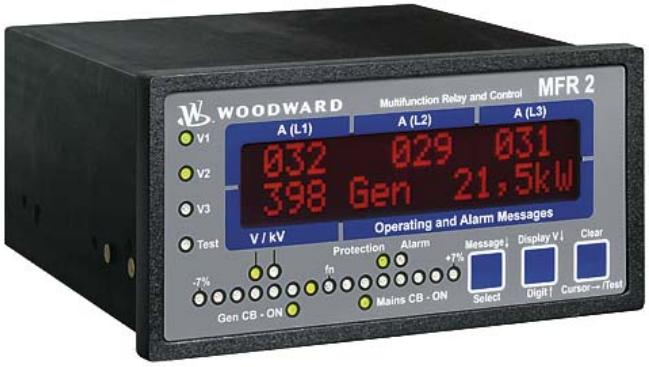
37355A

MFR 2
Multi Function Relay



Manual
from Version 3.5xxx

Manual 37355A

WARNING

Read this entire manual and all other publications pertaining to the work to be performed before installing, operating, or servicing this equipment. Practice all plant and safety instructions and precautions. Failure to follow instructions can cause personal injury and/or property damage.

The engine, turbine, or other type of prime mover should be equipped with an overspeed (overtemperature, or overpressure, where applicable) shutdown device(s), that operates totally independently of the prime mover control device(s) to protect against runaway or damage to the engine, turbine, or other type of prime mover with possible personal injury or loss of life should the mechanical-hydraulic governor(s) or electric control(s), the actuator(s), fuel control(s), the driving mechanism(s), the linkage(s), or the controlled device(s) fail.

Any unauthorized modifications to or use of this equipment outside its specified mechanical, electrical, or other operating limits may cause personal injury and/or property damage, including damage to the equipment. Any such unauthorized modifications: (i) constitute "misuse" and/or "negligence" within the meaning of the product warranty thereby excluding warranty coverage for any resulting damage, and (ii) invalidate product certifications or listings.

CAUTION

To prevent damage to a control system that uses an alternator or battery-charging device, make sure the charging device is turned off before disconnecting the battery from the system.

Electronic controls contain static-sensitive parts. Observe the following precautions to prevent damage to these parts.

- **Discharge body static before handling the control (with power to the control turned off, contact a grounded surface and maintain contact while handling the control).**
- **Avoid all plastic, vinyl, and Styrofoam (except antistatic versions) around printed circuit boards.**
- **Do not touch the components or conductors on a printed circuit board with your hands or with conductive devices.**

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Important definitions

WARNING

Indicates a potentially hazardous situation that, if not avoided, could result in death or serious injury.

CAUTION

Indicates a potentially hazardous situation that, if not avoided, could result in damage to equipment.

NOTE

Provides other helpful information that does not fall under the warning or caution categories.

Revision History

Rev.	Date	Editor	Changes
NEW	06-05-12	TP	New release in WW format based on 37131C, minor changes; package harmonization
A	07-12-11	TP	Minor changes

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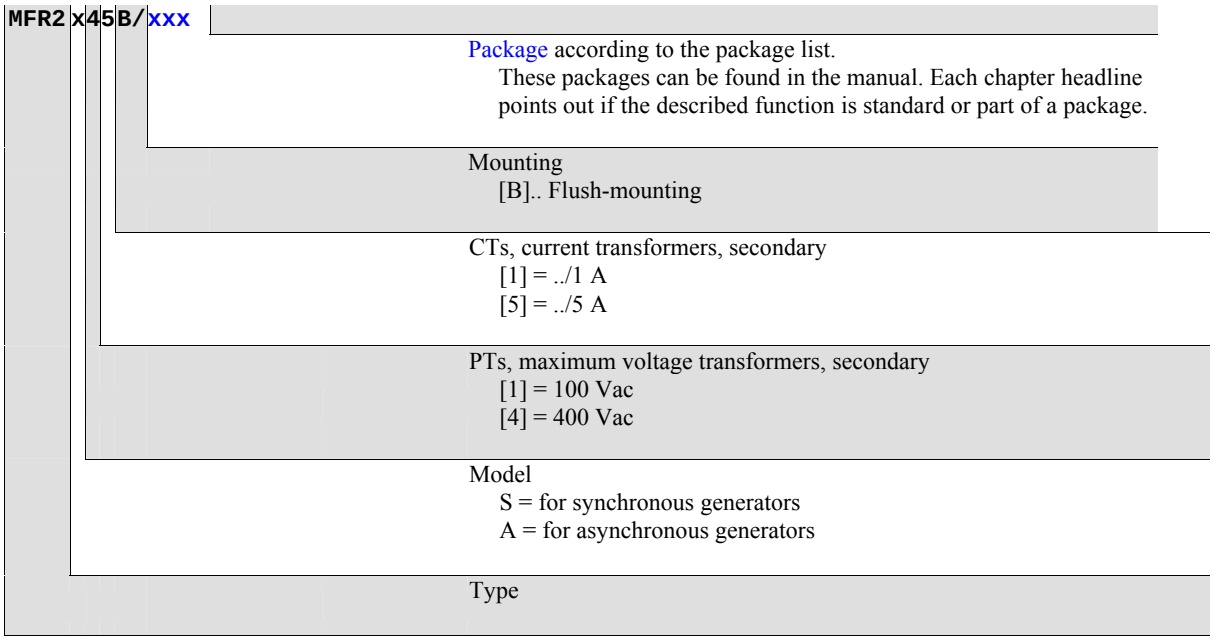
Chapter 1.
General Information

The MFR 2 is a multi function relay with mains and generator protection and control. The ability for the MFR 2 to quickly decouple from the mains when working in parallel with the mains gives complete generator protection for frequency, voltage, and real and re-active power control allowing load/var sharing between as many as eight units.

The detailed model description for the MFR 2 reads as follows:



Example:

- MFR2S15B/PSVA (flush mounted, standard unit for synchronous generators with 100 Vac PT measuring inputs, 5 Aac CT measuring input, mains ROCOF protection, two analog outputs and pulse output)
- MFR2A45B/PSV (flush mounted, standard unit for asynchronous generators with 400 Vac PT measuring inputs, 5 Aac CT measuring input)

Intended Use The unit must only be operated in the manner described by 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.

NOTE

This manual has been developed 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.

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

Chapter 2.
Electrostatic Discharge Awareness

All electronic equipment is static-sensitive, some components more than others. To protect these components from static damage, you must take special precautions to minimize or eliminate electrostatic discharges.

Follow these precautions when working with or near the control.

1. Before doing maintenance on the electronic control, discharge the static electricity on your body to ground by touching and holding a grounded metal object (pipes, cabinets, equipment, etc.).

2. Avoid the build-up of static electricity on your body by not wearing clothing made of synthetic materials. Wear cotton or cotton-blend materials as much as possible because these do not store static electric charges as easily as synthetics.

3. Keep plastic, vinyl, and Styrofoam materials (such as plastic or Styrofoam cups, cigarette packages, cellophane wrappers, vinyl books or folders, plastic bottles, etc.) away from the control, modules, and work area as much as possible.

4. **Opening the control cover may void the unit warranty.**
   Do not remove the printed circuit board (PCB) from the control cabinet unless absolutely necessary. If you must remove the PCB from the control cabinet, follow these precautions:

   - Ensure that the device is completely voltage-free (all connectors have to be disconnected).
   - Do not touch any part of the PCB except the edges.
   - Do not touch the electrical conductors, connectors, or components with conductive devices or with bare hands.
   - When replacing a PCB, keep the new PCB in the plastic antistatic protective bag it comes in until you are ready to install it. Immediately after removing the old PCB from the control cabinet, place it in the antistatic protective bag.

CAUTION

To prevent damage to electronic components caused by improper handling, read and observe the precautions in Woodward manual 82715, *Guide for Handling and Protection of Electronic Controls, Printed Circuit Boards, and Modules.*

Chapter 3.
Installation

CAUTION

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 units, or auxiliary or power contacts) must be connected to a suitable interference suppressor.

WARNING

All technical data and ratings indicated in this chapter are not definite! Only the values indicated in the Technical Data section on page 91 are valid!

The following chart may be used to convert square millimeters [mm²] to AWG and vice versa:

AWG	mm²	AWG	mm²	AWG	mm²	AWG	mm²	AWG	mm²	AWG	mm²
30	0.05	21	0.38	14	2.5	4	25	3/0	95	600MCM	300
28	0.08	20	0.5	12	4	2	35	4/0	120	750MCM	400
26	0.14	18	0.75	10	6	1	50	300MCM	150	1000MCM	500
24	0.25	17	1.0	8	10	1/0	55	350MCM	185		
22	0.34	16	1.5	6	16	2/0	70	500MCM	240		

Table 3-1: Conversion chart - wire size

Wiring Diagram

MFR 2S/PSV

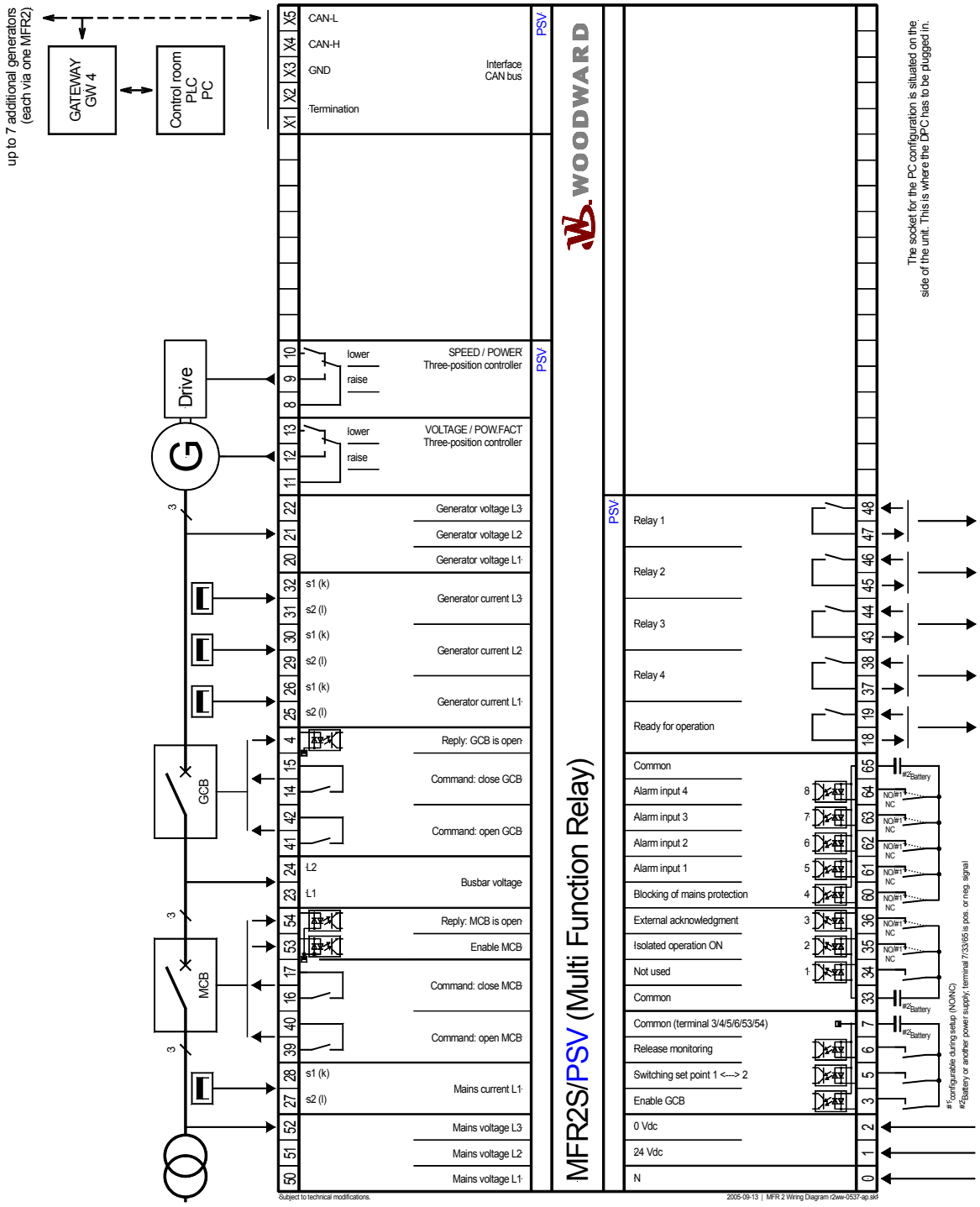


Figure 3-1: Wiring diagram MFR 2S/PSV

MFR 2S/PSVA

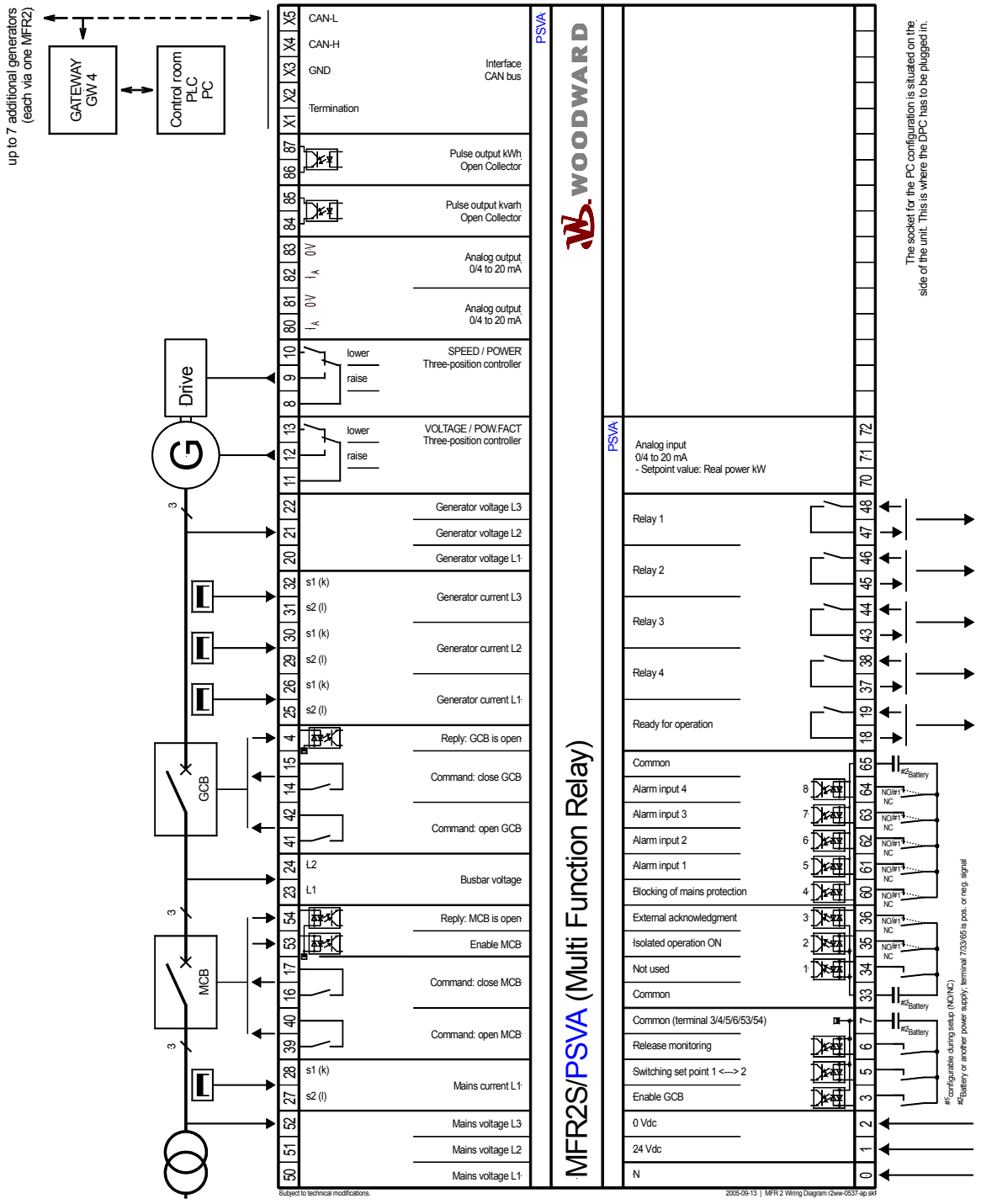


Figure 3-2: Wiring diagram MFR 2S/PSVA

MFR 2S/PSVT

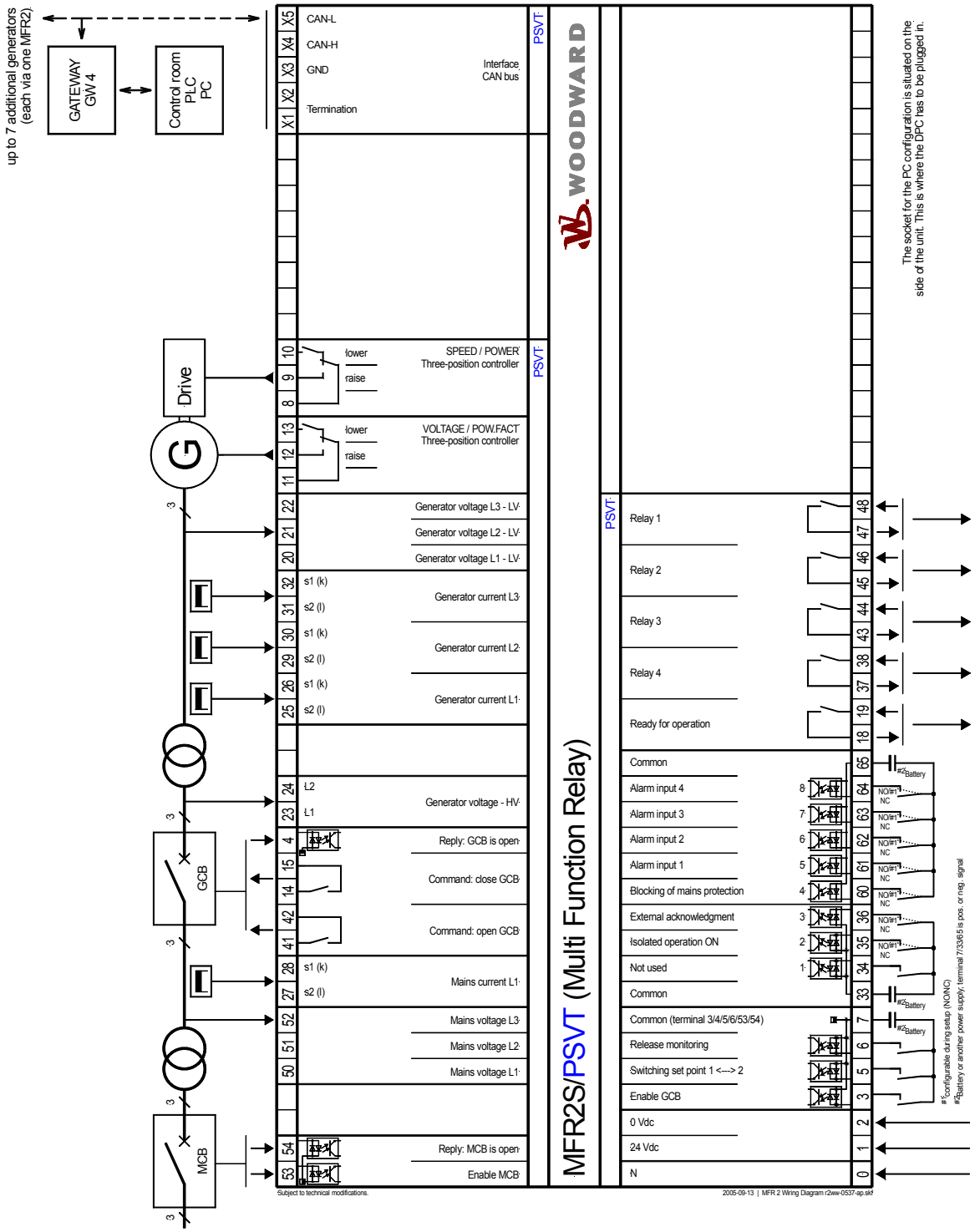


Figure 3-3: Wiring diagram MFR 2S/PSVT

MFR 2A/PSV

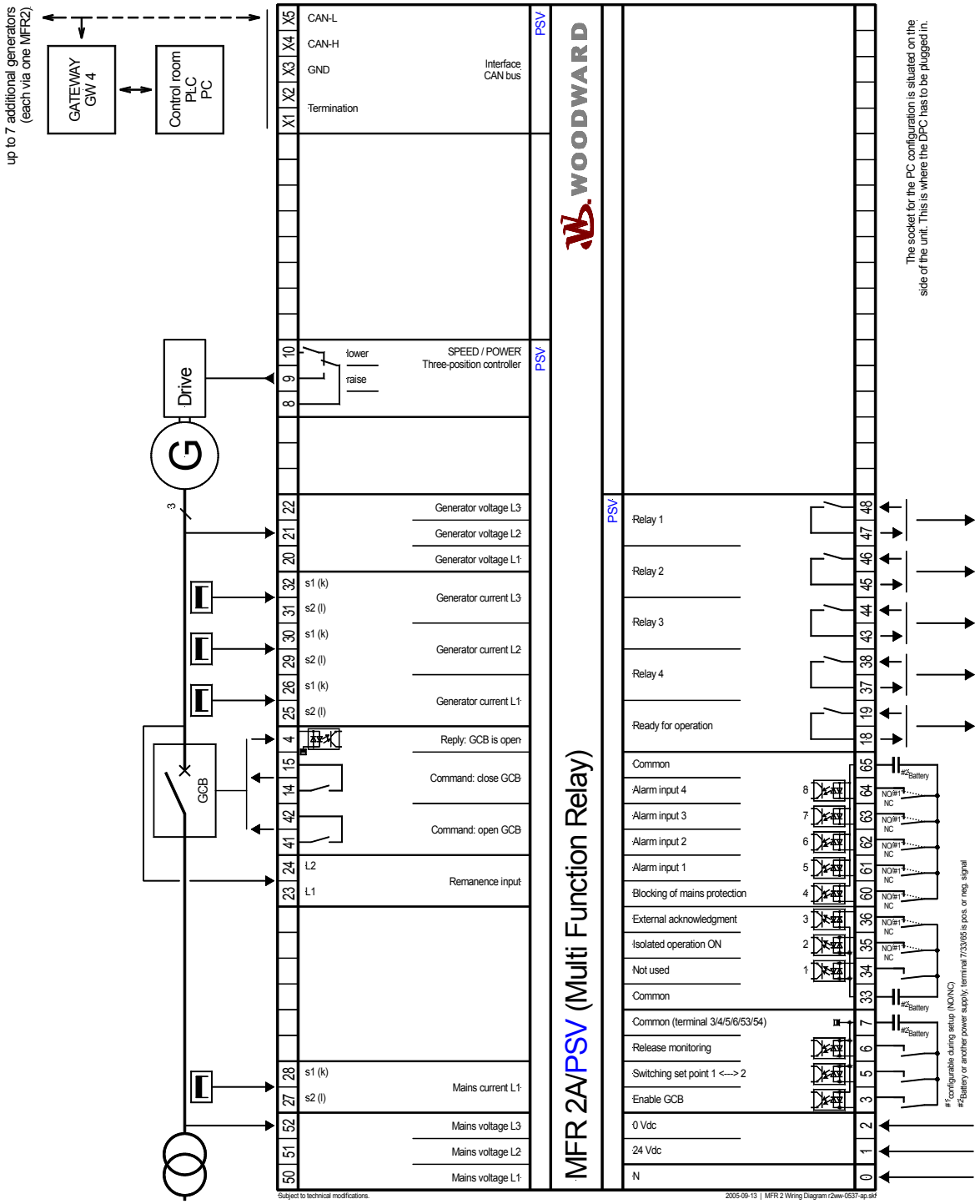


Figure 3-4: Wiring diagram MFR 2A/PSV

Power Supply

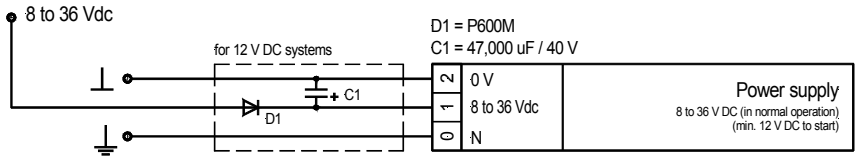


Figure 3-5: Power supply (24 Vdc)

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 to 36 V DC, 15 W	2.5 mm²
2	0 V reference point	2.5 mm²

Table 3-2: Power supply - terminal assignment

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).

Voltage Measuring Inputs (PSV / PSVA)

Generator

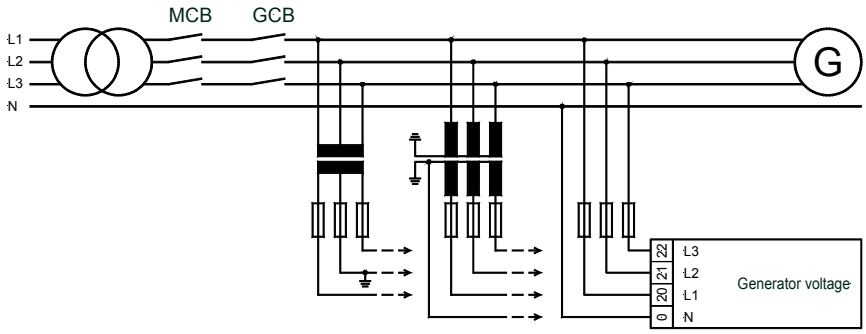


Figure 3-6: Measuring inputs - generator voltage

Terminal	Measurement	Description	A_{max}
20	400 V direct or via 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	Solder lug

Table 3-3: Measuring inputs - generator voltage - terminal assignment

Busbar

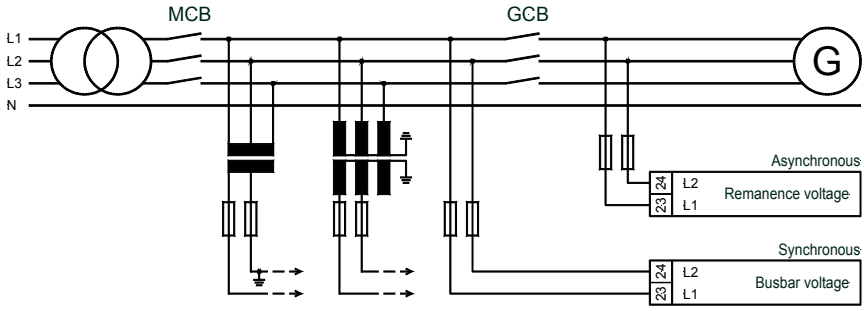


Figure 3-7: Measuring inputs - busbar voltage

Terminal	Measurement	Description	A_{max}
23	400 V direct or via transformer ../100 V	Busbar voltage L1	2.5 mm²
24		Busbar voltage L2	2.5 mm²

Table 3-4: Measuring inputs - busbar voltage - terminal assignment

Mains

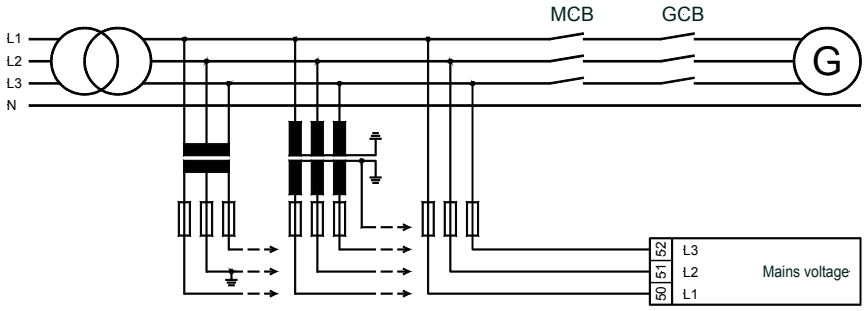


Figure 3-8: Measuring inputs - mains voltage

Terminal	Measurement	Description	A_{max}
50	400 V direct or via 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 three-phase system / transformer	Solder lug

Table 3-5: Measuring inputs - mains voltage - terminal assignment

NOTE

The mains voltage measuring inputs must be connected if the unit is used in mains parallel operation.

Voltage Measuring Inputs (PSVT)

Generator - Low Voltage Side (LV)

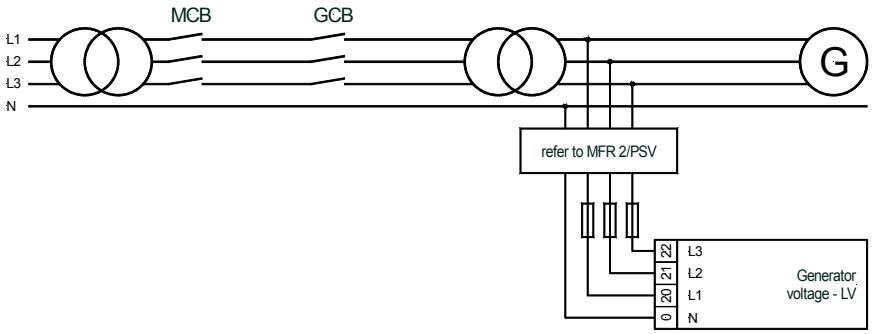


Figure 3-9: Measuring inputs - generator voltage

Terminal	Measurement	Description	A_{max}
20	400 V direct or via transformer ../100 V	Generator voltage L1 - low voltage side - LV	2.5 mm²
21		Generator voltage L2 - low voltage side - LV	2.5 mm²
22		Generator voltage L3 - low voltage side - LV	2.5 mm²
0		Neutral point of the 3-phase system / transformer	Solder lug

Table 3-6: Measuring inputs - generator voltage LV - terminal assignment

Generator - High Voltage Side (HV)

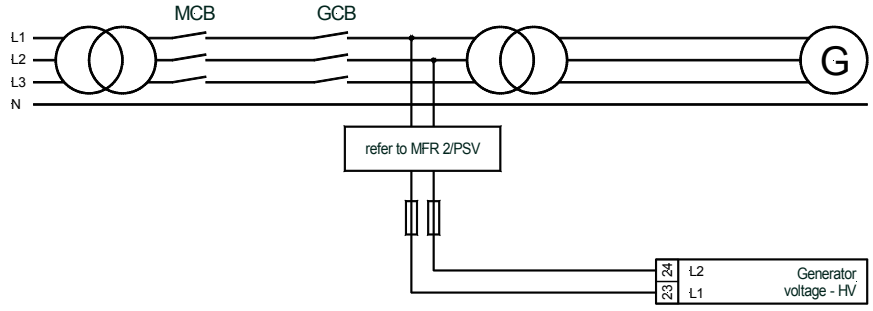


Figure 3-10: Measuring inputs - generator voltage

Terminal	Measurement	Description	A_{max}
23	400 V direct or via transformer ../100 V	Generator voltage L1 - high voltage side - HV	2.5 mm²
24		Generator voltage L2 - high voltage side - HV	2.5 mm²

Table 3-7: Measuring inputs - generator voltage HV - terminal assignment

Mains

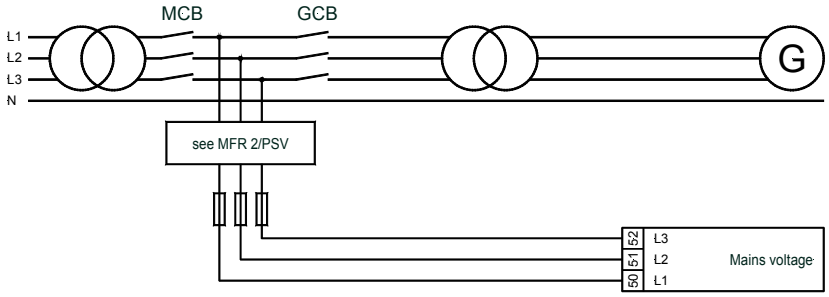


Figure 3-11: Measuring inputs - mains voltage

Terminal	Measurement	Description	A_{max}
50	400 V direct or via 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 three-phase system / transformer	Solder lug

Table 3-8: Measuring inputs - mains voltage - terminal assignment

Current Measuring Inputs

WARNING

Before disconnecting the secondary terminals of the transformer or the connection of the transformer at the unit make sure that the transformer is short circuited.

NOTE

Current transformers are generally to be earthed on one side secondarily.

Generator

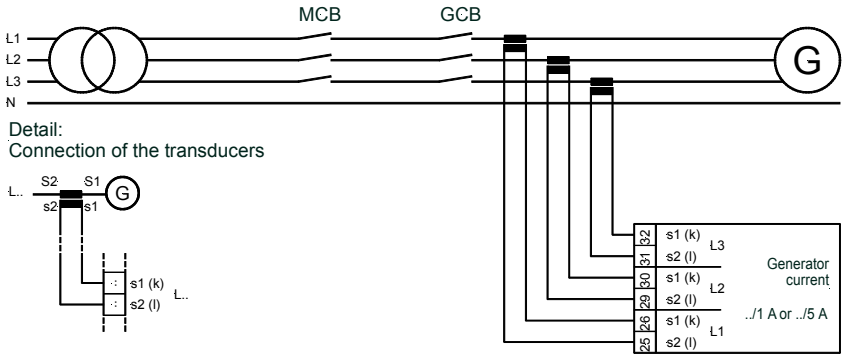


Figure 3-12: Measuring inputs - Generator current

Terminal	Measurement	Description	A_{max}
25	Transformer ../5A	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

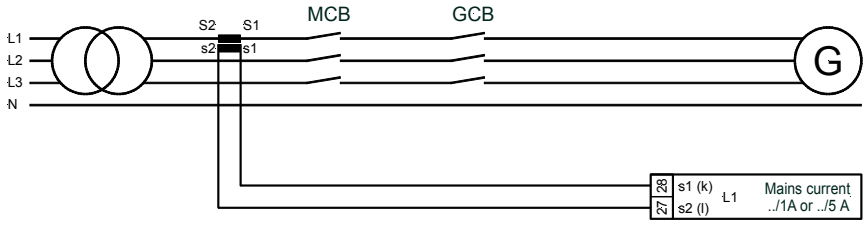


Figure 3-13: Measuring inputs - Generator current

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

Auxiliary and Control Inputs

Discrete Inputs

CAUTION

Please note that the maximum voltages which may be applied at the discrete inputs are defined as follows. Voltages higher than those specified destroy the hardware!

- **Maximum input range: $^{+}/_{-}$18 to 250 Vac/dc.**

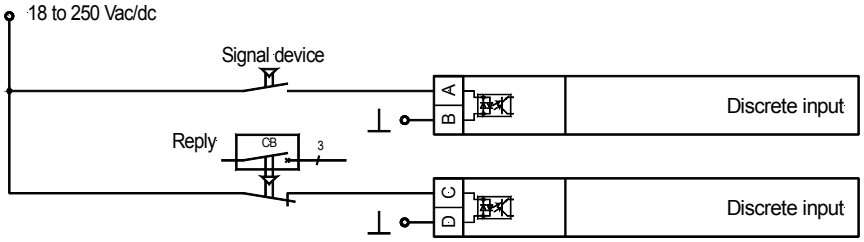


Figure 3-14: Discrete inputs

Terminal	Associated zero-terminal	Description (acc. DIN 40 719 part 3, 5.8.3)		A_{max}
Make contact				
A	***B***			
3	7	Enable GCB		2.5 mm²
5		Switching power set point value 1/2		2.5 mm²
6		Enable monitoring		2.5 mm²
53		Release MCB		2.5 mm²
34	33	not used	Discrete input 1	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
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
Normally closed contact				
C	***D***			
4	7	Reply: GCB is open		2.5 mm²
54		Reply: MCB is open		2.5 mm²

Analog Input (PSVA)

WARNING

The analog input of the MFR 2 is not isolated. When using an isolation monitor, we recommend to use two-pole, isolated transmitters.

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

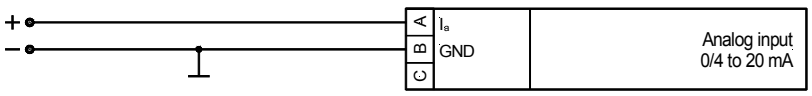


Figure 3-15: Analog input

Terminal			Description	A_{max}
A	***B***	***C***	(any of the following analog inputs:)	
70	71	72	Analog input 0/4-20 mA, Set point value P	2,5 mm²

Auxiliary And Control Outputs

Relay Outputs

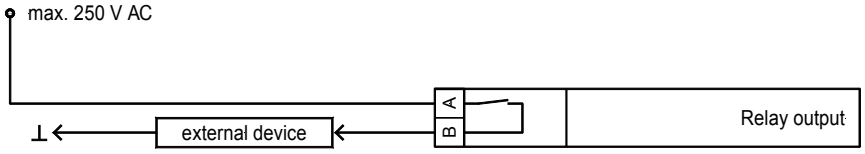


Figure 3-16: Relay outputs

Root	Closing	Description	A_{max}
A	***B***		
14	15	Synchronizing pulse, Command: close GCB	2.5 mm²
16	17	Synchronizing pulse, Command: close MCB	2.5 mm²
39	40	Synchronizing pulse, Command: open MCB	2.5 mm²
41	42	Synchronizing pulse, Command: open GCB	2.5 mm²
18	19	Ready 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

Analog Outputs (PSVA)

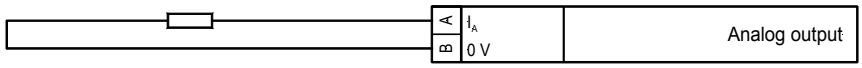


Figure 3-17: Analog outputs

I_A	0 V	Description	A_{max}
A	***B***		
80	81	Analog output 0/4 to 20 mA	1.5 mm²
82	83	Analog output 0/4 to 20 mA	1.5 mm²

Pulse Outputs (PSVA)

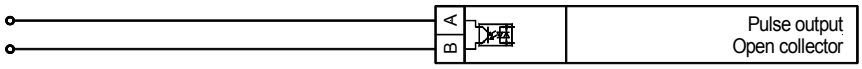


Figure 3-18: Pulse outputs

Terminal		Description	A_{max}
A	87	Pulse output (kWh pulse)	1.5 mm²
B	86	Emitter (open collector)	1.5 mm²
A	85	Pulse output (kvarh pulse)	1.5 mm²
B	84	Emitter (open collector)	1.5 mm²

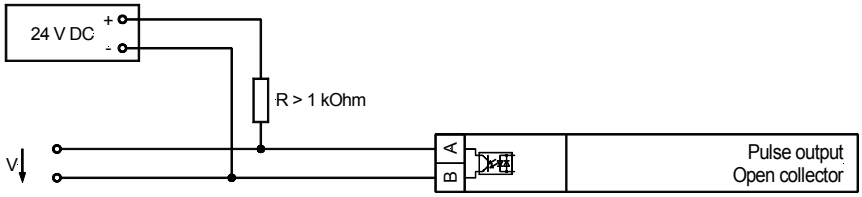


Figure 3-19: Pulse output - connection example

Controller Outputs

The governors are designed as three-step controllers (made of a change-over contact and a make contact).

Three-Step Controllers

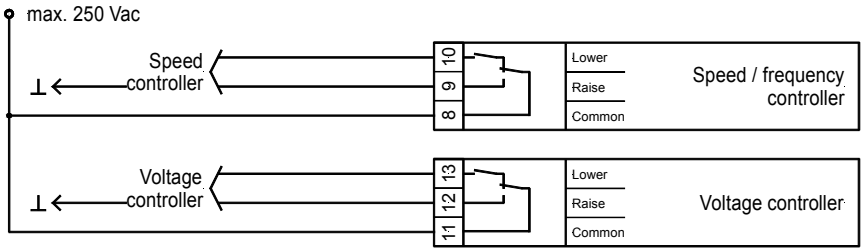


Figure 3-20: Controller - three position controller

Terminal		Description	A_{max}
8	common	Speed/frequency controller	2.5 mm²
9	higher		2.5 mm²
10	lower		2.5 mm²
11	common	Voltage controller	2.5 mm²
12	higher		2.5 mm²
13	lower		2.5 mm²

Interface

Interface Wiring

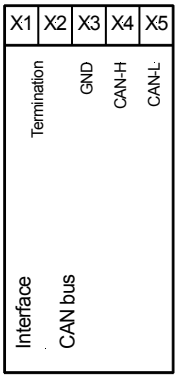


Figure 3-21: Interface - terminals

Terminal					Description
X1	X2	X3	X4	X5	
CAN-H	CAN-L	GND	CAN-H	CAN-L	CAN bus

CAN Bus Shielding

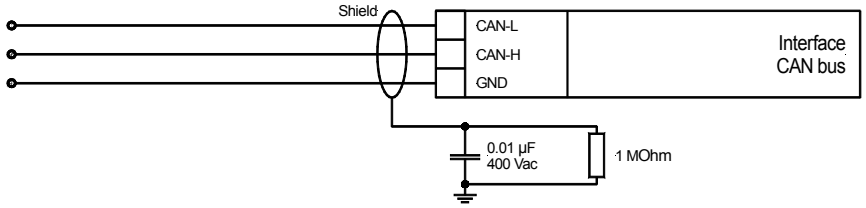


Figure 3-22: Interface - CAN bus shielding

CAN Bus Loop

NOTE

Please note that the CAN bus must be terminated at both ends with an impedance which corresponds to the wave impedance of the cable (e.g. 120 Ohm). The Engine CAN bus is terminated between CAN-H and CAN-L.

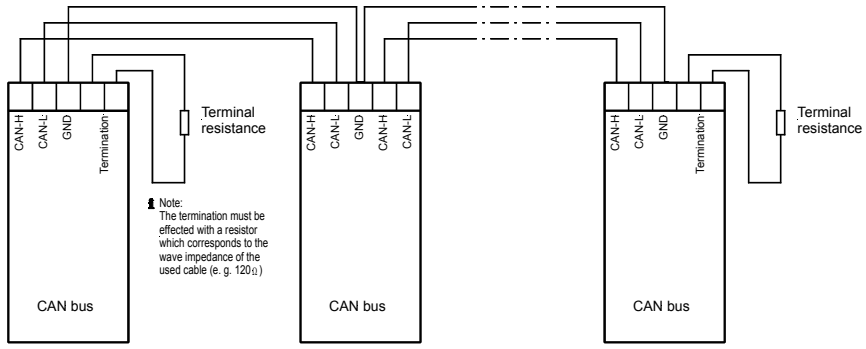


Figure 3-23: Interface - loop the CAN bus

Possible CAN Bus Problems

If no data is transmitted on the CAN bus, check the following common reasons for CAN bus communication problems:

- T structure bus is utilized
- CAN-L and CAN-H are interchanged
- Not all devices on the bus are using identical Baud rates
- Terminating resistor are missing
- Baud rate to high for wiring length

Maximum CAN Bus Length

The maximum length of the communication bus is 250 m.

The maximum specified length for the communication bus wiring might not be achieved if wire of poor quality is utilized, there is high contact resistance, or other conditions exist.

DPC - Direct Configuration Interface

NOTE

To configure via the configuration interface (direct configuration) you need the configuration cable (ordering code "DPC"), the program LeoPC1 (delivered with the cable) and the corresponding configuration files. Please consult the online help installed when the program is installed for a description of the LeoPC1 program and its setup.

If the parameter "Direct config." is switched to ON, the communication via the interface on terminals X1 through X5 is disabled.

Chapter 4.
Functional Description

Basic Considerations

Different Options

The MFR 2 consists of a base unit which is available in different packages. The particular package is described on the nameplate. This manual describes the basic unit and all packages.

Equipment with One Power Circuit Breaker

The MFR 2 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 is valid:

- 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") and
  - "Enable MCB" (term. 53): HIGH signal (logical "1").

The type and manner of system operation must be considered for monitoring configuration.

Equipment with Asynchronous/Induction Generators

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

- According to the concept of 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 and blocking control when starting respond on the measured frequency of the remanence voltage or generator voltage.
- The generator voltage control becomes only active if the GCB is closed.
- There is no synchronization time control.

Systems in Block Connection (Generator and Transformer) (PSVT)

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

NOTE

The PSVT package 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 separately and independent of both synchronization voltages, the phase shift caused by the transformer can be ignored.

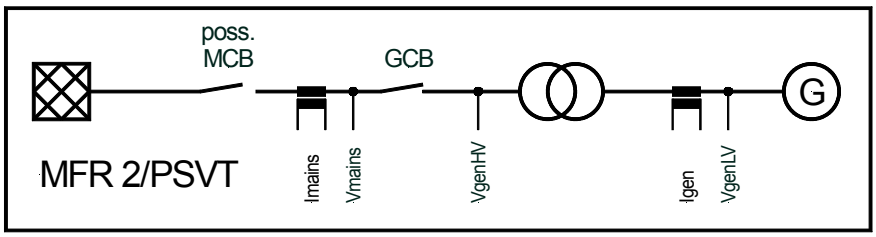


Figure 4-1: Block connection - schematic diagram

The individual measuring points have the following functions:

- Voltage, generator LV = protection and monitoring
- Current, generator = protection and monitoring
- Voltage, generator HV = synchronization and monitoring
- Voltage, mains = protection, synchronization and monitoring
- Current, mains = measuring and monitoring

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

- The MFR 2S/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 2S/PSVT.

Direction of Power

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 power.
Inductive generator power factor	The generator is overexcited and supplies inductive reactive power.
Positive mains real power	Real power is supplied to the mains.
Inductive mains power factor	The mains supplies inductive reactive power.

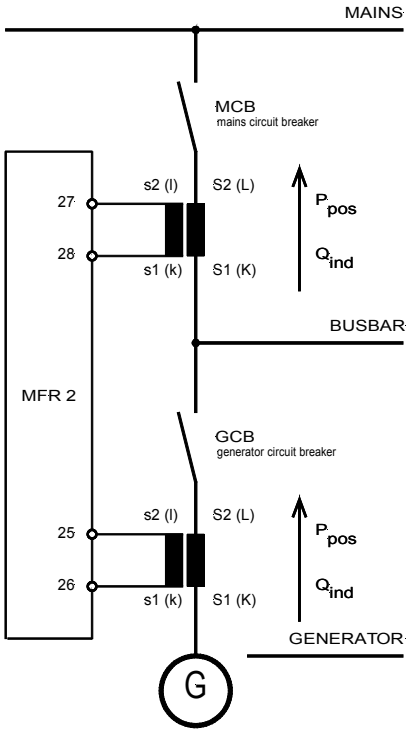


Figure 4-2: Direction of power

Power Factor Definition

The phasor diagram is used from the generator's view. This defines the following definitions.
Power Factor is defined as a ratio of the real power to apparent power. In a purely resistive circuit, the voltage and current waveforms are instep resulting in a ratio or power factor of 1.00 (often referred to as unity). In an inductive circuit the current lags behind the voltage waveform resulting in usable power (real power) and unusable power (reactive power). This results in a positive ratio or lagging power factor (i.e. 0.85lagging). In a capacitive circuit the current waveform leads the voltage waveform resulting in usable power (real power) and unusable power (reactive power). This results in a negative ratio or a leading power factor (i.e. 0.85leading).

Inductive: Electrical load whose current waveform lags the voltage waveform thus having a lagging power factor. Some inductive loads such as electric motors have a large startup current requirement resulting in lagging power factors.	Capacitive: Electrical load whose current waveform leads the voltage waveform thus having a leading power factor. Some capacitive loads such as capacitor banks or buried cable result in leading power factors.

Different power factor displays at the unit:

i0.91 (inductive) lg.91 (lagging)	c0.93 (capacitive) ld.93 (leading)

Reactive power display at the unit:

70 kvar (positive)	-60 kvar (negative)

Output at the interface:

+ (positive)	- (negative)

In relation to the voltage, the current is

lagging	leading

The generator is

over excited	under excited

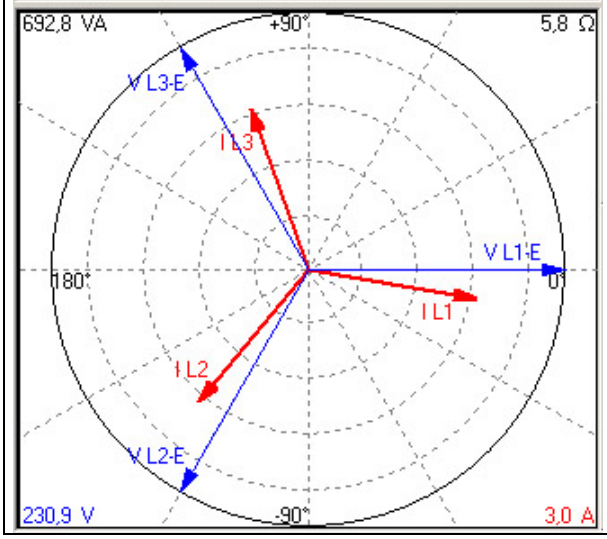
Control: If the control unit is equipped with a power factor controller

A voltage lower "-" signal is output as long as the measured value is "more inductive" than the reference set point Example: measured = i0.91; set point = i0.95	A voltage raise "+" signal is output as long as the measured value is "more capacitive" than the reference set point Example: measured = c0.91; set point = c0.95

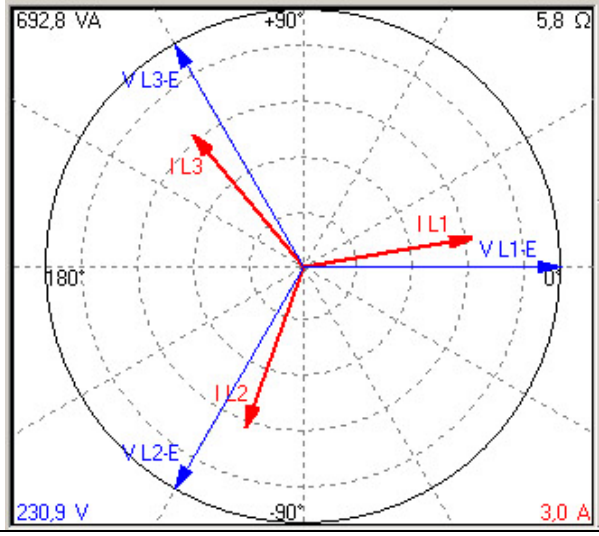
Phasor diagram:

inductive	capacitive

Signal	Magnitude	Phase	Real	Imaginary
V L1-E	230,9 V	0,00 °	230,9 V	0,000 V
V L2-E	230,9 V	-120,00 °	-115,5 V	-200,0 V
V L3-E	230,9 V	120,00 °	-115,5 V	200,0 V
I L1	2,000 A	-10,00 °	1,970 A	-347,3 mA
I L2	2,000 A	-130,00 °	-1,286 A	-1,532 A
I L3	2,000 A	110,00 °	-684,0 mA	1,879 A



Signal	Magnitude	Phase	Real	Imaginary
V L1-E	230,9 V	0,00 °	230,9 V	0,000 V
V L2-E	230,9 V	-120,00 °	-115,5 V	-200,0 V
V L3-E	230,9 V	120,00 °	-115,5 V	200,0 V
I L1	2,000 A	10,00 °	1,970 A	347,3 mA
I L2	2,000 A	-110,00 °	-684,0 mA	-1,879 A
I L3	2,000 A	130,00 °	-1,286 A	1,532 A



Circuit Breakers Control

Operating Sequence for the MCB

Figure 4-3 represents the switch behavior for the following settings:

MCB open via "Enable MCB": ON
Relay "Command: Open MCB": logic: A (operating current; NO)

Additional information may be obtained from the descriptions of the configuration screens.

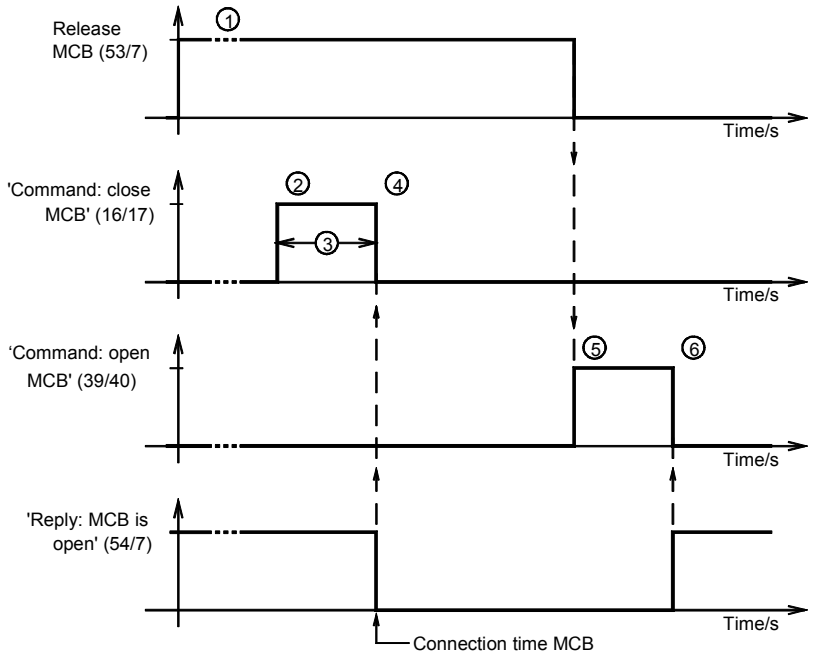


Figure 4-3: Activation of the circuit breakers - MCB

ON/OFF switching pulse:

1 Synchronization

→ ***2 close MCB:***

2 closing pulse for MCB energized
3 breaker inherent delay
4 closing pulse de-energized

→ ***5 open MCB:***

5 opening pulse for MCB energized
6 closing pulse de-energized

Operating Sequence for the GCB

Figure 4-4 represents the switch behavior for the following settings:

Shutdown: ON
Relay "Command: open GCB", logic: A (operating current; NO)
GCB continuous pulse: OFF

Additional information may be obtained from the descriptions of the configuration screens.

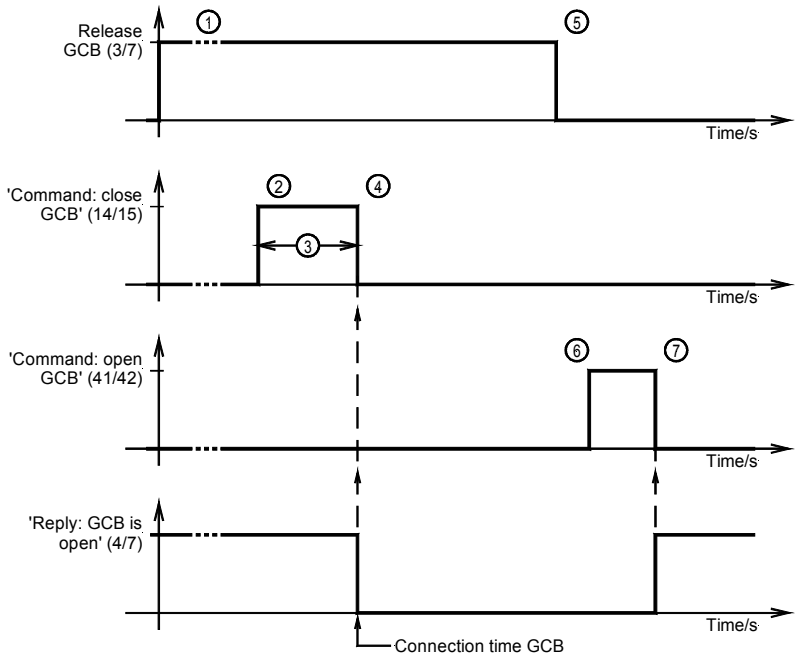


Figure 4-4: Activation of the circuit breakers - GCB

ON/OFF switching pulse:

1 Synchronization

→ ***2 close GCB:***

2 closing pulse for GCB energized
3 breaker inherent delay
4 closing pulse de-energized

→ ***6 open GCB:***

5 start of power reduction
6 end of power reduction
6 opening pulse for GCB energized
7 opening pulse de-energized

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

Function

Operating Conditions

Idle Control and Synchronization

Idle control: Generator voltage and frequency are adjusted to the configured set point values by raising and lowering the controller outputs for voltage and speed/frequency as required.
Synchronization: Generator voltage and frequency are adjusted to the busbar values (synchronization GCB) or to the mains values (synchronization MCB) by raising and lowering the controller outputs for voltage and speed as required. The command to connect the appropriate circuit breaker is output with respect to the breaker connect time so the breaker closes at the synchronization point.

Input signals				Function	
Reply: GCB is open	Enable GCB	Reply: MCB is open	Enable MCB		Additional conditions
1	0	x	x	No-load (idle) control (generator frequency/voltage)	A
1	0	x	x	No control	B
1	1	x	0	Synchronization of the GCB	C
0	x	1	1	Synchronization of the MCB	D

0: "OFF" / 1: "ON" / x: signal has no importance (0 or 1)

Table 4-1: Operating conditions - idle control and synchronization

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 transformer rated voltage. Voltage and frequency controllers as well as the synchronization can be switched ON or OFF by configuration.

Description of the additional condition	
A	Parameter "automatic idle control" is ON.
B	Parameter "automatic idle control" is OFF.
C	For the generator and for the busbar variables, the following must apply: - 50 % V_{set} < voltage < 125 % V_{set} - 80 % f_{rated} < frequency < 110 % f_{rated}
D	For the busbar and for the mains variables, the following must apply: - 50 % V_{set} < voltage < 125 % V_{set} - 80 % f_{rated} < frequency < 110 % f_{rated} If "Download and open GCB" is configured to "ON", "Enable GCB" must be enabled.

Table 4-2: Operating conditions - idle control and synchronization - conditions

Dead Bus Start

Dead bus start: Output of a connect command for the circuit breaker without synchronization.

Input signals				Function	Additional conditions
Reply: GCB is open	Enable GCB	Reply: MCB is open	Enable MCB		
1	1	1	0	Dead bus start GCB	E
1	x	1	1	Dead bus start MCB	F

0: "OFF" / 1: "ON" / x: signal has no importance (0 or 1)

Table 4-3: Operating conditions - dead bus start

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.

Description of the additional condition	
E	The parameter "Dead bus start generator breaker" is ON and the generator voltage and frequency are within the configured limits.
F	The parameter "Dead bus start mains breaker" is ON and is valid for the mains values: - 50 % V_{set} < voltage < 125 % V_{set} - 42 Hz < frequency < 110 % f_{rated}

Table 4-4: Operating conditions - dead bus start - conditions

Isolated Operation

Isolated operation: Generator voltage and frequency are adjusted to the configured set point values by raising and lowering the controller outputs for voltage and speed/frequency as required.

Input signals					Function	Additional conditions
Isolated operation 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	Isolated operation	---

0: "OFF" / 1: "ON" / x: signal has no importance (0 or 1)

Table 4-5: Operating conditions - isolated operation

An isolated operation only takes place if the generator frequency is greater than 42 Hz. Voltage control 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 enabled. Voltage, frequency, and synchronization control may be enabled or disable in the configuration menu.

Mains Parallel Operation

Mains parallel operation: The controller outputs raise and lower speed/frequency and voltage to adjust real power and power factor of the generator to the configured set point values.

Input signals					Function	Additional conditions
Isolated operation 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 importance (0 or 1)

Table 4-6: Operating conditions - mains parallel operation

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

Monitoring Blocking at Startup

In order to prevent undesired triggering of the generator protection when stopping and starting the generator, the monitoring is only enabled when reaching a minimum generator frequency and the discrete input "Enable monitoring" is energized. The type and behavior of this connection is explained in the following diagram. This type of release is only valid for the following monitoring functions:

- Generator undervoltage
- Generator underspeed
- Reverse/reduced power

When the minimum frequency is reached or exceeded, this is indicated by closing the relay configured for this. If monitoring is enabled, the "Protection" LED on the front panel is illuminated.

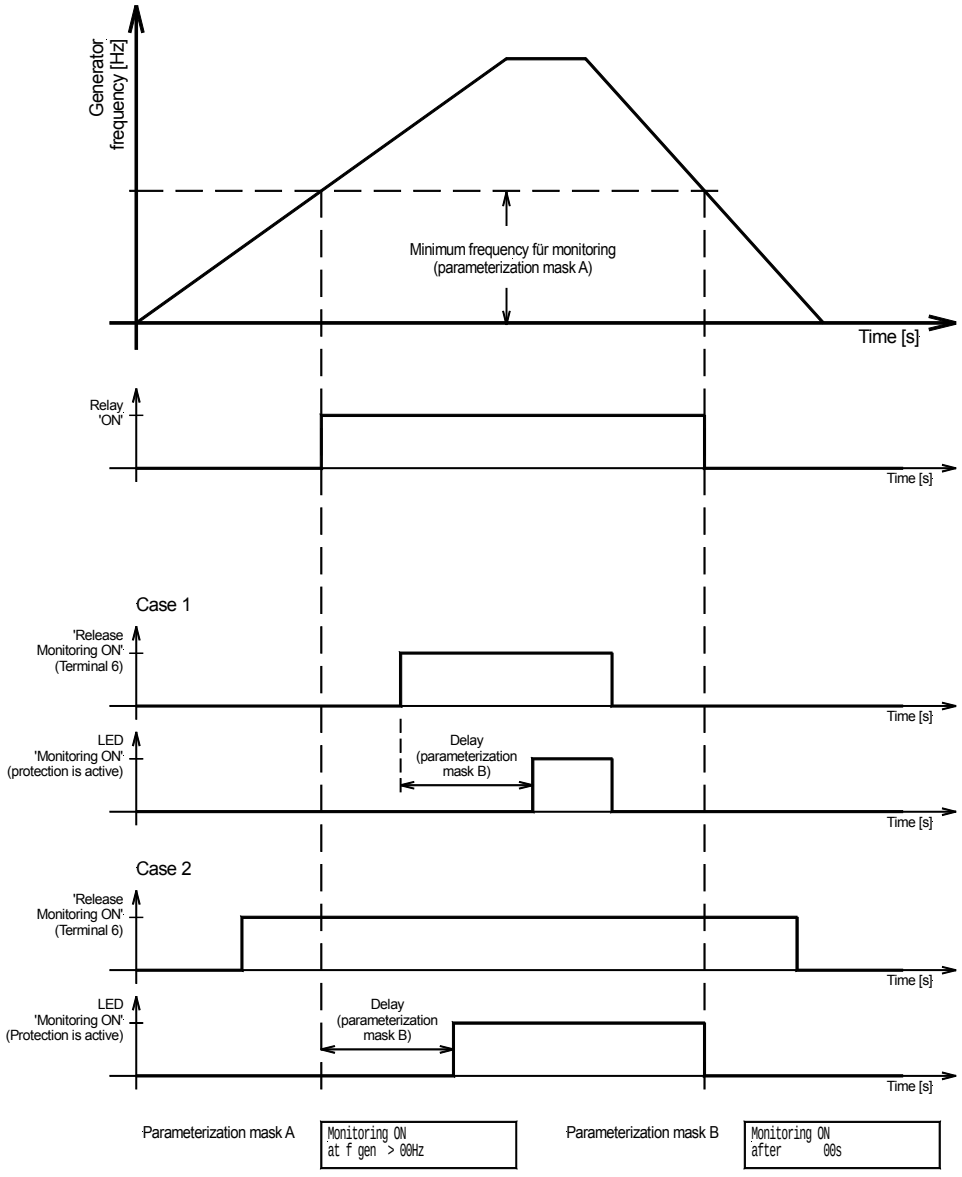


Figure 4-5: Monitoring blocking at startup

Load and/or Var Sharing

The control ensures load and/or var sharing proportional to the rated power of the generators under every operating condition (isolated operation in parallel with other gensets, or reverse synchronization of the busbar to the mains).
The controller can communicate with up to 8 generators with a maximum power rating of 16 MW each and 32 MW in the system. Any controller not in constant power/base load mode and that has the GCB closed will load and/or var share.

Isolated operation in parallel: Each controller participating in load/var sharing controls the generator set to which it is assigned in such a manner that the set frequency and the set voltage at the bus remain constant. This makes it imperative that the same frequency and voltage set points are configured for each controller.
All controllers communicate via a CAN bus. This enables the controllers to adjust the real power generated by the generator while remaining within the rated power of the generator. A smaller generator will contribute less real power as compared to a large generator, but they will both be utilized to the same capacity factor. An example of this would be a 100KW generator and a 1000KW generator and a load of 825KW. The 100KW generator would contribute 75KW and the 1000KW generator would contribute 750 KW or both generators would be at 75% of their rated capacity.
The reactive power will be allocated in a way that it is the same for all generators involved.

The parameter "active load share factor" can be used now to define the priority of the reference variable (frequency) for real power sharing. A higher percentage influences the control more towards frequency control. A lower percentage influences the control more towards real power sharing.
The parameter "reactive load share factor" can be used now to define the priority of the reference variable (voltage) for reactive power sharing. A higher percentage influences the control more towards voltage control. A lower percentage influences the control more towards reactive power sharing.

Synchronization of the busbar back to the mains: Distribution is carried out according to the type of isolated operation. The set point value for the bus frequency is determined by the mains frequency + $df_{max}/2$.
Example: If df_{max} = 0.2 Hz, this results for $df_{max}/2$ = 0.1 Hz (i.e. in a system of 50 Hz, the busbar will be raised to 50.1 Hz).

Pre-requisites: It is imperative that the rated system frequencies and the circuit breaker logic are set identically for all units participating in load/var sharing.

Description of the interface for load/var sharing: Load/var sharing is based on a multi-master-capable bus between the controls. This structure enables the parallel operation of up to 8 generators.

The following must be noted to ensure trouble-free operation of the CAN bus:

1. The maximum CAN bus length must not exceed 250 meters.
2. The CAN bus must be terminated at each end with terminating resistors that correspond to the wave impedance of the CAN bus cable (approx. 120 ohm).
3. The CAN bus must be of a linear structure. Dead-end feeders are not permissible.
4. The recommended cable for use as the CAN bus cable is a "Twisted-shielded-pair" (Ex.: Lappkabel Unitronic LIYCY (TP) 2×2×0.25, UNITRONIC-Bus LD 2×2×0.22).
5. The CAN bus cable must not be routed in the vicinity of high current power lines.

Schematic of the load/var sharing via CAN bus:
Each single unit compares the utilization factor of its generator with the mean utilization factor of all other generators. This control difference is compared with the control difference of the reference variable (e.g. frequency set point – measured frequency) and results a new reference variable.

Frequency control is carried out via the measured voltage/frequency of the voltage system.

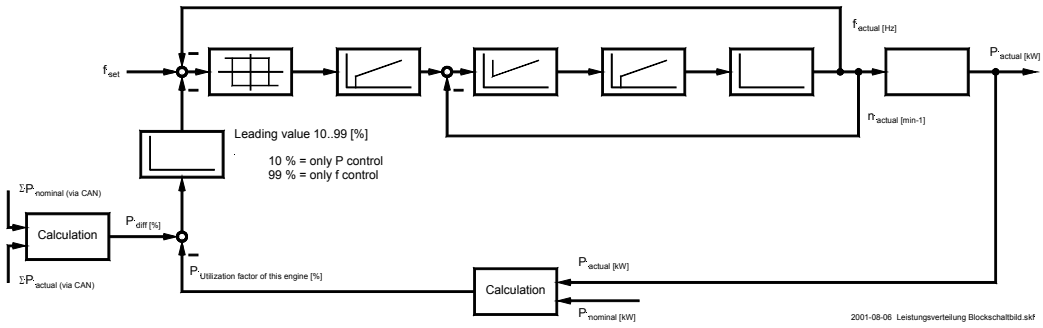


Figure 4-6: Load/var sharing - schematic

Monitoring and Protection Functions

Generator Protection

The generator protection consists of the monitoring functions 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.

Mains Protection

The mains protection consists of the monitoring functions for mains over-/undervoltage, mains over-/undervoltage as well as phase shift, asymmetry and df/dt monitoring (only PSVA package). 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.

Alarm Class

The monitoring functions are divided into four alarm classes:

F0 - Warning alarm - This alarm does not lead to an interruption of the operation. An alarm message is displayed without a centralized alarm.
→ Alarm text.

F1 - Warning alarm - This alarm does not lead to an interruption of the operation. An alarm message is displayed and a centralized alarm will be output.
→ Alarm text + flashing LED "Alarm" + Relay "Centralized alarm" (horn).

F2 - Triggering alarm - This alarm leads to a soft shutdown. A power reduction is performed prior to the GCB being opened. A coasting period is also carried out.
→ Alarm text + flashing LED "Alarm" + Relay "Centralized alarm" (horn) + coasting.

F3 - Triggering alarm - This alarm leads to the immediate opening of the GCB and a hard shutdown.
→ Alarm text + flashing LED "Alarm" + Relay "Centralized alarm" (horn)+ immediate shutdown.

Internally Detected Alarms

List of alarms determined internally depending on the monitored variables:

Type of alarm	Alarm class	Alarm text	Relay output (terminal)
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 (PSVA)	F0	**Fault df/dt**	
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**	
Temperature 1, warning	F1	**Temp 1 warning**	
Temperature 1, shutdown	F3	**Temp 1 tripping**	
Temperature 1, wire break	F0	**Temp 1 wire brk.**	
Temperature 2, warning	F1	**Temp 2 warning**	
Temperature 2, shutdown	F3	**Temp 2 tripping**	
Temperature 2, wire break	F0	**Temp 2 wire brk.**	
Maintenance interval expired	F1	**Maintenance**	
Centralized alarm			

Table 4-7: Alarms - text messages

Alarm Acknowledgement

By pressing the "ACK" push button, the output of the centralized alarm and the alarm messages on the LC display are acknowledged according to the following logic:

Horn: After 2 minutes the horn is reset regardless of the acknowledgement of an alarm.
Interface: All internal alarms are communicated via the interface.

NOTE

The control unit does not differentiate between short and long alarm acknowledgements when given through the interface. As soon as the acknowledgement bit is enabled via the interface, a "Long acknowledgement" will be performed. A "Short acknowledgement " via the interface is not possible.

Short acknowledgment (< 2.5 s)

Action

- The "ACK" push-button is pressed for 0.5 s < t < 2.5 s
- The terminal 36 is energized for 0.5 s < t < 2.5 s

Result

The "Alarm" LED changes from blinking to continually illuminated and the horn is silenced.

	Acknowledgment via …		
Operating mode	"ACK" button	terminal 36	interface input
AUTO	possible	possible	not possible
MANUAL	possible	not possible	not possible

Table 4-8: Alarms - short acknowledgment

Long acknowledgment (>2.5 s)

Action

- The "ACK" push-button is pressed for > 2.5 s
- The terminal 36 is energized for t > 2.5 s
- The acknowledge bit is enabled via the interface

Result

An alarm cannot be acknowledged if the fault condition still exists. If the fault condition is no longer present:

- The "Alarm" LED turns off
- The F1, F2 and F3 alarm relays are reset
- The display messages are acknowledged

	Acknowledgment via …		
Operating mode	"ACK" button	terminal 36	interface input
AUTO	possible	possible	possible
MANUAL	possible	not possible	not possible

Table 4-9: Alarms - long acknowledgment

Chapter 5.
Display And Operating Elements

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 display is a LC-display, consisting of 2 rows of 16 characters each, with indirect green lighting. The contrast of the display can be infinitely adjusted via a rotary potentiometer positioned on the left side of the control. The configuration plug is located on the left side of the unit as well. Please connect the direct configuration cable there (DPC).

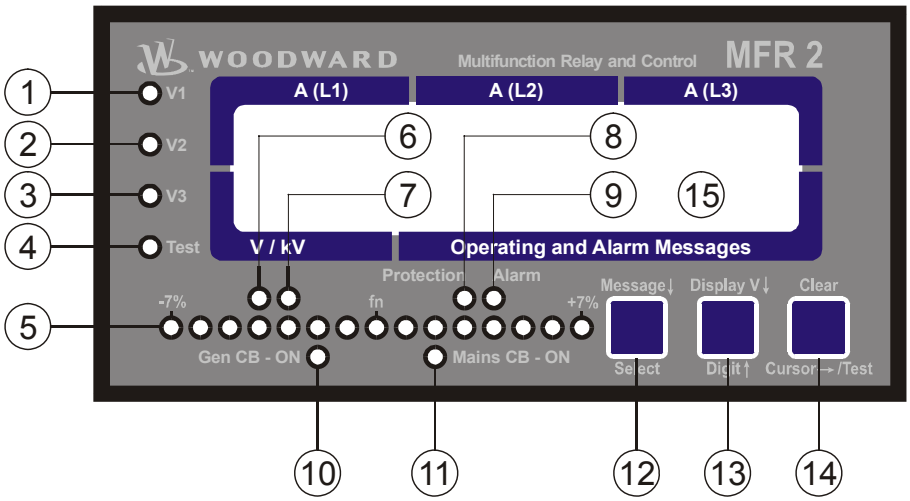


Figure 5-1: Front panel

Brief Description of LEDs and Push Buttons

LEDs

No	Description	Function
1	V1	Voltage L1
2	V2	Voltage L2
3	V3	Voltage L3
4	Test	Configuration mode active
5	Synchroscope	Display of phase position
6	V	Generator voltage in volts
7	kV	Generator voltage in kilovolts
8	Protection	Monitoring is active
9	Alarm	Alarm message present
10	Gen CB - ON	Reply: GCB is closed
11	Mains CB - ON	Reply: MCB is closed

Buttons

No	Description	Function
12	Message↓	Advance to next screen
12	Select	Confirm selection
13	Display V↓	Advance to next voltage display
13	Digit↑	Increase the digit
14	Clear	Acknowledgement of alarm messages
14	Cursor→/Test	Move cursor one position to the right

Others

No	Description	Function
15	LC Display	LC Display
	Potentiometer	Adjust LCD contrast

LEDs

1, 2, 3 **V1, V2, V3** (Color: green)

Voltage display

The LEDs V1, V2, or V3 indicate the phase(s) of the displayed voltage. If one LED is illuminated, the value indicated on the display is the wye (star) voltage between the indicated phase and neutral. If two LEDs are illuminated, the value indicated on the display is the delta voltage between the indicated phases.

4 **Test** (Color: red)

Configuration mode

The LED "Test" is flashing if configuration mode is active.

5 **-7% … fn … +7%** (Color: red/yellow/green)

Phase position / synchroscope

The row of LEDs indicates the current phase position between the two voltages indicated on the display. The green LED in the middle of the 15 LEDs indicates that the measured phase angle between the voltage systems is less than 12 ° electrical. The phase position is only displayed in the automatic mode and only, if the difference between the frequency values is smaller than 2 Hz and both voltages are within the specified permissible ranges. These ranges are defined as follows:

Frequency ranges	80 to 110 % f_{rated}
Voltage ranges	50 to 125 % V_{rated}

There are two different directions of rotation:

left → right . If the LEDs run from left to right, the generator frequency is too high, i.e. the generator or the variable mains rotate too fast

right → left . If the LEDs run from right to left, the generator frequency is too low, i.e. the generator respectively the variable mains rotate too slow

6 **V** (Color: green)

Generator voltage display in volts

If the "V" LED is illuminated, the engineering unit of the voltage value indicated on the display is volts [V].

7 **kV** (Color: green)

Generator voltage display in kilovolts

If the "kV" LED is illuminated, the engineering unit of the voltage value indicated on the display is kilovolts [kV].

8 **Protection** (Color: green)

Monitoring active

If the "Protection" LED is illuminated, the monitoring functions are enabled (refer to Monitoring Blocking at Startup on page 33).

9 **Alarm** (Color: red)

Alarm message present

If the "Alarm" LED is illuminated, the unit has detected an alarm which is processed according to the its alarm class. The message and the type of alarm are indicated on the display. If this LED is flashing, an alarm occurred with a group alarm. After a brief acknowledgment, this changes to continuous illumination and the centralized alarm is ceased.

10 **Gen CB - ON** **Generator power circuit breaker is closed**
Color: green

The LED "Gen CB - ON" signals the response of the GCB. The LED lights up if the discrete input "Reply: GCB is open" is de-energized and will extinguish as soon as the discrete input is energized.

11 **Mains CB – ON** **Mains power circuit breaker is closed**
Color: green

The LED "Bus CB - ON" signals the response of the MCB. The LED lights up if the discrete input "Reply: MCB is open" is de-energized and will extinguish as soon as the discrete input is energized.

Push Buttons

In order to facilitate the setting of the parameters the buttons are equipped with an "AUTOSCROLL" function while the controller is in the configuration mode. It permits the user to rapidly advance to the next setting and configuration screens, the digits, or the cursor position. The "AUTOSCROLL" function will only be enabled when the user presses and holds the corresponding buttons.

12 Message↓ / Select **Message↓ / Select**

Automatic mode: Message↓ - By pressing this button, the user advances through the display of operating and alarm messages.
Configuration: Select - By pressing this button, the user advances to the next configuration screen. If the value originally displayed has been changed via the "Digit↑" or "Cursor→/Test" push buttons, the newly set value is saved by pressing the "Select" push button once saves the newly set value. By pressing the button again, the user causes the system to advance to the next configuration screen.

13 Display V↓ / Digit↑ **Display V↓ / Digit↑**

Automatic mode: Display V↓ - By pressing this button, the user advances through the display of generator and mains voltages. The phase LEDs are illuminated accordingly.
Configuration: Digit↑ - By pressing this button, the position at which the cursor is presently located is increased by one digit. The increase is restricted by the permissible limits (see list of parameters included in the appendix). If the highest permissible number has been reached, the number automatically returns to the lowest permissible number.

14 Clear / Cursor →/Test **Clear / Cursor→/Test**

Automatic mode: Clear - Individual alarm messages are deleted by pressing this button provided the fault is no longer present.
Configuration: Cursor→/Test - This button moves the cursor one position to the right. When the cursor reaches the extreme right position it may be returned to the extreme left position by pressing the "Cursor→/Test" button again.

LC Display

15 LC-Display **LC-Display**

Performance values can be monitored from the two-line display, provided that the control is in automatic mode. In configuration mode, the individual parameters are displayed.

Display In Automatic Mode (First Line of the Display: Measured Values)

```
 000   000  000
---------------
```

Display in automatic mode, first line: measured current values

Display of the generator phase current values for each phase separately. If the slave pointer function is enabled, the maximum current values are displayed in this position.

Display In Automatic Mode (Second Line of the Display: Measured Values)

```
---------------
0.00 -----------
```

Display in automatic mode, second line: measured voltage values

Display of the generator voltage in the "V/kV" field on the left. The "V1", "V2", and "V3" LEDs indicate the phase(s) of the displayed voltage. If one LED is illuminated, the value indicated on the display is the wye (star) voltage between the indicated phase and neutral. If two LEDs are illuminated, the value indicated on the display is the delta voltage between the indicated phases.

```
---------------
---- xxxxxxxxxxx
```

Display in automatic mode, second line: operating and alarm messages

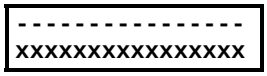
Display of operating and alarm messages in the "Operating and Alarm Messages" field on the right. Instead of " xxxxxxxxxxx " the following measuring values are indicated:

Generator real power
Generator power factor
Generator real energy* (positive, export)
Generator real energy* (negative, import)
Generator lagging reactive energy* (inductive)
Generator leading reactive energy* (capacitive)
Actual set value for real power controller
Maximum generator current (slave pointer)
Mains voltage dependent on the "V1", "V2", and "V3" LEDs
Mains real power (measured in single phase)
Mains power factor
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)

The display screens are displayed one after the other by pressing the "Message↓" button. If no button is pushed for approximately 1 minute, the display returns to the initial display screen automatically. If alarms have occurred, their message text is displayed in the order of occurrence in the display 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 displayed. During synchronization of the power circuit breakers, the basic screen is suppressed by the "Synchronization GCB" or "Synchronization MCB" message. The basic screen is displayed again after successful synchronization.

Display in Automatic Mode (Second Line of the Display: Alarm Indication)



Alarm indication, bottom line

Refer to Internally Detected Alarms on page 37 for a list of all alarm messages.

Chapter 6.
Configuration

Configuration can be done using a PC and the PC program LeoPC1 via the serial interface or via the front panel push buttons and the front panel LC display. If direct configuration via a PC is selected, the following baud rate is to be used:

- Configuration via direct configuration plug = 9,600 Baud (8 Bit, no parity, 1 stop bit)

CAUTION

Please note that configuration only should be done while the system is not in operation.

NOTE

A list of all parameters may be found in the appendix of this manual.

You can advance through the individual parameter screens if you are in configuration mode (simultaneously pressing of "Digit↑" and "Cursor→" push buttons permits access to the configuration mode) by using the "Select" button. If you press and hold the "Select" push button, the scroll function will be activated, allowing for the parameter screens to be advanced through more rapidly. The control unit will permit the operator to reverse up to four previous screens (exception: it is not possible to reverse from the first parameter to the last parameter or to backup through the service screens). To perform the reverse function through the parameter screens, the "Select" and "Cursor→" push buttons must be pressed and released simultaneously. The control unit will revert to automatic mode if an entry isn't performed, a change made, or any other action performed for 120 seconds.

NOTE

There are two different hardware versions described in this operating manual: A 100 V version [1] and a 400 V version [4]. The versions vary as far as the configuration screens and the parameter input ranges are concerned. The two types are differentiated by indicating the voltage: ([1] ... or [4] …).

Basic Data

Software version X.xxxx	**Software version**
	This screen displays the software version loaded into the control (the last two xx are for software revisions which do not affect the function of the unit).

Configuration Access

Password

The unit is equipped with a three-level code and configuration hierarchy, which allows different user access to the control. A distinction is made between:

Code level CS0 ***(User Level)*** Factory password = none
This code level allows for monitoring of the system and does not permit access to the parameters. Configuration is blocked.

Code level CS1 ***(Basis Service Level)*** Factory password = "**0 0 0 1**"
This code level entitles the user to change selected parameters, like setting Bar/PSI, °C/°F, and clock adjustment. Changing a password is not permitted at this level. This password expires two hours after entering the password and the user is returned to the CS0 level.

Code level CS2 ***(Commissioning Level)*** Factory password = "**0 0 0 2**"
Allows direct access to all parameters (displaying and changing). In addition, the user may also set the password for levels CS1 and CS2. This password expires two hours after entering the password and the user is returned to the CS0 level.

NOTE

Once the code level is entered, access to the configuration menus will be allowed for two hours or until another password is entered into the control. If a user needs to exit a code level, then code level CS0 should be entered. This will block any configuration of the control. A user may return to CS0 by allowing the entered password to expire after two hours or by changing any one digit on the random number generated on the password screen and entering it into the unit.

NOTE

The following configuration screen "Enter code number" only appears if the parameter "Password Protection" is configured "ON" (see below).

```
Enter code
number      0000
```

Enter code number **0000 to 9999**

Upon enabling the configuration mode, the user is required to enter an access code number, which identifies the various users. The displayed number XXXX is a randomly generated number (RN). If the random number is confirmed by pressing the "Select" button without being changed, the current level of access maintained. Upon entering either a level 1 or level 2 access code, the corresponding level of access is granted. If an incorrect access code is entered the control unit changes to code level 0 and all access is blocked until a code level 1 or 2 access code is entered.

```
Password
Protection   ON
```

Password protection **ON/OFF**

ON..... Password protection is enabled. Configuration access is enabled by entering the appropriate password (Code level 1/2). If an incorrect code number has been entered, configuration is blocked.

OFF..... Password protection is disabled. Access to configuration screens is permanently set to code level 2 and the code number is not queried. This parameter can only be changed if the code number of code level 2 has been entered.

Change Passwords

```
Define level 1
code        0000
```

Define level 1 password **0000 to 9999**

This screen appears only when the level 2 password has been entered. After entering the digits into this screen, the code level for level 1 (client) is set. After entering this code, the user only has the access rights assigned to this code level.
This code level (CS) is preset to **CS1 = 0 0 0 1**

```
Define level 2
code        0000
```

Define level 2 password **0000 to 9999**

This screen appears only when the level 2 password has been entered. After entering the digits into this screen, the code level for level 2 (technician) is set. After entering the code, the technician has the access rights with which he was assigned.
This code level (CS) is preset to **CS2 = 0 0 0 2**

Direct Configuration

NOTE

To carry out direct configuration, you require a direct configuration cable DPC (P/N 5417-557), the LeoPC1 program (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 PC program and its setup.

For configuration of the unit via PC program please proceed as follows:

- Install the PC program on your laptop/PC according to the installation manual.
- Before the end of the installation you are requested to select the language with which you want to start the PC program. You can change the language at any time. The selection of the language refers only to language with which the menus and subprograms of the PC program works. This setting will not change the language of the control unit being configured.
- After the installation of the PC program reboot your laptop/PC.
- Establish the connection between your laptop/PC and the unit via the DPC. Plug one side to the configuration plug of the unit and the other side to the COM1 port of your laptop/PC (other possibilities are described in the installation manual).
- You may start the PC program as follows:
  - by "Start/Program/Woodward/LeoPC" (starting at version 3.1.xxx), or
  - by a double click on a file ending ".cfg" in the subdirectory "LeoPC".
- After the PC program was started, establish the communication by pressing the "F2" button. This will establish a data link between the unit and the laptop/PC.
- Start the sub program "Device Parameterization" and adjust the parameter of the unit to your application using this manual.

```
Direct para.
             YES
```

Direct configuration **YES/NO**

YES .....Configuration via the configuration port is enabled. The following conditions must be met in order to carry out configuration via the direct configuration cable:
- A connection must be established via the direct configuration cable between the unit and the PC
- the Baud rate of the PC program must be set to 9,600 Baud
- the corresponding configuration file must be used (file name: "xxxx-xxxx-yyy-zz.asm", initiated by xxxx-xxxx-yyy-zz.cfg)

NO .....Configuration via the direct configuration cable is disabled.

Service Display

```
Service display
            ON
```

Service display **ON / OFF**

ON..... The following three screens are displayed. The service display is intended to assist when commissioning the unit.
OFF..... The screens of the service display are not displayed.

Double Voltage/Frequency Display for Synchronous Generators

```
B   000V 00.00Hz
G   000V 00.00Hz
```

```
B 00.0kV 00.00Hz
G 00.0kV 00.00Hz
```

Busbar / generator

The busbar and generator voltage and frequency are displayed. The phase position between generator and busbar is indicated by the synchroscope.
B..... Busbar voltage and frequency
G ..... Generator voltage and frequency

```
M   000V 00.00Hz
B   000V 00.00Hz
```

```
M 00.0kV 00.00Hz
B 00.0kV 00.00Hz
```

Mains / busbar

The mains and busbar voltage and frequency are displayed. The phase position between mains and busbar is indicated by the synchroscope.
M..... Mains voltage and frequency
B..... Busbar voltage and frequency

Double Voltage/Frequency Display for Asynchronous/Induction Generators

```
Remanence00.00Hz
Gen:000V 00.00Hz
```

Generator / remanence voltage

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

```
Mains000V00.00Hz
Remanence00.00Hz
```

Mains / remanence voltage

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

Relay States

```
Rel.:    MCB
f   V   GCB
```

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

Generator Number

```
Generator number
            0
```

Generator number **1 to 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 Assignment

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

Change relay assignment? **YES / NO**

This parameter permits the user to change how the relay outputs are configured. Refer to the list of parameters.

YES .....The relay assignments can be configured and the user may define the relay functionality and assignments. The subsequent screens are displayed.
NO .....The relays are configured with the factory default settings. The subsequent screens are not displayed.

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

Function of the relays 1, 2, 3, and 4 **E / D**

The individual relays may be configured as either E=Energized (Normally Open contacts) or D=De-energized (Normally Closed contacts).

E .....The relay is configured as normally open (N.O.) contacts. The relay will energize only if the assigned monitoring function has tripped.
D .....The relay is configured as normally closed (N.C.) contacts. The relay is always energized and will only de-energize if the assigned monitoring function has tripped.

NOTE The signal output is physically always configured as E (N.O.).

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

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

E .....The relay is configured as normally open (N.O.) contacts. The relay will energize only if the GCB is to be opened.
D .....The relay is configured as normally closed (N.C.) contacts. The relay is always energized and will only de-energize 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 .....The relay is configured as normally open (N.O.) contacts. The relay will energize only if the MCB is to be opened.
D .....The relay is configured as normally closed (N.C.) contacts. The relay is always energized and will only de-energize if the MCB is to be opened. The contact is closed in the normal state. In this way the output can be configured as fail-safe.

```
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 de-energized or if an activated mains monitoring function energizes. 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 energizes. The input "Enable MCB" has no effect on the function of the relay "Command: open MCB".

Auto Acknowledgement

```
Auto-acknowledge
relay        ON
```

Auto-acknowledgement relay **ON / OFF**

ON..... The relays de-energize if the criterion for triggering is no longer present.

OFF..... The relays remain energized until this is acknowledged. The screen "Messages auto-acknowledgement" does not appear.

```
Auto-acknowledge
messages     ON
```

Messages auto acknowledgment **ON / OFF**

This screen appears only if the parameter "Auto-acknowledge relay" is configured ON.

ON..... After the alarm condition is no longer detected, the message on the display is deleted.

OFF..... The alarm message remains in the display after the fault condition is no longer detected until manually cleared. The subsequent screen of this function is not displayed.

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

Clear displayed message delay **1 to 99 s**

This screen appears only if the parameter "Auto-acknowledge relay" is configured ON.

Alarm messages, which have been enabled, will be acknowledged after this configured delay time expires. This delay will initiate once the measure value exceeds/falls below the threshold limit +/- the hysteresis

Configure Basic Settings

==========

`Generator nom. frequency=00.0Hz`

Rated generator frequency **48.0 to 62.0 Hz**

Enter the rated frequency of the generator which in most cases is 50 Hz or 60 Hz.

`Gen. voltage primary 00.000kV`

Primary generator voltage **0.050 to 65.000 kV**

The primary generator voltage is set here in kV. The entry is used to output the primary voltages on the display. In the case of measured voltages of 400 V without a measurement transformer, 00.400 kV must be set here.

`Gen. voltage secondary 000V`

Secondary generator voltage **[1] 50 to 125 V, [4] 50 to 480 V**

The secondary generator voltage is set here in V. This entry serves to indicate the primary voltages in the display. In the case of measured voltages of 400 V without a measurement transformer, 400 V must be set here.

`Busb. voltage primary 00.000kV`

Primary busbar voltage **0.050 to 65.000 kV**

The primary busbar voltage is set here in kV. The entry is used to output the primary voltages on the display. In the case of measured voltages of 400 V without a measurement transformer, 00.400 kV must be set here.

`Busb. voltage secondary 000V`

Secondary busbar voltage **[1] 50 to 125 V, [4] 50 to 480 V**

The secondary busbar voltage is set here in V. This entry serves to indicate the primary voltages in the display. In the case of measured voltages of 400 V without a measurement transformer, 400 V must be set here.

`Mains voltage primary 00.000kV`

Primary mains voltage **0.050 to 65.000 kV**

The primary mains voltage is set here in kV. The entry is used to output the primary voltages on the display. In the case of measured voltages of 400 V without a measurement transformer, 00.400 kV must be set here.

`Mains voltage secondary 000V`

Secondary mains voltage **[1] 50 to 125 V, [4] 50 to 480 V**

The secondary mains voltage is set here in V. This entry serves to indicate the primary voltages in the display. In the case of measured voltages of 400 V without a measurement transformer, 400 V must be set here.

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

This screen only affects the display. The monitoring 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 phases (without a neutral conductor). The neutral lug (terminal 0) will not be connected. Only the phase-phase voltages are indicated in the display.

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

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

Generator current transformer **10 to 6,900/{x} A**

The input of the current transformer ratio is necessary for the indication and control of the actual monitored value. The current transformers ratio should be selected so at least 60% of the secondary current rating can be measured when the monitored system is at 100% of operating capacity (i.e. at 100% of system capacity a 5A CT should output 3A). If the current transformers are sized so that the percentage of the output is lower, the loss of resolution may cause inaccuracies in the monitoring and control functions and may affect the functionality of the control.
The control may be ordered with either ../1 A or ../5 A current transformer inputs. The CT inputs will dictate how this parameter is displayed on the control. Information about the current transformers inputs may be found on the unit data plate.

{x} = 1 ..... MFR2Sx**1**B/xxx = Current transformer with ../1 A rated current
{x} = 5 ..... MFR2Sx**5**B/xxx = Current transformer with ../5 A rated current

NOTE

The following parameter is only available for units with a software version of 3.5018 or higher. Units with a software version up to 3.5017 act as if "3" would be configured here.

`Format Power`

Power display format **1 / 2 / 3 / 4 / 5 / 6**

The format for the power display and (bus) transmission can be configured here. This parameter enables to find a setting, which gives enough resolution while being able to display the maximum value. The display format changes when an apparent power value is exceeded, which is calculated from the transformer settings according to the following formula:
S = UGNPRIM * IGNPRIM * √3
UGNPRIM = generator voltage transformer primary setting (Gen. voltage primary)
IGNPRIM = generator current transformer setting (Current transf. Generator)

NOTE If this parameter is configured for a higher resolution (higher value), large values (above the calculated apparent power) might be displayed incorrectly. However, this parameter does not affect the monitoring functions and analog outputs.

1 .....00.0k [W/VA/var] (S up to 10 kVA)
0000k [W/VA/var] (S from 10 kVA up to 1000 kVA)
00.0M [W/VA/var] (S from 1000 kVA up to 10 MVA)
000M [W/VA/var] (S from 10 MVA)

2 .....00.0k [W/VA/var] (S up to 20 kVA)
0000k [W/VA/var] (S from 20 kVA up to 2000 kVA)
00.0M [W/VA/var] (S from 2000 kVA up to 20 MVA)
000M [W/VA/var] (S from 20 MVA)

3 .....00.0k [W/VA/var] (S up to 30 kVA)
0000k [W/VA/var] (S from 30 kVA up to 3000 kVA)
00.0M [W/VA/var] (S from 3000 kVA up to 30 MVA)
000M [W/VA/var] (S from 30 MVA)

4 .....00.0k [W/VA/var] (S up to 40 kVA)
0000k [W/VA/var] (S from 40 kVA up to 4000 kVA)
00.0M [W/VA/var] (S from 4000 kVA up to 40 MVA)
000M [W/VA/var] (S from 40 MVA)

5 .....00.0k [W/VA/var] (S up to 50 kVA)
0000k [W/VA/var] (S from 50 kVA up to 5000 kVA)
00.0M [W/VA/var] (S from 5000 kVA up to 50 MVA)
000M [W/VA/var] (S from 50 MVA)

6 .....00.0k [W/VA/var] (S up to 60 kVA)
0000k [W/VA/var] (S from 60 kVA up to 6000 kVA)
00.0M [W/VA/var] (S from 6000 kVA up to 60 MVA)
000M [W/VA/var] (S from 60 MVA)

Example:
S = UGNPRIM * IGNPRIM * √3 = 10 kV * 200 A* √3 = 3,46 MVA
If this parameter is configured to "3" (default), the power format is 00.0 MW, if it is configured to "4", it is 0000 kW.


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

Mains current transformer **10 to 6,900/{x} A**

The input of the current transformer ratio is necessary for the indication and control of the actual monitored value. The current transformers ratio should be selected so at least 60% of the secondary current rating can be measured when the monitored system is at 100% of operating capacity (i.e. at 100% of system capacity a 5A CT should output 3A). If the current transformers are sized so that the percentage of the output is lower, the loss of resolution may cause inaccuracies in the monitoring and control functions and may affect the functionality of the control.
The control may be ordered with either ../1 A or ../5 A current transformer inputs. The CT inputs will dictate how this parameter is displayed on the control. Information about the current transformers inputs may be found on the unit data plate.

{x} = 1 ..... MFR2Sx**1**B/xxx = Current transformer with ../1 A rated current
{x} = 5 ..... MFR2Sx**5**B/xxx = Current transformer with ../5 A rated current

```
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 V_{L1-L2}. The power then is calculated as follows:
$P = 3 \times I_{L1} \times V_{L1-L2} \times$ 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.

```
Nomnial power
   Gen. = 0000kW
```

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

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

Configure Controller

CAUTION

An incorrect entry may lead to uncontrolled actions of the governor and may destroy the automatically regulated generator!

Controller Shutoff for Negative Load Jumps (Only with Three-Position Controllers)

The following function may be used to suppress the set point adjustment via the controller in the event of great load jumps. 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%`

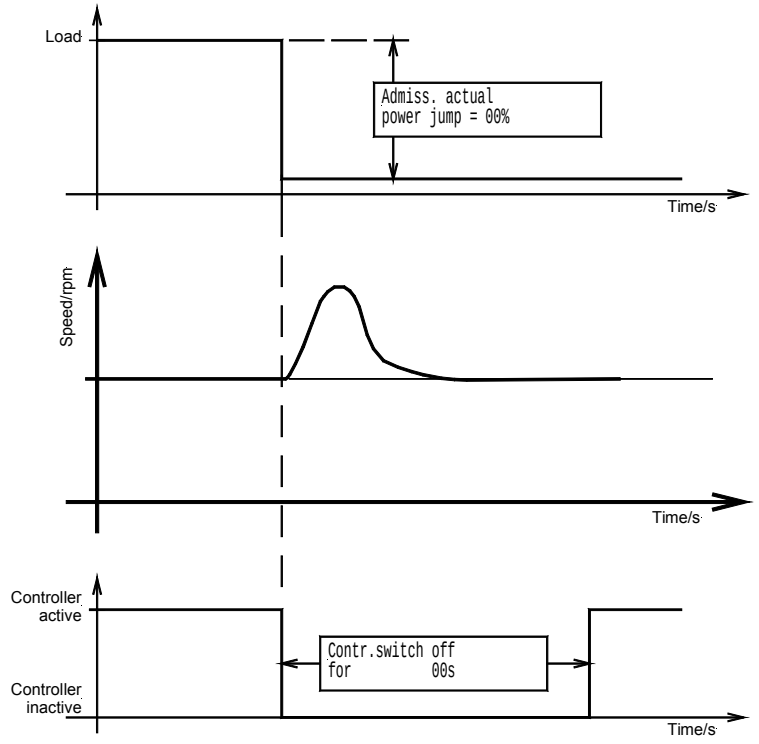
Permissible jump in real power **10 to 80 %**

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 to 99 s**

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



Shutdown

```
Download and
open GCB      ON
```

Shutdown **ON / OFF**

ON..... The generator will be as soon as "Enable GCB" is de-energized. This results in an automatic power reduction and subsequently the opening of the GCB via activation of the relay "Command: open GCB". If the unit participates in load sharing, this is terminated.

OFF..... De-energizing "Enable GCB" during operation has no effect.

Idle Control

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

Automatic idle control **ON / OFF**

ON..... The control of voltage and frequency in idle operation is carried out independent of the state of the command "Enable GCB" (terminal 3) (refer to Operating Conditions on page 30).

OFF..... Additional condition for a control of voltage and frequency in idle operation is the state of "Enable GCB" (terminal 3). Take care that by energizing terminal 3 the synchronization for the GCB is also enabled (refer to Operating Conditions on page 30).

Frequency Controller

Three-Position 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 .....No control is carried out and the subsequent screens of this function are not displayed.

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

Generator set point frequency **48.0 to 62.0 Hz**

The generator set point frequency is entered here. This is required for the frequency controller in isolated and idle operation.

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

Frequency controller insensitivity **0.02 to 1.00 Hz**

Idle/Isolated operation: The frequency is controlled in such a manner that, in its adjusted state, the actual value deviates from the set point frequency setting (configured set point) by the set sensitivity value at most.

Synchronization: The generator frequency is controlled in such a manner that, in its adjusted state, the differential frequency reaches the set sensitivity value at most. The mains or busbar frequency is used as the set point value.

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

Minimum frequency controller On period **10 to 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 to 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.

Voltage Controller (MFR 2S)

Three-Position Controller

```
Volt. controller
             ON
```

Voltage controller **ON / OFF**

ON..... Generator voltage control is carried out. The generator voltage is controlled in various manners depending on the task (idle / isolated operation / synchronization). The subsequent screens of this function are displayed.
OFF..... Control is not carried out, and the subsequent screens of this function are not displayed.

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

Voltage controller isolated mode **ON / OFF**

ON..... The voltage controller is enabled in isolated operation.
OFF..... The voltage controller is disabled in isolated operation.

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

Generator set point voltage **[1] 90 to 125 V; [4] 200 to 480 V**

The set point of the generator voltage is required for the voltage controller in idle or isolated operation.

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

Voltage controller set point ramp **1 to 400 V/s**

A change in set point is supplied to the controller via a ramp. The slope of the ramp is used to alter the rate at which the controller modifies the set point value. The more rapidly the change in the set point is to be carried out, the greater the value input here must be.

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

Voltage controller insensitivity **[1] 0,1 to 15,0 V, [4] 0,5 to 60,0 V**

Idle/Isolated operation: The voltage is controlled in such a manner that, in its adjusted state, the actual value deviates from the set point voltage setting (configured set point) by the set sensitivity value at most.
Synchronization: The generator voltage is controlled in such a manner that, in its adjusted state, the differential voltage reaches the set sensitivity value at most. The mains or busbar voltage is used as the set point value.

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

Minimum voltage controller ON period **10 to 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 has been set according 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 to 99.9**

The gain factor K_p influences the operating time of the relays. By increasing the factor, the operating time can be increased in the event of a certain control deviation.

Synchronization (MFR 2S)

```
Synchronization
functions   ON
```

Synchronization functions **ON / OFF**

ON .....An adaptation of the generator frequency and voltage to the busbar values (respectively busbar frequency and busbar voltage to the mains values) is carried out and a connect command is output. The subsequent screens of this function are displayed.

OFF .....No synchronization occurs, but idle control if necessary. No connect command is output. The subsequent screens of this function are not displayed.

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

Max. perm. differential frequency (pos. slip) **0.02 to 0.49 Hz**

The prerequisite of a connect command's being output is negative deviation from this set differential frequency. This value specifies the upper frequency (positive value corresponds to positive slip → generator frequency is greater than the busbar frequency).

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

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

The prerequisite of a connect command's being output is positive deviation from this set differential frequency. This value specifies the lower frequency (negative value corresponds to negative slip → generator frequency is less than the busbar frequency).

```
Synchronization
 dV max  =  00V
```

Max. perm. differential voltage **[1] 1 to 20 V, [4] 2 to 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 of connect relay **50 to 250 ms**

The duration of the connect pulse can be adjusted to the subordinate switching unit.

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

Inherent GCB delay **40 to 300 ms**

The closing time of the GCB corresponds to the lead time of the connect command. The connect command will be issued at the entered time before the synchronization point.

```
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 energized. If the power circuit breaker has to be opened, the relay de-energizes.

OFF .....The relay "Command: close GCB" remains energized 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 to 300 ms**

The closing time of the MCB corresponds to the lead time of the connect command. The connect command will be issued at the entered time before the synchronization point.

Connection Functions (MFR 2A)

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

GCB connection functions **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. perm. differential frequency (pos. slip) **0.05 to 2.00 Hz**

The prerequisite of a connect command's being output 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. perm. differential frequency (neg. slip) **0.05 to -2.00 Hz**

The prerequisite of a connect command's being output 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 duration of connect relay **50 to 250 ms**

The duration of the connect pulse can be adjusted to the subordinate switching unit.

```
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 energized. If the power circuit breaker has to be opened, the relay de-energizes.

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

Dead Bus Start (MFR 2S)

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. circ.break.
Dead bus op. ON
```

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

ON .....Release of the dead bus start function for the GCB. Furthermore conditions [refer to Dead Bus Start on page 31] have to be met to switch the GCB to the de-energized busbar. The subsequent screens of this function are displayed.
OFF .....No dead bus start of the GCB is carried out, and the subsequent screens of this function are not displayed.

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

Maximum differential frequency for GCB dead bus start **0.05 to 0.90 Hz**

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

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

Maximum differential voltage for GCB dead bus start **[1] 1 to 20 V, [4] 2 to 60 V**

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

```
Mains circ.break
Dead bus op. ON
```

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

ON .....Release of the dead bus start function for the GCB. Furthermore conditions [refer to Dead Bus Start on page 31] have to be met to switch the GCB to the de-energized busbar. The subsequent screens of this function are displayed.
OFF .....No dead bus start of the GCB is carried out, and the subsequent screens of this function are not displayed.

Synchronization Time Monitoring (MFR 2S)

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

Synchronization time monitoring **ON / OFF**

ON .....This setting ensures that the synchronization time of the GCB and the MCB will be monitored. A time counter starts simultaneously with the beginning of the synchronization. If, following the expiry of the set time, the power circuit breaker has not been enabled, a warning message "Synchronization time GCB" or "Synchronization time MCB" is output. Moreover, the synchronization procedure will be cancelled and the relay "ready for operation" de-energizes. By pressing the "Clear" button for at least 3 seconds or by removing one of the conditions, which are necessary for the synchronization (e.g. terminal 3 "Release CB"), the monitoring function is reset. The subsequent screens of this function are displayed.
OFF .....The synchronization time will not be monitored. The subsequent screens of this function are not displayed.

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

Final value for synchronization time monitoring **10 to 999 s**

Please refer to the above description of the configuration screen.

Power Factor Controller (MFR 2S)

```
Power factor
Controller   ON
```

Power factor controller **ON / OFF**

ON..... A load-independent, automatic control of the power φ factor will be carried out in the operation in parallel to the mains. On currents (smaller than 5 % of the transformer rated current) the power factor can be measured only very inaccurately and the controller is automatically locked. The subsequent screen masks of this option will be displayed.

OFF..... The frequency will not be controlled, and the (otherwise) subsequent screen masks of this option will not be displayed.

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

Power factor controller set point 1 **i0.70 to 1.00 to c0.70**

The set point 1 is active, if the input "Changeover setpoint 1↔2" (terminal 5) is not energized. The amount of the reactive load in operation in parallel with the mains is controlled in such a way, that the given power factor is used. The letters "i" and "c" stand for "inductive = lagging" (overexcited generator) and "capacitive = leading" (underexcited generator) reactive load.

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

Power factor controller set point 2 **i0.70 to 1.00 to c0.70**

The set point 2 is active, if the input "Changeover setpoint 1↔2" (terminal 5) is energized. The amount of the reactive load in operation in parallel with the mains is controlled in such a way, that the given power factor is used. The letters "i" and "c" stand for "inductive = lagging" (overexcited generator) and "capacitive = leading" (underexcited generator) reactive load.

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

Set point ramp of the power factor controller **0.05 to 0.30 /s**

A change in set point is supplied to the controller via a ramp. The slope of the ramp is used to alter the rate at which the controller modifies the set point value. The more rapidly the change in the set point is to be carried out, the greater the value input here must be.

Three-Position Controller

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

Insensitiveness of power factor controller **0.5 to 25.0 %**

The unit internally automatically calculates the amount of reactive load which corresponds to the power factor. In operation in parallel with the mains, the reactive load is controlled in such a manner that - in its controlled state - the actual value deviates from the internally calculated set point by no more than the set percentage of insensitivity. In this case, the percentage value refers to the generator nominal power.

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

Gain of power factor controller **0.1 to 99.9**

The gain K_p affects the operating time of the relays. By increasing this value, the operating time can be increased in case of a certain system deviation.

Set Point Specification Via Analog Input 0/4 to 20 mA (MFR 2S/PSVA)

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

Power factor controller external set point specification **ON / OFF**

ON .....The power factor set point 2 may be specified via an external signal 0/4 to 20 mA. This set point is active if the input "Changeover set-point 1↔2" (terminal 5) is energized. The following screens of this function are displayed.

OFF .....No external set point value specification can be carried out via the 0/4 to 20 mA input. The following screens of this function are not displayed.

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

Set point value specification analog input **0-20 / 4-20 mA**

The analog input of the power factor controller (terminals 27/28) can be changed here between 0 to 20 mA and 4 to 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 message "Wirebreak" is displayed.

```
External setp.
0/4mA =  00000kW
```

Scaling the minimum value **i0.70 to 1.00 to c0.70**

The minimum value of the set point is defined here.

```
External setp.
20mA =   00000kW
```

Scaling the maximum value **i0.70 to 1.00 to c0.70**

The maximum value of the set point is defined here.

Set Point Specification Via Interface (MFR 2S)

The following conditions must be fulfilled for a set point specification via the interface:

- "Setpoint 2" must be enabled via discrete input (terminal 5)
- Data transmission must be established

If a data transmission cannot be established (the interface was deactivated via the configuration screen or there is an interface fault), "Setpoint 2" will be adjusted.

Real Power Controller

```
Power controller
          ON
```

Real power controller **ON / OFF**

ON..... During the operation in parallel with the mains the real power is controlled to the pre-selected set point value. The subsequent screens of this function will be displayed.
OFF..... The power will not be controlled, and the subsequent screens of this function will not be displayed.

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

Set point ramp real-power controller **1 to 100 %/s**

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

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

Maximum power limitation **10 to 120 %**

The set point value of the real power controller is internally limited to this value, so that no higher value can be adjusted. The percentage value refers to the generator nominal power.

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  = 0000kW
```

Set point value 1 generator real power **0 to 32,000 kW**

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

```
Power controller
P set2  = 0000kW
```

Set point value 2 generator real power **0 to 32,000 kW**

The set point 1 is active when the discrete input "Changeover setpoint 1↔2" (terminal 5) is energized.

Set Point Specification Via Analog Input 0/4 to 20 mA (MFR 2S/PSVA)

```
Set Value extern
PowContr.    ON
```

Real power controller external set point specification **ON / OFF**

ON..... The real power set point 2 may be specified via an external signal 0/4 to 20 mA. This set point is active if the input "Changeover setpoint 1↔2" (terminal 5) is energized. The following screens of this function are displayed.
OFF..... No external set point value specification can be carried out via the 0/4 to 20 mA input. The following screens of this function are not displayed.

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

Set point value specification analog input **0-20 / 4-20 mA**

The analog input of the real power controller (terminals 27/28) can be changed here between 0 to 20 mA and 4 to 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 message "Wirebreak" is displayed.

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

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

The minimum value of the set point is defined here.

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

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

The maximum value of the set point is defined here.

Set Point Specification Via Interface

The following conditions must be fulfilled for a set point specification via the interface:

- "Setpoint 2" must be enabled via discrete input (terminal 5)
- Data transmission must be established

If a data transmission cannot be established (the interface was deactivated via the configuration screen or there is an interface fault), "Setpoint 2" will be adjusted.

Three-Position Controller

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

Insensitivity of active load controller **0.1 to 25.0 %**

When the unit operates in parallel with the mains the real power will be controlled in such a way that the actual value in the adjusted state differs no more from the real power set point than by the amount of the entered insensitivity. This percentage is based on the generator nominal power.

```
Power controller
Gain   Kp  00.0
```

Gain of real power controller **0.1 to 99.9**

The gain K_p affects the operating time of the relays. By increasing this value, the operating time can be increased in case of a certain system deviation.

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

Reduction of insensitivity for active load controller **1.0 to 9.9**

If no actuating pulse was issued for at least 5 seconds the insensitivity will be reduced by the entered factor.
Example: In case of an insensitivity of 2.5 % and a factor 2.0 the insensitivity will be increased to 5.0 % after 5 seconds. If the system deviation afterwards exceeds 5.0 % the original insensitivity (2.5 %) of the controller will be set automatically. Using this entry the frequent actuation processes which are not necessary can be avoided thus extending the life of the actuating device.

Analog Controller Outputs (PSVA)

```
Power controller
Gain Kp    000
```

P gain of the active load controller **1 to 240**

The proportional-action coefficient K_{PR} indicates the closed-loop control system gain. By increasing the gain, the response is increased to permit larger corrections to the variable to be controlled. The farther out of tolerance the process is the larger the response action is to return the process to the tolerance band. If the gain is configured too high, the result is excessive overshoot/undershoot of the desired value.

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

Reset time of the active load controller **0.0 to 60.0 s**

The reset time T_n represents the I-component of the PID controller. The reset time corrects for any offset (between set point and process variable) automatically over time by shifting the proportioning band. Reset automatically changes the output requirements until the process variable and the set point are the same. This parameter permits the user to adjust how quickly the reset attempts to correct for any offset. The reset time constant must be greater than the derivative time constant. If the reset time constant is too small, the engine will continually oscillate. If the reset time constant is too large, the engine will take to long to settle at a steady state.

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

Derivative action time of the active load controller **0.0 to 6.0 s**

The derivative-action time T_V represents the D-component of the PID controller. By increasing this parameter, the stability of the system is increased. The controller will attempt to slow down the action of the actuator in an attempt to prevent excessive overshoot or undershoot. Essentially this is the brake for the process. This portion of the PID loop operates anywhere within the range of the process unlike reset.

Partial Load Lead

```
Part-load lead
            ON
```

Partial load lead **ON / OFF**

ON..... Partial load lead is carried out, and the subsequent screens of this function are displayed. If the genset needs a warm-up phase, the power set point value can hereby be limited to the partial load value to be entered below after synchronization with the mains parallel operation.

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

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

Limit value partial load lead **5 to 110 %**

If the unit requires a warm-up period, a lower fixed power set point value can be specified after synchronizing to the operation in parallel with the mains. The limit value of partial load lead refers to the generator rated power.

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

Period of partial load lead **0 to 600 s**

Entry of the period during which the partial load lead will be maintained (after the first closing of the generator power circuit breaker when the unit is operated in parallel to the mains). If a partial load lead is not desired, enter "0" for this parameter.

Load/var Sharing

Load Sharing

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

Load sharing **ON / OFF**

ON .....Real power is shared between multiple generators operating in parallel. The generator outputs are distributed depending on the configured value. The subsequent screens of this function are displayed.
OFF .....No real power sharing is carried out, and the subsequent screens of this function are not displayed.

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

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

Increasing the load share factor increases the priority of the primary control variable to the control. The lower the factor is configured, the greater the priority of the secondary control variable.

Definition "Primary control variable"
• Isolated operation = frequency

Definition "Secondary control variable"
• Isolated operation = real power related to the other generators

The smaller this factor the higher the priority to equally share the load to all generators.

var Sharing (MFR 2S)

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

var sharing **ON / OFF**

ON .....Reactive power is shared between multiple generators operating in parallel. The generator outputs are distributed depending on the configured value. The subsequent screens of this function are displayed.
OFF .....No reactive power sharing is carried out, and the subsequent screens of this function are not displayed.

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

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

Increasing the load share factor increases the priority of the primary control variable (the voltage) to the control. The lower the factor is configured, the greater the priority of the secondary control variable (generator reactive power). Var sharing is activated during isolated parallel operating only.

Monitoring Configuration

Generator Overload Monitoring

The generator real power is monitored for exceeding the configured threshold value. If the threshold value is exceeded, the power is automatically reduced and the generator is disconnected from the mains by energizing the relay "Command: open GCB" (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 performed. The subsequent screens of this function are displayed.
OFF..... No overload monitoring is performed and the subsequent screens of this function are not displayed.

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

Threshold value generator overload monitoring **80 to 120 %**

The threshold value refers to the generator rated power.

Issuing of class 2 alarm

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

Generator overload monitoring delay **0.0 to 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 to 4**

If the monitoring function is triggered, the relay(s) configured here will be energized. If no relay is to be energized, "0000" must be configured here. This screen is only visible if "Change relay assignment" is configured YES.

Generator Reverse/Reduced Power Monitoring

The generator real power is monitored for falling below the configured threshold value. If the value is fallen below the threshold, the generator will be disconnected from the mains (alarm class 3) by energizing the relay "Command: open GCB". The message "Reverse/reduced load" appears on the display. The monitoring function is only active if the "Monitoring" LED is illuminated.

```
Reverse power
monitoring  ON
```

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

ON .....A reverse or reduced power monitoring of the generator real power is performed. The subsequent screens of this function are displayed.
OFF .....No reverse or reduced power monitoring is performed and the subsequent screens of this function are not displayed

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

Reverse/reduced power monitoring threshold value **-99 to 0 to +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.

Issuing of class 3 alarm

```
Reverse power
Delay     00.0s
```

Delay of reverse/minimum power monitoring **0.1 to 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
```

Generator reverse/reduced power output on relay **0 to 4**

If the monitoring function is triggered, the relay(s) configured here will be energized. If no relay is to be energized, "0000" must be configured here. This screen is only visible if "Change relay assignment" is configured YES.

Unbalanced Load Monitoring

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 will be disconnected from the mains (alarm class 3) by energizing the relay "Command: open GCB". The message "Load imbalance" appears on the display.

```
Load unbalance
monitoring   ON
```

Unbalanced load monitoring **ON/OFF**

ON..... Monitoring for unbalanced load of the generator real power will be performed. The subsequent parameters of this function are displayed.
OFF..... Monitoring is disabled and the subsequent screens of this function are not displayed.

```
Load unbalance
Threshold = 00%
```

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

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

Issuing of class 3 alarm

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

Delay of unbalanced load monitoring **0.04 to 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.

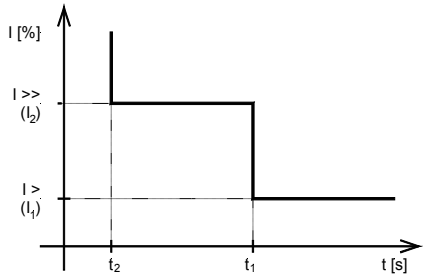
```
Load unbalance
Relay outp. 0000
```

Generator unbalanced load output on relay **0 to 4**

If the monitoring function is triggered, the relay(s) configured here will be energized. If no relay is to be energized, "0000" must be configured here. This screen is only visible if "Change relay assignment" is configured YES.

Definite Time-Overcurrent Monitoring

The individual currents of the generator are monitored with regard to excess. The transformer 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 will be disconnected from the mains (alarm class 3) by energizing the relay "Command: open GCB". The message "Gen. overcurrent 1", or "Gen. overcurrent 2" appears on the display.




```
Overcurrent
monitoring   ON
```

Unbalanced load monitoring **ON/OFF**

ON .....Monitoring for unbalanced load of the generator real power will be performed. The subsequent parameters of this function are displayed.
OFF .....Monitoring is disabled and the subsequent screens of this function are not displayed.

```
Overcurrent
Thresh 1   = 00%
```

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

If the value of the generator current exceeds the set percentage value in relation to the transformer rated current, a shutdown will be performed.

Issuing of class 3 alarm

```
Overcurrent
Delay 1  =00.00s
```

Delay of the overcurrent monitoring, level 1 **0.04 to 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
```

Generator overcurrent level 1 output on relay **0 to 4**

If the monitoring function is triggered, the relay(s) configured here will be energized. If no relay is to be energized, "0000" must be configured here. This screen is only visible if "Change relay assignment" is configured YES.

```
Overcurrent
Thresh 2   = 00%
```

Threshold value generator overcurrent, level 2 **0 to 300 %**

If the value of the generator current exceeds the set percentage value in relation to the transformer rated current, a shutdown will be performed.

Issuing of class 3 alarm

```
Overcurrent
Delay 2  =00.00s
```

Delay of the overcurrent monitoring, level 2 **0.04 to 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
```

Generator overcurrent level 2 output on relay **0 to 4**

If the monitoring function is triggered, the relay(s) configured here will be energized. If no relay is to be energized, "0000" must be configured here. This screen is only visible if "Change relay assignment" is configured YES.

Reactive Power Monitoring

Reactive power is monitored for exceeding the configured threshold value (leading and lagging). In this case the monitoring of the leading reactive power can be used as field-failure detection. If there is positive deviation from the threshold value, the generator will be disconnected from the mains (fault class 3) by energizing the relay "Command: open GCB". The message "Reactive power ind." or "Reactive power cap." appears on the display.

Lagging Reactive Power

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

Lagging reactive power monitoring **ON/OFF**

ON..... Monitoring for lagging reactive power will be performed. The subsequent parameters of this function are displayed.
OFF..... Monitoring is disabled and the subsequent screens of this function are not displayed.

```
Lagg.react.power
Threshold = 00%
```

Lagging reactive power monitoring threshold value **0 to 160 %**

If the value of the lagging reactive power exceeds the configured percentage value in relation to the generator rated power, a shutdown will be performed.

Issuing of class 3 alarm

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

Lagging reactive power monitoring delay **0.04 to 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
```

Lagging reactive power monitoring output on relay **0 to 4**

If the monitoring function is triggered, the relay(s) configured here will be energized. If no relay is to be energized, "0000" must be configured here. This screen is only visible if "Change relay assignment" is configured YES.

Leading Reactive Power (Field Failure Detection)

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

Leading reactive power monitoring **ON/OFF**

ON..... Monitoring for leading reactive power will be performed. The subsequent parameters of this function are displayed.
OFF..... Monitoring is disabled and the subsequent screens of this function are not displayed.

```
Lead.react.power
Threshold = 00%
```

Leading reactive power monitoring threshold value **0 to 160 %**

If the value of the leading reactive power exceeds the configured percentage value in relation to the generator rated power, a shutdown will be performed.

Issuing of class 3 alarm

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

Leading reactive power monitoring delay **0.04 to 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
```

Leading reactive power monitoring output on relay **0 to 4**

If the monitoring function is triggered, the relay(s) configured here will be energized. If no relay is to be energized, "0000" must be configured here. This screen is only visible if "Change relay assignment" is configured YES.

Generator Frequency Monitoring

The generator frequency is monitored for exceeding or falling below the configured threshold value. If the threshold value is exceeded or fallen below, the generator will be disconnected from the mains (alarm class 3) by energizing the relay "Command: open GCB". The message "Gen. overfreq.", or "Gen. underfreq." appears on the display. The underfrequency monitoring function is only active if the "Monitoring" LED is illuminated.

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

Generator frequency monitoring **ON/OFF**

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

OFF .....No monitoring is performed and the subsequent screens of this function are not displayed.

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

Threshold value: Generator overfrequency **40.0 to 70.0 Hz**

If the value of the generator frequency exceeds the value configured here, a shutdown will be performed.

Issuing of class 3 alarm

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

Generator overfrequency threshold delay **0.04 to 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
```

Generator overfrequency monitoring output on relay **0 to 4**

If the monitoring function is triggered, the relay(s) configured here will be energized. If no relay is to be energized, "0000" must be configured here. This screen is only visible if "Change relay assignment" is configured YES.

```
Gen. underfreq.
     f > 00.00Hz
```

Threshold value: Generator underfrequency **40.0 to 70.0 Hz**

If the value of the generator frequency falls below the value configured here, a shutdown will be performed.

Issuing of class 3 alarm

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

Generator underfrequency threshold delay **0.04 to 9.98 s**

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

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

Generator underfrequency monitoring output on relay **0 to 4**

If the monitoring function is triggered, the relay(s) configured here will be energized. If no relay is to be energized, "0000" must be configured here. This screen is only visible if "Change relay assignment" is configured YES.

Generator Voltage Monitoring

The generator voltage is monitored for exceeding or falling below the configured threshold value. If the threshold value is exceeded or fallen below, the generator will be disconnected from the mains (alarm class 3) by energizing the relay "Command: open GCB". The message "Gen. overvolt.", or "Gen. undervolt." appears in the display. The undervoltage monitoring function is only active if the "Monitoring" LED is illuminated.

```
Gen.voltage
Monitoring  ON
```

Generator voltage monitoring **ON / OFF**

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

OFF..... No monitoring is performed, and the subsequent screens of this function are not displayed.

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

Rated generator voltage **[1] 50 to 125 V, [4] 50 to 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 phase-phase voltage must be entered here.

```
Volt. Monit.Gen.
°°°°°°°°°°°°°°°°
```

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

Generator voltage measurement **Phase to phase / Phase-neutral**

The unit can either monitor the phase-neutral voltages (four-wire system) or the phase-phase voltages (three-wire system). Usually, for the low-voltage system (400 V-version) the phase-neutral voltages are monitored, while for the medium-high-voltage system (100 V-version), the phase-phase voltages are monitored. The monitoring of the phase-phase voltage is recommended to avoid a phase-earth fault in a compensated or isolated mains resulting in tripping of the voltage protection. If voltage measurement is performed without neutral conductor (i.e. parameter "Volt.-measuring" is configured "phase to phase", chapter Configure Basic Settings on page 52), the setting "phase to phase" must be selected here.

Phase-neutral.... The voltage at the terminals 0/20/21/22 is measured as a four-wire installation. All subsequent screens concerning voltage measuring refer to phase-neutral voltage (V_{Ph-N}).

Phase to phase .. If the voltage system connected to the terminals 20/21/22 is a three-wire system, this setting must be selected. All subsequent screens concerning voltage measuring refer to phase-phase voltage (V_{Ph-Ph}).

```
Gen.overvoltage
      V > 000%
```

Threshold value: Gen. overvoltage **20 to 150 %**

If the value of the generator voltage exceeds the value configured here, a shutdown will be performed.

Issuing of class 3 alarm

```
Gen.overvoltage
Delay     =0.00s
```

Generator overvoltage threshold delay **0.04 to 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.overvoltage
Relay outp. 0000
```

Generator overvoltage monitoring output on relay **0 to 4**

If the monitoring function is triggered, the relay(s) configured here will be energized. If no relay is to be energized, "0000" must be configured here. This screen is only visible if "Change relay assignment" is configured YES.

```
Gen.undervoltage
      V < 000%
```

Threshold value: Gen. undervoltage **20 to 150 %**

If the value of the generator voltage falls below the value configured here, a shutdown will be performed.

Issuing of class 3 alarm

```
Gen.undervoltage
Delay     =0.00s
```

Generator undervoltage threshold delay **0.04 to 9.98 s**

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

```
Gen.undervoltage
Relay outp. 0000
```

Generator undervoltage monitoring output on relay **0 to 4**

If the monitoring function is triggered, the relay(s) configured here will be energized. If no relay is to be energized, "0000" must be configured here. This screen is only visible if "Change relay assignment" is configured YES.

Mains Frequency Monitoring

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 in parallel with the mains must be disconnected from the mains automatically. The mains frequency is monitored for exceeding or falling below the set threshold value. If the threshold value is exceeded or fallen below, the system will be disconnected from the mains (alarm class 0) by energizing the relay configured for mains decoupling. 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 for overfrequency and underfrequency. The subsequent screens of this function are displayed.

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

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

Threshold value: Mains overfrequency **40.0 to 70.0 Hz**

If the value of the mains frequency exceeds the value configured here, a shutdown will be performed.

Issuing of class 0 alarm

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

Mains overfrequency threshold delay **0.04 to 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
```

Mains overfrequency monitoring output on relay **0 to 4**

If the monitoring function is triggered, the relay(s) configured here will be energized. If no relay is to be energized, "0000" must be configured here. This screen is only visible if "Change relay assignment" is configured YES.

```
Mains underfreq.
     f > 00.00Hz
```

Threshold value: Mains underfrequency **40.0 to 70.0 Hz**

If the value of the mains frequency falls below the value configured here, a shutdown will be performed.

Issuing of class 0 alarm

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

Mains underfrequency threshold delay **0.04 to 9.98 s**

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

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

Mains underfrequency monitoring output on relay **0 to 4**

If the monitoring function is triggered, the relay(s) configured here will be energized. If no relay is to be energized, "0000" must be configured here. This screen is only visible if "Change relay assignment" is configured YES.

Mains Voltage Monitoring

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 in parallel with the mains must be disconnected from the mains automatically. The mains voltages are monitored for exceeding or falling below the configured threshold value. If the threshold value is exceeded or fallen below, the system will be disconnected from the mains (alarm class 0) by energizing the relay configured for mains decoupling. 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 for overvoltage and undervoltage. The subsequent screens of this function are displayed.

OFF .....No monitoring is performed, and the subsequent screens of this function are not displayed.

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

Rated mains voltage **[1] 50 to 125 V, [4] 50 to 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 phase-phase voltage must be entered here.

```
Volt.Monit.Mains
°°°°°°°°°°°°°°°°
```

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

Mains voltage measurement **Phase to phase / Phase-neutral**

The unit can either monitor the phase-neutral voltages (four-wire system) or the phase-phase voltages (three-wire system). Usually, for the low-voltage system (400 V-version) the phase-neutral voltages are monitored, while for the medium-high-voltage system (100 V-version), the phase-phase voltages are monitored. The monitoring of the phase-phase voltage is recommended to avoid a phase-earth fault in a compensated or isolated mains resulting in tripping of the voltage protection. If voltage measurement is performed without neutral conductor (i.e. parameter "Volt.-measuring" is configured "phase to phase", chapter Configure Basic Settings on page 52), the setting "phase to phase" must be selected here.

Phase-neutral ....The voltage at the terminals 0/50/51/52 is measured as a four-wire installation. All subsequent screens concerning voltage measuring refer to phase-neutral voltage (V_{Ph-N}).

Phase to phase ...If the voltage system connected to the terminals 50/51/52 is a three-wire system, this setting must be selected. All subsequent screens concerning voltage measuring refer to phase-phase voltage (V_{Ph-Ph}).

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

Threshold value: Mains overvoltage **20 to 150 %**

If the value of the mains voltage exceeds the value configured here, a shutdown will be performed.

Issuing of class 0 alarm

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

Mains overvoltage threshold delay **0.04 to 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
```

Mains overvoltage monitoring output on relay **0 to 4**

If the monitoring function is triggered, the relay(s) configured here will be energized. If no relay is to be energized, "0000" must be configured here. This screen is only visible if "Change relay assignment" is configured YES.

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

Threshold value: Mains undervoltage **20 to 150 %**

If the value of the mains voltage falls below the value configured here, a shutdown will be performed.

Issuing of class 0 alarm

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

Mains undervoltage threshold delay **0.04 to 9.98 s**

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

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

Mains undervoltage monitoring output on relay **0 to 4**

If the monitoring function is triggered, the relay(s) configured here will be energized. If no relay is to be energized, "0000" must be configured here. This screen is only visible if "Change relay assignment" is configured YES.

Voltage Asymmetry Monitoring

The phase-phase voltages of the mains are monitored for asymmetry. An asymmetry is accepted if the difference between any two phase-phase voltages is larger than the configured threshold value. In this case, the system will be disconnected from the mains (alarm class 0) by energizing the relay configured for mains decoupling. The message "Asymmetry" appears in the display.

```
Asymmetry
monitoring   ON
```

Asymmetry monitoring **ON / OFF**

ON..... The mains voltage is monitored for asymmetry and the subsequent screens of this function are displayed.

OFF..... No monitoring is performed and the subsequent screens of this function are not displayed.

```
Asymmetry
Threshold = 00%
```

Asymmetry monitoring threshold value **0 to 99 %**

If the value of the asymmetry exceeds the configured percentage value in relation to the generator rated power, a shutdown will be performed.

Issuing of class 0 alarm

```
Asymmetry
Delay    =00.00s
```

Asymmetry monitoring delay **0.04 to 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
```

Asymmetry monitoring output on relay **0 to 4**

If the monitoring function is triggered, the relay(s) configured here will be energized. If no relay is to be energized, "0000" must be configured here. This screen is only visible if "Change relay assignment" is configured YES.

Phase Shift Monitoring (MFR 2S)

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 monitoring is only active if the mains voltage is above 70 % of the transformer rated voltage. If the threshold value is exceeded, the system will be disconnected from the mains (alarm class 0) by energizing the relay configured for mains decoupling. 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 .....No phase shift monitoring is performed, and the subsequent screens of this function are not displayed.

```
Phase shift
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.

Issuing of class 0 alarm

NOTE

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

```
Phase-shift
(One phase) 00°
```

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

Maximum phase difference **2 to 90 °**

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

```
Phase-shift
(3-phase)   00°
```

Maximum phase difference **2 to 90 °**

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

```
Phase-shift
Relay outp. 0000
```

Phase shift monitoring output on relay **0 to 4**

If the monitoring function is triggered, the relay(s) configured here will be energized. If no relay is to be energized, "0000" must be configured here. This screen is only visible if "Change relay assignment" is configured YES.

df/dt Monitoring (MFR 2S/PSVA)

The unit determines a measuring value for the rate of change of frequency (ROCOF). 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 will be disconnected from the mains (alarm class 0) by energizing the relay configured for mains decoupling. The message "Alarm df/dt" appears on the display.

```
df/dt
Monitoring   ON
```

df/dt monitoring **ON / OFF**

ON..... The mains voltage is monitored for asymmetry and the subsequent screens of this function are displayed.
OFF..... No monitoring is performed and the subsequent screens of this function are not displayed.

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

df/dt monitoring threshold value **1.0 to 9.9 Hz/s**

If the value of the rate of change of mains frequency exceeds the configured value, a mains disconnection will be performed.

Issuing of class 0 alarm

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

df/dt monitoring delay **0.1 to 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 screen.

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

df/dt monitoring output on relay **0 to 4**

If the monitoring function is triggered, the relay(s) configured here will be energized. If no relay is to be energized, "0000" must be configured here. This screen is only visible if "Change relay assignment" is configured YES.

Mains Decoupling

```
Mains decoupling
through    MCB
```

Mains decoupling via **GCB / MCB**

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

Battery Voltage Monitoring

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

Battery undervoltage threshold value **10.0 to 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." on the display and issues a centralized alarm (alarm class 1).

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

Battery undervoltage monitoring output on relay **0 to 4**

If the monitoring function is triggered, the relay(s) configured here will be energized. If no relay is to be energized, "0000" must be configured here. This screen is only visible if "Change relay assignment" is configured YES.

Centralized Alarm

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

Centralized alarm output on relay **0 to 4**

The centralized alarm is issued if one monitoring function with the alarm classes F1, F2 and F3 is triggered. If the centralized alarm is triggered, the relay(s) configured here will be energized. If "Auto-acknowledge messages" is configured ON, the centralized alarm relay de-energizes automatically after expiry of the drop-out delay. If no relay is to be energized, "0000" must be configured here. This screen is only visible if "Change relay assignment" is configured YES.

Enable Monitoring

```
Monitoring ON
after        00s
```

Delayed monitoring **1 to 99 s**

Time delay after the minimum frequency for monitoring (considering the discrete input "Enable monitoring") is exceeded and the activation of the specific monitoring functions.

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

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

The delayed monitoring is enabled after exceeding the frequency configured here.

```
f Gen > xx Hz
Relay outp. 0000
```

Exceeding minimum frequency output on relay **0 to 4**

If the above configured minimum frequency is exceeded, the relay(s) configured here will be energized. If no relay is to be energized, "0000" must be configured here. This screen is only visible if "Change relay assignment" is configured YES.

Configure Pulse Outputs (MFR 2S/PSVA)

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 reactive 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 below 100 ms also in case of maximum power.

Real Power Pulse Counter

```
Pulse/kWh
Logic  negative
```

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

positive ..... The open-collector output is closed per kWh pulse.
negative ..... The open-collector output is opened per kWh pulse.

```
Real power
Pulse/kWh 000.0
```

Pulses per kWh **0.1 to 150.0**

Output of the pulses which are set here is effected per active energy unit measured (kWh). (Ex.: If 20 kWh were measured and "**Pulse/kWh 020.00**" was set here, a total of 20 kWh × 20 pulses/kWh = 400 pulses, were output. The evaluation of the pulses must be carried out externally.)

Reactive Power Pulse Counter

```
Pulse/kvarh
Logic  negative
```

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

positive ..... The open-collector output is closed per kvarh pulse.
negative ..... The open-collector output is opened per kvarh pulse.

```
Reactive energy
P./kvarh  000.0
```

Pulses per kvarh **0.1 to 150.0**

Output of the pulses which are set here is effected per reactive energy unit measured (kvarh). (Ex.: If 20 kvarh were measured and "**P./kvarh 020.00**" was set here, a total of 20 kvarh × 20 pulses/kvarh = 400 pulses, were output. The evaluation of the pulses must be carried out externally.)

```
Pulse/kvarh
Type  leading
```

kvarh pulse for type of reactive power **leading / lagging**

leading ..... The pulse output occurs proportionally to the leading reactive power. If there is lagging reactive power, no pulses are emitted.
lagging ..... The pulse output occurs proportionally to the lagging reactive power. If there is leading reactive power, no pulses are emitted.

Configure Analog Outputs (MFR 2S/PSVA)

It is possible to assign a specific measurement variable to each available analog output. The output range may either be 0 to 20 mA or 4 to 20 mA. A list of the possible functions is shown below. The variable may be scaled via an upper and a lower input value. The inputs may also be assigned with prefixes.

Analog output name	setting range	Analog output name	setting range
Generator voltage V_{L1N}	0 to 65,000V	Generator voltage V_{L12}	0 to 65,000V
Generator voltage V_{L2N}	0 to 65,000V	Generator voltage V_{L23}	0 to 65,000V
Generator voltage V_{L3N}	0 to 65,000V	Generator voltage V_{L31}	0 to 65,000V
Generator current I_{L1}	0 to 9,999A	Generator real power	-32,000 to 32,000kW
Generator current I_{L2}	0 to 9,999A	Generator reactive power	-32,000 to 32,000kW
Generator current I_{L3}	0 to 9,999A	Generator frequency	15.00 to 85.00Hz
Generator power factor	c0.50 to 1.00 to i0.50		

The two analog outputs are located at the terminals 80/81 and 82/83. The following screens refer to the analog output at terminals 80/81 as an example.

```
Analog out.80/81
       0 .. 20mA
```

Analog output range **0 .. 20mA / 4 .. 20mA / OFF**

0 .. 20mA.....The analog output range is 0 to 20 mA.
4 .. 20mA.....The analog output range is 4 to 20 mA.
OFF .....0 mA are output and the and the subsequent screens of this function are not displayed.

```
Analog out.80/81
°°°°°°°°°°°°°°°°
```

Analog output name **refer to above table**

Selection of the variables to be specified (refer to above table).

```
Analog output
  0mA =   °°°°°°°
```

Scaling of the lower output value of the analog output **refer to above table**

The lower value, for which 0 or 4 mA (depending on the configured analog output range) are output, is configured here. The setting range depends on the selected analog output variable and is indicated in the above table.

```
Analog output
 20mA =   °°°°°°°
```

Scaling of the upper output value of the analog output **refer to above table**

The upper value, for which 20 mA are output, is configured here. The setting range depends on the selected analog output variable and is indicated in the above table.

Interface Configuration

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 energized.
OFF .....No monitoring is performed and the subsequent screens of this function are not displayed.

Counter Configuration

Maintenance Call Configuration

```
Service interval
     in    0000h
```

This screen is only visible on the unit and may not be configured using LeoPC1.

Maintenance call **0 to 9,999**

A maintenance interval is specified via this screen. A maintenance call (alarm class 1, "Maintenance") is displayed after this time has expired. 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 starts. Entering a value of "0" disables this function.

Operation Hours Counter Configuration

```
Set oper. hour
counter:  00000h
```

This screen is only visible on the unit and may not be configured using LeoPC1.

Setting operation hours counter **0 to 65,000 h**

This parameter can be used to specify the number of hours an engine has been in operation. This permits the user to display the correct number of engine hours if this controller is used on an older engine or this controller is to replace an older controller.

For safety reasons, the counter is set in a 2-step sequence.
The following sequence applies:

1st step Set and store the desired operating hours
2nd step Integrate the value which has been saved by

- Terminate the configuration mode and switch to automatic mode
- Display of the operating hours
- Press and hold the buttons "Select " and "Cursor" for at least 10 seconds simultaneously

Start Counter Configuration

```
Set counter of
starts   00000
```

This screen is only visible on the unit and may not be configured using LeoPC1.

Setting start counter **0 to 49,999**

The start counter is used to display how many times the engine has been started. Following each starting attempt the start counter is increased by one. This permits the user to display the correct number of starts if this controller is used on an older engine, a starter is replaced, or this controller is to replace an older controller.

Note: Exceeding the minimum monitoring frequency for one time is considered as a start.

For safety reasons, the counter is set in a 2-step sequence.
The following sequence applies:

1st step Set and store the desired operating hours
2nd step Integrate the value which has been saved by

- Terminate the configuration mode and switch to automatic mode
- Display of the number of engine starts
- Press and hold the buttons "Select " and "Cursor" for at least 10 seconds simultaneously

Energy Counter Configuration

```
energy counter
set in     xxxx
```

This screen is only visible on the unit and may not be configured using LeoPC1.

Setting energy counter **kilo / Mega**

The power produced may be measured in kWh/kvarh or MWh/Mvarh. The user defined which scale is desired for the controller with this parameter.

For safety reasons, the following counters are set in a 2-step sequence.
The following sequence applies:

1st step Set and store the desired operating hours
2nd step Integrate the value which has been saved by

- Terminate the configuration mode and switch to automatic mode
- Display of the number of engine starts
- Press and hold the buttons "Select " and "Cursor" for at least 10 seconds simultaneously

```
Set pos. active
energy 00000xWh
```

This screen is only visible on the unit and may not be configured using LeoPC1.

Configure positive real energy **0 to 65,500 kWh/MWh**

The user may input values into the kWh/MWh counter (depending on above parameter) with this parameter. This permits the user to display the correct number of kWh/MWh for a generator if this controller is used on an older engine or this controller is to replace an older controller. This value is taken over into the counter after performing the procedure described above.

```
Set neg. active
energy 00000xWh
```

This screen is only visible on the unit and may not be configured using LeoPC1.

Configure negative real energy **0 to 65,500 kWh/MWh**

The user may input values into the kWh/MWh counter (depending on above parameter) with this parameter. This permits the user to display the correct number of kWh/MWh for a generator if this controller is used on an older engine or this controller is to replace an older controller. This value is taken over into the counter after performing the procedure described above.

```
Set lagg. react.
ener. 00000xvarh
```

This screen is only visible on the unit and may not be configured using LeoPC1.

Configure lagging reactive energy **0 to 65,500 kvarh/Mvarh**

The user may input values into the kvarh/Mvarh counter (depending on above parameter) with this parameter. This permits the user to display the correct number of kvarh/Mvarh for a generator if this controller is used on an older engine or this controller is to replace an older controller. This value is taken over into the counter after performing the procedure described above.

```
Set lead. react.
ener. 00000xvarh
```

This screen is only visible on the unit and may not be configured using LeoPC1.

Configure leading reactive energy **0 to 65,500 kvarh/Mvarh**

The user may input values into the kvarh/Mvarh counter (depending on above parameter) with this parameter. This permits the user to display the correct number of kvarh/Mvarh for a generator if this controller is used on an older engine or this controller is to replace an older controller. This value is taken over into the counter after performing the procedure described above.

Resetting the Current Slave Pointer

A current slave pointer, which records and stores the maximum generator current for each phase, is implemented in the control. The display of the maximum generator currents in **automatic mode** can be selected via the "Message" button. The following screen appears in the display.

```
000 000 000 000
00.0   I Gen max
```

Display of the maximum generator current

The maximum generator current in each phase is displayed.
Reset: Pressing and holding the "Clear" button for 3 seconds while the current slave pointer screen is being displayed will reset the memory.

Discrete Inputs Configuration

The control unit provides the following discrete inputs:

Discrete input	Terminal	Function
DI 1	34	not used
DI 2	35	control input "Isolated operation ON"
DI 3	36	control input "External acknowledgement"
DI 4	60	control input "Blocking mains protection"
DI 5	61	Alarm input
DI 6	62	Alarm input
DI 7	63	Alarm input
DI 8	64	Alarm input

DI Operation Mode Configuration

NOTE

Operating current (N.O.): The discrete input is enabled by energizing it.
This does not provide wire break monitoring!

Closed circuit current (N.C.): The discrete input is enabled by de-energizing it.
This may provide wire break monitoring.

```
Dig. input   234
Function:    EEE
```

Function of the discrete alarm inputs 2 to 4 **E / R**

The discrete inputs may be operated by an operating current (N.O.) contact or a closed circuit current (N.C.) contact. The closed circuit current input may be used to monitor for a wire break. A positive or negative voltage difference may be utilized.

E..... The discrete input is analyzed as "enabled" by energizing it (N.O./operating current; E = energize to operate).

R..... The discrete input is analyzed as "enabled" by de-energizing it (N.C./idle current; R = release/de-energize to operate).

```
Dig. input   5678
Function:    EEEE
```

Function of the discrete alarm inputs 5 to 8 **E / R**

The discrete inputs may be operated by an operating current (N.O.) contact or a closed circuit current (N.C.) contact. The closed circuit current input may be used to monitor for a wire break. A positive or negative voltage difference may be utilized.

E..... The discrete input is analyzed as "enabled" by energizing it (N.O./operating current; E = energize to operate).

R..... The discrete input is analyzed as "enabled" by de-energizing it (N.C./idle current; R = release/de-energize to operate).

```
Dig. input   5678
delayed      YYYY
```

Delay of the discrete alarm inputs 5 to 8 **Y / N**

Y..... The associated alarm input is only monitored if the minimum monitoring frequency is exceeded.

N..... The discrete input is always monitored.

```
Dig. input   5678
Err. class   0000
```

Alarm class of the discrete alarm inputs 5 to 8 **0 to 3**

Different alarm classes can be assigned to each discrete alarm input.

DI Alarm Text Configuration

The alarm texts are displayed in the case of activation of an associated alarm input.

```
Fault text: t.61
Terminal 61
```

Setting the alarm text for terminal 61 **user-defined**

This parameter is used to enter the alarm text. The text for this parameters is user defined.

```
Fault text: t.62
Terminal 61
```

Setting the alarm text for terminal 62 **user-defined**

This parameter is used to enter the alarm text. The text for this parameters is user defined.

```
Fault text: t.63
Terminal 61
```

Setting the alarm text for terminal 63 **user-defined**

This parameter is used to enter the alarm text. The text for this parameters is user defined.

```
Fault text: t.64
Terminal 61
```

Setting the alarm text for terminal 64 **user-defined**

This parameter is used to enter the alarm text. The text for this parameters is user defined.

Password Configuration

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 and not interrupted for 2 hours, code level 0 is set automatically.

```
Define level 1
code        0000
```

Code level 1 (Customer) **0000 to 9999**

This screen appears in code level 2 (password protection enabled) first. Following the input of digits in this screen, the code level for level 1 (Customer) is set. For more information about password protection refer to page 47.

```
Define level 2
code        0000
```

Code level 2 (Commissioner) **0000 to 9999**

This screen appears in code level 2 (password protection enabled) first. Following the input of digits in this screen, the code level for level 2 (mechanic) is set. For more information about password protection refer to page 47.

Chapter 7.
Commissioning

DANGER - HIGH VOLTAGE

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:

LIFE THREATENING

WARNING

The unit may only be commissioned by a qualified technician. The "EMERGENCY STOP function must function safely before the commissioning and must not depend on the particular engine.

CAUTION

Prior to commissioning, check that all measuring voltages are correctly connected with regard to phases. The connect commands for the power circuit breakers must be disconnected at the power circuit breakers. 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

1. After checking if all measuring voltages are connected in-phase, the power supply has to be applied (24 Vdc) .

2. By simultaneous depression of the two buttons "Digit↑" and "Cursor→" you enter into configuration mode.

3. 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!

4. Check the entire wiring to the MFR 2. The wiring of some relays can be checked by changing from closed circuit current (N.O.) to operating current (N.C.) 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.

5. Execute now the test of the protective functions for the generator.

6. 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.

7. After a successful check of the synchronization please check the monitored current values, the power direction and the monitored power factor.

8. Please carry out further possible checks (depending on the application and the equipment of the MFR 2).

Appendix A.
Dimensions

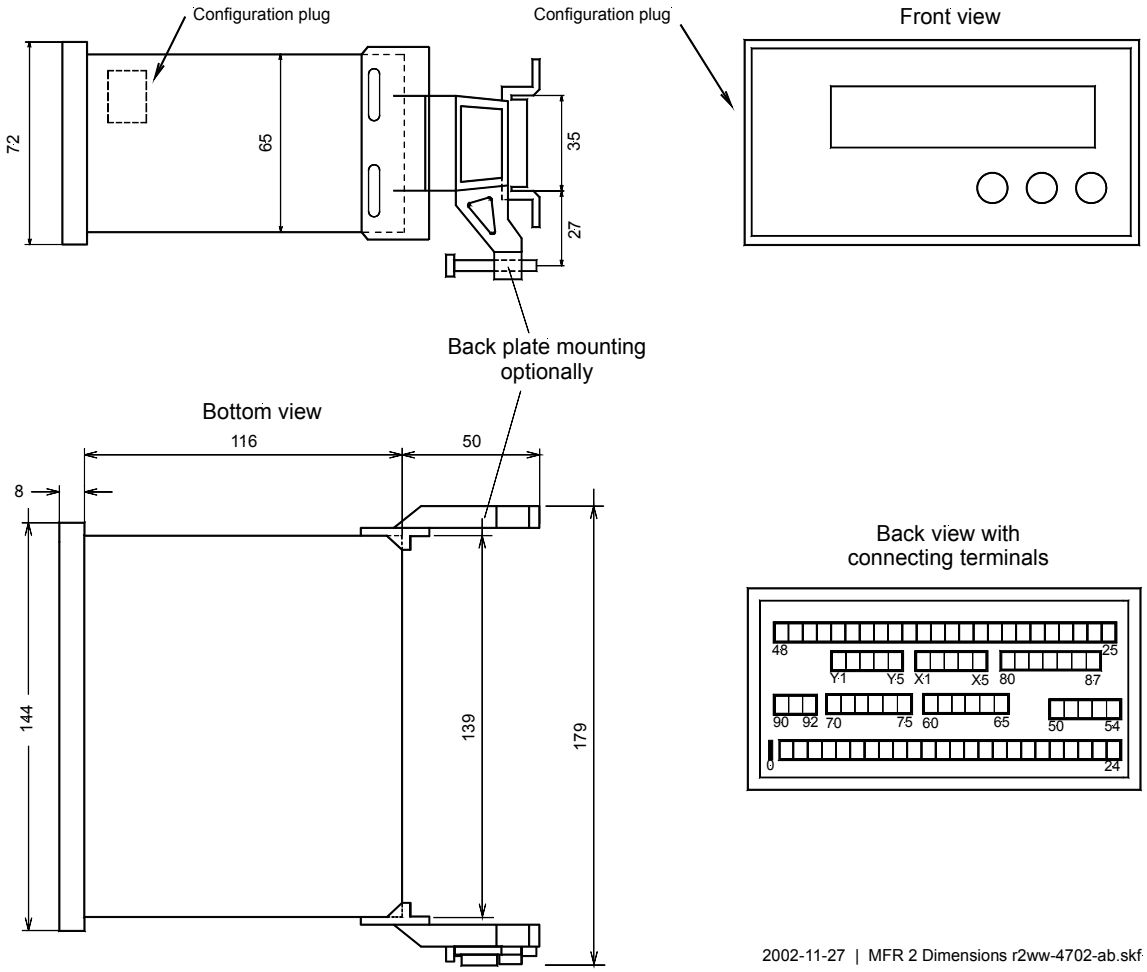


Figure 7-1: Dimensions

Appendix B.
Technical Data

Measuring voltage ----------

- Measuring voltage — Rated value (V_{rated}) ⅄/Δ ..... [1] 66/115 Vac
  [4] 230/400 Vac
  Maximum value V_{ph-ph} (UL/cUL) ..... [1] max. 150 Vac
  [4] max. 300 Vac
  Rated voltage $V_{ph-ground}$ ..... [1] 150 Vac
  [4] 300 Vac
  Rated surge voltage ..... [1] 2.5 kV
  [4] 4.0 kV
- Measuring frequency ..... 40.0 to 70.0 Hz
- Accuracy ..... Class 1
- Resistance ..... 0.1 %
- Linear measuring range ..... 1.3 × V_{rated}
- Input resistance ..... [1] 0.21 MΩ
  ..... [4] 0.7 MΩ
- Maximum power consumption per path ..... 0.15 W

Measuring current ---------- **isolated**

- Measuring current ..... [1] ../1 A
  ..... [5] ../5 A
- Accuracy ..... Class 1
- Linear measuring range — Generator ..... 3.0 × I_{rated}
  Mains ..... 1.5 × I_{rated}
- Power consumption ..... < 0.15 VA
- Rated short-time current (1 s) ..... [1] 50.0 × I_{rated}
  ..... [5] 10.0 × I_{rated}

Ambient variables ----------

- Power supply ..... 24 Vdc (9.5 to 32 Vdc)
- Intrinsic consumption ..... max. 15 W
- Ambient temperature ..... -20 to +70 °C
- Ambient humidity ..... 95 %, not condensing

Discrete inputs ---------- **isolated**

- Input range ($U_{Cont, discrete input}$) ..... Rated voltage 18 to 250 Vac/dc
- Input resistance ..... approx. 68 kΩ

Relay outputs ---------- **potential free**

- Contact material ..... AgCdO
- General purpose (GP) ($U_{Cont, relay output}$)
  AC ..... 2.00 Aac@250 Vac
  DC ..... 2.00 Adc@24 Vdc
  0.36 Adc@125 Vdc
  0.18 Adc@250 Vdc
- Pilot duty (PD) ($U_{Cont, relay output}$)
  AC B300
  DC ..... 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 to 200 °C

Analog outputs ---------- **isolated**
- At rated value ..... freely scaleable
- Insulation voltage ..... 3,000 Vdc
- Resolution PWM ..... 8/12 Bit
- -20/0/4 to 20 mA output ..... Maximum load 500 Ω
- 0 to 5 V / 0 to 10 V / ±5 V output ..... resistance ≤1 kΩ

Pulse outputs ----------
- Type ..... transistor output
- Rated gate voltage ..... 24 Vdc
- Maximum gate voltage ..... 32 Vdc
- Minimum gate current ..... 10 mAdc
- Maximum gate current ..... 30 mAdc (0.5 Vdc)

Interface ---------- **isolated**
- Insulation voltage ..... 3,000 Vdc
- Version ..... variable

Housing ----------
- Type ..... APRANORM DIN 43 700
- Dimensions (B × H × T) ..... 144 × 72 × 122 mm
- Front cutout (B×H) ..... 138 [+1.0] × 67 [+0.7] mm
- Wiring ..... Screw-type terminals
  depending on plug connector 1.5 mm², 2.5 mm²
  use 60/75 °C copper wire only
  use class 1 wire only or equivalent
- Weight ..... approx. 1,000 g

Protection ----------
- Protection system ..... IP42 from front at professional mounting
  IP54 from front with gasket (gasket: P/N 8923-1037)
  IP21 from back
- Front foil ..... insulating surface
- EMC test (CE) ..... tested according to applicable EN guidelines
- Listings ..... CE marking; UL listing for ordinary locations
  UL/cUL listed, Ordinary Locations, File No.: E231544

Appendix C.
Interface Telegram

Transmission Telegram

The data in the following table can be processed using a Gateway GW 4 or a PLC and transmitted to other bus systems. The MFR 2 sends its data via cyclic CAN messages with this.

The transfer rate of this communication is 125 kBaud.

The CAN ID, on which the MFR 2 is sending, is calculated as follows:

CAN ID = d‘800 + item number (or H‘320 + item number)

(The item number is a parameter, which can be set at the MFR 2, which influences directly the CAN ID on which the item sends its visualization messages.)

A visualization message, which is sent by an MFR 2, consists of 8 bytes and is composed as follows:

Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
H‘DD	MUX number	data word 1 high byte	data word 1 high byte	data word 2 high byte	data word 2 high byte	data word 3 high byte	data word 3 high byte

In a visualization message the byte 0 is always used to show the hexadecimal value DD. This one defines the message as a visualization message. Since the complete transmission telegram of the MFR 2 includes more than three data words, byte 1 sends a MUX number starting with 0 in addition. Therefore it is theoretically possible to send (256 × 3 = 768) words via the CAN ID. The whole telegram is built up as follows:

Line 1: MUX number 0, data word 1
Line 2: MUX number 0, data word 2
Line 3: MUX number 0, data word 3
Line 4: MUX number 1, data word 1
Line 5: MUX number 1, data word 2
Line 6: MUX number 1, data word 3
.
.
Line (n): MUX number (n-1/3), data word 1
Line (n+1): MUX number (n-1/2), data word 2
Line (n+2): MUX number (n-1/1), data word 3

n depends on the total length of the item-specific telegram and cannot be larger than H’FF.

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 /	Alarm class 0
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

CAN-Bus	Nr.	Content (words)	Unit	Comment
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
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		

VgenEXPO Exponent generator voltage
IgenEXPO Exponent generator current
PgenEXPO Exponent generator power
VbusEXPO Exponent busbar voltage
VmainsEXPO Exponent mains voltage
PmainsEXPO Exponent mains power
PgenWD Conversion factor steps → kW

Receiving Telegram

The data in the following table can be processed by a PLC or with any other suitable receiving unit.

The CAN ID, on which the MFR 2 is receiving, is as follows:

CAN ID = d‘831 (or H‘33F)

A remote message, which is received by an MFR 2, consists of 8 bytes and is composed 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

In a visualization message the byte 0 is always used to show the hexadecimal value EE. The generator number of the addressed MFR 2 must be sent on byte 1.

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:
- High byte = (Byte 0) XOR (Byte 2) XOR (Byte 4),
- Low byte = (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 sent is:

01/00 0000 1001 0110 B ➔ 4096 H

The total remote message of above example is therefore:

33F | EE | 01 | F5 01 | 40 96 | AF 62

NOTE

To process the set point values of the MFR 2 sent via interface, the discrete input "Setpoint value 1-2" at terminal 5 must be energized!

NOTE

If the DPC configuration cable is connected, the CAN interface is out of operation.

If remote control via CAN interface is enabled, the monitoring of the interface is also active. An interface fault is issued if bit 2 in the control word has the value "1" for more than 30 seconds or if bit 3 in the control word has not been sent with the value "0" for more than 30 seconds or the whole control word was not sent for more than 30 seconds.

To be able to monitor the set point messages as well, it is absolutely necessary that all three words are always sent consecutively. If an interface fault is issued, the configured fixed set point values will be used to control.

Appendix D.
Parameter List

Product number P/N _____ Rev _____

Version MFR 2 _____

Project _____

Serial number S/N _____ Date _____

Pkg.	Parameter 100/400V	Adjustment range	Standard setting	Customer settings	
CONFIGURE GENERAL PARAMETERS					
	Software version		V x.xxxx		
	Enter code	0000 to 9.999	XXXX		
	Password protection	ON/OFF	OFF	☐ ON ☐ OFF	☐ ON ☐ OFF
	Direct para.	YES/NO	NO	☐ Y ☐ N	☐ Y ☐ N
	Service display	ON/OFF	ON	☐ ON ☐ OFF	☐ ON ☐ OFF
CONFIGURE BASIC SETTINGS					
	Generator number	1 to 8	1		
	Change relay- function?	YES/NO	NO	☐ Y ☐ N	☐ Y ☐ N
	Funct. rel. 1234(R=releases)	E/R	EEEE		
	Relay "open GCB" Logic	E/R	E	☐ E ☐ R	☐ E ☐ R
	Relay "open GCB" Logic	E/R	E	☐ E ☐ R	☐ E ☐ R
	Open MCB via release MCB	ON/OFF	OFF	☐ ON ☐ OFF	☐ ON ☐ OFF
	Auto-acknowledge relay	ON/OFF	ON	☐ ON ☐ OFF	☐ ON ☐ OFF
	Auto-acknowledge messages	ON/OFF	ON	☐ ON ☐ OFF	☐ ON ☐ OFF
	Acknowledgement message aft.	1 to 99 s	1 s		
CONFIGURE GENERATOR AND MAINS SETTINGS					
	Generator nom. frequency	48.0 to 62.0 Hz	50.0 Hz		
	Gen. voltage primary	0.050 to 65.000 kV	6.300/0.400 kV		
	Gen. voltage secondary	50 to 125/50 to 480 V	100/400 V		
	Busb. voltage primary	0.050 to 65.000 kV	6.300/0.400 kV		
	Busb. voltage secondary	50 to 125/50 to 480 V	100/400 V		
	Mains voltage primary	0.050/65.000 kV	6.300/0.400 kV		
	Mains voltage secondary	50 to 125/50 to 480 V	100/400 V		
	Volt.-Measuring	Phase to phase Phase-neutral	Phase to phase	☐ p-p ☐ p-n	☐ p-p ☐ p-n
	Current transf. Generator	0 to 6.900/x A	1,000/x A		
	Format power	1 to 6	3		
	Current transf. Mains	0 to 6.900/x A	100/x A		
	Power measuring Gen.	one-phase / three-phase	three-phase		
	Nominal power Gen.	5 to 32,000 kW	500 kW		
CONFIGURE CONTROLLER					
	Controller disc.neg. load j.	ON/OFF	OFF	☐ ON ☐ OFF	☐ ON ☐ OFF
	Admissible act. power jump	10 to 80 %	22 %		
	Controller dis- connection	1 to 99 s	5 s		
	Download and open GCB	ON/OFF	OFF	☐ ON ☐ OFF	☐ ON ☐ OFF
	Control in no- load oper.	ON/OFF	OFF	☐ ON ☐ OFF	☐ ON ☐ OFF
	Freq. controller	ON/OFF	ON	☐ ON ☐ OFF	☐ ON ☐ OFF
	Generator freq. f set	40.0 to 70.0 Hz	50.0 Hz		
	Freq. controller Insens.	0.02 to 1.00 Hz	0.10 Hz		
	Freq. controller Time pulse>	10 to 250 ms	70 ms		
	Freq. controller Gain Kp	0.1 to 99.9	200		

Pkg.	Parameter 100/400V	Adjustment range	Standard setting	Customer settings	
CONFIGURE CONTROLLER					
	Volt. controller	ON/OFF	ON	☐ ON ☐ OFF	☐ ON ☐ OFF
	Volt. controller Isol. oper.	ON/OFF	ON	☐ ON ☐ OFF	☐ ON ☐ OFF
	Gen. voltage V set	90 to 125/200 to 480 V	100/400 V		
	Setpoint ramp V set	1 to 400 V/s	80 V/s		
	Volt. controller Insens.	0.5 to 15.0/0.5 to 60.0 V	2.5 V		
	Volt. controller Time pulse>	10 to 250 ms	70 ms		
	Volt. controller Gain Kp	0.1 to 99.9	20.0		
MFR 2S	Synchronization functions	ON/OFF	ON	☐ ON ☐ OFF	☐ ON ☐ OFF
..	Synchronization df max	0.02 to 0.49 Hz	0.18 Hz		
..	Synchronization df min	0.00 to -0.49 Hz	-0.10 Hz		
..	Synchronization dU max	1 to 20/2 to 60 V	5/20 V		
..	Synchronization Time pulse>	50 to 250 ms	240 ms		
..	Gen. circuit br. Pick-up t.	40 to 300 ms	80 ms		
..	Gen. circuit br. Cont. pulse	ON/OFF	OFF	☐ ON ☐ OFF	☐ ON ☐ OFF
MFR 2S	Mains circuit br. Pick-up t.	40 to 300 ms	80 ms		
MFR 2A	Connecting Gen.- circuit br.	ON/OFF	ON	☐ ON ☐ OFF	☐ ON ☐ OFF
..	Connect Gen. CB df max	0.05 to 2.00 Hz	0.18 Hz		
..	Connect Gen. CB df min	0.00 to 2.00 Hz	-0.10 Hz		
..	Connect Gen. CB Time pulse>	50 to 250 ms	240 ms		
MFR 2A	Gen. circuit br. Cont. pulse	ON/OFF	OFF	☐ ON ☐ OFF	☐ ON ☐ OFF
	Gen. circuit br.Dead bus op.	ON/OFF	OFF	☐ ON ☐ OFF	☐ ON ☐ OFF
	Dead bus op. GCB df max	0.05 to 0.90 Hz	0.25 Hz		
	Dead bus op. GCB dU max	1 to 20/2 to 60 V	10 V		
	Mains circuit brDead bus op.	ON/OFF	OFF	☐ ON ☐ OFF	☐ ON ☐ OFF
	Sync.time contr.	ON/OFF	OFF	☐ ON ☐ OFF	☐ ON ☐ OFF
	Sync.time contr. Delay time	10 to 999 s	120 s		
	Power factor Controller	ON/OFF	ON	☐ ON ☐ OFF	☐ ON ☐ OFF
	Pow.fact. contr. Setpoint 1	i0.70 to 1.00 to c0.70	1.00		
	Pow.fact. contr. Setpoint 2	i0.70 to 1.00 to c0.70	i0.80		
	Setpoint ramp Pf set	0.05 to 0.30 /s	0.30 /s		
	Pow.fact. contr. Insens.	0.5 to 25.0 %	1.0 %		
	Pow.fact. contr. Gain Kp	0.1 to 99.9	5.0		
	Power controller	ON/OFF	ON	☐ ON ☐ OFF	☐ ON ☐ OFF
	Power controller ramp =000%/	1 to 100 %/s	10 %/s		
	Power limitation P max	10 to 120 %	100/127 %		
	Power controller P set1	5 to 32,000 kW	250 kW		
	Power controller P set2	5 to 32,000 kW	500 kW		
PSVA	Set value extern PowContr	ON/OFF	ON	☐ ON ☐ OFF	☐ ON ☐ OFF
..	Analog input 0/4-20mA	0 to 20/4 to 20 mA	4 to 20 mA	☐ 0-20 ☐ 4-20	☐ 0-20 ☐ 4-20
..	Analog input 0/4 mA	0 to 32,000 kW	0		
PSVA	Analog input 20 mA	0 to 32,000 kW	500 kW		
	Power controller Insens.	0.1 to 25.0 %	2.0 %		
	Power controller Gain Kp	0.1 to 99.9	20.0		
	Power controller Sens.red.	1.0 to 9.9	2.0		
	Power controller Gain Kp	1 to 240	0		
	Reset time Power Tn	0.0 to 60.0 s	0.0 s		
	Derivative act. time(pow.)	0.0 to 6.0 s	5.36 s		
	Part-load lead	ON/OFF	ON	☐ ON ☐ OFF	☐ ON ☐ OFF
	Part-load lead Setpoint	5 to 110 %	15/19 %		
	Part-load lead Time	0 to 600 s	5 s		
	Active power load-share	ON/OFF	OFF	☐ ON ☐ OFF	☐ ON ☐ OFF
	Act. load share factor	10 to 99 %	50 %		
	Reactive power load-share	ON/OFF	OFF	☐ ON ☐ OFF	☐ ON ☐ OFF
	React load share factor	10 to 99 %	50 %		

Pkg.	Parameter 100/400V	Adjustment range	Standard setting	Customer settings	
CONFIGURE MONITORING					
	Overload power Monitoring	ON/OFF	ON	☐ ON ☐ OFF	☐ ON ☐ OFF
	Gen. Overload Max. power	80 to 120 %	110 %		
	Gen. overload Delay	0.1 to 600.0 s	3.0 s		
	Gen. Overload Relay outp.	0 to 4	0002		
	Reverse power monitoring	ON/OFF	ON	☐ ON ☐ OFF	☐ ON ☐ OFF
	Reverse power Threshold	+99 to 0 to -99 %	-10 %		
	Reverse power Delay	0.1 to 99.9 s	0.1 s		
	Reverse power Relay outp.	0 to 4	0002		
	Load unbalance Monitoring	ON/OFF	ON	☐ ON ☐ OFF	☐ ON ☐ OFF
	Load unbalance Threshold	0 to 100 %	20 %		
	Load unbalance Delay	0.04 to 99.98 s	0.10 s		
	Load unbalance Relay outp.	0 to 4	0002		
	Overcurrent monitoring	ON/OFF	ON	☐ ON ☐ OFF	☐ ON ☐ OFF
	Overcurrent Thresh. 1	0 to 300 %	120 %		
	Overcurrent Delay 1	0.04 to 99.98 s	0.1 s		
	Overcurrent 1 Relay outp.	0 to 4	0002		
	Overcurrent Thresh. 2	0 to 300 %	140 %		
	Overcurrent Delay 2	0.04 to 99.98 s	0.1 s		
	Overcurrent 2 Relay outp.	0 to 4	0002		
	Lagg.react.power monitoring	ON/OFF	ON	☐ ON ☐ OFF	☐ ON ☐ OFF
	Lagg.react.power Threshold	0 to 160 %	79 %		
	Lagg.react.power Delay	0.04 to 99.98 s	0.1 s		
	Lagg.react.power Relay outp.	0 to 4	0002		
	Lead.react.power monitoring	ON/OFF	ON	☐ ON ☐ OFF	☐ ON ☐ OFF
	Lead.react.power Threshold	0 to 160 %	79 %		
	Lead.react.power Delay	0.04 to 99.98 s	0.1 s		
	Lead.react.power Relay outp.	0 to 4	0002		
	Gen. frequency Monitoring	ON/OFF	ON	☐ ON ☐ OFF	☐ ON ☐ OFF
	Gen. overfreq. f >	40.0 to 70.0 Hz	55.00 Hz		
	Gen. overfreq. Delay	0.04 to 9.98 s	0.50 s		
	Gen. overfreq. Relay outp.	0 to 4	0002		
	Gen. underfreq. f <	40.0 to 70.0 Hz	45.00 Hz		
	Gen. underfreq. Delay	0.04 to 9.98 s	0.50 s		
	Gen. underfreq. Relay outp.	0 to 4	0002		
	Gen. voltage Monitoring	ON/OFF	ON	☐ ON ☐ OFF	☐ ON ☐ OFF
	Rated voltage Gen. Vn =	50 to 125/50 to 480V	400 V		
	Volt. Monit.Gen.	Phase to phase Phase-neutral	Phase to phase	☐ p-p ☐ p-n	☐ p-p ☐ p-n
	Gen. overvolt. V >	20 to 150 %	115 %		
	Gen. overvolt. Delay	0.04 to 9.98 s	0.50 s		
	Gen. overvolt. Relay outp.	0 to 4	0002		
	Gen. undervolt V <	20 to 150 %	85 %		
	Gen. undervolt. Delay	0.04 to 9.98 s	0.50 s		
	Gen. undervolt. Relay outp.	0 to 4	0002		
	Mains frequency Monitoring	ON/OFF	ON	☐ ON ☐ OFF	☐ ON ☐ OFF
	Mains overfreq. f >	40.0 to 70.0 Hz	50.20 Hz		
	Mains overfreq. Delay	0.04 to 9.98 s	0.10 s		
	Mains overfreq. Relay outp.	0 to 4	0001		
	Mains underfreq. f <	40.0 to 70.0 Hz	49.80 Hz		
	Mains underfreq. Delay time	0.04 to 9.98 s	0.10 s		
	Mains underfreq. Relay outp.	0 to 4	0001		

Pkg.	Parameter 100/400V	Adjustment range	Standard setting	Customer settings	
CONFIGURE MONITORING					
	Mains voltage monitoring	ON/OFF	ON	☐ ON ☐ OFF	☐ ON ☐ OFF
	Rated voltage Mains Vn =	50 to 125/50 to 480V	400 V		
	Volt. Monit.Mains	Phase to phase Phase-neutral	Phase to phase	☐ p-p ☐ p-n	☐ p-p ☐ p-n
	Mains overvolt. V >	20 to 150 %	110 %		
	Mains overvolt. Delay	0.04 to 9.98 s	0.10 s		
	Mains overvolt. Relay outp.	0 to 4	0001		
	Mains undervolt. V <	20 to 150 %	90 %		
	Mains undervolt. Delay	0.04 to 9.98 s	0.10 s		
	Mains undervolt. Relay outp.	0 to 4	0001		
	Asymmetry Monitoring	ON/OFF	OFF	☐ ON ☐ OFF	☐ ON ☐ OFF
	Asymmetry Threshold	0 to 99 %	40 %		
	Asymmetry Delay	0.04 to 99.98 s	0.50 s		
	Asymmetry Relay outp.	0 to 4	0001		
	Phase shift- Monitoring	ON/OFF	OFF	☐ ON ☐ OFF	☐ ON ☐ OFF
	Phase shift	one/three-phase three-phase only	three-phase only	☐ 1/3 ☐ 3	☐ 1/3 ☐ 3
	Phase-shift (One phase)	2 to 90 °	30 °		
	Phase-shift (3-phase)	2 to 90 °	8 °		
	Phase-shift Relay outp.	0 to 4	0001		
	df/dt- Monitoring	ON/OFF	OFF	☐ ON ☐ OFF	☐ ON ☐ OFF
	Release value df/dt>	1.0 to 9.9 Hz/s	2.6 Hz/s		
	Time delay df/dt	0.1 to 9.9 s	0.1 s		
	df/dt monitoring Relay outp.	0 to 4	0001		
	Mains decoupling through	GCB/MCB	MCB		
	Batt. undervolt. V <	10.0 to 35.0 V	20.0 V		
	Batt. undervolt. Relay outp.	0 to 4	0003		
	Central alarm Relay outp.	0 to 4	0003		
	Monitoring ON after	1 to 99 s	5 s		
	Monitoring ON at f gen >	15 to 70 Hz	15 Hz		
	f Gen > xx Hz Relay outp.	0 to 4	0000		
CONFIGURE OUTPUTS					
PSVA	Pulse/kWh Logic	positive/negative	positive	☐ pos. ☐ neg.	☐ pos. ☐ neg.
..	Active energy Pulse/kWh	0,1 to 150,0	10,0		
..	Pulse/kvarh Logic	positive/negative	positive	☐ pos. ☐ neg.	☐ pos. ☐ neg.
..	Reactive energy P./kvarh	0,1 to 150,0	10,0		
..	Pulse/kvarh Type	leading / lagging	lagging	☐ lead. ☐ lag.	☐ lead. ☐ lag.
..	Analog out. 80/81	0 to 20 / 4 to 20 mA / OFF	OFF	☐ 0 ☐ 4 ☐ Off	☐ 0 ☐ 4 ☐ Off
..	Analog out 80/81	according to list	-		
..	Analog output 0 mA	0 to max	-		
..	Analog output 20 mA	0 to max	-		
..	Analog out. 82/83	0 to 20 / 4 to 20 mA / OFF	OFF	☐ 0 ☐ 4 ☐ Off	☐ 0 ☐ 4 ☐ Off
..	Analog out 82/83	according to list	-		
..	Analog output 0 mA	0 to max	-		
PSVA	Analog output 20 mA	0 to max	-		
CONFIGURE INTERFACE					
	Control by Interface	ON/OFF	OFF	☐ ON ☐ OFF	☐ ON ☐ OFF
CONFIGURE COUNTER					
	Service interval in	0 to 9,999 h	300 h		
	Set oper. hour counter:	0 to 65,000 h	0 h		
	Set counter of starts	0 to 49,999	0		
	energy counter set in	kilo/Mega	Mega		
	Set pos. active energy	0 to 65,500 xWh	0 xWh		
	Set neg. active. energy	0 to 65,500 xWh	0 xWh		
	Set lagg. react. ener.	0 to 65,500 xvarh	0 xvarh		
	Set lead. react. ener.	0 to 65,500 xvarh	0 xvarh		

Pkg.	Parameter 100/400V	Adjustment range	Standard setting	Customer settings	
CONFIGURE DISCRETE INPUTS					
	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 to 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	0000 to 9999	0001		
	Define level 2 code	0000 to 9999	0002		

Appendix E.
Service Options

Product Service Options

The following factory options are available for servicing Woodward equipment, based on the standard Woodward Product and Service Warranty (5-01-1205) that is in effect at the time the product is purchased from Woodward or the service is performed. If you are experiencing problems with installation or unsatisfactory performance of an installed system, the following options are available:

- Consult the troubleshooting guide in the manual.
- Contact Woodward technical assistance (see "How to Contact Woodward" later in this chapter) and discuss your problem. In most cases, your problem can be resolved over the phone. If not, you can select which course of action you wish to pursue based on the available services listed in this section.

Returning Equipment For Repair

If a control (or any part of an electronic control) is to be returned to Woodward for repair, please contact Woodward in advance to obtain a Return Authorization Number. When shipping the unit(s), attach a tag with the following information:

- name and location where the control is installed;
- name and phone number of contact person;
- complete Woodward part numbers (P/N) and serial number (S/N);
- description of the problem;
- instructions describing the desired repair.

CAUTION

To prevent damage to electronic components caused by improper handling, read and observe the precautions in Woodward manual 82715, *Guide for Handling and Protection of Electronic Controls, Printed Circuit Boards, and Modules.*

Packing A Control

Use the following materials when returning a complete control:

- protective caps on any connectors;
- antistatic protective bags on all electronic modules;
- packing materials that will not damage the surface of the unit;
- at least 100 mm (4 inches) of tightly packed, industry-approved packing material;
- a packing carton with double walls;
- a strong tape around the outside of the carton for increased strength.

Return Authorization Number RAN

When returning equipment to Woodward, please telephone and ask for the Customer Service Department in Stuttgart [+49 (0) 711 789 54-0]. They will help expedite the processing of your order through our distributors or local service facility. To expedite the repair process, contact Woodward in advance to obtain a Return Authorization Number, and arrange for issue of a purchase order for the unit(s) to be repaired. No work can be started until a purchase order is received.

NOTE

We highly recommend that you make arrangement in advance for return shipments. Contact a Woodward customer service representative at +49 (711) 789 54-0 for instructions and for a Return Authorization Number.

Replacement Parts

When ordering replacement parts for controls, include the following information:

- the part numbers P/N (XXXX-XXX) that is on the enclosure nameplate;
- the unit serial number S/N, which is also on the nameplate.

How To Contact Woodward

Please contact following address if you have questions or if you want to send a product for repair:

Woodward GmbH
Handwerkstrasse 29
70565 Stuttgart - Germany

Phone: +49 (0) 711 789 54-0 (8:00 – 16:30 German time)
Fax: +49 (0) 711 789 54-100
e-mail: stgt-info@woodward.com

For assistance outside Germany, call one of the following international Woodward facilities to obtain the address and phone number of the facility nearest your location where you will be able to get information and service.

Facility	Phone number
USA	+1 (970) 482 5881
India	+91 (129) 409 7100
Brazil	+55 (19) 3708 4800
Japan	+81 (476) 93 4661
The Netherlands	+31 (23) 566 1111

You can also contact the Woodward Customer Service Department or consult our worldwide directory on Woodward's website (**www.woodward.com**) for the name of your nearest Woodward distributor or service facility. [For worldwide directory information, go to **www.woodward.com/ic/locations**.]

Engineering Services

Woodward Industrial Controls Engineering Services offers the following after-sales support for Woodward products. For these services, you can contact us by telephone, by e-mail, or through the Woodward website.

- Technical support
- Product training
- Field service during commissioning

Technical Support is available through our many worldwide locations, through our authorized distributors, or through GE Global Controls Services, depending on the product. This service can assist you with technical questions or problem solving during normal business hours. Emergency assistance is also available during non-business hours by phoning our toll-free number and stating the urgency of your problem. For technical engineering support, please contact us via our toll-free or local phone numbers, e-mail us, or use our website and reference technical support.

Product Training is available on-site from several of our worldwide facilities, at your location, or from GE Global Controls Services, depending on the product. This training, conducted by experienced personnel, will assure that you will be able to maintain system reliability and availability. For information concerning training, please contact us via our toll-free or local phone numbers, e-mail us, or use our website and reference ***customer training***.

Field Service engineering on-site support is available, depending on the product and location, from our facility in Colorado, or from one of many worldwide Woodward offices or authorized distributors. Field engineers are experienced on both Woodward products as well as on much of the non-Woodward equipment with which our products interface. For field service engineering assistance, please contact us via our toll-free or local phone numbers, e-mail us, or use our website and reference ***field service***.

Technical Assistance

If you need to telephone for technical assistance, you will need to provide the following information. Please write it down here before phoning:

Contact

Your company _____

Your name _____

Phone number _____

Fax number _____

Control (see name plate)

Unit no. and Revision: P/N: _____ REV: _____

Unit type MFR 2 _____

Serial number S/N _____

Description of your problem

_____

_____

_____

_____

_____

_____

_____

Please be sure you have a list of all parameters available.

We appreciate your comments about the content of our publications.

Please send comments to: stgt-documentation@woodward.com

Please include the manual number from the front cover of this publication.

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Homepage

http://www.woodward.com/power

Woodward has company-owned plants, subsidiaries, and branches, as well as authorized distributors and other authorized service and sales facilities throughout the world.

Complete address/phone/fax/e-mail information for all locations is available on our website (www.woodward.com).

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