37354A

MFR 15 Packages
Protection Relay & Control

Manual
Version 3.1xxx

Manual 37354A

WARNING

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

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

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

CAUTION

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

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

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

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Important definitions

WARNING

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

CAUTION

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

NOTE

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

Revision History

Rev.	Date	Editor	Changes
NEW	06-03-02	TP	Release based on 37143A
A	07-07-17	TP	Minor corrections

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Illustrations

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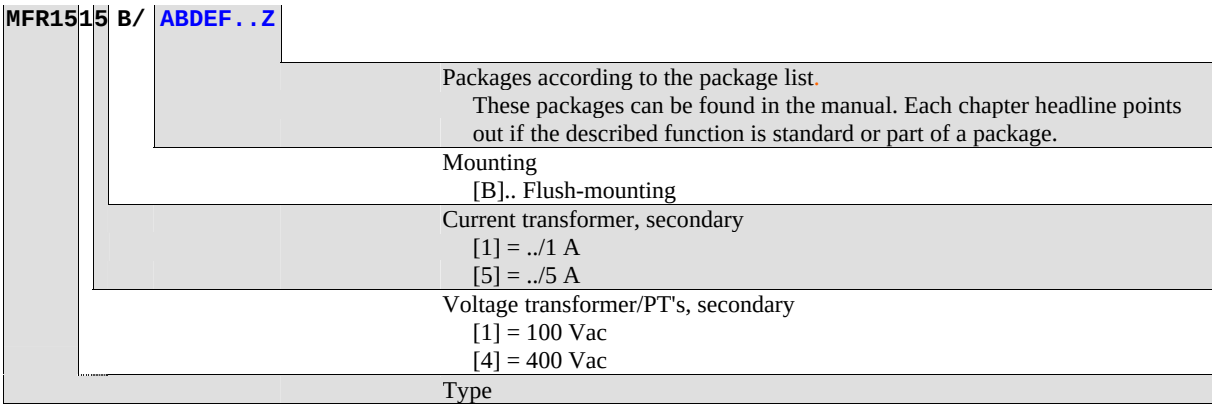
Chapter 1.
General Information

Introduction

The MFR 15 model combines a synchronizer, load (kW) and power factor (cosphi) control via discrete outputs, and generator protection and controller into one unit. The unit functionality is dependent upon the individual package selected.

The detailed model description for the MFR 15 reads as follows:



Examples:

- MFR1541B/SYN (flush mounted, standard unit with 400 Vac PT and ../1 A CT inputs with SYN Package [load sharing via analog line])
- MFR1515B/SYN-I (flush mounted, standard unit with 100 Vac PT and ../5 A CT inputs with SYN-I Package [load sharing via analog line, Interface RS-485/Modbus RTU Slave])

Measurement Value Logging

Voltage

Voltage is displayed as three-phase r.m.s measurement of the phase-neutral and/or phase-phase voltages. Single-phase r.m.s. measurement is utilized for 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 75):

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

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]

Active power

The active load 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 (cos φ)

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.

Package Functional Descriptions

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

Function		Package SY	Package SYN	Package SYN-I
General functions				
2 freely configurable relay outputs (change-over contacts)		✓	✓	✓
1 ready for operation relay output (normally open contact)		✓	✓	✓
Discrete input for blocking of protective functions or remote acknowledgment		✓	✓	✓
Password system		✓	✓	✓
3 Analog outputs - 20/0/4 to +20 mA		✓	✓	
Open-collector pulse output for kWh		✓	✓	
Interface, bi-directional				✓[#]
4-digit maximum control inputs		✓	✓	✓
Protective functions				
Three-phase over/under voltage monitoring (2 levels)	V>, V<	✓	✓	✓
Three-phase over/under frequency monitoring (2 levels)	f>, f<	✓	✓	✓
Voltage asymmetry monitoring	Vas>	✓	✓	✓
Overload monitoring	P>	✓	✓	✓
Reverse/reduced power monitoring	-P<, P<	✓	✓	✓
Unbalanced load monitoring	Ias>	✓	✓	✓
Reactive power monitoring (Loss of excitation monitoring)	-Q<, Q>	✓	✓	✓
Independent time-overcurrent monitoring	I>, I>>, I>>>	✓	✓	✓
Control / synchronization functions				
Synchronization of a power circuit breaker with voltage and frequency balancing		✓	✓	✓
Closing to a de-energized busbar (dead bus start) with a separate enable signal		✓	✓	✓
Controlling constant voltage and frequency for an isolated system		✓	✓	✓
Constant active-power controlling		✓	✓	✓
Power factor (cosphi) controlling		✓	✓	✓
Real power sharing			✓	✓
Analog input 0/4 to 20 mA for external set point		✓	✓	✓

[#] = 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

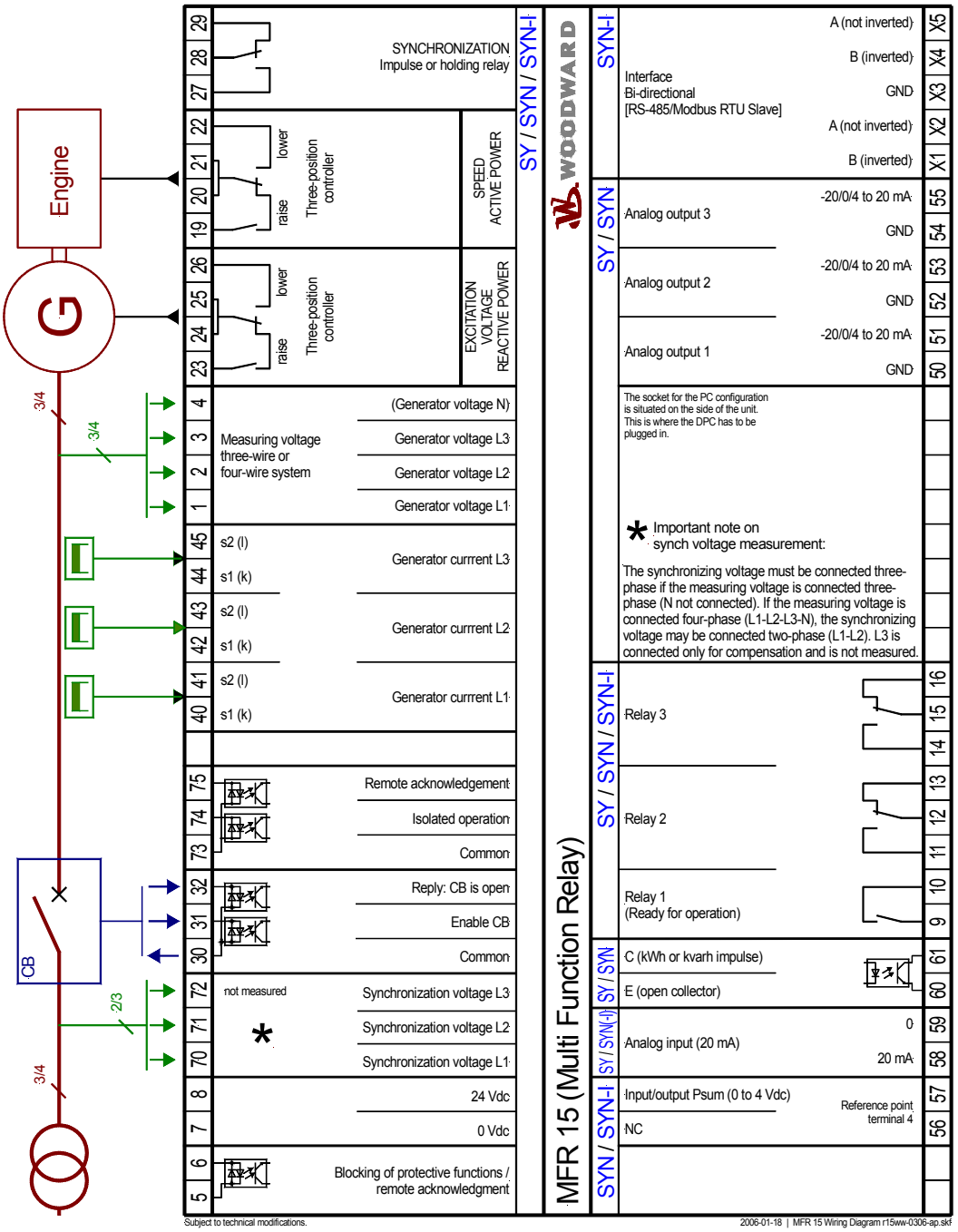


Figure 3-1: Wiring diagram

WARNING

All technical data and ratings indicated in this chapter are not definite! Only the values indicated under Technical Data on page 75 are valid!

CAUTION

A circuit breaker must be located 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

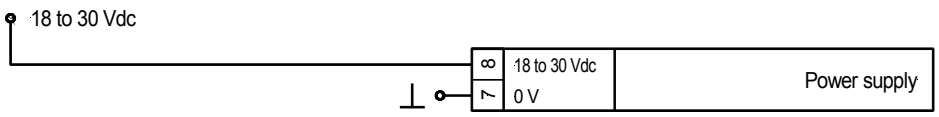


Figure 3-2: Power supply

Terminal	Description	A_{max}
Standard		
8	18 to 30 Vdc	2.5 mm²
7	0 V reference point	2.5 mm²

Measuring Inputs

Voltage

Generator Voltage

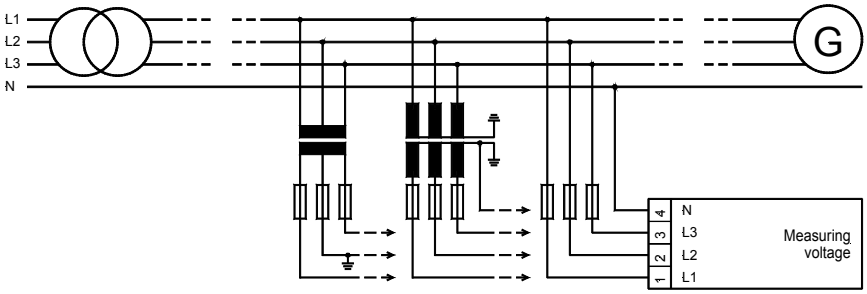


Figure 3-3: Measuring inputs - generator voltage

Terminal	Measurement	Description	A_{max}
1	400V direct or via transf. ../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/transf.	2.5 mm²

Synchronizing Voltage

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.

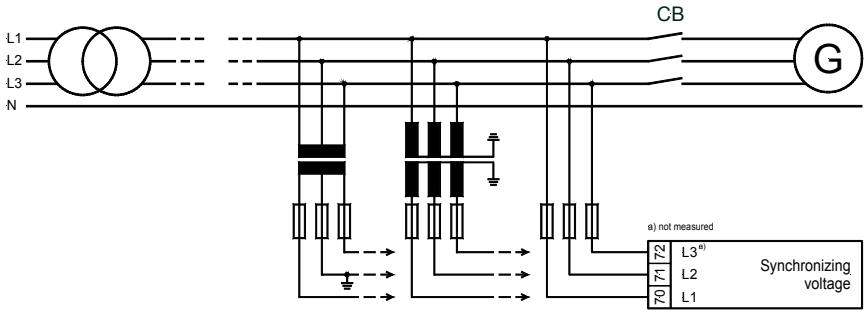


Figure 3-4: Measuring inputs - synchronizing voltage

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

Current

WARNING

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

NOTE

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

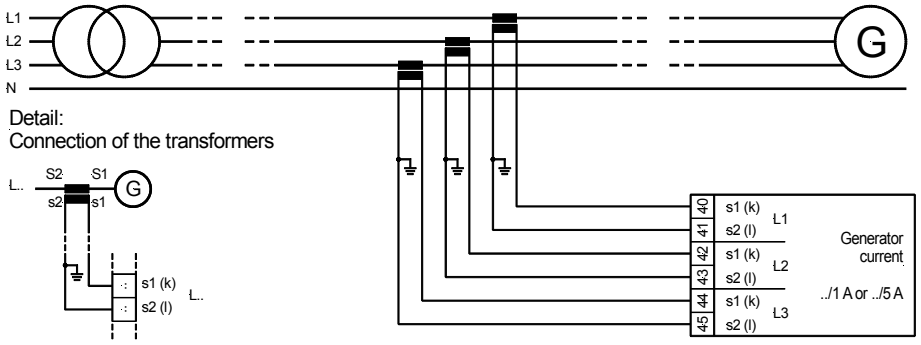


Figure 3-5: Measuring inputs - current

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

Auxiliary and Control Inputs

Discrete Inputs

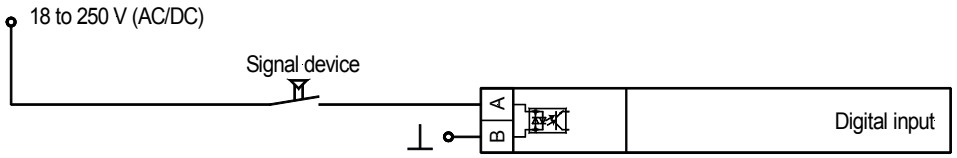
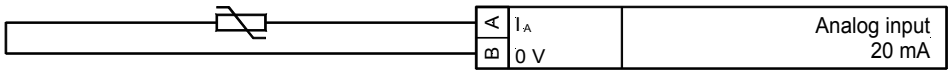


Figure 3-6: Discrete inputs

Terminal	Associated common	Description (according to DIN 40 719 Part 3, 5.8.3)	A_{max}
A	***B***		
5	6	Blocking of protective functions / remote acknowledgement	2.5 mm²
31	30	Enable power circuit breaker	2.5 mm²
32		Generator power circuit breaker is open	2.5 mm²
74	73	Isolated operation	2.5 mm²
75		Remote acknowledgement	2.5 mm²

Analog Inputs (Packages SY & SYN)



Terminal		Description	A_{max}
A I	**B** 0 V		
58	59	Analog input 0 to 20 mA for the power set point value specification	2.5 mm²
57	-	Input/output P-sum for the power distribution (Reference point is terminal 4)	2.5 mm²

Auxiliary and Control Outputs

Relay Outputs

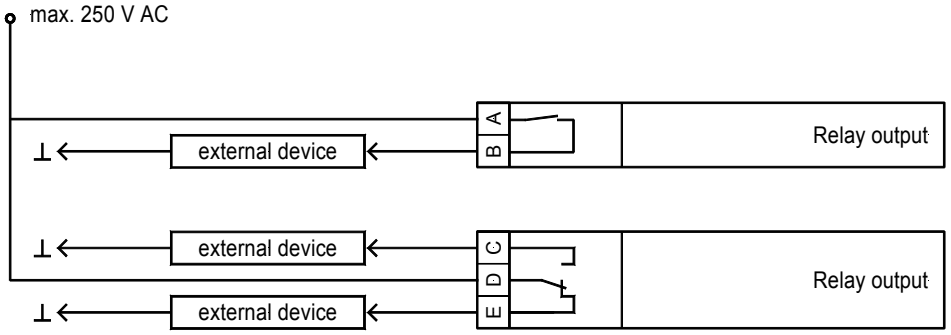


Figure 3-7: Relay outputs

Terminal			Description	
Make-contact				A_{max}
main	make			
A	***B***			
9	10		Relay 1 (ready for operation)	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
27	28	29	Synchronization (pulse/holding relay)	2.5 mm²

Pulse Output (Packages SY & SYN)

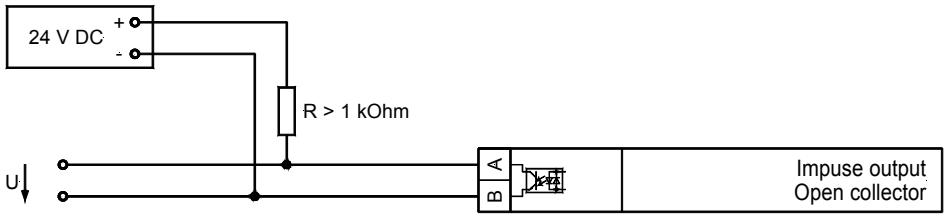


Figure 3-8: Pulse output

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

Analog Outputs (Packages SY & SYN)

NOTE

All 20 mA outputs are isolated from each other.

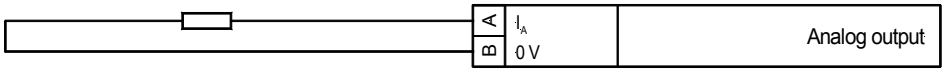


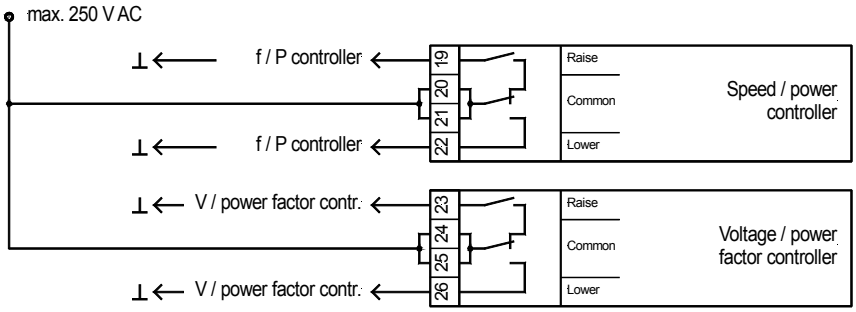
Figure 3-9: Analog outputs

Terminal		Description	A_{max}
0 to 20 / 4 to 20 -20 to +20 mA ***I_A*** ***A***	***0 V*** ***B***		
51	50	Analog output 1 Packages SY & SYN	1.5 mm²
53	52	Analog output 2 Packages SY & SYN	1.5 mm²
55	54	Analog output 3 Packages SY & SYN	1.5 mm²

Controller Outputs

The controller outputs are as three-position controllers in the standard version (made of a form C contact and a form A contact).

Three-Position Controller



Terminal	Assignment	Description	A_{max}
19	raise	Speed/active-power controller	2.5 mm²
20	common		2.5 mm²
21	common		2.5 mm²
22	lower		2.5 mm²
23	raise	Voltage/power-factor φ controller reactive power	2.5 mm²
24	common		2.5 mm²
25	common		2.5 mm²
26	lower		2.5 mm²

Interface (Package SYN-I)

Modbus Interface

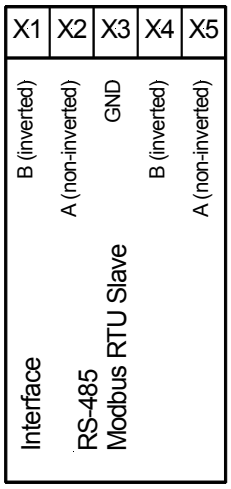


Figure 3-10: Interfaces

Terminal					Description
(X1)	(X2)	(X3)	(X4)	(X5)	
B	A	GND	B	A	RS-485, Modbus RTU Slave

NOTE

The Modbus interface connection may be performed at the terminals X1 through X3 or X3 through X5. The terminals X1 and X4 as well as X2 and X5 are connected internally.

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

Blocking of protective functions / 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**
- **Overfrequency**
- **Centralized alarm**

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

If the unit should not automatically reset the relays after the fault is no longer present, the parameter "**Auto clearing Relays**" must first be configured "**OFF**" (refer to "Auto Acknowledgement of the Relay" on page 63).

```
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.

Enable CB
Terminal 30/31

Energized ....
- **CB is open**
  - Enables operation of the power circuit breaker (voltage and frequency control may also be enabled).
- **CB is closed**
  - No function.

De-energized
- **CB is open**
  - The control will act in the following manner dependent upon the parameter "Aut.idle running control" in the section titled "No Load Control". If this parameter is configured as:
    "OFF": Frequency and voltage are not controlled.
    "ON": Frequency and voltage are controlled if both have surpassed the minimum permissible limits.
- **CB is closed**
  - The control will act in the following manner dependent upon if the parameter "Stop sequence" (refer to page 49) is enabled or disabled. If this parameter is configured as:
    "OFF": The active power controller and the power factor controller are enabled. The load is not reduced and the circuit breaker remains closed.
    "ON": The load is reduced according to the ramp rated configured in parameter "Stop sequence ramp" and the circuit breaker is opened when the load level reaches 10% of the configured load rating.

Reply: CB is open
Terminal 30/32

This DI is energized to signal the unit that the circuit breaker is open.

Isolated operation
Terminal 73/74

Energized .....
- Enable voltage/frequency control when circuit breaker is closed.
- Dead bus closure enabled when circuit breaker is open.

De-energized .
- Disable voltage/frequency control when circuit breaker is closed.

Control Outputs

NOTE

A description of the relay manager may be found in Changing the Relay Assignment starting on page 65.

Relay 1
Terminal 9/10

Output relay (type: make contact, NO)
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
Terminal 11 through 13
Output relay (type: change-over contact)
The "relay manager" controls this relay.

Relay 3
Terminal 14 through 16
Output relay (type: change-over contact)
The "relay manager" controls this relay.

Synchronization relay
Terminal 27 through 29
Output relay (type: change-over contact)
This relay is closed at the synchronous point (pulse or holding relay).

Functional Table

Input signal			Function	Condition
Discrete input: "Isolated operation"	Discrete input: "Reply: CB is open"	Discrete input: "Enable CB		
✧	**energized**	**de-energized**	No-load operation of generator enabled	A
energized	**energized**	**energized**	Dead bus closure or synchronization of circuit breaker enabled	B, C
de-energized	**energized**	**energized**	Synchronization of circuit breaker enabled	C
energized	**de-energized**	✧	Isolated operation enabled	D
de-energized	**de-energized**	✧	Power controller enabled Power factor controller enabled	E
de-energized	**de-energized**	✧		

Table 4-1: Operating modes - functional table

The control functionality is affected by the available discrete input signals. The user must ensure that the "Reply: CB is open" signal is energized only when the circuit breaker is open. The auxiliary contact of the circuit breaker must be a break contact. Table 4-1:Operating Modes illustrates the terminals that must be energized (24 Vdc) to enable specific control functionality. If the input terminal has the "✧" symbol in the provided space, the energizing (24 Vdc) or de-energizing (0 Vdc) the specific input will not affect the functionality of the control.

Conditions

The device functionality is dependent upon the measured voltages in addition to the state of the discrete inputs. If specific functionality of the control is desired, the related parameters must be enabled to permit the desired functionality regardless if the discrete inputs are energized or not.

Condition		
A	No-load operation	- Generator voltage must be greater than 50 % of V_N - Power circuit breaker is open - "Aut.idle running control" is configured as ON
B	Dead bus closure of circuit breaker	- Synchronization voltage must be less than 5 % of parameter "Volt.transformer sec. (MN)" - Generator voltage within the permissible limits
C	Synchronization Power circuit breaker	- Synchronization voltage within the permissible limits - Generator voltage within the permissible limits
D	Isolated operation	- Power circuit breaker must be closed
E	Power control enabled Power factor control enabled	- If "Stop sequence" is configured as OFF, - The CB must be closed / Reply: CB is open is de-energized - The discrete input "Release CB" must be de-energized

Table 4-2: Operating mode conditions

Definition of the Operating Modes

No-Load Control

The frequency and voltage are controlled at the configured set point levels when the circuit breaker is open. The conditions in Table 4-2: Operating mode conditions on page 22 for No-Load Control must be fulfilled to enable this functionality.

Isolated Operation

The frequency and voltage are controlled at the configured set point levels when the circuit breaker is closed. The conditions in Table 4-2: Operating mode conditions on page 22 for Isolated Operation must be fulfilled to enable this functionality. If the generator is connected to a constant voltage system (i.e. paralleled with another source) the DI "Isolated operation" must be de-energized (0 V DC). This disables the frequency and voltage controllers after synchronization has been accomplished. A droop mode is possible if several generators are operating in parallel in an isolated operation.

Synchronization of Circuit Breaker

The frequency and voltage are raised or lowered to match the system frequency and voltage prior to closing the circuit breaker if the following conditions are fulfilled:

- The parameter "Synchronizing functions" is configured as ON
- The busbar is energized (synchronization voltage)
- The generator voltage and frequency are within the configured permissible limits (all three phases)
- The DI "Reply: CB is open" is energized
- The DI "Enable CB" is energized

Dead Bus Closure of Circuit Breaker (Close CB Without Synchronization)

The power circuit breaker is closed without synchronization if the following conditions are fulfilled:

- The parameter "Dead busbar Operation" is configured as ON
- The busbar is not energized (busbar voltage is less than 5 % of parameter "Volt.transformer sec. (MN)")
- The generator voltage and frequency are within the configured limits (all three phases)
- The DI "Isolated operation" is energized
- The DI "Enable CB" is energized
- The DI "Reply: CB is open" is energized

Power Control and Power Factor Control

The control real power and power factor are simultaneously controlled if the following conditions are met:

- The circuit breaker is closed and the DI "Reply: CB is open" is de-energized
- The DI "Isolated operation" is de-energized
- The busbar is energized (synchronization voltage)
- The busbar voltage and frequency are within the configured permissible limits
- Terminal 31 (Enable CB) is de-energized and the parameter "Stop sequence" is configured as OFF
- Terminal 31 (Enable CB) is energized and the parameter "Stop sequence" is configured as ON

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.

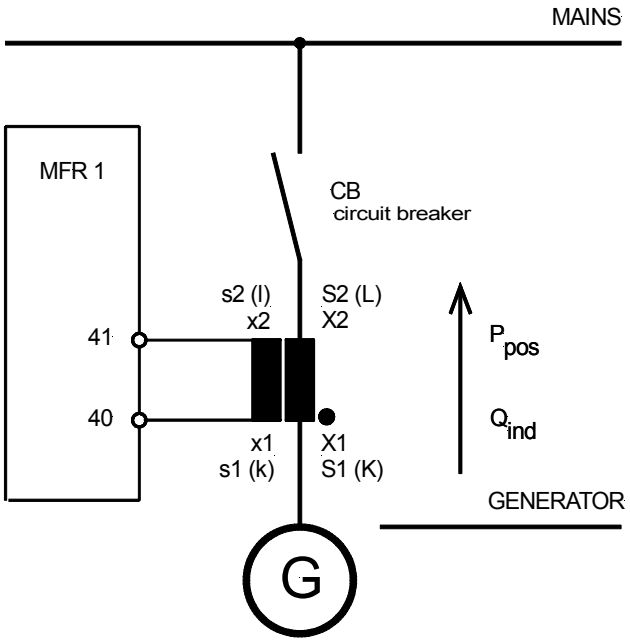


Figure 4-1: Direction of power

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)

In relation to the voltage, the current is

lagging	leading

The generator is

over excited	under excited

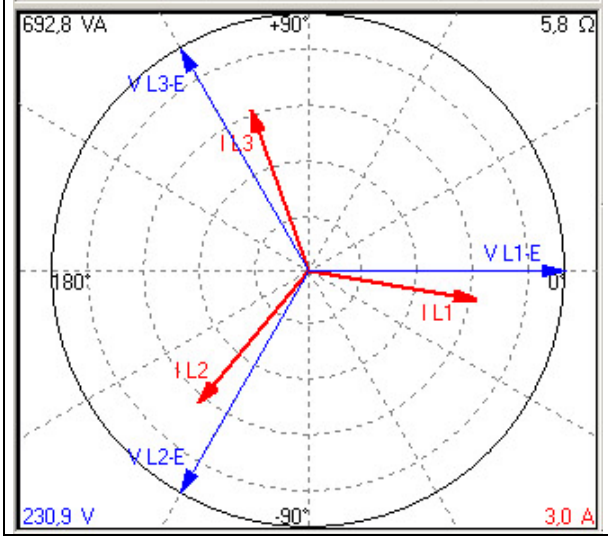
Control: If the control unit is equipped with a power factor controller

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

Phasor diagram:

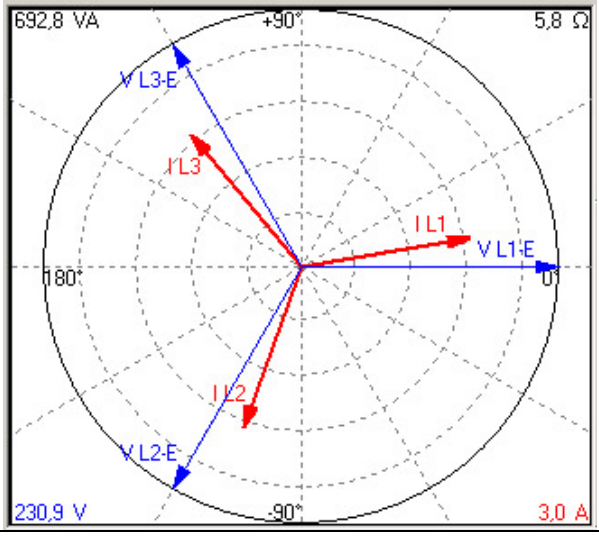
inductive

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



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	-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 4-3 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	Standard	**Overvolt.1**
Overvoltage, level 2	Standard	**Overvolt.2**
Undervoltage, level 1	Standard	**Und.volt.1**
Undervoltage, level 2	Standard	**Und.volt.2**
Asymmetry	Standard	**Asymmetry**
Overfrequency, level 1	Standard	**Overfreq.1**
Overfrequency, level 2	Standard	**Overfreq.2**
Underfrequency, level 1	Standard	**Und.freq.1**
Underfrequency, level 2	Standard	**Und.freq.2**
Independent time-overcurrent, level 1	Standard	**Ov.curr. 1**
Independent time-overcurrent, level 2	Standard	**Ov.curr. 2**
Independent time-overcurrent, level 3	Standard	**Ov.curr. 3**
Overload	Standard	**Overload**
Reverse-/reduced power	Standard	**Rev. power**
Unbalanced load	Standard	**Unbalance**
Reactive power, capacitive	Standard	**React.pow-**
Reactive power, inductive	Standard	**React.pow+**

Table 4-3: Alarm messages

Alarm Acknowledgement

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

By pressing the "Clear" button for at least 5 seconds, 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).

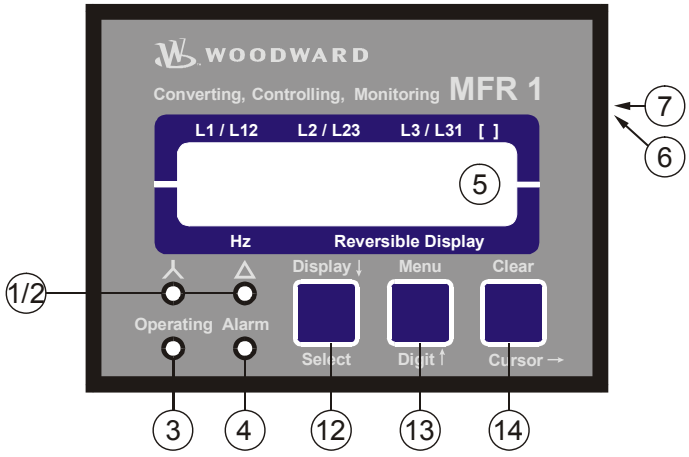


Figure 5-1: Front panel

Brief Description of LEDs and Push Buttons

LEDs

No.	Description	Function
1	"Wye"	Indication of the wye (star) voltages (phase-neutral)
2	"Delta"	Indication of the delta voltages (phase-phase)
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: measuring 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: Measuring 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]
• Synchronizing voltage	Unit dynamic in [V / kV]
• Synchronizing frequency	Unit static in [Hz]
• Synchronizing angle	Unit static in [°]
• Power factor controller set point	Unit dimensionless
• Power controller set point	Unit dynamic in [kW / MW]

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	Standard	**Overvolt.1**
Overvoltage, level 2	Standard	**Overvolt.2**
Undervoltage, level 1	Standard	**Und.volt.1**
Undervoltage, level 2	Standard	**Und.volt.2**
Asymmetry	Standard	**Asymmetry**
Overfrequency, level 1	Standard	**Overfreq.1**
Overfrequency, level 2	Standard	**Overfreq.2**
Underfrequency, level 1	Standard	**Und.freq.1**
Underfrequency, level 2	Standard	**Und.freq.2**
Independent time-overcurrent, level 1	Standard	**Ov.curr. 1**
Independent time-overcurrent, level 2	Standard	**Ov.curr. 2**
Independent time-overcurrent, level 3	Standard	**Ov.curr. 3**
Overload	Standard	**Overload**
Reverse-/reduced power	Standard	**Rev. power**
Unbalanced load	Standard	**Unbalance**
Reactive power, capacitive	Standard	**React.pow-**
Reactive power, inductive	Standard	**React.pow+**

Table 5-1: Alarm messages

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] and a 400 V-version [4]. The versions vary as far as the configuration screens and the parameter input ranges are concerned. The two types are differentiated by indicating the voltage: ([1] ... or [4] ...).

```
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 ***(Basis Service Level)*** Factory password = "**0 0 0 1**"
This code level entitles the user to change selected controller set points, enable auto-clearing display, and enable reset of the kWh counter. 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 (Package SYN-I). 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"!

```
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 51 does not appear.

Potential Transformer Configuration

```
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.

Note: If this parameter is changed, the value for the voltage controller set point will change accordingly. Please verify that the setting configured there is correct.

```
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.....MFR15x**1**B/xxx = Current transformer with ../1 A rated current
{x} = 5.....MFR15x**5**B/xxx = Current transformer with ../5 A rated current

```
Rated current
          0000A
```

Rated current **1 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 24.

```
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:

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

- three-phase 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

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.).

Configuration Screens

```
Synchronizing
functions    ON
```

Synchronizing functions **ON/OFF**

ON..... Synchronizing functions have been enabled, and the subsequent screens of this function are displayed.
OFF..... Synchronizing functions have been disabled, and 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 generator frequency being greater than the mains 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 generator frequency being less than the mains 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. The percentage configured here is a + or – value.

```
Signal CB On
Logic    impulse
```

Output signal for circuit breaker closure **constant/impulse**

constant.....The "Synchronization" relay (terminals 27/28/29) can be wired directly into the holding circuit of the circuit breaker. After the CB close command has been issued and the circuit breaker reply has been received, the "Synchronization" relay remains energized. The relay de-energizes as soon as the discrete input "Reply: CB is open" is re-energized. Opening the circuit breaker via this relay is not possible.

impulse.....The "Synchronization" relay issues a connection pulse. The circuit breaker holding circuit requires an external circuit with self-holding contacts. The CB aux contacts are used to detect the status of the holding circuit contacts.

NOTE

Release of holding circuit occurs if:

- **the generator voltage drops below 75 % of V_N**
- **the phase angle between generator and mains voltage exceeds 14 degrees**
- **the discrete input "Reply: circuit breaker is open" is energized**

The "continuous" signal does not release and open the circuit breaker if an alarm condition is detected. The breaker must be opened by an external opening circuit.

```
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.

Dead Bus Closure

Closing the circuit breaker can be accomplished even if the synchronization voltage is not present. The breaker close command is issued if the following conditions are met:

- The applied generator voltage is within the configured permissible limits
- The applied generator frequency is within the configured permissible limits
- The applied synchronization voltage does not exceed 5 % of the parameter "Volt.transformer sec. (MN)"
- The discrete input "Isolated operation" is energized signaling that the unit is not in parallel with the grid
- The discrete input "Release CB" is energized
- The discrete input " Reply: CB is open " is energized

CAUTION

The measuring voltages are normally protected. If an automatic circuit breaker trips, the unit may perform a dead bus closure. This can cause the generator to operate asynchronously and severely damage the system. To prevent this from happening, the dead bus closure functionality must be disabled through an external circuit if the automatic circuit breaker trips. This may be achieved by de-energizing either the "Isolated operation" discrete input (terminal 74) or "CB enabled" discrete input (terminal 31).

NOTE

If more than one unit is operating in parallel on an isolated system, only one control may have the parameter "Dead busbar Operation" enabled (configured as ON). All other controllers must have this parameter disabled. It is possible to enable the dead bus closure functionality in more than one controller if a higher-level control (i.e. a PLC) is utilized to regulate the breaker functionality of all units in the system. The higher-level control should only enable the circuit breaker in one lower-level controller during a dead bus closure condition by dictating which unit has its "Release CB" digital input energized and de-energizing all other "Release CB" digital inputs to other units.

```
Dead busbar
Operation     ON
```

Dead bus closure of circuit breaker **ON/OFF**

ON..... A dead bus closure is performed when a de-energized busbar is detected and the isolated operation" discrete input (terminal 74) is energized. All prerequisites for a dead bus closure must be met for this function to be performed. The subsequent screens of this function are displayed.

OFF..... Dead bus closure functionality is disabled. The subsequent screens of this function are not displayed.

```
Dead busbar op.
df max    0.00Hz
```

Maximum differential frequency for dead bus CB closure **0.05 to 5.00 Hz**

The maximum deviation of the generator frequency from the configured frequency controller set point for a breaker closure command to be issued is configured in this parameter.

```
Dead busbar op.
dV max    00.0%
```

Max. differential voltage for dead bus CB closure **00.1 to 20.0 %**

The maximum deviation of the generator voltage from the configured voltage controller set point for a breaker closure command to be issued is configured in this parameter. The value configured is a percentage of the PT secondary voltage.
Example:
If the PT secondary rated voltage is 120 V and 10% is configured for this parameter, the dead bus breaker closure command will be issued when the control monitors the secondary voltage is within +/-12 V of the rated PT secondary voltage (above 108 V or below 132 V).

No-Load Control

```
Aut.idle running
control      ON
```

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

ON .....With the power circuit breaker open and terminal 3 de-energized (CB disabled), frequency and voltage is controlled if the minimum permissible generator frequency and voltage have been reached.

OFF .....With the power circuit breaker open, frequency and voltage are controlled according to the following conditions:

- Terminal 3 energized (CB enabled):
  Frequency and voltage are controlled
- Terminal 3 de-energized (CB disabled):
  Frequency and voltage are not controlled

Frequency Controller

```
Freq. controller
              ON
```

Frequency controller **ON/OFF**

ON .....The generator frequency may be controlled. The generator frequency is controlled dependent upon the state of the relevant discrete inputs (isolated operation / synchronization). The subsequent screens of this function are displayed.

OFF .....The generator frequency is not controlled. The subsequent screens of this function are not displayed.

Configuring Frequency Set Points

```
Freq. controller
Setpoint  00.0Hz
```

Frequency controller – set point **48.0 to 62.0 Hz**

The generator frequency set point is defined in this screen. This value is the reference for the frequency controller when performing isolated and/or no-load operations. Generally 50 Hz or 60 Hz will be the values entered into this parameter. It is possible that a different value may be entered here.

```
Freq. controller
Dead band 0.00Hz
```

Frequency controller insensitivity **0.02 to 1.00 Hz**

Isolated operation ..The generator frequency is controlled in such a manner that the measured frequency does not deviate from the configured set point by more than the value configured in this parameter without the controller issuing a frequency raise/lower signal to the speed control. This prevents unneeded wear on the speed control and/or the contacts for terminals 19/20/21/22.

Synchronization .....The generator frequency is controlled in such a manner that the measured frequency does not deviate from the monitored busbar frequency by more than the value configured in this parameter without the controller issuing a frequency raise/lower signal to the speed control. This prevents unneeded wear on the speed control and/or the contacts for terminals 19/20/21/22. The value configured for this parameter must be less than half of the value configured for df max (maximum frequency differential) for synchronization.

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

Minimum frequency controller duty cycle **20 to 250 ms**

The minimum duty cycle for the speed raise/lower contacts should be configured so that the speed controller is able to respond reliably to the command issued. It is recommended that the shortest possible time period for this duty cycle be configured to ensure optimum control behavior.


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

Frequency controller gain **0.1 to 99.9**

The gain factor K_p influences the operating time of the relays. By increasing the gain, the response is increased to permit larger corrections to the frequency. The farther out of tolerance the frequency is the larger the response action is to return the frequency to the tolerance band. Excessive overshoot/undershoot of the desired value will result if the gain is configured too high.

Droop

```
Freq. controller
Droop     00.0%
```

Controller droop characteristic curve **00.0 to 20.0 %**

If this control is to be operated on a generator in parallel with other generators and frequency control is enabled, a droop characteristic curve must be used. Each generator in the system will require the same value to be configured for the droop characteristic, so that when the system is stable the active power will be distributed proportionally among all generators in relation to their rated power.

Example

Rated power: 500 kW
Rated frequency set point: 50.0 Hz
Droop 5.0 %

Active power 0 kW = 0 % of rated power
Frequency is adjusted to (50.0 Hz – [5.0% * 0.0]) = 50.0 Hz.

Active power +250 kW = +50 % of rated power
Frequency is adjusted to (50.0Hz – [5 % * 0.50]) = 48.75 Hz.

Active power +500 kW = +100 % of rated power
Frequency is adjusted to (50.0Hz – [5 % * 1.00]) = 47.50 Hz.

Active-Power Controller

```
Power controller
              ON
```

Active power controller **ON/OFF**

ON..... The active power controller is enabled. The active power is automatically adjusted to the configured set point in a mains-parallel operation. The subsequent screens of this function are displayed.
OFF..... The active power controller is disabled. The subsequent screens of this function are not displayed.

External Real Power Control

```
External setp.
Adjustment    ON
```

External control of active power set point **ON/OFF**

ON..... External control of the active power set point is enabled. The active power control set point is controlled via the 0/4 to 20mA input. The subsequent screens of this function are displayed.
OFF..... External control of the active power set point is disabled. The active power control set point is controlled via the internal active-power set point. The subsequent screens of this function are not displayed.

```
External setp.
      0 .. 20mA
```

Analog input range **0 to 20mA / 4 to 20mA**

0 to 20 mA....The analog input range is scaled from 0 to 20 mA.
4 to 20 mA....The analog input range is scaled from 4 to 20 mA.

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

Minimum value scaling **0 to 32,000 kW**

This parameter is only displayed if the parameter "External setp. Adjustment" has been enabled. The minimum control value for the active power is defined here (e.g. 0 kW). Dependent upon how this parameter is configured, this value will correspond to 0mA or 4mA.

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

Maximum value scaling **0 to 32,000 kW**

This parameter is only displayed if the parameter "External setp. Adjustment" has been enabled. The maximum control value for the active power is defined here (e.g. 100 kW). Dependent upon how this parameter is configured, this value will correspond to 20mA.

Internal Real Power Set Point

NOTE

This parameter is only visible if the parameter "External setp. Adjustment" has been configured "OFF".

```
Power controller
Setpoint 00000kW
```

Internal active power controller set point **0 to 32,000 kW**

The active power is adjusted to the value defined here.

Power Controller General Set Points

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

Active power load ramp rate **1 to 100 %/s**

The control will increase the load on the generator after the breaker has closed at the rate defined in this parameter. The ramp rate is a percentage of the generator rated power (refer to page 38) per second. The higher the configured percentage, the faster the load reference for the control is increased.
Example:
If the rated load for the generator is 100kW and 10%/s is configured for this parameter. The load ramp for the control is 10kW/s or it will take 10 seconds for the generator to load to 100%.

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

Active-power controller maximum power limitation **10 to 120 %**

The maximum active power of the generator may be limited by this parameter. The active power limit is defined as a percentage of the generator rated power (refer to page 38). The active power controller is prohibited from permitting the generator load to exceed the load reference point defined here. The active power controller is only functional when the generator is used in parallel with other sources of power. This parameter has no functionality in an isolated application.

Three-Position Controller

```
Power controller
Dead band 00.0%
```

Active power controller dead band **0.1 to 25.0 %**

The active power is controlled in such a manner that the measured load does not deviate from the active power set point by more than the percentage value of the dead band. The percentage configured here refers to the generator rated power. This prevents unneeded wear on the speed control and the output contacts.

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

Active power controller dead band reduction **1.0 to 9.9**

The dead band is increased by the factor configured here to further reduce wear on speed control, automatic voltage regulator and the output contacts. The dead band will only be increased by the configured factor after the control has not issued a raise/lower pulse for 5 seconds.

Example:

If a dead band is configured as 2.5% and the reduction factor is configured as 2.0, the dead band will be increased to 5.0% after 5 seconds. If the load deviates from the configured set point by more than 5.0% of the generator rated power, the dead band is reduced back to 2.5%. This dead band reduction factor can be utilized to reduce wear on the speed controls due to small load changes.

```
Power controller
Time pulse>000ms
```

Minimum active power controller duty cycle **20 to 250 ms**

The minimum duty cycle for the active power controller raise/lower contacts should be configured so that the speed controller is able to respond reliably to the command issued. It is recommended that the shortest possible time period for this duty cycle be configured to ensure optimum control behavior.

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

Active power controller gain factor **0.1 to 99.9**

The gain factor K_p influences the operating time of the relays. By increasing the gain, the response is increased to permit larger corrections to the active power control. The farther out of tolerance the active power is the larger the response action is to return the active power to the tolerance band. Excessive overshoot/undershoot of the desired value will result if the gain is configured too high.

Part-Load Warm-Up

```
Warm up load
Setpoint   000%
```

Warm up partial load limit **5 to 110 %**

If the engine requires a warm-up period, a fixed load value may be entered for the engine warm up period. The setting for the generator load that is to be utilized during this warm-up phase is defined by this parameter. The fixed load is a percentage of the generator rated power (refer to page 38).

```
Warm up load
Time       000s
```

Warm up period **0 to 600 s**

The length of the warm-up period with the part-load following the initial closure of the GCB in mains parallel operation is configured here. If an engine warm-up period is not desired, this parameter must be set to zero.

Voltage Controller

```
Volt. controller
              ON
```

Voltage controller **ON/OFF**

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

Configuring Voltage Set Point

```
Volt. controller
Setpoint    000V
```

Fixed-voltage set point value **[1] 50 to 125 V; [4] 70 to 440 V**

This parameter defines the voltage reference point for the control to use in isolated and no-load operations. The value entered into this parameter refers to the secondary rated voltage of the PTs or the system voltage if PTs are not utilized.

Three-Position Controller

```
Volt. controller
Dead band  00.0V
```

Voltage controller insensitivity **[1] 0.1 to 15.0 V; [4] 0.5 to 60.0 V**

Isolated operation ..The generator voltage is controlled in such a manner that the measured voltage does not deviate from the configured set point by more than the value configured in this parameter without the controller issuing a voltage raise/lower signal to the voltage regulator. This prevents unneeded wear on the voltage regulator and/or the contacts for terminals 23/24/25/26.
Synchronization .....The generator voltage is controlled in such a manner that the measured voltage does not deviate from the monitored busbar voltage by more than the value configured in this parameter without the controller issuing a voltage raise/lower signal to the voltage regulator. This prevents unneeded wear on the voltage regulator and/or the contacts for terminals 23/24/25/26. The value configured for this parameter must be less than the value configured for dV max (maximum voltage differential) for synchronization.

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

Minimum voltage controller duty cycle **20 to 250 ms**

The minimum duty cycle for the voltage raise/lower contacts should be configured so that the voltage regulator is able to respond reliably to the command issued. It is recommended that the shortest possible time period for this duty cycle be configured to ensure optimum control behavior.

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

Voltage controller gain **0.1 to 99.9**

The gain factor K_p influences the operating time of the relays. By increasing the gain, the response is increased to permit larger corrections to the voltage control. The farther out of tolerance the voltage is the larger the response action is to return the voltage to the tolerance band. Excessive overshoot/undershoot of the desired value will result if the gain is configured too high.

Droop

```
Volt. controller
Droop     00.0%
```

Controller droop characteristic curve **00.0 to 20.0 %**

If this control is to be operated on a generator in parallel with other generators and voltage control is enabled, a droop characteristic curve must be used. Each generator in the system will require the same value to be configured for the droop characteristic, so that when the system is stable the reactive power will be distributed proportionally among all generators in relation to their rated power.

Example

Rated power: 500 kW
Rated voltage set point: 400 V
Droop: 5.0 %

Reactive power 0 kvar = 0% of rated reactive power
Voltage is adjusted to (400 V – [5.0% * 0.0]) = 400 V.

Reactive power +250 kvar (ind) = +50 % of rated reactive power
Voltage is adjusted to (400 V – [5.0% * 0.50]) = 390 V.

Reactive power +500 kvar (ind) = +100 % of rated reactive power
Voltage is adjusted to (400 V – [5.0% * 1.00]) = 380 V.

Power-Factor Controller

NOTE

It is vital to ensure that the following variables are properly configured for the controller to operate properly

- **Rated power**
- **Primary current**
- **Primary voltage**

If these variables are not configured properly, the droop controller and/or power factor controller may not operate properly.

```
Power-factor-
controller    ON
```

Power factor controller **ON/OFF**

ON..... In a mains parallel operation automatic control of the power factor is enabled. If there are excessively low currents (secondary current less than 5 % of I_{rated}) the power factor cannot be accurately measured. In order to prevent power swings, the controller automatically locks the power factor at a set value. The subsequent screens of this function are displayed.

OFF..... Power factor control is disabled. The subsequent screens of this function are not displayed.

Power Factor Set Point

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

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

The generator may be operated at a predefined power factor when operated in parallel with the mains. The power factor for mains parallel operation is defined by this parameter. The designations "i" stands for inductive/lagging power factor (generator over excited) and "c" stands for capacitive/leading power factor (generator under excited).

Three-Position Controller (Standard)

```
Pow.fact. contr.
Dead band  00.0%
```

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

The unit automatically calculates the amount of reactive power required to maintain the power factor set point when operating in parallel with the mains. The reactive power is controlled in such a manner that the measured power factor does not deviate from the power factor set point by more than the percentage value of the dead band. The percentage configured here refers to the power factor controller set point. This prevents unneeded wear on the automatic voltage regulator and the output contacts.

```
Pow.fact. contr.
Time pulse>000ms
```

Minimum power factor controller duty cycle **20 to 250 ms**

The minimum duty cycle for the power factor raise/lower contacts should be configured so that the voltage regulator is able to respond reliably to the command issued. It is recommended that the shortest possible time period for this duty cycle be configured to ensure optimum control behavior.

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

Power factor controller gain **0.1 to 99.9**

The gain factor K_p influences the operating time of the relays. By increasing the gain, the response is increased to permit larger corrections to the power factor control. The farther out of tolerance the power factor is the larger the response action is to return the power factor to the tolerance band. Excessive overshoot/undershoot of the desired value will result if the gain is configured too high.

Shutdown

Power Reduction with Shutdown Command

Shutdown in mains parallel operation

The control must be in a mains parallel operation (the circuit breaker closed and the discrete input "isolated operation" de-energized). If the discrete input "Enable CB" is de-energized, the unit will perform constant power control (Packages SYN / SYN-I) or power factor control. By de-energizing the discrete input "Enable CB" it is possible to reduce the active power according to the parameter "Stop sequence ramp". When the load reaches 10% of the generator rated load (refer to page 38), the circuit breaker is opened. When the power factor controller is enabled, the power factor is adjusted to 1.00.

Shutdown in isolated parallel operation (only with Packages SYN / SYN-I)

The control must be in an isolated operation (the circuit breaker closed and the discrete input "isolated operation" energized). The power is proportionally distributed (Packages SYN / SYN-I) according the generator rated loads if the discrete input "Enable CB" is energized. When the discrete input "Enable CB" is de-energized, the generator stops participating in the load distribution control and the active load of the generator is reduced according to the parameter "Stop sequence ramp". When the active load reaches 10% of the generator rated load (refer to page 38), the circuit breaker is opened. The remaining generators that are participating in the load distribution control assume the load proportionally.

Shutdown achieved relay

Once the measured load of the generator reaches 10% of the generator rated power (refer to page 38), a "Stop order" message may be issued via the relay manager. This message may be used to open the circuit breaker if wired accordingly.

```
Stop sequence
             ON
```

Power reduction **ON/OFF**

ON..... The load is reduced and the assigned relay energizes after the measured load reaches 10% of the generator load rating (refer to page 38) when the discrete input "Release CB" is de-energized.

OFF..... The load is not reduced and the circuit breaker remains closed. The active power controller and the power factor controller are enabled if configured as ON in their respective parameters.

```
Stop sequence
Ramp      000%/s
```

Shutdown unload ramp rate **1 to 100 %/s**

The control will decrease the load on the generator at the rate defined in this parameter. The ramp rate is a percentage of the generator rated power (refer to page 38) per second. The higher the configured percentage, the faster the load reference for the control is decreased.

Example:

If a 100kW generator is running at full load and 10%/s is configured for this parameter. The load ramp for the control is 10kW/s or it will take 9 seconds for the generator to unload and open the circuit breaker. It takes 9 seconds for the load to be reduced to 10% of the load rating and the breaker is opened when the load reaches 10% of the generator load rating.

Active-Power Distribution (Packages SYN / SYN-I)

The control functionality in an isolated parallel operation ensures equal load sharing among the generators. Each MFR-15 participating in the load sharing controls its generator so that the primary control variable (frequency) remains constant. All controls utilize Psum (terminal57) to calculate and correct real load sharing for each unit. The secondary control variable (active power distribution) is utilized to maintain the load sharing. A weighing factor (reference variable) may be adjusted to place emphasis on the primary control variable (frequency) or the secondary control variable (active power distribution). The isolated system in a steady state condition will share the real load proportionally among all participating generators. The load sharing is performed as a percentage (i.e. 20%) of the rated power for the individual generator. The neutral terminal of all generators must be interconnected since this is used as reference point on terminal 4.

NOTE

This control does not perform reactive load sharing. This requires the voltage controller to be set up for parallel operations (i.e. droop mode).

Prerequisite

The following parameters **must** be configured identically for each unit that will participate in load sharing:

- Frequency controller set point
- Active power load sharing must be enabled
- The discrete input "Isolated operation" is energized on all units participating in load sharing

```
Active power
Load share    ON
```

Active power load sharing **ON/OFF**

ON .....Load sharing is enabled for multiple generators operating in parallel. The generator loads are distributed depending on the configured rated load for each generator. The subsequent screens of this function are displayed.

OFF .....Load sharing is disabled The subsequent screens of this function are not displayed.

```
Act. load share
Frequency   00%
```

Active-power load sharing reference variable **0 to 99 %**

The frequency and the active load are controlled in isolated operation dependent upon how this parameter is configured. The higher the number configured here, the more emphasis is placed by the control on maintaining the primary control variable (frequency). The lower the number configured here, the more emphasis is placed by the control on maintaining the secondary control variable (active power distribution).

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 37).

```
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 (400V-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

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, level 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

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, level 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.

Voltage Asymmetry Monitoring

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

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

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 underfrequency. 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.

Independent Time-Overcurrent Monitoring

NOTE

All percentage values of the current refer to the rated current (page 38).

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.

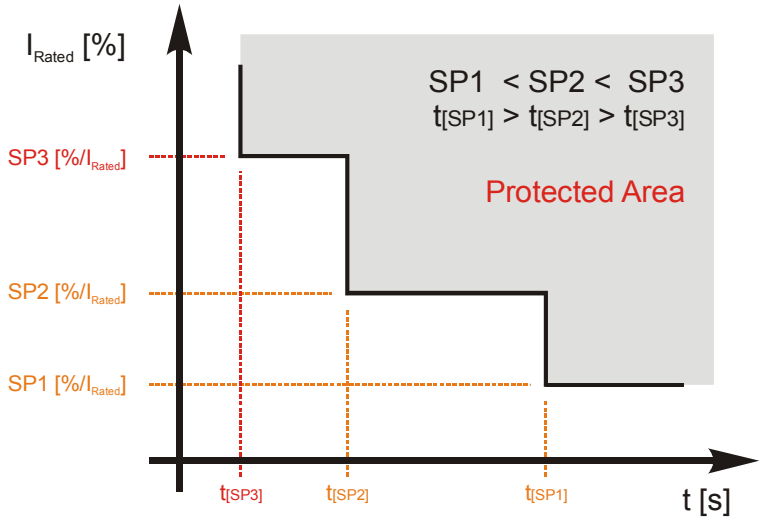


Figure 6-1: Diagram for independent time-overcurrent monitoring

```
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 38). 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 38). 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 38). 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.

Overload Monitoring

NOTE

All percentage values refer to a percentage of the configured rated power (page 38).

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 38). 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

NOTE

All percentage values refer to a percentage of the configured rated power (page 38).

Function: "Active load 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

NOTE

All percentage values refer to a percentage of the configured rated power (page 38).

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.

Reactive Power Monitoring

NOTE

All percentage values refer to a percentage of the configured rated power (page 38).

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 38). 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, inductive **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 38). 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.

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 63):

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 63):

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
xxxxxxxx 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.

Release delay for ...		Display indication instead of xxxxxxxx	Remark
Overvoltage	Standard	Overvolt.	Level 1 and level 2
Undervoltage	Standard	Und.volt	Level 1 and level 2
Asymmetry	Standard	Asymmetry	
Overfrequency	Standard	Overfreq.	Level 1 and level 2
Underfrequency	Standard	Underfrq	Level 1 and level 2
Independent time-overcurrent	Standard	Overcurr.	Levels 1, 2, and 3
Overload	Standard	Overload	
Reverse-/reduced power	Standard	Rev.power	
Unbalanced load	Standard	Unb. load	
Reactive power inductive	Standard	react.ind.	
Reactive power capacitive	Standard	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 on the display is deleted.

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

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

```
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.

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
```

Assign protective function output to relays **0 to 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.

Example.....A unit has a protective function that is required to output a signal to relays 2 and 3. That protective function relay assignment should be configured as 2300. 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 to 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	Standard	**Overvoltage 1**
Overvoltage, level 2	Standard	**Overvoltage 2**
Undervoltage, level 1	Standard	**Undervoltage 1**
Undervoltage, level 2	Standard	**Undervoltage 2**
Asymmetry	Standard	**Asymmetry**
Overfrequency, level 1	Standard	**Overfrequency 1**
Overfrequency, level 2	Standard	**Overfrequency 2**
Underfrequency, Level 1	Standard	**Underfrequency 1**
Underfrequency, Level 2	Standard	**Underfrequency 2**
Independent time-overcurrent, level 1	Standard	**Overcurrent 1**
Independent time-overcurrent, level 2	Standard	**Overcurrent 2**
Independent time-overcurrent, level 3	Standard	**Overcurrent 3**
Overload	Standard	**Overload**
Reverse-/reduced load	Standard	**Reverse/min.pow.**
Unbalanced load	Standard	**Unbalanced load**
Reactive power, capacitive	Standard	**Cap.react.pow**
Reactive power, inductive	Standard	**Ind.react.pow**
Interface Fault	Package SYN-I	**Interface fault**
Centralized alarm	Standard	**Collect Response**
Shutdown	Standard	**Stop order**

Table 6-2: Protective function 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 (Packages SY / SYN)

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 (Packages SY / SYN)

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 mA, 4 mA, -20 mA	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 (-20/0/4 to 20 mA: terminals 52/53)
Output of the wire-to-wire voltage L12:

20 mA-output

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

Output range of the analog output 2 (20mA) -20..+20mA / 0..20mA / 4..20mA / 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.

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

Output value of the analog output 2 see 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
```

Scaling of the lower output value see Table 6-3

Defines the lower limit of the output.

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

Scaling of the upper output value see Table 6-3

Defines the upper limit of the output.

Interface (Package SYN-I)

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 36).

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 D.

Screens for Modbus RTU Slave Protocol

```
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.

General Interface Screens

```
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:
   a.) Interrupt the "Connect" signal for the power circuit breaker.
   b.) The mains voltage (synchronization voltage) must be within the permissible limits.
   c.) Apply the "Release CB" signal. The synchronization will then be started.
   d.) 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.
   e.) 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

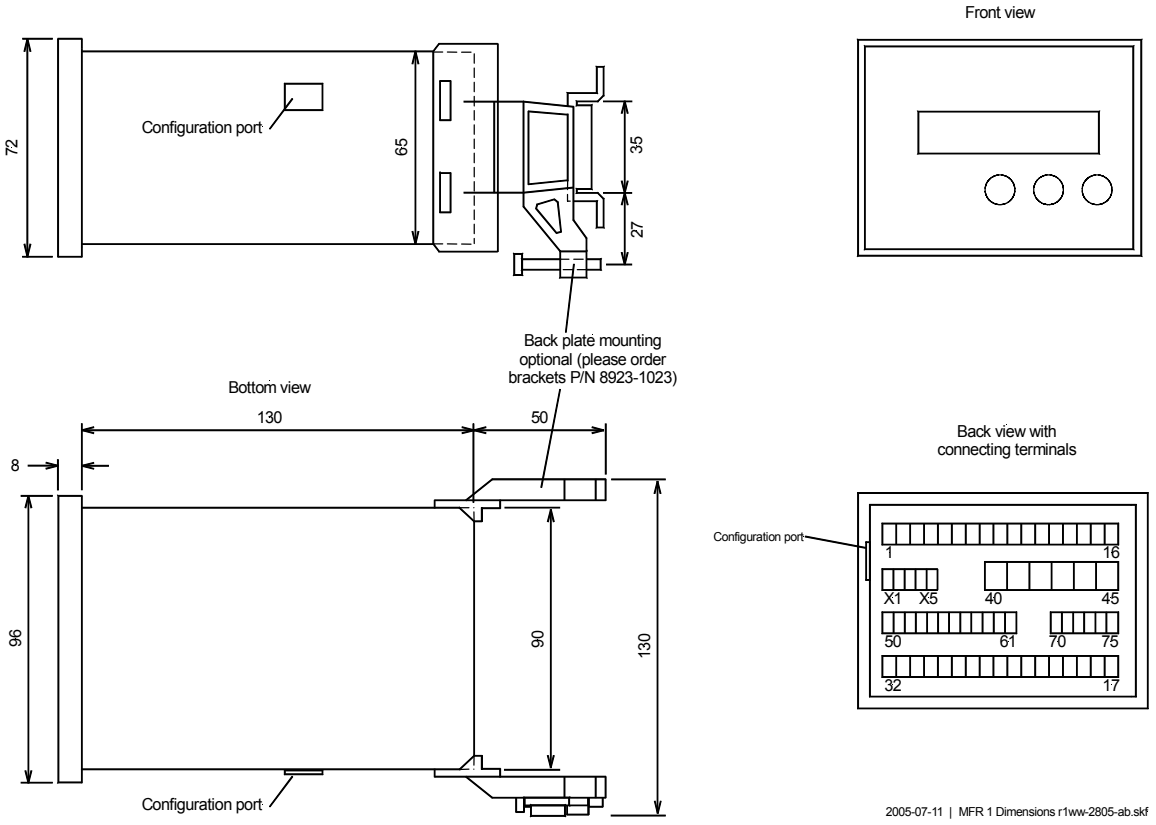
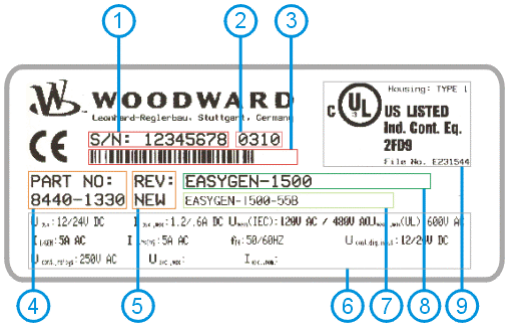


Figure 7-1: Dimensions

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
  - Maximum value V_{ph-ph} max. (UL/cUL) ..... [1] max. 150 Vac
    [4] max. 300 Vac
  - Rated voltage $V_{ph-ground}$ ..... [1] 150 Vac / 2.5 kV
    [4] 300 Vac / 4.0 kV
  - Rated surge voltage ..... [1] 2.5 kV
    [4] 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
- 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)
- 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

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
- 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 °	-
Miscellaneous			
Active energy	0 to 4.200 GWh		-

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): 0/1 = alarm not triggered 1/0 = alarm triggered	Bit 1 = 1 \ Bit 0 = 0 /	Vector/phase jump
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): 0/1 = alarm not triggered 1/0 = alarm triggered	Bit 1 = 1 \ Bit 0 = 0 /	Interface fault
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): 0/1 = alarm not triggered 1/0 = alarm triggered	Bit 1 = 1 \ Bit 0 = 0 /	Internal

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): 0/1 = alarm not triggered 1/0 = alarm triggered	Bit 1 = 1 \ Bit 0 = 0 /	Power level reached
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): 0/1 = alarm not triggered 1/0 = alarm triggered	Bit 1 = 1 \ Bit 0 = 0 /	Internal
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): 0/1 = alarm not triggered 1/0 = alarm triggered	Bit 1 = 1 \ Bit 0 = 0 /	Internal

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	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] 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 triggered" 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

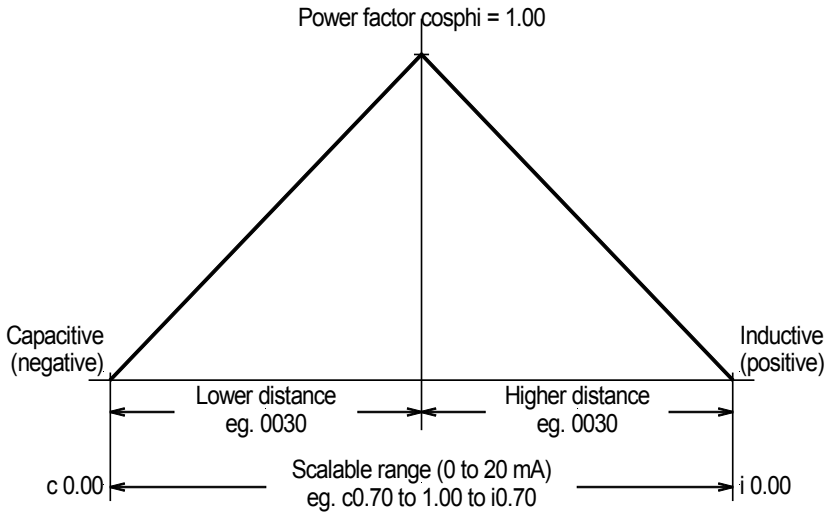


Figure 7-2: Interface, power factor scaling

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 Modbus RTU Slave

Transmitting protocol.....Modbus 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.

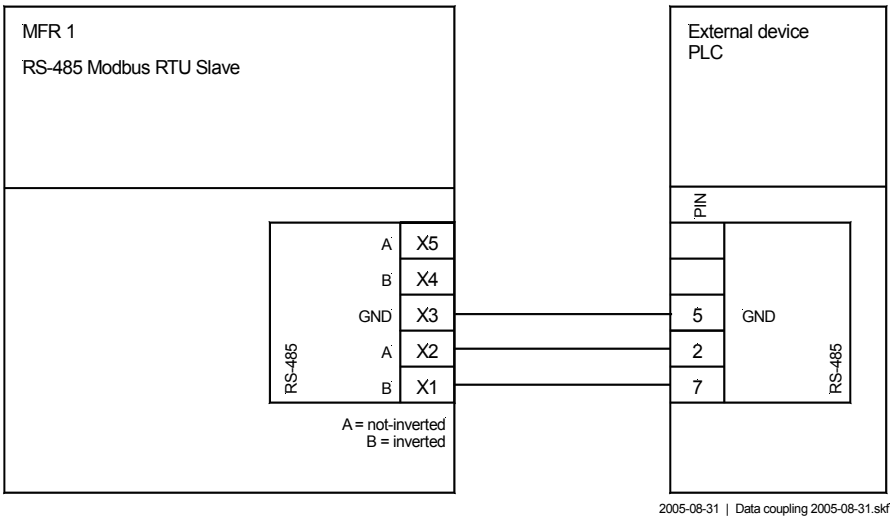


Figure 7–3: Interface - Modbus connection

Appendix E.
List of Parameters

Product number P/N _____ Rev _____

Version MFR 15 _____

Project _____

Serial number S/N _____ Date _____

Pckg	Parameter	Setting range 100/400 V version	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 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		
	Volt.transformer prim(MN)	00.100 to 65.000 kV	00.400 kV		
	Current transf.	1,999/{x} A	1,000/{x} A		
	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

Pckg	Parameter	Setting range 100/400 V version	Default setting	Customer setting	
CONTROL FUNCTIONS					
	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 %		
	Signal CB On Logic	constant / impulse	impulse	☐ c ☐ i	☐ c ☐ i
	Synchronization Time pulse>	50 to 250 ms	200 ms		
	Gen.circ.breaker Pick-up t.	40 to 300 ms	80 ms		
	Dead busbar Operation	ON/OFF	OFF	☐ 1 ☐ 0	☐ 1 ☐ 0
	Dead busbar op. df max	0.05 to 5.00 Hz	0.25 Hz		
	Dead busbar op. dV max	0.0 to 20.0 %	10.0 %		
	Aut.idle running control	ON/OFF	OFF	☐ 1 ☐ 0	☐ 1 ☐ 0
	Freq. controller	ON/OFF	ON	☐ 1 ☐ 0	☐ 1 ☐ 0
	Freq. controller Setpoint	48.0 to 62.0 Hz	50.0 Hz		
	Freq. controller Dead band	0.02 to 1.00 Hz	0.10 Hz		
	Freq. controller Time pulse>	10 to 250 ms	80 ms		
	Freq. controller gain kp=	0.1 to 99.9	10.0		
	Freq. controller Droop	0.0 to 20.0 %	5.0 %		
	Power controller	ON/OFF	ON	☐ 1 ☐ 0	☐ 1 ☐ 0
	External setp. Adjustment	ON/OFF	OFF	☐ 1 ☐ 0	☐ 1 ☐ 0
	External setp.	0 to 20 mA / 4 to 20 mA	0 to 20 mA	☐ 0 ☐ 4	☐ 0 ☐ 4
	External setp. 0 mA	0 to 32000 kW	000 kW		
	External setp. 20 mA	0 to 32000 kW	500 kW		
	Power controller Setpoint	0 to 32000 kW	500 kW		
	Power controller Ramp	1 to 100 %	50 %		
	Power limitation P. max	10 to 120 %	100 %		
	Power controller Dead band	0.1 to 25.0 %	2.5 %		
	Power controller Sens.red. *	1.0 to 9.9	2.0		
	Power controller Time pulse>	20 to 250 ms	80 ms		
	Power controller Gain kp=	0.1 to 99.9	5.0		
	Warm up load Setpoint	5 to 110 %	15 %		
	Warm up load Time	0 to 600 s	5 s		
	Volt. controller	ON/OFF	ON	☐ 1 ☐ 0	☐ 1 ☐ 0
	Volt. controller Setpoint	50 to 125 V / 70 to 440 V	100 / 400 V		
	Volt. controller Dead band	0.1 to 15.0 V / 0.5 to 60.0 V	3.0 V		
	Volt. controller Time pulse >	20 to 250 ms	80 ms		
	Volt. controller Gain kp=	0.1 to 99.9	10.0		
	Volt. controller Droop	0.0 to 20.0 %	5.0 %		
	Power-factor controller	ON/OFF	ON	☐ 1 ☐ 0	☐ 1 ☐ 0
	Pow.fact.contr. Setpoint	c0.70 to 1.00 to i0.70	1.00		
	Pow.fact.contr. Dead band	0.5 to 25.0 %	2.5 %		
	Pow.fact.contr. Time pulse >	20 to 250 ms	80 ms		
	Pow.fact.contr. Gain kp=	0.1 to 99.9	5.0		
	Stop sequence	ON/OFF	ON	☐ 1 ☐ 0	☐ 1 ☐ 0
	Stop sequence Ramp	1 to 100 %/s	5 %/s		
SYN SYN-I	Active power Load share	ON/OFF	ON	☐ 1 ☐ 0	☐ 1 ☐ 0
SYN SYN-I	Act. load share Frequency	10 to 99 %	50 %		

Pckg	Parameter	Setting range 100/400 V version	Default setting	Customer setting	
PROTECTION					
	Volt. Monitoring	Phase-neutral / Phase to phase	Phase to phase	☐ pn ☐ pp	☐ pn ☐ pp
	Overvoltage Monitoring	ON/OFF	ON	☐ 1 ☐ 0	☐ 1 ☐ 0
	Overvoltage 1 V(ph-ph)>	20 to 130 / 520 V	110 / 440 V		
	(Phase-N)>	10 to 75 / 300 V	64 / 254 V		
	Overvoltage 1 Delay	0.02 to 99.98 s	0.10 s		
	Overvoltage 2 V(ph-ph)>	20 to 130 / 520 V	120 / 480 V		
	(Phase-N)>	10 to 75 / 300 V	64 / 254 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 V	90 / 360 V		
	(Phase-N)<	10 to 75 / 300 V	51 / 207 V		
	Undervoltage 1 Delay	0.02 to 99.98 s	0.10 s		
	Undervoltage 2 V(ph-ph)<	20 to 130 / 520 V	80 / 320 V		
	(Phase-N)<	10 to 75 / 300 V	46 / 184 V		
	Undervoltage 2 Delay	0.02 to 99.98 s	0.04 s		
	Undervoltage Hysteresis	0 to 99 V	1 / 4 V		
	Asymmetry- Monitoring	ON/OFF	ON	☐ 1 ☐ 0	☐ 1 ☐ 0
	Asymmetry Response v.	0 to 99 V	10 / 40 V		
	Asymmetry Delay	0.02 to 99.98 s	2.00 s		
	Asymmetry Hysteresis	0 to 99 V	1 / 4 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		
	Underfrequency Hysteresis	0.01 to 9.99 Hz	0.05 Hz		
	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	0.10 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 %	200%		
	Overcurrent 3 Delay	0.02 to 99.98 s	0.04s		
	Overcurrent Hysteresis	1 to 300 %	5 %		
	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		
	Reverse/min.pow. Hysteresis	1 to 99 %	2 %		
	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		
	Unbalanced load Hysteresis	1 to 20 %	5 %		
	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	0.10s		
	Ind. react. pow. Response v.	0 to 100 %	30%		
	Ind. react. pow. Delay	0.02 to 99.98 s	0.10s		
	React. pow. mon. Hysteresis	1 to 20 %	2%		

Pckg	Parameter	Setting range 100/400 V version	Default setting	Customer setting	
RELAY CONFIGURATION					
	External Clearing	ON/OFF	OFF	☐ 1 ☐ 0	☐ 1 ☐ 0
	Auto-clearing relays	ON/OFF	OFF	☐ 1 ☐ 0	☐ 1 ☐ 0
	Release delay Overvoltage	0.02 to 99.98 s	0.10 s		
	Release delay Undervoltage	0.02 to 99.98 s	0.10 s		
	Release delay Asymmetry	0.02 to 99.98 s	0.10 s		
	Release delay Overfreq.	0.02 to 99.98 s	0.10 s		
	Release delay Underfrq.	0.02 to 99.98 s	0.10 s		
	Release delay Overcurr.	0.02 to 99.98 s	0.20 s		
	Release delay Overload	0.02 to 99.98 s	0.10 s		
	Release delay Rev.Power	0.02 to 99.98 s	0.10 s		
	Release delay Unb. Load	0.02 to 99.98 s	0.10 s		
	Release delay react.cap.	0.02 to 99.98 s	0.10 s		
	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
	Funct. relay 123 (R=release)	E/R	REE		
	Collect response to relay	0 to 3	0002		
	Overvoltage 1 to relay	0 to 3	0002		
	Overvoltage 2 to relay	0 to 3	0002		
	Undervoltage 1 to relay	0 to 3	0002		
	Undervoltage 2 to relay	0 to 3	0002		
	Asymmetry to relay	0 to 3	0002		
	Overfrequency 1 to relay	0 to 3	0003		
	Overfrequency 2 to relay	0 to 3	0003		
	Underfrequency 1 to relay	0 to 3	0003		
	Underfrequency 2 to relay	0 to 3	0003		
	Overcurrent1 to relay	0 to 3	0002		
	Overcurrent2 to relay	0 to 3	0002		
	Overcurrent3 to relay	0 to 3	0002		
	Overload to relay	0 to 3	0003		
	Reverse/min.pow. to relay	0 to 3	0003		
	Unbalanced load to relay	0 to 3	0002		
	Cap. react.pow. to relay	0 to 3	0002		
	Ind. react.pow. to relay	0 to 3	0002		
	Interface fault to relay	0 to 3	0002		

Pckg	Parameter	Setting range 100/400 V version	Default setting	Customer setting	
PULSE OUTPUT					
SY SYN	**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		
SY SYN	**RESET kWh**	ON/OFF	OFF	☐ 1 ☐ 0	☐ 1 ☐ 0
ANALOG OUTPUTS					
SY SYN	**Analog output 1**	OFF -20 to 20mA 0 to 20 mA 4 to 20 mA	-20 to 20mA	☐ OFF ☐ -/+20mA ☐ 0-20mA ☐ 4-20mA	☐ OFF ☐ -/+20mA ☐ 0-20mA ☐ 4-20mA
..	**Analog output 1**	see table at the end of the list of parameters	Active power		
..	**Analog output**		0 kW		
	Analog output		500 kW		
..	**Analog output 2**	OFF -20 to 20mA 0 to 20 mA 4 to 20 mA	-20 to 20mA	☐ OFF ☐ -/+20mA ☐ 0-20mA ☐ 4-20mA	☐ OFF ☐ -/+20mA ☐ 0-20mA ☐ 4-20mA
..	**Analog output 2**	see table at the end of the list of parameters	cosphi		
..	**Analog output**		c0.50		
	Analog output		i0.50		
..	**Analog output 3**	OFF -20 to 20mA 0 to 20 mA 4 to 20 mA	-20 to 20mA	☐ OFF ☐ -/+20mA ☐ 0-20mA ☐ 4-20mA	☐ OFF ☐ -/+20mA ☐ 0-20mA ☐ 4-20mA
..	**Analog output 3**	see table at the end of the list of parameters	I L1		
SY	**Analog output**		0 A		
SYN	**Analog output**		1,000 A		
INTERFACE					
SYN-I	**Device number MOD-Bus**	1 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		
..	**Serial control**	ON/OFF	ON	☐ 1 ☐ 0	☐ 1 ☐ 0
..	**Serial interface Monitoring**	ON/OFF	ON	☐ 1 ☐ 0	☐ 1 ☐ 0
SYN-I	**Inhibit via Interface**	ON/OFF	ON	☐ 1 ☐ 0	☐ 1 ☐ 0

Value	Lower and upper setting value	
	0 mA, 4 mA, -20 mA	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 15_____

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