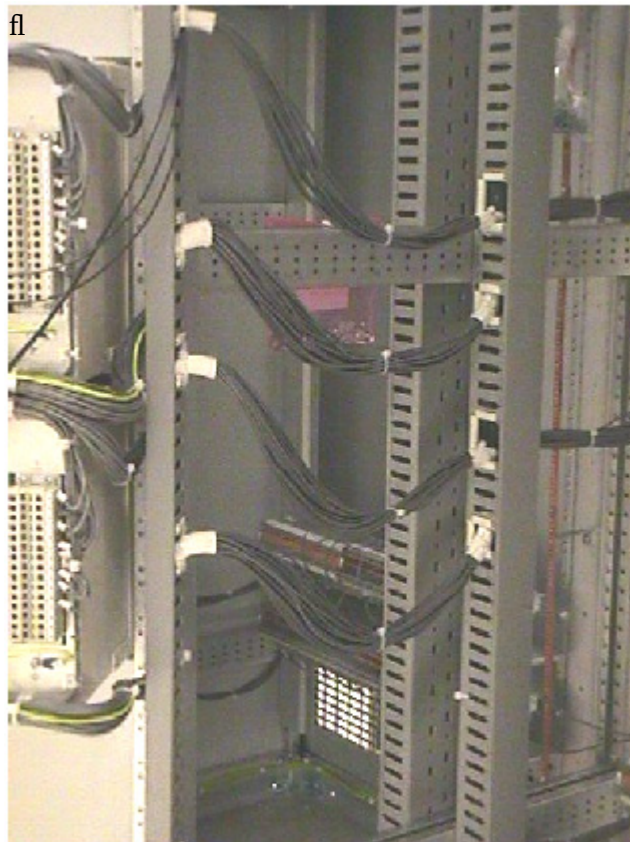
xx02000748.jpg



xx03000046.vsd

Figure 63: Wiring from the terminal connectors.

Number	Description
1	The earth cable, to earthed frame, should be as short as possible



xx02000750.vsd

Figure 64: The wiring to cubicle terminals.

5 Examples of terminal blocks and cables

5.1 Terminal blocks

The terminal blocks in [table 61](#) are manufactured by Phoenix. Refer to the manufacturer's recommendations regarding mounting. The different types of terminal blocks are:

- URTK6, used in AC current circuits together with switch bar SB2-8-T or SB4-8-T
- URTK/S-BEN 10, used in AC voltage & DC distribution circuits
- UK5-MTK-P/P, used for signals, i.e. alarm or event
- UK16, used for main DC circuits

Table 61: Assembling data for terminal blocks

Assembling data	URTK 6	URTK/S-BEN 10	UK5-MTK-P/P	UK16
Connectable conductor area according to IEC 228 class 5, mm ²	0.5-6	0.5-10	0.2-4	0.5-10
Rated current according to IEC228 class 5, A	41	57	16	57
Rated voltage AC (V)	400	500	800	800
Dimensions H x L x W on top hat rail 35 x 15	51 x 91 x 8.2	66 x 61x 8.2	66 x 51 x 6.2	54 x 42.5 x 10.2
Manufacturer's ordering number	3026272	0309109	3004032	3006014

5.2 Cables

Table 62: Technical data for cables

Type	H05V-K, H07V-K, according to Genelec HD 361, single core cables
Rated voltage U ₀ /U	300/500V (H05V-K)
	450/750V (H07V-K)
Fire condition test	IEC 332-1, HD 405.1
Operating temperature	70°C

Temperature index	70°C
Material	Cu, tinned, multi-stranded flexible conductor, according to IEC 228 class 5, with PVC Type TI 1 insulation
Color	Grey (GY) or Green/Yellow (GNYE) for protective earth conductors

Chapter 11 Cubicle layouts

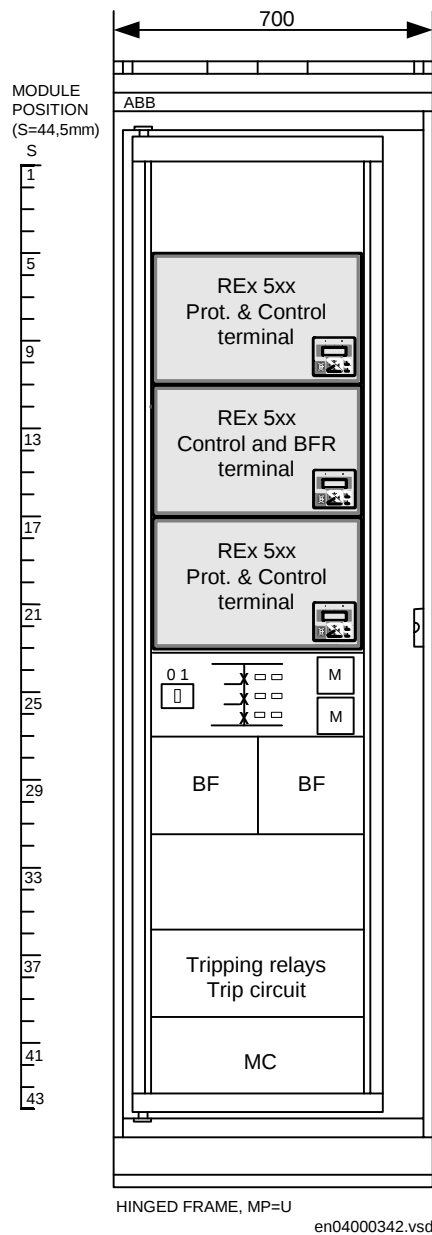
About this chapter

This chapter shows examples of typical cubicle layouts

1

Example 1

The following scope of supply applies to a 115 kV Line bay cubicle (diameter 1) for xxx substation:



2 Protection & Control terminals, REx 5xx for feeders 1 and 2 with the following functions:

- control
- scheme communication logic
- automatic switch onto fault logic
- power swing blocking
- autorecloser, 3-phase
- synchrocheck
- directional earth fault protection
- remote communication
- test switch

1 Control terminal, REx 5xx including breaker failure protection for the middle breaker

1 Back-up panel for 3 breaker

2 RAICA, Breaker failure relays

5 RXMS 1 Tripping relays

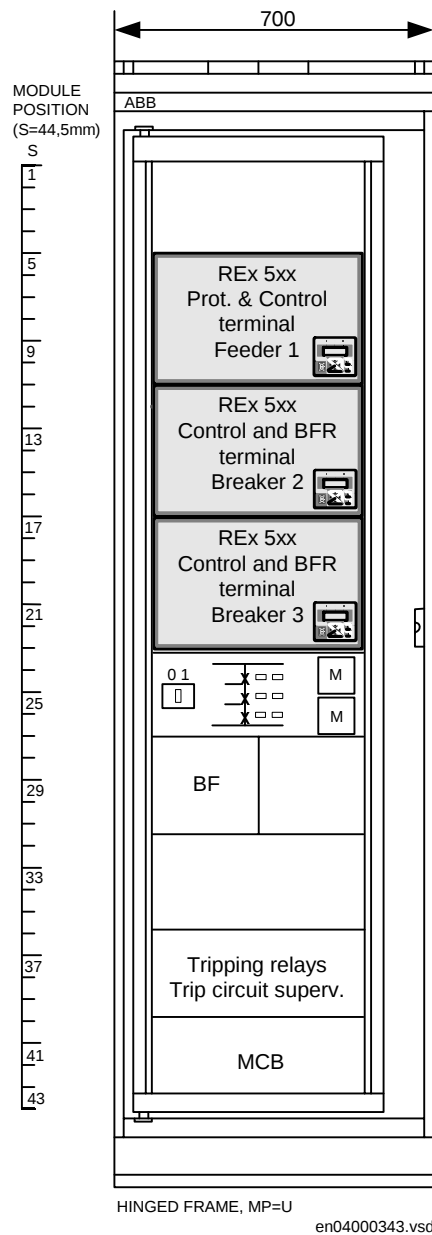
5 SPER 1C1 Trip circuit supervision

3 sets of Micro Circuit Breakers

2

Example 2

The following scope of supply applies to a 115 kV Line bay cubicle (diameter 2) for xxx substation:



1 Protection & Control terminal, REx 5xx for feeder 1 and 2 with the following functions:

- control
- scheme communication logic
- automatic switch onto fault logic
- power swing blocking
- autorecloser, 3-phase
- synchrocheck
- directional earth fault protection
- remote communication
- test switch

2 Control terminals, REx 5xx including breaker failure protection for the middle breaker

1 Back-up panel for 3 breaker

1 RAICA, Breaker failure relay

4 RXMS 1 Tripping relays

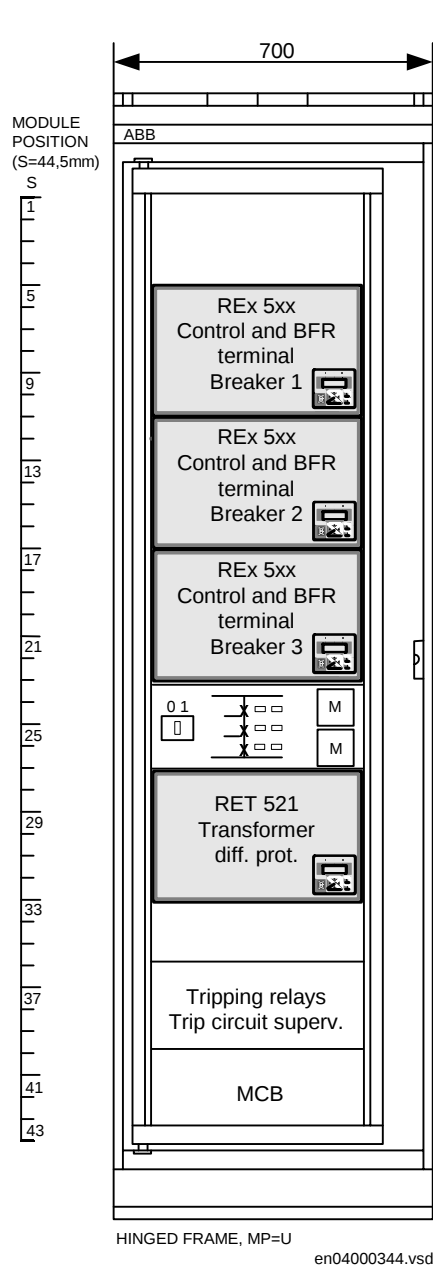
4 SPER 1C1 Trip circuit supervision

3 sets of Micro Circuit Breakers

3

Example 3

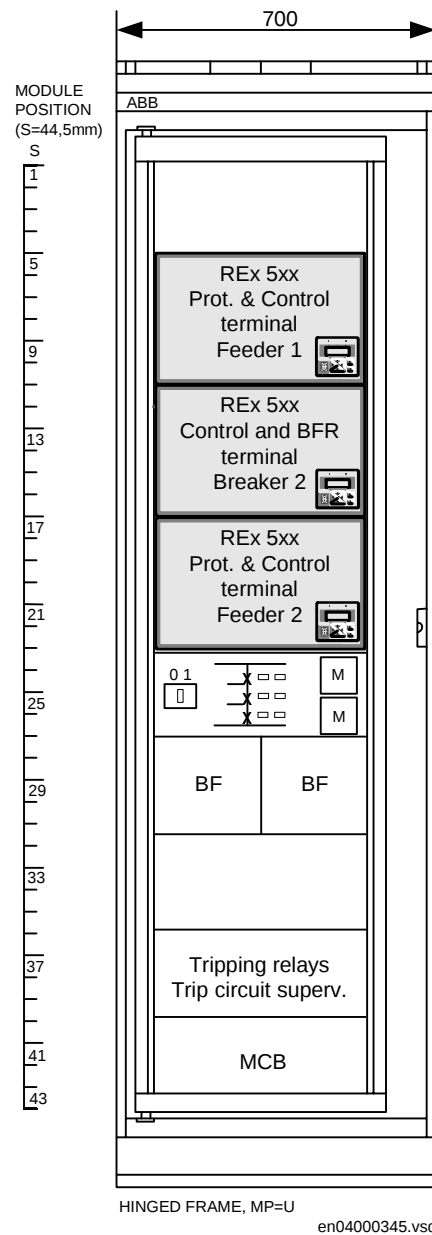
The following scope of supply applies to a 115/22 kV Line bay cubicle (diameter 3) for xxx substation:



4

Example 4

The following scope of supply applies for a 115 kV Line bay cubicle (diameter 4) for xxx substation:



2 Protection & Control terminals, REx 5xx for feeder 1 and 2 with the following functions:

- control
- scheme communication logic
- automatic switch onto fault logic
- power swing blocking
- autorecloser, 3-phase
- synchrocheck
- directional earth fault protection
- remote communication
- test switch

1 Control terminal, REx 5xx including breaker failure protection for the middle breaker

1 Back-up panel for 3 breaker

2 RAICA, Breaker failure relays

5 RXMS 1 Tripping relay

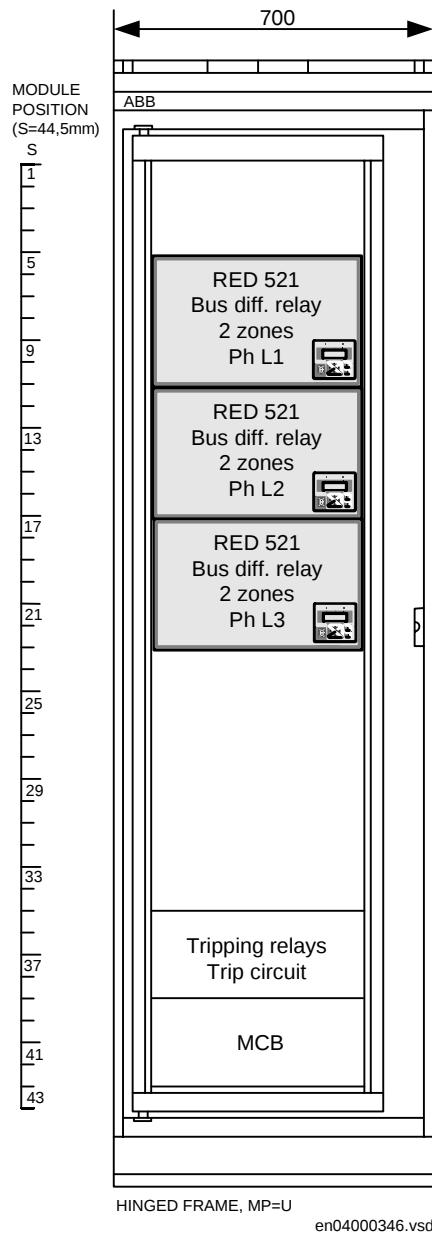
5 SPER 1C1 Trip circuit supervision

3 sets of Micro Circuit Breakers

5

Example 5

The following scope of supply applies to a 115 kV Busbar cubicle for xxx substation:



2 Bus differential relay, RED 521, up to 18 bays

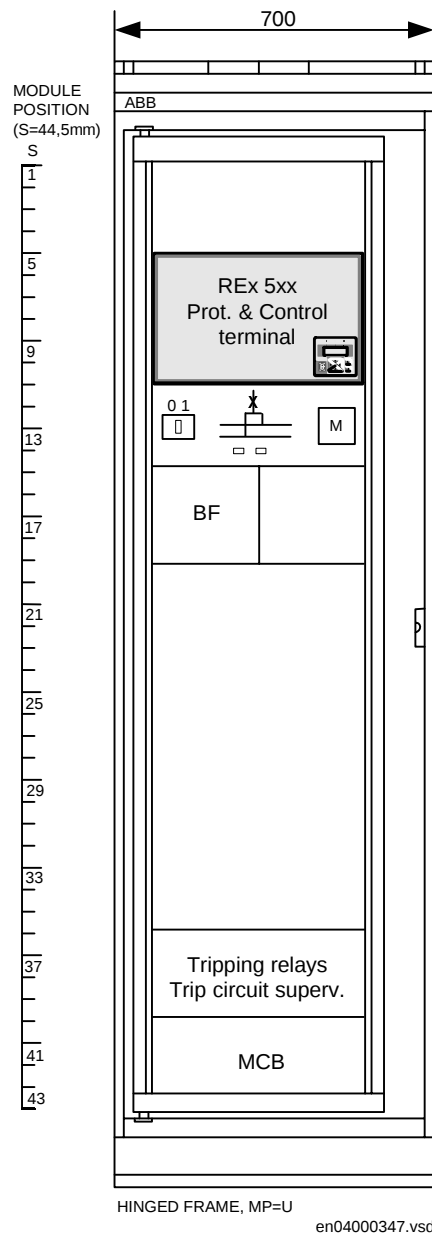
8 RXMS 1 Tripping relays

4 sets of Micro Circuit Breakers

6

Example 6

The following scope of supply applies to a 115 kV Line bay cubicle with 1 feeder for xxx substation:



1 Protection & Control terminal, REx 5xx for feeder 1 with the following functions:

- control
- scheme communication logic
- automatic switch onto fault logic
- power swing blocking
- autorecloser, 3-phase
- synchrocheck
- directional earth fault protection
- remote communication
- test switch

1 Back-up panel for 1 feeder

1 RAICA, Breaker failure relay

2 RXMS 1 Tripping relays

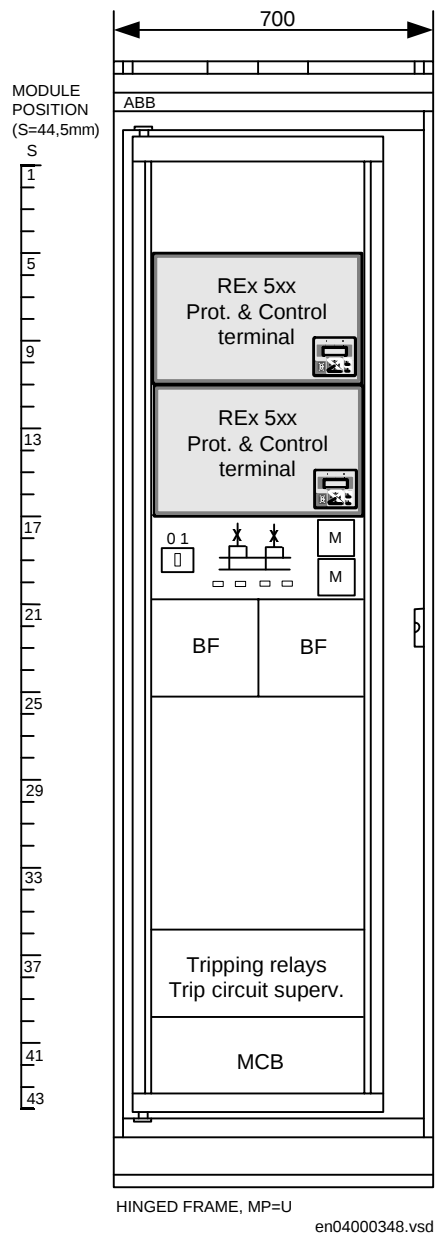
2 SPER 1C1 Trip circuit supervision

1 set of Micro Circuit Breakers

7

Example 7

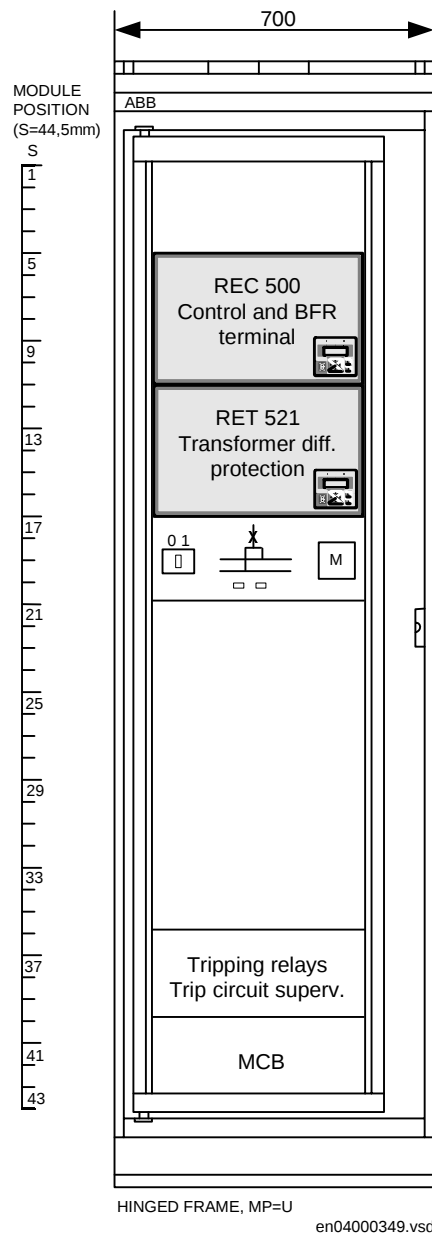
The following scope of supply applies to a 115 kV Line bay cubicle for 2 feeders for xxx substation:



8

Example 8

The following scope of supply applies to a 115/22 kV Transformer bay cubicle or cubicles for xxx substation:



1 Control terminal, REC 561 for feeder including breaker failure protection:

1 Transformer differential protection, RET 521, with 2 windings

1 Back-up panel

2 RXMS 1 Tripping relays

2 SPER 1C1 Trip circuit supervision

2 sets of Micro Circuit Breakers

9

Example 9

The following scope of supply applies to a 115 kV Bus coupler and Busbar cubicle for xxx substation:

