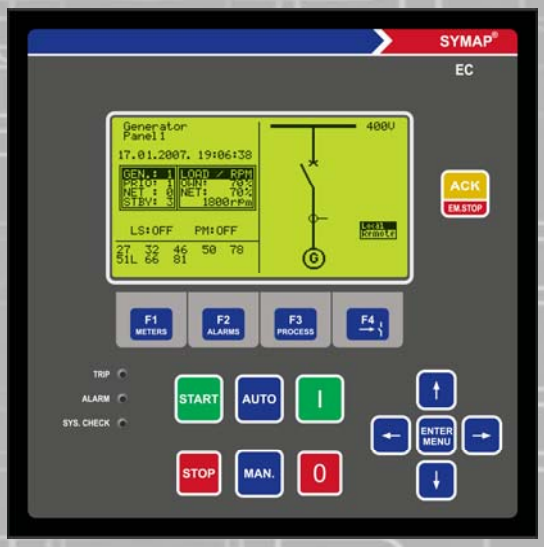
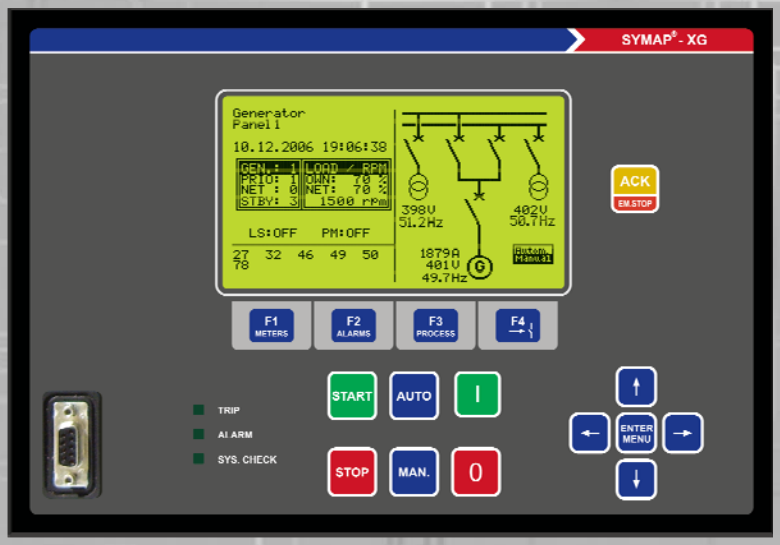
SYMAP®

- Power Protection
- Monitoring
- Diesel Control
- Power Management



User's Manual



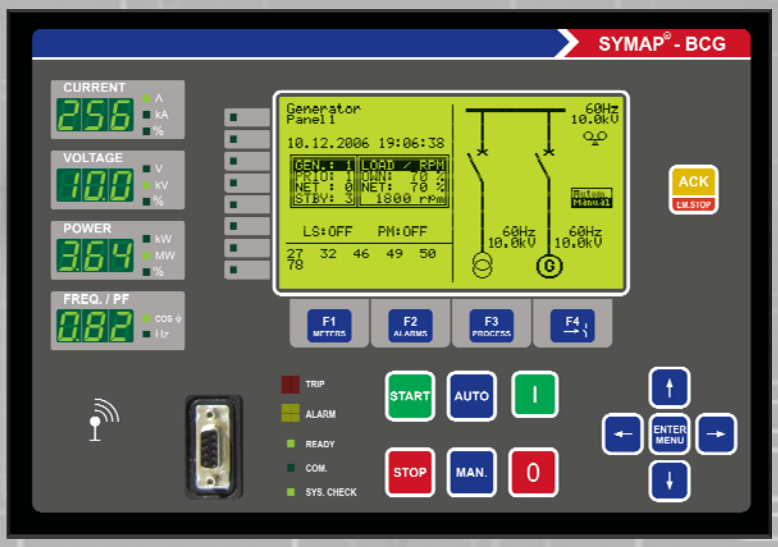


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Table of content

1 Introduction

The SYMAP® digital protection relay devices are described in this section. An overview of the units is given with regard to their characteristics, applications and functional scope.
There are three series of SYMAP® units as follows:

SYMAP®-Y	Essential cost series
SYMAP®-X	Basic series
SYMAP®-BC	Basic series expanded to include LED indicators, event data recorder, extended board, power management, and diesel control

For more detailed information about the hardware and software capabilities of these series, please refer to Chapter 1.8

1.1 SYMAP® Product Overview

SYMAP® is a digital protection relay for use in low, medium and high-voltage power systems. Because of its integrated protection functions and human-machine interface capabilities, it is an efficient and cost-effective solution for all types of switch bays. With three powerful microprocessors, SYMAP® offers complete protection functions for generators, motors (synchronous and asynchronous), transformers, power lines, and distributions. All protection functions can be activated simultaneously, and there are no limits to using all of them at the same time. With SYMAP®, five breaker controls can be activated, with all the necessary functions, such as display, control and blocking, for optimal breaker management. A small integrated PLC allows individual interlocks from controlling functions. For flexibility in commissioning and during use, both digital and analog outputs can be used to connect the SYMAP® control unit to main switchboard controls. Additionally, a variety of serial interfaces with different kinds of protocols can be used for communication between SYMAP® units and the central control system.

1.2 SYMAP® Human Machine Interface (HMI)

SYMAP® is easy to program and operate. A large graphic LCD with optional LED indicators can convey important data, such as the position of all connected breakers, parameter settings, and event records, at a glance. Graphics and measurements are displayed side-by-side on the LCD, so that the user does not have to switch between pages.

The entire programming of the SYMAP® device can be done with the keys on its front panel, eliminating the need to involve external programming devices. The programming is built in and is menu-tree driven, making setting parameters an intuitive process similar to inputting data in a modern handheld telephone. Optionally, parameters can also be programmed using a laptop computer. Using a laptop offers certain advantages; for example, parameter data stored in the laptop can be easily input into other SYMAP® units. Either way, ease of programming is guaranteed and on-site visits by the manufacturer's service engineers during commissioning are not required.

SYMAP® provides four hotkeys under the LCD through which four main groups of values can be accessed: "Meters", "Alarm", "Process" and "Breaker Control". The user can press the hotkeys to scroll through pages of information pertaining to these values.
Under the hotkey "Meters", detailed information of the electric measurement values, counters for active and reactive power, and working hours is provided. Under the hotkey "Alarms", all active

alarms, event stores, and blockings are displayed. Under "Process", all process data, such as synchronization display, motor thermal indication, and breaker counters, are shown.
Under "Breaker Control", up to five breakers can be accessed and controlled. When programming breaker controls, the user has access to a variety of layout configurations available through a library of graphics maintained within SYMAP®. Programmed blockings remain active when manual control of the breaker is used. Each of the highlighted breakers in the LCD can be controlled with the keys "O" and "I".

For enhanced security, access to SYMAP®'s parameter and breaker control data is protected by a code system. The code system offers two kinds of access: one by a transponder card and one by password input.

1.3 SYMAP® Protection Functions

SYMAP® provides the protection functions shown in the table 1-1 in accordance to ANSI. The protection functions are based on IEC rules.

Table 1-1 SYMAP® protection functions

ANSI no.	Protection function
2	Time starting
12	Overspeed
14	Underspeed
15	Matching device (motorpoti)
24	Overexcitation protection
25/A	Automatic synchronizing
27	Undervoltage, instantaneous, definite time
27 B	BUS undervoltage, definite time
32	Overload relay
37	Undercurrent protection
40/Q	Loss of field, reactive power, impedance
46	Reverse phase current
47	Phase sequence voltage
49	Thermal overload protection
50 BF	Breaker failure
50	Overcurrent, instantaneous
50 G/N	Current earth fault, instantaneous
51	AC time overcurrent, definite time, IDMT (6 curves)
51 G/N	AC ground overcurrent, definite time, IDMT (6 curves)
51 LR	Locked rotor
51V	Voltage restrained overcurrent
59	Overvoltage relay, instantaneous, definite time, normal inverse
59 B	BUS overvoltage relay, definite time
59 N	Residual overvoltage
64	Ground overvoltage
66	Start inhibit
67	AC directional overcurrent, definite time, IDMT
67GS/GD	AC directional earth fault, definite time
78	Vector surge supervision
78 S	Out of step tripping
79	Auto reclosing
81	Frequency supervision
81 B	BUS frequency supervision
86	Electrical lock out
87 G/M	Generator/Motor differential
87 LD	Line differential
87 N	Restrict earth fault relay
87 T	Transformer differential
94	Trip circuit supervision
95 i	Inrush blocking
-- FF	Fuse failure (voltages)

1.4 Recording Unit

SYMAP®'s recording unit contains up to three separate parts:

- Event history
- Detailed protection function history
- Measure data recorder (optional)

All data recorded by the unit can be transferred and analyzed via a PC tool. And, regardless of power supply, the data store is permanent. SYMAP®'s data recording unit stores the following:

- Protection function events, such as activation and eventual intervention
- The change of binary inputs and outputs
- The control of Local/Remote/Scada
- The change of each switching device
- On-Off commands through central power management system
- Every attempt or trail to give a command prohibited by interlocking
- Every alarm signal (also from diagnostics)
- Data logs for measurement inputs

1.4.1 Event History

SYMAP® automatically collects and stores all activated events with their number, title, appearing and disappearing status, and a time stamp. A maximum of 5000 events can be stored. In case of overflow, the oldest data will be recorded over.

1.4.2 Detailed Protection Function History

SYMAP® automatically collects and stores all activated events related to protection functions with the following detailed information:

- Event number
- Event title
- Time stamp
- Pickup or trip value (with fault phase indication)
- Setting value
- Trip time
- 3-line voltage and current pickup, synchronized with the trip event

A maximum of 1000 protection function events can be stored. In case of overflow, the oldest data will be recorded over.

1.4.3 Data Recorder (Optional)

The data recorder can log 16 analog inputs, 14 digital inputs and 12 digital outputs. The recorder has the following settings:

- Recorder on/off
- Number of samples per cycle (6 to 72)
- Recording period (5 s - 60 s)
- Pre-trigger (0 % - 100 %)
- Trigger event (stop for recorder)

The recording period depends on the number of samples. The recorder can be set with the pre-trigger in such a way as to record event data even before the event happens. Stopping the recorder can be triggered either by an event or by a preset time. For easier management and troubleshooting, event data can be transferred and analyzed via a PC tool. The transfer of data is made by a link through a plug on the front panel of the SYMAP® device.

1.5 Diagnostics and Monitoring

SYMAP® has three microprocessors that supervise each other, providing a watchdog system. Important functions are laid out in a double redundancy combination, operating independently with the second processor. Connected separately, an optional unit for short circuit protection operates parallel to the SYMAP® device and will do so even if the entire voltage fails.

SYMAP® provides various diagnostic and monitoring functions as follows:

- All memories (ROM′s, RAM′s, EEPROM′s)
- All analog reference voltages
- Automated test sequences
- Control power ON/OFF of SYMAP®
- Binary input and output for control logic

The following supervising systems are offered by SYMAP®:

- Self diagnostics of SYMAP®
- The inputs of analog data (auxiliary circuit)
- The status and position of switching device and motor's on-off status
- Supervising supply of trip coil
- Gas pressure
- Temperature inside panel
- Each operating life of breaker (hours)

1.6 Communication

SYMAP® can serve as the main bay controller for the power management system or substation system. The following list shows the station system items available through SYMAP®:

- Remote supervision
- Remote control
- Remote parameter setting
- Central registration of measured and calculated values
- Central event logging
- Central fault recording, analysis and logging
- Plant power management

1.7 Terminal Connections

All connections to SYMAP® are made with terminal plugs on the backside of the device, allowing the device to be exchanged easily. The terminal blocks are divided into the following groups:

- Analog input for measurement
- Additional analog channels
- Digital inputs and outputs
- Communication interfaces
- Extended board (optional)

1.7.1 Analog Input for Measurement

SYMAP® provides inputs for analog sensors at the rear of the device. If terminal plugs for the CT′s are disconnected the circuits will be linked automatically so that there is no disconnection in the CT circuit loops. A total of 17 analog inputs for current and voltage transformers are used for the protection functions. The following list shows the possible connections for current transformers (CT) and potential transformers (PT) that SYMAP® offers:

- 3 × CT for feeder current*
- 3 × CT for differential current
- 2 × CT for ground current
- 3 × PT for feeder voltage
- 3 × PT for BUS1 voltage
- 3 × PT for BUS2 voltage
- 2 × PT for ground voltage

***Note:** SYMAP®-BC series have 6 feeders current, because the current transformer for measurement and the current transformer for protection are separately fed here: 3 current transformers for measurement and 3 current transformers for protection (see chapter 4).

By use of **combined sensors**, SYMAP® can provide

- 3 × for feeder current
- 3 × for feeder voltage

With the analog inputs for measurement, the following values can be measured and displayed:

- 3 × phase-to-phase and line voltages of feeder and BUS1 and BUS2
- 3 × phase feeder current (average/max. value)
- 3 × phase differential current (max. value)
- Frequencies of all systems (min./max. value)
- Ground current and voltage (max. value)
- Active and reactive power of each phase
- Active and reactive ground power
- Power factor of each phase
- Active and reactive power counter (reverse and forward, constant and temporary)
- Operating hours
- Breaker cycles (life time)
- Harmonic waves of feeder current and voltage (up to 5th harmonic wave)

1.7.2 Additional Analog Channels

SYMAP® offers the following additional analog inputs and outputs for analog signals:

- 4 × analog inputs 4-20 mA (0-20 mA)
- 4 × analog outputs 4-20 mA (0-20 mA)

1.7.3 Digital Inputs and Outputs

SYMAP® offers the following digital inputs and relay outputs:

- 14 × digital inputs
- 12 × digital relay outputs

1.7.4 Communication Interfaces

SYMAP® provides communication ports available with the following interfaces:

- 1 RS232 on the front panel for programming and data output
- 2 CANBUS
- RS422/RS485 port
- 1 PROFIBUS DP (RS485 or optional via a fibre optic port)

1.7.5 Extended Board (Optional)

An extended board can be connected to SYMAP®, providing additional in and output channels. The extended board is customized to individual client requirements and can be equipped to a maximum of the following in and output channels:

- 36 digital inputs
- 24 relay outputs
- 8 analog outputs 4-20 mA
- 21 analog inputs PT 100/PT 1000 or analog inputs 4-20 mA

1.8 SYMAP® family

There are three different series within the SYMAP® family: Y, X and BC-Series. Table 1-2 shows the standard and optional hardware capabilities of these series. The hardware combination of the Y-Series is limited.

Table 1-2 Hardware capabilities of SYMAP® family

SYMAP® Series -	Y							X		BC	
Type -	EC	ECG	F	G	M	T	LD	X	XG	BC	BCG
Front panel											
- Graphic-LCD	X	X	X	X	X	X	X	X	X	X	X
- Keyboard	X	X	X	X	X	X	X	X	X	X	X
- 7 segment displays	-	-	-	-	-	-	-	-	-	X	X
- 8 Alarm LEDs	-	-	-	-	-	-	-	-	-	X	X
- Transponder access	-	-	-	-	-	-	-	-	-	X	X
COMMUNICATION											
- RS232	X	X	X	X	X	X	X	X	X	X	X
- PROFIBUS	-	(X)	(X)	(X)	(X)	(X)	(X)	(X)	(X)	(X)	(X)
- CANBUS1	-	-	-	-	-	-	-	X	X	X	X
- CANBUS2	X	X	-	-	-	-	-	X	X	X	X
- RS485/RS422	-	(X)	(X)	(X)	(X)	(X)	(X)	X	X	X	X
- IEC 60870-5-103, RS485	X	X	X	X	X	X	X	X	X	X	X
- MODEM (analog)	X	X	-	-	-	-	-	-	-	-	-
- MODEM (ISDN)	X	X	-	-	-	-	-	-	-	-	-
INPUTS/OUTPUTS											
- Digital inputs	20	20	20	20	20	20	20	14	14	14	14
- Digital inputs ext. board	-	-	-	-	-	-	-	(36)	(36)	(36)	(36)
- Relay outputs basic unit	16	16	16	16	16	16	16	12	12	12	12
- Relay outputs ext. board	-	-	-	-	-	-	-	(24)	(24)	(24)	(24)
ANALOG I/O 4-20 mA											
- Analog in 4-20 mA	1	1	1	1	1	1	1	4	4	4	4
- Analog out 4-20 mA	-	1	1	1	1	1	1	4	4	4	4
- PT100/PT1000 + ext. converter	-	-	-	-	8	-	-	(4)	(4)	(4)	(4)
- PT100/PT1000 ext. board	-	-	-	-	-	-	-	(21)	(21)	(21)	(21)
ANALOG INPUT FOR MEASURING AND PROTECTION											
- Total analog inputs	9	13	13	13	13	13	13	13	13	17	17
- 3 CT's for FEEDER CURRENT	-	-	X	-	X	X	X	X	X	X	X
- 3 Ph.current via combined sensor	-	-	-	-	-	-	-	-	-	X	X
- 3 CT's for DIFF. CURRENT	-	-	-	-	-	-	-	-	-	X	X
- CT for GROUND CURRENT 1	-	X*	X*	X*	X*	X*	X*	X*	X*	X	X
- CT for GROUND CURRENT 2	-	-	-	-	-	-	-	-	-	X	X
- 3 PT's for FEEDER VOLTAGE	X	X	X	X	X	X	X	X	X	X	X
- 3 Ph.voltage via combined sensor	-	-	-	-	-	-	-	-	-	X	X
- 3 PT's for BUS VOLTAGE 1	X	X	X	X	X	X	X	X	X	X	X
- 3 PT's for BUS VOLTAGE 2	X	X	X	X	X	X	X	X	X	X	X
- PT for GROUND VOLTAGE 1	-	X*	X*	X*	X*	X*	X*	X*	X*	X	X
- PT for GROUND VOLTAGE 2	-	-	-	-	-	-	-	-	-	X	X
RECORDING UNIT											
- Data logger	-	-	-	-	-	-	-	-	-	(X)	(X)
- Detailed protection history	X	X	X	X	X	X	X	X	X	X	X

*: one ground input available: U_{GND} I_{GND}

(X): function is special equipment which can be ordered separately (see order information)

Table 1-3 Software capabilities of SYMAP® family

SYMAP® Series -		Y							X		BC	
Type -		EC	ECG	F	G	M	T	LD	X	XG	BC	BCG
POWER MANAGEMENT MODULES												
- Synchronizing unit		X	X	X	X	X	X	X	X	X	X	X
- Load sharing/asymmetrical load ctrl.		-	X	-	-	-	-	-	-	X	-	X
- Frequency controller		X	X	-	-	-	-	-	-	X	-	X
- Voltage regulator		X	X	-	-	-	-	-	-	X	-	X
- Power factor control		-	X	-	-	-	-	-	-	X	-	X
- Load controller (big consumer)		-	X	-	-	-	-	-	-	X	-	X
- Load depending start/stop (PMS)		-	X	-	-	-	-	-	-	X	-	X
- Preferential trip management		-	X	-	-	-	-	-	-	X	-	X
- Blackout management		X	X	-	-	-	-	-	-	X	-	X
- Diesel control		X	X	-	-	-	-	-	-	X	-	X
LOGIC BUILDER UNIT (PLC)												
- Breaker controls/interlocks		X	X	X	X	X	X	X	X	X	X	X
- Logic diagrams		X	X	X	X	X	X	X	X	X	X	X
PROTECTION RELAYS (ACCORDING TO ANSI DEVICE NUMBERS)												
15	Matching device (motorpoti)	X	X	-	-	-	-	-	X	X	X	X
24	Overexcitation protection	-	X	-	X	X	-	-	X	X	X	X
25/A	Automatic synchronizing	X	X	X	X	X	-	-	X	X	X	X
27	Undervoltage, inst., def. time	X	X	X	X	X	X	X	X	X	X	X
27B	BUS undervoltage, def.time	X	X	X	-	-	X	X	X	X	X	X
32	Overload relay	-	X	X	X	X	X	-	X	X	X	X
37	Undercurrent protection	-	X	-	X	X	X	-	X	X	X	X
40/Q	Loss of field, reac.power, impedance	-	-	-	-	-	-	-	X	X	X	X
46	Reverse phase current	-	X	-	X	X	-	-	X	X	X	X
47	Phase sequence voltage	X	X	X	X	X	X	X	X	X	X	X
49	Thermal overload protection	-	X	X	X	X	X	-	X	X	X	X
50BF	Breaker failure	-	X	X	X	X	X	X	X	X	X	X
50	Overcurrent, instantaneous	-	X	X	X	X	X	X	X	X	X	X
50G/N	Current earth fault, instantaneous	-	X	X	X	X	X	X	X	X	X	X
51	AC time overcurrent, def.time, IDMT	-	X	X	X	X	X	X	X	X	X	X
51G/N	AC Ground overcurr., def.time, IDMT	-	X	X	X	X	X	X	X	X	X	X
51LR	Locked rotor	-	-	-	-	X	-	-	X	X	X	X
51V	Voltage restrained overcurrent	-	-	-	-	X	-	-	X	X	X	X
59	Overvoltage, inst., def. time, norm.inv.	X	X	X	X	X	X	X	X	X	X	X
59B	BUS overvoltage, relay definite time	X	X	X	X	X	X	X	X	X	X	X
59N	Residual overvoltage	X	X	X	X	X	X	X	X	X	X	X
64	Ground overvoltage	X	X	X	X	X	X	X	X	X	X	X
66	Start inhibit	X	X	-	-	X	X	X	X	X	X	X
67	AC dir. overcurrent, def. time, IDMT	-	X	X	X	X	X	X	X	X	X	X
67GS/GD	AC directional earth fault, definite time	-	X	X	X	X	X	X	X	X	X	X
78	Vector surge supervision	X	X	X	X	X	X	X	X	X	X	X
78S	Out of step tripping	-	X	-	X	-	-	-	X	X	X	X
79	Auto reclosing	-	X	X	X	X	X	X	X	X	X	X
81	Frequency supervision	X	X	X	X	X	X	X	X	X	X	X
81B	BUS frequency supervision	X	X	X	X	X	X	X	X	X	X	X
86	Electrical lock out	X	X	X	X	X	X	X	X	X	X	X
87G/M	Generator/Motor differential	-	-	-	-	-	-	-	-	-	X	X
87LD	Line differential	-	-	-	-	-	-	X	-	-	-	-
87N	Restrict earth fault relay	-	-	-	-	-	-	-	-	-	X	X
87T	Transformer differential	-	-	-	-	-	-	-	-	-	X	X
94	Trip circuit supervision	X	X	X	X	X	X	X	X	X	X	X
95i	Inrush blocking	-	X	X	X	X	X	X	X	X	X	X
-- FF	Fuse failure (voltages)	-	X	X	X	X	X	X	X	X	X	X

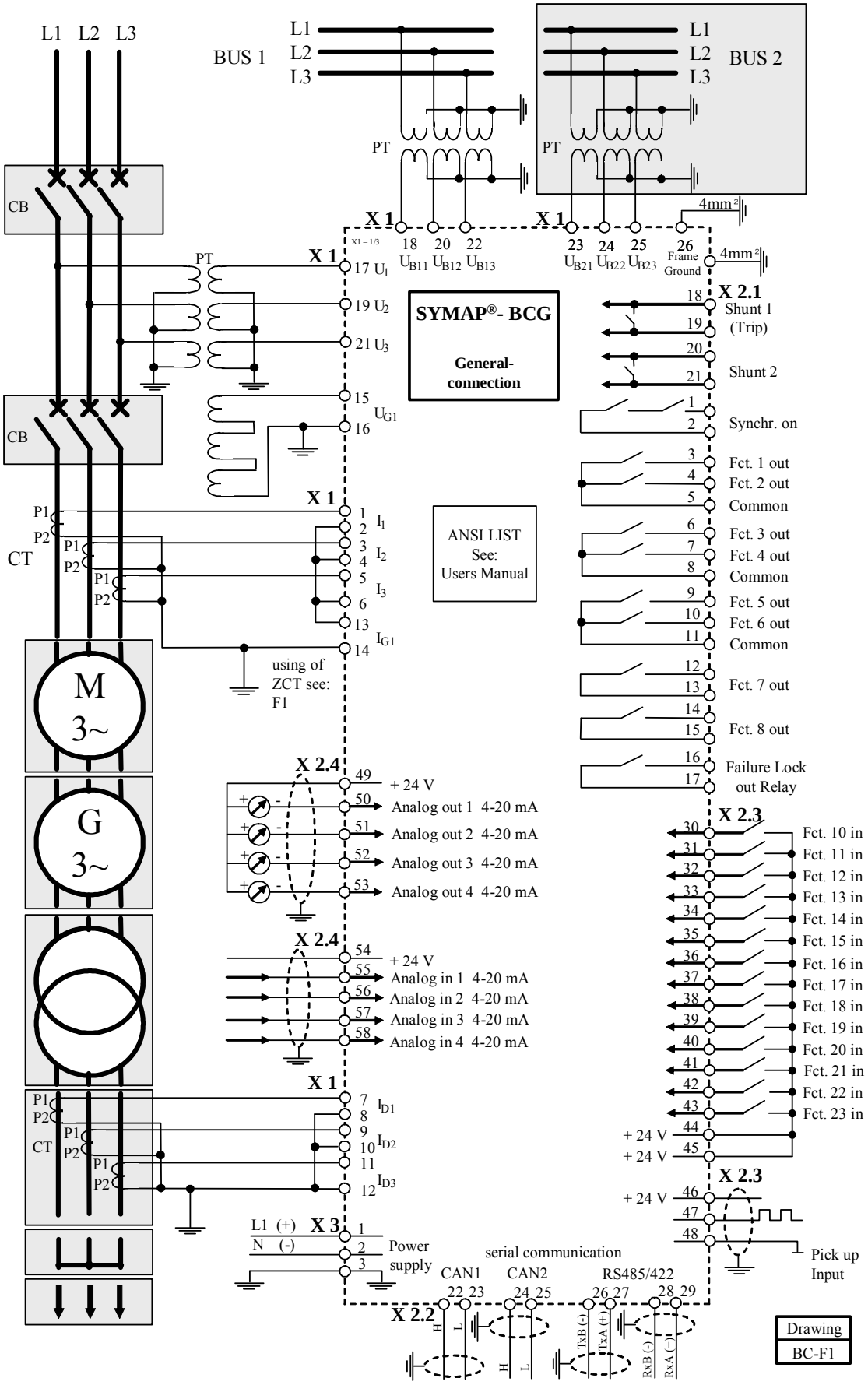


Figure 1-1 Configuration of SYMAP® series (Main Board)

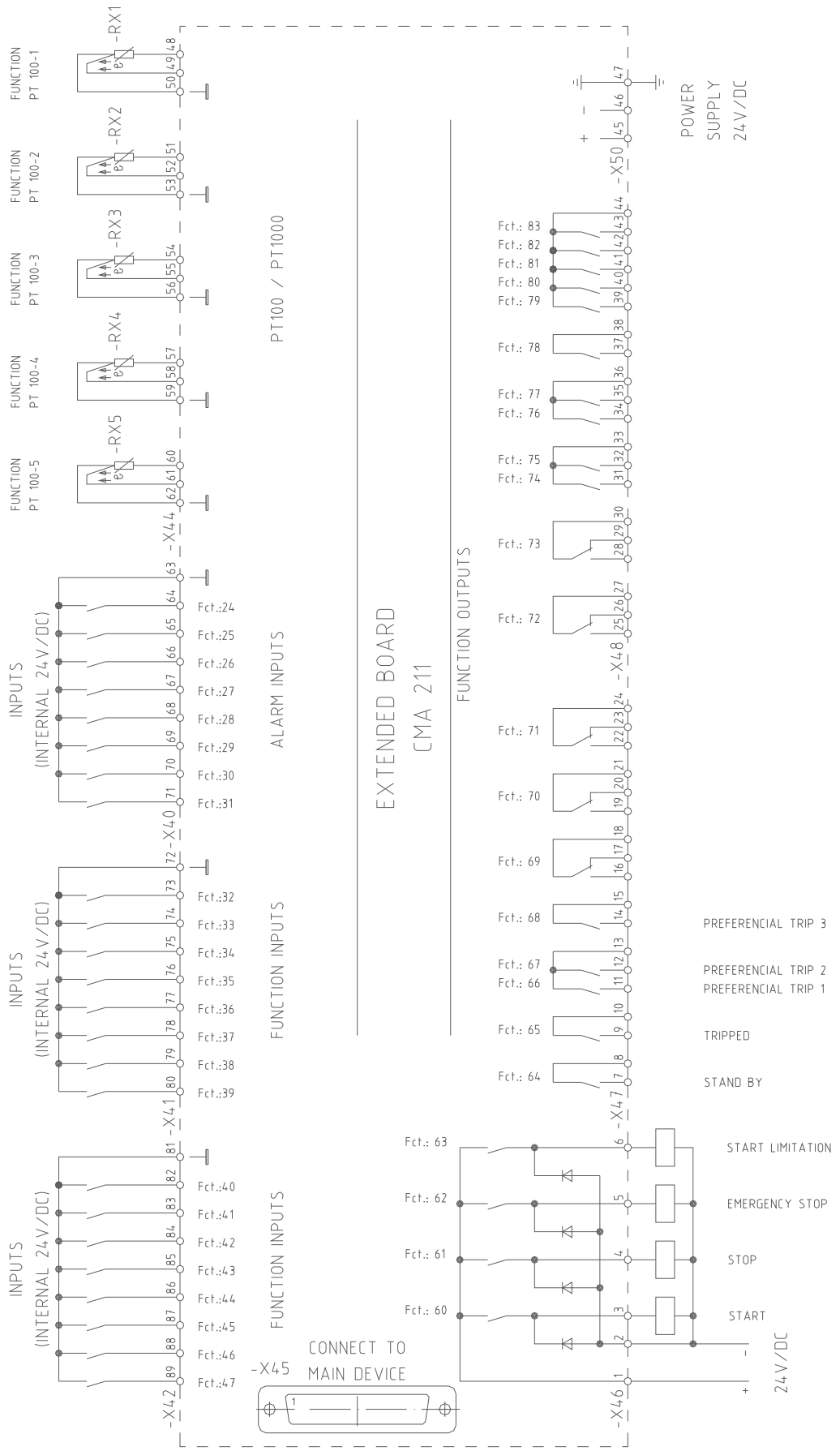


Figure 1-2 Configuration of SYMAP® - EXTERNAL AUX. BOARD/CMA211

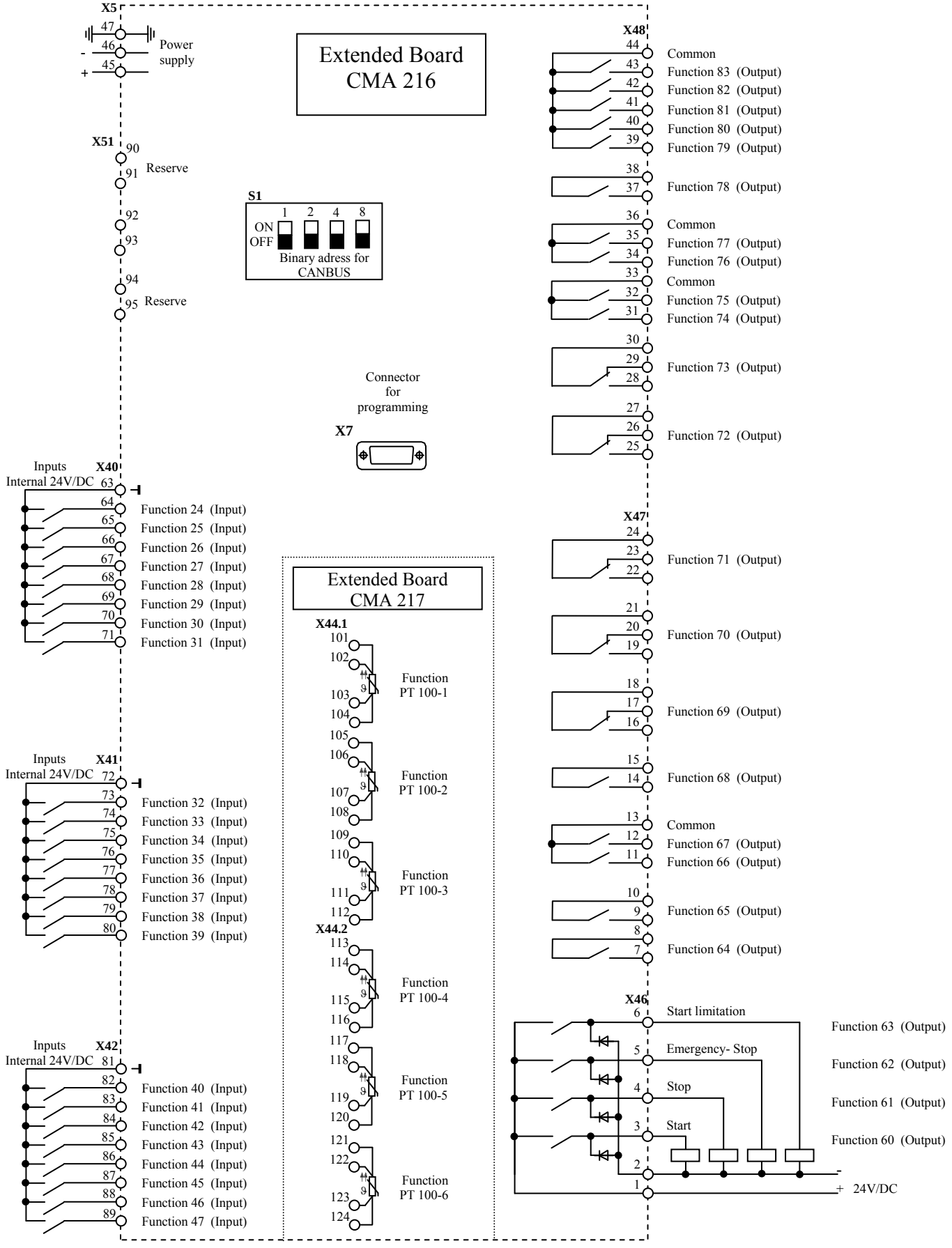


Figure 1-3 Configuration of SYMAP® - EXTERNAL AUX. BOARD/CMA216/217

Connecting the extended board CMA216 to the SYMAP® basic unit

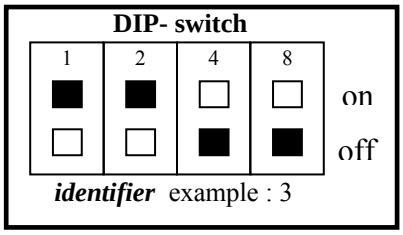
The extended board CMA216 will be connected via the field CANBUS to the basic unit. To release the communication to the extended board the SYMAP® the communication parameters [0308] to [0313] have to be set (**1.**). For communication of the extension board the communication speed must to be set to 125 KBd. On the extended board the DIP-switch must be set to the identifier value, which is giving with Parameter [0310] (**2.**). After Parameter and DIP-switch setting the communication line has to be connected according to item (**3.**).

1. SYMAP® Communication Parameter

Parameter	setting
[0308]	ON
[0310]	*example:* ***"03"***
[0311]	Standard
[0312]	125 kBd
[0313]	OFF

Identifier

2. CMA 216 DIP- switch setting



Each extended Board CMA216 must have the correspondend identifier from SYMAP®

3. Communication terminals

The extended board CMA216 has to be connected to the basic unit in the following way:

Communication line	SYMAP® basic unit	Extended board CMA216
CAN_high	X2.2/22	X51/92
CAN_low	X2.2/23	X51/93

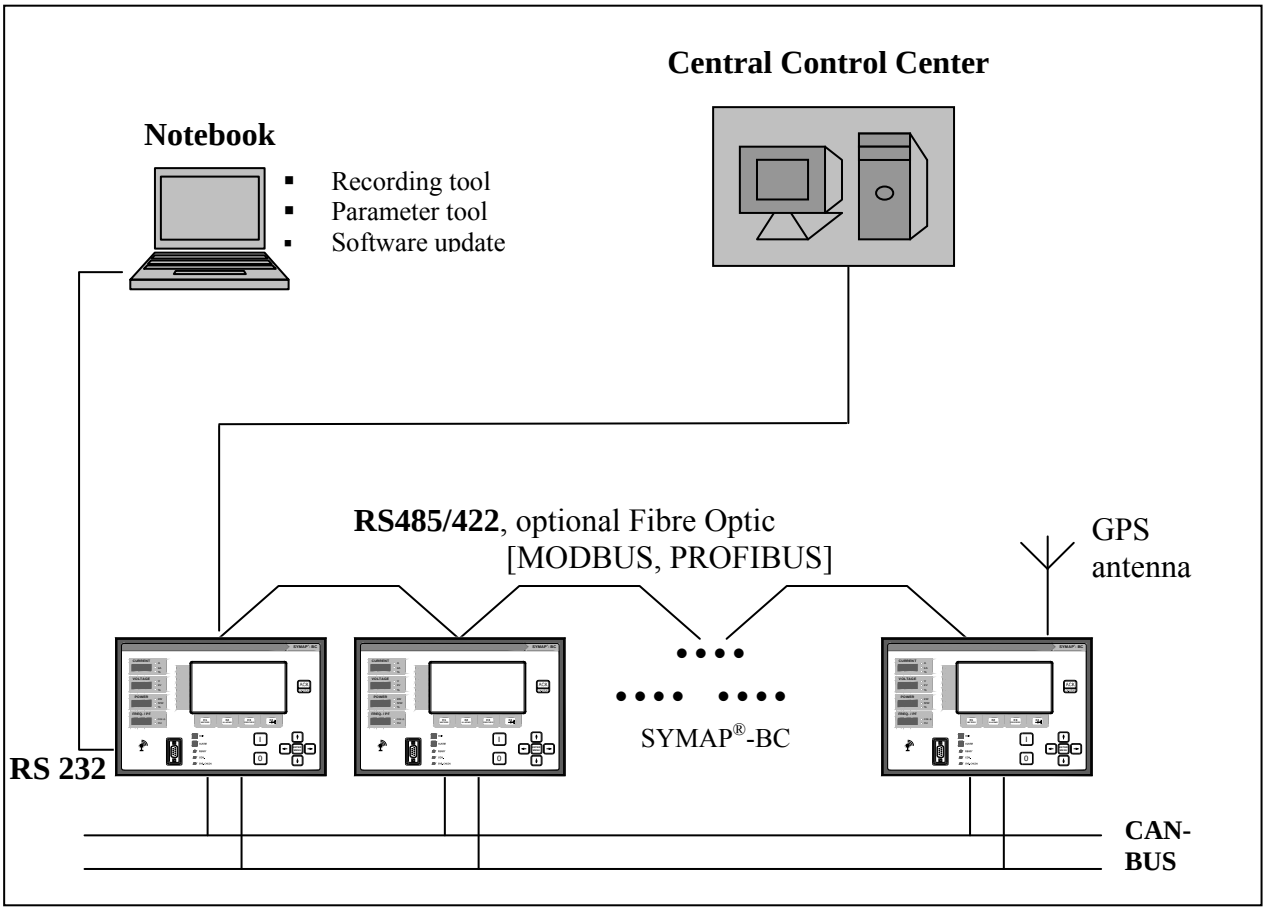


Figure 1-4 Configuration of communication with SYMAP®

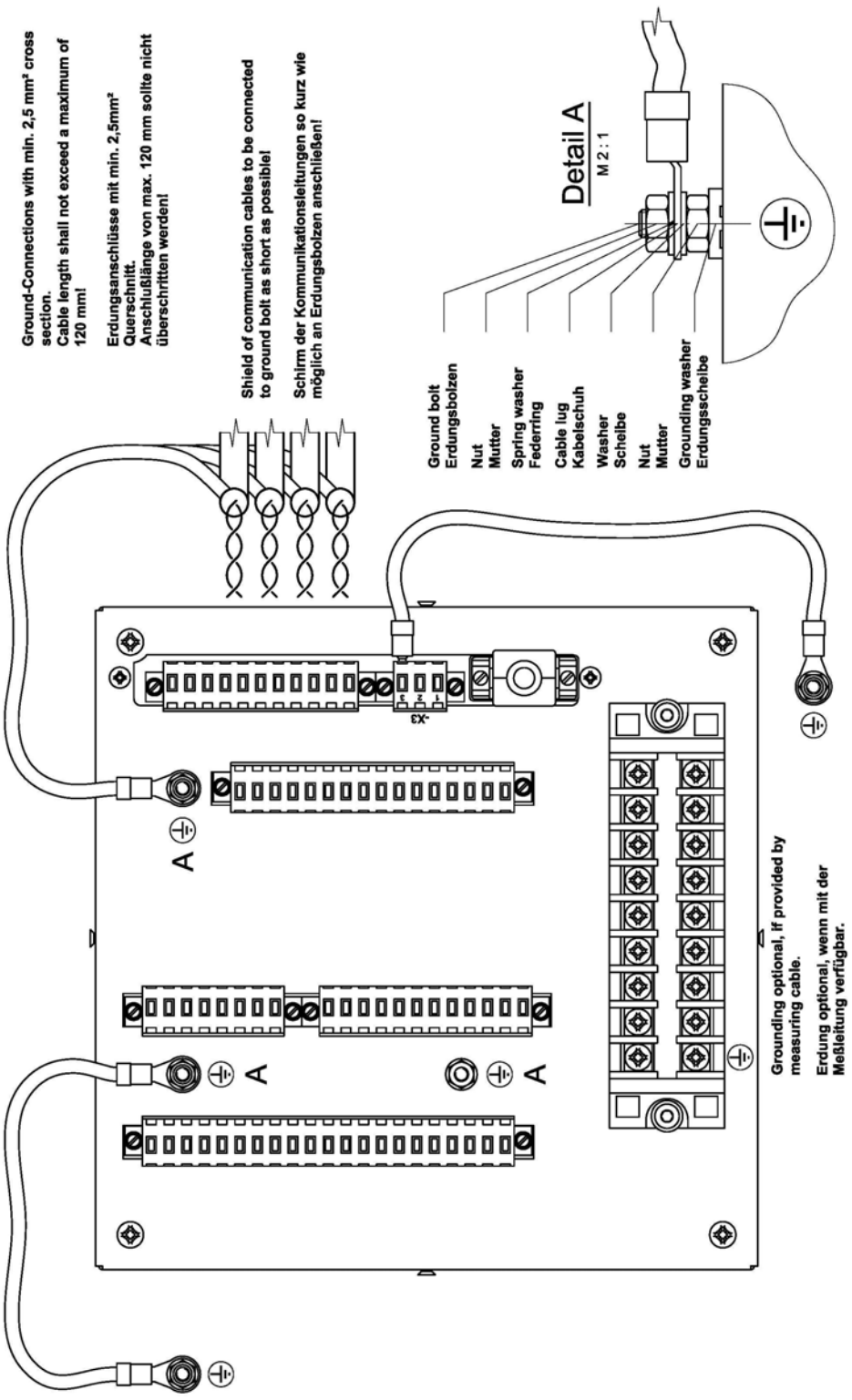


Figure 1-5 Graunding-Instructions for SYMAP®-Y

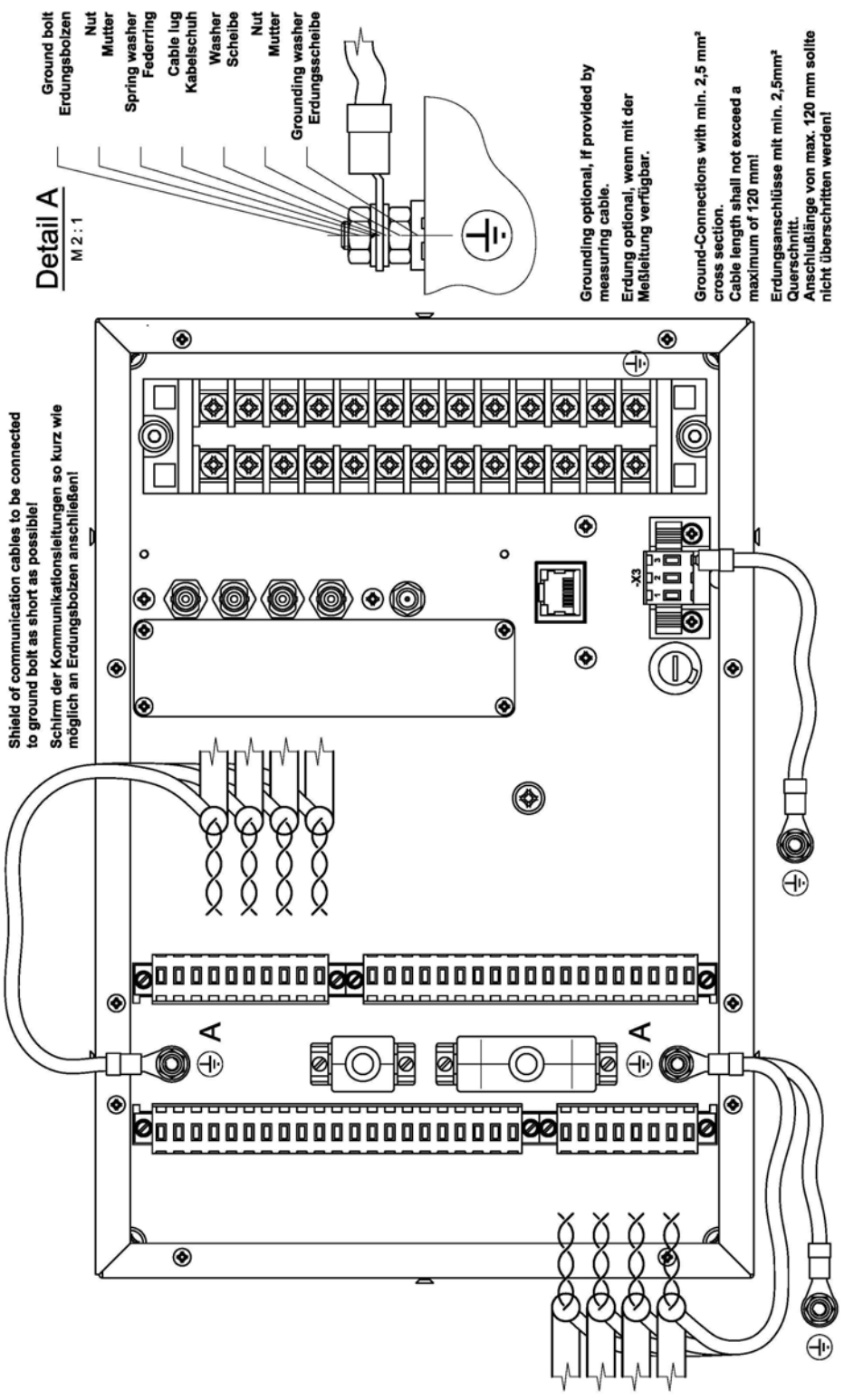


Figure 1-6 Graunding-Instructions for SYMAP®-BC

2 Operation of SYMAP®

This chapter describes the interface to the user. The interface comprises the display elements, the key pads, the RS232 port and the transponder.

2.1 Front panel

SYMAP® provides with its big graphic liquid crystal display (LCD), the 7-segment displays and single LED indicators a comfortable display panel. The 7-Segment displays, single LED indicators and Transponder (lines 1–5, 11) are only available for SYMAP® BC/BCG. Figure 2-1 shows in detail the elements on the front panel.

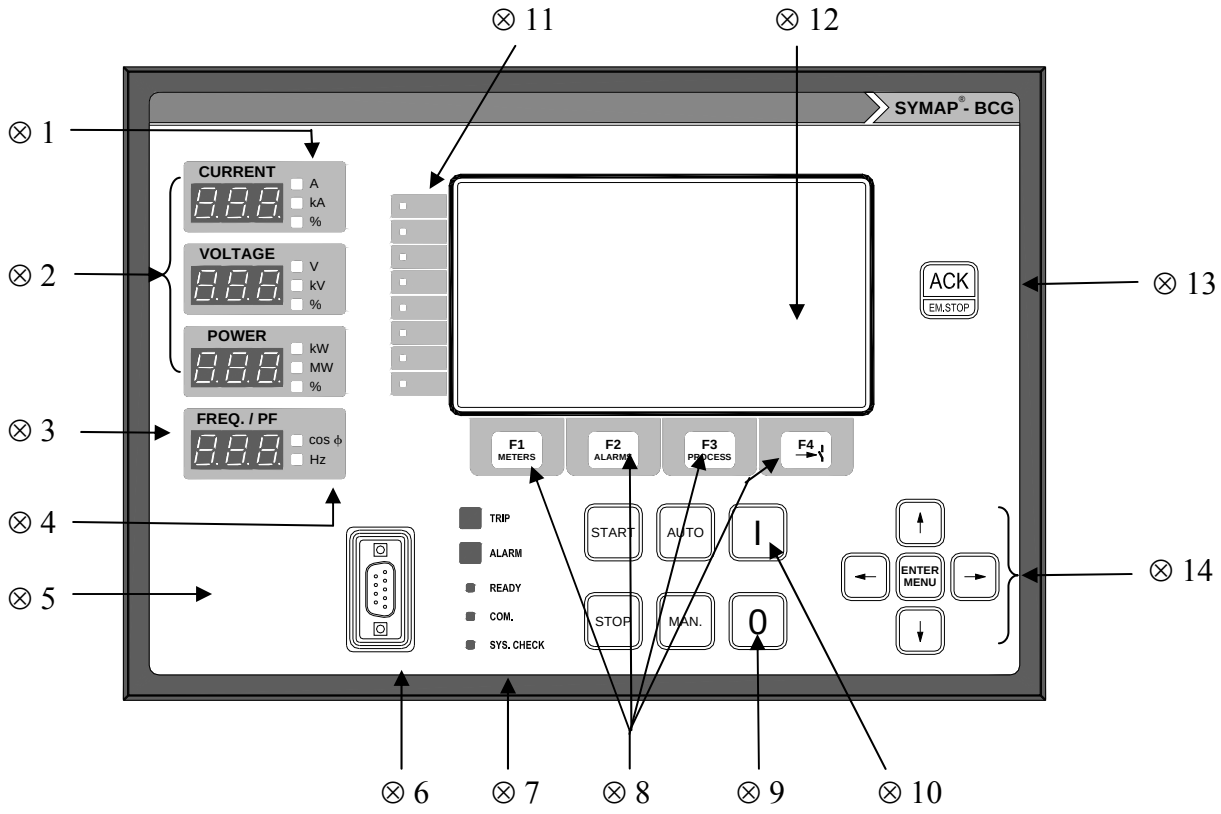


Figure 2-1 SYMAP®-BCG Front panel

⊗ 1: 7-segment display for of average current, voltage and power
- If one of the three current phases is above nominal the current display shows this phase blinking.
- The power display will blink in case of reverse power.

⊗ 2: LED unit indicator for the corresponding 7-segment display; the indication can be: for current: A, kA and %, for voltage V, kV and % and for power kW, MW and %.

⊗ 3: 7-segment display for power factor or alternative for frequency (programmable within 7-seg page)

⊗ 4: LED unit indicator which indicates Hz if frequency display is selected or cosφ for power factor.

⊗ 5: Location of transponder coil to allow user access with ID-card

⊗ 6: RS232 port for serial communication

⊗ 7: LED indicators for trip, alarm, ready to operation, communication and self-diagnosis

⊗ 8: Menu or short cut keys; by use of the menu the function keys F1-F4 have context functions, which will be explained in the above LCD. Without using the menu, the function keys can be used as short cut key with the following functions:

F1: enters directly the meters pages starting with the meters overview page

F2: enters directly the alarm/event pages starting with the alarm page

F3: opens directly the process pages starting with the synchronizing page

F4: activates the frame for the breaker control; by using the arrow keys or F4-key again the frame is moving from one breaker to the other. Only the breaker with the frame can be controlled by the user.

⊗ 9: Push button for opening of selected switching device

⊗ 10: Push button for closing- of selected switching device

⊗ 11: The programmable LED's for alarm, error and other indications

⊗ 12: Rear-lit liquid crystal display

⊗ 13: The push button for acknowledgement of alarms; in help with the stop key an emergency stop can be introduced.

⊗ 14: Navigation block; the navigation block comprises "ENTER" for activating the menu and the arrow keys to move the cursor or display frames.

2.2 Menu Tree

SYMAP® provides numerous of meters and process pages on LCD. In addition the settings and controls of the device can be displayed and modified. In help with the key pads on SYMAP® front panel the user will be guided through the menu in a very comfortable way. By pressing "ENTER" the user can be enter the menu. Figure 2-2 shows an overview how to get access to a selected display page of SYMAP®.

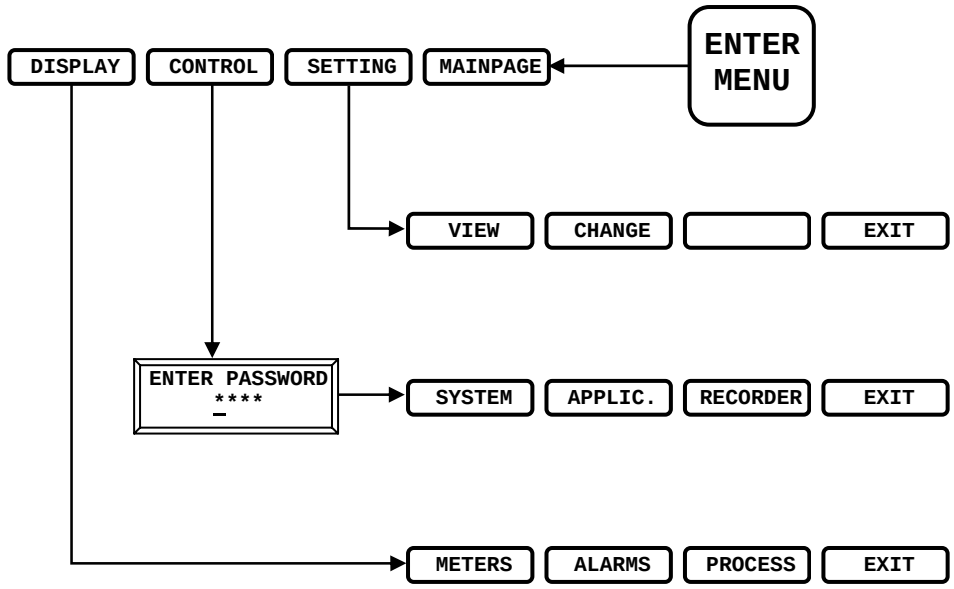


Figure 2-2 Menu tree

The menu tree is divided into three main sections:

- The first section is the free accessable DISPLAY pages. Here the user can get access to all meters, alarms and process pages.
- The second section is the password protected CONTROL pages. Within these pages the user can control the system (device) or applications, and change often usable parameters.
- The third section is the SETTING pages. Over these pages the user can change or view all parameters of the device. The CHANGE mode is password protected. Please refer to the Service manual for a detailed description of this section.

2.3 Graphic Pages

The LCD is separated into the graphic section on the right side and the text or context page on the left side. The graphic page (see Appendix A3) will be selected within the parameter settings (Enter > Setting > Change > System > General parameter > Parameter [0107]) and will be steadily displayed. The state of the breaker such as TEST POSITION, ON/OFF and EARTH POSITION are displayed in accordance to the breaker feed back signals set within the general parameters.

The graphic display is explained by the figure 2-3.

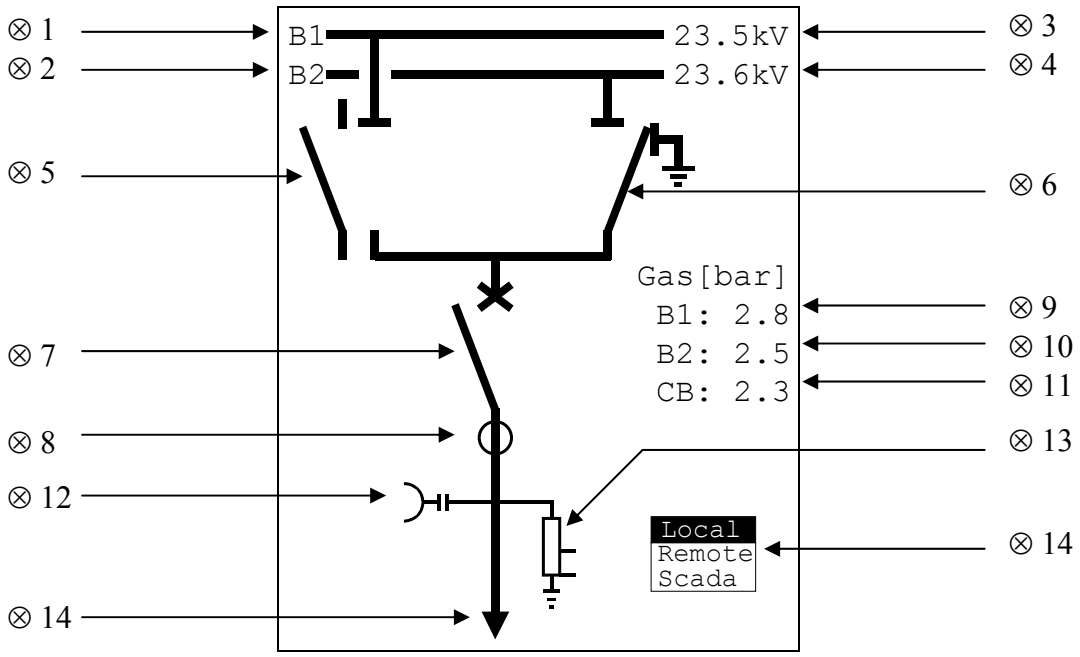


Figure 2-3 Graphic pages (demonstration example)

⊗ 1: The BUS1
⊗ 2: The BUS2
⊗ 3: The voltage of BUS1
⊗ 4: The voltage of BUS2
⊗ 5: The Breaker device BUS1 is in OUT position
⊗ 6: The Breaker device BUS2 is in EARTH position
⊗ 7: The Breaker device circuit breaker is in OFF position
⊗ 8: The current transformer of the feeder BUS
⊗ 9: The gas pressure of the switching device BUS1
⊗ 10: The gas pressure of the switching device BUS2
⊗ 11: The gas pressure of the switching device circuit breaker
⊗ 12: The capacitive connection for voltage measuring
⊗ 13: The resistive divider for voltage measuring
⊗ 14: The connection to the consumer
⊗ 15: The indication of the operating mode of SYMAP®

2.4 Text pages

On the left side of the LCD SYMAP® offers text pages. The text pages comprise the following pages:

- Meter pages, which contain all measuring results.
- Alarm/event pages which register all actual and passed alarms and events.
- Process pages, showing process information such as synchronizing unit or motor starting states.
- Control pages, which allow the user to change control modes of SYMAP®.

2.4.1 Main page

The main page appears after power-on-reset of SYMAP® system. This page shows the free programmable title, the date and time, the state of the several software functions and the activated protection functions of the device (see figure 2-4).

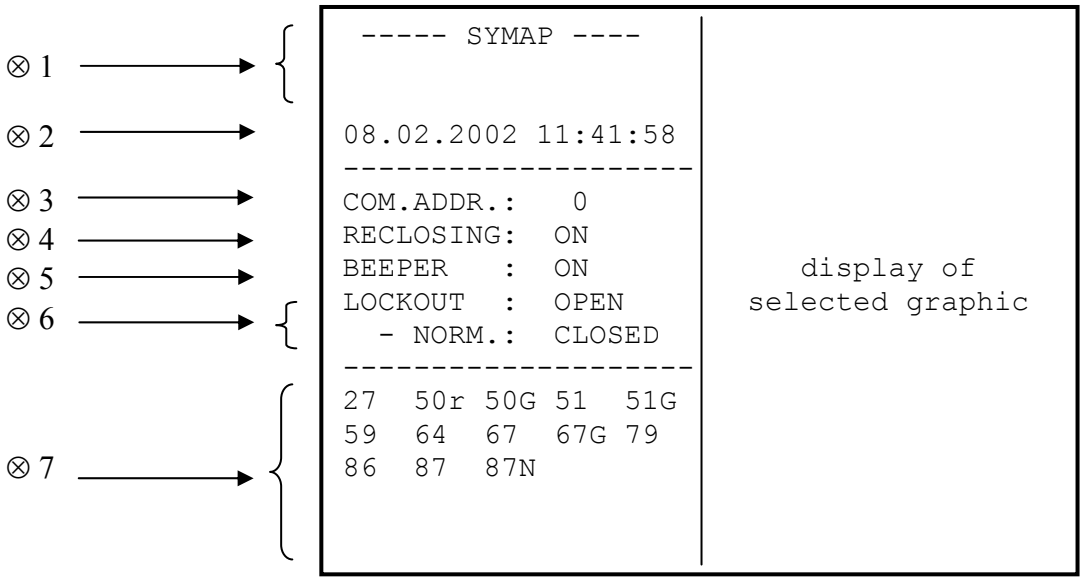


Figure 2-4 Main page (demonstration example)

⊗ 1: Device title; free programmable text
⊗ 2: The actual date (format selectable by parameter [0105]) and time
⊗ 3: The communication address of the SYMAP® device, see parameter [0301]
⊗ 4: The condition of recloser is shown.
⊗ 5: The condition of the alarm beeper is shown.
⊗ 6: The current and normal condition of the "lockout relay" is shown.
⊗ 7: Activated Protection functions will be displayed by their number (ANSI code).

2.4.2 Meter Pages

The measured value sides have a Deadband filter (parameter [0074]). This parameter can be achieved and changed only over the application of PCs „parameters tool " (see Parametertool, chapter 2.4.4) and is adjusted normaly to 2%. All measured values, which have less than 2% of the nominal value, are indicated with zero.
The meter pages give the user detailed information about the measuring inputs and their processing. The meters pages comprise the following pages:

- Overview
- Current meters
- Voltage meters
- Power meters
- Counter
- Ground values
- Harmonic waves
- Frequency meters
- Analog inputs

The meters list page is a meters content page. This page contains all possible meters pages the user can enter. By use of the navigation block the user can select and enter a certain meters page. To reach the METERS LIST in the menu, press the following key combination (see figure 2-5).

Key combination:

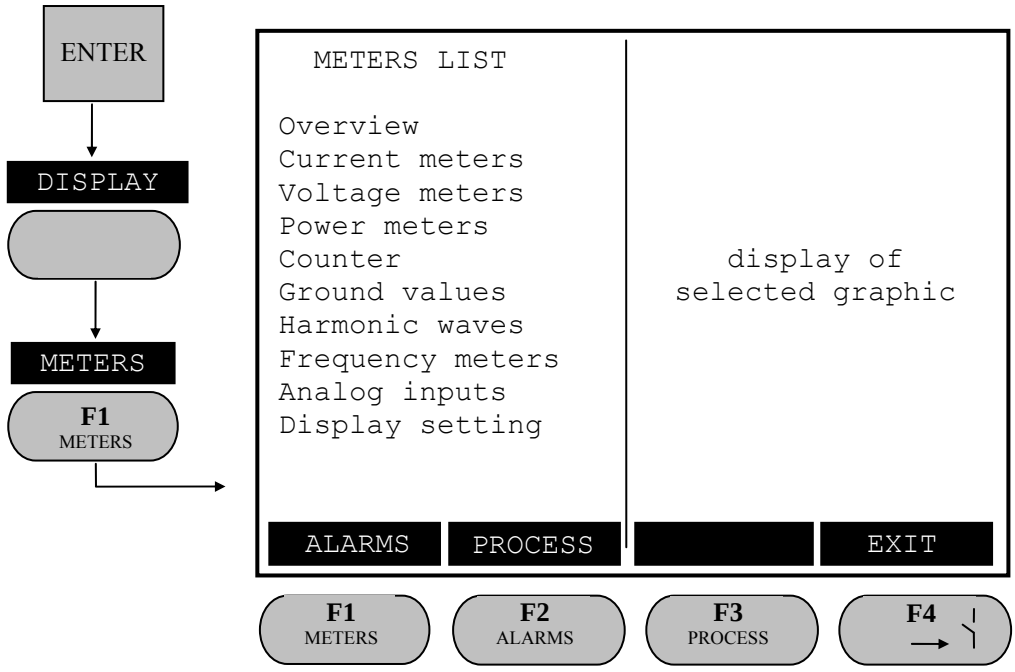


Figure 2-5 Meter pages

SHORTCUTS (if the menu bar is not visible):

- If a meter page is displayed it is possible to change the meter pages directly by using F1 (METERS) or the left/right keys.
- If a meter page is not displayed it is possible to recall the last displayed meter page directly by using F1 (METERS).

2.4.2.1 Meters Overview

This page gives an overview of each current and voltage phase and resulting power values (see figure 2-6).

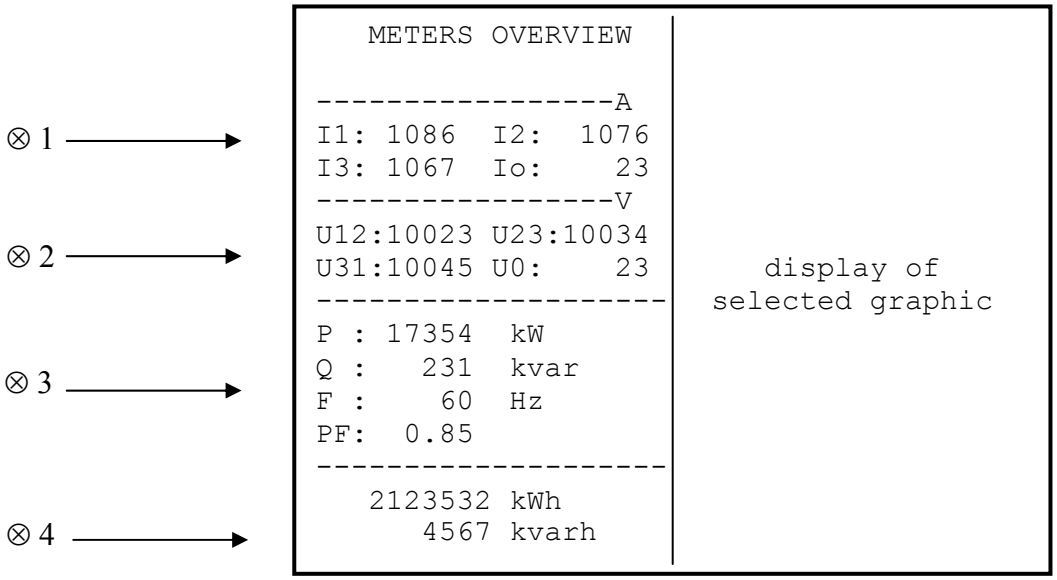


Figure 2-6 Meters overview

⊗ 1: The first section shows the current values I1-I3 and the corresponding calculated ground current. The unit of the current values is A.

⊗ 2: The second section shows the line voltage U12-U31 and the corresponding calculated ground voltage. The unit of the voltage values is V or kV if the nominal voltage parameter [0201] is greater than 99999 V.

⊗ 3: The third section contains the process values active power P, reactive power Q, the frequency F and the power-factor PF. The sign of the power values P, Q is shown behind the symbol.

⊗ 4: The last section contains the actual value of the kWh- and kvar-counter.

2.4.2.2 Current Meters

The current meters page shows more detailed information about the current values (see figure 2-7). In addition to the actual measured current value, an average value is calculated and the maximum-value is stored.

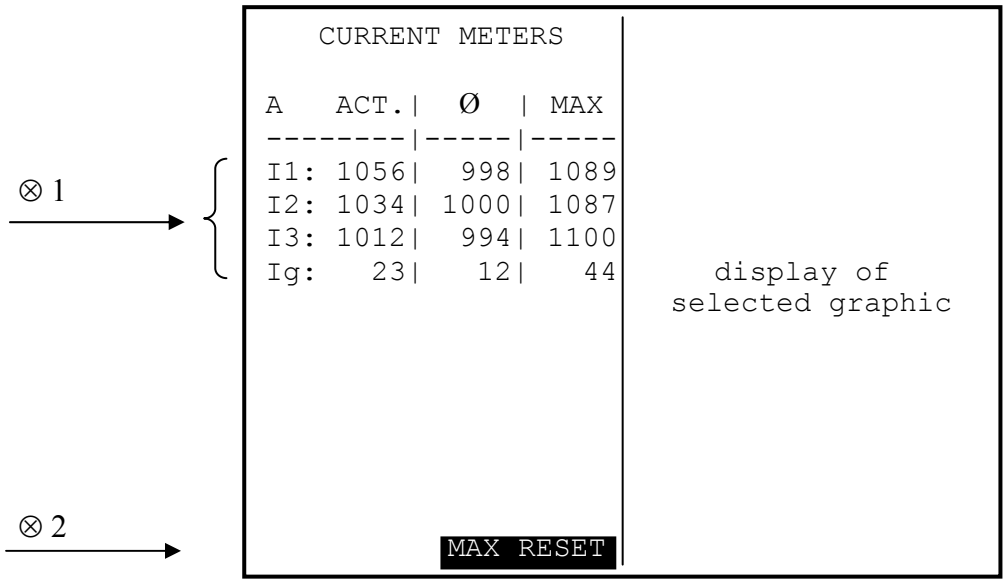


Figure 2-7 Current meters (standard version)

⊗ 1: The upper section of the current meters shows the line currents I1-I3 and the calculated ground current. The unit of the displayed value is A.
In the first column the actual measured value is shown.
Note: With SYMAP®-BC series current transformer for measurement and for protection are separate. The equipment registers therefore two different values. The dynamically higher value is indicated.
The second column shows the average value of the current, whereby parameter [0111] defines the average period for this calculation.
In the third column the peak values of the actual current are captured. The highest value within the last period is stored. To reset this value, F2 (MAX RESET) has to be pressed.

⊗ 2: Use F2 (MAX RESET) to reset the maximum values.

Meters current page for transformer application with three windings

The current meters page differs from the standard current meters page when the protection device is used for transformer application with three windings. Then, instead of the average and the maximum storage of each phase current, the primary current of the transformer and both secondary currents will be shown in the upper table.

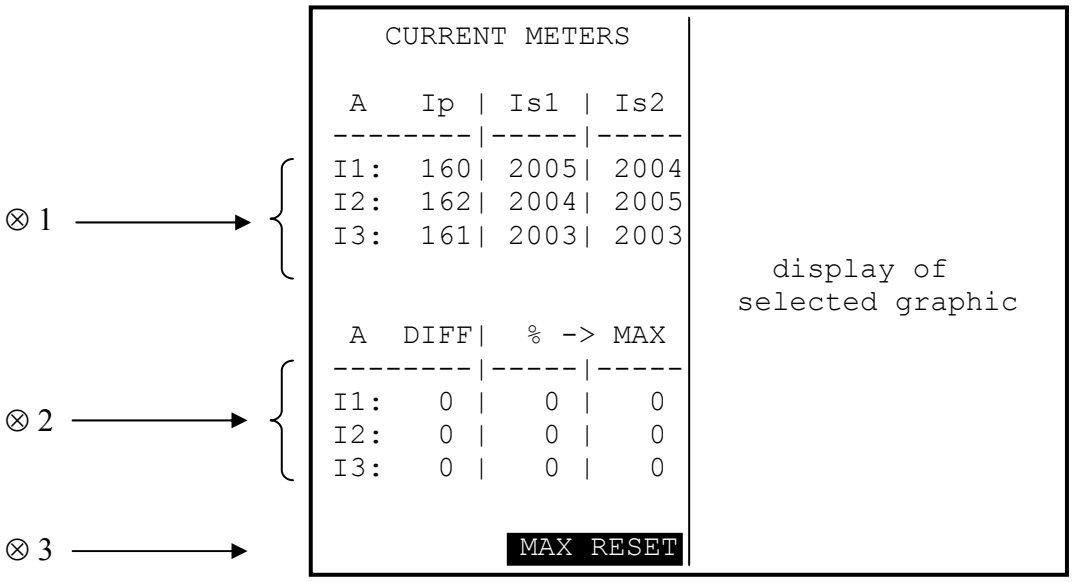


Figure 2-8 Current meters (transformer three windings version)

⊗ 1: The upper section of the current meters shows the Phase Currents I1-3 of the primary side and both secondary sides. The unit of the displayed value is A. In the first column (Ip) the actual measured value of the transformer primary side is shown. The next column (Is1) shows the current values of the transformer secondary side one. These values refer to the nominal-rated current (parameter [0200]) multiplied by the transformer winding ratio for secondary side one (parameter [0220]). The column with the title "Is2" shows the current values of the transformer secondary side two. These values refer to the nominal-rated current (parameter [0200]) multiplied by the transformer winding ratio for secondary side one (parameter [0225]).

⊗ 2: If differential protection is active the second section is displayed. The first column shows the differential current. The measuring principle is that the results of all phase currents flowing into the transformer have to be zero. If not, the current difference of the corresponding phase will be shown in this column. These values refer to the nominal-rated values of the primary side.
The second column shows the converted percentage values of the first column.
In the third column the peak values of the percentage values are stored.

⊗ 3: Use the F2 (MAX RESET) to reset the maximum values.

2.4.2.3 Voltage Meters

The voltage meters page shows each phase and line voltage of the corresponding measured voltage system (see figure 2-9).

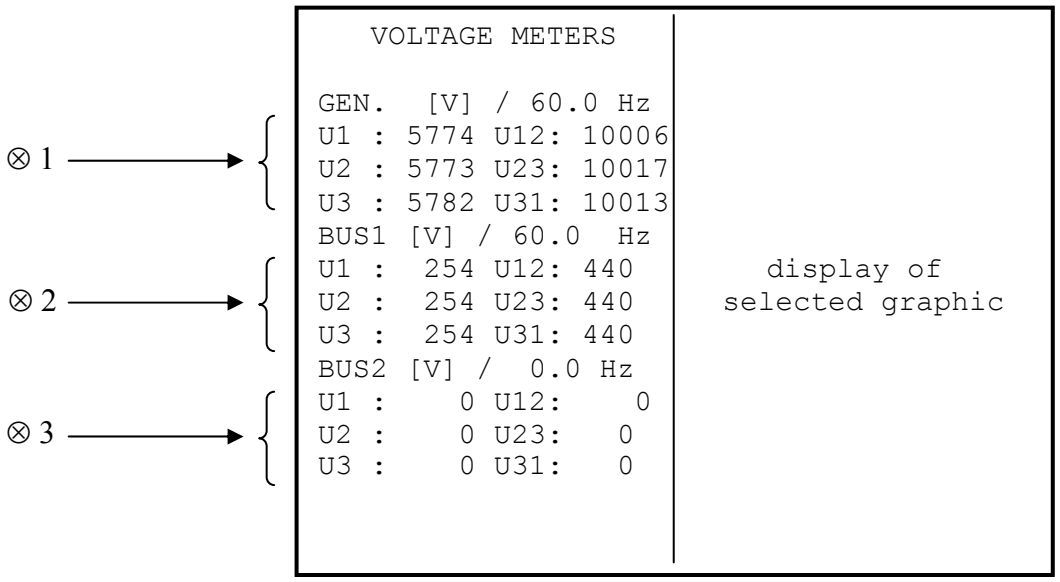


Figure 2-9 Voltage meters

⊗ 1: The first section shows the feeder voltages, measured via inputs -X1: 17, 19 and 21. The first line contains the title of the voltage system and the corresponding actual frequency. The left side shows the phase voltage of U1-U3, the right side the line voltage.

⊗ 2: The first section shows the BUS1 voltages, measured via inputs -X1: 18, 20 and 22. The first line contains the title of the voltage system and the corresponding actual frequency. The left side shows the phase voltage of U1-U3, the right side the line voltage.

⊗ 3: This part is only being displayed if the BUS2 input is enabled. The first section shows the BUS2 voltages, measured via inputs -X1: 23, 24 and 25. The first line contains the title of the voltage system and the corresponding actual frequency. The left side shows the phase voltage of U1-U3, the right side the line voltage. The unit of the voltage values for all 3 sections are V or kV if the nominal voltage parameter [0201] is greater than 99999 V.

2.4.2.4 Power Meters

The power meters page contains processed values of current and voltage measurements (see figure 2-10).

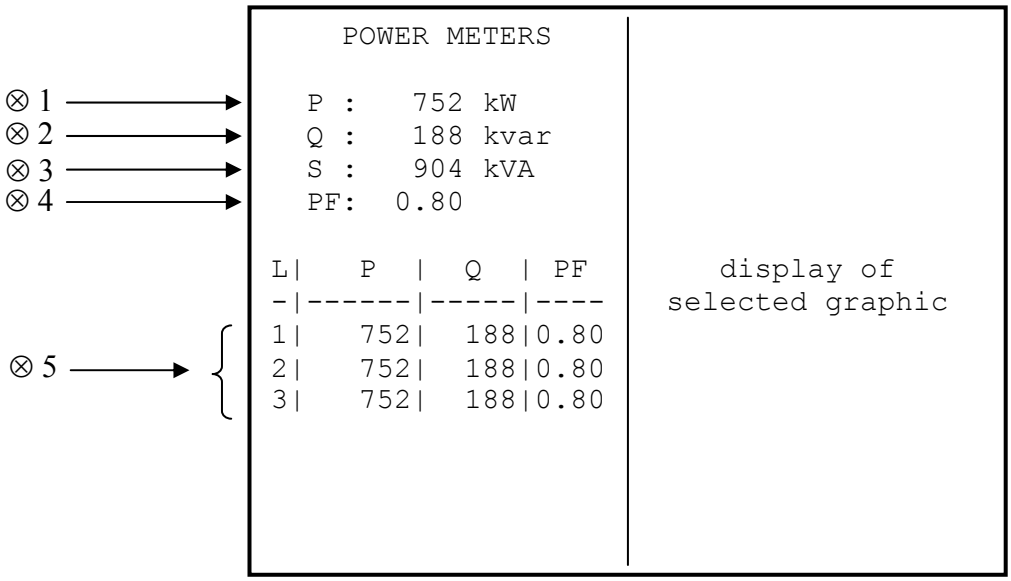


Figure 2-10 Power meters

⊗ 1: Active power of the feeder BUS with unit kW; the sign (+ or -) in front of the value shows the direction of the power flow.

⊗ 2: Reactive power of the feeder BUS with unit kvar; the sign (+ or -) in front of the value shows capacitive (-) or inductive load (+).

⊗ 3: Apparent power of the feeder BUS with unit kVA

⊗ 4: Power factor of the feeder BUS; the power factor shows the relation between active and reactive power.

⊗ 5: The second section of the power meters page shows in detail the active, reactive and the power factor of each phase. The active powers are shown with sign.

2.4.2.5 Counter

The counter page shows the counter contents of the processed values of active and reactive power, and of the working hours (see figure 2-11).

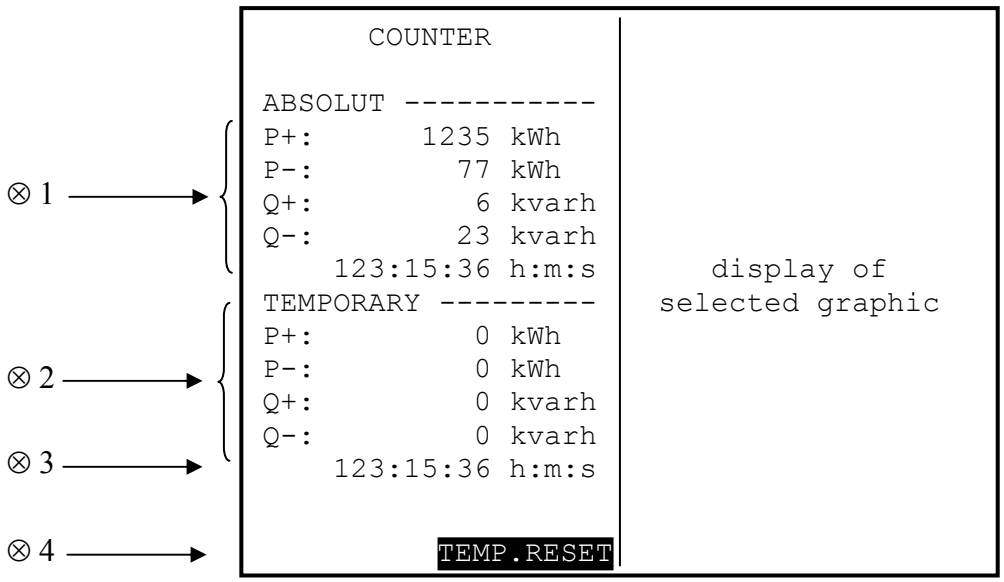


Figure 2-11 Counter

⊗ 1: The first section shows the contents of the absolute power and working hour's counters.
⊗ 2: The second section shows the contents of the temporary power and working hour's counters.

The explanations of the abbreviations:

- P+ : active forward power
- P- : active reverse power
- Q+ : reactive cap. power
- Q- : reactive ind. power

⊗ 3: The format of the working hour counter is: hhhhhh:mm:ss. These counters are working if feeder/generator frequency is detected.
⊗ 4: Reset button for temporary counter. By use of this button (F2), all temporary counters will be reset to zero.

The max. value of the power counters is 4294967295.
The max. value of the working hours counter is 999999:59:59.
If a counter reaches the max. value the counting will be continued at 0.

2.4.2.6 Ground Values

The ground values page contains all measured ground values and their processed power values (see figure 2-12).

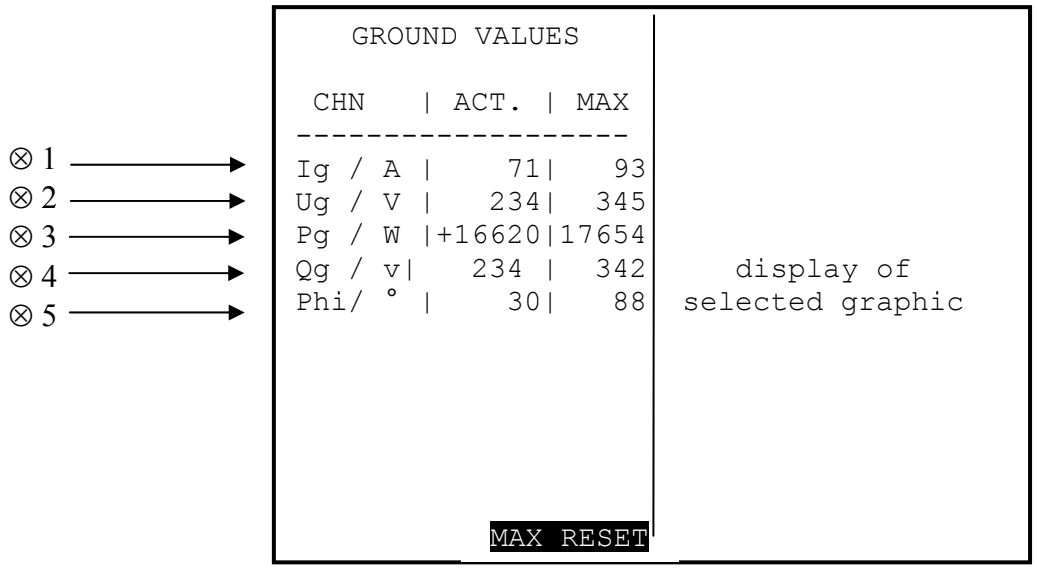


Figure 2-12 Ground values

⊗ 1: Actual measured value of GROUND CURRENT 1 with unit A; the second value in this line is the captured peak value.

⊗ 2: Actual measured value of GROUND VOLTAGE 1 with unit V; the second value in this line is the captured peak value.

⊗ 3: Calculated active ground power with unit W; the active ground power is calculated with ground current and ground voltage. The sign in front of the value shows the direction of the power flow, whereby (-) means reverse power.

⊗ 4: Calculated reactive ground power with unit v; the reactive ground power is calculated with ground current and ground voltage. The sign in front of the value with + shows inductive power and with - shows capacitive power.

⊗ 5: The angle between GROUND CURRENT 1 and GROUND VOLTAGE 1

2.4.2.7 Harmonic Waves

The harmonic wave page shows harmonic contents of feeder voltage and current (see figure 2-13). The displayed content relates to the true RMS value of the corresponding channel.

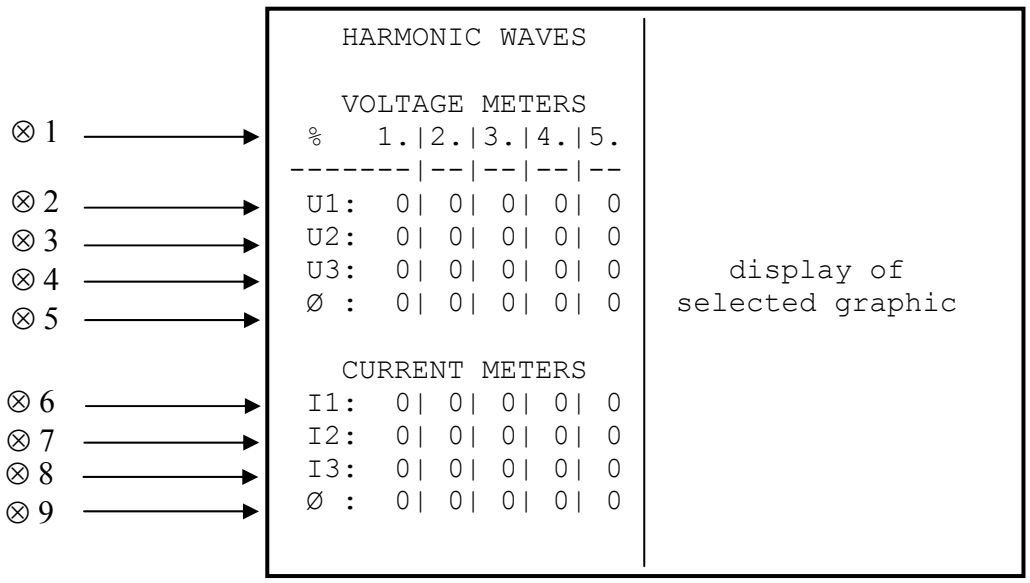


Figure 2-13 Harmonic waves

⊗ 1: Title line of the harmonics table; the table shows harmonic contents from the fundamental wave up to the content of the fifth harmonics. The harmonic content relates to the true RMS value of the corresponding measurement channel.
⊗ 2: Harmonic contents of phase voltage 1
⊗ 3: Harmonic contents of phase voltage 2
⊗ 4: Harmonic contents of phase voltage 3
⊗ 5: The average values of all phase voltages
⊗ 6: Harmonic contents of current phase 1
⊗ 7: Harmonic contents of current phase 2
⊗ 8: Harmonic contents of current phase 3
⊗ 9: The average values of all phase currents

2.4.2.8 Frequency Meters

The frequency meters page shows the measured frequencies of FEEDER, BUS1 and BUS2 system (if input enabled) including their captured minimum and maximum values and the difference (see figure 2-14). The difference is the difference between the actual period and the last period and shows the stability of a frequency. With the F2 RESET button the min/max values can be reset.

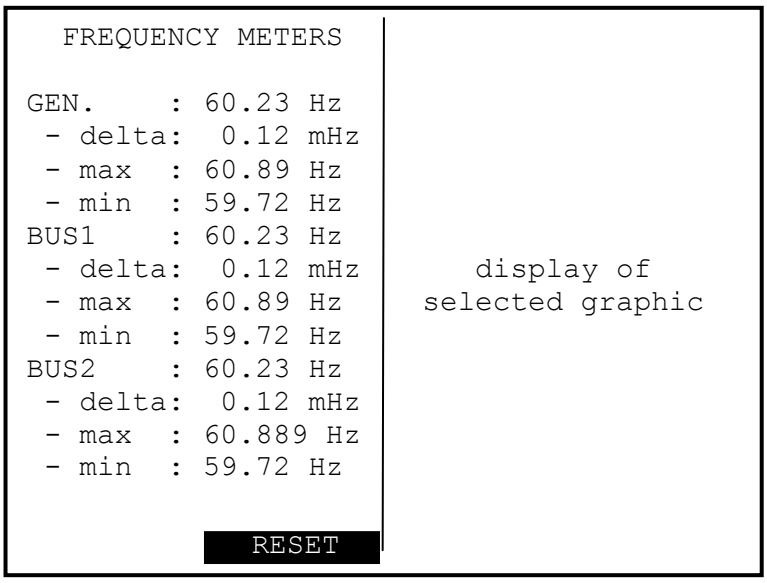


Figure 2-14 Frequency meters

2.4.2.9 Analog inputs

The page for the analogous inputs shows the user all the available measured analog inputs (see figure 2-15).

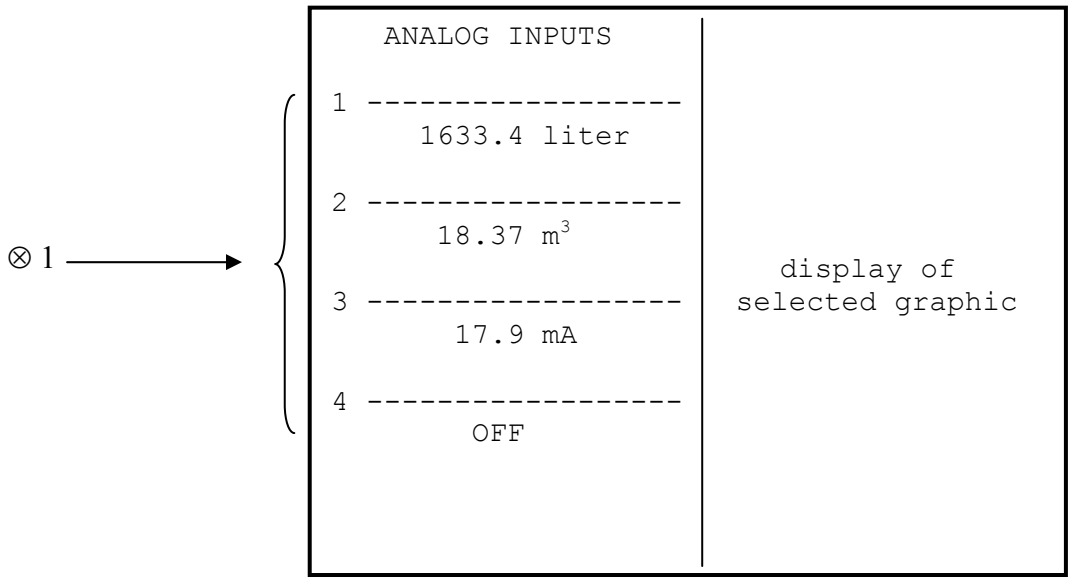


Figure 2-15 Analog inputs

⊗ 1 Actual measured values of the analog inputs; in accordance to the configuration of the device, the analogous inputs are displayed. At minimum, four analogous inputs are available. If the inputs are activated the actual value is displayed with its defined unit. If an external board is in use further analogous inputs and PT100 inputs are be displayed.

2.4.2.10 Display Setting

The display page is a control page for the 7-segment displays and the LCD (see figure 2-16). The user can set the unit of the values (percentage or actual value) and choose between frequency and power factor display. With the arrow keys, the display item can be chosen and the display unit selected. The percentage value relates to the nominal value of the feeder (see parameter chapter "nominal ratio values"). The display page can only be entered by using the menu: Enter > Display > Meters > Display setting.

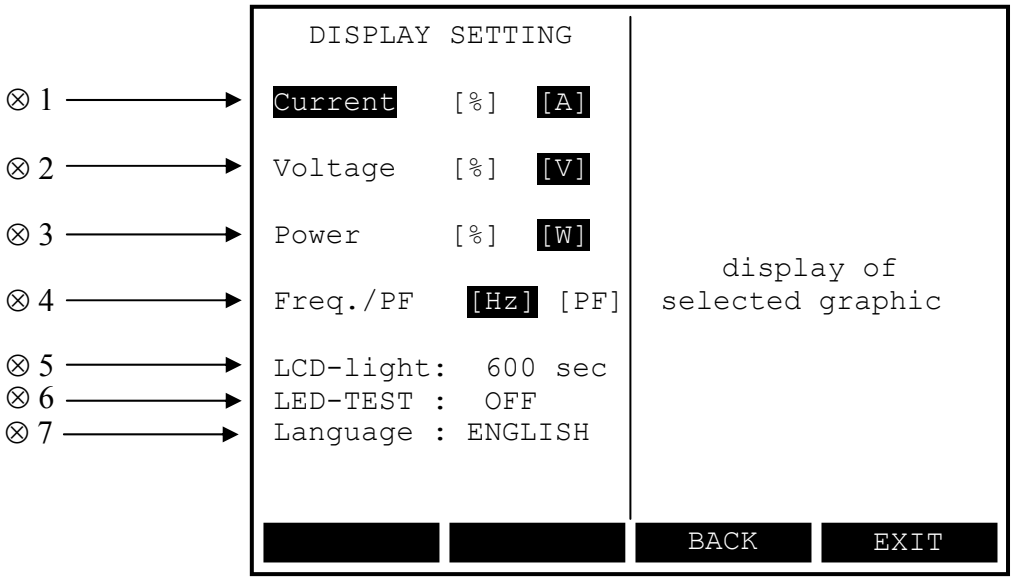


Figure 2-16 Display setting

The lines 1-4 are only valid for the 7-segment displays (only SYMAP® BC/BCG).

⊗ 1: Selection of the unit for current display; % will show the measure feeder current in percent (related to the nominal-rated current; parameter [0200]) and A will show the current in amperes.

⊗ 2: Selection of the unit for voltage display; % will show the measured feeder voltage in percent (related to the nominal-rated voltage; parameter [0201]) and V will show the voltage in volts.

⊗ 3: Selection of the unit for power display; % will show the measured feeder power in percent (related to the nominal-rated power; parameter [0202]) and W will show the power in watts.

⊗ 4: Selector for the fourth 7-segment display; select Hz to display the feeder frequency or PF to display the power factor of the feeder.

⊗ 5: After keyboard activities or occurrences of alarms, the backlight of the LC-display will be activated. The "LCD-light" defines the delay time to switch off the backlight again. The light is always on if this parameter is set to 9999 sec.

⊗ 6: The possibility to make a LED test of the SYMAP® device. The LED test comprises all 7-segment displays, as well as all LED indicators at the front panel.

⊗ 7: Selection of the displayed language. The languages are valid for the user menu, not for the settings menu section (this section is always in English).

2.4.3 Alarm/Event Pages

The second group of text pages contains the alarm and event pages. Within these pages SYMAP® provides detailed information about events, alarms and interlocks. By using the detailed event or protection histories, the user can easily follow the recorded events of a process. The "ALARM/EVENT LIST" is the overview page for the alarm and event pages. By using the navigation block, the user can select and enter a certain page. To enter the "ALARM/EVENT LIST" the key combination shown below must be pressed.

Key combination:

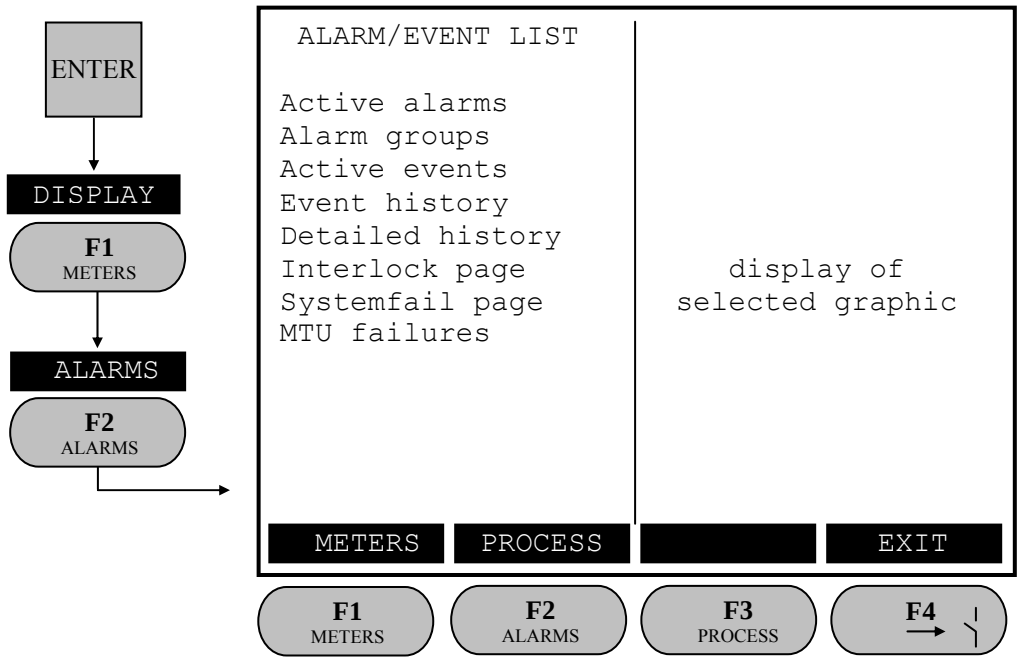


Figure 2-17 Alarms/Event list

SHORTCUTS (if the menu bar is not visible):

- If an ALARM/EVENT page is displayed it is possible to change the ALARM/EVENT pages directly by using the F2 (ALARMS) key or the left/right keys.
- If an ALARM/EVENT page is not displayed it is possible to recall the last displayed ALARM/EVENT page directly by using the F2 (ALARMS).

2.4.3.1 Active Alarms

The alarm page will be displayed automatically in case an alarm appears (see figure 2-18). Then in accordance with the alarm settings, the alarm number (event number) and the title of the alarm will be displayed. The alarms within this page are sorted by the appearance time. If more than eight alarms are stored by SYMAP® the user can scroll the alarm list up and down by using the navigation block.
In addition to the alarm text, the corresponding LED, on the left side of the LCD-display (only SYMAP®- BC, -BCG), and the internal beeper will be activated. The colour of the LED (green, amber and red) can be set within the parameter setting of the alarm controller. If an alarm occurs the corresponding LED will blink quickly fast as long as the alarm is acknowledged or the alarm is no longer active. The LED will blink slowly if the alarm is not active but not acknowledged. The table 2-1 shows the LED and beeper control in accordance to the alarm status.

Table 2-1 Alarm status

Alarm status	LED	Beeper
Alarm active (after appearance)	Blinking fast	Fast interval
Alarm active and acknowledged	Steadily on	off
Alarm inactive and not acknowledged	Blinking slow	Slow interval

If the beeper is switched on the user has to acknowledge the alarm twice: The first acknowledge will be used to switch off the beeper, and the second, to register the alarm.

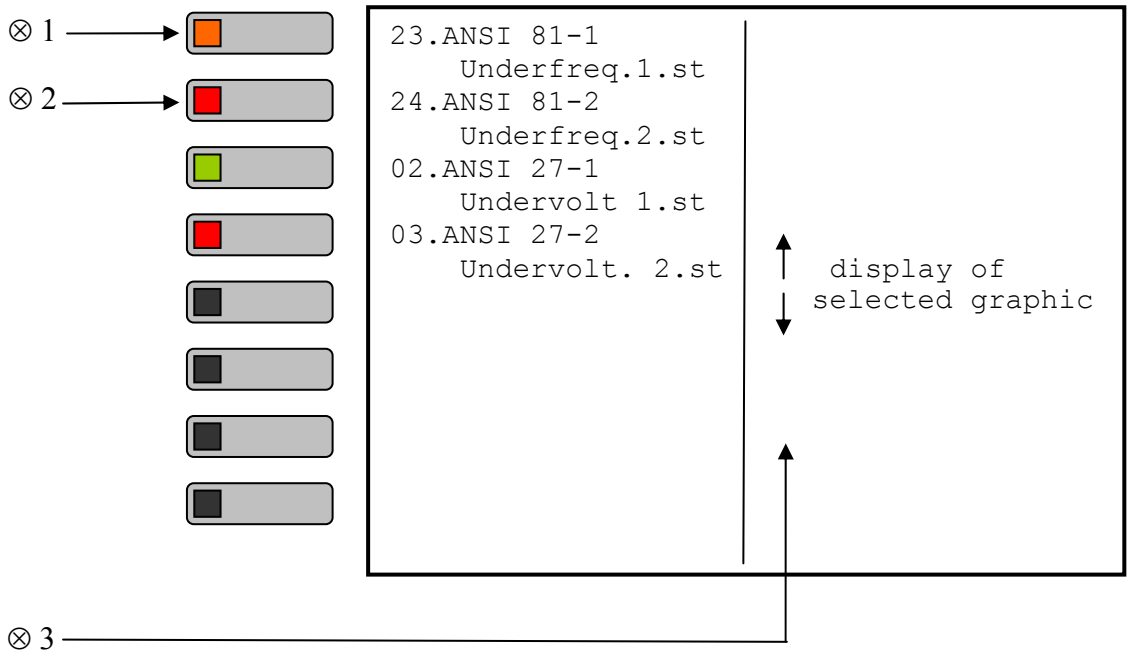


Figure 2-18 Active alarms

⊗ 1: This line shows the last stored alarm. The LED colour is given by the setting of the corresponding alarm channel. On the display itself, the two text lines of the alarm channel are shown.
⊗ 2: This line shows the previous stored alarm.
⊗ 3: If the arrows appear (more than 8 alarms active) the user can scroll up and down the alarm list by using the navigation block.

2.4.3.2 Alarm Groups

The alarm group page shows in the first lines the number of alarm groups and alarms that are active at the moment (see figure 2-19). Each alarm can be assigned to an alarm group within the alarm controller setting.

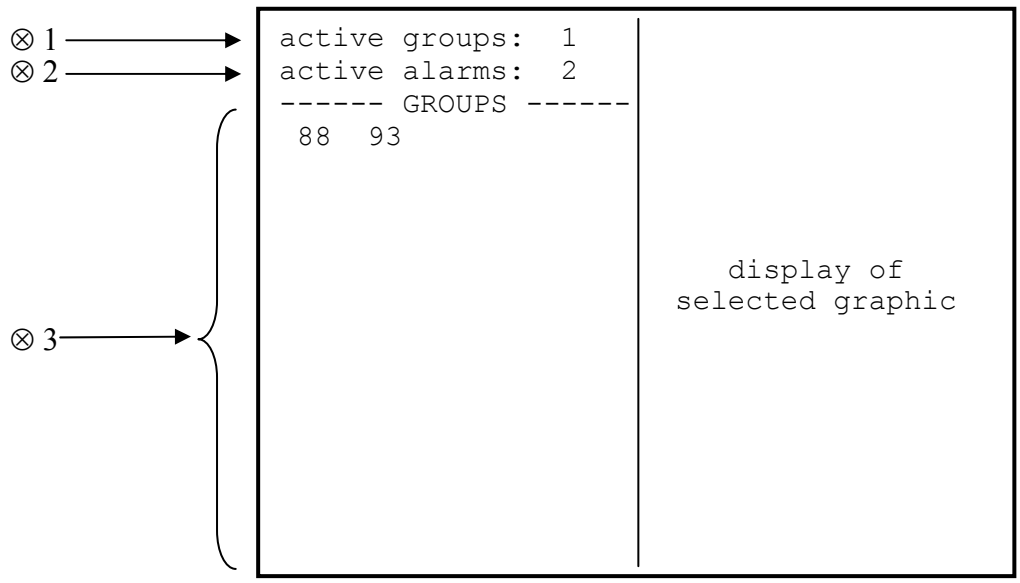


Figure 2-19 Alarm groups

⊗ 1: This line shows the present active number of groups.
⊗ 2: This line shows the present active number of alarms.
⊗ 3: This field shows a list of event numbers of the active groups.

2.4.3.3 Active Events

This page shows all active events by their number (see figure 2-20). The event list in the appendix shows all events which SYMAP® can handle.

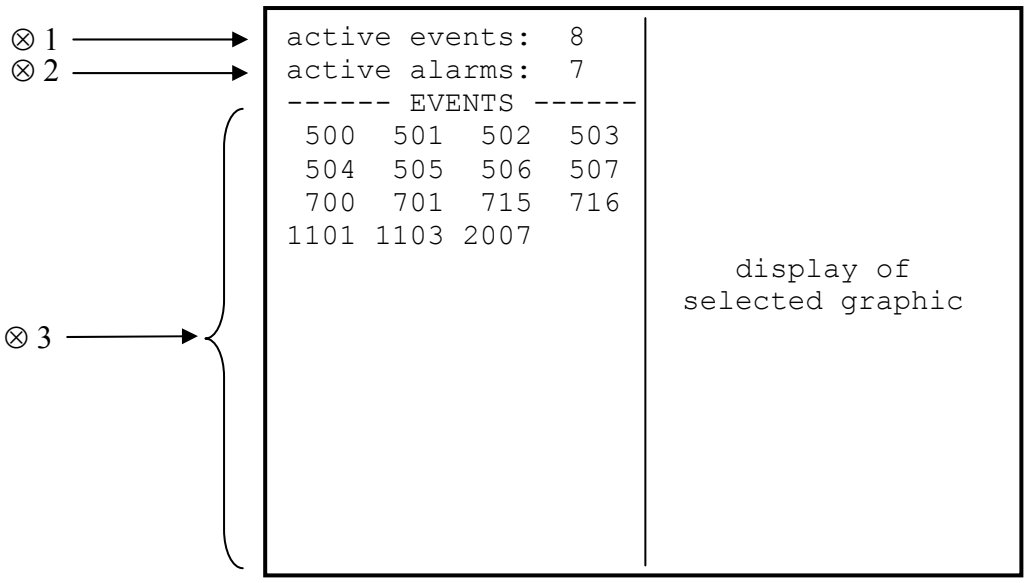


Figure 2-20 Active events

⊗ 1: This line shows the number of active events.
⊗ 2: This line shows the number of active alarms.
⊗ 3: These lines show a list of the actually active events.

2.4.3.4 Event History

The event history stores all events, whose status has changed. In addition to the event number, a text string and a time stamp will be issued. The event history page is sorted by the time stamp. Up to 5000 events can be stored. The user can scroll within this page by using the up/down keys of the navigation block. Figure 2-21 shows an example of a event history.

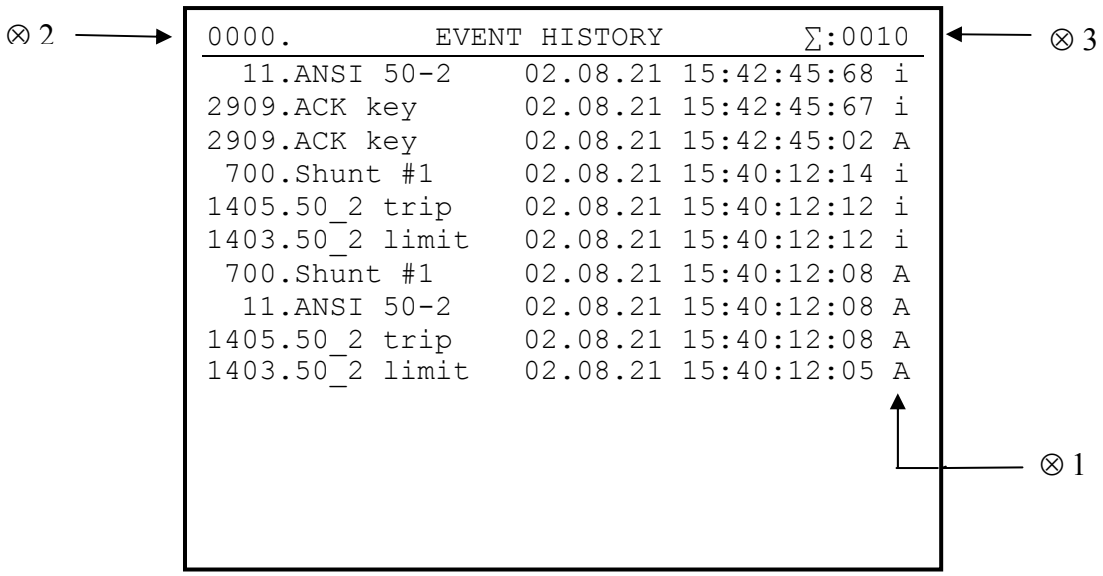


Figure 2-21 Event history

- The format of the time stamp is: year: month: day: hour: minutes: seconds: milliseconds.

⊗ 1 The last symbol in the line (i, A) shows whether the event has been changed to active status (A) or inactive status (i).
⊗ 2 The number (0000.) shows the scroll index.
⊗ 3 The number (∑: 0010) shows the amount of events actually stored.

2.4.3.5 Detailed Protection History

The detailed protection history stores all events of the protection functions of SYMAP®. The events within the detailed protection history are sorted by their time stamp (see figure 2-22). By using the "UP" and "DOWN" keys a certain event can be selected, and with "ENTER" another window containing detailed fault information can be opened. Up to 1000 events can be stored.

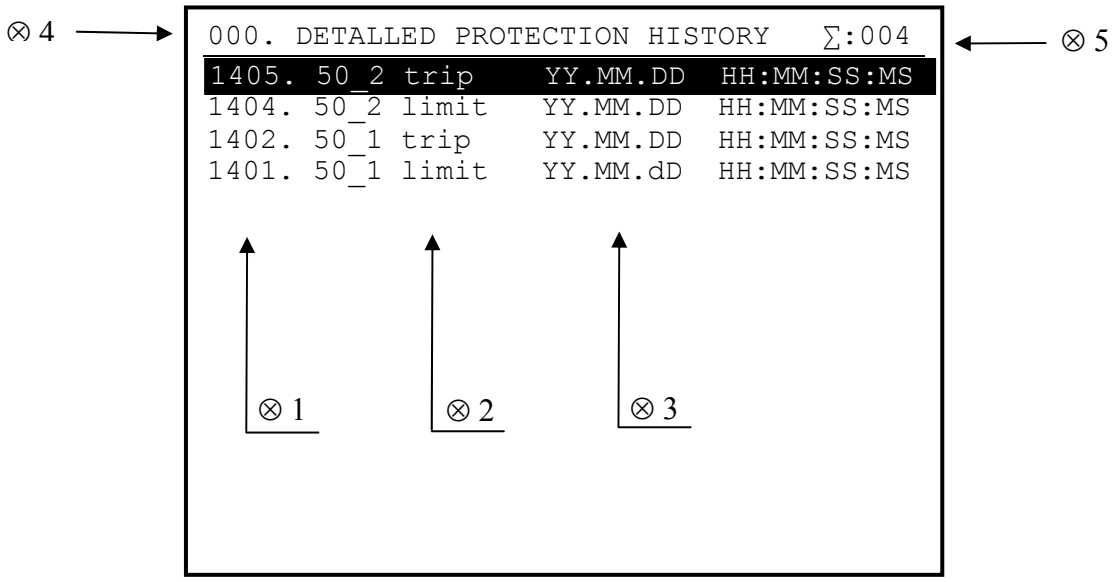


Figure 2-22 Protection history

⊗ 1: Event number of the alarm
⊗ 2: Text field for alarm description
⊗ 3: Time stamp with format: year: month: day: hour: minutes: seconds: milliseconds
⊗ 4 The number (000.) shows the scroll index.
⊗ 5 The number (∑: 004) shows the amount of events actually stored.

By using "ENTER", the user can open another window with detailed fault information. This window contains the fault information belonging to the selected alarm. Figure 2-23 shows an example of a detailed information window:

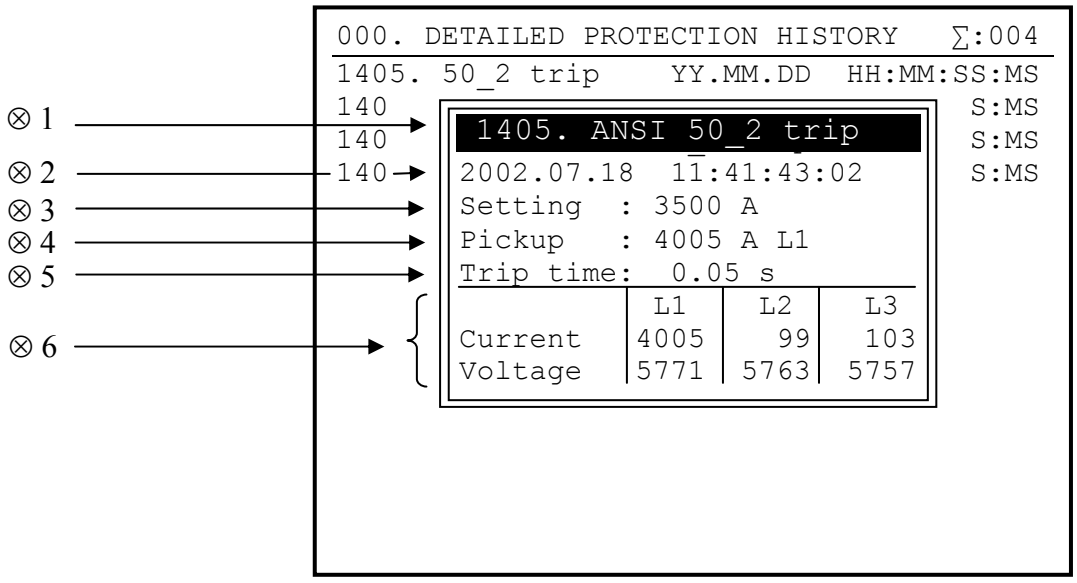


Figure 2-23 Detailed protection history

⊗ 1: Title line of alarm
⊗ 2: Time stamp of protection event
⊗ 3: Setting value of the corresponding protection alarm
⊗ 4: Pickup value of the event at the moment the event status changed and the fault phase (L1, L2 and L3)
⊗ 5: Trip time of the protection event
⊗ 6: Pickup status of all phase currents and voltages at the moment the event status changed

2.4.3.6 Interlock page

The interlock page appears when the user tried to control the breaker, but the interlock logic of the device blocked this action. Within this page the user has access to information about the action which was interrupted by the interlock. The information is:

The page shown on figure 2-24 appears automatically in case of interlock error. This page will be stored until the next interlock error occurs.

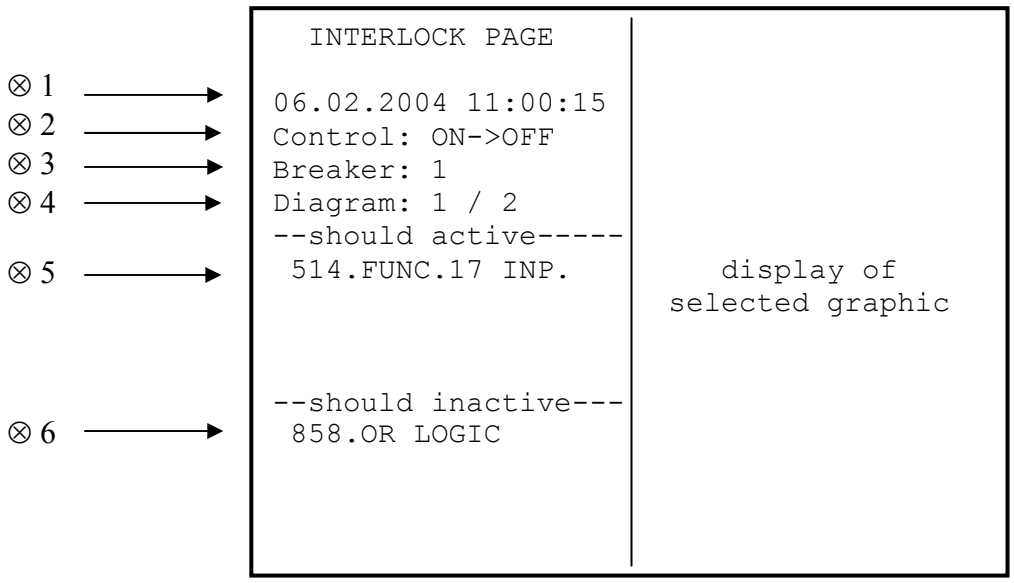


Figure 2-24 Interlock page

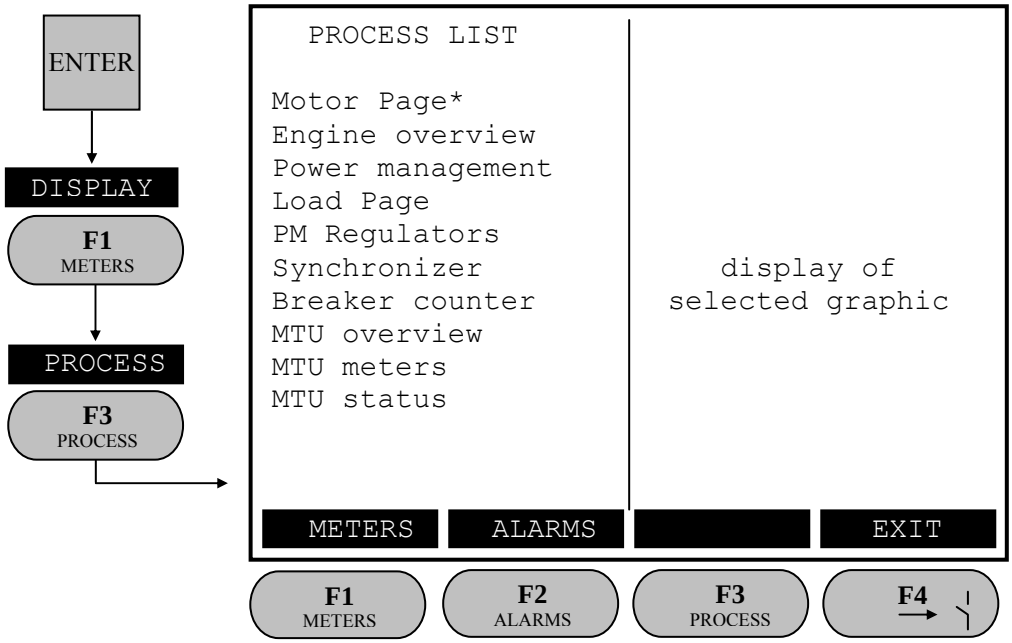
⊗ 1: Timestamp of the action
⊗ 2: Control: Which process was introduced by the user?
⊗ 3: The number of the breaker
⊗ 4: The diagram number of the interlock logic, which belongs to the corresponding breaker.
⊗ 5: The event number that should be activated to release the control.
⊗ 6: The event number that should be deactivated to release the control.

2.4.4 Process Pages

The third group of pages are the process pages. These pages show processed measured values, which are used for showing the user synchronizing process data or the thermal image of the motor or generator.

The "PROCESS LIST" is the content page of the process pages. **The content depends on the device type and the enabled software modules**. By using the navigation block, the user can select and enter a certain page. To enter the "PROCESS LIST" or to toggle within these pages, either the hotkey F3 or the key combination shown on figure 2-25 can be pressed.

Key combination:



*: only available if the motor protection is activated

Figure 2-25 Process list

SHORTCUTS (if the menu bar is not visible):

- If a process page is displayed it is possible to change the process pages directly by using F3 (PROCESS) or the left/right keys.
- If a process page is not displayed it is possible to recall the last displayed process page directly by using F3 (PROCESS).

2.4.4.1 Motor Page

This page is only available if the motor protection is activated (ANSI 37, ANSI 49, ANSI 51LR, ANSI 66). The page appears automatically, when the motor is in the starting phase. The motor page is separated into three sections (see figure 2-26). The first shows the actual state of the motor, the second, the status of Protection Functions ANSI 49 and ANSI 66 if activated and the third section an overview of the most important settings for the motor protection.

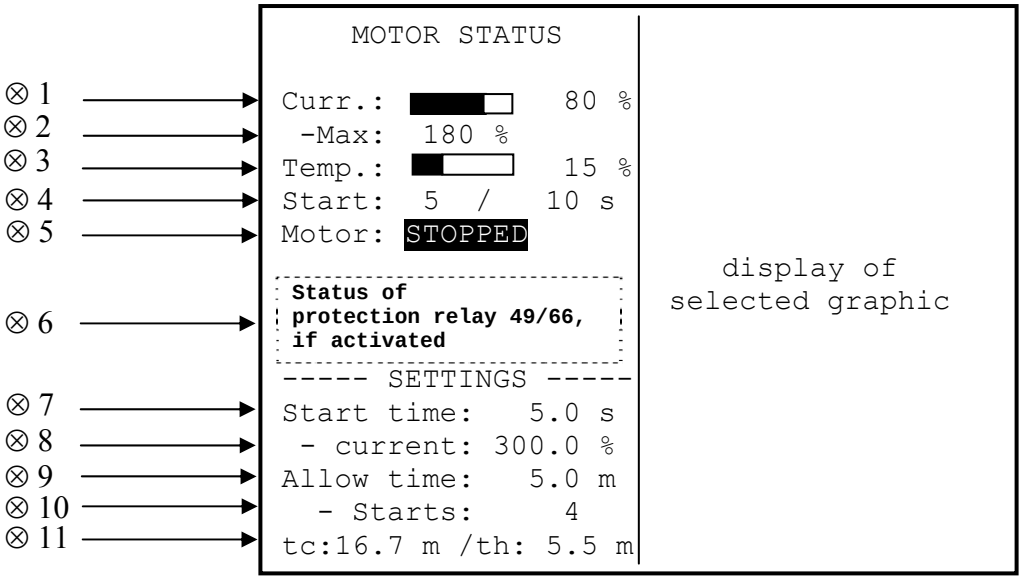


Figure 2-26 Motor status

⊗ 1: The actual current of the motor related to the rated current is shown. The bar graph shows the corresponding current value. The full scale of the bar graph is 100 %.

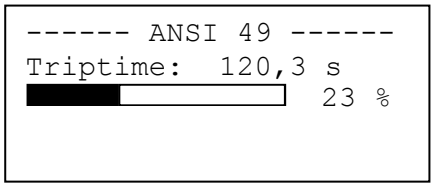
⊗ 2: The maximum current during the last motor start is shown.

⊗ 3: The actual thermal image of the motor is shown. The bar graph shows the corresponding temperature image value. The full scale of the bar graph is 100 %

⊗ 4: Start counter and timer; the counter shows the number of start attempts of the motor. The timer measures the duration of the starting phase and registers the last starting period of the motor.

⊗ 5: State of the motor; the state of the motor is shown: "STOPPED", "STARTING", or "RUNNING".

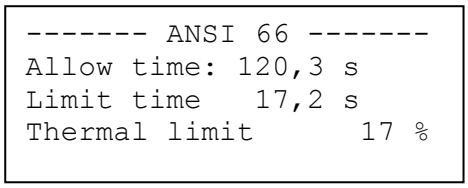
⊗ 6: Status of Protection Relays ANSI 49 and ANSI 66; if one of the protection relays (according to ANSI 49/ANSI 66) is activated detailed information will be shown.
If the actual motor current is higher than the setting of parameter [1341] the trip time will be calculated for the **Thermal Overload Relay** (ANSI 49) and the following window (see figure 2-27) will be displayed:



Thermal Overload Relay (ANSI 49) is active:
Calculated trip time (see Service Manual ANSI 49)
The bar graph shows the
passed trip delay time.
The full scale of the bar graph is 100% (= trip).

Figure 2-27 ANSI 49

If the Protection Relay ANSI 66 (Start Inhibit) is in use and one of the corresponding blocking conditions is fulfilled then the following window (see figure 2-28) will be displayed:



Motor start is blocked.
State of Allow time (set with parameter [1721]).
State of Limit time (see parameter [1723]).
State of thermal image of the motor (thermal limit: parameter [1724]).

Figure 2-28 ANSI 66

⊗ 7: The setting of the start time, parameter [1542]/ANSI 51 is shown.

⊗ 8: The setting of the start current, parameter [1541]/ANSI 51 is shown.

⊗ 9 & ⊗ 10: Within the period of time set by parameter [1721]/Start Inhibits for Motors Relay (ANSI 66) the maximum start attempts set by parameter [1722]/Start Inhibits for Motors Relay (ANSI 66) are allowed.

⊗ 11: The actual values of τcold (tc) and τhot (th) are shown, calculated by the settings of parameters [1342], [1343] and [1344]/Thermal Overload Relay (ANSI 49).

The figure 2-29 displays two possibilities of reaching the "running" condition of the motor during motor starting.

The first possibility is shown in Curve A.
The running phase of the motor will be introduced, when the current first crosses the nominal current limit and returns to a value below this limit.

The second possibility is shown in Curve B. The running phase is reached, when the maximum start time (parameter [1542]) is passed.

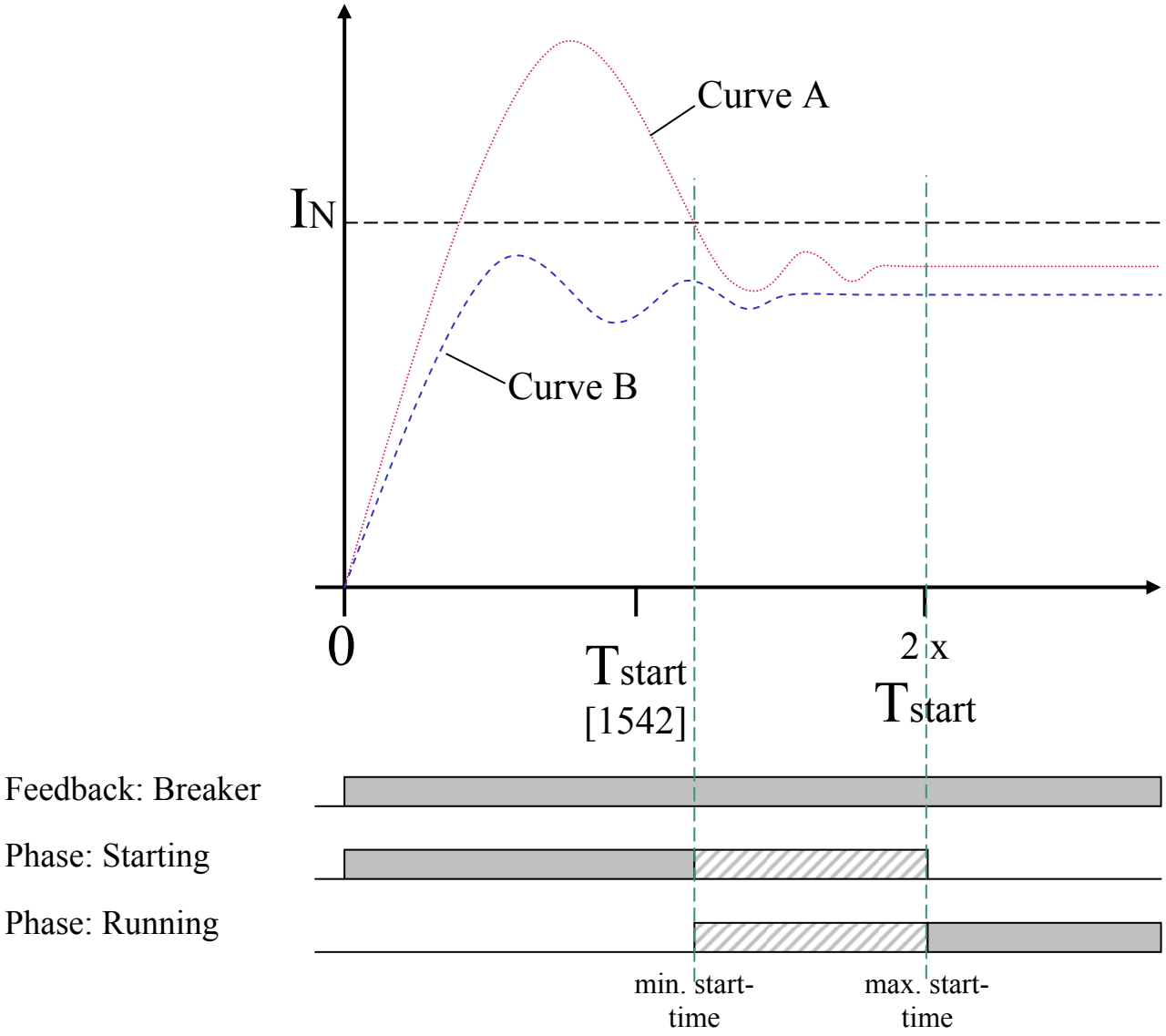


Figure 2-29 Motor Start Phase

2.4.4.2 Engine Overview Page

The diesel overview page shows the most important information for the diesel aggregate (see figure 2-30). Three sections contain the actual measured speed signals, the status window and the state of the most common counters, such as start or working hours.

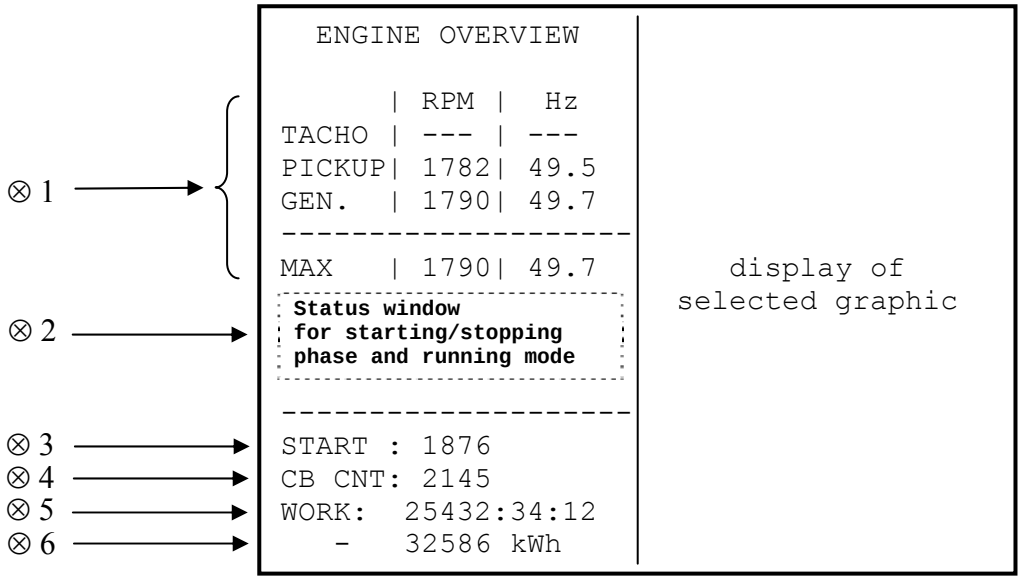


Figure 2-30 Diesel overview

⊗ 1: Speed signals; three measuring inputs for the speed signals of the aggregate are provided. These are an analog input (4-20 mA) for tacho generators, a pick-up input and a speed measurement via the generator voltage. If one of the speed inputs is active the numbers indicating RPM and Hz will be displayed. The first column shows the speed signal in rounds per minute (RPM), the second, the cycles per second (Hz). The maximum measured speed signal is shown in the last line. This maximum speed value is the reference speed signal of the aggregate and is used for all limit events, such as ignition speed.
Settings for speed measuring source:

Analog input (tacho): Enter > Setting > Change > System > Power management > Diesel control > Parameter [0265].

Pick-up input: Enter > Setting > Change > System > Power management > Diesel control > parameter [0266] to parameter [0267].

Via generator voltage: This measuring system will be activated automatically if 10 % generator voltage is detected. The frequency range for this input is 35 Hz to 75 Hz.

⊗ 2: Status window; the status window shows detailed information relevant to the active phases (starting, stopping, operation, stopped). Status window similar to the one in the main page (see Table 2-3) with exception of the phase timer. The phase timer appears within the starting and stopping phases and shows the current timer content of the corresponding phases. Within the starting phase the number of trials is displayed.

⊗ 3: Start counter; the start counter shows the number of starts that have taken.

⊗ 4: Circuit breaker state counter; counter will be increased if the status of the circuit breaker changes from off to on.

⊗ 5: Working hour counter; this value shows the working hours of the aggregate. The format is hours:minutes:seconds. For the hours eight digits are reserved.

⊗ 6 Active power counter; the kWh register counts the measured active power of the diesel aggregate.

2.4.4.3 Power Management Page

This page shows and stores all activities relevant to power management functions (see figure 2-31). Useful information, such as net load, stand-by load and spinning reserve, are displayed.

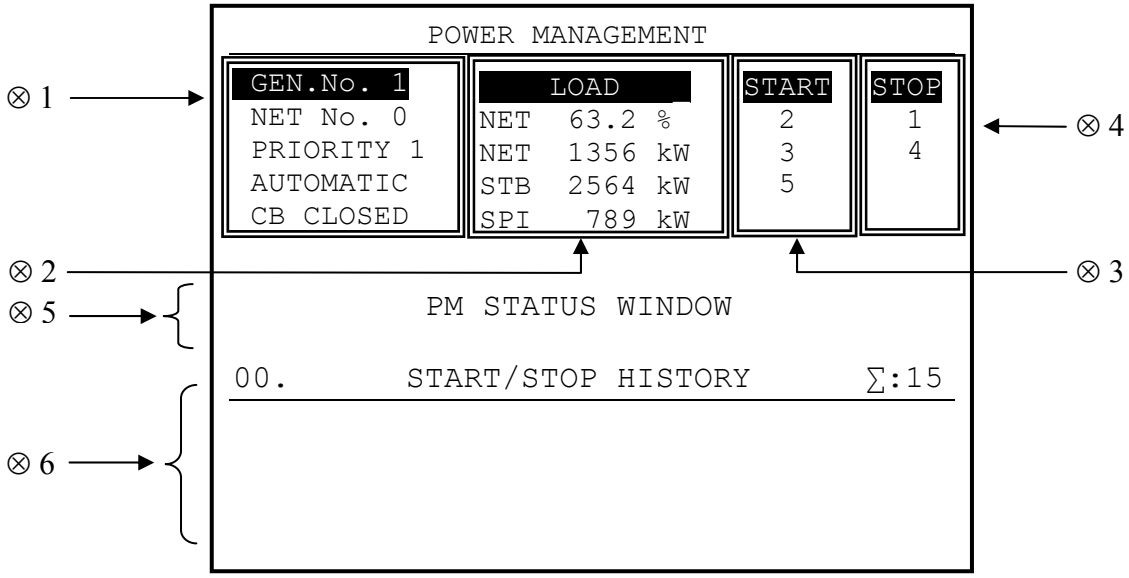


Figure 2-31 Power management

⊗ 1 Own status; this box shows the status of its own aggregate. The generator number parameter [0180], the BUS section (net) to which the circuit breaker is connected, the priority of the aggregate, the mode (automatic/manual), and the state of the circuit breaker are shown.

⊗ 2 Load status; this box gives an overview about the load conditions of the net to which the aggregate is connected. The active power of the net (BUS section) as a relative and absolute kWs is shown. Also the stand-by (STB) power and the spinning reserve (SPI) are displayed.

⊗ 3 Start list; the start list contains all diesel generators that are ready to start. The numbers are sorted by their corresponding priority. The first number in this column is the diesel aggregate with the highest priority and will be started next when the power management function detects a start condition.

⊗ 4 Stop list; the stop list contains all diesel generators that are loading the BUS section. The numbers are sorted by their corresponding priority. The first number in this column is the diesel aggregate with the highest priority and will be stopped next when the power management function detects a stop condition.

⊗ 5 PM status window; this status window gives detailed information about the action of the power management controller. All information, such as load depending starting or stopping condition or send of start and stop order, will be shown. Table 2-2 shows all information the device can display.

Table 2-2 PM Status

Status window	Description
PM: OFF	Power management is disabled.
PM: BLOCKED (by CANBUS node)	Power management is blocked by another device within the same net.
PM: BLOCKED (no CANBUS nodes)	Power management is blocked, since no CANBUS nodes are found.
PM: BLOCKED (all in manual)	Power management is blocked, since all devices are in manual mode.
PM: ON/slave	Power management is on. The corresponding device is slave.
PM: ON/master	Power management is on. The corresponding device is master.
PM: RANGE	The Load ranges are enabled.
PM: STOP BLOCKED (EVENT)	Load depending stopping is blocked by an event. Parameter [0912].
PM: STOP BLOCKED (consumer req.)	Load depending stopping is blocked by big consumer demand.
PM: STOP BLOCKED (LOAD PAGE)	Load depending stopping is blocked over the load page (see chapter 2.4.5.4).
PM: wait until starting	Power manager detects a starting diesel generator and blocks further start commands until the starting phase is finished.
PM: load balancing: 12 sec	After a circuit breaker is switched on, the power manager is waiting until the load is balanced within this net. The delay time for the load balancing process is set with parameter [0189].
G 2 reached 1.single load limit: 82 %/75 % Start G 1 in: 78 sec	Load depending start condition reached: The first line shows that Generator 2 exceeds the first load limit for start parameter [0903], followed by its actual power and the limit value. The second line shows that Generator 1 will be started next after the start delay time. This status will be shown if parameter [0902] is set to single.
G 2 reached 2.single load limit: 81%/80 % Start G 1 in: 34 sec	Load depending start condition reached: The first line shows that Generator 2 exceeds the second load limit for start parameter [0905], followed by its actual power and the limit value. The second line shows that Generator 1 will be started next after the start delay time. This status will be shown, if parameter [0902] is set to single.
1. total load limit reached: 84%/80 % Start G 1 in: 45 sec	Load depending start condition reached: The first line shows that the relative net power exceeds the first load limit for start parameter [0903], followed by the actual net power and the limit value. The second line shows that Generator 1 will be started next after the start delay time. This status will be shown if parameter [0902] is set to total.
2. total load limit reached: 84%/80 % Start G 1 in: 67 sec	Load depending start condition reached: The first line shows that the relative net power exceeds the second load limit for start parameter [0905], followed by the actual net power and the limit value. The second line shows that Generator 1 will be started next after the start delay time. This status will be shown if parameter [0902] is set to total.
Low frequency: 47.50 Hz/48.00 Hz Start G 1 in: 56 sec	Load depending start condition reached: The first line shows that the frequency of the net falls below the low frequency limit for start parameter [0907], followed by the actual frequency of the net and the limit value. The second line shows that Generator 1 will be started next after the start delay time.
G 2 have high current: 78 %/75% Start G 1 in: 67 sec	Load depending start condition reached: The first line shows that Generator 2 exceeds the current limit for start parameter [0909], followed by its actual current and the limit value.

	The second line shows that Generator 1 will be started next after the start delay time. This status will be shown if parameter [0902] is set to single.
High current reached: 78 %/75 % Start G 1 in: 79 sec	Load depending start condition reached: The first line shows that the relative net current exceeds the current limit for start parameter [0909], followed by the actual net current and the limit value. The second line shows that Generator 1 will be started next after the start delay time. This status will be shown, if parameter [0902] is set to total.
Load limit for stop reached: 55 %/60 % Stop G 4 in: 129 sec	Load depending stop condition reached: The first line shows that the relative net power falls below the remaining load limit for stop parameter [0913], followed by the actual net load and the limit value. The second line shows that Generator 4 will be stopped next after the stop delay time.
Load and current limit. Load: 54 %/60 % Stop G 4 in: 145 sec	Load depending stop condition reached: The first line shows that the relative net power and the relative net current falls below the remaining load and current limit for stop parameters [0913]-[0914], followed by the actual net load and the limit value. The second line shows that Generator 4 will be stopped next after the stop delay time.

⊗ 6 Start/stop history; this history stores all start and stop activities of each diesel generators. All devices within the same net will display the same history regardless of whether the SYMAP® -BCG, -XG unit is master or slave of the power management. The history stores the start/stop source, the corresponding limit, and the time stamp. A maximum of 100 events can be stored within this history. By use of the navigation block, the user can scroll through the stored events. The numbers in the title line on the left side show the event that is highlighted by the cursor. On the right side the number indicates the total number of events that are stored in the history. The table 2-3 shows all messages that can be displayed.

Table 2-3 Start/Stop history

Start/stop event	Description
Start sources	
1.load G 8: 67 % START G 2 29.11 15:14:55	First load limit reached by Generator 8 with 67 %. Generator 2 started at the following time.
2.load G 8: 67 % START G 2 29.11 15:14:55	Second load limit reached by Generator 8 with 67 %. Generator 2 started at the following time.
1.tot.load: 67 % START G 2 29.11 15:14:55	First total load limit reached by Generator 8 with 67%. Generator 2 started at the following time.
2.tot.load: 67 % START G 2 29.11 15:14:55	Second total load limit reached by Generator 8 with 67 %. Generator 2 started at the following time.
Low f: 49.78 Hz START G 2 29.11 15:14:55	Low frequency limit reached by Generator 8 with 49.78 Hz. Generator 2 started at the following time.
H.curr.G 8: 67 % START G 2 29.11 15:14:55	Single current limit reached by generator 8 with 67 %. Generator 2 started at the following time.
H. current: 67 % START G 2 29.11 15:14:55	Total current limit reached with 67 %. Generator 2 started at the following time.
G 1 BCR: 450 kW START G 2 29.11 15:14:55	Event of Generator 1 sends big consumer request (450 kW). Generator 2 started at the following time.
Key START G 2 29.11 15:14:55	Generator 2 started by keyboard request (front-panel) at following time stamp.
G 1 load page START G 2 29.11 15:14:55	Generator 2 started via the load page of Generator1 at the

Start/stop event	Description
	following time.
G 1 event: [0522] START G 2 29.11 15:14:55	Generator 1 started by event [0522] at the following time.
Blackout (all) START G 1 29.11 15:14:55	Generator 1 started by blackout at the following time. Parameter [0234] is set to: "start **all** stand-by diesel in case of blackout".
G4 AL50 prio.1 START G1 29.11 15:14:55	Generator 4 was stopped by prio.1 alarm (channel 56) and started generator 1 with start next diesel command.
G4 AL51 prio.2 START G1 29.11 15:14:55	Generator 4 was stopped by prio.2 alarm (channel 56) and started generator 1 with start next diesel command.
G4 AL52 prio.3 START G1 29.11 15:14:55	Generator 4 was stopped by prio.3 alarm (channel 56) and started generator 1 with start next diesel command.
Blackout (next) START G 1 29.11 15:14:55	Generator 1 started by blackout at the following time. Parameter [0234] is set to: "start **next** stand-by diesel in case of blackout".
Monitor (CANBUS) START G 1 29.11 15:14:55	Generator 1 started from CANBUS-monitor at the following time.
Serial communication START G 1 29.11 15:14:55	Generator 1 started via serial communication (RS422/RS485) at the following time.
Stop sources	
Load limit: 67 % STOP G 2 29.11 15:14:55	Load limit for stop reached with 67 %. Generator 2 stopped at the following time.
Load+curr.: 67 % STOP G 2 29.11 15:14:55	Load and current limit for stop reached with 67 %. Generator 2 stopped at the following time.
Key STOP G 2 29.11 15:14:55	Generator 2 stopped via keyboard (front panel) at the following time.
G 1 load page STOP G 2 29.11 15:14:55	Generator 2 stopped via load page of Generator 1 at the following time.
Blackout STOP G 1 29.11 15:14:55	Blackout stop after blackout start. Generator 1 stopped at the following time.
G1 AL56 prio.1 STOP G1 29.11 15:14:55	Generator 1 was stopped by prio.1 alarm (channel 56).
G1 AL57 prio.2 STOP G1 29.11 15:14:55	Generator 1 was stopped by prio.2 alarm (channel 57).
Monitor (CANBUS) STOP G 2 29.11 15:14:55	Generator 1 stopped via CANBUS Monitor at the following time.
serial communication STOP G 2 29.11 15:14:55	Generator 2 stopped via serial communication (RS422/RS485) at the following time.

2.4.4.4 Load page

The load control pages provide a load overview of all SYMAP® -BCG, -XG devices, which are linked via CANBUS1 (see figure 2-32). The line of the load table is sorted by the CANBUS identifier.

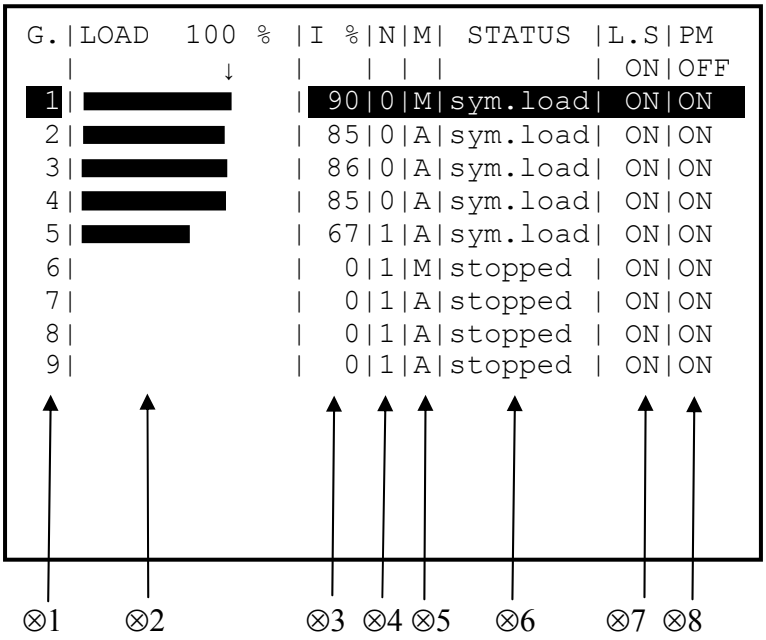


Figure 2-32 Load page

⊗ 1: Generator number; this number is defined by parameter [0180].
(Enter > Setting > Change > Power management > General > Parameter [0180])

⊗ 2: Load bar graph; the power indicator of the generator; the full scale of the bar graph is 110 %. The down-arrow in the second line indicates the 100 percent mark.

⊗ 3: Generator current; the current indicator of the generator; the unit of this value is percent.

⊗ 4: Net number; BUS section to which the generator is connected. The net number will be read from one or two function inputs, which will be defined with parameter [0182] and parameter [0183].
(Enter > Setting > Change > Power management > General > Parameter [0182] and Parameter [0183].

⊗ 5: Operating mode; the operating mode of the aggregate can be automatic "A" or manual "M".

⊗ 6 Status of diesel generator; table 2-4 shows all possible status indications with its meaning:

Table 2-4 Status of diesel generator

Status indication	Description
STOPPED	Aggregate is stopped.
RUNNING	Aggregate is in running mode. The circuit breaker is open.
Indication during starting phase	
PREGLOW	Preglow output is active.
ST.VALVE	Start valve output is active.
BREAKT.	Breaktime is active.
RUNN.UP	Running up supervision time is active.
R.F.LOAD	Ready for take load time is active during starting phase.
SYNC.	Synchronizing unit is working.
Indication during CB.is closed	
CB CLSD	Circuit breaker is closed.
SYM.LOAD	Symmetrical load sharing is active.
ASY.LOAD	Asymmetrical load sharing is active.
Indication during stopping phase	
DEL.STOP	Delay stop time is active during stopping phase.
L.REDUCT	Load reduction phase is active.
COOLDOWN	Cooling down phase is active.
RUN DOWN	Running down phase is active.
STOP FIX	Stop delay fix time is active.

⊗ 7 Status of load sharing (LS); if the load sharing function of the corresponding device is released "ON" will be displayed. If the load sharing function is blocked the user can easy find out, which device is responsible for blocking, since this device shows off status.

⊗ 8 Status of power management (PM); if the power management function of the corresponding device is released "ON" will be displayed. If the load sharing function is blocked the user can easy find out, which device is responsible for blocking, since this device shows off status.

2.4.4.5 Command window of load control page

In help with the navigation block, the user can select a certain generator number. By pressing the enter key a command windows on the right side can be opened (see figure 2-33). This command window shows all commands the user can send to the corresponding diesel aggregate. The command window can be password protected with parameter [0198] (General PM Parameter).

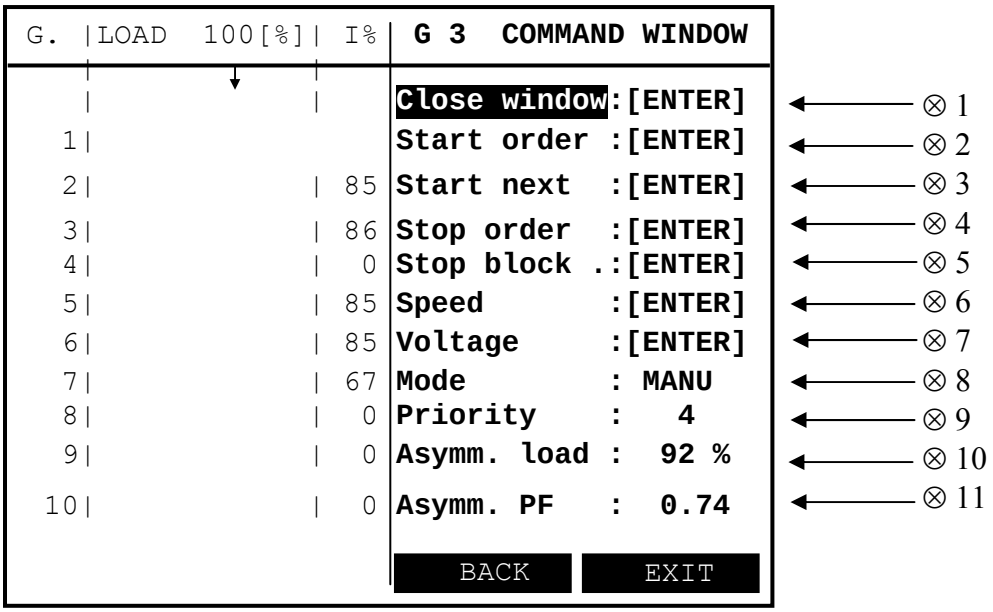


Figure 2-33 Command window of load control page

With the navigation block the user can select a command.
Title line: The title line contains the generator number, to which the command is send.

⊗ 1 **Close window:** By pressing the enter key the command window will be closed.

⊗ 2 **Sart order:** By pressing the enter key a start order is send to the corresponding aggregate.

⊗ 3 **Start next:** By pressing the enter key a start next aggregate command is sent. The aggregate which is next in the start sequence will be started.

⊗ 4 **Stop order:** By pressing the enter key a stop order to the corresponding aggregate will be sent.

⊗ 5 **Stop block:** By pressing the enter key a stop block for the load depending stopping (PM) will be activated. The text is changing to "ACTIV" and will be blinking on all nodes in the same net. The stop block can be disabled on any node in the same net by pressing the enter key again. The activation status is stored non-volatile.

⊗ 6 **Speed:** By pressing the enter key the speed higher and lower events can be activated in help with the arrow key (up and down). If the up key is active the event [2940] in the corresponding device will be activated as long as the key is pressed. With the down key event [2941] will be activated.

⊗ 7 **Voltage:** By pressing the enter key the voltage higher and lower events can be activated in help with the arrow key (up and down). If the up key is active the event [0961] in the corresponding device will be activated as long as the key is pressed. With the down key event [0962] will be activated.

⊗ 8 **Mode:** In this line the mode of the corresponding aggregate can be selected. The possible modes are: automatic and manual.

⊗9 **Priority:** The priority of the corresponding device can be set. To modify the number of priority, the arrow keys (up and down) has to be used.

⊗ 10 **Asymm.load:** The asymmetrical load limit for the corresponding device can be set.

⊗ 11 **Asymm.PF:** The asymmetrical power factor limit for the corresponding device can be set.

2.4.4.6 Regulator Page

SYMAP® -BCG, -XG provides four controllers to regulate the load, the frequency, the power factor and the voltage of the net. Status, actual measured values and activities of the regulators are shown in this page (see figure 2-41).

Function of regulater:

All regulators provide two events to control the diesel aggregate in both ways. To activate these events the user has to set these events to function outputs. After a definite break time the pulse time will be calculated, this depends from the difference of actual measured value to the set point. The break time and the pulse time of the events will be shown in the following lines.

Table 2-5 gives an overview of the speed control events for the corresponding controllers.

Table 2-5 speed control events

Regulator	Load sharing	Frequency
Speed higher (n>)	[0930]	[0952]
Speed lower (n<)	[0931]	[0953]

Table 2-6 gives an overview of the voltage control events for the corresponding controllers.

Table 2-6 voltage control events

Regulator	Power factor	Voltage
Voltage higher (U>)	[0975]	[0964]
Voltage lower (U<)	[0976]	[0965]

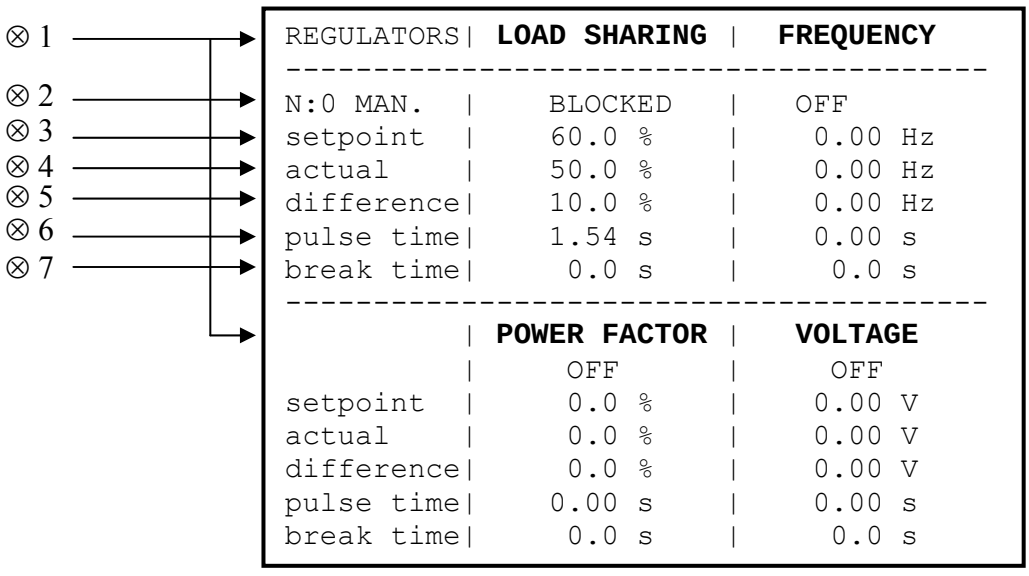


Figure 2-41 Operation of the regulators

⊗ 1: **Regulator title:** The page is subdivided into four boxes, which shows the information about the corresponding regulator.

⊗ 2: **N:** Net number, operating mode and regulator status; the net number (N: 0) shows the BUS section to which the generator is connected. The operating mode of the diesel aggregate shows "MAN", for manual mode and "AUTO" for automatic mode of the diesel aggregate.

Within the regulator boxes, the **state** of the regulators is shown:

- **OFF** -> switched off on this device
- **ON** -> enabled and operating
- **SYMM.** -> symmetric mode
- **ASYM.** -> asymmetric mode
- **DEADBAND** -> idle
- **CB OPEN** -> blocked: the CB is open
- **BLOCK (MANU.)** -> blocked: MANUAL mode
- **NO NET NODES** -> blocked: there are no other nodes (CANBUS)
- **OFF BY OTHER** -> switched OFF by another device
- **FREQ. RANGE** -> blocked: speedcontrol outside range (Parameters [0954] and [0955])
- **CURR.IN.BLOCK** -> blocked: analog input not enabled (Parameter [0935])

⊗ 3: **Setpoint** of the corresponding regulator: The set point of the regulator is the value to which the regulator the aggregate controls to. The set point can be calculated from the net or is fixed.

⊗ 4: **Actual:** Actual shows the measured or calculated value.

⊗ 5: **Difference:** It shows the difference between the set point and the actual value.

⊗ 6: **Pulse time:** The pulse time is the remaining time of the activated control event.

⊗ 7: **Break time:** The break time is the interval time of the regulator.

2.4.4.7 Priority page

SYMAP® XG/BCG provides a possibility to modify the priorities of all devices connected over the CANBUS. This can be easily done in help with the priority overview page. The page can be found in the menu as follows: Enter > Setting > Priority.

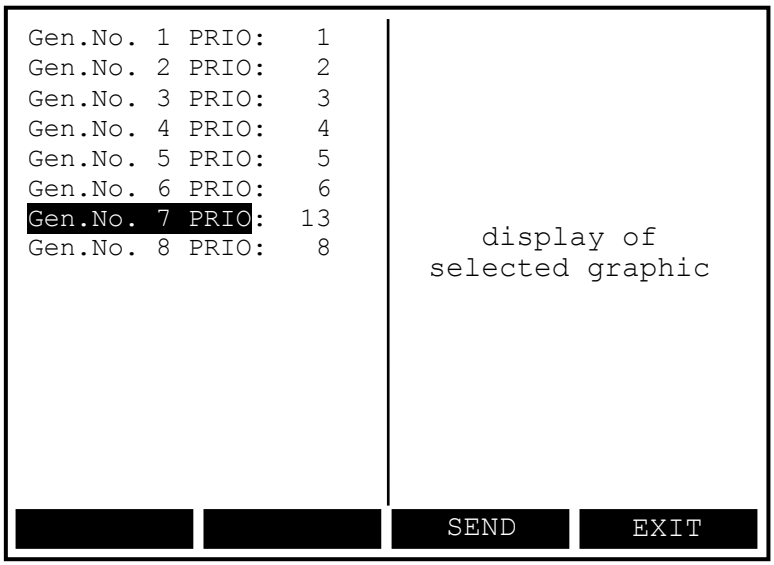


Figure 2-35 Priority page

In help with the navigation block, the user can select a certain generator number. By pressing the enter key, the priority of the corresponding device can be set. To modify the priority, the arrow keys (up and down) has to be used.
With the menu keys the modification can be executed or cancelled:

- **SEND:** The changings are only distributed over the CANBUS to the devices by pressing this key. In the case that some priorities are double set, the message "NOT OK" is blinking on this key, and a sending is not possible (plausibility check).
- **EXIT:** closes the page (but no sending of priorities!)

2.4.4.8 Synchronization Page

This page appears automatically after one of the three synchronization units is activated. If no synchronization unit is activated the page will appear as follows (see figure 2-36):

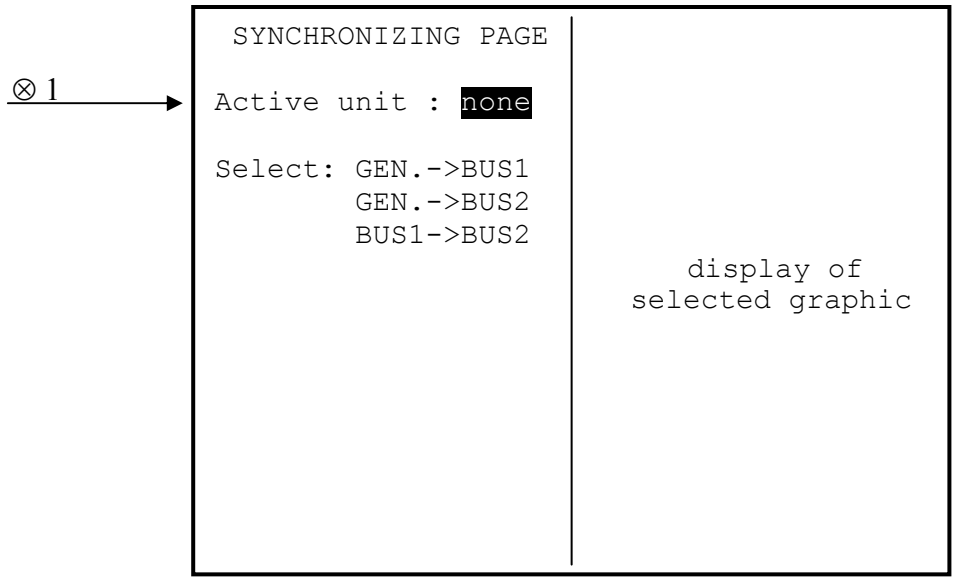


Figure 2-36 Synchronization page

⊗ 1: No synchronization unit is active.

With the Up-, Down- and "ENTER"-keys a unit can be selected and activated.
If one of the three synchronization units is active the page will appear as follows (see figure 2-37):

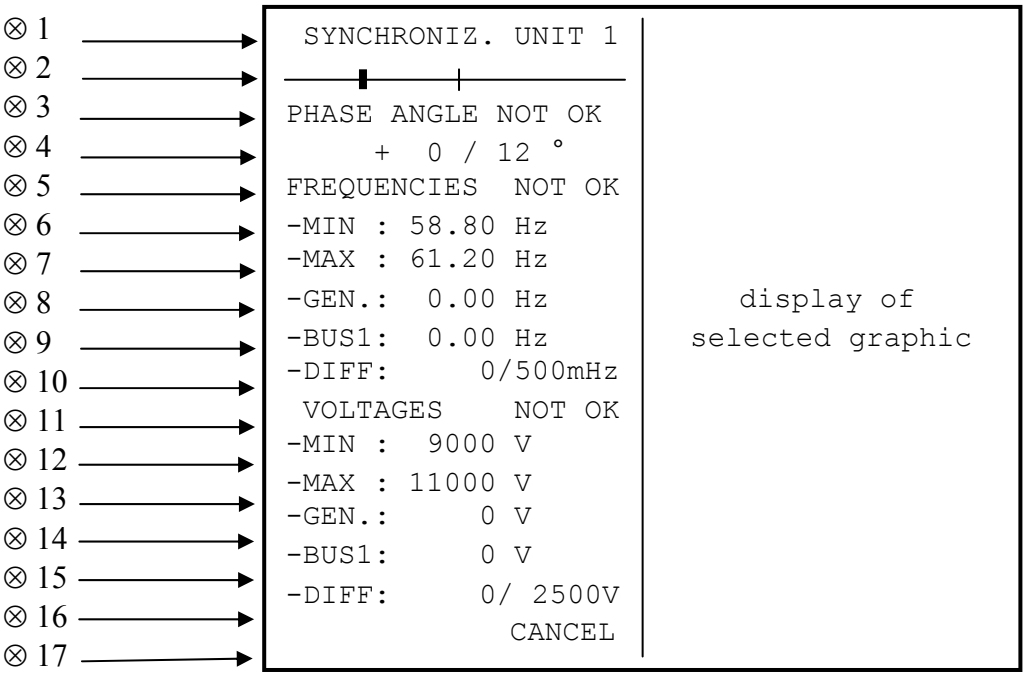


Figure 2-37 Exaple of synchronization unit 1

⊗ 1: Title and number of the activated synchronization unit

⊗ 2: Synchronoscope. The Synchronoscope is a graphic indicated that shows the difference in frequency and in phase angle of both systems during the synchronizing phase. Figure 2-38 shows the Synchronoscope when it is working.

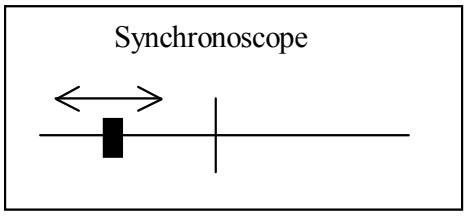


Figure 2-38 Synchronoscope

The reference for the graphic is the frequency and phase angle to which the system is synchronized (here BUS1). The horizontal line is the phase angle at 360°. The zero point is marked as a vertical line in the middle of the graphic and marks the zero point of the phase angle. The cursor moves on the horizontal line in reference to the system that is synchronized. The speed of the cursor is equal to the differential frequency of both systems. The cursor's position marks the difference in phase angle of both systems. If the cursor meets the zero point then both systems are synchronized in frequency and phase angle.

The figure 2-39 shows the movement of the cursor with regard to the differential frequency of both systems.

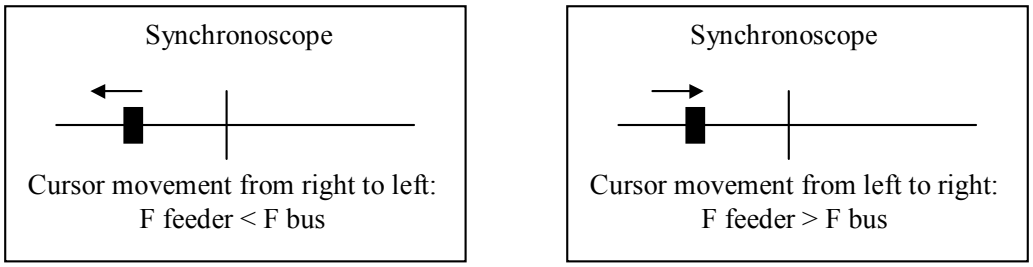


Figure 2-39 Cursor movement of synchronoscope

⊗ 3: Status of the phase angle checks, whereby:
OK: System is in the synchronization window
NOT OK: System is outside of the synchronization window

⊗ 4: The actual phase angle between BUS1 and the FEEDER is indicated and shows the maximum from parameter [1001] (Synchronization Unit 1).

⊗ 5: Status of the frequency check, whereby:
OK: BUS1 and the feeder are within the programmed limits.
NOT OK: At least one frequency lies outside of the programmed limits.

⊗ 6: Minimum frequency of the parameter [1003] (Synchronization Unit 1)

⊗ 7: Maximum frequency of the parameter [1004] (Synchronization Unit 1)

⊗ 8: Actual frequency of the FEEDER

⊗ 9: Actual frequency of BUS1

⊗ 10: The actual differential frequency between BUS1 and the feeder is indicated and shows the maximum of parameter [1002] (Synchronization Unit 1).

⊗ 11: Status of the voltage check, whereby

OK: The FEEDER and BUS1 are within the programmed limits.
NOT OK: At least one voltage lies outside of the programmed limits.
NEG.SEQ: One voltage has negative sequence (the sync. process is blocked).

⊗ 12: Minimum voltage of the parameter [1006] (Synchronization Unit 1)
⊗ 13: Minimum voltage of the parameter [1007] (Synchronization Unit 1)
⊗ 14: Actual voltage of the FEEDER
⊗ 15: Actual voltage of BUS1
⊗ 16: The actual differential voltage between BUS1 and the feeder is indicated and shows the maximum of parameter [1005] (Synchronization Unit 1).
⊗ 17: With the F2-key you can cancel the synchronization process.

2.4.4.9 Breaker Counter

The breaker counter page shows all breakers, which are managed by SYMAP®. Through the graphic selection (parameter [0107]) and the corresponding feedback parameters, the number and kind of breaker are defined. Within the breaker counter page, these breakers and their corresponding switching cycles and life times are displayed. The counters can be setted with parameter [0158] to parameter [0167].
The figure 2-40 shows a possible breaker configuration.

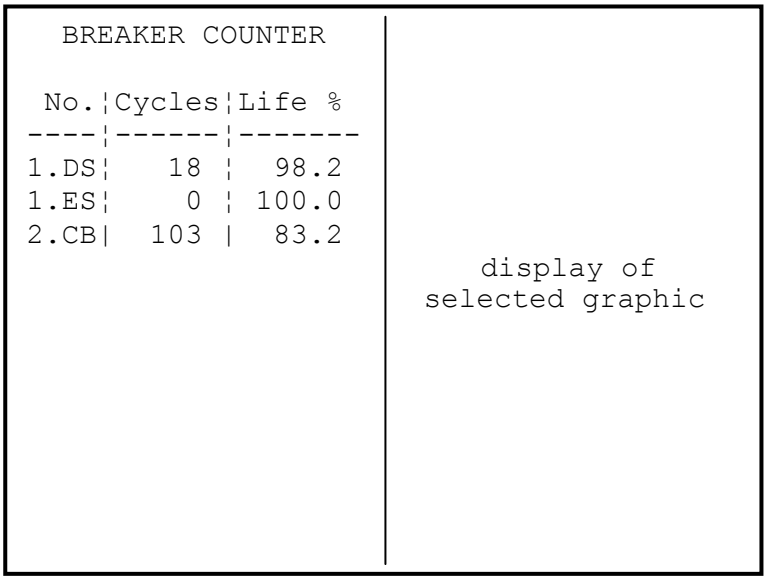


Figure 2-40 Breaker counter

Explanation of the abbreviations:

- CB: Current breaker
- DS: Disconnector
- ES: Earth switch

2.4.4.10 Contact Wear Page

This page is only available if the contact wear measurement is activated (parameter [1930]). The page appears automatically after Power ON of the device. The contact wear page is separated into three sections (see figure 2-41). The first section shows, in a table, the actual sum of the switching currents and the contact wear of the three phases, the second, the sum of the circuit breaker ON -> OFF cycles, and the third section, an overview and status of the limit settings.

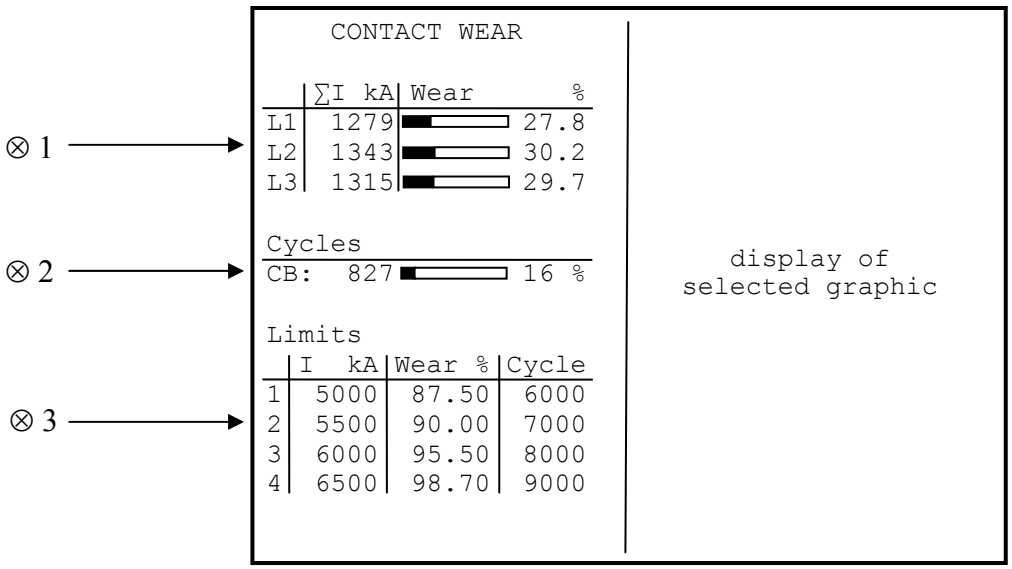


Figure 2-41 Contact wear page

⊗ 1: This table shows for every phase (L1-L3) the actual sum of the switching current (parameters [1931] to [1933] in kA) and the sum of the contact wear (parameters [1934] to [1936] in %). The bar graphs are showing the sum of the contact wear. The full scale for the bar graphs is 100 %.

⊗ 2: The actual sum (parameter [1937]) of the circuit breaker ON -> OFF cycles is shown. The bar graph shows the relation of the actual sum to the max. switching cycle (parameter [1938]).

⊗ 3: This table shows the four (1-4) switching current limits (parameters [1939] to [1942] in kA), the four contact wear limits (parameters [1943] to [1946] in %), and the four switch cycles limits (parameter [1947]-[1950]).
Note: The value of a limit in the table is blinking if the corresponding limit is reached.

2.4.5 SYMAP® -BCG, -XG Pages

The following four process pages are available only with SYMAP® -BCG, -XG and correspond to SYMAP® XG/BCG's power management functions.

2.4.5.1 SYMAP® -BCG, -XG Main Page

The main page of SYMAP® -BCG, -XG differs slightly from the main page of other SYMAP® types (see Chapter 2.4.1). In addition to the information provided by SYMAP®, this main page shows data about the diesel generator and the status of the loaded net (see figure 2-36).

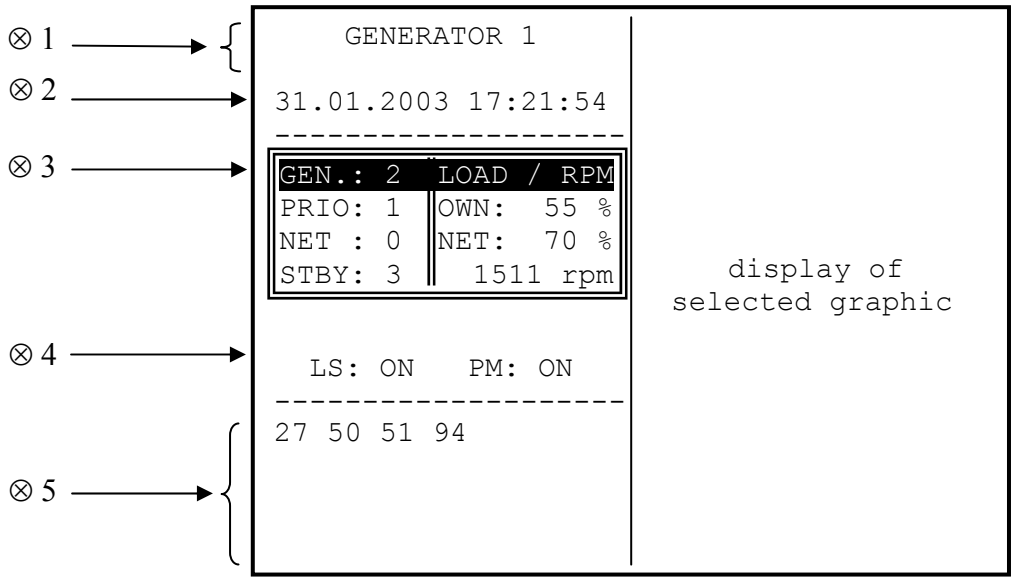


Figure 2-36 SYMAP® -BCG main page

⊗ 1: Generator/field title. Two lines are reserved for the title, which can be set directly within the main page. (Enter > Setting > Change > General parameter > Text [not yet activated]).

⊗ 2: Date/Time can be updated from the integrated real time clock (RTC), which can be set with parameter [0100] to parameter [0104]. The date format (YY:MM:DD) can be selected with Parameter [0105]. (Enter > Setting > Change > System > General parameter > parameter [0100] to parameter [0105]).

⊗ 3: Generator info box; this info box contains general information about the diesel generator and the net situation. In details this box contains:

- GEN.: Shows the generator number; this number can be set with parameter [0180] (Enter > Setting > Change > System > Power management > General > Parameter [0180]).
- PRIO: The priority of the diesel generator; the priority is used to define the sequence for starting and stopping of the power management functions. The priority can be set with parameter [0181]. (Enter > Setting > Change > System > Power management > General > parameter [0181]).
- NET: Net number; with the net number, the BUS section to which the generator is connected can be selected. The net number is read from one or two function inputs which are defined with parameter [0182] to parameter [0183]. (Enter > Setting > Change > System > Power management > General > parameter [0182] to parameter [0183])

- STBY: Stand-by aggregate; the stand-by aggregate shows which diesel will be started next by a power management functions.
- LOAD/SPEED: Load/Net load; this column shows the active power of the aggregate as a percentage (**OWN**), the relative active power of all aggregates that are loading the same net (**NET**) and the actual measured speed of the diesel in rounds per minute.

⊗ 4: Status window; this window shows detailed information of the diesel generator. During starting and stopping phase, detailed information about the phases will be shown. Table 2-2 shows all information that will be issued.

Table 2-2 Status window

Status window	Description
- during starting phase	
START: PREGLOWING	Preglow phase active.
START: START VALVE	Start valve is active.
START: WAIT RPM=0	Waiting until speed signal is 0, see parameter [0634]
START: BREAKTIME	Break time is active.
START: RUNNING UP	Running up supervision phase is active.
START: WAIT FOR LOAD	"Waiting for take load" phase is active.
START: SYNCHRONIZING	Synchronizing unit is active
- during stopping phase	
STOP: ALARM DELAY	Alarm delay time is active.
STOP: LOADREDUCTION	Off with load reduction phase is active.
STOP: COOLING DOWN	Cooling down phase is active.
STOP: RUNNING DOWN	Running down supervision time is active
STOP: FIXED DELAY	Stop delay fixed time is active.
- during operation or stopped mode	
PRELUBRICATING	Prelubrication interval is active.
LS:SYM PM:OFF	Status of load sharing and power management. The status of load sharing can be: LS: OFF load sharing switched off. LS: ON load sharing switched on. LS: SYM symmetrical load sharing on. LS: ASY asymmetrical load sharing on. The power management status can be: PM: OFF power management switched off. PM: ON power management switched on. PM: RANGE Load ranges switched on.

⊗ 5: Activated protection functions; this field contains all protection functions (ANSI device numbers) that have been activated (compare with relay settings). (Enter > Setting > Change > Relay > ANSI Device List).

2.4.5.2 MTU Process pages

If the second CANBUS interface is in use for MTU communication the MTU status and MTU meters pages are available. For more detailed information according to communication, Protocol handling, status and meters values, please refer to the MTU documents of MTU.

2.4.5.3 MTU STATUS

The MTU status page shows all status information received from the MTU controller via CANBUS2 interface (see figure 2-43).

MTU STATUS

Stop Activated	---
SS Overspeed (ECU)	---
Injection Limitation	---
SS Power Reduction Active	---
Combined Alarm Yellow (ECU)	---
Speed Demand Fail Mode	---
Combined Alarm Red (ECU)	---
Test Overspeed Active	---
Feedback Increase Speed	---
Feedback Decrease Speed	---
Feedback Local	---
LO P-Lube Oil	---
SS P-Lube Oil	---
LO P-Fuel	---
SS P-Fuel	---
LO P-Charge Air	---
LO Coolant Level	---
LO P-Fuel (Common Rail)	---
HI P-Fuel (Common Rail)	---
SS Override	---
Engine Running	---
Cylinder Cutout	---
Speed Limit 1	---
Speed Limit 2	---
Load Generator ON	---
Horn	---
Preheat Temperature Low	---
AL BIN-AUX 1	---
AL BIN-AUX 2	---
AL BIN-AUX 3	---
AL BIN-AUX 4	---
AL P-AUX 1 Limit 1	---
AL P-AUX 2 Limit 1	---
AL T-AUX 1 Limit 1	---
AL T-AUX 2 Limit 1	---
SS Coolant Level Charge Air	---
AL ECU Defect	---

MTU STATUS

AL Speed Demand Defect	---
LO ECU Power Supply Voltage	---
HI ECU Power Supply Voltage	---
HI T-Coolant (ECU)	---
SS T-Coolant (ECU)	---
HI T-Charge Air	---
HI T-Coolant Intercooler	---
HI T-Lube Oil	---
SS T-Lube Oil	---
SS T-Charge Air	---
HI T-ECU	---
SS Engine Speed Low	---
AL ECU Error/Check Error Code	---
AL Common Rail Leackage	---
AL P-AUX 1 Limit 2	---
AL P-AUX 2 Limit 2	---
AL Automatic Engine Stop	---
Feedback Alarm Reset	---
BIN AUX1	---
BIN AUX2	---
BIN AUX3	---
BIN AUX4	---
MG Start Speed Not Reached	---
MG Runup Speed Not Reached	---
MG Idle Speed Reached	---
AL T-AUX 1 Limit 2	---
AL T-AUX 2 Limit 2	---
Actual Operating Mode	---
LOLO ECU Power Supply Voltage	---
HIHI ECU Power Supply Voltage	---
AL P-Fuel Filter Diff. HI	---
SD Coolant Level	---
SD Coolant Level Charge Air	---
HI T-Fuel	---
Combined Alarm P-Fuel (Rail)	---
Combined Alarm P-Fuel (Rail)	---
Combined Alarm P-Fuel (Rail)	---

Figure 2-43 MTU Status

2.4.5.4 MTU METERS

The MTU meters page shows all meter-values received from the MTU controller via CANBUS2 interface (see figure 2-44).

MTU METERS

Engine Speed (ECU)	---	rpm
Injection Quantity	---	mm^3
Idle Speed	---	rpm
Nominal Speed	---	rpm
Engine Power Reserve	---	
Cylinder Cutout Code	---	
Speed demand source	---	
Feedback speed demand	---	rpm
Fbck Speed Demand Eff	---	rpm
Max Injection	---	mm^3
Nominal Speed	---	rpmP-
P-Lube Oil (ECU)	---	mbar
P-Lube Oil Limit LO	---	mbar
P-Lube Oil Limit LOLO	---	mbar
P-Fuel	---	bar
P-Charge Air	---	mbar
P-Fuel (Common Rail)	---	mbar
ECU Operating Hours	---	sec
Lube Oil (ECU)	---	mbar
Injection Quantity	---	%
Injection Limit HI	---	%
ECU Power Supply Volt	---	V
ECU Operating Hour	---	hour
Engine Speed Camshaft	---	rpm
Actual Fuel Consumpt.	---	l/h
Daily Fuel Consumpt.	---	m^3
Total Fuel Consumpt.	---	m^3
T-Coolant (ECU)	---	°C
T-Coolant Limit HI	---	°C
T-Coolant Limit HIHI	---	°C
T-Charge Air	---	°C
T-Charge Air Limit HI	---	°C
T-Coolant Intercooler	---	°C
T-Cool.Interc.Lim.HI	---	°C
T-Lube Oil	---	°C
T-Lube Oil Limit HI	---	°C
T-Lube Oil Limit HIHI	---	°C
T-Fuel	---	°C

MTU METERS

L1L P-Fuel	---	bar
L2L P-Fuel	---	bar
Engine Speed Limit HI	---	rpm
P-Charge Air Limit LO	---	mbar
T-Charge Air Lim HIHI	---	°C
T-ECU	---	°C
Eng.Speed Crankshaft	---	rpm
Actual Nodes on CAN2	---	
Lost Nodes on CAN2	---	
Fdb.Spd Demand an.CAN	---	rpm
Fdb.Spd Demand analog	---	rpm
Fdb.Speed Demand Freq	---	rpm
Mean Trip Fuel Consum	---	l/h
P-Aux 1	---	mbar
P-Aux 2	---	mbar
Actual Droop	---	%
Info Text	---	
Injecti.Quant.Act.DBR	---	%
Nominal Power	---	kw
Fan Speed	---	%
Actual Nodes on CAN	---	
Lost Nodes on CAN	---	
T-Aux 1	---	°C
T-Aux 2	---	°C
Status Transistor Out	---	
L1L ECU Power Supply	---	V
L2L ECU Power Supply	---	V
U1L ECU Power Supply	---	V
U2L ECU Power Supply	---	V
T-Aux 1 Limit 1	---	°C
T-Aux 1 Limit 2	---	°C
T-Aux 2 Limit 1	---	°C
T-Aux 2 Limit 2	---	°C
P-Aux 1 Limit 1	---	mbar
P-Aux 1 Limit 2	---	mbar
P-Aux 2 Limit 1	---	mbar
P-Aux 2 Limit 2	---	mbar
UL T-Fuel	---	°C
UL T-ECU	---	°C

Figure 2-44 MTU Meters

2.4.5.5 Control Pages

The control pages give the user the possibility to modify most common system and recorder settings.

2.4.5.6 System

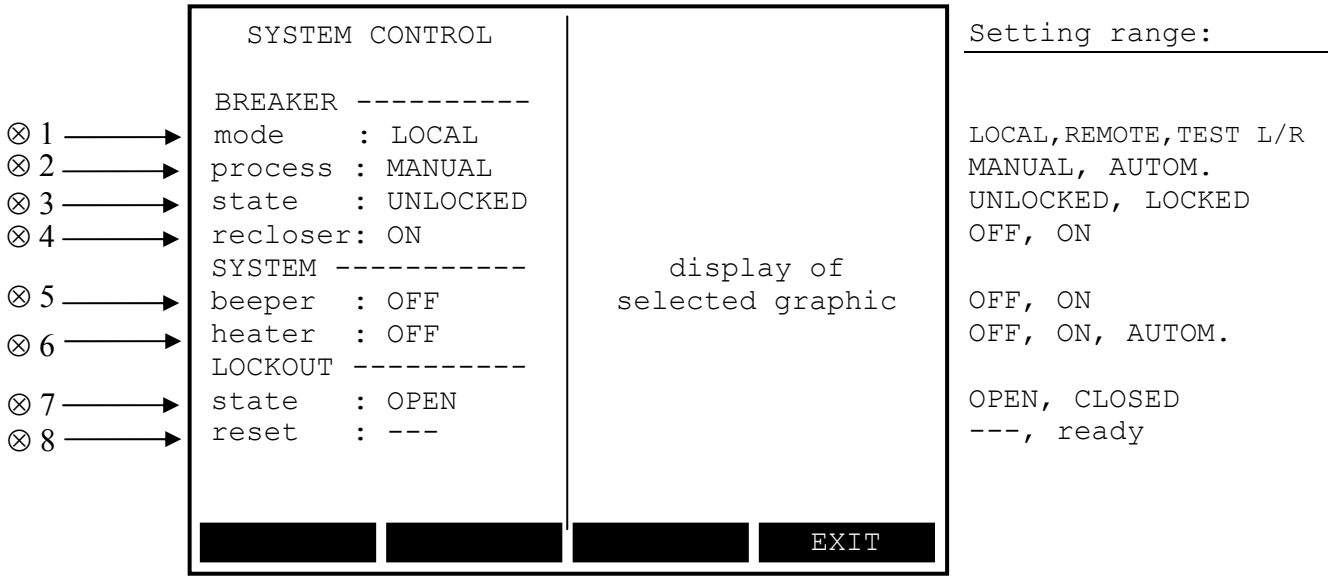


Figure 2-45 System control

⊗ 1: **mode:** Selection of the SYMAP® operation mode; SYMAP® provides, depending on the system configuration, three different selection combinations:
- LOCAL/REMOTE
- LOCAL/REMOTE/SCADA
- LOCAL/REMOTE/TEST_ L/TEST_R

⊗ 2: **process:** Selection of the SYMAP® breaker process mode; the user can choose between manual and automatic process mode (temp. disabled).

⊗ 3: **state:** Selection if the breakers (switching devices) are locked in the present position or unlocked. If the breakers are locked F4 to select a breaker for operation is not working.

⊗ 4: **recloser:** Selection if the automatic recloser function (ANSI 79) is on or off. In order to switch this function on, the event [1900] (AC reclosing relay) has to be switched on as well.

⊗ 5: **beeper:** Selection if the alarm beeper is released or switched off.

⊗ 6: **heater:** activates the heater events:
- **OFF:** Event [2932] and Event [2933] are inactive.
- **ON:** Event [2932] is active and Event [2933] is inactive.
- **AUTOM.:** Event [2933] is active and Event [2932] is inactive.

With these events the user can build applications with the event builder and binary outputs, and than control the applications over this page.

⊗ 7: **state:** The state of the lockout relay is shown.

⊗ 8: **reset:** The status of the reset mode of the lockout relay is shown.
- **---:** A reset is not possible.
- **ready:** A reset is with "ENTER" possible.

2.4.5.7 Applications

Over the application page the user can activate several events to control applications made with the event builder. Every line has an unique event number. Line "Test 1 ON" is connected with event [3300], line "Test 1 OFF" with event [3301] and so on. An event can be activated for 5 sec by selecting a line with Up- or Down-keys and then pressing "ENTER".

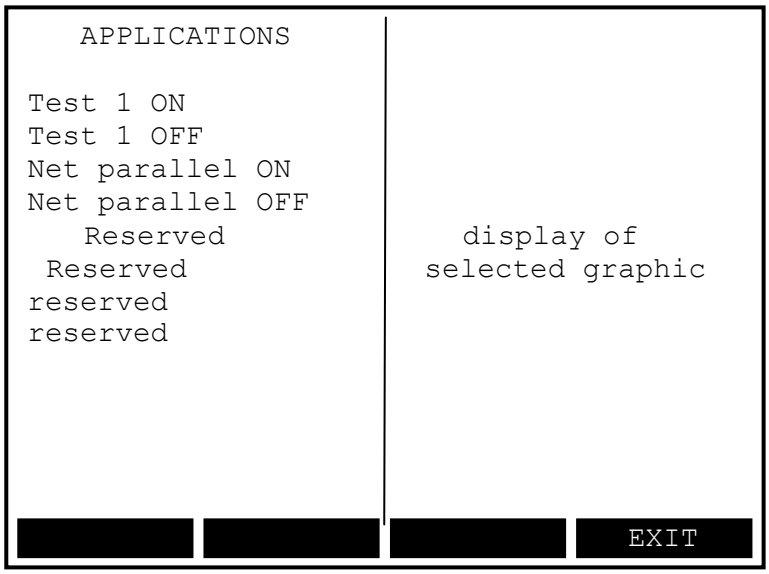


Figure 2-46 Applications

2.4.5.8 Recorder

In the recorder control page all settings for the recording unit can be done (see figure 2-47).

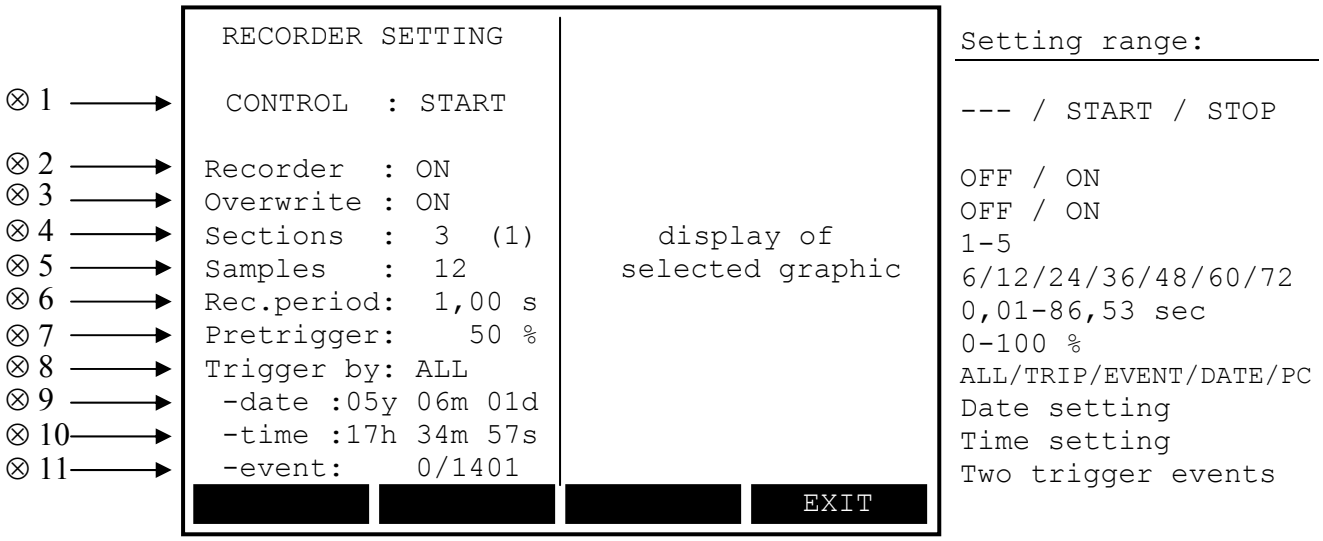


Figure 2-47 Recorder setting

Detailed description of the settings:

⊗ 1: Manual start or stop of the recorder (by pressing "ENTER")

⊗ 2: Enables the recorder

⊗ 3: Enables the overwrite mode; works only if more than one section is selected.
- OFF: After triggering the last section, the recording will stop definitely.
- ON: After triggering the last section, the recording will continue with the first section.

⊗ 4: Selects the number of the recording sections (1 up to 5); for every section the other settings are identical (like the number of samples, the period, the pretrigger etc.). If more than one section is selected and one section is triggered, the recording will continue automatically with the next section. The number in brackets shows which section is actually recorded.

⊗ 5: Selection of the samples per period of the measured generator or feeder frequency (35 Hz-70 Hz)

⊗ 6: Length of the recording time for every section; according to the memory size of the recording unit; table 2-8 gives an overview of the maximum recording time depending on the number of sections, the samples per period, and the nominal frequency.

Table 2-8 Maximum recording time

Max. period [sec] for 50 Hz nominal						
		Sections				
		1	2	3	4	5
Samples	6	86,53	43,26	28,84	21,63	17,39
	12	43,26	21,63	14,42	10,81	8,64
	24	21,63	10,81	7,21	5,40	4,32
	36	14,42	7,21	4,80	3,60	2,88
	48	10,81	5,40	3,60	2,70	2,16
	60	8,64	4,32	2,88	2,16	1,73
	72	7,21	3,60	2,40	1,80	1,44

Max. period [sec] for 60 Hz nominal						
		Sections				
		1	2	3	4	5
Samples	6	72,58	36,29	24,19	18,14	14,51
	12	36,29	18,14	12,09	9,07	7,25
	24	18,14	9,07	6,04	4,53	3,62
	36	12,09	6,04	4,03	3,02	2,41
	48	9,07	4,53	3,02	2,26	1,81
	60	7,25	3,62	2,41	1,81	1,45
	72	6,04	3,02	2,01	1,51	1,20

⊗ 7: Setting of the pre-trigger period in percent of the recording period

⊗ 8: Selection of the source to trigger (stop) the recorder

- ALL: The recorder will be triggered by all sources.
- TRIP: The recorder will be triggered only if a trip condition occurs (by an alarm or shunt #1).
- EVENT: The recorder will be triggered only if one of the events (see ⊗ 11) changes to the active state.
- DATE: The recorder will be triggered only if the clock reaches the setted time (see ⊗ 9 and ⊗ 10).
- PC: The recorder can be triggered only by the PC - Recorder Tool.

⊗ 9: Setting of the trigger date

⊗ 10: Setting of the trigger time

⊗ 11: Setting of the two trigger events

2.4.5.9 MTU

SYMAP® -BCG, -XG provides a certificated protocol to the MTU controller of MTU. For this application the CANBUS2 port will be used. If the application parameter of CANBUS2 port (parameter [0319]) is set to "MTU303 V1/all" the MTU control page will be displayed within the control menus. With this MTU control page the user can send instructions to the MTU controller via CANBUS2 interface.

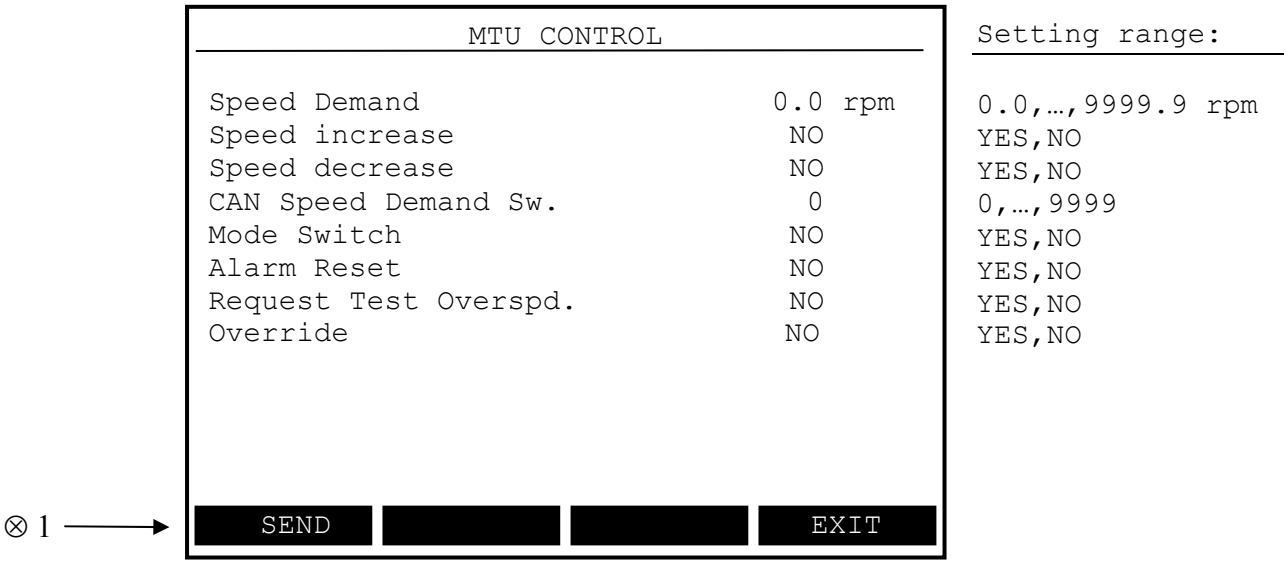


Figure 2-48 MTU control

⊗ 1: Menu line; with the F1 (SEND), the selected command and the corresponding status will be sent to the MTU controller. With F4 (EXIT), the MTU control window will be closed.

Each line of the MTU control menu can be selected with "UP" and "DOWN". Press "ENTER" to modify the selected control. With "UP" and "DOWN", the control can be changed. To fix the control, press "ENTER" again. The control can be sent to the MTU controller by using F1 (SEND).

Please refer to the MTU documentation to get more detailed information about MTU control.

2.5 Breaker Control

SYMAP® manages, depending on the selected graphic, a maximum of three breakers. According to the feedback signals, the position of the breakers is recognized and displayed on the graphic display. Invalid feedback signals are managed as well. All breaker controls are free programmable and can be reprogrammed through the event system of the device.

2.5.1 Schematic Overview of Breaker Control

All breaker controls run through four fields:

1. Trigger logic: The trigger logic introduces the breaker control process.
2. Interlock: The interlock function checks whether or not the breaker control is permitted. In case of interlock, the reason will be displayed at the left side of the LCD.
3. Breaker control: The breaker control manages the switching process of the breaker. During this process time supervision and failure management are active.
4. Outputs**:** Output control

2.5.2 Settings for Breaker Control

For the breaker control several settings have to be programmed.

1. **Graphic selection:** SYMAP® offers a variety of prepared graphics, which can be shown at the left side of the LCD. In the appendix A3 all possible graphic configurations are shown. With parameter [0107] the graphic is defined (Enter > Setting > Change > System > General parameter > Parameter [0107]).
2. **Feedback signals:** The positions of the breakers within the graphic are controlled by the feedback signals (binary inputs). The parameters for the breaker position feedbacks are separated into three sections: Breaker 1, 2 and 3 (Enter > Setting > Change> System > General parameter > Parameters [0113] to [0151]). Each breaker has its own feedback signals. The number of the breaker is counted clockwise, starting with the breaker in the upper left side of the drawing. Feedback signals which are not used must be set to "none". If a breaker with earth position is in use the corresponding earth feedback has to be defined. Only then will the earthing symbol of the breaker be displayed. For the binary inputs, the polarity (normaly open/normaly closed) and the delay time can be set (Enter > Setting > Change > System > Binary inputs).
3. **Control time:** For each breaker control, a control time must be defined (Enter > Setting > Change > System > General parameter > Parameters [0125], [0138] and [0151]). During that time, each breaker control will be supervised.
4. **Trigger logic of the breaker:** Within the trigger logic menu (Enter > Setting > Change > System > Event builder > Breaker control), the events that should trigger the breaker control process must be defined. The event list in the appendix A2 comprises all events that are available for the user. Table 2-9 shows an extract of the event list.

Table 2-9 Event list in the appendix A2

Event No.	Symbol	Description
[2900]	Local mode	Event [2900] is as long active as local mode is selected.
[2901]	Remote mode	Event [2901] is as long active as remote mode is selected.
[2907]	Start key	Event [2907] is active as long as the start key is pressed.
[2908]	Stop key	Event [2908] is active as long as the stop key is pressed.
[2910]	Select Breaker 1	Event [2910] is active if breaker 1 is selected (frame)
[2911]	Select Breaker 2	Event [2911] is active if breaker 2 is selected (frame)
[2912]	Select Breaker 3	Event [2912] is active if breaker 3 is selected (frame)

5. **Interlock of breaker controls:** (Enter > Setting > Change > System > Event builder > Interlock diagrams). With these logics (see appendix A2), the user can build his own breaker interlocks. For the interlocks all events in the event list are available. If no interlock is used the logic can be switched off.
6. **Output controller:** Each breaker control has its own Event number, (e.g. breaker 1 move from ON → OFF = Event [0115]). These control events must be linked to binary outputs to control the breakers (Enter > Setting > Change > System > Binary outputs). The table 2-10 shows all available breaker controls:

Table 2-10 Available breaker controls

Breaker Control		
ON	→	OFF
OFF	→	ON
EARTH	→	OFF
OFF	→	EARTH
OUT	→	IN
IN	→	OUT

2.5.3 Breaker Control Process

If the breaker control process is introduced via a trigger logic the corresponding interlock diagram will be checked. In case of interlock, the interlock page will appear with detailed fault information. In case of release, the corresponding breaker control event (controls the binary output) and the control time will be activated. The control event is set as long as the feedback signal of the breaker indicates a successful breaker movement or the control time is passed. In case the control time is passed, the corresponding "control time fail event" (events [0125], [0138] and [0151]) will be activated, with which the user can create an alarm. The fail events can be deactivated with the ACK.

2.5.4 Front Panel Handling

The control of the breaker from the front panel is only possible in "LOCAL" or "TEST L" operation mode and if the breakers are not "LOCKED". The breakers can be locked and unlocked within the Enter > Control > System > Breaker.
With F4, the breaker selector can be activated. Before selecting a breaker to control, the password (or alternative the transponder card) is requested. (The request of password can be disabled by parameter [0112]). After passing the password window the user has two minutes control-release without entering a password again and the selector frame will be displayed around the first breaker. By pressing F4 again or "left" and "right", the selector frame can be moved clockwise

from one breaker to the next. Each breaker selection has its own event number (event [2910] for Breaker 1 up to event [2912] for Breaker 3).
If more than one breaker control is possible (e.g. breaker is in "OFF"-position and the user can move the breaker out or switch it "ON") a window with possible controls appears at the left side of the LCD. With "up" and "down", the user can select the required breaker control. After this selection, the user can introduce the breaker control with 1 (on) and 0 (off). The control process can be interrupted by pressing F4.
Figure 2-49 shows how to introduce a breaker control from the front panel in local mode.

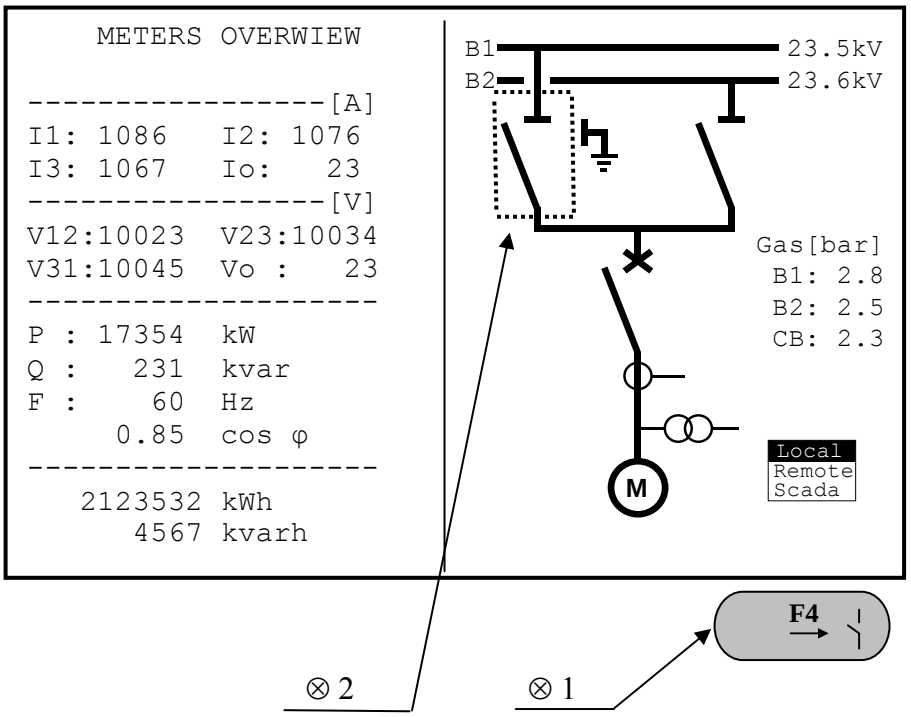


Figure 2-49 Front panel handling

⊗ 1: Introduce a breaker control by pressing F4
⊗ 2: The frame can be moved clockwise from one breaker to the next by pressing F4 again.

2.5.5 Test Mode

There are two ways to control the breaker if the breaker is not in service ("OUT"-position). The available modes are Test local (TEST L) and Test remote (TEST R). The controls in test mode have their own trigger logic (Enter > Setting > Change > System > Event builder > Breaker test mode). Here the required events for the breaker controls can be set. The process and the operation for the test mode is similar to the mode if the breaker is in service, but the interlock won't be checked. Table 2-11 shows an extract of the most used events within test mode.

Table 2-11 Most used events within test mode

Event No.	Symbol	Description
[2903]	Test mode L	Event [2903] is active as long as test local mode is selected.
[2904]	Test mode R	Event [2904] is active as long as test remote mode is selected.
[2907]	Start key	Event [2907] is active as long as the start key is pressed.
[2908]	Stop key	Event [2908] is active as long as the stop key is pressed.
[2910]	Select Breaker 1	Event [2910] is active if breaker 1 is selected (frame)
[2911]	Select Breaker 2	Event [2911] is active if breaker 2 is selected (frame)
[2912]	Select Breaker 3	Event [2912 is active if breaker 3 is selected (frame)

2.5.6 Fail Management

The following failures can be recognized:

- If a breaker has two feedback signals for one switch (e.g. on and off feedback) there are four possible feedback situations SYMAP® can read, but only two are valid. The fault Event [2913] (undefined breaker position) will be set if
  - Both feedback signals are active or
  - Both feedback signals are not active and no breaker movement is initiated from SYMAP®.

- If a breaker has two feedback signals (as in the previous item) and a breaker movement is initiated by SYMAP® then the control time (see parameters [0125], [0138] and [0151] for Breaker 1, 2 and 3) will be started. The corresponding "control fail Events" [0125] ,[0138] and [0151] will be activated if:
  - The control time is passed and both feedback signals are inactive (breaker movement interrupted).
  - The control time is passed and the breaker is still in its previous position.

- If only one feedback signal is available for one switch (e.g. only on feedback and no off feedback) and a breaker movement is initiated (breaker is moving from off to on position) and the breaker end position (on) won't be reached during the control supervising time, then the corresponding "control time fail event" will be activated.

- If only one feedback signal is available for one switch (e.g. only on feedback and no off feedback) and a breaker movement is initiated (breaker is moving from on to off position) and the breaker is still in its previous position (on) after the control supervising time, then the corresponding "control time fail event" will be activated.

> **Graphic display:** During the entire control supervising time, the previous position of the breaker will be displayed, if there is only one feedback signal available and a breaker movement away from this feedback is initiated.

Table 2-12 shows all breaker failure events:

Table 2-12 Breaker failure events

Event No.	Symbol	Description
[2913]	Breaker feedback failure	The feedback signals are invalid.
[0125]	Breaker 1 control time fail	The control time fail events will be set if the expected breaker situation fails to happen after this control supervision time is passed.
[0138]	Breaker 2 control time fail	
[0151]	Breaker 3 control time fail	

3 Technical characteristics

3.1 General technical characteristics

Table 3-1 shows the general technical characteristics of SYMAP®-family.

Table 3-1 General technical characteristics of SYMAP®-BC series

No.	Description	Condition/Characteristics	
1	Dimension (w x h x d)	200 x 192 x 81; 279 x 192 x 110; 279 x 192 x 150; Y: 200 x 200 x 87	
2	Weight	3 kg; 3,2 kg; 5 kg	
3	Power supply	12-36 V DC, 36-72 V DC, 80-300 V DC or 60-230 V AC	
4	Power consumption	< 30 W	
5	Ambient condition	Service temperature	-20 °C to +70°C
		Storage temperature	-40 °C to +70°C
		Transport temperature	-40 °C to +70°C
		Humidity	< 80 %
6	Degree of protection	Front panel	IP54 (IEC529)
		Terminals	IP10 (IEC529)
7	Vibration	Standards:	IEC 60068-2-6
		Frequency range:	5 Hz to 100 Hz
		Cross-over frequency:	15,8 Hz; +/- 1,0 mm amplitude to 1 g acceleration
		in 3 orthogonal axes (X,Y,Z)	
8	Seismic vibration	Standards:	KWU DWR 1300
		Frequency range:	5 Hz to 100 Hz
		Cross-over frequency:	11,2 Hz; +/- 10,0 mm amplitude to 5 g acceleration
		Sweep rate 5 Hz to 35 Hz:	1 Oct/min
		Sweep rate 35 Hz to 100 Hz:	10 Oct/min
		in 3 orthogonal axes (X,Y,Z)	
9	Tests	Electromagnetic compatibility	EN 55011, EN 61000-4, KERI
		Protection functions	IEC255, KERI

Table 3-2 shows the general technical characteristics of SYMAP®-X series.

Table 3-2 General technical characteristics of SYMAP®-X and -Y- series

No.	Description	Condition/Characteristics	
1	Dimension (w x h x d)	279 mm × 192 mm × 110 mm	
2	Weight	3.2 kg	
3	Power supply	12-36 V DC, 36-72 V DC, 80-300 V DC or 60-230 V AC	
4	Power consumption	< 30 W	
5	Ambient condition	Service temperature	-20°C to +70°C
		Storage temperature	-40°C to +70°C
		Transport temperature	-40°C to +70°C
		Humidity	< 80 %
6	Degree of protection	Front panel	IP54 (IEC529)
		Terminals	IP10 (IEC529)
7	Vibration	Standards:	IEC 60068-2-6
		Frequency range:	5 Hz to 100 Hz
		Cross-over frequency:	15,8 Hz; +/- 1,0 mm amplitude to 1 g acceleration
		in 3 orthogonal axes (X,Y,Z)	
8	Tests	Electromagnetic compatibility	EN 55011, EN 61000-4, KERI
		Protection functions	IEC255, KERI

3.2 Mounting instructions

The devices are designed for panel mounting. For proper function the mounting panel must have a thickness between 2.5 mm and 20 mm. The cut out dimensions are specified in the drawing at the appendix.
All external boards are built for mounting inside a switch cabinet. The connection cable between main device and external board must be shorter than 3 meter. The bending radius of the cable must not remain under 5 cm.

3.3 Binary inputs and outputs

Table 3-3 shows the binary inputs and outputs of the SYMAP®-family.
SYMAP® also has an external auxiliary I/O board for user to take then enough terminal numbers of I/O.

Table 3-3 Binary inputs/outputs characteristics of SYMAP® -BC and SYMAP®-X and -Y- series

No.	Description	Characteristics	
1	Binary inputs on board	14	
		Input voltage	24 V DC +/-30 %
		max. delay time	20 ms
		1 pick up	24 V DC +/-30 %
		cutoff frequency	9.6 kHz
2	Binary inputs on extension board	38	
		Input voltage	24 V DC +/-30 %
		max. delay time	200 ms
3	Binary outputs on board	10 relay	
		max. operating voltage/current making and breaking conditions	250 V/1 A AC ; 24 V/4 A DC continuous resistive 40 W at L/R ≤ 50 ms 5 A for 0,5 s 250 V/0.3 A DC resistive 20 W/0,1 A at L/R ≤ 20ms 5 A for 0,5 s for inductive loads use clamping diodes
		max. delay time	20 ms
		2 for trip (relay)	
		max. operating voltage/current making and breaking conditions	250 V/1 A AC; 24 V/4 A DC continuous resistive 40 W at L/R ≤ 50 ms 5 A for 0,5 s 220 V/0.4 A DC resistive or 110 V/1.5 A DC resistive 20 W at L/R ≤ 50 ms 5 A for 0,5 s for inductive loads use clamping diodes
		max. delay time	see ANSI device list
4	Binary outputs on extension board	24 relay	
		max. operating voltage/current making and breaking conditions	250 V/1A AC; 24 V/4A DC continuous resistive 40 W at L/R ≤ 50 ms 5 A for 0,5 s 250 V/0.3 A DC resistive 20 W/0.1 A at L/R ≤ 20 ms 5 A for 0,5 s for inductive loads use clamping diodes
		max. delay time	100 ms

3.4 Analogous inputs

Table 3-4 shows the analogous input characteristics of SYMAP®-BC and SYMAP®-X series.

Table 3-4 Analogous input characteristics of SYMAP® -BC and SYMAP® -X and -Y- series

No.	Description	Characteristics	
1	Current inputs	Conventional CT (current transformer)	Up to 8, frequency 45 Hz to 65 Hz
			Nominal current In: 1 A or 5 A
			Measuring rage: 0-20 × In
			Accuracy*: 0,2 % at 0-3 × In; 0,05 % at 3-20 × In The relative accuracy relates to full scale value (3×In or 20 × In) !
			Burden per phase 1 A: at In: approx. 0.007 VA at 20 × In: approx. 2.8 VA at 100 × In: approx. 1.5 kVA Devices with differential current input (comp. mode) have 0.014 VA/5.6 VA burden per *generator* phase.
			Burden per phase 5 A: at In: approx. 0.13 VA at 20 × In: approx. 45 VA at 100 × In: approx. 15 kVA Devices with differential current input (comp. mode) have 0.26 VA/90 VA burden per *generator* phase.
			AC current overload 1 A:250 × In for 0.5 cycle 100 × In < 1 s 30 × In < 10 s AC current overload 5 A:100 × In for 0.5 cycle 50 × In < 1 s 30 × In < 5 s
		Current sensor	Up to 3 ; nominal signal: 150 mV
	With connection cable (4 mm²; lengh: 2.5 m) and 5 A secondary CT take in consideration, that the total burden in case of 20 × In (5 A) = 227 VA		
2	Voltage inputs	Conventional PT (Voltage transformer)	Up to 9 - 2 of Vo inputs
			Nominal voltage Un:100 V/200 V/400 V/800 V
			Measuring range: 0…2 × Un
			Accuracy: 0.5 % The relative accuracy relates to full scale value (2 × Un) !
			Burden per phase: at Un=100 V: approx. 0.3 VA at Un=200 V: approx. 0.6 VA at Un=400 V: approx. 1.2 VA at Un=800 V: approx. 2.4 VA
		Resistive divider	Up to 3; nominal signal: 1.5 V
	For the current and voltage measurement (item 1 & 2) a Total Harmonic Distortion THD < 5% is expected.		
3	Analog inputs on board	Up to 4	
		Range	0-20 mA or 4-20 mA Accuracy: 1 % The relative accuracy relates to full scale value (20 mA) !
4	Analog inputs on extension board	Up to 19	
		Range	0-20 mA or 4-20 mA Accuracy: 1 % The relative accuracy relates to full scale value (20 mA) !
		Up to 8	
		Range	PT 100; 3 wire connection; -40 to +200 °C/ Accuracy: 1 % The relative accuracy relates to full scale value (200 °C) !

* This accuracy applies only to SYMAP®-BC series, where current transformer for measurement and protection are separate.

Table 3-5 Accuracy overview of the measuring inputs related to the protection functions:

ANSI Device code	Limit setting		Measurement	Delay time	
	Range	Steps (related to nominal)	Accuracy (related to nominal)	Setting range	Accuracy
24 Overexcitation	5.0 %-200.0 % of dU/dF	0.1 %	0.8 %	0.1 s-999.9 s	+/-5 % of tset min. 50 ms
27 Undervoltage	5.0 %-200.0 % of Un	0.1 %	0.5 %	0.03 s-99.99 s	+/-5 % of tset min. 50ms
27B Undervoltage BUS1	5.0 %-200.0 % of Un	0.1 %	0.5 %	0.03 s-99.99 s	+/-5 % of tset min. 100ms
32 Overload	5.0 %-200.0 % of Pn	0.1 %	0.8 %	0.1 s-999.9 s	+/-5 % of tset
37 Undercurrent	5.0 %-200.0 % of In	0.1 %	0.5 %	0.1 s-999.9 s	+/-5 % of tset min. 100 ms
40 Loss of field	5.0 %-1000.0 % of Pq	0.1 %	0.8 % up to 3 × In 2.0 % up to 20*In	0.1 s-999.9 s	+/-5 % of tset min. 100 ms
46 Reverse phase	5.0 %-2000.0 % of In	0.1 %	1.0 % up to 3 × In 2.0 % up to 20 × In	0.03 s-99.99 s or see curve	+/-5 % of tset min. 50 ms
47 Phase sequence	5.0 %-200.0 % of Un	0.1 %	0.5 %	0.03 s-99.99 s	+/-5 % of tset min. 50 ms
49 Thermal overload	5.0 %-1000.0 % of In	0.1 %	0.5 % up to 3 × In 1.0 % up to 10 × In	0.1 s-999.9 s	+/-5 % of tset min. 100 ms
50 Inst. overcurrent	10.0 %-2000.0 % of In	0.1 %	0.5 % up to 3 × In 1.0 % up to 20 × In	0.03 s-99.99 s	+/-5 % of tset min. 50 ms
50G/N Earth current	10.0 %-2000.0 % of In	0.1 %	0.5 % up to 3 × In 1.0 % up to 20 × In	0.03 s-99.99 s	+/-5 % of tset min. 50 ms
51 AC-Overcurrent	10.0 %-2000.0 % of In	0.1 %	0.5 % up to 3 × In 1.0 % up to 20 × In	0.03 s-99.99 s or see curve	+/-5 % of tset min. 50 ms
51G/N Earth current	10.0 %-2000.0 % of In	0.1 %	0.5 % up to 3 × In 1.0 % up to 20 × In	0.03 s-99.99 s or see curve	+/-5 % of tset min. 50 ms
51LR Locked rotor	5.0 %-2000.0 % of In	0.1 %	0.5 % up to 3 × In 1.0 % up to 20 × In	0.1 s-999.9 s	+/-5 % of tset min. 100 ms
59 Overvoltage	5.0 %-200.0 % of Un	0.1 %	0.5 %	0.03 s-99.99 s	+/-5 % of tset min. 50 ms
59N Resid.Overvolt.	5.0 %-200.0% of Un	0.1 %	0.8 %	0.03 s-99.99 s	+/-5 % of tset min. 50 ms
64 Ground voltage	5.0 %-200.0% of Un	0.1 %	0.5 %	0.1 s-999.9 s	+/-5 % of tset
66 Number of start	1-50	-	-	0.1 min-999.9 min.	+/-5 % of tset
67 Dir. Overcurrent	5.0 %-2000.0% of In	0.1 %	0.5% up to 3 × In 1.0% up to 20 × In	0.03 s-99.99 s	+/-5 % of tset min. 50 ms
67GS/GD Dir-earth fault	0.5 mA-30.0mA	0.1 mA	+/-0.2 mA	0.03 s-99.99 s	+/-5 % of tset min. 50 ms
	30 mA-6000mA	1 mA	+/-5 mA		
81 Frequency relay	35 Hz-70Hz	0.1 %	0.1 %	0.1 s-999.9 s	+/-5 % of tset min. 100 ms
87MG Differential	2.0 %-2000.0% of In	0.1 %	1.0 % up to 3 × In 2.5 % up to 20 × In	0.03 s-99.99 s	+/-5 % of tset min. 50 ms
87T Transf.Diff**.**	4.0 %-800.0% of In	0.1 %	2.0 % up to 8 × In	0.03 s-99.99 s	+/-5 % of tset min. 50 ms
87N Restrict earth fault	4.0 %-800.0% of In	0.1 %	2.0 % up to 8 × In	0.1 s-999.9 s	+/-5 % of tset min. 50 ms
87LD Linedifferential-protection	5.0 %-2000.0 % of In	0.1 %	2.0 % up to 3×In 3.0 % up to 20×In	0.1 s-999.9 s	+/-5 % of tset min. 70 ms
94 Trip circuit superv.	5.0 %-200.0% of Un	0.1 %	1.0 %	0.1 s-999.9 s	+/-5 % of tset
95i Inrush blocking	up to 99 % second harmonic	1 %	1 %	0.03 s-99.99 s	+/-5 % of tset
	5.0 %-2000.0 % of In	0.1 %	0.5 %		
All other setting incl. - preferential trip	5.0 %-200.0 % of nominal rated value	0.1 %	1.0 %	0.1 s-999.9 s	+/-10 % of tset min. 500 ms

3.5 Analogous outputs

Table 3-6 shows the analogous output characteristics of SYMAP®-BC and SYMAP®-X series.

Table 3-6 Analogous output characteristics of SYMAP® -BC and SYMAP®-X series

No.	Description	Characteristics	
1	Analog outputs on board	4	
		Range:	0-20 mA or 4-20 mA/in steps of 90 µA Accuracy: 1 % The relative accuracy relates to full scale value (20 mA) !
		Burden :	<500 Ω

3.6 Communication interface

Table 3-7 shows the communication characteristics of SYMAP®-BC and SYMAP®-X series.

Table 3-7 Communication characteristics of SYMAP® -BC and SYMAP®-X series

No.	Description	Characteristics
1	Front panel PC-Interface	Serial RS232 interface, 9-pin DSUB port on front panel for connecting a personal computer Transmission speed: 9 600 Baud-57 600 Baud Max. Transmission distance: 10 meters
2	Rear panel Control system Interface	Serial RS485 (RS422 only for MODBUS) ports; galvanic isolated Transmission speed: 9 600 Baud-57 600 Baud Max. Transmission distance: 1 kilometer PROFIBUS DP and MODBUS-RTU protocol available Max. Number of devices for one line: 32 Please use a high level twisted pair cable with a good shielding, the characteristic impedance should be between 108 Ohm and 132 Ohm. Please connect the shield on both sides of the cable. The max. cable length is 500 m. **Note:** The A/B lines of the two devices with the longest distance to each other should be terminated with a 120 Ω resistor on both sides.
3	Rear panel fiber optical Interface LD 860 LD 1300	Optical Wavelength: 660 nm; ST® connection port Max. Transmission distance: 400 meter PROFIBUS DP protocol available Max. Transmission speed for PROFIBUS DP: 12MBaud Max. Number of devices for one line: 32
4	Rear panel Field-BUS Interface	CANBUS port (physical layer for high-speed CAN ISO 11898) for communication between SYMAP® units Max. Number of devices for one line: 14 Termination necessary (120 Ω) Please use a twisted pair cable with a good shielding, the characteristic impedance should be between 108 Ohm and 132 Ohm. The max. cable length for the hole BUS is for high speed use (100 Bd) 40 m, with a lower speed (125 kBd) up to 200 m. **Note:** The high/low lines of the two devices with the longest distance to each other should be terminated with a 120 Ω resistor on both sides.

4 Order information X- and BC-Series

Ordering Code: SYMAP®- __ / __ / ___ / ___ / ___ / ___ / __ / __ / ___ / __ / __ / __
a. b. c. d. e. f. g. h. i. j. k. l.

Project:_____

Commission:_____

				Available for	
				-X	-BC
	a.	**Power supply**			
☐		24	: 12-36 V DC	●	●
☐		60	: 36-72 V DC	●	●
☐		110	: 60-230 V AC; 80-300 V DC	●	●
	b.	**Current transformer**			
☐		1A	: 1 A CT (0-20×In)	●	●
☐		1AM	: 1 A CT/separate measuring inputs (on request) (0-20×In)		●
☐		5A	: 5 A CT (0-20×In)	●	●
☐		5AM	: 5 A CT/separate measuring inputs (on request) (0-20×In) (0-20×In)		●
	c.	**Voltage transformer**			
☐		R100V	: 100 V/√3 PT secondary (resistor)	●	●
☐		R200V	: 200 V/√3 PT secondary (resistor)	●	●
☐		R400V	: 400 V/√3 PT secondary (resistor)	●	●
☐		R800V	: 800 V/√3 PT secondary (resistor)	●	●
☐		PT100V	: 100 V/√3 PT secondary (galvanic isolatad, without second BUSBAR)	●	●
☐		PT400V	: 400 V/√3 PT secondary (galvanic isolatad, without second BUSBAR)	●	●
	d.	**Current transformer for differential protection**			
☐		D0	: no differential protection		
☐		D1	: Generator and Motor application (compensation)		●
☐		D2	: Transformer 2 windings (vector groups)		●
☐		D3	: Transformer 3 windings (vector groups)		●
	e.	**Ground current**			
☐		GC0	: no ground current		
☐		GC1	: one ground current input (0-20×In)	●	●
☐		GC2	: two ground current inputs(0-20×In)		●
☐		GCS20	: one sensitive ground current input (0-20 mA)	●	●
☐		GCS100	: one sensitive ground current input (0-100 mA)	●	●
	f.	**Ground voltage**			
☐		GV0	: no ground voltage		
☐		G1V100	: one 100 V/√3 PT secondary (resistor)	●	●
☐		G1V200	: one 200 V/√3 PT secondary (resistor)	●	●
☐		G1V400	: one 400 V/√3 PT secondary (resistor)	●	●
☐		G1V800	: one 800 V/√3 PT secondary (resistor)	●	●
☐		G2V100	: two 100 V/√3 PT secondary (resistor)		●
☐		G2V200	: two 200 V/√3 PT secondary (resistor)		●
☐		G2V400	: two 400 V/√3 PT secondary (resistor)		●
☐		G2V800	: two 800 V/√3 PT secondary (resistor)		●
	g.	**Recording unit**			
☐		RU0	: without recording unit		
☐		RU1	: with recording unit	●	●
	h.	**communication (up to 5 ports available)**			
☐		C0	: standard (1×CANBUS [P.M.]); 1×RS 232 [PC])	●	●
☐		C1	: additional CANBUS port (direct engine control)	●	●
☐		C2	: additional RS422 or RS485 port (MODBUS)	●	●
☐		C3	: additional PROFIBUS DP port (RS485)	●	●
☐		C3F	: additional PROFIBUS DP port (fibre optic)	●	●
☐		C4F	: additional RS232 port (Fibre optic for 87LD)		
☐		C5	: additional RS485 port (IEC60870-5-103)	●	●
☐		C6	: ISDN-Modem	●	
☐		C7	: analog Modem	●	
☐		C12	: additional CANBUS and RS422 or RS485 port	●	●
☐		C13	: additional CANBUS and PROFIBUS DP port (RS485)	●	●
☐		C137	: additional CANBUS and PROFIBUS DP port (RS485) and analog Modem	●	

				Available for	
				-X	-BC
	i.	**Extended board type**			
☐	0	:	no connection		
☐	1	:	CMA 210 (16×PT100)	●	●
☐	2	:	CMA 211 (24×binary inputs; 5×PT100; 24×binary outputs)	●	●
☐	3	:	CMA 212 (16×binary inputs; 18×binary outputs)	●	●
☐	4	:	CMA 216 (24×binary inputs; 24×binary outputs)	●	●
☐	5	:	CMA 216 and CMA217 (24×binary inputs; 6×PT100; 24×binary outputs)	●	●
☐	6	:	CMA 218 (6×PT100)	●	●
	j.	**Special configurations (on request)**			
☐	0	:	none		
☐	1	:	ground insulation fault (for generator or motor rotor)		●
☐	2	:	with GPS module		●
☐	3	:	with additional transponder access		●
☐	4	:	"SHUNT1"-output normally closed (standard: n. o.)	●	●
	k.	**Nominalfrequency**			
☐	1	:	50 Hz	●	●
☐	2	:	60 Hz	●	●
	l.	**Frontpanel type**			
☐	1	:	SYMAP®-BC Stucke		●
☐	2	:	SYMAP®-BCG Stucke		●
☐	3	:	SYMAP®-BCG Stucke without prog.-connector		●
☐	4	:	SYMAP®-BC blue		●
☐	5	:	SYMAP®-BCG blue		●
☐	6	:	SYMAP®-X Stucke	●	
☐	7	:	SYMAP®-XG Stucke	●	
Customer-specific constructions are of spezial request available				●	●

Accessories:

- Programming and parameter setting communication cable, incl. micro-controller selection module.
- Flash-Loader programming software WINDOWS 95/98/2000/NT/XP
- Parameter setting software WINDOWS 95/98/2000/NT/XP
- Test box

4.1 Extension boards

The following extension boards are available (for the dimensions, please see the drawings at the appendix):

CMA210

- 16 PT100 sensor inputs two and three wire technology
- 24 VDC power supply

CMA211

- 24 binary inputs
- 24 binary outputs
- 5 PT100 sensor inputs two and three wire technology
- 24 VDC power supply

CMA212

- 16 binary inputs
- 18 binary outputs
- 24 VDC power supply

4.2 Power supply for extension boards

CMA220

- AC/DC converter input: 65-265 V AC/output: 24 V DC; 0.5 A

CMA221

- DC/DC converter input: 14-38 V DC/output: 24 V DC; 0.5 A

4.3 Additional board for short circuit redundancy

CMA198 (undervoltage coil and short circuit safety device terminal board)

- Control unit for the DC under voltage coil of the switching device Breaker
- Safety device for short circuit protection with selectable set point and time delay
- Connection to SYMAP® basic unit, terminals -X2.1: 18,19 (lockout relay)
- Borden per phase 1A: at 1 × In (1 A): approx.0,5 VA
  at 5 × In (5 A): approx.7,5 VA
- Borden per phase 5A: at 1 × In (5 A): approx.5 VA
  at 5 × In (25 A): approx.125 VA

5 Order information Y-Series

Ordering code:

SYMAP®- _ / _ / ___ / ___ / ___ / ___ / _ / _ / ___ / _
a. b. c. d. e. f. g. h. i. j.

Project:_____

Commission:_____

				Available for					
				EC	T	M	G	F	LD
	a.	**Power supply**							
☐	24	:	12 - 36 V DC	●	●	●	●	●	●
☐	60	:	36 - 72 V DC	●	●	●	●	●	●
☐	110	:	60 - 230 V AC; 80-300 V DC	●	●	●	●	●	●
	b.	**Current transformer**							
☐	1A	:	1 A CT (0 - 20 × In)		●	●	●	●	●
☐	5A	:	5 A CT (0 - 20 × In)		●	●	●	●	●
	c.	**Voltage transformer**							
☐	R100V	:	100 V/√3 PT secondary (resistor)	●	●	●	●	●	●
☐	R200V	:	200 V/√3 PT secondary (resistor)	●	●	●	●	●	●
☐	R400V	:	400 V/√3 PT secondary (resistor)	●	●	●	●	●	●
☐	R800V	:	800 V/√3 PT secondary (resistor)	●	●	●	●	●	●
☐	PT100V	:	100 V/√3 PT secondary (galvanic isolatad, without second BUSBAR)	●	●	●	●	●	●
☐	PT400V	:	400 V/√3 PT secondary (galvanic isolatad, without second BUSBAR)	●	●	●	●	●	●
	d.	**Ground corrent**							
☐	GC0	:	no ground corrent						
☐	GC1	:	one ground current input (0 - 20 × In)	●	●	●	●	●	
☐	GCS20	:	one sensitive ground corrent input (0-20 mA)	●	●	●	●	●	
☐	GCS100	:	one sensitive ground corrent input (0-100 mA)	●	●	●	●	●	
	e.	**Ground voltage**							
☐	GV0	:	no ground voltage						
☐	G1V100	:	one 100 V/√3 PT secondary (resistor; without second BUSBAR)	●	●	●	●	●	●
☐	G1V200	:	one 200 V/√3 PT secondary (resistor; without second BUSBAR)	●	●	●	●	●	●
☐	G1V400	:	one 400 V/√3 PT secondary (resistor; without second BUSBAR)	●	●	●	●	●	●
☐	G1V800	:	one 800 V/√3 PT secondary (resistor; without second BUSBAR)	●	●	●	●	●	●
	f.	**Communication**							
☐	C0RS	:	standard (1 x RS232 [PC] rear side)	●	●	●	●	●	●
☐	C0FS	:	standard (1 x RS232 [PC] front side)	●	●	●	●	●	●
☐	C1	:	additional CANBUS port (direct engine control)	●					
☐	C2	:	additional RS422 or RS485 port (MODBUS)		●	●	●	●	●
☐	C3	:	additional PROFIBUS DP port (RS485)		●	●	●	●	●
☐	C3F	:	additional PROFIBUS DP port (fibre optic)		●	●	●	●	●
☐	C4F860	:	additional port (fibre optic for 87 LD, wavelength 860 nm)						●
☐	C4F1300	:	additional port (fibre optic for 87 LD, wavelength 1300 nm)						●
☐	C5	:	additional RS485 port (IEC60870-5-103)	●	●	●		●	●
☐	C6	:	ISDN-Modem	●					
☐	C7	:	Analog Modem	●					
	g.	**Digital I/O**							
☐	0	:	none						
☐	1	:	"SHUNT1"-output normally closed (standard: n. o.)	●	●	●	●	●	●
☐	2	:	six additional binary inputs (optional)	●	●	●	●	●	●
☐	3	:	four additional relais outputs (optional)	●	●	●	●	●	●
☐	4	:	binary in- and output voltage 24 V DC	●	●	●	●	●	●
☐	5	:	binary in- and output voltage 60 V DC	●	●	●	●	●	●
☐	6	:	binary in- and output voltage 230 V DC	●	●	●	●	●	●
	h.	**Analog I/O (optional)**							
☐	1	:	one additional analog input/output (0 - 20 mA)	●					
☐	2	:	two additional analog input/output (0 - 20 mA)	●					
	i.	**Nominalfrequency**							
☐	1	:	50 Hz	●	●	●	●	●	●
☐	2	:	60 Hz	●	●	●	●	●	●
	j.	**Frontpanel type**							
☐	1	:	SYMAP®-EC Stucke	●					
☐	2	:	SYMAP®-F,G,T,M Stucke		●	●	●	●	●
Customer-specific constructions are of spezial request available				●	●	●	●	●	●

DET NORSKE VERITAS

MANAGEMENT SYSTEM CERTIFICATE

Certificate No.: 30667-2008-AQ-GER-TGA

This is to certify that

stucke GmbH
elektronik

am Standort:

Am Feenteich 18
D-22085 Hamburg

has been found to conform to the Management System Standard

ISO 9001:2000

This certificate is valid for the following product or service ranges:

Electrical engineering company providing the development, production and delivery of microprocessor protection relays, control units and electrical switchgears

Initial Certification date:
02.08.2002

This certificate is valid until:
31.07.2011

The audit has been performed under the supervision of

Winfried Paulat
Lead Auditor

Deutscher Akkreditierungs Rat
DAR
TGA-ZM-04-92-00

Place and date:
Essen, 01.08.2008

for the Accredited Unit:
DNV ZERTIFIZIERUNG UND UMWELTGUTACHTER GMBH

Nikolaus Kim
Management Representative

Lack of fulfilment of conditions as set out in the Certification Agreement may render this Certificate invalid.
DNV Zertifizierung und Umweltgutachter GmbH, Schnieringshof 14, 45329 Essen, Tel: +49 201 7296 300 Fax: +49 201 7296 333 - www.dnv.de/zertifizierung