37142B

MFR 13
Multi Function Relay

Manual
Software Version 3.1xxx

Manual 37142B

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.**

OUT-OF-DATE PUBLICATION

This publication may have been revised or updated since this copy was produced. To verify that you have the latest revision, be sure to check the Woodward website:

http://www.woodward.com/pubs/current.pdf

The revision level is shown at the bottom of the front cover after the publication number. The latest version of most publications is available at:

http://www.woodward.com/publications

If your publication is not there, please contact your customer service representative to get the latest copy.

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	03-03-26	Tr	Release
A	04-01-15	Tr	Update
B	07-07-18	TP	Update to reflect new format, minor corrections, and language revision

INACTIVE – FOR REFERENCE ONLY

The information in this publication is no longer current, and may not reflect changes or safety issues that have occurred since the publication was originally released.

Refer to the MFR 13 Packages manual 37353 for more recent information about the MFR 13 unit.

Contents

Illustrations and Tables

Illustrations

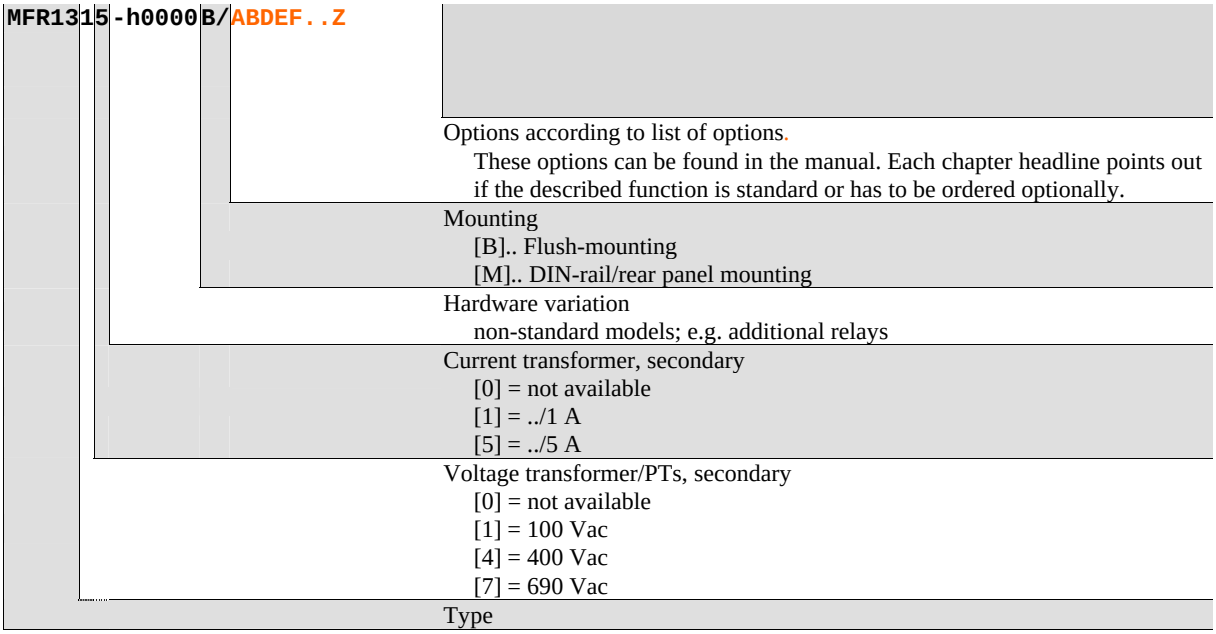
Tables

Chapter 1.
General Information

Introduction

The MFR 13 is an intelligent protection unit with integrated synch-check function (option YC). The primary values are measured over integrated voltage and current measuring inputs and converted into configurable limit values which are displayed and monitored. These values can be monitored on exceeding/lower deviation of the configured value and the connected power circuit breaker will open in case of mishandling. Different options offer additional functionality

The detailed model description for the MFR 13 reads as follows:



Examples:

- MFR1345B/A3PM (flush mounted, standard unit with 400 Vac PT and ../5 A CT inputs with Options A3 [3x -20/0/4 to +20 mA output] and PM [reverse/reduced load / overload monitoring])
- MFR1311B/PMPSU (flush mounted, standard unit with 100 Vac PT and ../1 A CT inputs with Options PM [reverse/reduced load / overload monitoring], PS [unbalanced load monitoring] and U [over-/undervoltage/-frequency and voltage asymmetry monitoring])

Measurement Value Logging

Voltage

Voltage is displayed as three-phase r.m.s measurement of the phase-neutral and/or phase-phase voltages. Option YC utilizes single-phase r.m.s. measurement of the synchronizing voltage V_{L1-L2}.
This device can be ordered with the following measuring voltage input ranges (rated voltages). Please indicate the measuring voltage input required when ordering (refer to Technical Data on page 83):

- 66 V/115 V ..... [1]
- 230 V/400 V ..... [4]
- 400 V/690 V ..... [7]

Frequency

Frequency measurement is extracted from the digitally filtered measuring voltages. The frequency is measured three-phase if the measured voltage exceeds 15% of the nominal voltage. This ensures rapid and precise measurement of the frequency. However the frequency is still measured correctly even if voltage is only applied to one phase.

Current

Three-phase measurement of the r.m.s. value.
- ../1 A ..... [1]
- ../5 A ..... [5]

Ground fault

The ground fault current is a calculation of the vectorial sum of the three phase currents (Option IS). This measurement is suitable for line-to-ground monitoring in a solidly or resistance grounded mains (e.g. In phase-to-phase low voltage mains). The line-to-ground current should at least represent 10% of the current transformer rated current in order to ensure reliable operation.

Displacement Voltage

The ground fault current is a direct measurement of the displacement voltage (Option IV). The measurement is carried out via the open delta winding (e-n-winding) of a voltage transformer or via a zero-point transformer in the generator star point.

Active power

The active power is measured though real time multiplication of either the three phase-to-neutral voltages and the three-phase conductor currents or single-phase measurement of voltage V_{12} and the current I_1.

Reactive power

The reactive power is calculated from the measured single-phase voltage V_{12} and the single-phase current I_1.

Power factor

Power factor is calculated time difference between the digitally filtered voltage V_{12} and current I_1. The power factor is accurately measured for both clockwise and counter-clockwise phase sequences.

Active energy

Active energy combines a time measurement with the measured positive active load. The counter is incorporated in the non-volatile memory and only computes positive energy. The memory is updated every 3 minutes with a resolution of 0.1 kWh. The unit automatically increases the engineering unit of measure when the maximum value has been reached. This permits a measuring range up to 4,290 GWh. This counter is not Physikalisch-Technische Bundesanstalt (PTB) calibrated.

Extent of Functions

Depending on the model, the unit is equipped with the following functions

Function	Option	Package				
		GP	GPX	GPX-I	GPY-I	GPY-I-N
General functions						
Max 7 relay outputs freely configurable (5 change-over contacts, 2 NO contacts)	R		✓	✓	✓	✓
1 ready for operation relay output (normally open contact)	Standard	✓	✓	✓	✓	✓
Discrete input for blocking or acknowledgment (not in 690 V-version)	Standard	✓	✓	✓	✓	✓
1 Analog output - 20/0/4 to +20 mA	A1					
1 Analog output - 10/0 to 10 V	A2					
3 Analog outputs - 20/0/4 to +20 mA	A3				✓	✓
4 Analog outputs -10/0 to 10 V	A4					
6 Analog outputs -20/0/4 to +20 mA	A6					
8 Analog outputs -10/0 to 10 V	A8					
Open-collector pulse output for kWh	M				✓	✓
Interface, uni-directional	SU					
Interface, bi-directional	SB			✓#	✓#	✓#
Interface, CAN bus incl. remote control	SF					
Wide-range power supply (90 to 265 Vac/dc)	N					✓
Protective functions						
Three phase over / under voltage monitoring (2 levels) V>, V<	U	✓	✓	✓	✓	✓
Zero voltage monitoring V ≠ 0	UN	✓	✓	✓	✓	✓
Voltage asymmetry monitoring Vas>	U	✓	✓	✓	✓	✓
Three-phase over / under frequency monitoring (2 levels) f>, f<	U	✓	✓	✓	✓	✓
dφ/dt phase shift monitoring dφ/dt	V					
df/dt-ROCOF monitoring df/dt	D					
Overload monitoring P>	PM	✓	✓	✓	✓	✓
Reverse/reduced power monitoring -P<	PM	✓	✓	✓	✓	✓
Unbalanced load monitoring Ias>	PS	✓	✓	✓	✓	✓
Reactive power monitoring (loss of excitation monitoring) -Q<, Q>	ZQ	✓	✓	✓	✓	✓
Load shift monitoring -ΔP<, +ΔP>	ZW					
Power factor monitoring cos φ	ZC					
Ground fault monitoring, calculated from $I_{L1}+I_{L2}+I_{L3}$ I_E>>	IS	✓				
Independent time-overcurrent monitoring I>, I>>, I>>>	IZ	✓	✓	✓	✓	✓
Non-directional ground fault monitoring via displacement voltage V_E>	IV					
Inverse time overcurrent monitoring (according to IEC) I_a>	IA	✓	✓	✓	✓	✓
Inverse time-overcurrent monitoring with voltage restraint I>, I>> (V<)	IU	✓	✓	✓	✓	✓
Power limit value monitoring P>	PZ					
Synchro-Check	YC		✓	✓	✓	✓
Packages						
MFR 13 with Options IS-IU-IZ-PM-PS-U-UN-ZQ		✓				
MFR 13 with Options IU-IZ-PM-PS-R-U-UN-YC-ZQ			✓			
MFR 13 with Options IU-IZ-PM-PS-R-SB-U-UN-YC-ZQ #				✓		
MFR 13 with Options A3-IU-IZ-M-PM-PS-R-SB-U-UN-YC-ZQ #					✓	
MFR 13 with Options A3-IU-IZ-M-N-PM-PS-R-SB-U-UN-YC-ZQ #						✓

= RS485/Modbus RTU Slave

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 all available packages. 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 enclosed at the rear 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

Wiring Diagram 100/400 Vac Versions

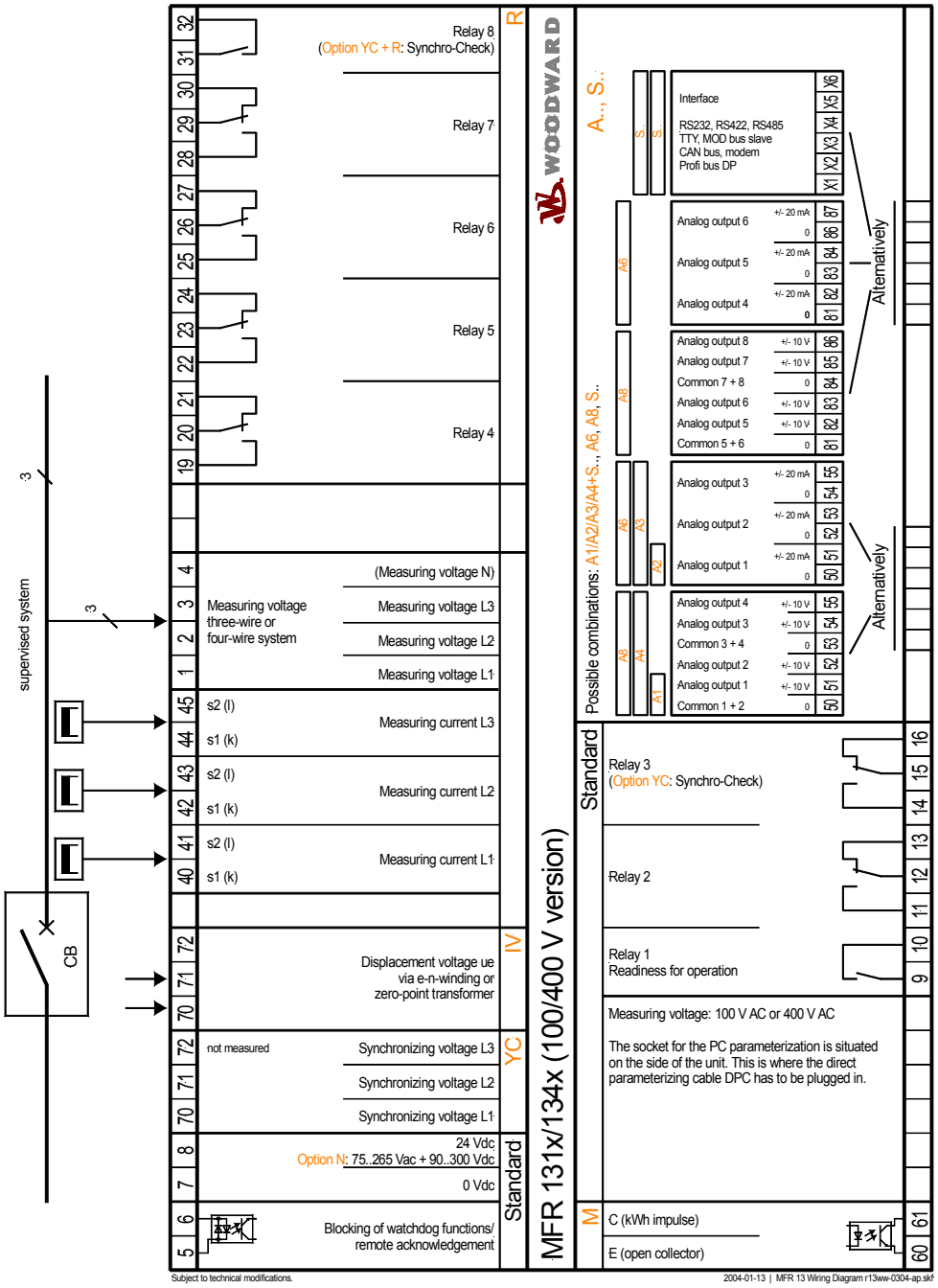


Figure 3-1: Wiring diagram 100/400 Vac (with options)

Wiring Diagram 690 Vac Versions

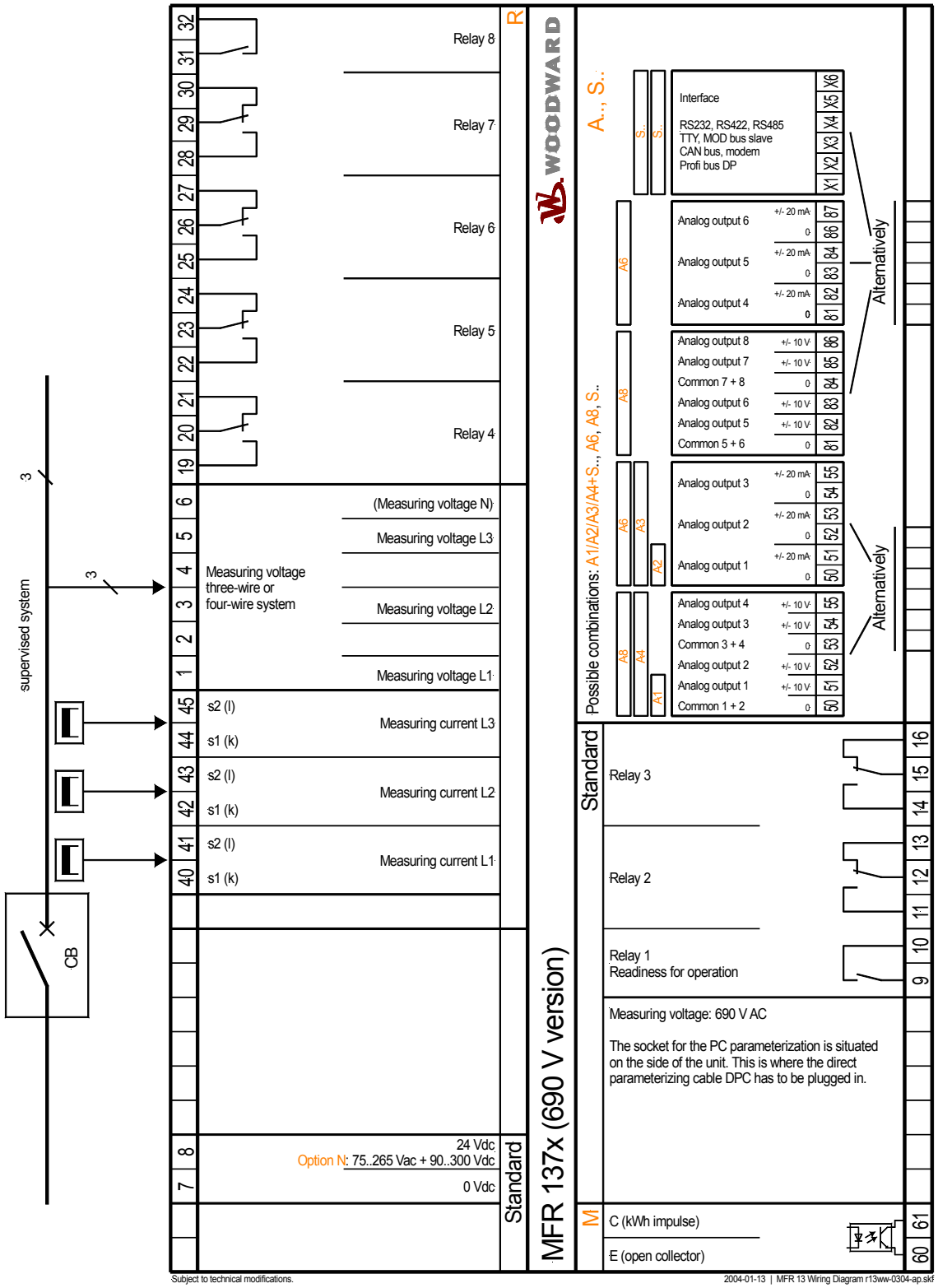


Figure 3-2: Wiring diagram 690 Vac (with options)

WARNING

All technical data and ratings indicated in this chapter are not definite! Only the values indicated under Technical Data on page 83 are valid!

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

Inductive devices connected to the system (such as operating current coils, undervoltage tripping units, or auxiliary/power contacts) must be connected to a suitable interference suppressor.

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

Power Supply (Standard)

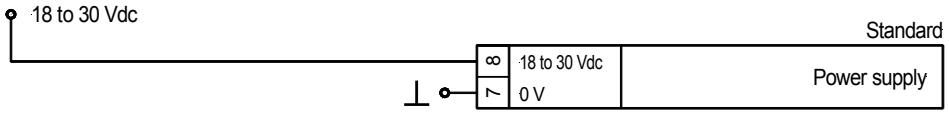


Figure 3-3: Power supply

Terminal	Description	A_{max}
Standard power supply unit (Standard)		
8	18 to 30 Vdc	2.5 mm²
7	0 V reference point	2.5 mm²

Wide Range Power Supply (Option N)

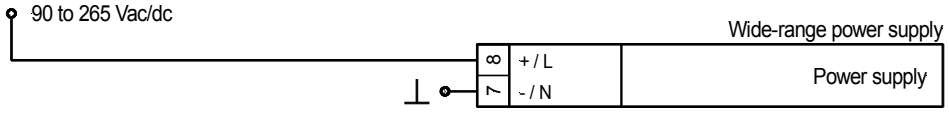


Figure 3-4: Wide range power supply

Terminal	Description	A_{max}
Wide range power supply unit (Option N)		
8	90 to 265 Vac/dc	2.5 mm²
7	0 V reference point	2.5 mm²

Measuring Inputs

Voltage

100/400 V Version

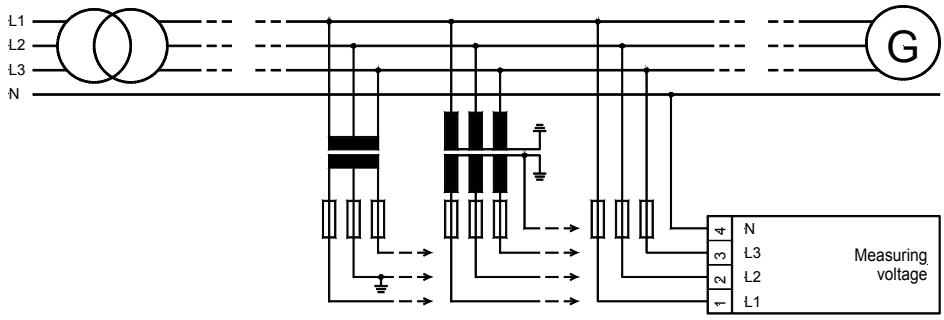


Figure 3-5: Measuring inputs - Voltage 100/400 V version

Terminal	Measurement	Description	A_{max}
1	400V direct or trans-former ../100V	Measuring voltage L1	2.5 mm²
2		Measuring voltage L2	2.5 mm²
3		Measuring voltage L3	2.5 mm²
4		Neutral point of the 3-phase system/transformer	2.5 mm²

690 V Version

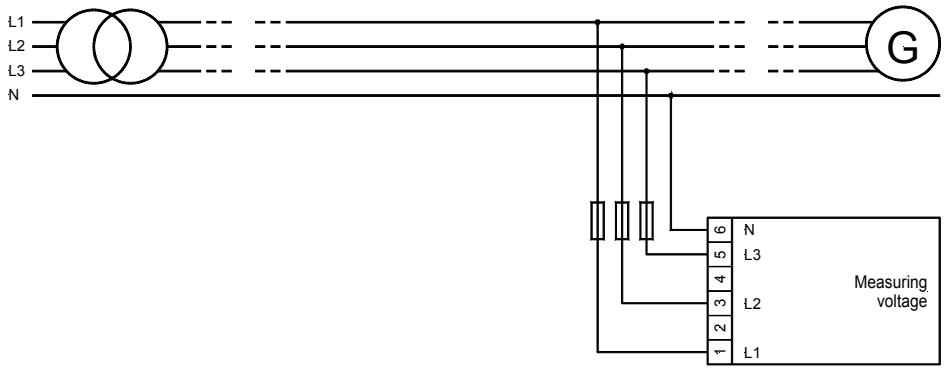


Figure 3-6: Measuring inputs - voltage, 690 V version

Terminal	Measurement	Description	A_{max}
1	690 V direct	Measuring voltage L1	2.5 mm²
2		-N/A-	2.5 mm²
3		Measuring voltage L2	2.5 mm²
4		-N/A-	2.5 mm²
5		Measuring voltage L3	2.5 mm²
6		Neutral point of the 3-phase system/transformer	2.5 mm²

Synchronizing Voltage (Option YC - Option IV not available)

NOTE

Connection of the phase voltage L3 to terminal 72 (synchronizing voltage) is necessary if

- **the generator voltage is connected as a three-wire-system and**
- **the power measurement of the generator power must be three-phase.**

If the input for balancing the measuring system is not connected, minor inaccuracies will occur during the three-phase power measurement. Functionality will not be affected if the voltage L3 is not connected and the power measurement is configured as single-phase.

NOTE

Option YC is not available for units with 690 V PT inputs.

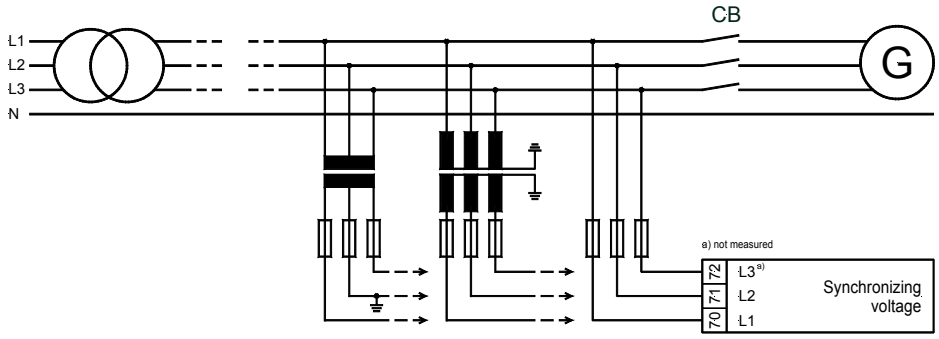


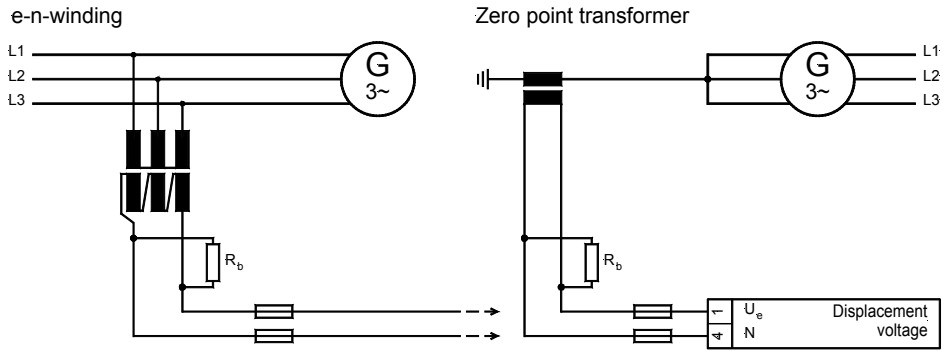
Figure 3-7: Measuring inputs - synchronizing voltage

Terminal	Measurement	Description	A_{max}
70	400V direct or via transf. ../100V	Synchronizing voltage L1	2.5 mm²
71		Synchronizing voltage L2	2.5 mm²
72		Synchronizing voltage L3 (not measured)	2.5 mm²

Neutral Voltage Displacement (Option IV - Options IU, IR not available)

WARNING

Voltage dividers must be utilized on voltage potential transformers that have secondary outputs greater than 100 Vac.



R_b = Loading resistor

Figure 3-8: Measuring inputs - displacement voltage

Terminal	Measurement	Description	A_{max}
Zero point transformer			
70	via zero point trans-former	Ve (displacement voltage)	2.5 mm²
71		N	2.5 mm²
72		not connected	2,5 mm²
Open e-n-winding			
70	via e-n-winding	Ve (displacement voltage)	2.5 mm²
71		N	2.5 mm²
72		not connected	2.5 mm²

Current

WARNING

Prior to disconnecting the current transformer connections or the connections of the transformer which are located at the unit, make sure that the transformer is short-circuited.

NOTE

Grounding of the secondary of a current transformer must always be single-sided.

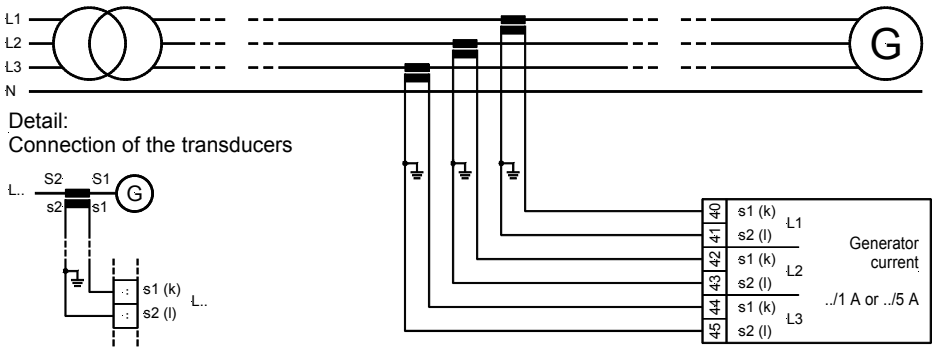


Figure 3-9: Measuring inputs - current

Terminal	Measurement	Description	A_{max}
40	Transformer ../1 A or ../5 A	Generator current L1, transformer terminal s1 (k)	4 mm²
41		Generator current L1, transformer terminal s2 (l)	4 mm²
42		Generator current L2, transformer terminal s1 (k)	4 mm²
43		Generator current L2, transformer terminal s2 (l)	4 mm²
44		Generator current L3, transformer terminal s1 (k)	4 mm²
45		Generator current L3, transformer terminal s2 (l)	4 mm²

Discrete Inputs

NOTE

The subsequent input "Blocking of protective unit / remote acknowledgement" is not available in the 690 V version (refer to "Control Inputs" on page 25.)

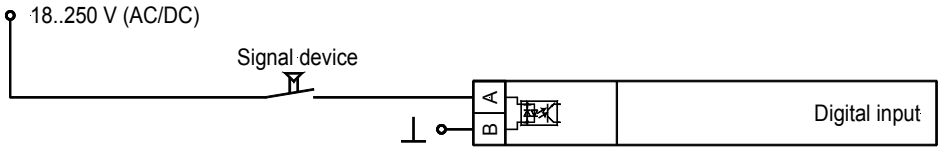


Figure 3-10: Discrete inputs

Terminal	Assigned common	Description (according to DIN 40 719 Part 3, 5.8.3)	A_{max}
A	***B***		
5	6	Blocking of protective device / remote acknowledgement (not in the 690 V version)	2.5 mm²

Outputs

Relay Outputs (Standard / Option R)

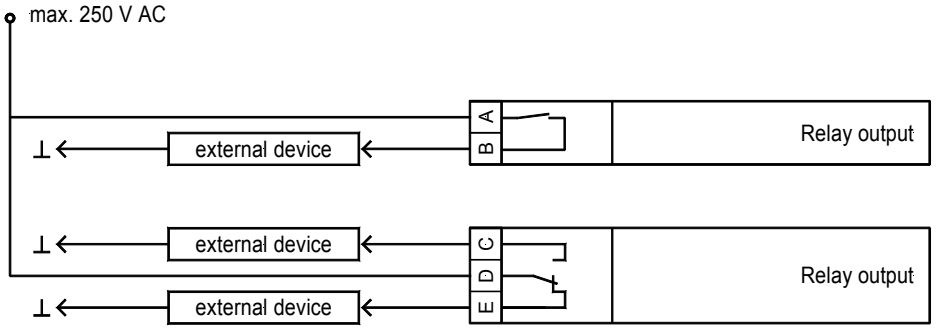


Figure 3-11: Relay outputs

			Description	
Make-contact				A_{max}
main		make		
A		***B***		
9		10	Relay 1	2.5 mm²
31		32	Relay 8 Option R	2.5 mm²
Change-over contact				
make	main	break		
C	***D***	***E***		
11	12	13	Relay 2	2.5 mm²
14	15	16	Relay 3	2.5 mm²
19	20	21	Relay 4 Option R	2.5 mm²
22	23	24	Relay 5 Option R	2.5 mm²
25	26	27	Relay 6 Option R	2.5 mm²
28	29	30	Relay 7 Option R	2.5 mm²

Pulse Output (Option M)

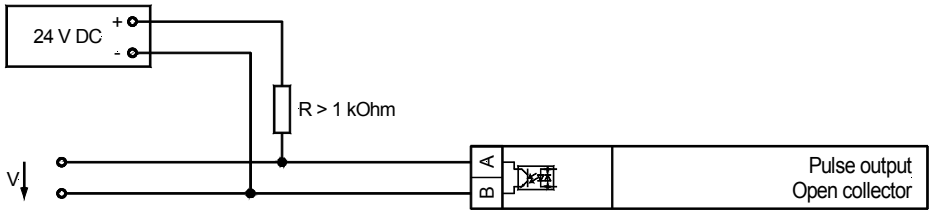


Figure 3-12: Pulse output

Terminal		Description	A_{max}
A	60	Pulse output (Open Collector)	2.5 mm²
B	61		

Analog Outputs (Option A1 to A8)

Possible combination The analog outputs and the interface may be combined as follows:

Option ...	S	A1 to A4	A6 to A8
simultaneous use of ...	•	•	-
	-	-	•

NOTE

All 20 mA outputs are electrically isolated from each other; the 10 V-outputs 1 to 4 are electrically isolated from outputs 5 to 8.

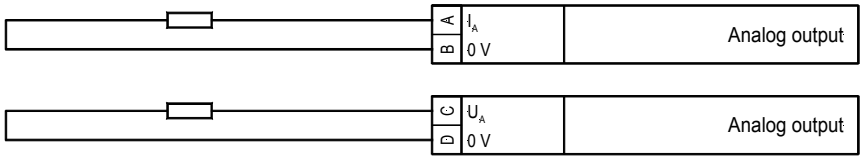


Figure 3-13: Analog outputs

		Description		A_{max}
0 to 20 / 4 to 20 -20 to +20 mA ***I_A*** ***A***	***0 V*** ***B***			
51	50	Analog output 1	Option A2/3/6	1.5 mm²
53	52	Analog output 2	Option A3/6	1.5 mm²
55	54	Analog output 3	Option A3/6	1.5 mm²
82	81	Analog output 4	Option A6	1.5 mm²
84	83	Analog output 5	Option A6	1.5 mm²
87	86	Analog output 6	Option A6	1.5 mm²
0 to 10 / -10 to +10 V ***V_A*** ***C***	***0 V*** ***D***			
51	50	Analog output 1	Option A1/4/8	1.5 mm²
52		Analog output 2	Option A4/8	1.5 mm²
54	53	Analog output 3	Option A4/8	1.5 mm²
55		Analog output 4	Option A4/8	1.5 mm²
82	81	Analog output 5	Option A8	1.5 mm²
83		Analog output 6	Option A8	1.5 mm²
85	84	Analog output 7	Option A8	1.5 mm²
86		Analog output 8	Option A8	1.5 mm²

Interface (Options SU/SB/SF)

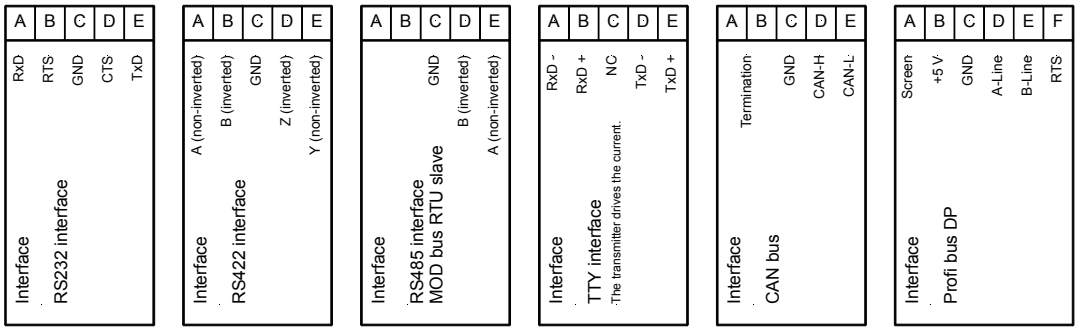


Figure 3-14: Interfaces

Terminal					Description
A (X1)	**B** (X2)	**C** (X3)	**D** (X4)	**E** (X5)	
RxD	RTS	GND	CTS	TxD	RS-232
A	B	GND	Z		RS-422
		GND	B	A	RS-485, Modbus RTU Slave
RxD-	RxD+	NC	TxD-	TxD+	TTY (transmitter drives current)
		GND	CAN-H	CAN-L	CAN bus

A (X1)	**B** (X2)	**C** (X3)	**D** (X4)	**E** (X5)	**F** (X6)	
Screen	+5 V	GND	A-Line	B-Line	RTS	Profibus DP (the file LEON00D9.GSD has to be used)

CAN Bus Shielding

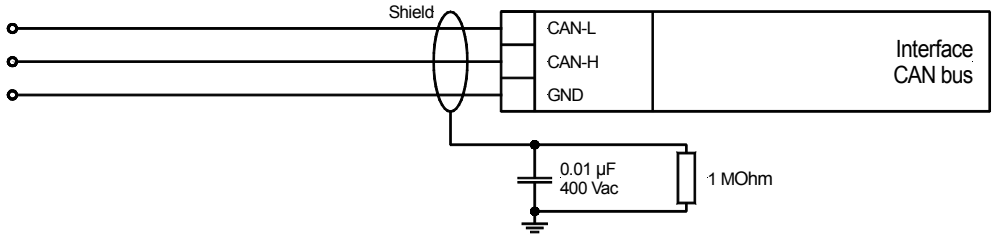


Figure 3-15: Interface - CAN bus shielding

CAN Bus Topology

NOTE

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

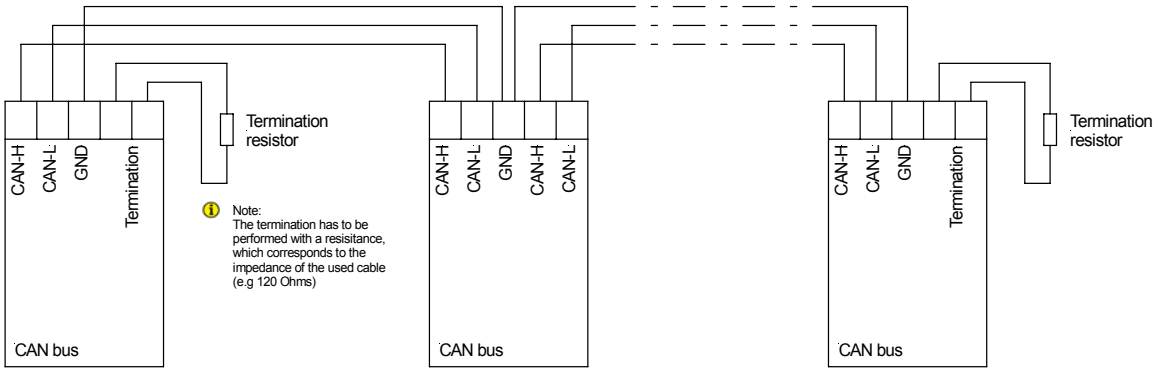


Figure 3-16: Interfaces - CAN bus topology

Possible CAN Bus Problems

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

- T structure bus is utilized (stub-end feeders or branch lines are not recommended)
- CAN-L and CAN-H are interchanged
- Not all devices on the bus are using identical Baud rates
- Terminating resistor(s) is/are missing
- Incorrect baud rate (too high) for length of CAN bus

Maximum CAN Bus Length

The maximum length of the communication bus wiring is dependent on the configured Baud rate. Refer to Table 3-2 for the maximum bus length (Source: CANopen; Holger Zeltwanger (Hrsg.); 2001 VDE VERLAG GMBH, Berlin und Offenbach; ISBN 3-8007-2448-0).

Baud rate	Max. length
1000 kbit/s	25 m
800 kbit/s	50 m
500 kbit/s	100 m
125 kbit/s	250 m
50 kbits/s	1000 m
20 kbit/s	2500 m

Table 3-2: Maximum CAN bus length

The maximum specified length for the communication bus wiring might not be achieved if poor quality wire is utilized, there is high contact resistance, or other conditions exist. Reducing the baud rate may overcome these issues.

DPC - Direct Configuration Interface

NOTE

Configuration with the direct configuration cable DPC (P/N 5417-557) is possible. A laptop/PC, the DPC cable, the program LeoPC1 version 3.1.1 or higher (included on CD Rom with unit), and the proper configuration files are required. Please consult the online help installed when the program is installed for a description of the LeoPC1 program and its setup.

WARNING

Only the DPC cable may be connected to the DPC interface. If other devices or lines are connected, the unit may be destroyed. Especially the connection of live lines (like phone lines) will destroy the unit.

CAUTION

The connection cable delivered with the DPC must be used between DPC and the unit to ensure proper functionality of the unit. An extension or utilization of different cable types for the connection between the unit and DPC may result a malfunction of the unit. This may possibly result in damage to components of the system. If an extension of the data connection line is required, only the serial cable (RS-232) between DPC and laptop/PC may be extended. It is recommended to use an industry standard cable for this.

NOTE

If the parameter "Direct config." is enabled on the control, communication via the CAN bus interface on terminals X1/X5 is disabled.

If the control unit detects that the engine is running (ignition speed exceeded), the direct configuration port is disabled.

Chapter 4.
Functional Description

Control Inputs

NOTE

The subsequent input "Blocking of protective device / remote acknowledgement" is not available in the 690 V version.

Blocking of protective function / Remote acknowledgement
Terminal 5/6

Energizing this discrete input disables various protective functions. This functionality may be desired if the control is used for generator protection. This keeps the control from recognizing fault conditions (i.e. undervoltage, underfrequency) when the generator is not operating. If blocking of these protective functions is not required, the discrete input should not be connected to any potential source.

The following protective functions cannot be blocked via this discrete input:

- **Overvoltage monitoring**
- **Overfrequency monitoring**
- **Zero voltage monitoring**
- **Ground fault monitoring (calculated)**

External acknowledgement of the relays via the discrete input "Blocking of protective device/remote acknowledgement"

If the unit should not automatically reset the relays after the fault is no longer present, the function "**Autoacknowledgement Relays**" must first be configured "**OFF**" (refer to "Auto Acknowledgement of the Relay" on page 70).

```
External
Clearing  ON
```

OFF ..... Alarms that cannot be blocked will not automatically reset after the fault condition is no longer present. Pressing the "Clear" button resets the relays.

ON ..... All alarm messages are reset if terminals 5/6 ("Blocking of protective functions / remote acknowledgement") are energized. Alarms that cannot be blocked are only reset after the fault is no longer present.

Control Outputs

NOTE

A description of the relay manager may be found in Changing the Relay Assignment (Relay Manager; Standard / Option R) starting on page 72.

Relay 1
Terminals 9/10
Output relay (type: make contact, N.O.)
The "relay manager" controls this relay.

NOTE

The "ready for operation" function is always assigned to relay 1. However, other protective functions may also be assigned to relay 1 additionally. Relay 1 is always configured as Normally Closed (break contact) and will de-energize if the unit is not ready for operation.

Relay 2, 3
Terminals 11 through 16
Output relay (type: change-over contact)
The "relay manager" controls these relays.

Option R
Relay 4 to 7
Terminals 19 through 30
Output relay (type: change-over contact)
The "relay manager" controls these relays.

Option R
Relay 8
Terminals 31/32
Output relay (type: make contact, N.O.)
The synch-check function is assigned to this relay.

NOTE

If the unit is equipped with Option YC, the synch-check function is assigned to relay 3.

If the unit is equipped with Options YC and R, the synch-check function is assigned to relay 8.

In this case, relay 3 or 8 cannot be configured with the relay manager.

Direction of power

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

Positive generator active load The generator supplies active load.

Inductive generator power factor
Positive reactive power The generator is overexcited and supplies inductive reactive power.

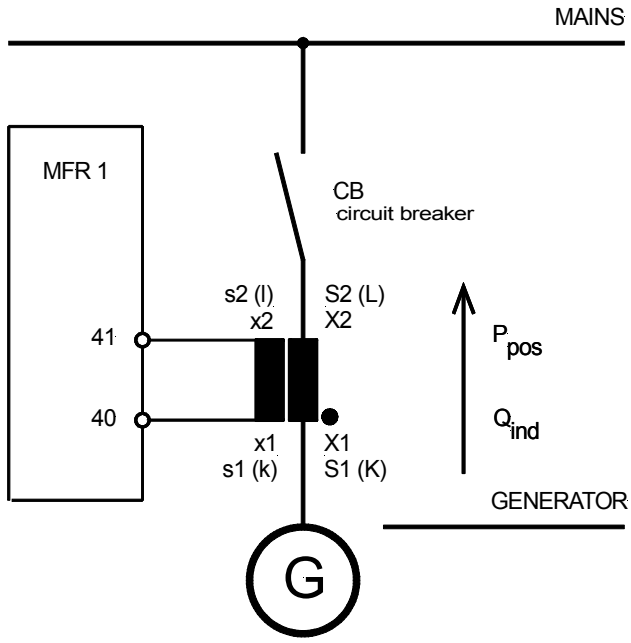


Figure 4-1: 'Direction of power

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)

Compared with the voltage, the current is …

lagging	leading

The generator is …

over excited	under excited

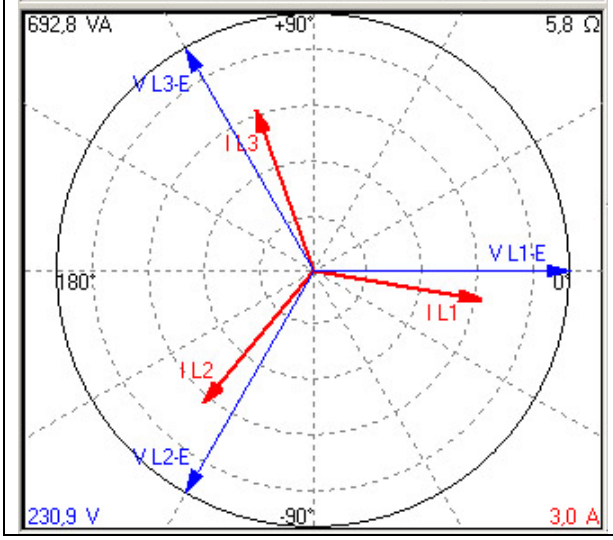
Control: If the control unit is equipped with a power factor controller, …

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

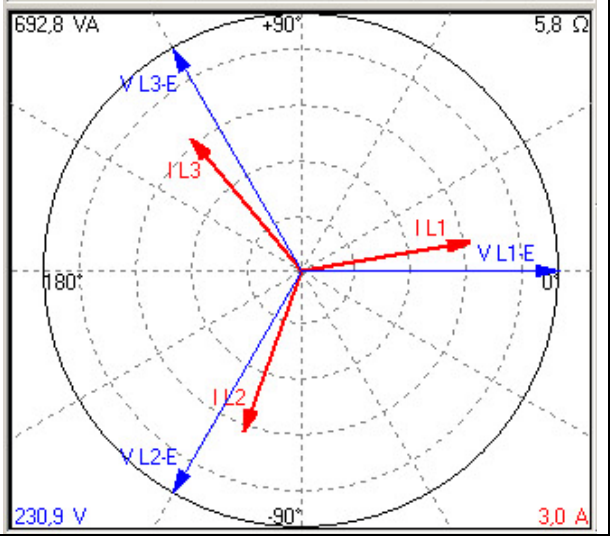
Phasor diagram:

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



Alarms

Alarm Messages

Table 4-1 contains a list of all alarm messages that the control may monitor for depending on how the unit is configured:

Alarm type		Alarm text
Overvoltage, level 1	Option U	Overvolt.1
Overvoltage, level 2	Option U	Overvolt.2
Undervoltage, level 1	Option U	Und.volt.1
Undervoltage, level 2	Option U	Und.volt.2
Asymmetry	Option U	Asymmetry
Overfrequency, level 1	Option U	Overfreq.1
Overfrequency, level 2	Option U	Overfreq.2
Underfrequency, level 1	Option U	Und.freq.1
Underfrequency, level 2	Option U	Und.freq.2
Phase shift	Option V	Phase jmp.
df/dt	Option D	Fault df
Independent time-overcurrent, level 1	Option IZ/IS	Ov.curr. 1
Independent time-overcurrent, level 2	Option IZ/IS	Ov.curr. 2
Independent time-overcurrent, level 3	Option IZ/IS	Ov.curr. 3
Inverse time-overcurrent	Option IA	I>(invers)
Inverse time-overcurrent with voltage restraint	Option IU	I>(invers)
Ground fault, calculated, levell 1	Option IS	Earthcur.1
Ground fault, calculated, level 2	Option IS	Earthcur.2
Overload	Option PM	Overload
Reverse-/reduced power	Option PM	Rev. power
Unbalanced load	Option PS	Unbalance
Power factor cosphi, level 1	Option ZC	Pow.fact.1
Power factor cosphi, level 2	Option ZC	Pow.fact.2
Reactive power, capacitive	Option ZQ	React.pow-
Reactive power, inductive	Option ZQ	React.pow+
Active power surge positive	Option ZW	Pow.shift+
Active power surge negative	Option ZW	Pow.shift-
Non-directional ground fault via displacement voltage, level 1	Option IV	E.faul.Ve>
Non-directional ground fault via displacement voltage, level 2	Option IV	E.faul.Ve>>

Table 4-1: Alarms

Alarm Acknowledgement

A fault/alarm is indicated by the "Alarm" LED.

By pressing the "Clear" button, the active faults are acknowledged. The following distinction is made between fault conditions:

The fault ...

- **is still active** — As long as the fault is still present, it cannot be acknowledged. The flashing "Alarm" LED on the front panel indicates that the alarm is still active.

- **is no longer active** — When the active fault has been eliminated, the flashing "Alarm" LED changes to steady illumination. If the parameter "Auto clearing displays" is configured "ON", the LED extinguishes after the resetting time has expired. If the parameter "Auto clearing displays" is configured "OFF", the LED is extinguished only after pressing the "Clear" button.

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 an 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 right side of the control. The configuration plug is located on the right side of the unit as well. Please connect the direct configuration cable there (DPC).

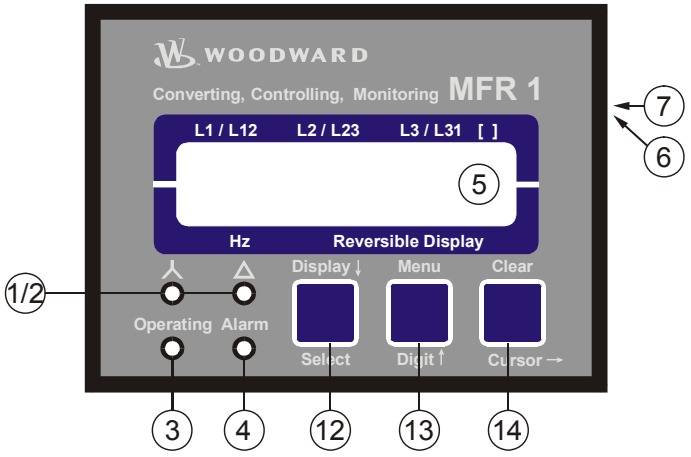


Figure 5-1: Front panel

Brief Description of LEDs and Push Buttons

LEDs

No.	Description	Function
1	"Wye"	Indication of the wye (star) voltages
2	"Delta"	Indication of the delta voltages
3	"Operating"	Automatic mode
4	"Alarm"	Alarm occurred

Push Buttons

No.	Description	Function
12	Display↓	Advance to next screen
12	Select	Confirm selection
13	Menu	Select menu
13	Digit↑	Increase the digit
14	Clear	Acknowledgement of alarm messages
14	Cursor→	Move cursor one position to the right

Miscellaneous

No.	Description	Function
5	LC Display	LC Display
6	Potentiometer	Adjust LCD contrast
7	DPC plug	Configuration plug

LEDs

NOTE

If neither of the "Wye" and "Delta" LEDs is illuminated, the first line of the display indicates the measured currents of the phases.

1 **"Wye"** Color: Yellow

Indication of the wye voltages

If this LED is illuminated, the values indicated on the display are the wye (star) voltages (phase-neutral).

2 **"Delta"** Color: Yellow

Indication of the delta voltages

If this LED is illuminated, the values indicated on the display are the delta voltages (phase-phase).

3 **"Operation "** Color: Green

Operation

This LED is illuminated constantly when the control unit is in the Automatic mode. If this LED is flashing, the control is in the configuration mode.

4 **"Alarm"** Color: Red

Alarm

This LED flashes as long as a set point limit is exceeded. When all measuring values are below the configured set point limit again and "Auto clearing display" is configured "OFF", this LED will change to steady illumination.

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 **Display↓ / Select**
Color: none

Display↓ / Select

Automatic mode: Display↓ - By pressing this button, the user advances through the display of operating (wye voltages, delta voltages, wire currents) and alarm messages. The "Wye" and "Delta" LEDs are illuminated accordingly.

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→" push buttons, the newly set value is saved by pressing the "Select" push button once. By pressing the button again, the user causes the system to advance to the next configuration screen.

13 **Menu / Digit↑**
Color: none

Menu / Digit↑

Automatic mode: Menu - By pressing this button, the user advances through the messages displayed on the second line of the display. (Various measured values and any alarm messages that have not been cleared are indicated.)

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 Appendix E). If the highest permissible number has been reached, the number automatically returns to the lowest permissible number.

14 **Clear / Cursor →**
Color: none

Clear / Cursor →

Automatic mode: Clear - Individual alarm messages are deleted by pressing this button provided the fault is no longer present.

Configuration: Cursor→ - 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→ button again.

LC Display

5 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)

NOTE

The user can scroll through the first display line with the button "Display ↓".

"Wye" = on, "Delta" = off
Wye voltages

```
230  230  230 V
----------------
```

"Wye" = off, "Delta" = on
Delta voltages

```
400  400  400 V
----------------
```

"Wye" = off, "Delta" = off
Phase currents

```
314  314  314 A
----------------
```

Display in automatic mode, first line: measured values

The following measured values are displayed (depending on the "Wye" and "Delta" LEDs):

- The "Wye" LED is illuminated, and the "Delta" LED is off.
  The wye (star) voltages (V_{L1-N}, V_{L2-N} and V_{L3-N}) of the four-wire system are indicated. If the application is a three-wire system, the configuration screen "**`Volt.-Measuring`**" must be configured to "**`phase to phase`**". The "Wye" LED will not illuminate in this application.
- The "Wye" LED is off and the "Delta" LED is illuminated.
  The delta voltages (V_{L1-L2}, V_{L2-L3} and V_{L3-L1}) of the phase-to-phase system/phase - neutral system are indicated.
- The "Wye" LED is off and the "Delta" LED is off.
  The phase currents (I_{L1}, I_{L2} and I_{L3}) are displayed

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

NOTE

The "Menu" button may be used to scroll through the messages shown on the second line of the display.

```
----------------
00.00 xxxxxxxxxx
```

Display in automatic mode, second line: measured values

The frequency is always indicated in [Hz].
Instead of "**`xxxxxxxxxx`**" the following measuring values are indicated:

• Power P	Unit dynamic in [kW / MW]	
• Power factor (cos φ)	Unit dimensionless	
• Reactive power Q	Unit dynamic in [kvar / Mvar]	
• Apparent power S	Unit dynamic in [kVA / MVA]	
• Active energy W	Unit dynamic in [kWh / MWh]	
• Displacement voltage V_e	Unit static in [%]	Option IV
• Ground current Ie	Unit static in [A]	Option IS
• Synchronizing voltage	Unit dynamic in [V/kV]	Option YC
• Synchronizing frequency	Unit static in [Hz]	Option YCv
• Synchronizing angle	Unit static in [°]	Option YC

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

NOTE

The user may scroll through the alarm messages that have occurred with the "Menu" button.

```
----------------
00.00 yyyyyyyyyy
```

Display in automatic mode, second line: alarm indication

Alarm messages are shown on the bottom line of the unit display. Table 5-1 contains a list of all alarm messages that the control may monitor for depending on how the unit is configured.

Alarm type		Alarm text
Overvoltage, level 1	Option U	Overvolt.1
Overvoltage, level 2	Option U	Overvolt.2
Undervoltage, level 1	Option U	Und.volt.1
Undervoltage, level 2	Option U	Und.volt.2
Asymmetry	Option U	Asymmetry
Overfrequency, level 1	Option U	Overfreq.1
Overfrequency, level 2	Option U	Overfreq.2
Underfrequency, level 1	Option U	Und.freq.1
Underfrequency, level 2	Option U	Und.freq.2
Phase shift	Option V	Phase jmp.
df/dt	Option D	Fault df
Independent time-overcurrent, level 1	Option IZ/IS	Ov.curr. 1
Independent time-overcurrent, level 2	Option IZ/IS	Ov.curr. 2
Independent time-overcurrent, level 3	Option IZ/IS	Ov.curr. 3
Inverse time-overcurrent	Option IA	I>(invers)
Inverse time-overcurrent with voltage restraint	Option IU	I>(invers)
Ground fault, calculated, levell 1	Option IS	Earthcur.1
Ground fault, calculated, level 2	Option IS	Earthcur.2
Overload	Option PM	Overload
Reverse-/reduced power	Option PM	Rev. power
Unbalanced load	Option PS	Unbalance
Power factor cosphi, level 1	Option ZC	Pow.fact.1
Power factor cosphi, level 2	Option ZC	Pow.fact.2
Reactive power, capacitive	Option ZQ	React.pow-
Reactive power, inductive	Option ZQ	React.pow+
Active power surge positive	Option ZW	Pow.shift+
Active power surge negative	Option ZW	Pow.shift-
Non-directional ground fault via displacement voltage, level 1	Option IV	E.faul.Ve>
Non-directional ground fault via displacement voltage, level 2	Option IV	E.faul.Ve>>

Table 5-1: Alarms

Chapter 6.
Configuration

Configuration can be performed via the front panel push buttons and the front panel LC display or using a PC and the PC program LeoPC1 via the serial interface. 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 Appendix E 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). 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], a 400 V version [4] and a 690 V version [7]. 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] … , [4] ... or [7] ...).

```
Adjust Settings:
SELECT (ANWAHL)
```

Configuration mode **Button "Select"**

After the configuration mode is enabled, the subsequent screens can be viewed and modified within the preset limits. Please note, that by depressing the "Select" button, the following screens are advanced by one screen each. If a parameter is configured "OFF", the related screens are not displayed or monitored by the control. Pressing the "Select" button will advance the displayed screen to the next parameter.

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).

SPRACHE/LANGUAGE ----------

Language selection **Deutsch/English**

The desired language for the controller to operate in is set by this parameter. The screens (configuration and display screens) can be displayed either in German or English.

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 ***(Basic 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 set, it will not be changed even after entering the configuration repeatedly an incorrect code number has been entered, the code level is set to CS0, thus locking the device for external persons.

If for 2 hours uninterruptedly supply voltage is applied, the device automatically switches to code level 0.

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. 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 granted 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 (basic service level) is enabled. 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 (commissioning level) is enabled. After entering the code, the user has the access rights assigned to this code level.
This code level (CS) is preset to **CS2 = 0 0 0 2**

Direct Configuration

NOTE

A direct configuration cable DPC (P/N 5417-557), the LeoPC1 program (supplied with the cable) and the corresponding configuration files are required to perform direct configuration. After the program has been installed, consult the online help 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 has been 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.

WARNING

If the following parameter "Direct parametr." is configured to "YES", communication via the interface terminals X1 to X5 is disabled. If communication is to be re-established via the interface terminals X1 to X5 after the unit is configured, the following parameter must be set to "NO"!

Moreover the following restrictions apply:

Option SU: Communication via the interface is locked.

Option A6: The analog outputs 3 to 6 are functionless during configuration.

Option A8 or A82: The analog outputs 5 to 8 are functionless during configuration.

If, after the configuration of the unit, communication via the interface should be re-established and the corresponding analog outputs should function again, the subsequent parameter must be set to "NO"!

```
Direct parametr.
            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 port is disabled.

Measurement

WARNING

The following values must be entered correctly for the generator to be monitored. Failure to do so may lead to incorrect measuring of parameters resulting in damage to or destruction of the generator and/or personal injury or death.

Voltage Measurement

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

This screen only affects the displayed values. The protective functions are defined below.

Voltage measuring — **Phase to phase/phase neutral**

This parameter determines how the voltage is to be measured. If this parameter is set to "**`Phase to phase`**", the configuration screen "**`Volt.-Monitoring`**" in section Type of Monitoring on page 45 does not appear.

Potential Transformer Configuration

NOTE

The following parameters are not available in the 690 V version.

Without Option YC

```
Volt.transformer
secondary  000V
```

Potential transformer secondary — **[1] 50 to 125 V; [4] 50 to 480 V**

The potential transformer secondary voltage is set here in V. This parameter is utilized to calculate the system voltage in the display. For voltages measured without a potential transformer, secondary and primary voltage must be configured the same.

```
Volt.transformer
primary 00.000kV
```

Potential transformer primary — **00.100 to 65.000 kV**

The potential transformer primary voltage is set here in kV. This entry is used to show the system voltage in the display.

Example: If a voltage of 400 V is measured without a potential transformer, the secondary transformer voltage must be configured to **`400V`** and the primary transformer voltage must be configured to **`00.400V`**.

With Option YC

```
Volt.transformer
sec.(GN)    000V
```

Generator potential transformer secondary **[1] 50 to 125 V; [4] 50 to 480 V**

The potential transformer secondary voltage is set here in V. This parameter is utilized to calculate the system voltage in the display. For voltages measured without a potential transformer, secondary and primary voltage must be configured the same.

```
Volt.transformer
prim(GN)00.000kV
```

Generator potential transformer primary **00.100 to 65.000 kV**

The potential transformer primary voltage is set here in kV. This entry is used to show the system voltage in the display.

```
Volt.transformer
sec.(MN)    000V
```

Mains potential transformer secondary **[1] 50 to 125 V; [4] 50 to 480 V**

The potential transformer secondary voltage is set here in V. This parameter is utilized to calculate the system voltage in the display. For voltages measured without a potential transformer, secondary and primary voltage must be configured the same.

```
Volt.transformer
prim(MN)00.000kV
```

Mains potential transformer primary **00.100 to 65.000 kV**

The potential transformer primary voltage is set here in kV. This entry is used to show the system voltage in the display.

Example: If a voltage of 400 V is measured without a potential transformer, the secondary transformer voltage must be configured to **`400V`** and the primary transformer voltage must be configured to **`00.400V`**.

Current Measurement

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

Current transformer **1 to 9,999/{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 ..... MFR13x**1**B/xxx = Current transformer with ../1 A rated current
{x} = 5 ..... MFR13x**5**B/xxx = Current transformer with ../5 A rated current

Rated Values

NOTE

The Option YC is not available for the 690 V units; please refer to chapter Control Inputs" on page 25.

```
Rated voltage
          000V
```

Rated voltage **[1] 5 to 125 V; [4] 10 to 480 V**

This parameter defines the system rated voltage. This will affect the permissible limits for synchronization (refer to Synchronization (Option YC)" on page 43).

```
Rated frequency
          00.0Hz
```

Rated frequency **40.0 to 70.0 Hz**

Enter the rated frequency of the generator (or the utility mains), which in most cases is 50 Hz or 60 Hz. This will affect the permissible limits for synchronization (refer to Synchronization (Option YC)" on page 43).

```
Rated current
          0000A
```

Rated current **10 to 9,999 A**

The system current rating is defined in this parameter. Percentage values in the protective functions refer to this parameter.

Power Measurement

NOTE

With a positive real power, a positive real current flows in the "k-l" direction in the CT. Positive reactive power means that with a positive effective direction, inductive reactive (lagging) current flows in the effective direction. If the control is connected to the terminals of a generator and if the outgoing circuits of the CT facing the generator are connected to "k ", the unit shows a positive real power when the generator supplies real power. Refer to the explanation in the chapter "Direction of power" on page 27.

```
Rated power
          00000kW
```

Rated power **5 to 32,000 kW**

The rated power is configured here. The exact value of the rated power is absolutely vital. Many measurement, control, and monitoring functions refer to this value (e.g. the percentage input for the power protection).

```
Power measuring
----------------
```

Power measurement **one-phase / three-phase**

Power measurement may be configured as one-phase or three-phase. If "one-phase power measurement" is set, the current and the voltage in phase L1 are used for power measurement. If "three-phase power measurement" is set, all three-phase currents and the relevant voltages are used for power measurement.

- one-phase power measurement:

$P = \sqrt{3} \times V_{L12} \times I_{L1} \times P.F\ (\cos\varphi)$

- threephase power measurement:

$P = V_{L1N} \times I_{L1} \times P.F\ (\cos\varphi) + V_{L2N} \times I_{L2} \times P.F\ (\cos\varphi) + V_{L3N} \times I_{L3} \times P.F\ (\cos\varphi)$

Control Functions

Synchronization (Option YC)

NOTE

The Option YC is not available for the 690 V-units; please refer to chapter Synchronizing Voltage (Option YC - Option IV not available) on page 16.

Output of the Signal "Systems are Synchronous"

After the control unit monitors voltages and frequencies are within permissible limits, it will issue a circuit breaker closure command to connect two systems. The closure command has a predefined minimum on time that is output to a relay. The permanent relay to which the output is made is the relay 3 (for units without the option R) or the relay 8 (for units including the option R).

The maximum permissible limits are:

- Generator System (GN): 75% to 112.5% of the rated voltage
- Mains System (MN): 87% to 112.5% of the rated voltage

Function "Synchronization of systems"
The control unit calculates internally the electrical angle of advance to issue the circuit breaker closure command. The corresponding lead-time remains constant due to the inherent delay of the breaker regardless of the frequency differential of the two systems. If the voltage and frequency differential of the two systems are within permissible limits, the breaker closure command may be issued under the following conditions:

- The respective monitored voltages of the two systems must be greater than 75 % and less than 112.5 % of the configured rated voltage.
- The monitored voltage differential of the two systems must fall below the configured maximum permissible voltage differential.
- The monitored frequency differential of the two systems must fall below the configured maximum permissible frequency differential
- The electrical angle between two coincident phases must be smaller than the respective permissible error angle (slip-dependent, max. 8 °elec.).

Synchronous Networks

A network is considered as synchronous if the frequency difference between the systems is less than 0.02134 Hz. The unit also issues a breaker closure order for synchronous networks, as long as the electrical angle between the two systems does not exceed the maximum permissible phase angle and the monitored voltage differential is less than the configured maximum permissible voltage differential.

Configuration Screens

```
Synchronizing
functions   ON
```

Synchronizing functions **ON/OFF**

ON .....Synchronizing functions have been enabled. The subsequent screens of this function are displayed.
OFF .....Synchronizing functions have been disabled. The subsequent screens of this function are not displayed.

```
Synchronization
df max    0.00Hz
```

Maximum permissible positive slip frequency differential for synchr. **0.02 to 0.49 Hz**

This parameter defines the upper permissible frequency differential limit for synchronization. Prior to the control issuing a breaker closure command, the monitored frequency differential of the two systems must be less than the value configured here.
Positive slip refers to the System (GN) frequency being greater than the System (MN) frequency.

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

Maximum permissible negative slip frequency differential for synchr. **0.00 to -0.49 Hz**

This parameter defines the lower permissible frequency differential limit for synchronization. Prior to the control issuing a breaker closure command, the monitored frequency differential of the two systems must be greater than the value configured here.
Negative slip refers to the System (GN) frequency being less than the System (MN) frequency.

```
Synchronization
dV max =  00.0%
```

Maximum permissible voltage differential **0.1 to 15.0 %**

A close command will not be issued until the measured differential voltage of the two systems is less than the value configured here. An internal hysteresis of 12.5% of the value configured will be applied to eliminate relay chatter. The percentage configured here is a + or – value.

```
Synchronization
Max phase < 00
```

Maximum permissible phase angle **1 to 60°**

The phase angle in synchronous networks must not exceed the value configured here to be able to energize the closing relay. If the value configured here is between 55° and 60°, the closing relay will not energize until the phase angle falls below 55°, but it will remain energized until the phase angle exceeds the configured value even if it is between 55° and 60°.

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

Minimum pulse time of the breaker close relay **50 to 250 ms**

The duration of the breaker closure command is defined by this parameter. The length of the pulse can be adjusted to the requirements of the individual breaker. The configured value defines the minimum on time of the pulse.

```
Gen.circ.breaker
Pick-up t. 000ms
```

Breaker inherent delay **40 to 300 ms**

All breakers have an inherent delay. This is the time from when the closure command is issued until the breaker contacts are closed. This parameter defines that time. The control unit uses the time value configured here to determine when the breaker closure command is issued independent of the frequency differential. This permits the breaker contacts to close as close as possible to the synchronous point.

Type of Monitoring

NOTE

The following screen will not be displayed, if the parameter "Volt.-Measuring" is configured to "Phase to phase" power measurement. (refer to Voltage Measurement on page 40).

```
Volt. Monitoring
----------------
```

Monitoring for **Phase-neutral/Phase to phase**

The unit can either monitor the phase-neutral voltages (four-wire system) or the phase-phase voltages (three-wire system). Usually, for low-voltage system (400/690 V version) the phase-neutral voltages are monitored, while for the medium and high-voltage systems (100 V-version), the phase-phase voltages are monitored. The monitoring of the phase-phase voltages is recommended to avoid a phase-earth fault in a compensated or isolated mains resulting in the voltage protection tripping. The only effect on the screen "Voltage measuring" is the one described in the above note. The settings in the screen "**Volt.-Monitoring**" do have the following effects on the configuration screens:

Phase-neutral: The voltage at the terminals 1/2/3/4 is measured as a four-wire installation. All subsequent screens concerning voltage measuring refer to phase-neutral voltage (V_{Ph-N}). This is indicated in the configuration screens by the supplement [**Phase-N**].

Phase to phase: If the voltage system connected to the terminals 1/2/3/4 is a three-wire system, this setting must be selected. All subsequent screens concerning voltage measuring refer to phase-phase voltage (V_{Ph-Ph}). In the configuration screens, this is indicated by the supplement [**V(ph-ph)**].

Protection

Overvoltage Monitoring (Option U)

Function: "Voltage not within permissible limits"
The monitored voltage in at least one phase is not within the configured permissible limits for overvoltage. The alarm message "**Overvolt.1**" or "**Overvolt.2**" will be displayed. This message **cannot** be suppressed with the discrete input "Blocking of protective functions / remote acknowledgement".

```
Overvoltage
Monitoring  ON
```

Overvoltage monitoring **ON/OFF**

ON .....Overvoltage monitoring is enabled. The subsequent screens of this function are displayed.
OFF .....Overvoltage monitoring is disabled. The subsequent screens of this function are not displayed.

Screen for **Phase-neutral**:

```
Overvoltage 1
(Phase-N)  >000V
```

Screen for **Phase to phase**:

```
Overvoltage 1
V(ph-ph)   >000V
```

Threshold overvoltage level 1 **(Phase-phase) [1] 20 to 150 V; [4] 20 to 520 V** **(Phase-neutral) [1] 10 to 87 V; [4] 10 to 300 V**

Overvoltage (level 1) is defined by this parameter. If this limit is reached or exceeded, the unit outputs the message "**Overvolt.1**". If a relay was assigned to this function in the relay manager, that relay will be energized.

```
Overvoltage 1
Delay      00.00s
```

Pickup delay, level 1 **0.02 to 99.98 s**

In order to initiate an overvoltage (level 1) alarm, the measured voltage must exceed and remain above the configured threshold without interruption for at least the period of time specified in this screen.

Screen for **Phase-neutral**:

```
Overvoltage 2
(Phase-N)  >000V
```

Screen for **Phase to phase**:

```
Overvoltage 2
V(ph-ph)   >000V
```

Threshold overvoltage level 2 **(Phase-phase) [1] 20 to 150 V; [4] 20 to 520 V** **(Phase-neutral) [1] 10 to 87 V; [4] 10 to 300 V**

Overvoltage (level 2) is defined by this parameter. If this limit is reached or exceeded, the unit outputs the message "**Overvolt.2**". If a relay was assigned to this function in the relay manager, that relay will be energized.

```
Overvoltage 2
Delay      00.00s
```

Pickup delay, level 2 **0.02 to 99.98 s**

In order to initiate an overvoltage (level 2) alarm, the measured voltage must exceed and remain above the configured threshold without interruption for at least the period of time specified in this screen.

```
Overvoltage
Hysteresis   00V
```

Hysteresis for the overvoltage monitoring, levels 1 + 2 **0 to 99 V**

In order to prevent system fluctuations from continually initiating overvoltage alarms (both levels), a lower release point is defined here. If the control monitors the voltage above the permissible limit, the voltage must drop below that threshold and the voltage level defined here for the fault condition to be recognized as no longer existing.
Example: If a 480 V system has an overvoltage limit of 510 V and a hysteresis of 10 V, the monitored voltage for an overvoltage alarm must drop below 500 V to reset the alarm.

Undervoltage Monitoring (Option U)

Function: "Voltage not within permissible limits"
The monitored voltage in at least one phase is not within the configured permissible limits for undervoltage. The alarm message "**Und.volt.1**" or "**Und.volt.2**" will be displayed. This message **cannot** be suppressed with the discrete input "Blocking of protective functions / remote acknowledgement".

```
Undervoltage
Monitoring  ON
```

Undervoltage monitoring **ON/OFF**

ON..... Undervoltage monitoring is enabled. The subsequent screens of this function are displayed.
OFF..... Undervoltage monitoring is disabled. The subsequent screens of this function are not displayed.

Screen for **Phase-neutral**:

```
Undervoltage 1
(Phase-N)  <000V
```

Screen for **Phase to phase**:

```
Undervoltage 1
V(ph-ph)   <000V
```

Threshold undervoltage level 1
(Phase-phase) [1] 20 to 150 V; [4] 20 to 520 V
(Phase-neutral) [1] 10 to 87 V; [4] 10 to 300 V

Undervoltage (level 1) is defined by this parameter. If this limit is reached or fallen below, the unit outputs the message " **Und.volt.1**". If a relay was assigned to this function in the relay manager, that relay will be energized.

```
Undervoltage 1
Delay      00.00s
```

Pickup delay, level 1 **0.02 to 99.98 s**

In order to initiate an undervoltage (level 1) alarm, the measured voltage must fall below and remain below the configured threshold without interruption for at least the period of time specified in this screen.

Screen for **Phase-neutral**:

```
Undervoltage 2
(Phase-N)  <000V
```

Screen for **Phase to phase**:

```
Undervoltage 2
V(ph-ph)   <000V
```

Threshold undervoltage level 2
(Phase-phase) [1] 20 to 150 V; [4] 20 to 520 V
(Phase-neutral) [1] 10 to 87 V; [4] 10 to 300 V

Undervoltage (level 2) is defined by this parameter. If this limit is reached or fallen below, the unit outputs the message " **Und.volt.2**". If a relay was assigned to this function in the relay manager, that relay will be energized.

```
Undervoltage 2
Delay      00.00s
```

Pickup delay, level 2 **0.02 to 99.98 s**

In order to initiate an undervoltage (level 2) alarm, the measured voltage must fall below and remain below the configured threshold without interruption for at least the period of time specified in this screen.

```
Undervoltage
Hysteresis   00V
```

Hysteresis for the undervoltage monitoring, levels 1 + 2 **0 to 99 V**

In order to prevent system fluctuations from continually initiating undervoltage alarms (both levels), a higher release point is defined here. If the control monitors the voltage below the permissible limit, the voltage must rise above that threshold and the voltage level defined here for the fault condition to be recognized as no longer existing.
Example: If a 480 V system has an undervoltage limit of 440 V and a hysteresis of 10 V, the monitored voltage for an overvoltage alarm must rise above 450 V to re-set the alarm.

Zero Voltage Monitoring (Option UN)

Function: "Voltage within permissible limits"
All three phases of the measured voltages are below the configured limit for a zero voltage condition. This function may be used for dead bus detection and as a release signal to permit dead bus closure of the circuit breaker. This message **cannot** be blocked with the discrete input "Blocking of protective functions / remote acknowledgement". The control unit does not display a message for this condition.

```
Zero-voltage
Monitoring  ON
```

Zero voltage monitoring **ON/OFF**

ON .....Zero voltage monitoring is enabled. The subsequent screens of this function are displayed.
OFF .....Zero voltage monitoring is disabled. The subsequent screens of this function are not displayed.

```
Zero-voltage
----------------
```

Options UN + YC only

Monitoring type of the zero voltage monitoring **Option UN: Generator 3ph**
Options UN + YC: Busbar 1ph / Generator 3ph

Busbar 1ph ..Zero voltage monitoring is performed by measuring two phases on the busbar.
Generator 3ph Zero voltage monitoring is performed by measuring three phases on the generator.

```
Zero-voltage
V(ph-ph)  <000V
```

Zero voltage threshold **8 to 150 V**

The threshold for detecting a zero voltage condition is defined by this parameter. If this limit is reached or fallen below, the unit does not display a message. If a relay was assigned to this function in the relay manager, that relay will be energized.

```
Zero-voltage
Delay     00.00s
```

Pickup delay **0.02 to 99.98 s**

In order to for the control to recognize a zero voltage condition, the measured voltage must fall below and remain below the configured threshold without interruption for at least the period of time specified in this screen.

```
Zero-voltage
Hysteresis  00V
```

Hysteresis for the zero voltage monitoring **0 to 99 V**

In order to prevent system fluctuations from continually initiating a zero voltage condition, a higher release point is defined here. If the control monitors the voltage below the permissible limit, the voltage must rise above that threshold plus the voltage level defined here for the fault condition to be recognized as no longer existing.

```
Release delay
Zerovolt. 00.00s
```

Release delay **0.02 to 99.98 s**

To ensure that the signal relay resets after a zero voltage conditions has occurred, the zero voltage threshold (including the hysteresis) must be exceeded without interruption for the time specified by this parameter. The control will auto-acknowledge a zero voltage condition regardless of how "Autoclearing Relays" is configured.

NOTE

A message is not displayed on the screen for zero voltage conditions.

Voltage Asymmetry Monitoring (Option U)

The phase-phase voltages are monitored.

Function "Voltage asymmetry not within permissible limits"
The monitored phase-phase voltage differential in the three phases is not within the configured permissible limits for asymmetry (asymmetric voltage vectors; the threshold corresponding to the differential value). The alarm message "**Asymmetry**" will be displayed. This message can be suppressed with the discrete input "Blocking of protective functions / remote acknowledgement".

```
Asymmetry-
Monitoring  ON
```

Asymmetry monitoring **ON/OFF**

ON..... Voltage asymmetry monitoring is enabled. The subsequent screens of this function are displayed.
OFF..... Voltage asymmetry monitoring is disabled. The subsequent screens of this function are not displayed.

```
Asymmetry
Response v. 00V.
```

Maximum permissible asymmetry **0 to 99 V**

The maximum voltage asymmetry is defined by this parameter. If this limit is reached or exceeded, the unit outputs the message "**Asymmetry**". If a relay was assigned to this function in the relay manager, that relay will be energized.

```
Asymmetry
Delay     00.00s
```

Pickup delay **0.02 to 99.98 s**

In order to initiate a voltage asymmetry alarm, the measured voltage differential must rise above and remain above the configured threshold without interruption for at least the period of time specified in this screen.

```
Asymmetry
Hysteresis  00V
```

Hysteresis for the asymmetry monitoring **0 to 99 V**

In order to prevent system fluctuations from continually initiating a voltage asymmetry fault, a lower release point is defined here. If the control monitors the voltage asymmetry beyond the permissible limit, the voltage differential must fall below that threshold plus the voltage level defined here for the fault condition to be recognized as no longer existing.

Overfrequency Monitoring (Option U)

The frequency monitoring is performed on two levels. The frequency measuring is monitored three-phase if all voltages are greater than 15 % of the rated value (100 V or 400 V). This ensures quick and precise measurement of the frequency. The frequency is still monitored correctly even if voltage is only applied to one phase.

Function "Frequency not within permissible limits"
The monitored frequency is not within the configured permissible limits for overfrequency. The alarm message "**Overfreq.1**" or "**Overfreq.2**" will be displayed. This message **cannot** be suppressed with the discrete input "Blocking of protective functions / remote acknowledgement".

```
Overfrequency-
Monitoring  ON
```

Overfrequency Monitoring **ON/OFF**

ON .....Overfrequency monitoring is enabled. The subsequent screens of this function are indicated.
OFF .....Overfrequency monitoring is disabled. The subsequent screens of this function are not displayed.

```
Overfrequency 1
     f > 00.00Hz
```

Threshold overfrequency, level 1 **40.00 to 80.00 Hz**

Overfrequency (level 1) is defined by this parameter. If this limit is reached or exceeded, the unit outputs the message "**Overfreq.1**". If a relay was assigned to this function in the relay manager, that relay will be energized.

```
Overfrequency 1
Delay     00.00s
```

Pickup delay, level 1 **0.02 to 99.98 s**

In order to initiate an overfrequency (level 1) alarm, the measured frequency must exceed and remain above the configured threshold without interruption for at least the period of time specified in this screen.

```
Overfrequency 2
     f > 00.00Hz
```

Threshold overfrequency, level 2 **40.00 to 80.00 Hz**

Overfrequency (level 2) is defined by this parameter. If this limit is reached or exceeded, the unit outputs the message "**Overfreq.2**". If a relay was assigned to this function in the relay manager, that relay will be energized.

```
Overfrequency 2
Delay     00.00s
```

Pickup delay, level 2 **0.02 to 99.98 s**

In order to initiate an overfrequency (level 2) alarm, the measured frequency must exceed and remain above the configured threshold without interruption for at least the period of time specified in this screen.

```
Overfrequency
Hysteres. 0.00Hz
```

Hysteresis for the overfrequency monitoring, levels 1+2 **0.01 to 9.99 Hz**

In order to prevent system fluctuations from continually initiating overfrequency alarms (both levels), a lower release point is defined here. If the control monitors the frequency above the permissible limit, the frequency must drop below that threshold and the frequency level defined here for the fault condition to be recognized as no longer existing.
Example: If a 60 Hz system has an overfrequency limit of 70 Hz and a hysteresis of 5 Hz, the monitored frequency for an overfrequency alarm must fall below 65 Hz to reset the alarm.

Underfrequency Monitoring (Option U)

The frequency monitoring is performed on two levels. The frequency measuring is monitored three-phase if all voltages are greater than 15 % of the rated value (100 V or 400 V). This ensures quick and precise measurement of the frequency. The frequency is still monitored correctly even if voltage is only applied to one phase.

Function "Frequency not within permissible limits"
The monitored frequency is not within the configured permissible limits for overfrequency. The alarm message "**Und.freq.1**" or "**Und.freq.2**" will be displayed. This message can be suppressed with the discrete input "Blocking of protective functions / remote acknowledgement".

```
Underfrequency-
Monitoring  ON
```

Underfrequency Monitoring **ON/OFF**

ON..... Underfrequency monitoring is enabled. The subsequent screens of this function are indicated.
OFF..... Underfrequency monitoring is disabled. The subsequent screens of this function are not displayed.

```
Underfrequency 1
     f < 00.00Hz
```

Threshold underfrequency, level 1 **40.00 to 80.00 Hz**

Underfrequency (level 1) is defined by this parameter. If this limit is reached or fallen below, the unit outputs the message "**Und.freq.1**". If a relay was assigned to this function in the relay manager, that relay will be energized.

```
Underfrequency 1
Delay     00.00s
```

Pickup delay, level 1 **0.02 to 99.98 s**

In order to initiate an underfrequency (level 1) alarm, the measured frequency must fall below and remain below the configured threshold without interruption for at least the period of time specified in this screen.

```
Underfrequency 2
     f < 00.00Hz
```

Threshold underfrequency, level 2 **40.00 to 80.00 Hz**

Underfrequency (level 2) is defined by this parameter. If this limit is reached or fallen below, the unit outputs the message "**Und.freq.2**". If a relay was assigned to this function in the relay manager, that relay will be energized.

```
Underfrequency 2
Delay     00.00s
```

Pickup delay, level 2 **0.02 to 99.98 s**

In order to initiate an underfrequency (level 2) alarm, the measured frequency must fall below and remain below the configured threshold without interruption for at least the period of time specified in this screen.

```
Underfrequency
Hysteres. 0.00Hz
```

Hysteresis for the underfrequency monitoring, levels 1 + 2 **0.01 to 9.99 Hz**

In order to prevent system fluctuations from continually initiating underfrequency alarms (both levels), a higher release point is defined here. If the control monitors the frequency below the permissible limit, the frequency must rise above that threshold and the frequency level defined here for the fault condition to be recognized as no longer existing.
Example: If a 60 Hz system has an underfrequency limit of 50 Hz and a hysteresis of 5 Hz, the monitored frequency for an overfrequency alarm must rise above 55 Hz to reset the alarm.

Vector / Phase Shift Monitoring (Option V)

A vector/phase shift is defined as the sudden variation of the voltage curve which may be caused by a major generator load change. The control unit measuring circuit detects the change in the cycle duration. This change in the cycle duration is compared with a mean value calculated from previous measurements. The monitoring may be carried out three-phased or one/three-phased. The threshold in degrees indicates the time difference between the mean value and the instantaneous value, referring to the duration of a full cycle. The monitoring can be configured in different ways. The vector/phase shift monitor can also be used as an additional method to decouple from the mains. Vector/phase shift monitoring is only enabled after the monitored voltage exceeds 70% of the PT secondary rated voltage.

Function: "Cycle duration of the voltage not within permissible limits"
The voltage cycle duration is not within the configured vector/phase shift limits. The alarm message "**Ph. shift**" appears. This message can be suppressed with the discrete input "Blocking of protective functions / remote acknowledgement".

```
Phase jump
monitoring  ON
```

Vector/phase shift monitoring **ON/OFF**

ON .....Vector/phase shift monitoring is enabled. The voltage/frequency cycle duration is being monitored to ensure it does not exceed the defined limits. The subsequent screens of this function are displayed.
OFF .....Vector/phase shift monitoring is disabled, and the subsequent screens of this function are not displayed.

```
Phase jump monit
----------------
```

Vector/phase shift monitoring **one/three phase / 3 phase only**

one/three phase: An alarm will be issued if the phase angle in any one phase exceeds the configured phase shift phase angle limit. Monitoring of single-phase voltage is exceptionally sensitive and may lead to nuisance tripping if the configured phase angle is to low.
3 phase only: An alarm will be issued if the phase angle in all three phases exceeds the configured phase shift phase angle limit within two waveforms.

NOTE

If the monitoring is configured as "3 phase only", only one of the two subsequent screens will be displayed. If the monitoring is configured as "one/three-phase", both configuration screens will be displayed.

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

This screen is only visible if monitoring is configured **"one/three phase".**

Vector/phase shift monitoring phase angle, single-phase **2 to 90 °**

An alarm will be issued if the phase angle in any one phase exceeds the configured phase shift phase angle limit. If the monitored voltage/frequency reaches or exceeds the phase shift limit, the unit outputs the message "**Ph. shift**". If a relay was assigned to this function in the relay manager, that relay will be energized.

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

Vector/phase shift monitoring phase angle, three-phased **2 to 90 °**

An alarm will be issued if the phase angle in any all three phases exceeds the configured phase shift phase angle limit. If the monitored voltage/frequency reaches or exceeds the phase shift limit, the unit outputs the message "**Ph. shift**". If a relay was assigned to this function in the relay manager, that relay will be energized.

df/dt (ROCOF) Monitoring (Option D)

Function: "Rate Of Change Of Frequency (ROCOF) is not within permissible limits"
Rate of Change Of Frequency (ROCOF) monitoring measures the stability of the frequency. The frequency of a generator will vary due to changing loads and compensation of the fuel system. The rate of these frequency changes due to the load variances is relatively high compared to those of a large network. The control unit calculates the unit of measure per unit of time. The df/dt is measured over 4 sine waves to ensure that it is differentiated from a phase shift. This results in a response time of approximately 100ms. This message can be suppressed with the discrete input "Blocking of protective functions / remote acknowledgement".

```
df/dt-
Monitoring   ON
```

df/dt monitoring **ON/OFF**

ON..... Rate Of Change Of Frequency monitoring is enabled. The subsequent screens of this function are displayed.
OFF..... Rate Of Change Of Frequency monitoring is disabled. The subsequent screens of this function are not displayed.

```
df/dt
Response>0.0Hz/s
```

Tripping df/dt **1.0 to 9.9 Hz/s**

The Rate Of Change Of Frequency threshold is defined by this parameter. If this limit is reached or exceeded, the unit outputs the message "**Fault df**". If a relay was assigned to this function in the relay manager, that relay will be energized.

```
df/dt
Delay    T= 0.0s
```

Pickup delay **0.1 to 9.9 s**

In order to initiate a Rate Of Change Of Frequency alarm, the measured df/dt must exceed and remain above the configured threshold without interruption for at least the period of time specified in this screen.

Independent Time-Overcurrent Monitoring (Option IS/IZ)

NOTE

All percentage values of the current refer to the rated current (page 42).

Function: Current is monitored depending on parameter "Overcurrent Monitoring". The time-overcurrent alarm contains three limits and can be setup as a step definite time overcurrent alarm as illustrated in the figure below. Monitoring of the maximum phase current is performed in three steps. Every step can be provided with a delay time independent of the other steps.

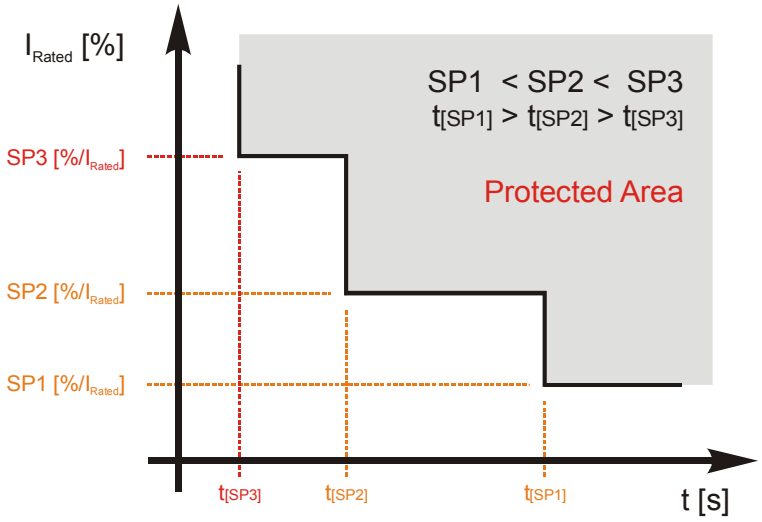


Figure 6-1: Diagram for independent time-overcurrent monitoring

```
Overcurrent
Monitoring  ON
```

Independent time-overcurrent monitoring **ON/OFF**

ON .....Independent time-overcurrent monitoring is enabled. The subsequent screens of this function are displayed.

OFF .....Independent time-overcurrent monitoring is disabled. The subsequent screens of this function are not displayed.

```
Overcurrent 1
        I> 000%
```

Threshold independent time-overcurrent, level 1 **0 to 300 %**

Overcurrent (level 1) is defined by this parameter. The percentage configured in this parameter refers to the configured rated system current (refer to page 42). If this limit is reached or exceeded, the unit outputs the message "**`overcurrent 1`**". If a relay was assigned to this function in the relay manager, that relay will be energized.

```
Overcurrent 1
Delay     00.00s
```

Pickup delay, level 1 **0.02 to 99.98 s**

In order to initiate an overcurrent (level 1) alarm, the measured current must exceed and remain above the configured level 1 threshold without interruption for at least the period of time specified in this screen.

```
Overcurrent 2
         I> 100%
```

Threshold independent time-overcurrent, level 2 **0 to 300 %**

Overcurrent (level 2) is defined by this parameter. The percentage configured in this parameter refers to the configured rated system current (refer to page 42). If this limit is reached or exceeded, the unit outputs the message "**overcurrent 2**". If a relay was assigned to this function in the relay manager, that relay will be energized.

```
Overcurrent 2
Delay     00.00s
```

Pickup delay, level 2 **0.02 to 99.98 s**

In order to initiate an overcurrent (level 2) alarm, the measured current must exceed and remain above the configured level 2 threshold without interruption for at least the period of time specified in this screen.

```
Overcurrent 3
         I> 100%
```

Threshold independent time-overcurrent, level 3 **0 to 300 %**

Overcurrent (level 3) is defined by this parameter. The percentage configured in this parameter refers to the configured rated system current (refer to page 42). If this limit is reached or exceeded, the unit outputs the message "**overcurrent 3**". If a relay was assigned to this function in the relay manager, that relay will be energized.

```
Overcurrent 3
Delay     00.00s
```

Pickup delay, level 3 **0.02 to 99.98 s**

In order to initiate an overcurrent (level 3) alarm, the measured current must exceed and remain above the configured level 3 threshold without interruption for at least the period of time specified in this screen.

```
Overcurrent
Hysteresis  000%
```

Hysteresis for the independent time-overcurrent monitoring, levels 1, 2 + 3 1 to 300 %

In order to prevent system fluctuations from continually initiating overcurrent alarms (levels 1, 2 + 3), a lower release point is defined here. If the control monitors the current above the permissible limit, the current must drop below that threshold and the current level defined here for the fault condition to be recognized as no longer existing.
Example: If a 1000A system has an overcurrent limit 1 of 110% (1100A) and a hysteresis of 105% (1050A), the monitored current for an overcurrent alarm must drop below 1050A to reset the alarm.

Inverse Time-Overcurrent Monitoring (Option IA)

NOTE

All percentage indications of the current refer to the rated current (see page 42).

Function: Monitoring of overcurrents including inversely proportional time dependent tripping characteristic. The selected trip curve defines the tripping time according to the measured current. The tripping time will be decreased according to a defined curve the higher the measured current is. According to IEC 255 three different characteristics are available.

Normal inverse: $$t = \frac{0.14}{(I/I_P)^{0.02} - 1} * t_p[s]$$

Very inverse: $$t = \frac{13.5}{(I/I_P) - 1} * t_p[s]$$

Extremely inverse: $$t = \frac{80}{(I/I_P)^2 - 1} * t_p[s]$$

Formula definitions:

t:	tripping time
t_p	time set point value
I	fault current / monitored current
I_n	rated (nominal) current
I_p	current set point value

If t is greater than 162 s the system trips at 162 s. If t is lower than t_{min} the tripping time is t_{min}. The reaction time for t_{min} depends on the time it takes to monitor the fault and the operating time of the relays. t_{min} is at least 20 ms.

Please consider during configuration:

for I_{start}: $I_{start} > I_n$ and $I_{start} > I_p$
for I_p the smaller I_p is, the steeper is the slope of the tripping curve

Configuration Screens

```
Inv.time ov.cur.
Monitor.     ON
```

Inverse time-overcurrent monitoring **ON/OFF**

ON..... Inverse time-overcurrent monitoring is enabled. The subsequent screens of this function are displayed.
OFF..... Inverse time-overcurrent monitoring is disabled. The subsequent screens of this function are not displayed.

```
Inv.time char.
---------------
```

Inverse time-overcurrent: characteristic **Normal / High / Extreme**

Normal. ..... "Normal inverse" characteristic used
High ..... "Very inverse" characteristic used
Extreme..... "Extremely inverse" characteristic used

```
Inv.time ov.cur.
       Tp=0.00s
```

Inverse time-overcurrent: time constant Tp **0.01 to 1.99s**

The time constant for t_p is defined by this parameter.

```
Inv.time ov.cur.
      Ip=0.0*In
```

Inverse time-overcurrent: current constant Ip **0.1 to 3.0*In**

The current constant for I_p is defined by this parameter. This setpoint is dependent upon the rated current (I_n)

```
Inv.time ov.cur.
I start= 0.00*In
```

Inverse time-overcurrent: I-Start **1 to 3.00*In**

The lower tripping value for inverse time-overcurrent protection is defined by this parameter. If the monitored current (I) is below I_{Start}, the inverse time-overcurrent protection does not trip. I_p is used as the lower tripping value if I_{Start} is configured less than I_p.

Characteristics

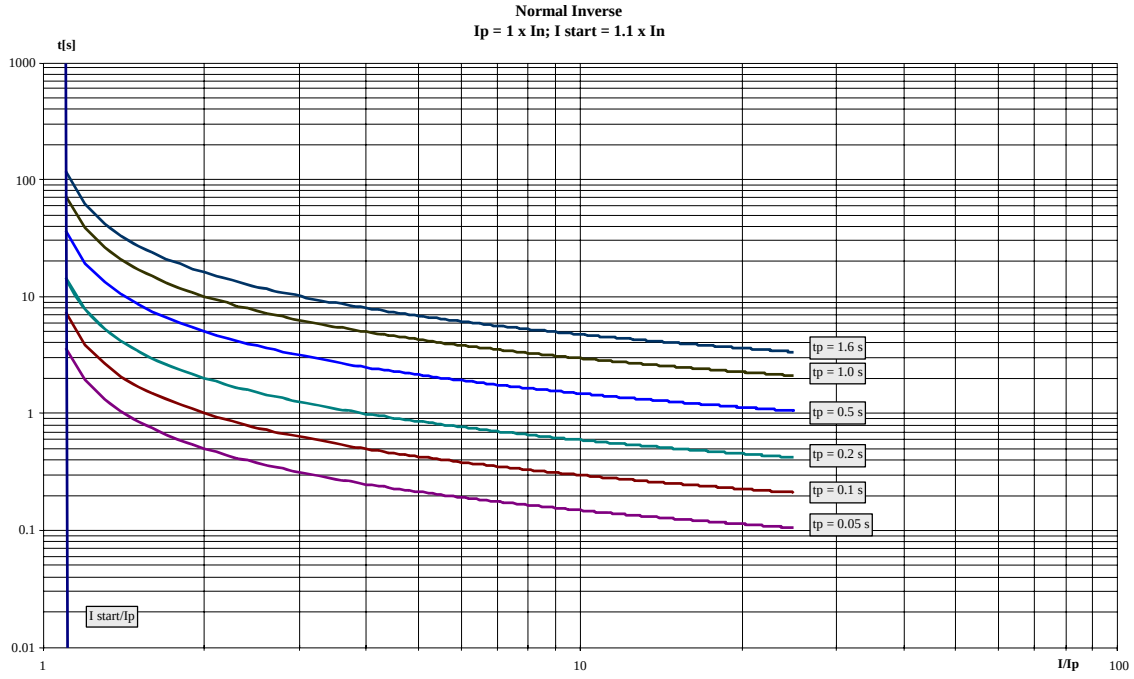


Figure 6-2: Inverse time-overcurrent - characteristic "normal inverse"

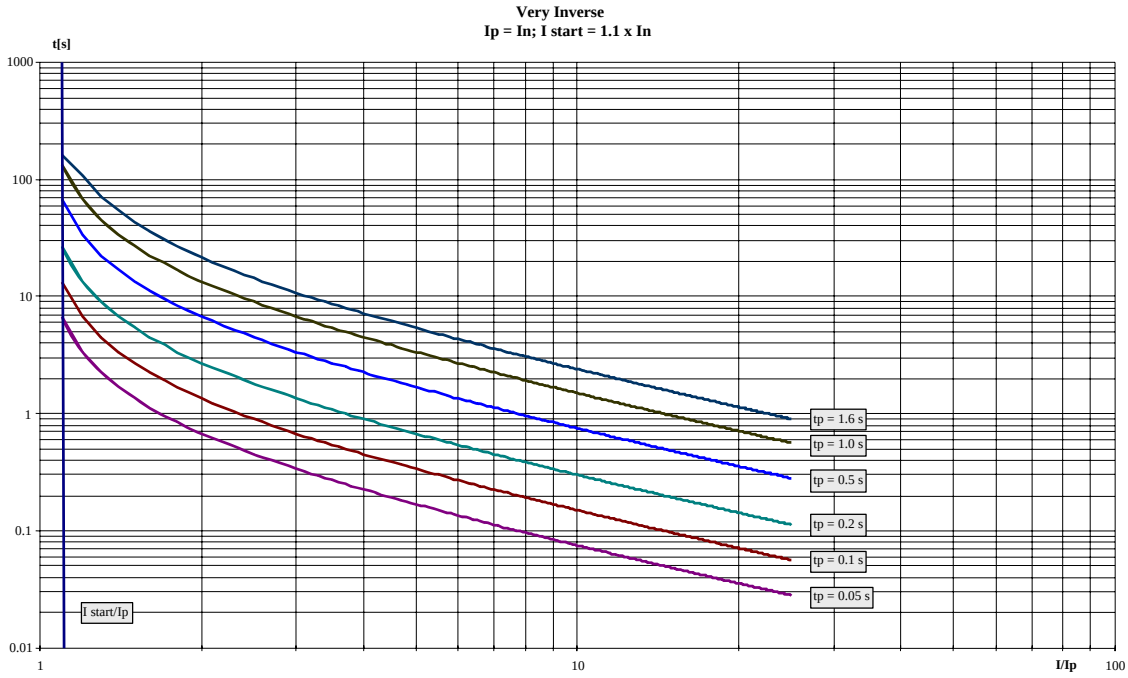


Figure 6-3: Inverse time-overcurrent - characteristic "very inverse"

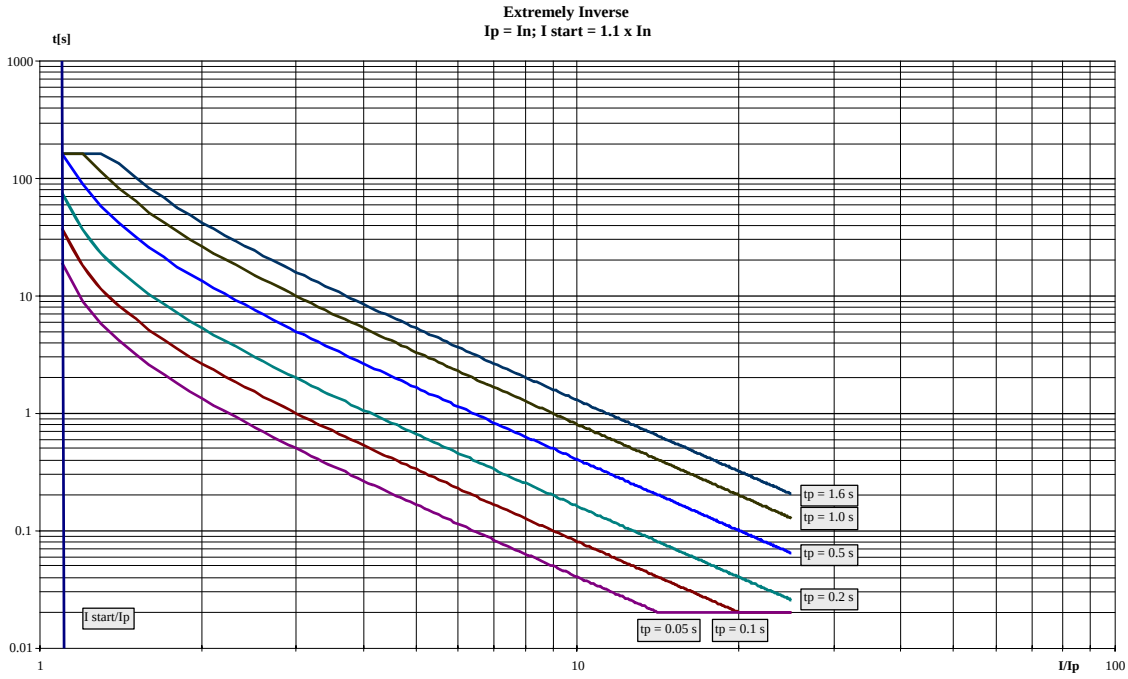


Figure 6-4: Inverse time-overcurrent - characteristic "extremely inverse"

Inverse Time-Overcurrent Monitoring with Voltage Restraint (Option IU)

NOTE

This monitoring function is an additional functionality for the inverse time overcurrent monitoring function. If the inverse time overcurrent monitoring is disabled, time-overcurrent monitoring with voltage restraint is disabled too.

All percentage indications of the current are in relation to the rated current (see page 42).

Function: This function is recommended for a generator that must be monitored with droop excitation and precautions for short-circuit excitation (e.g. supplementary components) are not available. A short-circuit close to the terminal may be caused due to the low voltage excitation cannot be maintained. As a result, the unit cannot maintain power in order to initiate a voltage independent overcurrent delay. The voltage restraint functionality reduces the overcurrent threshold proportionally with the monitored voltage. The reduction of the inverse time threshold occurs according to Figure 6-5.

Current L1: corresponds to voltage L1-L2
Current L2: corresponds to voltage L2-L3
Current L3: corresponds to voltage L3-L1

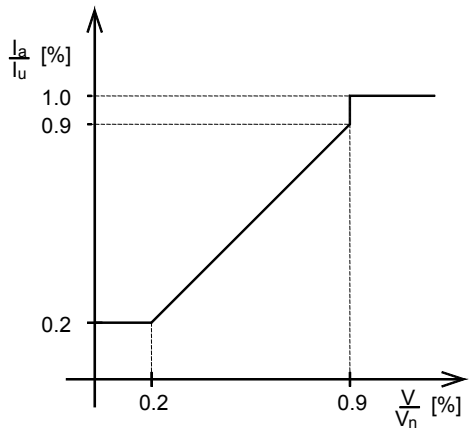


Figure 6-5: Characteristic of the inverse time-overcurrent monitoring with voltage restraint (knee curve setting 20 %)

Legend:
- I_a Adjusted current threshold value
- I_p Configured value (configured with inverse time overcurrent monitoring)
- V_n Rated voltage
- V Monitored voltage

Example:

Initial conditions:
Rated voltage V_n = 100 V
Configured value I_p = 2.0*5 A = 10 A (rated current I_n = 5 A)

Case 1 (monitored voltage V > 90% V_n):
As long as the monitored voltage exceeds 90% of the rated voltage, the configured value will not be adjusted.
-> $I_a = I_p$

Case 2 (monitored voltage V < 90% V_n , but actual voltage V > knee curve setting):
If the monitored voltage falls below 90% of the rated voltage, the configured value is adjusted proportionally with the ratio of monitored and rated voltage.
-> $I_a = (V/V_n) * I_p$

Case 3 (monitored voltage V < knee curve setting):
If the monitored voltage falls below the percentage value of the rated voltage configured by the knee curve setting, the configured value is adjusted to the proportional value at the knee curve setting.
-> I_a = {(knee point setting in [%])/100} * I_p
If the knee curve setting is configured to 20% for example and the monitored voltage is lower than 20% of the rated voltage, the adjusted value I_a falls not below 20% of the configured value I_p.

```
Inv.time ov.cur.
V-restr.     ON
```

Inverse time-overcurrent monitoring with voltage restraint **ON/OFF**

ON .....Inverse time-overcurrent monitoring with voltage restraint is enabled. The subsequent screens of this function are displayed.
OFF .....Inverse time-overcurrent monitoring with voltage restraint is disabled. The subsequent screens of this function are not displayed.

```
Inv.time ov.curr
knee curve U>00%
```

Threshold inverse time-overcurrent with voltage restraint **10 to 90 %**

The threshold limit for the voltage is defined in this parameter. The knee of the curve describes the lower limit of the threshold value lowering, i.e. the trip current belonging to this limit remains valid and will not be lowered further in case of an additional voltage drop.

Ground Fault Monitoring, Calculated (Option IS)

Ground fault monitoring for low-impedance or solidly grounded systems.

Function: The ground fault monitoring can be configured for two threshold limits. The third harmonics single-phase components may result in false currents being monitored on the grounding circuit. A digital anti-aliasing filter is utilized to separate theses harmonics and prevent inaccurate values caused by harmonics from being displayed. If the actual sine wave of the ground current exceeds the configured threshold, an alarm message is displayed. This message can be suppressed with the discrete input "Blocking of protective functions / remote acknowledgement".

Acquiring the measured value:

- The ground current is measured by calculating the vectorial sum of the three monitored phase currents. The current transformer should be sized so that the configured ground current threshold is at least 10% of the transformer's current rating to ensure proper operation.

```
Earth current
monitoring   ON
```

Ground fault monitoring **ON/OFF**

ON..... Ground fault monitoring is enabled. The subsequent screens of this function are displayed.
OFF..... Ground fault monitoring is disabled. The subsequent screens of this function are not displayed.

```
Earth current 1
Response =  000%
```

Threshold ground fault, level 1 **10 to 300 %**

Ground fault current (level 1) is defined by this parameter. The percentage configured here refers to the configured rated current (refer to page 42). If this limit is reached or exceeded, the unit outputs the message "**Earthcur.1**". If a relay was assigned to this function in the relay manager, that relay will be energized.

```
Earth current 1
Delay    00.00s
```

Pickup delay, level 1 **0.02 to 99.98 s**

In order to initiate a ground fault current (level 1) alarm, the measured ground fault current must exceed and remain above the configured threshold without interruption for at least the period of time specified in this screen.

```
Earth current 2
Response =  000%
```

Threshold ground fault, level 2 **10 to 300 %**

Ground fault current (level 2) is defined by this parameter. The percentage configured here refers to the configured rated current (refer to page 42). If this limit is reached or exceeded, the unit outputs the message "**Earthcur.2**". If a relay was assigned to this function in the relay manager, that relay will be energized.

```
Earth current 2
Delay    00,00s
```

Pickup delay, level 2 **0.02 to 99.98 s**

In order to initiate a ground fault current (level 2) alarm, the measured ground fault current must exceed and remain above the configured threshold without interruption for at least the period of time specified in this screen.

```
Earth current
Hysteresis  000%
```

Hysteresis for the ground fault monitoring, levels 1+2 **1 to 300 %**

In order to prevent system fluctuations from continually initiating ground fault current alarms (levels 1 & 2), a lower release point is defined here. If the control monitors the current above the permissible limit, the current must drop below that threshold and the current level defined here for the fault condition to be recognized as no longer existing.
Example: If a 1000A system has a ground fault current limit 1 of 5% (50A) and a hysteresis of 2% (20A), the monitored current for a ground fault current alarm must drop below 20A to reset the alarm.

Overload Monitoring (Option PM)

NOTE

All percentage values refer to a percentage of the configured rated power (page 42).

Function: "Positive active load not within the permissible range"
The single-phase or three-phase active load is above the configured limit for overload. The message "**overload**" is displayed. This message can be suppressed with the discrete input "Blocking of protective device / remote acknowledgement".

```
Overload
Monitoring  ON
```

Overload monitoring **ON/OFF**

ON .....Overload monitoring is enabled. The subsequent screens of this function are displayed.
OFF .....Overload monitoring is disabled. The subsequent screens of this function are not displayed.

```
Overload
Response v.000%
```

Threshold overload **0 to 150 %**

The overload threshold is defined by this parameter. The percentage configured here refers to the configured rated power (refer to page 42). If this limit is reached or exceeded, the unit outputs the message "**overload** ". If a relay was assigned to this function in the relay manager, that relay will be energized.

```
Overload
Delay time  000s
```

Pickup delay **0 to 300 s**

In order to initiate an overload alarm, the measured active load must exceed and remain above the configured threshold without interruption for at least the period of time specified in this screen.

```
Overload
Hysteresis  00%
```

Hysteresis for the overload monitoring **0 to 99 %**

In order to prevent system fluctuations from continually initiating overload alarms, a lower release point is defined here. If the control monitors the active load above the permissible limit, the load must drop below the percentage of the rated load defined here for the fault condition to be recognized as no longer existing.
Example: If a 100kW rated system has an overload limit of 120% (120kW) and a hysteresis of 95% (95kW), the monitored load for an overload alarm must drop below 95kW to reset the alarm.

Reverse/Reduced Power Monitoring (Option PM)

NOTE

All percentage values refer to a percentage of the configured rated power (page 42).

Function: "Active power not within the permissible range"
The generator power limits may be configured as reduced power or reverse power depending on the threshold value configured in the control. If the single-phase or three-phase measured real power is below the adjusted limit of the reduced load or below the adjusted value of the reverse power, an alarm will be issued. The message "**Rev. Power**" appears. This message can be suppressed with the discrete input "Blocking of protective device / remote acknowledgement".

```
Reverse/min.pow.
Monitoring  ON
```

Reverse/reduced power monitoring **ON/OFF**

ON..... Reverse/reduced power monitoring is enabled. The subsequent screens of this function are displayed.
OFF..... Reverse/reduced power monitoring is disabled. The subsequent screens of this function are not displayed.

```
Reverse/min.pow.
          -00%
```

Threshold reverse/reduced power **-99 to 99 %**

Reverse power monitoring: If the direction of the active power reverses and the measured power value falls below the configured negative percentage value, the unit issues the message "**Rev. Power**".
Reduced power monitoring: If the measured power falls below the configured positive percentage value, the unit issues the message "**Rev. Power**".

If a relay was assigned to this function in the relay manager, that relay will be energized.

```
Reverse/min.pow.
Delay     00.00s
```

Pickup delay **0.02 to 99.98 s**

In order to initiate an overload alarm, the measured active load must exceed and remain above the configured threshold without interruption for at least the period of time specified in this screen.

```
Reverse/min.pow.
Hysteresis  00%
```

Hysteresis for the reverse/reduced power monitoring **0 to 99 %**

In order to prevent system fluctuations from continually initiating reverse/reduced power alarms, a lower release point is defined here. If the control monitors the active load above the permissible limit, the load must drop below the percentage of the rated load defined here for the fault condition to be recognized as no longer existing.

Unbalanced Load Monitoring (Option PS)

NOTE

All percentage values refer to a percentage of the configured rated power (page 42).

Function: "Unbalanced load not within the permissible range"
The percentage threshold value indicates the permissible variation of phase current from the arithmetic mean value of all three-phase currents. If the measured value is greater than the threshold, the message "**Unbalance**" appears. This message can be suppressed with the discrete input "Blocking of protective device / remote acknowledgement".

```
Unbalanced load
Monitoring  ON
```

Unbalanced load monitoring **ON/OFF**

ON .....Unbalanced load monitoring is enabled. The subsequent screens of this function are displayed.
OFF .....Unbalanced load monitoring is disabled. The subsequent screens of this function are not displayed.

```
Unbalanced load
Response v. 000%
```

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

The maximum unbalanced load refers to the measured three-phase currents. If an asymmetrical load causes the phase currents to exceed the configured percentage for the configured time, the unit displays the alarm message "**Unbalance**". If a relay was assigned to this function in the relay manager, that relay will be energized.

```
Unbalanced load
Delay     00.00s
```

Pickup delay **0.02 to 99.98 s**

In order to initiate an unbalanced load alarm, the measured active load must exceed and remain above the configured differential threshold without interruption for at least the period of time specified in this screen.

```
Unbalanced load
Hysteresis  00%
```

Hysteresis for the unbalanced load monitoring **1 to 20 %**

In order to prevent system fluctuations from continually initiating unbalanced load alarms, a lower release point is defined here. If the control monitors the active load above the permissible differential limit, the load must drop below the load differential percentage defined here for the fault condition to be recognized as no longer existing.

Power Factor Monitoring (option ZC)

Function: "Power factor cos phi not within the admissible range"
If the excitation of a generator is regulated by a reactive current governor, operation within the capacitive (underexcited) range could be avoided by interrupting the control signals by means of the power factor monitoring. For the two limiting values both, inductive and capacitive thresholds may be set. It is also possible to set the limiting value 1 to a capacitive and the limiting value 2 to an inductive threshold. The message "**cosphi1**" or "**cosphi2**" appears. This message can be suppressed with the discrete input "Blocking of protective device / remote acknowledgement".

```
cosphi
Monitoring  000
```

cos φ -monitoring **ON/OFF**

ON.....The cos φ (power factor) is being monitored, and the subsequent masks of this function are displayed.
OFF.....Monitoring is not carried out, and the subsequent screen masks of this function are not displayed.

```
cosphi 1
Response v.i0,00
```

Threshold cos φ level 1 **c0.01 to 1.00 to i0.01**

The value of the power factor cos φ (level 1) to be monitored is set in this mask. If the value is either reached or exceeded (inductive) or fallen below (capacitive), the unit issues the message "**cosphi 1**". If additionally, a relay was configured via the relay manager, an output is also made to this relay.

```
cosphi 1
Delay     00,00s
```

Delay cos φ level 1 **0.02 to 99.98 s**

For a tripping to occur, the threshold must be exceeded without interruption for at least the period of time specified in this mask.

```
cosphi 2
Response v.c0,00
```

Threshold cos φ 2 **c0.01 to 1.00 to i0.01**

The value of the power factor cos φ (level 2) to be monitored, is set in this mask. If this value is reached or exceeded (inductive) or fallen below (capacitive), the unit issues the message "**cosphi 2**". If additionally, a relay was configured via the relay manager, an output is also made to this relay.

```
cosphi 2
Delay     00,00s
```

Delay cos φ level 2 **0.02 to 99.98 s**

For a tripping to occur, the threshold must be exceeded without interruption for at least the period of time specified in this mask.

```
cosphi mon.
Hysteresis  0,00
```

Hysteresis cos φ - monitoring **0.01 to 0.50**

In order to avoid that the signal relay keeps picking up and dropping when approaching the preset threshold for the power factor (both levels), the difference between the pickup and the release value (hysteresis) can be entered here as a percentage value.

Reactive Power Monitoring (Option ZQ)

NOTE

All percentage values refer to a percentage of the configured rated power (page 42).

Function: "Reactive power not within the permissible range"
The control may monitor the reactive power and provide protection against excessive inductive (over excitation) or capacitive (under excitation) load conditions. The control will display "**React.pow+**" or "**React.pow-**" if the inductive or capacitive load has exceeded the permissible limits. This message can be suppressed with the discrete input "Blocking of protective device / remote acknowledgement".

```
Reactive power
Monitoring  ON
```

Reactive power monitoring **ON/OFF**

ON .....Reactive power monitoring is enabled. The subsequent screens of this function are displayed.
OFF .....Reactive power monitoring is disabled. The subsequent screens of this function are not displayed.

```
Cap. react. pow.
Response v.000%
```

Threshold reactive power, capacitive **0 to 100 %**

The capacitive reactive power threshold is defined by this parameter. The percentage configured here refers to the configured rated power (refer to page 42). If this limit is reached or exceeded, the unit outputs the message "**React.pow-**". If a relay was assigned to this function in the relay manager, that relay will be energized.

```
Cap. react. pow.
Delay     00.00s
```

Pickup delay **0.02 to 99.98 s**

In order to initiate a capacitive reactive power alarm, the measured capacitive reactive load must exceed and remain above the configured differential threshold without interruption for at least the period of time specified in this screen.

```
Ind. react. pow.
Response v.000%
```

Threshold reactive power, inducitive **0 to 100 %**

The inductive reactive power threshold is defined by this parameter. The percentage configured here refers to the configured rated power (refer to page 42). If this limit is reached or exceeded, the unit outputs the message "**React.pow+**". If a relay was assigned to this function in the relay manager, that relay will be energized.

```
Ind. react. pow.
Delay     00.00s
```

Pickup delay **0.02 to 99.98 s**

In order to initiate an inductive reactive power alarm, the measured inductive reactive load must exceed and remain above the configured differential threshold without interruption for at least the period of time specified in this screen.

```
React. pow. mon.
Hysteresis 00%
```

Hysteresis for the reactive power monitoring **1 to 20 %**

In order to prevent system fluctuations from continually initiating reactive power alarms, a lower release point is defined here. If the control monitors the capacitive or reactive load above the permissible limit, the reactive load must drop below the percentage defined here for the fault condition to reset for the fault condition to be recognized as no longer existing.

Load Shift Monitoring (Option ZW)

NOTE

All percentage values refer to a percentage of the configured rated power (page 42).

Function: "Active Load Surges not within the admissible range"
The unit logs the three-phase current reactive power by means of the 3 phase voltages and the 3 wire currents. Tripping occurs in case of a sudden variation of the active power, if the variation exceeds a certain settable threshold. Tripping occurs neither for slow variations of the active load, nor for sudden variations of the reactive load. (For a tripping to occur, the active load change must exceed the threshold within 2 measuring periods). If the measured value is greater than the threshold, the message "**Load shift+**" or "**Load shift-**" appears. These message can be separately controlled via the relay manager and can be suppressed with the discrete input "Blocking of protective device / remote acknowledgement".

```
Act. power shift
Monitoring  000
```

Load Shift Monitoring **ON/OFF**

ON..... A load shift is being monitored, and the subsequent masks of this function are displayed.
OFF..... Monitoring is not carried out, and the subsequent screen masks of this function are not displayed.

```
Release value
Power shift= 00%
```

Admissible Active Power Surge **10 to 80 %**

If the value of the active load shifts by a value equal to or greater than the set percentage value (referring to the nominal power; refer to page 42), the unit issues a message. The protective unit differentiates between positive (load) and negative (load reducing) load shifts (the messages issued are therefore either "**Load shift+**" or "**Load shift-**"). If additionally, a relay was configured via the relay manager, an output is also made to this relay.

Non-Direct. Ground-Fault Monit. via Displacement Volt. (Option IV)

The unit may be used to monitor for earth faults in the stator winding of three-phase motors drawing current from the mains via a unit-connected transformer. If a ground current fault is detected, the control senses the current phase shift, providing about a 95% protection of the windings rating.

First tripping level for the displacement voltage

Function: "Measurement of the displacement voltage (level 1)"
The displacement voltage is usually measured via the open delta winding (e-n-winding) of a potential transformer or via a zero sequence transformer in the star point of the machine. If potential transformers with secondary voltages greater than 100V (e.g. 240 V, 500 V), the voltage at the earth fault input terminal must be reduced to a voltage level less than 100V through the use of a voltage divider. The single-phase third harmonics components may result in false currents being monitored on the grounding circuit. A digital anti-aliasing filter is utilized to separate theses harmonics and prevent inaccurate values caused by harmonics from being displayed. If the actual sine wave of the ground current exceeds the configured threshold, the alarm message "**E.fault Ve**" is displayed. This message cannot be suppressed with the discrete input "Blocking of protective functions / remote acknowledgement".

```
Earth fault
monitoring  ON
```

Non-directional ground fault monitoring **ON/OFF**

ON .....The non-directional ground fault monitoring is enabled. The subsequent screens of this function are displayed.
OFF .....The non-directional ground fault monitoring is disabled. The subsequent screens of this function are not displayed.

```
Earth fault Ve>
Response v. 000%
```

Threshold displacement voltage, level 1 **3 to 100 %**

The displacement voltage threshold (level 1) is defined by this parameter. The percentage configured here refers to the configured rated voltage of the potential transformer secondary (generally 100 V). If this limit is reached or exceeded, the unit outputs the message "**E.fault Ve**". If a relay was assigned to this function in the relay manager, that relay will be energized.

```
Earth fault Ve>
Delay     00.00s
```

Pickup delay, level 1 **0.02 to 99.98 s**

In order to initiate a ground fault alarm, the displacement voltage threshold (level 1) must be exceeded and remain above the configured threshold without interruption for at least the period of time specified in this screen.

Second tripping level for the displacement voltage

Function: "Measurement of the displacement voltage (level 2)/disconnect impedance reactor"
Isolated or compensated distribution systems may use an impedance reactor to increase the resistance to earth. This type of equipment generally isn't designed for continuous rated current at full displacement. Therefore, this equipment must be disabled when the displacement voltage exceeds a set value. **It must be taken into consideration that the impedance reactor may only be disabled after the earth fault alarm has been initiated.** This requires a longer delay time be configured if the impedance reactor must be turned off. Additionally the displacement voltage threshold (level 2) must be configured higher than the level 1 threshold. When the displacement voltage threshold (level 2) has been exceeded, the alarm message "**Earth Ve>>**" is displayed. This message cannot be suppressed with the discrete input "Blocking of protective functions / remote acknowledgement".

```
Earth fault Ve>>
Response v. 000%
```

Threshold displacement voltage, level 2 **3 to 100 %**

The displacement voltage threshold (level 2) is defined by this parameter. The percentage configured here refers to the configured rated voltage of the potential transformer secondary (generally 100 V). If this limit is reached or exceeded, the unit outputs the message "**Earth Ve>>**". If a relay was assigned to this function in the relay manager, that relay will be energized.

```
Earth fault Ve>>
Delay    =00.00s
```

Pickup delay, level 2 **0.02 to 99.98 s**

In order to initiate a ground fault alarm, the displacement voltage threshold (level 2) must be exceeded and remain above the configured threshold without interruption for at least the period of time specified in this screen.

```
Release delay
Earth f.v.00.00s
```

Release delay for non-directional ground fault **0.02 to 99.98 s**

In order to prevent system fluctuations from continually initiating non-directional ground fault current alarms (levels 1 & 2), the monitored displacement voltage must remain below the threshold limit for the time configured here. The level 1 alarm will auto-acknowledge only if the parameter "Auto-clearing Relays" is configured as "ON". The level 2 alarm will always auto-acknowledge.

Relay Configuration

NOTE

Clearing of faults and fault messages from the control unit will depend on the parameters "External clearing", "Auto-clearing Relays", and "Auto-clearing Display". These three parameters will influence the other depending on how each is configured. This is explained in the following text.

```
External
Clearing     ON
```

External acknowledgement of the relays via the discrete input "Blocking of protective functions / remote acknowledgement".

Acknowledgement via the discrete input **ON/OFF**

"**Auto-clearing Relays**" configured "**OFF**" (refer to "Auto Acknowledgement of the Relay" on page 70):

OFF .....Alarms that cannot be blocked with discrete input "Blocking of protective functions / remote acknowledgement" will not be reset when the fault condition is no longer present. Pressing the "Clear" button resets the relays.
ON .....All alarms are reset when the discrete input "Blocking of protective functions / remote acknowledgement" (terminals 5/6) is energized. Alarms which cannot be blocked with the discrete input "Blocking of protective functions / remote acknowledgement" are only reset after the fault condition is no longer present.

"**Auto-clearing Relays**" configured "**ON**" (refer to "Auto Acknowledgement of the Relay" on page 70):

OFF .....Pressing the "Clear" button resets the displayed fault messages.
ON .....All displayed fault messages are reset when the discrete input "Blocking of protective functions / remote acknowledgement" (terminals 5/6) is energized. Alarms which cannot be blocked with the discrete input "Blocking of protective functions / remote acknowledgement" are only reset after the fault condition is no longer present.

Auto Acknowledgement of the Relays

```
Auto-clearing
Relays       ON
```

Relay auto acknowledgment **ON/OFF**

ON .....Automatic clearing of the relays is enabled. The relays are automatically reset when the fault condition is no longer detected. The alarm message in the display is cleared according to how the parameter "**Auto-clearing Display**" is configured.
OFF .....Automatic clearing of the relays is disabled. Pressing the "Clear" button resets the relays.

The alarm message in the display is cleared according to how the parameter "**Auto-clearing Display**" is configured. The subsequent screens of this function are not indicated.

NOTE

The subsequent screens are only visible if the parameter "Auto-clearing Relays" and the corresponding protective function are enabled and the control unit is equipped with the protective functionality.

```
Release delay
xxxxxxxxx 00.00s
```

Release delay of the relays **0.02 to 99.98 s**

The individual relays will reset if "Auto-clearing relays" has been enabled and the monitored values have returned to the permissible limits plus / minus the hysteresis (depending on monitoring) without interruption for the time specified in this parameter. If the monitored value exceeds / falls below the threshold limit, the delay timer re-initiates its countdown. The following protective functions may have reset delays configured.

Monitoring for ...		Display indication instead of xxxxxxxx	Remark
Overvoltage	Option U	**Overvolt.**	Level 1 and level 2
Undervoltage	Option U	**Und.volt**	Level 1 and level 2
Asymmetry	Option U	**Asymmetry**	
Overfrequency	Option U	**Overfreq.**	Level 1 and level 2
Underfrequency	Option U	**Underfrq**	Level 1 and level 2
Phase shift	Option V	**Phase sh.**	
df/dt	Option D	**df/dt**	
Independent time-overcurrent	Option IZ	**Overcurr.**	Overcurrent 1, 2, and 3
Inverse time-overcurrent	Option IU	**Curr.-Inv**	
Inverse time-overcurrent with voltage restraint	Option IU	**Curr.-Inv**	
Ground fault, calculated	Option IS	**Earth f.**	Ground current 1 and 2
Non-directional ground fault via displacement volt. Ve	Option IV	**Earth F.v.**	
Active load surge	Option PW	**Load shift.**	Positive and negative
Power factor 1 / 2	Option ZC	**cosphi 1 / 2**	
Overload	Option PM	**Overload**	
Reverse-/reduced power	Option PM	**Rev.power**	Reverse and reduced load
Unbalanced load	Option PS	**Unb. load**	
Reactive power inductive	Option ZQ	**react.ind.**	
Reactive power capacitive	Option ZQ	**react.cap.**	

Table 6-1: Release delay of the relays

Auto Acknowledgement of Messages

```
Auto-clearing
Display      ON
```

Messages auto acknowledgment **ON/OFF**

ON .....After the alarm condition is no longer detected, the message in 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.

NOTE

The subsequent parameter "`Clearing display after  `" is not visible if "`Auto-clearing Relays`" is configured to "`OFF`".

```
Clearing display
       after 00s
```

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

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

Changing the Relay Assignment (Relay Manager; Standard / Option R)

```
Change relay-
allocation?  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.

NOTE

All relay outputs are configured the same. The following is an example showing relays 1 through 3. Depending on the model purchased, the unit may have up to 8 configurable relays.

Example: Relay 1 to 3

```
Funct. relay 123
(R=releases) RRR
```

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

The individual relays may be configured as either E=Energizes (Normally Open contacts) or R=Releases (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.
R .....The relay is configured as normally closed (N.C.) contacts. The relay is always energized and will only de-energize (release) if the assigned monitoring function has tripped.

NOTE Relay 1 is configured as R (release/N.C.) and cannot be modified.

NOTE

The following screen(s) will only be displayed if the unit is equipped with the corresponding protective function(s), the protective function is enabled, and the parameter "`Change relay allocation`" is enabled.

```
xxxxxxxxxxxxxxx
to relay    0000
```

Output of the protective units to the relays **0..4/8**

Each digit in this parameter is used to assign one relay to a protective function. Up to four relay outputs may be assigned to a protective function. The control may be configured as follows:

0..... If the protective function is not assigned to a relay, a "0" must be configured in the display. None of the relay outputs will energize/de-energize when the corresponding protective function trips if all four relay assignments are configured with a "0". A message for the protective function will still be visible in the unit display.

1/2/3 ..... Relay 1 (terminals 9/10), relay 2 (terminals 11/12/13), and/or relay 3 (terminals 14/15/16) are available for assignment to protective function on all units.

4/5/6/7/8 ..... Relay 4 (terminals 19/20/21), relay 5 (terminals 22/23/24), relay 6 (terminals 25/26/27), relay 7 (terminals 28/29/30), and/or 31/32 (relay 8) are available for assignment to protective function if the unit is equipped with Option R.

Example..... A unit equipped with Option R has a protective function that is required to output a signal to relays 2,4, and 7. That protective function relay assignment should be configured as 2470. The sequence of the numbers has no significance in the functionality or operations.

A relay output may be assigned to more than one protective function. This will cause the relay to issue a signal when any of the configured protective functions trip. If a relay should only issue a signal when a specific protective function trips, then the relay must not be assigned to any other protective function.

Monitoring of ... output to relay		Indication on display instead of xxxxxxxxxx
Overvoltage, level 1 / 2	Option U	**Overvoltage 1/ Overvoltage 2**
Undervoltage, level 1 / 2	Option U	**Undervoltage 1 / Undervoltage 2**
Zero voltage	Option UN	**Zero-voltage.**
Asymmetry	Option U	**Asymmetry**
Overfrequency, level 1 / 2	Option U	**Overfrequency 1 / Overfrequency 2**
Underfrequency, Level 1 / 2	Option U	**Underfrequency 1 / Underfrequency 2**
Phase shift	Option V	**Phase sh.**
df/dt	Option D	**df/dt**
Independent time-overcurrent, level 1 / 2 / 3	Option IZ	**Overcurrent 1 / 2 / 3**
Inverse time-overcurrent	Option IU	**Inv.time ov.curr**
Inverse time-overcurrent with voltage restraint	Option IU	**Inv.time ov.curr**
Ground fault, calculated, level 1 / 2	Option IS	**Earth Fault 1 / Earth Fault 2**
Non-directional ground fault via displacement volt. Ve	Option IV	**Displac. volt.**
Overload	Option PM	**Overload**
Reverse-/reduced load	Option PM	**Reverse/min.pow.**
Unbalanced load	Option PS	**Unbalanced load**
Reactive power, capacitive	Option ZQ	**Cap.react pow.**
Reactive power, inductive	Option ZQ	**Ind.react pow.**
Load shift, negative	Option ZW	**Pow.shift-**
Load shift, positive	Option ZW	**Pow.shift+**
cosphi, level 1 / 2	Option ZC	**Pow.fact.1 / Pow.fact.2**
Non-directional ground fault via displ. volt., level 1 / 2	Option IV	**Earth Ve> / Earth Ve>>**
Interface fault		**Interface Fault**
Centralized alarm		**Collect Response**

Table 6-2: Protective device output to relay

NOTE

The "ready for operation" function is always assigned to relay 1. However, other protective functions may also be assigned to relay 1 additionally. Relay 1 is always configured as Normally Closed (break contact) and will de-energize if the unit is not ready for operation.

Pulse Output of the Positive Active Energy (Option M)

NOTE

If the negative active power or the positive and negative reactive power must be logged, use a measuring transducer such as the Woodward UMT 1.

```
Pulse output
p.duration 0.00s
```

Pulse duration **0.04 to 1.00 s**

The duty cycle of one output pulse is defined here.
Note: The pulse duration must be configured for compatibility to the kWh impulse. It may be possible to configure overlapping impulses that may be recognized as a continuous signal.

```
Pulse/kWh
Logic ----------
```

Output of the kWh-pulse **positive/negative**

The output logic of the kWh-pulse can be either negative (the collector-output [terminal 60/61] is de-energized for each positive kWh-pulse), or positive (the collector-output [terminal 60/61] is energized for each positive kWh-pulse).

```
Active energy
Pulse/kWh  000.0
```

Pulses per positive kWh **0.1 to 150.0**

The quantity of pulses per measured kWh is defined here. The pulses issued by this controller must be analyzed by an external control.
Example: If this parameter is configured as "**`Pulse/kWh 020.00`**" and 20 kWh are measured the number of pulses that will be output will be 400 or 20 kWh × 20 pulses/kWh = 400 pulses

```
RESET kWh
          ON
```

RESET kWh measuring **ON/OFF**

Enabling this parameter permits the kWh meter to be reset to zero by pressing the "Select" and "Digit↑" buttons while in the automatic operating mode.

NOTE

The kWh-counter is reset by:

1. **Verify the control is in automatic mode.**
2. **Verify that the kWh-counter is displayed in the lower line of the display.**
3. **Press and hold the "Select" and "Digit↑" buttons for at least 5 seconds.**

After the counter has been successfully reset, the screens will display "`0000.0 kWh`".

Analog Outputs (Options A1/2/3/4/6/8)

NOTE

The common use of the analog outputs, the interfaces and the discrete inputs depends on their respective combinations. Please pay attention to the combinations possible as described in the introduction.

CAUTION

The function of the analog outputs is restricted during configuration via the side connector (version 3.xxx). The parameter "Direct parametr." must be set to "NO" in order to make all analog outputs available (also see chapter "Direct Configuration" on page 39).

It is possible to configure a linear measuring range for each analog output and assign it to a specific measured value (refer to Table 6-3). The -20/0/4 to 20 mA analog outputs may be configured as a -20 to 20 mA, 0 to 20 mA, or 4 to 20 mA output. The user may define the upper and lower limits of the analog input measuring range. Text may be assigned to the input as well.

Value	Lower and upper setting value	
	0 V, -10 V 0 mA, 4 mA, -20 mA	10 V, 20 mA
Vol 1	0 to 65,000 V	
Vol 2	0 to 65,000 V	
Vol 3	0 to 65,000 V	
Vol ph-N AV	0 to 65,000 V	
Vol ph-N max	0 to 65,000 V	
Vol ph-N min	0 to 65,000 V	
Vol 1-2	0 to 65,000 V	
Vol 2-3	0 to 65,000 V	
Vol 3-1	0 to 65,000 V	
Vol ph-ph AV	0 to 65,000 V	
Vol ph-ph max	0 to 65,000 V	
Vol ph-ph min	0 to 65,000 V	
Frequency	40.00 to 80.00 Hz	
Current L1	0 to 9,999 A	
Current L2	0 to 9,999 A	
Current L3	0 to 9,999 A	
Current AV	0 to 9,999 A	
Current max	0 to 9,999 A	
Current min	0 to 9,999 A	
Direct. Cur 1	-9,999 to 9,999 A	
Direct. Cur 2	-9,999 to 9,999 A	
Direct. Cur 3	-9,999 to 9,999 A	
Dir. Current AV	-9,999 to 9,999 A	
Dir. Current max	-9,999 to 9,999 A	
Dir. Current min	-9,999 to 9,999 A	
Active power	-32,000 to 32,000 kW	
Reactive power	-32,000 to 32,000 kvar	
Apparent power	0 to 32,000 kVA	
cosphi	i0.01 to 1.00 to c0.01	

[1].... The sign of the current values is defined by the polarity of the active component.

Table 6-3: Analog outputs, table of values

Example: analog output 2 (-10/0 to 10 V: terminals 50/52, -20/0/4 to 20 mA: terminals 52/53)
Output of the phase-to-phase voltage V_{L1-L2}:

20 mA output

```
Analog output 2
      0 .. 20 mA
```

10 V output

```
Analog output 2
      0 .. 10 V
```

Output range of the analog output 2 **(20 mA) –20..+20 / 0..20 / 4..20 mA / OFF**
(10 V) –10..+10 / 0..10 V / OFF

The only variable that may be changed for this parameter is the lower value for this analog output. The upper limit is always +20 mA.
-20..20mA.....-20 mA is the configured low limit for the analog output
0..20mA.....0 mA is the configured low limit for the analog output
4..20mA.....4 mA is the configured low limit for the analog output
OFF .....The analog output is not enabled. The subsequent screens of this function are not displayed.

The only variable that may be changed for this parameter is the lower value for this analog output. The upper limit is always +10 V.
-10..+10 V.....-10 V is the configured low limit for the analog output
0..10 V .....0 V is the configured low limit for the analog output
OFF .....The analog output is not enabled. The subsequent screens of this function are not displayed.

```
Analog output 2
---------------
```

Output value of the analog output 2 **refer to Table 6-3**

The parameter that is to be assigned to the output is selected here (refer to Table 6-3).

```
Analog output
  0mA =   00000V
```

Example for 20 mA-output

Scaling of the lower output value **refer to Table 6-3**

Defines the lower limit of the output.

```
Analog output
20mA =   00000V
```

Example for 20 mA-output

Scaling of the upper output value **refer to Table 6-3**

Defines the upper limit of the output.

Interface (options SU/SB)

CAUTION

The communications bus interface functionality is disabled when the direct configuration port is enabled. The parameter "Direct parametr." must be set to "NO" to re-enable the communication bus interface (refer to "Direct Configuration" on page 39).

NOTE

These screens and all related screens are only displayed if the particular communication option is included on the control unit. If the individual communication protocol is not included, the related screens will not be displayed.

NOTE

A description of the communication protocols may be found in Appendix E.

Screens for Protocol DK3964 (Option SU)

```
Data block
RK512        000
```

Data block RK512 **0 to 255**

Data block address in receiver (e. g. PLC).

```
Data word RK512
          000
```

Data word RK512 **0 to 255**

Data word address in receiver (e.. g. PLC).

Screens for Protocol Profibus DP Slave (Option SU)

```
Device number
Profibus     000
```

Device number profi-bus DP slave **0 to 126**

Device number for the profi-bus DP slave.

Screens for Protocol Modbus RTU Slave (Option SU/SB)

```
Device number
MOD-Bus      000
```

Device number Modbus RTU Slave **1 to 255**

Device number for the Modbus RTU Slave.

```
Baudrate
            0000
```

Baud rate Modbus RTU Slave **1,200 / 2,400 / 4,800 / 9,600 / 19,200 Baud**

The baud rate of the Modbus RTU Slave is defined here.

```
Parity
           none
```

Parity Modbus RTU Slave **none / even / odd**

The parity of the Modbus RTU Slave is defined here.

```
Stopbits
           one
```

Stop bits Modbus RTU Slave **one / two**

The number of stop bits of the Modbus RTU Slave is defined here.

```
Delay to send
MOD-Bus   00.0ms
```

Waiting time transmission after read request **0.2 to 50.0 ms**

After the read request by the master, the minimum waiting time before transmitting the answer is configured here. This allows the controller to adjust the response time to the master so that it can process the answer.

Screens for Protocol CAN Bus (Options SU/SB)

NOTE

Please note that IDs must not be allocated twice. This applies to all units linked to the bus system. Moreover, all IDs adjusted at the unit must be set to different values.

Procedure for transmission-IDs: The same "Basic-ID Transmission" is allocated to all units existing within the bus system. This allows a grouping of the various types of information. (Example: The same "Basic-ID Transmission" = 800 is allocated to all units. By means of the different unit numbers, the individual IDs are then allocated; unit number 1: ID = 801; unit number 2: ID = 802; etc.)

```
Device number
CAN-Bus      0
```

Device number CAN-bus **1 to 8**

The device number at CAN-bus is entered here. The device number affects the calculation of the transmitting- and controlling IDs.

```
Baudrate
          0000
```

Baudrate CAN-Bus **125/250/500kBaud**

Setting the baudrate.

```
Base-ID (send)
            0000
```

Basic - ID Transmission **0 to 2015**

The ID, from which the device is transmitting its operating data, is calculated from the Basic-ID Transmission + Device Number CAN-Bus.

```
Base-ID (remote)
            0000
```

Basic - ID control **0 to 2015**

The ID, at which the device receives control data, is calculated from the Basic-ID-Control + Device Number CAN-Bus.

```
ID (parametriz.)
            0000
```

ID for remote parameterization **0 to 2015**

Here the ID is entered on which the unit receives parameterization data. If the remote parameterization occurs via a system GW 4, these ID's must always be set to the value 831.

General Screens for All Interfaces (Option SB)

```
Serial control
              ON
```

Control via interface **ON/OFF**

ON..... Control via the serial interface is enabled and control orders received via the interface are processed.
OFF..... Control via the serial interface is disabled and control orders received via the interface are ignored.

```
Serial interface
Monitoring  ON
```

Interface monitoring **ON/OFF**

ON..... The interface monitoring is enabled. The control expects to receive bits 2 and 3 to be written to "00" in the control word by the master control within 15 seconds after receiving the last message. If these bits are not read within the prescribed time, and unsuccessful data exchange is detected, and the alarm message "**Interface**" is issued.
OFF..... The interface monitoring is disabled.

```
Interface fault
to relay    0000
```

Relay assignment for interface error **0 to 3 / 0 to 8**

Relays may be configured to energize when an interface fault is detected. The desired relays that to energize are configured here. The relays will only energize if the parameter "**Serial interface monitoring**" is configured as "**ON**".

```
Inhibit via
Interface    ON
```

Blocking via the interface **ON/OFF**

ON..... The protective functions messages (i.e. underfrequency) may be suppress via the interface. This operates in the same manner as terminals 5/6 "Blocking of protective functions / remote acknowledgement".
OFF..... The protective functions messages (i.e. underfrequency) cannot be suppress via the interface.

Chapter 7.
Commissioning

DANGER - HIGH VOLTAGE

When commissioning the control, please observe all safety rules that apply to the handling of live equipment. Ensure that you know how to provide first aid in the event of an uncontrolled release of energy 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:

L I F E T H R E A T E N I N G

CAUTION

Only a qualified technician may commission unit. The "EMERGENCY-STOP" function must be operational prior to commissioning of the system, and must not depend on the unit for its operation.

CAUTION

Prior to commissioning ensure that all measuring devices are connected in correct phase sequence. The connect command for the unit circuit breaker must be disconnected at the unit circuit breaker. The field rotation must be monitored for proper rotation. Any absence of or incorrect connection of voltage measuring devices or other signals may lead to malfunctions and damage the unit, the engine, and/or components connected to the unit!

Procedure

1. After wiring the unit and ensuring all voltage-measuring devices are phased correctly, apply the control system voltage (i.e. 24 Vdc). The "Operation" LED will illuminate.

2. By simultaneously pressing the two push buttons "Digit↑" and "Cursor→", the configuration mode is accessed. After entering the access code number, the unit may be configured according to the application requirements (see the chapter regarding the parameters).

The MFR 1 will not issue a "Connect" signal while it is in configuration mode.

3. After applying the measured variables, the unit will display the measured values. These values should be confirmed with a calibrated measuring instrument.

4. After the unit has been configured for the application, the configuration mode is exited by simultaneously pressing the "Digit↑" and "Cursor→" buttons.

5. Check all protection functions and the relay outputs.
   Check all control outputs as well as the setting and behavior of the controller outputs (frequency & voltage)

6. Check the synchronization (Option YC):
   a.) Interrupt the "Connect" signal for the power circuit breaker.
   b.) The mains voltage (synchronization voltage) must be within the permissible limits.
   c.) In the moment a connection command is output, the differential voltage between the corresponding conductors must be equal to zero. This check must be carried out for all three phases, in order to check the correctness of the rotating field.
   d.) After a successful check, the "Connect" signal can be connected again.

7. Check the dead bus start function
   Prior to checking the dead bus start function, the output of the "Connect" signal must be interrupted.

8. If steps 1 through 7 have been carried out successfully, parallel operations may be commenced. It is recommended to start with a constant power/baseload operation (approx. 25 % of the generator rated power) initially. While this operation is being carried out, the displayed measured values must be verified. Test the GCB shutdown. Check the real power controller and if necessary the power factor controller for proper operation. Enter various set point values and verify proper operation.

Appendix A.
Dimensions

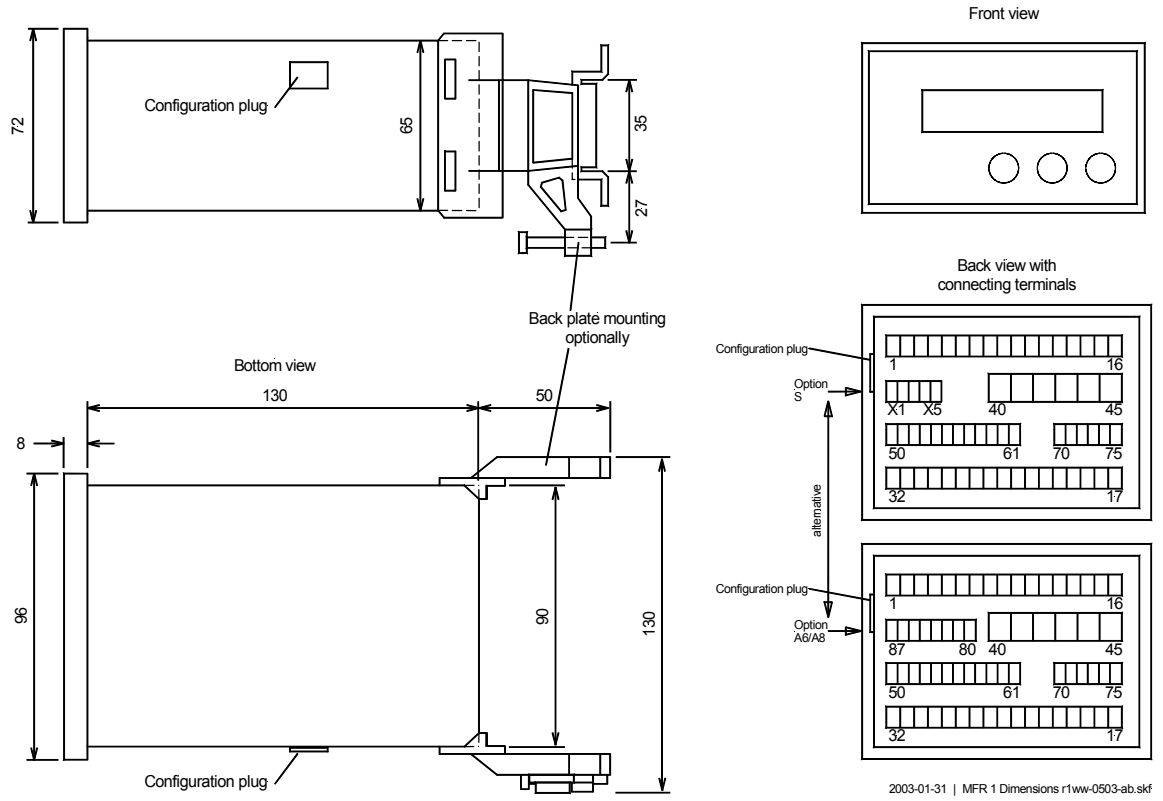
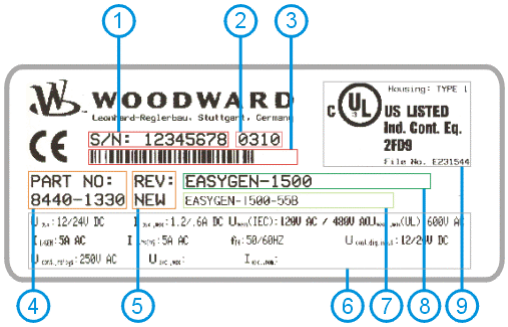


Figure 7-1: Dimensions

Appendix B.
Technical Data

Nameplate



1	S/N	Serial number (numerical)
2	S/N	Date of production (YYMM)
3	S/N	Serial number (Barcode)
4	P/N	Item number
5	REV	Item revision number
6	Details	Technical data
7	Type	Description (long)
8	Type	Description (short)
9	UL	UL sign

Measuring voltage

- Measuring voltage — Standard (V_{rated}) ⅄/Δ ..... [1] 66/115 Vac
  [4] 230/400 Vac
  [7] 398/690 Vac
  Maximum value V_{ph-ph} max. (UL/cUL) ..... [1] max. 150 Vac
  [4] max. 300 Vac
  [7] max. 600 Vac
  Rated voltage $V_{ph-ground}$ ..... [1] 150 Vac
  [4] 300 Vac
  [7] 400 Vac
  Rated surge voltage ..... [1] 2.5 kV
  [4] 4.0 kV
  [7] 4.0 kV
- Measuring frequency ..... 40.0 to 80.0 Hz
- Accuracy ..... Class 1
- Resistance ..... 0.1 %
- Linear measuring range ..... 1.3 × V_{rated}
- Input resistance ..... [1] 0.21 MΩ
  [4] 0.7 MΩ
  [7] 1.0 MΩ
- Maximum power consumption per path ..... 0.15 W

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

- Measuring current I_{rated} ..... [1] ../1 A
  [5] ../5 A
- Accuracy ..... Class 1
- Linear measuring range ..... 3.0 × I_{rated}
- Power consumption ..... < 0.15 VA
- Rated short-time current (1 s) ..... [1] 100.0 × I_{rated}
  [5] 20.0 × I_{rated}

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

- Power supply — Standard ..... 24 Vdc (18 to 30 Vdc)
  Wide range power supply — (Option N) ..... 90 to 265 Vac/dc
- Intrinsic consumption ..... max. 12 W
- Ambient temperature — Storage ..... -40 to 85 °C / -40 to 185 °F
  Operational ..... -20 to 70 °C / -4 to 158 °F
- Ambient humidity ..... 95 %, not condensing
- Maximum altitude ..... 2000 m
- Degree of pollution 2

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

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

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

- Contact material ..... AgCdO
- General purpose (GP) ($V_{Cont, relay output}$)
  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) ($V_{Cont, relay output}$)
  AC .....
  DC ..... 1.00 Adc@24 Vdc
  0.22 Adc@125 Vdc
  0.10 Adc@250 Vdc

Analog outputs ---------- **isolated**

- At rated value ..... freely scaleable
- Insulation voltage ..... 1,500 Vdc
- Resolution PWM ..... 12 Bit
- -20/0/4 to 20 mA output ..... Maximum load 500 Ω
- -10/0 to 10 Vdc outpu ..... Internal resistance ≤1 kΩ

Pulse output ----------

- Type ..... transistor output
- Rated gate voltage ..... 24 Vdc
- Maximum gate voltage ..... 32 Vdc
- Minimum gate current ..... 10 mA dc
- Maximum gate current ..... 30 mA dc (0.5 Vdc)

Interface ---------- **isolated**

- Insulation voltage ..... dependent on model: 500 to 3,000 Vdc
- Version ..... variable

Housing ----------

- Type ..... APRANORM DIN 43 700
- Dimensions (W × H × D) ..... 96 × 72 × 130 mm
- Front cutout (W × H) ..... 91 [+1.0] × 67 [+0.7] mm

- Wiring ..... Screw-type terminals depending on connector 1.5 mm², 2.5 mm², or 4 mm²
- Recommended tightening torque ..... [1.5 mm² / 2.5 mm²] 0.5 Nm, [4 mm²] 0.6 Nm
  use 60/75 °C copper wire only
  use class 1 wire only or equivalent
- Weight ..... approx. 800 g

Protection ----------

- Protection system ..... IP42 from front with correct mounting
  IP54 from front with gasket (gasket: P/N 8923-1036)
  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
  (Option N not UL/cUL listed)
- Marine-Approval ..... GL

Appendix C.
Measured Quantities and Accuracy

Measuring value	Display/range	Accuracy	Note
Frequency			
f_{L1}, f_{L2}, f_{L3}	40.0 to 80.0 Hz	0.05 Hz	
Voltage			
V_{L1}, V_{L2}, V_{L3}, V_{L12}, V_{L23}, V_{L31}	0 to 520 V/0 to 65 kV	1 %	Accuracy depending on the configured transformer ratio
Current			
I_{L1}, I_{L2}, I_{L3}	0 to 9,999 A	1 %	Accuracy depending on the configured transformer ratio
Real power			
Total real actual power	-32.0 to 32.0 MW	2 %	Accuracy depending on the configured transformer ratio
Re-active power			
Actual value in L1, L2, L3	-32.0 to 32.0 Mvar	2 %	Accuracy depending on the configured transformer ratio
Apparent power			
Actual value in L1, L2, L3	0 to 45.0 MVA	2 %	Accuracy depending on the configured transformer ratio
Power factor (cos φ)			
Actual value (cos φ_{L1})	c0.00 to 1.00 to i0.00	1.5 °	-

Reference conditions: The data apply to the following reference conditions:

- Input voltage = sinusoidal rated voltage
- Input current = sinusoidal rated current
- Frequency = rated frequency ± 2 %
- Power supply = rated voltage ± 2 %
- Power factor cos φ = 1
- Ambient temperature 23 °C ± 2 K
- Warm-up period = 20 minutes.

Appendix D.
Interface Telegram

Communication Interface Addresses

Transmission Message

Number				Content (words)	Unit	Remark
3964	Modbus	CAN bus	Profibus			
00 01	**1** (02, 03)	**MUX=1, 1**	**0**	Telegram header	"302"	Telegram type
02 03	**2** (04, 05)	**MUX=1, 2**	**1**	Voltage L12	V	
04 05	**3** (06, 07)	**MUX=1, 3**	**2**	Voltage L23	V	
06 07	**4** (08, 09)	**MUX=2, 1**	**3**	Voltage L31	V	
08 09	**5** (10, 11)	**MUX=2, 2**	**4**	Voltage L1N	V	
10 11	**6** (12, 13)	**MUX=2, 3**	**5**	Voltage L2N	V	
12 13	**7** (14, 15)	**MUX=3, 1**	**6**	Voltage L3N	V	
14 15	**8** (16, 17)	**MUX=3, 2**	**7**	Frequency L12	Hz × 100	
16 17	**9** (18, 19)	**MUX=3, 3**	**8**	Current L1	A	
18 19	**10** (20, 21)	**MUX=4, 1**	**9**	Current L2	A	
20 21	**11** (22, 23)	**MUX=4, 2**	**10**	Current L3	A	
22 23	**12** (24, 25)	**MUX=4, 3**	**11**	Power factor (cosphi)	dim.less × 100	
24 25	**13** (26, 27)	**MUX=5, 1**	**12**	Real power	kW	
26 27	**14** (28, 29)	**MUX=5, 2**	**13**	Reactive power	kvar	
28 29	**15** (30, 31)	**MUX=5, 3**	**14**	Busbar voltage L12	V	
30 31	**16** (32, 33)	**MUX=6, 1**	**15**	Busbar voltage L12	Hz × 100	
32	**17** (34)	**MUX=6, 2**	**16**	Exponent	dim.less	VGN
33	**17** (35)	**MUX=6, 2**	**16**		dim.less	IGN
34	**18** (36)	**MUX=6, 3**	**17**	Exponent	dim.less	PGN/QGN
35	**18** (37)	**MUX=6, 3**	**17**		dim.less	VSS
36 37	**19** (38, 39)	**MUX=7, 1**	**18**	Generator real energy	kWh	High Word
38 39	**20** (40, 41)	**MUX=7, 2**	**19**			Low Word
40 41	**21** (42, 43)	**MUX=7, 3**	**20**	Internal alarms 1	Bit 15 = 1 \ Bit 14 = 0 /	Overfrequency level 2
					Bit 13 = 1 \ Bit 12 = 0 /	Underfrequency level 2
					Bit 11 = 1 \ Bit 10 = 0 /	Overvoltage level 2
					Bit 9 = 1 \ Bit 8 = 0 /	Overvoltage level 2
					Bit 7 = 1 \ Bit 6 = 0 /	Unbalanced load
					Bit 5 = 1 \ Bit 4 = 0 /	Overcurrent level 1
					Bit 3 = 1 \ Bit 2 = 0 /	Overload
				Note (example bit 15/14): 0/1 = alarm not triggered 1/0 = alarm triggered	Bit 1 = 1 \ Bit 0 = 0 /	Reverse/reduced power

Number				Content (words)	Unit	Remark
3964	Modbus	CAN bus	Profibus			
42 43	**22** (44, 45)	**MUX=8, 1**	**21**	Internal alarms 2	Bit 15 = 1 \ Bit 14 = 0 /	Overfrequency level 1
					Bit 13 = 1 \ Bit 12 = 0 /	Underfrequency level 1
					Bit 11 = 1 \ Bit 10 = 0 /	Overvoltage level 1
					Bit 9 = 1 \ Bit 8 = 0 /	Undervoltage level 1
					Bit 7 = 1 \ Bit 6 = 0 /	Overcurrent level 3
					Bit 5 = 1 \ Bit 4 = 0 /	df/dt alarm
					Bit 3 = 1 \ Bit 2 = 0 /	Asymmetry (voltage)
				Note (example bit 15/14):	Bit 1 = 1 \ Bit 0 = 0 /	Vector/phase jump
				0/1 = alarm not triggered		
				1/0 = alarm triggered		
44 45	**23** (46, 47)	**MUX=8, 2**	**22**	Internal alarms 3	Bit 15 = 1 \ Bit 14 = 0 /	Power factor level 1
					Bit 13 = 1 \ Bit 12 = 0 /	Power factor level 2
					Bit 11 = 1 \ Bit 10 = 0 /	Inductive reactive power
					Bit 9 = 1 \ Bit 8 = 0 /	Capacitive reactive power
					Bit 7 = 1 \ Bit 6 = 0 /	Positive real power surge
					Bit 5 = 1 \ Bit 4 = 0 /	Negative real power surge
					Bit 3 = 1 \ Bit 2 = 0 /	Overcurrent level 2
				Note (example bit 15/14):	Bit 1 = 1 \ Bit 0 = 0 /	Interface fault
				0/1 = alarm not triggered		
				1/0 = alarm triggered		
46 47	**24** (48, 49)	**MUX=8, 3**	**23**	Internal alarms 4	Bit 15 = 1 \ Bit 14 = 0 /	Busbar : Overfrequency
					Bit 13 = 1 \ Bit 12 = 0 /	Busbar : Underfrequency
					Bit 11 = 1 \ Bit 10 = 0 /	Busbar : Overvoltage
					Bit 9 = 1 \ Bit 8 = 0 /	Busbar : Undervoltage
					Bit 7 = 1 \ Bit 6 = 0 /	Internal
					Bit 5 = 1 \ Bit 4 = 0 /	Internal
					Bit 3 = 1 \ Bit 2 = 0 /	Internal
				Note (example bit 15/14):	Bit 1 = 1 \ Bit 0 = 0 /	Internal
				0/1 = alarm not triggered		
				1/0 = alarm triggered		

Number				Content (words)	Unit	Remark
3964	Modbus	CAN bus	Profibus			
48 49	**25** (50, 51)	**MUX=9, 1**	**24**	Internal alarms 5	Bit 15 = 1 \ Bit 14 = 0 /	Internal
					Bit 13 = 1 \ Bit 12 = 0 /	Internal
					Bit 11 = 1 \ Bit 10 = 0 /	Internal
					Bit 9 = 1 \ Bit 8 = 0 /	Internal
					Bit 7 = 1 \ Bit 6 = 0 /	Internal
					Bit 5 = 1 \ Bit 4 = 0 /	Internal
					Bit 3 = 1 \ Bit 2 = 0 /	Zero voltage
				Note (example bit 15/14):	Bit 1 = 1 \ Bit 0 = 0 /	Power level reached
				0/1 = alarm not triggered		
				1/0 = alarm triggered		
50 51	**26** (52, 53)	**MUX=9, 2**	**25**	Internal alarms 6	Bit 15 = 1 \ Bit 14 = 0 /	Ground fault Ve, level 1
					Bit 13 = 1 \ Bit 12 = 0 /	Internal
					Bit 11 = 1 \ Bit 10 = 0 /	Internal
					Bit 9 = 1 \ Bit 8 = 0 /	Internal
					Bit 7 = 1 \ Bit 6 = 0 /	Internal
					Bit 5 = 1 \ Bit 4 = 0 /	Ground fault Ve, level 2
					Bit 3 = 1 \ Bit 2 = 0 /	Internal
				Note (example bit 15/14):	Bit 1 = 1 \ Bit 0 = 0 /	Internal
				0/1 = alarm not triggered		
				1/0 = alarm triggered		
52 53	**27** (54, 55)	**MUX=9, 3**	**26**	Internal alarms 7	Bit 15 = 1 \ Bit 14 = 0 /	Internal
					Bit 13 = 1 \ Bit 12 = 0 /	Internal
					Bit 11 = 1 \ Bit 10 = 0 /	Inverse time-overcurrent
					Bit 9 = 1 \ Bit 8 = 0 /	Internal
					Bit 7 = 1 \ Bit 6 = 0 /	Internal
					Bit 5 = 1 \ Bit 4 = 0 /	Internal
					Bit 3 = 1 \ Bit 2 = 0 /	Internal
				Note (example bit 15/14):	Bit 1 = 1 \ Bit 0 = 0 /	Internal
				0/1 = alarm not triggered		
				1/0 = alarm triggered		

Receive Message

Number		Content (words)	Unit	Remark
3964	Modbus			
00 01	**1 (02, 03)**	Set point value active power $P_{Setpoint}$	kW	0 to 32000
02 03	**2 (04, 05)**	Set point value Power factor ($\varphi_{Setpoint}$)	Power factor × 100	-99 to 100 [1]
04 05	**3 (06, 07)**	Control word	Bit 15 = 1	Blocking of watchdog active [2]
			Bit 14 = 1	free
			Bit 13 = 1	free
			Bit 12 = 1	free
			Bit 11 = 1	free
			Bit 10 = 1	Release isolated operation [3]
			Bit 9 = 1	free
			Bit 8 = 1	Option R: Release power circuit breaker [4]
			Bit 7 = 1	free
			Bit 6 = 1	free
			Bit 5 = 1	free
			Bit 4 = 1	Acknowledge [5]
			Bit 3 = 1	Transmission watchdog bit 1 [6]
			Bit 2 = 1	Transmission watchdog bits 0 [6]
			Bit 1 = 1	free
			Bit 0 = 1	free
06 07	**4 (08, 09)**	Set point frequency $f_{Setpoint}$	Hz × 100	3200 to 6800 [7]
08 09	**5 (10, 11)**	Set point voltage $V_{Setpoint}$	V	0 to 480 [8]
10 11	**6 (12, 13)**	free		

[1] The transmitted number has a sign (When connected correctly - = capacitive, + = inductive; 100 means power factor = 1)
[2] This control bit is ignored, if the screen "Blocking via interface" is configured as "OFF".
[3] Corresponds to the discrete input "Release isolated operation" (terminal 73/74).
[4] Option R: Corresponds to the discrete input "Release CB" (terminal 30/31).
[5] Corresponds to the "Acknowledge" button.
[6] Here, a "00" must always be sent. If these bits are not configured as "00", the alarm "Interface" is sent after 15 seconds (only if the screen "Interface monitoring" is set to "ON").
[7] Example: 4856 = 48.56 Hz
[8] The voltage set point relates to the set secondary voltage.
For voltage transformers 10.0 kV/100 V a voltage set point value of 100 V must be set (corresponds to $V_{Setpoint}$ = 10.0 kV)

Description of the Data Format

NOTE

Certain addresses have two parts, the measured value and the exponent multiplier!

Voltage and current	0 to 9999 without sign	measured in [V, A], no exponent
Real power	0 to 9999 with sign	measured in [W]; data format: two's complement positive = positive power negative = negative power (reverse power)
Reactive power	0 to 9999 with sign	measured in [var]; data format: two's complement positive = inductive negative = capacitive
Frequency		measured in [Hz × 100]
Real energy	32 Bit	measured in [kWh]; data format: two's complement positive = exported real energy negative = imported real energy
Power factor (cos phi)	-99 to +100	measured in [cos phi × 100] positive = inductive/leading, generator over-excited negative = capacitive/lagging, generator under-excited

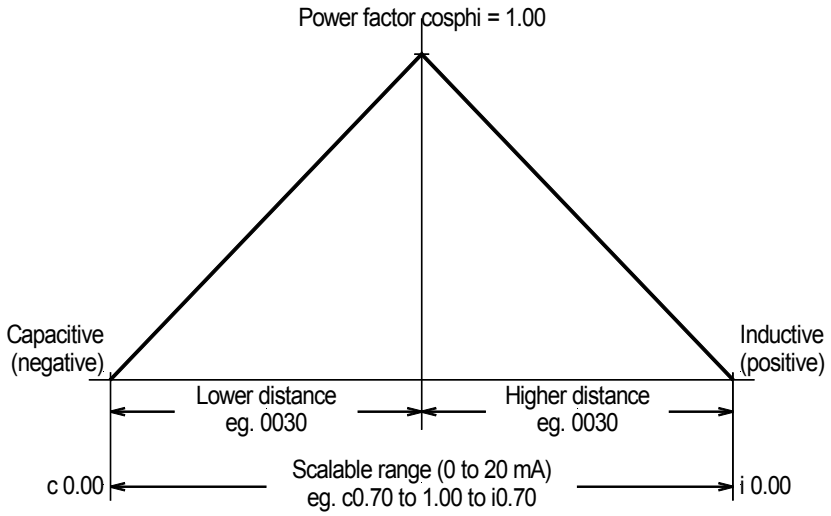


Figure 7-2: Interface, power factor scaling

Examples

V_{G12} = 103, exponent = 2

103×10^{2} [V] = 1,030 [V] = 10.3 kV

I_{G1} = 80, exponent = -1

80×10^{-1} [A] = 8.0 [A] = 8.0 A

P_{GN} = 123, exponent = 4

123×10^{4} [W] = 1,230,000 [W] = 1.23 MW

P_{GN} = 803, exponent = 2

803×10^{2} [W] = 80,300 [W] = 80.3 kW

f_{GN} = 5230

5230 [Hz × 100] = 52.30 [Hz] = 52.3 Hz

Power factor = 87

87 [Cos phi × 100] = 0.87 [Cos phi] = i0.87

Bit Change at Tripping of a Watchdog Function

If one of the watchdog functions (protective alarms) trips, the corresponding bits (for example bit 15/14 = over-frequency limit 2) will change from not tripped (= 0/1) to tripped (= 1/0).

Framework Data for the Interfaces

Framework Data for Procedure 3964 (TTY, RS-232, RS-485)

String length.....8 bit
Stop bit.....1 bit
Parity bit.....1 bit with even parity
Idle state.....This corresponds to the state log. "1" (20 mA with TTY)
Data format.....16 bit binary value
Transmission rate.....9,600 Baud.
Other baud rates on request. The records are transferred cyclically.

RK 512 interpreter procedure: See Siemens documentation on procedure 3,964.

Framework Data for Hardware Handshaking RTS/CTS (RS-232, RS-422)

String length.....8 bit
Stop bit.....1 bit
Parity bit.....1 bit with even parity
Idle state.....This corresponds to the state log. "1" (20 mA with TTY)
Data format.....16 bit binary value
Transmission rate.....9,600 Baud.
Other baud rates on request. The records are transferred cyclically.

Procedure: When the transmitter is ready for data transmission, it notifies the receiver of this by switching its control line RTS to "ON". The prerequisite of this is that no data are received (CTS = "OFF"). The receiver registers this status and indicates its readiness to receive by switching its RTS line to "ON". The transmitter can then begin transmitting when it detects this "ON" status on its CTS line. As soon as the receiver withdraws its RTS signal (RTS = "OFF"), the transmitter interrupts its transmission and waits until the receiver is ready to receive again. The initialization conflict (both subscribers set the RTS line simultaneously) and timeout (one subscriber waits in vain for a reply) must be taken into consideration.

Framework Data for Modbus RTU Slave

Transmitting protocol.....MOD bus RTU slave
Hardware.....Interface RS-485
Transmission rate.....adjustable
Slave address.....adjustable
Parity.....adjustable

A maximum of 10 words can be read or 4 words written with one command. Modbus function codes 03, 04, 06 and 16 are supported.

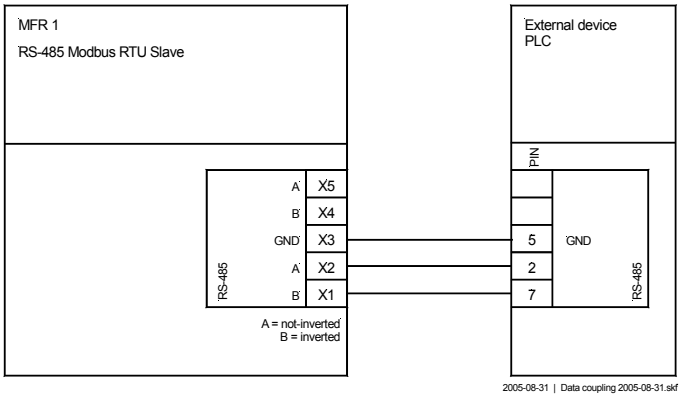


Figure 7–3: Interface - Modbus connection

Framework Data for CAN Bus

Transmitting protocol ..... CAN (CiA)
Hardware ..... CAN bus
Transmission rate..... adjustable
Special characteristic ..... Bt0 = 03, Bt1 = 1C

Every 200 ms a data telegram of 8 bytes is sent, which is structured as follows (all word variables are in the high byte / low byte format):

Transmission Data

ID..... Base ID sending + CAN number

Byte 1..... Multiplexer [1 to 9]
Byte 2..... always 221
Byte 3/4 ..... 1. data word (note table, no. 1), multiplexed (MUX = 1, 1)
Byte 5/6 ..... 2. data word (note table, no. 2), multiplexed (MUX = 1, 2)
Byte 7/8 ..... 3. data word (note table, no. 3), multiplexed (MUX = 1, 3)
etc.

Control Data (Option SB)

ID..... Base ID control + CAN number

A data telegram of 7 Bytes is expected, which is structured as follows (all word vari-ables are in the high byte / low byte format):

Byte 1..... Multiplexer
Byte 2/3 ..... 1. data word (note table, no. 1), multiplexed (MUX = 1, 1)
Byte 4/5 ..... 2. data word (note table, no. 2), multiplexed (MUX = 1, 2)
Byte 6/7 ..... 3. data word (note table, no. 3), multiplexed (MUX = 1, 3)
etc.

Configuration Data (Option SF)

ID..... ID configure (default value: 831)

No ID’s can be assigned twice in the system. This applies for all devices coupled to the bus system. Likewise all ID's set on the unit must be set to different values.

Procedure for base-ID transmission: All units available in the bus system are assigned to the same "Base ID transmission". The types of information are grouped in this way.

Example: The base ID transmission = 800 is used with all units. The individual ID's are assigned to the various unit numbers.

Unit number 1: ID = 801
Unit number 2: ID = 802
etc.

Procedure for base ID control: The same procedure applies for base-ID control. (Standard value 224)

Framework Data for Profibus DP

Receiving Range

Byte 0 and the following.....Telegram according to description

Example: .....No. 1 - Byte 0/1 = telegram header "302"
No. 2 - Byte 2/3 = voltage L12
No. 3 - Byte 4/5 = voltage L23
No. 4 - Byte 6/7 = voltage L31
etc.

Byte 185.....The bit 0 toggles every 2.5 seconds. This can be used for control if the interface still functions flawlessly.

Transmitting Range (Option SB)

Byte 0.....Block pre-selection (is not taken into account)
Byte 1.....The bit 0 is used as a watchdog. If monitoring is switched ON in the configuration screen, this bit must be toggle every 4 seconds. The unit monitors this and possibly triggers a fault and reinitializes the interface.
Byte 8/9.....Control word 1
Byte 10/11.....Control word 2
Byte 12/13.....Control word 3

Connection Example

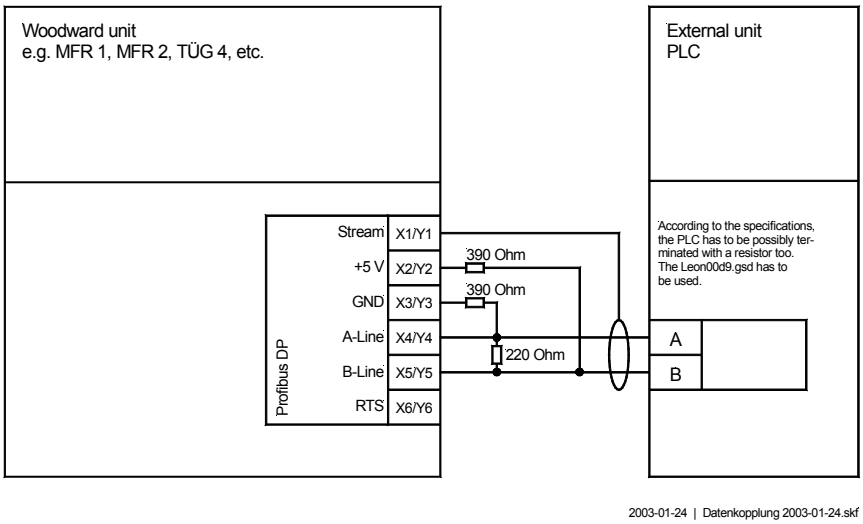


Figure 7-4: Interface, Profibus DP slave

Appendix E.
List of Parameters

Product number P/N _____ Rev _____

Version MFR 13 _____

Project _____

Serial number S/N _____ Date _____

Option	Parameter	Setting range	Default setting	Customer setting	
BASIC DATA					
	Software version	-	-		
	SPRACHE/LANGUAGE	German/English	English	☐ G ☐ E	☐ G ☐ E
	Enter code	0000 to 9999	-		
	Password Protection	ON/OFF	ON	☐ 1 ☐ 0	☐ 1 ☐ 0
	Define level 1 code	0000 to 9999	0001		
	Define level 2 code	0000 to 9999	0002		
	Direct parametr.	YES/NO	NO	☐ Y ☐ N	☐ Y ☐ N
MEASUREMENT					
	Volt.-Measuring	Phase to phase / Phase-neutral	Phase-neutral	☐ pn ☐ pp	☐ pn ☐ pp
	Volt.transformer secondary	50 to 125/50 to 480 V	100/400 V		
	Volt.transformer primary	00.100 to 65.000 kV	00.400 kV		
YC	Volt.transformer sec.(GN)	50 to 125/50 to 480 V	100/400 V		
..	Volt.transformer prim(GN)	00.100 to 65.000 kV	00.400 kV		
..	Volt.transformer sec.(MN)	50 to 125/50 to 480 V	100/400 V		
YC	Volt.transformer prim(MN)	00.100 to 65.000 kV	00.400 kV		
	Current transf.	1,999/{x} A	1,000/{x} A		
	Rated voltage	5 to 125/10 to 480 V	100/400 V		
	Rated frequency	40.0 to 70.0 Hz	50.0 Hz		
	Rated current	1 to 9,999 A	1,000 A		
	Rated power	5 to 32,000 kW	500 kW		
	Power measuring	one-phase/three-phase	three-phase	☐ s ☐ t	☐ s ☐ t
CONTROL FUNCTIONS					
YC	Synchronizing	ON/OFF	ON	☐ 1 ☐ 0	☐ 1 ☐ 0
..	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 dV max	0.1 to 15.0 %	6.0 %		
..	Synchronization Max phase <	1 to 60°	2°		
	Synchronization Time pulse>	50 to 250 ms	200 ms		
YC	Gen.circ.breaker Pick-up t.	40 to 300 ms	80 ms		

Option	Parameter		Setting range	Default setting	Customer setting	
PROTECTION						
	Volt. Monitoring		Phase-neutral / Phase to phase	Phase to phase	☐ pn ☐ pp	☐ pn ☐ pp
U	Overvoltage	Monitoring	ON/OFF	ON	☐ 1 ☐ 0	☐ 1 ☐ 0
..	Overvoltage 1	V(ph-ph)>	20 to 130 / 520 / 900 V	110/440/769 V		
..		(Phase-N)>	10 to 75 / 300 V / 20 to 900 V	64/254/444 V		
..	Overvoltage 1	Delay	0.02 to 99.98 s	0.10 s		
..	Overvoltage 2	V(ph-ph)>	20 to 130 / 520 / 900 V	120/480/839 V		
..		(Phase-N)>	10 to 75 / 300 V / 20 to 900 V	64/254/485 V		
..	Overvoltage 2	Delay	0.02 to 99.98 s	0.04		
..	Overvoltage	Hysteresis	0 to 99 V	1/4 V		
..	Undervoltage	Monitoring	ON/OFF	ON	☐ 1 ☐ 0	☐ 1 ☐ 0
..	Undervoltage 1	V(ph-ph)<	20 to 130 / 520 / 900 V	90/360/629 V		
..		(Phase-N)<	10 to 75 / 300 V / 20 to 900 V	51/207/363 V		
..	Undervoltage 1	Delay	0.02 to 99.98 s	0.10 s		
..	Undervoltage 2	V(ph-ph)<	20 to 130 / 520 / 900 V	80/320/559 V		
..		(Phase-N)<	10 to 75 / 300 V / 20 to 900 V	46/184/323 V		
..	Undervoltage 2	Delay	0.02 to 99.98 s	0.04 s		
U	Undervoltage	Hysteresis	0 to 99 V	1/4/8 V		
UN	Zero-voltage	Monitoring	ON/OFF	ON	☐ 1 ☐ 0	☐ 1 ☐ 0
UN/ +YC	Zero-voltage		Busbar 1ph / Generator 3ph	Generator 3ph	☐ B1 ☐ G3	☐ B1 ☐ G3
UN	Zero-voltage	V(ph-ph)<	8 to 150 V	8 V		
..	Zero-voltage	Delay	0.02 to 99.98 s	0.25 s		
..	Zero-voltage	Hysteresis	0 to 99 V	1/4/8 V		
..	Release delay	Zerovolt.	0.02 to 99.98 s	0.04 s		
UN	Zero-voltage	Monitoring	ON/OFF	ON	☐ 1 ☐ 0	☐ 1 ☐ 0
U	Asymmetry-	Monitoring	ON/OFF	ON	☐ 1 ☐ 0	☐ 1 ☐ 0
..	Asymmetry	Response v.	0 to 99 V	10/40/69 V		
..	Asymmetry	Delay	0.02 to 99.98 s	2.00 s		
..	Asymmetry	Hysteresis	0 to 99 V	1/4/6 V		
..	Overfrequency-	Monitoring	ON/OFF	ON	☐ 1 ☐ 0	☐ 1 ☐ 0
..	Overfrequency 1	f>	40.00 to 80.00 Hz	50.2 Hz		
..	Overfrequency 1	Delay	0,02 to 99.98 s	0.10 s		
..	Overfrequency 2	f>	40.00 to 80.00 Hz	51.0 Hz		
..	Overfrequency 2	Delay	0.02 to 99.98 s	0.04 s		
..	Overfrequency	Hysteresis	0.01 to 9.99 Hz	0.05 Hz		
..	Underfrequency-	Monitoring	ON/OFF	ON	☐ 1 ☐ 0	☐ 1 ☐ 0
..	Underfrequency 1	f<	40.00 to 80.00 Hz	49.8 Hz		
..	Underfrequency 1	Delay	0.02 to 99.98 s	0.10 s		
..	Underfrequency 2	f<	40.00 to 80.00 Hz	49.0 Hz		
..	Underfrequency 2	Delay	0.02 to 99.98 s	0.04 s		
U	Underfrequency	Hysteresis	0.01 to 9.99 Hz	0.05 Hz		
V	Phase jump	monitoring	ON/OFF	ON	☐ 1 ☐ 0	☐ 1 ☐ 0
..	Phase jump mon.		one/three-phase / 3 phase only	3 phase only	☐ 1/3 ☐ 3	☐ 1/3 ☐ 3
..	Phase-jump value	(one phase)	3 to 90 °	30 °		
V	Phase-jump value	(3-phase)	3 to 90 °	8 °		
D	df/dt-	Monitoring	ON/OFF	ON	☐ 1 ☐ 0	☐ 1 ☐ 0
..	df/dt	Response>	1.0 to 9.9 Hz/s	2.5 Hz/s		
D	df/dt	Delay	0.1 to 9.9 s	0.1 s		
IS/IZ	Overcurrent	Monitoring	ON/OFF	ON	☐ 1 ☐ 0	☐ 1 ☐ 0
..	Overcurrent 1	I>	0 to 300 %	120 %		
..	Overcurrent 1	Delay	0.02 to 99.98 s	0.1 s		
..	Overcurrent 2	I>	0 to 300 %	160 %		
..	Overcurrent 2	Delay	0.02 to 99.98 s	0.04 s		
..	Overcurrent 3	I>	0 to 300 %			
..	Overcurrent 3	Delay	0.02 to 99.98 s			
IS/IZ	Overcurrent	Hysteresis	1 to 300 %	5 %		

Op-tion	Parameter	Setting range	Default setting	Customer setting	
PROTECTION					
IA	Inv.time ov.curr monitoring	ON/OFF	ON	☐ 1 ☐ 0	☐ 1 ☐ 0
..	Inv.time char.	Normal / High / Extreme	Extreme		
..	Inv.time ov.curr Tp=	0.01 to 1.99 s	0.10 s		
..	Inv.time ov curr Ip=	0.1 to 3.0*In	1.0 * In		
IA	Inv.time ov.curr I start=	1 to 3.00*In	1.00 * In		
IU	Inv.time ov.cur. V-restr.	ON/OFF	ON	☐ 1 ☐ 0	☐ 1 ☐ 0
IU	Inv.time ov.curr Knee curve	10 to 99 %	20 %		
IS	Earth current monitoring	ON/OFF	ON	☐ 1 ☐ 0	☐ 1 ☐ 0
..	Earth current 1 Response	10 to 300 %	120 %		
..	Earth current 1 Delay.	0.02 to 99.98 s	0.1 s		
..	Earth current 2 Response	10 to 300 %	160 %		
..	Earth current 2 Delay	0.02 to 99.98 s	0.04 s		
IS	Earth current Hysteresis	0 to 300 %	5 %		
PM	Overload Monitoring	ON/OFF	ON	☐ 1 ☐ 0	☐ 1 ☐ 0
..	Overload Response v.	0 to 150 %	120 %		
..	Overload Delay	0 to 300 s	20 s		
..	Overload Hysteresis	1 to 99 %	2 %		
..	Reverse/min.pow. Monitoring	ON/OFF	ON	☐ 1 ☐ 0	☐ 1 ☐ 0
..	Reverse/min.pow.	-99 to 99 %	-10 %		
..	Reverse/min.pow. Delay	0.02 to 99.98 s	3.0 s		
PM	Reverse/min.pow. Hysteresis	1 to 99 %	2 %		
PS	Unbalanced load Monitoring	ON/OFF	ON	☐ 1 ☐ 0	☐ 1 ☐ 0
..	Unbalanced load Response v.	0 to 100 %	20 %		
..	Unbalanced load Delay	0.02 to 99.98 s	0.25 s		
PS	Unbalanced load Hysteresis	1 to 20 %	5 %		
ZC	cos-phi Moniotring	ON/OFF	ON	☐ 1 ☐ 0	☐ 1 ☐ 0
..	cos-phi 1 Response v.	c0.01 to 1.00 to i0.01	i0.80		
..	cos-phi 1 Delay	0.02 to 99.98 s	0.10 s		
..	cos-phi 2 Response v.	c0.01 to 1.00 to i0.01	c0.80		
..	cos-phi 2 Delay	0.02 to 99.98 s	0.10 s		
ZC	cos-phi mon. Hysteresis	0.01 to 0.50	0.01		
ZQ	Reactive power Monitoring	ON/OFF	ON	☐ 1 ☐ 0	☐ 1 ☐ 0
..	Cap. react. pow. Response v.	0 to 100 %	30 %		
..	Cap. react. pow. Delay	0.02 to 99.98 s	0.10 s		
..	Ind. react. pow. Response v.	0 to 100 %	30 %		
..	Ind. react. pow. Delay	0.02 to 99.98 s	0.10 s		
ZQ	React. pow. mon. Hysteresis	1 to 20 %	2 %		
ZW	Act. power shift Monitoring	ON/OFF	ON	☐ 1 ☐ 0	☐ 1 ☐ 0
ZW	Release value Power shift	10 to 80 %	10 %		
IV	Earth fault monitoring	ON/OFF	ON	☐ 1 ☐ 0	☐ 1 ☐ 0
...	Earth fault Ve Response v.	3 to 100 %	0.50 %		
...	Earth fault Ve> Delay	0.02 to 99.98 s	0.1 s		
...	Earth fault Ve>> Response v.	3 to 100 %	1.00 %		
...	Earth fault Ve>> Delay	0.02 to 99.98 s	0.04 s		
IV	Release delay Earth f.v.	00.00 s			

Option	Parameter	Setting range	Default setting	Customer setting	
RELAYS					
	External Clearing	ON/OFF	OFF	☐ 1 ☐ 0	☐ 1 ☐ 0
	Auto-clearing relays	ON/OFF	OFF	☐ 1 ☐ 0	☐ 1 ☐ 0
U	Release delay Overvoltage	0.02 to 99.98 s	0.10 s		
U	Release delay Undervoltage	0.02 to 99.98 s	0.10 s		
U	Release delay Asymmetry	0.02 to 99.98 s	0.10 s		
U	Release delay Overfreq.	0.02 to 99.98 s	0.10 s		
U	Release delay Underfrq.	0.02 to 99.98 s	0.10 s		
V	Phase sh. Delay	0.02 to 99.98 s	0.20 s		
D	df/dt Delay	0.02 to 99.98 s	0.20 s		
IZ	Release delay Overcurr.	0.02 to 99.98 s	0.20 s		
IS	Release delay Earth F.	0.02 to 99.98 s	0.20 s		
IV	Displac.Ue Delay	0.02 to 99.98 s	0.20 s		
PW	Load shift Delay	0.02 to 99.98 s	0.20 s		
ZC	cosphi 1 Delay	0.02 to 99.98 s	0.10 s		
UC	cosphi 2 Delay	0.02 to 99.98 s	0.10 s		
PM	Release delay Overload	0.02 to 99.98 s	0.10 s		
PM	Release delay Rev.Power	0.02 to 99.98 s	0.10 s		
PS	Release delay Unb. Load	0.02 to 99.98 s	0.10 s		
ZQ	Release delay react.cap.	0.02 to 99.98 s	0.10 s		
ZQ	Release delay react.ind.	0.02 to 99.98 s	0.10 s		
	Auto-clearing Display	ON/OFF	OFF	☐ 1 ☐ 0	☐ 1 ☐ 0
	Clearing display after	1 to 99 s	1 s		
	Change relay- allocation	YES/NO	NO	☐ Y ☐ N	☐ Y ☐ N
YC	Funct. relay 12	E/R	RE		
	Funct. relay 123	E/R	REE		
R	Funct. relay 45	E/R	EE		
R	Funct. relay 678	E/R	EEE		
R+YC	Funct. relay 67	E/R	EE		
U	Overvoltage 1 to relay	0 to 4/8	0002		
U	Overvoltage 2 to relay	0 to 4/8	0002		
U	Undervoltage 1 to relay	0 to 4/8	0002		
U	Undervoltage 2 to relay	0 to 4/8	0002		
UN	Zero-voltage to relay	0 to 4/8	0002		
U	Asymmetry to relay	0 to 4/8	0002		
U	Overfrequency 1 to relay	0 to 4/8	0003		
U	Overfrequency 2 to relay	0 to 4/8	0003		
U	Underfrequency 1 to relay	0 to 4/8	0003		
U	Underfrequency 2 to relay	0 to 4/8	0003		
V	Phase jmp. to relay	0 to 4/8	0003		
D	Fault df/dt to relay	0 to 4/8	0003		
IZ	Overcurrent1 to relay	0 to 4/8	0002		
IZ	Overcurrent2 to relay	0 to 4/8	0002		
IZ	Overcurrent3 to relay	0 to 4/8	0002		
IU	Current-Inv. to relay	0 to 4/8	0002		
IS	Earth Fault 1 to relay	0 to 4/8	0003		
IS	Earth Fault 2 to relay	0 to 4/8	0003		
IV	Displac.volt. to relay	0 to 4/8	0003		
PM	Overload to relay	0 to 4/8	0003		
PM	Reverse/min.pow. to relay	0 to 4/8	0003		
PS	Unbalanced Load to relay	0 to 4/8	0002		
ZQ	Ind. react.pow. to relay	0 to 4/8	0002		
ZQ	Neg. react.pow. to relay	0 to 4/8	0002		
ZW	Pow.shift- to relay	0 to 4/8	0002		
ZW	Pow.shift+ to relay	0 to 4/8	0002		
ZC	cosphi 1 to relay	0 to 4/8	0002		
ZC	cosphi 2 to relay	0 to 4/8	0002		
IV	Earth Ve> to relay	0 to 4/8	0002		
IV	Earth Ve>> to relay	0 to 4/8	0002		
	Interface Fault to relay	0 to 4/8	0002		

Op-tion	Parameter	Setting range	Default setting	Customer setting	
PULSE OUTPUT					
M	**Pulse output p.duration**	0.04 to 1.00 s	0.10 s		
..	**Pulse output Logic**	positive/negative	negative		
..	**Active energy Pulse/kWh**	0.10 to 150.00	1.00		
M	**RESET kWh**	ON/ON/OFF	OFF	☐ 1 ☐ 0	☐ 1 ☐ 0
ANALOG OUTPUTS					
A2/3/6 A1/4/8	**Analog output 1**	OFF -20 to +20mA 0 to 20 mA 4 to 20 mA	-20 to +20mA	☐ AUS ☐ -/+20mA ☐ 0-20mA ☐ 4-20mA	☐ AUS ☐ -/+20mA ☐ 0-20mA ☐ 4-20mA
		OFF -10 to +10 V 0 to 10 V	-10 to +10V	☐ AUS ☐ -/+10V ☐ 0-10V	☐ AUS ☐ -/+10V ☐ 0-10V
..	**Analog output 1**	see table at the end of the list of parameters	Active power		
A2/3/6	**Analog output**		0 kW		
A1/4/8	**Analog output**		500 kW		
A3/6 A4/8	**Analog output 2**	OFF -20 to +20mA 0 to 20 mA 4 to 20 mA	-20 to +20mA	☐ AUS ☐ -/+20mA ☐ 0-20mA ☐ 4-20mA	☐ AUS ☐ -/+20mA ☐ 0-20mA ☐ 4-20mA
		OFF -10 to +10 V 0 to 10 V	-10 to +10V	☐ AUS ☐ -/+10V ☐ 0-10V	☐ AUS ☐ -/+10V ☐ 0-10V
..	**Analog output 2**	see table at the end of the list of parameters	cosphi		
A3/6	**Analog output**		c0.50		
A4/8	**Analog output**		i0.50		
A3/6 A4/8	**Analog output 3**	OFF -20 to +20mA 0 to 20 mA 4 to 20 mA	-20 to +20mA	☐ AUS ☐ -/+20mA ☐ 0-20mA ☐ 4-20mA	☐ AUS ☐ -/+20mA ☐ 0-20mA ☐ 4-20mA
		OFF -10 to +10 V 0 to 10 V	-10 to +10V	☐ AUS ☐ -/+10V ☐ 0-10V	☐ AUS ☐ -/+10V ☐ 0-10V
..	**Analog output 3**	see table at the end of the list of parameters	I L1		
A3/6	**Analog output**		0 A		
A4/8	**Analog output**		1,000 A		
A4/6/8	**Analog output 4**	OFF -20 to +20mA 0 to 20 mA 4 to 20 mA	-20 to +20mA	☐ AUS ☐ -/+20mA ☐ 0-20mA ☐ 4-20mA	☐ AUS ☐ -/+20mA ☐ 0-20mA ☐ 4-20mA
		OFF -10 to +10 V 0 to 10 V	-10 to +10V	☐ AUS ☐ -/+10V ☐ 0-10V	☐ AUS ☐ -/+10V ☐ 0-10V
..	**Analog output 4**	see table at the end of the list of parameters	I L2		
..	**Analog output**		0 A		
A4/6/8	**Analog output**		1,000 A		
A6/8	**Analog output 5**	OFF -20 to +20mA 0 to 20 mA 4 to 20 mA	-20 to +20mA	☐ AUS ☐ -/+20mA ☐ 0-20mA ☐ 4-20mA	☐ AUS ☐ -/+20mA ☐ 0-20mA ☐ 4-20mA
		OFF -10 to +10 V 0 to 10 V	-10 to +10V	☐ AUS ☐ -/+10V ☐ 0-10V	☐ AUS ☐ -/+10V ☐ 0-10V
..	**Analog output 5**	see table at the end of the list of parameters	I L3		
..	**Analog output**		0 A		
A6/8	**Analog output**		1,000 A		

Op-tion	Parameter	Setting range	Default setting	Customer setting	
ANALOG OUTPUTS					
A6/8	**Analog output 6**	OFF -20 to +20mA 0 to 20 mA 4 to 20 mA	-20 to +20mA	☐ AUS ☐ -/+20mA ☐ 0-20mA ☐ 4-20mA	☐ AUS ☐ -/+20mA ☐ 0-20mA ☐ 4-20mA
..		OFF -10 to +10 V 0 to 10 V	-10 to +10V	☐ AUS ☐ -/+10V ☐ 0-10V	☐ AUS ☐ -/+10V ☐ 0-10V
..	**Analog output 6**	see table at the end of the list of parameters	Frequency		
..	**Analog output**		45.00 Hz		
A6/8	**Analog output**		55.00 Hz		
A8	**Analog output 7**	OFF -20 to +20mA 0 to 20 mA 4 to 20 mA	-20 to +20mA	☐ AUS ☐ -/+20mA ☐ 0-20mA ☐ 4-20mA	☐ AUS ☐ -/+20mA ☐ 0-20mA ☐ 4-20mA
..		OFF -10 to +10 V 0 to 10 V	-10 to +10V	☐ AUS ☐ -/+10V ☐ 0-10V	☐ AUS ☐ -/+10V ☐ 0-10V
..	**Analog output 7**	see table at the end of the list of parameters	Reactive power		
..	**Analog output**		0 kvar		
A8	**Analog output**		500 kvar		
A8	**Analog output 8**	OFF -20 to +20mA 0 to 20 mA 4 to 20 mA	-20 to +20mA	☐ AUS ☐ -/+20mA ☐ 0-20mA ☐ 4-20mA	☐ AUS ☐ -/+20mA ☐ 0-20mA ☐ 4-20mA
..		OFF -10 to +10 V 0 to 10 V	-10 to +10V	☐ AUS ☐ -/+10V ☐ 0-10V	☐ AUS ☐ -/+10V ☐ 0-10V
..	**Analog output 8**	see table at the end of the list of parameters	Apparent power		
..	**Analog output**		0 kVA		
A8	**Analog output**		500 kVA		
INTERFACE					
SU/SB	**Data block RK512**	0 to 255	0		
..	**Data word RK512**	0 to 255	0		
..	**Device number Profibus**	0 to 126	1		
..	**Device number MOD-Bus**	0 to 255	1		
..	**Baudrate**	1,200 / 2,400 / 4,800 / 9,600 / 19,200 Baud	9.600 Baud		
..	**Parity**	none/even/odd	none		
..	**Stopbits**	one/two	one		
..	**Delay to send MOD-Bus**	0.2 to 50.0 ms	0.0 ms		
..	**Device number CAN-Bus**	1..8	1		
..	**Baudrate**	125 / 250 / 500 kBaud	125 kBaud		
..	**Base-ID (send)**	0 to 2,015	224		
SU/SB	**Base-ID (remote)**	0 to 2,015	831		
SB	**Serial control**	ON/OFF	ON	☐ 1 ☐ 0	☐ 1 ☐ 0
..	**Serial interface Monitoring**	ON/OFF	ON	☐ 1 ☐ 0	☐ 1 ☐ 0
..	**Interface fault to relay**	0 to 4/8	0003		
SB	**Inhibit via Interface**	ON/OFF	ON	☐ 1 ☐ 0	☐ 1 ☐ 0

Value	Lower and upper setting value	
	0 V, -10 V 0 mA, 4 mA, -20 mA	10 V, 20 mA
Vol 1	0 to 65,000 V	
Vol 2	0 to 65,000 V	
Vol 3	0 to 65,000 V	
Vol ph-N AV	0 to 65,000 V	
Vol ph-N max	0 to 65,000 V	
Vol ph-N min	0 to 65,000 V	
Vol 1-2	0 to 65,000 V	
Vol 2-3	0 to 65,000 V	
Vol 3-1	0 to 65,000 V	
Vol ph-ph AV	0 to 65,000 V	
Vol ph-ph max	0 to 65,000 V	
Vol ph-ph min	0 to 65,000 V	
Frequency	40.00 to 80.00 Hz	
Current L1	0 to 9,999 A	
Current L2	0 to 9,999 A	
Current L3	0 to 9,999 A	
Current AV	0 to 9,999 A	
Current max	0 to 9,999 A	
Current min	0 to 9,999 A	
Direct. Cur 1	-9,999 to 9,999 A	
Direct. Cur 2	-9,999 to 9,999 A	
Direct. Cur 3	-9,999 to 9,999 A	
Dir. Current AV	-9,999 to 9,999 A	
Dir. Current max	-9,999 to 9,999 A	
Dir. Current min	-9,999 to 9,999 A	
Active power	-32,000 to 32,000 kW	
Reactive power	-32,000 to 32,000 kvar	
Apparent power	0 to 32,000 kVA	
cosphi	i0.01 to 1.00 to c0.01	

[1] ··· The sign of the current values is defined by the polarity of the active component.

Table 7-1: Analog outputs, table of values

Appendix F.
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 (refer to "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 (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 (711) 789 54-0 (8.00 - 16.30 German time)
Fax: +49 (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 13 _____

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.

Woodward GmbH
Handwerkstrasse 29 - 70565 Stuttgart - Germany
Phone +49 (711) 789 54-0 • Fax +49 (711) 789 54-100
stgt-info@woodward.com

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).

2007/7/Stuttgart