Manual

MFR 2

- Multifunction Relay -

Version 3.5xxx

CE

Version 37131C
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37131_C_Manual MFR2.doc

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NOTE

These manual has been developed are intended for a unit fitted with all available options. Inputs/outputs, functions, configuration screens and other details described, which do not exist on your unit may be ignored.

ATTENTION

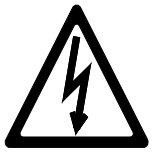
The present manual has been prepared to enable the installation and commissioning of the unit. On account of the large variety of parameter settings, it is not possible to cover every possible combination. The Manual are therefore only a guide. In case of incorrect entries or a total loss of functions, the default settings can be taken from the enclosed list of parameters.

1.1 Safety Notes for the User

This documentation contains the relevant information for the normal use of the product described herein. It is intended to be read by qualified staff.

Danger notes

The following notes are intended to guarantee your own personal safety as well as to protect the unit and other units connected to it against damages. Safety notes and warnings intended to prevent any danger to the life and health of users or maintenance personnel and to avoid any damage will be identified in this documentation by means of the symbols and terms listed below. Within the framework of this documentation, the signals and terms that are used have the following meaning:



DANGER !!!

The DANGER symbol draws your attention to dangers while the description indicates how to handle and/or avoid such hazards. Any non-observance may cause fatal or serious injuries as well as considerable damage to property.

WARNING !

If the warnings are not observed, the unit and any devices attached to it may be destroyed. Please take into account appropriate precautions.

ATTENTION

This symbol points to important notes concerning the mounting, installation, and connection of the unit. This note absolutely must be observed when connecting the unit.

NOTE

References to other notes and supplements as well as tables and lists are identified by means of the "i" symbol. Most of the referenced sections are included in the Annex.

Intended use

This unit may only be used for the applications described in this manual. The prerequisite for a proper and safe operation of the product is correct transportation, storage, and installation as well as careful operation and maintenance.

1.2 Connection of the Unit

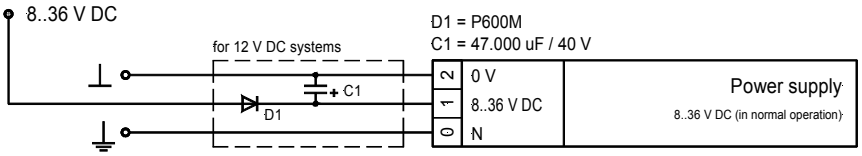
WARNING !

A circuit breaker must be provided near to the unit and in a position easily accessible to the operator. This must also bear a sign identifying it as an isolating switch for the unit.

NOTE

Inductivities connected (such as coils of operating current or undervoltage tripping devices, or auxiliary or power contacts) must be connected to a suitable interference suppressor.

1.2.1 Power Supply



Terminal	Description	A_{max}
0	Neutral point of the three-phase system or neutral terminal of the voltage transformer (Measuring reference point)	Solder lug
1	8-36 V DC, 15 W	2.5 mm²
2	0 V reference point	2.5 mm²

1.2.2 Measuring Inputs

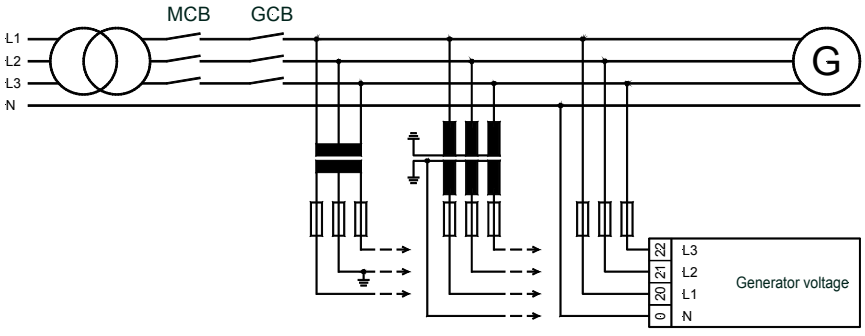
NOTE

Starting with version V3.5013, the unit is equipped with an automatic rotary field detection and may therefore be used in three-phase systems with a clockwise rotary field (right-handed rotary field) as well as with a counter-clockwise rotary field (left-handed rotary field).

a.) Voltage Measuring Inputs

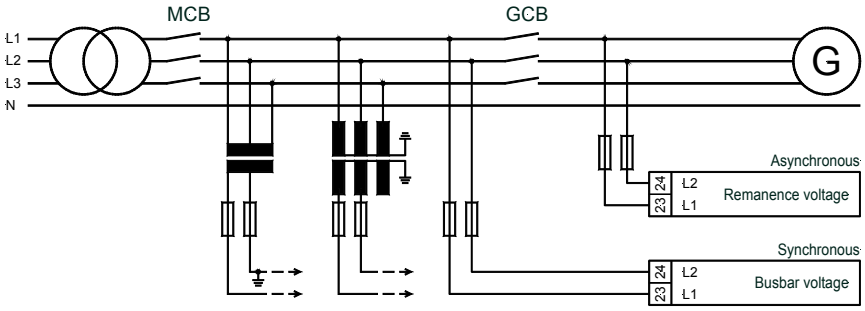
a.1) Version PSV& PSVA

- ***Generator***



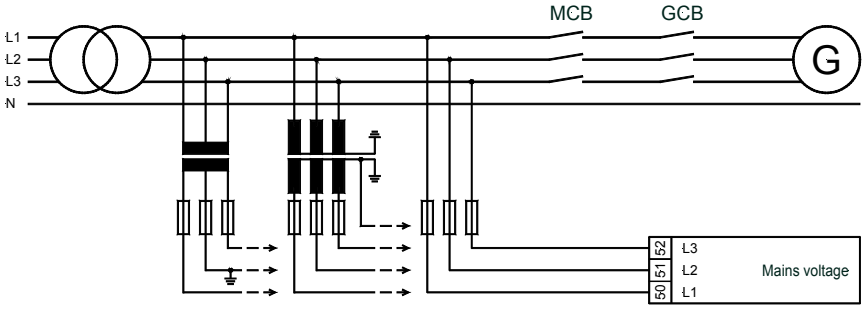
Terminal	Measurement	Description	A_{max}
20	direct or with measuring transformer ../100 V	Generator voltage L1	2.5 mm²
21		Generator voltage L2	2.5 mm²
22		Generator voltage L3	2.5 mm²
0		Neutral point of the 3-phase system/transformer	2.5 mm²

• ***Busbar***



Terminal	Measurement	Description	A_{max}
23	direct or ../100 V	Busbar voltage L1	2.5 mm²
24		Busbar voltage L2	2.5 mm²

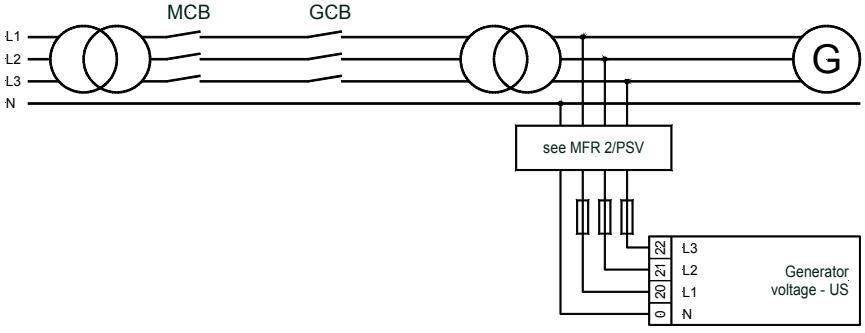
• ***Mains***



Terminal	Measurement	Description	A_{max}
50	direct or with measuring transformer ../100 V	Mains voltage L1	2.5 mm²
51		Mains voltage L2	2.5 mm²
52		Mains voltage L3	2.5 mm²
0		Neutral point of the 3-phase system/transformer	2.5 mm²

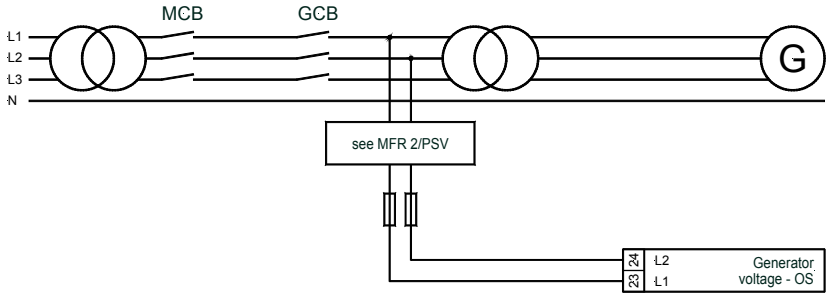
a.2) Version PSVT

• ***Generator*** Low voltage side - US



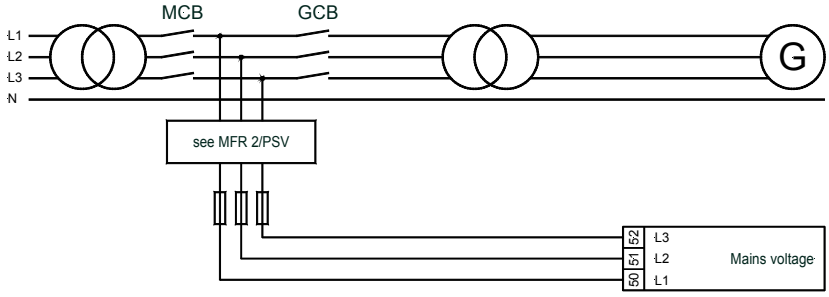
Terminal	Measurement	Description	A_{max}
20	direct or with measuring transformer ../100 V	Generator voltage L1 - low voltage side - US	2.5 mm²
21		Generator voltage L2 - low voltage side - US	2.5 mm²
22		Generator voltage L3 - low voltage side - US	2.5 mm²
0		Neutral point of the 3-phase system/transformer	2.5 mm²

• ***Generator*** High voltage side (OS)



Terminal	Measurement	Description	A_{max}
23	direct or ../100 V	Generator voltage L1 - high voltage side - OS	2.5 mm²
24		Generator voltage L2 - high voltage side - OS	2.5 mm²

• ***Mains***



Terminal	Measurement	Description	A_{max}
50	direct or with measuring transformer ../100 V	Mains voltage L1	2.5 mm²
51		Mains voltage L2	2.5 mm²
52		Mains voltage L3	2.5 mm²
0		Neutral point of the 3-phase system/transformer	2.5 mm²

b.) Current Measuring Inputs

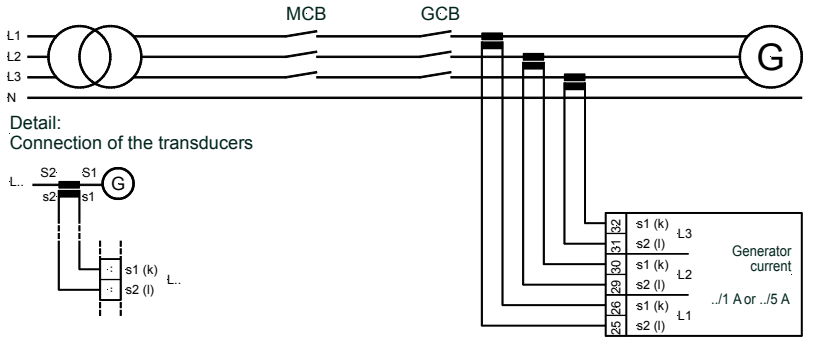
WARNING !

Before detaching the secondary current transformer connections or the connections of the current transformer on the unit, make sure that it is shunted.

NOTE

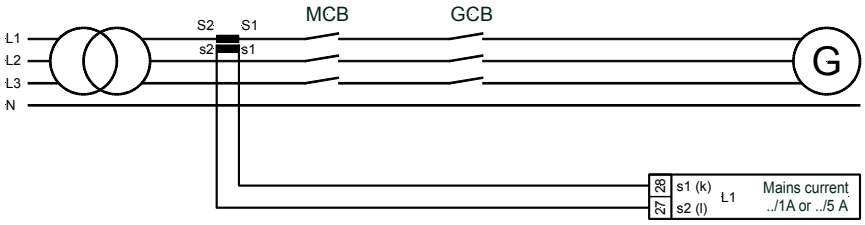
Generally, current transformers are to be grounded secondary at one line.

• ***Generator***



Terminal	Measurement	Description	A_{max}
25	Measuring transformer ../1 A or ../5 A	Generator current L1, transformer terminal s2 (l)	2.5 mm²
26		Generator current L1, transformer terminal s1 (k)	2.5 mm²
29		Generator current L2, transformer terminal s2 (l)	2.5 mm²
30		Generator current L2, transformer terminal s1 (k)	2.5 mm²
31		Generator current L3, transformer terminal s2 (l)	2.5 mm²
32		Generator current L3, transformer terminal s1 (k)	2.5 mm²

- ***Mains***



Terminal	Measurement	Description	A_{max}
27	Transformer ../1 A ../5 A	Mains current L1, transformer terminal s2 (l)	2.5 mm²
28		Mains current L1, transformer terminal s1 (k)	2.5 mm²

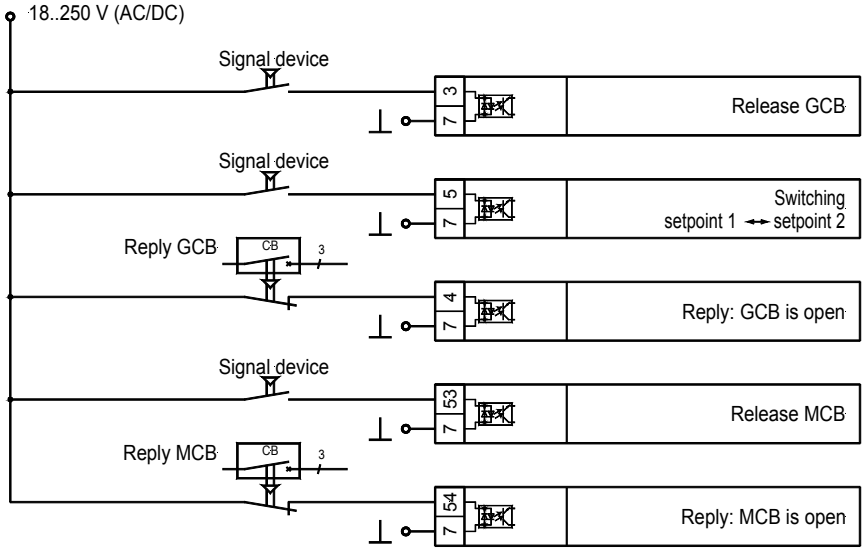
1.2.3 Auxiliary and Control Outputs

NOTE

The common use of the analog outputs, the pulse output, the discrete inputs and the Pt100 temperature input is possible only under certain conditions. Because of the various project stages, there may be differences between the present user instructions and the delivered hardware.

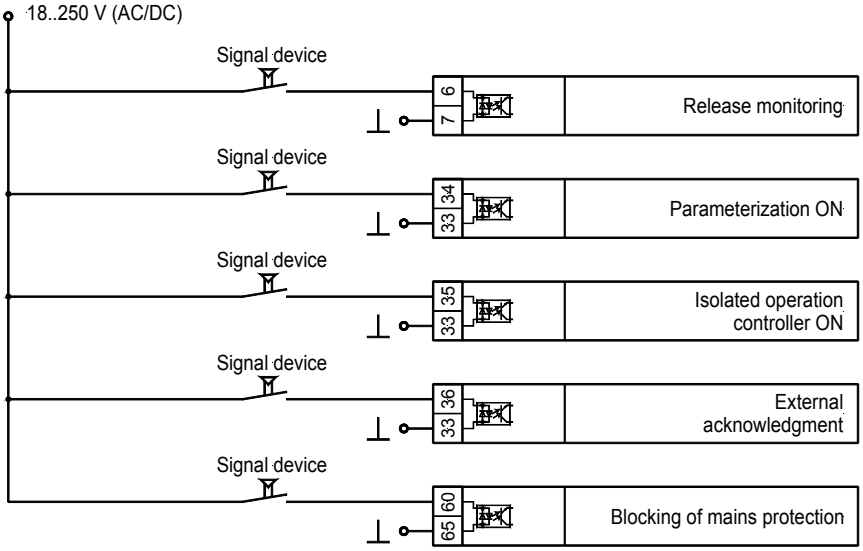
a.) Discrete Inputs

- **Control inputs**



Terminal	Associated Common	Description (according to DIN 40 719 Part 3, 5.8.3)	A_{max}
Make contact			
3	7	Enable GCB	2.5 mm²
5		Switching "Setpoint 1 ↔ 2"	2.5 mm²
53		Enable MCB	2.5 mm²
Break contact			
4	7	Reply: GCB is open	2.5 mm²
54		Reply: MCB is open	2.5 mm²

- **Control inputs**

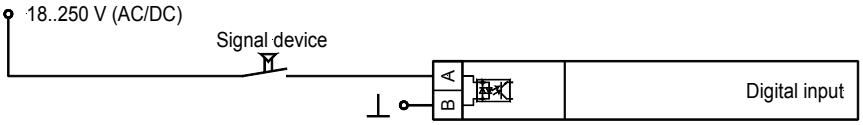


Terminal	Associated Common	Description (according to DIN 40 719 Part 3, 5.8.3)		A_{max}
Make contact (NO)				
6	7	Enable monitoring		2.5 mm²
34	33	not used		2.5 mm²
35		Isolated operation controller ON	Discrete input 2	2.5 mm²
36		External acknowledgement	Discrete input 3	2.5 mm²
60	65	Blocking of mains protection	Discrete input 4	2.5 mm²

The discrete inputs may be either connected in a positive or a negative logic circuit:

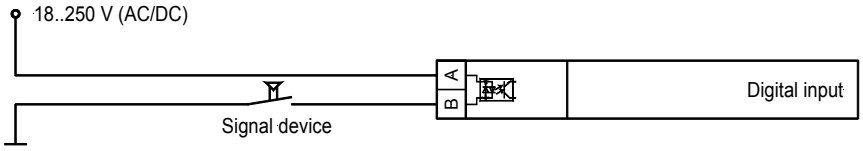
Positive logic circuit The discrete input is connected with **+24 V DC.**
Negative logic circuit The discrete input is connected with **GND.**

- **Alarm inputs** (positive logic circuit)



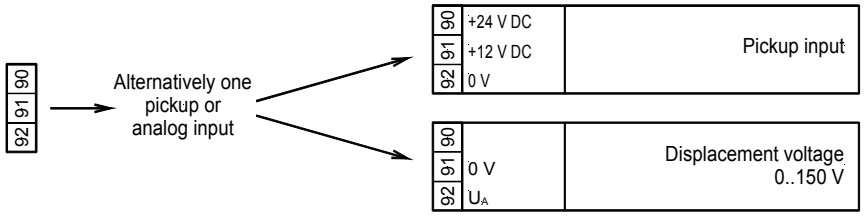
Terminal	Associated Common	Description (according to DIN 40 719 Part 3, 5.8.3)	A_{max}
A	***B***	***Make contact (NO)***	
61	65	Discrete input 5	2.5 mm²
62		Discrete input 6	2.5 mm²
63		Discrete input 7	2.5 mm²
64		Discrete input 8	2.5 mm²

Example for a **negative logic circuit**



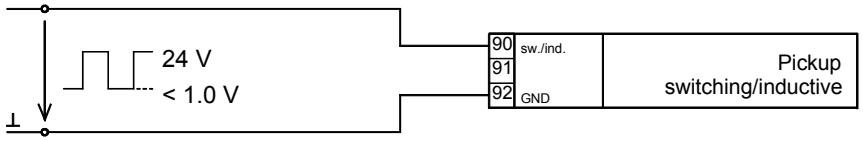
Associated Common	Terminal	Description (according to DIN 40 719 Part 3, 5.8.3)	A_{max}
A	***B***	***Make contact (NO)***	
65	61	Discrete input 5	2.5 mm²
	62	Discrete input 6	2.5 mm²
	63	Discrete input 7	2.5 mm²
	64	Discrete input 8	2.5 mm²

b.) Analog Input (Options I3/N)



Terminal			Description (Any of the following analog inputs:)		A_{max}
90	91	92			
see below			Pickup		
	0 V	U_A	Installation voltage	0-150 V	2.5 mm²

c.) Pickup Input (Option N)



Terminal	Description		A_{max}
90	Pickup	switching/inductive	2.5 mm²
91			2.5 mm²
92		GND	2.5 mm²

Calculations

Maximum rated speed = 3,600 rpm

Since the bandwidth of the input is limited to 20 kHz, the following must always apply:

$$20{,}000\text{kHz} \geq \frac{\text{Rated speed}_{max} \times \text{Number of teeth}}{60\text{s}}$$

(Rated speed_{max} is the maximum speed that can be displayed.)

The following calculation formulas apply:

Maximum rated speed

$$\text{Rated speed}_{max} \leq \frac{60\text{s} \times 20{,}000\text{kHz}}{\text{Number of teeth}}$$

Maximum number of teeth

$$\text{Number of teeth} \leq \frac{60\text{s} \times 20{,}000\text{kHz}}{\text{Rated speed}_{max}}$$

Specification

Specification of the input circuit for inductive speed sensors

Signal forming	**sinusoidal**
Minimum input voltage of 300-5,000 Hz	$\geq 0.3\ V_{eff}$
Minimum input voltage of 200-10,000 Hz	$\geq 0.5\ V_{eff}$
Minimum input voltage of 100-20,000 Hz	$\geq 1.3\ V_{eff}$

Note
Rated ambient temperature = 25 °C; when the ambient temperature rises, the minimum input voltage is increased by approx. 0.3 V/°C.

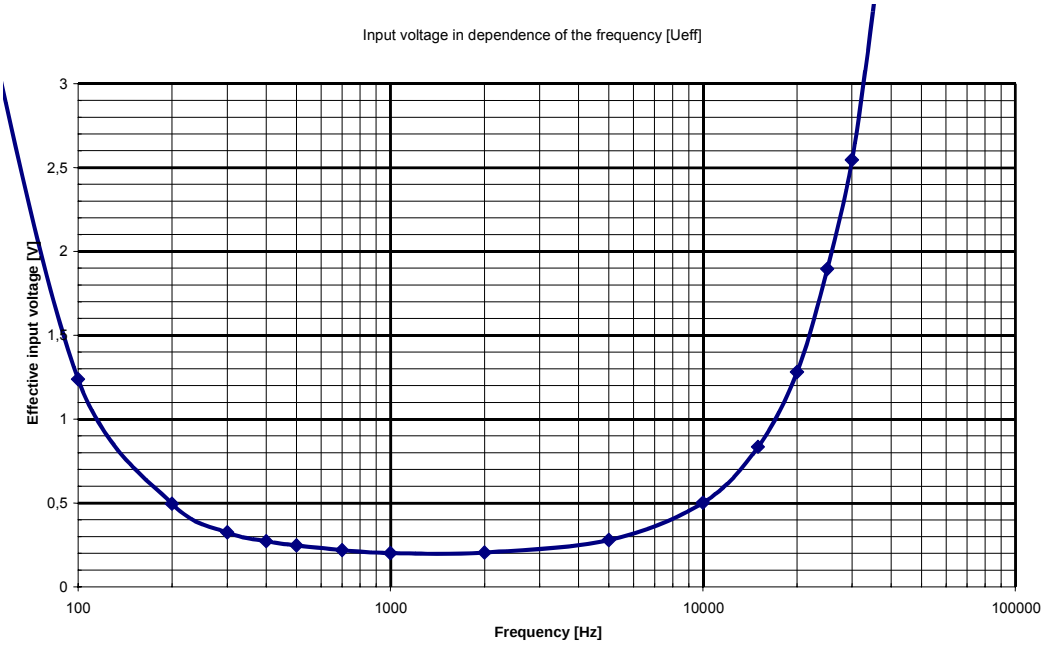


Figure 1: Typical behavior of the input voltage sensitivity at an ambient temperature of 25 °C.

d.) Analog Inputs (PSVA & Option T2/X/Xc)

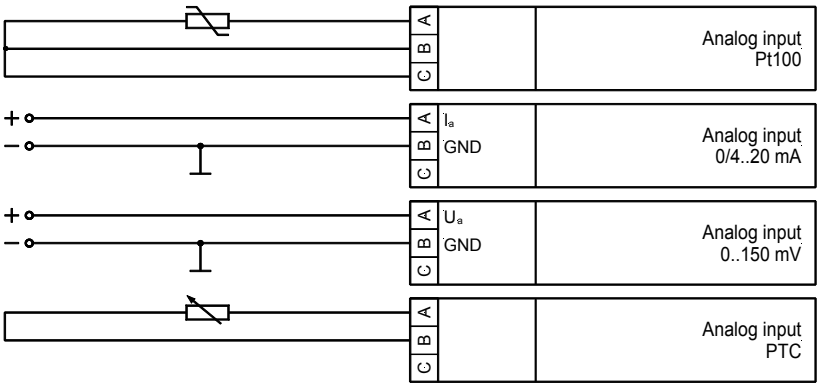
NOTE

The temperature measuring input is always configured in 3-conductor technology. If a 2-conductor resistance is used, the terminals 71/72, or 74/75 must be connected to each other using a jumper.

WARNING !

The analog inputs of the MFR are not isolated. When using an isolation monitor, we recommend to use two-pole, isolated transmitters.

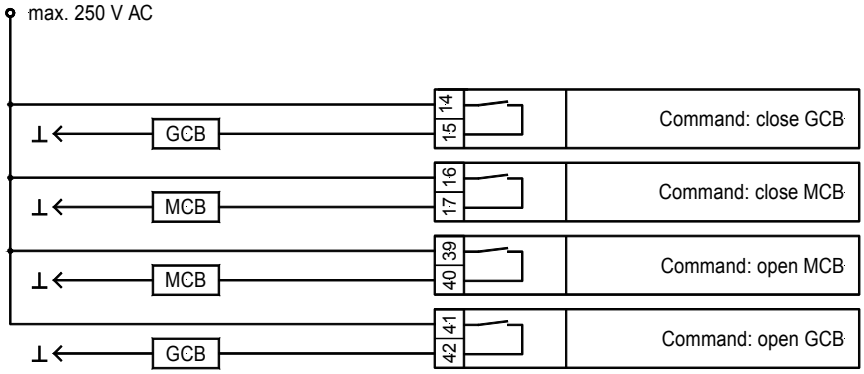
The analog inputs for active transmitters (0 to 20 mA, 0 to 10V) should only be operated with two-pole, isolated transmitters.



Terminal			Description	A_{max}
A	***B***	***C***	(any of the following analog inputs:)	
70	71	72	Analog input 1 [1] • PSVA 0/4-20 mA, Setpoint value P • Option T2 Alternative aus: Pt100, 0/4-20 mA, PTC (16,5 kOhm) • Option X 0/4-20 mA, Setpoint value P	2,5 mm²
73	74	75	Analog input 2 [2] • Option T2 Alternative aus: Pt100, 0/4-20 mA, 0-150 mV • Option Xc 0/4-20 mA, Setpoint value cosphi	2,5 mm²

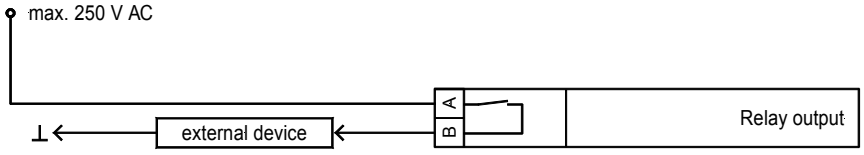
a.) Relay Outputs

- **Power circuit breaker**



Root	Switched	Description	A_{max}
14	15	Command: close GCB	2.5 mm²
16	17	Command: close MCB	2.5 mm²
39	40	Command: open MCB	2.5 mm²
41	42	Command: open GCB	2.5 mm²

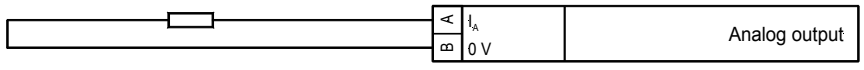
- **Relay (general)**



Root ***A***	Switched ***B***	Description	A_{max}
18	19	Readiness for operation	2.5 mm²
37	38	Relay output 4	2.5 mm²
43	44	Relay output 3	2.5 mm²
45	46	Relay output 2	2.5 mm²
47	48	Relay output 1	2.5 mm²

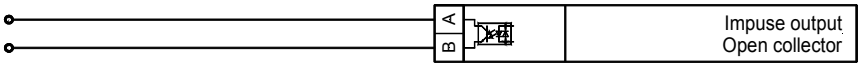
(RM)..configurable with the relay manager

b.) Analog Outputs (PSVA & Options A2/A4)



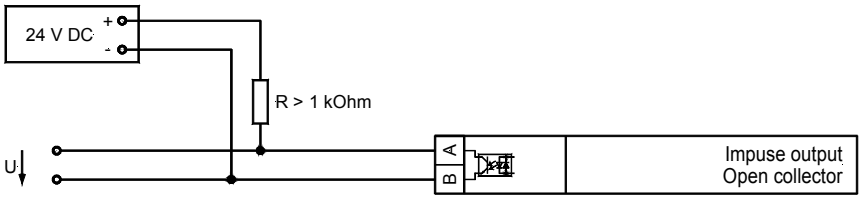
I_A ***A***	0 V ***B***	Description		A_{max}
80	81	Analog output 0/4-20 mA	PSVA/A2	1.5 mm²
82	83	Analog output 0/4-20 mA	PSVA/A2	1.5 mm²
Y1	Y2	Analog output 0/4-20 mA	PSVA/A4	1.5 mm²
Y5	Y4	Analog output 0/4-20 mA	PSVA/A4	1.5 mm²

1.2.5 Pulse Output (PSVA & Option M/Mb)



Terminal		Description	A_{max}
A	87	Pulse output (kWh pulse), option M: PSVA/option M ON: max. 30 mA; OFF: 27 V	1.5 mm²
B	86	Emitter (open collector)	1.5 mm²
A	85	Pulse output (kvarh pulse), option Mb: PSVA/option M ON: max. 30 mA; OFF: 27 V	1.5 mm²
B	84	Emitter (open collector)	1.5 mm²

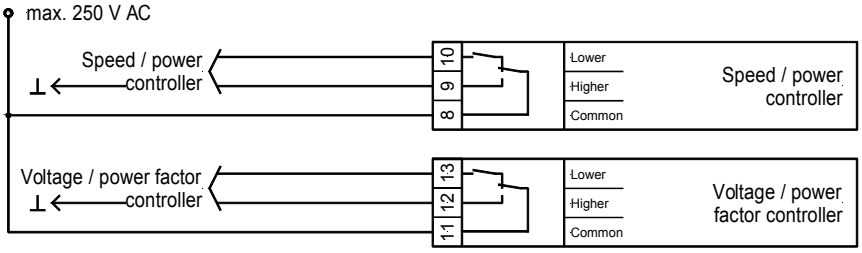
Example



1.2.6 Controller Outputs (Standard/Options Qf/Qu)

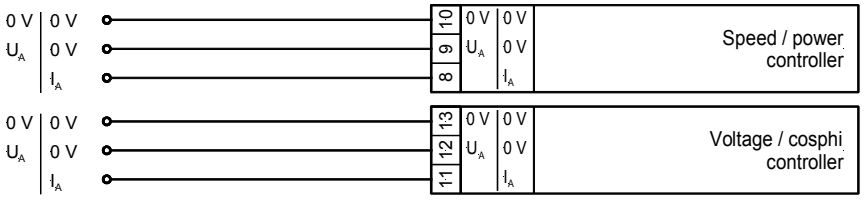
The governors of the standard version are designed as three-position controllers (made of a change-over contact and a make contact). If options Qu or Qf are ordered, they are configured as a quasi-continuous controller with analog outputs. In addition other configuration screens appear.

a.) Three-Step Controller (Standard)



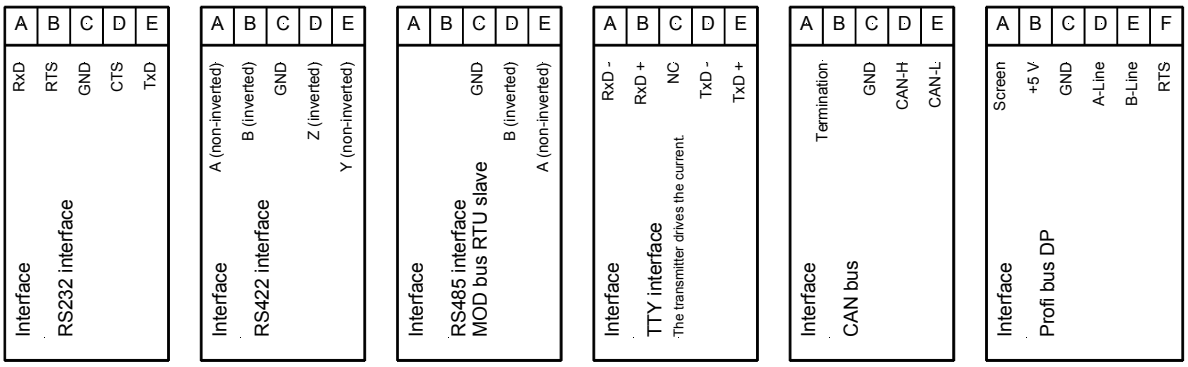
Terminal	Assignment	Description	A_{max}
8	common	Speed/power controller	2.5 mm²
9	higher		2.5 mm²
10	lower		2.5 mm²
11	common	Voltage/cos φ controller ***(only for version "synchronous")***	2.5 mm²
12	higher		2.5 mm²
13	lower		2.5 mm²

b.) Analog Controller Output (Options Qf/Qu)



Terminal	Assignment		Description	A_{max}
	I	**U**		
8	I		Speed/power controller	2.5 mm²
9	0 V	U_A		2.5 mm²
10	0 V	0 V		2.5 mm²
11	I		Voltage/power factor controller	2.5 mm²
12	0 V	U_A	***(only for version "synchronous")***	2.5 mm²
13	0 V	0 V		2.5 mm²

1.2.7 Interface (Standard & Options Su/Sb)



Terminal					Description
Whether the terminals are designated X or Y depends on the configuration of the system. Please refer to the wiring diagram (A = X/Y, B = X/Y, etc.).					
A (X1/Y1)	**B** (X2/Y2)	**C** (X3/Y3)	**D** (X4/Y4)	**E** (X5/Y5)	
Standard					
CAN-H[#]	CAN-L[#]	GND	CAN-H	CAN-L	CAN-Bus
Option Su/Sb					
RxD	RTS	GND	CTS	TxD	RS232
		GND	B	A	RS485, MOD bus RTU slave
RxD-	RxD+	NC	TxD-	TxD+	TTY (transm. drives the current)
A (X1/Y1)	**B** (X2/Y2)	**C** (X3/Y3)	**D** (X4/Y4)	**E** (X5/Y5)	**F** (X6/Y6)	
Option Su/Sb						
Shield	+5 V	GND A-	A-Line	B-Line	RTS	Profi bus DP (use the file LEON00D9.GSD)

[#]..can be used to loop the CAN bus or/and to connect the termination resistance.

NOTE

Please note that the CAN bus must be terminated with an impedance which corresponds to the wave impedance of the cable (e.g. 120 Ohm).

NOTE

For the configuration via the configuration connector (direct configuration) you need a direct configuration cable (order code "DPC"), the program LeoPC 1 (supplied with the cable) and the corresponding configuration files. Please consult the online help installed when the program is installed for a description of the LeoPC 1 PC program and its setup.

2.1 What to Consider when Using ...

2.1.1 ... the Different Options

The MFR 2/PSV consists of a base unit that can also be expanded with options. As a result, a multitude of different units adapted to the particular use is possible. The particular options that a specific unit includes can be derived from the nameplate. These manual describes the basic unit and all options, regardless of the restriction that the options cannot be combined in any desired manner. Likewise, the connection diagram is labeled for all conceivable connection possibilities. For a particular unit, one must via the options choose the connection terminals and the chapter and reference in the manual that are pertinent to the unit in question.

2.1.2 ... Equipment with One Power Circuit Breaker

The MFR 2/PSV is designed for systems with two power circuit breakers (mains power circuit breaker MCB and generator power circuit breaker GCB). However, it is also possible to operate systems with only one power circuit breaker. It is also advisable to trigger this breaker from the unit as a GCB and to connect the corresponding terminals. Moreover, the following applies:

- If the generator is only operated in isolated operation or isolated parallel operation, the following applies:
  - "Reply: MCB is open" (term. 54): HIGH-signal (log. "1") and
  - "Enable MCB" (term. 53): LOW signal (logical "0").
- If the generator is only operated in mains parallel operation, the following applies:
  - "Reply: MCB is open" (term. 54): LOW-Signal (logical "0") und
  - "Enable MCB" (term. 53): HIGH signal (logical "1").

The type and manner of system operation must be taken into account in the configuration of the monitoring.

2.1.3 ... Equipment with Asynchronous/Induction Generators

If systems with systems with asynchronous/induction generators are used, the following must be noted:

- According to the concept of an an asynchronous/induction generator there is no voltage and power factor controller.
- Systems with asynchronous/induction generators are 1 CB systems. Only the GCB is operated.
- Connect the remanent voltage to terminals 23/24. Terminal 23/24 has a zoom function as long as the unit is not operated mains parallel, as the unstimulated synchronous generator is not yet able to generate voltage. Control is carried out on the basis of voltage measurement at terminals 20/21/22 and 50/51/52. Terminal 20 must thus be connected to terminal 23 and terminal 21 to terminal 24.
- Make sure that the input "Reply: MCB is open" is controlled by a continuous LOW-signal (e.g. do not connect or link with the terminal 7 "Common").
- Connect the terminal 53 "Enable MCB" to a continuous HIGH-signal (e.g. connect with the terminal 1 "Power supply"). This informs the unit that it is in mains parallel operation. Power control is carried out.
- The relay "Command: close MCB" and "Command: open MCB" and the LED "Mains CB on" have no function.
- The generator frequency control (see chapter 4.9.7) and blocking control when starting (see chapter 2.5) respond on the measured frequency of the remanence voltage or generator voltage.
- The generator voltage control (see chapter 4.9.8) becomes only active if the GCB is closed.
- There is no synchronization time control.

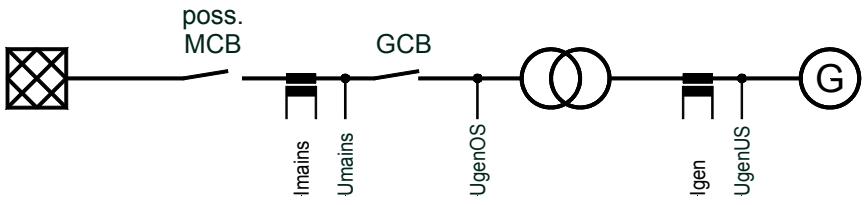
2.1.4 ... Systems in Block Connection (Generator and Transformer) [PSVT]

The version MFR 2/PSVT is adjusted for systems in which generator and transformer are connected directly.

NOTE

The version "PSVT" can operate only one circuit breaker. Thereby the synchronization voltage is measured twice directly at the circuit breaker. The third measuring point (current and voltage) is used only for generator protection. As this measuring point is taken separatly and independent of both synchronization voltages, the phase shift caused by the transformer can be ignored.

Schematic circuit diagram



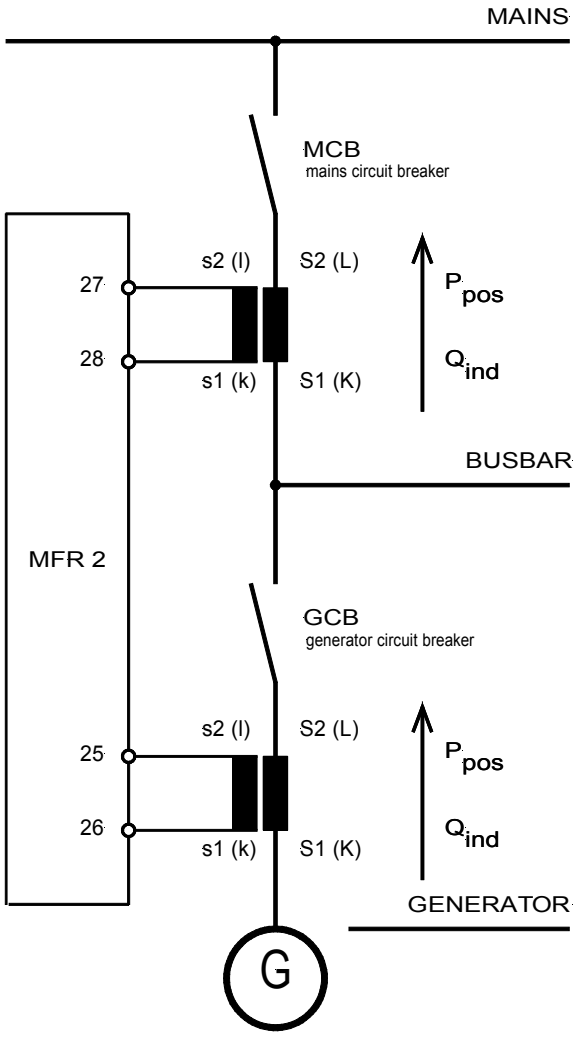
The individual measuring points have the following functions:
- Voltage, generator US = protection and monitoring
- Current, generator = protection and monitoring
- Voltage, generator OS = synchronization and monitoring
- Voltage, mains = protection, synchronization and monitoring
- Current, mains = measuring and monitoring

Concerning the configuration and functionality of the MFR 2/PSVT there are deviations compared with MFR 2/PSV or MFR 2/PSVA which were not described in the different chapters. These are resumed in the following:

- The MFR 2/PSVT can operate only the generator circuit breaker (GCB).
- The "Reply: MCB is open" is used to realize mains parallel operation. The LED "Mains-CB ON" indicates the response of the MCB. If the system has no separate MCB and the connection to the mains is made by closing the GCB, the input "Reply: MCB is open" has to be connected steady with 0 V.
- The discrete input "Enable MCB" may not be attached or should be connected with 0 V.
- As no MCB is operated, all screens and service monitoring referring to the MCB do not apply.
- There is no dead bus operation function.
- There is no busbar voltage, but a "generator voltage of the low voltage side" and a "generator voltage of the high voltage side". By using these terms it is assumed that the low voltage side of the transformer is directly connected with the generator and the high voltage side is connected with the mains (as a version of this definition the MFR 2 can also operate higher voltages on the low voltage side than on the high voltage side.).
- The mains voltage (terminals 50/51) and the generator voltage high voltage side (terminals 23/24) are the voltages used to synchronize the GCB.
- The service monitoring is only used to display the both voltages which have to be synchronized.
- The measurement of generator current and generator voltage of the low voltage side are used for generator protection only.
- A possible phase shift between high and low voltage side caused by the transformer is not relevant for the functions of the MFR 2/PSVT.

If the unit's current transformers are wired according to the pin diagram shown, the following values are displayed:

- **Positive generator real power** — The generator supplies real load
- **Lagging generator power factor cos φ** — The generator is overexcited and supplies lagging re-active power
- **Positive mains real power** — Real load is supplied to the mains
- **Lagging mains power factor cos φ** — The mains pick up lagging re-active power

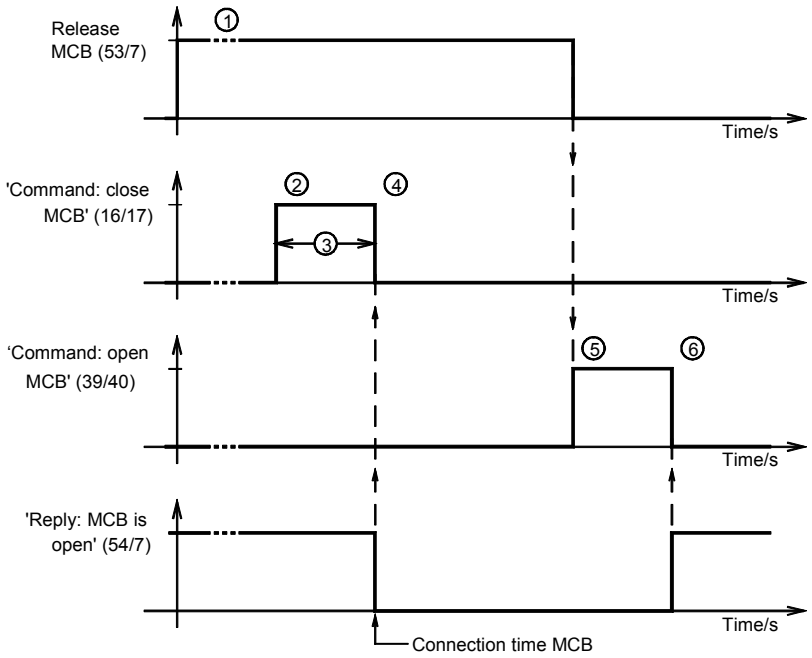


2.3.1 Operation Sequence for the MCB

The diagram below is only applicable if the following is set on the unit:

- MCB open via MCB release: ON
- Relay "Command: open MCB", Logic: A

Additional information can be obtained from the descriptions of the input screens.



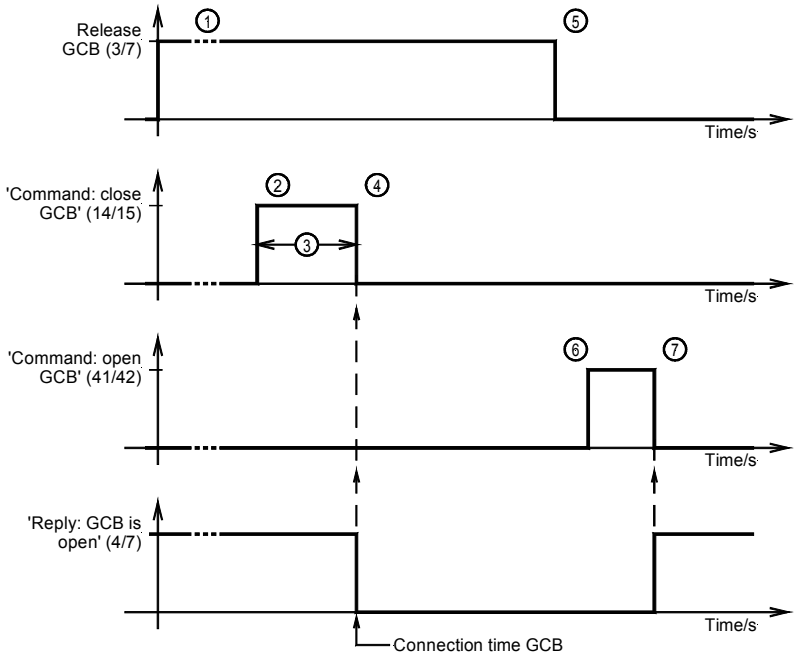
On/off switching pulse MCB

① Synchronization
→ ② ***MCB CLOSE:*** ② closing pulse for MCB set; ① switcher time delay; ④ switch-on impulse deleted;
→ ⑤ ***Open MCB:*** ⑤ opening pulse MCB set; ⑥ switch-off impulse deleted.

The diagram below only applies if the following is set on the unit:

- Stoppage: ON
- Relay "Command: open GCB", logic: A
- Generator switch continuous pulse: OFF

Additional information can be derived from the descriptions of the input screens.



Closing/opening pulse GCB

① Synchronization
→ ② ***GCB CLOSE:*** ② closing pulse GCB set; ③ switcher time delay; ④ switch-on impulse deleted;
→ ⑥ ***OPEN GCB:*** ⑤ beginning of the power reduction; ⑥ end of the power reduction; Opening pulse GCB set ⑦ switch-off impulse deleted

Between ⑤ and ⑥ the power is reduced. When the power is close to zero "0", the GCB is opened.

2.4.1 No Load Operation and Synchronization

No-load control

Voltage and frequency of the generator are adjusted to the configured setpoint values by virtue of the relays of the three-position controller for voltage and speed being triggered appropriately.

Synchronization

Generator voltage and frequency are adjusted to the busbar variables (synchronization GCB) or to the mains variables (synchronization MCB), by virtue of the relay of the three-position controller for voltage and speed being triggered appropriately. Taking into account the breaker connect time, the connect command for the appropriate power circuit breaker is output at the synchronous point.

Input signals				Function	Conditions
Reply: GCB is open	Enable GCB	Reply: MCB is open	Enable MCB		
1	x	x	x	No-load control	A
1	1	x	x	No-load control	B
1	1	x	0	No-load control Synchronization GCB	B C
0	x	1	1	Synchronization MCB	D

0: "OFF" 1: "ON" x: Signal has no significance (0 or 1)

A no-load operation only occurs if the generator frequency is larger than 42 Hz. A control of the voltage only occurs if the generator voltage is at least 50 % of the secondary converter rated voltage. Voltage and frequency controllers as well as the synchronization can be switched on or off by configuration.

Condition	Description
A	The parameter "Automatic no-load control" is ON.
B	The parameter "Automatic no-load control" is OFF.
C	For the generator variables and for the busbar variables, the following must apply: - 50 % $U_{Setpoint}$ < Voltage < 125 % $U_{Setpoint}$ - 80 % f_{Rated} < Frequency < 110 % f_{Rated}
D	For the busbar variables and for the mains variables, the following must apply: - 50 % $U_{Setpoint}$ < Voltage < 125 % $U_{Setpoint}$ - 80 % f_{Rated} < Frequency < 110 % f_{Rated} - The "Command: open GCB" may not be set.

2.4.2 Dead Bus Operation

Dead bus operation Output of a connect command for the power circuit breaker without synchronization.

Input signals				Function	Conditions
Reply: GCB is open	Enable GCB	Reply: MCB is open	Enable MCB		
1	1	1	0	GCB dead bus operation	E
1	x	1	1	MCB dead bus operation	F

0: "OFF" 1: "ON" x: Signal has no significance (0 or 1)

The busbar must be de-energized.

In the case that several MFR 2 were connected via CAN bus, a dead bus operation blocking of the GCB is active. That means that from the units which got a release for dead bus operation only that unit with the smallest generator number gets a switch-on command for the GCB. All other units do not issue a switch-on command. In this way it is prevented that asynchronous generator voltages were connected via CAN bus by simultaneous dead bus operation commands. The presence of the CAN bus connection has to be controlled in the display in automatic mode.

Condition	Description
E	The parameter "Gen. circuit br. dead bus op." is ON and the generator voltage and frequency are within the configured limits.
F	The parameter "Mains circuit br. dead bus op." is ON and is valid for the mains values: - 50 % $U_{Setpoint}$ < Voltage < 125 % $U_{Setpoint}$ - 42 Hz < Frequency < 110 % f_{rated}

2.4.3 Isolated Operation

Isolated operation Voltage and frequency of the generator are adjusted to the configured setpoint values, by virtue of the relay of the three-position controller for voltage and speed being triggered appropriately.

Input signals					Function	Conditions
Isolating controller ON	Reply: GCB is open	Enable GCB	Reply: MCB is open	Enable MCB		
0	0	x	1	0	no action	
1	0	x	1	0	Isolating control	

0: "OFF" 1: "ON" x: Signal has no significance (0 or 1)

A control in isolated operation only takes place if the generator frequency is greater than 42 Hz. A control of the voltage only takes place if the generator voltage is at least 80 % of the secondary transformer rated voltage and the parameter "Voltage controller isolated operation" is set to ON". Voltage and frequency controller as well as the synchronization can be switched on or off by configuration.

Mains parallel operation

Real power and power factor of the generator are adjusted to the configured setpoint values, by virtue of the relay of the three-position controller for power factor (voltage) and power (speed) being switched appropriately.

Input signals					Function	Conditions
Isolating controller ON	Reply: GCB is open	Enable GCB	Reply: MCB is open	Enable MCB		
x	0	x	0	x	Mains parallel operation	

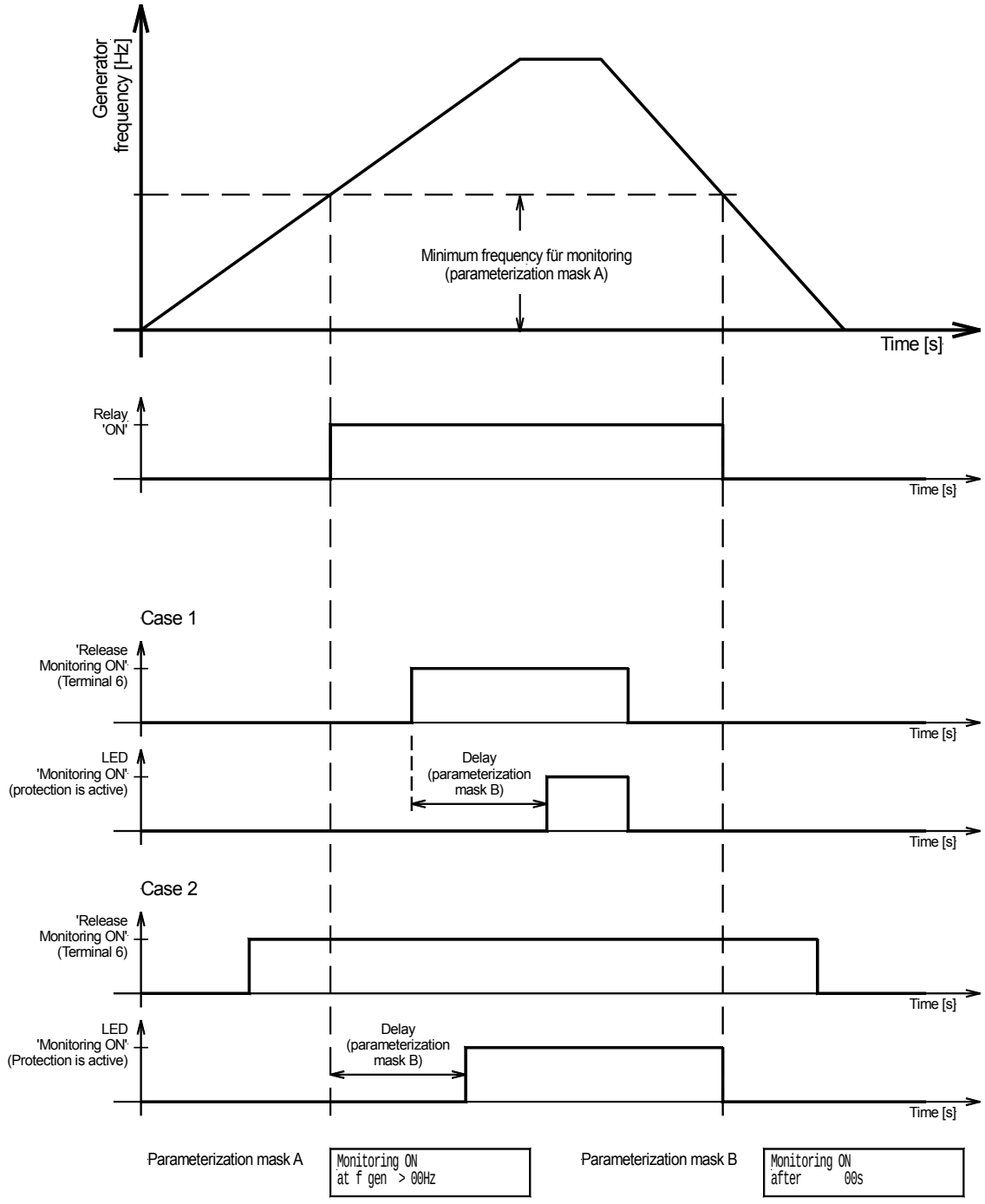
0: "OFF" 1: "ON" x: Signal has no significance (0 or 1)

Mains parallel operation takes place only if the generator frequency is greater than 42 Hz. Note: if during mains parallel operation the generator frequency falls below 50 % of the rated value, the relay "Command: open GCB" is activated.

In order to prevent undesired triggering of the generator protection when stopping and starting the generator, the release of monitoring is linked to reaching of a generator minimum frequency and the discrete input "Enable monitoring". The type and manner of linking is explained in the following diagram. This type of release includes exclusively the following watchdogs:

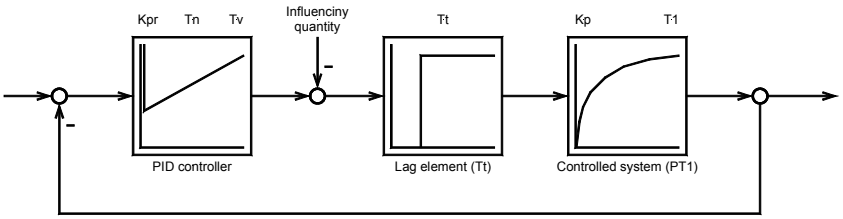
- Generator undervoltage
- Generator undervoltage (generator underspeed with option N)
- Reverse/reduced power

When the minimum frequency is exceeded, this is indicated by closing the relay configured for this.. Whether or not the watchdogs are released and thus active can be recognized on the "Monitoring" LED on the pressure sensitive front membrane.



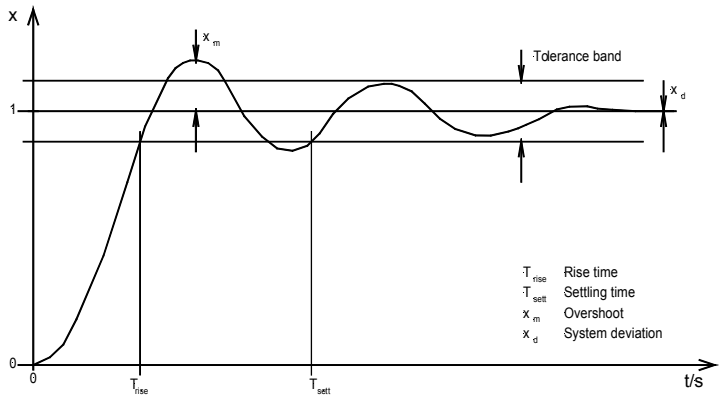
As an alternative to a three-position controller output, the unit may also be equipped with an analog controller output. Other configuration masks then appear in configuration mode. The analog PID controller forms a closed-loop control loop together with the controlled system (usually a first-order lag element). The parameters of the PID controller (proportional-action coefficient K_{PR}, derivative-action time T_V and reset time T_n) can be modified individually. The configuration screens are used for this purpose.

Control loop



If an abrupt disturbance variable is applied to the control loop, the reaction of the controlled system can be recorded at the output as a function of time (step response).

Step response (example)



Various values can be obtained from the step response; these are required for adjusting the controller to its optimum setting:

Rise time T_{rise} Period starting when the value of the control variable leaves a predefined tolerance range for the control variable following a jump in the disturbance variable or reference input variable and ending the first time the value re-enters this range.

Settling time $T_{settling}$ Period starting when the value of the control variable leaves a predefined tolerance range for the control variable following a step in the disturbance variable or reference input variable and ending when the value re-enters this range permanently.

Overshoot x_m Highest transient setpoint value deviation during the transition from one steady-state condition to a new steady-state condition following modification of the disturbance variable or reference input variable ($x_{m\ optimum} \leq 10$ %).

System deviation x_d Permanent deviation from the final value (PID controller: $x_d = 0$).

By different conversions from these values, the values K_{PR}, T_n and T_V can be determined. Moreover, it is possible, by performing various calculations, to determine the optimal controller settings, e.g. by calculating compensation or adjustment of the time constants, T-sum rule, symmetric optimum, Bode-diagram. Other setting procedures and information may be obtained from current literature.

2.6.1 Controller Setting

ATTENTION

The following must be observed regarding the controller setting:

- Ensure that the emergency shutdown system is ready for use.
- While determining the critical frequency, pay attention to the amplitude and frequency.
- If the two values change uncontrollably:

→ EMERGENCY SHUTDOWN

a.) Initial State

Initial state The start position of the controller is determined using the initial state of the controller. If the controller is switched off, the basic setting can be used to output a fixed controller position.

```
Starting point
Freq.      000%
```

Initial state frequency controller **0-100 %**

Analog controller output setting with controller switched off. This value is also used as the initial value.

```
Starting point
Voltage    000%
```

Voltage controller initial state **0-100 %**

Analog controller output setting with controller switched off. This value is also used as the initial value.

b.) General Settings

The setting rule described below only serves as an example. Whether this method is suitable for setting your particular controlled system has not been and cannot be taken into account as each controlled system behaves uniquely.

There are various methods of setting a controller. The setting rules of Ziegler and Nichols are explained below (determination for abrupt disturbances on the system input); this setting method assumes a pure lag element connected in series with a first-order lag system.

1. Controller operated as a P-only controller
   (where $T_n = \infty$ [screen setting: $T_n = 0$], $T_V = 0$).
2. Increase gain K_{PR} (P-gain) until the control loop oscillates continuously at $K_P = K_{Pcrit}$.

⚠ Attention If the unit starts to oscillate uncontrollably, carry out an emergency shutdown and alter the screen setting accordingly.

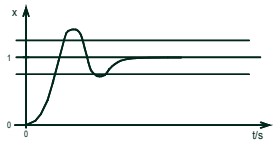
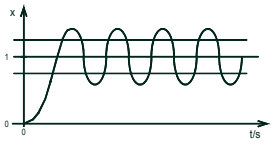
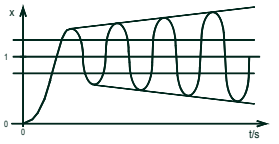
3. At the same time: measure the critical cycle duration T_{crit}
4. Set the parameters:

PID controller

$K_{PR} = 0.6 \times K_{Pcrit}$
$T_n = 0.5 \times T_{crit}$
$T_V = 0.125 \times T_{crit}$

PI controller

$K_{PR} = 0.45 \times K_{Pcrit}$
$T_n = 0.83 \times T_{crit}$

Step response		
Controller setting Optimum ($x_m \leq 10$ %)	**Controller setting T_{crit}**	**Controller setting incorrect**
		


```
Pr.sensitivity
      Kpr=000
```

P gain (K_{PR}) Proportional action coefficient **1-240**

The proportional-action coefficient K_{PR} indicates the closed-loop control system gain. The variable to be controlled is achieved more rapidly by increasing the P-gain.

```
Reset time
      Tn=00.0s
```

Reset time (T_n) **0.2-60.0 s**

The reset time T_n represents the I-component of the PID controller. The I-component results in permanent control deviation being eliminated in the controlled state.

```
Derivative act.
time(xxxx) 0.00s
```

Derivative-action time (T_V) **0.00-6.00 s**

Derivative-action time T_V represents the D-component of the PID controller. An increase in the phase reserve (stability) and the attenuation results from increasing this parameter.

Control guarantees that, in isolated operation (in parallel with other gensets or reverse synchronization of the busbar to the mains), the real power (in reference to the relevant rated power) is evenly distributed over all generators operating in parallel to the busbar.

Isolated operation in parallel

Each controller involved in distribution control influences the generator to which it is assigned in such a manner that the rated frequency (main control variable) which has been configured remains constant. All units are interlinked via a CAN bus, via which any deviation in real power can be determined for each generator. This control variable is taken into consideration on controlling the frequency. The weighting, with which the secondary and the main control variable (= "reference variable") are processed, can be set via a factor. In controlled state, the isolated system has the set rated frequency, whereby the total real power (in reference to the relevant rated power) is subdivided equally amongst those generators involved in distribution control.

Note

1. The generator rated frequencies (page 44) absolutely must be set for all units involved in distribution control at the same values for each.
2. The rated power of all participating units should not differ more than 50 % otherwise the quality of the distribution afflicts.
3. The direct configuration via the lateral plug has to be de-activated otherwise the CAN bus is out of operation.
4. The CAN bus connection is correct, if the right number of units connected via the CAN bus is shown in the display.
5. The discrete input "Isolated controller ON" must be set.
6. The adjusted power limitation has higher priority than the distribution.
7. The parameter "Load sharing" and var sharing" must be set equally in all connected units.

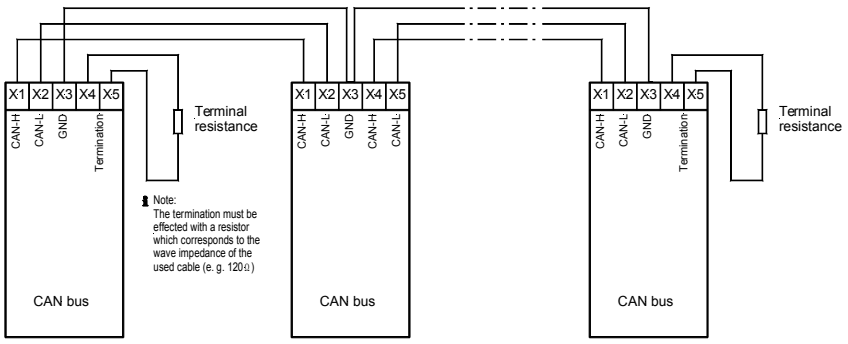
Description of the interface for the distribution control system

Distribution control is based on a multi-master-capable bus between the units. This structure enables the parallel operation of up to 8 generators.

To guarantee a trouble-free operation, please observe the following:

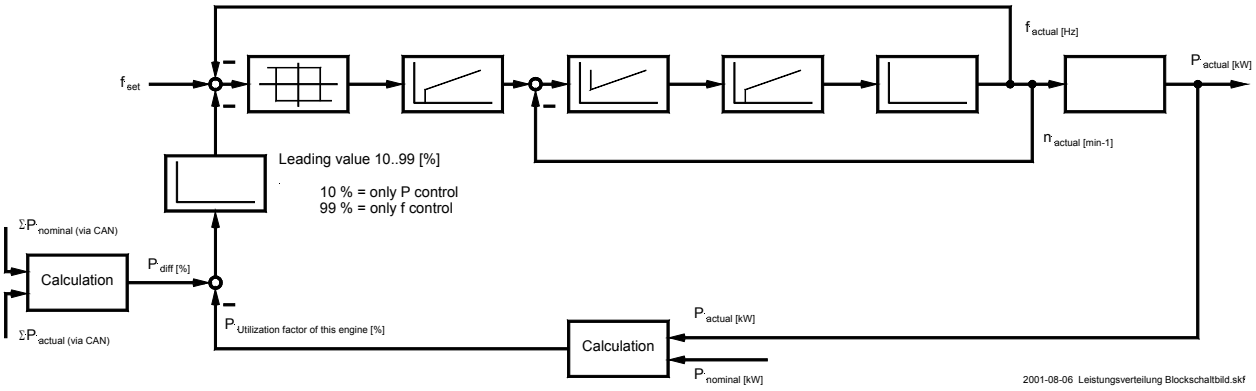
1. The bus length must not exceed 250 m.
2. Each end of the bus must be terminated with terminating resistors which correspond to the wave impedance of the bus cable (approx. 120 Ω).
3. The structure of the bus must be linear. Dead-end feeders are not permissible.
4. Shielded "Twisted-Pairs" are to be preferred as bus cables (example: Lappkabel Unitronic LIYCY (TP) 2×2×0.25, UNITRONIC-Bus LD 2×2×0.22).
5. The bus cable may not be laid in the vicinity of strong current lines.

Wiring diagram



Whether, and the manner in which, a unit carries out real power or frequency control in isolated operation in parallel with other generators, is defined by the "real power distribution reference variable." parameter in % in Chapter 4.8.12 "Load and/or Var Sharing" on page 58 of this manual. In this case, 10 % means increased real power control, and 99 % increased frequency control. This parameter must be input individually for each unit.

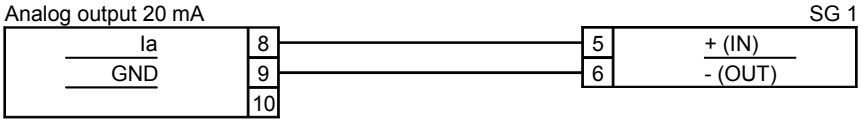
In the case of the following control system, it must be noted that each unit calculates the mean utilization factor of all units from the data transmitted via the CAN bus, and then compares this with its own utilization factor. The utilization factor is compared with the reference variable, and results in the new reference variable. Frequency and real power control are simultaneously carried out in these units (corresponding to the reference variable).



2.8.1 Speed Governor SG 1

NOTE

Please note the wiring diagram for the SG 1. 180 Hz version pickups are supported.



Determination of the percentage

Divisor = ($f_{Pickup} \times 13$) / 2,400 Hz

f_{Pickup} = Number of $teeth_{Pickup}$ [Number] × Rated $speed_{aggregate}$ [min^{-1}] × 1/60 [s]

Example

Number of Pickup teeth = 158 teeth
Rated unit speed = 1,500 min^{-1}

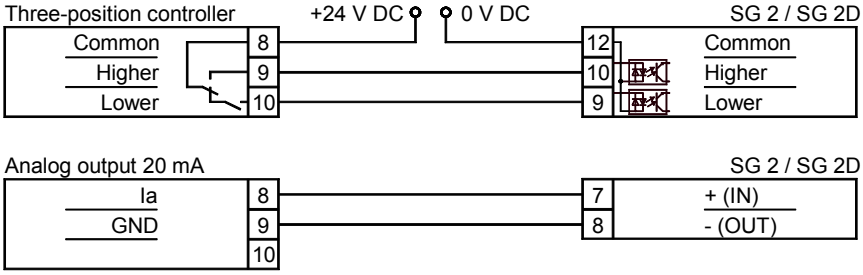
f_{Pickup} = 158 teeth× 1,500 min^{-1} × 1/60 s = 3,950.00 Hz
Divisor = (3,950.00 Hz × 13) / 2,400 Hz = 21.40
Setting on the PCB = 2×10^1 and 1×10^0

For the Pickup with the number of teeth 158/133/175 teeth, the setting must be 21/18/23.

2.8.2 SG 2/SG 2D Speed Governor

NOTE

Please note the wiring diagram for the SG 2/SG 2D. The LeoPC1 program is required for configuration of the speed governor.



2.9.1 Generator Protection

The generator protection consists of the watchdogs for generator over-/undervoltage, generator over-/underfrequency as well as overload, reverse/reduced load, unbalanced load, overcurrent and re-active power (lagging/leading). With the exception of the overload, the triggering of a watchdog leads to activation of the relay "Command: open GCB". Each watchdog must be enabled separately via configuration. Moreover, each watchdog can be assigned to one or more signal relays.

2.9.2 Mains Protection

The mains protection consists of the watchdogs for mains over-/undervoltage, mains over-/undervoltage as well as phase shift, asymmetry and df/dt monitoring (only with option D). The mains decoupling in triggering of a mains failure is continually active and can be set via the configuration on the relay "Command: open GCB" or the relay "Command: open MCB". Every watchdog must be enabled separately via the configuration. Moreover, every watchdog can be assigned to one or more signal relays.

2.9.3 Alarm Classes

The monitoring functions are divided into four alarm classes:

F0 **Warning alarm**
This alarm does not cause an interruption of the operation. An output is made without centralized alarm.
→ Alarm text + configured signaling relay

F1 **Warning alarm**
This alarm does not cause an interruption of the operation. Output of the centralized alarm.
→ Alarm text + flashing LED "Alarm" + relay centralized alarm fault (horn) + configured alarm relay

F2 **Triggering alarm**
This alarm causes a shutoff of the generator. The real power is first reduced before the GCB is opened.
→ Alarm text + flashing LED "Alarm" + relay centralized alarm (horn) + transmit + configured signaling relay

F3 **Triggering alarm**
This alarm leads to the immediate triggering of the relay "Command: open GCB".
→ Alarm text + flashing "Alarm" LED + group alarm relay (horn) + shutdown + configured signaling relay

2.9.4 Internally Detected Alarms

Type of alarm	Alarms-class	Alarm text
Generator overfrequency	F3	Gen.Overfreq.
Generator underfrequency	F3	Gen.Underfreq.
Generator overvoltage	F3	Gen.Overvolt.
Generator undervoltage	F3	Gen.Undervolt.
Battery undervoltage	F1	Batt. Undervolt.
Generator overload	F2	Gen. Overload
Generator reverse/reduced load	F3	Rev./red. load
Mains overfrequency	F0	Mains Overfreq.
Mains underfrequency	F0	Mains Underfreq.
Mains overvoltage	F0	Mains Overvolt.
Mains undervoltage	F0	Mains Undervolt.
Mains asymmetry	F0	Asymmetry
Mains phase shift	F0	Phase shift
Mains df/dt fault (option D)	F0	Fault df/dt
Displacement voltage (option I3)	F3	ground fault
Generator time-overcurrent, level 1	F3	Gen.Overcurrent 1
Generator time-overcurrent, level 2	F3	Gen.Overcurrent 2
Generator unbalanced load	F3	Unbalanced lo.
Generator re-active power, lagging	F3	Lead.react.load
Generator re-active power, leading	F3	Lagg.react.load
Synchronization time fault	F1	Synchr.TimeContr
Interface fault (option Sb)	F1	Interface
Generator overtemperature (option T1,T2)	F1	Gen.-over temp.
Analog input 1 (0/4-20 mA), warning (option T1/T2)	F1	Anin 1 Warning
Analog input 1 (0/4-20 mA), shutdown (option T1/T2)	F1	Anin 1 Tripping
Analog input 1 (4-20 mA), wire break (option T1/T2)	F0	Anin 1 Wire break
Analog input 2 (0/4-20 mA), warning (option T1/T2)	F1	Anin 2 Warning
Analog input 2 (0/4-20 mA), shutdown (option T1/T2)	F1	Anin 2 Tripping
Analog input 2 (4-20 mA), wire break (option T1/T2)	F0	Anin 2 Wire break
Battery overcurrent, level 1 (option T1/T2)	F1	Batt. over current 1
Battery overcurrent, level 2 (option T1/T2)	F1	Batt. over current 2
Temperature 1, warning	F1	Temp 1 warning
Temperature 1, shutdown	F3	Temp 1 tripping
Temperature 1, wire break	F0	
Temperature 2, warning	F1	Temp 2 warning
Temperature 2, shutdown	F3	Temp 2 tripping
Temperature 2, wire break	F0	
Centralized alarm		

Note: All fault states can be freely assigned to the signaling relay in configuration mode.

Please notice the maximum 4 alarm texts can be displayed! If more than 4 alarms are active at the same time, only the messages of the first four alarms can be displayed.

2.9.5 Acknowledge Alarms

By pressing the "Clear" button, the signaling relay, the group alarm message and the alarm messages in the LCD display are acknowledged:

short acknowledgement (1 s) Acknowledgement of the group alarm message and the alarm messages of class F0 and F1

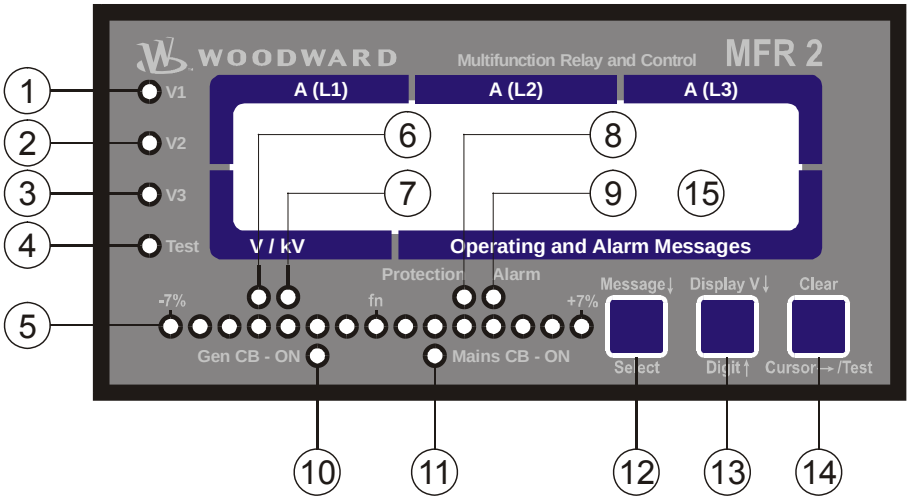
Long acknowledgement (5 s) Acknowledgement of the group alarm message and the alarm messages of class F2 and F3

For alarms of class F0 the signal relay is automatically acknowledged after the triggering condition has been taken away.

Refer to the descriptions of configuration screens for additional information.

3.1 Front Membrane

The pressure-sensitive membrane of the front panel consists of a plastic coating. All keys have been designed as touch-sensitive membrane switch elements. The LCD display comprises 2 × 16 characters that are indirectly illuminated in red. Contrast of the display is infinitely variable by a rotary potentiometer at the left side. The configuration bushing is located on the left side of the unit. Please connect the direct configuration cable (DPC) there.



Light-emitting diodes

① "V1" ..... Voltage L1
② "V2" ..... Voltage L2
③ "V3" ..... Voltage L3
④ "Test" ..... Configuration mode active
⑤ "-7%..f_N..+7%" ..... Generator frequency display
⑥ "V" ..... Generator voltage in volts
⑦ "kV" ..... Generator voltage in Kilovolts
⑧ "Protection" ..... Monitoring is active
⑨ "Alarm" ..... Alarm message
⑩ "Gen CB - ON" ..... Reply: GCB is closed
⑪ "Mains CB - ON" ..... Reply: NLS is closed

Buttons

⑫ "Message↓" ..... Scrolling messages and displays
⑫ "Select" ..... Confirm selection
⑬ "Display V↓" ..... Scroll display of the voltages
⑬ "Digit↑" ..... Increase digit
⑭ "Clear" ..... Acknowledge alarm
⑭ "Cursor→/Test" ..... Input position one to the right

Display

⑮ "LC display" ..... LC display

①②③ ***LED "V1..V2..V3"***

Voltage control **Color "GREEN"**

The light-emitting diodes "V1", "V2" and "V3" indicate which voltage (U_{L1N}, U_{L2N}, U_{L3N}, U_{L12}, U_{L23} or U_{L31}) is currently indicated. This applies both to the generator and the rated voltage display.

④ ***LED "TEST"***

Test **Color "RED"**

The "Test" LED flashes if the configuration mode is active.

⑤ ***LED "-7%..f_N..+7%"***

Phase angle / synchroscope **Colors "RED/YELLOW/GREEN"**

Automatic mode

The row of LED's between -7 % and +7 % is used to visualize the generator frequency. The rated frequency (f_N) is entered in the "Generator rated frequency" screen. Using limit values -7 % and +7 % an increment of 1 % per LED results. If the frequency is larger than 107 % f_N or smaller than 93 % f_N, the corresponding external LED flashes.

Configuration mode

The row of LED's indicates the current phase position between the two voltages displayed, if the service display is active. The green LED in the middle of the 15 LED's indicates that the measured phase angle between the voltage systems is less than 12° electrical. The phase angle is only displayed if the two frequencies are within the range 80-110 % f_N.

There are two phase sequences:

-7 % → +7 % On running the LED's from left to right, the generator frequency is too high, i.e., the generator is turning too fast.

+7 % → -7% On running the LED's from right to left, the generator frequency is too low, i.e., the generator is turning too slow.

⑥ ***LED "V"***

Generator voltage display in V **Color "GREEN"**

If the LED lights up "V", the generator voltage is indicated on the display in the unit of volts.

⑦ ***LED "kV"***

Generator voltage indication in kV **Color "GREEN"**

If the LED "kV" lights up, the generator voltage is indicated in the display in the unit of kilovolts.

⑧ ***LED "Protection"***

Protection **Color "GREEN"**

The LED "Protection" shows, that the monitoring is active (see also chapter 2.5 "Monitoring Blocking at Startup" on page 25).

⑨ ***LED "Alarm"***

Alarm **Color "RED"**

If the LED "Alarm" lights up, the unit has detected an alarm which is processed according to the its alarm class. The message and the type of alarm are shown on the LC display. If this LED flashes, a alarm has run in with a group alarm. Via brief acknowledgment, this switches to continuous illumination, and the centralized alarm is ceased.

⑩ ***LED "Gen CB - ON"***

GCB is closed **Color "GREEN"**

If the GCB is closed, the unit indicates this by lighting the LED "Gen CB - ON". The LED signals the reply of the GCB (terminal 4, "Reply: GCB is open").

⑪ ***LED "Mains CB - ON"***

MCB is closed **Color "GREEN"**

If the MCB is closed, the unit shows this by illumination of the "Mains CB - ON". The LED signals the reply of the MCB (terminal 54, "Reply: MCB is open").

3.3 Buttons

In order to facilitate the setting of the parameters, the buttons have an AUTOROLL function. It allows switching to the next setting and configuration screens, the digits, or the cursor position. The AUTOROLL function will only be activated when the user depresses the corresponding keys for a certain period of time.

⑫ ***BUTTON "Message↓..Select"***

Message↓..Select **Color "NONE"**

Automatic mode..... "Message" Pressing this button advances the display of the operating and alarm messages.

Configuration mode.. "Select“ The jump to the next input screen occurs. If the originally displayed value has been changed by the buttons "Digit↑“ or "Cursor→/Test" then the newly set value is saved by pressing the "Select“ saved. By pressing this button again, the user causes the system to display the next entry screen.

⑬ ***BUTTON "Display V↓..Digit↑"***

Display V↓..Digit↑ **Color "NONE"**

Automatic mode..... "Display V↓“ Pressing this button advances the display of the generator and mains voltage.

Configuration mode.. "Digit↑“ The cursor is increased by one digit from where the cursor found itself, using this button. The increase is restricted by the admissible limits (see list of parameters included in the Annex). In case the maximum number is reached which can be set, the number automatically returns to the lowest admissible number.

⑭ ***BUTTON "Clear..Cursor→/Test"***

Acknowledge..Cursor→/Test **Color "NONE"**

Automatic mode..... "Clear“ By pressing the button, all alarm messages are deleted if they are no longer detected.

Configuration mode.. "Cursor→/Test“ This button moves the cursor one position to the right. When the last right-hand position is reached, the cursor automatically moves to the first position left-hand of the value to be entered.

⑮ ***..... DISPLAY "LC display"***

LC display

The LC display outputs corresponding messages and values depending on the particular mode. In input mode the parameters are changed and in automatic mode, e.g. the voltages and currents are displayed.

Top line Display of the generator conductor currents for each phase separate according to the writing. If the slave pointer function is selected in the subsequent screen, the maximum currents are displayed in this position.

Lower line In the "V/kV" field, the generator voltage is displayed depending on the LED's U1, U2 and U3: If only one of the LED's U1, U2 or U3 lights up, the corresponding voltage conductor ground is displayed. If two of the LED's light up, the accompanying external conductor voltage is displayed.

In the "Command and alarm messages" field, the following operating conditions are displayed:

Basic indication mask

- Display of the generator real power (depending on the configuration is determined in a single phase or in three phases).

Subsequent screens

(Depending on the options used, additional screens may appear)

- Generator power factor φ
- Generator real energy # (positive, delivery)
- Generator real energy # (negative, acceptance)
- Generator lagging re-active energy #
- Generator leading re-active energy #
- Actual set value for real power controller
- Maximum generator current (slave pointer)
- Mains voltage depended on the LED's U1, U2 and U3
- Mains real power (measured in single phase)
- Mains power factor φ
- Mains current
- Operating hours
- Remaining time until the next maintenance
- Start counter
- Battery voltage (supply voltage of the unit)
- Number of units connected on the CAN bus

(# The display of the energy counter will be updated every 3 minutes.

These masks are displayed one after the other by pressing the button "Message↓". If no button is pushed for approximately 1 minute, the display automatically changes to the initial display screen. If alarms have occurred, their message texts are displayed in the sequence of their occurrence in the display screens before the basic screen. Please notice the maximum of 4 alarms that can be displayed! If more than 4 alarms are active at the same time, only the messages of the first four alarms can be run over the display. During synchronization of the power circuit breakers, the basic screen is hidden by the message "Synchronization GCB" or "Synchronization MCB". The basic screen is displayed again following successful synchronization.

When entry mode is activated (by simultaneously pressing the "Digit↑" and "Cursor→" buttons; the "Test“ LED flashes) the entry screens can be scrolled through by pressing the "Select" button. If the "Select" button is pressed for a longer period of time, the scroll function will be activated, and the screens will be browsed rapidly. By simultaneously depressing the buttons "Select" and "Position→" you can step backwards through the last four configuration masks. Exception: The service display and the break from the first to the last screen. Please note that it is not possible to scroll back through the displays. If no entry, modification or any other action is carried out for 90 seconds, the unit automatically returns to the automatic mode.

WARNING !

Incorrect entries may lead to wrong measured results and undesired unit performance.

NOTE

There are two different types of hardware, which are described in this manual: A 100 V-version [1] and a 400 V-version [4]. The configuration screen and parameters differ in both versions, and the setting limits also differ. The two types are differentiated by placing their respective voltage values first ([1] ... or [4] ...).

```
Software version
    Vx.xxxx
```

Software version

Display of the software version.

The unit is equipped with a three-level code and configuration hierarchy, which enables it to visualize various configuration screens for different users. A distinction is made between:

- **Code level 0 (CL0) -** User: Third party
  This code level enables no access whatsoever to the parameters. The configuration is blocked.

- **Code level 1 (CL1) -** User: Plant operator
  This code level entitles the user to change a few selected parameters. Changing a code number is not possible in this case.

- **Code level 2 (CL2) -** User: Commissioner
  With code level 2 the user has direct access to all parameters (displaying and changing). In addition, in this level the user may also set the code number for levels 1 and 2 or switch off the password protection.

```
Enter code
          XXXX
```

Enter code number **0-9999**

On accessing the configuration mode, a code number, which identifies the various users, is requested. The displayed number XXXX is a random number (RN). If the random number has been confirmed with "Select" without being changed, the unit's code level remains. On entering the code number for level 1 respectively level 2, the unit switches into code level CL1 respectively CL2 and the parameters can be changed accordingly. On entering a wrong code number, the unit switches into code level 0.

NOTE

Two hours after entering the code number the code level automatically drops back to CL0!

The default code number for code level 1 (CL1) is "0001"!

The default code number for code level 2 (CL2) is "0002"!

Only in code level 2 the password protection can be switched off!

```
Enter code
Protection    ON
```

Password protection **ON/OFF**

ON .....Access to configuration is done by entering the relevant code number (code level 1/2). If a wrong code number was entered, the configuration will be blocked.

OFF .....The user has direct access to all parameters, the code number is not requested.

4.2 Configuration Via the Side Connector (Direct Configuration)

NOTE

For the configuration via the side connector (direct configuration), you need a direct configuration cable (order code "DPC"), the program LeoPC 1 (supplied with the cable) and the corresponding configuration files. Please consult the online help installed when the program is installed for a description of the LeoPC 1 PC program and its setup.

WARNING !

If the following parameter, "Direct configuration", is set to "ON", communication via the interface with terminals X1-X5 is locked. If communication is to be re-established via X1-X5 interface after configuration, the following parameter must be set to "NO"!

The parameters of the unit can be read via lateral plug at any time. With the password protection switched off or if the unit is in code level 2, writing of parameters via direct configuration is also possible. If the password protection is switched on and the unit is in code level 0 or 1, the password (code number) of code level 2 must be entered via direct configuration, to modify the parameters. The possibility, to modify parameters via display, is not affected thereby.

```
Direct para.
        YES
```

Configuration via the configuration plug **YES/NO**

YES .....Configuration via lateral plug is possible. The following further conditions for configuration via lateral plug must be met:
- A connection between the unit and the PC via the direct configuration cable must be available,
- the baud rate of the LeoPC program must be 9.600 Baud and
- one must use the corresponding configuration file (filename: "*.asm", called by *.cfg).

NO .....Configuration via lateral plug cannot be carried out.

4.3 Service Display

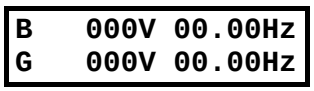
```
Service display
            ON
```

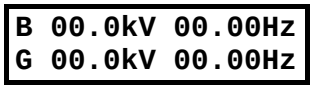
Service display **ON/OFF**

ON .....The following three screens are displayed. The service display is to assist when commissioning the unit.

OFF .....The screens of the service display are not displayed.

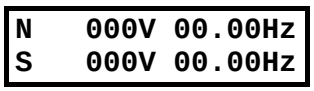
4.3.1 Double Voltage/Frequency Display for Synchronous Generators

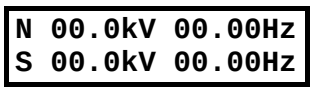




Busbar/Generator

The busbar and generator voltage and frequency are displayed. The phase position between generator and busbar is indicated by the synchroscope (LED-strap):
B.....Busbar voltage and frequency
G.....Generator voltage and frequency

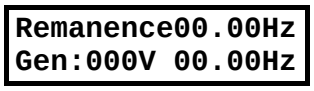




Mains/busbar

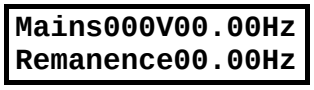
The busbar and generator voltage and frequency are displayed. The phase position between mains and busbar is indicated by the synchroscope (LED-strap):
M.....Mains voltage and frequency
S .....Busbar voltage and frequency

4.3.2 Double Voltage/Frequency Display for Asynchronous/Induction Generators



Generator/remanence voltage

The generator and remanence voltage and frequency are displayed.
Gen..... Generator voltage and frequency
Remanence .... Frequency of the remanence voltage



Mains/remanence voltage

The mains and remanence voltage and -frequency are displayed.
Mains ..... Mains voltage and frequency
Remanence .... Frequency of the remanence voltage

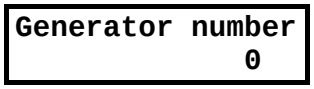
4.3.3 Relay States

Power circuit breaker states and relay states of the controller

The display forwards the current state of the three-position controller and the signals to the power circuit breakers:

f	+	raise frequency	terminal 8/9
	-	lower frequency	terminal 8/10
U	+	raise voltage	terminal 11/12
	-	lower voltage	terminal 11/13
MCB	On	Connect pulse for the MCB	terminal 16/17
	Off	Disconnect pulse for the MCB	terminal 39/40
GCB.....	On	Connect pulse for the GCB	terminal 14/15
	Off	Disconnect pulse for the GCB	terminal 41/42

4.4 Generator Number Configuration



Generator number **1-8**

If several generators are available and these are coupled via a bus, a different number must be assigned to each generator for differentiation purposes. The generator number 1 should be assigned even in the case of individual units. This number is also used to generate the CAN ID. If the unit is equipped with Modbus , this number is conform with the Slave address.

```
Change relay-
function?  YES
```

Change relay assignment? **YES/NO**

YES .....The subsequent screens are displayed. In the configuration of the watchdog (at a different position) the associated screen for the relay assignment is visible.

NO .....The subsequent screens are not displayed. In the configuration of the watchdogs (at another position) the accompanying screen for the relay assignment is not visible.

NOTE

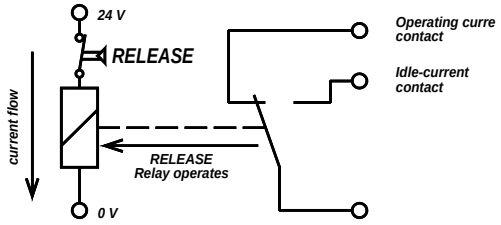
Operating current (NO) After the tripping, the relay picks up, i. e. current is flowing through the coil while in operate condition.

→ In the event of a loss of the supply voltage, the status of the relay is not changed and no tripping occurs. In this case, the relay's readiness for operation should be monitored.

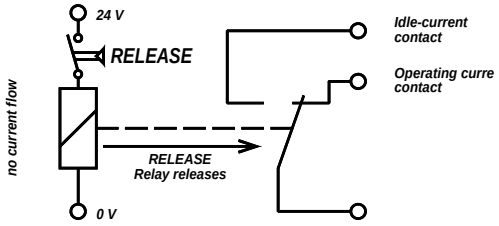
Closed-circuit current (NC) After the tripping, the relay drops out, i. e. current is flowing through the coil while in release condition. The relay is pulled in the idle state (= no tripping).

→ In the event of a loss of the supply voltage, the status of the relay is changed and a tripping occurs.

Relay programmed as 'operating current relay'



Relay programmed as 'idle-current relay'




```
Funct. rel. 1234
(R=releases)EEEE
```

Function relay 1, 2, 3 and 4 **E/D**

A choice is made between different control principles by selecting either operating current contact (NO) or idle current contact (NC). An operating current output (NO) can be used if a wire break may not lead to any great fault; the idle current output (NC) performs advanced tasks e.g. for safety-relevant lines.

E .....Energize to operate (operating current output/NO): The discrete signal output functions as a working current output.

D .....De-energize to operate (idle current output/NC): The discrete signal output functions as idle current output.

Note: The signal output is physically always configured as a normally open contact

```
Relay "open GCB"
Logic          E
```

Logic for the relay "Command: open GCB" **E/D**

E .....Energize to operate (NO): The relay "Command: open GCB" works in the operating current (NO) principle, i.e. it triggers if the GCB is to be opened.

D .....De-energize to operate (NC): The relay "Command: open GCB" operates according to the idle current principle (NC), i.e. it drops out if the GCB is to be opened. The contact is closed in the normal state. In this way the output can be configured as fail-safe.

```
Relay "open MCB"
Logic          E
```

Logic for the relay "Command: open MCB" **E/D**

E ..... Energize to operate (NO): The relay "Command: open MCB" operates according to the operating current (NO) principle, i.e. it picks up if the MCB is to be opened.

D ..... De-energize to operate: The relay "Command: open MCB" operates according to the idle current (NC) principle, i.e. it drops out if the MCB is to be opened. In the normal state the contact is closed. In this way the output can be configured in fail-safe manner.

```
Open MCB via
release MCB  ON
```

Activation of the control function "Command: open MCB" **ON/OFF**

ON ..... The relay "Command: open MCB" is triggered if the input "Enable MCB" is reset or if an activated mains monitoring function picks up. In this way the MCB can be opened using the signal "Enable MCB".

OFF ..... The relay "Command: open MCB" is triggered exclusively if an activated mains monitoring function picks up. The input "Enable MCB" has no effect on the function of the relay "Command: open MCB".

4.6 Auto-Acknowledgement

```
Auto-acknowledge
relay       ON
```

Auto-acknowledgement relay **ON/OFF**

ON ..... The relays drop back into the idle state if the criterion for triggering is no longer present.

OFF ..... The relays remain in the triggered state until this is acknowledged. The screen "Messages auto-acknowledgement" does not appear.

```
Auto-acknowledge
messages    ON
```

Messages auto-acknowledgement **ON/OFF**

This screen only appears if the screen "Relay auto-acknowledgement" is set to ON.

ON ..... After the alarm condition is no longer detected, and the time "Acknowledge messages after ..." has expired, the message in the display is deleted.

OFF ..... After the alarm condition is no longer detected, the message in the display is not deleted, and the subsequent screen of this option is not displayed.

```
Acknowledge
message aft. 00s
```

Drop-out delay messages **1-99 s**

This screen only appears if the screen "Relay auto-acknowledgement" is set to ON. The acknowledgement of the alarm messages occurs after the specified time.

```
Generator nom.
frequency=00.0Hz
```

Generator rated frequency **48.0-62.0 Hz**

The generator rated frequency is entered in this screen.

```
Gen. voltage
primary 00.000kV
```

Primary generator voltage **0.050-65.000 kV**

The primary transformer rated voltage of the generator voltage transformer is to be entered here. The entry is used to output the primary voltages on the display.

```
Gen. voltage
secondary  000V
```

Secondary generator voltage **[1] 50-125 V; [4] 50-480 V**

The secondary transformer rated voltage of the generator voltage transformer is to be entered here. The entry is used to output the primary voltages on the display.

```
Busb. voltage
primary 00.000kV
```

Primary busbar voltage **0.050-65.000 kV**

The primary transformer rated voltage of the busbar voltage transformer is to be entered here. The entry is used to output the primary voltages on the display.

```
Busb. voltage
secondary  000V
```

Secondary busbar voltage **[1] 50-125 V; [4] 50-480 V**

The secondary transformer rated voltage of the busbar voltage transformer is to be entered here. The entry is used to output the primary voltages on the display.

```
Mains voltage
primary 00.000kV
```

Primary mains voltage **0.050-65.000 kV**

The primary transformer rated voltage of the mains voltage transformer is to be entered here. The entry is used to output the primary voltages on the display.

```
Mains voltage
secondary  000V
```

Secondary mains voltage **[1] 50-125 V; [4] 50-480 V**

The secondary transformer rated voltage of the mains voltage transformer is to be entered here. The entry is used to output the primary voltages on the display.

```
Volt.-Measuring
°°°°°°°°°°°°°°°°
```

This screen only affects the display. The watchdog screens are defined further below.

Voltage measurement **Phase-to-phase/Phase-neutral**

Phase-to-phase..... The electrical system (generator, busbar and mains) consists of only the three external conductors (without a neutral conductor). In this way the N-lug (terminal 0) cannot be connected. Only the external conductor voltages are indicated in the display.

Phase-neutral..... The electrical system (generator, busbar and mains) consists of the three external conductors and a neutral conductor. As a result, the N-lug (terminal 0) must be connected. The external conductor voltages and the voltages of conductor N are indicated in the display.

```
Current transf.
Generator 0000/0
```

Generator current transformer **0-6.900/x A**

The primary transformer rated current of the generator current transformer is to be entered here. The ratio must be selected in such a manner that, at maximum power, at least 40 % of the transformers rated current flows. A lower percentage may lead to incorrect measurements.

{X} / 1 A.... Secondary rated current = 1 A at primary rated current = {X} A;
{X} / 5 A.... Secondary rated current = 5 A at primary rated current = {X} A;
{X} ..... e.g. from the main row 10, 15, 20, 30, 50 or 75 A and the decimal fractions and multiples of these or the corresponding secondary series with 12.5, 25, 40 or 60 A.

```
Current transf.
Mains     0000/0
```

Mains current transformer **0-6.900/x A**

The primary transformer rated current is to be entered here. The ratio must be selected in such a manner that, at maximum power, at least 40 % of the transformers rated current flows. A lower percentage may lead to incorrect measurements.

{X} / 1 A Secondary rated current = 1 A at primary rated current = {X} A;
{X} / 5 A Secondary rated current = 5 A at primary rated current = {X} A;
{X} e.g. from the main series 10, 15, 20, 30, 50 or 75 A and the decimal fractions and multiples of these or the corresponding secondary series with 12.5, 25, 40 or 60 A.

```
Power measuring
Gen.  xxxxxxxxxx
```

Generator power measurement **one-phase/three-phase**

one-phase..... The calculation of the real power is made taking into account the current in phase L1 and the external conductor voltage U_{L1-L2}. The power then is calculated as follows:
$P = 3 \times I_{L1} \times U_{L1-L2} \times$ power factor.

three-phase ..... The calculation of real power is made taking into account all external conductor currents and voltages as real-time effective value measurement.

```
Nominal power
   Gen. =00000kW
```

Generator rated power **5-32,000 kW**

The rated real power of the generator is to be entered here.

4.8 Controller Configuration

WARNING !

An incorrect entry may lead to uncontrolled actions of the controller, which may cause the destruction of the generator.

4.8.1 Controller Shutoff in the Event of Negative Load Jumps (only with three-position controllers)

The following function can be used to suppress the setpoint adjustment via the controller in the event of great load shifts. In this way a subordinate controller is given time to compensate for the load jump.

```
Controller disc.
neg. load j. ON
```

Controller shutoff in the event of negative load jumps **ON/OFF**

ON .....If a negative load jump is determined, the frequency and voltage controllers are shut down in isolated/no-load operation. The subsequent screens are displayed.

OFF .....There is no controller shutoff and the subsequent screens of this function are not displayed.

```
Admissible act.
power jump = 00%
```

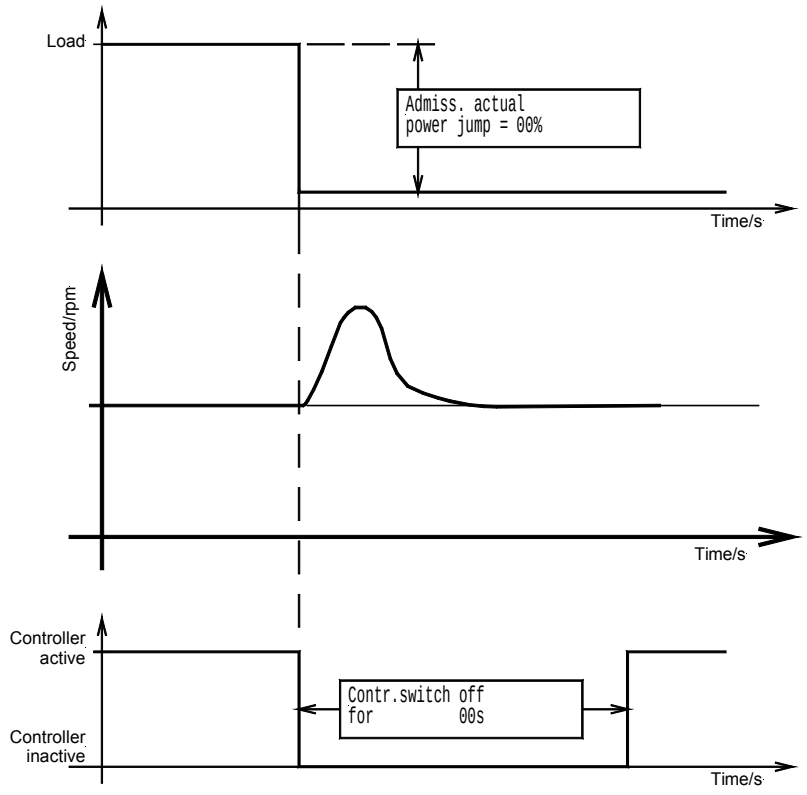
Permissible jump in real power **10-80 %**

Permissible negative abrupt change in the generator real power in relation to the generator rated power. If the load shifts abruptly by an amount larger than specified here, the controllers are shut down for the set time.

```
Controller dis-
connection   00s
```

Controller shutoff in the event of real power jump for **1-99 s**

In case of a load jump, the controllers are shut off for the duration set here.



4.8.2 Shut-Down

```
Download and
open GCB      ON
```

Stoppage **ON/OFF**

ON .....The generator is stopped when "Enable GCB" is removed. That means that an automatic power reduction and subsequently the opening of the GCB via activation of the relay "Command: open GCB". If the unit is involved in a load sharing, this is terminated.

OFF .....The removal of the command "Enable GCB" during the operation has no effect.

4.8.3 No-Load Control

```
Controll in no-
load oper.   ON
```

Automatic no-load control **ON/OFF**

ON .....The control of voltage and frequency in no-load operation is carried out independent of the state of the command "Enable GCB" (terminal 3) (see also chapter 2.4 "Operating Conditions" starting on page 22).

OFF .....Additional condition for a control of voltage and frequency in no-load operation is the setting of "Enable GCB" (terminal 3). Take care that by setting terminal 3 the synchronization for the GCB is also enabled (see also chapter 2.4 "Operating Conditions" starting on page 22).

4.8.4 Frequency Controller

a.) Three-Step Controller (Standard)

```
Freq. controller
           ON
```

Frequency controller **ON/OFF**

ON .....The generator frequency is controlled. The generator frequency is controlled in various manners depending on the task (isolated operation / synchronization). The subsequent screens of this function are displayed.

OFF .....There is no control, and the subsequent masks of this function are not displayed**.**

```
Generator freq.
 f set  = 00.0Hz
```

Generator setpoint frequency **48.0-62.0 Hz**

The generator setpoint frequency is entered here. This is required for the frequency controller in isolated and no-load operation.

```
Freq. controller
Insens. = 0.00Hz
```

Insensitivity frequency controller **0.02-1.00 Hz**

Through the relays "raise/lower" the three-position controller outputs actuating pulses as long as the system deviation is higher than the pre-set insensitivity. The control deviation in the "No-load controlling" operating state is the deviation of the generator actual frequency from the generator setpoint frequency, and in the "synchronization" operating state is the deviation of the generator/busbar frequencies or busbar/mains frequencies.

```
Freq. controller
Time pulse>000ms
```

Minimum frequency controller On period **10-250 ms**

The minimum ON period of the relay should be selected in such a manner that the downstream adjustment facility responds reliably to the pulse that corresponds to the set time. The smallest possible time must be set in order to ensure optimum control behavior.

```
Freq. controller
Gain   Kp=00.0
```

Frequency controller gain **0.1-99.9**

The amplification factor K_p affects the turn-on time of the relay. By increasing the factor, the operating time can be increased in the event of a certain control deviation.

b.) Analog Controller Output (Option Qf - Instead of Three-Step Controller)

```
Freq. controller
            ON
```

Frequency controller **ON/OFF**

ON .....The generator frequency is controlled. The generator frequency is controlled in various manners depending on the task (isolated operation / synchronization). The subsequent screens of this function are displayed.

OFF .....There is no control, and the subsequent masks of this function are not displayed**.**

```
Generator freq.
 f set  = 00.0Hz
```

Generator setpoint frequency **48.0-62.0 Hz**

The generator setpoint frequency is entered here. This is required for the frequency controller in isolated and no-load operation.

```
Starting point
Freq.      000%
```

Initial setting frequency controller **0-100 %**

Setting of the analog controller output when the controller is switched off. This value also is referred to as an initial value, for instance when changing from an real load controller to a frequency controller.

```
Pr.-sensitivity
Freq.  Kpr=000
```

P gain frequency controller **1-240**

The proportional coefficient specifies the gain (see analog controller).

```
Reset time
Freq.  Tn=00.0s
```

Reset time frequency controller **0.0-60.0 s**

The reset time T_n marks the I-share of the PID-controller (see analog controller).

```
Derivative act.
time(freq) 0.00s
```

Derivative-action time frequency controller **0.00-6.00 s**

The derivative-action time T_V marks the D-share of the PID-controller (see analog controller).

```
Freq. controller
logic   positive
```

Logic for the frequency controller **positive/negative**

positive .....If the actual value of the frequency is lower than the frequency setpoint value, the frequency controller increases the actuating signal.

negative .....If the actual value of the frequency is lower than the frequency setpoint value, the frequency controller decreases the actuating signal.

a.) Three-Step Controller (Standard)

```
Volt. controller
          ON
```

Voltage controller **ON/OFF**

ON .....The generator voltage is controlled**.** The subsequent screens of this function are displayed.
OFF .....There is no control, and the subsequent masks of this function are not displayed**.**

```
Volt. controller
Isol. oper.  ON
```

Isolated operation voltage controller **ON/OFF**

ON .....A control of the generator voltage is carried out in isolated operation. The subsequent screens of this function are displayed.
OFF .....There is no control, and the subsequent masks of this function are not displayed.

```
Gen. voltage
  V set  = 000V
```

Generator setpoint voltage **[1] 90-125 V; [4] 200-480 V**

The setpoint of the generator voltage is need for the voltage controller in no-load or isolated operation.

```
Setpoint ramp
  V set = 000V/s
```

Voltage controller setpoint ramp **1-400 V/s**

The setpoint ramp indicates how rapidly (in volts per second) the voltage setpoint is supposed to approach its limit value. The change is linear.

```
Volt. controller
Insens.   00.0V
```

Voltage controller insensitivity **[1] 0.5-15.0 V; [4] 0.5-60.0 V**

Isolated operation..... The voltage is controlled in such a manner that the deviation of the actual value from the preset rated voltage, when correctly adjusted, does not exceed the value of the preset insensitivity (setpoint value from mask setting).
Synchronization..... The generator voltage is controlled in such a manner, that the differential voltage, when correctly adjusted, does not exceed the set insensitivity. The mains or busbar voltage is used as the setpoint value.

```
Volt. controller
Time pulse>000ms
```

Minimum voltage controller ON period **10-250 ms**

The minimum ON period of the relay should be selected in such a manner that the downstream adjustment facility responds reliably to the pulse that corresponds to the set time. The smallest possible time must be set in order to ensure optimum control behavior.

```
Volt. controller
Gain   Kp=00.0
```

Voltage controller gain factor **0.1-99.9**

The amplification factor K_p affects the turn-on time of the relay. By increasing the factor, the operating time can be increased in the event of a certain control deviation.

b.) Analog Controller Output (Option Qu - Instead of Three-Step Controller)

```
Volt. controller
          ON
```

Voltage controller **ON/OFF**

ON .....The generator frequency is controlled. The subsequent screens of this function are displayed.
OFF .....There is no control, and the subsequent masks of this function are not displayed.

```
Volt. controller
Isol. oper.  ON
```

Voltage controller isolated operation **ON/OFF**

ON .....A control of the generator voltage is carried out in isolated operation. The subsequent screens of this function are displayed.
OFF .....There is no control, and the subsequent masks of this function are not displayed**.**

```
Gen. voltage
  V set  = 000V
```

Generator setpoint voltage **[1] 90-125 V; [4] 200-480 V**

The setpoint of the generator voltage is needed for the voltage controller in no-load and isolated operation.

```
Setpoint ramp
  V set = 000V/s
```

Voltage controller setpoint ramp **1-400 V/s**

The setpoint ramp indicates how rapidly (in volts per second) the voltage setpoint is supposed to approach its limit value. The change is linear.

```
Starting point
Voltage   =000%
```

Voltage controller initial setting **0-100 %**

Setting of the analog controller output when the controller is switched off. This value also is referred to as an initial value, for instance when changing from a power factor cosphi to a voltage controller.

```
Pr.-sensitivity
Volt.  Kpr=000
```

P gain voltage controller **1-240**

The proportional coefficient specifies the gain (see analog controller).

```
Reset time
Volt.  Tn=00.0s
```

Voltage controller reset time **0.0-60.0 s**

The reset time T_n marks the I-share of the PID-controller (see analog controller).

```
Derivative act.
time(volt) 0.00s
```

Derivative-action time voltage controller **0.00-6.00 s**

The derivative-action time T_n marks the D-share of the PID-controller (see analog controller).

```
Volt. controller
logic   positive
```

Logic for the voltage controller **positive/negative**

positive .....If the actual value of the voltage is lower than the setpoint value, the voltage controller increases the actuating signal.
negative .....If the actual value of the voltage is lower than the setpoint value, the voltage controller decreases the actuating signal.

```
Synchronization
functions    ON
```

Synchronization functions **ON/OFF**

ON .....A synchronization of the generator frequency and voltage is being carried out for the GCB as well as for the MCB. The connect command for the particular power circuit breaker is made with a low positive slip. The subsequent screens of this function are displayed.

OFF .....No synchronization is carried out, and the subsequent screens are not displayed.

```
Synchronization
 df max = 0.00Hz
```

Max. perm. differential frequency for synchron. (pos. slip) **0.02-0.49 Hz**

The prerequisite of a connect command's being output is negative deviation from this set differential frequency. This value indicates the upper frequency (positive value corresponding to positive slip → generator frequency higher than busbar frequency during synchronization of GCB; busbar frequency higher than mains frequency during synchronization MCB).

```
Synchronization
 df min=- 0.00Hz
```

Max. perm. differential frequency for synchron. (neg. slip) **0.00-0.49 Hz**

A required condition for the output of an add-on order is that the pre-set differential frequency is exceeded. This value indicates the upper frequency (negative value corresponding to positive slip → generator frequency less than busbar frequency during synchronization of GCB; busbar frequency less than mains frequency during synchronization MCB).

```
Synchronization
 dU max  =  00V
```

Max. perm. differential voltage for synchronization **[1] 1-20 V; [4] 2-60 V**

To ensure that a connect command will be issued, the actual value must fall below the entered differential voltage.

```
Synchronization
Time pulse>000ms
```

Min. pulse duration connection relay synchronization **50-250 ms**

The duration of the connect impulse can be adjusted to the subordinate switching unit. The time set here shall apply for the connection pulse of the GCB and for that of the MCB.

```
Gen. circuit br.
Pick-up t.=000ms
```

Inherent delay of GCB **40-300 ms**

The pickup time of the GCB corresponds to the lead time of the connect command. The add-on order is output at the pre-set time, before the synchronous point is reached.

```
Gen. circuit br.
Cont. pulse  ON
```

Continuous pulse output for the GCB **ON/OFF**

ON .....The relay "Command: close GCB" can be looped directly into the self-holding circuit of the power circuit breaker. After the connect command has been output and with a successfully executed reply, the relay "Command: close GCB" remains picked up. If the power circuit breaker has to be opened, the relay drops out.

OFF .....The relay "Command: close GCB" remains picked up only for the set pulse duration. Generator power circuit breaker self-holding must be carried out via an external self-holding circuit.

```
Mains circuit br
Pick-up t.=000ms
```

Inherent delay of MCB **40-300 ms**

The pickup time of the MCB corresponds to the lead time of the connect command. The add-on order is output at the pre-set time, before the synchronous point is reached.

```
Connecting Gen.-
circuit br.  ON
```

Connect functions GCB **ON/OFF**

ON .....If the conditions set in the following screens are satisfied, a connect command is output to the GCB via the relay "Command: close GCB". The subsequent screens of this function are displayed.

OFF .....The GCB is not connected, and the subsequent screens of this function are not displayed.

```
Connect Gen. CB
 df max = 0.00Hz
```

Max. permissible differential frequency (pos. slip) **0.05-2.00 Hz**

Prerequisite for the output of a connect command is that the frequency of the remanence voltage exceeds those of the voltage by no more than this differential frequency.

```
Connect Gen. CB
 df min=- 0.00Hz
```

Max. permissible differential frequency (neg. slip) **0.00-2.00 Hz**

Prerequisite for the output of a connection command is that the frequency of the remanence voltage falls below that of the mains voltage by no more than this differential frequency.

```
Connect. Gen. CB
Time pulse>000ms
```

Min. pulse time of the connection relay **50-250 ms**

The duration of the connect pulse can be adjusted to the subordinate switching unit. The time set here shall be valid for the connect pulse of the GCB.

```
Gen. circuit br.
Cont. pulse  ON
```

Connect pulse output for the generator power circuit breaker **ON/OFF**

ON .....The relay "Command: close GCB" can be looped directly into the self-holding circuit of the power circuit breaker. After the connect command has been output and there is a successful reply of the power switch, the relay "Command: close GCB" remains picked up. If the power circuit breaker has to be opened, the relay drops out.

OFF .....The relay "Command: close GCB" remains picked up on for the set pulse time. GCB self-holding must be carried out via an external self-holding circuit.

4.8.8 Dead Bus Operation (Synchronous Generators Only)

If the busbar is in a de-energized state, the direct connection (dead bus operation) of the GCB or the MCB may be carried out. If both connect commands are issued simultaneously, priority is given to the MCB. If several MFR 2 were connected via a CAN bus, a dead bus operation blocking is active, so that only the unit with the lowest generator number gets an add-on pulse.

```
Gen. circuit br.
Dead bus op.  ON
```

Dead bus operation of GCB **ON/OFF**

ON .....In case of a dead busbar or an open MCB, a dead bus operation is carried out. The prerequisite of this is the detection of an operating condition which corresponds to the specifications. The subsequent screens of this function are displayed.

OFF .....A dead bus operation is not effected, and the subsequent masks of this function are not displayed.

```
Dead bus op. GCB
 df max = 0.00Hz
```

Max. differential frequency for dead bus operation **0.05-0.90 Hz**

The prerequisite of the output of the connect command is that the generator frequency may, at most, deviate from the setpoint by the set value.

```
Dead bus op. GCB
 dU max =   00V
```

Max. differential voltage for dead bus operation **[1] 1-20 V; [4] 2-60 V**

The prerequisite of the output of the connect command is that the generator voltage may, at most, deviate from the setpoint by the set value.

```
Mains circuit br
Dead bus op.  ON
```

Dead bus operation of MCB **ON/OFF**

ON .....In case of a dead busbar or an open GCB, a dead bus operation is carried out. The prerequisite of this is the detection of an operating condition which corresponds to the specifications. The subsequent screens of this function are displayed.

OFF .....A dead bus operation is not effected, and the subsequent masks of this function are not displayed.

4.8.9 Synchronizing Time Monitoring (Synchronous Generators Only)

```
Sync.time contr.
            ON
```

Monitoring of synchronization time **ON/OFF**

ON .....The synchronization is time monitored. At the beginning of the synchronization process, a timer is started. If, following the expiration of the time set below, the power circuit breaker has not closed, a warning message "Synch. time monitoring" is output. The time monitoring applies for the synchronization of both the GCB and the MCB. The subsequent screen is displayed.

OFF .....Monitoring is not carried out, and the subsequent screen is not displayed.

```
Sync.time contr.
Delay time 000s
```

Final value for time monitoring **10-999 s**

If a synchronization of the generator is started, the counter is started simultaneously. If the power circuit breaker is not closed after the pre-set time, a warning is released "Synchr. time monit.".

4.8.10 Power-Factor Controller (Synchronous Generators Only)

```
Power factor
Controller ON
```

Power-factor φ controller **ON/OFF**

ON .....In mains parallel operation, load-dependent control of the power factor φ is carried out. The angle between the current in phase L1 and the voltage between phases L1 and L2 are decisive. The controller outputs an actuating signal as soon as the measured generator current is larger than approximately 5 % of the converter secondary rated current. The subsequent screens of this function are displayed.

OFF .....There is no control, and the subsequent masks of this function are not displayed.

```
Pow.fact. contr.
Setpoint 1  0.00
```

Setpoint 1 power-factor φ controller **i0.70-1.00-c0.70**

The setpoint 1 is active, if the input "Changeover setpoint 1↔2" (terminal 5) has not been set. The designations "i" and "c" stand for lagging (generator overexcited) and leading (generator underexcited) re-active power.

```
Pow.fact.contr.
Setpoint 2  0.00
```

Setpoint 2 power-factor φ controller **i0.70-1.00-c0.70**

Setpoint 2 is active when the input "Changeover setpoint 1↔2" (terminal 5) has been set. The designations "i" and "c" stand for lagging (generator overexcited) and leading (generator underexcited) re-active power.

```
Setpoint ramp
Pf set   =0.00/s
```

Power-factor controller setpoint φ ramp **0.05-0.30 /s**

The setpoint ramp indicates how rapidly the power-factor φ setpoint approaches its limit value. The approach is linear.

a.) Three-Step Controller (Standard)

```
Pow.fact. contr.
 Insens.   00.0%
```

Power factor controller insensitivity **0.5-25.0 %**

In mains parallel operation, the re-active power is controlled in such a manner that, in its regulated state, the actual value deviates from the setpoint by the percentage value of the insensitivity setting at the most. In this case, the percentage value refers to the generator rated power.

```
Pow.fact. contr.
Gain  Kp  00.0
```

Power-factor controller gain **0.1-99.9**

The amplification factor K_p affects the turn-on time of the relay. By increasing the factor, the operating time can be increased in the event of a certain control deviation.

b.) Analog Controller Outputs (Option Qu - Instead of Three-Step Controller)

In the case of analog controller output, the parameters of voltage controller are used for power-factor controlling.

c.) Setpoint Specification - Specified Via Analog Input 0/4-20 mA (Option Xc)

```
Set Value extern
PowFacCon.    ON
```

Power-factor controller external setpoint specification **ON/OFF**

ON .....Es the power-factor setpoint 2 may be specified via an external signal. The subsequent screens of this function are displayed. This setpoint is active if the input "Changeover setpoint 1↔2" (terminal 5) has been set.

OFF .....If this function is set to "OFF", external setpoint value specification cannot be carried out via the 0/4-20 mA input. The subsequent two screens of this function are not displayed.

```
Analog input
       0/4-20mA
```

Power factor setpoint value specification analog input **0-20 / 4-20 mA**

The analog input of the power-factor controller (terminals 73/74) can be switched here between 0-20 mA and 4-20 mA depending on the setpoint source.

0-20 mA.....Minimum value of the setpoint at 0 mA; maximum value at 20 mA.

4-20 mA.....Minimum value of the setpoint at 4 mA; maximum value at 20 mA. A wire break control is carried out. If the signal falls under the value of 2 mA the constant set value is used for control.

```
Analog input
0/4mA =     0.00
```

Minimum value scaling **i0.70-1.00-c0.70**

The minimum value of the setpoint is defined here.

```
Analog input
20mA =      0.00
```

Maximum value scaling **i0.00-1.00-c0.00**

The maximum value of the setpoint is defined here.

d.) Setpoint Specification - Specification Via Interface (Option Sb/Sf)

Preconditions for a setpoint specification via the interface are:
- "Setpoint 2" must be activated via the discrete input (terminal 5) and
- the data transmission must be developed.

If a data transmission can be developed (the interface was deactivated via the configuration screen or there is an interface fault), "Setpoint 2" is adjusted.

4.8.11 Real-Power Controller

```
Power controller
            ON
```

Real-power controller **ON/OFF**

ON .....When the real-power controller is turned on, the real power is adjusted to the pre-selected setpoint in mains-parallel operation. The subsequent screens of this function are displayed.

OFF .....There is no control, and the subsequent masks of this function are not displayed.

```
Power controller
Ramp    = 000%/s
```

Setpoint ramp real-power controller **1-100 %/s**

A change of the setpoint is transferred to the controller via a ramp. The slope of the ramp changes the speed the controller uses to change the setpoint. The higher the value entered here, the faster the setpoint is changed.

```
Power limitation
P max.=    000 %
```

Real-power controller maximum power limitation **10-120 %**

If the maximum real generator load is to be limited, a percentage, based on the rated generator power, will be entered in this screen. The controller adjusts the unit in such a manner that this value is not exceeded.

NOTE

For the set value power control the transfer point to the mains is not considered, which means that, in the event of excess power, power is exported to the mains, whereas, in the event of a power deficit, the power difference is imported from the mains.

```
Power controller
P set1 = 00000kW
```

Setpoint 1 generator real power **0-32,000 kW**

The setpoint 1 is active when the input "Changeover setpoint 1↔2" (terminal 5) is not set.

```
Power controller
Pset2 = 00000kW
```

Setpoint 2 Generator real power **0-32,000 kW**

The setpoint 2 is active if the input "Changeover setpoint 1↔2" (terminal 5) is set.

a.) Setpoint Specification - Specification Via Analog Input 0/4-20 mA (PSVA & Option X)

```
Set value extern
PowContr    ON
```

Real-power controller external setpoint specification **ON/OFF**

ON .....The real load setpoint 2 can be preset via an external signal**.** The subsequent screens of this function are displayed. This setpoint is active, if the input "Changeover setpoint 1↔2" (terminal 5) is set.

OFF .....If this function is set to "OFF", external setpoint value specification cannot be carried out via the 0/4-20 mA input. The subsequent two screens of this function are not displayed.

```
Analog input
       0/4-20mA
```

Setpoint value specification analog input **0-20 / 4-20 mA**

The analog input of the real power controller (terminals 70/71) can be switched over here between 0-20 mA and 4-20 mA.

0-20 mA.....Minimum value of the setpoint at 0 mA; maximum value at 20 mA.

4-20 mA.....Minimum value of the setpoint at 4 mA; maximum value at 20 mA. A wire break control is carried out. If the signal falls under the value of 2 mA the constant set value is used for control.

```
Analog input
0/4mA =  00000kW
```

Scaling the minimum value **[1] 0-32,000 kW; [4] 0-6,900 kW**

The minimum value of the setpoint is defined here.

```
Analog input
20mA =   00000kW
```

Scaling the maximum value **[1] 0-32,000 kW; [4] 0-6,900 kW**

The maximum value of the setpoint is defined here.

b.) Setpoint Specification - Specification Via Interface (PSVA & Option Sb/Sf)

Prerequisites for a setpoint specification via the interface are:
- "Setpoint 2" must be activated via the discrete input (terminal 5) and
- the data transmission must be developed.

If no data transmission can be developed (the interface was deactivated via the configuration screen or an interface fault is present), "Setpoint 2" is adjusted.

c.) Three-Step Controller (Standard)

```
Power controller
Insens. = 00.0%
```

Insensitivity real load controller **0.1-25.0 %**

In mains parallel operation, the real power is controlled in such a manner that, in its regulated state, the actual value deviates from the power setpoint by the percentage value of the sensitivity setting at the most. In this case, the percentage value refers to the generator rated power.

```
Power controller
Gain   Kp= 00.0
```

Real power controller gain factor **0.1-99.9**

The amplification factor K_p affects the turn-on time of the relay. By increasing the factor, the operating time can be increased in the event of a certain control deviation.

```
Power controller
Sens.red. *0.0
```

Real power controller sensitivity reduction **1.0-9.9**

If no further adjusting pulse has been output for at least 5 s the insensitivity is reduced by the input factor.
For example: In case of an insensitivity of 2.5 % and a factor 2.0, insensitivity is increased to 5.0 % after 5 s. In the event that the system deviation then exceeds 5.0 % again, the governor automatically goes back to its original sensitivity (2.5 %). This input can be used, in the event of small control deviations, to avoid unnecessarily frequent actuation processes, thereby protecting the adjustment facility.

d.) Analog Controller Outputs (Option Qf - Instead of Three-Step Controller)

```
Power controller
Gain Kpr     000
```

Real-power controller P gain **1-240**

The proportional coefficient specifies the gain (see analog controller).

```
Reset time
Power  Tn=00.0s
```

Real-power controller reset time **0.0-60.0 s**

The reset time T_n marks the I-share of the PID-controller (see analog controller).

```
Derivative act.
time(pow.) 0.00s
```

Real-power controller derivative-action time **0.0-6.0 s**

The derivative-action time T_V marks the D-share of the PID-controller (see analog controller).

e.) Part-Load Lead

```
Part-load lead
          ON
```

Part-load lead **ON/OFF**

ON .....Part-load lead is carried out, and the subsequent screens of this function are displayed. If the genset needs a warmup phase, the power setpoint value can hereby be limited to the part-load value to be entered below after synchronization with the mains parallel operation.

OFF .....No part-load lead is carried out and the subsequent screens of this function are not displayed.

```
Part load lead
Setpoint = 000 %
```

Part-load lead limit value **5-110 %**

After synchronization, the generator power is limited to the part-load value set here.

```
Part-load lead
Time       000s
```

Period of part-load lead **0-600 s**

Input of the holding time with part-load following initial closure of the power circuit breaker in mains parallel operation.

4.8.12 Load and/or Var Sharing

```
Active power
load-share  ON
```

Load sharing **ON/OFF**

ON .....Real power is distributed to several generators operating in parallel. The generator outputs are distributed depending on the set value. The subsequent screens of this function are displayed (see also chapter 2.7 "Load/Var" starting from page 29).

OFF .....There is no control, and the subsequent masks of this function are not displayed.

```
Act. load share
factor     =00%
```

Load sharing reference variable **10-99 %**

Increasing the weighting factor increases the influence of the main control variable (in isolated operation: Frequency, in mains operation: real power) on control. The smaller the factor which is set, the greater the influence of the secondary control variable (generator real power). The behavior of frequency control (isolated operation) is determined by the main control variable, that of real power distribution by the secondary control variable.

```
Reactive power
load-share  ON
```

(only sychronous generators)

var sharing **ON/OFF**

ON .....Re-active power is distributed to several generators operating in parallel. The generator outputs are distributed depending on the set value. The subsequent screens of this function are displayed (see also chapter 2.7 "Load/Var" starting from 29).

OFF .....There is no control, and the subsequent masks of this function are not displayed**.**

```
React.load share
factor     =00%
```

(only synchronous generators)

var sharing reference variable **10-99 %**

Increasing the weighting factor increases the influence of the main control variable (in isolated operation: Voltage, in mains parallel operation: re-active power) on control. The smaller the factor which is set, the greater the influence of the secondary control variable (generator re-active power). The behavior of voltage control (isolated operation) is determined by the main control variable, that of re-active power distribution by the secondary control variable.

4.9.1 Generator Overload Monitoring

Function The generator real power is monitored for exceeding the set pickup value. If the pickup value is exceeded, the power is automatically reduced and the generator, via triggering of the relay "Command: open GCB" is disconnected from the mains (alarm class 2). The message "Gen. overload" appears on the display.

```
Overload power
Monitoring  ON
```

Overload monitoring **ON/OFF**

ON .....Generator real power overload monitoring is carried out. The subsequent screens of this function are displayed.

OFF .....There is no monitoring, and the subsequent masks of this function are not displayed.

```
Gen. Overload
Max. power=000%
```

Pickup value generator overload monitoring **80-120 %**

The pickup value refers to the generator rated power.

Triggering of alarm class 2

```
Gen. overload
Delay     000.0s
```

Generator overload monitoring delay **0.0-600.0 s**

In order to trip monitoring, the threshold value must be exceeded without interruption for at least the period of time specified in this screen.

```
Gen. Overload
Relay outp. 0000
```

Generator overload output on relay **0-4**

The triggering of the watchdog is output to the alarm relay set here. If there should be no alarm via relay, "0000" is to be set at this position. This screen can only be seen if the screen "Change relay assignment" is set to YES.

4.9.2 Generator Reverse/Reduced Power Monitoring

Function The generator real power is monitored with regard to its falling below the set triggering value. If the threshold value is fallen below, the generator, via triggering of the relay "Command: open GCB", is disconnected from the mains (alarm class 3). The message "Reverse/reduced load" appears on the display. The watchdog is only active if the "Monitoring" lights up.

```
Reverse power
monitoring  ON
```

Reverse/minimum load monitoring **ON/OFF**

ON .....A reverse or reduced load monitoring of the generator real power is carried out. The subsequent screens of this function are displayed.

OFF .....There is no monitoring, and the subsequent masks of this function are not displayed.

```
Reverse power
Threshold = 00%
```

Reverse/reduced power monitoring threshold value **$^{-}$99-0-$^{+}$99 %**

The threshold value refers to the input rated power of the generator.

Reduced power monitoring ..... Tripping, if the real load falls below the (positive) limiting value**.**

Reverse load monitoring..... triggering, if the direction of the real power is reversed and the (negative) limit value is fallen below.

Triggering of alarm class 3

```
Reverse power
Delay     00.0s
```

Delay of reverse/minimum load monitoring **0.1-99.9 s**

In order for tripping to occur, negative deviation from the threshold value must occur without interruption for at least the period of time specified in this screen.

```
Reverse power
Relay outp.0000
```

Output reverse/reduced load on relay **0-4**

The triggering of the watchdog is output on the alarm relay set here. Should no signal occur via relay, "0000" is to be set in this position. This screen can only be seen if the screen "Change relay assignment" is set to YES.

4.9.3 Unbalanced Load Monitoring

Function The unbalanced load watchdog monitors the individual currents of the generator on a percentage deviation from the arithmetic means of all generator currents. If an unbalanced load is detected, the generator, via triggering of the relay "Command: open GCB", is disconnected from the mains (alarm class 3). The message "Load imbalance" appears on the display.

```
Load unbalance
Monitoring  ON
```

Unbalanced load monitoring **ON/OFF**

ON .....The generator unbalanced load is monitored. The subsequent screens of this function are displayed.

OFF .....There is no monitoring, and the subsequent masks of this function are not displayed.

```
Load unbalance
Threshold  =000%
```

Maximum permissible unbalanced load **0-100 %**

Monitoring of the set maximum unbalanced load is carried out in reference to the generator rated current which has been set.

Tripping of alarm class 3

```
Load unbalance
Delay   =00.00s
```

Unbalanced load monitoring delay **0.04-99.98 s**

In order to trip monitoring, the threshold value must be exceeded without interruption for at least the period of time specified in this screen.

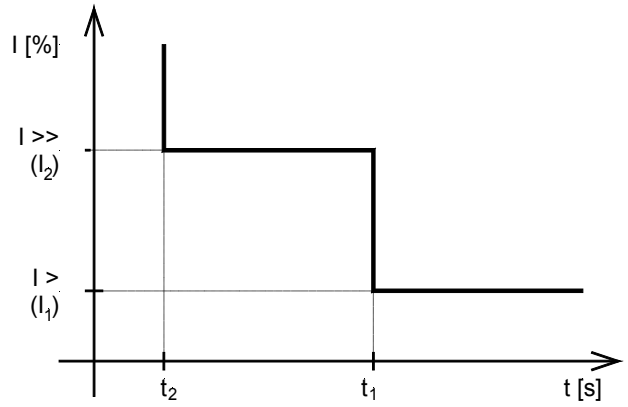
```
Load unbalance
Relay outp.0000
```

Signal unbalanced load on relay **0-4**

The triggering of the watchdog is output to the alarm relay set here. Should there be no signal via relay, "0000" is to be set in this place. This screen can only be seen if the screen "Change relay assignment" is set to YES.

4.9.4 Definite Time-Overcurrent Protection

Function The individual currents of the generator are monitored with regard to excess. The converter rated current is used as the reference value. The overcurrent watchdog has been configured for two stages and thus offers the possibility of setting the triggering level 1 to a lower triggering value with a relatively long delay time and triggering level 2 to a higher triggering value with a lesser delay (rapid triggering). If the exceeding a value is detected, the generator, via triggering of the relay "Command: open GCB" are disconnected from the mains (alarm class 3). The message "Gen. overcurrent 1", or "Gen. overcurrent 2" appears on the display.




```
Overcurrent
monitoring    ON
```

Overcurrent monitoring **ON/OFF**

ON .....The generator current is monitored, and the subsequent masks of this function are displayed

OFF .....There is no monitoring, and the subsequent masks of this function are not displayed.

```
Overcurrent
Thresh 1   =000%
```

Threshold value generator overcurrent, level 1 **0-300 %**

If the value of the generator current exceeds the set percentage value in relation to the converter rated current, a shutdown occurs.

Triggering of alarm class 3

```
Overcurrent
Delay 1   00.00s
```

Delay of the overcurrent monitoring, level 1 **0.04-99.98 s**

In order to trip monitoring, the threshold value must be exceeded without interruption for at least the period of time specified in this screen.

```
Overcurrent 1
Relay outp. 0000
```

Message overcurrent stage 1 to relay **0-4**

Triggering of the monitor is output to the alarm relay set here. If no signal is to occur via relay, "0000" is to be set in this position. This screen can only be see if the screen "Change relay assignment" is set to YES.

```
Overcurrent
Thresh 2   =000%
```

Generator overcurrent threshold value level 2 **0-300 %**

If the value of the generator current exceeds the set percentage value in relation to the converter rated current, there is a shutdown.

Triggering of alarm class 3

```
Overcurrent
Delay 2   00.00s
```

Delay of overcurrent monitoring, level 2 **0.04-99.98 s**

In order to trip monitoring, the threshold value must be exceeded without interruption for at least the period of time specified in this screen.

```
Overcurrent 2
Relay outp. 0000
```

Message overcurrent level 2 on relay **0-4**

The triggering of the monitor is set to the signal relay set here. If no message is made via relay, "0000" is to be set in this position. This screen can only be seen if the screen "Change relay assignment" is set to YES.

4.9.5 Ground Fault Monitoring (Option I3)

Function

The unit can be installed in the stator winding of three-phase machines to detect ground faults. Primarily, in the case of ground faults, the occurrence of a displacement voltage is used for triggering, whereby a protective area up to approximately 95 % of the winding can be achieved.

The displacement voltage is typically measured using the open delta winding (e-n-winding) of a voltage converter or using a zero-point transformer in the machine star point. Normally, on these transformers a secondary voltage of 500 V is set in the event of a terminal ground fault so that a voltage splitter is required (Translation 500 V / 100 V). The single-phase parts of the very strong third harmonics occurring with synchronous machines add up such that the fundamental wave can be measured without interference only by using an especially effective digital filtering method.

The displacement voltage is monitored with regard to its exceeding the set threshold value. If the threshold value is exceeded, the generator, via triggering of the relay "Command: open GCB", is disconnected from the mains (alarm class 3). The "Ground fault" message appears on the display.

```
Earth-fault
monitoring   ON
```

Ground fault monitoring **ON/OFF**

ON .....Displacement voltage is monitored. The subsequent screens of this function are displayed.
OFF .....There is no monitoring, and the subsequent masks of this function are not displayed.

```
Residual volt.
Response v. 000V
```

Ground fault triggering with a displacement voltage of **1-125 V**

If the value of the displacement voltage exceeds the value set here, there is a shutdown.

Triggering of alarm class 3

```
Residual volt.
Delay    =00.00s
```

Delay of ground fault monitoring **0.02-99.98 s**

In order to trip monitoring, the threshold value must be exceeded without interruption for at least the period of time specified in this screen.

```
Residual volt.
Relay outp. 0000
```

Signal ground fault on relay **0-4**

The triggering of the watchdog is output on the alarm relay set here. If there is to be no signal via relay, "0000" is to be set in this position. This screen can only be seen if the screen "Change relay assignment" is set to YES.

4.9.6 Re-Active Power Monitoring

Function Re-active power is monitored with regard to its exceeding the set threshold value (leading and lagging). In this case the monitoring of the leading re-active power can be used as field-failure detection. If there is positive deviation from the threshold value, the generator, via triggering of the relay "Command: open GCB", is disconnected from the mains (fault class 3). The message "Reactive power ind." or "Reactive power cap." appears on the display.

a.) Lagging Re-Active Power

```
Lagg.react.power
monitoring  ON
```

Lagging re-active power monitoring **ON/OFF**

ON .....The lagging re-active power is monitored.
OFF .....There is no monitoring, and the subsequent masks of this function are not displayed.

```
Lagg.react.power
Threshold   000%
```

Lagging re-active power monitoring threshold value **0-160 %**

If the value of the lagging re-active power exceeds the set percentage value in relation to the generator rated power a shutdown occurs.

Triggering of alarm class 3

```
Lagg.react.power
Delay     00.00s
```

Lagging re-active power monitoring delay **0.04-99.98 s**

In order to trip monitoring, the threshold value must be exceeded without interruption for at least the period of time specified in this screen.

```
Lagg.react.power
Relay outp. 0000
```

Signal lagging re-active power on relay **0-4**

The triggering of the watchdog is output to the alarm relay set here. If no signal is to occur via relay, "0000" is to be set in this position. This screen can only be seen if the screen "Change relay assignment" is set to YES.

b.) Leading Re-Active Power (field failure detection)

```
Lead.react.power
monitoring   ON
```

Leading re-active power monitoring **ON/OFF**

ON .....The leading re-active power is monitored.
OFF .....There is no monitoring, and the subsequent masks of this function are not displayed.

```
Lead.react.power
Threshold   000%
```

Leading re-active power monitoring threshold value **0-160 %**

If the value of the leading re-active power exceeds the set percentage value in relation to the generator rated power, there is a shutdown.

Triggering of alarm class 3

```
Lead.react.power
Delay     00.00s
```

Leading re-active power monitoring delay **0.04-99.98 s**

In order to trip monitoring, the threshold value must be exceeded without interruption for at least the period of time specified in this screen.

```
Lead.react.power
Relay outp. 0000
```

Signal leading re-active power on relay **0-4**

The triggering of the watchdog is output to the alarm relay set here. If there is to be no signaling via relay, "0000" is to be set in this position. This screen can only be seen if the screen "Change relay assignment" is set to YES.

4.9.7 Generator Frequency Monitoring

Function The generator frequency is monitored with regard to exceeding or falling below the set threshold value. If the threshold value is exceeded or fallen below, the generator, via triggering of the relay "Command: open GCB", is disconnected from the mains (alarm class 3). The message "Gen. overfreq.", or "Gen. underfreq." appears on the display. The watchdog for underfrequency is only active if the LED "Monitoring" lights up.

```
Gen.frequency.
Monitoring  ON
```

Generator frequency monitoring **ON/OFF**

ON .....The generator frequency is monitored. The generator frequency is monitored as regards overfrequency and underfrequency. The subsequent screens of this function are displayed.

OFF .....There is no monitoring, and the subsequent masks of this function are not displayed.

```
Gen. overfreq.
     f > 00.00Hz
```

Generator overfrequency threshold value **40.0-70.0 Hz**

If the value of the generator frequency exceeds that value set here, there is a shutdown.

Triggering of alarm class 3

```
Gen. overfreq.
Delay     =0.00s
```

Generator overfrequency pickup delay **0.04-9.98 s**

In order to trip monitoring, the threshold value must be exceeded without interruption for at least the period of time specified in this screen.

```
Gen. overfreq.
Relay outp. 0000
```

Signal generator overfrequency on relay **0-4**

The triggering of the watchdog is output to the alarm relay set here. If there is to be no signaling via relay, "0000" is to be set in this position. This screen can only be seen if the screen "Change relay assignment" is set to YES.

```
Gen. underfreq.
     f < 00.00Hz
```

Generator underfrequency threshold value **40.0-70.0 Hz**

If the value of the generator frequency falls below the value set here, there is a shutdown.

Triggering of alarm class 3

```
Gen. underfreq.
Delay     =0.00s
```

Generator underfrequency pickup delay **0.04-9.98 s**

In order for tripping to occur, negative deviation from the threshold value must occur without interruption for at least the period of time specified in this screen.

```
Gen. underfreq.
Relay outp. 0000
```

Signal generator under frequency on relay **0-4**

The triggering of the watchdog is output to the signal relay set here. If there is to be no signaling via relay, "0000" is to be set in this position. This screen can only be seen if the screen "Change relay assignment" is set to YES.

4.9.8 Generator Voltage Monitoring

Function The delta voltages of the generator are monitored for exceeding or falling below the set threshold value. If the threshold value is exceed or fallen below, the generator, via triggering of the relay "Command: open GCB", is disconnected from the mains (alarm class 3). The message "Gen. overvolt.", or "Gen. undervolt." appears in the display. The watchdog for undervoltage is only active if the LED "Monitoring" lights up.

```
Gen.voltage
Monitoring  ON
```

Generator voltage monitoring **ON/OFF**

ON .....The generator voltage is monitored. The generator voltage is monitored with regard to overvoltage and undervoltage. The subsequent screens of this function are displayed.

OFF .....There is no monitoring, and the subsequent masks of this function are not displayed.

```
Rated voltage
Gen.  Vn = 000V
```

Rated generator voltage **[1] 50-125 V, [4] 50-480 V**

The threshold values for the generator voltage monitoring refer to this rated value. Regardless of the measurement or monitoring, the secondary value of the delta voltage has to be entered here.

```
Volt. Monit.Gen.
xxxxxxxxxxxxxxx
```

Voltage monitoring generator **Phase to phase/Phase-neutral**

The device can either monitor the phase-neutral voltages or the phase to phase voltages. It is usual to monitor the phase-neutral voltages in low voltage mains and phase to phase voltages in medium voltage mains. A monitoring of the phase to phase voltages is necessary in particular if a ground fault shall not trigger the voltage protection in isolated or compensated mains.
If the voltage measurement is performed without a neutral line (i.e. parameter voltage monitoring = phase to phase, chapter Basic Settings on page 44), the setting "phase to phase" must be selected here.

Phase to phase..The phase to phase voltages (V_{L-L}) are monitored.

Phase-neutral..The phase-neutral voltages (V_{L-N}) are monitored.

```
Gen.overvolt.
      V > 000%
```

Gen. overvoltage threshold value **20-150 %**

If the value of the generator voltage exceeds the value set here, there is a shutdown.

Triggering of alarm class 3

```
Gen. overvolt.
Delay     =0.00s
```

Generator overvoltage pickup delay **0.04-9.98 s**

In order to trip monitoring, the threshold value must be exceeded without interruption for at least the period of time specified in this screen.

```
Gen. overvolt.
Relay outp. 0000
```

Signal generator overvoltage on relay **0-4**

The triggering of the watchdog is output to the signal relay set here. If there is to be no signaling via relay, "0000" is to be set in this position. This screen can only be seen if the screen "Change relay assignment" is set to YES.

```
Gen.undervolt.
      V < 000%
```

Threshold value gen. undervoltage **20-150 %**

If the value of the generator voltage falls below the value set here, there is a shut-down.

Triggering of alarm class 3

```
Gen. undervolt.
Delay     =0.00s
```

Generator undervoltage pickup delay **0.04-9.98 s**

In order for tripping to occur, negative deviation from the threshold value must occur without interruption for at least the period of time specified in this screen.

```
Gen. undervolt.
Relay outp. 0000
```

Signal generator undervoltage on relay **0-4**

The triggering of the watchdog is output to the signal relay set here. If there is to be no signaling via relay, "0000" is to be set in this position. This screen can only be seen if the screen "Change relay assignment" is set to YES.

4.9.9 Mains Frequency Monitoring

Function The monitoring of mains frequency is absolutely necessary if a generator is operated within a public network. In case of a mains failure (e.g. short interruption of power supply) the generator working mains parallel must be automatically disconnected from the mains. The mains frequency is monitored with regard to exceeding or falling below the set threshold value. If the threshold value is exceeded or fallen below, the system, via triggering of the relay configured for mains decoupling, is disconnected from the mains (alarm class 0). The message "Mains overfrequency" or "Mains underfrequency" appears on the display.

```
Mains frequency
Monitoring  ON
```

Mains frequency monitoring **ON/OFF**

ON .....The mains frequency is monitored. The mains frequency is monitored as regards overfrequency and underfrequency. The subsequent screens of this function are displayed.

OFF .....There is no monitoring, and the subsequent masks of this function are not displayed.

```
Mains overfreq.
     f > 00.00Hz
```

Mains overfrequency threshold value **40.0-70.0 Hz**

If the value of the mains frequency exceeds the value set here, there is a mains disconnection.

Triggering of alarm class 0

```
Mains overfreq.
Delay     =0.00s
```

Mains overfrequency pickup delay **0.04-9.98 s**

In order to trip monitoring, the threshold value must be exceeded without interruption for at least the period of time specified in this screen.

```
Mains overfreq.
Relay outp. 0000
```

Signal mains overfrequency on relay **0-4**

The triggering of the watchdog is output to the signal relay set here. If there is to be no signaling via relay, "0000" is to be set in this position. This screen can only be seen if the screen "Change relay assignment" is set to YES.

```
Mains underfreq.
     f < 00.00Hz
```

Mains underfrequency threshold value **40.0-70.0 Hz**

If the value of the mains frequency falls below the value set here, there is a mains disconnection.

Triggering of alarm class 0

```
Mains underfreq.
Delay time=0.00s
```

Mains underfrequency pickup delay **0.04-9.98 s**

In order for tripping to occur, negative deviation from the threshold value must occur without interruption for at least the period of time specified in this screen.

```
Mains underfreq.
Relay outp. 0000
```

Signal mains underfrequency on relay **0-4**

The triggering of the watchdog is output to the signal relay set here. If there is to be no signaling via relay, "0000" is to be set in this position. This screen can only be seen if the screen "Change relay assignment" is set to YES.

4.9.10 Mains Voltage Monitoring

Function Monitoring the mains voltage is absolutely necessary if a generator is operated within a public network. In case of a mains failure (e.g. short interruption of power supply) the generator working mains parallel must be automatically disconnected from the mains. The delta voltages of the mains are monitored with regard to exceeding or falling below that set threshold value. If the threshold value is exceeded or fallen below, the system, via triggering of the relay configured for mains decoupling, is disconnected from the mains (alarm class 0). The message "Mains overvolt." or "Mains undervolt." appears on the display.

```
Mains voltage
monitoring    ON
```

Mains voltage monitoring **ON/OFF**

ON .....The mains voltage is monitored. The mains voltage is monitored with regard to overvoltage and undervoltage. The subsequent screens of this function are displayed.

OFF .....There is no monitoring, and the subsequent masks of this function are not displayed.

```
Rated voltage
Mains  Vn = 000V
```

Rated mains voltage **[1] 50-125 V, [4] 50-480 V**

The threshold values for the mains voltage monitoring refer to this rated value. Regardless of the measurement or monitoring, the secondary value of the delta voltage has to be entered here.

```
Volt.Monit.mains
xxxxxxxxxxxxxxx
```

Spannungsüberwachung Netz **Drei-/Vierleiternetz**

The device can either monitor the phase-neutral voltages or the phase to phase voltages. It is usual to monitor the phase-neutral voltages in low voltage mains and phase to phase voltages in medium voltage mains. A monitoring of the phase to phase voltages is necessary in particular if a ground fault shall not trigger the voltage protection in isolated or compensated mains.
If the voltage measurement is performed without a neutral line (i.e. parameter voltage monitoring = phase to phase, chapter Basic Settings on page 44), the setting "phase to phase" must be selected here.

Phase to phase..The phase to phase voltages (V_{L-L}) are monitored.

Phase-neutral..The phase-neutral voltages (V_{L-N}) are monitored.

```
Mains overvolt.
       V > 000%
```

Threshold mains overvoltage **20-150 %**

If the value of the mains voltage exceeds the value set here, there is a mains disconnection.

Triggering of alarm class 0

```
Mains overvolt.
Delay      0.00s
```

Mains overvoltage pickup delay **0.04-9.98 s**

In order to trip monitoring, the threshold value must be exceeded without interruption for at least the period of time specified in this screen.

```
Mains overvolt.
Relay outp. 0000
```

Signal mains overvoltage on relay **0-4**

The triggering of the watchdog is output to the signal relay set here. If there is to be no signaling via relay, "0000" is to be set in this position. This screen can only be seen if the screen "Change relay assignment" is set to YES.

```
Mains undervolt.
       V < 000%
```

Mains undervoltage threshold value **20-150 %**

If the value of the mains voltage exceeds the value set here, there is a mains disconnection.

Triggering of alarm class 0

```
Mains undervolt.
Delay     =0.00s
```

Mains undervoltage pickup delay **0.04-9.98 s**

In order for tripping to occur, negative deviation from the threshold value must occur without interruption for at least the period of time specified in this screen.

```
Mains undervolt.
Relay outp. 0000
```

Signal mains undervoltage on relay **0-4**

The triggering of the watchdog is output to the signal relay set here. If there is to be no signaling via relay, "0000" is to be set in this position. This screen can only be seen if the screen "Change relay assignment" is set to YES.

4.9.11 Asymmetry Monitoring

Function The delta voltages of the mains are monitored with regard to asymmetry. An asymmetry is accepted if the difference between any two delta voltages is larger than the set threshold value. In this case, the system, via triggering of the relay configured for mains decoupling, is disconnected from the mains (alarm class 0). The message "Asymmetry" appears in the display.

```
Asymmetry
Monitoring  ON
```

Asymmetric monitoring **ON/OFF**

ON .....The mains voltage is monitored with regard to asymmetry, and the subsequent screens of this function are displayed.

OFF .....There is no monitoring, and the subsequent masks of this function are not displayed.

```
Asymmetry
Threshold   00%
```

Asymmetry threshold value **0-99 %**

If the value of the voltage difference exceeds the value set here, there is a mains disconnection.

Triggering of alarm class 0

```
Asymmetry
Delay     00.00s
```

Pickup delay of the asymmetry monitoring **0.04-99.98 s**

In order to trip monitoring, the threshold value must be exceeded without interruption for at least the period of time specified in this screen.

```
Asymmetry
Relay outp. 0000
```

Signal asymmetry on relay **0-4**

The triggering of the watchdog is output to the signal relay set here. If there is to be no signaling via relay, "0000" is to be set in this position. This screen can only be seen if the screen "Change relay assignment" is set to YES.

4.9.12 Phase Shift Monitoring (Synchronous Generators Only)

Function A phase shift is a sudden change in the voltage curve, and may be caused by a major load change. In this case, the unit detects a change in the cycle duration once. This change in the cycle duration is compared with a calculated mean value from previous measurements. The monitoring is carried out in three phases or, alternatively, even in one phase. The phase shift monitor is only active if the mains voltage is larger than 70 % of the converter rated voltage. If the threshold value is exceeded, the system, via triggering of the relay configured for mains decoupling is separated from the mains (alarm class 0). The message "Phase shift" appears in the display.

```
Phase shift-
Monitoring  ON
```

Phase shift monitoring **ON/OFF**

ON .....The mains frequency is monitored, and a phase shift is registered within the defined range. The subsequent screens of this function are displayed.

OFF .....There is no monitoring, and the subsequent masks of this function are not displayed.

```
Phase jmp monit.
one/three phase
```

Phase shift monitoring **one/three-phase / three-phase only**

one/three-phase ...During single-phase voltage phase shift monitoring, tripping occurs if the phase shift exceeds the specified threshold value in at least one of the three phases. **Note:** If a phase shift occurs in one or two phases, the single-phase threshold is considered; if a phase shift occurs in all three phases, the three-phase threshold is considered; This type of monitoring is very sensitive, and may lead to false tripping if the selected phase angle settings are too small.

three-phase only ..During three-phase voltage phase shift monitoring, tripping occurs only if the phase shift exceeds the specified threshold value in all three phases within 2 cycles.

Triggering of alarm class 0

NOTE

If the monitoring is set to **"three-phase only",** only the lower of the two subsequent masks is visible; if the monitoring is set to **"one/three-phase",** both configuration masks are visible.

```
Phase-jump value
(One phase) 00°
```

This screen is only visible if the monitoring is set to "one/three-phase".

Maximum phase difference **2-90°**

Tripping occurs if the electrical angle of the voltage curve shifts in at least one phase by more than the specified angle.

```
Phase-jump value
(3-phase)   00°
```

Maximum phase difference **2-90°**

Tripping occurs if the electrical angle of the voltage curve shifts in all three phases by more than the specified angle.

```
Phase-jump value
Relay outp. 0000
```

Signal phase shift on relay **0-4**

The triggering of the watchdog is output to the signal relay set here. If there is to be no signaling via relay, "0000" is to be set in this position. This screen can only be seen if the screen "Change relay assignment" is set to YES.

4.9.13 df/dt Monitoring (PSVA & Option D)

Function The unit determines a measuring value for the change in frequency. In order to enable reliable differentiation between phase shift and df/dt, measurement is carried out over 4 cycles. This results in a minimum tripping time of approx. 100 ms. If the threshold value is exceeded, the system, via triggering of the relay configured for mains decoupling, is disconnected from the mains (alarm class 0). The message "Alarm df/dt" appears on the display.

```
df/dt
Monitoring  ON
```

df/dt monitoring **ON/OFF**

ON .....Mains frequency monitoring is carried out, and any change in frequency per unit of time within the defined range is registered. The subsequent screens of this function are displayed.

OFF .....There is no monitoring, and the subsequent masks of this function are not displayed.

```
Release value
df/dt  > 0.0Hz/s
```

df/dt monitoring threshold value **1.0-9.9 Hz**

If the value of the mains frequency change exceeds the value set here, there is a mains disconnection.

Triggering of alarm class 0

```
Time delay
df/dt     T=0.0s
```

df/dt monitoring triggering delay **0.1-9.9 s**

In order to trip monitoring, the threshold value must be exceeded without interruption for at least the period of time specified in this mask.

```
df/dt monitoring
Relay outp. 0000
```

Signal df/dt monitoring on relay **0-4**

The triggering of the watchdog is output to the signal relay set here. If there is to be no signaling via relay, "0000" is to be set in this position. This screen can only be seen if the screen "Change relay assignment" is set to YES.

4.9.14 Mains Decoupling

```
Mains decoupling
through    MCB
```

Mains decoupling via **GCB/MCB**

The mains protection consists of the watchdogs for mains over-/undervoltage, mains over-/underfrequency as well as phase shift, asymmetry and df/dt monitoring (with option D). The mains decoupling upon triggering of a mains watchdog is always active and can be output to the relay "Command: open GCB" or to the relay "Command: open MCB".

4.9.15 Battery Voltage Monitoring

```
Batt. undervolt.
      V < 00.0V
```

Battery undervoltage threshold value **10.0-35.0 V**

The supply voltage is continuously monitored. Continuous negative deviation from the set limit value for at least 15 seconds leads to the output of the alarm message "Batt. undervolt.“ in the LCD display and to output of the centralized alarm (alarm class 1).

```
Batt. undervolt.
Relay outp. 0000
```

Signal battery undervoltage on relay **0-4**

The triggering of the watchdog is output to the signal relay set here. If there is to be no signaling via relay, "0000" is to be set in this position. This screen can only be seen if the screen "Change relay assignment" is set to YES.

4.9.16 Centralized Alarm

```
Central alarm
Relay outp. 0000
```

Centralized alarm on relay **0-4**

The centralized alarm is set on an OR link of all watchdogs of alarm classes F1, F2 and F3. The triggering of the centralized alarm is output to the alarm relay set here. If "Auto-acknowledge messages" is configured ON, the centralized alarm relay de-energizes automatically after expiry of the drop-out delay. If there is to be no signaling via relay, "0000" is to be set in this position. This screen can only be seen if the screen "Change relay assignment" is set to YES.

4.10 Enable Monitoring

```
Monitoring ON
after       00s
```

Delayed monitoring **1-99 s**

Time delay between when the minimum frequency for monitoring (taking into account the discrete input "Enable monitoring") is exceeded and the activation of specific watchdogs.

```
Monitoring ON
at f gen  > 00Hz
```

Minimum frequency for monitoring **15-70 Hz**

After reaching this frequency, the delayed monitoring is switched on.

```
f Gen > xx Hz
auf Relais  0000
```

Exceeding minimum frequency on relay **0-4**

The exceeding of the above adjustable minimum frequency for monitoring will be displayed on the here set signal relay. If no message via relay shall occur you have to adjust here „0000“. This screen is only visuable if the screen „change relay assignement“ is put „YES“.

4.11 Configure Pulse Outputs

NOTE

The pulse outputs of the energy counter are not calibrated!

These outputs issue pulses whose frequency is proportional to the measured real power or re-active power. The frequency of the pulses can be adjusted. The length of a pulse is minimum 50 ms and maximum 100 ms. The pulse frequency is adjustable in this way, that the distance of two pulses does not fall under 100 ms also in case of maximum power.

4.11.1 Pulse counter for real power ((PSVA & option M)

```
Pulse/kWh
Logic  negative
```

Pulse counter for measuring the real power **positive/negative**

positive ....The pulse output means closing the output or a voltage nearly zero volt over the output terminals.
negative ...The pulse output means opening the output.

```
Reactive energy
Pulse/kWh 000,0
```

Pulse counter real power **0.1-150.0**

Number of the pulses/kWh (pulse frequency).

4.11.2 Pulse counter re-active power (PSVA & option Mb)

```
Pulse/kvarh
Logic  negative
```

Pulse counter for measuring the re-active power **positive/negative**

positiv .....The pulse output means closing the output or a voltage nearly zero volt over the output terminals.
negativ .....The output of a pulse means opening the output.

```
Reactive energy
P./kvarh  000,0
```

Pulse counter re-active power **0.1-150.0**

Number of the pulses/kvarh (pulse frequency)./

```
Pulse/kvarh
 Type  leading
```

kvarh pulse for type of reactive power **leading/lagging**

leading .....The pulse output occurs proportionally to the leading re-active power. If there is lagging re-active power, no pulses are emitted.
lagging .....The pulse output occurs proportionally to the lagging re-active power. If there is leading re-active power, no pulses are emitted.

Analog output names and setting ranges			
Generator voltage U_{L1N}	0 to 65,000 V	Generator voltage U_{L12}	0 to 65,000 V
Generator voltage U_{L2N}	0 to 65,000 V	Generator voltage U_{L23}	0 to 65,000 V
Generator voltage U_{L3N}	0 to 65,000 V	Generator voltage U_{L31}	0 to 65,000 V
Generator current I_{L1}	0 to 9,999 A	Generator real power	-32,000 to 32,000 kW
Generator current I_{L2}	0 to 9,999 A	Gen. reactive power	32,000 to 32,000 kW
Generator current I_{L3}	0 to 9,999 A	Generator frequency	15.00 to 85.00 Hz
Generator power factor	c0.50 to 1 to i0.50	Engine speed (option N)	

It is possible to assign a completely specific measuring variable to each available analog output. Output may be carried out as a 0 to 20 mA or as a 4 to 20 mA value. A list of the possible parameters is indicated above. The variable may be scaled via an upper and a lower input value. The inputs can also have signs.

Analog outputs PSVA & option A2 = 80/81 and 82/83.
Option A4 = 80/81, 82/83 and Y1/Y2, Y4/Y5

Example Analog output 80/81:

```
Analog out.80/81
      0 .. 00mA
```

Analog output range **0-20 / 4-20 mA / OFF**

0 / 20 mA..... For the lower value, 0 mA are output.
4 / 20 mA..... For the lower value, 4 mA are output.
OFF ..... If the function is set to "OFF", 0 mA are output, and the subsequent screens of this function are not displayed.

```
Analog out.80/81
----------------
```

Analog output name **refer to table above**

Selection of the variables to be specified (see above table on this).

```
Analog. output
  0mA =  -------
```

Scaling lower output value analog output **refer to table above**

Determination of the lower value, for which 0/4 mA are output. The setting range depends on the selected analog output variable and is indicated in the above table.

```
Analog output
 20mA =  -------
```

Scaling upper output value analog output **refer to table above**

Determination of the upper value, for which 20 mA are output. The setting range depends on the selected analog output variable and is indicated in the above table.

4.13.1 Modbus RTU Slave (Option Su/Sb)

```
Control by
MODBUS      ON
```

Control with MOD bus RTU slave **ON/OFF**

ON .....The control via the serial interface is activated and accepts control commands, that come via the interface.
OFF .....The reception of control data is rejected.

```
Interface fault
Relay outp. 0000
```

Signal interface fault on relay **0-4**

The triggering of the watchdog is output to the signal relay set here. If there is to be no signaling via relay, "0000" is to be set in this position. This screen can only be seen if the screen "Change relay assignment" is set to YES.

```
Delay to send
MOD-Bus   00,0ms
```

Waiting time transmission **0,2-50,0 ms**

Using an interface RS485 the bus is released at a certain point of time for only one user for transmitting. As the MOD bus is a master slave system, the release of the bus is determined by a master. Only if the master, for example a PLC, has released the bus, the MFR 2 (= slave) can send. Depending on which master is used, the MFR 2 must wait for this release command different times after receipt of the master message. A shorter waiting period accompanies a high data transmission rate. However if the waiting period is selected smaller than the release time of the master transmission faults occur. In this screen the waiting time of the MFR 2 can be adjusted according to the respective master.

4.13.2 Siemens DK3964 (Option Su/Sb)

```
   Interface
          ON
```

Interface **ON/OFF**

ON .....The interface is activated.
OFF .....The interface is deactivated.

```
Baud rate
          0000
```

Baud rate **1,200 / 2,400 / 4,800 / 9,600 / 19,200 baud**

The data transmission rate is set here. It must be conform with the other bus participants.

```
Parity
          none
```

Parity **none / direct / indirect**

The data transmission rate is set here. It must be conform with the other bus participants.

```
Sending cycle
            00s
```

Transmission cycle time **0-10 s**

The transmission cycle time is the time distance between two transmissions.

```
Interpreter
Rk512       ON
```

Interpreter Siemens DK3964 RK512 **ON/OFF**

ON .....The interpreter RK512 is activated.
OFF .....The interpreter RK512 is de-activated.

```
Data module
           000
```

Data component **0-255**

Data component address in the receiver (e.g. SPS).

```
Data word
           000
```

Data word **0-255**

Data word address in the receiver (e.g. SPS).

```
Interface fault
Relay outp. 0000
```

Signal interface fault on relay **0-4**

The triggering of the watchdog is output to the signal relay set here. If there is to be no signaling via relay, "0000" is to be set in this position. This screen can only be seen if the screen "Change relay assignment" is set to YES.

4.13.3 Profibus DP (Option Su/Sb)

```
PROFIBUS-Station
           000
```

Station number Profibus DP Slave **1-125**

The station number must be entered here under which the MFR 2 transmits and receives via the Profibus.

```
Control by<
PROFIBUS     OFF
```

[only with option Sb]

Setpoint value and acknowledgment via Profibus **ON/OFF**

ON .....The data received via the Profibus are accepted from the MFR 2 (see receiving telegram). It can be acknowledged via the Profibus and setpoints are accepted by the MFR 2 via Profibus (if the discrete input "Changing setpoint 1<->2" is set).

OFF .....The received data were ignored by the MFR 2.

```
PROFIBUS
Watchdog     OFF
```

[only with option Sb]

Toggle-Watchdog **ON/OFF**

The possibility to enable a watchdog in and for the interface telegram using byte 1, bit 0 Es is given. This bit is to be toggled minimum every 4 seconds from the transmitting device. The toggle bit - and through this the function - of transmission of the Profibus can be monitored from the MFR 2.

ON .....The toggle bit is monitored from the MFR 2. If there is no change in the toggle bit at least every 4 seconds an interface alarm is triggered, and the Profibus interface is re-initialized.

OFF .....The toggle bit status is ignored.

Important note:
Independent of the toggle bit two watchdog bits are available in control word 3 (refer to the interface protocol). This have to be transmitted with status '0' and re-set a counter in the MFR 2. If status '0' is not received for at least every 15 seconds an interface alarm in the MFR 2 is triggered. This watchdog can not be deactivated and has to be triggered always!

```
Interface fault
Relay outp. 0000
```

[only with option Sb]

Signal interface fault on relay **0-4**

The triggering of the watchdog is output to the signal relay set here. If there is to be no signaling via relay, "0000" is to be set in this position. This screen can only be seen if the screen "Change relay assignment" is set to YES.

NOTE

Please use the attached file Leon00d9.gsd to configure your PLC.

If the Toggle watchdog is not used then the first 8 byte have to be transmitted with the content „0“ to the MFR 2. The user data consisting of three control words, always start after byte 8 (see receiving telegram).

4.13.4 CAN Bus Interface

```
Control by
Interface   ON
```

Control via interface **ON/OFF**

ON .....The control via the serial interface is activated and accepts control commands, that come via the interface. The control of the interface is active and releases interface faults, if longer than 30 seconds no message will be received. In case of an interface fault only the relay configured for centralized alarm will be switched.

OFF .....The reception of control data is rejected, and the control of the interface is deactivated.

4.14 Counter Configuration

4.14.1 Setting of the Maintenance Call

```
Service interval
    in    0000h
```

Maintenance call **0-9,999 h**

A maintenance interval is specified via this screen. A maintenance call (alarm class 1, "Maintenance") is displayed after this time interval. In automatic mode, the remaining time until the next maintenance call can be displayed in the display. After acknowledgement of the maintenance signal, a new maintenance interval begins.

4.14.2 Setting of the Operation Hours Counter

```
Set oper. hour
counter:  00000h
```

Setting operation hours counter **0-65,000 h**

The operating hours counter is set in a 2-level procedure:

1st step.....Setting and saving the desired counter state

2nd step .....Integration of the new counter state by

- changing from configuration to automatic mode
- visualization of the operating hours counter
- simultaneously pressing the buttons "Select " and "Cursor" for at least 10 seconds

4.14.3 Setting of the start counter

```
Set counter of
starts   00000
```

Setting start counter **0-49,999**

Exceeding the "Minimum frequency for monitoring" for the first time counts as a start.
The start counter is set in a 2-step procedure:
1st step.....Setting and saving the desired start number
2nd step .....Integrating the saved start number by

- changing from configuration to automatic mode
- visualization of the start counter
- simultaneously pressing the buttons "Select" and "Cursor" for at least 10 seconds.

4.14.4 Setting of the Energy Counter

The counters are set using a two-level procedure.
1st step.....Setting the desired counter state
2nd step.....Integrating the new counter state:

- Changing from configuration to automatic mode
- Visualization of the counter to be set (in the display)
- Simultaneously pressing the buttons "Select" and "Cursor" for at least 10 s

```
energy counter
set in     xxxx
```

Setting energy counter **kilo/Mega**

kilo .....The entry of the manipulated variables in the subsequent screens is made in the unit kWh or kvarh.
Mega .....The entry of the manipulated variables in the subsequent screens is made in the unit MWh or Mvarh.

```
Set pos. active
energy 00000xWh
```

Configure positive real energy **0-65,500 kWh/MWh**

This value is integrated into the counter of the electrical real energy only after carrying out the procedure described above as a new counter state.

```
Set neg. active
energy  00000xWh
```

Configure negative real energy **0-65,500 kWh/MWh**

This value is only integrated into the counter of the electrical real energy in the negative direction only after carrying out the procedure described above as a new counter state.

```
Set lagg. react.
ener. 00000xvarh
```

Configure lagging r-eactive energy **0-65,500 kvarh/Mvarh**

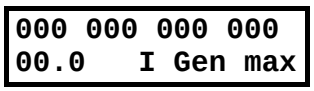
This value is integrated into the counter of the lagging reactive energy only after carrying out the procedure described above as a new counter state.

```
Set lead. react.
ener. 00000xvarh
```

Configure leading re-active energy **0-65,500 kvarh/Mvarh**

This value is integrated in the counter of leading reactive energy only after carrying out the procedure described above as a new counter state.

4.14.5 Current Slave Pointer Resetting



Display of the maximum generator current

A current slave pointer that saves the maximum generator current separately for each phase is realized in the unit. The display of the maximum generator currents in **automatic mode** can be selected via the "Message" button. This indication appears in the display.

Reset The current slave pointer is reset by pressing the "Acknowledge" button for 2.5 s. In order to achieve this, the indication described above must be visible in the display.

4.15 Analog Inputs Configuration (Option T2)

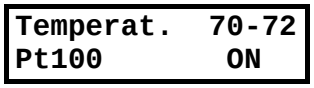
4.15.1 Pt100 Input

The resistance input Pt100 is designed for temperatures up to 240 °C. Each input can be monitored in two levels. The first stage is defined as warning and triggers alarm class 1, the second stage is defined as shutdown and triggers alarm class 3.

Wire break control If the input was connected correctly, an interruption of the measurement resistor (terminal 70/71 or 73/74) as well as a temperature higher than 216 °C will be interpreted as a wire break and on the display a respectively message is issued.

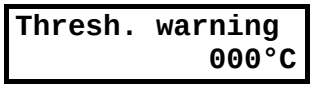
Assignment Analog input 1 = Temperature 1 = terminals 70-72
Analog input 2 = Temperature 2 = terminals 73-75

Example Analog input 2 (terminals 70-72):



Pt100 input **ON/OFF**

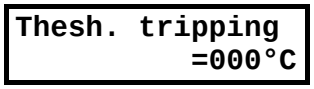
ON .....The temperature monitoring is turned on. The subsequent screens of this function are displayed.
OFF .....No monitoring are carried out, and the subsequent masks of this function are not displayed.



Limit value "Warning" **0-200 °C**

In this screen, the limit value at which a warning occurs is input.

Triggering of alarm class 1



Limit value "Shutdown" **0-200 °C**

The limit value at which tripping occurs is input in this screen.

Triggering of alarm class 3

```
Hyst. warning
        =000°C
```

Hysteresis "Warning" **0-200 °C**

In order for the warning to be resettable, the limit value warning minus hysteresis must be fallen below.

```
Hyst. tripping
        =000°C
```

Hysteresis "Shutdown" **0-200 °C**

In order that the tripping is resettable, the limit value tripping minus the hysteresis must be fallen below.

```
Thresh. warning
Delay    =000s
```

Delay "Warning" **0-999 s**

In order for a warning to be possible, the limit value must be uninterruptedly exceeded for at least as long as indicated in this screen.

```
Thresh.tripping
Delay    =000 s
```

Delay "Shutdown" **0-999 s**

In order for a tripping to be possible, the limit value must be uninterruptedly exceeded at least as long as specified in this screen.

```
Warning
Relay outp. 0000
```

"Warning" on relay **0-4**

The exceeding of the limit value warning will be issued on the here adjusted signal relays. If there is to be no signaling via relay, "0000" is to be set in this position. This screen can only be seen if the screen "Change relay assignment" is set to YES.

```
Tripping
Relay outp. 0000
```

"Shutdown" on relay **0-4**

The exceeding of the value tripping will be issued on the here adjusted signal relays. If there is to be no signaling via relay, "0000" is to be set in this position. This screen can only be seen if the screen "Change relay assignment" is set to YES.

4.15.2 Scaleable Analog Input 0/4-20 mA

The signal 0/4-20 mA is a linear converted numerical value. The measuring value, which results of this conversion, will be displayed in the automatic mode as long as the value is within the defined signal limits. Two control limits can be defined. If the input signal is defined on 4-20 mA, additionally wire break control can be activated.

Example Analog input 1 (terminal 70-72)

```
Analog input 1
term.70/71   OFF
```

Analog input 1 **ON/OFF**

ON ..... The display of the measuring value in automatic mode is activated and the following adjustable limit values will be monitored. The subsequent screens of this function are displayed.

OFF ..... The display of the measuring value in automatic mode will be set zero and the input is not monitored. The subsequent screens of this function are displayed.

```
Analog input 1
Type    0/4-20mA
```

Signal range **0-20 / 4-20 mA**

0-20 mA.... The minimum value of the input signal is 0 mA and the maximum value is 20 mA. No wire break monitoring occurs.

4-20 mA.... The minimum value of the input signal is 4 mA and the maximum value is 20 mA. If the signal falls below 2 mA value the message "wire break" occurs and the relay centralized alarm responds.

```
Value at
0/4mA =  ±0000
```

Numerical value at 0mA or 4mA **$^{-}$9,999-0-$^{+}$9,999**

The mA-signal is converted into a numerical values and is displayed. For converting the numerical value which corresponds to the lower signal limit is entered here.

```
Value at
 20mA =  ±0000
```

Numerical value at 20mA **$^{-}$9,999-0-$^{+}$9,999**

The mA-signal is converted into a numerical value and is displayed. For converting the numerical value which corresponds to the upper signal limit is entered here.

```
Anin 1 monitor.
for   xxxxxxxxx
```

Monitoring for ... **high limit mon. / low limit mon.**

high limit mon. The monitoring of the measuring value occurs on exceeding. That means that the MFR 2 responds it the measured value is larger than the set limit value.

low limit mon. The monitoring of the measuring value occurs on negative deviation. That means that the MFR 2 responds it the measured value is smaller than the set limit value..

```
Thresh. warning
Value    =±0000
```

Limit value "Warning" **$^{-}$9,999-0-$^{+}$9,999**

The limit value at which in case of exceeding or negative deviation warning occurs is configured here.

```
Thresh. tripping
Value    =±0000
```

Limit value "Shutdown" **$^{-}$9,999-0-$^{+}$9,999**

The limit value at which in case of exceeding or negative deviation tripping occurs is configured here.

```
Thresh. warning
Delay    =000s
```

Delay for "Warning" **0-999 s**

In order for warning to occur, the limit value must be exceeded or fallen below without interruption for at least the period of time specified in this screen.

```
Thresh. tripping
Delay    =000s
```

Delay for "Shutdown" **0-999 s**

In order for tripping to occur, the limit value must be exceeded or fallen below without interruption for at least the period of time specified in this screen.

```
Thresh. warning
Relay outp. 0000
```

"Warning" on relay **0-4**

The exceeding of the value warning will be issued on the here adjusted signal relays. If there is to be no signaling via relay, "0000" is to be set in this position. This screen can only be seen if the screen "Change relay assignment" is set to YES.

```
Thresh. tripping
Relay outp. 0000
```

"Shutdown" on relay **0-4**

The exceeding of the value tripping will be issued on the here adjusted signal relays. If there is to be no signaling via relay, "0000" is to be set in this position. This screen can only be seen if the screen "Change relay assignment" is set to YES.

4.15.3 Input PTC 0-16.5 kΩ for Generator Temperature

The measured resistance 0-16.5 kΩ will be linear converted into 0-100 %. A monitoring limit can be defined.

```
Generatortemp.
 PTC       OFF
```

Analog input PTC **ON/OFF**

ON .....The following adjustable limit value is monitored, and the following screens of this function are displayed.
OFF .....The input is not monitored, and the following screens of this function are not displayed.

```
Threshold
Gen.Temp.= 000%
```

Limit value generator temperature **0-100 %**

The limit value at which in case of exceeding tripping occurs is configured here.

```
Operate delay
Gen.Temp. =000s
```

Delay **0-600 s**

In order that tripping occurs, the limit value must be exceeded for at least the period of time specified in this screen.

```
Revert delay
Gen.Temp. =000s
```

Hysteresis delay **0-600 s**

In order that the tripping is reset, the limit value must fall below for at least the period of time specified in this screen.

```
Hysteresis
Gen.Temp. = 00%
```

Hysteresis **0-50 %**

In order that the tripping can be reset, the limit value minus the hysteresis must be fall below.

```
Generatortemp.
Relay outp. 0000
```

Alarm on relay **0-4**

The exceeding of the value will be issued on the here adjusted signal relays. If no signal shall occur via relay, "0000" is to be set in this position. This screen can only be seen if the screen "Change relay assignment" is set to YES.

4.15.4 Input 0-150 mV for Battery Current Monitoring

```
Batt. current
monitoring   OFF
```

Battery current **ON/OFF**

ON .....The following adjustable limit values are monitored, and the following screens of this function are displayed.
OFF .....The input is not monitored, and the following screens of this function are not displayed.

```
Batt. current
  0mV =   00,0 A
```

Battery current at 0 mV **0.0-99.9 A**

The mV signal of the analog input will be converted into a battery current in A and monitored. For converting the value in A - which corresponds to the lower signal limit of 0 mV - must be set here.

```
Batt. current
150mV =   00,0 A
```

Battery current at 150 mV **0.0-99.9 A**

The mV signal of the analog input will be converted into a battery current in A and monitored. For converting the value in A - which corresponds to the upper signal limit of 150 mV - must be set here.

```
Thresh. level 1
Curr. =   00,0 A
```

Limit value battery current level 1 **0.0-99.9 A**

The limit value of level 1 which should be monitored, is set here.

```
Thresh. level 2
Curr. =   00,0 A
```

Limit value battery current level 2 **0.0-99.9 A**

The limit value of level 1 which should be monitored, is set here.

```
Batt. overcur  1
Delay      =000s
```

Delay tripping level 1 **0-600 s**

To occur a tripping of level 1, the limit value of level 1 must be exceeded at least for the time monitored in this screen.

```
Batt.overcur  2
Delay      =000s
```

Delay tripping level 2 **0-600 s**

To occur a tripping of level 2, the limit value of level 2 must be exceeded at least for the time monitored in this screen.

```
Batt. overcur  1
Relay outp. 0000
```

Tripping level 1 on relay **0-4**

The exceeding of the limit value of level 1 will be issued on the here adjusted signal relays. If no signal shall occur via relay, "0000" is to be set in this position. This screen can only be seen if the screen "Change relay assignment" is set to YES.

```
Batt.overcur  2
Relay outp. 0000
```

Tripping level 2 on relay **0-4**

The exceeding of the limit value of level 2 will be issued on the here adjusted signal relays. If no signal shall occur via relay, "0000" is to be set in this position. This screen can only be seen if the screen "Change relay assignment" is set to YES.

4.16 Discrete Inputs Configuration

Discrete inputs	Discrete input 1	terminal 34	not used
	Discrete input 2	terminal 35	Control input "Isolated controller ON"
	Discrete input 3	terminal 36	Control input "External acknowledgement"
	Discrete input 4	terminal 60	Control input "Blocking mains protection"
	Discrete input 5	terminal 61	Alarm input
	Discrete input 6	terminal 62	Alarm input
	Discrete input 7	terminal 63	Alarm input
	Discrete input 8	terminal 64	Alarm input

a.) Mode of operation

Operating current (NO) In order to activate the function of the discrete input in question, or in order to trigger a alarm, this must be set; i.e. the associated terminal is connected to voltage.

Idle current (NC) If the terminal is not wired or not set, thus de-energized, the associated function of the discrete input is active. In this way, the inputs can be wired in a fail-safe manner.

```
Dig. input   234
Function:    000
```

Function of discrete inputs 2, 3 and 4 **E/R**

A choice is made between different control principles by selecting either operating current contact or idle current contact (see above).
E .....Energize to operate: The dig. input functions as a working current input.
R .....Release to operate: The discrete input functions as a idle current input.

```
Dig. input   5678
Function:    0000
```

Function of discrete inputs 5, 6, 7 and 8 **E/R**

A choice is made between different control principles by selecting either operating current contact or idle current contact (see above).
E .....Energize to operate: The dig. input functions as a working current input.
R .....Release to operate: The discrete input functions as a idle current input.

```
Dig. input   5678
delayed      0000
```

Delay of discrete inputs 5, 6, 7 and 8 **Y/N**

Y .....The associated alarm input is registered only if the minimum frequency for monitoring is exceeded.
N .....The discrete output is always evaluated.

```
Dig. input   5678
Err. class   0000
```

Alarm class of discrete inputs 5, 6, 7 and 8 **0-3**

Different alarm classes are assigned to discrete alarm inputs 5 to 8.

b.) Alarm texts

The alarm texts are displayed in the case of activation of an associated alarm input.

```
Fault text: t.61
Terminal 61
```

Alarm text terminal 61 **optional**

Using the buttons "Cursor→", "Digit↑" and "Select" the alarm texts can be set. Letters and digits, as well as a few special characters, can be inserted.

```
Fault text:t. 62
Terminal 62
```

Alarm text terminal 62 **optional**

Using the buttons "Cursor→", "Digit↑" and "Select" the alarm texts can be set. Letters and digits, as well as a few special characters, can be inserted.

```
Fault text:t. 63
Terminal 63
```

Alarm text terminal 63 **optional**

Using the buttons "Cursor→", "Digit↑" and "Select" the alarm texts can be set. Letters and digits, as well as a few special characters, can be inserted.

```
Fault text:t.64
Terminal 64
```

Alarm text terminal 64 **optional**

Using the buttons "Cursor→", "Digit↑" and "Select" the alarm texts can be set. Letters and digits, as well as a few special characters, can be inserted.

4.17 Configure Password

NOTE

Once the code level is set, this is not changed, even if the configuration mode is accessed steady. If an incorrect code number is input, the code level is set to CL0, and the item is thereby blocked for third parties.

If the supply voltage is present, uninterrupted, at the item for 2 hours, code level 0 is automatically set.

```
Define level 1
code         XXXX
```

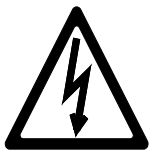
Code level 1 (customer) **0000-9999**

This screen first appears in code level 2 (password protection enabled). Following the input of digits in this screen, the code level for level 1 (Customer) is set. More information to password protection see on page 39.

```
Define level 2
code         XXXX
```

Code level 2 (commissioner) **0000-9999**

This screen first appears in code level 2 (password protection enabled). Following the input of digits in this screen, the code level for level 2 (mechanic) is set. More information to password protection see on page 39.



DANGER !!!

When commissioning the unit, please observe the five safety rules that apply to the handling of live equipment. Make sure that you know how to provide first aid in current-related accidents and that you know where the first-aid kit and the nearest telephone are. Never touch any live components of the system or on the back of the system:

DANGER TO LIFE

WARNING !

The unit may only be commissioned by a qualified technician. The "EMERGENCY STOP" function must be safely working prior to the commissioning, and must not depend on the unit.

ATTENTION

1. Prior to the commissioning make sure that all measuring voltages are connected in correct phase sequence. The rotating field must be measured. Any lack or incorrect connection of measuring voltages or other signals may lead to incorrect functions and damage the unit as well as engines and components connected to the unit.

Procedure

2. The power supply (24 V_{DC}) must be applied following a check to ensure that all measuring voltages have been connected in the correct phase relation.

3. Change into the output mode and setting of all operating data.

4. In absence of all releases and replies, there must be a check as to whether the applied voltages correspond to the displayed values. **Attention:** If there is no measuring voltage, this may lead to an asynchronous/induction add-on order in case of an active dead bus operation!

5. Check the entire wiring to the MFR 2. The wiring of some relays can be checked by changing from closed circuit current (NO) to operating current (NC) and thus to switch (please do not forget after the check to configure them again correctly). The response of the circuit breakers must be checked.

6. Execute now the test of the protective functions for the generator

7. Synchronize the GCB or the MCB. Before inserting one of the two circuit breaker it is absolutely necessary to check whether the measuring voltages are attached correctly. It must also be checked whether the synchronous conditions are fulfilled in the moment when the MFR 2 issues an add-on pulse. This check can easily occur in measuring the difference voltage directly at the appropriate circuit breaker.

8. After a successful check of the synchronization please check the monitored current values, the power direction and the monitored power factor.

9. Please carry out further possible checks (depending on the application and the equipment of the MFR 2).

6.1 Interface (Standard, Terminals X1-X5)

6.1.1 Transmission Telegram

The data of the following table can be handled by a PLC, a Gateway GW 4 or any other suitable receiving unit. The CAN-ID on which the MFR 2 transmits is generated by the number 800 (= 320_{hex}) plus the set generator number:

CAN-ID = 800 + generator number

Each separate message is assembled out of 8 Byte and is built as follows:

Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
MUX-number	H'DD	Data word 1 High-Byte	Data word 1 Low-Byte	Data word 2 High-Byte	Data word 2 Low-Byte	Data word 3 High-Byte	Data word 3 Low-Byte

Byte 1 is always used to show the hexadecimal value DD. This one defines the message as a visualization message. Byte 0 sends a MUX number which enumerates from 1 to 13. The following table shows which data word assigns to the respective MUX number.

The transmitting counter in word 38 can be used to monitor the functional efficiency of the CAN at the MFR 2. This counter is increased by one after sending a message. It must be increased thus always by 13 if it sends itself, because the whole telegram consists of 13 messages.

CAN-Bus	No.	Content (words)	Unit	Comment
MUX=1,1	**1**	Telegram call sign	"408"	Telegram type
MUX=1,2	**2**	Generator voltage L12	V × $10^{UGNEXPO}$	
MUX=1,3	**3**	Generator voltage L23	V × $10^{UGNEXPO}$	
MUX=2,1	**4**	Generator voltage L31	V × $10^{UGNEXPO}$	
MUX=2,2	**5**	Generator frequency	Hz × 100	
MUX=2,3	**6**	Generator current L1	A × $10^{IGNEXPO}$	
MUX=3,1	**7**	Generator current L2	A × $10^{IGNEXPO}$	
MUX=3,2	**8**	Generator current L3	A × $10^{IGNEXPO}$	
MUX=3,3	**9**	Generator power factor	dim.los × 100	$^{-}$99-100-$^{+}$99
MUX=4,1	**10**	Generator real power	W × $10^{PGNEXPO}$	
MUX=4,2	**11**	Busbar voltage	V × $10^{UGNEXPO}$	100 V units: V × $10^{USSEXPO}$
MUX=4,3	**12**	Busbar frequency	Hz × 100	
MUX=5,1	**13**	Mains voltage L12	V × $10^{UNTEXPO}$	
MUX=5,2	**14**	Mains voltage L23	V × $10^{UNTEXPO}$	
MUX=5,3	**15**	Mains voltage L31	V × $10^{UNTEXPO}$	
MUX=6,1	**16**	Mains frequency	Hz × 100	
MUX=6,2	**17**	Mains current L1	A × $10^{INTEXPO}$	
MUX=6,3	**18**	Mains power factor	dim.los × 100	$^{-}$99-100-$^{+}$99
MUX=7,1	**19**	Mains interchange real power	W × $10^{PNTEXPO}$	
MUX=7,2	**20**	Status of the power circuit breakers	Bit 15 = 1 \ Bit 14 = 1 /	Internal
			Bit 13 = 1 \ Bit 12 = 1 /	Internal
			Bit 11 = 1 \ Bit 10 = 1 /	Internal
			Bit 9 = 1 \ Bit 8 = 1 /	Internal
			Bit 7 = 1 \ Bit 6 = 1 /	GCB is closed
			Bit 5 = 1 \ Bit 4 = 1 /	MCB is closed
			Bit 3 = 1 \ Bit 2 = 1 /	Internal
		Note: 1/1 means: watchdog has released 0/0 means: watchdog has not released	Bit 1 = 1 \ Bit 0 = 1 /	Internal
MUX=7,3	**21**	Alarm class	Bit 15 = 1 \ Bit 14 = 1 /	Internal
			Bit 13 = 1 \ Bit 12 = 1 /	Internal
			Bit 11 = 1 \ Bit 10 = 1 /	Internal
			Bit 9 = 1 \ Bit 8 = 1 /	Internal
			Bit 7 = 1 \ Bit 6 = 1 /	Alarm class 3
			Bit 5 = 1 \ Bit 4 = 1 /	Alarm class 2
			Bit 3 = 1 \ Bit 2 = 1 /	Alarm class 1
		Note: 1/1 means: watchdog has released 0/0 means: watchdog has not released	Bit 1 = 1 \ Bit 0 = 1 /	Internal

CAN-Bus	Nr.	Content (words)	Unit	Comment
MUX=8,1	**22**	Internal alarms 1	Bit 15 = 1 \ Bit 14 = 1 /	Generator overfrequency
			Bit 13 = 1 \ Bit 12 = 1 /	Generator underfrequency
			Bit 11 = 1 \ Bit 10 = 1 /	Generator overvoltage
			Bit 9 = 1 \ Bit 8 = 1 /	Generator undervoltage
			Bit 7 = 1 \ Bit 6 = 1 /	Limiting performance reached
			Bit 5 = 1 \ Bit 4 = 1 /	Battery undervoltage
			Bit 3 = 1 \ Bit 2 = 1 /	Generator overload
		Note: 1/1 means: watchdog has released 0/0 means: watchdog has not released	Bit 1 = 1 \ Bit 0 = 1 /	Generator reverse power
MUX=8,2	**23**	Internal alarme 2	Bit 15 = 1 \ Bit 14 = 1 /	Mains overfrequency
			Bit 13 = 1 \ Bit 12 = 1 /	Mains underfrequency
			Bit 11 = 1 \ Bit 10 = 1 /	Mains overvoltage
			Bit 9 = 1 \ Bit 8 = 1 /	Mains undervoltage
			Bit 7 = 1 \ Bit 6 = 1 /	df/dt
			Bit 5 = 1 \ Bit 4 = 1 /	Synchronization time exceeded
			Bit 3 = 1 \ Bit 2 = 1 /	Mains asymmetry
		Note: 1/1 means: watchdog has released 0/0 means: watchdog has not released	Bit 1 = 1 \ Bit 0 = 1 /	Mains vector jump
MUX=8,3	**24**	Internal alarms 3	Bit 15 = 1 \ Bit 14 = 1 /	Re-active power lagging
			Bit 13 = 1 \ Bit 12 = 1 /	Re-active power leading
			Bit 11 = 1 \ Bit 10 = 1 /	Interface alarm
			Bit 9 = 1 \ Bit 8 = 1 /	Unbalanced load
			Bit 7 = 1 \ Bit 6 = 1 /	Generator overcurrent, level 1
			Bit 5 = 1 \ Bit 4 = 1 /	Generator overtemperature
			Bit 3 = 1 \ Bit 2 = 1 /	Maintenance call
		Note: 1/1 means: watchdog has released 0/0 means: watchdog has not released	Bit 1 = 1 \ Bit 0 = 1 /	False start

CAN-Bus	No	Content (words)	Unit	Comment
MUX=9,1	**25**	Internal alarms 4	Bit 15 = 1 \ Bit 14 = 1 /	Analog input 1, level 1
			Bit 13 = 1 \ Bit 12 = 1 /	Analog input 1, level 2
			Bit 11 = 1 \ Bit 10 = 1 /	Analog input 2, level 1
			Bit 9 = 1 \ Bit 8 = 1 /	Analog input 2, level 2
			Bit 7 = 1 \ Bit 6 = 1 /	Real power surge, positive
			Bit 5 = 1 \ Bit 4 = 1 /	Real power surge, negative
			Bit 3 = 1 \ Bit 2 = 1 /	Generator overcurrent, level 2
		Note: 1/1 means: watchdog has released 0/0 means: watchdog has not released	Bit 1 = 1 \ Bit 0 = 1 /	Displacement voltage
MUX=9,2	**26**	Running hours	h × 65.535	High Word
MUX=9,3	**27**		h	Low Word
MUX=10,1	**28**	Maintenance call	h	
MUX=10,2	**29**	Start counter	dimension less	
MUX=10,3	**30**	Battery voltage	V × 10	
MUX=11,1	**31**	Generator real energy	kWh × 65.535	High Word
MUX=11,2	**32**		kWh	Low Word
MUX=11,3	**33**	**H.B.** Exponent generator power **L.B.** Exponent generator voltage		PGNEXPO UGNEXPO
MUX=12,1	**34**	**H.B.** Exponent generator current **L.B.** free		IGNEXPO
MUX=12,2	**35**	**H.B.** Exponent mains power **L.B.** Exponent mains voltage		PNTEXPO UNTEXPO
MUX=12,3	**36**	**H.B.** Exponent mains current **L.B.** free		INTEXPO
MUX=13,1	**37**	**H.B.** Exponent bsubar voltage (100 V version only) **L.B.** frei		USSEXPO
MUX=13,2	**38**	Transmitting counter	dimension less	
MUX=13,3	**39**	free		

6.1.2 Receiving Telegram

The data of the following table can be handled by a PLC or with any other suitable receiving unit.

The CAN ID on which the MFR 2 receives is 831 (= $33F_{hex}$).

Each separate message is assembled out of 8 Byte and is built as follows:

Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
H‘EE	Generator number	Address High-Byte	Address Low-Byte	Data word High-Byte	Data word Low-Byte	Check sum High-Byte	Check sum Low-Byte

The byte 0 is always used to show the hexadecimal value EE. This one defines the message as a visualization message. On Byte 1 the generator number of the addressed MFR 2 must be send.

For the address of Byte 2 and 3 is valid: Set value Real power = 501 (= $1F5_{hex}$), set value power factor = 502 (= $1F6_{hex}$), control word = 503 (= $1F7_{hex}$).

The test amounts were calculated as follows:
- Highbyte = (Byte 0) XOR (Byte 2) XOR (Byte 4),
- Lowbyte = (Byte 1) XOR (Byte 3) XOR (Byte 5).

The following data words can be received by the MFR 2.

No	Content (words)	Unit	Comment
1	Set value for real power	kW	see below
2	Set value for generator cos φ		Example: **0064H** cos φ = 1.00 **0063H** cos φ = i 0.99 (lagging) **FF9EH** cos φ = k0.98 (leading)
3	Control word		Bit 15 Internal Bit 14 Internal Bit 13 Internal Bit 12 Internal Bit 11 Internal Bit 10 Internal Bit 9 Internal Bit 8 Internal Bit 7 Internal Bit 6 Internal Bit 5 Internal Bit 4 = 1 Acknowledgement Bit 3 = 0 always 0 Bit 2 = 0 always 0 Bit 1 = 1 Internal Bit 0 = 1 Internal

Coding of the power setpoint:

The power value uses the bits 0 to 13. Bit 14 must be 1, bit 15 must be 0. Thus power rating up to 16.383 kW can be transmitted.

Example:
A power of 150 W shall be adjusted. Then the value to be send is:

01/00 0000 1001 0110 B ➔ 4096 H

NOTE

To process the setpoint values of the MFR 2 sent via interface, the discrete input "Setpoint value 1-2“ at terminal 5 must be set!

NOTE

If the configuration via the lateral plug is connected, the CAN interface is out of operation.

If remote control via CAN interface is switched on, the monitoring of the interface is also active. An interface fault is tripped if bit 2 in the control word is more than 30 seconds set to "1" or if bit 3 in the control word has not send with "0" for more than 30 seconds or the whole control word was not send for more than 30 seconds.

So that this monitoring can also include the setpoint messages, it is absolutely necessary that always all three words were sent consecutively. If an interface fault is tripped, the configured fixed setpoint values were consulted for control.

6.2 Interface (Option Su/Sb; Terminals Y1-Y5)

6.2.1 Transmission Telegram

NOTE

Units of version 3.4000 and 3.4002 are sending the telegram type 408. This is identically to type 409 except the information of the displacement voltage.

Number				Content (words)	Unit	Comment
3964		MOD-Bus	Profibus			
00	**01**	**1** (00, 01)	**0**	Telegram call sign	"409"	Telegram type
02	**03**	**2** (02, 03)	**1**	Generator voltage L12	V	
04	**05**	**3** (04, 05)	**2**	Generator voltage L23	V	
06	**07**	**4** (06, 07)	**3**	Generator voltage L31	V	
08	**09**	**5** (08, 09)	**4**	Generator frequency	Hz x 10	
10	**11**	**6** (10, 11)	**5**	Generator current L1	A	
12	**13**	**7** (12, 13)	**6**	Generator current L2	A	
14	**15**	**8** (14, 15)	**7**	Generator current L3	A	
16	**17**	**9** (16, 17)	**8**	Generator power factor	dimension less	1.00 **0064H** i0.99 (lagging) **0063H** k0.98 (leading) **FF9EH**
18	**19**	**10** (18, 19)	**9**	Generator real power	kW	
20	**21**	**11** (20, 21)	**10**	Engine speed (optionally)	1min	
22	**23**	**12** (22, 23)	**11**	Busbar voltage	V	
24	**25**	**13** (24, 25)	**12**	Busbar frequency	Hz x 10	
26	**27**	**14** (26, 27)	**13**	Mains voltage L12	V	
28	**29**	**15** (28, 29)	**14**	Mains voltage L23	V	
30	**31**	**16** (30, 31)	**15**	Mains voltage L31	V	
32	**33**	**17** (32, 33)	**16**	Mains frequency	Hz x 10	
34	**35**	**18** (34, 35)	**17**	Mains current L1	A	
36	**37**	**19** (36, 37)	**18**	Mains power factor	dimension less	1.00 **0064H** i0.99 (lagging) **0063H** k0.98 (leading) **FF9EH**
38	**39**	**20** (38, 39)	**19**	Mains interchange real power	kW	
40	**41**	**21** (40, 41)	**20**	Status of the power circuit breakers	Bit 15 = 1 \ Bit 14 = 1 /	Internal
					Bit 13 = 1 \ Bit 12 = 1 /	Internal
					Bit 11 = 1 \ Bit 10 = 1 /	Internal
					Bit 9 = 1 \ Bit 8 = 1 /	MCB is closed
					Bit 7 = 1 \ Bit 6 = 1 /	Internal
					Bit 5 = 1 \ Bit 4 = 1 /	Internal
					Bit 3 = 1 \ Bit 2 = 1 /	Internal
				Note: 1/1 means: watchdog has released 0/0 means: watchdog has not released	Bit 1 = 1 \ Bit 0 = 1 /	GCB is closed
42	**43**	**22** (42, 43)	**21**	Alarm class	Bit 15 = 1 \ Bit 14 = 1 /	Internal
					Bit 13 = 1 \ Bit 12 = 1 /	Internal
					Bit 11 = 1 \ Bit 10 = 1 /	Internal
					Bit 9 = 1 \ Bit 8 = 1 /	Internal
					Bit 7 = 1 \ Bit 6 = 1 /	Internal
					Bit 5 = 1 \ Bit 4 = 1 /	Alarm class 3
					Bit 3 = 1 \ Bit 2 = 1 /	Alarm class 2
				Note: 1/1 means: watchdog has released 0/0 means: watchdog has not released	Bit 1 = 1 \ Bit 0 = 1 /	Alarm class 1

Number			Content (words)	Unit	Comment
3964	MOD-Bus	Profibus			
44 45	**23** (44, 45)	**22**	Internal alarms	Bit 15 = 1 \ Bit 14 = 1 /	Generator overfrequency
				Bit 13 = 1 \ Bit 12 = 1 /	Generator underfrequency
				Bit 11 = 1 \ Bit 10 = 1 /	Generator overvoltage
				Bit 9 = 1 \ Bit 8 = 1 /	Generator undervoltage
				Bit 7 = 1 \ Bit 6 = 1 /	Generator overload
				Bit 5 = 1 \ Bit 4 = 1 /	Generator reverse power
				Bit 3 = 1 \ Bit 2 = 1 /	Battery undervoltage
			Note: 1/1 means: watchdog has released 0/0 means: watchdog has not released	Bit 1 = 1 \ Bit 0 = 1 /	Generator unbalanced load
46 47	**24** (46, 47)	**23**	Internal alarms	Bit 15 = 1 \ Bit 14 = 1 /	Generator overcurrent 1
				Bit 13 = 1 \ Bit 12 = 1 /	Generator overcurrent 2
				Bit 11 = 1 \ Bit 10 = 1 /	Mains overfrequency
				Bit 9 = 1 \ Bit 8 = 1 /	Mains underfrequency
				Bit 7 = 1 \ Bit 6 = 1 /	Mains overvoltage
				Bit 5 = 1 \ Bit 4 = 1 /	Mains undervoltage
				Bit 3 = 1 \ Bit 2 = 1 /	Mains asymmetry
			Note: 1/1 means: watchdog has released 0/0 means: watchdog has not released	Bit 1 = 1 \ Bit 0 = 1 /	Mains phase shift
48 49	**25** (48, 49)	**24**	Internal alarms	Bit 15 = 1 \ Bit 14 = 1 /	Time monitoring Synchronization
				Bit 13 = 1 \ Bit 12 = 1 /	df/dt
				Bit 11 = 1 \ Bit 10 = 1 /	Internal
				Bit 9 = 1 \ Bit 8 = 1 /	Internal
				Bit 7 = 1 \ Bit 6 = 1 /	Re-active power monitoring lagging
				Bit 5 = 1 \ Bit 4 = 1 /	Re-active power monitoring leading
				Bit 3 = 1 \ Bit 2 = 1 /	Internal
			Note: 1/1 means: watchdog has released 0/0 means: watchdog has not released	Bit 1 = 1 \ Bit 0 = 1 /	Displacement voltage

Number				Content (words)	Unit	Comment
3964		MOD-Bus	Profibus			
50	**51**	**26** (50, 51)	**25**	Internal alarms	Bit 15 = 1 \ Bit 14 = 1 /	Temperature monitoring temperature 1, warning
					Bit 13 = 1 \ Bit 12 = 1 /	Temperature monitoring temperature 1, shutdown
					Bit 11 = 1 \ Bit 10 = 1 /	Temperature monitoring temperature 2, warning
					Bit 9 = 1 \ Bit 8 = 1 /	Temperature monitoring temperature 2, shutdown
					Bit 7 = 1 \ Bit 6 = 1 /	Internal
					Bit 5 = 1 \ Bit 4 = 1 /	Internal
					Bit 3 = 1 \ Bit 2 = 1 /	Interface alarm
				Note: 1/1 means: watchdog has released 0/0 means: watchdog has not released	Bit 1 = 1 \ Bit 0 = 1 /	Generator PTC
52	**53**	**27** (52, 53)	**26**	Displacement voltage	V	
54	**55**	**28** (54, 55)	**27**	Operation mode	Bit 15 = 1 \ Bit 14 = 1 /	Internal
					Bit 13 = 1 \ Bit 12 = 1 /	Internal
					Bit 11 = 1 \ Bit 10 = 1 /	Internal
					Bit 9 = 1 \ Bit 8 = 1 /	Internal
					Bit 7 = 1 \ Bit 6 = 1 /	Changeover setvalue 1/2
					Bit 5 = 1 \ Bit 4 = 1 /	Release GCB
					Bit 3 = 1 \ Bit 2 = 1 /	Internal
				Note: 1/1 means: watchdog has released 0/0 means: watchdog has not released	Bit 1 = 1 \ Bit 0 = 1 /	Internal
56	**57**	**29** (56, 57)	**28**	Running hours	h	High Word × 65.535
58	**59**	**30** (58, 59)	**29**			Low Word
60	**61**	**31** (60, 61)	**30**	Maintenance call	h	
62	**63**	**32** (62, 63)	**31**	Battery voltage	V x 10	
64	**65**	**33** (64, 65)	**32**	Generator real energy	kWh	High Word × 65.535
66	**67**	**34** (66, 67)	**33**			Low Word
68	**69**	**35** (68, 69)	**34**	Temperature 1	°C	
70	**71**	**36** (70, 71)	**35**	Temperature 2	°C	
72	**73**	**37** (72, 73)	**36**	Generator re-active energy, positive (lagging)	kvarh	High Word × 65.535
74	**75**	**38** (74, 75)	**37**			Low Word
76	**77**	**39** (76, 77)	**38**	Generator re-active energy, negative (leading)	kvarh	High Word × 65.535
78	**79**	**40** (78, 79)	**39**			Low Word
80	**81**	**41** (79, 81)	**40**	Generator re-active power	kvar	

6.2.2 Receiving Telegram (Option Sb)

a.) Receiving Telegram via DK3964

Number	Content (words)	Unit/Bit	Comment
3964			

00	**01**	Reserve		
02	**03**	Reserve		
04	**05**	Real power setpoint	kW	see below
06	**07**	Power factor setpoint	dimension less	1.00 **0064H** i0.99 (lagging) **0063H** c0.98 (leading) **FF9EH**
08	**09**	Acknowledgement		**00F0H** Acknowledgement **000FH** No acknowledgement
10	**11**	Reserve		
12	**13**	Reserve		
14	**15**	Reserve		
16	**17**	Reserve		
18	**19**	Reserve		

Coding of the power setpoint:

The power value uses bits 0 to 13. Bit 14 must be 1, bit 15 must be 0. Thus power rating up to 16.383 kW can be transmitted.

Example:
A power of 150 W shall be adjusted. Then the value to be send is:

01/00 0000 1001 0110 B ➔ 4096 H

NOTE

To process the setpoint values of the MFR 2 sent via interface, the discrete input "Change setpoint 1-2“ at terminal 5 must be set!

b.) Receiving Telegram Via MOD Bus RTU Slave and Profibus DP Slave

Number		Content (words)	Unit	Comment
MOD-Bus	Profibus			
01 (00, 01)	**4** (8,9)	Generator real power Setpoint	kW	see below
02 (02, 03)	**5** (10,11)	Generator-power factor Setpoint	dim.los	$^{-}$99-100-$^{+}$99
03 (04, 05)	**6** (12,13)	Control word	Bit 15 = 1	Internal
			Bit 14 = 1	Internal
			Bit 13 = 1	Internal
			Bit 12 = 1	Internal
			Bit 11 = 1	Internal
			Bit 10 = 1	Internal
			Bit 9 = 1	Internal
			Bit 8 = 1	Internal
			Bit 7 = 1	Internal
			Bit 6 = 1	Internal
			Bit 5 = 1	Internal
			Bit 4 = 1	Alarm acknowledgement
			Bit 3 = 0	always 0
			Bit 2 = 0	always 0
			Bit 1 = 1	internal
			Bit 0 = 1	internal

In the control word two watchdog bits were set (Bit 2 and Bit 3). These must be always send in status '0' and after every receipt a counter in the MFR 2 is reset. If for more than 15 seconds these bits were not received in status '0' the MFR 2 releases an interface fault. This watchdog can not be deactivated and has to be served always!

Coding of the power setpoint:

The power value uses bits 0 to 13. Bit 14 must be 1, bit 15 must be 0. Thus power rating up to 16.383 kW can be transmitted.

Example:
A power of 150 W shall be adjusted. Then the value to be send is:

01/00 0000 1001 0110 B ➔ 4096 H

NOTE

To process the setpoint values of the MFR 2 sent via interface, the discrete input "Change setpoint 1-2" at terminal 5 must be set!

6.3.1 Framework Data for the Procedure 3964 (TTY, RS232, RS485)

Data
Length of characters..... 8 Bit
Stop bit ..... 1 bit
Parity bit ..... 1 bit with even parity
Release condition..... Corresponds to the log status. 1 (20 mA at TTY)
Data format ..... 16-bit binary values
Transmitting rate ..... 9,600 baud. Other baud rates on request. The records are transferred cyclically.

Procedure Interpreter RK 512 See Siemens documents for procedure 3964.

6.3.2 Framework Data for Hardware Handshaking RTS/CTS (RS232, RS422)

Data
Length of characters 8 Bit
Stop bit ..... 1 bit
Parity bit ..... 1 bit with even parity
Data format ..... 16-bit binary values
Transmitting rate ..... 9,600 baud. Other baud rates on request. The records are transferred cyclically.

Procedure If the transmitter is ready for the data transmission, it informs the receiver by setting its control wire RTS into the "ON"-status. The prerequisite of this is that no data are received (CTS = "OFF"). The receiver registers this status and indicates its readiness to receive by switching its RTS line to "ON". The transmitter can then begin transmitting when it detects this "ON" status on its CTS line. As soon as the receiver withdraws its RTS signal (RTS = "OFF"), the transmitter interrupts its transmission and waits until the receiver is ready to receive again. The initialization conflict (both subscribers set the RTS line simultaneously) and time-out (one subscriber waits in vain for a reply) must be taken into consideration.

6.3.3 Framework Data for the MOD Bus RTU Slave

Data
Transmitting rate ..... 9.600 Baud.
Length of characters..... 8 Bit
Stop bit ..... 1 Bit
Parity bit ..... none
Protocol ..... MOD-Bus RTU Slave
Slave address..... Generator number
Submitted commands.... 3, 4, 6, 16
Restrictions..... maximum 10 words readable with one request
maximum 3 words writeble with one request

Parameters

Transmission protocol ..... CAN (CiA)
Hardware ..... CAN bus
Transmission rate ..... 125 kBaud

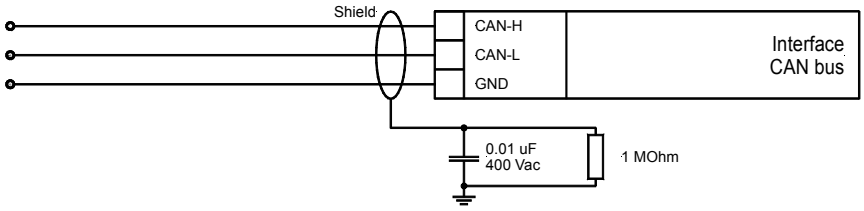
Every 200 ms a data telegram of 8 bytes is sent, which is structured as follows (all word variables are in the high byte / low byte format):

Additional messages about real power and re-active power are transmitted. These contain more internal information which were used also for dead bus operation blocking. These distribution messages were send via the CAN ID 385+generator number and are only used for internal assignment in the MFR 2.

NOTE

Please note that the CAN bus must be terminated with an impedance which corresponds to the wave impedance of the cable (e.g. 120 Ohm).

CAN bus screening



Receiving range

Byte 0 and the following ..... Telegram according to description

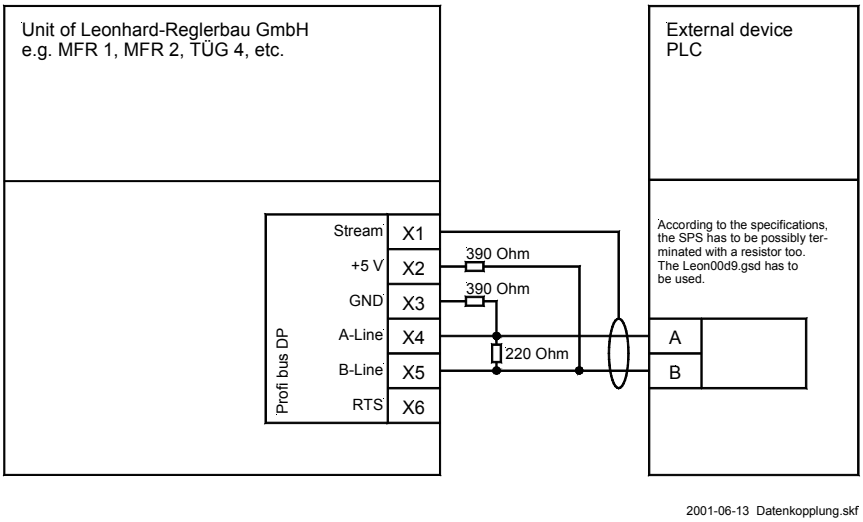
For example: No. 1 - byte 0/1 = Telegram ID "302"
No. 2 - byte 2/3 = voltage L12
No. 3 - byte 4/5 = voltage L23
No. 4 - byte 6/7 = voltage L31
etc.

Byte 185 ..... The bit 0 inverts every 2.5 seconds. This can be used for control if the interface still functions flawlessly.

Received data

Byte 0 ..... Block pre-selection (is not taken into account)
Byte 1 ..... The bit 0 is used as a watchdog. If monitoring is switched on in the configuration screen, this bit must be flipped every 4 seconds. The unit monitors this and possibly triggers a alarm and reinitializes the interface.
Byte 2-7 ..... must be always 0
Byte 8/9 ..... Word No. 5 (see telegram)
Byte 10/11 ..... Word No. 6 (see telegram)
Byte 12/13 ..... Word No. 7 (see telegram)

Connection example



Measuring quantities
- Measuring voltages Rated:.....[1] 66/115 Vac, [4] 230/400 Vac
  UL:..... [1] max. 150 Vac, [4] max. 300 Vac
- Measuring currents..... ../1 A, ../5 A
- Measuring frequency..... 40.0-70.0 Hz
- Accuracy.....class 1

Ambient variables
- Power supply.....9.5-32 V_{DC}, intrinsic consumption max. 15 W
- Ambient temperature.....-20-70 °C
- Ambient humidity..... 95 %, non-condensing

Measuring inputs
- **Voltage**.....resistances 0.1 %
- Linear measuring range up to.....1.3 × U_N
- Input resistance.....[1] 0.21 MΩ, [4] 0.7 MΩ
- Maximum power consumption per path.....0.15 W

- **Current**.....metallically separated
- Linear measuring range up to..... I_{Gen} = 3.0 × I_N, I_{mains} = 1.5 × I_N
- Power consumption..... < 0.15 VA
- Rated short-time current (1 s).....[../1 A] 50.0 × I_N, [../5 A] 10.0 × I_N

Discrete inputs
- Metallically separated
- Input range.....18-250 Vdc or ac
- Input resistance.....ca. 68 kΩ

Potential-free outputs
- Metallically separated
- Contact material..... AgCdO
- Load (GP) ($U_{Cont, relay output}$)..... 2.00 Aac@250 Vac
  2.00 Adc@24 Vdc / 0.36 Adc@125 Vdc / 0.18 Adc@250 Vdc
- Inductive load (PD) ($U_{Cont, relay output}$).....B300
  1.00 Adc@24 Vdc / 0.22 Adc@125 Vdc / 0.10 Adc@250 Vdc

Analog inputs
- Freely scaleable.....resolution 10 bit
- Pt100 Input.....for measuring resistances according to IEC 751
  2/3-conductor measurement, 0-200 °C

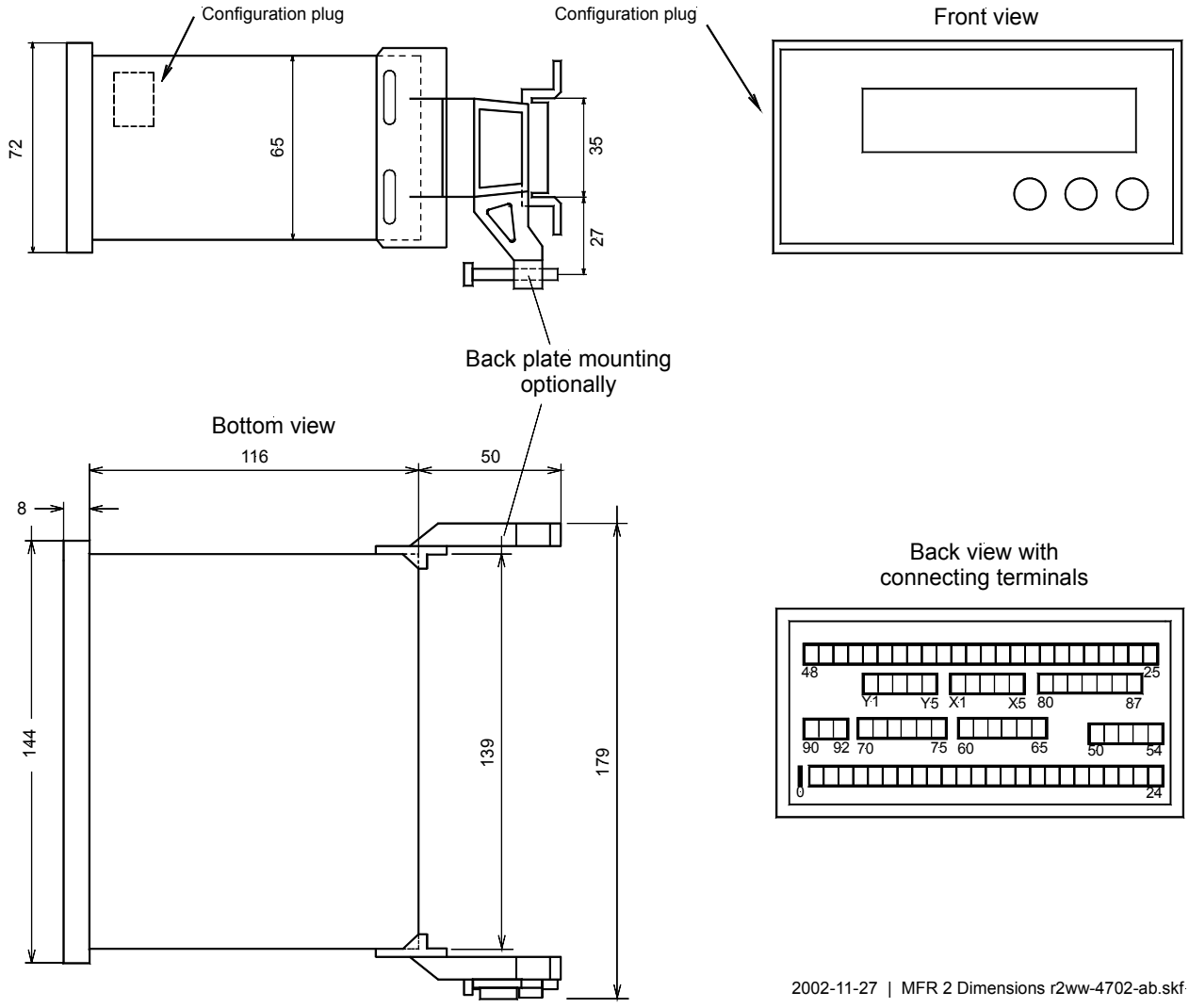
Analog outputs
- For actual value output..... freely scaleable,
  metallically separated, insulation voltage 3,000 V_{DC}
  0-5 V, ±5 V, 0-10 V, 0-20 mA
- Resolution PWM.....8/12 bit (depending on model)
- 0/4-20 mA-output..... maximum load 500 Ω
- 0-5V/0-10 V/±5 V output..... resistance ≤1 kΩ

Interface
- Metallically separated.....isolation voltage 3,000 V_{DC}
- Version..... variable

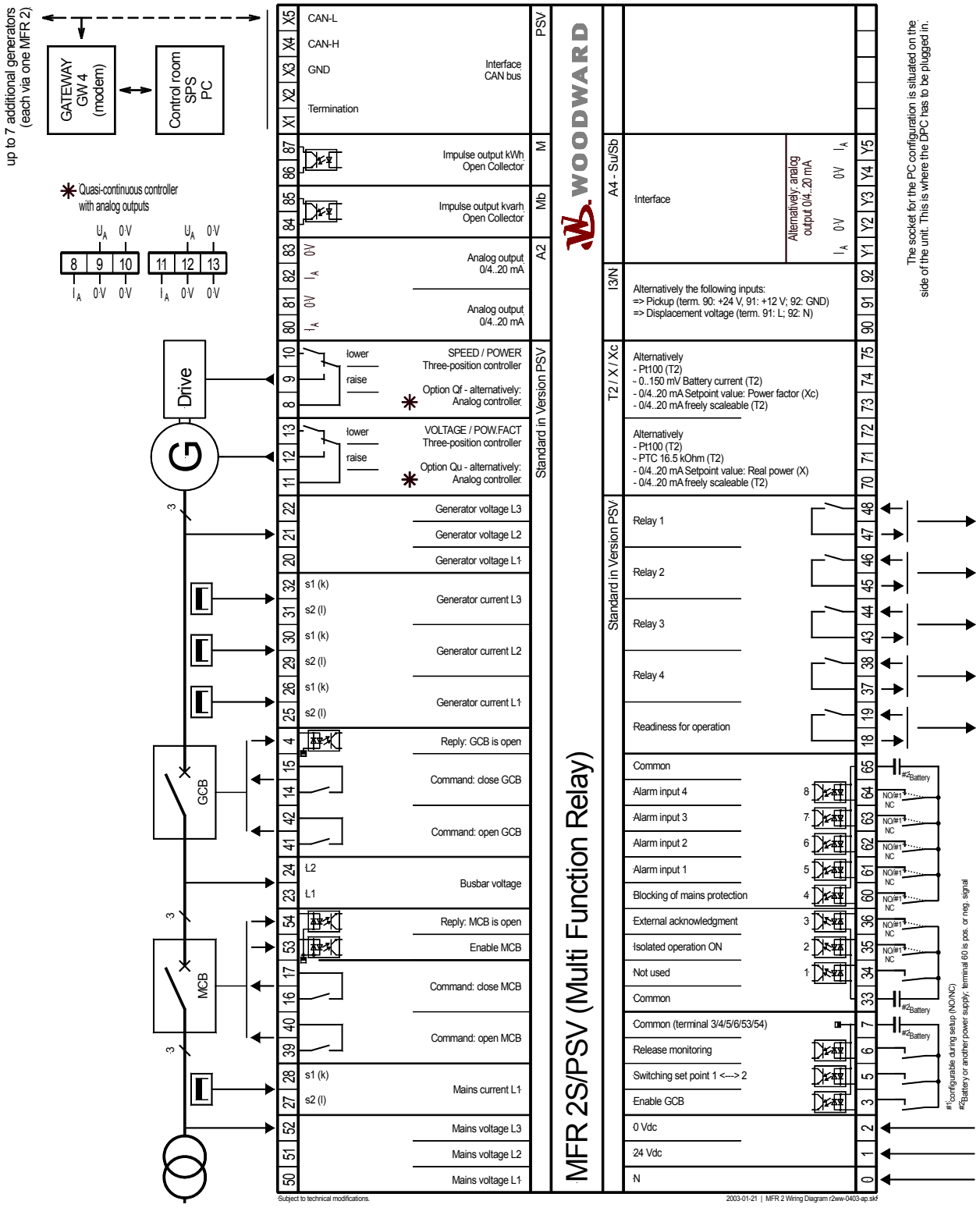
Housing
- Type..... APRANORM DIN 43 700
- Dimensions (B×H×T).....144 × 72 × 122 mm
- Front cutout (B×H).....138 × 67 mm
- Connection.....screw-type connectors, depending on
  plug connector 1.5 mm² or 2.5 mm²
- Weight.....depending on model, approx. 1,000 g

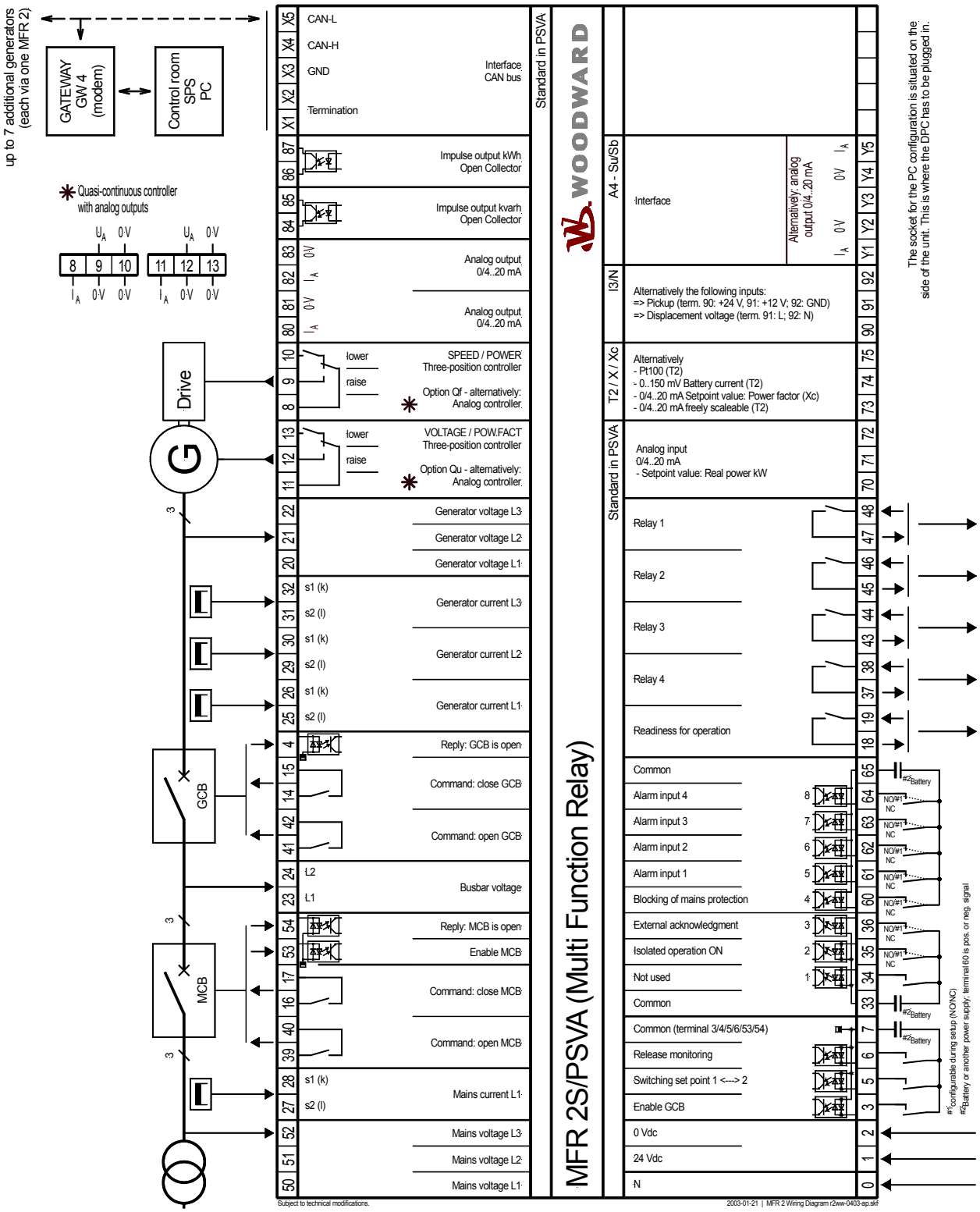
Protection
- Disturbance test (CE).....tested according to applicable EN guidelines
- Type approvals..... UL and cUL Listed, Ordinary Locations, File No.: E212970
- Protection system (of the installation housing).....Type 1
- Front foil..... insulating surface

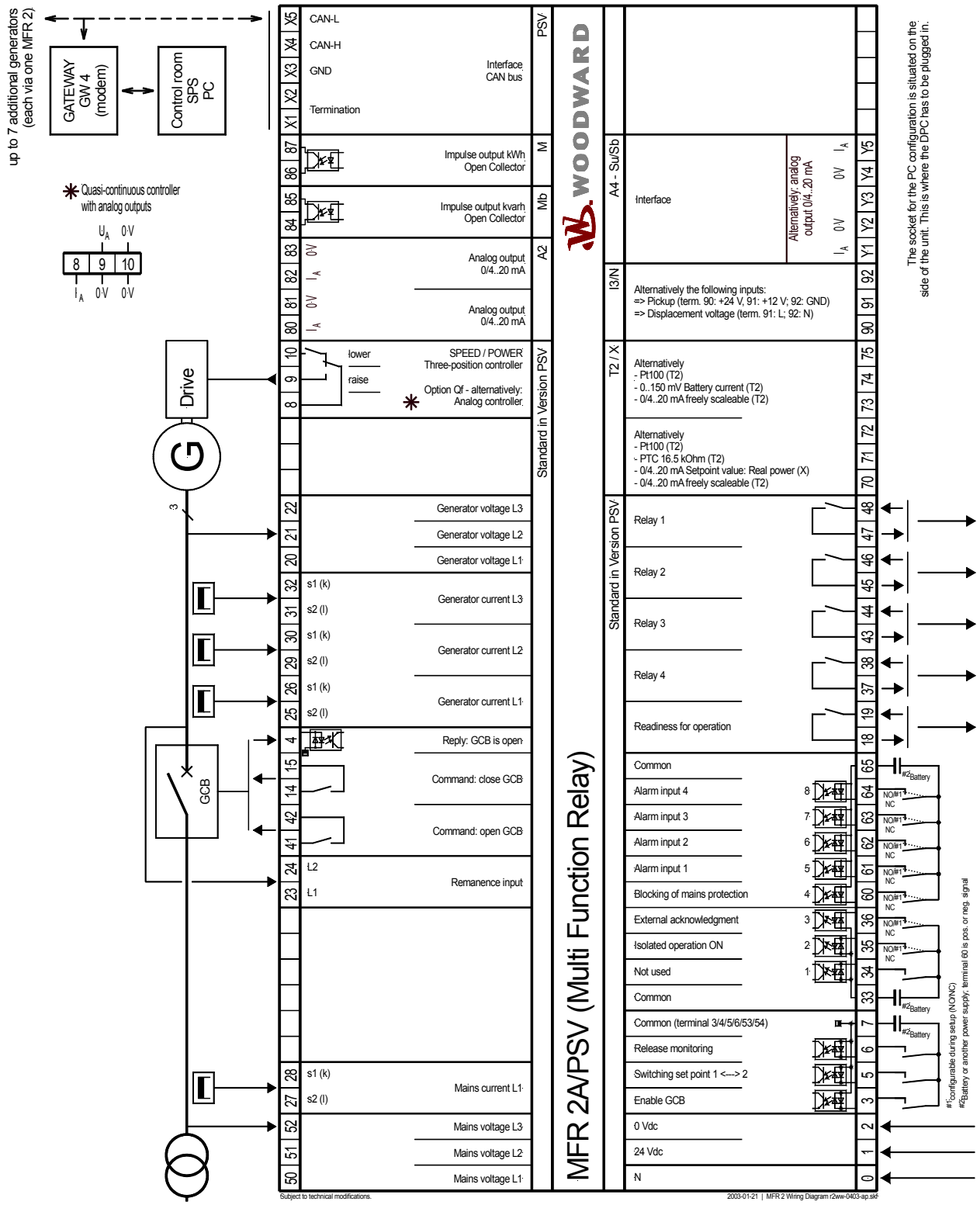
Housing	Type APRANORM DIN 43700
Dimensions	144 × 72 × 122 mm
Front cutout	138 × 67 mm
Connection	Screw type connector, depending on plug connector 1.5 mm² or 2.5 mm²
Protection system	IP 21
Weight	depending on model, approx. 1,000 g

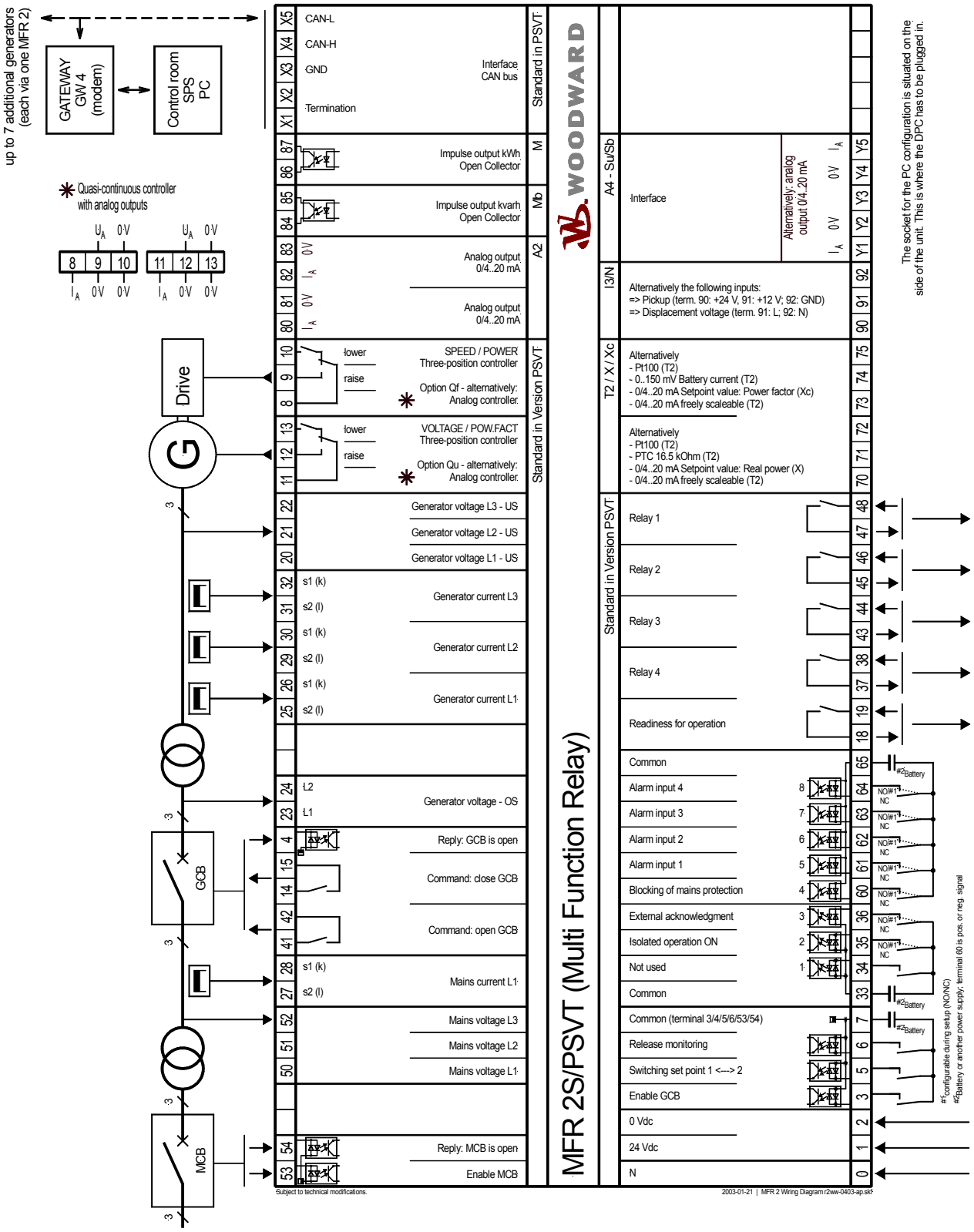


6.6.1 MFR 2S/PSV - Version for Synchronous Generators




up to 7 additional generators (each via one MFR 2)
GATEWAY GW 4 (modem)
Control room SPS PC
Quasi-continuous controller with analog outputs
CAN-L
CAN-H
GND
Termination
Interface CAN bus
Standard in PSVA
Impulse output kWh Open Collector
Impulse output kvarh Open Collector
Analog output 0/4..20 mA
Analog output 0/4..20 mA
lower
raise
SPEED / POWER Three-position controller
Option Qf - alternatively: Analog controller
VOLTAGE / POW.FACT Three-position controller
Option Qu - alternatively: Analog controller
Generator voltage L3
Generator voltage L2
Generator voltage L1
Generator current L3
Generator current L2
Generator current L1
Reply: GCB is open
Command: close GCB
Command: open GCB
Busbar voltage
Reply: MCB is open
Enable MCB
Command: close MCB
Command: open MCB
Mains current L1
Mains voltage L3
Mains voltage L2
Mains voltage L1
Drive
G
GCB
MCB
MFR 2S/PSVA (Multi Function Relay)
A4 - Su/Sb
Interface
Alternatively: analog output 0/4..20 mA
I3/N
Alternatively the following inputs:
=> Pickup (term. 90: +24 V, 91: +12 V; 92: GND)
=> Displacement voltage (term. 91: L; 92: N)
T2 / X / Xc
Alternatively
- Pt100 (T2)
- 0..150 mV Battery current (T2)
- 0/4..20 mA Setpoint value: Power factor (Xc)
- 0/4..20 mA freely scaleable (T2)
Standard in PSVA
Analog input
0/4..20 mA
- Setpoint value: Real power kW
Relay 1
Relay 2
Relay 3
Relay 4
Readiness for operation
Common
Alarm input 4
Alarm input 3
Alarm input 2
Alarm input 1
Blocking of mains protection
External acknowledgment
Isolated operation ON
Not used
Common
Common (terminal 3/4/5/6/53/54)
Release monitoring
Switching set point 1 <---> 2
Enable GCB
0 Vdc
24 Vdc
N
The socket for the PC configuration is situated on the side of the unit. This is where the DPC has to be plugged in.
#1) configurable during setup (NO/NC)
#2) Battery or another power supply; terminal 60 is pos. or neg. signal
Subject to technical modifications.
2003-01-21 | MFR 2 Wiring Diagram r2ww-0403-ap.skf




up to 7 additional generators (each via one MFR 2)
GATEWAY GW 4 (modem)
Control room SPS PC
Quasi-continuous controller with analog outputs
Drive
G
GCB
MCB
MFR 2S/PSVT (Multi Function Relay)
WOODWARD
Standard in PSVT
Standard in Version PSVT
A4 - Su/Sb
I3/N
T2 / X / Xc
CAN-L
CAN-H
GND
Termination
Interface CAN bus
Impulse output kWh Open Collector
Impulse output kvarh Open Collector
Analog output 0/4..20 mA
SPEED / POWER Three-position controller
lower
raise
Option Qf - alternatively: Analog controller
VOLTAGE / POW.FACT Three-position controller
Option Qu - alternatively: Analog controller
Generator voltage L3 - US
Generator voltage L2 - US
Generator voltage L1 - US
Generator current L3
Generator current L2
Generator current L1
Generator voltage - OS
Reply: GCB is open
Command: close GCB
Command: open GCB
Mains current L1
Mains voltage L3
Mains voltage L2
Mains voltage L1
Reply: MCB is open
Enable MCB
Interface
Alternatively: analog output 0/4..20 mA
Alternatively the following inputs:
=> Pickup (term. 90: +24 V, 91: +12 V; 92: GND)
=> Displacement voltage (term. 91: L; 92: N)
Alternatively
- Pt100 (T2)
- 0..150 mV Battery current (T2)
- 0/4..20 mA Setpoint value: Power factor (Xc)
- 0/4..20 mA freely scaleable (T2)
Alternatively
- Pt100 (T2)
- PTC 16.5 kOhm (T2)
- 0/4..20 mA Setpoint value: Real power (X)
- 0/4..20 mA freely scaleable (T2)
Relay 1
Relay 2
Relay 3
Relay 4
Readiness for operation
Common
Alarm input 4
Alarm input 3
Alarm input 2
Alarm input 1
Blocking of mains protection
External acknowledgment
Isolated operation ON
Not used
Common
Common (terminal 3/4/5/6/53/54)
Release monitoring
Switching set point 1 <---> 2
Enable GCB
0 Vdc
24 Vdc
N
The socket for the PC configuration is situated on the side of the unit. This is where the DPC has to be plugged in.
#1configurable during setup (NO/NC)
#2Battery or another power supply; terminal 60 is pos. or neg. signal
Subject to technical modifications.
2003-01-21 | MFR 2 Wiring Diagram r2ww-0403-ap.skf

MFR 2 - Multi Function Relay

Version _____

Project _____

Unit number _____ Date _____

Option	Parameter Line 1 - Text - Line 2	Setting range 100/400 V; 1/5 A	Standard setting	Customer settings		
	Software version	-	V x.xxxx			
	Enter code XXXX	0-9999	0001/0002			
	Enter code protection ON	ON/OFF	ON			
	Direct para.	YES/NO	NO	☐ Y ☐ N	☐ Y ☐ N	☐ Y ☐ N
	Service display	ON/OFF	ON	☐ on ☐ off	☐ on ☐ off	☐ on ☐ off
	ENVIRONMENTAL DATA CONFIGURATION					
	Generator number	1-8	1			
	Change relay- function?	YES/NO	Yes	☐ Y ☐ N	☐ Y ☐ N	☐ Y ☐ N
	Funct. rel. 1234 (R=releases)	E/R	EEEE	☐ E ☐ R	☐ E ☐ R	☐ E ☐ R
	Relay "open GCB" Logic	E/R	E	☐ E ☐ R	☐ E ☐ R	☐ E ☐ R
	Relay "open MCB" Logic	E/R	E	☐ E ☐ R	☐ E ☐ R	☐ E ☐ R
	Open MCB via release MCB	ON/OFF	OFF	☐ on ☐ off	☐ on ☐ off	☐ on ☐ off
	Auto-acknowledge relay	ON/OFF	ON	☐ on ☐ off	☐ on ☐ off	☐ on ☐ off
	Auto-acknowledge messages	ON/OFF	ON	☐ on ☐ off	☐ on ☐ off	☐ on ☐ off
	Acknowledgement message aft.	1-99 s	1 s			
	GENERATOR AND MAINS CONFIGURATION					
	Generator nom. frequency	48.0-62.0 Hz	50.0 Hz			
	Gen. volt. primary	0.050/65.000 kV	6.300/0.400 kV			
	Gen. volt. secondary	50-125/50-480 V	100/400 V			
	Busb. voltage primary	0.050/65.000 kV	6.300/0.400 kV			
	Busb. voltage secondary	50-125/50-480 V	100/400 V			
	Mains voltage primary	0.050/65.000 kV	6.300/0.400 kV			
	Mains voltage secondary	50-125/50-480 V	100/400 V			
	Volt.-Measuring	Ph.-to-ph./Ph.-neutral	Phase-to-phase	☐ p-p ☐ p-n	☐ p-p ☐ p-n	☐ p-p ☐ p-n
	Current transf. Generator	0-6.900/x A	1,000/x A			
	Current transf. Mains	0-6.900/x A	100/x A			
	Power measuring Gen.	1ph. / 3ph.	three-phase	☐ 1 ☐ 3	☐ 1 ☐ 3	☐ 1 ☐ 3
	Nominal power Gen.	5-32,000 kW	500 kW			
	CONTROLLER CONFIGURATION					
	Controller disc. neg. load j.	ON/OFF	OFF	☐ on ☐ off	☐ on ☐ off	☐ on ☐ off
	Admissible act. power jump	10-80 %	22 %			
	Controller dis- connection	1-99 s	5 s			
	Download and open GCB	ON/OFF	OFF	☐ on ☐ off	☐ on ☐ off	☐ on ☐ off
	Control in no- load oper.	ON/OFF	OFF	☐ on ☐ off	☐ on ☐ off	☐ on ☐ off
	Freq. controller	ON/OFF	ON	☐ on ☐ off	☐ on ☐ off	☐ on ☐ off
	Generator freq. f set	40.0-70.0 Hz	50.0 Hz			
	Freq. controller Insens.	0.02-1.00 Hz	0.10 Hz			
	Freq. controller Time pulse>	10-250 ms	70 ms			
	Freq. controller Gain Kp	0.1-99.9	200			
Qf	Starting point Freq.	0-100 %	0 %			
..	Pr.-sensitivity Freq. Kpr	1-240	100			
..	Reset time Freq. Tn	0.0-60.0 s	2.0 s			
Qf	Derivative act. time (freq.)	0.00-6.0 s	2.5.s			
	Freq. controller logic	positive/negative	positive	☐ p ☐ n	☐ p ☐ n	☐ p ☐ n
	Volt. controller	ON/OFF	ON	☐ on ☐ off	☐ on ☐ off	☐ on ☐ off
	Volt. controller Isol. oper.	ON/OFF	ON	☐ on ☐ off	☐ on ☐ off	☐ on ☐ off
	Gen. voltage V set	90-125/200-480 V	100/400 V			
	Setpoint ramp V set	1-400 V/s	80 V/s			
	Volt. controller Insens.	0.5-15.0/0.5-60.0 V	2.5 V			
	Volt. controller Time pulse>	10-250 ms	70 ms			
	Volt. controller Gain Kp	0.1-99.9	20.0			
Qu	Starting point Voltage	0-100 %	50 %			
..	Pr.-sensitivity Volt. Kpr	1-240	100			
..	Reset time Volt. Tn	0.0-60.0 s	2.5 s			
Qu	Derivative act. time (volt)	0.00-6.0 s	0.0 s			
	Volt. controller logic	positive/negative	positive	☐ p ☐ n	☐ p ☐ n	☐ p ☐ n

Option	Parameter Line 1 - Text - Line 2	Setting range 100/400 V; 1/5 A	Standard setting	Customer settings		
	CONTROLLER CONFIGURATION					
MFR 2S	Synchronization functions	ON/OFF	ON	☐ on ☐ off	☐ on ☐ off	☐ on ☐ off
..	Synchronization df max	0.02-0.49 Hz	0.18 Hz			
..	Synchronization df min	0.00-0.49 Hz	-0.10 Hz			
..	Synchronization dU max	1-20/2-60 V	5/20 V			
..	Synchronization Time pulse>	50-250 ms	240 ms			
..	Gen. circuit br. Pick-up t.	40-300 ms	80 ms			
..	Gen. circuit br. Cont. pulse	ON/OFF	OFF	☐ on ☐ off	☐ on ☐ off	☐ on ☐ off
MFR 2S	Mains circuit br. Pick-up t.	40-300 ms	80 ms			
MFR 2A	Connecting Gen.- circuit br.	ON/OFF	ON	☐ on ☐ off	☐ on ☐ off	☐ on ☐ off
..	Connect Gen. CB df max	0.05-2.00 Hz	0.18 Hz			
..	Connect Gen. CB df min	0.00-2.00 Hz	-0.10 Hz			
..	Connect Gen. CB Time pulse>	50-250 ms	240 ms			
MFR 2A	Gen. circuit br. Cont. pulse	ON/OFF	OFF	☐ on ☐ off	☐ on ☐ off	☐ on ☐ off
	Gen. circuit br. Dead bus op.t	ON/OFF	OFF	☐ on ☐ off	☐ on ☐ off	☐ on ☐ off
	Dead bus op. GCB df max	0.05-0.90 Hz	0.25 Hz			
	Dead bus op. GCB dU max	1-20/2-60 V	10 V			
	Mains circuit br Dead bus op.	ON/OFF	OFF	☐ on ☐ off	☐ on ☐ off	☐ on ☐ off
	Sync.time contr.	ON/OFF	OFF	☐ on ☐ off	☐ on ☐ off	☐ on ☐ off
	Sync.time contr. Delay time	10-999 s	120 s			
	Power factor Controller	ON/OFF	ON	☐ on ☐ off	☐ on ☐ off	☐ on ☐ off
	Pow.fact. contr. Setpoint 1	i0.70-1.00-c0.70	1.00			
	Pow.fact. contr. Setpoint 2	i0.70-1.00-c0.70	i0.80			
	Setpoint ramp Pf set	0.05-0.30 /s	0.30 /s			
	Pow.fact. contr. Insens.	0.5-25.0 %	1.0 %			
	Pow.fact. contr. Gain Kp	0.1-99.9	5.0			
Xc	Set Value extern PowFacCon.	ON/OFF	ON	☐ on ☐ off	☐ on ☐ off	☐ on ☐ off
..	Analog input 0/4-20mA	0-20/4-20 mA	4-20 mA			
..	Analog input 0/4mA	i0.70-1.00-c0.70	i0.80			
Xc	Analog input 20mA	i0.70-1.00-c0.70	1.00			
	Power controller	ON/OFF	ON	☐ on ☐ off	☐ on ☐ off	☐ on ☐ off
	Power controller ramp = 000%/s	1-100 %/s	10 %/s			
	Power limitation P max	10-120 %	100/127 %			
	Power controller P set1	5-32,000 kW	250 kW			
	Power controller P set2	5-32,000 kW	500 kW			
X	Set value extern PowContr	ON/OFF	ON	☐ on ☐ off	☐ on ☐ off	☐ on ☐ off
..	Analog input 0/4-20mA	0-20/4-20 mA	4-20 mA			
..	Analog input 0/4 mA	5-32,000 kW	0			
X	Analog input 20 mA	5-32,000 kW	500 kW			
	Power controller Insens.	0.1-25.0 %	2.0 %			
	Power controller Gain Kp	0.1-99.9	20.0			
	Power controller Sens.red.	1.0-9.9	2.0			
Qf	Pr.-sensitivity Power Kpr	1-240	0			
..	Reset time Power Tn	0.0-60.0 s	0.0 s			
Qf	Derivative act. time(pow.)	0.0-6.0 s	5.36 s			
	Part-load lead	ON/OFF	ON	☐ on ☐ off	☐ on ☐ off	☐ on ☐ off
	Part-load lead Setpoint	5-110 %	15/19 %			
	Part-load lead Time	0-600 s	5 s			
	Active power load-share	ON/OFF	OFF	☐ on ☐ off	☐ on ☐ off	☐ on ☐ off
	Act. load share factor	10-99 %	50 %			
	Reactive power load-share	ON/OFF	OFF	☐ on ☐ off	☐ on ☐ off	☐ on ☐ off
	React load share factor	10-99 %	50 %			
	CONFIGURATION OF THE PROTECTIVE FUNCTIONS					
	Overload power Monitoring	ON/OFF	ON	☐ on ☐ off	☐ on ☐ off	☐ on ☐ off
	Gen. Overload Max. power	80-120 %	110 %			
	Gen. overload Delay	0.1-600.0 s	3.0 s			
	Gen. Overload Relay outp.	0-4	0002			
	Reverse power monitoring	ON/OFF	ON	☐ on ☐ off	☐ on ☐ off	☐ on ☐ off
	Reverse power Threshold	+99-0-99 %	-10 %			
	Reverse power Delay	0.1-99.9 s	0.1 s			
	Reverse power Relay outp.	0-4	0002			
	Load unbalance Monitoring	ON/OFF	ON	☐ on ☐ off	☐ on ☐ off	☐ on ☐ off
	Load unbalance Threshold	0-100 %	20 %			
	Load unbalance Delay	0.04-99.98 s	0.10 s			
	Load unbalance Relay outp.	0-4	0002			

Option	Parameter Line 1 - Text - Line 2	Setting range 100/400 V; 1/5 A	Standard setting	Customer settings		
	CONFIGURATION OF THE PROTECTIVE FUNCTIONS					
	Overcurrent monitoring	ON/OFF	ON	☐ on ☐ off	☐ on ☐ off	☐ on ☐ off
	Overcurrent Thresh. 1	0-300 %	120 %			
	Overcurrent Delay 1	0.04-99.98 s	0.1 s			
	Overcurrent 1 Relay outp.	0-4	0002			
	Overcurrent Thresh. 2	0-300 %	140 %			
	Overcurrent Delay 2	0.04-99.98 s	0.1 s			
	Overcurrent 2 Relay outp.	0-4	0002			
I3	**Earth-fault monitoring**	ON/OFF	OFF	☐ on ☐ off	☐ on ☐ off	☐ on ☐ off
..	**Residual volt. Response v.**	1-125 V	8 V			
..	**Residual volt. Delay**	0.02-99.98 s	0.10 s			
I3	**Residual volt. Relay outp.**	0-4	0002			
	Lagg.react.power monitoring	ON/OFF	ON	☐ on ☐ off	☐ on ☐ off	☐ on ☐ off
	Lagg.react.power Threshold	0-160 %	79 %			
	Lagg.react.power Delay	0.04-99.98 s	0.1 s			
	Lagg.react.power Relay outp.	0-4	0002			
	Lead.react.power monitoring	ON/OFF	ON	☐ on ☐ off	☐ on ☐ off	☐ on ☐ off
	beac. pow. cap. Threshold	0-160 %	79 %			
	Lead.react.power Delay	0.04-99.98 s	0.1 s			
	Lead.react.power Relay outp.	0-4	0002			
	Gen. frequency Monitoring	ON/OFF	ON	☐ on ☐ off	☐ on ☐ off	☐ on ☐ off
	Gen. overfreq. f >	40.0-70.0 Hz	55.00 Hz			
	Gen. overfreq. Delay	0.04-9.98 s	0.50 s			
	Gen. overfreq. Relay outp.	0-4	0002			
	Gen. underfreq. f <	40.0-70.0 Hz	45.00 Hz			
	Gen. underfreq. Delay	0.04-9.98 s	0.50 s			
	Gen. underfreq. Relay outp.	0-4	0002			
	Gen. voltage Monitoring	ON/OFF	ON	☐ on ☐ off	☐ on ☐ off	☐ on ☐ off
	Rated voltage Gen. Vn =	50-125/50-480V	400 V			
	Volt. Monit.Gen.	Phase to phase/neutral	Phase to phase			
	Gen. overvolt. V >	20..150 %	115 %			
	Gen. overvolt. Delay	0.04-9.98 s	0.50 s			
	Gen. overvolt. Relay outp.	0-4	0002			
	Gen. undervolt V <	20..150 %	85 %			
	Gen. undervolt. Delay	0.04-9.98 s	0.50 s			
	Gen. undervolt. Relay outp.	0-4	0002			
	Mains frequency Monitoring	ON/OFF	ON	☐ on ☐ off	☐ on ☐ off	☐ on ☐ off
	Mains overfreq. f >	40.0-70.0 Hz	50.20 Hz			
	Mains overfreq. Delay	0.04-9.98 s	0.10 s			
	Mains overfreq. Relay outp.	0-4	0001			
	Mains underfreq. f <	40.0-70.0 Hz	49.80 Hz			
	Mains underfreq. Delay time	0.04-9.98 s	0.10 s			
	Mains underfreq. Relay outp.	0-4	0001			
	Mains voltage monitoring	ON/OFF	ON	☐ on ☐ off	☐ on ☐ off	☐ on ☐ off
	Rated voltage Mains Vn =	50-125/50-480V	400 V			
	Volt. Monit.Mains	Phase to phase/neutral	Phase to phase			
	Mains overvolt. V >	20..150 %	110 %			
	Mains overvolt. Delay	0.04-9.98 s	0.10 s			
	Mains overvolt. Relay outp.	0-4	0001			
	Mains undervolt. V <	20..150 %	90 %			
	Mains undervolt. Delay	0.04-9.98 s	0.10 s			
	Mains undervolt. Relay outp.	0-4	0001			
	Asymmetry Monitoring	ON/OFF	OFF			
	Asymmetry Threshold	0-99 %	40 %			
	Asymmetry Delay	0.04-99.98 s	0.50 s			
	Asymmetry Relay outp.	0-4	0001			
	Phase shift- Monitoring	ON/OFF	OFF	☐ on ☐ off	☐ on ☐ off	☐ on ☐ off
	Phase jmp monit.	1/3ph. / 3ph.only	three-phase only			
	Phase-jump value (One phase)	2-90 °	30 °			
	Phase-jump value (3-phase)	2-90 °	8 °			
	Phase-jump value Relay outp.	0-4	0001			
	df/dt- Monitoring	ON/OFF	OFF	☐ on ☐ off	☐ on ☐ off	☐ on ☐ off
	Release value df/dt>	1.0-9.9 Hz/s	2.6 Hz/s			
	Time delay df/dt	0.1-9.9 s	0.1 s			
	df/dt monitoring Relay outp.	0-4	0001			
	Mains decoupling through	GCB/MCB	MCB			
	Batt. undervolt. V <	10.0-35.0 V	20.0 V			
	Batt. undervolt. Relay outp.	0-4	0003			

Option	Parameter Line 1 - Text - Line 2	Setting range 100/400 V; 1/5 A	Standard setting	Customer settings		
	MONITORING CONFIGURATION					
	Central alarm Relay outp.	0-4	0003			
	Monitoring ON after	1-99 s	5 s			
	Monitoring ON at f gen >	15-70 Hz	15 Hz			
	f Gen > xx Hz Relay outp.	0-4	0000			
	OUTPUTS CONFIGURATION					
M	Pulse/kWh Logic	positive/negative	positive	☐ p ☐ n	☐ p ☐ n	☐ p ☐ n
M	Active energy Pulse/kWh	0,1-150,0	10,0			
Mb	Pulse/kvarh Logic	positive/negative	positive	☐ p ☐ n	☐ p ☐ n	☐ p ☐ n
..	Reactive energy P./kvarh	0,1-150,0	10,0			
Mb	Pulse/kvarh Type	leading / lagging	lagging	☐ c ☐ i	☐ c ☐ i	☐ c ☐ i
A2/4	Analog out. 80/81	0-20 / 4-20 mA / OFF	OFF	☐ on ☐ off	☐ on ☐ off	☐ on ☐ off
..	Analog out 80/81	according to list	-			
..	Analog output 0 mA	0-max	-			
..	Analog output 20 mA	0-max	-			
..	Analog out. 82/83	0-20 / 4-20 mA / OFF	OFF	☐ on ☐ off	☐ on ☐ off	☐ on ☐ off
..	Analog out. 82/83	according to list	-			
..	Analog output 0 mA	0-max	-			
..	Analog output 20 mA	0-max	-			
..	Analog out. Y1/Y2	0-20 / 4-20 mA / OFF	OFF	☐ on ☐ off	☐ on ☐ off	☐ on ☐ off
..	Analog out. Y1/Y2	according to list	-			
..	Analog output 0 mA	0-max	-			
..	Analog output 20 mA	0-max	-			
..	Analog out. Y4/Y5	0-20 / 4-20 mA / OFF	OFF	☐ on ☐ off	☐ on ☐ off	☐ on ☐ off
..	Analog out. Y4/Y5	according to list	-			
..	Analog output 0 mA	0-max	-			
A2/4	Analog output 20 mA	0-max	-			
Su/Sb	**INTERFACE CONFIGURATION**					
.. MOD	Control by MODBUS	ON/OFF	ON	☐ on ☐ off	☐ on ☐ off	☐ on ☐ off
..	Interface error Relay outp.	0-4	0000			
.. MOD	Delay to send MOD-Bus	0.2-50.0 ms	3.0 ms			
3964	Interface	ON/OFF	OFF	☐ on ☐ off	☐ on ☐ off	☐ on ☐ off
..	Baud rate	1,200 / 2,400 / 4,800 / 9,600 / 19,200 Baud	9600 Baud			
	Parity	none/direct/indirect	direct			
	Sending cycle	0-10 s	1 s			
	Interpreter Rk512	ON/OFF	ON	☐ on ☐ off	☐ on ☐ off	☐ on ☐ off
	Data module	0-255	0			
	Data word	0-255	0			
.. 3964	Interface error Relay outp.	0-4	0000			
.. Profib.	PROFIBUS-station	1-125	50			
..	Control by PROFIBUS	ON/OFF	ON	☐ on ☐ off	☐ on ☐ off	☐ on ☐ off
..	PROFIBUS Watchdog	ON/OFF	OFF	☐ on ☐ off	☐ on ☐ off	☐ on ☐ off
.. Profib.	Interface fault Relay outp.	0-4	0000			
.. CAN	Control by Interface	ON/OFF	OFF	☐ on ☐ off	☐ on ☐ off	☐ on ☐ off
	COUNTER CONFIGURATION					
	Service interval in	0-9,999 h	300 h			
	Set oper. hour counter:	0-65,000 h	0 h			
	Set counter of starts	0-49,999	0			
	energy counter set in	kilo/Mega	Mega			
	Set pos. active energy	0-65,500 xWh	0 xWh			
	Set neg. active. energy	0-65,500 xWh	0 xWh			
	Set lagg. react. ener.	0-65,500 xvarh	0 xvarh			
	Set lead. react. ener.	0-65,500 xvarh	0 xvarh			

Option	Parameter Line 1 - Text - Line 2	Setting range 100/400 V1/ 5 A	Standard setting	Customer settings		
	INPUTS CONFIGURATION					
T2	Temperat. 70-72 Pt100	ON/OFF	OFF	☐ on ☐ off	☐ on ☐ off	☐ on ☐ off
..	Thresh. warning	0-200 °C	0 °C			
..	Thresh. tripping	0-200 °C	0 °C			
..	Hyst. warning	0-200 °C	5 °C			
..	Hyst. tripping	0-200 °C	5 °C			
..	Thresh. warning Delay.	0-999 s	1 s			
..	Thresh. tripping Delay	0-999 s	1 s			
..	Warning Relay outp.	0-4	0000			
..	Tripping Relay outp.	0-4	0000			
..	Analog input 1 term.70/71	ON/OFF	OFF	☐ on ☐ off	☐ on ☐ off	☐ on ☐ off
..	Analog input 1 Typ	0-20 / 4-20 mA	4-20 mA			
..	Value at 0/4mA	-9,999-0-+9,999	400			
..	Value at 20mA	-9,999-0-+9,999	2,000			
..	Anin 1 monitor. for	high lim./low lim.	high limit mon.	☐ h ☐ l	☐ h ☐ l	☐ h ☐ l
..	Thresh. warning Value=	-9,999-0-+9,999	0			
..	Thresh. tripping Value=	-9,999-0-+9,999	0			
..	Thresh. warning Delay=	0-999 s	1 s			
..	Thresh. tripping Delay=	0-999 s	1 s			
..	Thresh. warning Relay outp.	0-4	0000			
..	Thresh. tripping Relay outp.	0-4	0000			
..	Generatortemp. PTC	ON/OFF	OFF	☐ on ☐ off	☐ on ☐ off	☐ on ☐ off
..	Threshold Gen.Temp.=	0-100 %	0 %			
..	Operate delay Gen.Temp.=	0-600 s	1 s			
..	Revert delay Gen.Temp.=	0-600 s	1 s			
..	Hysteresis Gen.Temp.=	0-50 %	5 %			
..	Generatortemp. Relay outp.	0-4	0000			
..	**INPUTS CONFIGRATION - INPUT 2 (TERMINALS 73-75)**					
..	Temperat. 73-75 Pt100	ON/OFF	OFF	☐ on ☐ off	☐ on ☐ off	☐ on ☐ off
..	Thresh. warning	0-200 °C	0 °C			
..	Thresh.tripping	0-200 °C	0 °C			
..	Hyst. warning	0-200 °C	5 °C			
..	Hyst. tripping	0-200 °C	5 °C			
..	Thresh. warning Delay=	0-999 s	1 s			
T2	Thresh. tripping Delay=	0-999 s	1 s			
..	Thresh. warning Relay outp.	0-4	0000			
..	Thresh. tripping Relay outp.	0-4	0000			
..	Analog input 2 Kl.73/74	ON/OFF	OFF	☐ on ☐ off	☐ on ☐ off	☐ on ☐ off
..	Analog input 2 Type	0-20 / 4-20 mA	4-20 mA			
..	Value at 0/4mA	-9,999-0-+9,999	400			
..	Value at 20mA	-9,999-0-+9,999	2,000			
..	Anin 2 monitor for	high lim./low lim.	high limit mon.	☐ h ☐ l	☐ h ☐ l	☐ h ☐ l
..	Thresh. warning Value=	-9,999-0-+9,999	0			
..	Thresh. tripping Value=	-9,999-0-+9,999	0			
..	Thresh. warning Delay =	0-999 s	1 s			
..	Thresh. tripping Delay =	0-999 s	1 s			
..	Thresh. warning Relay outp.	0-4	0000			
..	Thresh. tripping Relay outp.	0-4	0000			
..	Batt. current monitoring	ON/OFF	OFF	☐ on ☐ off	☐ on ☐ off	☐ on ☐ off
..	Batt. current 0mV =	0.0-99.9 A	0.0 A			
..	Batt. current 150mV =	0.0-99.9 A	10.0 A			
..	Thresh. level 1 Curr. =	0.0-99.9 A	0.0 A			
..	Thresh. level 2 Curr. =	0.0-99.9 A	0.0 A			
..	Batt. overcur 1 Delay =	0-600 s	1 s			
..	Batt. overcur 2 Delay =	0-600 s	1 s			
..	Batt. overcur 1 Relay outp.	0-4	0000			
T2	Batt. overcur 2 Relay outp.	0-4	0000			
	DISCRETE INPUT CONFIGURATION					
	Dig. input 234 Function:	E/R	EEE			
	Dig. input 5678 Function:	E/R	EEEE			
	Dig. input 5678 delayed	Y/N	NNNN			
	Dig. input 5678 Err. class	0-3	0000			
	Fault text: t. 61	Any	Terminal 61			
	Fault text: t. 62	Any	Terminal 62			
	Fault text: t. 63	Any	Terminal 63			
	Fault text: t. 64	Any	Terminal 64			
	CONFIGURE PASSWORDS					
	Define level 1 Code	0-9999	0001			
	Define level 2 Code	0-9999	0002			