REG216, REG216 Compact
REC216

Numerical Generator Protection
Numerical Control Unit

Operating Instructions

1MDU02005-EN
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13th edition

Applies for software version V6.2

This document has been carefully prepared and reviewed. Should in spite of this the reader find an error, he is requested to inform us at his earliest convenience.

The data contained herein purport solely to describe the product and are not a warranty of performance or characteristic. It is with the best interest of our customers in mind that we constantly strive to improve our products and keep them abreast of advances in technology. This may, however, lead to discrepancies between a product and its "Technical Description" or "Operating Instructions".

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1. INTRODUCTION

1. INTRODUCTION

These Operating Instructions apply to the digital generator protection REG 216, REG 216 Compact and to the digital control unit REC 216. In these instructions, the designation RE. 216 is used to refer to both types.

1.1. Application of the protection system

A number of different protection functions are provided in the software permanently stored within the RE. 216 system. The functions required to protect a specific plant can be individually selected, activated and set. A particular protection function may be used several times in different protection schemes. How the signals are to be processed by the protection for the plant in question such as the assignment of tripping, signalling and logic signals to the various inputs and outputs is also determined by appropriately configuring the software.

The system hardware is modular in structure. The number of electronic devices and I/O units actually installed, for example, to increase the number of protection functions or for purposes of redundancy, can vary according to the requirements of the particular plant.

Because of its modular design and the possibility of selecting protection and other functions by configuring the software, the generator protection REG 216 can be adapted for the protection of small, medium and large generators as well as large motors, power transformers and feeders, while the control unit REC 216 can perform data acquisition and control and supervision functions in medium and high-voltage substations.

1.2. Other relevant documents

A general description of the system and the electronic devices and I/O units installed and the corresponding technical data are to be found in data sheet 1MRB520004-Ben "Type REG 216 and Type REG 216 Compact Generator Protection".

Each RE. 216 protection system is engineered to fulfil the particular requirements of the plant concerned. A specific set of diagrams is provided for each installation, which defines the system with respect to the electronic devices and I/O units installed, their locations and the internal wiring.

The set of plant diagrams includes:

- single-line diagram of the protection: complete representation of the plant showing the c.t. and v.t. connections to the protection.
- standard cable connections: block diagram showing the protection equipment cabling (electronic equipment racks to I/O units).
- protection cubicle layout: installation and locations of the electronic equipment and I/O units.
- electronic rack layout: equipment locations within a rack.
- measurement circuits (three-phase plant diagram): connection of the c.t's and v.t's to the protection.
- auxiliary supply: external connection and internal distribution of the auxiliary d.c. voltage supply.
- I/O signals: external connection and internal wiring of the tripping and signalling outputs and the external input signals.

1.3. General instructions

The electronic units may only be inserted into or removed from the equipment rack when the auxiliary supply is switched off!

The auxiliary supply is switched off by means of a switch on the auxiliary d.c. supply units 216NG61, resp. 216NG62 or 216NG63. The following must be noted in this respect:

- Every electronic equipment rack is equipped with its own auxiliary power supply unit.
- Either one or a maximum of two redundant 216NG6. auxiliary d.c. supply units can be installed in an equipment rack.
- Where two redundant auxiliary d.c. supply units are fitted, both units must be switched off.

(See also Section 2.2.)

Any work carried out on the protection such as internal adjustments, inserting soldered jumpers, wiring, connections etc., may only be performed by suitably qualified personnel.

In addition to these instructions, all applicable local regulations governing work and safety must be strictly observed when installing, wiring and commissioning the protection.

Modifications and repairs to the electronic units or software changes may not be performed by the user. No liability will be accepted and any warranty becomes invalid in the case of improper interference or tampering with the protection equipment. Defective units must be returned to ABB for repair (see also Section 7.).

August 2000

2. DESCRIPTION OF HARDWARE

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2.1. Complete system

An RE. 216 protection system comprises at least an electronic equipment rack Type 216MB62 with the electronic modules inserted (plug-in units) and a number of I/O units, which are in effect the interface with the primary plant. The protection system is available as a **cubicle version** or as a **compact version**.

Figure 12.1 shows an example of a 216MB61 equipment rack installed in the hinged frame of a protection cubicle. The electronic modules are designed as plug-in units, which are inserted from the front. The B448C parallel bus provides communication between the electronic units and is fitted to the rear of the rack. Also situated at the rear are the connectors for the standard cables to the I/O units and for connecting a printer.

The input transformer, auxiliary relay I/O and tripping relay units are mounted on the inside of the rear panel of the protection cubicle (see Figure 12.2.).

The number and type of electronic units installed, their locations in a rack, the number of racks and the number and arrangement of I/O units varies from plant to plant.

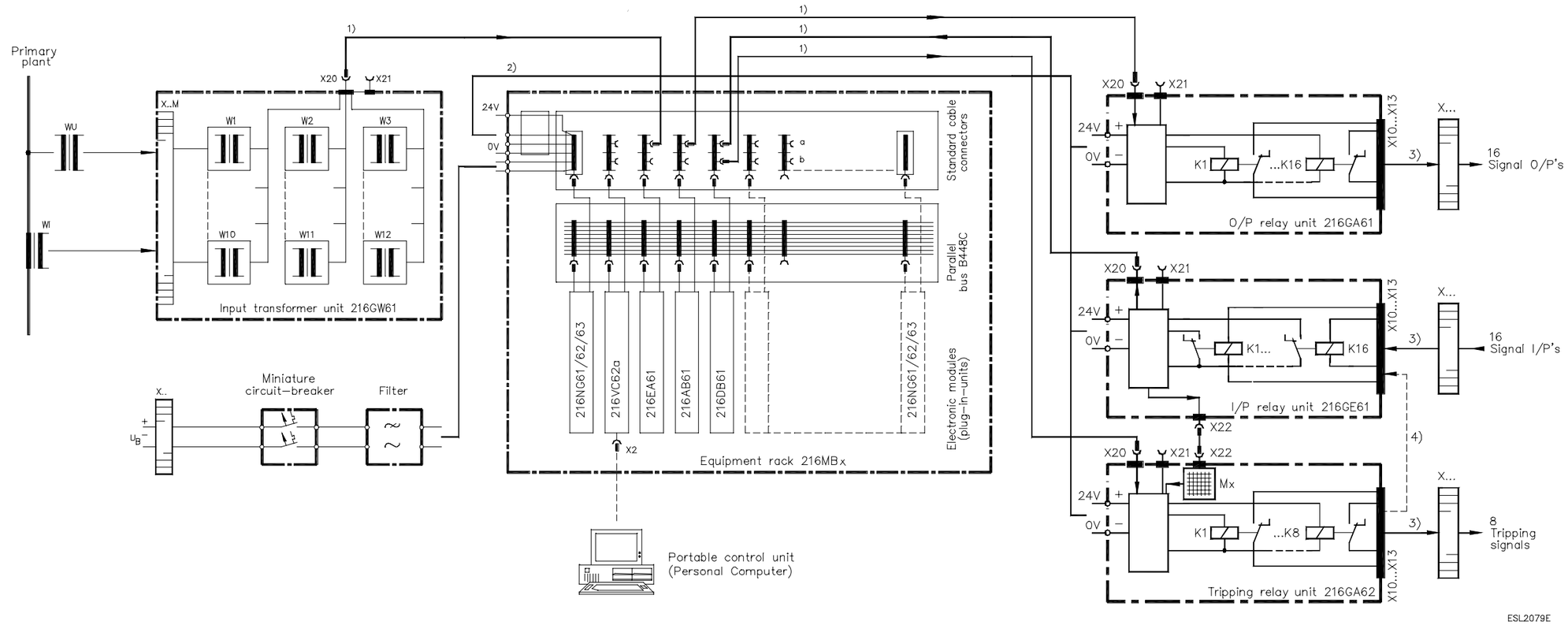
Refer to the corresponding set of diagrams for the execution of an RE. 216 system for a particular plant.

A **compact version** of the REG 216 protection is also available, which is basically a standardised equipment rack (see Section 2.3.). The compact version can be mounted either in an open frame or in a cubicle with other equipment.

2.2. Cubicle version

2.2.1. Principle of operation

Fig. 2.1 illustrates the basic operating principle of the individual units and modules, which make up a complete protection system.



216NG61/ : Auxiliary supply units; DC/DC converters
216NG62
216NG63

216VC62a : Processor unit

216EA61 : Analogue I/P unit (A/D converter)

216AB61 : Binary O/P unit

216DB61 : Binary I/P and tripping unit

Fig. 2.1 Principle of operation of the RE. 216 protection system (see next page for legend)

Legend of Fig. 2.1:

WU, WI	:	primary v.t's and c.t's
W1...W12	:	input v.t's and c.t's
U_B	:	auxiliary d.c. supply (station battery)
X...M	:	measuring input terminals
X...	:	auxiliary supply and signal terminals
X20, 21	:	25 pin standard cable connector
X22	:	15 pin standard cable connector
X10...13	:	20 pin wiring cable connector
1)	:	25 core standard cable core gauge 0.25 mm^2
2)	:	single wire leads wire gauge 1.5 mm^2
3)	:	20 core wiring cable core gauge 1.5 mm^2
4)	:	wiring cable (only if K9...K16 in 216GE61 are used for trip circuit supervision)
a/b	:	50 pin standard cable connector on rack 216MB62 a: 25 pin upper half b: 25 pin lower half
X2	:	25 pin RS423 serial interface connector (for connecting portable control unit)
K...	:	auxiliary relays
Mx	:	single-diode matrix (tripping logic) with 10 I/P's and 10 O/P's.

The primary system c.t's and v.t's are connected directly to the 216GW61 input transformer unit. The signals of the measured input variables are stepped down to a suitable level for processing by the electronic circuits (analogue signals) and transferred via the system cable to the 216EA61 unit, which digitises them and transmits them to the B448C parallel bus.

The digitised measured variables derived from the primary system quantities are continuously compared by the processing unit 216VC62a with the pick-up settings of the protection functions. If a protection function picks up, the corresponding signal or tripping command is transmitted via the B448C bus to the 216AB61 O/P unit resp. to the 216DB61 I/O unit. The allocation of the signals and tripping commands at the O/P's of the protection functions to the various channels of the 216AB61 output unit or of the 216DB61 I/P signal and tripping unit is also determined by the software installed in the 216VC62a processor unit.

The output signals from the 216AB61 unit (signalling channels) and 216DB61 unit (trip channels) control the auxiliary relays K1...K16 of the 216GA61 O/P relay unit or 216GA62 tripping relay unit. The auxiliary relays' contacts are potentially-free and wired to terminals for connection to external signalling and tripping circuits.

The external input signals connected to the protection energise the auxiliary relays K1...K16 in the 216GE61 I/P relay unit. The potentially-free contacts of K1...K16 transmit the external signals to the 216DB61 unit and thence to the B448C bus. By appropriate configuration of the software in the 216VC62a processing unit, external signals can be assigned to the various protection functions, e.g. for logical combination (interlocking and blocking) with trip signals or for exciting the tripping channels 1...8.

Tripping circuits 1...8 can be directly energised by all or just some of the I/P channels 1...10 (K1...K10) of 216GE61 via the diode matrix (tripping logic) of 216GA62 (see Section 2.6.). Provision is also made for some of the channels 9...16 (K9...K16) of 216GE61 to be used for supervising the external tripping circuits 1...8 instead of for the connection of external inputs. This is an option, which must be specified in the order to enable the corresponding wiring to be included when engineering the protection.

In order to supply the electronic units with power the protection must be connected to an external auxiliary d.c. supply (station battery). The auxiliary d.c. supply unit 216NG61, 216NG62 or 216NG63 (DC/DC converters) steps the station battery voltage down to 24 V and provides electrical insulation between input and output voltages. The 24 V supply is distributed to the units inserted in the protection equipment rack via the B448C parallel bus. The 216NG61, 216NG62 or 216NG63 power supply unit also supplies the electronic circuits on the I/O units. A 216MB66 equipment rack can be equipped with just one or with two redundant 216NG61, 216NG62 or 216NG63 auxiliary d.c. supply

units. Redundant units can be connected to the same or to two different station batteries.

All software configuration, i.e. selection and setting of the protection functions and the assignment of signals to the inputs and outputs, is performed via the RS-423 serial interface on the 216VC62a processing unit. The corresponding connector is the 25 pin socket X2 on the front of the unit, to which a personal computer is connected.

2.2.2. Layout of equipment rack Type 216MB66

Fig. 2.2 shows an example of the arrangement of the electronic units in the equipment rack. The equipment rack is sub-divided into 21 divisions (T). Divisions 1-3 and 19-21 are always used for auxiliary d.c. supply units 216NG61, 216NG62 or 216NG63. In principle, the electronic units may be located in any of the remaining divisions 4-18, providing that the system cable connections were correspondingly installed. For reasons of standardisation, however, the various types of units are always located at the same position in the equipment rack.

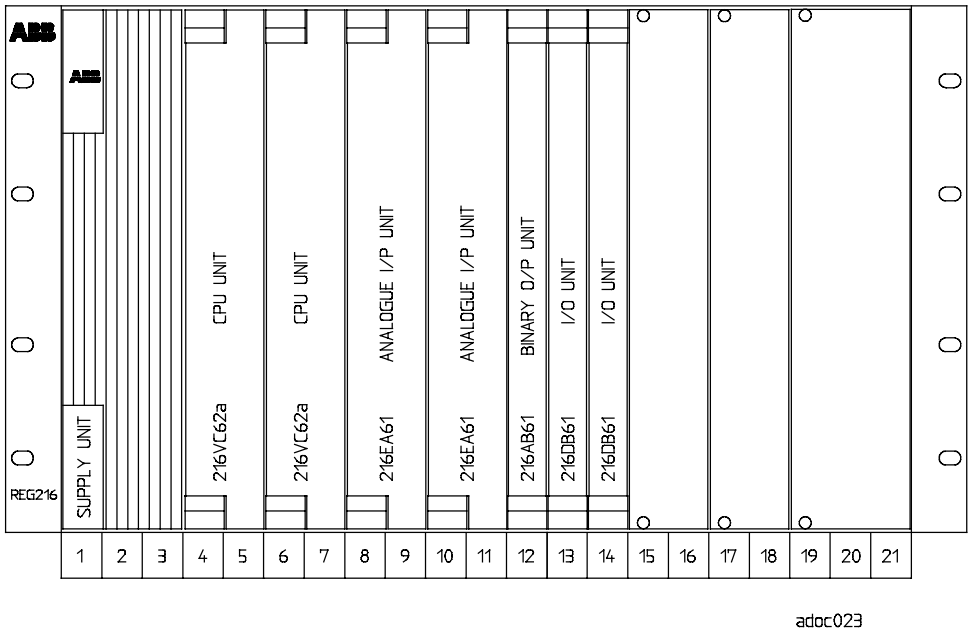


Fig. 2.2 Locations of the electronic units in the 216MB66 equipment rack

Consult the specific set of diagrams for the layout of the electronic units in the 216MB66 equipment rack of a particular plant.

Table 2.1 gives the standard slot references for the various units. For example, a maximum of two 216VC62a processing units can be installed in an equipment rack and are always located in slot 4 and 6.

The designations and numbering of the I/O signals for the I/P and O/P units of a protection system are given in the column "I/O channel definition". Note that the quantity of I/O channels given for each group of the same type of units refers to the particular equipment rack and not the entire system. The total quantity of I/O channels for the entire system is given by the number of I/O units installed (see also Section 2.2.3. and the set of specific plant diagrams).

Rack division	Unit No.	Unit Type 216	Capacity / Function	I/O channel definition	
				Connector a above	Connector b below
1-3	1.	NG61, 62, 63	Aux. supply for complete rack		
4 5	2.	VC62a	425% computing capacity X2		X4
6 7	3.	VC62a	425% computing capacity X2		X4
8-9	1.	EA61	24 analogue I/P's: meas. channels	CH01...CH12 1)	CH13...CH24 1)
10-11	2.	EA61	24 analogue I/P's: meas. channels	CH25...CH36 2)	CH37...CH48 2)
12	1.	AB61	32 binary O/P's: signalling channels	CHO001...CHO016	CHO017...CHO032
13	2.	AB61	32 binary O/P's: signalling channels	CHO033...CHO048	CHO049...CHO064
	3.	AB61	32 binary O/P's: signalling channels	CHO065...CHO080	CHO081...CHO096
	4.	AB61	32 binary O/P's: signalling channels	CHO097...CHO112	CHO113...CHO128
	5.	AB61	32 binary O/P's: signalling channels	CHO129...CHO144	CHO145...CHO160
	6.	AB61	32 binary O/P's: signalling channels	CHO161...CHO176	CHO177...CHO192
	1.	DB61	16 binary I/P channels 8 binary tripping O/P channels	CHI01...CHI16	CHO01...CHO08
	2.	DB61	16 binary I/P channels 8 binary tripping O/P channels	CHI17...CHI32	CHO09...CHO16
	3.	DB61	16 binary I/P channels 8 binary tripping O/P channels	CHI33...CHI48	CHO17...CHO24
	4.	DB61	16 binary I/P channels 8 binary tripping O/P channels	CHI49...CHI64	CHO25...CHO32
	5.	DB61	16 binary I/P channels 8 binary tripping O/P channels	CHI65...CHI80	CHO33...CHO40
	6.	DB61	16 binary I/P channels 8 binary tripping O/P channels	CHI81...CHI96	CHO41...CHO48
	1	AC61	16 binary O/P's 8 analogue O/P's	CHO01...CHO16	AA01...AA08
	2	AC61	16 binary O/P's 8 analogue O/P's	CHO17...CHO32	AA09...AA16
	3	AC61	16 binary O/P's 8 analogue O/P's	CHO33...CHO48	AA17...AA24
	4	AC61	16 binary O/P's 8 analogue O/P's	CHO49...CHO64	AA25...AA32
	5	AC61	16 binary O/P's 8 analogue O/P's	CHO65...CHO80	AA33...AA40
	6	AC61	16 binary O/P's 8 analogue O/P's	CHO81...CHO96	AA41...AA48

X2: connector for portable control unit

1) rack division 9

2) rack division 11

Rack division	Unit No.	Unit Type 216	Capacity / Function	I/O channel definition	
				Connector a above	Connector b below
	1	EB61	32 binary I/P's	CHI01...CHI16	CHI17...CHI32
	2	EB61	32 binary I/P's	CHI33...CHI48	CHI49...CHI64
	3	EB61	32 binary I/P's	CHI65...CHI80	CHI81...CHI96
	4	EB61	32 binary I/P's	CHI97...CHI112	CHI113...CHI128
	5	EB61	32 binary I/P's	CHI129...CHI144	CHI145...CHI160
	6	EB61	32 binary I/P's	CHI161...CHI176	CHI177...CHI192
	7	EB61	32 binary I/P's	CHI193...CHI208	CHI209...CHI224
	8	EB61	32 binary I/P's	CHI225...CHI240	CHI241...CHI256
19-21	2.	NG61, 62, 63	Redundant aux. supplies for complete rack		

Table 2.1 Locations of the units in the standard 216MB66 equipment rack

2.2.3. Alternative system versions

The number of electronic units and I/O units used in a protection system varies according to plant requirements. The maximum quantities of electronic units in one system (a single 216MB66 equipment rack) are given in Table 2.1.

The numbers of I/O signals given for the versions listed in Table 2.2 to Table 2.4 refer to a complete system (single system with one 216MB66 equipment rack). An equipment rack can accommodate one or two 216VC62a processing units and therefore the versions given in Table 2.2 to Table 2.4 can have a total computing capacity of 425% or 850%.

1. Analogue I/P's			
	Quantity	**Quantity**	**Max. capacity (channels)**
Version	**216EA61**	**216GW61**	**Analogue I/P signals**
1.1	1	1	12
1.2	1	2	24
1.3	2	3	36
1.4[1)]	2	4	48

Table 2.2 Alternative versions: Analogue I/P signals

2. Signals				
	Quantity	**Quantity**	**Max. capacity (channels)**	
Version	**216AB61**	**216GA61**	**Signals**	**Alarms**
2.1	1	1	14	2
2.2	1	2	30	2
2.3	2	3	46	2
2.4	2	4	62	2

Table 2.3 Alternative versions: Signals and alarms

[1)] in 2 cubicles according to version

3. Tripping O/P's and external I/P's					
	Quantity	**No. of modules**		**Max. capacity (channels)**	
Version	**216DB61**	**216GA62**	**216GE61**	**Tripping O/P's**	**External I/P's**
3.1	1	1	---	8	---
3.2	1	1	1	8	16
3.3	2	2	---	16	---
3.4	2	2	1	16	16
3.5	2	2	2	16	32
3.6	3	3	---	24	---
3.7	3	3	1	24	16
3.8	3	3	2	24	32
3.9	3	3	3	24	48
3.10	4	4	---	32	---
3.11	4	4	1	32	16
3.12	4	4	2	32	32
3.13	4	4	3	32	48
3.14	4	4	4	32	64

Table 2.4 Alternative versions: Tripping O/P's and external I/P's

An RE. 216 protection system can comprise several 216MB66 equipment racks. The possible configurations can be seen from Fig. 2.3. The table refers to the standard equipment rack and the I/O modules actually installed may be as given in Section 2.2.3.

Depending on the quantity of I/O modules, one or several panels may be necessary.

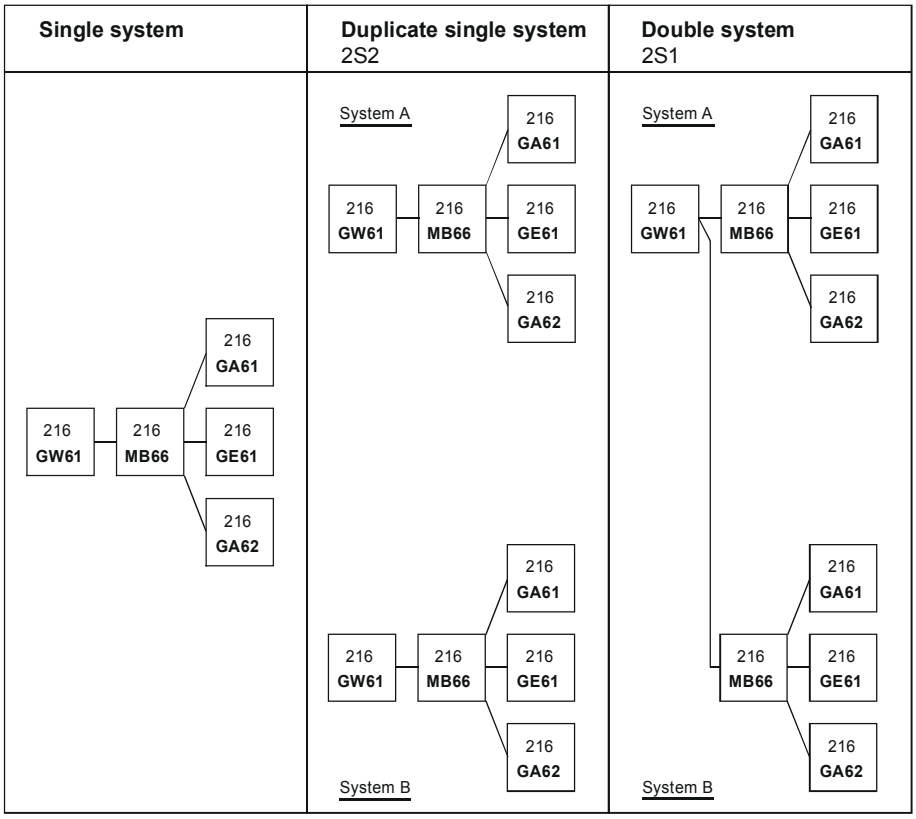


Fig. 2.3 System configurations

2.3. Compact version

There are two main versions available:

The single system in the system rack 216MB66 and the redundant version in the system rack 216MB68. The possible system configurations are shown in Fig. 2.4.

The functional units are completely enclosed and are protected according to DIN Protection Class IP30. They are preferably mounted in a rack corresponding to the installation diagrams in Figures 12.18 to 12.22. The 216GD61a and 216GW62 units are mounted on a hinged bracket for ease of service. When installing the protection, attention must be paid that a vertical clearance of at least 90 mm must be left between the various assemblies (see Fig. 12.18 to 12.21).

The electronic units are arranged as described in Section 2.2.2.

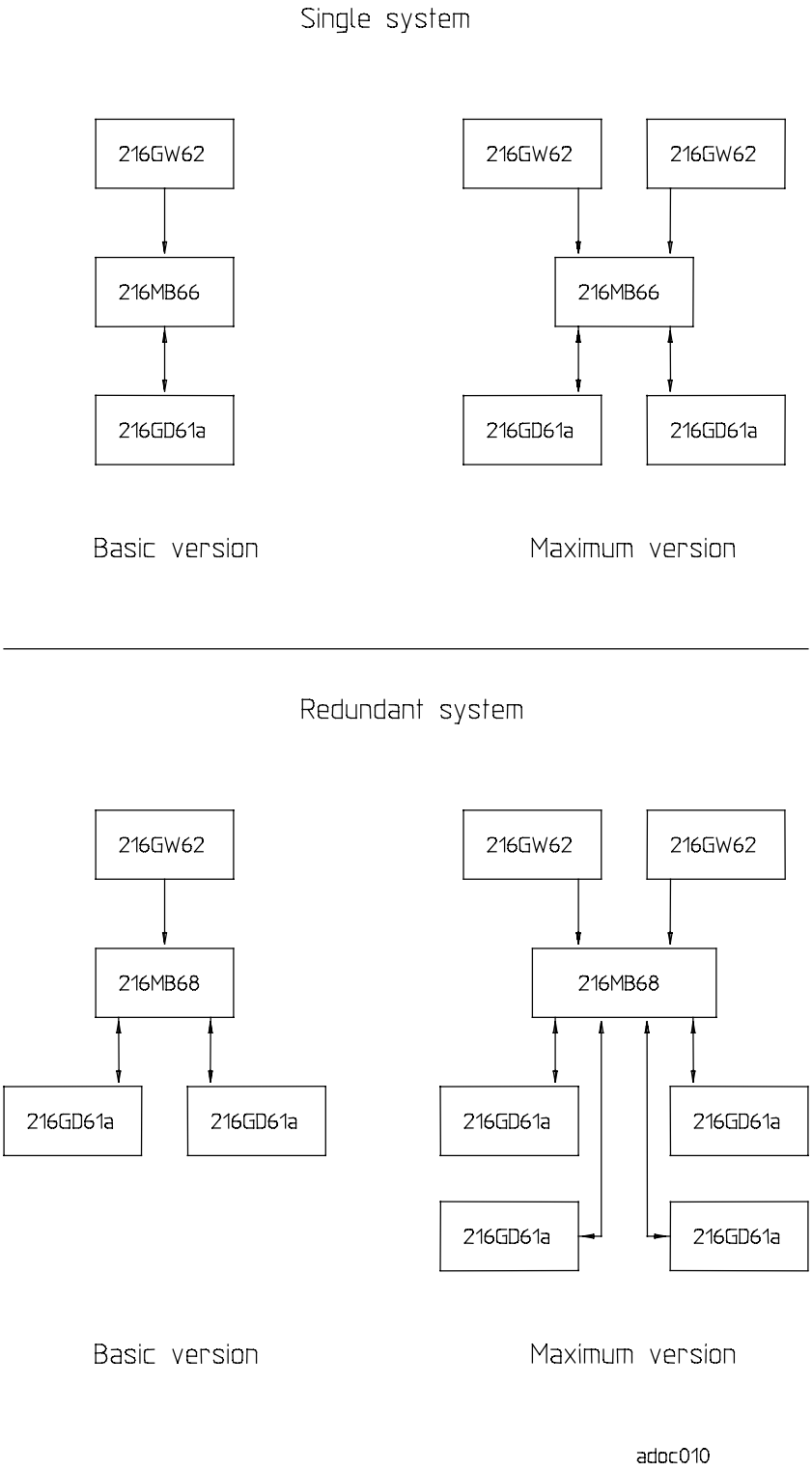


Fig. 2.4 System configuration compact version

2.3.1. Single system

The basic version of the single system REG 216 consists of the following components:

- 1 electronic equipment rack 216MB66 (incl. electronic units)
- 1 input transformer module 216GW62
- 1 relay- and opto-coupler module 216GD61a
- Accessories (connecting cable 216IK61, etc.).

Fig. 2.5 shows the maximum version in the equipped electronic equipment rack

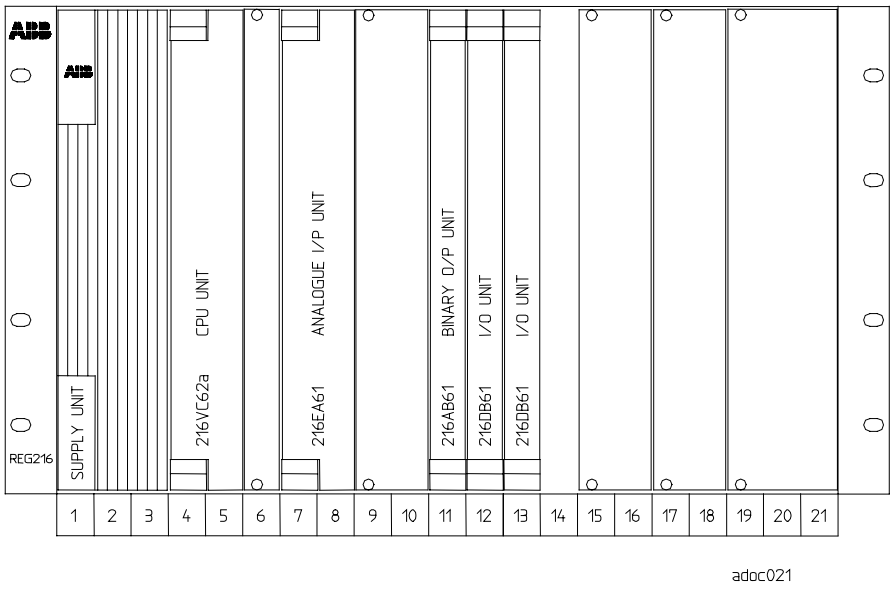


Fig. 2.5 Rack 216MB66; compact version (Single system)

2.3.2. Redundant system

The basic version of the redundant system REG 216 consists of the following components:

- 1 electronic equipment rack 216MB68 (incl. electronic units)
- 1 input transformer module 216GW62
- 1 relay- and opto-coupler module 216GD61a
- Accessories (connecting cable 216IK61, etc.).

Fig. 2.6 shows the maximum version in the equipped electronic equipment rack

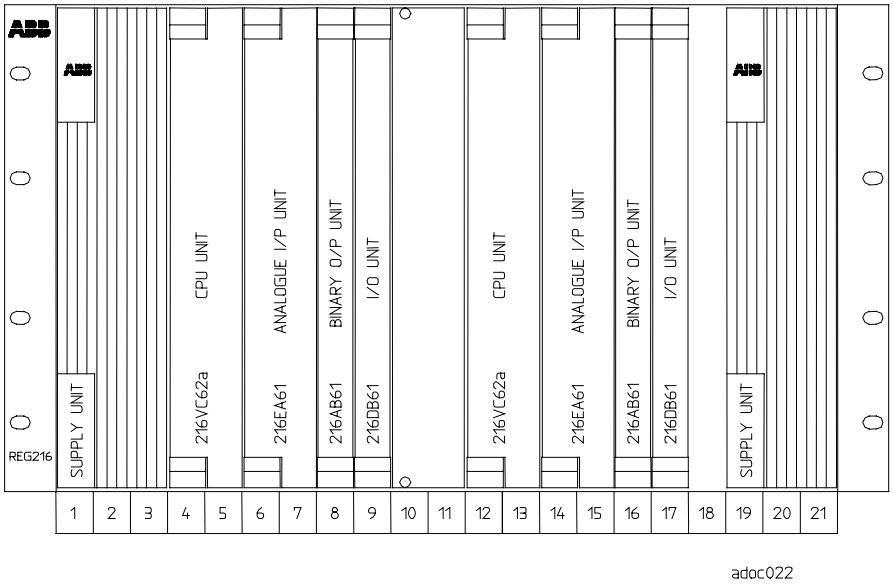


Fig. 2.6 Rack 216MB68; compact version (redundant system)

The following units are normally installed:

Type	**LG, GV**	**LG, MV**	**RG, GV**	**RG, MV**
216NG6.	1	1	1	1
216VC62a	1...2	1...2	1	1
216EA61	1	1	1	1
216AB61	1	1	1	1
216DB61	1	2	1	2

For the versions the following maximum values result for the number of inputs and outputs per group:

Inputs / Outputs	**GV**	**MV**
Analogue Inputs	12	24
Binary Inputs	12 + 4	24 + 8
Signalling outputs	2 + 14	2 + 30
Tripping outputs	8	16

Abbreviations: LG: left group; rack slots 1...11
RG: right group; rack slots 12...21
GV: basic version
MV: maximum version

The following units are normally installed:

Type	Electronic units in basic version	Electronic units in full version
216NG6.	1...2	1...2
216VC62a	1	1...2
216EA61	1	1
216AB61	1	1
216DB61	1	2

The following maximum quantities of I/P's and O/P's result:

Inputs / Outputs	Basic version	Full version
Analogue I/P's	12	24
Binary I/P's	12 + 4	24 + 8
Signalling O/P's	2 + 14	2 + 30
Tripping O/P's	8	16

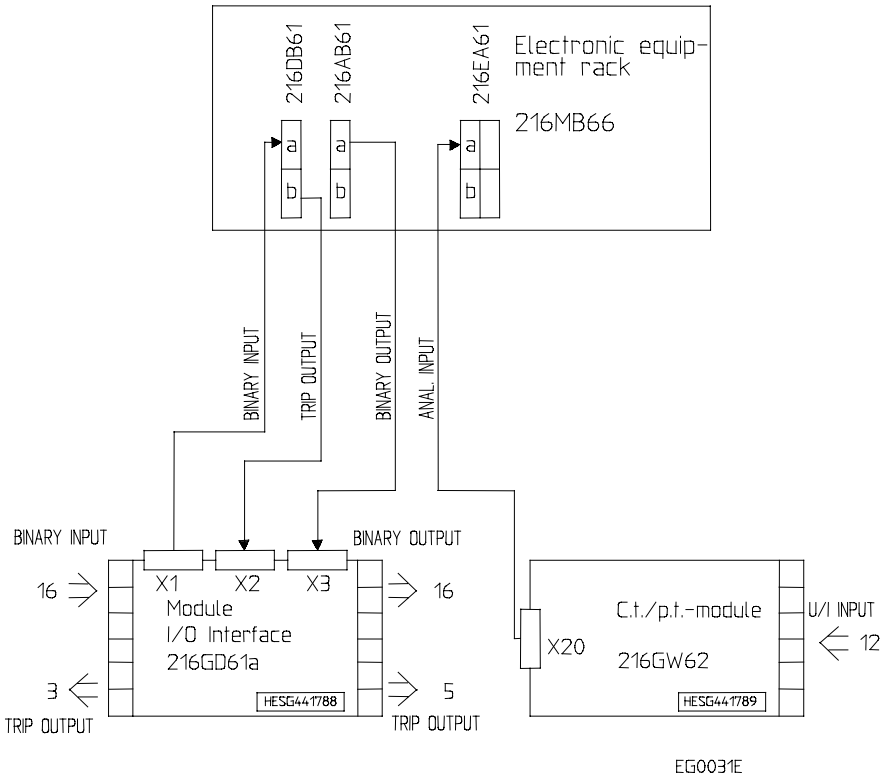


Fig. 2.7 Wiring diagram of the basic version

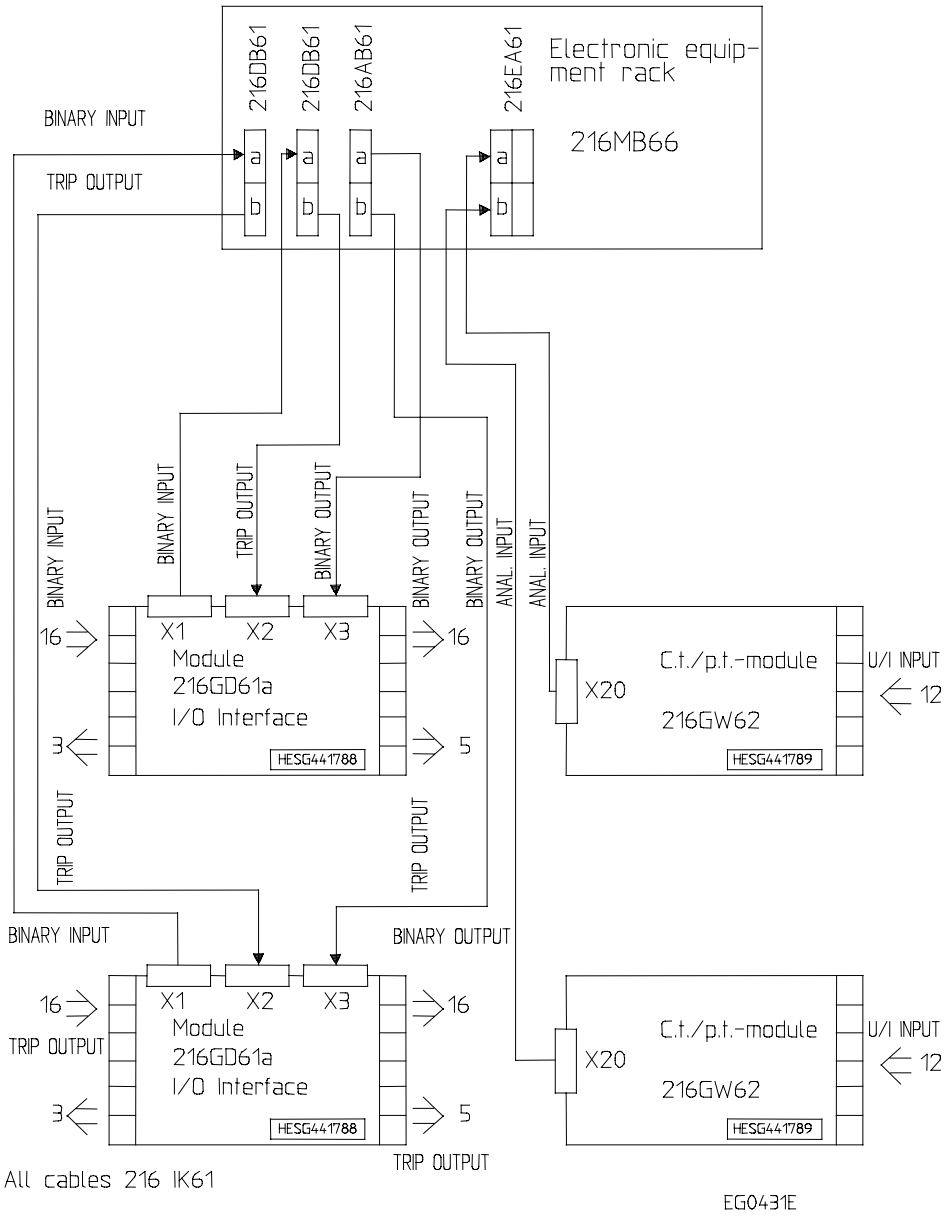


Fig. 2.8 Wiring diagram of the full version

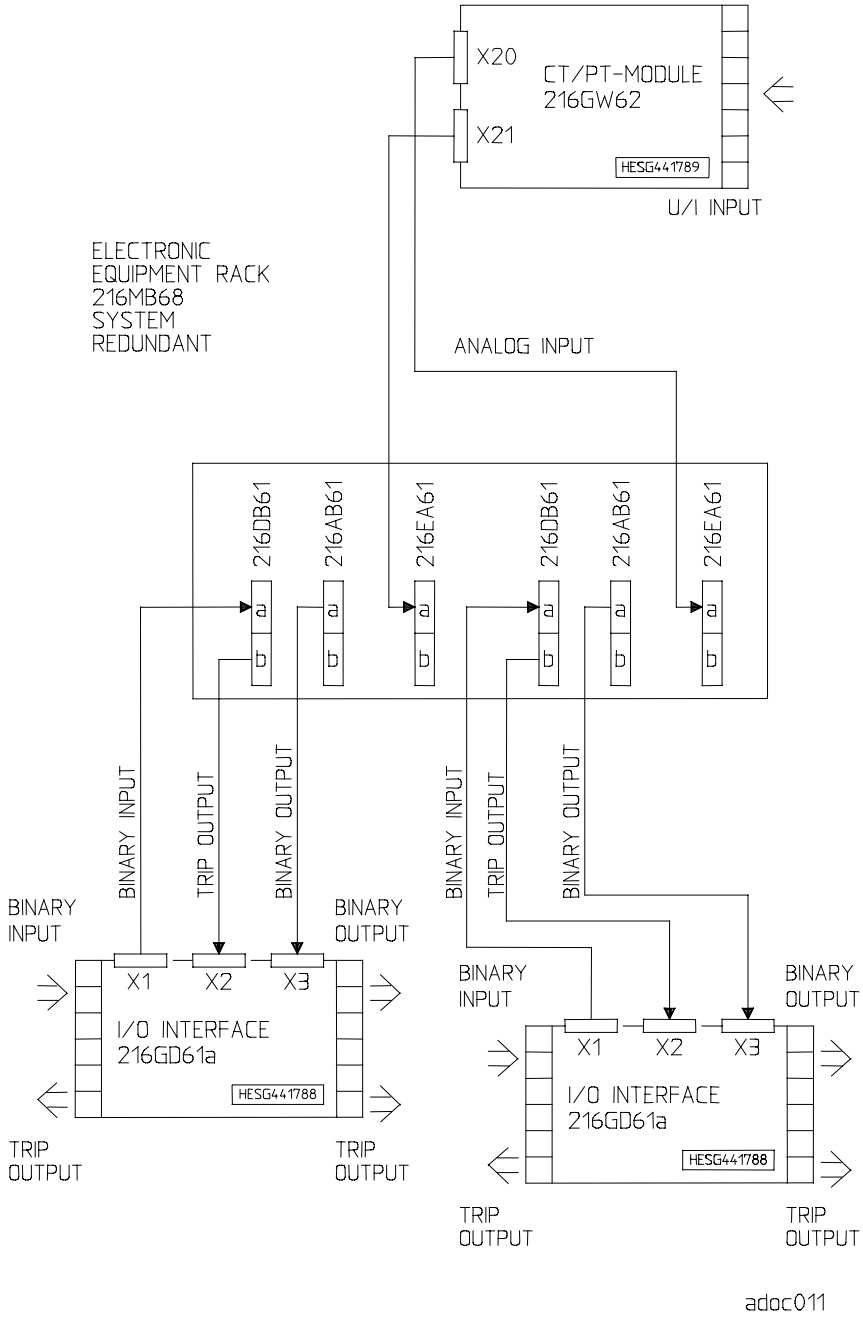


Fig. 2.9 Wiring diagram of the basic version

When allocating the signalling and trip relays to protection functions in the full version, note that the channel number is determined by the electronic units:

- The 216AB61 unit has 32 (2 x 16) signalling outputs. All outputs 1...16 are available for use on the 216GD61a. When using a second 216GD61a unit, signalling relay O/P's 1...16 and 17...32 can be controlled.
- Apart from the binary I/P's, the 216DB61 unit is equipped with 8 tripping O/P's. Outputs 1...8 are available for use on the 216GD61a and, when there is a second 216GD61a, outputs 9...16 as well.

216IK61 standard cables connect the electronic equipment rack to the other assemblies of the system via connectors X1, X2, X3 and X20. The wiring diagram for the basic version is shown in Fig. 2.7 and for the full version in Fig. 2.8.

Further details of the auxiliary relay and opto-coupler unit 216GD61a are given in Section 2.7.2.

Figure 12.40 shows the wiring diagram of a redundant auxiliary d.c. supply with a reset switch. Only those terminals used on lesser versions (e.g. basic version) are wired.

2.4. Auxiliary supply

2.4.1. Auxiliary supply distribution

A system resp. the 216MB6. equipment rack can be equipped with one or two redundant auxiliary d.c. supply units (DC/DC converters). Fig. 2.10 shows the auxiliary d.c. supply system with either two 216NG61, 216NG62 or 216NG63 units.

All electronic units and I/O modules have been designed to operate with redundant auxiliary d.c. supplies. As long as one of the two 24 V supplies is available, the correct operation of all the equipment's functions is assured. The B448C parallel bus has two redundant auxiliary d.c. supply lines designated USA and USB and the redundant supplies for the electronic units are achieved by connecting them to both. The 216NG6. units also provide the auxiliary d.c. supply for the I/O modules. The corresponding auxiliary voltage UP (24 V)/ZP (0 V) is distributed to the individual I/O modules via a terminal block.

Legend of Fig. 2.10:

USA, USB	:	aux. supply lines		24 V DC
ZD	:	aux. supply return line		0 V
SML	:	general alarm line		"System defect"
CK	:	stand-by signal line		"Stand-by"
Red.	:	"Redundant" circuit (connections to the redundant 216NG6.)		
F100	:	fuses:	216NG61	6.3 A slow
			216NG62	2.5 A slow
			216NG63	1.6 A slow
K100	:	aux. signalling relay "24 V failure"		
UP	:	aux. supply line for I/O modules		24 V
ZP	:	aux. supply return line for I/O modules		0 V

See legend of Fig. 2.1 for other symbols.

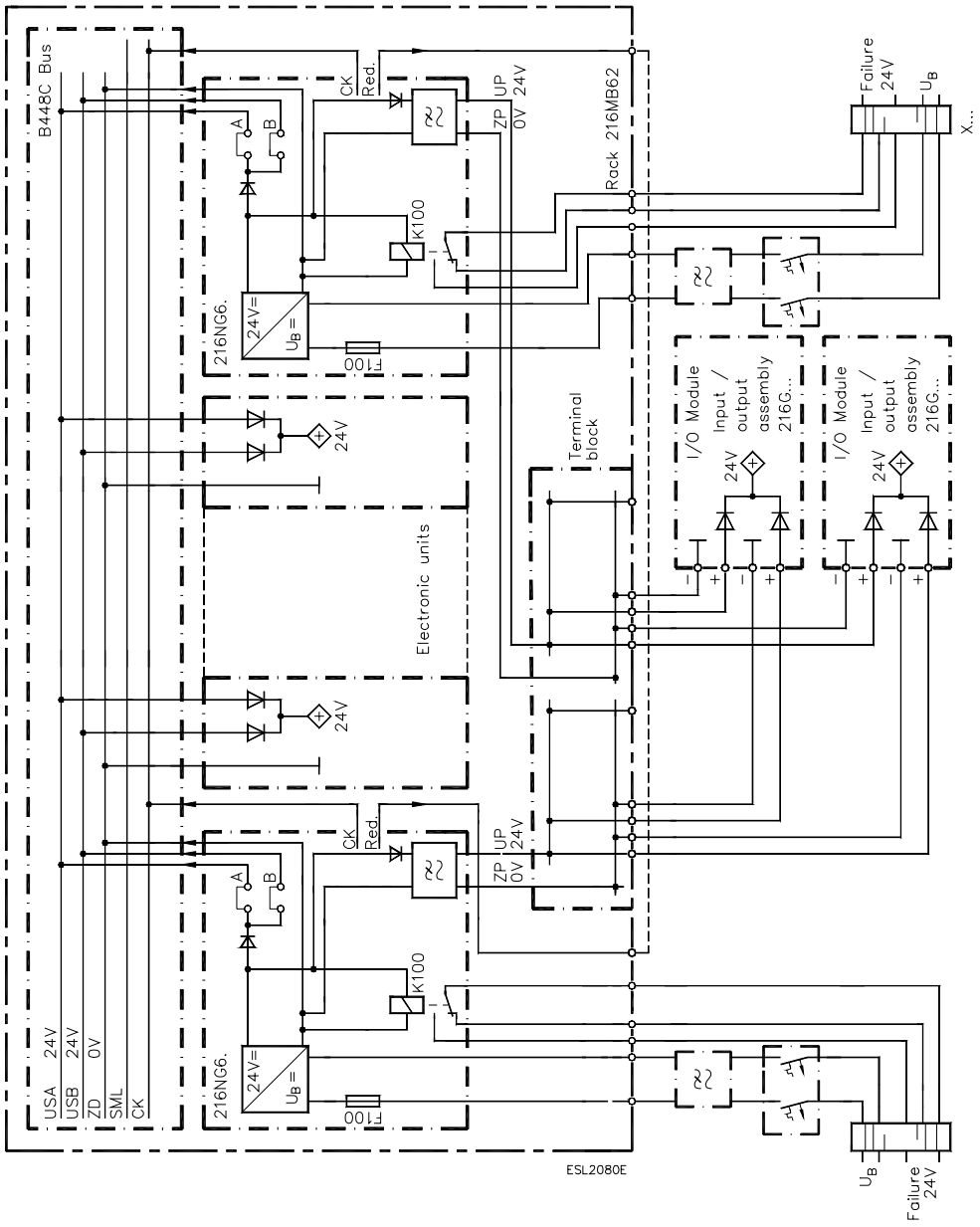


Fig. 2.10 Auxiliary supply system of the RE. 216

216MB66 rack with 1 auxiliary supply unit Type 216NG6.:

Plug-in jumpers A and B must both be inserted.

- The 216NG6. feeds both auxiliary supply lines USA and USB on B448C.
- The I/O modules have a single supply.

216MB66 rack with 2 auxiliary supply units Type 216NG6.:

Plug-in jumpers A and B on all 216NG6.'s must both be inserted.

- The auxiliary supply lines USA and USB are supplied separately by the two redundant 216NG6. units.
- The I/O modules are supplied separately by the two redundant 216NG6. units.

It is also possible for the first 216NG6. unit to supply just the parallel bus and electronic units and the second 216NG6. to supply just the I/O modules (i.e. single supply). In this case:

- plug-in jumpers A and B on the first 216NG6. must be inserted
- plug-in jumpers A and B on the second 216NG6. must be withdrawn.

Refer to the specific set of installation diagrams for the wiring of the auxiliary d.c. supply circuit for a particular plant.

Should the 24 V auxiliary d.c. supply fail, none of the stored functions or user settings are lost.

2.4.2. Auxiliary d.c. supply units 216NG61, 216NG62 and 216NG63

The 216NG6. auxiliary d.c. supply unit transforms the station battery voltage U_B to 24 V d.c. and provides electrical insulation between I/P and O/P. The technical data are given in the data sheet (refer to Section 1.2. for the data sheet number). Depending on the station battery voltage U_B, one of the following types is installed:

216NG61 :	for U_B	=	48 / 60 V DC ± 25 %, i.e. 36...75 V DC
216NG62 :	for U_B	=	110 / 125 V DC ± 25 %, i.e. 82.5...156 V DC
216NG63 :	for U_B	=	220 / 250 V DC ± 25 %, i.e. 165...312.5 V DC

Design

Figures 12.3 and 12.4 show the front and rear views of the auxiliary d.c. supply units. The units have a width of 3 divisions (3T). The operation and the construction of the three types 216NG61, 62 and 63 are identical.

Frontplate signals and controls (see Fig. 12.3)

LED "U IN" (green):
Lights when the I/P voltage (station battery voltage U_B) is available.

LED "U OUT" (green):
Lights when the O/P voltage (24 V DC before the plug-in jumpers A and B) is available.

Both LED's "U IN" and "U OUT" must be lit during normal operation, i.e. when the protection is on-line and functioning.

Switch "I/O":
Main ON/OFF switch for the auxiliary d.c. supply unit.
I : ON
O : OFF

Settings (see Fig. 12.4)

The states of the plug-in jumpers A and B at the rear of the unit determine whether one or both of the auxiliary d.c. supply lines USA and USB are supplied. Fig. 2.11 shows the corresponding plug-in jumper positions (see also Fig. 2.10).

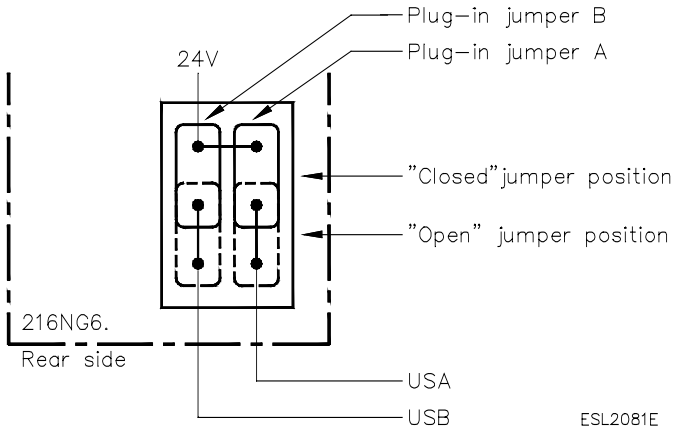


Fig. 2.11 Plug-in jumpers A and B on 216NG6.

"Closed" position: USA or USB supplied with 24 V
"Open" position : USA or USB not supplied

"24 V failure" signal

The failure of the 24 V output voltage is signalled on the front of the unit concerned by the LED "U OUT".

The failure of the 24 V output voltage is signalled remotely in three ways (see Fig. 2.10):

a) By auxiliary signalling relay K100 in 216NG6. .
K100 is continuously energised in normal operation, i.e. when the 216NG6. is switched on, and resets in the event of a failure of the 24 V output voltage.

b) By the stand-by signal line (bus conductor) CK.
CK is at logical "1" during normal operation (O/P CHO02 energised). O/P CHO02 resets in the event of a failure of the 24 V output voltage.
Note: If two 216NG6. auxiliary supply units are installed in an equipment rack and the jumpers are set for redundant supply, the failure of the 24 V output voltage of just one of the units is not signalled by the CK bus conductor.

c) In the event of an auxiliary supply failure, the first binary O/P unit energises the SML "System defect" signal line on the B448 parallel bus. This is signalled remotely via channel CHO01.

2.5. Parallel bus and electronic units

2.5.1. Equipment rack 216MB66 with parallel bus B448C

Figures 12.5 and 12.6 show the equipment rack without the plug-in electronic units. The 19" rack is 21T (T = 17 mm) wide and 6U (U = 44.55 mm) high. The rack, the B448C parallel bus, the connectors for the standard cables and the terminal block form an invariable unit.

Settings

No settings have to be made to the equipment rack.

Care should be taken that the standard cables go to the appropriate connectors for the electronic units actually inserted. Refer also to Sections 2.2.1. and 2.2.2. and the set of specific plant diagrams.

2.5.2. Processing unit 216VC62a

All the available protection and logic functions described in Section 3 are stored as a software module library in the 216VC62a processing unit. All the user settings for the activated functions and the configuration of the protection, i.e. assignment of I/P and O/P signals (channels) to the protection functions, are also stored in this unit. The software is downloaded using the operator program.

The protection functions and their associated settings necessary for a particular plant are selected and stored with the aid of the portable user interface (PC). Every activated function requires a certain percentage of the total available computing capacity of the processing unit (see Section 3).

The processing unit 216VC62a has a computing capacity of 425%.

The 216VC62a is used both as a processor and as an interface to the interbay bus (IBB) in the substation monitoring system (SMS) and the substation automation system. The available communication protocols are:

- SPA BUS
- LON BUS
- MCB interbay bus
- MVB process bus.

The SPA BUS interface is always available. The LON and MVB protocols are transferred by PC cards.

The supply to the memory in the 216VC62a is maintained in the event of an interruption by a gold condenser so that the event list and disturbance recorder data remain intact. The disturbance recorder data can be read via either the interface on the front of the 216VC62a or the object bus. The data can be evaluated using the “EVECOM” evaluation program. The internal clock of the RE. 216 can be synchronised via the object bus interface of SMS/SCS systems or by a radio clock.

I/P signals (channels) from the B448C bus:

- digitised measured variables: primary system currents and voltages
- logic signals: external I/P signals
- 24 V auxiliary supply and data exchange with the B448C bus.

O/P signals (channels) to the B448C bus:

- signal O/P’s from the protection and logic functions selected
- tripping O/P’s from the protection and logic functions selected
- data exchange with the B448C bus.

The designation of the I/O channels is identical to that of the I/O unit (see Table 2.1).

The main components of the unit are:

• Processor type; for running the programs	80486 DX-2, 50MHz
• Bus interface (DPM/RAM) for data exchange with the B448C bus	64 kByte
• Program memory (Flash EPROM) for storing protection and logic functions (software module library)	4 MByte
• Data memory (RAM), main memory for running programs	2 MByte
• Data memory (Flash EEPROM) for recording selected functions and settings	2 MByte

- Serial interface (RS 232) for connection of the portable user interface
- PCMCIA interface for LON / MVB buses
- Serial interface (RS 232) for SPA bus,

Frontplate signals and controls (see Fig. 12.7)

LED "AL" (red):
Alarm. Lights for an internal defect. See Section 6.1. for possible causes.

LED "MST" (yellow):
Master. Lights when the unit is communicating with the bus and data are being exchanged. (May light only briefly or flash.)

LED's "L1-L6" (yellow):
L1, L2: System status (see Section 6.2.)
L3, L4: Communication (with the user interface (PC)) (see Section 6.2.)
L5: LON wink telegram received
L6: Flash EEPROM's in write mode.

Socket "PSV":
Passive. The unit's functions are blocked when the shorting pin is inserted.

Socket "RES":
Reset. The program is restarted by briefly inserting the shorting pin. All other units are reinitialised at the same time. The list of events is not deleted.

Settings

No (hardware) settings are necessary on the 216VC62a unit itself.

2.5.3. Analogue I/P unit 216EA61

The 216EA61 input unit receives the analogue measured variables from the 216GW61 input transformer module, digitises them and transfers them to the B448C bus.

The unit has 24 analogue I/P channels, i.e. a maximum of two 216GW61 input transformer modules can be connected to a 216EA61 I/P unit (see also Section 2.6.1.).

- connector "a" (upper) : channels CH01...CH12
- connector "b" (lower) : channels CH13...CH24

Within the protection system, the designations of the O/P channels correspond to those of the I/P channels. Where a system requires several 216EA61 units, the measurement channels are designated within the system according to Table 2.1.

Design

Figure 12.8 shows the front view of the 216EA61 I/P unit, which is a plug-in unit with a width of 2 standard divisions (2T). The internal auxiliary supply voltage is 5 V and is derived inside the unit from the 24 V auxiliary d.c. supply. The unit's main components are:

- a 24 (measurement) channel analogue (-40 V...+40 V)-to-digital converter
- a processor for pre-processing the measured variables (80C186)
- a bus interface (64 kByte DPM/RAM)
- a program memory (128 kByte EPROM)
- a main memory (64 kByte RAM)
- an electrically deletable and programmable data memory (8 kByte EEPROM).

Frontplate signals and controls (see Fig. 12.8)

LED "ALARM" (red):
Lights when the unit has an internal defect. See Section 6.1. for possible causes.

LED "MST" (yellow):
Master. Lights when the unit communicates with the bus and exchanges data. (May light only briefly or flash.)

LED "RUN" (green):
Operation. Lights when the program is running, i.e. it lights continuously during normal operation. (The digitised measured variables are not transferred to the bus, if this LED is not lit.)

Socket "PASSIVE":
The A/D converter is blocked and no data (digitised measured variables) are transferred to the bus when the shorting pin is inserted. The already stored data and measured variables are not deleted.

Socket "RESET":
The program is restarted by briefly inserting the shorting pin. All the units are reinitialised and the stored measured variable tables are deleted.

Settings

No (hardware) settings are necessary on the 216EA61 unit itself.

The measuring channels are assigned to the activated protection functions (configuration) with the aid of the portable user interface (PC) connected to the 216VC62a unit.

Refer to the set of specific plant diagrams for the configuration of the particular plant.

2.5.4. Binary O/P unit 216AB61

The 216AB61 output unit transfers signals generated by the activated protection functions to the auxiliary relays K1...K16 in the 216GA61 O/P relay unit for purposes of remote signalling.

The unit has 32 O/P channels, i.e. a single 216AB61 unit can control two 216GA61 O/P relay units (see also Section 2.4.2.).

- connector "a" (upper) : channels CHO01...CHO16
- connector "b" (lower) : channels CHO17...CHO32

If there are several 216AB61 units in a system, the O/P channels are designated within the system according to Table 2.1.

O/P channels CHO01 and CHO02 of the first 216AB61 unit in a system (at rack division 12; see Fig. 2.2) are reserved for system alarm signals.

- CHO01 : Stand-by (general alarm line SML); active during normal fault-free operation.
- CHO02 : No system defect (stand-by signal line CK); active during normal operation.

Refer to Section 6.2. for the significance of the system alarm signals.

All 32 O/P channels of the second 216AB61 unit in a system are available for the signals of active protection functions.

Design

Figure 12.10 shows the front view of the binary O/P unit, which is a plug-in unit with a width of 1 standard division (1T). The internal auxiliary supply voltage is 5 V and is derived inside the unit from the 24 V auxiliary d.c. supply. The unit's main components are:

- a bus interface
- an O/P register and O/P monitor
- O/P driver stages.

Frontplate signals and controls (see Fig. 12.10)

LED "AL" (red):
Alarm. Lights when the unit has an internal defect. See Section 6.1. for possible causes.

LED's "CH OUT" (yellow):
O/P channels. Indicate which of the activated protection or logic functions have picked up. The LED's remain lit for as long as the functions remain the picked up.

- 01...32 of the first unit corresponding to CHO01...CHO32
- 01 and 02 of the first unit light continuously during normal operation (system alarm signal).
- 01...32 of the second unit corresponding to CHO33...CHO64

Socket "PSV":
Passive. All O/P channels are blocked when the shorting pin is inserted. None of the LED's light. The statuses stored in the O/P register are not deleted.

Settings (see Fig. 12.11)

The position of the plug-in jumper XJ1 on the PCB determines whether the unit's system alarm signals ("System defect" and "Stand-by" signals CHO01, CHO02) are operational or not. They must be in operation in the first O/P unit of a system.

- 1st 216AB61 (at rack division 12): XJ1 in position X4-X5
- 2nd 216AB61 (at rack division 13): XJ1 in position X3-X4

The signalling channels are assigned to the activated protection functions (configuration) with the aid of the portable user interface (PC) connected to the 216VC62a unit.

Refer to the set of specific plant diagrams for the configuration of the particular plant.

2.5.5. Analogue/binary O/P unit 216AC61

O/P unit 216AC61 has 8 analogue and 16 binary O/P channels. The analogue O/P's supply impressed currents in the range 0 - 20 mA, e.g. for driving instruments. They are thus used for displaying the variables measured by protection functions or an SCS. The analogue and binary O/P channels are neither electrically insulated from each other nor from the auxiliary supply.

The binary O/P signals generated by the active protection functions (protection and control) can be transferred to the auxiliary relays K1...K16 in the O/P relay unit 216GA61 for purposes of remote signalling.

- connector "a" (upper) : binary channels CHO01...CHO16
- connector "b" (lower) : analogue channels AA001...AA008

Where a system requires several 216AB61 and/or 216AC61 units, the O/P channels are designated within the system according to Table 2.1.

If the system does not include a 216AB61 unit, the binary O/P channels CHO01 and CHO02 of the first 216AC61 unit (at rack division 12; see Fig. 2.2) are used for the system alarms (the unit can thus be used instead of a 216AB61).

- CHO01 : Stand-by (general alarm line SML); active during normal fault-free operation.
- CHO02 : No system defect (stand-by signal line CK); active during normal operation.

Refer to Section 6.2. for the significance of the system alarm signals.

All 16 O/P channels of the second 216AC61 unit in a system are available for the signals of active protection functions.

Design

Figure 12.43 shows the front view of the analogue/binary O/P unit, which is a plug-in unit with a width of 1 standard division (1T). The internal auxiliary supply voltages are 5 V and ±15 V for the analogue O/P circuits and are derived inside the unit from the 24 V auxiliary d.c. supply. The unit's main components are:

- a bus interface
- an O/P register and O/P monitor for binary signals
- O/P driver stages for binary signals
- an O/P register for analogue signals
- a D/A converter
- O/P driver stages for analogue O/P currents.

Frontplate signals and controls (see Fig. 12.43)

LED "AL" (red):

Alarm. Lights when the unit has an internal defect. See Section 6.1. for possible causes.

LED's "CH OUT" (yellow):

O/P channels. Indicate which of the activated protection or logic functions have picked up. The LED's remain lit for as long as the functions remain picked up.

CH OUT 01...16 of the first unit corresponding to CHO01...CHO16
CH OUT 01 and 02 of the first unit light continuously during normal operation (system alarm signal)
CH OUT 01...16 of the second unit corresponding to CHO17...CHO32

Socket "PSV":

Passive. All O/P channels are blocked when the shorting pin is inserted. None of the LED's light. The statuses stored in the O/P register are not deleted. None of the analogue O/P's conducts current (0 mA).

Settings (see Fig. 12.44):

The position of the plug-in jumper XJ1 on the PCB determines whether the unit's system alarm signals ("System defect" and "Stand-by" signals CHO01, CHO02) are operational or not. They must be in operation in the first O/P unit of a system.

- 216AB61/216AC61 (at rack division 12):
  XJ1 in position X4-X5 (active)
- Additional O/P units (from rack division 13 onwards):
  XJ1 in position X3-X4

The signalling channels are assigned to the activated protection functions (configuration) with the aid of the portable user interface (HMI) connected to the 216VC62a unit.

The analogue channels are assigned to variables measured by either an SCS or protection functions using the HMI (Function AC61). The scale of the O/P current range can be varied within ±400 % of its nominal range of 0...20 mA, the minimum and maximum percentages being set separately.

Example: Display of the measured value of a current function with a rated current In = 1 A.

Scale: Minimum = 0 %, Maximum = 200 %. The O/P of 0...20 mA corresponds to 0...2 A.

Example: Display of the measured value of a power function from -50 % to +150 % Pn.

Scale: Minimum = -50 %, Maximum = 150 %
0 mA corresponds to P = -50 %, 5 mA corresponds to P = 0 % and 20 mA corresponds to P = +150 %.

When displaying SCS measure variables, 100 % O/P current corresponds to a value of 160. The range of values is limited to ±320, i.e. the practical scaling value for SCS measured variables is ± 200 %.

2.5.6. Binary I/P and tripping unit 216DB61

The binary I/P and tripping unit comprises 16 I/P and 8 O/P channels. The O/P channels are used to transfer the tripping commands of activated protection functions to the 216GA62 tripping relay module (see also Section 2.6.3.). The I/P channels are used for external signals from the 216GE61 I/P relay module, which it transfers to the 216VC62a processing unit via the bus (see also Section 2.6.4.).

- connector "a" (upper) : I/P channels CHI01...CHI16
- connector "b" (lower) : channels CHO01...CHO08.

If there are several 216DB61 units in a system, the I/P and O/P channels are designated within the system according to Table 2.1.

The position of the plug-in jumper BR1 on the PCB of 216DB61 determines whether the "ENABLE" and "BLOCK CH OUT" functions are operational or not, i.e. whether the tripping channels CHO01...CHO08 are enabled or disabled. The enabling and blocking functions only concern the 216DB61 unit.

BR1 in position X4: (B/E inactive, see Fig. 5.21d)

The ENABLE 1/2 and BLOCK 1/2 functions are disabled. I/P channels CHI13...CHI16 function as normal external I/P's, i.e. the signals are transferred via the bus to the 216VC62a unit as in the case of channels CHI01...12.

BR1 in position X3: (B/E active)

The ENABLE 1/2 and BLOCK 1/2 functions are enabled.

The ENABLE 1 and 2 I/P's (CHI13 and CHI14) both have to be enabled (AND gate) for O/P channels CHO01...08 to be enabled.

In order to disable channels CHO01...08, a logical "1" must be applied to either the BLOCK 1 I/P or the BLOCK 2 I/P (CHI15 or CHI16; OR gate).

The tripping channels are also disabled, should a short-circuit occur in one of the tripping channel driving stages. Either channel group CHO01, 03, 05, 07 is disabled or channel group CHO02, 04, 06, 08, depending on in which group the short-circuit is.

Design

Figure 12.12 shows the front view of the binary I/P and tripping unit, which is a plug-in unit with a width of 1 standard division (1T). The internal auxiliary supply voltage is 5 V and is derived inside the unit from the 24 V auxiliary d.c. supply. The unit's main components are:

- a bus interface
- an I/P register
- an O/P register and O/P monitor
- O/P driver stages
- fault detector.

Frontplate signals and controls (see Fig. 12.12)

LED "AL" (red):

Alarm. Lights when the unit has an internal defect. See Section 6.1. for possible causes.

LED's "CH IN" (yellow):
01...12

I/P channels. Indicate which of the I/P's CHI01...CHI12 are energised.

LED's "ENABLE" (yellow):
1/2

BR1 in position X4: (B/E inactive)
Light when I/P's CHI13...CHI14 are energised.

Caution:

BR1 in position X3: (B/E active)
LED's 1 and 2 must be continuously lit during normal operation. (CH OUT enabled).

LED's "BLOCK" (yellow):
1/2

BR1 in position X4: (B/E inactive)
Light when I/P's CHI15...CHI16 are energised.

BR1 in position X3: (B/E active)
LED's 1 and 2 must not light during normal operation.
(CH OUT enabled)

LED's "CH OUT" (yellow):
01...08

Tripping signals. Light according to which of the channels CHO01...CHO08 are energised.

Settings (see Fig. 12.13)

The position of the plug-in jumper BR1 on the PCB determines whether the functions for enabling and disabling the tripping channels are in operation or not.

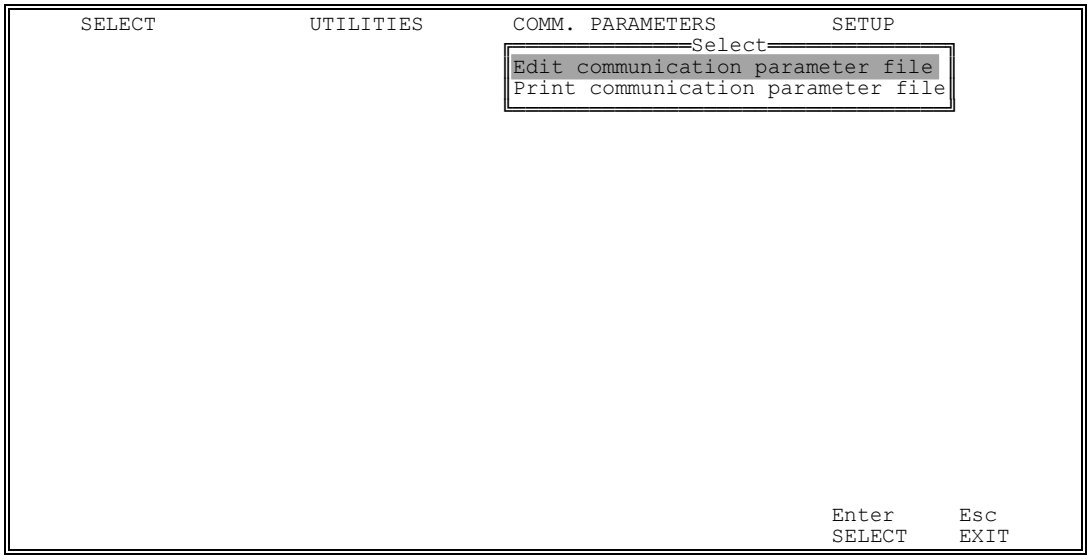
The tripping channels are assigned to the activated protection functions (configuration) with the aid of the portable user interface (PC) connected to the 216VC62a unit.

The earmarking of the various I/P's to be recorded as events is also performed via the HMI (binary inputs).

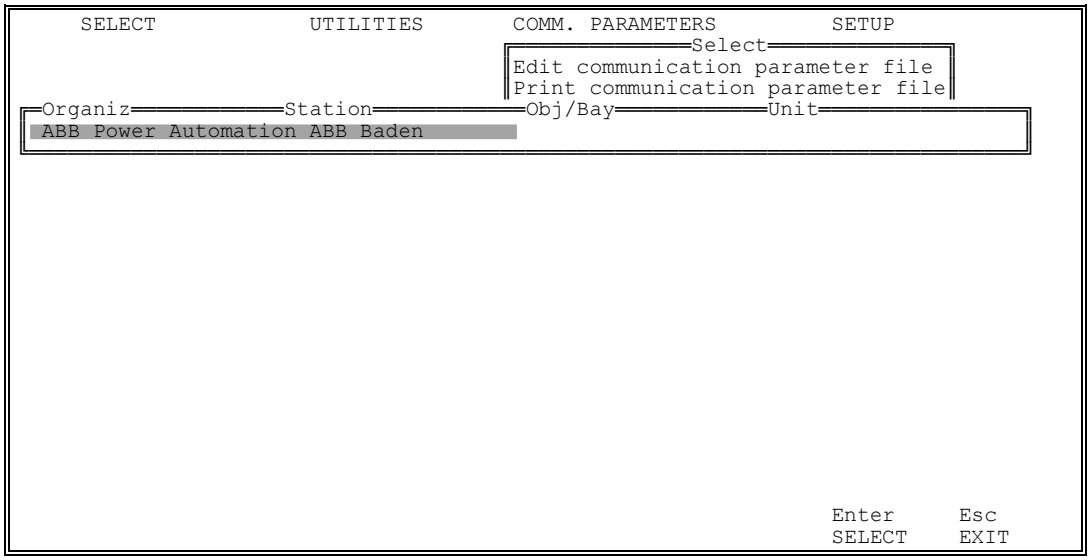
Refer to the set of specific plant diagrams for the configuration of the particular plant.

5.13.5.2. Updating the Spin.CNF file

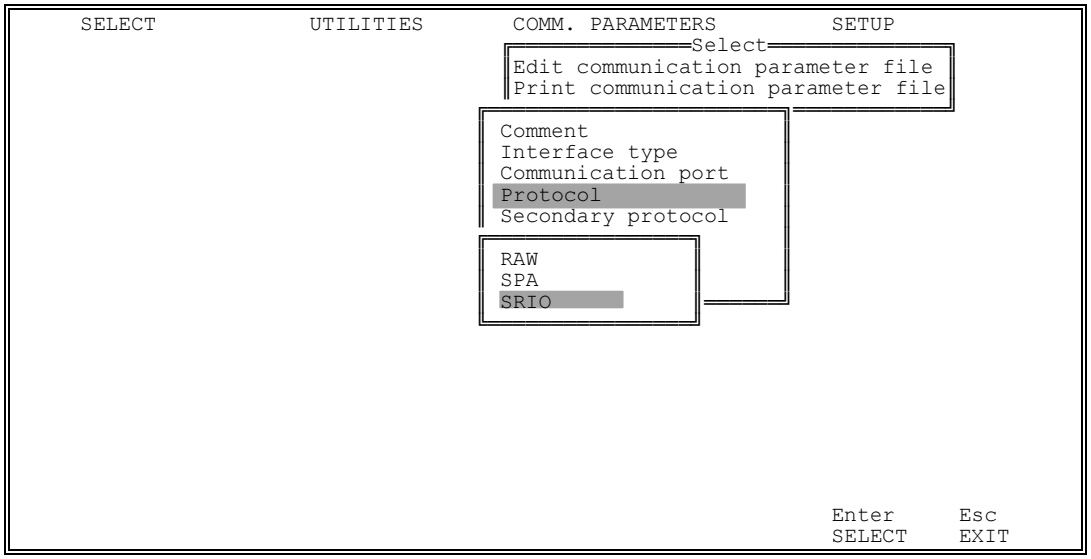
- Select *Edit comunication parameter file* from the *Comm parameters* menu.



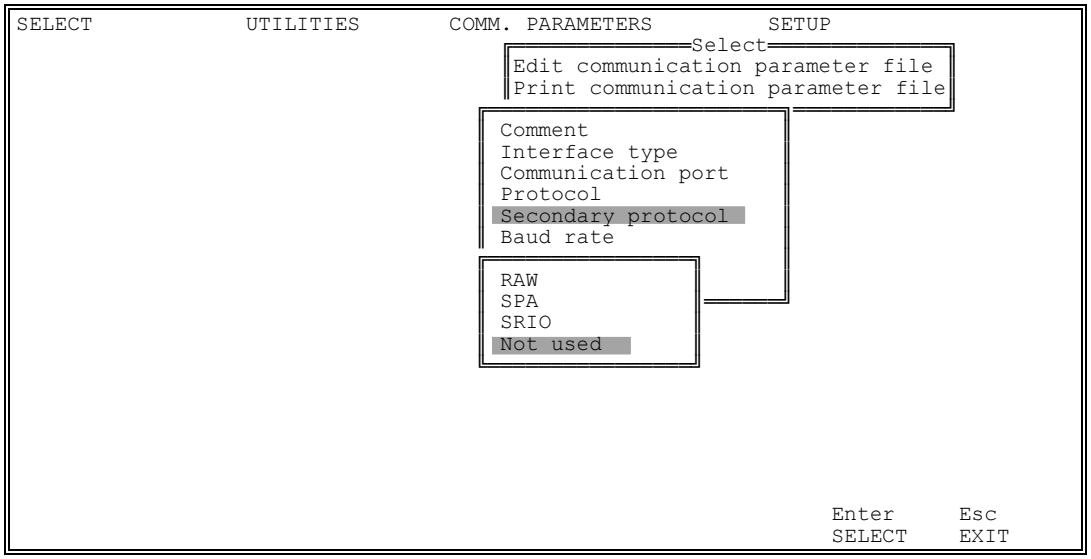
- Select the desired station and respond with 'Yes' to the question *'Continue with this file?'*.



- Select *'SRIO'* from the *Protocol* sub-menu.



- Select **NOT USED** from the *Secondary protocol* sub-menu

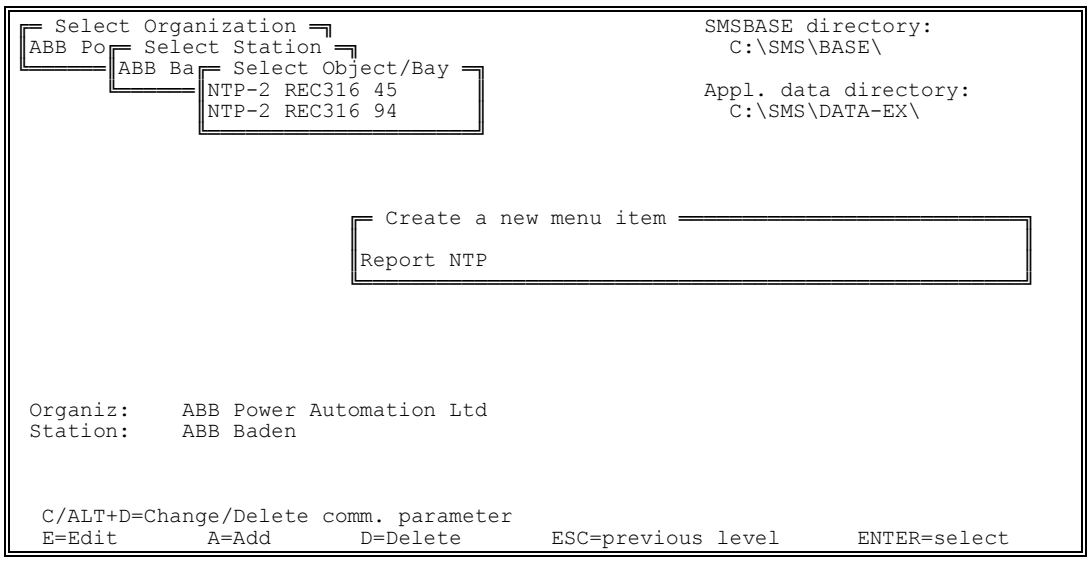


- All other settings can be left at their default values.

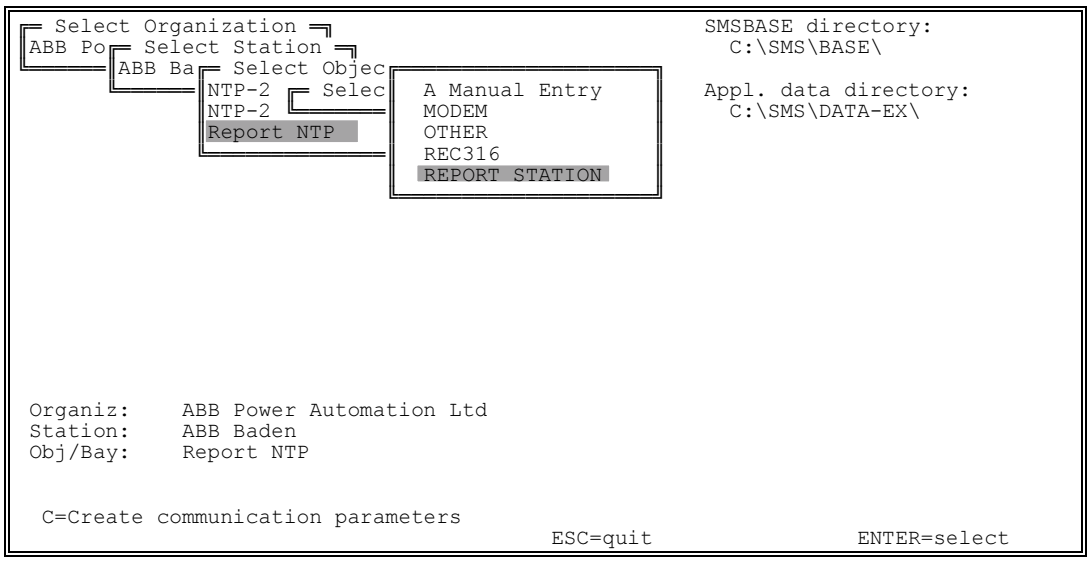
Note that all the above settings must agree with the SRIO settings (Syspar 4).

5.13.5.3. Creating a report station

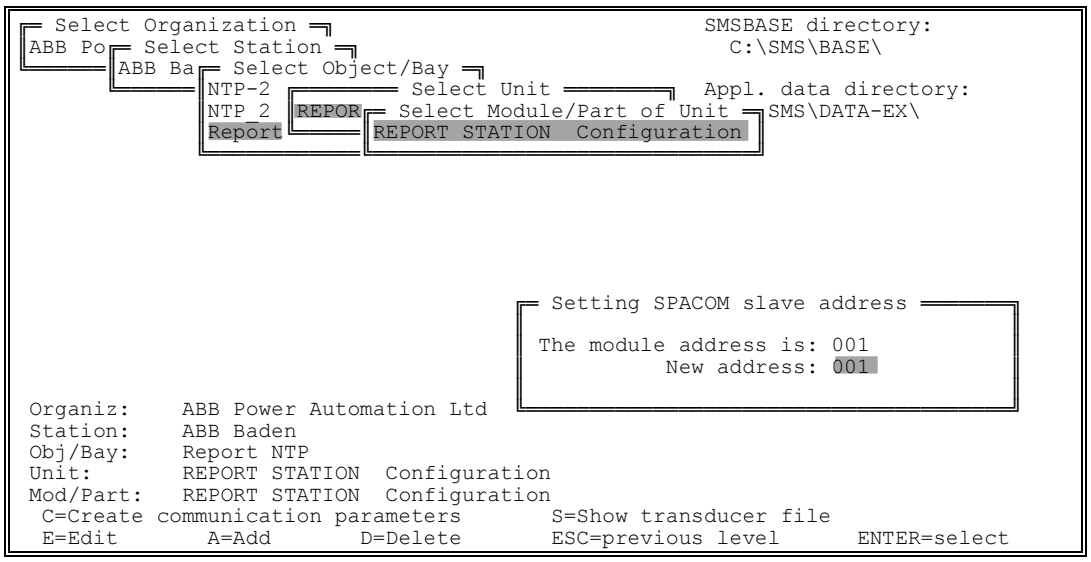
- Select *Alter application structure* from the *Utilities* menu.
- Omit levels 1 and 2 by pressing <Enter>.
- **Level 3:** To enter a bay name for the report station, select *Select object/bay* and enter 'a'.



- **Level 4:** Press <Enter> to proceed to the *Select unit* window and enter 'a'. Now select *Report station* from the list which appears.



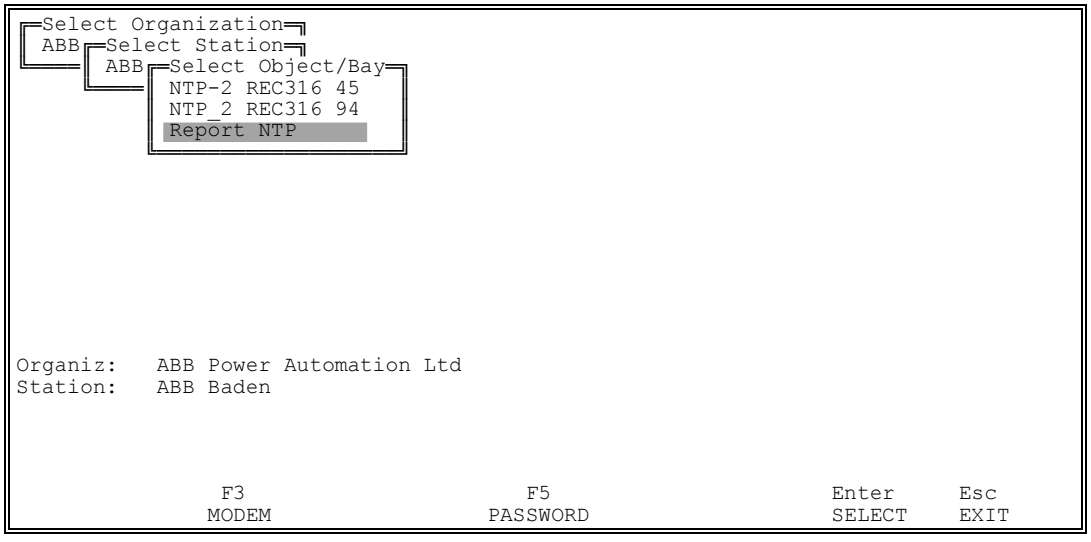
- **Level 5:**
  Press <Enter> to proceed to the *Select module/part of unit* window and then the data input window *Set Spacom slave address.* The default values in this window can be accepted.



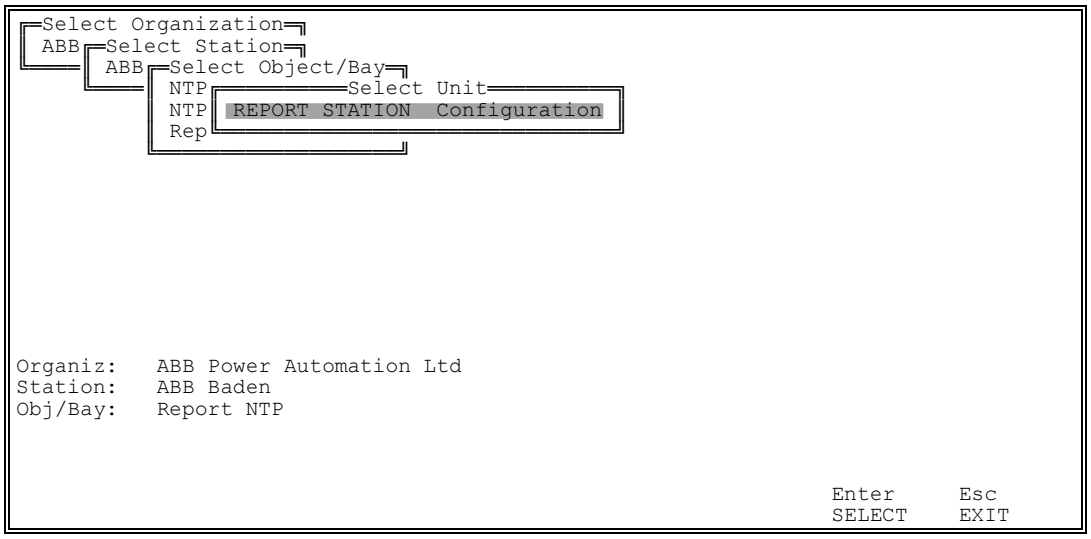
Take care not to enter a device address in this window.

5.13.5.4. Entering the SRIO address for 'Reporting'

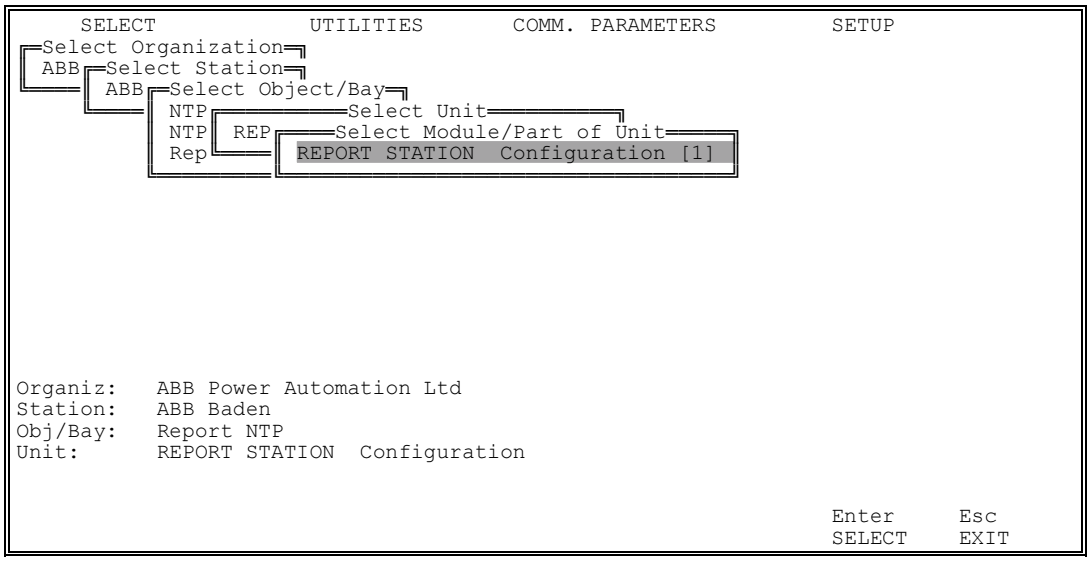
- Select the menu item *Select* from the main menu and then the *Select object/bay* window (Level 3). Now select the report station.



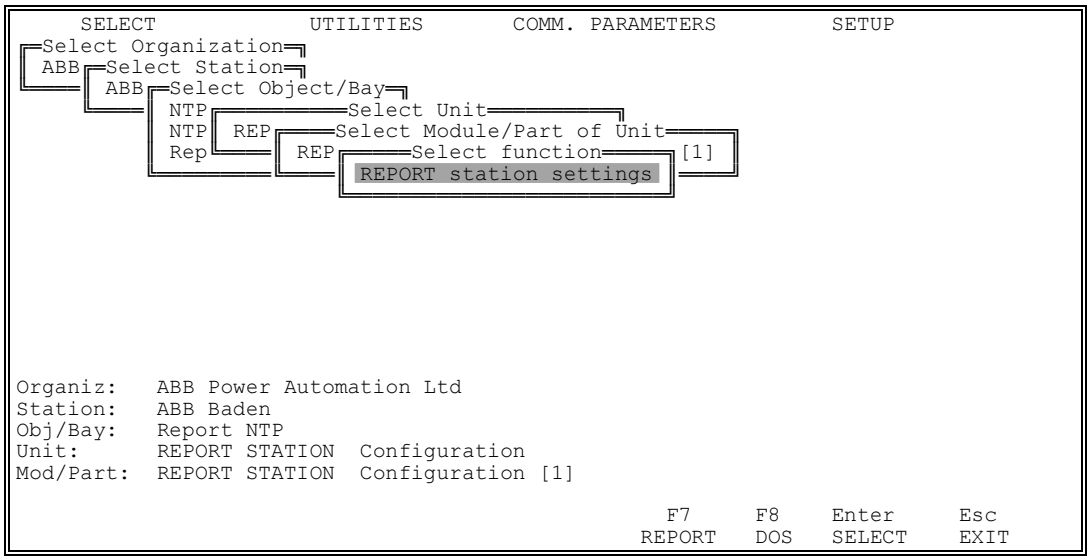
- Select Report station configuration in the Select unit window (Level 4).



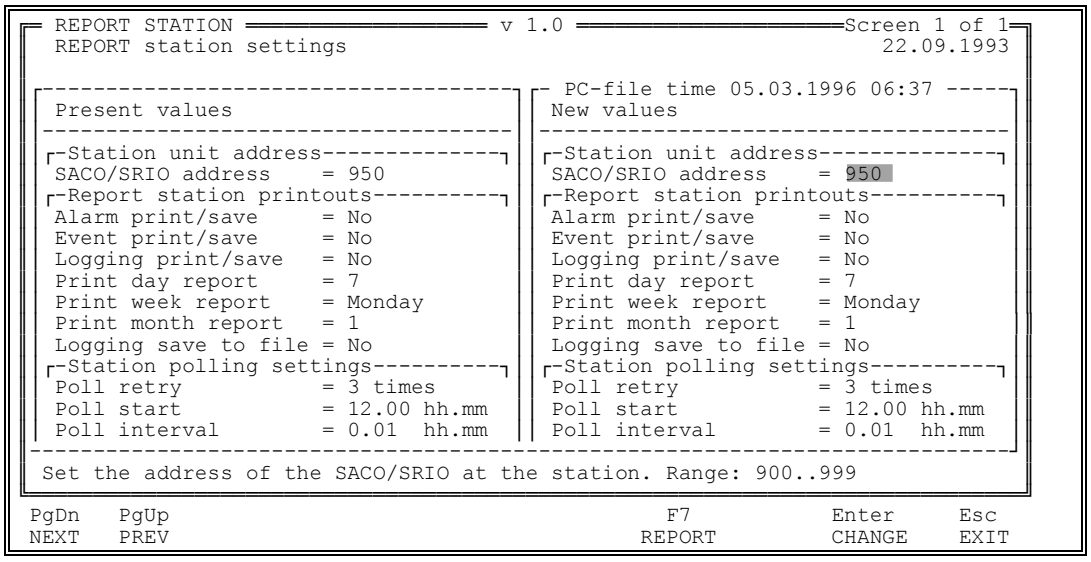
- Select *Report station configuration* in the *Select module/part of unit* window (Level 5).



- Select the menu item *Select function* and then *Report station settings* (Level 6).



- The SRIO address can now be entered and all the 'Reporting' settings made in the window which opens.



Refer to the Section 'Reporting' in the SMS010 manual for further information.

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6. SELF-MONITORING AND DIAGNOSIS

6. SELF-MONITORING AND DIAGNOSIS

6.1. Self-monitoring and diagnosis

The RE. 216 system is equipped with self-monitoring and diagnostic functions, which operate continuously and instantly block the protection functions should a defect occur and the correct operation of the protection be in question.

A defect is signalled on the frontplate of the device and remotely by the general alarm signalling relay. The program records the disturbance in the event list.

The status of the system and the individual units and the event list can be viewed using the diagnostic function on the control unit (PC).

6.1.1. Self-monitoring

Each unit has its own self-monitoring function, which signals the status of the unit to the system via its device status register.

The principal signals transmitted by the function are:

GNB : unit not ready
SSG : general device alarm
SSS : general system alarm.

A defect is also signalled to the other units connected to the bus by the “SML” or “CK” bus lines and on the frontplate of the unit concerned by the alarm LED “AL”.

A defective unit sets the general alarm bus line “SML” (i.e. applies a logical “1”). In normal operation, the bus line “CK” oscillates at the clock frequency of the B448C bus. A defective unit disables this signal (i.e. connects the line to logical “0”).

Legend for the following tables:

1 : logical “1” or LED lit
0 : logical “0” or LED extinguished
- : no influence.

6.1.1.1. Auxiliary supply units 216NG61, 216NG62 and 216NG63

Status	**Signal via:**		
	UIN	**UOUT**	**CK**
Normal operation “ON"	1	1	-
O/P voltage failure	1	0	0
I/P voltage failure	0	0	0

6.1.1.2. Processor unit 216VC62A

Status	**Signal via:**			
	Status	**CK**	**SML**	**AL**
Normal operation	-	-	-	0
24 V supply failure	-	0	-	0
Internal 5 V supply failure	SSG	0	1	1
Internal clock failure	SSG	0	1	1
RAM or ROM failure	SSG	-	1	1
B448C bus failure	SSS	-	-	0
"PASSIVE” connector inserted	GNB	-	-	0

Device status register:

Symbol	**Function**	**Weighting**
GNB	Unit not ready (passive pin inserted)	0002 Hex
EEPROM	FUPLA code not valid	0005 Hex
STG	Incorrect device configuration	0004 Hex
SSG	General alarm for device failure	0010 Hex
SSS	General alarm for system failure	0020 Hex
BBOE	Warm start following bus time-out	0040 Hex
SWTO	Warm start following watchdog time-out	0080 Hex
RAM	RAM error	0100 Hex
ROM	ROM error	0200 Hex
BERI	B448C bus failure	1000 Hex
ARBG	MBIC failure	2000 Hex
PER	Failure of a peripheral device - failure of the auxiliary supply for the O/P module of a 216AB61 - warm start of an other unit	4000 Hex
SML	SML line active	8000 Hex

6.1.1.3. Analogue input unit 216EA61

Status	**Signal via:**				
	Status	**CK**	**SML**	**AL**	**RUN**
Normal operation	-	-	-	0	1
24 V supply failure	-	0	-	0	0
Internal 5 V supply failure	SSG	0	1	1	0
Internal clock failure	SSG	0	1	1	0
RAM, ROM error	SSG	-	1	1	0
Defective analogue section	SSG	-	1	1	0
B448C bus failure	SSS	-	-	0	-
"PASSIVE" connector inserted	GNB	-	-	0	0

Device status register:

Symbol	**Function**	**Weighting**
GNB	Device not ready (passive pin inserted)	0002 Hex
STG	A/D converter disabled	0004 Hex
SSG	General alarm for device failure	0010 Hex
SSS	General alarm for B448C bus failure	0020 Hex
BBO	Warm start following bus time-out	0040 Hex
SWTO	Warm start following watchdog time-out	0080 Hex
RAM	RAM error	0100 Hex
ROM	ROM error	0200 Hex
VREF	Reference voltage out of tolerance	0400 Hex
ASE	Analogue section supply failure	0800 Hex
BERI	B448C bus failure	1000 Hex
ARBG	Arbitration error (Not all analogue data can be transferred via the bus.)	2000 Hex
PER	Redispatch interrupt	4000 Hex
SML	SML line active	8000 Hex

6.1.1.4. Binary input unit 216EB61

Status	**Signal via:**			
	Status	**CK**	**SML**	**AL**
Normal operation	-	-	-	0
24 V supply failure	-	0	-	0
Internal 5 V supply failure	SSG	0	1	1
Internal clock failure	SSG	0	1	1
RAM, ROM error	SSG	-	1	1
B448C bus failure	SSG	-	1	1
"PASSIVE" connector inserted	GNB	-	-	0

Device status register:

Symbol	**Function**	**Weighting**
GNB	Device not ready (passive pin inserted)	0002 Hex
STG	Incorrect device configuration, event signal disabled	0004 Hex
SSG	General alarm for device failure	0010 Hex
SSS	General alarm for B448C bus failure	0020 Hex
BBOE	Warm start following bus time-out	0040 Hex
SWTO	Warm start following watchdog time-out	0080 Hex
RAM	RAM error	0100 Hex
ROM	ROM error	0200 Hex
BERI	B448C bus failure	1000 Hex
ARBG	Synapsen 2 error: Synapse 2 from the analogue I/P unit 216EA61 is missing	2000 Hex

6.1.1.5. Binary input and output unit 216DB61

Status	**Signal via:**		
	Status	**SML**	**AL**
Normal operation	-	-	0
Internal 5 V supply failure	-	1	1
Defective O/P channel driver	SSG, FA0	1	1
Tripping relay module supply failure	SSG, FA1	1	1
Data transmission error for a received tripping signal	SSG, FA2	1	1
I/P module UP supply failure	SSG, UP	1	1
Device not initialised	GNB	1	1

Device status register:

Symbol	**Function**	**Weighting**
GNB	Device not ready	0002 Hex
SSG	General alarm for device failure	0010 Hex
FA0	Tripping channel driver failure	--
FA1	Tripping relay module supply failure	--
FA2	Data transmission error for a received tripping signal	--
FK0..7	Channel No. definition (1..8) for signals FA0..FA2	--
ZS	Time-out operated (A tripping signal was not transmitted twice.)	--
BL1	An FA0 signal has set the blocking flip-flop for group 1 (channels 1, 3, 5, 7).	--
BL2	An FA0 signal has set the blocking flip-flop for group 2 (channels 2, 4, 6, 8).	--
UP	I/P module supply failure	--
DISB	The functions ENABLE 1/2 and BLOCK 1/2 are not in operation (see Section 2.5.6.)	--

6.1.1.6. Binary output unit 216AB61

Status	**Signal via:**				
	Status	**SML**	**AL**	**CHO01**[*)]	**CHO02**[*)]
Normal operation	-	-	0	1	1
Redundant 24 V supply failure (on the B448C bus)	-	1	1	0	-
Internal 5 V supply failure	-	1	1	0	-
UP supply failure	UP	-	0	-	-
"PASSIVE" - Connector inserted	GNB	-	1	0	0
Device not initialised	GNB	1	1	0	0
System alarm functions [*)]:					
"SML" bus line active	-	-	-	0	-
"CK" bus line blocked	-	-	1	0	0

Device status register:

Symbol	**Function**	**Weighting**
GNB	Device not ready (passive pin inserted)	0002 Hex
UP	O/P module supply failure	--
S	Special function for channels CHO01 and CHO02 active	--

[*)] only of significance if a special function is active.

6.1.1.7. Analogue/binary output unit 216AC61

Status	**Signal via:**				
	Status	**SML**	**AL**	**CHO01*)**	**CHO02*)**
Normal operation	-	-	0	1	1
Redundant 24 V supply failure (on the B448C bus)	-	1	1	0	-
Internal 5 V supply failure	-	1	1	0	-
UP supply failure	UP	-	0	-	-
Internal ± 15 V supply failure	-	1	1	0	-
"PASSIVE" - Connector inserted	GNB	-	1	0	0
Device not initialised	GNB	1	1	0	0
System alarm functions *):					
"SML" bus line active	-	-	-	0	-
"CK" bus line blocked	-	-	1	0	0

Device status register:

Symbol	**Function**	**Weighting**
GNB	Device not ready (passive pin inserted)	0002 Hex
UP	O/P module supply failure	--
S	Special function for channels CHO01 and CHO02 active	--

*) Only of consequence, if special function active.

6.1.2. Self-diagnosis

In addition to continuous hardware self-monitoring, a diagnostics routine runs on the 216VC62A processing unit which performs the following functions:

- cyclic testing of its own memories (RAM, EPROM, EEPROM).
- monitoring the correct running of the program (watchdog). The operation of the microprocessor is monitored by a watchdog, which is basically a timer. The program must reset the watchdog at least once every 50 ms. If the program does not run correctly (run-time error) the timer goes the full time and resets the processor. The diagnostic system reports a warm start.
- initialisation and checking that the actual configuration of all the devices connected to the B448C bus agrees with the set hardware configuration.
- evaluation of all the disturbance signals from all the units, setting the status of the protection system and blocking of the protection functions if necessary.
- entry in the event list.

The status of the protection system can be determined with the aid of the control unit's (PC) diagnostic function (see Section 5.9.) and can assume one of the four following states:

No error:	Normal operation
Urgent error:	A unit is defective or passive. The protection is partially operational (underfunction). The SML line is set.
Fatal error:	The system is blocked. The SML line is set.

Every change in the status of the device gives rise to an entry in the event list. The same list can also be viewed and printed using the HMI (PC).

The diagnostic function can make the following entries in the event list:

Signal	**Significance**
Cold system start	Signal generated upon switching on the auxiliary supply.
Warm system start	The system has been reinitialised due to a software or hardware error (watchdog).
Diagnostics: System status ...	The status of the system has changed as indicated by the message.
Diagnostics: Device ...	An error has been detected in the device indicated. Refer to Section 6.1.1. for the significance.
A/D error	A 216EA61 analogue I/P unit has detected and error and initiated a warm system start.
Software error	A software (run-time) error has reinitialised the system. Further information can be obtained via the control unit (menus: “Diagnostics” → “Read run-time error data”). Refer also to Section 6.3.1.
Bus error	A data transfer error was detected on the B448C parallel bus and a warm system start initiated.
Program stop	The protection program was stopped, for example, for changing parameter settings or because a fatal error was discovered.
Program start	The protection program was initialised, for example, after switching the system on or after parameters have been reset.

There now follow some examples of event lists:

a) Entries after switching on the auxiliary supply:

0	00:00:00.000	Cold system start
1	00:00:00.000	Diagnostics: Unit 216VC62A No.1: No error
2	00:00:00.000	Diagnostics: Unit 216VC62A No.2: No error
3	00:00:00.000	Diagnostics: Unit 216DB61 No.1: No error
4	00:00:00.000	Diagnostics: Unit 216DB61 No.2: No error
5	00:00:00.000	Diagnostics: Unit 216AB61 No.1: No error
6	00:00:00.000	Diagnostics: Unit 216AB61 No.2: No error
7	00:00:00.000	Diagnostics: Unit 216AB61 No.3: No error
8	00:00:00.000	Diagnostics: Unit 216EB61 No.1: No error
9	00:00:00.000	Diagnostics: Unit 216EB61 No.2: No error
10	00:00:00.000	Diagnostics: Unit 216EB61 No.3: No error
11	00:00:00.000	Diagnostics: Unit 216EB61 No.4: No error
12	00:00:00.000	Diagnostics: Unit 216EB61 No.5: No error
13	00:00:00.000	Diagnostics: Unit 216AC61 No.1: No error
14	00:00:00.000	Diagnostics: System status: No error
15	00:00:00.826	ParSet1 ON
16	00:00:0.828	Reinitialisation
17	00:00:00.830	BinI/P No.9/ 6 ON
		BinI/P No.9/ 7 ON
		BinI/P No.9/ 8 ON
		BinI/P No.9/ 9 ON
18	1994-11-05 10:41;00.360	HMI active ON

The date and time are only added and synchronised after the control unit (PC) has been connected.

b) Entries following connection of the control unit (PC) and after binary I/P No. 1 has been switched on and then off again:

14 1990-07-29 05:28:28.758 BinI/P No. 1 ON
15 1990-07-29 05:28:29.111 BinI/P No. 1 OFF

c) Entries when the passive pin is inserted on the 216AB61 unit:

20 1990-07-29 05:32:51.021 Diagnostics: Unit 216AB61 No.2: GNB (0002H)
21 1990-07-29 05:32:51.021 Diagnostics: System status: Urgent error

The number in brackets at the end of the status line indicates the contents of the device status register for the unit concerned. It can be decoded with the aid of the weighting data (see Section 6.1.1.).

For example, entry No. 22: Unit 216VC62A No.4: SSS (8020H)

```
  8000H : SML   SML bus line active
+ 0020H : SSS   General system alarm
  ---------
  8020H
  =====
```

d) Entries when the passive pin is withdrawn:

26 1990-07-29 05:32:55.158 Diagnostic: Unit 216AB61 No.2: No error
27 1990-07-29 05:32:55.158 Diagnostics: System status: Non-urgent error

e) Entries after switching on the auxiliary supply, if the device configuration is incorrect:

1	00:00:00.000	Diagnostics: Unit 216VC62A No.1: No error
2	00:00:00.000	Diagnostics: Unit 216VC62A No.2: No error
3	00:00:00.000	Diagnostics: Unit 216DB61 No.1: No error
4	00:00:00.000	Diagnostics: Unit 216DB61 No.2: No error
5	00:00:00.000	Diagnostics: Unit 216AB61 No.1: No error
6	00:00:00.000	Diagnostics: Unit 216AB61 No.2: No error
7	00:00:00.000	Diagnostics: Unit 216AB61 No.3: No error
8	00:00:00.000	Diagnostics: Unit 216EB61 No.1: No error
9	00:00:00.000	Diagnostics: Unit 216EB61 No.2: No error
10	00:00:00.000	Diagnostics: Unit 216EB61 No.3: No error
11	00:00:00.000	Diagnostics: Unit 216EB61 No.4: No error
12	00:00:00.000	Diagnostics: Unit 216AC61 No.1: No error
13	00:00:00.000	Diagnostics: System status: No error
14	00:00:00.636	Diagnostics: Unit 216VC62A No.2: SSS (0024H)
15	00:00:00.741	Diagnostics: System status: Urgent error
16	00:00:00.721	Diagnostics: Unit 216VC62A No.1: (0004H)
17	00:00:00.741	Diagnostics: Unit 216VC62A No.1: SSS (0024H)

Event messages Nos. 11..13 indicate the device status SSS (0024H).
This means:

```
  0004H : STG   Incorrect device configuration
+ 0020H : SSS   General system alarm
  ---------
  0024H
  =====
```

The above entries can have the following causes:

- The units are not inserted at the positions defined in the device settings.
- The plug-in jumpers on the 216DB61 binary I/P and tripping units are not at the locations defined in the device settings (see Section 2.5.6.).

The parameter settings can be changed by selecting the following sequence of menus:

→ “Editor”
→ “Edit hardware functions”
→ “Edit binary channels”
→ “Enable/block”

- The plug-in jumpers on the 216AB61 binary O/P units are not at their correct locations (see Section 2.5.4.).

6.2. Signals during normal operation

The green LED's on the front of all the units should be lit during normal operation and the red LED's should not.

The yellow LED's on the I/P and O/P units indicate the statuses of the associated channels.
Channels CH001 and CH002 on the **first** 216AB61 or 216AC61 binary O/P unit are especially important, because they are used for monitoring the entire system:

CH001: System ready
The following errors can reset this channel to logical "0":

- The protection program is not running.
- The diagnostic function sets the status to "Fatal error" or "Urgent error".
- The device configuration does not agree with the hardware configuration defined in the program.
- The EEPROM does not contain any valid protection parameters.
- The FUPLA function has been configured, however the FUPLA code is invalid or not loaded.

CH002 : No system error
This line is set by the diagnostics routine during initialisation and remains active until a device failure blocks the "CK" bus line. In this case CH001 is also set to log. 0; the system does not run (see Section 6.1.1.).

The yellow LED's on the 216VC62a processing unit(s) respond as follows to the various operating statuses:

System status	LED L1	LED L2
No error	0	0
Urgent error	1	0
Fatal error	1	1

Communication	**LED L3**	**LED L4**
transmit	1	0
receive	0	1

Communication with the control and setting PC

LED 5 lights briefly when a LON wink telegram is received.

LED 6 lights while executing a write operation to the program flash memory.

LED “MST” lights whenever the corresponding unit accesses the B448C bus in a master role.

LED “AL” indicates that the unit to which it belongs is defective.

In the event of a disturbance signal (CH001 and CH002 off), it can be determined whether the protection is running by observing the display of the cycling time in the “Display analogue channels window.
A display of (0) means that the protection is not running.
The protection then **has to be reset** using the resetting pin.

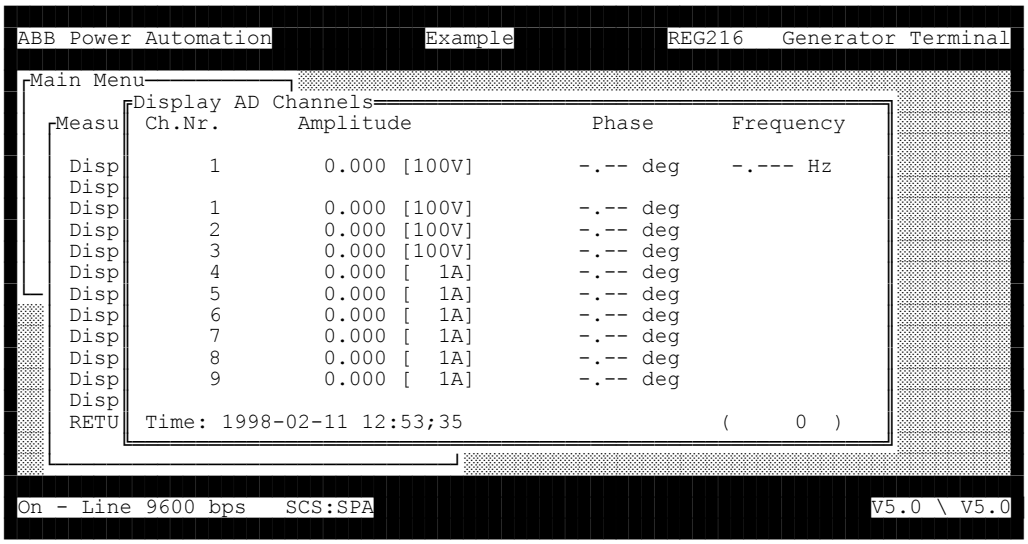

Fig. 6.1 Cycling time display